

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

Internals for Towers, Drums, and Fixed Bed Reactors

GP 05-02-01

Scope

- 1) [I] This Global Practice (GP) 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.
 - 2) [I] An asterisk (*) indicates that a decision by the Purchaser is required or that additional information is furnished by the Purchaser.
-

Downstream, Chemical, Upstream, Downstream Imperial Oil	For ExxonMobil Use Only	Version 3.1.0
Page 1 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

Table of Contents

Table of Figures	4
Table of Tables.....	5
1. Required References.....	6
1.1. Global Practices–ExxonMobil Engineering Practices	6
1.2. AISC–American Institute of Steel Construction	6
1.3. ASME–American Society of Mechanical Engineers	6
2. Additional Requirements	6
2.1. Global Practices–ExxonMobil Engineering Practices	6
2.2. ASME–American Society of Mechanical Engineers	7
2.3. ASTM–American Society for Testing and Materials	7
2.4. NACE–Nace International.....	8
3. Definitions	8
4. Documentation Requirements.....	9
5. Materials	10
6. Design.....	12
6.1. General	12
6.2. Corrosion Allowance	14
6.3. Minimum Metal Thickness	14
6.4. Loads and Stresses	15
6.5. Dimensional Requirements.....	15
6.6. Structural	17
6.7. Internal Pipes and Thermowells	18
6.8. Bolting	18
6.9. Accesses through Trays, Grids, and Decks.....	19
6.10. Drain Holes	19
7. Additional Design Requirements for Internals of Towers and Drums.....	20
7.1. Downcomer Anti-Jump Baffles and Anti-Vortex Baffles.....	20
7.2. Downcomers, Seal Pans, Drawoff Boxes, Accumulator Stacks, Feed Inlets, Reboiler Returns	22

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 2 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

7.3.	Packed Tower Sections	23
7.4.	Entrainment Screens	24
8.	Additional Design Requirements for Internals of Fixed Bed Reactors	25
8.1.	General	25
8.2.	Reactor Outlet Collector Rings	25
8.3.	Catalyst Unloading Nozzles, Scale Trap Baskets, and Shrouds	26
8.4.	Wire Screen	26
9.	Fabrication	27
9.1.	General	27
9.2.	Trays	28
10.	Inspection and Testing.....	29
10.1.	Inspection	29
10.2.	Leakage and Flow Measurement Tests.....	30
10.3.	Quench Gas Nozzles.....	31
11.	Additional Requirements for Welded Internals in Wet H₂S Service.....	31
12.	Handling and Storage.....	32
Appendix: Figures		33
Record of Change		47
Attachment: Purpose Codes Definitions		49

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 3 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

Table of Figures

Figure 1: Subway Grating or Panel Strip Configuration	21
Figure 2: Baffle Design and Installation	21
Figure 3: Wire Pad and Top Grating for Mist Eliminators	25
Figure A-1: Jet Tab Details.....	33
Figure A-2: Bubble Cap (Vacuum) (for Low Pressure Drop)	34
Figure A-3: Bubble Cap (Standard and Raised).....	35
Figure A-4: Detail of Shed Construction.....	36
Figure A-5: Annular Ring and Wear Plate for Use with Tangential Inlet Nozzle(s) in Pipestill Flash Zone Service.....	37
Figure A-6: Reactor Thermowell Expansion Guide	38
Figure A-7: Tray Guide for Thermowell or Dump Tube	38
Figure A-8: Support Plates for Random Packing Beds	39
Figure A-9: Outlet Collector Ring	40
Figure A-10: Bottom Catalyst Unloading Nozzle	41
Figure A-11: Side Catalyst Unloading Nozzle	42
Figure A-12: Scale Trap Basket–Cylindrical.....	43
Figure A-13: Scale Trap Basket–Rectangular	44
Figure A-14: Hold-Down Plates for Bed Screen	45
Figure A-15: Tolerances for Vessel Internals.....	46

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 4 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

Table of Tables

Table 1: Materials Specifications	11
Table 2: Default Total Corrosion Allowances	14
Table 3: Nominal Tray Diameters	16
Table 4: Tray Support Ring Width	16
Table 5: Tray or Deck Drain Holes	20
Table 6: Baffle Design and Installation	21
Table 7: Dimensional Data for Wire Screens	27
Table 8: Mesh Average Opening/Metric Conversion	27
Table 9: Leakage Rates	31

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 5 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

1. Required References

[I] This Section lists Practices and Standards that are generically referenced and assumed to be part of this document. Unless otherwise specified herein, use the latest edition.

1.1. Global Practices–ExxonMobil Engineering Practices

GP 18-07-01	Welding Procedures
GP 20-01-01	Inspection of Equipment and Materials

1.2. AISC–American Institute of Steel Construction

AISC M016	Manual of Steel Construction Allowable Stress Design
-----------	--

1.3. ASME–American Society of Mechanical Engineers

Unless specific references to the ASME Code are listed, an IHS link to the Introduction is provided to facilitate accessing the relevant parts of the Code.

ASME B31.3	Process Piping
ASME SEC II D	BPVC Section II D - Materials Part D - Properties
ASME SEC VIII D2	BPVC Section VIII - Rules for Construction of Pressure Vessels - Division 2 Alternative Rules
ASME SEC IX	BPVC Section IX - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

2. Additional Requirements

* [I] The following Practices and Standards shall be used with this Practice as specified by Owner's Engineer.

2.1. Global Practices–ExxonMobil Engineering Practices

GP 03-16-01	Flanged Joints, Gaskets, and Bolting
GP 15-02-01	Temperature Instruments
GP 18-10-01	Additional Requirements for Materials
GP 18-12-01	Positive Material Identification

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 6 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

2.2. ASME–American Society of Mechanical Engineers

ASME B16.5	Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.20	Metallic Gaskets for Pipe Flanges Ring-Joint, Spiral-Wound, and Jacketed
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME SEC VIII D1 MA APP 2	Appendix 2 Rules for Bolted Flange Connections with Ring Type Gaskets
ASME SEC VIII D1 MA APP 6	Appendix 6 Methods for Magnetic Particle Examination (MT)
ASME SEC VIII D1 MA APP 12	Appendix 12 Ultrasonic Examination of Welds (UT)

2.3. ASTM–American Society for Testing and Materials

ASTM A 36/A 36M	Standard Specification for Carbon Structural Steel
ASTM A 167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 176	Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 193/A 193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A 204/A 204M	Standard Specification for Pressure Vessel Plates, Alloy Steel, Molybdenum
ASTM A 240/A 240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 276	Standard Specification for Stainless Steel Bars and Shapes
ASTM A 283/A 283M	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 285/A 285M	Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
ASTM A 307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A 387/A 387M	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
ASTM A 414/A 414M	Standard Specification for Steel, Sheet, Carbon, for Pressure Vessels

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 7 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

ASTM A 515/A 515M	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 569/A 569M	(Discontinued) Standard Specification for Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial
ASTM A 570/A 570M	(Discontinued) Standard Specification for Structural Steel, Sheet and Strip, Carbon, Hot-Rolled
ASTM A 675/A 675M	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM B 127	Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
ASTM B 164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B 265	Standard Specification for Titanium and Titanium Alloy Strip, Sheet, and Plate
ASTM B 348	Standard Specification for Titanium and Titanium Alloy Bars and Billets

2.4. NACE–Nace International

NACE MR0175	Petroleum and Natural Gas Industries Materials for Use in H ₂ S-Containing Environments in Oil and Gas Production
-------------	--

3. Definitions

Term	[I] Description
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
non-structural components	Trays, decks, pans, integral minor beams, liquid redistributors, downcomers, grids, hold-down grids and internal non-pressure piping
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
total corrosion allowance	Corrosion allowance for all internals which are exposed to corrosion on all surfaces
tray accessories	Bubble caps, chimneys, weirs, baffles and entrainment screen supports

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 8 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

4. Documentation Requirements

- 1) [I] Fabricator shall submit drawings to Owner for approval before fabrication begins. Drawings shall show all assembly and process details, and the following:
 - a) Design temperature and design loads
 - b) Extent of ultrasonic, radiographic, magnetic-particle-inspection, or other nondestructive tests
 - c) Stress-relieving, and special welding procedures
 - d) All materials 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 shown in an overall elevation, 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, piece numbers, and dimensional tolerances for all parts to facilitate shop or field installation.
 - h) Positive Materials Identification (PMI) testing requirements.
 - i) Weld details for all support rings, downcomer support bars and support beam clips that are welded to the vessel shell.
- 2) [I] The following additional information for liquid distributors, redistributors and associated pre-distribution hardware shall also be included on Fabricator drawings (heads shall be given at the turn-down rate, the design rate and the turn-up rate [typically 120 percent of design] based on water):
 - a) For gravity-type distributors, the size and location of all metering orifices and final distribution elements shall be clearly shown.
 - b) A table of head versus flow rate shall be included for the distributor and any pre-distribution boxes.
 - c) Expected heads at process conditions shall also be given, accounting for vapor-pressure drop through the distributor and liquid viscosity effects.
 - d) Required level tolerance.
- 3) [I] The following additional information for valve trays shall be included on Fabricator drawings:
 - a) Number, lift weight, and size of each valve type.
 - b) The complete valve layout on the tray deck, including the distance from the valves to downcomers, tray support rings, and tray panel edges.
 - c) Valve pitch.
 - d) All proprietary features on the tray deck for the downcomer entrance or exit shall be clearly shown and dimensioned.
- 4) [I] The following additional information for sieve trays shall be included on Fabricator drawings:
 - a) Number and size of sieve holes.
 - b) Hole layout on the tray deck, including the distance from the sieve holes to downcomers, tray support rings, and tray panel edges.

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 9 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

- c) Typical sieve hole pitch.
 - d) Total active hole area.
 - e) All proprietary features on the tray deck for the downcomer entrance or exit shall be clearly shown and dimensioned.
- 5) * [I] For items that cannot be entirely shop-fabricated, Vendor shall submit design drawings to Owner for approval. Such drawings shall clearly designate all field welds.
- 6) [I] Fabricator shall perform design calculations. Two copies shall be furnished with (or prior to) submittal of prints for approval. Structural design calculations for trays and internal supports shall be included. Where calculations are made by computer; all input data, assumptions, and results summaries shall be furnished.
- 7) [I] Final data—after final approval of drawings, Fabricator shall supply the following certified data to Owner:
- a) Certified drawings containing all information required by Items 1 and 2 of this Section.
 - b) Data reports executed in accordance with the applicable Code.
- 8) [I] Vendor certification of leakage rate—Vendor shall certify that all bubble cap trays meet the specified leakage rate, when installed per Vendor instructions. Vendor shall additionally demonstrate that gasketing material and gasket-to-metal seal designs (if permitted) have been successfully used in similar services.

5. Materials

- 1) * [R] Materials for internals shall be specified.
- 2) [R] Acceptable ASTM grades and Specifications for a number of standard internal materials are listed in Table 1.

Table 1: Materials Specifications

Material	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					
1-1/4Cr-1/2Mo through 5Cr-1/2Mo					

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 10 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

Material	ASTM Standards				
	Plate	Sheet	Strip	Bars	Bolts & Nuts
High Alloy Steels					
12Cr welded components	A 176 and A 240, Types 405 and 410S			A 276 Type 405	A 193/A 193M B6; and A 194/A 194M Gr 6F (with Selenium), or Gr 6
12Cr non-welded components	A 176 and A 240, Types 405, 410 or 410S			A 276 Type 405 or 410	
18Cr 8Ni: Types 304, 316, 321, 347	A 167 and A 240			A 276	A 193/A 193M B8 and A 194/A 194M Gr 8
Non-Ferrous					
Nickel Copper (Monel)	B 127			B 164	B 164
Titanium	B 265 Gr2			B 348 Gr2	B 348 Gr 4

- 3) [R] Free machining grades of steel shall not be permitted.
Exception: Type-416 nuts, furnished to ASTM A 194/A 194M Gr 6F with selenium, are acceptable for use with ASTM A 193/A 193M B6 bolts.
- 4) [R] For trays with valves, alloy (12Cr minimum) valve elements are required if the tray deck is carbon steel.
- 5) [R] 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.
- 6) [R] Reinforced PTFE gasket shall be used for acid or caustic service below 600°F (315°C). Ensure that the reinforcement material is compatible with the service.
- 7) [R] All bolting hardware shall be of the same nominal chemistry as the internals to which they connect. However, 12Cr bolting hardware shall be used for carbon steel internals when the specified corrosion allowance for the internal structural component is $>1/8$ in. (3 mm).
- 8) [M] Bolting hardware for manways in grids, decks, and trays shall be of corrosion resistant materials in order to facilitate opening for inspection and maintenance.
- 9) [R] Crinkled wire mesh entrainment screens (CWMS) shall meet the following requirements:
 - a) Materials of the supports, rods, or straps shall be at least equivalent in terms of corrosion resistance to that of the other vessel internals.
 - b) 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.
- 10) * [R] Baffle-plate and wear-plate material shall be of the same nominal composition as the internal structural components, unless otherwise specified.

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 11 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

6. Design

6.1. General

- 1) * [M] All internals (except shrouds and outlet collectors) shall be removable with vertical thermowells in place. Such internals shall be designed to pass through the nearest manhole above their level, unless otherwise specified.
- 2) [M] All parts to be installed after vessel fabrication is complete shall be designed to pass through the manways provided on the vessel.
- 3) [M] Formed deck sections shall have a maximum weight of 110 lbs (50 kg) unless permanent lifting facilities are available inside the vessel, or unless Owner's Engineer otherwise approves.
- 4) [M] All parts (except tray manways) shall be designed to permit installation and removal from the topside.
- 5) [O], [R] For reactors, screens shall be attached on top of reactor grids and catalyst-support hardware to prevent inerts and catalyst from:
 - a) Falling through holes or slot openings.
 - b) Blocking clearances in support hardware that are required for thermal expansion.
- 6) [O] For reactors, bed-support beams and grids shall have a minimum open area of 50 percent 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 percent 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 1½ in. (38 mm).
- 7) [O] Bubble cap trays, chimney trays, and drawoff boxes: Seal welded chimney trays shall be used for total drawoff trays in all services. All drawoff boxes shall be seal welded leak-tight construction.
 For other services in which bubble cap trays are used as drawoff trays (partial or total drawoff trays) they shall be seal-welded.
 To eliminate leakage, seal welding shall be performed at all panel-to-panel, panel-to-support ring, panel-to-beam, and chimney (riser)-to-panel connections, except at internal manways. Recessed inlet-boxes shall not be permitted for sealing the downcomers that feed to drawoff trays.
 For seal welded construction, differential thermal expansion between the shell and internals shall be considered.
 Gaskets and packing may be used in the assembly of bubble cap trays to meet specified leakage rates in other services.
- 8) * [O] All tray joints shall be of lap construction that does not interfere with liquid flow on the decks. Butt joints on seal-welded trays are acceptable if approved by Owner's Engineer. Lip-slot or tab-slot construction for panel-to-panel joints is acceptable. Slots shall not add more than 1 percent to overall open area of tray.
- 9) * [R] Tray sections shall be fastened to the support ring and support beams with frictional tray clamps or through bolting. J-bolts shall not be accepted. Spacing of clamps and bolts shall be close enough to ensure tight construction. Supplier shall specify the required bolt torque on the drawings.

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 12 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

Alternate methods of tray-to-ring attachment (i.e., wedge-clamp) shall require Owner's Engineer approval.

- 10) * [R] Bolt hole or clamp spacing around the edge of tray, deck, or grid sections shall not exceed 7 in. (177 mm), except for trays with liquid loads <2 gpm/in. (17.88 m³/h-m) of chordal weir length, where minimizing leakage is critical to the tray's performance (as specified by Owner). These "minimal-leakage" trays shall be attached to the tray support rings by heavy-duty clips on spacing of ≤ 3 in. (75 mm).
- 11) [M] Trays of sectional construction, clamped to supports welded to the vessel shell, shall be provided for towers of 30 in. (760 mm) diameter or larger. Cartridge trays shall not be accepted unless approved by Owner's Engineer.
- 12) [R] Tower bottom baffles shall be of all-welded construction. Such baffles shall be seal-welded to the vessel shell or head, except where differential thermal expansion between the vessel and internals is of such magnitude as to preclude this design.
- 13) [O] When the design of a tower is changed from trays to packing, the existing tray rings and downcomer bolting bars shall be removed to within:
 - a) 1/4 in. (6 mm) of the vessel wall for all structured packing installations.
 - b) 1/4 in. (6 mm) of the vessel wall for towers 4 ft (1220 mm) in diameter or smaller, with random or grid packing.
 - c) 1/2 in. (13 mm) of the vessel wall for in towers larger than 4 ft (1220 mm) in diameter, with random or grid packing.
- 14) * [O] Manholes internal to beds shall be provided with plugs. Depending upon tower size, packing size and criticality of service, certain process nozzles shall be plugged as specified.

6.2. Corrosion Allowance

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

$$TCA = 2 \times C_r \times L_d$$

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

- a) For structural components, design life shall equal that specified for the vessel, unless otherwise specified.
 - b) Unless otherwise specified, design life of non-structural components, tray accessories, and internal piping shall equal 1/3 the value specified for the vessel.
- 2) [R] The factor of 2 accounts for the fact that corrosion of the internal occurs from both sides.
- 3) [R] If not specified, the default total corrosion allowance shall be as shown in Table 2.

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 13 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub

Table 2: Default Total Corrosion Allowances

Type of Internal	Material of Internal	Default Total Corrosion Allowance	
		in.	mm
Structural Component	CS and low-alloy (Cr-Mo)	0.12	3.0
	Alloy ⁽¹⁾	0.02	0.5
Non-Structural Component or Tray Accessory	CS and low-alloy (Cr-Mo)	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.			

6.3. Minimum Metal Thickness

- 1) * [O], [R] For structural and non-structural components, the minimum required metal thickness (fully corroded) is 0.068 in. (1.73 mm). A fully corroded thickness, in excess of the minimum, may be used for mechanical design considerations, or if increased thickness results in a more economical design.
- 2) * [O], [R] For tray accessories, the minimum required metal thickness (fully corroded) is 0.060 in. (1.5 mm).
- 3) * [O], [R] Thickness of tower packing (including Glitsch grid, Flexi-grid, Pall rings, ballast rings, flexi-rings, etc.) shall be specified.
- 4) [O], [R] The minimum thickness of tray support rings and downcomer bolting bars shall be $\frac{3}{16}$ in. (5 mm) fully corroded.

6.4. Loads and Stresses

- 1) * [R] Reactor internals shall be designed to support their own weight plus the live loads specified.
- 2) [R] Where live loads are not specified, structural components, non-structural components and tray accessories shall be designed to support their own weight at design temperature, plus the following live loads:
 - a) Fractionating trays—design live load shall be the greater of 30 psf (1.436 kPa) or the weight of water 2 in. (50 mm) over the highest weir setting or riser height.
 - b) Areas under downcomers—design live load shall be the greater of 64 psf (3.064 kPa) or a head of water one-half of the height of the downcomer.
 - c) Pans (drawoff and accumulation)—design live load shall be the greater of 1 psi (6.894 kPa) or the weight of water at the maximum operating level of the pan.
 - d) Baffles (including shed rows, disc, and donuts) with no normal operating liquid level shall use a design live load of 1 psi (6.894 kPa) up or down on the projected horizontal area.

GP 05-02-01	Internals for Towers, Drums, and Fixed Bed Reactors	March 2005
-------------	---	------------

- e) Entrainment screen components shall be designed for a differential pressure of 0.1 psi (0.689 kPa) unless otherwise specified. The need for a higher differential pressure shall be based on anticipated fouling or upset conditions.
- 3) [R] Allowable unit stresses for non-pressure-containing internals shall be according to ASME Section VIII Division 2 (ASME SEC VIII D2). For stresses beyond the temperature range listed in ASME Section VIII Division 2, ASME B31.3 shall be used.
- 4) [O] Maximum deflection from the horizontal for trays, distributors and liquid distributor trays under specified operating conditions shall not exceed:
 - a) $\frac{1}{8}$ in. (3 mm) for vessel diameters $\leq$ 120 in. (3050 mm).
 - b) $\frac{3}{16}$ in. (5 mm) for vessel diameters >120 in. (3050 mm) to 240 in. (6100 mm).
 - c) $\frac{1}{4}$ in. (6 mm) for vessel diameters >240 in. (6100 mm).
- 5) [O] Maximum deflection of spray-nozzle laterals shall not exceed $\frac{1}{2}$ in. (13 mm). The supports for the spray-nozzle headers and laterals shall not apply a moment on the laterals or the main inlet flange into the tower.
- 6) [M] Maintenance loads—structural components shall be designed for a concentrated live load of 300 lbs (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 need not be considered for maintenance loads.

6.5. Dimensional Requirements

- 1) [R] For reactors, wire screen dimensions shall be according to Table 7. For crinkle wire mesh screen (CWMS) dimensions, see Section 7.4, Item 1e.
- 2) [O] Bolt spacing in downcomers shall not exceed 6 in. (150 mm).
- 3) [O] Jet tray tab dimensions shall be according to Figure A–1.
- 4) [O] For bubble cap trays, cap and chimney riser dimensions shall be according to Figure A–2 and Figure A–3. Bubble caps shall be removable. They shall be held to the chimneys by means of individual hold-down bolting devices.
- 5) [M] Maximum unsupported length (minor dimension only) of trays, baffles, and pans shall be as limited by access manways.
- 6) [R] Maximum calculated deflection for seal pans, draw-off boxes and draw trays at operating temperature and in the corroded condition, shall be $\frac{1}{4}$ in. (6 mm). Such calculation shall be based upon the dead load of the metal, plus a uniform live load equal to the weight of water at the maximum operating liquid level.
- 7) [R], [O] For all trays except cartridge and pedestal tray assemblies, the nominal tray diameter shall be determined to the nearest $\frac{1}{4}$ in. (6 mm) according to Table 3.

DNST, CHEM, UPST, DIOL	For ExxonMobil Use Only	Version 3.1.0
Page 15 of 47	©ExxonMobil Development Company	



Documents

Document Sharing Hub