Technical guide
Plating on Plastics

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Introduction

The plating of plastics is normally undertaken for either decorative or functional use. Through plating the particular properties of plastics, light weight, design flexibility and economy of manufacturing, are enhanced by the addition of properties usually associated with metals. These include reflectiveness, abrasion resistance, electrical conductivity and a variety of decorative surfaces.

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Why do designers choose plastic ?

- lightweight material
- High production capability
- Low unit cost compared with metal alternatives
- Intricate patterns easily reproduced
- Good mouldings can achieve a mirror finish
- No intermediate polishing required between moulding and plating
- No base material corrosion

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Design considerations

- Integral parts should be used to avoid welded joints
- Gates should be put in non appearance areas and should be 50% larger than for conventional mouldings
- Ribs and bosses should be designed to eliminate"sink" marks
- Texturing can be used to break up large flat surfaces and hide any defects such as scratches
- Draft angles should be at least 1° for easy removal from the mould (preferably 30)
- Parting lines should be put in non-significant areas if possible
- "Close tolerance fits" must include the final plate in the part design
- Wall thickness should be as thick as possible for rigidity and adhesion (minimum 1.5mm)

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- Plate uniformity, as a result of high and low current densities must be considered in the initial Design.

- The designer should be aware of:
  1. V grooves
  2. 90° angles

And should keep

1. Letters close to the surface
2. Angles as large as possible

- Consideration should also be given to blind holes, rack contact areas and part rigidity

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Moulding prior to plating

The quality of the mouldings for plating are one of the most important factors of the process. Poor mouldings give poor results.
A.B.S. Is a rigid copolymer containing distinct globules of butadiene. In the moulding process it is vital that an even distribution of butadiene is produced at the surface of the plastic and that this surface has minimum moulded in stress.In large scale production at least 50% of all problems associated with the plating of A.B.S. Can be attributed to either design or operational moulding faults.

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Moulding for plating
Considerations and effects

- **Use a reciprocating screw moulding machine**

- **Proper drying of resin**

A.B.S. Pellet must be pre-dried for 2-3hrs at 80-85°c immediately prior to moulding. Moisture in the Resin can cause "splay" or delamination on the part that may result in a blister

- **Proper fill speeds;**

Small components up to 90gms	5-7secs.
Large components up to	25secs.

Too short a fill speed can overpack a mould thus making it harder to etch and leading To poor adhesion

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- **Proper melt temperature 245-270°c**

Too cold a melt temperature causes internal stress to increase and become incorporated in the part leading to uneven etch and thermal cycling test failure. Too hot a melt may cause the material to degrade and thus give poor adhesion

- **Proper mould temperature 65-80°c**

Too cold a mould will cause the plastic to "skin" ,that is, the first material to hit the mould wall hardens and the hot material under it flows creating a surface skin effect that may cause delamination

- **Proper cooling time up to 30secs**

Longer cooling times promote the dissipation of internal stresses

- **Highly polished mould;**

Poor mould surfaces can cause defects in the moulded part, such as pits. These show up in the final plate and cause rejects

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Mould release agents
And fillers

Silicone type mould release agents should not be used. These compounds are extremely difficult to remove and usually lead to adhesion failures (blisters) or skip plate. Silicones interfere with
The function of the etching process. Moulders of plastics for plating do not generally use mould release chemicals, if it is necessary to use a mould release, then a stearate or soap type material should be used sparingly. In some cases, fillers are added to plastics for increasing strength (glass), making the material fire retardant (sb2o3, organic phosphate) or to impart colour (carbon black tio2). These can cause Problems in plating.

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For example, glass will usually give a rough surface to the finished part.

Some fire retardants can diffuse to the surface during etching leaving a film that is difficult to wash off and cause adhesion failures. If this non adherent layer can be removed good adhesion may be obtained.

When colorants are etched from the plastic substrate they are normally suspended as particles within the etch solution. Once a critical concentration has been reached, shelf roughness ie. Star dusting will occur.

Other fillers such as caco3 are added for ease of etching of a difficult plastic. These fillers are preferentially etched out of the surface to create the bonding sites required for good adhesion. Large particles create poor surface appearance.

Usually in a situation of this type, a happy medium is achieved where adhesion is adequate and the part looks acceptable.

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Quality control of mouldings

Whilst some defects may be obvious, others are not; moulded in strain, entrapped water and micro pits are some of the more troublesome, less obvious, defects. The following tests may give an indication of faults in mouldings prior to plating.

- **Acetic acid test**

Incorrect moulding practice can cause high internal stress which can seriously affect the moulded component during plating. Immersing a component in glacial acetic acid for 30secs will highlight stress as a white mark on
The surface of the component. These isolated marks may cause a problem during the plating cycle. Peeling of the plastic surface indicates "skinning" or delamination. Cracks or actual breakage indicate a highly stressed material. Mouldings in this condition should not be plated.

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- **Oven tests**

Moulded samples may be placed in an oven at a temperature of 90°c±5°c for up to one hour. Deformation of the part must be related to plated part performance.

- **Test for occluded water**

Immersion in boiling water for one hour is a useful test for detecting entrapped moisture, however, the small blisters raised by this test will never be as severe as water blisters produced during the conditioning and plating process. After removing from boiling water, components should be examined with a magnifying glass

Plating process

The plating on plastic process can be broken down into six major steps.

1. Cleaning

This removes grease, finger prints and other impurities which would otherwise havean adverse effect on the adhesion.

2. Surface conditioning

The surface conditioner, which is prepared from special acids, transforms the structure of the plastic surface in such a way that a strong adhesion can be obtained between it and the chemical nickel/copper. This conditioning is an important step in the chemical treatment of plastic for electroplating. The cause of poor Adhesion can often be referred back to improper conditioning.

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3. Surface activation

The surface activator is containing palladium which attaches itself to the surface of the plastic. The component is then immersed in an accelerator to remove a protective film from the surface of the palladium.

4. Electroless nickel deposition

The activated component is then immersed in an electroless nickel solution, which deposits a thin layer of metal over the whole of the plastic substrate. This metal layer then becomes the conductor for subsequent electroplating.

5. Electrolytic copper plating

6. Final electrolytic plating *nickel, gold, silver, chrome.*

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