Machining is a general term describing a group of processes that consist of the removal of material an modification of the surfaces of a workpiece after it has been produced.

- Advantages
  - Good dimensional accuracy
  - Good geometry, sharp edges
  - Economical

- Disadvantages
  - Wasted material
  - More time than some other processes
**Elements of Machining**

- Machine (machine tool)
- Material
- Cutting tool
- Operational plan and settings
  - feeds, speeds, etc.
- Environment (coolant)

**Examples of Machining**

- Figure 21.1 Some examples of common machining operations.

**Machine Tools: Lathe**

**Milling Machine Tools**

**Cutting Material with Tool**

**Turning**

Schematic illustration of the turning operation showing various features.

Page 2
Tool Types

- Tool steels
- High-speed steel
- Ceramics (aluminum oxide)
- Coated carbides
**Characteristics of Tool Materials**

- **TABLE 22.2**
  - General Characteristics of Cutting Tool Materials: These Tool Materials Have a Wide Range of Compositions and Properties - overlapping (characteristics exist in many categories of Tool Materials)

- **Relative Cutting Time of Tool Materials**

- **Select Proper Tool Video**

- **Wear Patterns on Tools**

- **Machined Steel Surfaces**

- **Applying Cutting Fluids**

Figure 22.12 Schematic illustration of the proper methods of applying cutting fluids (flooding) in various machining operations: (a) turning, (b) milling, (c) thread milling, and (d) drilling.
Turned Surface Feed Marks

Surface roughness:

\[ R_a = \frac{\sum f}{N} \]

where

- \( f = \) feed
- \( R_a = \) tool nose radius

Feed and Speed Selection

Factors Influencing Machining

Energy Requirements

Tool Life Economics

Terminology

- Independent Variables
  - Material (machinability)
  - Cutting tool
  - Speed (sfpm)
  - Depth of cut (in)
  - Feed (ipr or ips)
  - Cutting conditions

- Dependent Variables
  - Metal removal rate
  - Cut time
  - Horsepower
  - Temperature
  - Surface finish

**Table 21.1 Factors Influencing Machining Operations**

**Table 21.2 Approximate Range of Energy Requirements in Cutting Operations at the Drive Motor of the Machine Tool (For Dull Tools, Multiply by 1.25)**

**Figure 21.18 Cost per hour for a machining process versus cutting speed.**
Tool Life

- Taylor’s tool life model
- Fredrick Taylor – 1907 (ASME)
- \( VT^n = C \) (.08 < n < .7)
  - Where \( V \) = surface speed (in/min)
  - \( T \) = tool life in minutes
  - \( n \) = value based on material and tool
  - \( C \) = a constant

Taylor Tool Life Equation

\[
VT^n = C
\]

Buying Tools - Companies

- Carboloy
- Kennemetal
- Many others