Holemaking
Center Drill

- Twist drills tend to wander on a surface compromising the position of a hole
- Start by center drilling a starting hole
- Center drills have a thicker shank and afford less deflection
The twist drill is used to create through holes or holes of prescribed depth. Periodically retracting the twist drill is described as peck drilling. Peck drilling assists removal of chips and permits coolant entrance into the hole.
Twist drill sizes are often reported in gauges. Gauges 80 to 1 run from diameters of 0.0135” to 0.228”, respectively. Gauges A to Z run from diameters of 0.234” to 0.413”, respectively.
Drill Chuck

• Do not expose to side loads as doing so can damage the internal mechanisms
Reaming

- Reaming = enlarging a hole
- Used to attain superior hole tolerance (4 decimal precision)
- Go slow (~200 RPM) and use plenty of cutting fluid
- Max. +0.01” material removed after primary drilling operation
Countersinking

- Used to create a flush interface between a screw and feature face and/or remove burrs
- Typical angles include 60°, 82°, 90°, 110°, and 120°
- Run at low speed
Screws and (Bolts)

Which one is a bolt and which one is a screw?

These are both screws!!!
Screws and (Bolts)

A bolt utilizes a nut whereas a screw engages with a feature.
Screw (Hole) Naming Conventions

Thread specifications of the Unified Thread Standard (UTS)

- **Class of fit**
  - 1 = Loose fitting / low tolerance
  - 2 = Consistent fit / tolerance (common)
  - 3 = High precision

- **Major diameter**
  - 0.060” + .013”
  - x this number

- **Thread pitch**
  - TPI = threads per inch

- **Thread form**
  - UNC = Unified National Course
  - UNF = Unified National Fine
  - UNEF = Unified National Extra Fine

- **Thread orientation**
  - A = External
  - B = Internal

Example: #8-32 UNC-2A
Screw (Hole) Naming Conventions

Metric thread standard

Nominal diameter (mm)

Thread pitch (mm)

Metric designation

Class of internal thread

Class of external thread

M8-1.25 6H6G
UNC vs. UNF

**UNC**: Most common, fewer threads, easier to insert and remove

**UNF**: Shallower threads = larger minor diameter and load carrying capability, improved tension adjustment
Tap

• Used to create internal threads
Tap with Tap Guide

- Tap guide ensures parallelity to pilot hole
- Force along tap axis provided by quill and spring-loaded tap guide pin
External Threads

Die

Lathe
Tap Drill Selection

Mounting block

(2X) 4-40 UNC THRU

Tap drill chart
(MEAM design wiki)

<table>
<thead>
<tr>
<th>thread size</th>
<th>tap drill</th>
<th>clearance (close)</th>
<th>clearance (free)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-80 UNF</td>
<td>3/64 (0.047&quot;)</td>
<td>52 (0.064&quot;)</td>
<td>50 (0.070&quot;)</td>
</tr>
<tr>
<td>2-56 UNC</td>
<td>50 (0.070&quot;)</td>
<td>43 (0.089&quot;)</td>
<td>41 (0.096&quot;)</td>
</tr>
<tr>
<td>4-40 UNC</td>
<td>43 (0.089&quot;)</td>
<td>32 (0.116&quot;)</td>
<td>30 (0.129&quot;)</td>
</tr>
<tr>
<td>6-32 UNC</td>
<td>36 (0.107&quot;)</td>
<td>27 (0.144&quot;)</td>
<td>25 (0.150&quot;)</td>
</tr>
<tr>
<td>8-32 UNC</td>
<td>29 (0.136&quot;)</td>
<td>18 (0.170&quot;)</td>
<td>16 (0.177&quot;)</td>
</tr>
</tbody>
</table>
Tapping Process

- Center drill divot
- Twist drill pilot hole based on hole specification
- Cut threads with tap using guide

*Note: all steps should be completed during a single session*