

# Workmanship Acceptance Standards

**Subject: O.D and I.D tolerances and concentricity**

**Scope:** To establish common practice for specifying tolerances of outside and inside diameters and concentricity of washers.

## O.D. and I.D. tolerances (decimal inches)

O.D.	+	-
.062 to .311	.000	.005
.312 to .374	.008	.005
.375 to .625	.015	.005
.626 to .922	.015	.007
.923 to 2.750	.030	.007
2.751 to 5.000	.045	.010
5.001+	.065	.010
I.D.	+	-
.032 to .124	.000	.005
.125 to .249	.008	.005
.250 to .625	.015	.005
.626 to 1.500	.030	.007
1.501 to 2.625	.045	.010
2.626+	.065	.010

Above tolerances are based on ANSI B18.22

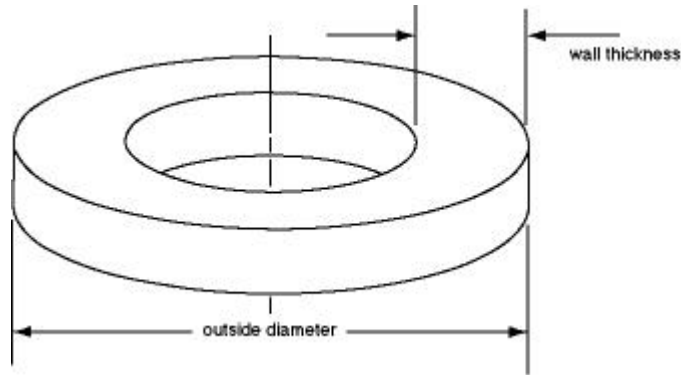
## concentricity (decimal inches)

I.D. Range	Concentricity in T.I.R.
.032 to .124	.005
.125 to .249	.013
.250 to .625	.020
.626 to 1.500	.037
1.501 to 2.625	.055
2.626+	.075

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	DATA SHEET NO. <b>WD 1001</b>

**Subject: wall thickness**

**Scope:** Establish common practice for specifying acceptable limits for wall thickness on flat washers.



**wall thickness table**

O.D. range		minimum wall thickness	
inches	millimeters	inches	millimeters
.1875 – .375	4.76 – 9.5	.0625	1.6
.375 – 1	9.5 – 25	.09375	2.4
1 – 2	25 – 51	.125	3.2
2 – 3	51 – 76	.1875	4.76
3 – 5	76 – 127	.25	6.35
<b>For:</b>		<b>Minimum wall:</b>	
low carbon steel annealed 1050 high carbon steel annealed copper alloys – all tempers aluminum alloys – all tempers		2 times metal thickness but not less than above chart	
stainless steel annealed blue steel* pre-tempered high carbon steel*		3 times metal thickness but not less than above chart	

\* Note: Contact your WASHER DIVISION member for exceptions. Special tooling or set-up procedures sometimes permit less wall. There is a limit of up to .020 inch maximum thickness of blue steel and pre-tempered high carbon steel.

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	DATA SHEET NO. <b>WD 1002</b>

**Subject: flatness**

**Scope:** Establish common practice for specifying acceptable limits for flatness on flat washers.

**Measuring variation from flatness**

Variation from flatness is measured by laying the part on a surface plate with the convex side up and measuring the maximum rise. The “roll over” on the edges of the washer is not to be measured.

Outside Diameter (inches)	Flat within T.I.R.
.000 – 1.000	.010
1.001 – up	.010/inch

Note: Washer faces shall be parallel within 0.002/inch.

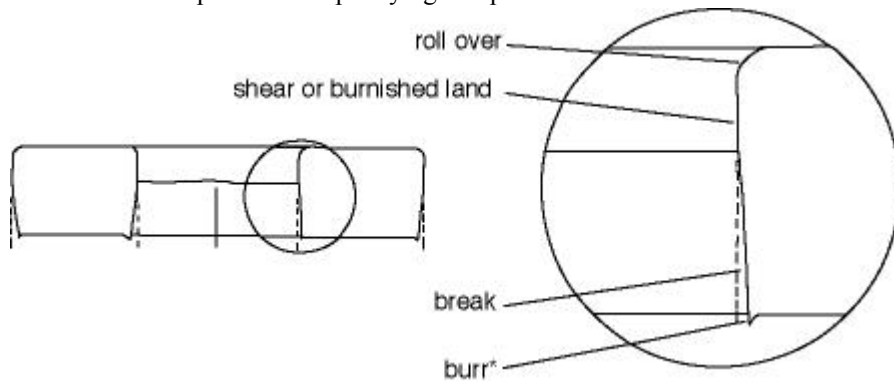
Parts that are relatively thin in relation to their outside diameter may be subjected to the following pressure when measuring flatness.

Material Thickness (inches)	Outside Diameter (inches)	Pressure (ounces)
.001 – .005	.000 – up	2
.006 – .010	.500 – up	4
.011 – .020	1.000 – up	8
.021 – .030	2.000 – up	16
.031 – .040	3.000 – up	24

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	DATA SHEET NO.
	<b>WD 1003</b>

**Subject: burrs**

**Scope:** Establish common practice for specifying acceptable limits for burrs on flat washers.



Requirement	Material Thickness (inches)	Allowable burr (inches)
When deburring is not specified	.001 – .004 .005 – up	.0005 10% of thickness
When deburring is specified as “must be burr free”	.001 – .004 .005 – .030 .031 – up	.0003 .0005 2% of thickness

\*Burr is ragged, usually sharp, protrusions on edges of metal stampings.

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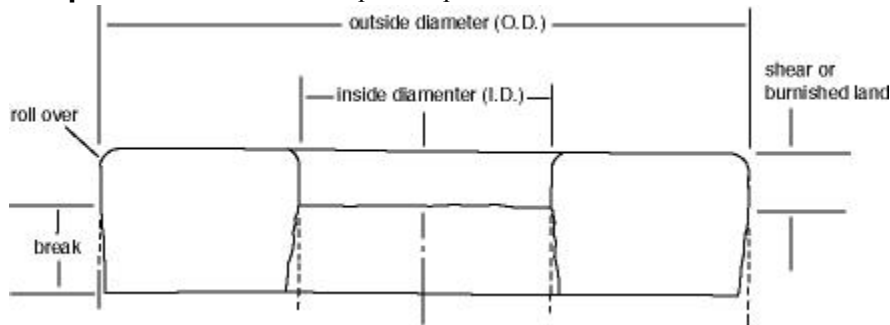
**2-1-92**

DATA SHEET NO.

**WD 1004**

**Subject: measuring washer dimensions**

**Scope:** Establish common inspection parameters.



**Feature Size:** This is to be measured only in the cut portion of the hole and the cut portion of the outside diameter.

**Shear or Burnished Land:** This is a burnished area which is approximately one third of material thickness.

**Break:** This is an area which is tapered about three degrees. This area has a rougher surface than the cut area.

**Roll Over:** This is a natural consequence of the punching process and the mechanical properties of the material being punched.

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DATA SHEET NO.

**WD 1005**

**Subject: methods of measurement**

**Scope:** Establish common practice for measurement of washers.

**Outside Diameter (O.D.):** Use micrometer at shear or burnished land.

**Inside Diameter (I.D.):** Use plug gauges.

**Thickness:** Use micrometer measurement exclusive of burr.

**Flatness (for flat washers only):** Washer must pass between two parallel surfaces whose distance is equal to the allowable material tolerance plus the allowed flatness tolerance.

**Burr:** Use a dial indicator as it has a minimum amount of pressure, will not crush the burr, and gives the most accurate reading.

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