Unified Thread Standard
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The Unified Thread Standard (UTS) defines a standard thread form and series—along with allowances, tolerances, and designations—for screw threads commonly used in the United States and Canada. It has the same 60° profile as the ISO metric screw thread, but the characteristic dimensions of each UTS thread (outer diameter and pitch) were chosen as an inch fraction rather than a millimeter value. The UTS is currently controlled by ASME/ANSI in the United States.

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Origins

See the "History of standardization" section of the screw thread article.

Basic profile

Each thread in the series is characterized by its major diameter \( D_{maj} \) and its pitch, \( P \). UTS threads consist of a symmetric V-shaped thread. In the plane of the thread axis, the flanks of the V have an angle of 60° to each other. The outermost 0.125 and the innermost 0.25 of the height \( H \) of the V-shape are cut off from the profile.

The pitch \( P \) is the distance between thread peaks. For UTS threads, which are single-start threads, it is equal to the lead, the axial distance that the screw advances during a 360° rotation. UTS threads do not usually use the pitch parameter; instead a parameter known as threads per inch (TPI) is used, which is the reciprocal of the pitch.

The relationship between the height \( H \) and the pitch \( P \) is found using the following equation:[1]

\[
H = \cos(30°) \times P
= \frac{\sqrt{3}}{2} \times P
\approx 0.866 \times P
\]

In an external (male) thread (e.g., on a bolt), the major diameter \( D_{maj} \) and the minor diameter \( D_{min} \) define maximum dimensions of the thread. This means that the external thread must end flat at \( D_{maj} \) but can be rounded out below the minor diameter \( D_{min} \). Conversely, in an internal (female) thread (e.g., in a nut), the major and minor diameters are minimum dimensions, therefore the thread profile must end flat at \( D_{min} \) but may be rounded out beyond \( D_{maj} \).

The minor diameter \( D_{min} \) and effective pitch diameter \( D_p \) are derived from the major diameter and pitch as
Designation

The standard designation for a UTS thread is a number indicating the nominal (major) diameter of the thread, followed by the pitch measured in threads per inch. For diameters smaller than \( \frac{1}{4} \) inch, the diameter is indicated by an integer number defined in the standard; for all other diameters, the inch figure is given.

This number pair is optionally followed by the letters UNC, UNF or UNEF if the diameter-pitch combination is from the “coarse”, “fine” or “extra fine” series, and may also be followed by a tolerance class.

Example: #6-32 UNC 2B (major diameter: 0.1380 inch, pitch: 32 tpi)

### Unified Screw Threads — UNC, UNF and UNEF[2]

<table>
<thead>
<tr>
<th>Major diameter (inch ( \times ) mm)</th>
<th>Uniform Screw Threads — UNC, UNF and UNEF[2]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Coarse (UNC)</strong></td>
</tr>
<tr>
<td></td>
<td>d (TPI)</td>
</tr>
<tr>
<td>#0 0.0600 ( \times ) 1.5240</td>
<td>None</td>
</tr>
<tr>
<td>#1 0.0730 ( \times ) 1.8542</td>
<td>64</td>
</tr>
<tr>
<td>#2 0.0860 ( \times ) 2.1844</td>
<td>56</td>
</tr>
<tr>
<td>#3 0.0990 ( \times ) 2.5146</td>
<td>48</td>
</tr>
<tr>
<td>#4 0.1120 ( \times ) 2.8448</td>
<td>40</td>
</tr>
<tr>
<td>#5 0.1250 ( \times ) 3.1750</td>
<td>40</td>
</tr>
<tr>
<td>#6 0.1380 ( \times ) 3.5052</td>
<td>32</td>
</tr>
<tr>
<td>#8 0.1600 ( \times ) 4.1656</td>
<td>32</td>
</tr>
<tr>
<td>#10 0.1900 ( \times ) 4.8260</td>
<td>24</td>
</tr>
<tr>
<td>#12 0.2160 ( \times ) 5.4864</td>
<td>24</td>
</tr>
<tr>
<td>1/4 0.2500 ( \times ) 6.3500</td>
<td>20</td>
</tr>
<tr>
<td>5/16 0.3125 ( \times ) 7.9375</td>
<td>18</td>
</tr>
<tr>
<td>3/8 0.3750 ( \times ) 9.5250</td>
<td>16</td>
</tr>
<tr>
<td>7/16 0.4375 ( \times ) 11.1125</td>
<td>14</td>
</tr>
<tr>
<td>1/2 0.5000 ( \times ) 12.7000</td>
<td>13</td>
</tr>
<tr>
<td>9/16 0.5625 ( \times ) 14.2875</td>
<td>12</td>
</tr>
<tr>
<td>5/8 0.6250 ( \times ) 15.8750</td>
<td>11</td>
</tr>
<tr>
<td>3/4 0.7500 ( \times ) 19.0500</td>
<td>10</td>
</tr>
<tr>
<td>7/8 0.8750 ( \times ) 22.2250</td>
<td>9</td>
</tr>
<tr>
<td>1 1.0000 ( \times ) 25.4000</td>
<td>8</td>
</tr>
</tbody>
</table>

The following formula is used to calculate the major diameter of a numbered screw greater than or equal to 0: \[ \text{Major diameter} = \text{Screw # } \times \text{ 0.013 in } + 0.060 \text{ in}. \] For example, a number 10 calculates as: \#10 \times 0.013 in + 0.060 in = 0.190 in major diameter.

A Unified Miniature screw thread series is defined in ANSI standard B1.10, for fasteners of 0.3 to 1.4 millimetres (0.0118 to 0.0551 inch) diameter. These sizes are intended for watches, instruments, and miniature mechanisms and are interchangeable with threads made to ISO Standard 68.[3] These screw sizes are denoted by multiple zeroes, i.e., #000. The formula for number sizes smaller than size #0 is given by \[ \text{Major diameter} = 0.060 \text{ in } - \text{Zero size } \times \text{ 0.013 in}, \] with the zero size being the number of zeroes after the first. So a #00 screw is 0.047 in dia., #000 is 0.034 in dia., etc.

\[ D_{\text{min}} = D_{\text{maj}} - 2 \cdot \frac{5}{8} \cdot H \]
\[ = D_{\text{maj}} - \frac{5\sqrt{3}}{8} \cdot P \]
\[ \approx D_{\text{maj}} - 1.082532 \times P \]
\[ D_p = D_{\text{maj}} - 2 \cdot \frac{3}{8} \cdot H \]
\[ = D_{\text{maj}} - \frac{3\sqrt{3}}{8} \cdot P \]
\[ \approx D_{\text{maj}} - 0.649519 \times P \]
The number series of machine screws once included more odd numbers and went up to #16 or more. Standardization efforts in the late 19th and the early part of the 20th century reduced the range of sizes considerably. Now, it is less common to see machine screws larger than #14, or odd number sizes other than #1, #3 and #5. Even though #14 and #16 screws are still available, they are not as common as sizes #0 through #12.

Sometimes "special" diameter and pitch combinations (UNS) are used, for example a 0.619 in (15.7 mm) major diameter with 20 threads per inch. UNS threads are rarely used for bolts, but rather on nuts, tapped holes, and threaded ODs. Because of this UNS taps are readily available. Most UNS threads have more threads per inch than the correlating UNF or UNEF standard, therefore they are often the strongest thread available. Because of this they are often used in applications where high stresses are encountered, such as machine tool spindles or automotive spindles.

**Gauging**

A screw thread gaging system comprises a list of screw thread characteristics that must be inspected to establish the dimensional acceptability of the screw threads on a threaded product and the gauge(s) which shall be used when inspecting those characteristics.

Currently this gaging UTS is controlled by:

- ASME/ANSI B1.2-1983 Gages And Gaging For Unified Inch Screw Threads

This Standard provides essential specifications and dimensions for the gages used on Unified inch screw threads UN [unified] and UNR [external threads only] thread form, and covers the specifications and dimensions for the thread gages and measuring equipment listed in Tables 1 and 2. The basic purpose and use of each gage are also described.


(a) This Standard presents screw thread gaging systems suitable for determining the acceptability of Unified [UN], UNR [external threads only], UNJ [internal and external threads], M, and MJ thread gages on externally and internally threaded products. It establishes the criteria for screw thread acceptance when a gaging system is used. (b) A screw thread gaging system comprises a list of screw thread characteristics that must be inspected to establish the dimensional acceptability of the screw threads on a threaded product and the gauge(s) which shall be used when inspecting those characteristics.

(c) Federal Government Use. When this Standard is approved by the Department of Defense and federal agencies and is incorporated into Federal Standard-H28/20 [FED-STD-H28/20], Screw Thread Standards for Federal Services, Section 20, the use of this Standard by the federal government is subject to all the requirements and limitations of Federal Standard-H28/20 [FED-STD-H28/20]. These standards provide essential specifications and dimensions for the gages used on Unified inch screw threads (UN, UNR, UNJ thread form) on externally and internally threaded products. It also covers the specifications and dimensions for the thread gages and measuring equipment. The basic purpose and use of each gage are also described. It also establishes the criteria for screw thread acceptance when a gaging system is used.

**Tolerance classes**

A classification system exists for ease of manufacture and interchangeability of fabricated threaded items. Most (but certainly not all) threaded items are made to a classification standard called the Unified Screw Thread Standard Series. This system is analogous to the fits used with assembled parts. Classes 1A, 2A, 3A apply to external threads; Classes 1B, 2B, 3B apply to internal threads. Class 1 threads are loosely fitting threads intended for ease of assembly or use in a dirty environment.

Class 2 threads are the most common. They are designed to maximize strength considering typical machine shop capability and machine practice.

Class 3 threads are used for closer tolerances.

Thread class refers to the acceptable range of pitch diameter for any given thread. The pitch diameter is indicated as Dp in the figure shown above. There are several methods that are used to measure the pitch diameter. The most common method used in production is by way of a Go/no go gauge.

**Related standards**

- ASME/ANSI B1.1 – 2003 Unified Inch Screw Threads, UN & UNR Thread Form
- ASME/ANSI B1.15 – 1995 Unified Inch Screw Threads, UNJ Thread Form

**See also**

- British standard pipe thread
- British Standard Whitworth
- ISO metric screw thread
- List of drill and tap sizes
- List of screw drives
- National pipe thread
- Nut (hardware)
- William Sellers
- United States Standard thread

**Notes**

Bibliography


External links

- Unified Screw Threads with Tolerances (http://www.amesweb.info/Screws/AsmeUnifiedInchScrewThread.aspx)
- Unified Coarse/Fine diameters and tap drill sizes (http://www.carbidedepot.com/formulas-tap-standard.htm) (US units)
- Unified Coarse/Fine tap drill sizes (http://www.metalmart.com/Guides/Tap_Drill_Sizes.aspx) (US units)
- Imperial Metric fastening size conversion charts (http://www.baconslow.co.uk/tools/conversion%20charts.htm)
- Conversion chart Whitworth/BSF/AF and metric (http://www.baconslow.co.uk/tools/spanners.html/chart)
- Spanner Jaw Sizes (http://www.sat.dundee.ac.uk/~psc/spanner_jaw.html) Additional information and spanner jaw size table.
- Unified Screw Threads Series (http://www.efunda.com/designstandards/screws/screwun.cfm)


Categories: Mechanical standards | Screws | Threading (manufacturing)