

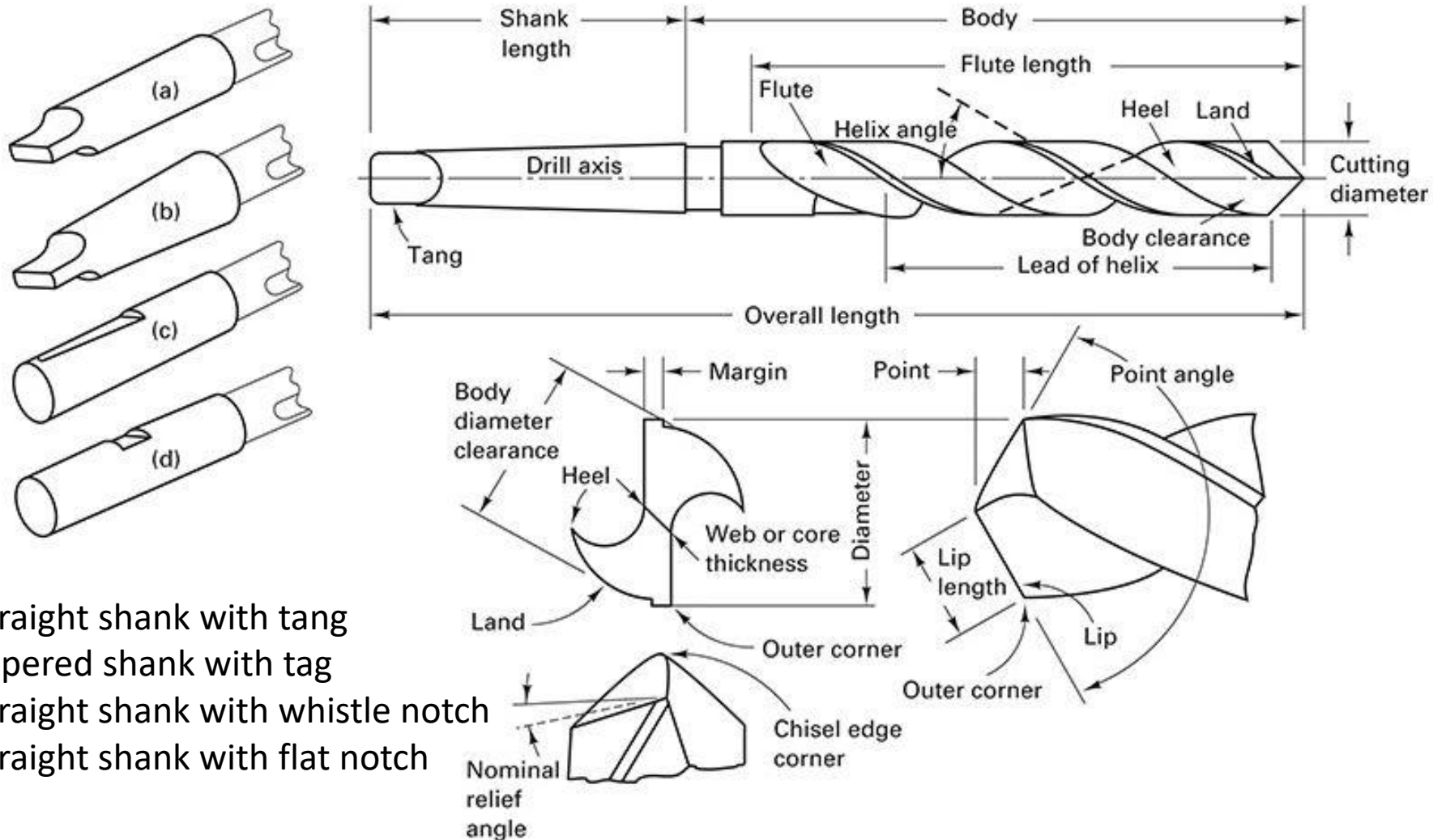
# Drilling and Related Hole-making Processes

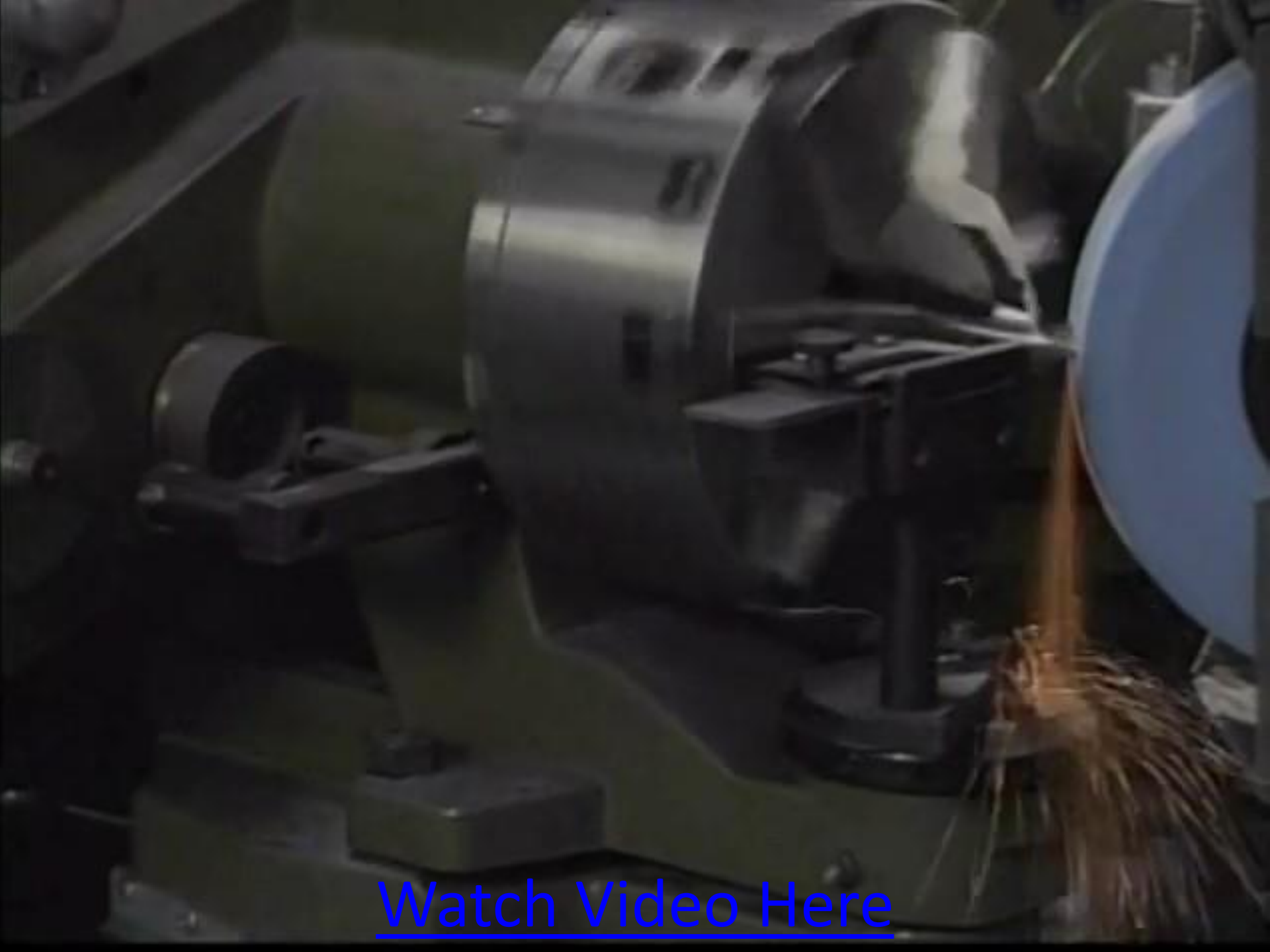


# The Twist Drill

[Watch Video Here](#)

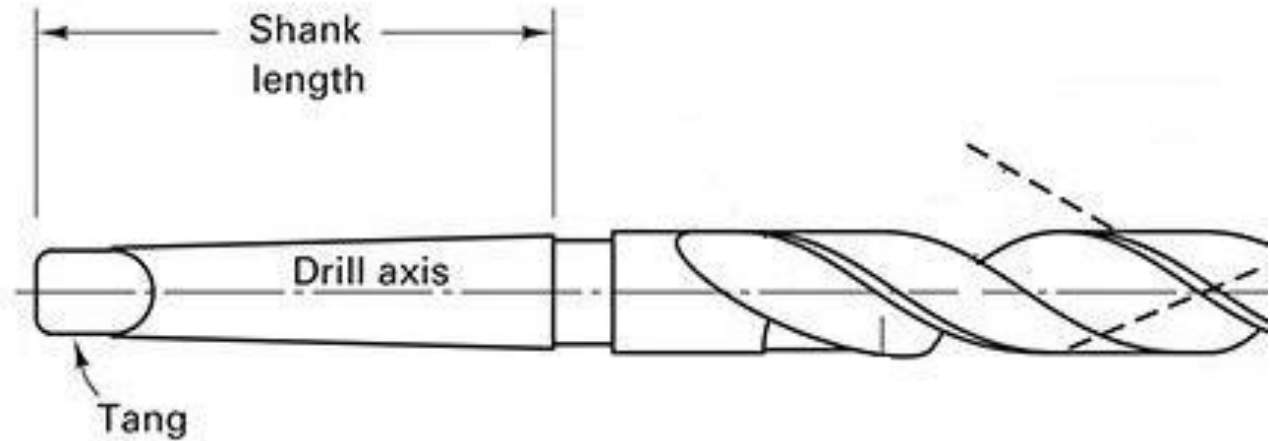
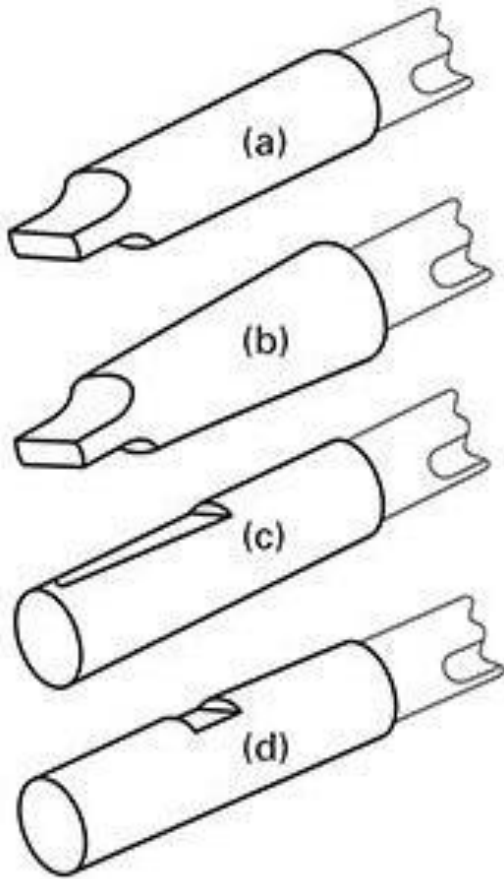
# Nomenclature and Geometry of Conventional Twist Drill





[Watch Video Here](#)

# Shanks

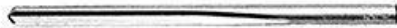


- (a) Straight shank with tang
- (b) Tapered shank with tag
- (c) Straight shank with whistle notch
- (d) Straight shank with flat notch

# Shanks and Twist Drill Types



Taper Shank, Sub Land



Straight Shank, Straight Flute



Straight Shank High Helix



Bit Shank



Straight Shank

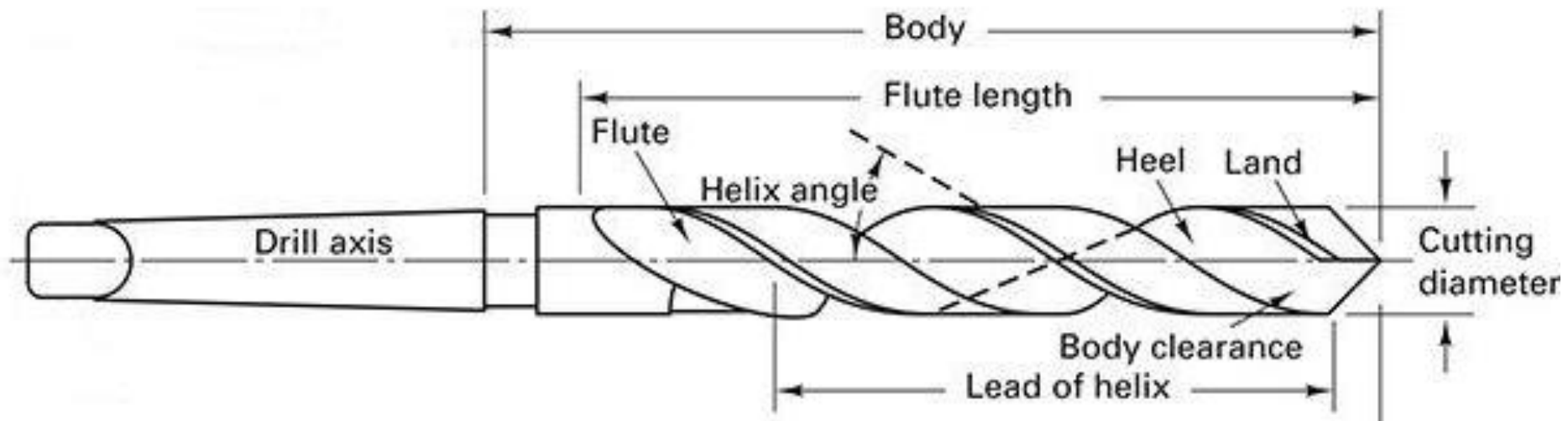


Taper Shank

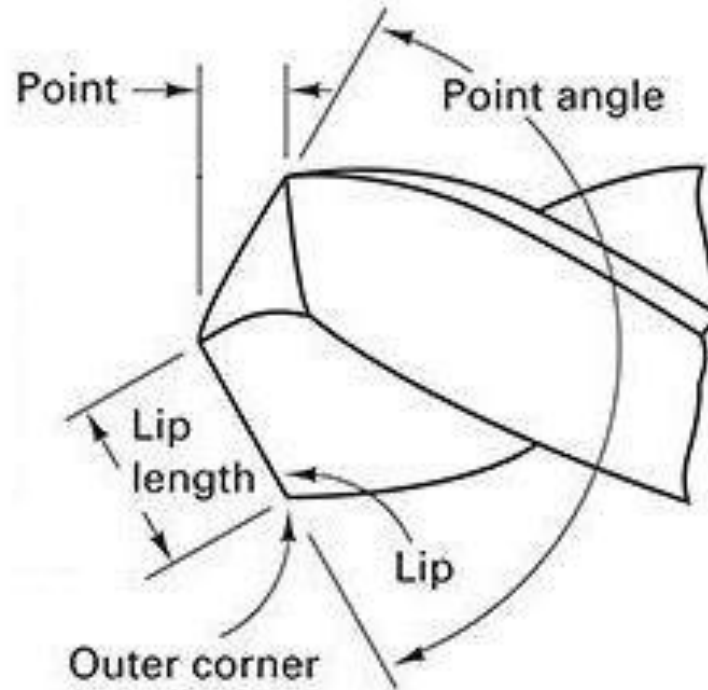


Straight Shank, three flute

# Drill Body

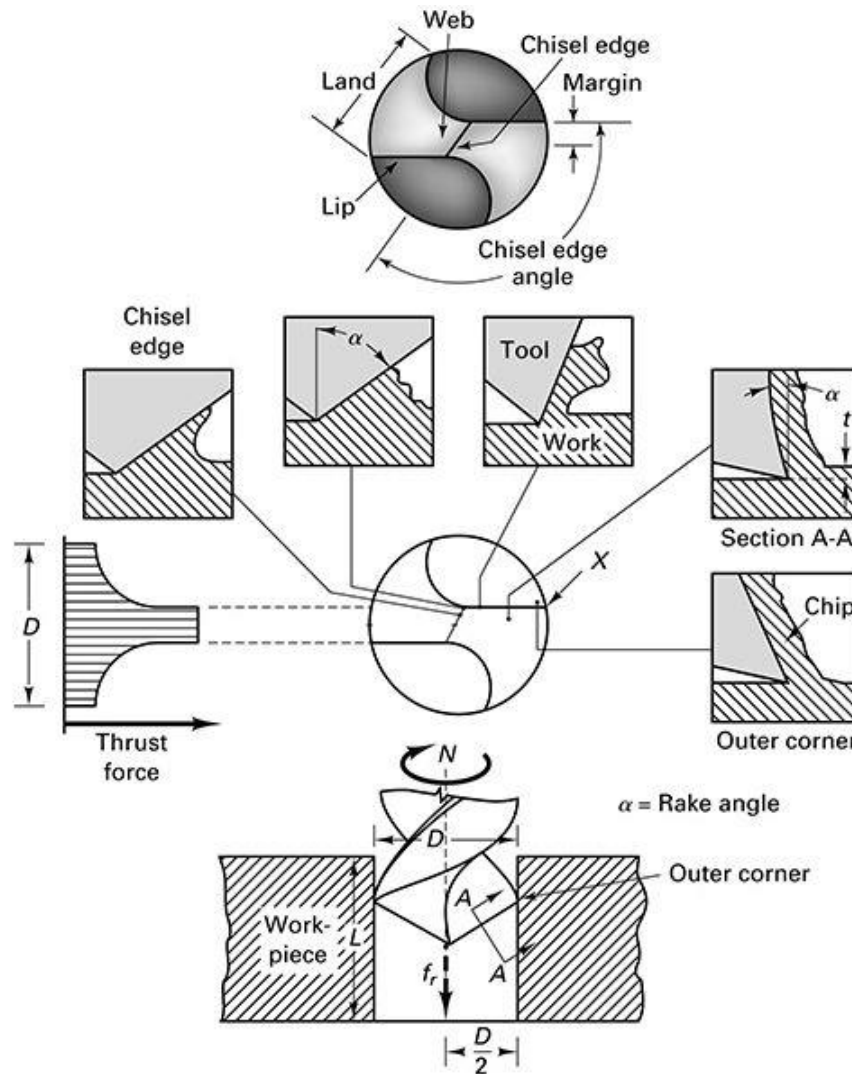


# Point (Cone) Angle

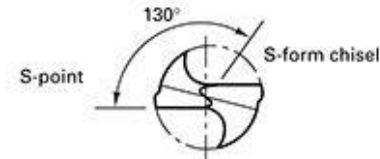
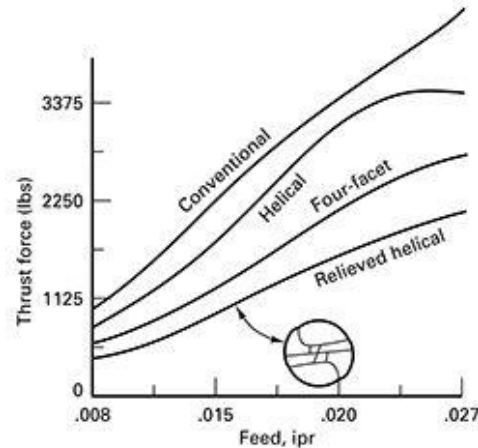




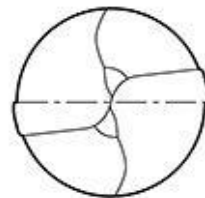
# Drill Point



# Drill Point Variations to Reduce Thrust

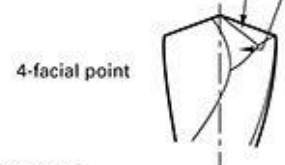


Helical (S-shape chisel point)  
 Can eliminate center drilling on NC machining centers  
 Excellent hole geometry  
 Close relationship between drill size and hole size  
 Increased tool life  
 Lower thrust requirements  
 Leaves burr on breakthrough

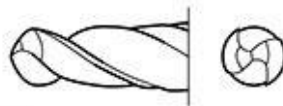


Relieved helical  
 Reduces thrust force  
 Eliminates chisel end  
 Equal, rake angle

Secondary angle 30° – 40° (true)  
 Primary angle 4° – 8° (true)



Four-facet  
 Good self-centering ability  
 Breaks up chips for deep-hole drilling  
 Can be generated in a single grinding operation: reduces thrust.  
 Eliminates center drilling in NC

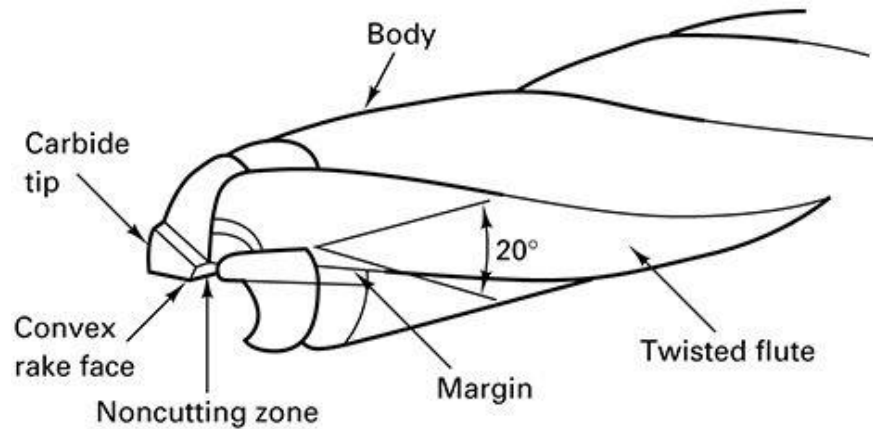


Bickford  
 Combination of helical and Racon point features  
 Self-centering and reduced burrs  
 Excellent hole geometry  
 Increased tool life

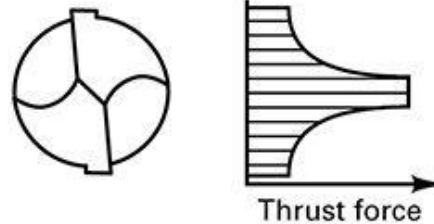


Racon (radiused conventional point)  
 Increased feed rates  
 Increased tool life (8–10 times in C.I.)  
 Reduced burrs at breakthrough  
 Not self-centering

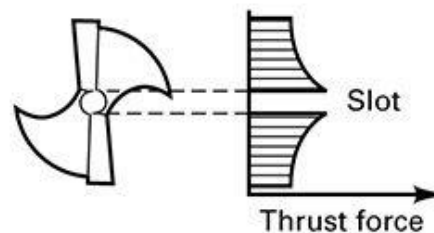
# Low Thrust Drill Point



Conventional drill with large thrust force at web.



Center core drill or slot point drill with greatly reduced thrust  
Center core removed by ductile fracture (tension)



# Improper Grinding

**Outer corners break down:** Cutting speed too high; hard spots in material; no cutting compound at drill point; flutes clogged with chips

**Cutting lips chip:** Too much feed; lip relief too great

**Checks or cracks in cutting lips:** Overheated or too quickly cooled while sharpening or drilling

**Chipped margin:** Oversize jig bushing

**Drill breaks:** Point improperly ground; feed too heavy; spring or backlash in drill press, fixture, or work; drill is dull; flutes clogged with chips

**Tang breaks:** Imperfect fit between taper shank and socket caused by dirt or chips or by burred or badly worn sockets

**Drill breaks when drilling brass or wood:** Wrong type drill; flutes clogged with chips

**Drill spits up center:** Lip relief too small; too much feed

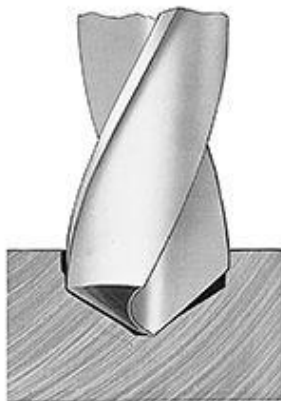
**Drill will not enter work:** Drill is dull; web too heavy; lip relief too small

**Hole rough:** Point improperly ground or dull; no cutting compounds at drill point; improper cutting compound; feed too great; fixture not rigid

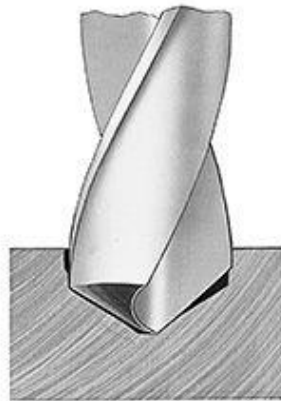
**Hole oversize:** Unequal angle of the cutting edges; unequal length of the cutting edges; see part (a)

**Chip shape changes while drilling:** Dull drill or cutting lips chipped

**Large chip coming from one flute, small chip from the other:** Point improperly ground, one lip doing all the cutting

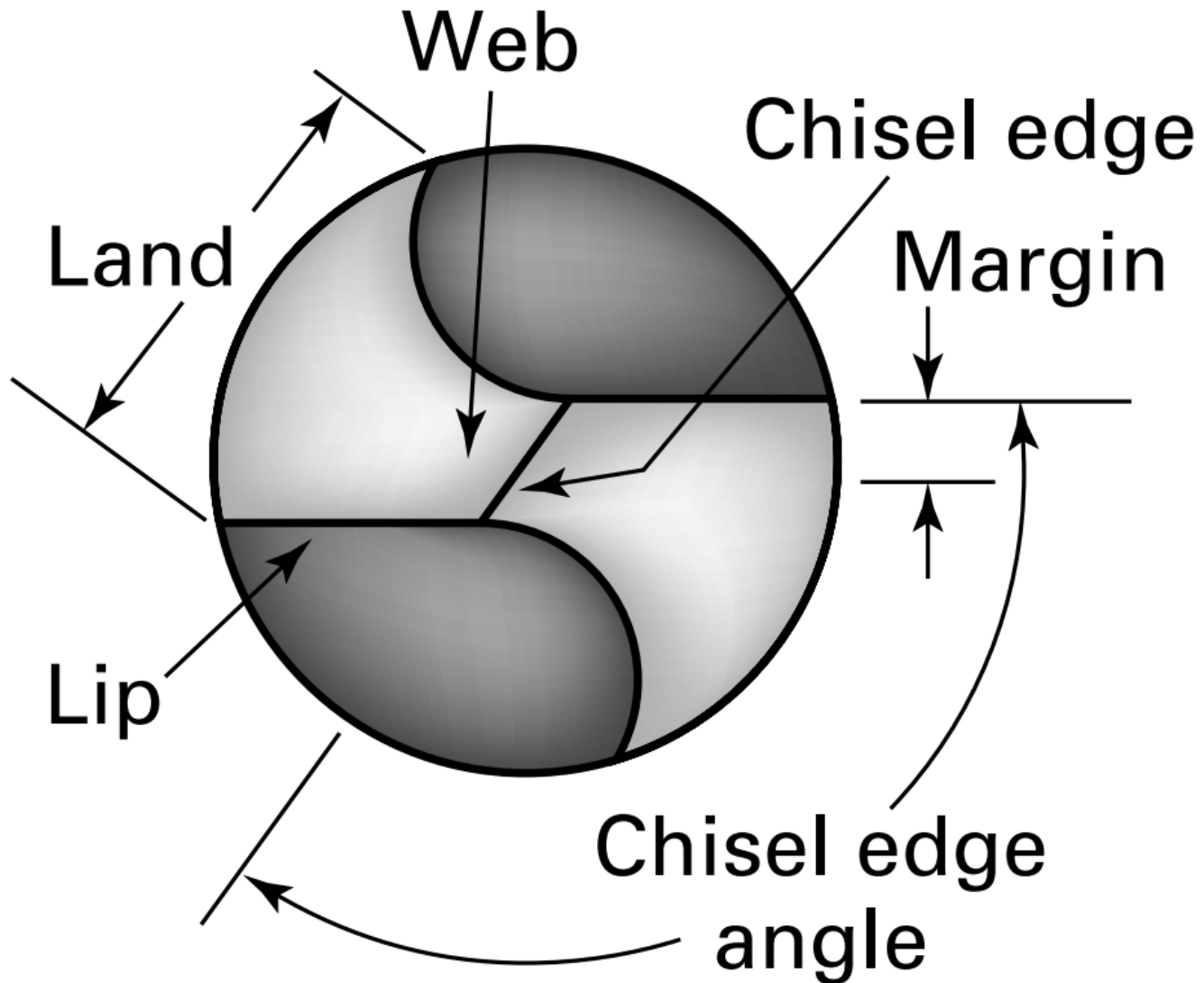


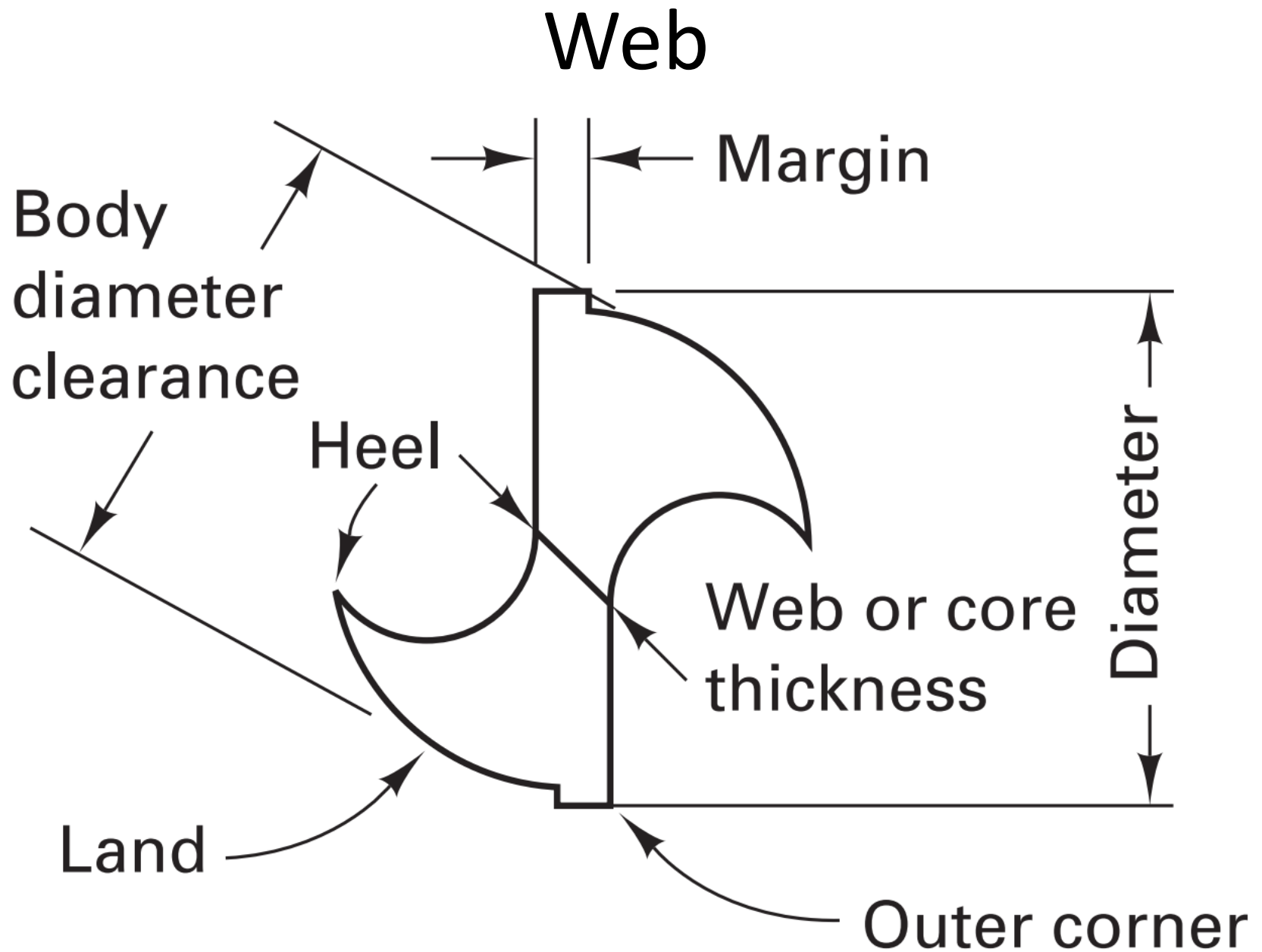
(a) Angle unequal



(b) Length unequal

# Chisel-Edge Angle





# Drill Sizes

## Millimeter series

increments of 0.01 – 0.5mm in dia. from 0.015mm

## Numerical series

No. 80 (0.0135") to No. 1 (0.228")

## Letter sizes

A (0.234") to Z (0.413")

## Fractional sizes

by 1/64" up to over 4 inches

# Hole Saw

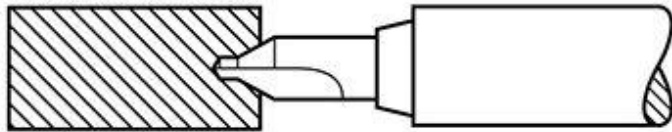




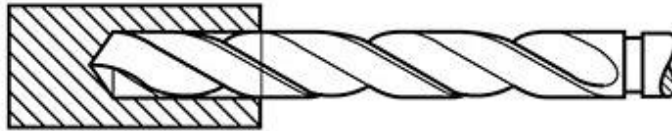
# Center Drill



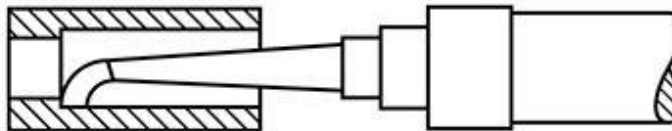
# Four Steps to an Accurate Hole



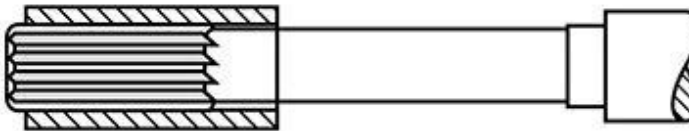
Step 1 Centering and countersinking with a combination center drill and countersink.  
*(Courtesy of Chicago-Latrobe)*




Step 2 Drilling with a standard twist drill.



Step 3 Truing hole by boring.



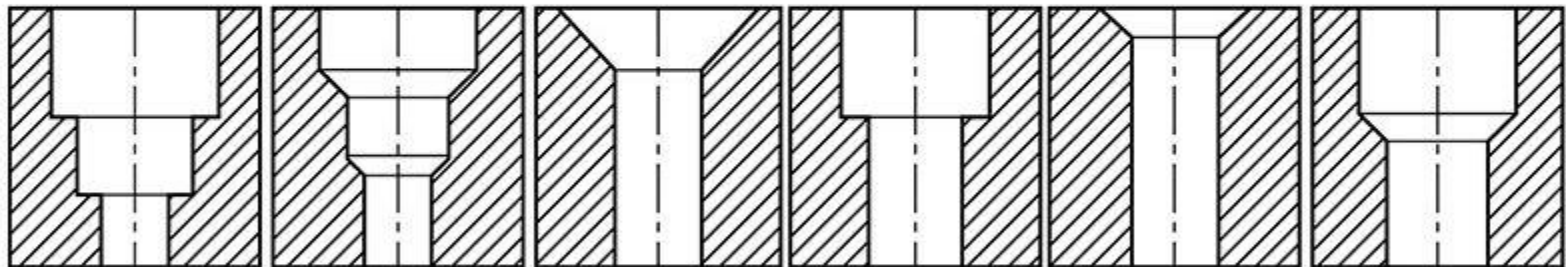
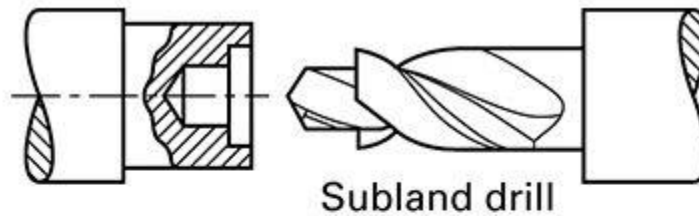
Step 4 Final sizing and finishing with a reamer.



**Center Drill**

[Watch Video Here](#)

# Combination Drills



Drill multiple  
diameters

Multiple drill  
countersink  
and counterbore

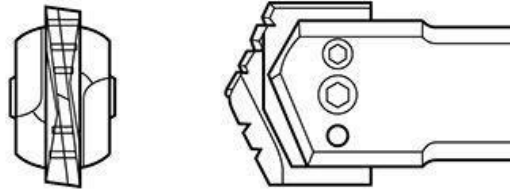
Drill and  
countersink

Drill and  
counterbore

Drill and  
chamfer

Drill,  
countersink,  
and counterbore

# Spade Drill



Regular spade drill

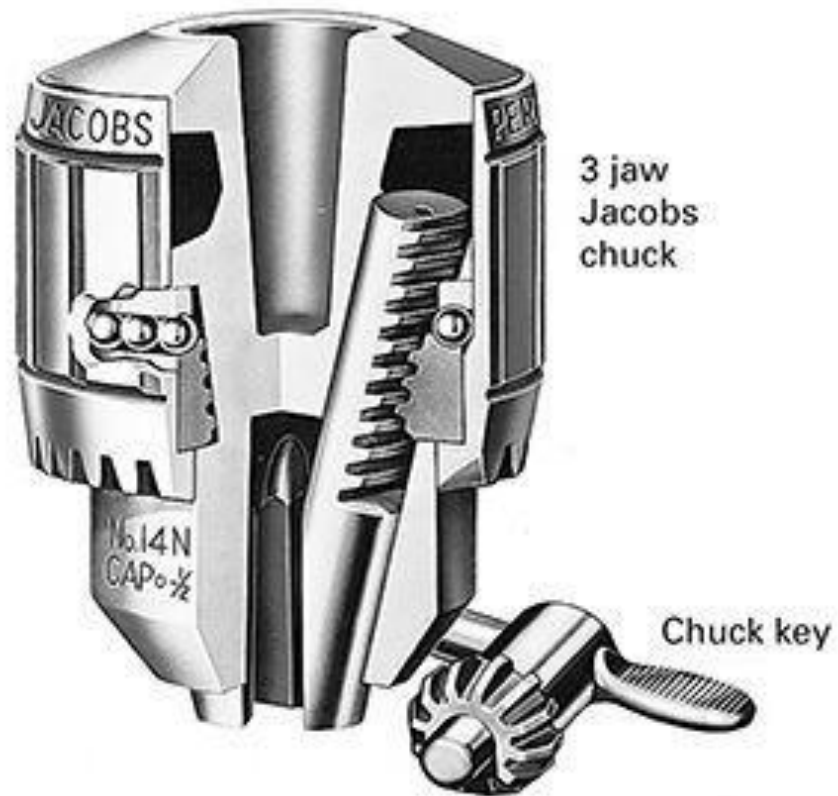


Spade drill with oil holes

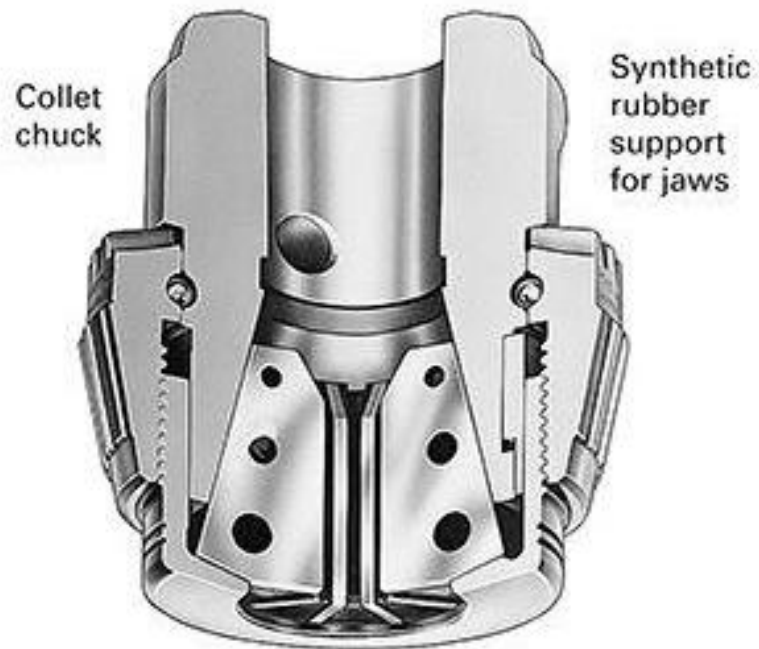
# Morse Taper



# Universal (Jacobs) Chuck

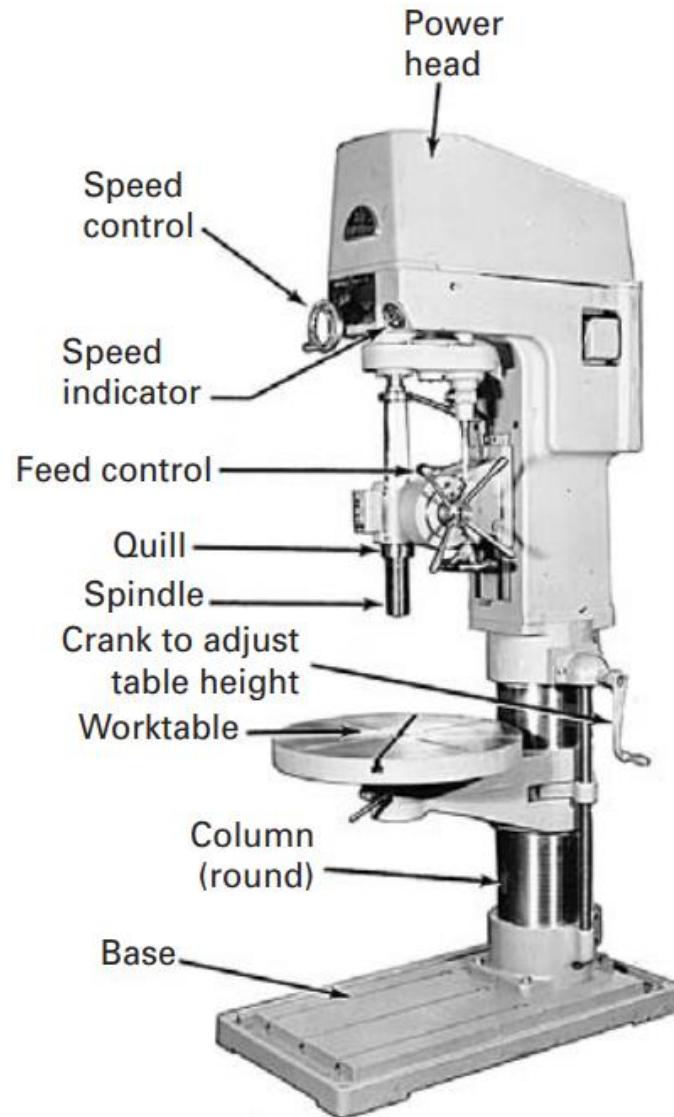


# Collet Chuck

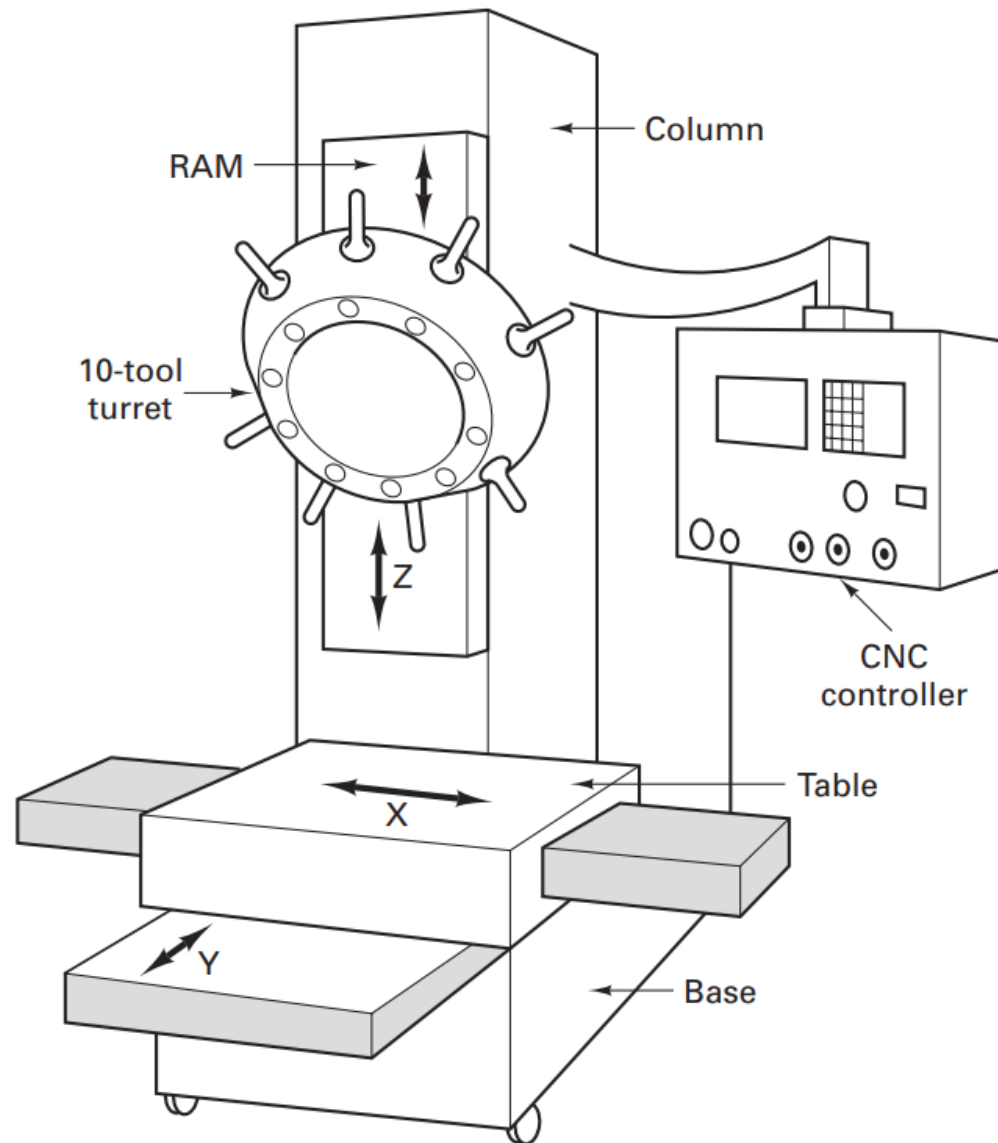




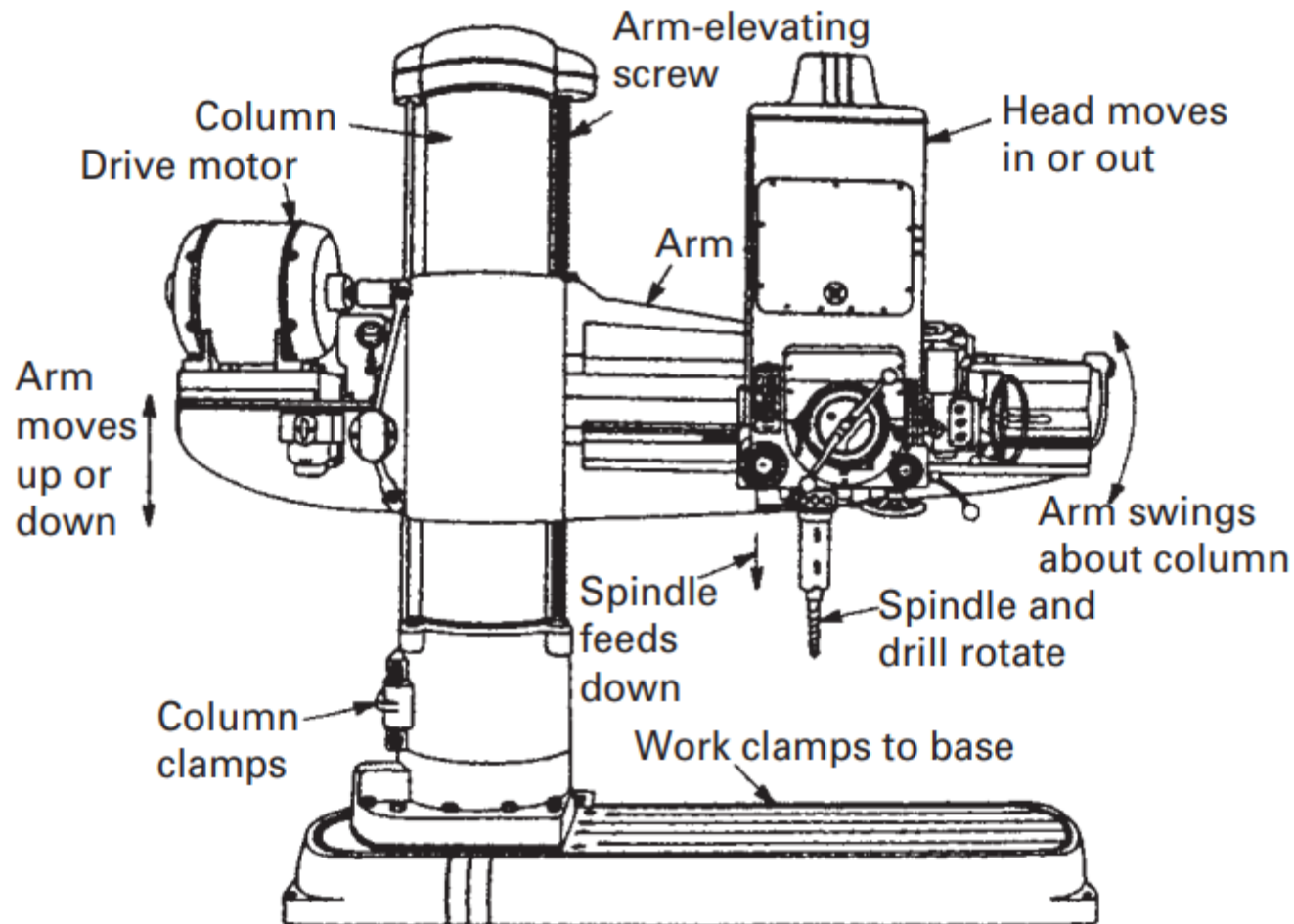
# Upright Column Drilling Machine



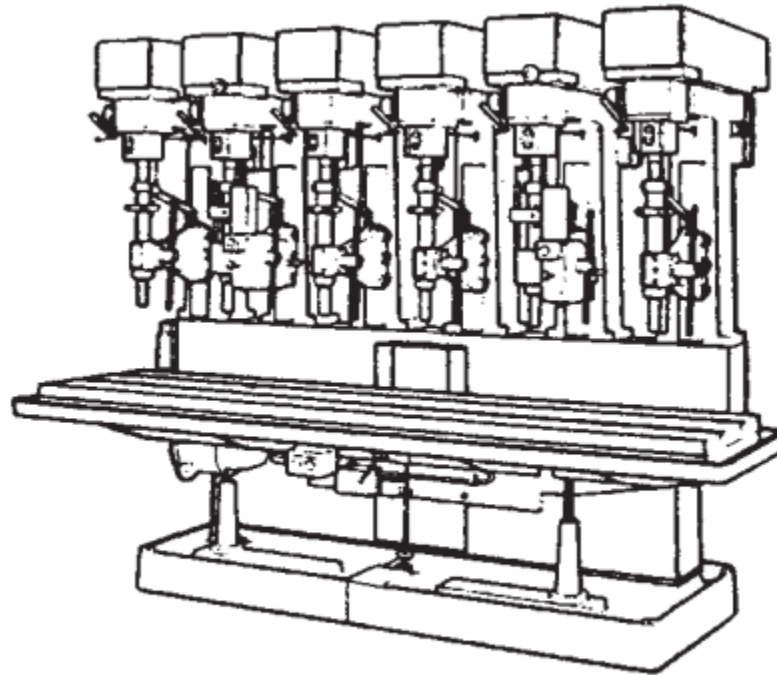
# CNC Turret Drilling Machine



# Radial Drill Press

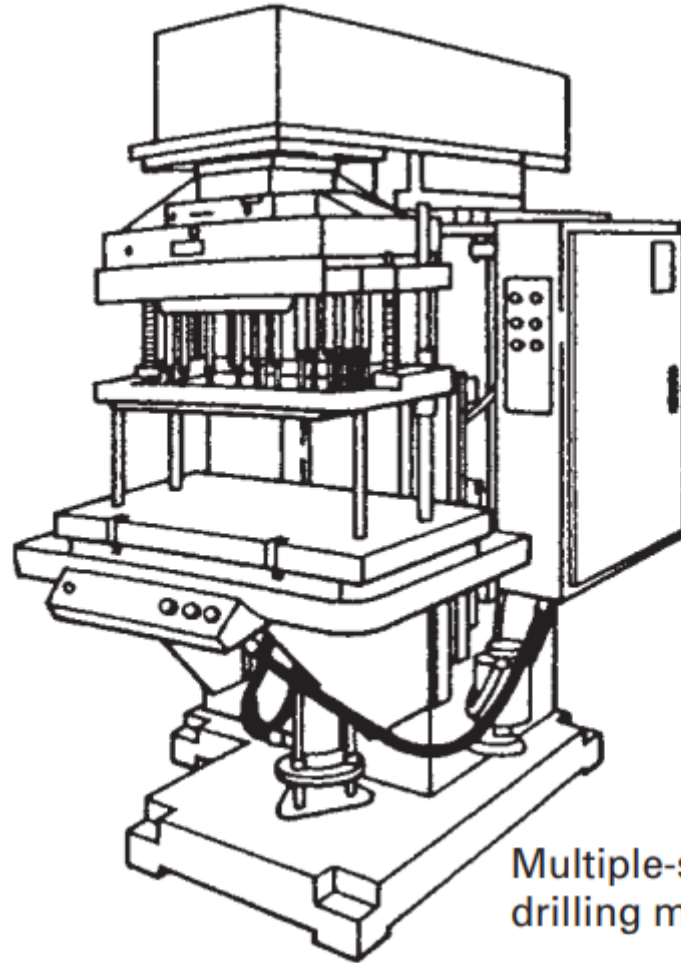


# Gang Drilling Machine



Gang-drilling  
machine

# Multiple Spindle Drilling Machine



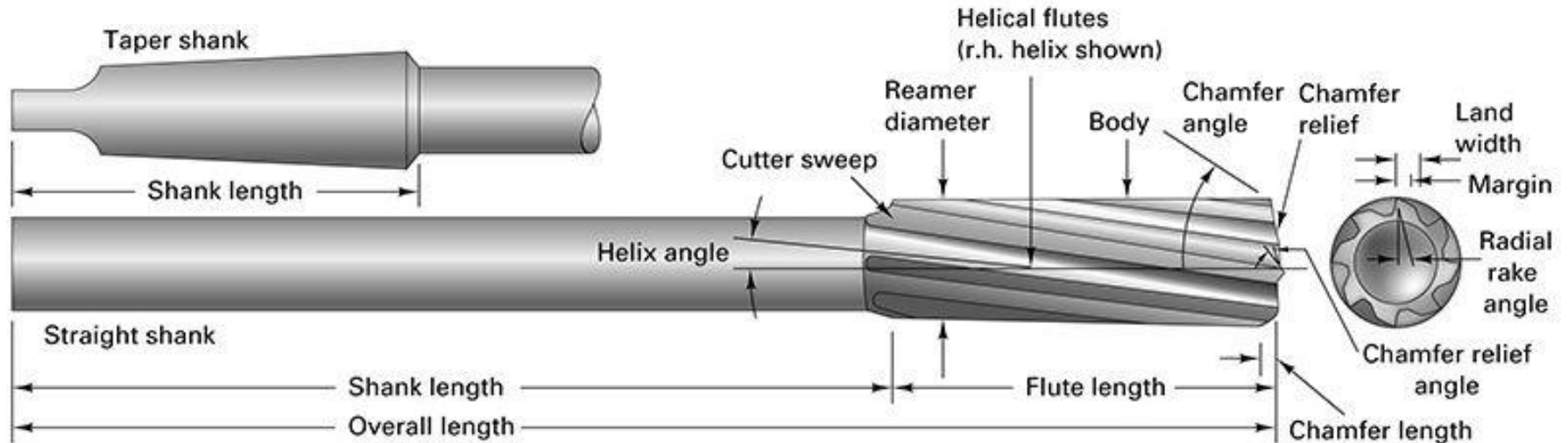
Multiple-spindle  
drilling machine

# HOLE FINISHING OPERATIONS

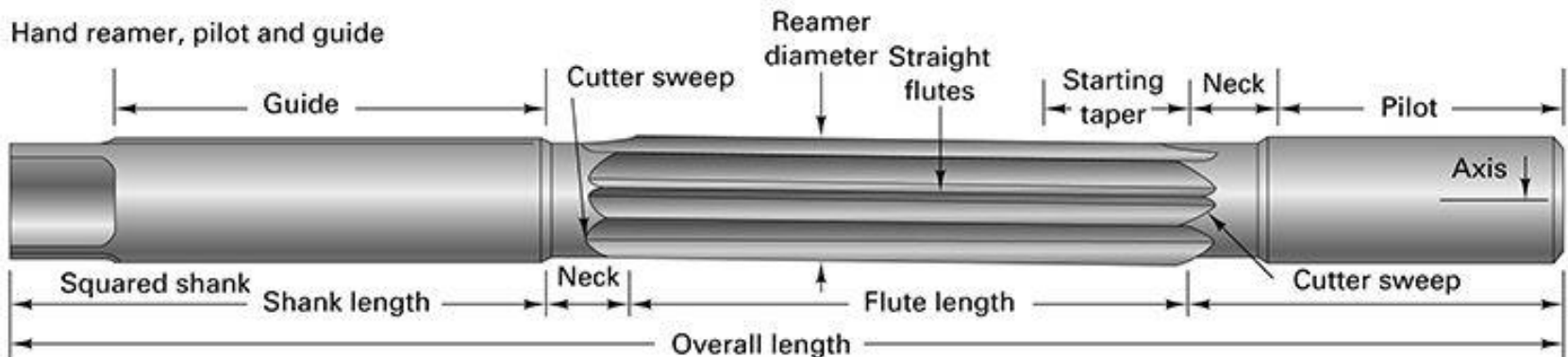
[Watch Video Here](#)

# Reamer Nomenclature

Chucking reamer



Hand reamer, pilot and guide



# Counterbore, Countersink & Spot Face

