Turning Machining - Definition

*Turning* is the process of machining external, or internal cylindrical and conical surfaces in which the part is rotated as the tool is held against it on a machine called a *lathe*. Mathematically, each surface machined on a lathe is a *surface of revolution*.
The workpiece is rotated while the tool is fed at some feed rate (mm per revolution). The desired cutting speed \( V \) determines the rpm of the workpiece.
How a Lathe can be used:  1. Drilling

If a hole needs to be drilled in the end face of the part, then a drill can be mounted in the tailstock. The cylindrical part is held in the chuck, and the spindle rotates the part at high speed. The tailstock wheel is then used to feed the tool into the face of the part, to cut the hole.

How a Lathe can be used:  2. Using a cutting tool in the tool-post

The tool post can move along the slide, by turning the carriage wheel; the tool can also be moved closer or farther from the rotation axis of the part – by turning the cross-slide wheel.

The part is held in the chuck, and rotates at high speed; by controlling the relative position of the tool against the part (by using the cross-slide wheel and carriage wheel), we can control the material removal and the shape produced.
The main parts of a Lathe - (Description)

- **Bed**: the foundation of the lathe
- **Spindle**: Carries the workholders, Hole to accept long work or bar stock
• **Tailstock:** Can slide longitudinally. Locks at desired location

• **Carriage:** Along with the apron provides the base for mounting and moving cutting tools

• **Cross slide:** Mounted to the carriage and provides movement for facing and cut-off operations.

---

• **Compound:** Mounted to the cross slide. Can rotate for angle cuts. It holds the tool post for cutting tools.

• **Toolholder:** A holding device mounted on the compound into which the cutting tool is clamped

• **Leadscrew:** Precision screw that runs the length of the bed. Used to drive the carriage under power for turning and thread cutting operations.
Types of Turning Operations

Turning can produce a variety of revolved shapes. The typical cutting operations on a lathe are shown in the figure.

Among these operations, only drilling requires the tool to be fed by moving the tailstock along the slide. In all other processes, the bar stock is held in a fixture at the spindle, with the opposite planar face free. However, if the stock is long, the tailstock may be used to provide extra support to the free end of the bar.
**Types of Turning Operations**

The tool feeds along a straight line

Tool is fed at an angle creates a conical geometry

---

**Types of Turning Operations**

Instead of feeding the tool along a straight line, the tool follows a contour

The tool creates a groove moving along a straight line (axis Z)
Types of Turning Operations

- **cut-off**: The tool is fed radially into the rotating work at the same location. (If passes the center then parting)

- **thread cut**: The tool is fed linearly across the outside surface of the rotating workpart in a direction parallel to the axis of rotation at a large effective feed rate, thus creating threads in the cylinder.

Types of Turning Operations

- **facing**: Tool is fed along x axis creates a flat surface at the end.

- **boring, internal groove**: A single point tool is fed linearly, parallel to the axis of rotation, on the inside diameter of an existing hole in the part.
Feeding the drill into the rotating work along its axis.

This is not a machining operation. Does not involve a cutting operation. It is a metal forming operation used to produce a regular cross-hatched pattern in the work surface.

Types of Turning Operations

Video - animation
An example with the most common types of surfaces machined by any lathe machine.

- External cylindrical surface
- External profiled surface
- External conical surface
- External threaded surface
- Flat surface
- Internal cylindrical surface

The cutting motion (rpm) is performed by the part. The feeding motion is performed by tools parallel (longitudinal) or perpendicular (transversal) to the rotation axis of the part.

Transversal / Longitudinal Feed
Methods of holding the stock in a Lathe

(a) **collets**

A **collet-type work-holder**: collets are common in automatic feeding lathes – the workpiece is a long bar; each short part is machined and then cut-off; the collet is released, enough bar is pushed out to make the next part, and the collet is pulled back to grip the bar; the next part is machined, and so on.

(b) **3-jaw chucks**

**3-jaw chucks** can be used in **three positions**: The figure shows the first; if the stock has an internal cylindrical surface, or is a tube, then the jaws of the chuck can be used to grip the part from inside by exerting an outward force; this allows the entire outer surface to be accessible to the tool. Finally, by reversing the jaws, larger sized bars can be held by using different levels of the steps.
4-Jaw chucks can be used to cut rotational shapes whose axis is offset (but parallel to) the axis of the part. This is because the opposite pairs of jaws can move independently.
EXAMPLE OF PART MACHINED BY A TURNING MACHINING CENTER

Calculations in Turning - Cutting Speed

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>Turning and Boring Rough Cut</th>
<th>Finish Cut</th>
<th>Threading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m/min</td>
<td>ft./min</td>
<td>m/min</td>
</tr>
<tr>
<td>MACHINE STEEL</td>
<td>27</td>
<td>90</td>
<td>30</td>
</tr>
<tr>
<td>TOOL STEEL</td>
<td>21</td>
<td>70</td>
<td>27</td>
</tr>
<tr>
<td>CAST IRON</td>
<td>18</td>
<td>60</td>
<td>24</td>
</tr>
<tr>
<td>BRONZE</td>
<td>27</td>
<td>90</td>
<td>30</td>
</tr>
<tr>
<td>ALUMINUM</td>
<td>61</td>
<td>200</td>
<td>93</td>
</tr>
</tbody>
</table>