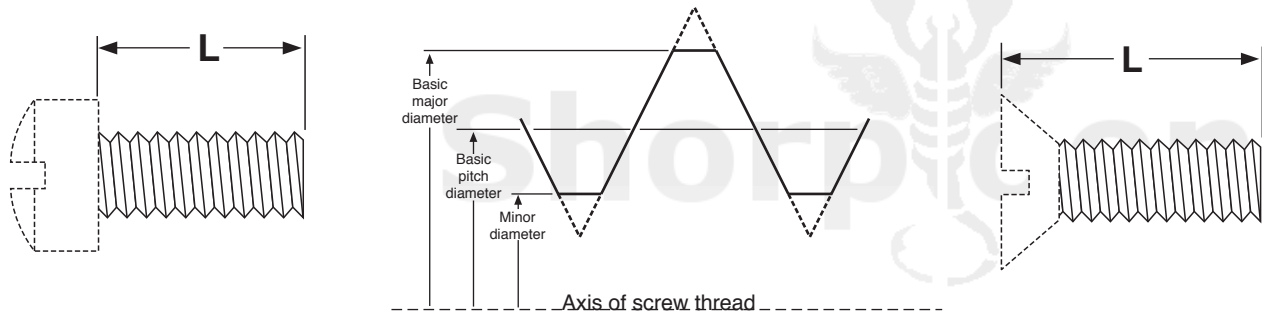


# MACHINE SCREWS

## DIMENSIONS



### 2A EXTERNAL THREADS FOR MACHINE SCREWS AND SEMS

ASME B 1.1 (2008)

| Nominal Size & Threads per Inch | Series Designation | Allowance | Major Diameter |       | Pitch Diameter |       |           | Stress Area, in <sup>2</sup> | Tensile Strength, <sup>a</sup> lb., min. (STEEL screws only) |
|---------------------------------|--------------------|-----------|----------------|-------|----------------|-------|-----------|------------------------------|--|
|                                 |                    |           | Max            | Min   | Max            | Min   | Tolerance |                              |  |
| 0-80 0.060                      | UNF                | .0005     | .0595          | .0563 | .0514          | .0496 | .001762   | 0.00180                      | -  |
| 1-64 0.073                      | UNC                | .0006     | .0724          | .0686 | .0623          | .0603 | .001970   | 0.00263                      | -  |
| 1-72 0.073                      | UNF                | .0006     | .0724          | .0689 | .0634          | .0615 | .001899   | 0.00278                      | -  |
| 2-56 0.086                      | UNC                | .0006     | .0854          | .0813 | .0738          | .0717 | .002127   | 0.00370                      | -  |
| 2-64 0.086                      | UNF                | .0006     | .0854          | .0816 | .0753          | .0733 | .002040   | 0.00394                      | -  |
| 3-48 0.099                      | UNC                | .0007     | .0983          | .0938 | .0848          | .0825 | .002302   | 0.00487                      | -  |
| 3-56 0.099                      | UNF                | .0007     | .0983          | .0942 | .0867          | .0845 | .002191   | 0.00523                      | -  |
| 4-40 0.112                      | UNC                | .0008     | .1112          | .1061 | .0950          | .0925 | .002507   | 0.00604                      | 360  |
| 4-48 0.112                      | UNF                | .0007     | .1113          | .1068 | .0978          | .0954 | .002361   | 0.00661                      | 396  |
| 5-40 0.125                      | UNC                | .0008     | .1242          | .1191 | .1080          | .1054 | .002562   | 0.00796                      | 470  |
| 5-44 0.125                      | UNF                | .0007     | .1243          | .1195 | .1095          | .1070 | .002484   | 0.00830                      | 498  |
| 6-32 0.138                      | UNC                | .0008     | .1372          | .1312 | .1169          | .1141 | .002820   | 0.00909                      | 550  |
| 6-40 0.138                      | UNF                | .0008     | .1372          | .1321 | .1210          | .1184 | .002614   | 0.01015                      | 609  |
| 8-32 0.164                      | UNC                | .0009     | .1631          | .1571 | .1428          | .1399 | .002916   | 0.0140                       | 850  |
| 8-36 0.164                      | UNF                | .0008     | .1632          | .1577 | .1452          | .1424 | .002804   | 0.01474                      | 884  |
| 10-24 0.190                     | UNC                | .0010     | .1890          | .1818 | .1619          | .1586 | .003319   | 0.0175                       | 1050   |
| 10-32 0.190                     | UNF                | .0009     | .1891          | .1831 | .1688          | .1658 | .003004   | 0.0200                       | 1200   |
| 12-24 0.216                     | UNC                | .0010     | .2150          | .2078 | .1879          | .1845 | .003400   | 0.0242                       | 1450   |
| 12-28 0.216                     | UNF                | .0010     | .2150          | .2085 | .1918          | .1886 | .003224   | 0.0258                       | 1548   |
| 1/4-20 0.250                    | UNC                | .0011     | .2489          | .2408 | .2164          | .2127 | .003731   | 0.0318                       | 1900   |
| 1/4-28 0.250                    | UNF                | .0010     | .2490          | .2425 | .2258          | .2225 | .003322   | 0.0364                       | 2200   |
| 5/16-18 0.3125                  | UNC                | .0012     | .3113          | .3026 | .2752          | .2712 | .004041   | 0.0524                       | 3150   |
| 5/16-24 0.3125                  | UNF                | .0011     | .3114          | .3042 | .2843          | .2806 | .003660   | 0.0580                       | 3480   |
| 3/8-16 0.375                    | UNC                | .0013     | .3737          | .3643 | .3331          | .3287 | .004363   | 0.0775                       | 4650   |
| 3/8-24 0.375                    | UNF                | .0011     | .3739          | .3667 | .3468          | .3430 | .003804   | 0.0878                       | 5268   |
| 1/2-13 0.500                    | UNC                | .0015     | .4985          | .4876 | .4485          | .4435 | .004965   | 0.1419                       | 8500   |
| 1/2-20 0.500                    | UNF                | .0013     | .4987          | .4906 | .4662          | .4619 | .004288   | 0.1599                       | 9594   |

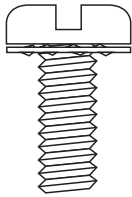
  

| Tolerance on Length<br><br>L | Nominal Screw Size | Nominal Screw Length |                          |                        |            |
|------------------------------|--------------------|----------------------|--------------------------|------------------------|------------|
|                              |                    | Up to 1/2 in., incl. | Over 1/2 to 1 in., incl. | Over 1 to 2 in., incl. | Over 2 in. |
|                              |                    | 0 thru 12            | -0.02                    | -0.03                  | -0.06      |
| 1/4 thru 3/4                 | -0.03              | -0.03                | -0.06                    | -0.09                  |            |

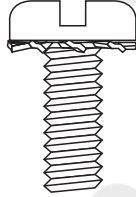
<sup>a</sup>Tensile strength values are based on 60,000 psi. and apply to carbon steel screws and SEMS only. Hex and Hex Washer head machine screws of sufficient length may be wedge tensile tested. Other head styles may be axial tensile tested.

**Mechanical & Performance Requirements** **Sems**

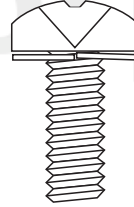
**MACHINE SCREWS WITH FREE-SPINNING LOCKWASHERS**



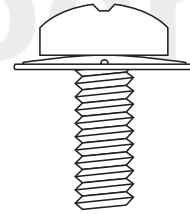
**Internal Tooth**



**External Tooth**



**Split-Lock**



**Conical**

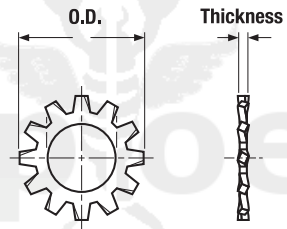
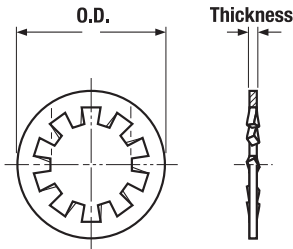
|                                 |   |
|---------------------------------|---|
| <b>Description</b>              | A machine screw and free-spinning lock-washer manufactured as one assembly. Steel SEMS are available with the following types of washers: internal tooth, external tooth, split-lock and conical. Stainless SEMS are offered with external tooth lock washers.  |
| <b>Applications/ Advantages</b> | The washer/screw assembly makes this a locking screw with the washer providing the locking action. Machine pre-assembly provides cost savings to the end user.<br><b>Internal Tooth SEMS:</b> Recommended when it is desirable to hide the teeth for appearance or to prevent snagging.<br><b>External Tooth SEMS:</b> Preferred over the internal tooth style as the teeth provide greater torsional resistance being on the larger radius.<br><b>Split-Lock SEMS:</b> Preferred over tooth lockwasher SEMS for use with hardened bearing surfaces.<br><b>Conical SEMS:</b> Provides a higher retained clamp load & improved compensation for thermal cycling and vibration. Can accept a high tension load and maintain spring action. The washer design makes for better control during installation, and improved tool bit life. Ideal for clamping fragile materials and for spanning large clearance holes. |
| <b>Material</b>                 | <b>Steel Screws--</b> AISI 1022 or equivalent steel.<br><b>Steel Washers-- Split-lock:</b> SAE 1055-1065 carbon steel; <b>Tooth-lock:</b> SAE 1050-1065; <b>Conical:</b> SAE 1050.<br><b>Stainless Screws--</b> SAE 18-8 stainless steel or 410 martensitic stainless steel<br><b>Stainless Washers-- Split-lock:</b> SAE J405 302-305; <b>Tooth-lock:</b> SAE 410 stainless steel; <b>Conical:</b> 410 stainless steel   |
| <b>Hardness</b>                 | <b>Steel Screws--</b> Rockwell B70 - B100.<br><b>Steel Washers-- Split-lock:</b> Rockwell C38 - 46; <b>Tooth-lock:</b> Rockwell C40 - 50; <b>Conical:</b> Rockwell C42 - 46.<br><b>Stainless Washers-- Split-lock:</b> Rockwell C35 - 43; <b>Tooth-lock:</b> Rockwell C40 - 50; <b>Conical:</b> Rockwell B88 minimum.   |
| <b>Tensile Strength</b>         | <b>Steel:</b> 60,000 psi. minimum. No. 2 diameter SEMS screws are not subject to tensile testing. No. 4 SEMS screws shorter than 1/2" are not subject to tensile testing. SEMS screws of diameters No. 6 to 10 inclusive, which are shorter than 1/2" or 3D (where D is the nominal screw size in inches) are not subject to tensile testing. Such SEMS screws of a size to be tested shall meet the tensile load requirements given on page 84.<br><b>18-8 Stainless:</b> No. 4: 99,000 psi. minimum; No. 6 & No. 8: 96,000 psi. minimum.<br><b>Note:</b> No. 4, No. 6 and No. 8 SEMS screws which are shorter than 1/2" are not subject to tensile testing.<br><b>410 Stainless:</b> No. 4, No. 6 and No. 8 SEMS screws which are shorter than 1/2" are not subject to tensile testing.   |
| <b>Plating</b>                  | See Appendix-A for information on the plating of steel SEMS.  |

**HOW SEMS SPECIFICATIONS VARY FROM MACHINE SCREWS**

- The maximum diameter of the unthreaded shank shall be less than the maximum major diameter of the thread by an amount sufficient to prevent disassembly of the washer from the screw.
- The unthreaded length on full threaded screws is measured to the contacting face of the washer instead of to the bearing face of the screw.
- The minimum underhead fillet radius is equivalent to 5% of the basic screw diameter.

**Tooth-Lock,  
Split & Conical**

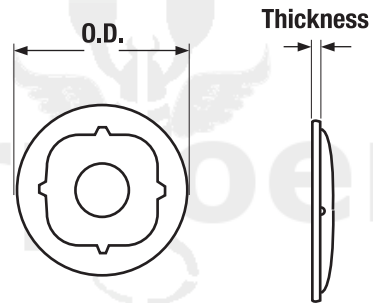
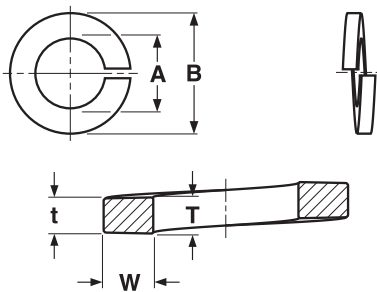
**SEMS Washer Specs for Pan Head Screws**



**TOOTH-LOCK WASHERS FOR PAN HEAD SEMS**

ASME B18.13-2017

| Nominal Size or Basic Screw Diameter |       | Internal Tooth   |      |                         |      | External Tooth   |      |                         |      |
|--------------------------------------|-------|------------------|------|-------------------------|------|------------------|------|-------------------------|------|
|                                      |       | Washer Thickness |      | Washer Outside Diameter |      | Washer Thickness |      | Washer Outside Diameter |      |
|                                      |       | Max              | Min  | Max                     | Min  | Max              | Min  | Max                     | Min  |
| 2                                    | .0860 | .016             | .010 | .185                    | .175 | .016             | .010 | .180                    | .170 |
| 4                                    | .1120 | .018             | .012 | .268                    | .258 | .018             | .012 | .230                    | .220 |
| 6                                    | .1380 | .022             | .016 | .288                    | .278 | .022             | .015 | .285                    | .270 |
| 8                                    | .1640 | .023             | .018 | .338                    | .327 | .023             | .018 | .320                    | .305 |
| 10                                   | .1900 | .024             | .018 | .383                    | .372 | .024             | .018 | .381                    | .365 |
| 12                                   | .2160 | .027             | .020 | .408                    | .396 | .027             | .020 | .420                    | .395 |
| 1/4                                  | .2500 | .028             | .023 | .478                    | .466 | .028             | .023 | .510                    | .494 |
| 5/16                                 | .3125 | .034             | .028 | .610                    | .597 | .034             | .028 | .610                    | .588 |



**WASHERS FOR SPLIT-LOCK & CONICAL PAN HEAD SEMS**

ASME B18.13,-2017 & Shakeproof\*

| Nominal Size or Basic Screw Diameter |       | Split-Lock               |      |                    |                               |                           | Conical* |                  |                         |      |
|--------------------------------------|-------|--------------------------|------|--------------------|-------------------------------|---------------------------|----------|------------------|-------------------------|------|
|                                      |       | Washer Inside Diameter A |      | Washer Section Min |                               | Washer Outside Diameter B |          | Washer Thickness | Washer Outside Diameter |      |
|                                      |       | Max                      | Min  | Width W            | Thickness $\frac{T \pm t}{2}$ | Max                       | Min      | Ref              | Max                     | Min  |
| 2*                                   | .0860 | .080                     | .075 | .035               | .020                          | .156                      | .145     | .015             | .210                    | .200 |
| 4*                                   | .1120 | .101                     | .096 | .055               | .034                          | .217                      | .206     | .015             | .250                    | .244 |
| 6                                    | .1380 | .121                     | .116 | .062               | .034                          | .253                      | .240     | .030             | .320                    | .307 |
| 8                                    | .1640 | .144                     | .138 | .078               | .040                          | .308                      | .294     | .035             | .383                    | .370 |
| 10                                   | .1900 | .162                     | .156 | .109               | .047                          | .356                      | .342     | .035             | .446                    | .433 |
| 1/4                                  | .2500 | .217                     | .209 | .120               | .062                          | .465                      | .449     | .045             | .515                    | .495 |

\*Dimensions of Square-Cone® washers are to Shakeproof specifications. Square-Cone® is a registered trademark of Shakeproof division of Illinois Tool Works.

**SEMS Washer Specs for Hex Washer Head Screws** **Tooth-Lock**



| <b>TOOTH LOCK WASHERS FOR HEX HEAD SEMS</b> |       |                  |      |                         |      |                  |      |                         |      | ASME B18.13-2017 |
|---|-------|------------------|------|-------------------------|------|------------------|------|-------------------------|------|------------------|
| Nominal Size or Basic Screw Diameter        |       | Internal Tooth   |      |                         |      | External Tooth   |      |                         |      |                  |
|   |       | Washer Thickness |      | Washer Outside Diameter |      | Washer Thickness |      | Washer Outside Diameter |      |                  |
|   |       | Max              | Min  | Max                     | Min  | Max              | Min  | Max                     | Min  |                  |
| 4   | .1120 | .018             | .012 | .268                    | .258 | .018             | .012 | .230                    | .220 |                  |
| 6   | .1380 | .022             | .016 | .288                    | .278 | .022             | .016 | .285                    | .270 |                  |
| 8   | .1640 | .023             | .018 | .338                    | .327 | .023             | .018 | .320                    | .305 |                  |
| 10  | .1900 | .024             | .018 | .383                    | .372 | .024             | .018 | .381                    | .365 |                  |
| 12  | .2160 | .027             | .020 | .408                    | .396 | .027             | .020 | .410                    | .395 |                  |
| 1/4   | .2500 | .028             | .023 | .478                    | .466 | .031             | .028 | .475                    | .460 |                  |
| 5/16  | .3125 | .034             | .028 | .610                    | .597 | .031             | .028 | .580                    | .567 |                  |
| 3/8   | .3750 | .040             | .032 | .692                    | .678 | .040             | .032 | .660                    | .640 |                  |

| <b>TOOTH LOCK WASHERS FOR HEX WASHER HEAD SEMS</b> |       |                  |      |                         |      |                  |      |                         |      | ASME B18.13-2017 |
|--|-------|------------------|------|-------------------------|------|------------------|------|-------------------------|------|------------------|
| Nominal Size or Basic Screw Diameter               |       | Internal Tooth   |      |                         |      | External Tooth   |      |                         |      |                  |
|  |       | Washer Thickness |      | Washer Outside Diameter |      | Washer Thickness |      | Washer Outside Diameter |      |                  |
|  |       | Max              | Min  | Max                     | Min  | Max              | Min  | Max                     | Min  |                  |
| 4  | .1120 | .018             | .012 | .268                    | .258 | .018             | .012 | .230                    | .220 |                  |
| 6  | .1380 | .022             | .016 | .288                    | .278 | .022             | .016 | .317                    | .306 |                  |
| 8  | .1640 | .023             | .018 | .338                    | .327 | .023             | .018 | .317                    | .306 |                  |
| 10   | .1900 | .024             | .018 | .383                    | .372 | .024             | .018 | .406                    | .395 |                  |
| 12   | .2160 | .027             | .020 | .408                    | .396 | .027             | .020 | .406                    | .395 |                  |
| 1/4  | .2500 | .028             | .023 | .478                    | .466 | .028             | .023 | .580                    | .567 |                  |
| 5/16   | .3125 | .034             | .028 | .610                    | .597 | .034             | .028 | .654                    | .640 |                  |
| 3/8  | .3750 | .040             | .032 | .692                    | .678 | .040             | .032 | .760                    | .740 |                  |