DESIGN FOR POLISHING AND PLATING

Polishing and plating are generally considered to be a part of finishing process.

**Polishing processes**

*Conventional polishing*

In conventional polishing, surface irregularities are removed from the workpiece by using abrasive particles which is glued to a flexible wheel or a belt. Often this process is referred as flexible grinding. Roughing, fining, and oiling are common terms for three steps of polishing. Metal removal process might be slow or rapid and causes some plastic deformation of the metal surface. Wheels can be made up of fabric, hemp, leather, wood, or felt. Polishing belts have contact wheels of various materials and the most common is rubber. For faster cutting, harder wheels and for contoured shapes soft wheels are preferred. To extend the service life of abrasive surface, different lubricants like tallow, wax, and fatty acids are used in both wheel and belt polishing.

**Buffing:**

Buffing operation is carried out after polishing with a finer abrasive to further smoothen the surface and to provide the surface a lustrous, grain less finish. Through this process a very little material is removed from the work piece. In buffing the abrasive is generally loosely held by the wheel.

**Barrel polishing or Tumbling:**

This is a deburring operation used for surface polishing. This process requires, a rotating barrel or vibrating hopper, water, a compound (cleaners or detergents plus fine abrasives) a medium (chunks of ceramic, stone, or metal) and the parts to be polished. When a rotation in the barrel or vibration in the hopper is given, it causes the medium to rub against the part with the abrasive action.

**Electropolishing:**

Electro polishing is a reverse process of electroplating. In this, the work piece acts as anode. After connecting the anode and cathode to DC power source, the setup is immersed in a
A typical nature of the electrolytic action is that the higher points including micro-projections are subjected to more intense electrolytic action and metal removal is more rapid. The process is gradual, finally resulting a smooth and glossy metal surface.

**Characteristics and applications**

Through polishing operations, surface imperfections like scratch marks, gates, stretch marks, cutting-tool marks, pits, parting lines, etc. are removed thereby improving the appearance of the workpiece. However, small dimensional refinement is also possible through polishing. This is required for surface smoothing purpose prior to plating, anodizing, painting, or for other surface finishes. In addition to these, few more applications of polishing are listed below.

1. It improves the contour of a part for enhancing fluid around propeller, turbine, or fan blades.
2. It provides clearance for assembly. It helps in the removal of burrs.
3. It prepares the surface for different operations like brazing, soldering and surface finishing.
4. It provides better resistance to corrosion by removing pockets in which contaminants can collect and stressed areas that could promote stress corrosion.
5. It makes the inspection of surface imperfections easier in various forged, cast and formed metal parts. This is because such defects are more visible if the surface is smooth.

Examples of different manufactured components having polished surfaces are plumbing fittings, cutlery, door hardware, automotive bumpers and trim, firearms parts, wrenches, pliers, and other tools, bicycle handle bars, golf-club heads and shafts, fishing-reel parts, stainless-steel and aluminum panels for appliances, turbine blades, nose cones, hydraulic cylinders, square and round tubing, bar stock, fountain pens, and cast cooking utensils. If part surfaces look like reflectors and having mirror-like surfaces, then both polishing and buffing must have done.
Suitable materials

All metallic and rigid nonmetallic materials with uniform and fine grained structure are preferred for the polishing process, the most suitable being then on-ductile machinable metals. However, ductile materials are also can be used for polishing in this method.

Design recommendations

It is recommended to have the workpiece in such a shape that the polishing wheel or belt can contact all points of the surface uniformly without any interference. Few design recommendations for the parts for wheel or belt polishing and buffing are listed below.

1. It is recommended to avoid compound curves, inside or outside sharp corners, deep recesses and other irregular shapes. If it is unavoidable, mild contours need to be provided as shown in Figure M5.2.1.

![Figure M5.2.1: Avoid deep recesses, irregular shapes and sharp corners](image)

2. Designs of parts involving hooked edges or sharp projections that are likely to cut the polishing wheel or belt as illustrated in Figure M5.2.2.
3. The obstructions like bosses, handles etc. which puts restriction on the free access of the wheel or belt to the surface to be polished are to be avoided as shown in Figure M5.2.3.

4. It is recommended to avoid polishing on large surfaces.

5. It is advisable to design parts which can be easily hold by hand or fixture so as to avoid difficulty in polishing.
In addition to these, the recommended design guidelines for barrel polishing are listed below.

1. Parts with small holes, slots and recesses are to be avoided in case of barrel-polish as illustrated in Figure M5.2.4.

![Not these](image1)

**Figure M5.2.4:** Small holes, slots, or recesses are undesirable in parts to be barrel-polished.

2. It is difficult to do barrel polish at interior surfaces of large holes, recesses and shielded areas. Hence, it recommended not to specify a polished surface in this location as shown in Figure M5.2.5.

![Polish inside and outside surface](image2)

**Figure M5.2.5:** Interior surfaces is not recommended for barrel-polished

3. Large flat surfaces should not be specified to be barrel polished.
Certain parts like springs and other wire or strip parts might get interlock and tangle during the barrel finishing operation and hence care must be taken.

**Recommended tolerances**

Table M5.2.1 summarizes the recommended surface finish to be provided for Mechanically Polished, Barrel-Polished, and Electro polished Surfaces.

**Table M5.2.1:** Recommended Surface-Finish for polishing. *(Source: Design for Manufacturability Handbook by James G Bralla, 2nd Ed)*

<table>
<thead>
<tr>
<th>Surface finish( µm)</th>
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<tbody>
<tr>
<td>Most economical</td>
<td>0.4</td>
</tr>
<tr>
<td>Normal</td>
<td>0.2</td>
</tr>
<tr>
<td>Finest</td>
<td>0.05</td>
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