SURFACE FINISH

SURFACE FINISH IS THE TERM USED TO DESCRIBE THE TEXTURE OF A SURFACE

What is Surface Finish?

- **Surface finish is a measurement of surface roughness**, often expressed in micro-inches or micrometers, signifying the texture and excellence of a material or component's exterior. Higher surface finish values signify a smoother surface, while lower values denote increased surface roughness.
- The significance of surface finish lies in its profound influence on component performance, longevity, and visual appeal. A refined surface finish can enhance performance through diminished friction, reduced wear and tear, and improved fluid flow dynamics. Moreover, it elevates a component's aesthetic appeal, rendering it more appealing to discerning customers.

Advantages of Surface Finishing Process

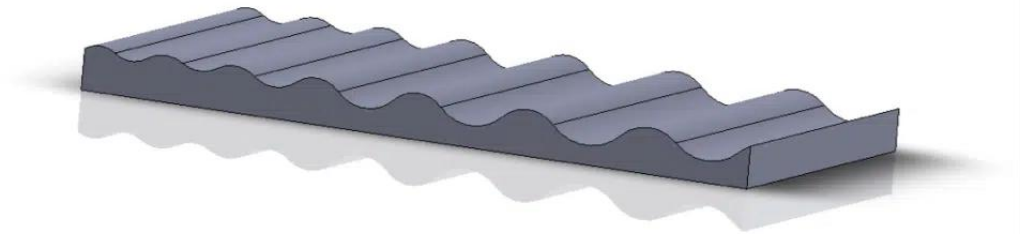
- The various advantages of Surface Finishing:
  I. Enhanced appearance.
  II. Improved corrosion resistance.
  III. Increased durability.
  IV. Reduced friction.
  V. Better electrical conductivity.
  VI. Tighter tolerances.
  VII. Stress relief.
  VIII. Improved adhesion for coatings.
  IX. Reduced surface roughness.

Roughness

- Roughness is the term used to describe the *small or microscopic* features that make a surface feel granular and abrasive. These features can be so small that the surface has a specular (mirror like) appearance, or they can be larger and random like sand, they can be larger and more orderly and they can be elongated in a machining direction.

Waviness

- Waviness is a commonly used term to denote the larger or *macroscopic* variations in a surface that can be thought of as *flatness.*
- The waviness of a surface will generally be on a larger scale than the roughness.



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Lay

- Lay is used to describe the machining features resulting from the *direction of tool/process* movement in creating a surface, usually present as extended lines of roughness which can be straight, curved or in closed patterns such as circles, depending on the toolpath.

Finishing Processes

- For several applications, grinding cannot meet the accuracy and surface finish requirements. For such applications, workpieces are subjected to final finishing operations, e.g., honing, lapping etc.

Some of the purpose of finishing surfaces of metal parts are:

(i) To improve the surface appearance—By polishing, buffing, burnishing.

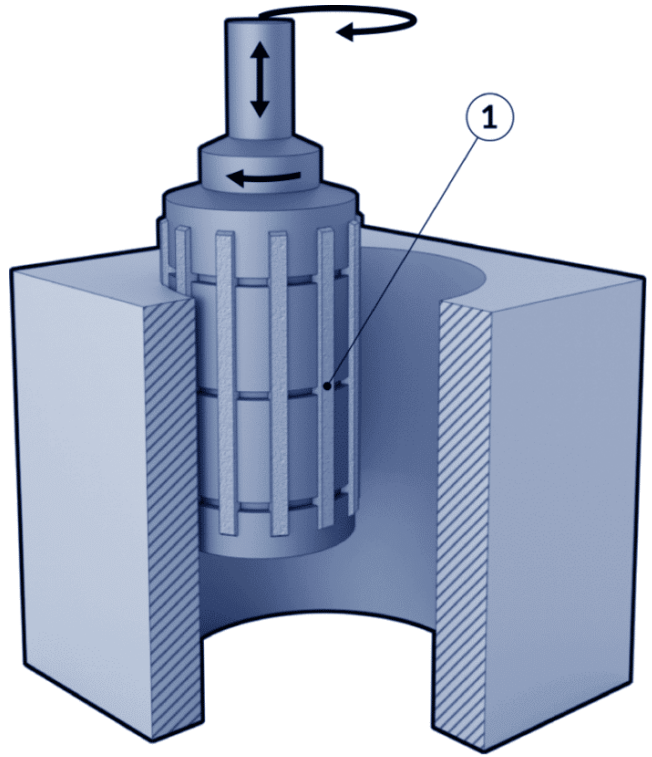
(ii) To improve dimensional accuracy and surface finish (smoothness)—By lapping, honing, superfinishing etc.

(iii) To provide a clean finish to the surfaces of a machine part, by buffing etc. to enable them to be coated with other metal (aluminium and nickel plating)—By electro depositing method.

(iv) To improve the functional properties of the machine parts (e.g., wear resistance, fatigue strength, power losses in friction of motion, strength of interference fits of mating parts, corrosion resistance).

Honing

- Honing is a grinding or abrading process in which very little material is removed. It is used primarily to remove the marks on the surface left by previous operations.



Honing Process

- In honing, the material is removed by abrasive sticks (aluminium oxide or silicon carbide) mounted in a mandrel or fixture.
- By floating action between the work and tool, the pressure exerted in the tool is transmitted equally to all sides.
- The honing tool is given a slow reciprocating motion as it rotates. This action results in rapid removal of stock and at the same time generation of a straight and round surface.
- A metal frame which holds the abrasive sticks during honing operation is known as a hone or a honing tool.

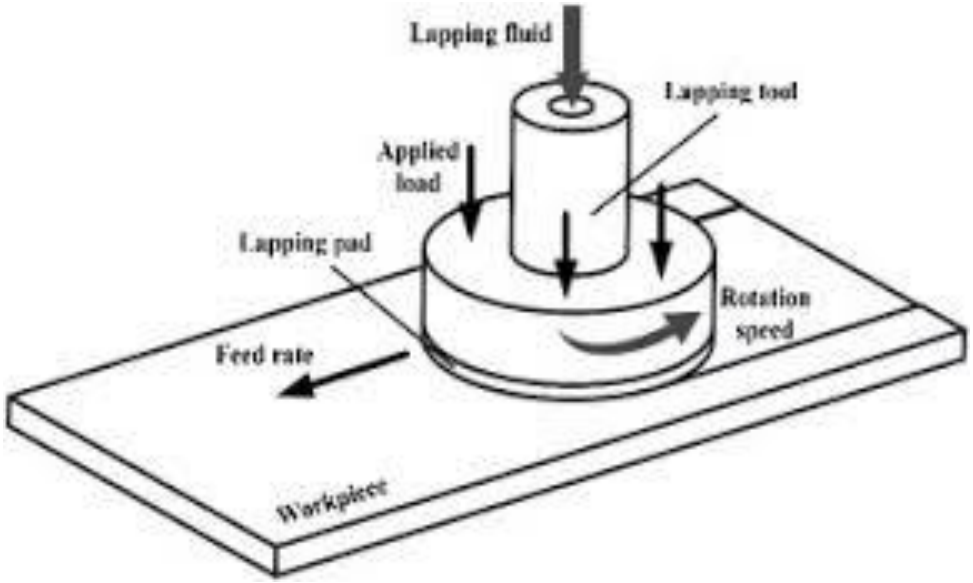
What is Lapping?

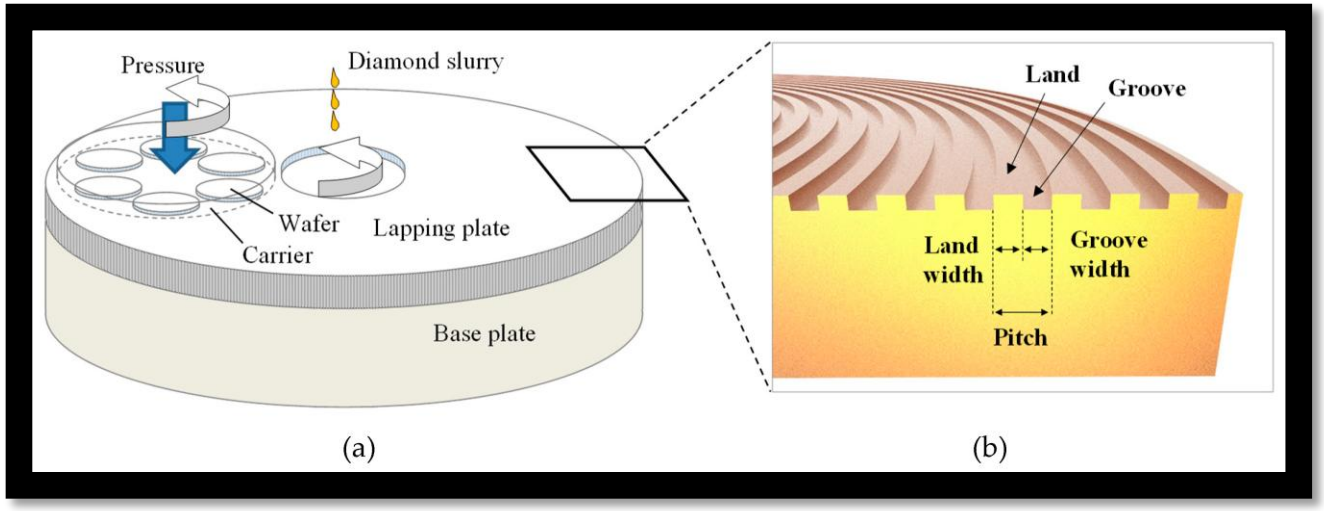
- **Lapping is a finishing process following after grinding, and designed to produce an exceptionally high degree of surface finish as well as a perfectly true surface accurate to size within extremely close limits.**
- Lapping is a precision finishing technique employed to achieve a fine surface finish. It primarily relies on abrasives acting as cutting agents, temporarily supported by laps. Typically, material removal during lapping falls within the range of 0.003 to 0.03 mm, although in specific instances, it can extend to 0.08 to 0.1 mm.
- Common lap materials include cast iron, soft steel, copper, brass, hardwood, hardened steel, and glass.
- In the lapping process, aluminium oxide abrasive is used to create a smooth and highly polished surface on various materials, such as metals, ceramics, and optical components.

lapping process

- In lapping process a layer of fine abrasive particles, usually suspended in a liquid, is held between the workpiece and the lap. The lap material being softer than the workpiece (generally cloth, copper or cast iron) causes the abrasive grains to get embedded on to the lap surface when pressure is applied between the lap and the workpiece. These grains cut the work in the same way as in grinding when relative motion is provided between the workpiece and the lap. Because of variations in grain size from particle to particle, not all the grains get embedded into the lap and these loose grains roll and slide between the workpiece and the lap and cause some material removal. Embedded grains are however, responsible for bulk of material removed and abraded workpiece conforms to the shape of the lap.

lapping process





Examples of lapping work :

1. Hand lapping :
   - Surface plates
   - Holes and pins
   - Tappet valves and valve seats
   - Jigs and fixture bushes
   - Slip gauges
   - Plug gauges

2. Machine lapping :
   - Diesel engine
   - injectors Oil burner parts
   - Gauges
   - Ball and roller bearing faces
   - Machine bearings
   - Measuring instruments

Superfinishing

- Superfinishing is an abrading process, efficient in surface refining of cylindrical, flat, spherical and cone shaped parts.
- It is not primarily a dimension changing process but mainly used for producing finished surface of fine quality on metals. Only a slight amount of stock is removed (average 0.002 to 0.02 mm on a disc).
- **The honing process involves two motions whereas superfinishing requires three to five or even more.** As a result of these motions the abrasive particle path is random and never repeats itself.

Superfinishing

- Superfinishing is generally used for :

  (i) Correcting inequalities in geometry.

  (ii) Removing surface fragmentation.

  (iii) Reducing surface stresses and burns and thus restoring surface integrity.

Examples of work :

- Crankshaft journals
- Automotive pistons
- Cylindrical shanks of valve tappets
- Roller bearing surfaces

Sl. No.	Aspects	Lapping	Honing	Superfinishing
1	Type of surface produced	Used to produce geo metrically true surface in addition to surface finish.	Used for finishing internal round holes.	Used to produce extremely light quality surface finish and not dimensional.
2	Abrasive tools used	Lapping consists of the use of loose abrasive particles with some vehicle. Mesh size of abrasive particles ranges from 120-1200	It makes use of bonded sticks called hones. Mesh size of abrasive particles ranges from 80–600.	It also makes use of bonded abrasive stones, but of finer mesh size ranging from 400–600.
3	Types of surface/ material for which used	It is normally used for hard surfaces, e.g., steel and cast irons.	It can be used for both soft and hard materials.	It can also be used for both soft and hard materials.
4	Type of process/ operation	Finishing (metal removal is very small up to 0.025 mm)	Metal removal (metal removal is high up to 0.75 mm)	Superfinishing (Metal removal is very small up to 0.005 mm)
5	Motion of the workpiece and tool	Both workpiece and laps are in motion.	Hone is rotating whereas the work piece is held stationary	Both workpiece and abrasive stone are in motion.

Polishing and Buffing

- Both these processes are used for making the surfaces smoother along with a glossy finish.
- Polishing and buffing wheels are made of cloth, felt or such material which is soft and has a cushioning effect.
- **Polishing -** It is done with a very fine abrasive in loose form smeared on the polishing wheel with the work rubbing against the flexible wheel. A very small amount of material is removed in polishing.
- **Buffing -** In this process the abrasive grains in a suitable carrying medium such as grease are applied at suitable interval to the buffing wheel. Negligible amount of material is removed in buffing while a very high lustre is generated on the buffed surface.