

As an industry leader in tank component fabrication, Paul Mueller Company holds itself to high quality standards. The standards for tank head fabrication detailed in this white paper may not be the same standards used by other tank component fabricators. Paul Mueller Company's tank head tolerances have been calculated to meet the needs of the complete vessel fabricators we serve while taking into consideration modern tank head fabrication techniques and procedures.

Note: These tolerances apply to austenitic (300 series) material only. Any tolerances for special or non-standard material should be discussed with your salesperson. When products are designed as ASME, the configurations and tolerances set forth in Division 1, Section VIII shall take precedence over all other tolerances.

STRAIGHT FLANGE

Both straight flange and finished depth cannot be held simultaneously; therefore, heads will be trimmed to comply with overall depth tolerances as long as minimum straight flange is held as follows:

HEAD THICKNESS	STANDARD STRAIGHT FLANGE	MINIMUM STRAIGHT FLANGE
12 gauge or less	1"	$\frac{1}{2}$ "
10 gauge or greater	1 $\frac{1}{2}$ "	$\frac{1}{2}$ "

If the standard straight flange length must be held, please notify your salesperson of the requirement prior to fabrication and Paul Mueller Company will apply a tolerance of $\pm \frac{1}{8}$ " and allow the depth to become a reference dimension. The maximum straight flange we offer is 3" and is special order only.

The tolerance for toe-out or toe-in for typical flanged and dished heads will be $\pm \frac{1}{16}$ " as measured at 90° from the machined edge. All heads and cones with a knuckle radius under 2" and of any material thickness 10 gauge and thicker (12 gauge and thinner cannot be flanged with a 2" straight flange using a small knuckle radius), there shall be a maximum of 2" straight flange. A tolerance of $\frac{3}{32}$ " on the toe-out and $\frac{1}{16}$ " on the toe-in shall have applied to all heads with less than a 2" knuckle radius as described above.

CIRCUMFERENCE AND FINISHED INSIDE DEPTH

The following tolerances apply to all typical flanged and dished heads for tank components (for specialized head type tolerances, please consult with your sales representative):

HEAD DIAMETER	CIRCUMFERENCE	FINISHED INSIDE DEPTH
35" or less	$\pm \frac{1}{8}$ "	$+\frac{1}{2}$ " to $-\frac{1}{8}$ "
36" thru 96"	$\pm \frac{1}{8}$ "	$+\frac{1}{2}$ " to $-\frac{1}{8}$ "
97" thru 144"	$\pm \frac{1}{8}$ "	$+\frac{3}{4}$ " to $-\frac{1}{8}$ "
145" and above	$\pm \frac{1}{8}$ "	$+1$ " to $-\frac{1}{8}$ "

Note: Out-of-round shall not exceed 1% of the outside diameter.

CIRCUMFERENCE AND FINISHED INSIDE DEPTH (CONTINUED)

If the finished inside depth must be held, please notify your sales representative of the requirement in advance of fabrication and Mueller will apply a tolerance of $\pm\frac{1}{8}$ " on the depth and there will not be any tolerance, except minimum, held on the straight flange.

All toriconical heads have a circumference tolerance of $\pm\frac{1}{2}$ ". Cones that are not flanged do not have a circumference tolerance and will require trim and fit at installation by the customer. All cones have a finished inside depth (FID) tolerance of ± 1 ". (Cones that are swaged at the bottom end may have an additional height tolerance of -0" to $+\frac{1}{2}$ " above the typical tolerance).

MINIMUM THICKNESS

Forming Allowances

Minimum thickness of material after forming, not including polishing for typical flanged and dished heads:

ASME Flanged and Dished

DIAMETER	$\frac{1}{2}$ " THICK OR LESS	GREATER THAN $\frac{1}{2}$ " THICK
16" to 300"	Add .03125"	Add .0625"

80:10

DIAMETER	$\frac{1}{2}$ " THICK OR LESS	GREATER THAN $\frac{1}{2}$ " THICK
20" to 220"	Add .0625"	Add 15%

2:1 Elliptical

DIAMETER	$\frac{1}{2}$ " THICK OR LESS	GREATER THAN $\frac{1}{2}$ " THICK
20" to 168"	Add .0625"	Add 15%

For example: a $\frac{3}{8}$ " thick, ASME flanged and dished tank head, with an as is/as is material finish and #2/#2 weld finish has a .375"-.03125" forming allowance to equal .3437" total minimum thickness after forming, but before polishing.

Non-code heads with minimum thickness requirements must be special ordered and noted in advance of fabrication for assurance and verification. For custom flanged and dished, toriconical or other designs with special order geometry, please contact your sales representative for minimum thickness after forming.

Grinding Allowances

Due to the custom nature of fabrication components, Paul Mueller Company recommends that you contact your salesperson to review your specific application and assess an agreed upon final minimum thickness with your quotation.

REVERSE DISH

Typical flanged and dished heads will have a tolerance of reversed conditions as follows:

HEAD DIAMETER	MAXIMUM REVERSE
0" thru 100"	$\frac{1}{8}$ "
101" thru 144"	$\frac{3}{16}$ "
145" and above	$\frac{1}{4}$ "

Measurement of reverse will be accomplished by the placement of a 12" straight edge from the knuckle to dish tangent toward the center hole and measuring the gap between the straight edge and the outer surface of the head. For specialized head types (specifically toriconical heads), contact your sales representative for additional tolerance information.

FLATNESS

The head (squared or beveled edge) when laid on a flat surface will not exceed a maximum gap of $\frac{1}{4}$ " across a 48" distance and will not have an abrupt change greater than $\frac{1}{16}$ " over a 12" distance along the surface. This tolerance does not apply to flanged only heads (specifically with welded seams) or specialized head types. For additional clarification, please consult your salesperson.

DISH RADIUS (CROWN RADIUS)

The dish radius (crown radius) tolerance for dished heads will be in compliance with ASME, Section VIII, Div I, UG-81(a) unless specifically stated in the order that the head must meet UG-81(b) for external pressure designed heads.

FLARED AND DISHED HEADS

Flared and dished heads shall have the following tolerances:

DIAMETER	OUTSIDE DIAMETER	INSIDE DIAMETER	OUT-OF-ROUND
All	$+\frac{1}{2}$ " thru -0"	$\pm \frac{1}{2}$ "	Not to exceed 1% of Outside Diameter

Note: Inside diameter tolerance is reference only.

DISHED ONLY HEADS

Dished only heads shall have the following tolerances:

DIAMETER	OUTSIDE DIAMETER	INSIDE DIAMETER	OUT-OF-ROUND
All	N/A	$+\frac{1}{2}$ " thru -0"	Not to exceed 1% of Outside Diameter

Note: Dished only heads will be sold on the basis of outside diameter only.

FLANGED ONLY HEADS

Flanged only heads shall have a circumference tolerance of $\pm \frac{1}{8}$ ". Some warpage of the flat portion may be expected depending on diameter, thickness of material, and the knuckle radius. Any manual pressure to obtain flatness is acceptable.

HEAD DIAMETER	FLATNESS TOLERANCE
60" or less	$\pm \frac{3}{16}$ "
61" thru 95"	$\pm \frac{1}{4}$ "
96" thru 120"	$\pm \frac{1}{2}$ "

Note: Flanged only head flatness tolerances do not apply to heads with weld seams.