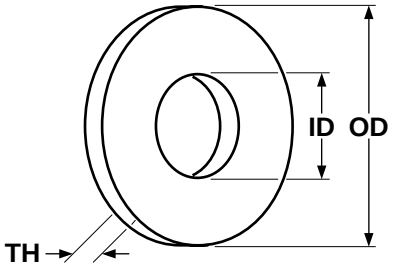
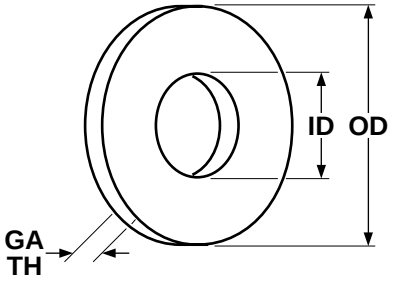


Machine Screw Washers

Washer Size	Inside Diameter		Outside Diameter		Thickness	
	Max	Min	Max	Min	Max	Min
2	0.097	0.087	0.224	0.214	0.022	0.014
3	0.114	0.104	0.255	0.245	0.023	0.018
4	0.130	0.120	0.286	0.276	0.030	0.022
5	0.145	0.135	0.286	0.276	0.030	0.022
6	0.155	0.145	0.380	0.370	0.036	0.028
8	0.175	0.165	0.380	0.370	0.036	0.028
10	0.209	0.199	0.443	0.433	0.036	0.028
12	0.232	0.222	0.505	0.495	0.052	0.044
14	0.270	0.260	0.567	0.557	0.052	0.044
5/16	0.335	0.325	0.630	0.620	0.054	0.046
3/8	0.397	0.387	0.693	0.683	0.054	0.046

Description	The smallest type of flat washer with an outside diameter equal to slightly twice the size of the inside diameter.	
Applications/ Advantages	Designed for use with machine screws in general industrial applications.	
Material	*Steel*	*Stainless*
	Washers are punched from cold-rolled steel.	18-8 Stainless steel
Plating	See Appendix-A for plating information.	Stainless machine screw washers are usually furnished without any additional coating.

Low Carbon Steel *SAE Flat* Washers



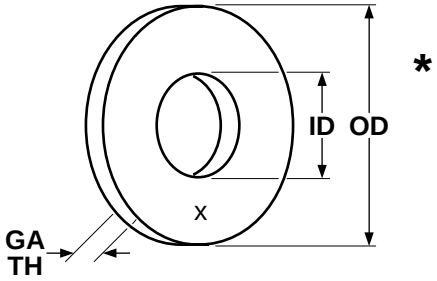
SAE Low Carbon Washers

ANSI B18.22.1

Bolt Size	Outside Diameter			Inside Diameter			Thickness			Approximate Number per 50 Pounds
	Nominal	Max	Min	Nominal	Max	Min	American Standard (Gauge)	Max	Min	
4	5/16	0.320	0.307	1/8	0.133	0.120	(1/32)	.040	.025	83300
6	3/8	0.390	0.370	5/32	0.164	0.151	18 (3/64)	.065	.036	39500
8	7/16	0.453	0.433	3/16	0.196	0.183	18 (3/64)	.065	.036	29500
10	1/2	0.515	0.495	7/32	0.227	0.214	18 (3/64)	.065	.036	22750
3/16	9/16	0.577	0.557	1/4	0.265	0.245	18 (3/64)	.065	.036	
12	9/16	0.577	0.557	1/4	0.265	0.245	16 (1/16)	.080	.051	14700
1/4	5/8	0.640	0.620	9/32	0.296	0.276	16 (1/16)	.080	.051	11100
5/16	11/16	0.703	0.681	11/32	0.359	0.339	16 (1/16)	.080	.051	9750
3/8	13/16	0.827	0.805	13/32	0.419	0.401	16 (1/16)	.080	.051	7000
7/16	59/64	0.937	0.915	15/32	0.484	0.464	16 (1/16)	.080	.051	5500
1/2	1-1/16	1.092	1.055	17/32	0.546	0.526	13 (3/32)	.121	.074	2800
9/16	1-3/16	1.186	1.149	19/32	0.609	0.589	13 (3/32)	.121	.074	2250
5/8	1-5/16	1.342	1.305	21/32	0.686	0.649	13 (3/32)	.121	.074	1850
3/4	1-1/2	1.499	1.462	13/16	0.842	0.805	10 (9/64)	.160	.108	1050
7/8	1-3/4	1.780	1.743	15/16	0.968	0.931	10 (9/64)	.160	.108	775
1	2	2.030	1.993	1-1/16	1.092	1.055	10 (9/64)	.160	.108	585
1-1/8	2-1/4	2.280	2.243	1-3/16	1.280	1.243	10 (9/64)	.160	.108	460
1-1/4	2-1/2	2.530	2.493	1-5/16	1.405	1.368	9 (5/32)	.192	.136	335
1-3/8	2-3/4	2.780	2.743	1-7/16	1.530	1.493	9 (5/32)	.213	.136	275
1-1/2	3	3.030	2.993	1-9/16	1.655	1.618	9 (5/32)	.213	.153	230

Description	Similar to a USS washer, but with slightly smaller inside and outside diameters. Also, most but not all SAE washers are made from thinner materials than USS washers.
Applications/ Advantages	SAE washers were designed to serve similar purposes as the USS washers, but specifically to meet the requirements in the field of automotive engineering.
Material	Plain washers shall be punched from hot-rolled, hot-rolled and pickled, or cold-rolled steel, or shall be machined from bar stock or tubing, or may be forged at the manufacturer's option.
Plating	See Appendix-A for information about the plating of steel flat washers.

Flat *SAE Through-Hardened* Washers



SAE Through-Hardened Flat Washers

ANSI B18.22.1, Wrought Washer

Bolt Size	Outside Diameter			Inside Diameter			Thickness		Approximate Number per 50 Pounds
	Nominal	Max	Min	Nominal	Max	Min	Max	Min	
6	3/8	0.390	0.370	5/32	0.164	0.151	.065	.036	39500
8	7/16	0.453	0.433	3/16	0.196	0.183	.065	.036	29500
10	1/2	0.515	0.495	7/32	0.227	0.214	.065	.036	22750
12	9/16	0.577	0.557	1/4	0.265	0.245	.080	.051	14700
1/4	5/8	0.640	0.620	9/32	0.296	0.276	.072	.055	10000
5/16	11/16	0.703	0.681	11/32	0.359	0.339	.072	.055	10000
3/8	13/16	0.827	0.805	13/32	0.419	0.401	.072	.055	7000
7/16	59/64	0.937	0.915	15/32	0.484	0.464	.072	.055	5000
1/2	1-1/16	1.092	1.055	17/32	0.546	0.526	.121	.097	2425
9/16	1-3/16	1.186	1.149	19/32	0.609	0.589	.121	.097	2250
5/8	1-5/16	1.342	1.305	21/32	0.686	0.649	.146	.122	1340
3/4	1-15/32	1.499	1.462	13/16	0.842	0.805	.146	.122	1120
7/8	1-3/4	1.780	1.743	15/16	0.968	0.931	.160	.136	695
1	2	2.030	1.993	1-1/16	1.092	1.055	.160	.136	555
1-1/8	2-1/4	2.280	2.243	1-1/4	1.280	1.243	.160	.136	435
1-1/4	2-1/2	2.530	2.493	1-3/8	1.405	1.368	.160	.136	350
1-1/2	3	3.030	2.993	1-5/8	1.655	1.618	.160	.136	240
1-3/4	3-3/8	3.405	3.368	1-7/8	1.905	1.868	.201	.178	150
2	3-3/4	3.780	3.748	2-1/8	2.155	2.118	.201	.178	125

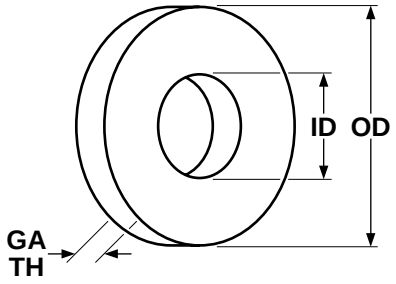
Description	Dimensionally equivalent to the low carbon SAE flat washer counterparts, but with tighter tolerances on thickness, manufactured from a higher grade of steel and heat-treated.
Applications/ Advantages	Designed to perform the same functions as low carbon SAE flat washers, but for use specifically with high-strength hardened steel bolts.
Material	SAE 1035 - 1050 steel
Hardness	Rockwell C38 - 45
Plating	See Appendix-A for information about the plating of through-hardened flat washers.

*Product standards require all through-hardened washers 1/4" diameter and larger to bear the insignia identifying its manufacturer. "X" represents one location such an insignia may appear.

Washers

USS Flat

Low Carbon Steel



USS Low Carbon Washers

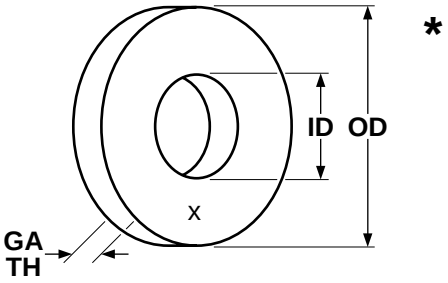
ANSI B18.22.1

Bolt Size	Outside Diameter			Inside Diameter			Thickness			Approximate Number per 50 Pounds
	Nominal	Max	Min	Nominal	Max	Min	American Standard (Gauge)	Max	Min	
3/16	9/16	0.577	0.557	1/4	0.265	0.245	18 (3/64)	.065	.036	18050
1/4	3/4	0.749	0.727	5/16	0.327	0.307	16 (1/16)	.080	.051	7450
5/16	7/8	0.905	0.868	3/8	0.390	0.370	14 (5/64)	.104	.064	4350
3/8	1	1.030	0.993	7/16	0.453	0.433	14 (5/64)	.104	.064	3350
7/16	1-1/4	1.280	1.243	1/2	0.515	0.495	14 (5/64)	.104	.064	2050
1/2	1-3/8	1.405	1.368	9/16	0.577	0.557	12 (7/64)	.132	.086	1300
9/16	1-1/2	1.499	1.462	5/8	0.640	0.620	21 (7/64)	.132	.086	1100
5/8	1-3/4	1.780	1.743	11/16	0.718	0.681	10 (9/64)	.160	.108	650
3/4	2	2.030	1.993	13/16	0.842	0.805	9 (5/32)	.177	.122	455
7/8	2-1/4	2.280	2.243	15/16	0.968	0.931	8 (11/64)	.192	.136	325
1	2-1/2	2.530	2.493	1-1/16	1.092	1.055	8 (11/64)	.192	.136	265
1-1/8	2-3/4	2.780	2.743	1-1/4	1.280	1.243	8 (11/64)	.192	.136	225
1-1/4	3	3.030	2.993	1-3/8	1.405	1.368	8 (11/64)	.192	.136	190
1-3/8	3-1/4	3.295	3.240	1-1/2	1.545	1.490	7 (3/16)	.213	.153	150
1-1/2	3-1/2	3.545	3.490	1-5/8	1.670	1.615	7 (3/16)	.213	.153	130
1-5/8	3-3/4	3.795	3.740	1-3/4	1.795	1.740	7 (3/16)	.213	.153	115
1-3/4	4	4.045	3.990	1-7/8	1.920	1.865	7 (3/16)	.213	.153	100
1-7/8	4-1/4	4.295	4.240	2	2.045	1.990	7 (3/16)	.213	.153	90
2	4-1/2	4.545	4.490	2-1/8	2.170	2.115	7 (3/16)	.213	.153	79
2-1/4	4-3/4	4.795	4.740	2-3/8	2.420	2.365	5 (7/32)	.248	.193	60
2-1/2	5	5.045	4.990	2-5/8	2.670	2.615	4 (15/64)	.280	.210	52
2-3/4	5-1/4	5.315	5.240	2-7/8	2.940	2.865	3 (1/4)	.310	.228	45
3	5-1/2	5.565	5.490	3-1/8	3.190	3.115	2 (5/32)	.327	.249	43

Description	A thin, flat, circular steel part with a centrally located hole.
Applications/ Advantages	Washers are designed for assembly around a bolt or screw, between the bearing surface of the fastener and the part to which it is attached. Flat washers are used to improve stress distribution, and to span large clearance holes. USS washers are designed to meet the majority of industrial applications in manufacturing, maintenance and repair.
Material	Plain washers shall be punched from hot-rolled, hot-rolled and pickled, or cold-rolled steel, or shall be machined from bar stock or tubing, or may be forged at the manufacturer's option.
Plating	See Appendix-A for information about the plating of low carbon flat washers.

Washers

USS Through-Hardened Flat



USS Through-Hardened Flat Washers

ANSI B18.22.1, Wrought Washer

Bolt Size	Outside Diameter			Inside Diameter			Thickness		Approximate Number per 50 Pounds
	Nominal	Max	Min	Nominal	Max	Min	Max	Min	
1/4	3/4	0.749	0.727	5/16	0.327	0.307	.072	.055	7500
5/16	7/8	0.905	0.868	3/8	0.390	0.370	.080	.064	5000
3/8	1	1.030	0.993	7/16	0.453	0.433	.080	.064	3500
7/16	1-1/4	1.280	1.243	1/2	0.515	0.495	.080	.064	2500
1/2	1-3/8	1.405	1.368	9/16	0.577	0.557	.121	.097	1500
9/16	1-1/2	1.499	1.462	5/8	0.640	0.620	.121	.097	1100
5/8	1-3/4	1.780	1.743	21/32	0.687	0.649	.146	.122	700
3/4	2	2.030	1.993	13/16	0.842	0.805	.146	.122	500
7/8	2-1/4	2.280	2.243	15/16	0.968	0.931	.160	.136	350
1	2-1/2	2.530	2.493	1-1/16	1.092	1.055	.160	.136	300
1-1/8	2-3/4	2.780	2.743	1-1/4	1.280	1.243	.160	.136	250
1-1/4	3	3.030	2.993	1-3/8	1.405	1.368	.160	.136	200
1-1/2	3-1/2	3.545	3.490	1-5/8	1.670	1.615	.160	.136	150

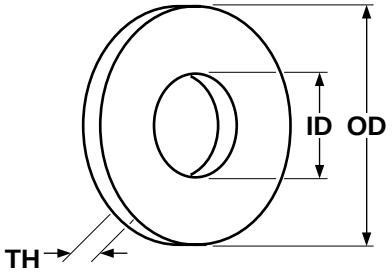
Description	Dimensionally similar to the USS plain washer counterparts, but with tighter tolerances on thickness, manufactured from a higher grade of steel and heat-treated.
Applications/ Advantages	Designed to perform the same functions as USS plain washers, but for use specifically with high-strength hardened steel bolts.
Material	SAE 1035 - 1050 steel
Hardness	Rockwell C38 - 45
Plating	See Appendix-A for information about the plating of through-hardened flat washers.

*Product standards require all through-hardened washers 1/4" diameter and larger to bear the insignia identifying its manufacturer. "X" represents one location such an insignia may appear.

Washers

Standard Flat

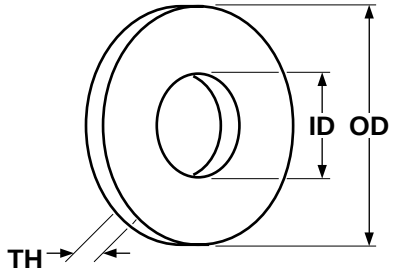
18-8 Stainless Steel



STANDARD FLAT WASHERS - 18-8 STAINLESS STEEL			
Size	OD	ID	TH
	Outside Diameter	Inside Diameter	Thickness
	Nominal	Nominal	Nominal
4	.312	.125	.031
6	.375	.156	.031
8	.375	.172	.031
10	.438	.203	.031
1/4	.625	.281	.050
5/16	.750	.344	.050
3/8	.875	.391	.050
3/8	1.000	.391	.062
7/16	1.125	.500	.050
1/2	1.250	.562	.055 - .062
5/8	1.500	.688	.062
3/4	1.750	.812	.075
7/8	2.000	.938	.095 - .109
1	2.000	1.062	.095 - .109

Description	A thin, flat, circular stamping with a centrally located hole, made from an 18-8 austenitic stainless steel.
Applications/ Advantages	Designed for use with 18-8 stainless steel screws and nuts in general industrial applications where parts are subject to corrosion.
Material	18-8 stainless steel

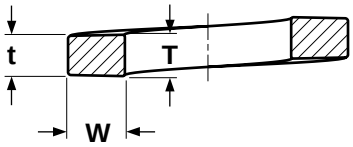
316 Stainless Steel *Standard Flat* Washers

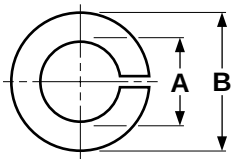


Commercial Flat Washers - 316 Stainless Steel			
Size	OD	ID	TH
	Outside Diameter	Inside Diameter	Thickness
	Nominal	Nominal	Nominal
1/4	.625	.281	.045
1/4	.688	.281	.045
5/16	.750	.344	.045
3/8	.875	.406	.045
3/8	1.000	.406	.045
1/2	1.250	.531	.055
5/8	1.500	.688	.075
3/4	1.750	.812	.075
7/8	2.000	.938	.095
7/8	2.250	.938	.105
1	2.000	1.062	.095
1	2.500	1.062	.105

Description	A thin, flat, circular stamping with a centrally located hole, made from a 316 austenitic stainless steel.
Applications/ Advantages	Designed for use with 316 stainless steel screws and nuts in general industrial applications where parts are subject to corrosion.
Material	316 stainless steel

Regular & High-Alloy Split





Regular & High Alloy Helical Spring Lockwashers

ASME B18.21.1-1999

Nominal Washer Size		A		B	(T+t)/2	W
		Inside Diameter		Outside Diameter	Mean Section Thickness	Section Width
		Max	Min	Max	Min	Min
#2	0.086	0.094	0.088	0.172	0.020	0.035
#3	0.099	0.107	0.101	0.195	0.025	0.040
#4	0.112	0.120	0.114	0.209	0.025	0.040
#5	0.125	0.133	0.127	0.236	0.031	0.047
#6	0.138	0.148	0.141	0.250	0.031	0.047
#8	0.164	0.174	0.167	0.293	0.040	0.055
#10	0.190	0.200	0.193	0.334	0.047	0.062
#12	0.216	0.227	0.220	0.377	0.056	0.070
1/4	0.250	0.260	0.252	0.487	0.062	0.109
5/16	0.312	0.322	0.314	0.583	0.078	0.125
3/8	0.375	0.385	0.377	0.680	0.094	0.141
7/16	0.438	0.450	0.440	0.776	0.109	0.156
1/2	0.500	0.512	0.502	0.869	0.125	0.171
9/16	0.562	0.574	0.564	0.965	0.141	0.188
5/8	0.625	0.641	0.628	1.073	0.156	0.203
3/4	0.750	0.766	0.753	1.265	0.188	0.234
7/8	0.875	0.894	0.878	1.459	0.219	0.266
1	1.000	1.024	1.003	1.656	0.250	0.297
1-1/8	1.125	1.153	1.129	1.847	0.281	0.328
1-1/4	1.250	1.280	1.254	2.036	0.312	0.359
1-3/8	1.375	1.408	1.379	2.219	0.344	0.391
1-1/2	1.500	1.534	1.504	2.419	0.375	0.422
1-3/4	1.750	1.789	1.758	2.679	0.389	0.424
2	2.000	2.039	2.008	2.936	0.422	0.427

Description	**Regular:** A coiled, hardened, split circular washer with a slightly trapezoidal wire section. **High-Alloy:** Dimensionally identical to a regular split lock washer but made from 4037 alloy steel (sizes over 1" are equivalent to heavy split lockwashers in size and material). **Stainless:** A regular split lock washer made from austenitic stainless steel.
Applications/ Advantages	**Regular:** (A) Applies greater bolt tension per unit of applied torque; (B) Provides a hardened bearing surface, creating more uniform torque control; (C) Provides more uniform load distribution; (D) Resists loosening caused by vibration and corrosion; (E) Is preferred lockwasher for use with hardened bearing surfaces. **High-Alloy:** Designed for use with Grade-5 & Grade-8 bolts and nuts. **Stainless:** For use with stainless nuts and screws of a similar stainless alloy in corrosive environments.
Material	**Carbon Steel:** SAE J403 1055 - 1065 carbon steel. **High-Alloy Steel:** 1/4 thru 1": SAE J404 4037 alloy steel; 1-1/8 thru 1-1/2": SAE J403 1055 - 1065 carbon steel **18-8 Stainless:** SAE J405 302 - 305 stainless steel. **316 Stainless:** SAE J405 316 stainless steel.
Hardness	**Carbon & High-Alloy Steel:** Rockwell C38 - 46 **Stainless:** Thru 5/8": Rockwell C35 - 43; Sizes over 5/8": Rockwell C32 - 43
Twist Test	With the washer in a vice with the split ends free and straight above the vice jaws, a 90° segment of the free end is gripped with a wrench and bent. Washers are to withstand being twisted through a 90° angle without signs of fracture. When the washer ultimately fractures beyond the prescribed 90° limit, the structure at the breaking point shall show a fine grain.
Plating	See Appendix-A for information about the plating of carbon steel and alloy steel lock washers.