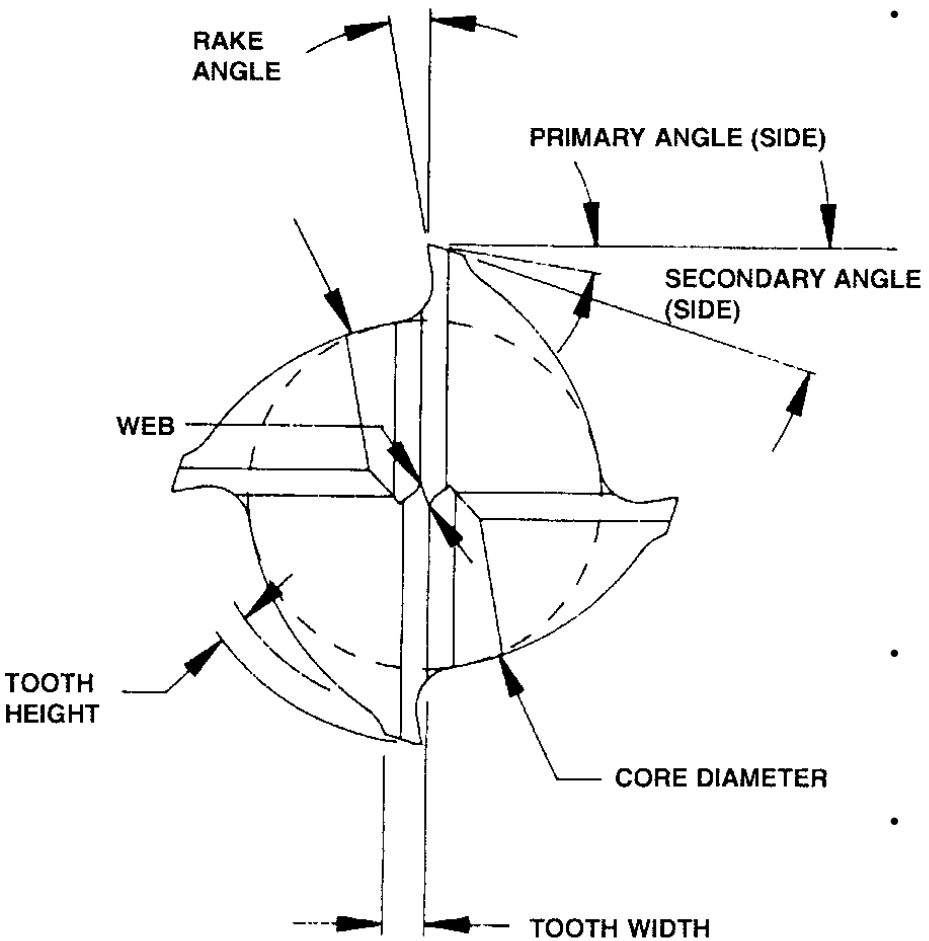

Lotta 101
Tools and Toolholding

Tool Terminology
What kind of tools are there
How tools are held securely in place

Endmills
Facemills
Corncobs
Saws
Drills

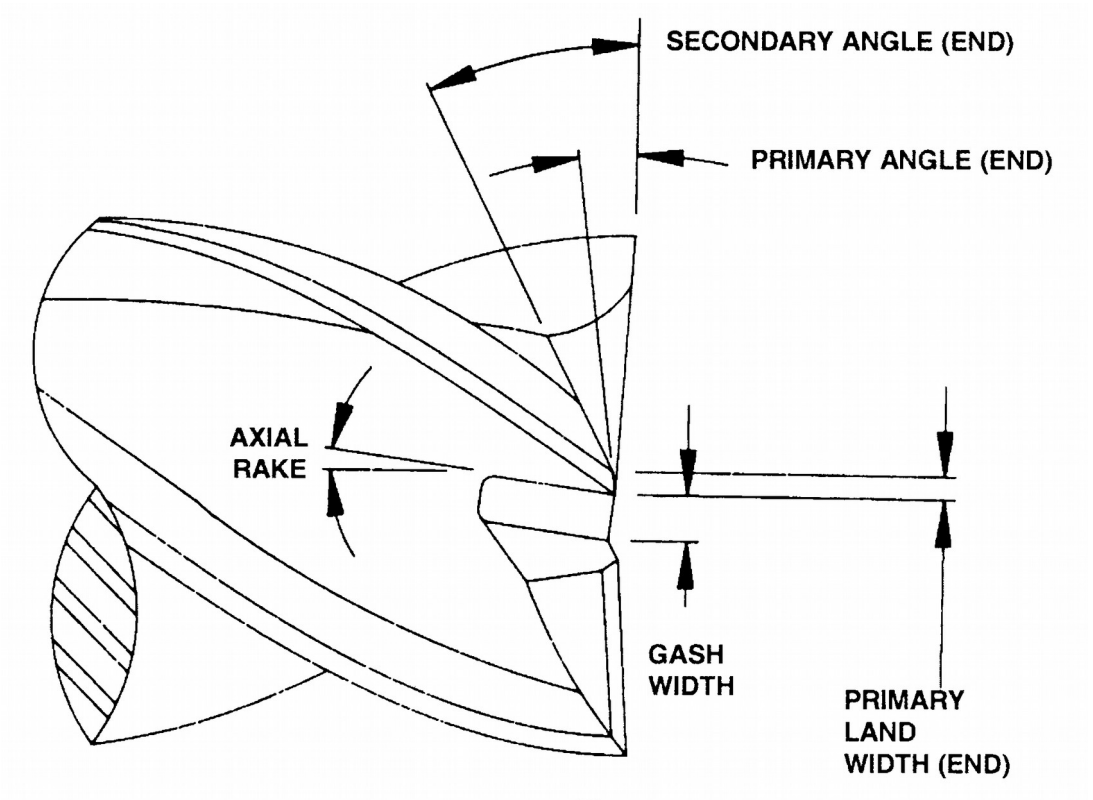
Fixing the tool holder to the spindle
Fixing a tool to the tool holder

Cutter Terminology

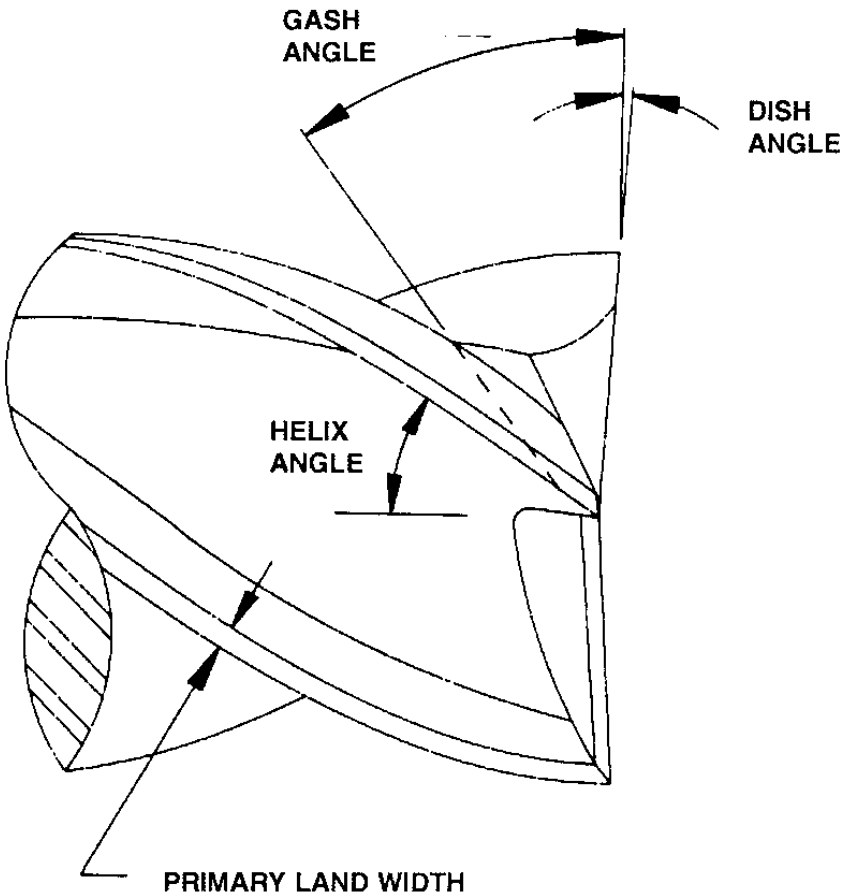


- Rake - The angular relationship between the tooth face or a tangent to the tooth face at a given point and a reference plane or line. An angular feature ground onto the surface of an end mill.
  - Axial rake - The angle formed by a plane passing through the axis and a line coinciding with or tangent to the tooth face.
  - Effective rake - The rake angle influencing chip formation most is that measured normal to the cutting edge. The effective rake angle is greatly affected by the radial and axial rakes only when corner angles are involved.
  - Helical rake - For most purposes the terms helical and axial rake can be used interchangeably. It is the inclination of the tooth face with reference to a plane through the cutter axis.
- Negative Rake - Exists when the initial contact between tool and workpiece occurs at a point or line on the tooth other than the cutting edge. The rake surface leads the cutting edge.
- Positive Rake - Exists when the initial contact between the cutter and the workpiece occurs at the cutting edge. The cutting edge leads the rake surface.

Cutter Terminology - continued

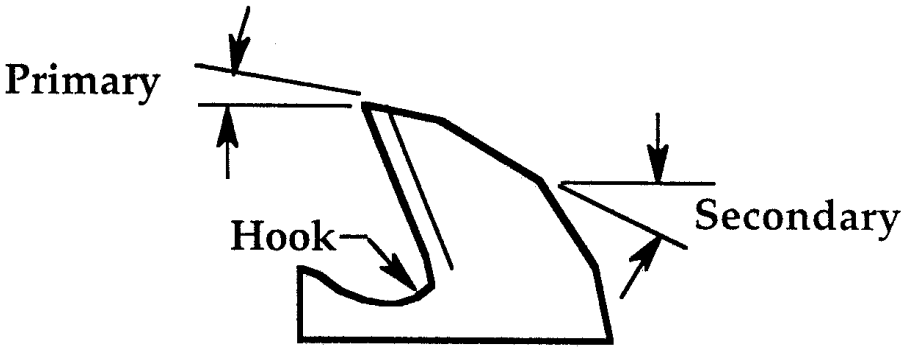


Cutter Terminology - Endmills



- Gash (Notch) - The secondary cuts on a tool to provide chip space at corners and ends. The space forming the end cutting edge, which is used when feeding axially.
- Gash angle - The relief angle of the gash feature.
- Gash width - The width of the gash feature. The space between cutting edges, which provides chip space and resharpening capabilities. Sometimes called the flute.
- Helical - A cutting edge or flute which progresses uniformly around a cylindrical surface in an axial direction. The normal helical direction is a right direction spiral.
- Helix Angle - The angle formed by a line tangent to the helix and a plane through the axis of the cutter or the cutting edge angle which a helical cutting edge makes with a plane containing the axis of a cylindrical cutter.
- Hook - A term used to refer to a concave condition of a tooth face. This term implies a curved surface rather than a straight surface. Hook must be measured at the cutting edge, making measurement difficult.
- Land - The narrow surface of a profile sharpened cutter tooth immediately behind the cutting edge

Cutter terminology



Clearance Angle - The angle formed by the cleared surface and line tangent to the cutting edge.
Clearance: Primary (1st angle, 5°-9°) - Relief adjacent to the cutting edge.
Clearance: Secondary (2nd angle, 14°-17°) - Relief adjacent to cutting edge
Clearance: Tertiary (3rd) - Additional relief clearance provided adjacent to the secondary angle.

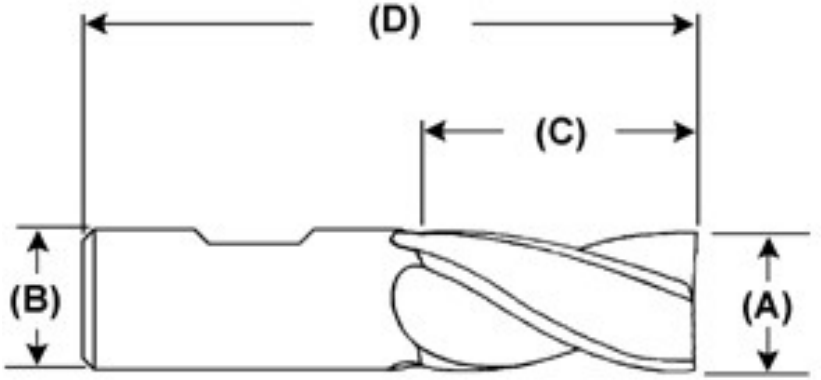
Tool Materials

- Carbon Steel
  - Your basic steel. Old material, not really used any more for milling tools
- High Speed Steel (HSS).
  - Alloy steel with varying amounts of cobalt and tungsten (wolfram for the rest of you)
  - Significantly harder and tougher than plain carbon steel
  - Still used a lot in ”ordinary” tools
- Tungsten Carbide or just ”carbide”
  - An alloy of metallic tungsten and carbon. There are numerous ”grades” for varying purposes
  - Very hard, very high melting point
  - Material of choice for modern high speed milling

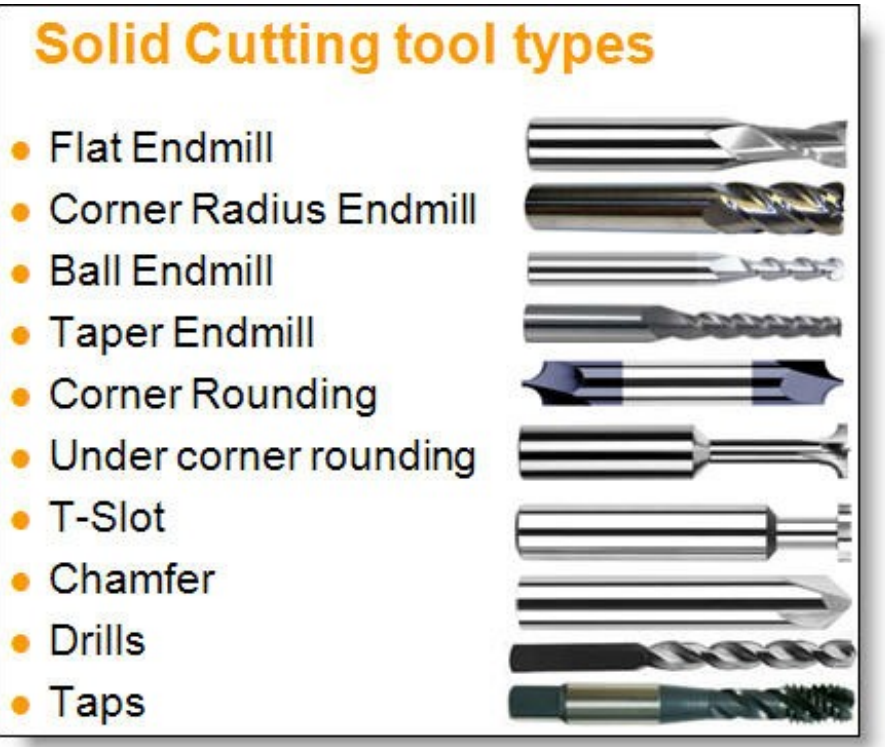
Endmills – general Purpose Tools

- An endmill is a basically cylindrical cutter with a various number of cutters of *flutes.*
- Flutes and shank are connected by a *shoulder* (smaller diameters)

A - mill size or cutting diameter
B - shank diameter
C - length of cut or flute length
D - overall length

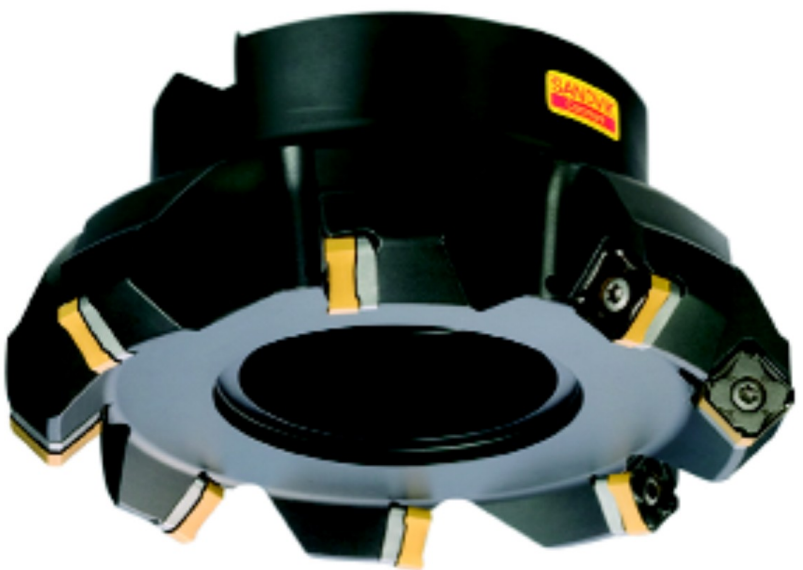


- The shoulder and shank are not usable for cutting. Do not let them rub against the workpiece!



Facemills – Getting Flat Surfaces Quickly

- Facemills are used solely for roughing flat surfaces out of workpieces



- Practically always the facemill format is a *crown* with *indexable carbide inserts*

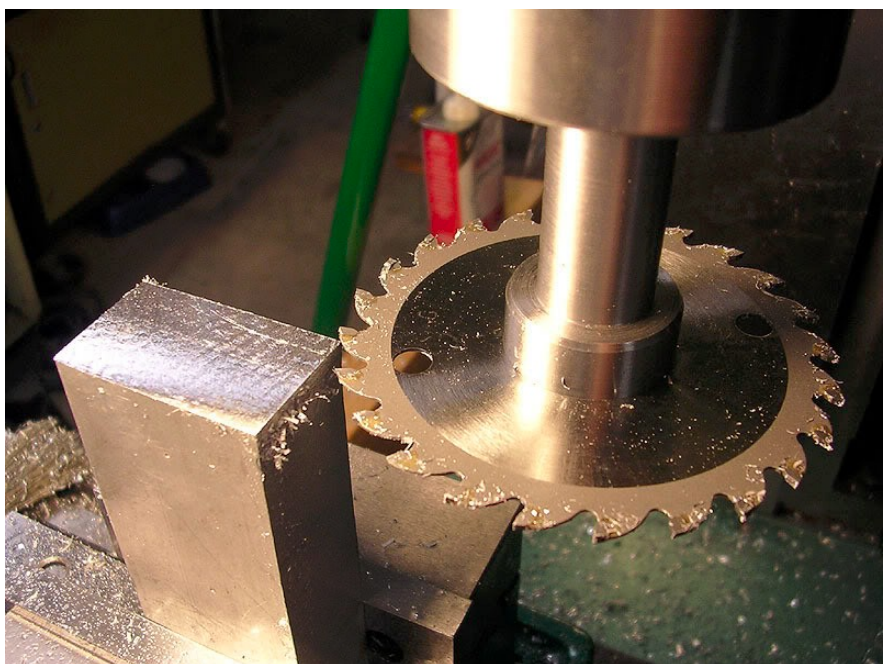
Corncob mills

- ”Corncob” mills are made for high profile side cut milling.

- Like facemills, corncobs are practically always with indexable carbide inserts.
- Unlike facemills, the inserts create long flutes along the mill, enabling it to mill deep vertical features.
- Corncobs are roughing tools

Slitting saws

- Used for parting and cutting narrow slits through parts of the workpiece



- Slitting saws are steel disks with integral teeth (HSS) or brazed carbide inserts.
- Yhe saw is fixed to an arbor that passes through a central hole. There may or may not be a locking key preventing slippage
- There are innumerable saws of differing material, diameter and tooth pitching for various purposes

Drills

- A CNC mill can use the same regular drills as a drill press.
- Attachment is by a regular chuck or a Morse cone (recommended)

Tool Holders – Attachment to the Machine

- The machine spindle has a standard attachment for accommodating various tool holders
  - There are several mutually incompatible attachment standards with varying fixing cones such as ISO, CAT, BT, R8. Lotta uses a type BT40 tool holder
- The tool holder is locked in place to the spindle using a stud bolt in the holder and an interlocking, pneumatically operated draw bar in the spindle

Tool Holders - Attachment to the Tool
Collet attachment – ER-collet

- An ER collet is a multiply split (thus flexible) conical collet with cylindrical bore
- The collet is compressed by a clamping nut, causing it to grip the tool
- The tool shank must be cylindrical
- Various ER-collets sizes for nominal diameters 11, 16, 20, 25, 32, 40 mm
- Each (metric) series has collets at 1 mm intervals up to the maximum for the series
- Larger collets accommodate diameters ~1mm down from nominal

Tool Holders - Attachment to the Tool
Screw fixture – Weldon collet

- The tool is fixed into a precision ground bore using a locking screw. To facilitate this, the tool must have a flat for the screw
- Weldon-fixture is simple and reliable but not as accurately concentric as ER due to the asymmetric fixing force
- Each Weldon collet only accepts the precise nominal diameter tool

Tool Holders - Attachment to the Tool
Facemill / Crown Mill Arbor

- For attaching heavy roughing tools
- The arbor aligns the tool radially
- An end bolt secures the tool against a precision ground surface axially
- Shoulder lugs transmit the needed torque to the tool

Tool Holders - Attachment to the Tool
Morse taper (MT)

- A Morse taper is a self-holding fixture for drills and reamers
- It is not reliable against radial forces so not suitable for tools with sideways forces
- Several sizes MT1 … MT5 for diferent size tools
- The tool is attached by tapping it in and removed by wedging from the top tang

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