

MEAM 150

FUNDAMENTALS OF MECHANICAL PROTOTYPING



THREADED FASTENERS
MAKING HOLES
CREATING THREADS

THREADED FASTENERS



MINIMUM ENGAGEMENT $\sim 1.5 \times$ SCREW DIAMETER

HEAD HEIGHT \sim SCREW DIAMETER

HEAD DIAMETER $\sim 1.5 \times$ SCREW DIAMETER

THREADS

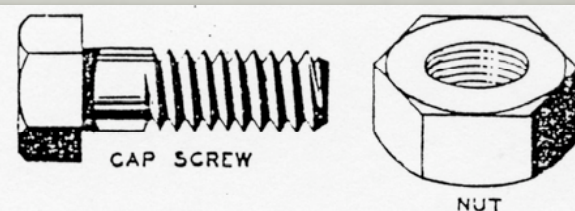
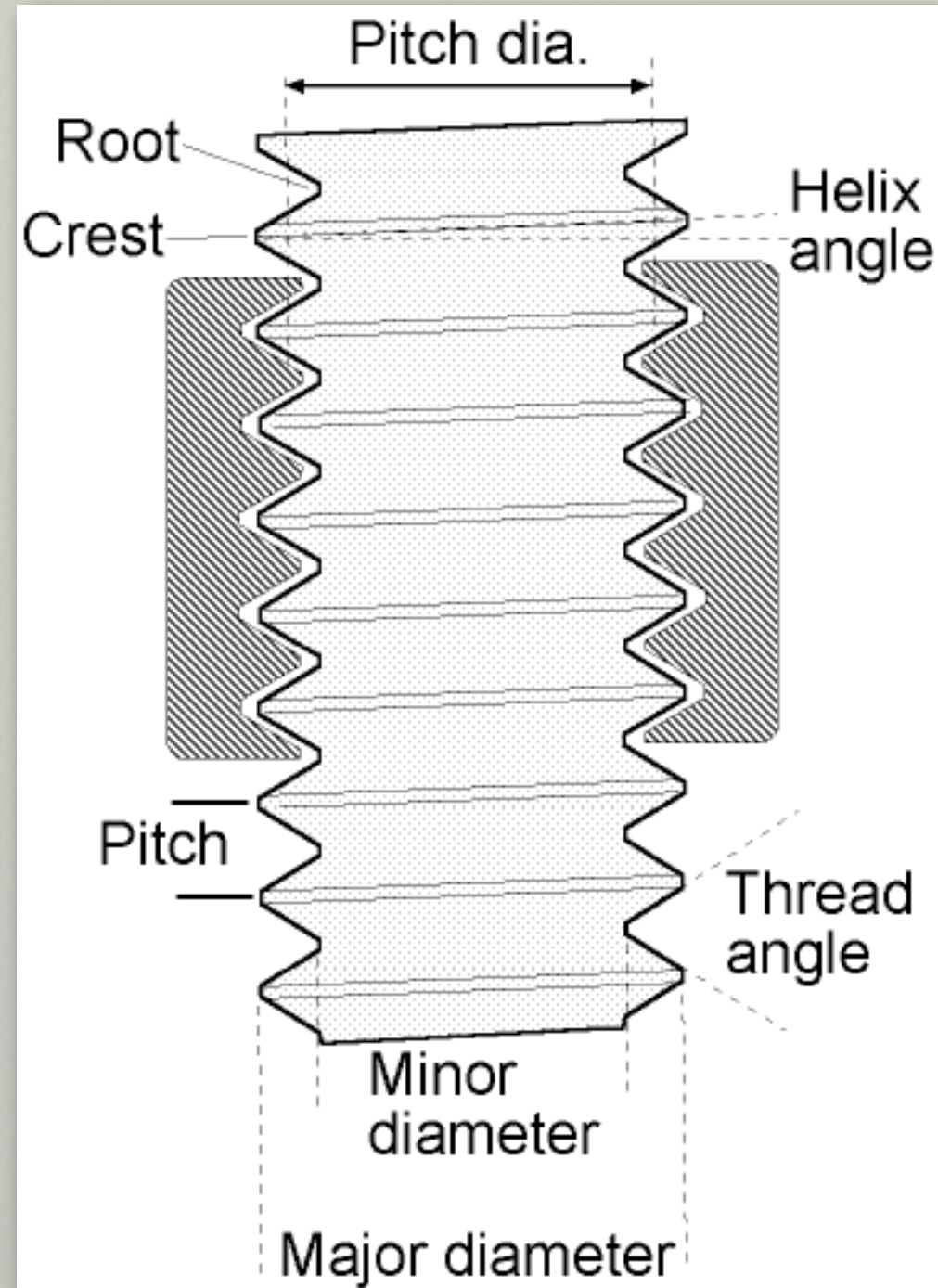


Fig. 471. Threads on Screw and Nut

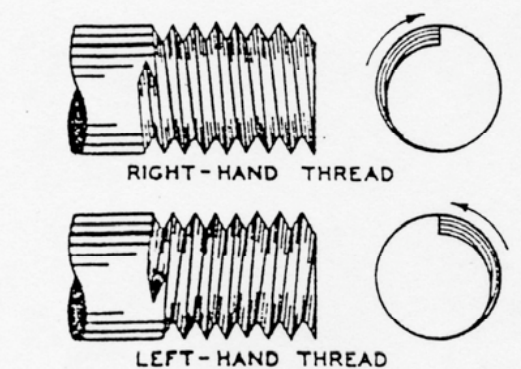


Fig. 472. Right-Hand and Left-Hand Threads

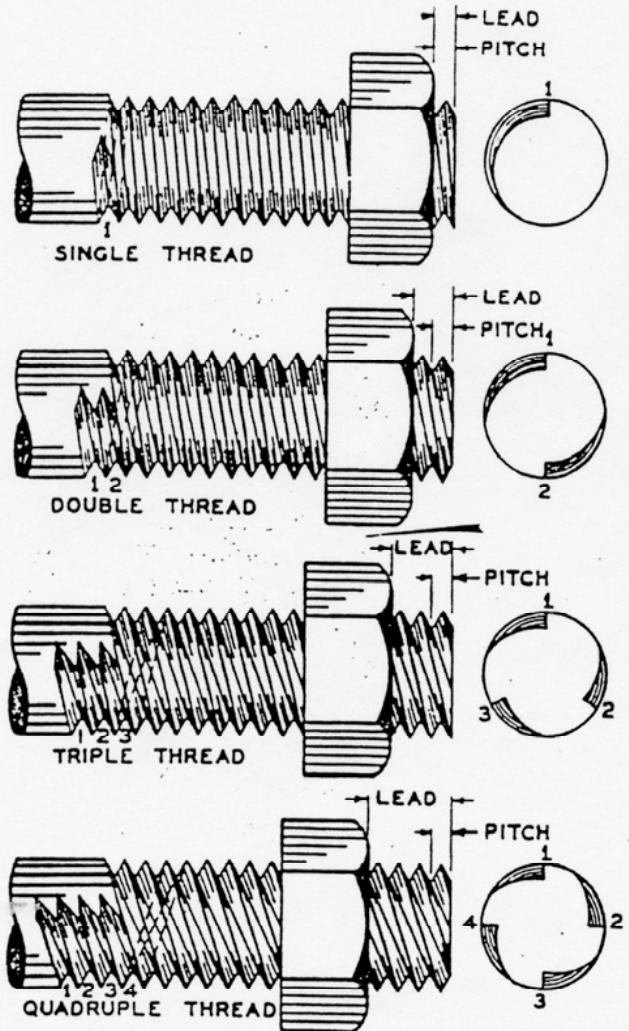


Fig. 473. Single, Double, Triple, and Quadruple Threads

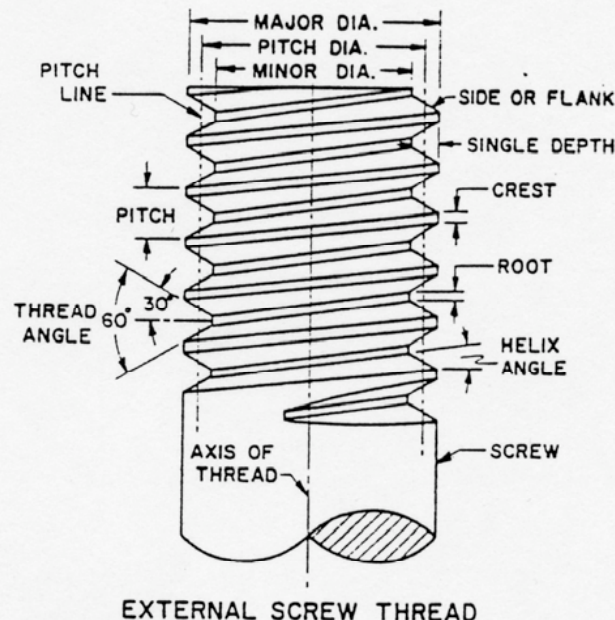


Fig. 474. Principal Parts of a Screw Thread

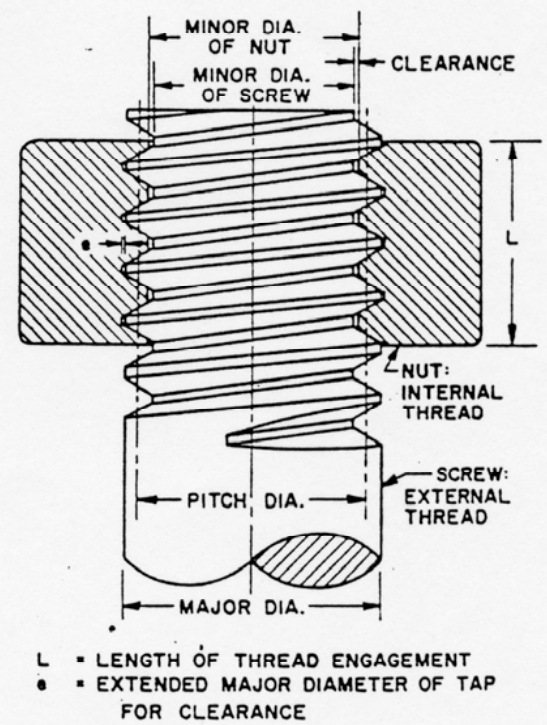


Fig. 475. Comparison Between the Minor Diameters of a Screw and a Nut, Showing Clearance

External threads and internal threads have the same basic pitch diameters.

COMMON THREAD SIZES (U.S.)

THREAD	SERIES	O.D.
0 - 80	UNF	0.060
2 - 56	UNC	0.086
4 - 40	UNC	0.112
6 - 32	UNC	0.138
8 - 32	UNC	0.164
10 - 24	UNC	0.190
10 - 32	UNF	0.190
12 - 24	UNC	0.216
1 / 4 - 20	UNC	0.250
1 / 2 - 28	UNF	0.250
5 / 16 - 18	UNC	0.312
3 / 8 - 16	UNC	0.375
1 / 2 - 13	UNC	0.500



MACHINE SCREWS



Pan



Button



Large Diameter (Truss)



Round



Extra-Wide Low Profile Head



Binding



Fillister



Cheese



Hex



Flat



Oval



Phillips



Slotted



Combination (Phillips/Slotted)



Slotted with Vent



Torx



Hex



Pozidriv



Tamper-Resistant Pin-in-Torx



Tamper-Resistant Tri-Groove



Tamper-Resistant One-Way



Tamper-Resistant Drilled Spanner

SOCKET CAP SCREWS



Standard



Button



Flat



Drilled Head
Wire screws together to prevent
loosening from vibration.



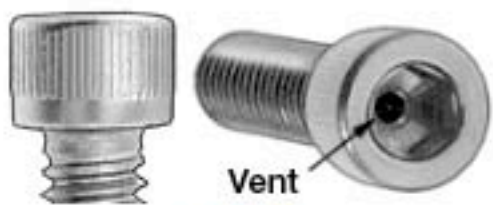
Flange Socket



Flange Button



Low



Vented
Vented hole is drilled through entire
length.



Hex Socket



Torx



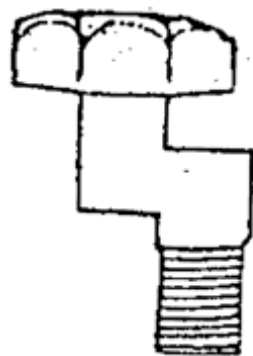
Tamper Resistant Pin-in-Hex
Socket



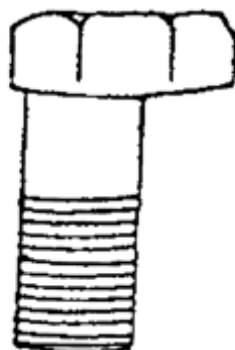
Tamper Resistant Pin-in-Torx



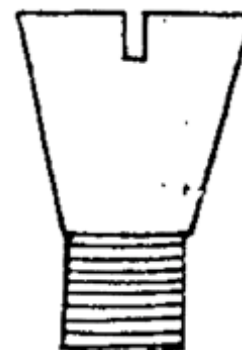
Tamper Resistant High Security
Screws are unique
configuration from
McMaster-Carr.



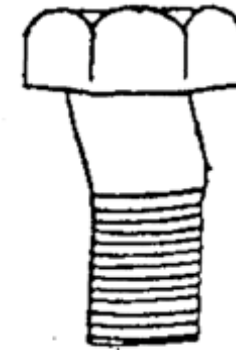
FOR MISMATCHED HOLES



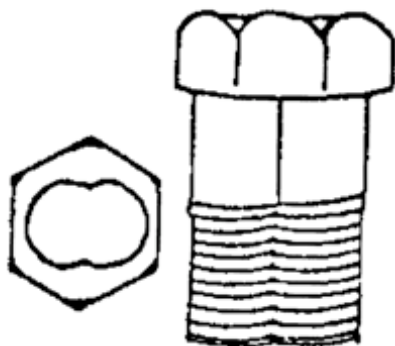
FOR HOLES TOO NEAR THE EDGE



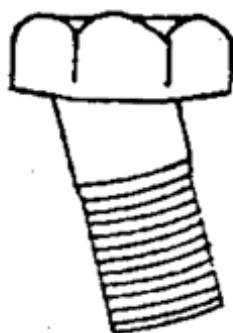
FOR HOLES COUNTER-SUNK TOO DEEP



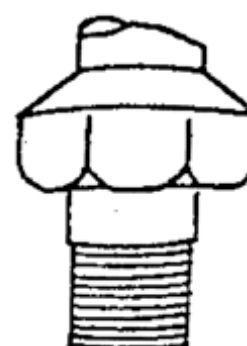
FOR HOLES DRILLED CROOKED, THEN - STRAIGHT



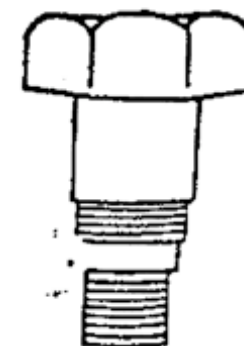
BINOCULAR BOLT - FOR DOUBLE DRILLED HOLES



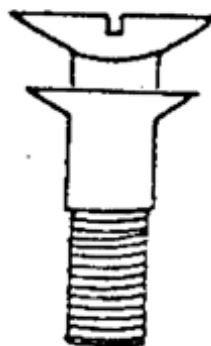
FOR HOLES NOT DRILLED STRAIGHT



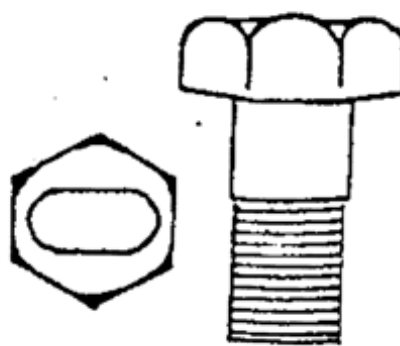
FOR HOLES WITH COUNTER-SINK ON WRONG SIDE



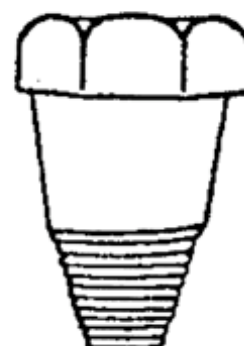
FOR HOLES DRILLED TOO BIG, THEN - RIGHT SIZE



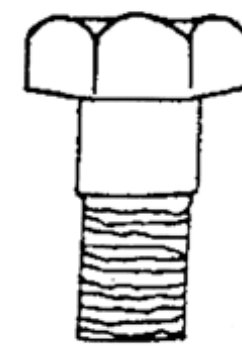
FOR DOUBLE COUNTER-SUNK HOLES



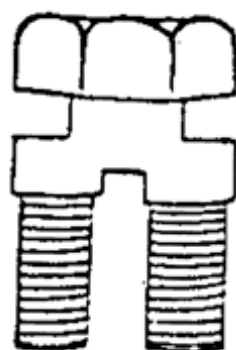
FOR OUT-OF-ROUND HOLES



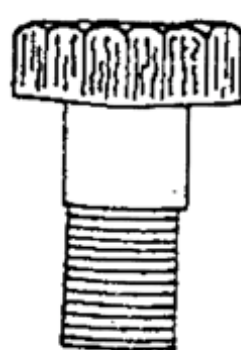
FOR TAPERED HOLES



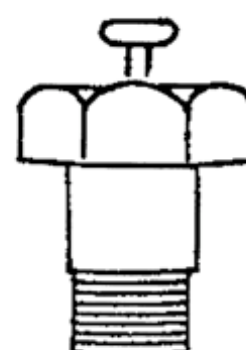
PRE-STRIPPED FOR EASY OVERTIGHTENING



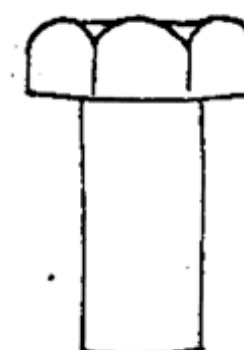
FOR REDRILLED HOLES THAT STILL DON'T MATCH



SERRATED HEAD FOR VISE GRIP TORQUING

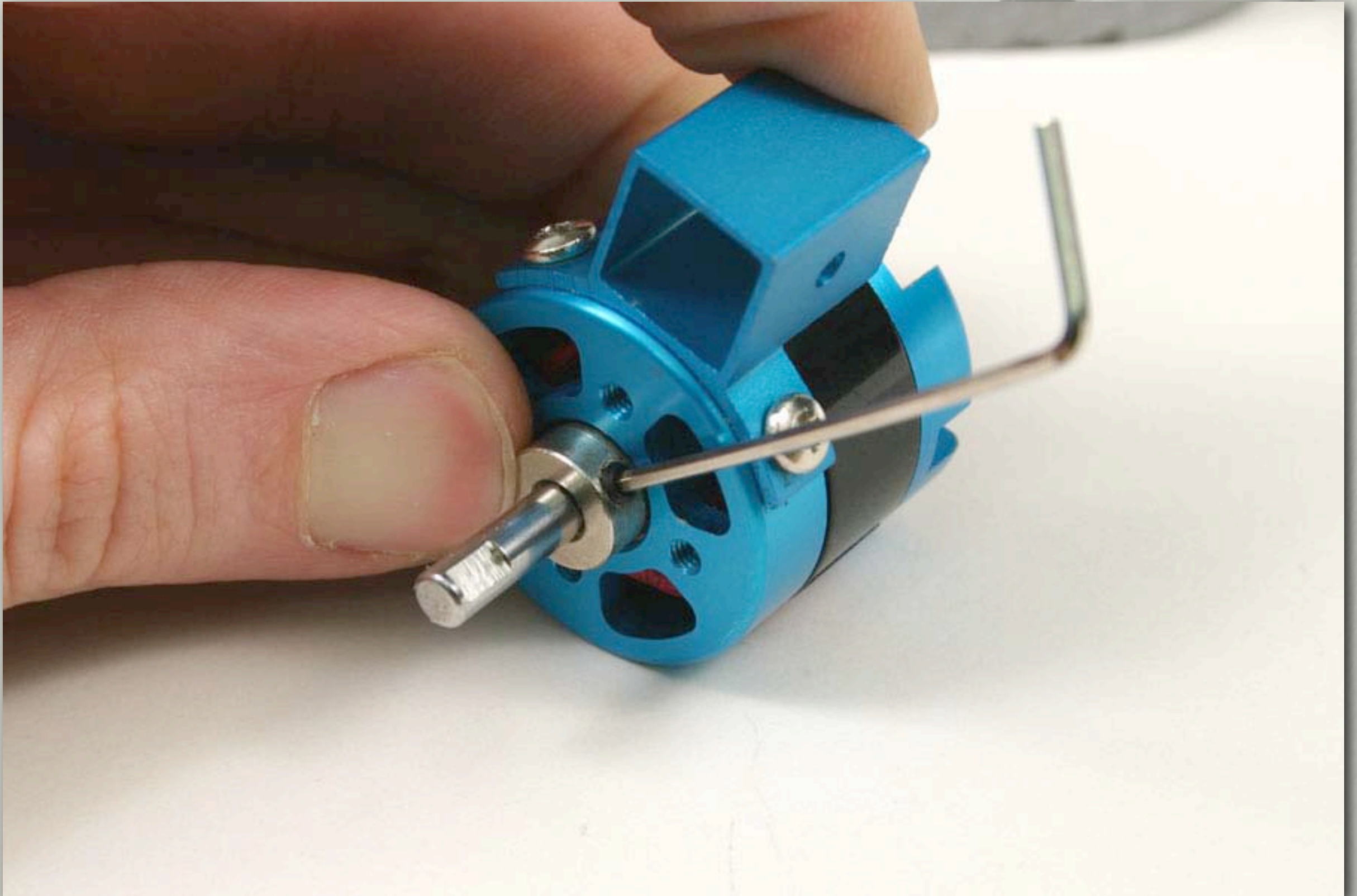


HAMMER HEAD BOLT - FOR HARD TO START HOLES



FOR THREAD-LESS BOLT HOLES

SET SCREWS



SET SCREWS



Standard Socket

The most common screw style.



Self-Locking Socket

Locking element increases holding power. Perfect for tough jobs.



Hollow-Lock Socket

Often used to lock other set screws in place, to hold pins, and to adjust spring tension.



Slotted

Install with a standard slotted screwdriver.



Square Head

Easy to access by hand or with a wrench when you need more torque.



Swivel Pad Socket

Pad swivels to make maximum contact against angled surfaces.



Cup

Most popular style. Thin edge digs into contact surface for high holding power.



Knurled Cup

Knurls improve grip and prevent backing out or loosening.



Vented Cup

Vent fluids and gases while holding parts securely in place.



Cone

Highest holding power of any point style. Sharp tip wedges into surface.



Flat

Best for making frequent adjustments. Tip won't mar contact surface.



Oval

Ideal for making frequent adjustments. Tip has small contact area causing little damage.



Extended Point

Also known as dog point and pilot point set screws. Often used in place of dowel pin.



Soft Tip

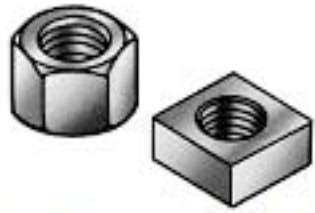
Rigid yet soft tip conforms to texture and curves of surface without marring.



Swivel Ball Bearing

Also known as ball-ended thrust screws. Ball bearings swivel in all directions.

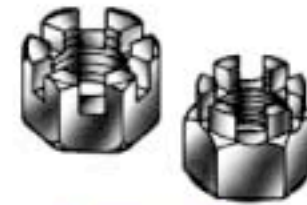
NUTS



Machine Screw and Hex Nuts



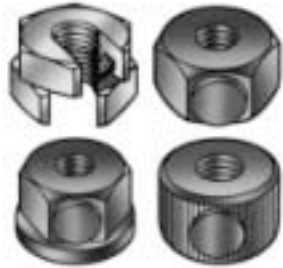
Locknuts



Slotted Nuts



Barrel Nuts (Binding Barrels)



Quick-Threading Nuts



Flange Nuts



Coupling Nuts



T-Slot Nuts



Acorn Nuts



Wing Nuts



Thumb Nuts



Tamper-Resistant Nuts



Push Nuts and Retainers



Weld Nuts



Allen Nuts



General Purpose Acme Nuts



Strut Channel Nuts



Slip Joint Nuts



Handle Nuts



Binding Nuts



Regulator and Welding Hose Fitting Nuts



Speed Nuts



Captive Nuts



Thin Nuts with Specialty Threads

WASHERS



Round Hole



Square Hole



Slotted



D (Clipped)



Spherical



Laminated



Notched



Tag Hole



Spring Lock



Tooth Lock



Belleville



Retaining



Wave



Finger Spring



Wedge Lock



Countersunk



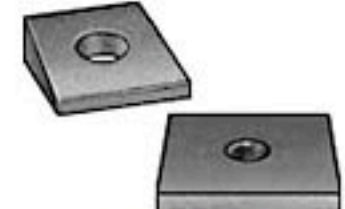
Bonded



Waffle



Pressure-Sealing



Square



Shoulder



Cup

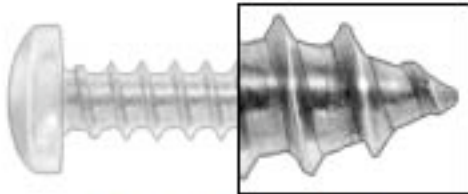


Structural



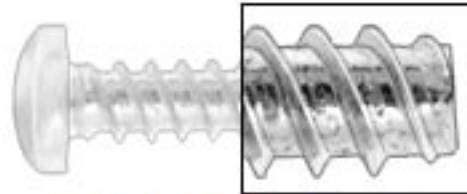
Flange

SELF-TAPPING



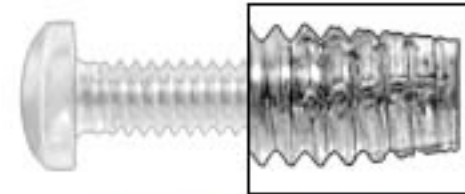
Sheet Metal Screws

Have a pointed end and widely spaced threads. Self-starting in thin sheet metal. In thicker materials, a drilled hole is recommended.



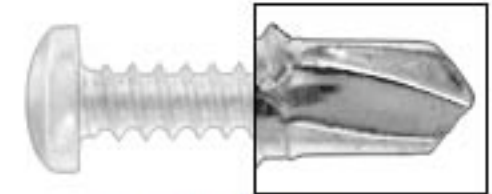
Thread-Forming Screws

Have a blunt point and fine threads. Form threads in metal, plastic, and plywood. A drilled hole is required.



Thread-Cutting Screws

Have blunt, tapered, tap-fluted end that cuts machine screw threads and ejects material as it turns. Use in metal, plastic, and plywood. A drilled hole is required.



Self-Drilling Screws

Drill their own hole, tap a thread, and fasten material in a single operation. Excellent for use in sheet metal.

WOOD



Phillips



Slotted



Square



Combination (Phillips/Square)



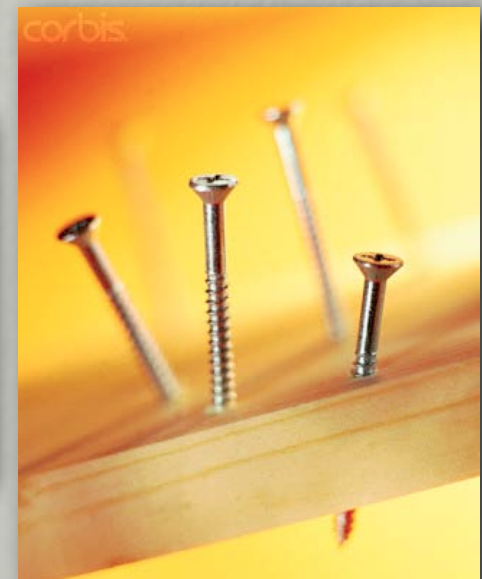
Hex



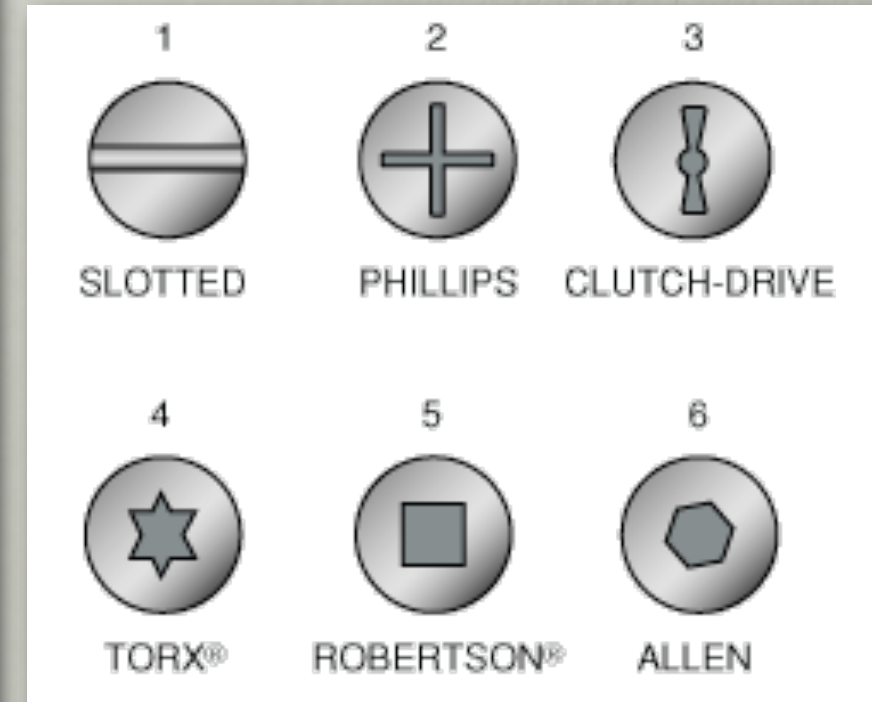
Torx



Uni-Drive



DRIVES



A close-up photograph of a drill bit drilling into a metal surface. The drill bit is dark and has a double-flute design. It is positioned vertically, and a small amount of metal shavings is being ejected from the hole it is drilling. The background is a blurred, light-colored surface.

MAKING HOLES

CENTER DRILL




TWIST DRILL



PECK DRILLING

DRILL SETS



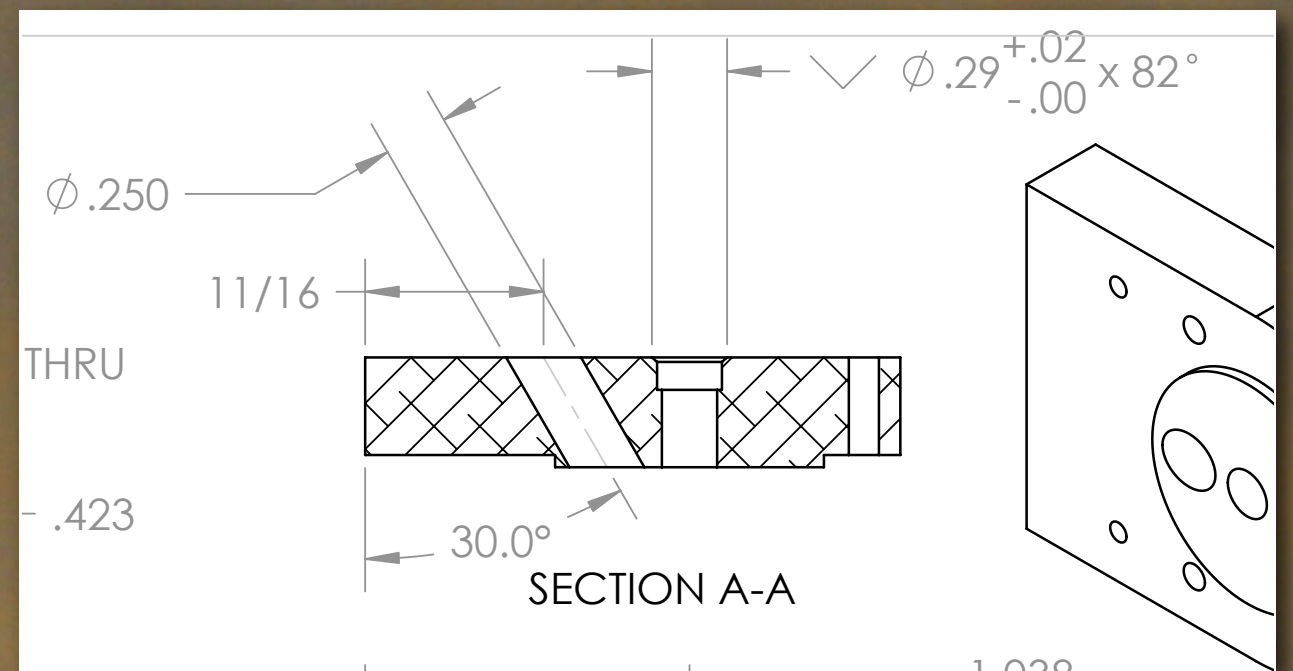


THE DRILL CHUCK

NEVER USE FOR
SIDE LOADS!!

REAMING

SLOW IT DOWN!
USE PLENTY OF CUTTING FLUID



82°

COUNTERSINK

THREAD CUTTING



TAP



DIE



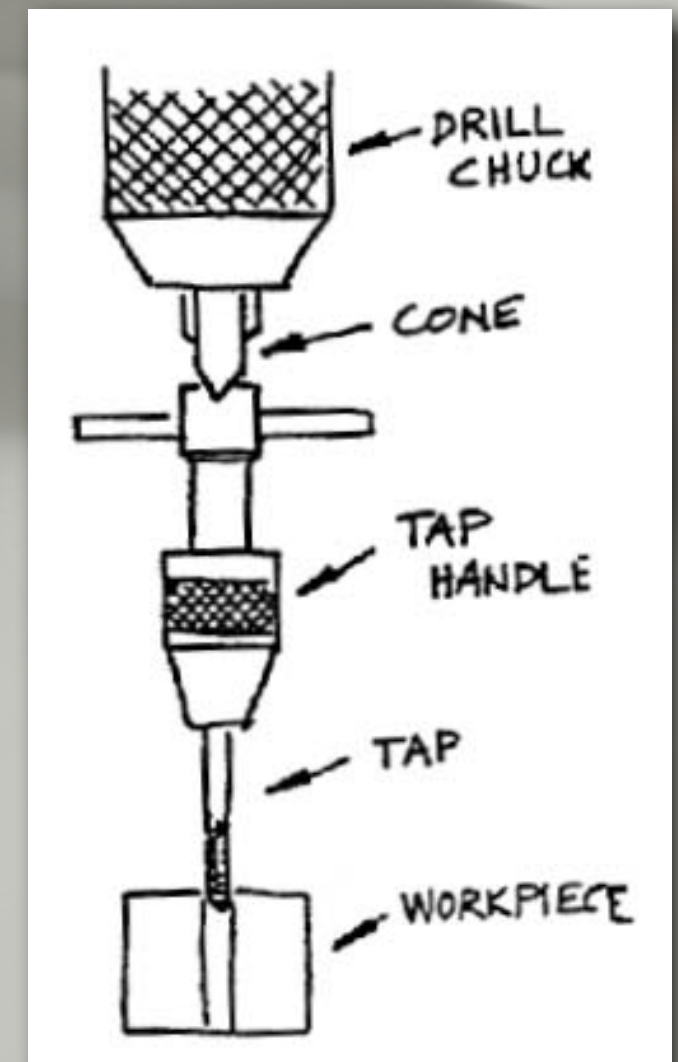
CENTER DRILL

PILOT HOLE

TAP BY HAND

USE LUBRICATION

BREAK CHIPS OFTEN





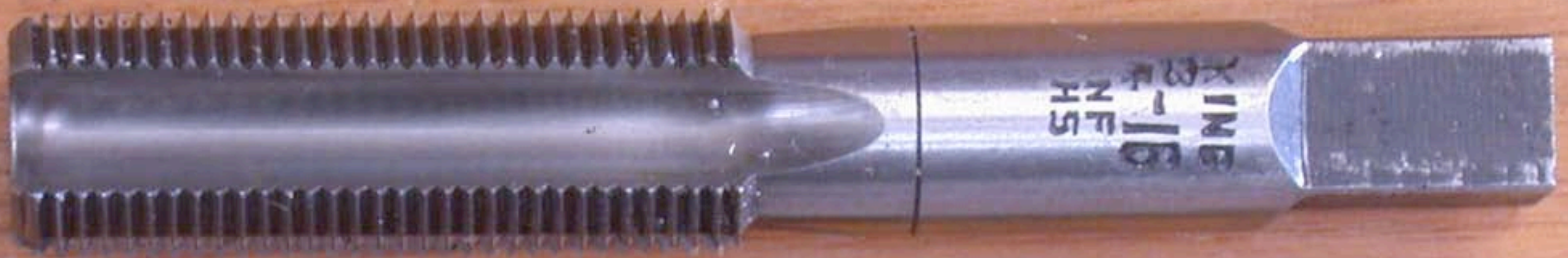
CENTER DRILL

TWIST DRILL



TAP





PILOT HOLE DRILL SIZES

THREAD	SERIES	O . D .	PILOT
0 - 80	UNF	0 . 060	3 / 64
2 - 56	UNC	0 . 086	NO . 50
4 - 40	UNC	0 . 112	NO . 43
6 - 32	UNC	0 . 138	NO . 36
8 - 32	UNC	0 . 164	NO . 29
10 - 24	UNC	0 . 190	NO . 25
10 - 32	UNF	0 . 190	NO . 21
12 - 24	UNC	0 . 216	NO . 16
1 / 4 - 20	UNC	0 . 250	NO . 7
1 / 4 - 28	UNF	0 . 250	NO . 3
5 / 16 - 18	UNC	0 . 312	F
3 / 8 - 16	UNC	0 . 375	5 / 16
1 / 2 - 13	UNC	0 . 500	27 / 64