

Chapter

# 10

# Vessels

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**Horizontal Tanks (HT)** ..... 10-3

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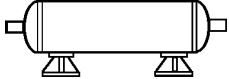


## Horizontal Tanks (HT)

Horizontal vessels are commonly used as settling drums, surge tanks, reactors and distillate drums. A settling drum is used for phase separation between two immiscible liquids. The L/D ratio of a settling drum is normally four. A surge tank or surge drum is used to maintain a constant flowrate of liquid to a downstream piece of equipment when the flowrate of liquid from the upstream piece of equipment is fluctuating. The fluctuations in flow rate are absorbed by the surge drum by allowing the liquid level in this drum to rise and fall. Horizontal drums are frequently filled with catalyst and used as reactors. Placing catalyst in horizontal vessels allows shallow bed depths and large cross-sectional areas. A typical example of horizontal vessels being used as reactors is the Claus reactor. A distillate or reflux drum provides space for overhead condensables from a distillation column to separate from vapors. Surge drums and distillate drums are normally vertical. If there is settleable water in the feed to these vessels, however, the vessel is erected with a water pot.

The horizontal vessel is a pressure vessel fabricated according to the rules of the specified code (i.e., Section VIII Division 1 of the ASME Code) and erected in the horizontal position. Although the horizontal vessel may be supported by lugs in an open steel structure, the more usual arrangement is for the vessel to be erected at grade and supported by a pair of saddles.

Cylindrical, pressure/vacuum, code design and construction, includes heads, single wall (base material, clad/lined), saddles/lugs, nozzles and manholes.

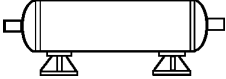
Description	Type
<p>Multi-wall design for high pressure service with total wall thickness of individual, thin, heat-shrunk cylinders (maximum 2 INCHES [50 MM] thick) heat shrunk, pressure vacuum design and construction according to user-designated design code standard.</p>	<p><b>MULTI WALL</b></p> 
<p>This item is a horizontal process vessel, the total wall thickness of which is made up of individual cylinders. Each individual cylinder is no more than two inches thick. The composite is made as follows. A cylinder is fabricated with a diameter slightly larger than the innermost cylinder. This cylinder is expanded thermally, slipped over the inner cylinder and as it cools, a tight shrink fit is obtained. This procedure is repeated until the total wall thickness is built up.</p>	
<p><b>Application Symbol:</b> Defines vessel function and related piping/instrumentation model. Default: *blank*</p> <ul style="list-style-type: none"> <li>blank - Standard continuous process vessel</li> <li>BATCH - Batch process vessel</li> <li>STORAGE - Storage vessel</li> <li>RECVR - Receiver</li> <li>KO - Knock-out drum</li> </ul> <p><b>Shell Material:</b> For clad plate, specify the backing plate material. (Cladding is defined below.) See Chapter 28 for materials. Default: *A 515*.</p> <p><b>Capacity:</b> Enter either capacity or diameter and length.</p> <p><b>Diameter:</b> Enter either capacity or diameter and length.</p> <p><b>Vessel T-T Length:</b> Enter either capacity or diameter and length.</p> <p><b>Design Press. - Gauge:</b> If pressure and vacuum entered, design is for worst case. Default: *15* PSIG [*100* KPA].</p> <p><b>Design Vacuum - Gauge:</b> If pressure and vacuum entered, design is for worst case. Default: pressure.</p> <p><b>Design Temperature:</b> Default: 650 DEG F [340 DEG C] ferrous material; 250 DEG F [120 DEG C] other material.</p> <p><b>Operating Temp.:</b> Default: design temperature.</p> <p><b>Cladding Material:</b> See Chapter 28; for cladding materials.</p>	

Continued on next page

Horizontal Tanks (HT) - continued

Description	Type
<p><b>MULTI WALL</b> - continued</p> <p><b>Manhole Diameter:</b> Max: 48 INCHES [1,200 MM]; Default: *18* INCHES [*450* MM]</p> <p><b>Number of Manholes:</b> Default: *1*.</p> <p><b>% All. for Internals:</b> Specify an allowance for internals as a percent of basic vessel weight. Default: *0.0*.</p> <p><b>Diameter of Drip Leg:</b> Drip leg (boot) diameter and length must be specified if required.</p> <p><b>Length of Drip Leg:</b> Drip leg (boot) diameter and length must be specified if required.</p> <p><b>Base Mat'l Thickness:</b> Base material thickness including corrosion allowance.</p> <p><b>Corrosion Allowance:</b> Default: 0.125 INCHES [3 MM] for CS, 0.0 for other materials.</p> <p><b>Weld Efficiency %:</b> 50 - 100; ASME/JIS codes only, where allowed for thin wall vessels; Default: Area Basis.</p> <p><b>Stress Relief:</b> Default: See Area Design Basis. CODE - Provide stress relief if code requires YES - Provide stress relief NO - No stress relief required</p> <p><b>Cladding Thickness:</b> Default: 1.125 INCHES [3 MM] if cladding material is specified; otherwise 0.0.</p> <p><b>Stiff'g Ring Spacing:</b> Default stiffeners designed for vacuum only, enter 0.0 if not required.</p> <p><b>Head Type Symbol:</b> ELLIP - 2:1 ellipsoidal HEMI - Hemispherical TORI - Torispherical (ASME)</p> <p><b>No. Body Flange Sets:</b> Number of sets (pairs) of body flanges of same diameter as vessel.</p> <p><b>Diameter Option:</b> Defines desired diameter as ID or OD; Default - see Area Design Basis. OD - Outside diameter ID - Inside diameter</p>	

## Horizontal Tanks (HT) - continued

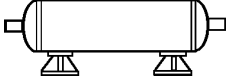
Description	Type
<p>Horizontal pressure/vacuum drum. Use minus pressure for vacuum design.</p> <p>The capacity excludes the volume of the heads. If both the vessel dimensions and capacity are specified, the system-calculated capacity must agree with the specified capacity to within plus or minus 10% to avoid an error condition. To secure desired vessel size, specify the diameter and height directly. A value must be specified if vessel diameter and/or vessel height (or length) are not specified. If vessel diameter and height (or length) are specified, the vessel volume is calculated from these dimensions. If only vessel capacity is specified, a straight side length-to-diameter ratio is chosen by the system, considering cost and practicability. (Default ratio is 2:1.)</p> <p><b>Application Symbol:</b> Defines vessel function and related piping/instrumentation model. Default: *blank*</p> <ul style="list-style-type: none"> <li>blank - Standard continuous process vessel</li> <li>BATCH - Batch process vessel</li> <li>STORAGE - Storage vessel</li> <li>RECVR - Receiver</li> <li>KO - Knock-out drum</li> </ul> <p><b>Shell Material:</b> For clad plate, specify the backing plate material. (Cladding is defined below.) See Chapter 28 for materials. Default: *A 515*.</p> <p><b>Capacity:</b> Enter either capacity or diameter and length. The capacity excludes the volume of the heads. If both the vessel dimensions and capacity are specified, the system-calculated capacity must agree with the specified capacity to within plus or minus 10% to avoid an error condition. To secure desired vessel size, specify the diameter and height directly. A value must be specified if vessel diameter and/or vessel height (or length) are not specified. If vessel diameter and height (or length) are specified, the vessel volume is calculated from these dimensions. If only vessel capacity is specified, a straight side length-to-diameter ratio is chosen by the system, considering cost and practicability.</p> <p><b>Diameter:</b> Enter either capacity or diameter and length. A value must be specified if vessel capacity is not specified. If both capacity and height (or length) are specified, the diameter is calculated from these values.</p> <p><b>Vessel T-T Length:</b> Enter either capacity or diameter and length. A value must be specified if vessel capacity is not specified. If both vessel capacity and diameter are specified, the height (or length) is calculated from these values.</p> <p><b>Design Press. - Gauge:</b> If pressure and vacuum entered, design is for worst case; Default: *15* PSIG [*100* KPA] pressure.</p> <p><b>Design Vacuum - Gauge:</b> If pressure and vacuum entered, design is for worst case. Default: pressure.</p> <p><b>Design Temperature:</b> Default: 650 DEG F [340 DEG C] ferrous material; 250 DEG F [120 DEG C] other material.</p>	<p>HORIZ-DRUM</p> 

Continued on next page

Horizontal Tanks (HT) - continued

Description	Type
HORIZ-DRUM - continued	
<p><b>Operating Temp.:</b> Default: design temperature. The operating temperature is used in the calculation of piping and insulation thickness.</p>	
<p><b>Cladding Material:</b> See Chapter 28 for cladding materials.</p>	
<p><b>Manhole Diameter:</b> Max: 48 INCHES [1,200 MM]; Default: *18* INCHES [*450* MM].</p>	
<p><b>Number of Manholes:</b> Default: *1*.</p>	
<p><b>% All. for Internals:</b> Specify an allowance for internals as a percent of basic vessel weight. Default: *0.0*. This value adjusts vessel weight and cost accordingly.</p>	
<p><b>Diameter of Drip Leg:</b> Drip leg (boot) diameter and length must be specified if required.</p>	
<p><b>Length of Drip Leg:</b> Drip leg (boot) diameter and length must be specified if required.</p>	
<p><b>Base Material Thickness:</b> Base material thickness including corrosion allowance.</p>	
<p><b>Corrosion Allowance:</b> Default: 0.125 INCHES [3 MM] for CS, 0.0 for other materials.</p>	
<p><b>Weld Efficiency %:</b> ASME/JIS codes only, where allowed for thin wall vessel; Default: Area Basis. Range: 50 - 100.</p>	
<p><b>Stress Relief:</b> Default: See Area Design Basis. CODE - Provide stress relief if code requires YES - Provide stress relief NO - No stress relief required</p>	
<p><b>Cladding Thickness:</b> Default: 0.125 INCHES [3 MM] if cladding material is specified, otherwise: 0.0.</p>	
<p><b>Stiff'g Ring Spacing:</b> Default stiffeners designed for vacuum only, enter 0.0 if not required.</p>	
<p><b>Head Type Symbol:</b> If no value is specified, the system selects the torispherical type and calculates its thickness. If the head is thicker than the vessel shell, the system selects the 2:1 ellipsoidal type head thickness. If the head is still thicker than the shell, the system selects the hemispherical type head. ELLIP - 2:1 ellipsoidal HEMI - Hemispherical TORI - Torispherical (ASME)</p>	
<p><b>No. Body Flange Sets:</b> Number of sets (pairs) of body flanges of same diameter as vessel.</p>	
<p><b>Diameter Option:</b> Defines desired diameter as ID or OD; Default - see Area Design Basis. OD - Outside diameter ID - Inside diameter</p>	

## Horizontal Tanks (HT) - continued

Description	Type
<p>Jacketed horizontal pressure/vacuum drum.</p> <p><b>Application Symbol:</b> Defines vessel function and related piping/instrumentation model. Default: *blank*</p> <ul style="list-style-type: none"> <li>blank - Standard continuous process vessel</li> <li>BATCH - Batch process vessel</li> <li>STORAGE - Storage vessel</li> <li>RECVR - Receiver</li> <li>KO - Knock-out drum</li> </ul> <p><b>Shell Material:</b> For clad plate, specify the backing plate material. See Chapter 28 for materials. Default: *A 515*.</p> <p><b>Capacity:</b> Enter either capacity or diameter and length.</p> <p><b>Diameter:</b> Enter either capacity or diameter and length.</p> <p><b>Vessel T-T Length:</b> Enter either capacity or diameter and length.</p> <p><b>Design Press. - Gauge:</b> If pressure and vacuum entered, design is for worst case; Default: *15* PSIG [*100* KPA].</p> <p><b>Design Vacuum - Gauge:</b> If pressure and vacuum entered, design is for worst case; Default: pressure.</p> <p><b>Design Temperature:</b> Default: 650 DEG F [340 DEG C] ferrous material; 250 DEG F [120 DEG C] other materials.</p> <p><b>Operating Temp:</b> Default: design temperature.</p> <p><b>Cladding Material:</b> See Chapter 28 for materials.</p> <p><b>Jacket Press. - Gauge:</b> Default: *90* PSIG [*620* KPA].</p> <p><b>Jacket Type:</b> Default: *FULL*</p> <ul style="list-style-type: none"> <li>FULL - Full jacket</li> <li>PIPE - Half-pipe jacket</li> </ul> <p><b>Jacket Material:</b> See Chapter 28 for materials. Default: *CS*.</p> <p><b>Manhole Diameter:</b> Max: 48 INCHES [1,200]; Default: 18 INCHES [450 MM].</p> <p><b>Number of Manholes:</b> Default: *1*.</p> <p><b>% All. for Internals:</b> Specify an allowance for internals as a percent of basic vessel weight. Default: *0.0*.</p> <p><b>Diameter of Drip Leg:</b> Drip leg (boot) diameter and length must be specified if required.</p> <p><b>Length of Drip Leg:</b> Drip leg (boot) diameter and length must be specified if required.</p> <p><b>Base Mat'l Thickness:</b> Base material thickness including corrosion allowance.</p> <p><b>Corrosion Allowance:</b> Default: 0.125 INCHES [3 MM] for CS, 0.0 for other material, double if jacketed.</p> <p><b>Weld Efficiency %:</b> ASME/JIS codes only, where allowed for thin wall vessels; Default: Area Basis. Range: 50 - 100.</p> <p><b>Stress Relief:</b> Default: See Area Design Basis.</p> <ul style="list-style-type: none"> <li>CODE - Provide stress relief if code requires</li> <li>YES - Provide stress relief</li> <li>NO - No stress relief required</li> </ul> <p><b>Cladding Thickness:</b> Default: 0.125 INCHES [3 MM] if cladding material is specified; otherwise: 0.0.</p> <p><b>Stiff'g Ring Spacing:</b> Default stiffeners designed for vacuum only, enter 0.0 if not required.</p> <p><b>Head Type Symbol:</b></p> <ul style="list-style-type: none"> <li>ELLIP - 2:1 ellipsoidal</li> <li>HEMI - Hemispherical</li> <li>TORI - Torispherical (ASME)</li> </ul> <p><b>No. Body Flange Sets:</b> Number of sets (pairs) of body flanges of same diameter as vessel.</p> <p><b>Diameter Option:</b> Defines desired diameter as ID or OD; Default: See Area Design Basis.</p> <ul style="list-style-type: none"> <li>OD - Outside diameter</li> <li>ID - Inside diameter</li> </ul>	<p>JACKETED</p> 

## Vertical Tanks (VT)

Vertical process vessels are typically used as either surge drums or knock out drums. When used as surge drums, they act like shock absorbers, maintaining a constant flowrate of liquid out of the vessel regardless of the flowrate into it. If liquid flows in faster than the constant rate it flows out, the vessel fills with liquid. If liquid flows in slower than the constant rate it is removed, then the liquid level drops. The liquid level is constantly fluctuating in order to absorb these variations in flow and maintain a constant flowrate out. When a vertical process vessel is used as a knock out drum, a mixture of gas and liquid flows into the vessel and this mixture is separated into its gas and liquid components within the vessel. The gas then flows out the top of the vessel and the liquid flows out the bottom.

Vertical process vessels, as their name indicates, are erected in the vertical position. They are cylindrical in shape with each end capped by a domed cover called a head. The length to diameter ratio of a vertical vessel is typically 3:1.

Typically, vertical process vessels hold less than 5000 GALLONS.

Vertical tanks include: process, storage applications liquid, gas, solid processing and storage; pressure/vacuum code design for process and certain storage vessel types; includes heads, single wall, saddles, lugs, nozzles, manholes, legs or skirt, base ring, davits where applicable.

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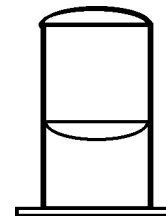
### Description

### Type

#### Pressure/Vacuum Service

Cylindrical vertical pressure/vacuum vessel.  
Use minus pressure for vacuum design.

CYLINDER



**Application Symbol:** Defines vessel function and related piping/instrumentation model. Default: \*blank\*

- blank - Standard continuous process vessel
- BATCH - Batch process vessel
- STORAGE - Storage vessel
- RECVR - Receiver
- KO - Knock-out drum

**Shell Material:** For clad plate, specify the backing plate material. See Chapter 28 for materials. Default: \*A 515\*.

**Capacity:** Enter either capacity or diameter and height. The capacity excludes the volume of the heads. If both the vessel dimensions and capacity are specified, the system calculated capacity must agree with the specified capacity to within plus or minus 10% to avoid an error condition. To secure desired vessel size, specify the diameter and height directly. A value must be specified if vessel diameter and/or vessel height (or length) are not specified. If vessel diameter and height (or length) are specified, the vessel volume is calculated from these dimensions. (Default is 2:1.) If only vessel capacity is specified, a straight side length-to-diameter ratio is chosen by the system, considering cost and practicability.

**Diameter:** Enter either capacity or diameter and height. A value must be specified if vessel capacity is not specified. If both vessel capacity and height (or length) are specified, the diameter is calculated from these values. If both vessel capacity and diameter are specified, the height (or length) is calculated from these values.

**Vessel T-T Height:** Enter either capacity or diameter and height. See Diameter.

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## Vertical Tanks (VT) continued

Description	Type
CYLINDER - continued	
<p><b>Design Press. - Gauge:</b> If pressure and vacuum entered, design is for worst case; Default: *15* PSIG [*100* KPA].</p>	
<p><b>Design Vacuum - Gauge:</b> If pressure and vacuum entered, design is for worst case; Default: pressure.</p>	
<p><b>Design Temperature:</b> Default: 650 DEG F [340 DEG C] ferrous material, 250 DEG F [120 DEG C] other material.</p>	
<p><b>Operating Temp.:</b> Default: design temperature.</p>	
<p><b>Skirt Height:</b> Skip if legs required, enter 0.0 if hung in OPEN structure; Default: 1.5 x diameter. If the capacity is 10,000 GALLONS [37 M3] or less, the vessel is designed with 4-foot [1.25 M] pipe legs. For a capacity greater than 10,000 GALLONS [37 M3], the vessel is designed with a skirt. The skirt height is calculated as 1.5 x vessel diameter, with minimum and maximum calculated heights of 4 - 32 FEET [1.25 - 9.5 M].</p>	
<p><b>Leg Height:</b> Skip if skirt required, enter 0.0 if hung in OPEN structure; Default: *4* FEET [1.25 M]. See Skirt Height.</p>	
<p><b>Wind/Seismic Design:</b> Default: Vessel designed for wind and seismic loads defined in Project Basis. W+S - Wind and seismic design required WIND - Wind design only SEIS - Seismic design only NONE - Delete wind and seismic design</p>	
<p><b>Fluid Volume %:</b> For seismic design, fluid volume as a % of vessel volume (water assumed). Max: 100; Default: *20*.</p>	
<p><b>Manhole Diameter:</b> Max: 48 INCHES [1,200 MM]; Default: 18 INCHES [450 MM].</p>	
<p><b>Number of Manholes:</b> Default: *1*.</p>	
<p><b>% All. for Internals:</b> Default: *0.0*.; Specify an allowance for internals as a percent of basic vessel weight.</p>	
<p><b>Base Mat'l Thickness:</b> Base material thickness including corrosion allowance.</p>	
<p><b>Corrosion Allowance:</b> Default: 0.125 INCHES [3 MM for CS, 0.0 for other materials.</p>	
<p><b>No. Body Flange Sets:</b> Number of sets (pairs) of body flanges of same diameter as vessel.</p>	
<p><b>Weld Efficiency %:</b> ASME/JIS codes only, where allowed for thin wall vessels; Defaults: Area Basis. Range: 50 - 100.</p>	
<p><b>Stress Relief:</b> Default: See Area Design Basis. CODE - Provide stress relief if code requires YES - Provide stress relief NO - No stress relief required</p>	
<p><b>Cladding Material:</b> If no cladding material is specified, the system assumes that the vessel is not clad regardless of any input for cladding thickness. See Chapter 28 for materials.</p>	
<p><b>Cladding Thickness:</b> Default: 0.125 INCHES [3 MM] if cladding material is specified, otherwise 0.0. See Cladding Material.</p>	
<p><b>Stiff'g Ring Spacing:</b> Default stiffeners designed for vacuum only, enter 0.0 if not required.</p>	

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Vertical Tanks (VT) continued

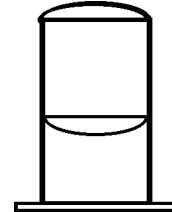
Description	Type
CYLINDER - continued	
<p><b>Head Type Symbol:</b> If no value is specified, the system selects the torispherical type head and calculates the thickness. If the head is thicker than the vessel shell, the system selects the 2:1 ellipsoidal type head and recalculates the head thickness. If the head is still thicker than the shell, the system selects the hemispherical type head.</p> <p>ELLIP - 2:1 ellipsoidal            HEMI - Hemispherical            TORI - Torispherical (ASME)</p> <p><b>Bottom Head Thick:</b> Base material thickness including corrosion allowance.</p> <p><b>Top Head Thickness:</b> Base material thickness including corrosion allowance.</p> <p><b>Diameter Option:</b> Defines desired diameter as ID or OD; Default: See Area Design Basis.</p> <p>OD - Outside diameter            ID - Inside diameter</p> <p><b>ASME Design Basis:</b> Applicable only for ASME code design. See following entries for fatigue data. Default: *D1NF*.</p> <p>D1NF - ASME Division 1 - no fatigue analysis            D1F - ASME Division 1 - with fatigue analysis            D2NF - ASME Division 2 - no fatigue analysis            D2F - ASME Division 2 - with fatigue analysis</p> <p><b>Start-up Cycles x 1000:</b> ASME fatigue only. Thousands of start-up cycles during the full equipment life. Range: 5.00 - 0.02.</p> <p><b>Pressure Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design pressure during equipment life. Default: *0*.</p> <p><b>Pressure Amplitude %:</b> ASME fatigue only. Amplitude of process deviation as percent of design pressure. Default: *0*.</p> <p><b>No. Hydrostatic Test:</b> ASME fatigue only. Number of hydrostatic tests during the full equipment life. Default: *0*.</p> <p><b>Temp. Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design temperature in equipment life. Default: *0*.</p> <p><b>Temp. Amplitude %:</b> ASME fatigue only. Amplitude of temperature as a percent of design temperature. Default: *0*.</p>	

Vertical Tanks (VT) continued

Description	Type
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Multi-wall design for high pressure service. Total wall thickness of individual thin heat shrunk cylinders (maximum 2 INCH [50 MM] thick each).

MULTI WALL



**Application Symbol:** Defines vessel function and related piping/instrumentation model. Default: \*blank\*

- blank - Standard continuous process vessel
- BATCH - Batch process vessel
- STORAGE - Storage vessel
- RECVR - Receiver
- KO - Knock-out drum

**Shell Material:** For clad plate, specify the backing plate material. See Chapter 28 for materials. Default: \*A 515\*.

**Capacity:** Enter either capacity or diameter and height.

**Diameter:** Enter either capacity or diameter and height.

**Vessel T-T Height:** Enter either capacity or diameter and height.

**Design Press. - Gauge:** If pressure and vacuum entered, design is for worst case. Default: \*15\* PSIG [\*100\* KPA].

**Design Vacuum - Gauge:** If pressure and vacuum entered, design is for worst case.

**Design Temperature:** Default: 650 DEG F [340 DEG C] ferrous material, 250 DEG F [120 DEG C] other material.

**Operating Temp.:** Default: design temperature.

**Skirt Height:** Skip if legs required, enter 0.0 if hung in OPEN structure; Default: 1.5 x diameter.

**Leg Height:** Skip if skirt required, enter 0.0 if hung in OPEN structure; Default: \*4\* FEET [\*1.25\* M].

**Wind/Seismic Design:** Default: Vessel designed for wind and seismic loads defined in Project Basis.

- W+S - Wind and seismic design required
- WIND - Wind design only
- SEIS - Seismic design only
- NONE - Delete wind and seismic design

**Fluid Volume %:** Max: 100; Default: \*20\*; For seismic design; fluid volume as a % of volume (water assumed).

**Manhole diameter:** Max: 48 INCHES [1,200 MM]; Default: \*18\* INCHES [\*450\* MM].

**Number of Manholes:** Default: \*1\*.

**% All. for Internals:** Specify an allowance for internals as a percent of basic vessel weight. Default: \*0.0\*.

**Base Mat'l Thickness:** Base material thickness including corrosion allowance.

**Corrosion Allowance:** Default: 0.125 INCHES [3 MM] for CS, 0.0 for other materials.

**No. Body Flange Sets:** Number of sets (pairs) of body flanges of same diameter as vessel.

**Weld Efficiency %:** ASME/JIS codes only, where allowed for thin wall vessels; Range: 50 - 100; Default: Area Basis.

**Stress Relief:** Default: see Area Design Basis.

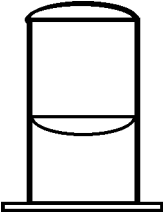
- CODE - Provide stress relief if code requires
- YES - Provide stress relief
- NO - No stress relief required

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Vertical Tanks (VT) continued

Description	Type
<b>MULTI WALL</b> - continued	
<p><b>Cladding Material:</b> See Chapter 28 for cladding materials.</p> <p><b>Cladding Thickness:</b> Default: 0.125 INCHES [3 MM] if cladding material is specified, otherwise - 0.0.</p> <p><b>Stiff'g Ring Spacing:</b> Default stiffeners designed for vacuum only, enter 0.0 if not required.</p> <p><b>Head Type Symbol:</b>            ELLIP - 2:1 ellipsoidal            HEMI - Hemispherical            TORI - Torispherical (ASME)</p> <p><b>Bottom Head Thick:</b> Base material thickness including corrosion allowance.</p> <p><b>Top Head Thickness:</b> Base material thickness including corrosion allowance.</p> <p><b>Diameter Option:</b> Defines desired diameter as ID or OD;            Default: see Area Design Basis.            OD - Outside diameter            ID - Inside diameter</p> <p><b>ASME Design Basis:</b> Applicable only for ASME code design.            See following entries for fatigue data. Default: *D1NF*.            D1NF - ASME Division 1 - no fatigue analysis            D1F - ASME Division 1 - with fatigue analysis            D2NF - ASME Division 2 - no fatigue analysis            D2F - ASME Division 2 - with fatigue analysis</p> <p><b>Start-up Cycles x 1000:</b> ASME fatigue only. Thousands of start-up cycles during the full equipment life.            Range: 5.00 - 0.02.</p> <p><b>Pressure Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design pressure during equipment life.            Default: *0*.</p> <p><b>Pressure Amplitude %:</b> ASME fatigue only. Amplitude of process deviation as percent of design pressure. Default: *0*.</p> <p><b>No. Hydrostatic Test:</b> ASME fatigue only. Number of hydrostatic tests during the full equipment life. Default: *0*.</p> <p><b>Temp. Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design temperature in equipment life.            Default: *0*.</p> <p><b>Temp. Amplitude %:</b> ASME fatigue only. Amplitude of temperature as a percent of design temperature. Default: *0*.</p>	

## Vertical Tanks (VT) continued

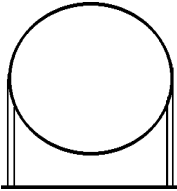
Description	Type
<p>Jacketed, cylindrical, vertical pressure/vacuum vessel.</p> <p><b>Application Symbol:</b> Defines vessel function and related piping/instrumentation model. Default: *blank*</p> <p>blank - Standard continuous process vessel            BATCH - Batch process vessel            STORAGE - Storage vessel            RECVR - Receiver            KO - Knock-out drum</p> <p><b>Shell Material:</b> For clad plate, specify the backing plate material. (Cladding is specified below.) Default: *A 515*.</p> <p><b>Capacity:</b> Enter either capacity or diameter and height.</p> <p><b>Diameter:</b> Enter either capacity or diameter and height.</p> <p><b>Vessel T-T Height:</b> Enter either capacity or diameter and height.</p> <p><b>Design Press. - Gauge:</b> If pressure and vacuum entered, design is for worst case. Default: *15* PSIG [*100* KPA].</p> <p><b>Design Vacuum - Gauge:</b> If pressure and vacuum entered, design is for worst case. Default: pressure.</p> <p><b>Design Temperature:</b> Default: 650 DEG F [340 DEG C] ferrous material, 250 DEG F [120 DEG C] other material.</p> <p><b>Operating Temp.:</b> Default: design temperature.</p> <p><b>Jacket Press. - Gauge:</b> Default: *90* PSIG [*620* KPA].</p> <p><b>Jacket Type:</b> Default: *FULL*</p> <p>FULL - Full jacket            PIPE - Half-pipe jacket</p> <p><b>Jacket Material:</b> See Chapter 28 for materials. Default: *CS*.</p> <p><b>Skirt Height:</b> Skip if legs required, enter 0.0 if hung in OPEN structure; Default: *1.5 x diameter*.</p> <p><b>Leg Height:</b> Skip if skirt required. Enter 0.0 if hung in OPEN structure; Default: *4* FEET [*1.25* M].</p> <p><b>Wind/Seismic Design:</b> Default: Vessel designed for wind and seismic loads defined in Project Basis.</p> <p>W+S - Wind and seismic design required            WIND - Wind design only            SEIS - Seismic design only            NONE - Delete wind and seismic design</p> <p><b>Fluid Volume %:</b> Max: 100; Default: *20*.; For seismic design; fluid volume as a % of vessel volume (water assumed).</p> <p><b>Manhole Diameter:</b> Max: 48 INCHES [1,200 MM]; Default: *18* INCHES [*450* MM].</p> <p><b>Number of Manholes:</b> Default: *1*.</p> <p><b>% All. for Internals:</b> Specify an allowance for internals as a percent of basic vessel weight. Default: *0.0*.</p> <p><b>Base Mat'l Thickness:</b> Base material thickness including corrosion allowance.</p> <p><b>Corrosion Allowance:</b> Default: 0.125 INCHES [3 MM] for CS, 0.0 for other material, double if jacketed.</p> <p><b>No. Body Flange Sets:</b> Number of sets (pairs) of body flanges of same diameter as vessel.</p> <p><b>Weld Efficiency %:</b> ASME/JIS codes only, where allowed for thin wall vessels; Range: 50 - 100; Default: Area Basis.</p>	<p><b>JACKETED</b></p> 

Continued on next page

Vertical Tanks (VT) continued

Description	Type
<b>JACKETED</b> - continued	
<p><b>Stress Relief:</b> Default: See Area Design Basis.            CODE - Provide stress relief if code requires            YES - Provide stress relief            NO - No stress relief required</p> <p><b>Cladding Material:</b> See Chapter 28 for cladding materials.</p> <p><b>Cladding Thickness:</b> Default: 0.125 INCHES [3 MM] if cladding material is specified, otherwise - 0.0.</p> <p><b>Stiff'g Ring Spacing:</b> Default stiffeners designed for vacuum only, enter 0.0 if not required.</p> <p><b>Head Type Symbol:</b>            ELLIP - 2:1 ellipsoidal            HEMI - Hemispherical            TORI - Torispherical (ASME)</p> <p><b>Bottom Head Thick:</b> Base material thickness including corrosion allowance.</p> <p><b>Top Head Thickness:</b> Base material thickness including corrosion allowance.</p> <p><b>Diameter Option:</b> Defines desired diameter as ID or OD;            Default: see Area Design Basis.            OD - Outside diameter            ID - Inside diameter</p> <p><b>ASME Design Basis:</b> Applicable only for ASME code design.            See following entries for fatigue data. Default: *D1NF*.            D1NF - ASME Division 1 - no fatigue analysis            D1F - ASME Division 1 - with fatigue analysis            D2NF - ASME Division 2 - no fatigue analysis            D2F - ASME Division 2 - with fatigue analysis</p> <p><b>Start-up Cycles x 1000:</b> ASME fatigue only. Thousands of start-up cycles during the full equipment life.            Range: 5.00 - 0.02.</p> <p><b>Pressure Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design pressure during equipment life.            Default: *0*.</p> <p><b>Pressure Amplitude %:</b> ASME fatigue only. Amplitude of process deviation as percent of design pressure. Default: *0*.</p> <p><b>No. Hydrostatic Test:</b> ASME fatigue only. Number of hydrostatic tests during the full equipment life. Default: *0*.</p> <p><b>Temp. Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design temperature in equipment life.            Default: *0*.</p> <p><b>Temp. Amplitude %:</b> ASME fatigue only. Amplitude of temperature as a percent of design temperature. Default: *0*.</p>	

## Vertical Tanks (VT) continued

Description	Type
<b>High Pressure Gas/Liquid Storage</b>	
<p>Sphere pressure/vacuum design to 3000 PSIG [20500 KPA]. Use minus pressure for vacuum design.</p>	<b>SPHERE</b>
<p>This item is used by chemical, rubber, petroleum and paper industries for storing large volumes of anhydrous ammonia, butadiene, butane and other gases at high temperature.</p>	
<p>A spherical tank is elevated and supported by legs fabricated from structural steel columns or pipe. Sphere sizes range as high as 90 FEET in diameter and are typically constructed of high strength steel. These tanks are commonly used for high pressure storage of gases and volatile liquids, typically in the range of 5 - 250 PSIG. Storing volatile liquids at high pressures raises the boiling point of the liquid and therefore minimizes or eliminates that need for costly refrigeration equipment to liquify the material being stored.</p>	
<p><b>Shell Material:</b> For clad plate, specify the backing plate material. See Chapter 28 for materials. Default: *A 515*.</p>	
<p><b>Capacity:</b> Enter either capacity or diameter.</p>	
<p><b>Diameter:</b> Enter either capacity or diameter.</p>	
<p><b>Design Press. - Gauge:</b> -15 - 3,000 PSIG [-100 - 20,5000]; Default: 15 PSIG [100 KPA].</p>	
<p><b>Design Temperature:</b> Max: 1,500 DEG F [815 DEG C]; Default: *68* DEG F [*20* DEG C].</p>	
<p><b>Operating Temp.:</b> Default: design temperature.</p>	
<p><b>Manhole Diameter:</b> Max: 48 INCHES [1,200 MM]; Default: *18* INCHES [*450* MM].</p>	
<p><b>Number of Manholes:</b> Default: *1*.</p>	
<p><b>% All. for Internals:</b> Specify an allowance for internals as a percent of basic vessel weight. Default: *0.0*.</p>	
<p><b>Base Mat'l Thickness:</b> Base material thickness including corrosion allowance.</p>	
<p><b>Corrosion Allowance:</b> Default: 0.125 INCHES [3 MM] for CS, 0.0 for other materials.</p>	
<p><b>Cladding Material:</b> See Chapter 28 for cladding materials.</p>	
<p><b>Cladding Thickness:</b> Default: 0.125 INCHES [3 MM] if cladding material is specified, otherwise - 0.0.</p>	
<p><b>Diameter Option:</b> Defines desired diameter as ID or OD; Default: see Area Design Basis. OD - Outside diameter ID - Inside diameter</p>	
<p><b>ASME Design Basis:</b> Applicable only for ASME code design. See following entries for fatigue data. Default: *D1NF*.</p>	
<p>D1NF - ASME Division 1 - no fatigue analysis</p>	
<p>D1F - ASME Division 1 - with fatigue analysis</p>	
<p>D2NF - ASME Division 2 - no fatigue analysis</p>	
<p>D2F - ASME Division 2 - with fatigue analysis</p>	
<p><b>Start-up Cycles x 1000:</b> ASME fatigue only. Thousands of start-up cycles during the full equipment life. Range: 5.00 - 0.02.</p>	

Continued on next page

## 10-16 ICARUS Reference

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### Vertical Tanks (VT) continued

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Description	Type
<b>SPHERE</b> - continued	
<b>Pressure Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design pressure during equipment life. Default: *0*.	
<b>Pressure Amplitude %:</b> ASME fatigue only. Amplitude of process deviation as percent of design pressure. Default: *0*.	
<b>No. Hydrostatic Test:</b> ASME fatigue only. Number of hydrostatic tests during the full equipment life. Default: *0*.	
<b>Temp. Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design temperature in equipment life. Default: *0*.	
<b>Temp. Amplitude %:</b> ASME fatigue only. Amplitude of temperature as a percent of design temperature. Default: *0*.	

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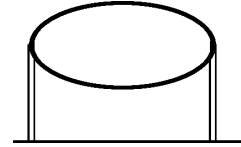
## Vertical Tanks (VT) continued

## Description

## Type

Spheroid to 750000 GALLONS [2840 M3]. Field erected.  
This item is commonly used for storage of gasolines and other volatile liquids.

SPHEROID



Spheroids vary in shape and size, but generally fall into one of the following categories:

- **Hemispheriod:** Spherical segments comprising the roof and bottom of the tank are joined to a cylindrical middle section. Hemispheriods are used for pressures up to 5 PSI and capacities to 25,000 barrels. For capacities to 50,000 barrels the roof and bottom are noded.
- **Hortonspheriod:** Spherical segments are joined together in a somewhat elliptical shape. Hortonspheriods are capable of handling storage at pressure from 5 to 30 PSIG.

Hortonspheriods and hemispheriods are designed to rest on a prepared grade conforming to the shape of the bottom (usually sand). Spheroidal shaped tanks are often more economical than cylindrical pressure vessels for storage at pressures greater than 0.5 PSI.

**Shell Material:** For clad plate, specify the backing plate material. See Chapter 28 for materials. Default: \*A 515\*.

**Capacity:** Enter either capacity or diameter and height. Range: 60,000 - 750,000 GALLONS [230 - 2,840 M3];

**Diameter:** Enter either capacity or diameter and height.

**Height:** Enter either capacity or diameter and height.

**Design Press. - Gauge:** Range: 0.0 - 15 PSIG [0.0 - 100 KPA]; Default: \*15\* PSIG [\*100\* KPA].

**Design Temperature:** Default: \*68\* DEG F [\*20\* DEG C].

**Operating Temp.:** Default: design temperature.

**Manhole Diameter:** Max: 48 INCHES [1,200 MM]; Default: \*18\* INCHES [\*450\* MM].

**Number of Manholes:** Default: \*1\*.

**% All. for Internals:** Default: Specify an allowance for internals as a percent of basic vessel weight. Default: \*0.0\*.

**Base Mat'l Thickness:** Base material thickness including corrosion allowance.

**Corrosion Allowance:** Default: 0.125 INCHES [3 MM] for CS, 0.0 for other materials.

**Cladding Material:** See Chapter 28 for cladding materials.

**Cladding Thickness:** Default: 0.125 INCHES [3 MM] if cladding material is specified, otherwise - 0.0.

**Diameter Option:** Defines desired diameter as ID or OD; Default - see Area Design Basis.  
OD - Outside diameter  
ID - Inside diameter

Vertical Tanks (VT) continued

**Description**

**Type**

**Near-Atmospheric Liquid Storage**

The available roof types are FLAT, FLOAT, CONE, LIFT, OPEN, INFLT, and INCN.

Use minus pressure for vacuum design. Field erected.

Floating roof tanks are frequently used in the storage of kerosene and jet fuels. Floating roofs may be installed inside a tank with a fixed roof or used as a tank's only cover. Typically constructed from polyurethane foam blocks or nylon cloth impregnated with rubber or plastic, floating roofs are designed to completely contact the surface of the storage products and thereby eliminate the vapor space between the product level and the fixed roof. This feature makes floating roofs desirable for the following reasons:

1. Reduction of evaporation and breathing losses.
2. Reduction of tank corrosion.
3. Increased safety from fire or explosion.

Floating roof tanks are suitable for storage of products having vapor pressures from 2 to 15 PSIA. Products that boil at temperatures under the normal range of atmospheric conditions should not be stored in floating roof tanks.

Cone roof tanks are used for storage of low pressure products (e.g., oil, diesel and asphalt.) Cone roof tanks are usually field fabricated out of carbon steel. Roofs are sloped upward to the center at a slight angle. Typically, ranging from 50,000 - 1,000,000 GALLONS capacities, they are used for storage of low vapor pressure products (less than 2 PSIA) when evaporation losses and breathing losses are not considered important.

Lifter roof tanks are generally field fabricated. They have a minimum capacity of 40,000 GALLONS [152 M2]. Lifter roof tanks can be specified with pressure from 0 - 0.05 PSIG [0 - 0.3 KPA] and a maximum temperature of 250 DEG F [120 DEG C]. The default temperature is \*68\* DEG F [\*20\* DEG C].

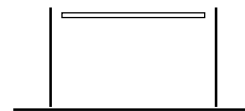
Open top tanks are designed and constructed according to user-generated design code standards. Open top tanks have a maximum temperature of 250 DEG F [120 DEG C]. The default temperature is \*68\* DEG F [\*20\* DEG C].

**STORAGE**

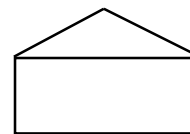
Flat roof tank



Floating roof tank



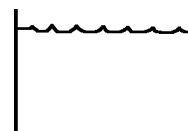
Cone roof tank



Lifter roof tank



Open top tank



Continued on next page


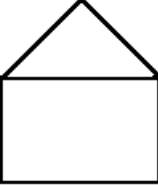
## Vertical Tanks (VT) continued

Description	Type
STORAGE - continued	
<p><b>Shell Material:</b> For clad plate, specify the backing plate material (cladding is defined below). See Chapter 28 for materials. Default: *A285C*.</p> <p><b>Capacity Units:</b> Unit of measure for the capacity entry. Enter capacity unit symbol as entered in project specifications. If units are not changed, enter GALLONS [M3] or BARRELS [M3].</p> <p><b>Capacity:</b> Enter either capacity (see capacity unit entry for units) or diameter and height.</p> <p><b>Diameter:</b> Enter either capacity or diameter and height.</p> <p><b>Height:</b> Enter either capacity or diameter and height.</p> <p><b>Roof Type:</b> Default: *FLAT*</p> <ul style="list-style-type: none"> <li>FLAT - Flat roof tank</li> <li>CONE - Cone roof tank</li> <li>FLOAT - Floating roof tank</li> <li>LIFT - Lifter</li> <li>OPEN - Open roof tank</li> <li>INFLT - Internal floater with flat roof</li> <li>INCN - Internal floater with cone roof</li> </ul> <p><b>Bottom Type:</b> Default: *FLAT*</p> <ul style="list-style-type: none"> <li>FLAT - Single flat bottom</li> <li>DBL - Double bottom</li> </ul> <p><b>Design Press. - Gauge:</b> 0.0 - 2.5 PSIG [0.0 - 17 KPA]; Default: *0.05* PSIG [*0.35* KPA].</p> <p><b>Design Temperature:</b> Default: *68* DEG F [*20* DEG C].</p> <p><b>Operating Temperature:</b> Default: design temperature.</p> <p><b>Manhole Diameter:</b> Max: 48 INCHES [1,200 MM]; Default: *18* INCHES [*450* MM].</p> <p><b>Number of Manholes:</b> Default: *1*.</p> <p><b>% All. for Internals:</b> Specify an allowance for internals as a percent of basic vessel weight. Default: *0.0*.</p> <p><b>Base Mat'l Thickness:</b> Base material thickness including corrosion allowance.</p> <p><b>Corrosion Allowance:</b> Default: *0.125* INCHES [*3* MM] for CS, *0.0* for other materials.</p> <p><b>Cladding Materials:</b> See Chapter 28 for cladding materials.</p> <p><b>Cladding Thickness:</b> Default: *0.125* INCHES [*3* MM] if cladding material is specified; otherwise: *0.0*.</p> <p><b>Specific Gravity:</b> Range: 0.2 - 5.0; Default: *1.0*.</p> <p><b>Diameter Option:</b> Defines desired diameter as ID or OD; Default: See Area Design Basis.</p> <ul style="list-style-type: none"> <li>OD - Outside diameter</li> <li>ID - Inside diameter</li> </ul> <p><b>Diam. Flame Arrestor:</b> Range: 1.0 - 8.0 IN DIAM [25.0 - 200.0 MM DIAM].</p> <p><b>Diam. Conserv. Vent:</b> Range: 1.0- 8.0 IN DIAM [25.0 - 200.0 MM DIAM].</p>	

Vertical Tanks (VT) continued

Description	Type
<p>Cryogenic storage tank - double wall, superinsulated.</p> <p><b>Shell Material:</b> See Chapter 28 for materials. Default: *SS304*.  <b>Capacity:</b> Enter either capacity or diameter and height.                      Range: 300.0 - 60,000.0 GALLONS [1.20 - 227.00 M3].  <b>Diameter:</b> Enter either capacity or diameter and height.  <b>Vessel t-t Height:</b> Enter either capacity or diameter and height.  <b>Design Press. - Gauge:</b> If both pressure and vacuum are entered, design is for worst case. Default: 250.0 PSIG [1,720 KPA].  <b>Design Vacuum - Gauge:</b> If both pressure and vacuum are entered, design is for worst case. Default: pressure.  <b>Design Temperature:</b> Default: -320.0 DEG F [-195 DEG C].  <b>Operating Temp.:</b> Default: design temperature.  <b>Jacket Press. - Gauge:</b> Min: -14.70 PSIG [-100.0 KPA];                      Default: -14.70 PSIG [-100.0 KPA]  <b>Jacket Material:</b> See Chapter 28 for materials. Default: *CS*.  <b>Skirt Height:</b> Skip if legs are required. Enter '0.0' if hung in OPEN structure. Default: 1.5 x diameter.  <b>Leg Height:</b> Skip if legs are required. Enter '0.0' if hung in OPEN structure. Default: 1.5 x diameter.  <b>Wind/Seismic Design:</b> Default: Vessel designed for wind and seismic loads defined in Project Basis.                      W+S - Wind and seismic design required                      WIND - Wind design only                      SEIS - Seismic design only                      NONE - Delete wind and seismic design  <b>Fluid Volume %:</b> For seismic design, fluid volume as a % of vessel volume (water assumed).  <b>Manhole Diameter:</b> Max: 48.0 INCHES [1,200.0 MM];                      Default: 18.0 INCHES [450.0 MM]  <b>Number of Manholes:</b> Default: *0*.  <b>% All. for Internals:</b> Specify an allowance for internals as a percent of basic vessel height.  <b>Base Mat'l Thickness:</b> Base material thickness including corrosion allowance.  <b>Corrosion Allowance:</b> Default: 0.125 INCHES [3 MM] for CS, 0.0 for other materials.  <b>Weld Efficiency %:</b> ASME/JIS codes only, where allowed for thin wall vessels. Range: 50 - 100; Default: Area Basis.  <b>Stress Relief:</b> Default: See Area Design Basis.                      CODE - Provide stress relief if code requires                      YES - Provide stress relief                      NO - No stress relief  <b>Stiff'g Ring Spacing:</b> Default stiffeners designed for vacuum only, enter '0.0' if not required.  <b>Head Type Symbol:</b>                      ELLIP - 2:1 ellipsoidal                      HEMI - Hemispherical                      TORI - Torispherical (ASME)  <b>Diameter Option:</b> Defines desired diameter as ID or OD.                      Default: See Area Design Basis.                      OD - Outside diameter                      ID - Inside diameter</p>	<p><b>CRYOGENIC</b></p>

## Vertical Tanks (VT) continued

Description	Type
<p>Flat bottom dome top. FRP to 30000 GALLONS [113 M3], HAVAG to 7000 GALLONS [26 M3].</p> <p>Fiberglass Reinforced Plastic Storage Tank: Filament-wound with a bisphenol - a polyester resin (e.g., Atlac 282). Flat bottom and dome top under 2.5 PSIG [16.7 KPA], otherwise dished heads.</p> <p>Haveg Storage Tank.</p> <p><b>Material Selection:</b> Default: *FRP* FRP - FRP HAVEG - Haveg</p> <p><b>Volume:</b> Volume or diameter + height required input Range: 1,000 - 30,000 GALLONS [3.8 - 113 M3]</p> <p><b>Diameter:</b> Volume or diameter + height input. Max: 12.0 FEET [93.6 M].</p> <p><b>Height:</b> Volume or diameter + height required input.</p> <p><b>Gauge Pressure:</b> Range: 0.00 - 15.00 PSIG [0 - 100 KPA]; Default: *0.05* PSIG [*0.3* KPA].</p> <p><b>Temperature:</b> Max: 300 DEG F [120 DEG C]; Default: *68* DEG F [*20* DEG C].</p>	<p>PLAST TANK</p> 
<p>Wooden storage tanks to 50000 GALLONS [1890 M3].</p> <p><b>Material Selection:</b> Default: *CYPRS* CYPRS - Cypress REDWD - Redwood PINE - Pine FIR - Fir</p> <p><b>Volume:</b> Volume or diameter + height required input. Range: 800 - 50,000 GALLONS [3.1 - 189 M3].</p> <p><b>Diameter:</b> Volume or diameter + height required input.</p> <p><b>Gauge Pressure:</b> Range: 0.0 - 0.05 PSIG [0.0 - 0.3 KPA]. Default: *0.05* PSIG [*0.3* KPA].</p> <p><b>Temperature:</b> Max: 250 DEG F [120 DEG C]; Default: *68* DEG F [*20* DEG C].</p>	<p>WOOD TANK</p> 

Vertical Tanks (VT) continued

**Description**

**Type**

**Near-Atmospheric Gas Storage**

Telescoping gas holder.

Low pressure gas vessel.

**Shell Material:** For clad plate, specify the backing plate material.

See Chapter 28 for materials. Default: \*A285C\*.

**Capacity:** Enter either capacity or diameter and height.

**Diameter:** Enter either capacity or diameter and height.

**Height:** Enter either capacity or diameter and height.

**Design Press. - Gauge:** Range: 0.0 - 2.5 PSIG [0.0 - 17 KPA];

Default: \*0.05\* PSIG [\*0.35\* KPA].

**Design Temperature:** Default: \*68\* DEG F [\*20\* DEG C].

**Operating Temp.:** Default: Design temperature.

**Manhole Diameter:** Max: 48 INCHES [1,200 MM];

Default: \*18\* INCHES [\*450\* MM]

**Number of Manholes:** Default: \*1\*.

**% All. for Internals:** Specify an allowance for internals as a percent of basic vessel weight. Default: \*0.0\*.

**Base Mat'l Thickness:** Base material thickness including corrosion allowance.

**Corrosion Allowance:** Default: 0.125 INCHES [3 MM] if cladding material is specified; otherwise 0.0.

**Cladding Material:** See Chapter 28 for materials.

**Cladding Thickness:** Default: 0.125 INCHES [3 MM] if cladding material is specified, otherwise 0.0.

**Diameter Option:** Defines desired diameter as ID or OD.

Default: - See Area Design Basis.

OD - Outside diameter

ID - Inside diameter

GAS HOLDER



**Atmospheric Solid/Liquid Storage**

Cone bottom, flat top storage bin.

**Shell Material:** For clad plate, specify the backing plate material.

See Chapter 28 for materials. Default: \*A285C\*.

**Capacity:** Enter either capacity or diameter and height.

**Diameter:** Enter either capacity or diameter and height.

**Height:** Enter either capacity or diameter and height.

**Design Press. - Gauge:** Min: 0.0 PSIG [0.0 KPA];

Default: 0.05 PSIG [0.35 KPA].

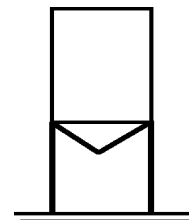
**Design Temperature:** Default: 68 DEG F [20 DEG C] to 0.05 PSI [0.35 KPA]; else 650 DEG F [340 DEG C] ferrous, 250 DEG F [120 DEG C] other.

**Operating Temp.:** Default: Design temperature.

**Leg Height:** Enter '0.0' if bin hung in OPEN structure;

Default: \*4\* FEET [\*1.25\* M].

CONE BTM



Continued on next page

## Vertical Tanks (VT) continued

Description	Type
CONE BTM - continued	
<p><b>Manhole Diameter:</b> Max: 48 INCHES [1,200 MM]; Default: *18* INCHES [*450* MM].</p>	
<p><b>Number of Manholes:</b> Default: *1*.</p>	
<p><b>% All. for Internals:</b> Specify an allowance for internals as a percent of basic vessel weight. Default: *0.0*.</p>	
<p><b>Base Mat'l Thickness:</b> Base material thickness including corrosion allowance.</p>	
<p><b>Corrosion Allowance:</b> Default: *0.125* INCHES [*3* MM] for CS, *0.0* for other materials.</p>	
<p><b>No. Body Flange Sets:</b> Number of sets (pairs) of body flanges of same diameter as vessel.</p>	
<p><b>Stress Relief:</b> Default: See Area Design Basis CODE - Provide stress relief if code requires YES - Provide stress relief NO - No stress relief</p>	
<p><b>Cladding Material:</b> See Chapter 28 for materials.</p>	
<p><b>Cladding Thickness:</b> Default *0.125* INCHES [*3* MM] if cladding material is specified; otherwise: *0.0*.</p>	
<p><b>Bottom Head Tank:</b> Base material thickness including corrosion allowance.</p>	
<p><b>Top Head Thickness:</b> Base material thickness including corrosion allowance.</p>	
<p><b>Diameter Option:</b> Defines desired diameter as ID or OD; Default - see Area Design Basis. OD - Outside diameter ID - Inside diameter</p>	
<p><b>ASME Design Basis:</b> Applicable only for ASME code design. See following entries for fatigue data. Default: *D1NF*. D1NF - ASME Division 1 - no fatigue analysis D1F - ASME Division 1 - with fatigue analysis D2NF - ASME Division 2 - no fatigue analysis D2F - ASME Division 2 - with fatigue analysis</p>	
<p><b>Start-up Cycles x 1000:</b> ASME fatigue only. Thousands of start-up cycles during the full equipment life. Range: 5.00 - 0.02.</p>	
<p><b>Pressure Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design pressure during equipment life. Default: *0*.</p>	
<p><b>Pressure Amplitude %:</b> ASME fatigue only. Amplitude of process deviation as percent of design pressure. Default: *0*.</p>	
<p><b>No. Hydrostatic Test:</b> ASME fatigue only. Number of hydrostatic tests during the full equipment life. Default: *0*.</p>	
<p><b>Temp. Cycles x 1000:</b> ASME fatigue only. Thousands of deviations from design temperature in equipment life. Default: *0*.</p>	
<p><b>Temp. Amplitude %:</b> ASME fatigue only. Amplitude of temperature as a percent of design temperature. Default: *0*.</p>	

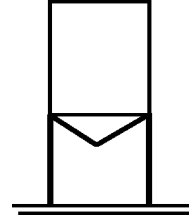
Vertical Tanks (VT) continued

**Description**

**Type**

Live bottom storage bin.

LIVE BTM



**Shell Material:** For clad plate, specify the backing plate material.

See Chapter 28 for materials. Default: \*A285C\*.

**Capacity:** Enter either capacity or diameter and height.

**Diameter:** Enter either capacity or diameter and height.

**Height:** Enter either capacity or diameter and height.

**Design Temperature:** Default: \*68\* DEG F [\*20\* DEG C]

**Operating Temp.:** Default: Design temperature.

**Leg Height:** Enter '0.0' if bin hung in OPEN structure;

Default: \*4\* FEET [\*1.25\* M].

**Manhole Diameter:** Max: 48 INCHES [1,200 MM];

Default: \*18\* INCHES [\*450\* MM].

**Number of Manholes:** Default: \*1\*.

**% All. for Internals:** Specify an allowance for internals as a percent of basic vessel weight. Default: \*0.0\*.

**Base Mat'l Thickness:** Base material thickness including corrosion allowance.

**Corrosion Allowance:** Default: \*0.125\* INCHES [\*3\* MM] for CS, \*0.0\* for other materials.

**No. Body Flange Sets:** Number of sets (pairs) of body flanges of same diameter as vessel.

**Stress Relief:** Default: See Area Design Basis.

CODE - Provide stress relief if code requires

YES - Provide stress relief

NO - No stress relief

**Cladding Material:** See Chapter 28 for materials.

**Cladding Thickness:** Default \*0.125\* INCHES [\*3\* MM] if cladding material is specified; otherwise: \*0.0\*.

**Diameter Option:** Defines desired diameter as ID or OD;

Default - see Area Design Basis.

OD - Outside diameter

ID - Inside diameter



Vertical Tanks (VT) continued

Description	Type
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**Tile Chests**

Tile chests provide tile lined tanks for storage of liquids, suspensions or slurries. Although tile chests are used in the chemical industry, they are predominantly used in pulp and paper mills for storing fiber suspensions at various stages of processing. Chests can be rectangular or cylindrical and may be concrete or metallic. Various designs are available depending on the nature of the fluid — high density, low density.

Tile Chests, rectangular concrete include the follow options.

- Single tile chest
- Group of tile chests
- One chest in a group of chests.

**Grouping Option:** PARTGRP is used for one chest in assemblage, WHLGRP to define an entire assemblage.  
Default: \*PARTGRP\*.

- SINGLE - Tile chest is a single stand-alone item
- PARTGRP - One chest of a multi-group assemblage
- WHLGRP - Entire multi-group assemblage

**Length:** Enter either chest dimensions or capacity.

**Height:** Enter either chest dimensions or capacity.

**Width:** Enter either chest dimensions or capacity.

**Chest Capacity:** Enter either chest dimensions or capacity. For WHLGRP only - capacity of entire group, otherwise - capacity this chest.

**Tile/Lining Type:** Default: \*25RSB\*

- 25RSB - 2.5 INCHES [62 MM] red shale brick
- 45RSB - 4.5 INCHES [112 MM] red shale brick
- 80RSB - 8.0 INCHES [200 MM] red shale brick

**Tile/Lining %:** Percent of chest surface to be lined, 100% = one side; 200% = inside + outside. Max: 200; Default: 100.

**Configuration:** Default: \*OPEN\*

- OPEN - Open top chest
- CLOSED - Chest has a roof

**Installation Option:** Default: \*GRADE\*

- GRADE - Tile chest is constructed on grade
- STRUCT - Tile chest is within a structure

**Capacity of Group:** For PARTGRP chest only, capacity of entire group; Default: 4x chest capacity.

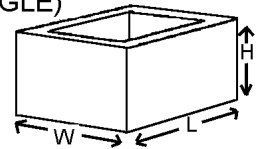
**No. Chests in Group:** For WHLGRP chest only, enter number of chests in entire assemblage. Default: \*4\*.

**Partition Lengthwise:** Number of full length partitions parallel to length dimension (may be fraction).

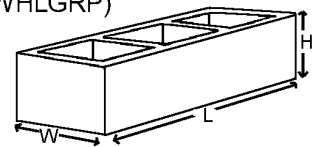
**Partition Widthwise:** Number of width wide partitions parallel to width dimension (may be fraction).

**CHEST-REC**

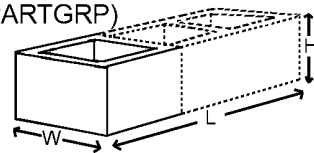
(SINGLE)



(WHLGRP)



(PARTGRP)



Continued on next page

Vertical Tanks (VT) continued

Description	Type
<b>CHEST-REC</b> - continued	
<b>Soil Type Symbol:</b>	
SOFT CLAY	- Bearing: 2000 PSF [100 KN/M2]
FIRM CLAY	- Bearing: 4000 PSF [200 KN/M2]
WET SAND	- Bearing: 4000 PSF [200 KN/M2]
SAND+CLAY	- Bearing: 4000 PSF [200 KN/M2]
DRY SAND	- Bearing: 600 PSF [300 KN/M2]
SAND	- Bearing: 8000 PSF [400 KN/M2]
GRAVEL	- Bearing: 12000 PSF [600 KN/M2]
SOFT ROCK	- Bearing: 16000 PSF [800 KN/M2]
HARDPAN	- Bearing: 20000 PSF [1000 KN/M2]
MED-ROCK	- Bearing: 30000 PSF [1400 KN/M2]
HARD ROCK.	- Bearing: 80000 PSF [3800 KN/M2]
<b>Product Density:</b> Default: *62.4* PCF.	
<b>Exclude Excavation %:</b> Exclude portion of calculated quantity if not required or common with other items. Max: 100; Default: *0.0*.	
<b>Exclude Footings %:</b> Exclude portion of calculated quantity if not required or common with other items. Max: 100; Default: *0.0*.	
<b>Exclude Floor %:</b> Exclude portion of calculated quantity if not required or common with other items. Max: 100; Default: *0.0*.	
<b>Exclude Wall-Length %:</b> Exclude portion of calculated quantity if not required or common with other items. Max: 100; Default: *0.0*.	
<b>Exclude Wall-Width %:</b> Exclude portion of calculated quantity if not required or common with other items. Max: 100; Default: *0.0*.	

## Vertical Tanks (VT) continued

## Description

## Type

Tile Chests, Cylindrical

Low density tile chest with a capacity range of 3000 to 300000 GALLONS [12 to 1135 M3]. Chest is available in concrete or metallic materials of construction.

High density tile chest with a capacity range of 30000 to 1300000 GALLONS [114 to 4921 M3]. Chest is available in concrete or metallic materials of construction.

**Shape Symbol:** Default: \*CYLLD\*

CYLLD - Cylindrical chest, low density stock

CYLHD - Cylindrical chest, high density stock

**Diameter:** Chest dimensions or capacity required.

**Height:** Chest dimensions or capacity required.

**Chest Capacity:** Chest dimensions or capacity required.

**Tile/Lining Type:** Default: \*25RSB\*

25RSB - 2.5 INCH [62 MM] red shale brick

45RSB - 4.5 INCH [112 MM] red shale brick

80RSB - 8.0 INCH [200 MM] red shale brick

**Tile/Lining %:** Percent of chest to be lined. 100% = one side;

200% = inside + outside. Max: 200; Default: \*100\*.

**Configuration:** Default: \*OPEN\*

OPEN - Open top chest

CLOSED - Chest has a roof

**Installation Option:** Default: \*GRADE\*

GRADE - Tile chest is constructed on grade

STRUCT - Tile chest is within a structure

**Soil Type Symbol:**

SOFT CLAY - Bearing: 2000 PSF [100 KN/M2]

FIRM CLAY - Bearing: 4000 PSF [200 KN/M2]

WET SAND - Bearing: 4000 PSF [200 KN/M2]

SAND+CLAY - Bearing: 4000 PSF [200 KN/M2]

DRY SAND - Bearing: 600 PSF [300 KN/M2]

SAND - Bearing: 8000 PSF [400 KN/M2]

GRAVEL - Bearing: 12000 PSF [600 KN/M2]

SOFT ROCK - Bearing: 16000 PSF [800 KN/M2]

HARDPAN - Bearing: 20000 PSF [1000 KN/M2]

MED-ROCK - Bearing: 30000 PSF [1400 KN/M2]

HARD ROCK - Bearing: 80000 PSF [3800 KN/M2]

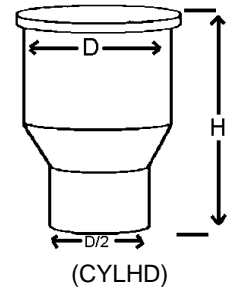
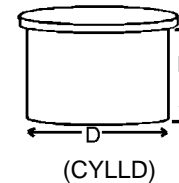
**Product Density:** Default: \*62.4\* PCF [1,000 KG/M3].

**Exclude Excavation %:** Exclude portion of calculated quantity if not required or common with other items. Max: 100; Default: \*0.0\*.

**Exclude Footings %:** Exclude portion of calculated quantity if not required or common with other items. Max: 100; Default: \*0.0\*.

**Exclude Floor %:** Exclude portion of calculated quantity if not required or common with other items. Max: 100; Default: \*0.0\*.

CHEST-CYL



Vertical Tanks (VT) continued

Description	Type
<p><b>Shell Material:</b> For clad plate, specify the backing plate material. (Cladding is defined below.) Default: *A285C*.</p> <p><b>Capacity:</b> Enter either capacity or diameter and height.</p> <p><b>Diameter:</b> Enter either capacity or diameter and height.</p> <p><b>Height:</b> Enter either capacity or diameter and height.</p> <p><b>Tile/Lining Type:</b> Default: *25RSB*</p> <p>25RSB - 2.4 INCH [62 MM] red shale brick            45RSB - 4.5 INCH [112 MM] red shale brick            80RSB - 8.0 INCH [200 MM] red shale brick</p> <p><b>Tile/Lining %:</b> Percent of chest surface to be lined.            100% = one side; 200% = inside + outside. Max: 200;            Default: *100*.</p> <p><b>Roof Type:</b> Default: *FLAT*</p> <p>FLAT - Flat roof tank            CONE - Cone roof tank            FLOAT - Floating roof tank            LIFT - Lifter            OPEN - Open top tank            INFLT - Internal floater with flat roof            INCN - Internal floater with cone roof</p> <p><b>Design Press. - Gauge:</b> Range: 0 - 2.5 PSIG [0 - 17.0 KPA];            Default: *0.05* PSIG [*0.35* KPA].            Ignore this field for open top tanks.</p> <p><b>Design Temperature:</b> Default: *68* DEG F [*20* DEG C].</p> <p><b>Operating Temp.:</b> Default: Design temperature.</p> <p><b>Manhole Diameter:</b> Max: 48 INCHES [1,200 MM];            Default: *18* INCHES [450.0 MM].</p> <p><b>Number of Manholes:</b> Default: *1*.</p> <p><b>% All. for Internals:</b> Specify an allowance for internals as a percent of basic vessel weight. Default: *0.0*.</p> <p><b>Base Mat'l Thickness:</b> Base material thickness including corrosion allowance.</p> <p><b>Corrosion Allowance:</b> Default: *0.125* INCHES [*3* MM] for CS, *0.0* for other materials.</p> <p><b>Cladding Material:</b> See Chapter 28 for cladding materials.</p> <p><b>Cladding Thickness:</b> Default: *0.125* INCHES [*3* MM] for cladding material, otherwise *0.0*.</p> <p><b>Specific Gravity:</b> Range: 0.2 - 5.0; Default: *1.0*.</p> <p><b>Diameter Option:</b> Defines desired diameter as ID or OD.            Default: See Area Design Basis.</p> <p><b>Bottom Type:</b> Default: *FLAT*</p> <p>FLAT - Single flat bottom            DBL - Double bottom</p>	<p><b>CHEST-MTL</b></p>