GRINDING

PART 2
Grinding

Grinding is a material removal process accomplished by abrasive particles that are contained in a bonded grinding wheel rotating at very high surface speeds.

The rotating grinding wheel consists of many cutting teeth (abrasive particles) and the work is feed relative to the rotating grinding wheel to accomplish material removal.
INTRODUCTION TO GRINDING PROCESS

- It is the only economical method of cutting hard material like hardened steel.
- It produces very smooth surface, suitable for bearing surface.
- Surface pressure (cutting force) is minimum in grinding operation.
Grinding Process
Basic cylindrical grinding arrangement

Basic centreless grinding arrangement

Some common types of grinding wheels

Grinding face
Grinding wheel
Traverse
Wheel spindle
Workpiece

Grinding wheel
Magnetic base
Workpiece
Reciprocating table
Traverse

External
Internal
SURFACE GRINDING

ABRASIVE WHEEL

SPINDLE

COOLANT

WORKPIECE

DEPTH OF CUT

RECPROCATING WORK TABLE

CHIPS
Centre less Grinding machine
Centerless grinding process
Centre less Grinding

A. Grinding wheel
B. Grinding face
C. Regulating wheel
D. Work piece
E. Work rest blade

Movements
1. Grinding wheel   2. Work
3. Regulating wheel 4. Infeed
5. Traverse

\( \theta = \) Angle of tilt of regulating wheel
Cylindrical Grinding Machine
Cylindrical Grinding

Movements

1. Wheel
2. Work (rotates)
3. Traverse
4. Infeed
A basic overview of Internal Diameter Cylindrical Grinding. The Curved Arrows refer to direction of rotation.
Internal Diameter Cylindrical Grinding
Surface Grinding

- Grinding wheel
- Work table
- Traverse
- Crossfeed
- Oblique view
Surface Grinding machine
Surface grinding is used to produce a smooth finish on flat surfaces. It is a widely used abrasive machining process in which a spinning wheel covered in rough particles (grinding wheel) cuts chips of metallic or nonmetallic substance from a workpiece, making a face of it flat or smooth. The typical precision of a surface grinder depends on the type and usage, however $\pm 0.002$ mm should be achievable on most surface grinders.
CONSTRUCTION OF A GRINDING WHEEL

• In order make the grinding wheel suitable for different work situations, the features such as abrasive, grain size, grade, structure and bonding materials can be varied.

• A grinding wheel consists of an abrasive that does the cutting, and a bond that holds the abrasive particles together.
GRAIN SIZE

- The number indicating the size of the grit represents the number of openings in the sieve used to size the grain. The larger the grit size number, the finer the grit.
GRADE

• Grade indicates the strength of the bond and, therefore, the `hardness` of the wheel.

• In a hard wheel the bond is strong and it securely anchor the grit in place, and therefore, reduces the rate of wear.

• In a soft wheel, the bond is weak and the grit is easily detached resulting in a high rate of wear.
STRUCTURE

• This indicates the amount of bond present between the individual abrasive grains, and the closeness of the individual grain to each other. An open structured wheel will cut more freely. That is, it will remove more metal. In a given time and produce less heat.
STANDARD SHAPES OF GRINDING WHEELS

- Straight wheel
- Cylinder
- Tapered
- Recessed one side
- Straight cup
- Recessed both sides
- Flaring cup
- Dish
- Saucer
- Mounted wheels
SPECIFICATION OF GRINDING WHEELS

- Standard wheel markings
- Diameter of the wheel
- Bore diameter of the wheel
- Thickness of the wheel
- Type of the wheel
SELECTION OF GRINDING WHEEL

For grinding a job the right grinding wheel is to be selected. The selection of a grinding wheel will depend on the following factors.

• Material to be ground
• Amount of stock to be removed
• Finish required
• Area of contact
• Wheel speed
• Work speed
• Personal factor
• Method of cooling
GRINDING WHEEL DRESSING & TRUING

- **Dressing** refers to the removing of clogs and blunt abrasive grains from the surface of the grinding wheel. Dressing exposes the cutting edges which restore the correct cutting action of the wheel. Dressing is done on a glazed or loaded wheel to recondition it.

- **Truing** refers to the shaping of the wheel to make it run concentric with the axis. When a new grinding wheel is mounted, it must be trued before use to remove the run out.
GLAZING & LOADING

• When the surface of a grinding wheel develops a smooth and shining appearance, it is said to be glazed. This indicate the abrasive particles on the wheel face are not sharp. These are worked down to bond level.

• When soft materials like aluminium, copper, lead, etc. are ground the metal particles get clogged between the abrasive particles. This condition is called loading.
GRINDING SPEED
<table>
<thead>
<tr>
<th>TYPE OF GRINDING</th>
<th>WHEEL SPEED m/sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rough grinding wheel with vitrified bond</td>
<td>25</td>
</tr>
<tr>
<td>Rough grinding wheels with resinoid bond</td>
<td>45</td>
</tr>
<tr>
<td>Surface grinding wheels with vitrified bond</td>
<td>20-25</td>
</tr>
<tr>
<td>Internal grinding wheels with vitrified bond</td>
<td>20-35</td>
</tr>
<tr>
<td>Centreless grinding wheels with vitrified bond</td>
<td>30-80</td>
</tr>
<tr>
<td>Cylindrical grinding wheels with vitrified bond</td>
<td>30-35</td>
</tr>
<tr>
<td>Cutting off wheels with resinoid bond</td>
<td>45-80</td>
</tr>
<tr>
<td>Hand grinding of tools</td>
<td>20-25</td>
</tr>
<tr>
<td>Automatic grinding of tools</td>
<td>25-35</td>
</tr>
<tr>
<td>Hand grinding of carbide tools</td>
<td>18-25</td>
</tr>
</tbody>
</table>
DEPTH OF CUT

- It is the thickness of the material removed in surface grinding for one cut.
- Depth of cut in grinding depend on the:
  - Cutting load
  - Power of the machine
  - Finish required
SURFACE GRINDING MACHINE

• It is precision grinding machine to produce flat surface on a workpiece. It is a more economical and more practical method of accurately finishing flat surface than filling and scraping.
SPECIFICATION OF A SURFACE GRINDER

- Maximum dia. of the wheel that can be held on the spindle.
- Maximum size of the job that can be ground. \((150\times150\times400)\).
- The type of drive of the work table: hydraulic/electrical.
TYPES OF SURFACE GRINDERS

• Horizontal spindle reciprocating table
• Horizontal spindle rotary table
• Vertical spindle reciprocating table
• Vertical spindle rotary table
SURFACE GRINDING OPERATIONS

- Grinding flat surface
- Grinding vertical surface
- Grinding slot
- Grinding angular surface
- Grinding a radius
- Cutting off
Cylindrical grinders are used to grind the external or internal surface of a cylindrical workpiece. By cylindrical grinding the diameter of a workpiece can be maintained to a close tolerance (up to 0.0025 mm), and a high quality surface finish can be obtained (up to N4).
TYPES OF CYLINDRICAL GRINDERS

• External cylindrical grinders
• Internal cylindrical grinders
• Universal cylindrical grinders
• Centreless grinders
Grinding wheel selection

- Abrasive: Generally, Aluminium Oxide abrasives are well suited for steels and ferrous metals, while Silicon Carbide abrasives are ideal for grinding cast iron, non-ferrous metals and non-metallic materials.
Structure of grinding wheel

- Bond material
- Pores (air gaps)
- Abrasive grains
GRINDING FLUID

The Grinding fluid serves three main functions:
• Reduces Wheel wear.
• Cools the w/p.
• Flushes away the chips.
Honing or to "Hone" is an abrasive machining process that produces a precision surface on a metal workpiece by scrubbing an abrasive stone against it along a controlled path. Honing is primarily used to improve the geometric form of a surface, but may also improve the surface texture.

Typical applications are the finishing of cylinders for internal combustion engines, air bearing spindle and gears. There are many types of hones but all consist of one or more abrasive stones that are held under pressure against the surface they are working on.
Superabrasives and hone head for cylinders.
**Lapping** is a machining process, in which two surfaces are rubbed together with an abrasive between them, by hand movement or by way of a machine.

**Polishing** is the process of creating a smooth and shiny surface by rubbing it or using a chemical action, leaving a surface with a significant specular reflection.