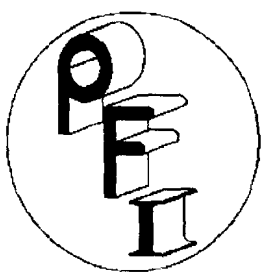
TANK AND VESSEL HANDBOOK



PROCESS
FABRICATORS
INC.

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PROCESS
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INC.

PO BOX 3556
LITTLETON CO 80161
USA
Phone 303-932-6885
Fax 303-932-6205

PROCESS FABRICATORS INC.

Introduction

Process Fabricators, Incorporated (PFI) is an engineering and fabrication company dedicated to serving the process and natural resource industries by designing and building quality tanks and vessels and modular process systems. With fabrication facilities located near Sterling, Colorado and engineering offices near Denver, PFI offers the capability to produce a wide variety of custom fabricated products.

Quality Assurance

PFI is pledged to provide quality products and services on all of our projects to ensure total satisfaction. We have a Quality Assurance Department that supports both our ASME code program and our non-code fabrication. Our quality controller reports directly to our president and is responsible for inspecting and testing our products to exacting guidelines.

Engineering

PFI has one of the most capable professional engineering staffs in the industry. Our engineers and drafters combine years of expertise with extensive code and regulation knowledge.

PFI was founded as a consulting engineering firm. Subsequent acquisition of major manufacturing facilities created a fabricator with comprehensive engineering support.

PFI utilizes the latest computer technology to facilitate our designs. Our Computer Aided Design (CAD) system allows quick turn around time for detailed designs. We utilize computerized vessel design software and specialized CAD drafting packages for increased efficiency.

In addition to fabrication support capabilities, PFI has an experienced team of chemical, metallurgical, mechanical and electrical engineers along with piping and mechanical designers. This enables us to better understand our clients needs and offer total solutions to their problems.

Fabrication Codes

PFI routinely builds to the following list of standards as required by the application. Additional requirements and specifications may be accommodated for specific situations.

American Society of Mechanical Engineers, ASME Sections VIII and IV
American Petroleum Institute, API 12F, API 650 and API 620
American Welding Society, AWS
American Waterworks Association, D100
Department of Transportation, DOT
Sanitary Standards, 3A
Underwriters Laboratories, UL-142

PROCESS FABRICATORS INC.

Fabrication Facilities

The most cost effective tank and vessel design will vary among fabricators depending on their equipment, facilities, expertise and standard procedures.

Fabrication during the design phase of a project can frequently lead to reduced final costs with no reduction in system functionality if the fabricator understands what you are trying to accomplish. We at PFI strive to accomplish just that.

Facilities

Outside storage and fabrication area:	14 acres
Shop building area:	45,000 ft^2
Height under crane hook:	24 ft
Crane capacity per bay:	15 tons
Bay width:	40 ft
Large single crane	25 tons

Mobile Equipment

Handling capabilities for oversized and over weight fabrications is frequently accomplished by utilizing the yard area and mobile equipment including the following.

Forklifts, up to 15,000 lb capacity
Boom truck
Hydraulic tilt trailer
Cranes, up to 40,000 lb capacity
Manlifts
Vessel hauling trailers

Welding Processes

Automatic Submerged Arc - SUBARC
Semi Automatic Metal Inert Gas - MIG
Semi Automatic Flux Core Wire
Semi Automatic Tungsten Inert Gas - Wire Feed TIG
Manual / Tungsten Inert Gas - TIG
Manual / Shielded Metal Arc - stick

Plate Fabrication

Plate Shear - 12 ft by 3/8" thick capacity
Plasma Cutter - up to 1" thick
Flame Cutting
Circular Shear - 3/8" capacity
Pantograph Shape Cutter
Plate Rolling - up to 7/8" thick by 12 ft wide
Press Brake - 12 ft by 200 tons
Automatic Welding Manipulators - Subarc - 16 ft diameter capacity
Tank Turning Rolls - up to 90 tons
CNC Plasma cutting table 9ft x 26ft

Structural Steel Fabrication

PFI maintains extensive facilities for the fabrication of structural steel for skids, platforms, towers, walkways, handrails and stairs including the following equipment.

Circular Cold Saw - 49" diameter blade
Iron Workers - up to 111 ton capacity with punch, notcher, coper, angle shear, rod shear and bar shear
Stationary Punch - 50 ton capacity
Portable Punches - web and flange
Radial Drill Press
Magnetic Base Drills

Piping Fabrication

PFI has complete pipe fabricator capabilities to compliment modular process system fabrication including the following equipment.

Pipe Turning Rolls
Positioners
Pipe Benders
Threading and Grooving Equipment
Beveling Equipment
Horizontal Band Saw
Pipe Coiling machine

Electrical Fabrication

PFI maintains an electrical fabrication department to compliment modular systems fabrications including the following.

Control panel shop
Calibration and testing equipment
480 volt, 3 phase power
PLC programming

Finishing

Sand blasting
Shot blasting
Paint booth

Testing and Inspection

Hydrostatic test pumps
Water storage tank - 50,000 gallons
Radiography equipment
Die penetrant testing
Natural Gas, Propane and Diesel Fuel Systems

Field Erected Tanks

When capacity requirements dictate building tanks larger than shipping conditions allow, PFI will erect tanks at the job site. Shell sections are rolled and other components are cut to size in the shop. Components are shipped to the job site and PFI crews assemble and weld the components to build the tank. Field coating and painting services are also offered.

PRODUCTS MANUFACTURED BY PROCESS FABRICATORS, INC.

WATER TREATMENT
Softeners
Strippers
Deionizers
Sand Filters
Deaerators
Clarifiers
Carbon Columns
Bio Reactors
Oil / Water Separators
Flotation Cells
Screens
Reverse Osmosis

AGRICULTURE
Fertilizer Tanks
Molasses Tanks
Water Tanks
Grain Bins
Dairy Tanks

CHEMICAL PROCESSING
Reactors
Autoclaves
Packed Towers
Tray Towers
Retorts

OIL AND GAS PRODUCTION
Tank Batteries
Separators
Surge Bottles
Heater Treaters
Line Heaters
Gun Barrels
Lease Tanks

SYSTEMS
Modular Process Units
Skid Mounted Plants
Gold Recovery Plants
Compressor Packages
Metering Stations
Chemical Injection Systems
Merrill Crowe Units
Pilot Plants

MINING
Carbon Columns
Dearators
Zinc Cones
Strip Vessels
Acid Wash Vessels
Flotation Cells
Sieve Bend Screens
Mixer Settlers

ENVIRONMENTAL REMEDIATION
Mercury Retorts
Soil Processing

GENERAL INDUSTRY
Vertical Tanks
Horizontal Tanks
Air Receivers
Blowdown Tanks
Storage Water Heaters
Flash Tanks
Trailer Tanks
Double Wall Tanks
Secondary Containment Tanks
Above Ground Fuel Storage Tanks
Bins
Silos
Mixing Tanks
Blenders
Portable Tanks
Hoppers
Truck Tanks

SANITARY PROCESSING
Food Mixers
Brewing Tanks
3A Processing

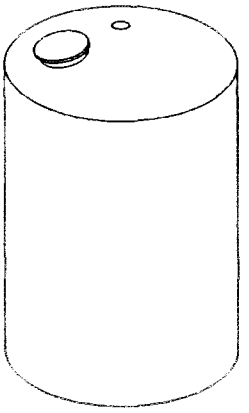
EQUIPMENT
Filter Presses
Sieve Bend Screens
Melting Furnaces
Carbon Regenerators
Scrubbers
Rotary Kilns

PROCESS FABRICATORS INC.

TANK STYLES AND INFORMATION

PROCESS FABRICATORS INC.

Vertical Storage Tanks



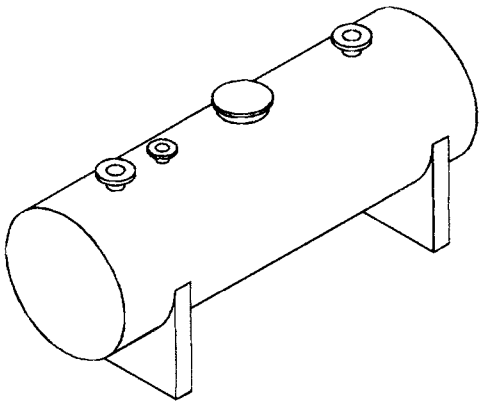
Flat Bottom

Built for storage of liquid products in bulk. Our flat bottom, cone roof tanks are extremely durable and exceed U.L. Standard 142 in strength, corrosion resistance, and appearance. Costly footings and pier forming are eliminated; only a concrete slab or compacted aggregate base is required. Standard features include a 18" roof manway and exterior primer coating.

Cylindrical Tank Capacity in Gallons

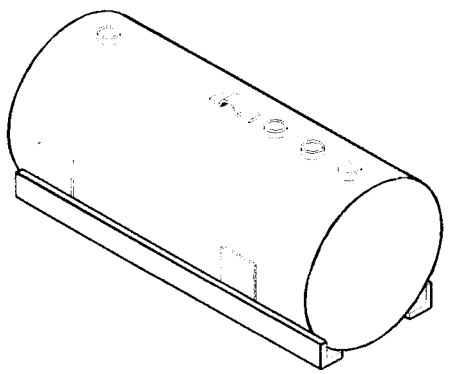
	Length or Depth											
Diameter		5'-0"	6'-0"	7'-0"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	approximate increase per foot / length
	2'-6"	184	220	257	294	330	367	404	440	476	514	550	36
	3'-0"	264	317	370	423	476	529	582	635	690	740	793	53
	3'-6"	360	432	504	576	648	720	792	864	936	1008	1080	72
	4'-0"	470	564	658	752	846	940	1034	1128	1222	1318	1459	94
	4'-6"	595	715	833	952	1071	1190	1309	1428	1547	1666	1758	119
	5'-0"	734	881	1028	1175	1322	1469	1616	1763	1910	2056	2203	146
	6'-0"	1058	1269	1481	1692	1904	2115	2327	2538	2749	2960	3171	211
	7'-0"	1440	1727	2015	2303	2591	2879	3167	3455	3743	4030	4319	288
	8'-0"	1880	2256	2632	3008	3384	3760	4136	4512	4888	5264	5640	376
	9'-0"	2379	2855	3331	3807	4283	4759	5335	5811	6285	6763	7268	475
	10'-0"	2938	3523	4113	4700	5288	5875	6463	7050	7648	8235	8820	587
	11'-0"	3555	4265	4976	5687	6398	7109	7820	8531	9239	9949	10659	710
	12'-0"	4230	5076	5922	6768	7614	8460	9306	10152	10908	11754	12600	846
	13'-0"	4964	5957	6950	7943	8936	9929	10922	11915	12905	13897	14889	992
	13'-6"	5265	6318	7371	8424	9477	10530	11582	12734	13786	14838	15890	1053
	14'-0"	5758	6909	8061	9213	10364	11515	12667	13818	14967	16130	17471	1151
	14'-6"	6180	7416	8652	9880	11124	12360	13596	14832	16068	17304	18740	1236
	15'-0"	6610	7931	9253	10575	11898	13219	14541	15863	17183	18505	19827	1321

Horizontal Storage Tanks



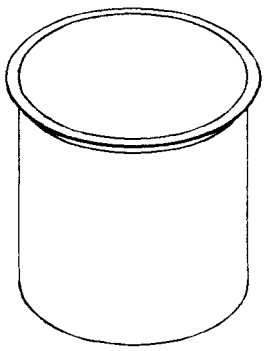
Rugged and durable above ground horizontal tanks are excellent for use in all types of liquid storage and processing applications. Coatings and linings can be provided as required for corrosion protection. Fittings and accessories can be tailored to meet specific application requirements. Available in capacities up to 50,000 gallons. Above ground horizontal tanks can be constructed in accordance with U.L. Standard 142 if required. See NFPA 30 and your state flammable liquids code for complete installation rules and regulations.

Skid Tanks



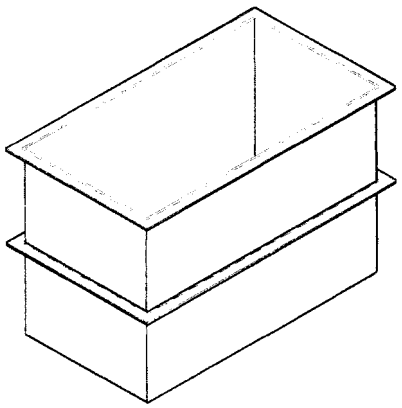
Durable skid tanks are available with heavy-duty or light-duty skids. Heavy-duty skid tanks combine mobility with structural integrity for highly flexible, safe storage. Light duty skid tanks with welded anti-roll supports provide safe, dependable stationary storage.

Vertical Open Top Tanks



Vertical open top tanks are generally constructed including a rolled angle ring to increase tank rigidity. Bolt down covers with manways or hinged "split covers" are available and frequently specified. Hinged split covers facilitate easy inspection or manual loading of tank contents. Bolt down covers are excellent choices for tanks that have contents which are not frequently checked, or when used to prohibit easy access.

Rectangular Open Top Tanks



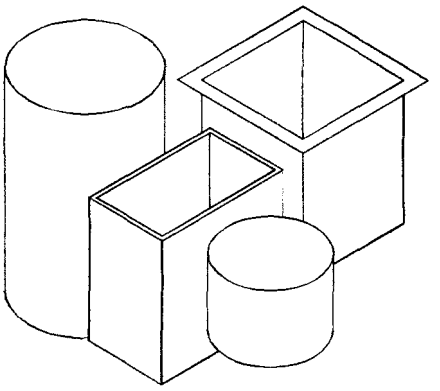
Rectangular open top tanks with external structural support bracing are ideal when maximizing storage volume is required, or when storage area is limited. This is because of the way that a rectangular tank uses space...., for example;

...a 3' x 5' horizontal storage tank holds approximately 264 gallons in 35 cubic feet.
...whereas a rectangular storage tank which occupies the same area (3' x 3' x 5') will hold 337 gallons in 45 cubic feet, a 27% increase.

Rectangular Tank Capacities in Gallons

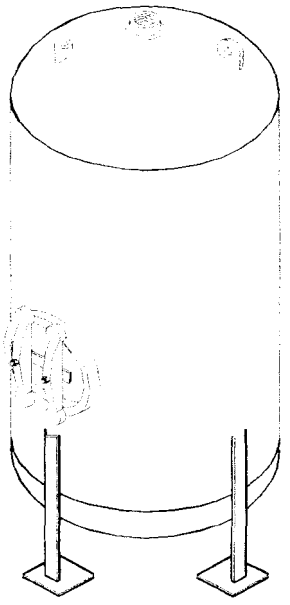
	Length											
Width x Height (square)		5'-0"	6'-0"	7'-0"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	approximate increase per foot / length
	2'-0"	150	180	210	240	270	300	330	360	389	419	449	30
	2'-6"	234	281	327	374	421	468	514	561	608	654	701	47
	3'-0"	337	404	427	539	606	674	741	808	875	942	1010	67
	3'-6"	458	550	641	733	825	916	1008	1100	1191	1283	1374	92
	4'-0"	598	718	838	957	1077	1197	1316	1436	1556	1676	1795	120
	5'-0"	935	1122	1309	1496	1683	1870	2057	2244	2431	2618	2805	187
	6'-0"	1346	1616	1885	2154	2424	2693	2962	3231	3501	3770	4039	269
	8'-0"	2394	2872	3351	3830	4308	4787	5266	5745	6223	6702	7181	479

Plastic Tanks



Process Fabricators, Inc. custom fabricates tanks from polypropylene, polyethylene, PVC, CPVC and Kynar. Hot air and extrusion welding processes are utilized for material joining. Encapsulated steel reinforcement or external steel support systems are frequently provided.

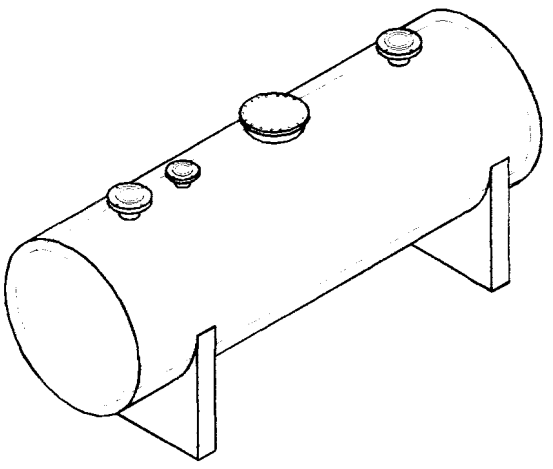
Sanitary Stainless Steel Tanks



Tanks and vessels for storage and processing of products common to the food, dairy and pharmaceutical processing industries are designed and constructed in compliance with the 3A Sanitary Standards. This includes stainless steel construction, complete draining capability and elimination of all internal crevices.

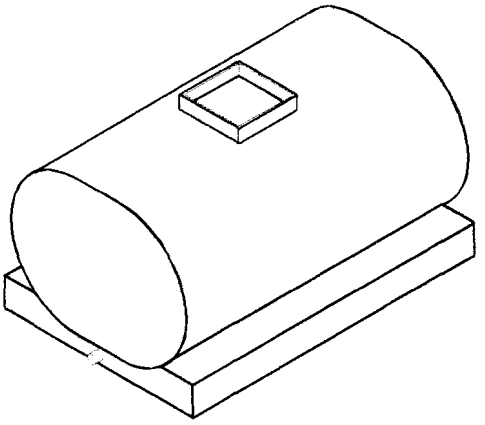
PROCESS FABRICATORS INC.

Double Wall Containment Tanks



Designed specifically for the storage of hazardous liquids and chemicals, a double-wall provides maximum leak protection. Double wall containment type tanks are available in both vertical and horizontal configurations, with a maximum capacity of 30,000 gallons.

Transport Tanks

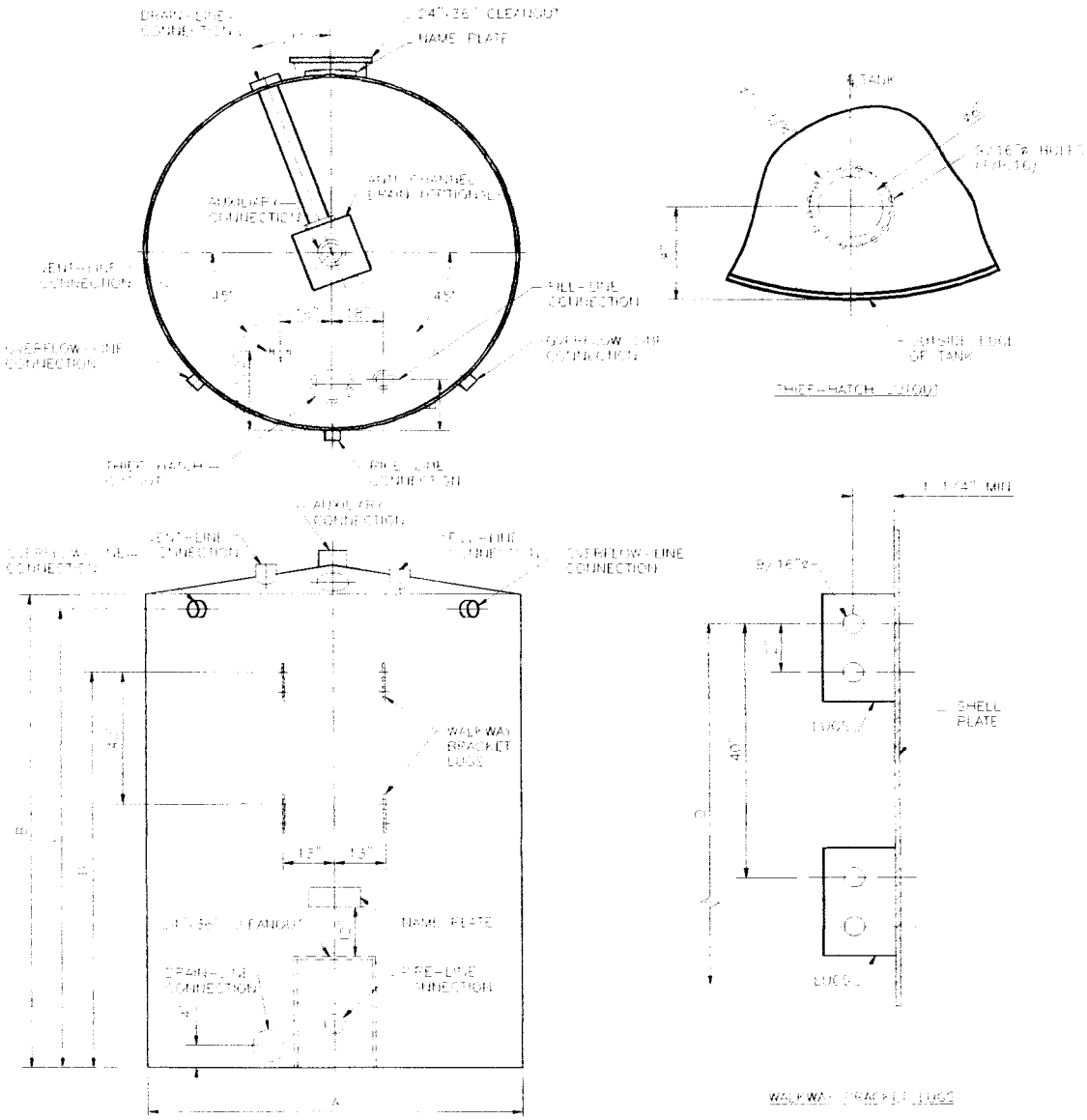


Process Fabricators, Inc. fabricates transport tanks in a wide variety of shapes and sizes.

- Obround truck tanks
- Cylindrical truck tanks
- Rectangular truck tanks
- Trailer tanks
- Pallet tanks
- ASME and DOT Standards

Crude Oil Production Tanks

Oil production tanks are designed and engineered for the storage of crude oil, condensate, hydrocarbon products and non-potable water. These tanks meet API 650 specifications if required. Available in flat or cone bottom styles, each tank includes heavy-duty couplings, openings per API 12F standards, a 24" x 36" cleanout manway and exterior primer coating.



PROCESS FABRICATORS INC.

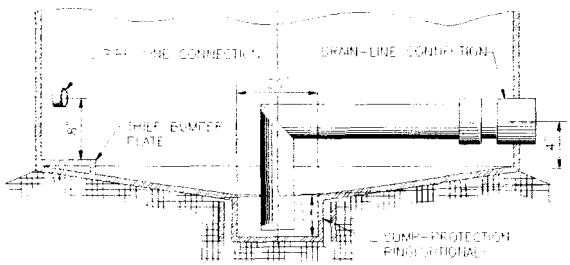
Crude Oil Production Tanks (cont.)

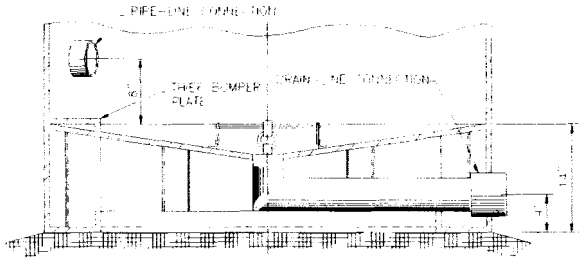
Standard Features...

- 3/16" thick carbon steel sidewalls
- 1/4" thick carbon steel flat bottom
- 3/16" thick carbon steel cone roof
- 2 ft. x 3 ft. rectangular cleanout manway
- (3) 3" threaded connections
- (2) 4" threaded connections
- Exterior primer coating

Optional Features...

- Type A cone bottom
- Type B cone bottom
- Heating coils
- Stairs, walkways, ladders - API or OSHA
- Oil water separator internals
- Internal coatings and linings
- Exterior epoxy coating





Type A Cone Bottom **Type B Cone Bottom**

The API style B cone bottom provides a very cost effective way to build a completely free draining tank that mounts on a flat floor or foundation. This economical bottom type can be furnished on any of our vertical style tanks.

Cylindrical Tank Capacity in Gallons

Nominal Capacity bbl.	Nominal Capacity gallons	Design Pressure oz. per in² press./vacuum		Approximate Working Capacity bbl.	Outside Diameter	Height	Height of Overflow Connection	Height of Walkway Connection	Location of Fill Line Connection	Size of Connections C-1,C-2 C-3,C-7	Size of Connections C-4,C-5 C-6
90	3822	16	1/2	72	7'-11"	10'-0"	9'-6"	7'-7"	1'-2"	3"	3"
100	4200	16	1/2	79	9'-6"	8'-0"	7'-6"	5'-7"	1'-2"	3"	3"
150	6300	16	1/2	129	9'-6"	12'-0"	11'-6"		1'-2"	3"	3"
200	8400	16	1/2	166	12'-0"	10'-0"	9'-6"	7'-7"	1'-2"	3"	4"
210	8820	16	1/2	200	10'-0"	15'-0"	14'-6"	12'-7"	1'-2"	3"	4"
250	10500	16	1/2	224	11'-0"	15'-0"	14'-6"	12'-7"	1'-2"	4"	4"
300	12600	16	1/2	266	12'-0"	15'-0'	14'-6"	12'-7"	1'-2"	4"	4"
400	16600	16	1/2	366	12'-0"	20'-0"	19'-6"	17'-7"	1'-2"	4"	4"
500	21000	16	1/2	466	12'-0"	25'-0"	24'-6"	22'-7	1'-2"	4"	4"
500	21000	16	1/2	479	15'-6"	16'-0"	15'-6"	13'-7"	1'-2"	4"	4"
750	31500	16	1/2	746	15'-6"	24'-0"	23'-6"	21'-7"	1'-2"	4"	4"

NOTE: The approximate working capacities listed above apply to flat bottom tanks.

Type A (unskirted) cone-bottom tanks have 6" more working height than corresponding flat bottom tanks. The approximate increase in capacities are 4 bbl. for the 7'-11" diameter tanks, 6 bbl. for the 9'-6" diameter tanks, 7 bbl. for the 10'-0" diameter tanks, 8 bbl. for the 11'-0 diameter tanks, 10 bbl. for the 12'-0" diameter tanks, and 17 bbl. for the 15'-6" diameter tanks.

Type B (skirted) cone-bottom tanks have 8" less working height than corresponding flat bottom tanks. The approximate decrease in capacities are 6 bbl. for the 7'-11" diameter tanks, 8 bbl. for the 9'-6" diameter tanks, 9 bbl. for the 10'-0" diameter tanks, 11 bbl. for the 11'-0 diameter tanks, 13 bbl. for the 12'-0" diameter tanks, and 15 bbl. for the 15'-6" diameter tanks.

Tank Saddles

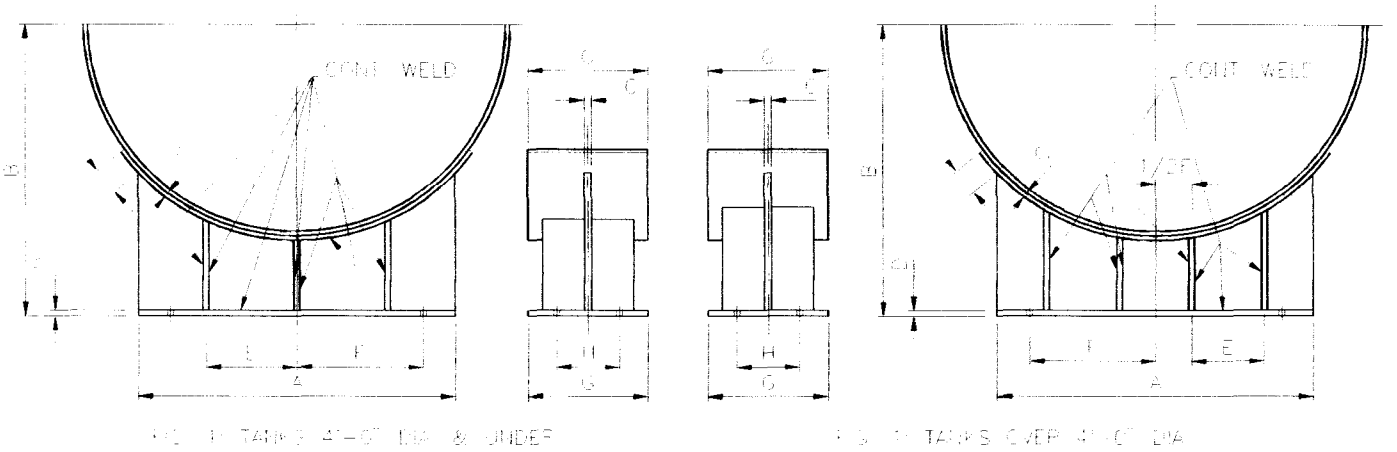


Table of Saddle Dimensions

Nominal Drum Dia.	A	B	C	D	E	F	G	H	Size of Rib	Weight per Saddle(lb.)
1'-6"	1'-4"	1'-4"	1/4"	1/4"	5"	6 1/2"	6"	3 1/2"	2 3/4"x1/4"	60
2'-0"	1'-10"	1'-7"	1/4"	1/4"	7 1/2"	9 1/2"	6"	3 1/2"	2 3/4"x1/4"	70
2'-6"	2'-3"	1'-10"	1/4"	1/4"	9"	11 1/4"	6"	3 1/2"	2 3/4"x1/4"	120
3'-0"	2'-8"	2'-1"	1/4"	1/4"	11"	1'-1 1/2"	6"	3 1/2"	2 3/4"x1/4"	170
3'-6"	3'-2"	2'-4"	1/4"	1/4"	1'-1"	1'-4"	6"	3 1/2"	2 3/4"x1/4"	200
4'-0"	3'-7"	2'-7"	3/8"	3/8"	1'-2 1/2"	1'-6"	6 1/2"	3 1/2"	2 3/4"x3/8"	230
4'-6"	4'-0"	2'-10"	3/8"	3/8"	1'-0"	1'-9"	6 1/2"	3 1/2"	2 3/4"x3/8"	270
5'-0"	4'-5"	3'-1"	3/8"	3/8"	1'-1"	1'-11"	6 1/2"	3 1/2"	2 3/4"x3/8"	310
5'-6"	4'-10"	3'-4"	3/8"	3/8"	1'-2"	2'-1"	6 1/2"	3 1/2"	2 3/4"x3/8"	350
6'-0"	5'-3"	3'-7"	3/8"	3/8"	1'-4"	2'-4"	6 1/2"	3 1/2"	2 3/4"x3/8"	420
6'-6"	5'-9"	3-10"	3/8"	3/8"	1'-5"	2'-6"	6 1/2"	3 1/2"	2 3/4"x3/8"	710
7'-0"	6'-2"	4'-1"	3/8"	3/8"	1'-7"	2'-8"	8"	5 1/2"	3 1/2"x3/8"	710
7'-6"	6'-7"	4'-4"	3/8"	3/8"	1'-8"	2'-11"	8"	5 1/2"	3 1/2"x3/8"	880
8'-0"	7'-0"	4'-7"	3/8"	3/8"	1'-9"	3'-1"	8"	5 1/2"	3 1/2"x3/8"	940
8'-6"	7'-6"	4'-10"	3/8"	3/8"	1'-11"	3'-4"	8"	5 1/2"	3 1/2"x3/8"	1350
9'-0"	7'-11"	5'-1"	3/8"	1/2"	2'-0"	3'-6"	8"	5 1/2"	3 1/2"x3/8"	1430
9'-6"	8'-4"	5'-4"	3/8"	1/2"	2'-1"	3'-8"	8"	5 1/2"	3 1/2"x3/8"	1760
10'-0"	8'-9"	5'-7"	1/2"	1/2"	2'-2"	3'-10"	8"	5 1/2"	3 1/2"x1/2"	1860
10'-6"	9'-2"	5'-10"	1/2"	1/2"	2'-4"	4'-0"	8"	5 1/2"	3 1/2"x1/2"	2080
11'-0"	9'-8"	6'-1"	1/2"	1/2"	2'-5"	4'-3"	8"	5 1/2"	3 1/2"x1/2"	2180
11'-6"	10'-1"	6'-4"	1/2"	1/2"	2'-6"	4'-5"	8"	5 1/2"	3 1/2"x1/2"	2340
12'-0"	10'-6"	6'-7"	1/2"	1/2"	2'-8"	4'-7"	8"	5 1/2"	3 1/2"x1/2"	2500

NOTES:... 1. Omit center rib for 1'-6" diameter.....2. All anchor bolt holes to be 7/8" diameter.....3. Saddles can be shipped loose or welded to the vessel.

PROCESS FABRICATORS INC.

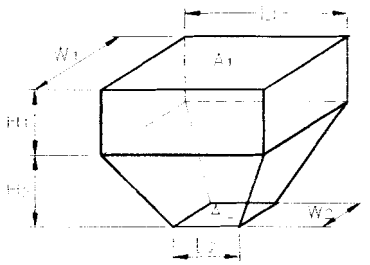
Bins, Silos and Hoppers

Process Fabricators, Inc. designs and fabricates a wide variety of tanks for bulk material storage in both cylindrical and rectangular shapes.

Rectangular Hopper Capacity Calculation

Hopper Volumes Trigonometric Functions

$$Vol = h_1 A_1 + [A_1 + A_2 + A_1 A_2]$$
$$A_1 = W_1 L_1$$
$$A_2 = W_2 L_2$$



Capacity Chart for Cylindrical Silos

1	2	3	4	5	6	7	8	9	10	11	12
Tank Inside Diameter	Capacity per foot of tank shell	45° Hopper with 12" Diameter Discharge		60° Hopper with 12" Diameter Discharge		70° Hopper with 12" Diameter Discharge		Working Volume Data "E" cubic feet to be subtracted from shell volume for angle of repose (Deck not included)			
"D"	ft³	volume C ft³	height "A"	volume C ft³	height "A"	volume C ft³	height "A"	volume E ft³	"G"	volume E ft³	"G"
8'-0"	50	67	3'-6"	116	6'-1"	184	9'-7"	63	1'-10"	112	3'-4"
9'-0"	64	95	4'-0"	165	6'-11"	262	11'-0"	89	2'-1"	160	3'-9"
10'-0"	79	131	4'-6"	226	7'-10"	359	12'-4"	122	2'-4"	220	4'-2"
11'-0"	95	174	5'-0"	302	8'-8"	478	13'-9"	162	2'-7"	292	4'-7"
12'-0"	113	226	5'-6"	392	9'-6"	621	15'-1"	211	2'-10"	380	5'-0"
13'-0"	133	287	6'-0"	498	10'-5"	790	16'-6"	268	3'-0"	483	5'-5"
14'-0"	154	359	6'-6"	622	11'-3"	987	17'-10"	335	3'-3"	603	5'-10"

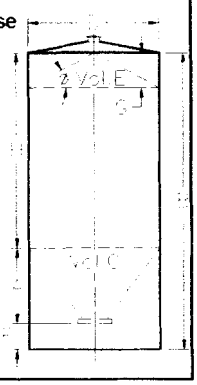
Example: (from tank shown)
Find the working volume of a tank 12'-0" diameter by 47'-4" high tank with a 45° hopper and a 12" diameter outlet, 2'-6" hopper clearance and assume the product stored produces an angle of repose of 25°.

Step 1: Find H
H = B-(F+A) (see column 4 and note)
= 47'-4" -(2'-6" + 5'-6")
H = 39'-4"

Step 2: Find total volume of shell (TVS)
TVS = H x cu. ft./ft. of shell (see column 2)
TVS = 39'-4" 113 cu. ft.
= 4445 cubic feet

Step 3: Find working volume of tank (WVT)
WVT = TVS + Vol. C - Vol. E (see columns 3 and 9)
WVT = 4445 cu. ft. + 226 cu. ft. - 211 cu. ft.
= 4460 cubic feet

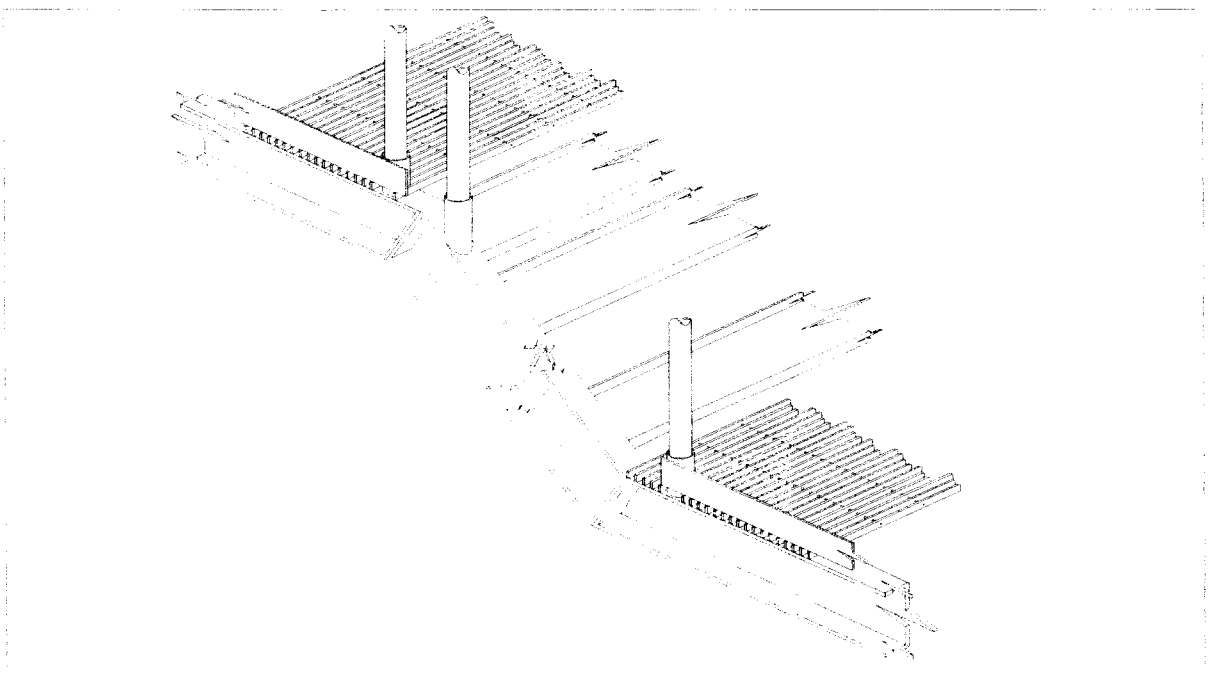
Where A = Height of hopper
B = Overall tank height
vol. C = Hopper volume
D = Inside diameter of tank
ϕ = Angle of repose
vol. E = Subtract for angle of repose
F = Hopper Clearance
G = Height of the angle of repose
H = Height of the shell above hopper



Optional Accessories

Complete bulk material handling units are offered including the following integrated components.

- fill pipe
- discharge feeder
- live bottom
- dust collection
- level indicators
- vibrators
- air cannons
- heat tracing
- insulation
- bucket elevator
- screw conveyor
- ladder
- handrails



PROCESS FABRICATORS INC.

Tank Estimate Worksheet

Use this form to assist in general planning of your tank requirements. Complete the form to the best of your abilities, including sheet 2. Fax the completed form to **Process Fabricators, Inc. (303) 932-6205.** Or call our sales department at (303) 932-6885. A completed "Tank Estimate Worksheet" will help us be more accurate when analyzing your tank and vessel needs. Thank You.

Type of tank:..... ☐ horizontal
☐ vertical
☐ rectangular
☐ other_____

Tank style: Top..... ☐ open top
☐ dished top
☐ cone roof
☐ flat top
☐ other_____

Bottom..... ☐ flat bottom
☐ dished bottom
☐ cone bottom
☐ sloped bottom
☐ other_____

Support..... ☐ leg support
☐ lug support
☐ skirt support
☐ saddle support
☐ other_____

Material:..... ☐ carbon steel
☐ stainless steel
☐ alloy steel
☐ other_____

Shell OUTSIDE diameter:_____

Shell thickness:_____

Shell length (seam to seam):_____

Tank capacity:_____

Corrosion allowance:_____

Tank service:_____

Lining:..... ☐ none
☐ epoxy
☐ rubber
☐ polyurethane
☐ polyethylene
☐ other_____

Exterior finishes:..... ☐ none
☐ prime
☐ finish coat_____
☐ other_____

Accessories:..... ☐ agitator
☐ agitator supports
☐ baffles
☐ dip tube
☐ level indicator
☐ conservation vent
☐ cover
☐ manway (page 2)
☐ nozzles (page 2)
☐ caged ladder
☐ uncaged ladder
☐ walkway
☐ stairway
☐ handrail
☐ other_____

Code:..... ☐ API 12f / API 650
☐ UL 142
☐ ASME Sec. VIII, Div. 1
☐ other_____

Stamp:..... ☐ yes ☐ no

Pressure (PSIG): design_____
operating_____

Temperature (°F) design_____
operating_____

Tank Estimate Worksheet (cont.)

Connections and Manways:

Description: _____ size: _____ type: ☐ _____ ☐ _____
notes: _____

Description: _____ size: _____ type: ☐ _____ ☐ _____
notes: _____

Description: _____ size: _____ type: ☐ _____ ☐ _____
notes: _____

Description: _____ size: _____ type: ☐ _____ ☐ _____
notes: _____

Description: _____ size: _____ type: ☐ _____ ☐ _____
notes: _____

Description: _____ size: _____ type: ☐ _____ ☐ _____
notes: _____

Quantity of tanks required (this description only): _____

Notes: _____

Company name: _____

Project name: _____

Contact name: _____

Company address: _____

City: _____ State: _____ Zip code: _____

Phone number: ( ) _____ Fax number: ( ) _____

PROCESS FABRICATORS INC.

Standard Tank Sizes

Use this chart together with the "Tank Estimate Worksheet" to assist in determining the tank or vessel which is best suited for your personal requirements.

Sidewall Height or Length (seam to seam)

Outside Diameter (O.D.)	2'-0"	3'-0"	4'-0"	5'-0"	6'-0"	7'-0"	8'-0"	10'-0"	12'-0"	14'-0"	16'-0"	20'-0"	24'-0"	30'-0"	36'-0"	40'-0"
2'-0"	□	□	□	□	□											
2'-6"	□	□	□	□	□											
3'-0"	□	□	□	□	□											
3'-6"			□	□	□	□	□	□								
4'-0"			□	□	□	□	□	□	□							
4'-6"			□	□	□	□	□	□	□							
5'-0"			□	□	□	□	□	□	□							
5'-6"			□	□	□	□	□	□	□							
6'-0"			□	□	□	□	□	□	□	□	□					
7'-0"				□	□	□	□	□	□	□	□	□				
8'-0"					□	□	□	□	□	□	□	□	□	□	□	□
9'-0"					□	□	□	□	□	□	□	□	□			
10'-0"							□	□	□	□	□	□	□	□	□	□
11'-0"							□	□	□	□	□	□				
12'-0"							□	□	□	□	□	□	□	□		
13'-0"							□	□	□	□	□	□				
14'-0"								□	□	□	□	□	□	□	□	□
14'-6"								□	□	□	□	□				
15'-0"								□	□	□	□	□	□	□	□	□
15'-6"								□	□	□	□	□				

Although the above chart lists "standard" tank sizes, **Process Fabricators Inc.** can also design and fabricate custom tanks of diameters and heights which are not listed. Feel free to contact Process Fabricators with your specific tank and vessel needs.

PROCESS
FABRICATORS
INC.

10,001 So. Hwy. 121
RR #1
Littleton, Colorado, 80125
(303)932-6885 Fax (303)932-6205

CODE AND NON-CODE VESSEL STYLES AND INFORMATION

The Meaning of A.S.M.E. Pressure Vessel Construction and Certification

It may seem hard to believe today, but in the late 1800's deaths and injuries from boiler and pressure vessel explosions were as common place as automobile accident fatalities are today. Newspapers, on a daily basis would report the latest incident of destruction resulting from the power of steam. Engineers could take pride in the growing superiority of American technology, but they could not ignore the price of 50,000 deaths and 2,000,000 injuries by boiler and pressure vessel accidents that occurred annually.

The publication of the boiler code of the American Society of Mechanical Engineers in 1915 was the beginning of the solution to this problem. The formation of the National Board of Boiler and Pressure Vessel Inspectors in 1919 created the enforcement mechanism for the A.S.M.E recommendations.

An increasing number of states and cities now make it mandatory that pressure vessels installed within their jurisdiction be A.S.M.E. certified. The following information serves to explain the procedure and its importance.

The American Society of Mechanical Engineers (A.S.M.E) publishes a procedural code for those manufacturers wishing to comply and display the various stamps of approval. Process Fabricators, Incorporated manufactures tanks under Section 8, Division 1 of the code. Tanks so manufactured and accepted by an A.S.M.E. inspector bear the unfired symbol "U" stamped on a nameplate which is affixed to each tank. Other requirements for code stamp include certification of each factory welder, documentation of material, and acceptance of the finished product by the "in house" A.S.M.E. inspector.

Factory welders must be certified for capability under the code by an assigned factory engineer. Certification under Section 9 of the code must be obtained by a factory welder for each function of welding. This includes finished or back welding, installation of couplings and flanges, automatic machine welding, mig welding (welding less flux), and tank shell and head welding. Certification is granted only within a material thickness range, for example, a maximum of one-half inch. Welding of greater thicknesses requires additional certification. A requirement met by a code welder is to weld a coupon plate for stress test. This 6" by 12" plate is welded and surface ground, cut in four 1 1/2" by 12" strips, and inserted in a press to be bent. The weld must withstand a 180° bend without evidence of weld defect. Welder certification also applies to specific welding rods, compatible with the steel material normally used by the steel manufacturer. Welders leaving one shop must be re-certified in the next. All material used in code manufacture must be documented under Section 2 of the code. The steel source is required to furnish the manufacture mill report having a heat number, a slab number, and a material specification describing the chemical analysis and physical properties of the steel. This information is retained by the manufacturer and upon request, the mill test report and data sheet are made available to others. The data sheet shows the shell and head thickness, the number and size of couplings or flanges used, date of the inspection and the A.S.M.E. inspector's signature. This data sheet is also sent to "National Board" in Columbus, Ohio with a factory assigned sequential number. National Board is independent of A.S.M.E. and simply serves as a source of filed information on all A.S.M.E. manufactured tanks.

All A.S.M.E. "U" stamp manufacturers have an A.S.M.E. inspector on the premise. The inspector is the sole judge of code acceptability. He is an employee of a licensed insurance company and has jurisdiction over all phases of code manufacture. He is authorized to suspend manufacture at any time or request that code imperfections be corrected. He may require the imperfect weld to be removed through gouging and properly re-welded. His acceptance may, however, be declared void by an A.S.M.E. field inspector. The inspector actually travels with each tank through all phases of manufacture. He first compares the mill test report with the steel received to ensure compatibility. He then measures the steel sheet to be certain that it conforms dimensionally and that its shape is square. Next, as the shell is rolled into a circular shape, he checks for roundness. One percent (1%) of the nominal diameter is the maximum allowable difference between the long and short dimension. As the inside seam is welded, he checks the inside longitudinal seam for weld defects. When the head is installed on the shell, he checks for alignment and allows a difference of one-fourth the material thickness. A 1/2" plate would tolerate a 1/16" difference. The quality of weld is then checked for couplings, manways and accessories. Outside visual inspection checks for pinholes, undercuts, overlap, lack of weld penetration, slag, and inclusion and excessive reinforcement. At the final inspection, the tank and all coils go to hydrostatic tests at 1.5 times the working pressure and is observed for leaks. Process Fabricator's engineering department is additionally involved in the code in that they must calculate and design all openings and accessories such as nozzles for flanges and manways so that they meet the stress requirements outlined in the code.

A.S.M.E. Boiler and Pressure Vessel Code Section VIII, Division 1

Including the Summer 1979 Addenda

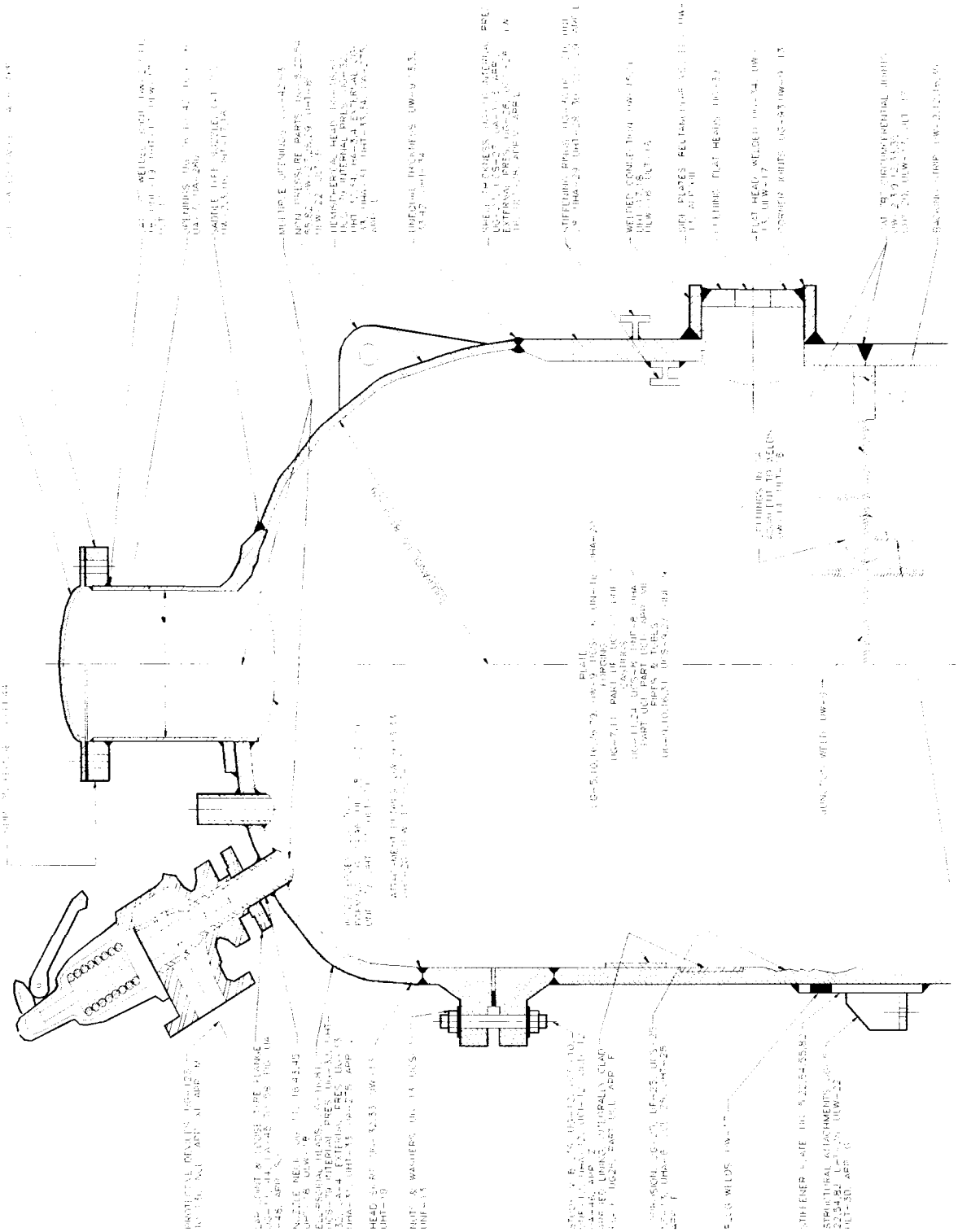
Quick Reference Guide

The purpose of this guide is to illustrate some of the types of pressure vessel construction which are provided for under Section VIII, Division 1of the A.S.M.E. code and to furnish direct reference to the applicable rule in the code. In the event of a discrepancy, the rules in the current edition of the code shall govern. This should be used only as a quick reference. The current edition of the code should always be referenced.

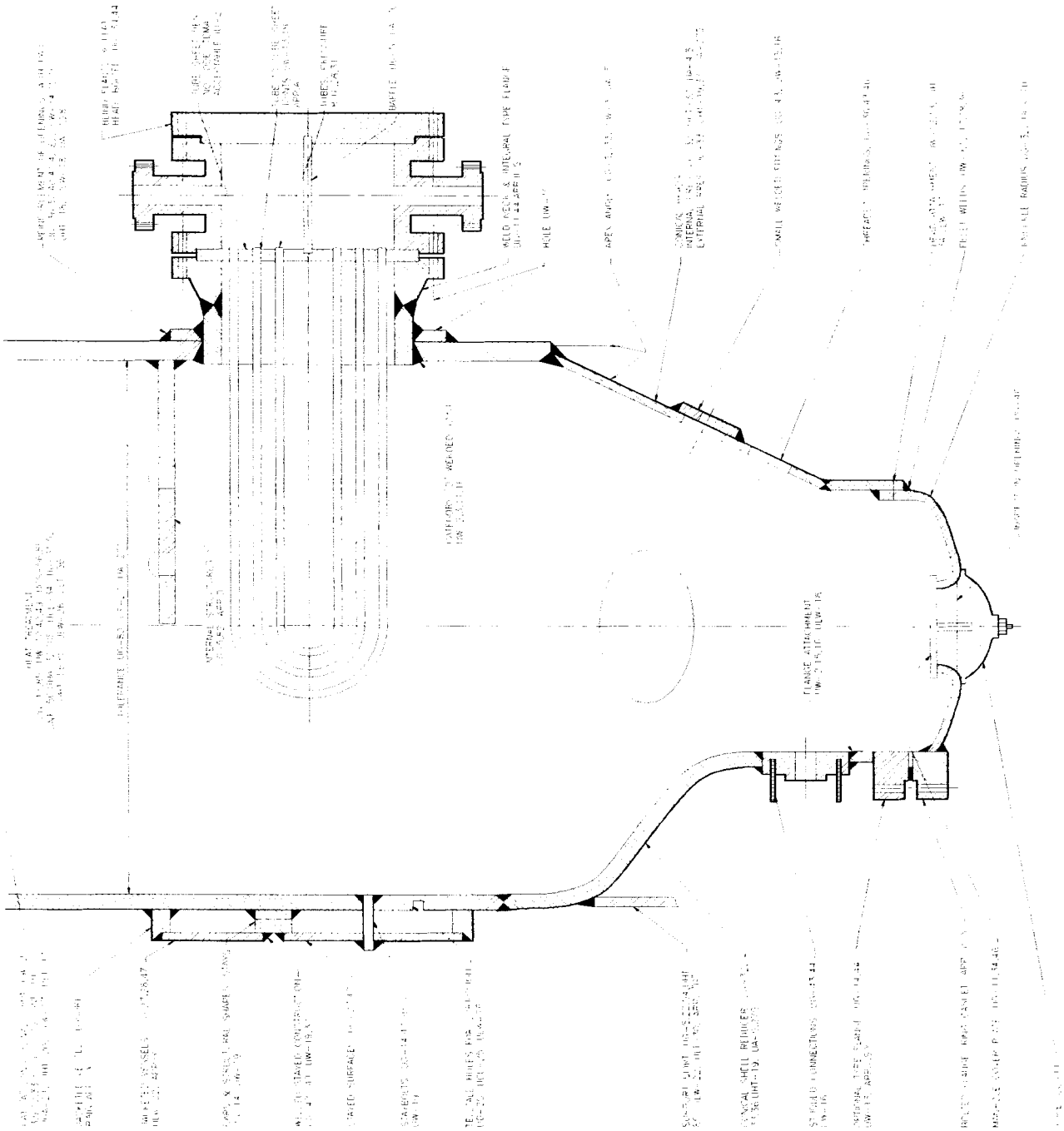
Compliments of the Hartford Steam Boiler Inspection and Insurance Company.

PROCESS FABRICATORS INC.

A.S.M.E. Reference Drawing



A.S.M.E. Reference Drawing



Welding Definitions Used in Tank Construction

Arc Welding

A group of welding processes wherein coalescence is produced by heating an electric arc with or without application of pressure or use of filler metal.

Backing Strip

A strip of material of any kind placed adjacent to the root of the welding groove to aid in obtaining full penetration of the weld, and which may or may not be removed after the weld is completed.

Brazing

A group of welding processes wherein the filler metal is a non-ferrous metal or alloy whose melting point is higher than 800°F, but lower than that of the metals or alloys to be joined.

Carbon-Arc Welding

Arc welding process wherein coalescence is produced by heating with an electric arc between a carbon electrode and the work and no shielding is used. Pressure and filler metal may or may not be used.

Efficiency (of a joint)

The ratio of the strength of a joint to the strength of the plates which it unites, to be used in design, expressed as a percentage.

Flash Welding

A resistance welding process wherein coalescence is produced, simultaneously over the entire area of abutting surfaces, by the heat obtained by resistance to the flow of electric current between the two surfaces, and by the application of pressure after heating is substantially completed. Finishing and upsetting are accompanied by expulsion of metal from the joints.

Forge Welding

A group of welding processes wherein coalescence is produced by the heat in a forge or by other suitable means, such as electrical resistance, oxy-acetylene flame, Thermit reaction, induction, and by applying pressure or blows.

Fusion Welding

The term fusion welding is intended to mean shielded metal arc welding or oxy-acetylene welding except where otherwise specifically indicated.

Gas Welding

A gas welding process wherein coalescence is produced by heating the work with a gas flame or flames obtained from the combustion of acetylene with oxygen followed by the application of pressure.

Induction Welding

A welding process wherein coalescence is produced by the heat obtained from resistance of the work to the flow of induced electric current, followed by the application of pressure.

Welding Definitions Used in Tank Construction

Joint, Welded

A localized union of two or more parts by welding.

Joint, Butt

A welded joint between two abutting parts lying in approximately the same places.

Joint, Single Welded Butt

A butt joint welded from one side only.

Joint, Double Welded Butt

A butt joint welded from both sides.

*Note: A joint with filler metal added from one side only is considered equivalent to a double welded butt joint when and if means are provided for accomplishing complete penetration and reinforcement on both sides of the joint.

Joint, Double Welded Lap

A lapped joint in which the overlapped edges of the members to be joined are welded along the edges of both members.

Joint, Edge

A welded joint connecting the edges of two or more parallel or nearly parallel parts.

Joint, Lap

A welded joint in which two overlapping parts are connected by means of fillet, plug, slot, spot, projection or seam welds.

Joint, Single Welded Lap

A lapped joint in which overlapped edges of the members to be joined are welded along the edge of one member.

Magnetic Particle and Inspection

A method of detecting cracks and similar discontinuity at or near the surface in iron and the magnetic alloys of steel. It consists of properly magnetizing the material and applying finely divided magnetic particles which form patterns indicating the discontinuity.

Operation Normal

Operation within the design limits of a vessel.

Operating Pressure

The pressure at which a vessel normally operates. It shall not exceed the maximum allowable pressure and is usually materially lower to avoid loss of the contents of a vessel through the opening of the safety valves.

Welding Definitions Used in Tank Construction

Oxy-Acetylene Welding

Gas-welding process wherein coalescence is produced by heating with a gas flame obtained from the combustion of acetylene with carbon with or without the application of pressure or the use of filler metal.

Pressure - Thermit Welding

A Thermit - Welding process wherein coalescence is produced by heating with superheated liquid metal and slag resulting from the chemical reaction between iron oxide and aluminum, and by applying pressure. The liquid metal from the reaction is not used as a filler material.

Pressure Design

The pressure fixed upon for the purpose of figuring the thickness of different parts of the vessel.

Radiographing

The process of passing electronic radiations through an object and obtaining a record of its soundness upon a sensitized film.

Resistance Welding

A group of welding processes wherein coalescence is produced by the heat obtained from resistance of the work of the flow of electric current in a circuit of which the work is a part, and by the application of pressure.

Sheilded Metal Arc Welding

Arc welding process wherein coalescence is produced by heating with an electric arc between a covered metal electrode and the work. Sheilding is obtained from decomposition of the electrode covering. Pressure is not used, and filler material is obtained from the electrode.

Submerged Arc Welding

Arc welding process wherein coalescence is produced by heating with an electric arc between a bare metal electrode and the work. The welding is sheilded by a blanket of granular fusible material on the work. Pressure is not used. Filler material is obtained from the electrode and sometimes from a supplementary welding rod.

Temperature, Operating or Working

The temperature that the metal of the vessel attains under normal operation of the vessel.

Thermit Welding

A group of welding processes wherein coalescence is produced by heating with superheated liquid metal and slag resulting from a chemical reaction between a metal oxide and aluminum with or without the application of pressure. Filler metal, when used, is obtained from the liquid metal.

Vessel, Clad

A vessel made from plate having a corrosion-resistant material integrally bonded to a base of less resistant material.

Vessel, Layer or Laminated

A vessel having a shell which is made up of two or more separate layers.

Vessel, Lined

A vessel having a corrosion resistant lining attached intermittently to the vessel wall.

Weld, Fillet

A weld, approximately triangular cross section, as used on a lap joint, toe joint or corner joint joining two surfaces approximately at right angles to each other.

Weld, Full Fillet

A fillet weld whose size is equal to the thickness of the thinner member joined.

Weld, Plug

A weld made in a hole in one member of a lap joint, joining that member to that portion of the surface of the other member which is exposed through the hole. The walls of the hole may or may not be parallel, and the hole may be partially or completely filled with weld metal.

Weld, Seal

A weld used primarily to obtain tightness and prevent leakage.

Working Pressure, Maximum Allowable

The maximum permissible internal or external working pressure of a vessel for the designated operating temperature.

Working Stress, Maximum Allowable

The maximum unit stress permitted a material used in a vessel.

Welding Filler Materials

Welding Process

Material	Metal Tk.	Arc Weld	MIG Weld	TIG Weld	Spot Weld	Gas Weld	Electron Beam	Oxyacet Brazing	Lead Solder
CARBON STEEL	less than 1/8"	X	X	X	X	X	X	X	X
	1/8" to 1/4"	X	X	X	X	X	X	X	X
	1/4" to 3/4"	X	X			X	X	X	
	3/4" and up	X	X			X	X		
LOW ALLOY STEEL	less than 1/8"	X	X	X	X	X	X	X	X
	1/8" to 1/4"	X	X	X	X	X	X	X	X
	1/4" to 3/4"	X	X				X		
	3/4" and up	X	X				X		
STAINLESS STEEL	less than 1/8"	X	X	X	X	X	X	X	X
	1/8" to 1/4"	X	X	X	X		X	X	X
	1/4" to 3/4"	X	X				X		
	3/4" and up	X	X				X		
CAST IRON									
	1/8" to 1/4"	X	X	X		X		X	X
	1/4" to 3/4"	X	X			X		X	
	3/4" and up	X	X			X		X	
ALUMINUM	less than 1/8"	X	X	X	X	X	X	X	X
	1/8" to 1/4"	X	X	X	X	X	X	X	X
	1/4" to 3/4"	X	X	X			X	X	
	3/4" and up	X	X				X		
TITANIUM	less than 1/8"		X	X		X	X	X	X
	1/8" to 1/4"		X	X			X		
	1/4" to 3/4"		X	X			X		
	3/4" and up		X				X		
COPPER & BRASS	less than 1/8"		X	X		X	X	X	X
	1/8" to 1/4"		X				X	X	X
	1/4" to 3/4"		X				X	X	
	3/4" and up		X				X		
MAGNESIUM	less than 1/8"		X	X	X		X	X	
	1/8" to 1/4"		X	X	X		X	X	
	1/4" to 3/4"		X				X		
	3/4" and up		X				X		

Characteristics of Metals

Metal	Weight per cu. ft. (lbs)	Melting Point		Boiling Point	
		°F	°C	°F	°C
Aluminum	166	1217	658	4442	2450
Bronze	548	1566-1832	850-1000		
Brass	527	1652-1724	900-940		
Carbon	219	6512	3600		
Chromium	431	3034	1615		
Copper	555	1981	1083	4703	2595
Gold	1205	1946	1063	5380	2971
Iron	490	2786	1530	5430	2999
Lead	708	621	327	3137	1725
Magnesium	109	1100	593		
Manganese	463	2300	1260		
Mild Steel	490	2462-2786	1350-1530	5450	3049
Nickel	555	2645	1452	4950	2732
Silver	655	1761	960	4010	2210
Tin	455	449	231	4120	2271
Titanium	218	3263	1795		
Tungsten	1186	5432	3000	10706	5930
Zinc	443	786	419	1663	906
4130 Steel	495	2550		5500	3051

Color of Steel at Various Temperatures

	°F	°C
Faint Red	900	482
Blood Red	1050	566
Dark Cherry Red	1075	579
Medium Cherry Red	1250	677
Cherry Red	1375	746
Bright Red & Scaling	1550	843
Salmon and Scaling	1650	899
Orange	1725	941
Lemon	1825	996
Light Yellow	1975	1079
White	2200	1204
Dazzling White	2350	1288

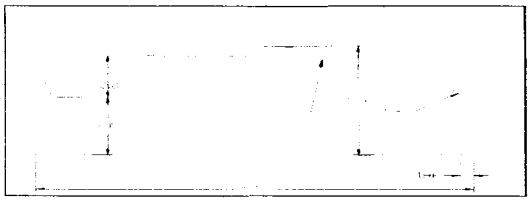
Temperature of Welding Fuels

FUEL	AIR° F	w/OXYGEN° F
Acetylene (C2H2)	4800° F	6300° F
Hydrogen (H2)	4000° F	5400° F
Propane (CaHa)	3800° F	5300° F
Butane	3900° F	5400° F
Mapp Gas	2680° F	5300° F
Natural Gas (CH4+H2)	3800° F	5025° F

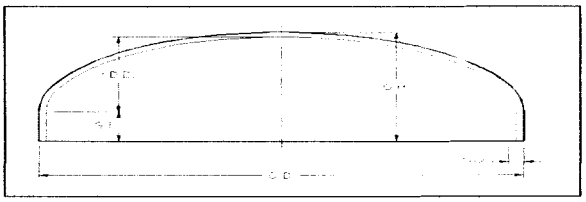
TANK AND VESSEL ACCESSORIES

Stock Heads

Flanged and Dished



Elliptical (2:1 Ratio)



ASME Carbon Steel

	OD \ THK	1/4	3/8	1/2	5/8
ELLIPTICAL (2:1)	8 5/8		X	X	
	10 3/4	X	X	X	
ASME	12 3/4	X	X	X	
FLANGED	14		X	X	
AND DISHED	16	X	X	X	
	18		X	X	
A516-70	20		X	X	
Hot Formed	24		X	X	
and Normalized	26		X		
	30	X	X	X	X
37 1/2° Outside	36		X	X	X
Bevel with a	42		X	X	
1/16" Land	48		X	X	

	OD \ THK	3/16	1/4	5/16	3/8	1/2	5/8
ASME	48"	X	X	X	X	X	
FLANGED	60"	X	X	X	X	X	
AND DISHED	72"		X	X	X	X	
	84"			X	X	X	
A285-C and 516-70	96"			X	X	X	X
	108"		X		X	X	
Square	120"		X		X	X	X
Machined	312"			X	X	X	X
Edge	144"			X	X	X	X

Stainless Steel

	OD \ THK	3/16	1/4	
ASME	12	X	X	
FLANGED	14	X	X	
AND DISHED	16	X	X	
	18	X	X	No Center Hole
304, 304L,	20	X	X	
316, and 316L	24	X	X	
	30	X	X	
Square	36	X	X	
Machined	42	X	X	
Edge	48	X	X	1 1/2" Center Hole
	54	X	X	
	60	X	X	
	72	X	X	

Stainless Steel Caps

	OD	SF \ THK	3/16	1/4	5/16	3/8
ELLIPTICAL (2:1)	6 5/8"	1 3/4"	X		X	
A-403 WELD CAP	8 5/8"	1 11/16"	X		X	
	10 3/4"	2 1/8"	X			X
304L and 316L	12 3/4"	2 5/8"	X	X		X

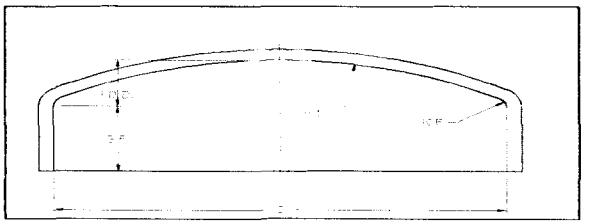
	OD	SF \ THK	3/16	1/4	3/8
ELLIPTICAL (2:1)	14	2 13/16	X		X
ASME	16	2 13/16	X		X
SECTION VIII	18	2	X	X	X
	20	2	X		X
304L and 316L	24	2	X	X	X
	30	2		X	X
Beveled Edge	36	2		X	X

Non-Code Carbon Steel

	OD \ THK	3/16	1/4	5/16
NON-CODE	42"	X	X	
STANDARD	48"	X	X	
FLANGED	54"	X	X	
AND DISHED	60"	X	X	
	66"	X	X	
Square	72"	X	X	
Machined	84"		X	X
Edge	96"		X	X
	108		X	X
	120"		X	X

OD - Outside Diameter
THK - Thickness
OH - Overall Height
SF - Straight Flange
RD - Radius of Dish
ICR - Inside Corner Radius
IDD - Inside Depth of Dish

Approximate Volumes of Heads (gallon)

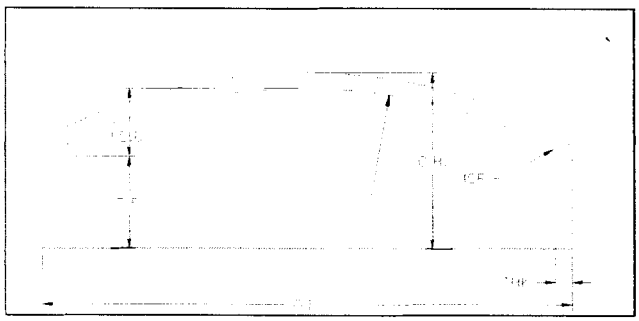


Does Not Include Straight Flange Capacity

OD - Outside Diameter
THK - Thickness
OH - Overall Height
SF - Straight Flange
RD - Radius of Dish
ICR - Inside Corner Radius
IDD - Inside Depth of Dish

ID	ELLIPTICAL	ASME F&D	HEMISPHERICAL	DISHED ONLY	80-10	STANDARD F&D	ID
12	.98	.61	1.96	.40	.87	.61	12
18	3.31	2.07	6.61	1.36	3.06	2.07	18
24	7.83	4.91	15.67	3.22	7.19	4.91	24
30	15.30	10.25	30.60	6.30	12.84	7.62	30
36	26.44	16.58	52.88	10.88	22.88	12.79	36
42	41.99	27.62	83.97	17.28	35.75	19.87	42
48	62.67	39.31	125.34	25.79	53.68	29.18	48
54	89.23	58.10	178.46	36.72	76.78	41.01	54
60	122.41	76.78	244.80	50.37	105.73	55.67	60
66	162.92	103.25	325.83	67.05	142.61	75.59	66
72	211.52	135.19	423.01	87.04	179.03	97.21	72
78	268.93	167.20	537.82	110.67	228.55	122.60	78
84	335.89	217.54	671.73	138.22	285.01	152.07	84
90	413.12	261.09	826.20	170.01	360.21	185.90	90
96	501.38	323.45	1002.70	206.33	429.43	224.41	96
102	601.39	379.74	1202.70	247.48	520.65	267.89	102
108	713.88	442.08	1427.67	293.77	604.59	316.66	108
114	839.59	529.78	1679.08	345.51	718.48	402.85	114
120	979.26	607.21	1958.39	402.98	821.83	466.52	120
126	1133.61	714.90	2267.08	466.50	979.42	536.56	126
132	1303.39	809.04	2606.62	536.37	1106.13	613.26	132
138	1489.33	934.15	2978.47	612.88	1258.85	696.93	138
144	1692.16	1051.27	3384.10	696.35	1476.76	878.87	144
150	1912.61	1227.02	3824.99	787.07	1642.63	886.38	150
156	2151.43	1361.28	4302.59	885.35	1828.42	992.76	156
162	2409.34	1504.82	4818.38	991.49	2193.16	1107.32	162
168	2687.08	1712.89	5373.83	1105.78	2409.23	1230.36	168
174	2985.39	1879.89	5970.40	1228.54	2638.61	1362.17	174
180	3304.99	2057.21	6609.57	1360.06	2881.68	1503.08	180
186	3646.63	2312.53	7292.81	1500.65	3150.28	1653.36	186
192	4011.04	2515.83	8021.58	1650.61	3422.79	1813.34	192
198	4398.95	2730.51	8797.34	1810.24	3710.18	1983.30	198
204	4811.09	3078.42	9621.58	1979.85	4040.51	2163.55	204
210	5248.21	3324.02	10495.76	2159.73	4404.50	2354.40	210
216	5711.03	3582.12	11421.34	2350.19	4805.78	2556.15	216
222	6200.29	3853.00	12399.81	2551.53	5213.69	2769.09	222
228	6716.73	4187.61	13432.61	2764.05	5644.08	2993.54	228
234	7261.07	4700.90	14521.23	2988.06	6097.53	3229.79	234
240	7834.06	5025.88	15667.14	3223.85	6574.65	3478.14	240

Standard ASME Flanged and Dished Heads



OD	-	Outside Diameter
THK	-	Thickness
OH	-	Overall Height
SF	-	Straight Flange
RD	-	Radius of Dish
ICR	-	Inside Corner Radius
IDD	-	Inside Depth of Dish

Sizes and Thicknesses of Heads

THK / OD	12 GA	11 GA	10GA	3/16, 1/4	5/16	3/8, 7/16	1/2, 9/16	5/8	11/16, 3/4	13/16, 7/8	15/16	1	1 1/8, 1 1/4	1 3/8, 1 1/2	1 3/4, 2	2 1/4, 2 1/2, 2 3/4	3, 3 1/4	3 1/2, 3 3/4	4	4 1/4, 4 1/2	4 3/4	5	5 1/2	6	THK / OD
10 3/4				X	X	X	X	X																	10 3/4
12	X	X	X	X	X	X	X	X	X																12
12 3/4	X	X	X	X	X	X	X	X	X																12 3/4
14	X	X	X	X	X	X	X	X	X																14
16	X	X	X	X	X	X	X	X	X																16
18	X	X	X	X	X	X	X	X	X																18
20	X	X	X	X	X	X	X	X	X																20
22	X	X	X	X	X	X	X	X	X																22
24	X	X	X	X	X	X	X	X	X	X	X	X													24
26	X	X	X	X	X	X	X	X	X	X	X	X													26
28	X	X	X	X	X	X	X	X	X	X	X	X	X												28
30	X	X	X	X	X	X	X	X	X	X	X	X	X												30
32	X	X	X	X	X	X	X	X	X	X	X	X	X												32
34	X	X	X	X	X	X	X	X	X	X	X	X	X												34
36	X	X	X	X	X	X	X	X	X	X	X	X	X												36
42	X	X	X	X	X	X	X	X	X	X	X	X	X	X											42
44	X	X	X	X	X	X	X	X	X	X	X	X	X	X											44
48	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										48
54			X	X	X	X	X	X	X	X	X	X	X	X	X										54
60			X	X	X	X	X	X	X	X	X	X	X	X	X	X									60
66			X	X	X	X	X	X	X	X	X	X	X	X	X	X									66
72			X	X	X	X	X	X	X	X	X	X	X	X	X	X									72
78,84				X	X	X	X	X	X	X	X	X	X	X	X	X	X								78,84
90				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					90
96				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				96
102				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				102
108,114				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			108,114
120				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		120
126				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	126
132				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	132
138				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	138
144				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	144
150,156					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	150,156
162,168						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	162,168
174						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	174
180,192						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		180,192
204,216						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			204,216
228						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					228
240						X	X	X	X	X	X	X	X	X											240

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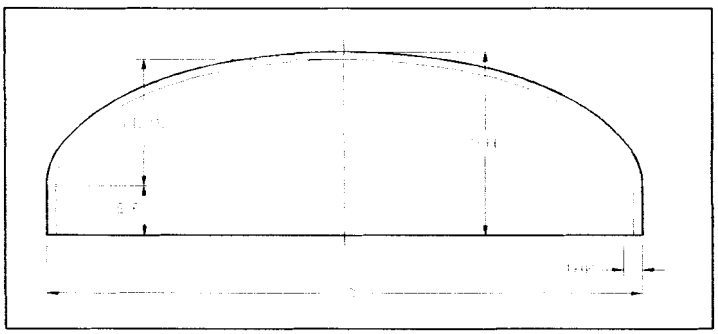
2:1 Elliptical Heads

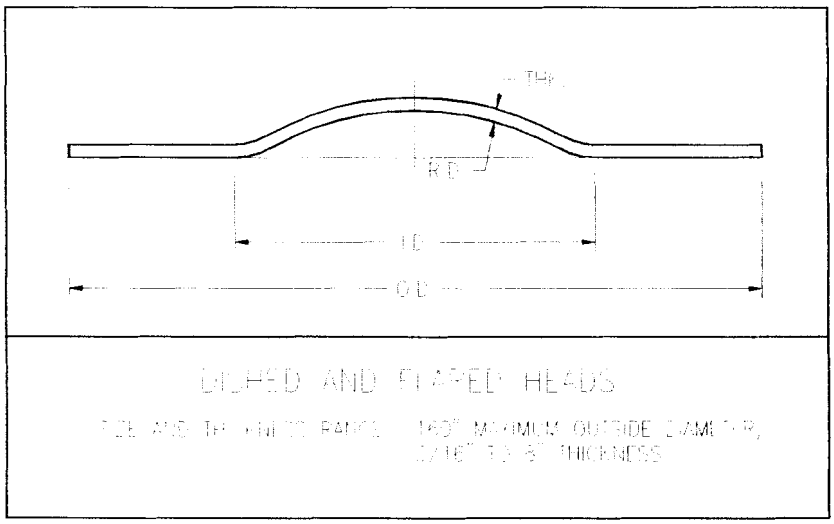


OD	-	Outside Diameter
THK	-	Thickness
OH	-	Overall Height
SF	-	Straight Flange
RD	-	Radius of Dish
ICR	-	Inside Corner Radius
IDD	-	Inside Depth of Dish

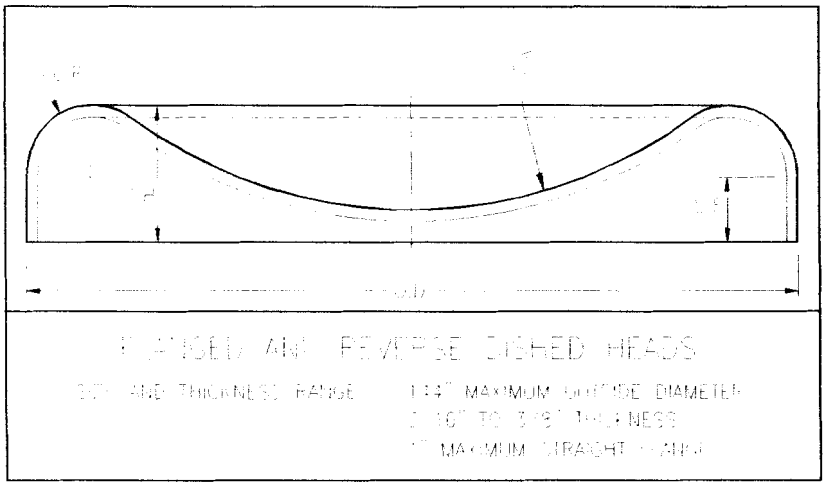
Sizes and Thicknesses of Heads

THK / OD	3/16	1/4	5/16	3/8, 7/16	1/2, 9/16, 5/8	11/16, 3/4, 13/16	7/8, 1	1 1/8, 1 1/4	1 3/8	1 1/2, 1 5/8, 1 3/4	1 7/8	2	2 1/4, 2 1/2, 2 3/4	3	3 1/4	3 1/2	3 3/4	4, 4 1/4, 4 1/2	4 3/4	5, 5 1/4	5 1/2	5 3/4	6	6 1/2	7		THK / OD
6	X	X	X	X	X	X	X	I	I	I																	6
8	X	X	X	X	X	X	X	X	X	I																	8
10	X	X	X	X	X	X	X	X	X	X	X	X															10
12	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I												12
14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I												14
16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I												16
18	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I												18
20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I												20
22	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X												22
24	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I										24
30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I										30
36	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X									36
42	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							42
48	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I						48
54	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I				54
60	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	60
66		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	66
72		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	72
78			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	78
84				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	84
90				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	90
96				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	96
102				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	102
108				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	108
114				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	114
120				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	120
126				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	126
132				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	132
138				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	138
144				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	144
150				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	150
156				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	156
168				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	168
180				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	180
192				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	192
204				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	204
216				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	216
228				X	X	X	X	X																			228
240				X	X	X	X	X																			240

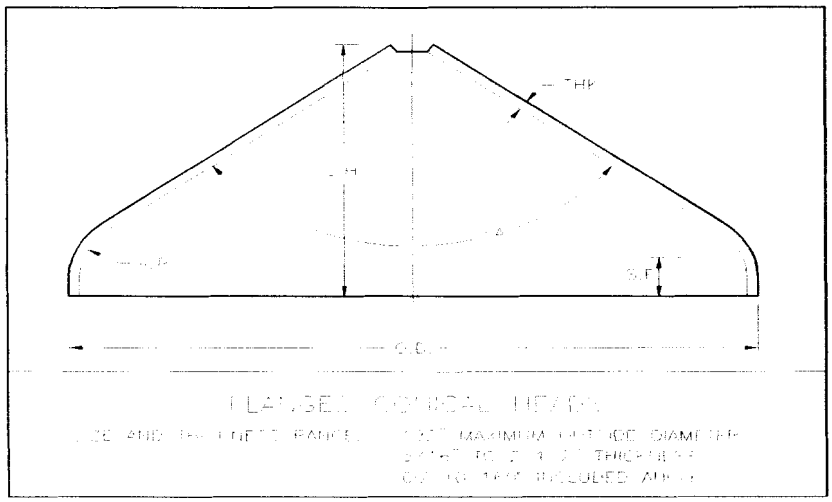
Special Design Heads and Services



DISHED AND FLARED HEADS



FLANGED AND REVERSE DISHED HEADS



FLANGED CONICAL HEADS

OD - Outside Daimeter
ID - Inside Diameter
THK - Thickness
OH - Overall Height
SF - Straight Flange
RD - Radius of Dish
ICR - Inside Corner Radius
IA - Included Angle

Heat Treating

Heads up to 160 inch diameter can be solution annealed, pickled or sand-blasted. Carbon steel heads up to 240 inch diameter are stress relieved or normalized to meet A.S.M.E. code.

Cleaning

All solution annealed stainless steel heads are pickled or sandblasted prior to shipment. All cold formed heads are solvent cleaned prior to shipment

Stainless Steel Polishing

Upon request, the inside and outside diameter of a head can be polished. All polishing is performed after forming. Heads are spray protected and crated for shipment.

No. 4 Polish	15-25 RMS
No. 4 Pit Free	10-20 RMS
No. 100 Grit	30-70 RMS

Circle Cutting

Complete cirle cutting facilities are available if customer prefers to supply square plate for heads.

Heads with Seams

Frequently, delivery is expedited by putting a welded seam in the head provided customer's pressure calculations permit. The seam, made by code-qualified welders, is X-rayed if required. Partial Data Sheets (A.S.M.E. Form U-2) are available.

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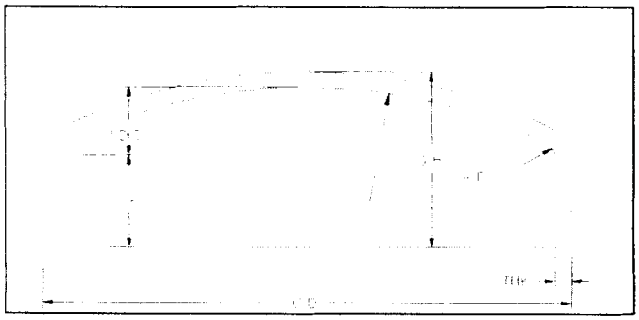
Standard or Shallow Flanged and Dished Heads



OD	-	Outside Diameter
THK	-	Thickness
OH	-	Overall Height
SF	-	Straight Flange
RD	-	Radius of Dish
ICR	-	Inside Corner Radius
IDD	-	Inside Depth of Dish

Sizes and Thicknesses of Heads

THK OD	11 GA	10 GA	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/2	2	3 1/2	4	4 1/2	THK OD
12	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X												12
18	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I										18
24	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I										24
30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X									30
36	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							36
42	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I						42
48	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I				48
54	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	54
60		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	60
66		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	66
72			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	72
78				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	78
84				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	84
90				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	90
96				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	96
102				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	102
108				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	108
114				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	114
120				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	120
126				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	126
132				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	132
138				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	138
144				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	144
156				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	156
168				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	168
180				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	180
192				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	192
204				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	204
216				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	216
228				X	X	X	X	X																			228
240				X	X	X	X	X																			240

Thinning Allowance and Tolerance Charts

Hot Formed Thinning Allowance

Elliptical or Flanged and Dished Heads
Hot Pressed or Hot Pressed and Spun Heads

I.D.	Min. Thk. Over	Min. Thk. Incl.	Add Extra Inches
6 5/8" through 16"		7/16"	1/16"
	7/16"	15/16"	1/8"
	15/16"	1 7/16"	3/16"
	1 7/16"	1 15/16"	1/4"
	1 15/16"	ASK	ASK
Over 16" through 26"		13/16"	1/16"
	13/16"	1 7/16"	1/8"
	1 7/16"	1 15/16"	3/16"
	1 15/16"	2 7/16"	1/4"
	2 7/16"	2 15/16"	1/2"
	2 15/16"	ASK	ASK
Over 26" through 36"		13/16"	1/16"
	13/16"	1 7/16"	1/8"
	1 7/16"	1 15/16"	3/16"
	1 15/16"	2 7/16"	1/4"
	2 7/16"	2 15/16"	3/8"
	2 15/16"	ASK	ASK
Over 36" through 116"		15/16"	1/16"
	15/16"	1 15/16"	1/8"
	1 15/16"	2 15/16"	3/16"
	2 15/16"	ASK	ASK

Hemispherical Heads

Hot Pressed Heads

O.D.	Min. Thk. Over	Min. Thk. Incl.	Add Extra Inches
8 5/8" through 26"		1 1/16"	3/16"
	1 1/16"	2 1/16"	3/8"
	2 1/16"	2 15/16"	5/8"
	2 15/16"		ASK
Over 26"		1 1/16"	3/16"
	1 1/16"	2 1/16"	1/4"
	2 1/16"	2 15/16"	1/2"
	2 15/16"		ASK

Cold Formed Tolerance

Flanged and Dished Heads

O.D.	CT	ORT	OH*	SF*	THK.
12"-24"	1/8"	1%	1/4"	1/4"	Up to and Including 1/2" Thick
25"-60"	1/8"	1%	1/4"	1/4"	
61"-96"	1/8"	1%	1/4"	1/4"	
97"-120"	1/8"	1%	1/4"	1/4"	
121"-144"	1/8"	1%	1/4"	1/4"	
145"-Above	3/16"	1%	1/2"	1/2"	
26"-60"	1/8"	1%	1/4"	1/4"	Over 1/2" Thick to 1" Thick
61"-96"	3/16"	1%	1/4"	1/4"	
97"-120"	3/16"	1%	3/8"	1/4"	
121"-144"	3/16"	1%	3/8"	1/4"	
145"-Above	3/16"	1%	1/2"	1/2"	
61"-96"	1/4"	1%	3/4"	1/2"	Over 1" Thick
97"-120"	5/16"	1%	1"	3/4"	
121"-Above	3/8"	1%	1"	3/4"	

It is impossible to maintain the straight flange and the overall height. If the straight flange must be held, the above tolerance in the overall height will not apply. If the overall height must be held, the tolerance on the straight fllange will not apply. If any of the above tolerances are required, it must be so stated on the purchase order.

Dished Only Heads

O.D.	FT*
12"-48"	+1/2", -0"
49"-96"	+3/4", -0"
97"-144"	(+1 1/2", -0")
145"-Above	(on application)

Tolerances are based on untrimmed heads one inch thick and under, with the dish radius equal to the diameter. If customer requires square trimmed heads, on heads over one inch thick or with a dish radius different than the diameter, the tolerance shall be agreed upon at the time of order.

Flanged Only Heads

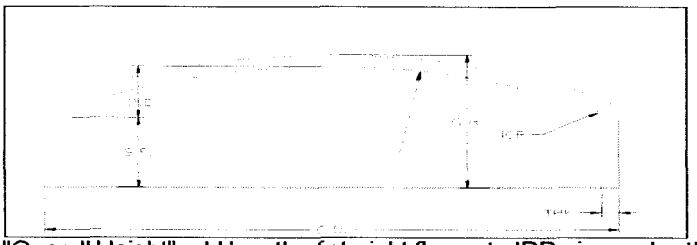
O.D.	FT*
12"-60"	3/16"
61"-95"	1/4"
96"-120"	3/8"
121"-Above	1/2"

Tolerances do not apply to welded construction

O.D. - Outside Diameter
I.D. - Inside Diameter
THK - Thickness
OH - Overall Height
SF - Straight Flange

CT - Circumference Tolerance
ORT - Out of Round Tolerance
DT - Diameter Tolerance
FT - Flatness Tolerance

ASME Flanged and Dished Heads IDD Chart



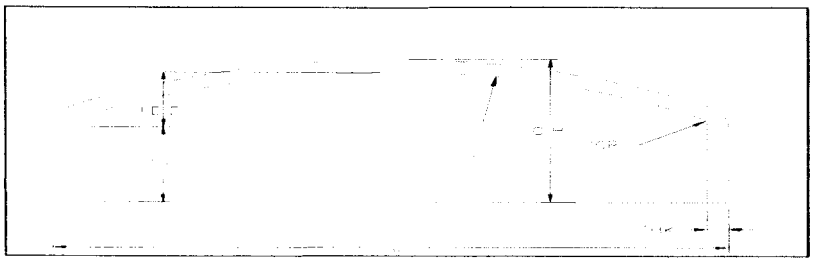
For "Overall Height" add length of straight flange to IDD given, plus thickness of material.

OD - Outside Diameter
THK - Thickness
OH - Overall Height
SF - Straight Flange
RD - Radius of Dish
ICR - Inside Corner Radius
IDD - Inside Depth of Dish

Use When RD Equals Diameter Minus 6"

OD \ THK	ICR	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	7/8"	1"
30	3	6.24	6.20	6.16	6.11	6.07	6.03	5.99	5.94	5.90	5.86	5.98	6.11
32	3	6.50	6.46	6.42	6.37	6.33	6.29	6.25	6.21	6.16	6.12	6.25	6.38
34	3	6.76	6.72	6.68	6.64	6.59	6.55	6.51	6.47	6.43	6.39	6.51	6.65
36	3	7.02	6.98	6.94	6.90	6.86	6.82	6.77	6.73	6.69	6.65	6.78	6.91
38	3	7.69	7.65	7.61	7.57	7.53	7.49	7.45	7.41	7.37	7.33	7.26	7.18
40	3	7.96	7.91	7.87	7.83	7.80	7.76	7.72	7.68	7.64	7.60	7.52	7.45
42	3	8.22	8.18	8.14	8.10	8.06	8.02	7.98	7.94	7.91	7.87	7.79	7.72
44	3	8.49	8.45	8.41	8.37	8.33	8.29	8.25	8.21	8.17	8.13	8.06	7.98
46	3	8.75	8.71	8.67	8.63	8.59	8.56	8.52	8.48	8.44	8.40	8.33	8.25
48	3	9.02	8.98	8.94	8.90	8.86	8.82	8.78	8.75	8.71	8.67	8.59	8.52
50	3	9.28	9.24	9.21	9.17	9.13	9.09	9.05	9.01	8.97	8.94	8.86	8.79
52	3.25	9.97	9.93	9.89	9.85	9.82	9.78	9.74	9.70	9.67	9.63	9.56	9.48
54	3.25	10.24	10.20	10.16	10.12	10.08	10.05	10.01	9.97	9.93	9.90	9.82	9.75
56	3.25	10.50	10.46	10.43	10.39	10.35	10.31	10.28	10.24	10.20	10.17	10.09	10.02
58	3.25	10.77	10.73	10.69	10.66	10.62	10.58	10.54	10.51	10.47	10.43	10.36	10.29
60	3.25	11.04	11.00	10.96	10.92	10.89	10.85	10.81	10.77	10.74	10.70	10.63	10.55
62	3.25	11.30	11.27	11.23	11.19	11.15	11.12	11.08	11.04	11.01	10.97	10.90	10.82
64	4.25	11.85	11.82	11.78	11.74	11.71	11.67	11.63	11.60	11.56	11.52	11.45	11.38
66	4.25	12.12	12.09	12.05	12.01	11.97	11.94	11.90	11.86	11.83	11.79	11.72	11.65
68	4.25	12.39	12.35	12.32	12.28	12.24	12.21	12.17	12.13	12.10	12.06	11.99	11.92
70	4.25	12.66	12.62	12.58	12.55	12.51	12.47	12.44	12.40	12.36	12.33	12.25	12.18
72	4.75	13.21	13.17	13.14	13.10	13.06	13.02	12.99	12.96	12.92	12.88	12.81	12.74
74	4.75	13.48	13.44	13.41	13.37	13.33	13.30	13.26	13.22	13.19	13.15	13.08	13.01
76	4.75	13.75	13.71	13.67	13.64	13.60	13.56	13.53	13.49	13.46	13.42	13.35	13.28
78	4.75	14.01	13.98	13.94	13.90	13.87	13.83	13.80	13.76	13.72	13.69	13.62	13.54
80	5	14.43	14.39	14.35	14.32	14.28	13.24	14.21	14.17	14.14	14.10	14.03	13.96
82	5	14.69	14.66	14.62	14.58	14.55	14.51	14.48	14.44	14.40	14.37	14.30	14.23
84	5.75	15.39	15.36	15.32	15.29	15.25	15.21	15.18	15.14	15.11	15.07	15.00	14.93
86	5.75	15.66	15.63	15.59	15.55	15.52	15.48	15.45	15.41	15.38	15.34	15.27	15.20
88	5.75	15.93	15.89	15.86	15.82	15.79	15.75	15.71	15.68	15.64	15.61	15.54	15.47
90	5.75	16.20	16.16	16.13	16.09	16.05	16.02	15.98	15.95	15.91	15.88	15.81	15.74
92	5.75	16.47	16.43	16.39	16.36	16.32	16.29	16.25	16.22	16.18	16.14	16.07	16.00
94	5.75	16.73	16.70	16.66	16.63	16.59	16.55	16.52	16.48	16.45	16.41	16.34	16.27
96	6.5	17.44	17.40	17.37	17.33	17.29	17.26	17.22	17.19	17.15	17.12	17.05	16.98
98	6.5	17.70	17.67	17.63	17.60	17.56	17.53	17.49	17.46	17.42	17.39	17.32	17.25
100	6.5	17.97	17.94	17.90	17.87	17.83	17.79	17.76	17.72	17.69	17.65	17.58	17.51
102	6.5	18.24	18.20	18.17	18.13	18.10	18.06	18.03	17.99	17.96	17.92	17.85	17.78

ASME Flanged and Dished Heads IDD Chart



OD - Outside Diameter
THK - Thickness
OH - Overall Height
SF - Straight Flange
RD - Radius of Dish
ICR - Inside Corner Radius
IDD - Inside Depth of Dish

For "Overall Height" add length of straight flange to IDD given, plus thickness of material.

Use When RD Equals Diameter Minus 6"

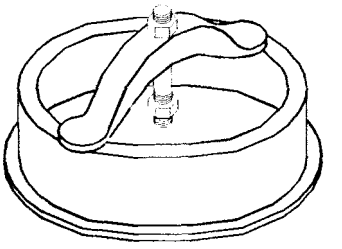
OD \ THK	ICR	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	7/8"	1"
104	6.5	18.51	18.47	18.44	18.40	18.37	18.33	18.30	18.26	18.22	18.19	18.12	18.05
106	6.5	18.78	18.74	18.70	18.67	18.63	18.60	18.56	18.53	18.49	18.46	18.39	18.32
108	6.5	19.04	19.01	18.97	18.94	18.90	18.87	18.83	18.80	18.76	18.73	18.66	18.59
110	7.25	19.75	19.71	19.68	19.64	19.61	19.57	19.54	19.50	19.47	19.43	19.36	19.29
112	7.25	20.02	19.98	19.95	19.91	19.88	19.84	19.81	19.77	19.74	19.70	19.63	19.56
114	7.25	20.28	20.25	20.21	20.18	20.14	20.11	20.07	20.04	20.00	19.97	19.90	19.83
116	7.25	20.55	20.52	20.48	20.45	20.41	20.38	20.34	20.31	20.27	20.24	20.17	20.10
118	7.25	20.82	20.78	20.75	20.71	20.68	20.64	20.61	20.57	20.54	20.50	20.43	20.36
120	7.25	21.09	21.05	21.02	20.98	20.95	20.91	20.88	20.84	20.81	20.77	20.70	20.63
122	8	21.79	21.76	21.72	21.69	21.65	21.62	21.58	21.55	21.52	21.48	21.41	21.34
124	8	22.06	22.03	21.99	21.96	21.92	21.89	21.85	21.82	21.78	21.75	21.68	21.61
126	8	22.33	22.29	22.26	22.22	22.19	22.15	22.12	22.08	22.05	22.02	21.95	21.88
128	8	22.60	22.56	22.53	22.49	22.46	22.42	22.39	22.35	22.32	22.28	22..21	22.15
130	8	22.86	22.83	22.79	22.76	22.72	22.69	22.66	22.62	22.59	22.55	22.48	22.41
132	8	23.13	23.10	23.06	23.03	22.99	22.96	22.92	22.89	22..85	22.82	22.75	22.68
134	8.625	23.77	23.73	23.70	23.66	23.63	23.59	23.56	23.52	23.49	23.45	23.39	23.32
136	8.625	24.03	24.00	23.96	23.93	23.90	23.86	23.83	23.79	23..76	23.72	23.65	23.58
138	8.625	24.30	24.27	24.23	24.20	24.16	24.13	24.09	24.06	24.02	23.99	23.92	23.85
140	8.625	24.57	24.53	24.50	24.47	24.43	24.40	24.36	24.33	24.29	24.26	24.19	24.12
142	8.625	24.84	24.80	24.77	24.73	24.70	24.66	24.63	24.59	24.56	24.52	24.46	24.39
144	8.75	25.18	25.14	25.11	25.07	25.04	25.00	24.97	24.94	24.90	24.87	24.80	24.73
150	10	26.72	26.68	26.65	26.61	26.58	26.54	26.51	26.48	26.44	26.41	26.34	26.27
156	10	27.52	27.48	27.45	27.42	27.38	27.35	27.31	27.28	27.24	27.21	27.14	27.07
162	10	28.32	28.29	28.25	28.22	28.18	28.15	28.12	28.08	28.05	28.01	27.94	27.88
168	11	29.71	29.68	29.65	29.61	29.58	29.54	29..51	29.48	29.44	29.41	29.34	29.27
174	11	30.52	30.48	30.45	30.41	30.38	30.35	30.31	30.28	30.24	30.21	30.14	30.07
180	11	31.32	31.29	31.25	31.22	31.18	31.15	31.11	31.08	31.04	31.01	30.94	30.87
186	12	32.71	32.68	32.64	32.61	32.58	32.54	32.51	32.47	32.44	32.41	32.34	32.27
192	12	33.52	33.48	33.45	33.41	33.38	33.34	33.31	33.28	33.24	33.21	33.14	33.07
198	12	34.32	34.28	34.25	34.21	34.18	34.15	34.11	34.08	34.04	34.01	33.94	33.87
204	13.5	36.01	35.97	35.94	35.91	35.87	35.84	35.80	35..77	35.74	35.70.	35.64	35.57
210	13.5	36.81	36.78	36.74	36.71	36.67	36.64	36.61	36.57	36.54	36.50	36.44	36.37
216	13.5	37.61	37.58	37.54	37.51	37.48	37.44	37.41	37.37	37.34	37.31	37.24	37.17
222	13.5	38.41	38.38	38.35	38.31	38.28	38.24	38.21	38.18	38.14	38.11	38.04	37.97
228	14	39.51	39.48	39.44	39.41	39.38	39.34	39.31	39.27	39.24	39.21	39.14	39.07
234	16	41.50	41.47	41.44	41.40	41.37	41.34	41.30	41.27	41.23	41.20	41.13	41.07
240	16	42.31	42.27	42.24	42.20	42.17	42.14	42.10	42.07	42.04	42.00	41.93	41.87

PROCESS FABRICATORS INC.

Handholes and Manholes

Stainless Steel • ASME Code Handhole Assemblies

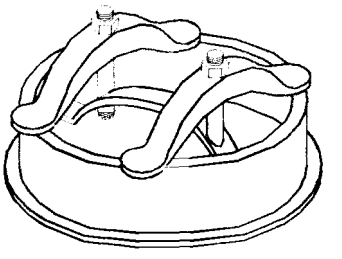
	Est Weight	PSI @ 100°F
Type 304L Stainless Steel		
4" x 6" x 1/4" x 1.6" with Neoprene Gasket	7.0	640
6" x 8" x 1/4" x 2" with Neoprene Gasket	16.0	340
6" x 8" x 1/2" x 3" with Neoprene Gasket	22.5	340
Type 316L Stainless Steel		
4" x 6" x 1/4" x 1.6" with Neoprene Gasket	7.0	640
6" x 8" x 1/4" x 2" wth Neoprene Gasket	16.0	340
6" x 8" x 1/2" x 3" with Neoprene Gasket	22.5	340



- Manholes include the elliptical ring and cover, gasket, two yokes and two nuts and bolts.
- Separate component parts are available
- All parts are Stainless Steel
- Gaskets are either neoprene or "non-asbestos". Neoprene gaskets are furnished unless noted.

Stainless Steel • ASME Code Manhole Assemblies

	Est Weight	PSI @ 100°F
Type 304L Stainless Steel		
11" x 15" x 3/4" x 4"	69.0	460
12" x 16" x 3/4" x 4"	83.0	400
14" x 18" x 3/4" x 4"	105.0	460
Type 316L Stainless Steel		
11" x 15" x 3/4" x 4"	69.0	352
12" x 16" x 3/4" x 4"	83.0	360
14" x 18" x 3/4" x 4"	105.0	440



- Manholes include the elliptical ring and cover, gasket, two yokes and two nuts and bolts.
- Separate component parts are available
- All parts are Stainless Steel
- Gaskets are either neoprene or "non-asbestos". Neoprene gaskets are furnished unless noted.

Handholes and Manholes

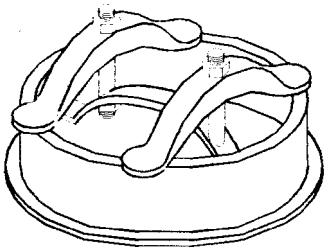
Carbon Steel • Elliptical ASME Code Handhole Assemblies

	Est Weight	PSI @ 100°F
3" x 4" x .337" x 1.125"	4.5	880
4" x 6" x 1/4" x 1.6"	6	640
4" x 4" x 3/4" x 3"	19	640
6" x 8" x 1/4" x 2"	11	400
6" x 8" x 3/4" x 3"	28	400

- Handholes include the elliptical ring and cover, gasket, one yoke and one nut and bolt.
- Separate component parts are available
- Gaskets are either neoprene or "non-asbestos". Neoprene gaskets are furnished unless noted.

Carbon Steel • Elliptical ASME Code Manhole Assemblies

	Est Weight	PSI @ 100°F
11" x 15" x 3/4" x 3" w/ 1/4" cover	56.0	300
11" x 15" x 3/4" x 3" w/ 3/8" cover	73.0	600
11" x 15" x 3/4" x 4"	66.0	300
11" x 15" x 3/4" x 4"	77.0	300
12" x 16" x 3/4" x 3"	61.0	400
12" x 16" x 3/4" x 4"	72.0	400
12" x 16" x 1" x 4"	86.0	400
14" x 18" x 3/4" x 4"	105.0	440
14" x 18" x 1" x 4"	121.0	440



- Manholes include the elliptical ring and cover, gasket, two yokes and two nuts and bolts.
- Separate component parts are available
- Gaskets are either neoprene or "non-asbestos". Neoprene gaskets are furnished unless noted.

Carbon Steel • Elliptical Non-Code Manhole Assemblies

	Est Weight	PSI @ 100°F
11" x 15" x 1/2" x 3" Non-code elliptical ring with 1 yoke, cover and neoprene gasket.	39.0	
11" x 15" x 1/2" x 3" Non-code elliptical ring with 2 yokes, cover and neoprene gasket	45.0	

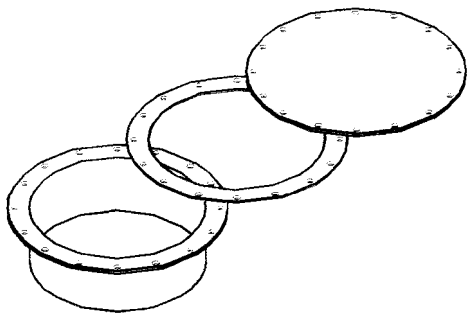
Neoprene is a synthetic rubber material highly resistant to oil, heat, light and oxidation. Maximum temperature limit is 250°F.

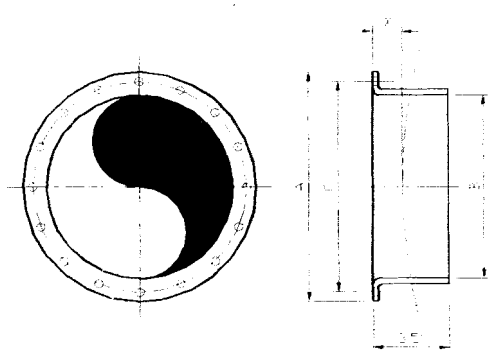
All carbon steel manhole pressure ratings are good to 650°F.

Handholes and Manholes

Non-Pressure Standard Storage Manways, Frames and Covers

	Est Weight	PSI @ 100°F
16" x 1/4" Frame	20.5	
1/4" Cover	23.5	
16" Neoprene Gasket		
16" Treated Fiber Gasket		
Bolts and Nuts (priced per set)		
18" x 1/4" Frame	22.0	
1/4" Cover	28.0	
5/16" Cover	35.0	
18" Neoprene Gasket		
18" Treated Fiber Gasket		
Bolts and Nuts (priced per set)		
20" x 1/4" Frame	25.5	
1/4" Cover	33.5	
5/16" Cover	41.5	
20" Neoprene Gasket		
20" Treated Fiber Gasket		
Bolts and Nuts (priced per set)		
24" x 1/4" Frame	33.0	
1/4" Cover	45.2	
5/16" Cover	56.5	
3/8" Cover	67.8	
24" Neoprene Gasket		
24" Treated Fiber Gasket		
Bolts and Nuts (priced per set)		





Double Pierced Non-Code Manways, for Below Liquid Level Applications

	No. of Holes	Est. Weight
18" x 1/4" Frame	36	22.0
1/4" Cover		28.0
5/16" Cover		35.0
20" x 1/4" Frame	48	25.5
1/4" Cover		33.5
5/16" Cover		41.5
24" x 1/4" Frame	48	33.0
1/4" Cover		45.2
5/16" Cover		56.5

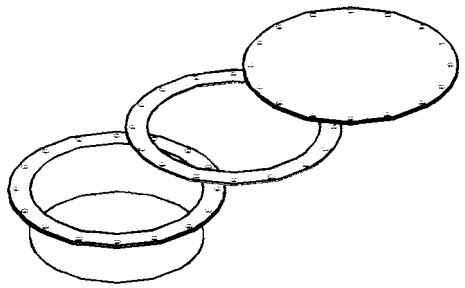
When dimension "X" is 2", the minimum wall thickness of a single-walled tank is "D"

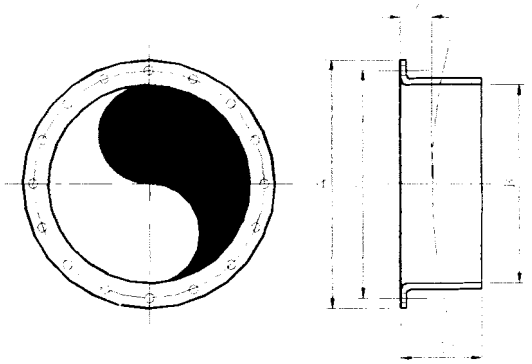
	16"	18"	20"	24"
A	20.5	22.5	24.5	28.5
B	16	18	19.5	23.5
C	19	21	23	27
D	52.5	66	77	116.5

Handholes and Manholes

Longneck Manways, Frames and Covers

	Est Weight PSI @ 100°F
18" x 1/4" Frame w/7" Neck	36.7
1/4" Cover	28.0
5/16" Cover	35.0
18" Neoprene Gasket	
18" Treated Fiber Gasket	
Bolts and Nuts (priced per set)	
20" x 1/4" Frame w/7" Neck	42.8
1/4" Cover	35.0
5/16" Cover	41.5
20" Neoprene Gasket	
20" Treated Fiber Gasket	
Bolts and Nuts (priced per set)	
24" x 1/4" Frame w/7" Neck	84.6
1/4" Cover	
5/16" Cover	106.0
3/8" Cover	117.3
24" Neoprene Gasket	
24" Treated Fiber Gasket	
Bolts and Nuts (priced per set)	





These one-piece, stamped manways (there's no weld seam to leak) have a 7" neck especially designed for use in double walled tanks where the neck must penetrate both shells, composite tanks or other applications where extra clearance is needed under the horizontal flange. They can also be used in small diameter tanks where the curvature is too tight for standard manways.

Double Pierced Longneck Manways, for Below Liquid Level Applications

	No. of Holes	Est. Weight
18" x 1/4" Frame	36	22.0
1/4" Cover		28.0
5/16" Cover		35.0
20" x 1/4" Frame	48	25.5
1/4" Cover		33.5
5/16" Cover		41.5
24" x 1/4" Frame	48	33.0
1/4" Cover	45.2	
5/16" Cover		56.5

When dimension "X" is 2", the minimum wall thickness of a single-walled tank is "D"

	18"	20"	24"	
A	22.5	24.5	28.5	
B	18	19.5	23.5	
C	21	23	27	
D	22.5	26.8	36.5	

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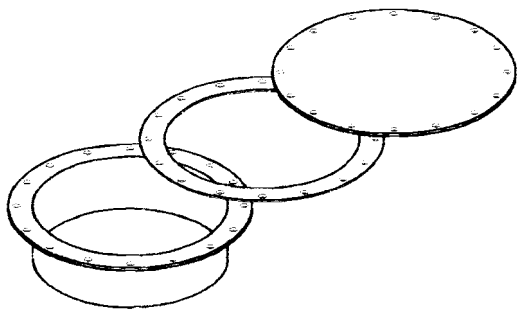
Handholes and Manholes

316L Stainless Steel Non-Code Manways

	Est Weight
18" x 1/4" Frame	22.0
1/4" Cover	28.0
20" x 1/4" Frame	25.5
1/4" Cover	33.5
24" x 1/4" Frame	33
1/4" Cover	45.2

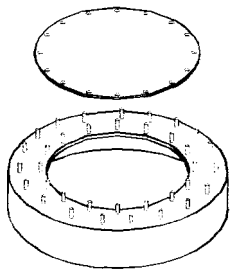


Reverse Flange Manways for Jacketed, Composite and Underground Tanks

36" O.D. x 24" I.D. x 1/4" x 8"O.A.H.
with 24 - 1/2" x 1 1/4" studs on 27" BC
and 24 - 1/2" x 1 1/4" studs on 32" BC

36" O.D. x 24" I.D. x 1/4" x 8" O.A.H.
with 24 - 1/2" x 1 1/4" studs on 27" BC
and 24 - 1/2" x 2 1/2" studs on 32" BC

Each includes 1/4" cover, fiber gasket and 48 - 1/2" nuts.

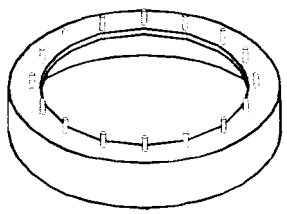


These 8" high one-piece manways are die-formed without weld seams. Reverse flange manways offer exceptional "piece to piece" consistency. Their smooth, rounded shoulders work well with containment jacket membranes. And with 48 accurately placed and welded 1/2" studs, they are ready for bolted covers and sumps in place.

30" Inverted Flange Manways for Composite and Coated Tanks

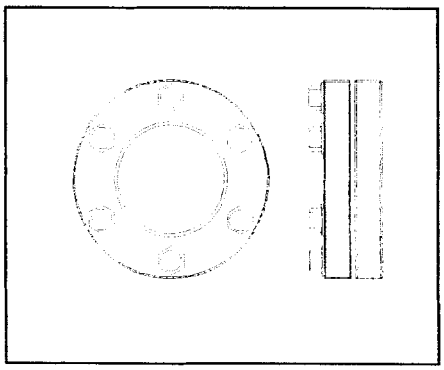
30" O.D. x 24" I.D. x 7" O.A.H.
with 24 - 1/2" studs on 27" BC
A635 Material

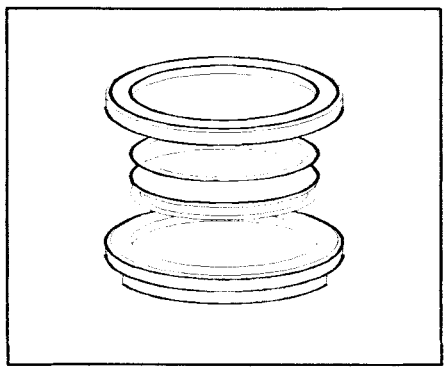
Each includes 1/4" cover, fiber gasket and 48 - 1/2" nuts.

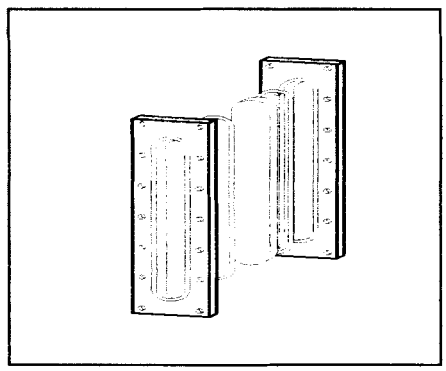


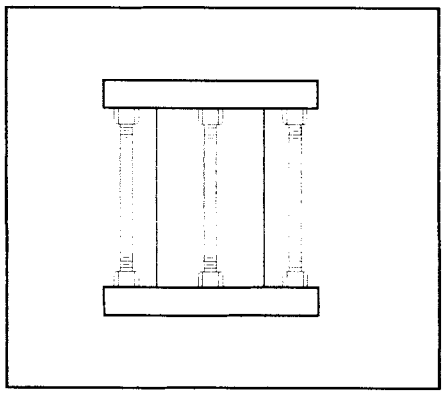
A 30" diameter and a 7" neck give you considerably more room to install plumbing. Their inverted flange and smooth corner radius make it much easier to apply a protective coating and virtually eliminate the possibility of uncoated, unprotected areas. Made in one-piece from A635 steel. 24-threaded studs on a 27" bolt circle allow you to use a standard 24" x 1/4", 5/16" or 3/8" cover and gasket

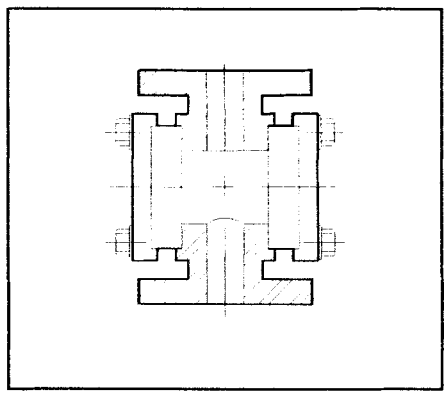
Observation Equipment

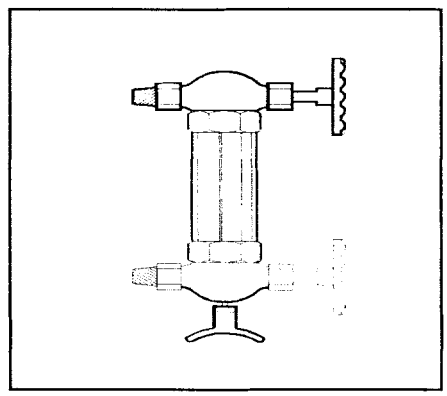

Circular Sightglasses

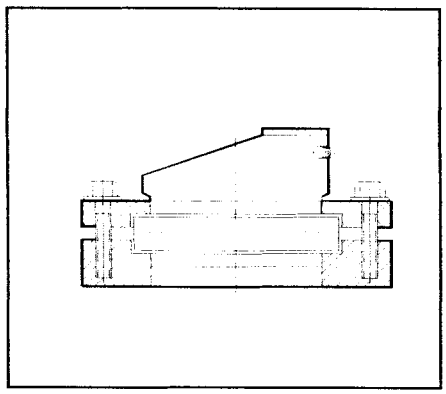

Sanitary Sightglasses

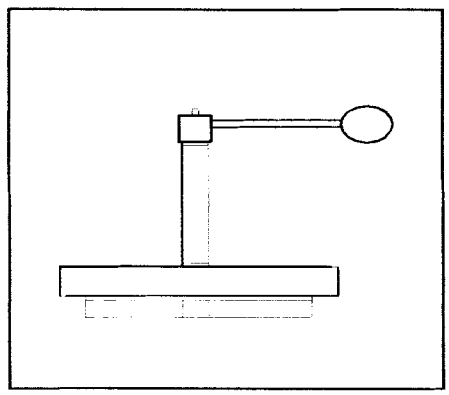

Rectangular Sightglasses

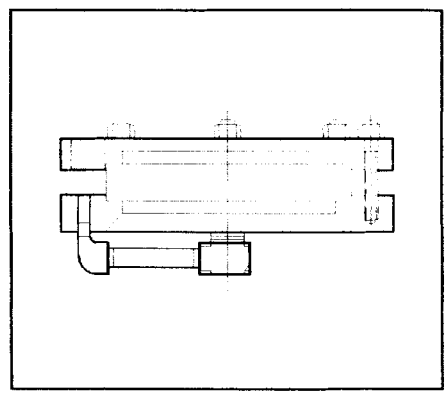

Full View Sight Flow Indicators


Teflon Lined Sight Flow Glasses

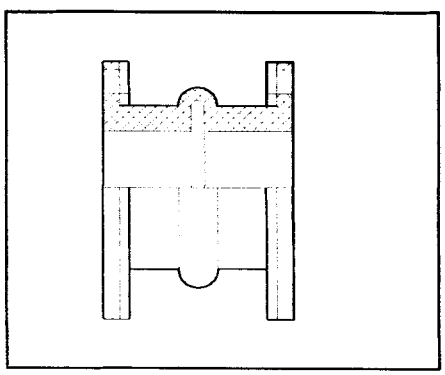

Tubular Sight Flow Indicators

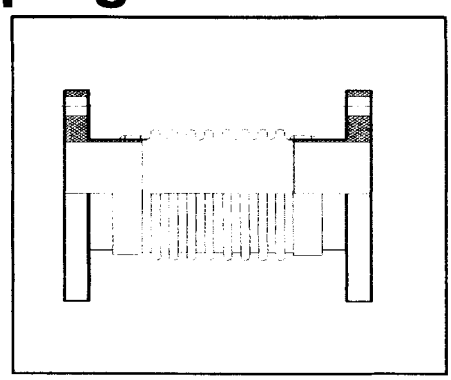

Light / Sightglasses

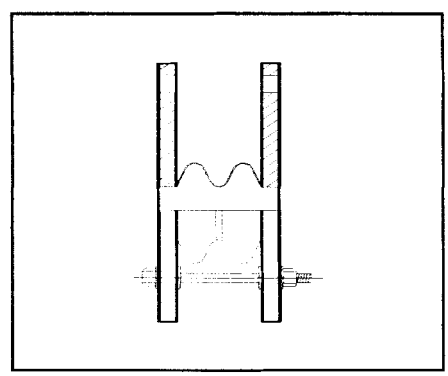

Window Wipers


Spray Wash Systems

Piping Accessories


Rubber Pipe Expansion Joints

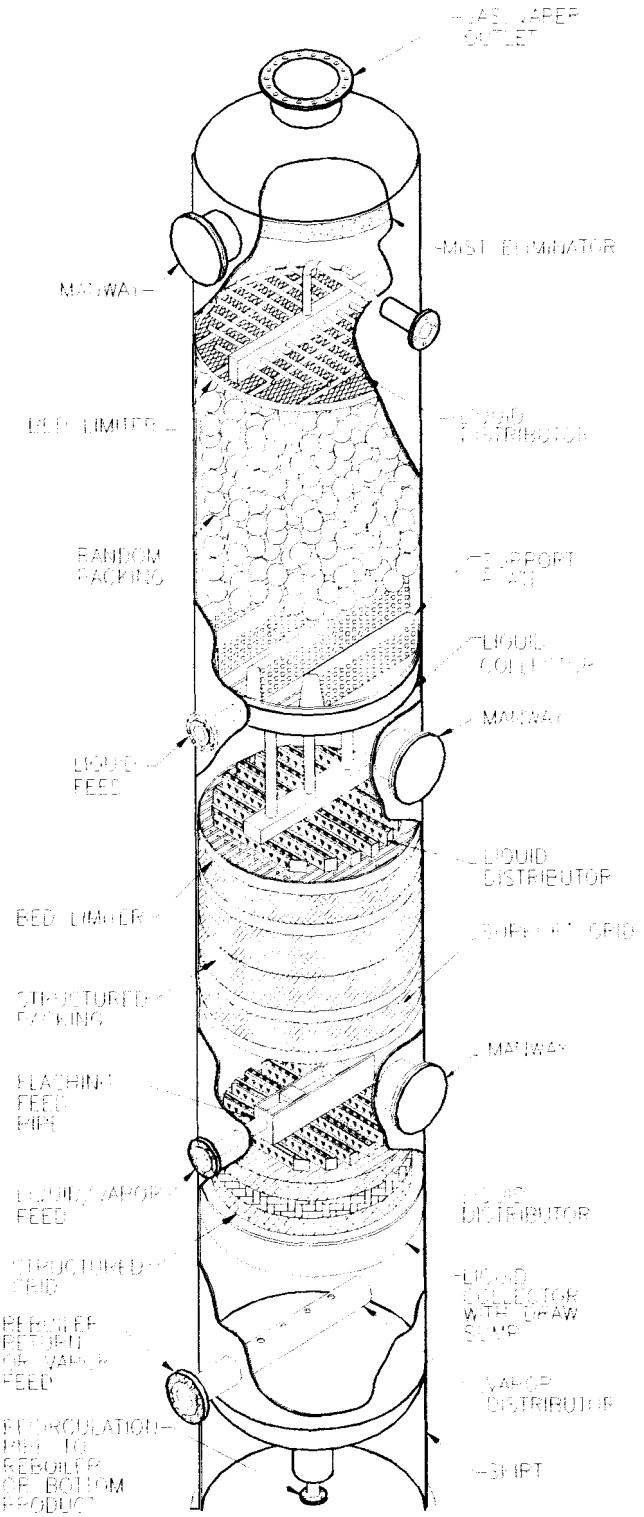

Metallic Pipe Expansion Joints


Teflon Pipe Expansion Joints

Packed Columns

The Contents of a Packed Column

Beyond the packing itself, a packed column will always contain a combination of liquid distributors, liquid collectors, liquid re-distributors, packing supports, gas distributors and mist eliminators. Each one of these elements is carefully selected and designed to be able to achieve maximum packing performance. Process Fabricators will assist you in determining the internals to match your application.



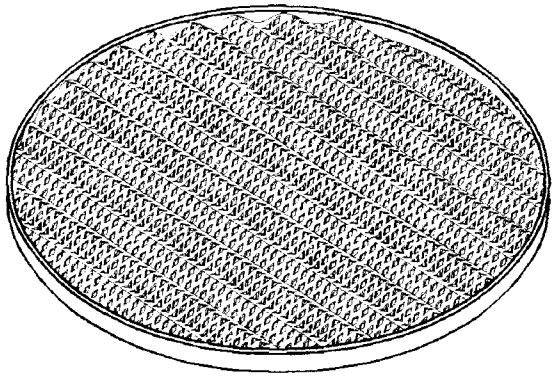
Typical Applications

Column packings and internals are widely applied in the following processes.

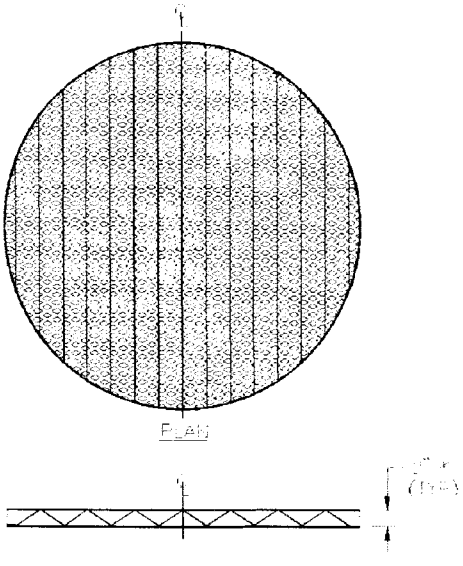
- Absorption
- Desorption
- Distillation
- Rectification
- Extraction
- Drying
- Cooling
- Humidification
- Condensation
- Scrubbing
- Mixing
- Stripping
- Aeration
- Deaeration
- Degassification
- Precipitation
- Mist Elimination
- Particulate Removal
- Biological Filtration
- Desaltification
- Oil-Water Separation

The above listed are the most common applications however other applications may also benefit from the utilization of a packed tower. Contact Process Fabricators for more information.

Light Duty Support Plates



These support plates are designed for small diameter towers (less than 30" I.D.) with lightweight beds, where the fabrication of a model 101 is not practical. Model 103 support plates are manufactured from expanded metal.



Tower I.D.	Support Ring Width	Load Capacity, Lbs. / Ft²		Height (H)
		Carbon Stl.	Stainless Stl.	
6" - 12"	Clips	6 1/2"	2520	3140
121/4"-173/4"	3/4"	9"	1220	1520
18" - 23 3/4"	1"	12"	670	830
24" - 30"	1 1/4"	15"	400	500

Notes:

- Approximate weight for standard construction in carbon or stainless steel: 3 lbs./sq. ft.
- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.

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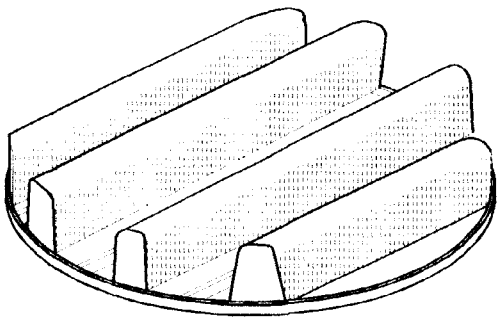
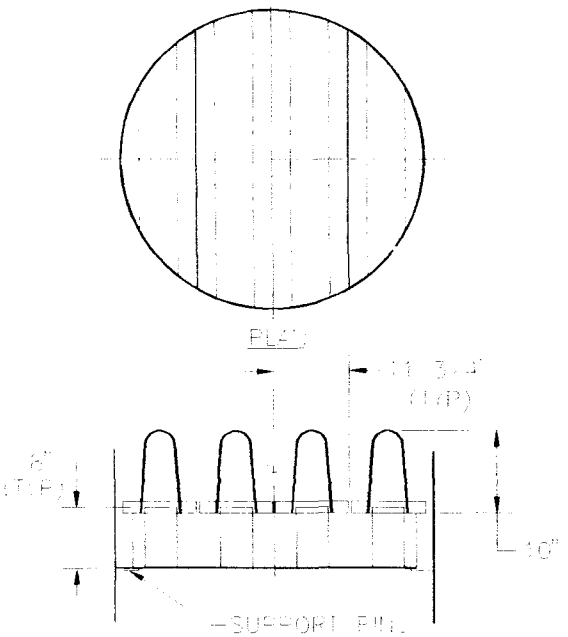
Gas Injection Packing Support Plates





The models are the most common devices for supporting random packing. Model 101R has a round unperforated top and is used in towers 30" inside diameter and larger. Model 101 has a flat perforated top and is used in towers less than 30" inside diameter.

Vapor passes through slots in the arches while liquid passes through the slots on the deck. Maximum throughput capacity and the minimum pressure drop are maintained by keeping the vapor passages clear of liquid.

At normal operating rates, the pressure drop across the plate is low. Usually below 1/4" water. Free area is normally between 80% and 100%+ of the towers cross-sectional area, depending on diameter, so the plate does not bottleneck the towers operation. The support plates are fabricated in sections for installation through the vessel mainway, and are usually clamped to a support ring.

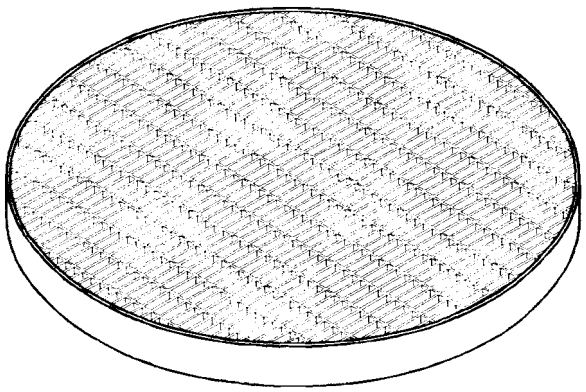
The structural strength of these plates allows bed depths up to 30 feet and higher. A mid-span beam is usually required for diameters larger than 9 feet. Unusual loading or corrosion conditions may also require additional support.

Tower I.D.	Support Ring Width	Load Capacity, Lbs./Ft.²	
		Carbon Stl.	Stainless Stl.
101			
12" - 17 3/4"	3/4"	3980	2560
18" - 22 3/4"	1"	2220	1430
24" - 29 3/4"	1 1/4"	1420	910
101R			
30" - 59 1/2"	1 1/2"	2000	1390
60" - 89 1/2"	2"	1020	710
90" - 119 1/2"	2 1/2"	550	390
120" - 137 1/2"	2 1/2"	1650	1150
138" - 179 1/2"	3"	1020	710

Notes:

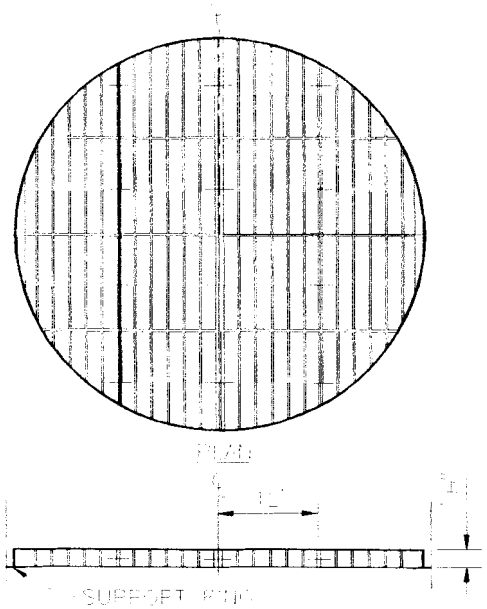
- These figures are typical values. Actual values will vary with temperature, diameter, and material type/thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

Packing Support Plates



These grid type plates are used in columns with short bed depths, and where efficient space utilization is essential, since they take up less tower height than a model 101R.

The model 104 is frequently used in the short beds of crude atmospheric and vacuum towers.



Tower I.D.	Support Ring Width	Load Capacity, Lbs./Ft.²		Height (H)
		Carbon Stl.	Stainless Stl.	
6" - 11 3/4"	Clips	1170	1400	1"
12" - 17 3/4"	3/4"	780	930	1"
18" - 22 3/4"	1"	580	690	1"
24" - 29 3/4"	1 1/4"	580	690	1 1/4"
30" - 59 1/2"	1 1/2"	550	660	2"
60" - 89 1/2"	2"	340	400	2 1/2"
90" - 119 1/2"	2 1/2"	550	660	2"
120" - 137 1/2"	2 1/2"	510	610	2 1/2"
138" - 179 1/2"	3"	330	400	2 1/2"

Notes:

- Approximate weight for standard construction in carbon or stainless steel: 12 lbs./sq. ft.
- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation. Center support beams may be required for diameters of 9 feet or larger.

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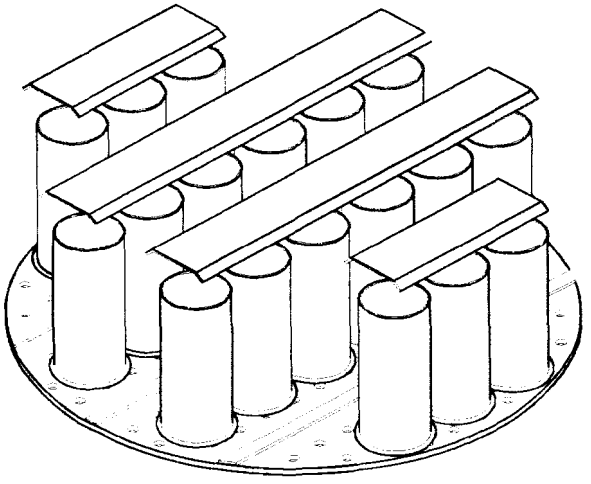
Plate Distributors

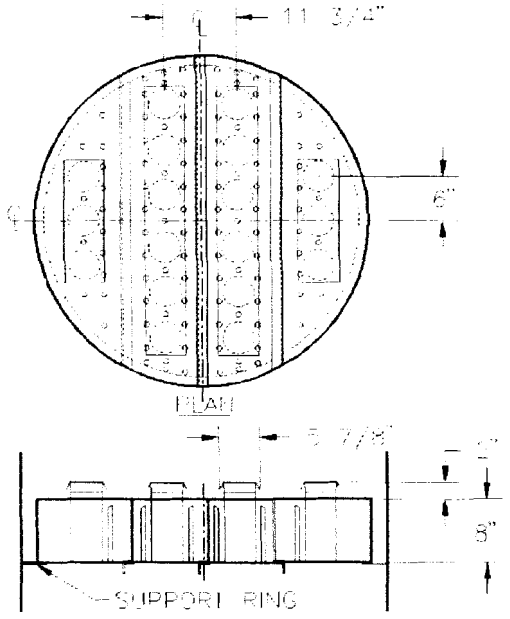


The Model 301A Orifice Plate Distributor is the most common liquid distributor for general purpose, non-fouling applications. Vapor passes the plate through gas risers while liquid flows through holes on the deck.

Pressure drop across the distributor is typically 0.25" - 0.5" w.c., and the standard design has a turndown ratio of 2:1. Higher turndown ratios are possible when taller vapor risers are used.

Model 301A distributors are fabricated in sections for installation through manways, and are usually clamped to a support ring. For tower diameters less than 30" where clamps are inaccessible, a rim is put around the periphery of the distributor to contain the liquid.

Model 301A distributors are commonly used as redistributors by simply adding hats over the gas risers to prevent liquid from falling through. The Model 301A also can be used as a liquid collector by deleting the orifice holes and installing a downcommer or draw sump. The same style can be used as a vapor distributor at the bottom of a column, but the plate is designed with a higher pressure drop.

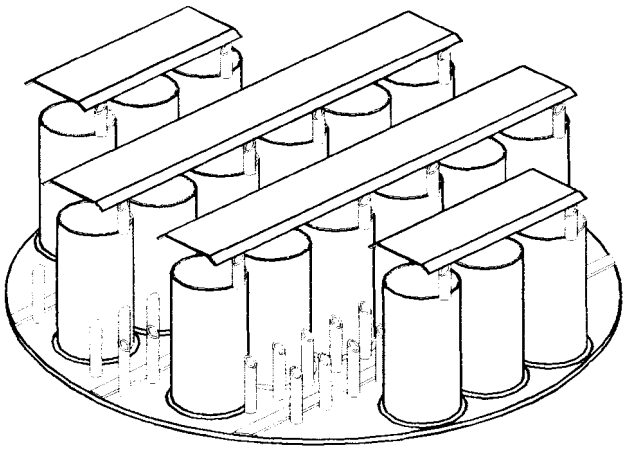


Tower I.D.	Support Ring Width	No. of Risers	Net Weight Carbon or Stainless Stl.
6" - 17 3/4"	Clips	1 -4	7 - 30 lbs.
18" - 23 3/4"	1"	4	30 -40 lbs.
24" - 29 3/4"	1 1/4"	4	40 - 60 lbs.
30" - 59 1/2"	1 1/2"	6 - 28	60 - 230 lbs.
60" - 89 1/2"	2"	28 - 75	230 - 500 lbs.
90" - 119 1/2"	2 1/2"	75 - 128	500 - 800 lbs.

Notes:

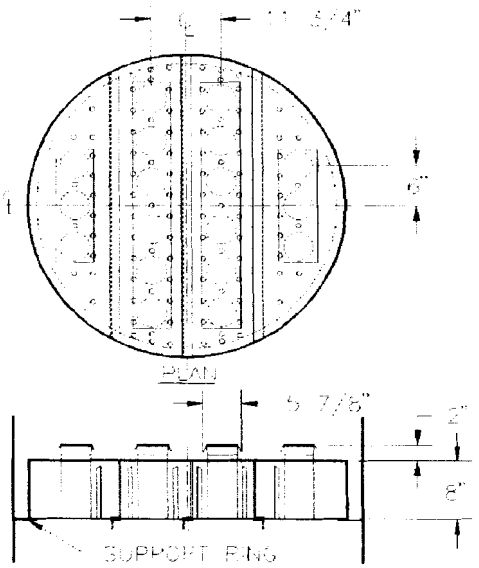
- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

Orifice Plate Distributors with Drip Tubes



Model 301B is similar to Model 301A, except drip tubes are used in place of some or all of the plate orifices. The 301B is used to increase the turndown ratio or to accomodate a fouling service. With a combination of holes and drip tubes, turndown ratios of 5:1 are practical without increasing riser height. When used for fouling service, solids settle out on the deck and clear liquid flows through the drip tubes.

Model 301B has antimigration bars that eliminate the need for a bed limiter. The antimigration feature is important because its cost is less than the cost for a separate distributor and bed limiter. Also, when there is no bed limiter installed between the distributor and the packing, there is less chance of maldistribution from liquid hitting the bed limiter.



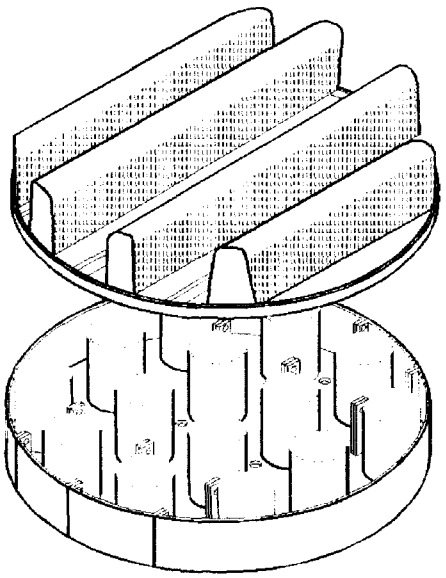
Tower I.D.	Support Ring Width	No. of Risers	Net Weight Carbon or Stainless Stl
6" - 17 3/4"	Clips	1 -4	7 - 30 lbs.
18" - 23 3/4"	1"	4	30 -40 lbs.
24" - 29 3/4"	1 1/4"	4	40 - 60 lbs.
30" - 59 1/2"	1 1/2"	6 - 28	60 - 230 lbs.
60" - 89 1/2"	2"	28 - 75	230 - 500 lbs.
90" - 119 1/2"	2 1/2"	75 - 128	500 - 800 lbs.

Notes:

- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

PROCESS FABRICATORS INC.

Combination Support Plates / Redistributors

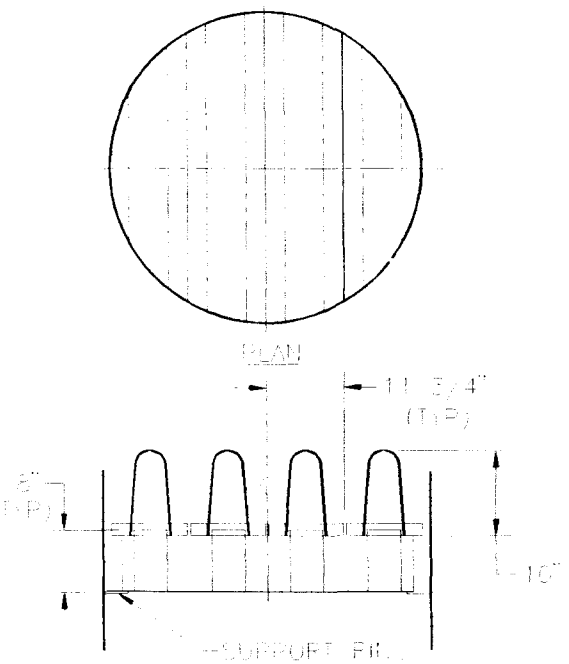


Model 201A is simply a Model 301A distributor in combination with a Model 101R support plate. The support plate is supported by the rim of the re-distributor. Therefore, only one support ring is required for the two internals. This reduces the tower height required for redistribution.

The combination plate is used where liquid redistribution is required between packed beds and no feed introduced at that location.

The overall height is typically 14" to 18" and plates are fabricated in sections for installation through column manways.

For non-fouling service, the Model 201A is used. For fouling service of high turndown requirements the Model 201B with drip tubes is used. These combination support plates / redistributors are also available with the same anti-migration feature as Model 301AM and 3018M, which eliminates the need for a separate bed limiter.

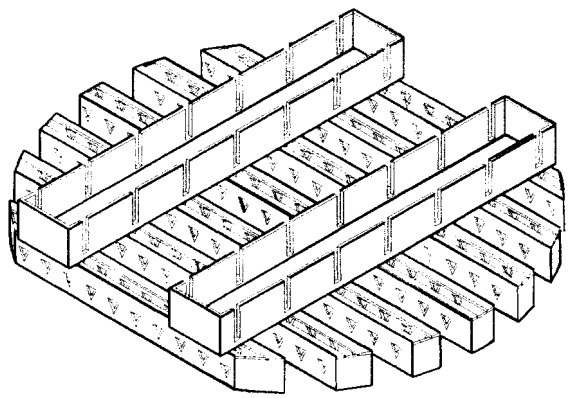


Tower I.D.	Support Ring Width	No. of Sections	Load Capacity #'s / ft.² Carbon Stl.
12" - 17 3/4"	Clips	1	4000
18" - 23 3/4"	1"	1	2200
24" - 29 3/4"	1 1/4"	2	1400
30" - 59 1/2"	1 1/2"	2 - 5	2000
60" - 89 1/2"	2"	5 - 7	1000.
90" - 119 1/2"	2 1/2"	7 - 10	550

Notes:

- Approximate weight for standard construction...
  - Carbon Steel 21.5 #'s / ft.²
  - Stainless Steel 13.0#'s / ft.²
- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

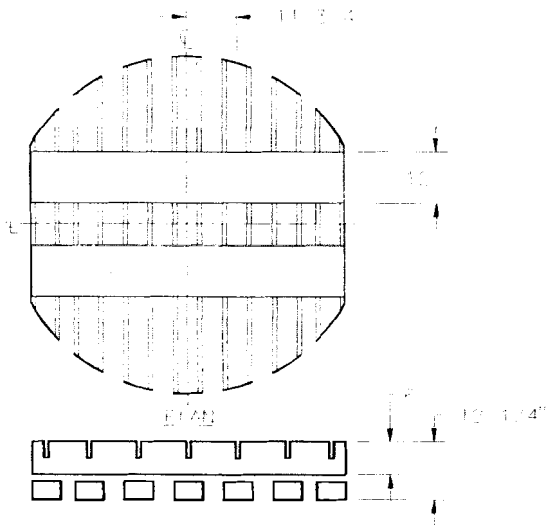
Trough Distributors



The Model 302 through distributor is generally used in towers with high liquid rates or fouling service. Turndown characteristics are very good (at least 4:1) because of the tapered notch design.

Liquid is introduced into the parting box, which properly distributes the liquid into the laterals. Generally, one parting box is required for towers up to 8 feet in diameter. Multiple parting boxes are used for larger diameter towers or high liquid rates.

Model 302 trough distributors are fabricated in sections for installation through manways and are supported on a support ring (and beams if required). This distributor is also available with an integral bed limiter as Model 302M.



Tower I.D.	Number of Troughs	Net Weight, Lbs.		Max. Flow Rate, GPM
		Carbon Stl.	Stainless Stl.	
36" - 42"	3	120	65	400
48" - 54"	4	180	100	700
60" - 66"	5	275	150	1000
72" - 78"	6	365	200	1500
84" - 90"	7	475	260	2000
96" - 102"	8	600	320	2500
108" - 114"	9	730	400	3100

Notes:

- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.
- Actual number of parting boxes will depend on liquid rates.

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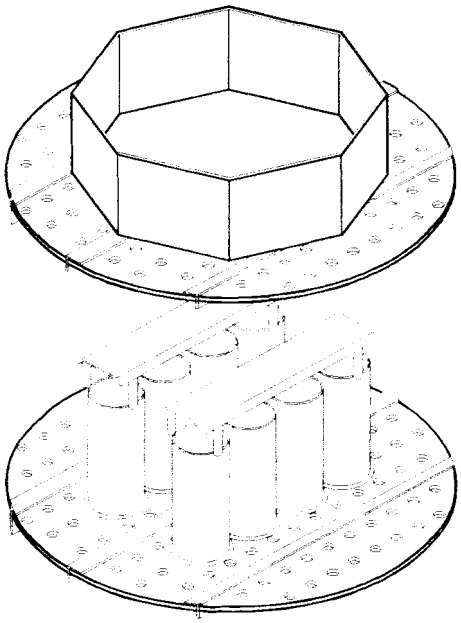
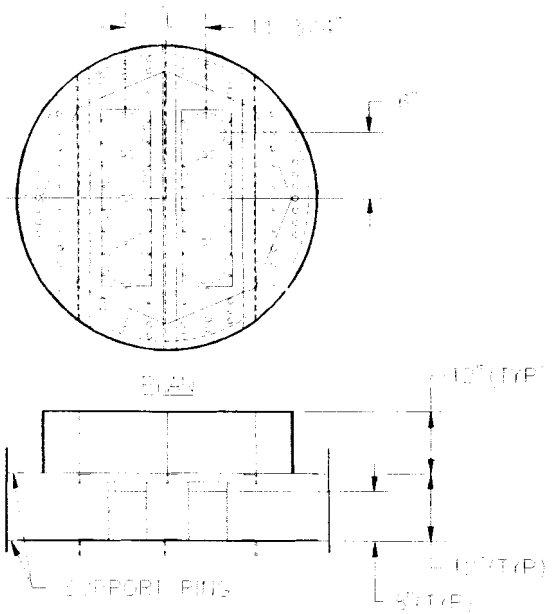
Flashing Feed Distributors



The flashing feed distributor is used to disengage the vapor phase from a two-phase feed. The Model 300 consists of two plates, an upper gallery which is 50% open for vapor disengagement, and a lower plate for liquid distribution which is similar to Model 301A. Each plate requires a separate support ring.

The two-phase feed is fed to the upper gallery where the vapor disengages from the liquid. A "V" baffle is typically used in front of the feed nozzle to deflect the feed around the tower wall. Holes in the bottom of the upper gallery transfer the liquid to the lower plate where the liquid is distributed over the packing.

The upper gallery height is typically 12 inches, and the spacing between the two plates is also 12 inches. The Model 300 flashing feed distributor is fabricated in sections for passage through column manways.

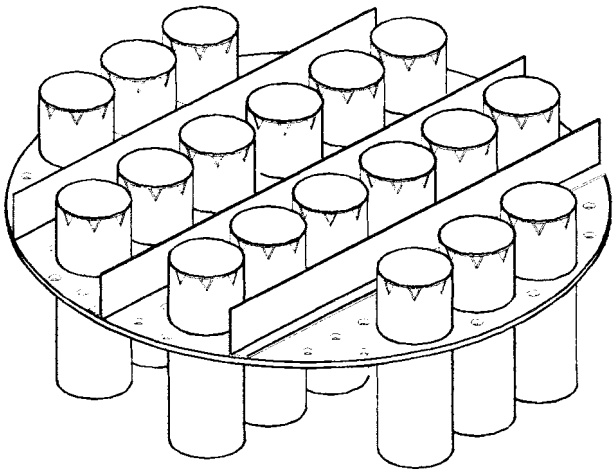


Tower I.D.	Support Ring Width	No. of Risers	Net Weight Carbon or Stainless Stl.
6" - 17 3/4"	Clips	1 -4	7 - 30 lbs.
18" - 23 3/4"	1"	4	30 -40 lbs.
24" - 29 3/4"	1 1/4"	4	40 - 60 lbs.
30" - 59 1/2"	1 1/2"	6 - 28	60 - 230 lbs.
60" - 89 1/2"	2"	28 - 75	230 - 500 lbs.
90" - 119 1/2"	2 1/2"	75 - 128	500 - 800 lbs.

Notes:

- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

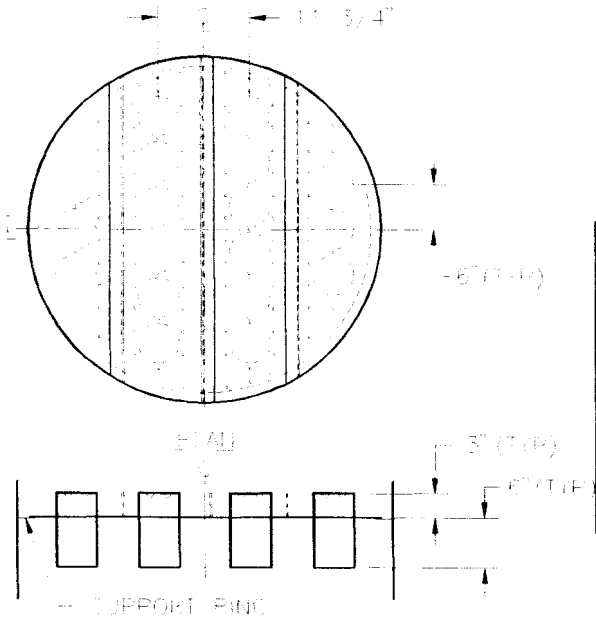
Disperser / Support Plates



These are multi-purpose plate designs used in packed liquid / liquid extractors.

Model 600 functions as a support plate, a disperser for the light phase (or heavy phase with modifications), and a redisperser. A ladder pipe distributor (Model 304) can be used in conjunction with the plates to introduce either phase into the column.

Custom designed to meet all diameter, material and installation requirements, the plates feature sectional construction to allow passage through manways.



Tower I.D.	Number of Sections	Load Capacity #'s/ft.²		Flow Range,GPM
		Carbon Stl.	Stainless Stl.	
12" - 17 3/4""	1	380	320	16 - 70
18" - 23 3/4"	1 - 2	380	320	35 - 125
24" - 29 3/4"	2 - 3	380	320	125 - 200
30" - 59 1/2"	3 - 5	380	320	200 - 800
60" - 89 1/2"	5 - 7	380	320	400 - 1800
90" - 119 1/2"	7 - 9	380	320	900 - 3100

Notes:

- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

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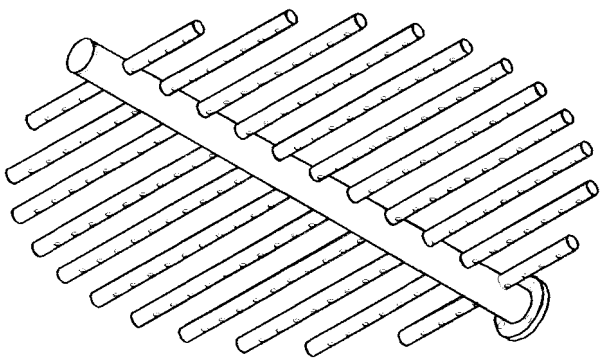
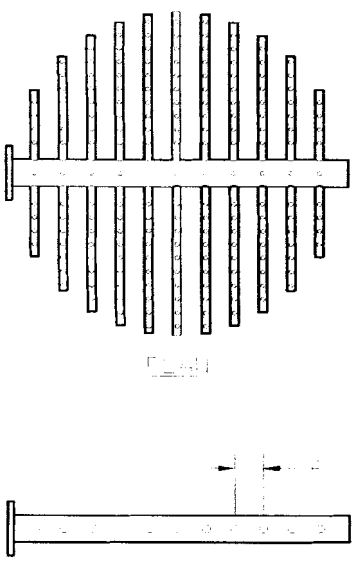
Ladder Pipe Distributors



Model 304 ladder pipe distributors are used where the liquid feed is under pressure, and can be very helpful when the tower height available for the distributor is limited. This distributor is often specified over shallow bed depths where maximum efficiency is required, and in services with relatively low liquid rates (less than 10 gpm / sq. ft.). They are recommended only in clean services, especially where low flow rates result in small holes being used. These distributors are commonly employed in liquid / liquid extraction columns.

A moderately high turndown is possible (about 4:1) because the distributor can be designed for a higher hole pressure drop than a gravity distributor. The Model 304 is well suited for applications with high vapor rates, since the free area for vapor flow is relatively large and pressure drop across the distributor is generally negligible.

Model 304 ladder pipe distributors are fabricated for passage through column manways. The distributor is supported by an internal nozzle flange on the main header and a support saddle on the opposite end of the header.

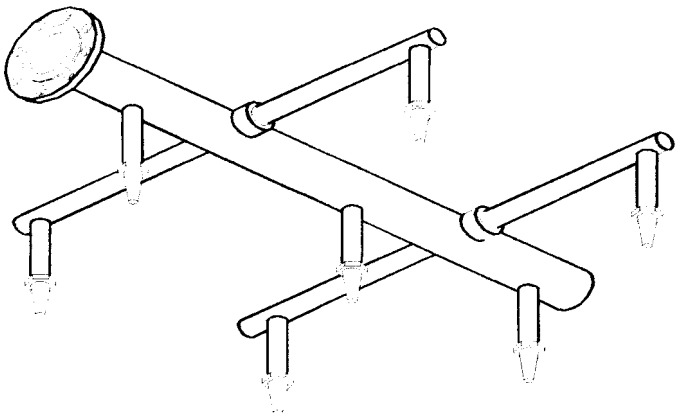


Tower I.D.	Typical Flow GPM	Header Diameter	No. Laterals per side	Aprox. Wt. Lbs.
17 1/4"	18	1 1/2"	2	10
23 1/4"	30	2"	3	17
29 1/4"	50	2"	4	25
36"	70	3"	5	50
42"	95	3"	6	65
48"	125	3"	7	85
54"	160	4"	8	115
60"	200	4"	9	140
66"	250	4"	10	160
72"	300	6"	11	300
84"	400	6"	12	340
96"	500	6"	13	450

Notes:

- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

Spray Nozzle Distributors

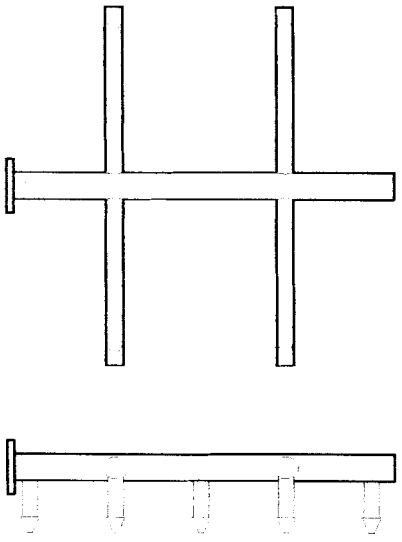


Spray nozzle distributors are primarily used for heat transfer and refinery applications where a uniform distribution pattern is critical due to short bed heights. They are also commonly used in scrubbers and in wash zones, condensing zones and pump around zones of crude oil vacuum towers.

They can be designed for liquid rates as low as 0.1 gpm / sq. ft. of tower area, and have been used in columns with diameters in excess of 30 feet.

The maximum turndown of a spray distributor is 2:1 at a typical pressure drop across the nozzles of 10-15 psi.

Spray nozzle distributors are fabricated for passage through manways. They are supported by an internal flange on the main header, and by column wall attachments to support the opposite end of the header and the laterals, as required. The nozzle tips are typically 12" - 30" above the packing, depending on spray nozzle layout, spray angle, flow rate and column diameter.

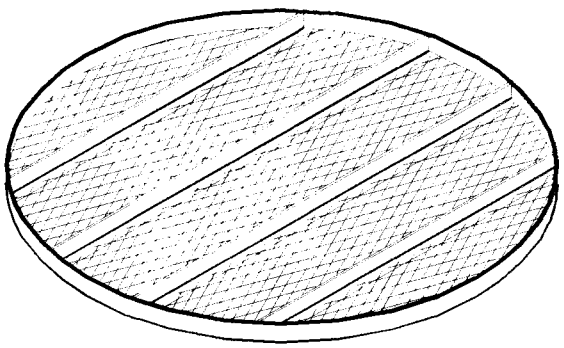


Tower I.D.	Header Diameter	No. Laterals Per side	No. of Nozzles	Typ. Flow GPM
36"		0	1	
42"	2"	0	1	50
48"		0	1	
54"	3"	0	1	80
60"		0	1	
72"	4"	2	7	150
84"		2	7	
96"	4"	2	7	250
108"		2	7	
120"	6"	2	7	400

Notes:

- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

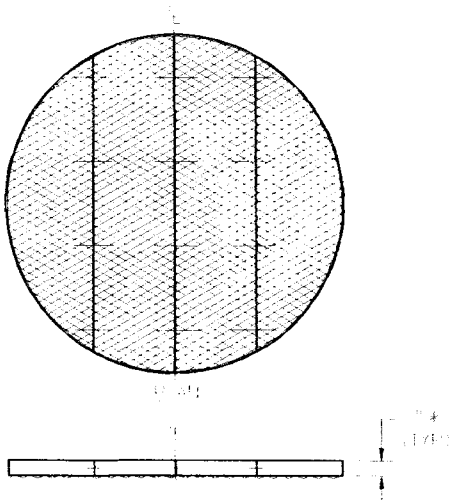
Bed Limiters



Attached to support rings or bolting clips above the packed bed, a bed limiter prevents the loss of packing if high pressure drop or surge conditions cause sudden bed expansions.

Lightweight mesh is attached to the bed limiter to prevent carryover of smaller size packing. Integral bed limiters may be used with most gravity distributors, thereby eliminating the need for a separate bed limiter. This reduces cost by eliminating one device and its support ring, and minimizes the risk of maldistribution caused by liquid splashing on a separate bed limiter.

The overall height of bed limiters is about 2 inches.

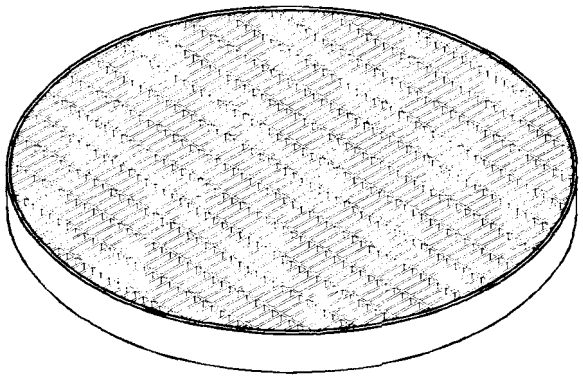


Tower I.D.	Support Ring Width	Apx. Weight Carbon or Stainless Stl.
6" - 29 3/4"	1 1/4"	30 lbs.
30" - 59 1/2"	1 1/2"	110 lbs.
60" - 89 1/2"	2"	240 lbs.
90" - 119 1/2"	2 1/2"	430 lbs.
120" - 137 1/2"	2 1/2"	570 lbs.

Notes:

- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

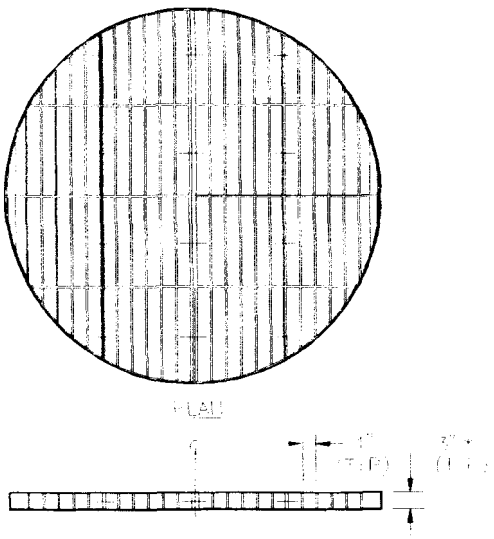
Hold Down Plates



Hold down plates rest directly on top of the packed bed and are used exclusively to hold ceramic tower packing in place. They are not recommended for metal or plastic packing.

The plates inhibit fluidization of the top layer of packing during tower operation. Like the bed limiters, deliver at least as much throughput capacity as the packing at low pressure drops.

The overall height of hold down plates is usually 3 inches, but can be as high as 6 inches.



Model 501 Hold Down Plates

Tower I.D.	Support Ring Width	Apx. Weight Carbon or Stainless Stl.
6" - 29 3/4"	Rests	110 lbs.
30" - 59 1/2"		440 lbs.
60" - 89 1/2"	on	1000 lbs.
90" - 119 1/2"		1750 lbs.
120" - 137 1/2"	Packing	2300 lbs.

Notes:

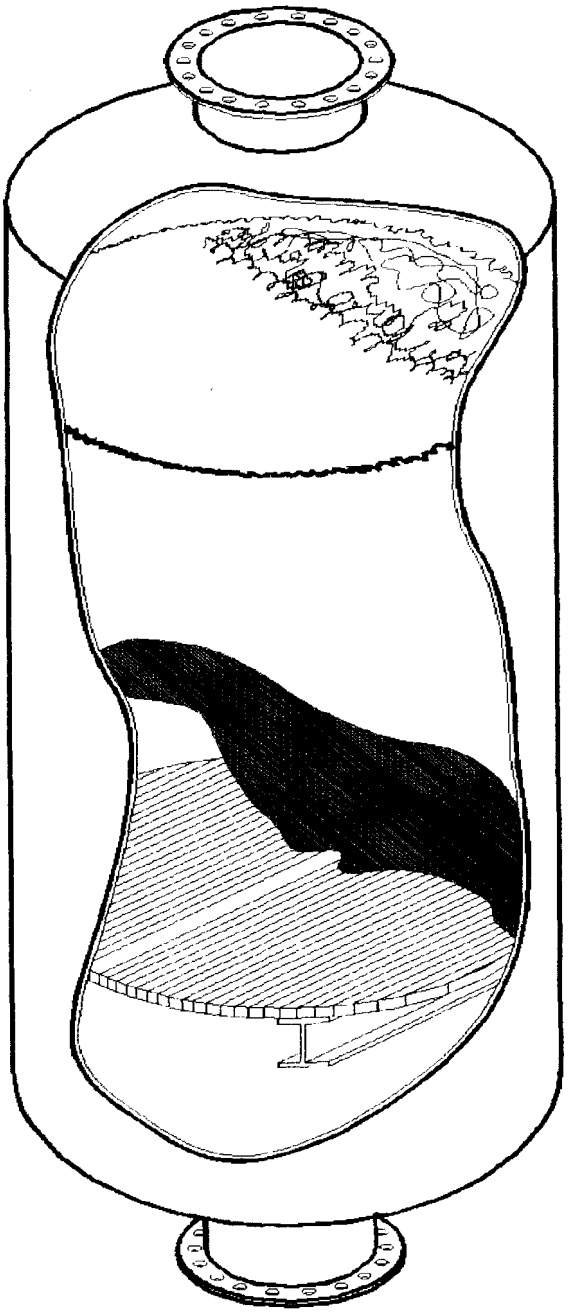
- These figures are typical values. Actual values will vary with temperature, diameter and material type and thickness.
- Larger sizes are available.
- All internals are segmented as required for installation.
- Center support beams may be required for diameters of 9 feet or larger.

Standard Grids

Standard Grids

Standard grid design is a real labor saving device. Standard grids consist of welded sections which can be installed through a manway. This substantially reduces the time that is required for a wire mesh unit.

Flanged, SBS and SR grid designs vary to accomodate different load, and pressure requirements.



Flanged Grids

The unique flanged grid minimizes vessel support structure. Each section is banded with a support flange which extends above the screen surface. These flanges are structural members which are bolted together. Standard construction material for flanged screens is 410S stainless steel wire screen with low carbon steel supports. Another common method of construction uses all low carbon steel for those applications not requiring the performance of stainless steel or other alloy metals. The flanged grid can have a flush top surface by inverting the flanges.

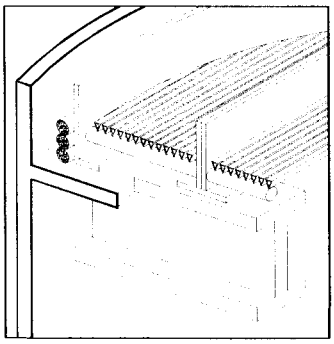
SBS Grids

For heavy loads, SBS (side by side) grids are built with rectangular bars welded to the screen support rods. Unlike flanged grids which are restricted to materials available for flange components, SBS grids can be constructed in a wide variety of materials.

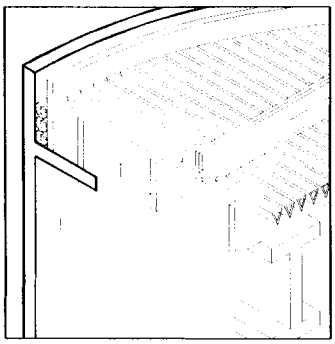
SR Grids

A variation on the SBS grids, SR (single rod) grids have a single rod design for use with lighter loads.

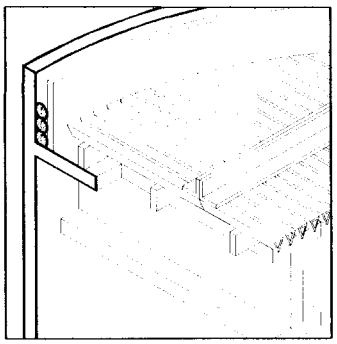
Standard Grid Dimensions



Flanged Grid



SBS Grid



SR Grid

SR & SBS Grids

grid design	screen depth (inch)
SR-A	1 1/8"
SR-B	1 5/8"
SR-C	1 5/8"
SBS-D	2 1/8"
SBS-D1	3 3/16"
SBS-E	3 1/8"
SBS-E1	3 3/16"
SBS-F	3 1/8"
SBS-G	4 1/8"
SBS-G1	4 3/16"

Notes:
1. Material of construction: 304, 316, 321stainless steels. Other special alloys also available.

20 PSI (1.4 bar) Design

vessel I.D. (feet/inches)	support beams required	min.dia.open for install	estimated grid weight (lbs.)
2'-0"	0	12 3/4"	90
2'-6"	0	15 3/4"	120
3'-0"	0	13"	210
3'-6"	0	15"	250
4'-0"	1	16 3/4"	300
4'-6"	1	14 1/2"	430
5'-0"	1	16"	490
5'-6"	1	17 1/4"	555
6'-0"	1	15 1/44"	725
6'-6"	1	16 1/2"	810
7'-0"	1	17 1/2"	900
7'-6"	2	16"	1110
8'-0"	2	17"	1200
8'-6"	2	17 3/4"	1300
9'-0"	2	16 1/4"	1550
9'-6"	2	17 1/4"	1675
10'-0"	2	18"	1800
10'-6"	3	16 3/4"	2100
11'-0"	3	17 1/2"	2225
11'-6"	3	18"	2375
12'-0"	3	17"	2700

Notes:
1. Material of construction: screen-410S, frame-carbon steel
2. Design conditions: temperature-650°f, load-20 PSI (1.4 bar) and 50 PSI (3.5 bar), stress-16,500 PSI (401S) and 16,900 PSI (c.s.)
3. Actual vessel should not be less than nominal minus 1/4" to assure fit of grid.
4. for slot openings less than .025" (0.6mm), special sealing devices are required at the panel joints, and are available upon request.
5. Contact PFI for intermediate size availability.

50 PSI (3.5 bar) Design

vessel I.D. (feet/inches)	Supportbeams required	min.dia.open for install	estimated grid weight (lbs.)
2'-0"	0	12 3/4"	95
2'-6"	0	15 3/4"	125
3'-0"	1	13"	220
3'-6"	1	15"	320
4'-0"	1	13"	330
4'-6"	1	14 1/2"	460
5'-0"	1	16"	530
5'-6"	2	14 1/4"	700
6'-0"	1	15 1/4"	775
6'-6"	2	14"	975
7'-0"	2	15"	1075
7'-6"	2	16"	1175
8'-0"	3	14 3/4"	1425
8'-6"	3	15 1/2"	1550
9'-0"	3	14 1/2"	1825
9'-6"	3	15 1/4"	1950
10'-0"	3	14 1/2"	2250
10'-6"	4	15"	2400
11'-0"	4	17 3/4"	2550
11'-6"	4	14 3/4"	2875
12'-0"	4	15 1/2"	3050

Notes:
1. Material of construction: screen-410S, frame-carbon steel
2. Design conditions: temperature-650°f, load-20 PSI (1.4 bar) and 50 PSI (3.5 bar), stress-16,500 PSI (401S) and 16,900 PSI (c.s.)
3. Actual vessel should not be less than nominal minus 1/4" to assure fit of grid.
4. for slot openings less than .025" (0.6mm), special sealing devices are required at the panel joints, and are available upon request.
5. Contact PFI for intermediate size availability.

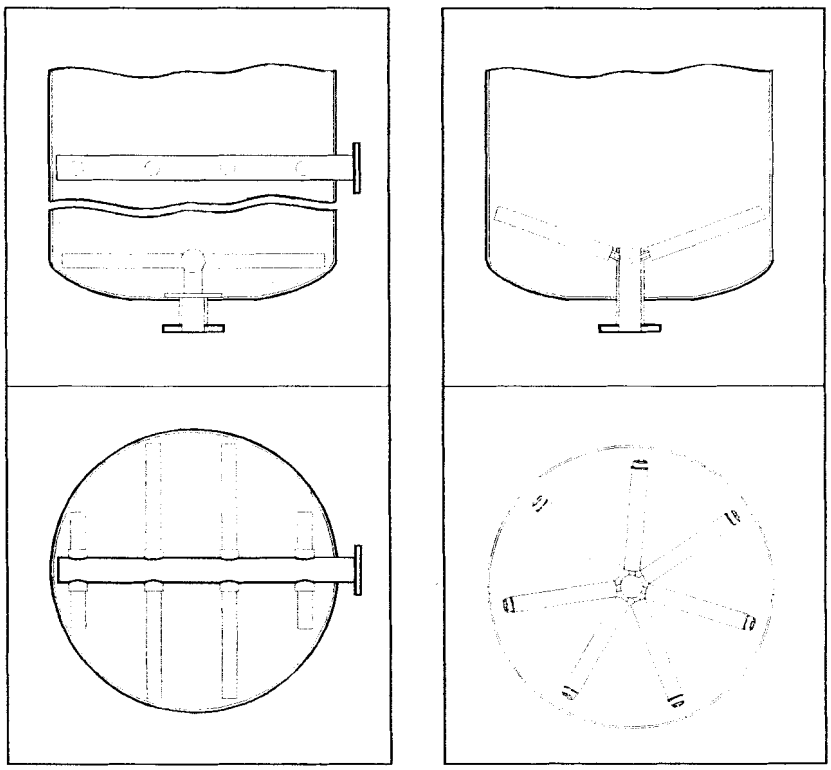
PROCESS FABRICATORS INC.

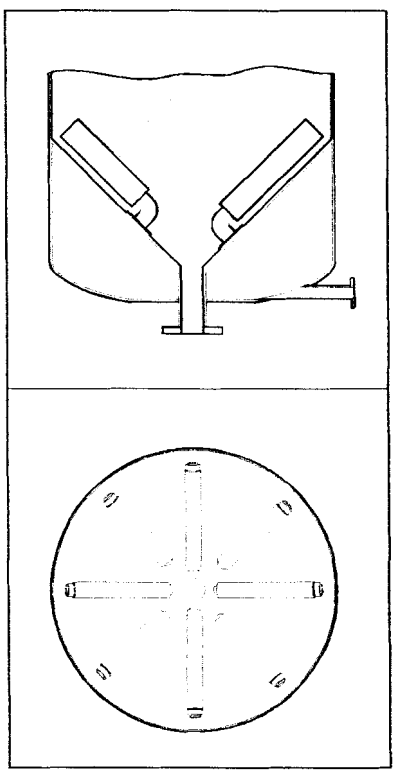
Screen Laterals for Water Conditioning, Resin Retention and Filtration Applications.

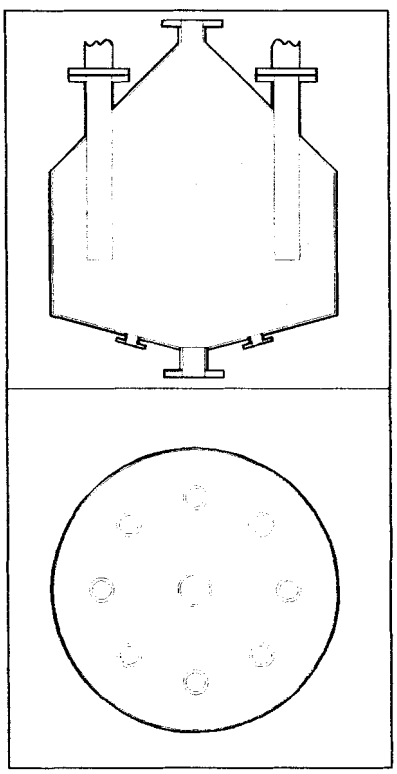
Lateral Applications

The primary function of screen laterals is to retain the treatment media while collecting the treated liquid or gas. Laterals are most often used as media retention elements in demineralizers, ion exchange processes, dryers, dehydrators, carbon columns, reactors and sand and clay filters. The liquid or gas flow through the media can be either up or down and is collected by the laterals. Drilled pipe bases can be added to the laterals to ensure proper distribution during backwash or regeneration cycles, as well as providing increased strength. Threaded, flanged or welded connections are available.

Laterals are manufactured in standard sizes which range from 1 to 20 inches in diameter. Continuous "V" slot openings range in sizes from .001 inches upward in increments of .001 inches.







1 . Header Laterals

Screens are attached perpendicular to the header pipe. Insert is a vertical view of laterals from the top of the vessel. Side or bottom outlets can be provided

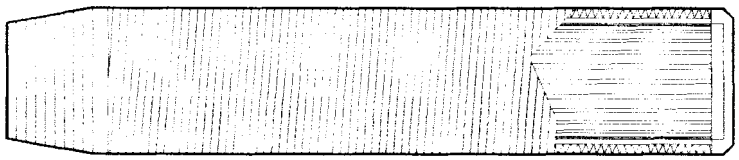
2. Hub Laterals

Screens are attached to a central hub forming a radial pattern. Single or multiple tiers of laterals, offset or in a horizontal plane, can be constructed, depending upon the level of effective collection and distribution efficiency desired.

3. Radial Laterals

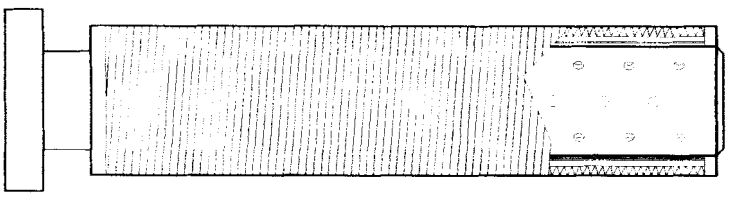
Screens are attached individually to an interior plate within the vessel in a radial pattern with opening into a collection and distribution chamber. This design may be used in up or down-flow systems. Vessel design permits media bed dumping without opening the vessel.

Wedge Wire Screen Laterals



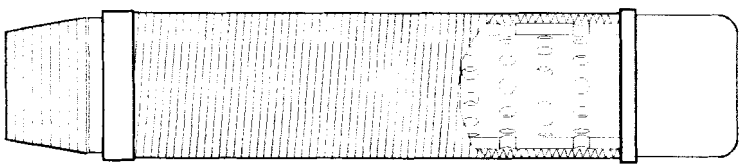
1. Monometal Lateral...

The welded, unitized single alloy construction makes this type of lateral the most versatile collector. The monometal lateral can be fabricated from alloys compatible with the toughest environments. Continuous "V" shaped slot openings are available from .001 inches or larger.



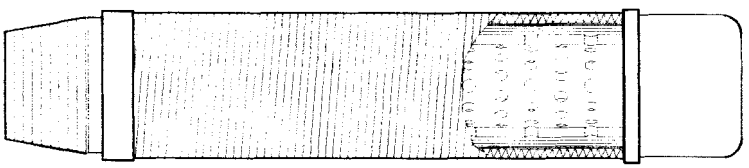
2. Pipe Based Lateral...

Efficient distribution and strength are achieved with a pipe based lateral. This effective collector / distributor can also be supplied with threaded, flanged or welded connections.



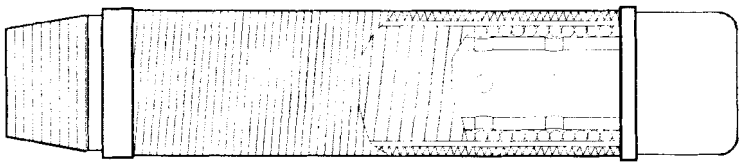
3. W.O.P. Lateral

The W.O.P. (wrapped on pipe) lateral consists of a drilled pipe and one layer of "V" shaped wrap wire. It is most often used as a collector or with large slot openings, as a support core for a fine wire mesh.



4. Poly Plus Lateral

Designed with two layers of plastic wire. The first layer is arranged longitudinally along the base pipe to permit longitudinal flow channels between the pipe and the helical exterior wire wrap. This assures an unobstructed water flow to all inner pipe perforations. The poly plus laterals are used primarily as collectors.



5. Hela-Flow Lateral

Designed to be used for media retention. It functions as a collector during the on-stream cycle and as a distributor during backwash cycles. Starting from the inside out, hela-flow screens offer custom drilled hole patterns in the plastic pipe base, to suit design requirements. Then the first plastic wire wrap is laid in a helical design around the pipe base with large spacings to form a continuous helical flow channel. Next, a longitudinal layer of support ribs are added to form longitudinal flow channels. The third, and outer wrap is applied to form a continuous helix with an inward opening "V" slot and creates a stable interface. The outer wire wrap can be spaced from .006 of an inch or larger to satisfy all media retention requirements.

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Lateral Design Information

The product design information outlined in the following pages is intended to help answer general questions about which screen design would best accommodate your screen needs. However, if there is any question about the specific design or construction of a screen for the application under consideration, please call Process Fabricators for assistance. Process Fabricators experience in a wide variety of applications enables them to explain the trade-offs associated with the various design parameters that are necessary to arrive at a final product design.

Since all applications are different, and screens are designed and constructed for the specific requirements of each project, the following information should be obtained in order to develop complete cost and design quotations.

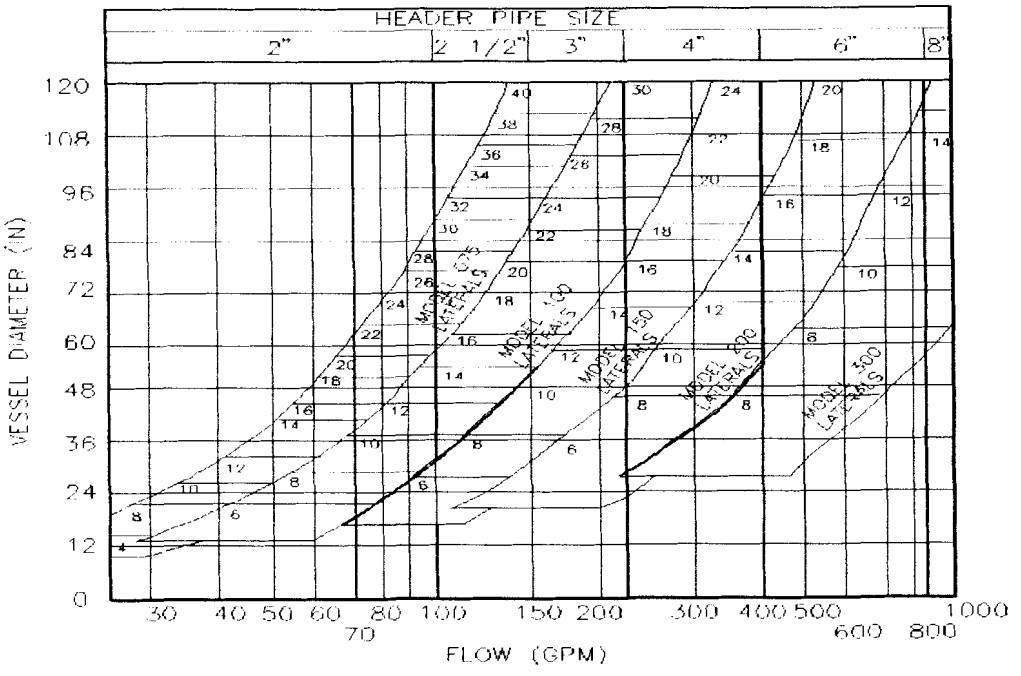
System Operating Conditions

1. Operating temperature of temperature transients.
2. Operating pressures.
3. Flow rate and / or open area of screen desired.
4. Allowable or desired pressure loss.
5. Particle size to be retained
6. Direction of flow through screen, and whether back wash distribution is necessary.
7. Type of particle to be retained, and whether particles are to be retained inside or outside of screen.
8. Amount of collapse (burst) and beam loading the screen must withstand.
9. Type of environment - water, acid, alkali - as specifically described as possible.

Physical Size Requirements

1. Critical diameter - inside or outside.
2. Length of screen - overall and / or effective area.
3. Fittings and piping - to be described in detail or by drawings.
4. Screen slot size desired.
5. Overall dimensions.

Lateral Size and Quantity Chart



- Header and lateral dimensions refer to pipe size dimensions.
- The lateral dimensions refer to the minimum recommended pipe size when used for collection only, or the minimum recommended internal pipe size when used for distribution also.
- The maximum header velocity is 10 ft./sec.
- The velocity through the lateral fittings is 2 1/2 to 5 ft./sec.
- Can be used for standard, channel rod or pipe base screen design.
- Example: given a 72" diameter vessel and a 300 GPM flow rate... chart shows a 4" P.S. header and (16) 1 1/2" P.S.laterals.
- Chart is recommended for estimation purposes only. For specific design recommendations, contact PFI.
- Good for header/lateral designs only (bottom or side outlet).

Screen Design Information

Calculation of Screen Open Area

The open area factor (OAF) for any wedge wire screen can be determined by dividing the slot size by the sum of the slot size plus the face width of the wire. See following page for dimensions of commonly used wire shapes.

$$OAF = \frac{\text{slot size}}{\text{slot size+wire width}}$$

Having both the open area factor (OAF) and the total screen surface area (TA), the total open area (OA) is simply the product of these two factors.

$$OA = (OAF)\,(TA)$$

The total screen surface area (TA) is the diameter times the length times p.

$$TA = p\,DL$$

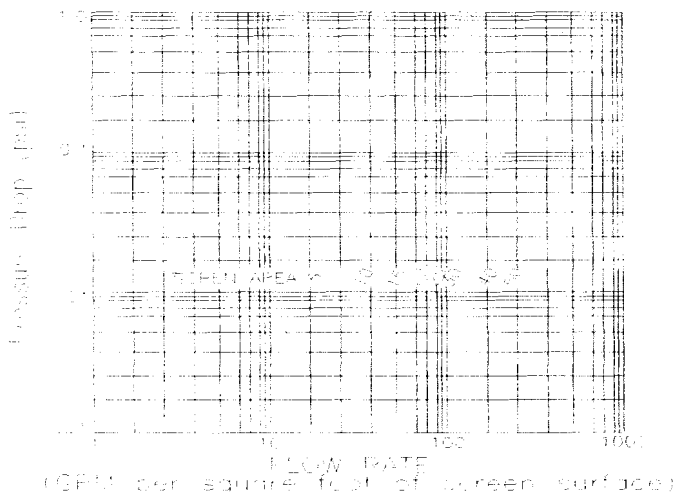
Pressure Drop

The pressure drop (Dp) through a wedge wire screen can be approximated by using the graph below, which shows Dp as a function of flow rate and open area (for water at 60°F). This represents the pressure drop through the screen surface only and does not include losses due to flow through the ID of the cylinder. These losses could be approximated using conventional pressure drop through pipe calculations.

The flow rate per square foot of cylindrical screen surface can be calculated from the expression.

$$\frac{144Q}{pdL}$$

Where Q = Total flow in GPM.
d = Outside diameter of screen in inches.
L = Total length of screen(s) in system.



Slot Opening Equivalents			
Inches	Millimeters	Microns	Std. Mesh
.001	-	25	-
.0015	-	37	400
.002	-	50	270
.003	-	75	200
.004	1/16	100	150
.005	1/8	125	120
.006	-	149	100
.007	-	177	80
.008	1/8	200	70
.010	1/4	250	60
.012	-	305	50
.014	-	355	45
.016	-	400	40
.020	1/2	500	35
.023	-	590	30
.028	-	710	25
.030	3/4	750	-
.033	-	840	20
.039	1	1000	18
.047	-	1190	16
.049	1 1/4	1250	-
.055	-	1410	14
.059	1 1/2	1500	-
.066	-	1680	12
.069	1 3/4	1750	-
.078	2	2000	-
.089	2 1/4	2250	-
.094	-	2380	8
.098	2 1/2	2500	-
.108	2 3/4	2750	-
.111	-	2790	7
.118	3	3000	-
.132	-	3330	6
.138	3 1/2	3500	-
.157	4	4000	5
.185	-	4700	4
.197	5	5000	-
.236	6	6000	-
.263	-	6700	3
.312	-	7900	2.5

Mixing Tank Design

A vertical, cylindrical tank with a liquid-height-to-diameter ratio (Z/T) equal to one is often used as a base point for designing mixing tanks. For blending and solid suspension, the optimum liquid-depth-to-tank-diameter ratio Z/T for minimum power is usually about 0.6 to 0.7. While this may be the ratio for minimum power consumption, it may not represent the minimum Z/T for equipment cost or tank cost. Other factors may enter into the choice of tank shape and batch geometry.

A single impeller can usually operate at liquid coverages from 0.5d to 2d (where D is impeller diameter). The placement of an impeller is more often governed by the requirements for mixing during "draw-off" (emptying the vessel) than by optimum process conditions. For example, for blending, the optimum impeller for Z/T=1 would be at the midpoint of the liquid depth. However, this is seldom practical since tanks must usually be mixed during "draw-off". However, the midpoint position should be considered for a continuous flow process tank.

Multiple axial-flow impellers have less tendency to produce separate flow patterns - one per impeller - than multiple radial flow impellers. With increase batch viscosity, however, the flow patterns that they produce become more radial, and the tendency for zone mixing increases. If axial flow impellers are placed too close together (usually less than one impeller diameter spacing), they may behave as a single larger impeller. When this occurs there is a decrease in the amount of power drawn by the impellers and a decrease in pumping capacity.

Radial flow impellers should normally be located at least 1.5d apart, and the most effective coverage is 1/2 to 1 1/2 impeller diameters, depending on the requirements for surface motion. If the impeller is placed too close to the bottom of the tank, particularly with disk impellers, the flow patterns tend to develop a swirl (at the bottom), and the lower pumping zone for the impeller is throttled considerably. If multiple impellers are placed too close together, there is a critical point at which the flow between them is interrupted and the impellers behave as a single impeller. Thus, there are more important constraints on impeller location for achieving predictable and satisfactory results.

Normally the behavior of flat bottoms, ASME dish bottoms or shallow cone tanks (less than 15°) is essentially equivalent. However, this is not always true for very sensitive solids suspension applications. With spherical bottoms or deep cones, some additional degree of baffling may be required to prevent severe swirling in those areas. Horizontal cylindrical tanks are commonly used, and careful consideration is given to clearances between impellers and tank components. But there is no reason why horizontal cylindrical tanks cannot be used for adequate mixing.

Axial flow or radial flow impellers in un-baffled tanks containing low viscosity fluids tend to swirl and produce vortices which are almost always undesirable. Installing baffles destroys these vortices and promotes a flow pattern conducive to good mixing.

The term standard baffles usually refers to four vertical baffles in a cylindrical tank, each of which is between one tenth and one twelfth of the tank diameter in width. In normal practice, there is a space between the baffle and the tank wall equal to about one-third the baffle width. It is also desirable to keep the baffles off of the bottom of the tank by the same amount to keep solids from depositing.

Mixing Tank Design

Proper matching of impeller and motor is frequently based on the turnover, or pumping rate, for the application (Polymer mixing is the exception)

Pumping rate is arrvied at by the following...

$$Q = \frac{N_Q N d^3}{230}$$

where:

Q =pumping rate in gallons per minute
N =mixer speed in RPM
d =Impeller diameter in inches
N_Q=pumping coefficient for impeller type

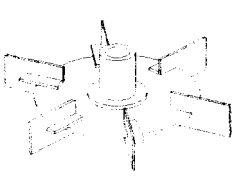
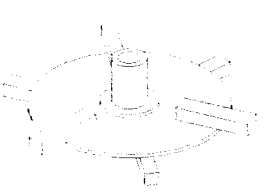
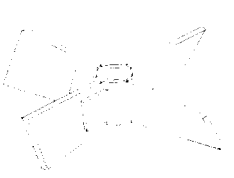
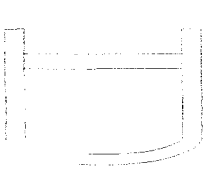
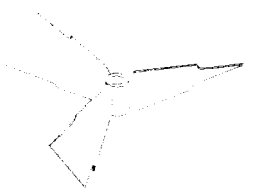
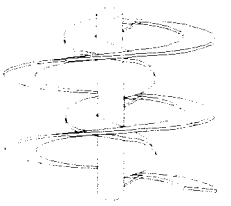
(1.0 or "square" pitch marine propeller, N_Q=0.5)
(1.5 "steep" pitch marine propeller, N_Q=0.77)

Impeller horsepower requirements can be calculated from:

$$HP = \frac{N_Q N d^3}{1.53 \times 10^{13}}$$

where:
HP=horsepower required
N =mixer speed in RPM
d =propellor diameter in inches
P =specific gravity of mixture
N_p=power coeficient for a class of propellers
(1.0 or "square" pitch marine propeller, N_p=0.35)
(1.5 "steep" pitch marine propeller, Np=0.85)

Description of the seven basic impellers

Name	Description	Illustration	Name	Description	Illustration
Flat blade	vertical blades bolted to support disk		Propeller three blades	constant pitch, skewed-back blades	
Bar turbine	six blades bolted/ welded to top and bottom of support disk		Axial flow four blades	constant angle at 45°	
Anchor	two blades with or without cross arm		Axial flow three blades	variable blade angle, near constant pitch	
			Double spiral	two helical flights, pitch = $1/2D_o$	

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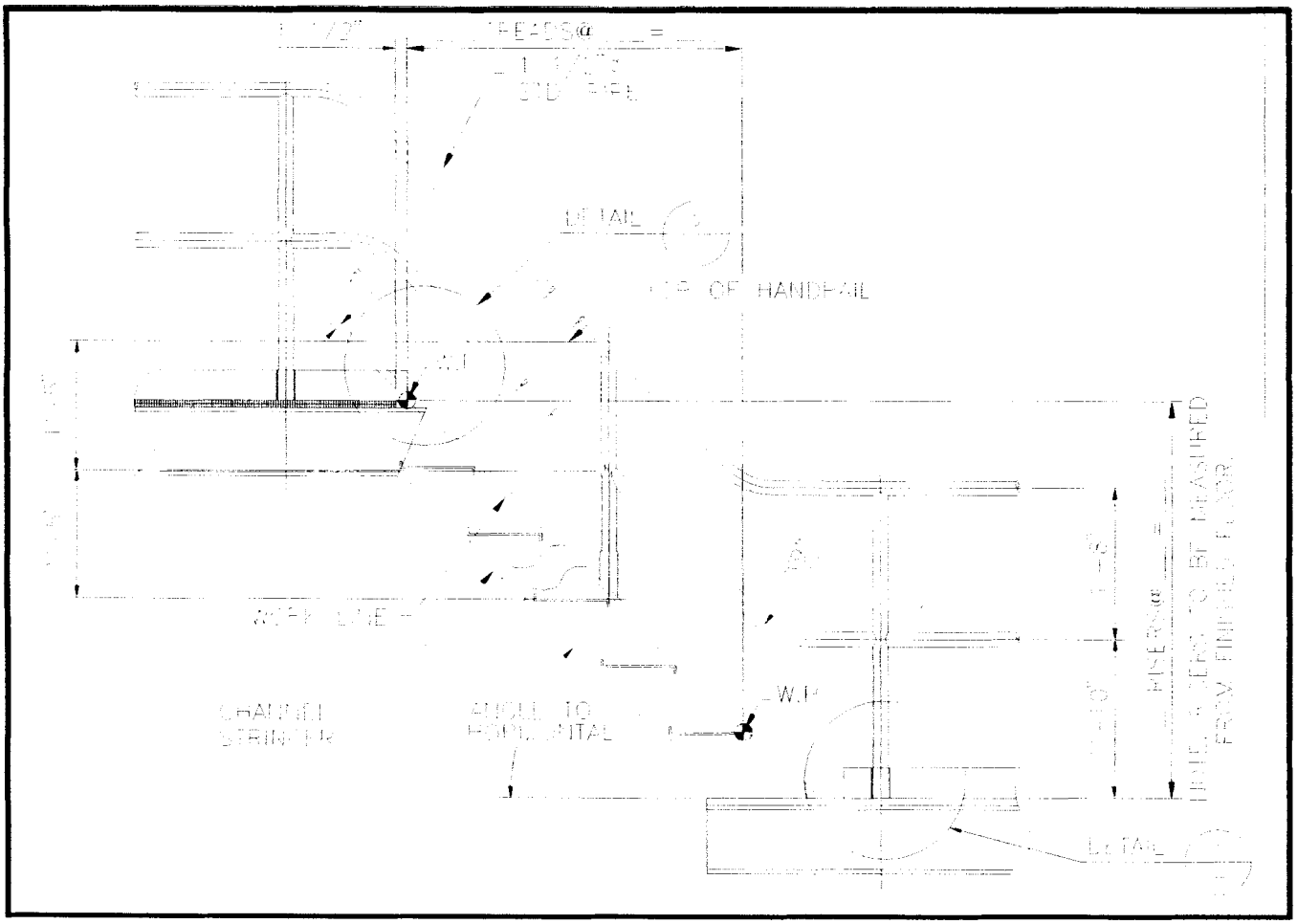
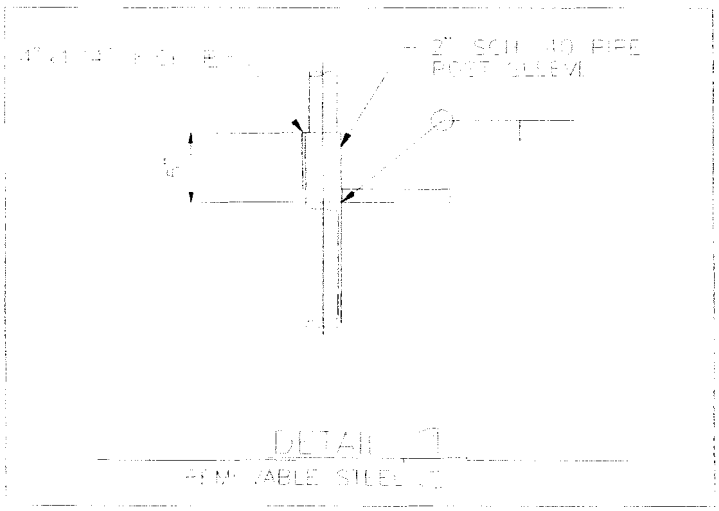
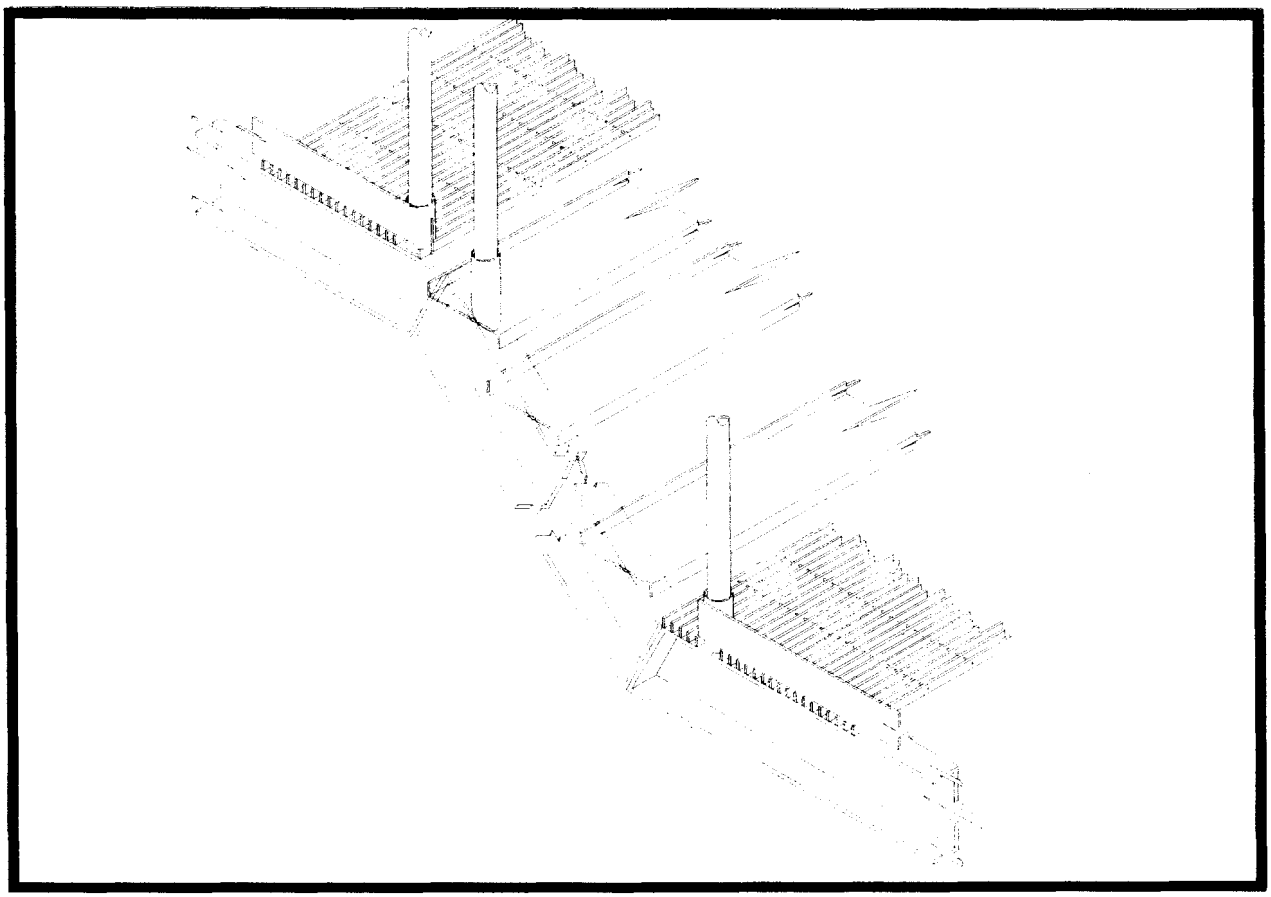
Standard Stair and Handrail Details



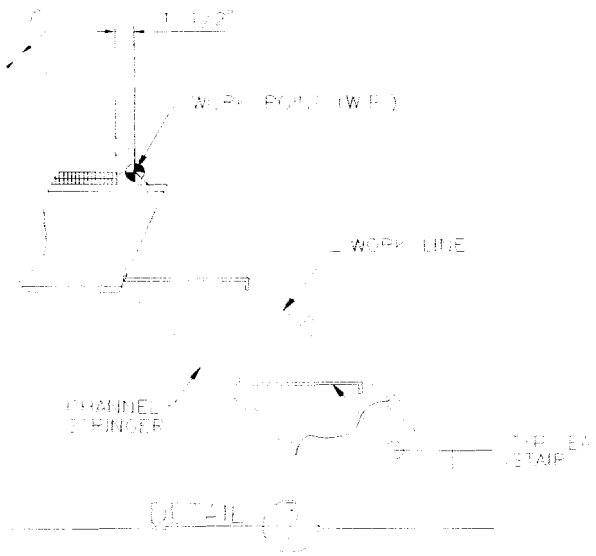
Standard Section



Standard Stair and Handrail Details



Stair Detail



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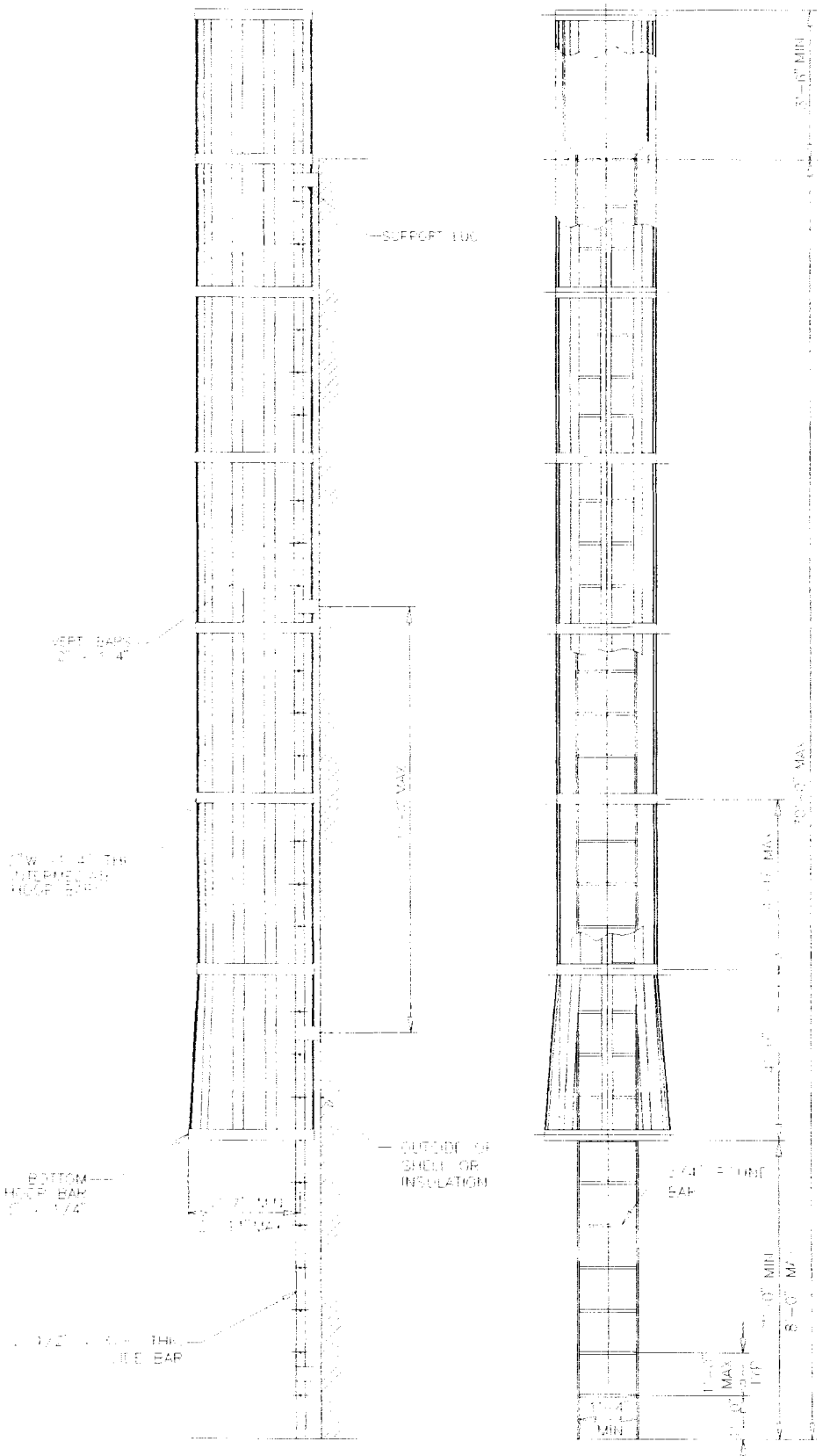
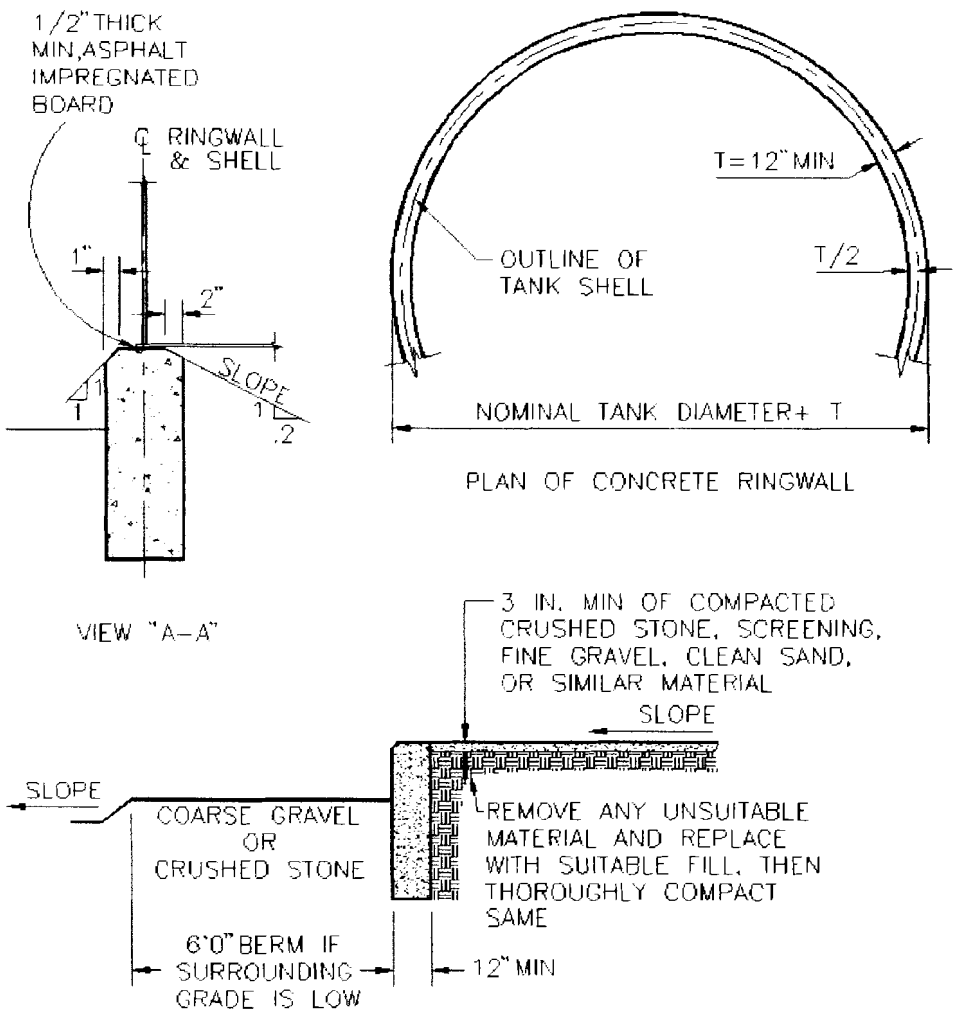
Standard Ladders and Safety Cages



Concrete Ringwall Foundation



Notes:

1. For reinforcement, the ringwall should be reinforced against temperature and shrinkage and to resist the lateral pressure of the confined fill with its surcharge. It is suggested that the minimum reinforcing in any ringwall be 0.002 times the cross-sectional area of wall above-grade, with additional reinforcement as may be required for resisting lateral earth pressure. The latest edition of the American Concrete Institute's Building Code requirements for Reinforced Concrete (ACI 318 and ANSI A89.1) is recommended for stress values and material specifications.

2. Top of concrete ringwall should be smooth and level. Strength of concrete should be at least 3,000 PSI after 28 days. Lap reinforcement splices to develop full strength in bond.

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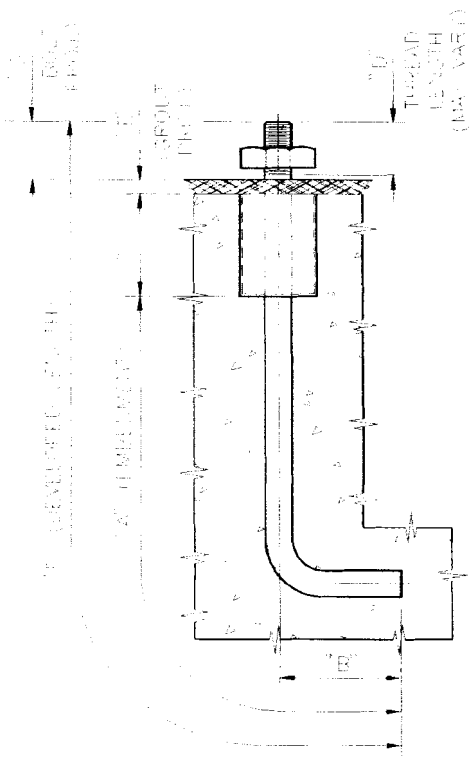
Anchor Bolt Installation

Based on American Standard form screw threads...American Standard B-1, 1/1/1935



Notes:

1. These are the maximum dimensions for standard anchor bolts (to develop total tensile strength for live and dead loads).
2. "F" = A + C + E + G (if sleeves are used).
3. "F" = A + E + G (if sleeves are not used).
4. "E" = Grout projection, usually 1" (may vary).
5. Sleeves: no. 26 GA. Black sheet iron, both ends closed with centered holes in both ends. Holes 1/16" larger than bolt diameter.
6. All dimensions are in inches.
7. When the anchor bolts are subject to stresses produced by wind or seismic forces, multiply the required tensile strength by 1.33. This multiplier is also usually used for tall fractionating towers, stacks, etc.

For Ordinary Conditions

"A" Based on Tensile Stress = 1200 Lbs. / Sq. In.
Bond Stress = 120 Lbs. / Sq. In. x 1.33

Bolt Dia.	A	B	C	D	Tensile Strength
1/2	6	3	2 x 6	2	1500
5/8	8	3	2 x 6	2	2350
3/4	10	3	2 x 6	2 1/2	3600
7/8	12	4	2 1/2 x 12	2 1/2	5040
1	13	4	2 1/2 x 12	3	6600
1 1/8	15	4	2 1/2 x 12	3 1/2	8280
1 1/4	17	4	3 x 18	4	10680
1 3/8	19	4	3 x 18	4	12700
1 1/2	20	4	3 x 18	4 1/2	15360
1 5/8	23	5	3 1/2 x 18	5	18360
1 3/4	24	5	3 1/2 x 24	5	21120
1 7/8	26	5	3 1/2 x 24	6	24360
2	28	5	4 x 24	6	27600
2 1/4	32	6	5 x 24	7	36300
2 1/2	36	6	5 x 24	7 1/2	44600

For Special Conditions

"A" Based on Tensile Stress = 1500 Lbs. / Sq. In.
Bond Stress = 120 Lbs. / Sq. In. x 1.33

Bolt Dia.	A	B	C	D	Tensile Strength
1/2	8	3	2 x 6	2	1875
5/8	10	3	2 x 6	2	2940
3/4	12	3	2 x 6	2 1/2	4500
7/8	14	4	2 1/2 x 12	2 1/2	6300
1	17	4	2 1/2 x 12	3	8250
1 1/8	18	4	2 1/2 x 12	3 1/2	10350
1 1/4	21	4	3 x 13	4	13350
1 3/8	24	4	3 x 13	4	15900
1 1/2	26	4	3 x 18	4 1/2	19200
1 5/8	28	5	3 1/2 x 18	5	22950
1 3/4	30	5	3 1/2 x 24	5	26400
1 7/8	32	5	3 1/2 x 24	6	30450
2	36	5	4 x 24	6	34500
2 1/4	40	6	5 x 24	7	45300
2 1/2	44	6	5 x 24	7 1/2	55750

The information contained in this handbook is provided as a service to the industry. Process Fabricators, Inc. makes no guarantee to the accuracy of the information contained herein.