Basics of Drill
Three Key Elements of a Cutting Tool

- 3 Elements Needed in a Good Cutting Tool
- Well Balanced For Best Performance
- Only Good as the Weakest Link

Geometry

Cutting Tool

Coating

Material
Drill Terms

Plain parallel shank

Endmill shank

Cylindrical shank

Flatted shank

Parallel shank with tang drive
Drill Terms Continued

- Chisel edge corner
- Chisel edge clearance
- Body clearance diameter
- Depth of body clearance
- Cutting edge length
- Flank clearance angle
- Point angle
- Leading edge of land
- Helix angle
- Outer corner
- Cutting edge
- Heel
- Face
- Body clearance

- Width of land
- Thinning
- Margin
- Width of margin
- Width of flute
- Web thickness
- Web
- Cutter sweep
Drill Flutes

- Evacuate Chips
- Generally Two Flutes
- Usually Spiral Helix Shape

- Low Helix 10-20°
  - Harder Material 35 HRC +
- Regular GP Helix 28-30°
- High Helix 40° +
  - Stringy Chips

High Helix EX - UG, AG-SUS, MQL, L517P, L545P

Low Helix EX – Aqua Hard
Compare Flute Types

Conventional
- “J” Shaped
- General Purpose
- 3-4 X Ø Deep Before Pecking

Parabolic
- Increased Flute Space
- Better Chip Evacuation
- Deep Hole Drilling
Point Angles

- 118° - General purpose point.
- 135°, 140°, 150° - Hi-performance points.
- Various Other Drill point angles
- Flat Bottom 180° (Not Pictured)
Point Angle Difference

High Point Angle (Flatter Point)
- Narrow Chips
- Harder/Tougher Materials

Lower Point Angle (Sharper Point)
- Wider Chip
- Softer Materials

• EX – 135° & 140°
• EX – 90° & 118°
Web

- Core of Drill
- Usually Tapered for Rigidity
- **Torsional** Strength
- Web Examples
  - Light EX - DLC
  - Medium EX – L501/HSS
  - Heavy EX – AG
  - Power Long
Web Construction

Parallel Web - Thin

Parallel Web - Heavy

High Helix

30° Helix

Thinned Web then Parallel

Constant Increase

EX - Aqua Drill
Hard List 9548

EX - AG SUS Drill
L65694P & L6596P

EX - SG Drills,
HSCO Drills
Effects of Web on Drill Re-Sharpening

- Web thickness
- Chisel edge length
- Drill Diameter

Sections A-A and B-B
Web Thinning

• Drill Web is Non-Cutting
• Consume Power and Torque to Plow Through the Work
• Thinning Reduces These

Ground notch to thin web and reduce chisel edge length
Types of Web Thinning

No Thinning

- No Material Removed

S-Type (Conventional)

- Follows the Flute Contour
- Easy to Thin
Types of Web Thinning

X-Type (Split Point)
- Reduce Thrust
- Very Effective with Thick Web
- Deep Hole Drilling

H-Type (Notched)
- Centering and Reduced Force
- Very Effective with Thick Web
- Deep Hole Drilling
Back Taper

- Drill Ø is Tapered Towards the Shank
- Avoid Rubbing of Margin(s) and Hole Wall
  - Decrease Heat
  - Decrease Friction
- 0.04/100mm – 0.1/100mm
- A Limiting Factor in Drill Re-Sharpening
Margin(s)

- Improve Guide of Drill
- Larger/Additional Margins Increase Stability (Precision)
Clearance Angle

• The Purpose is to Avoid Rubbing of the Flank
• Too Big of an Angle Weakens the Cutting Edge
Chip Type and Tool Life

Cone and Spiral Chips

- Basic Chip Type
- Low Harness Materials
- Easily Ejected
- Increase Feed to Break Chips

1. Cone and spiral type

Long Pitch Chips

- Ejected Straight Without Rolling
- Often Stick and Cause Jams
  - Decreased Accuracy
  - Possible Drill Breakage

2. Long pitch type
Chip Type and Tool Life

Fan Type Chips
- High Feed Drilling
- Easily Ejected

Cutting Off Type Chips
- Slightly High Feeds
- Low Work Material not Ductility
- Generally Unfavorable
  - Increase Vibration
  - Fluctuation of Breaking Resistance

Zigzag Type Chip
- Low Feed
- Easily Clogged
# Chip Type and Tool Life

## Needle Type Chip
- Brittle Materials
- Easily Ejected Except in Vertical Drilling

## Powder Type
- Cast Iron
- Deteriorate Cutting Fluid
- Can Congeal like Concrete

- Watch for Chip Color Change
- Chips Become Darker (Brown, Violet, Black) as
  - Temperature Increases
  - Tool Life Decreases
Thank You