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Recommended Procedures for Cleaning Metal and Plastic Parts for Optimum Adhesion

I Introduction to types of surface preparation methods:

Normally optimum surface preparation is achieved through chemical surface preparation. This in general is true since the nature of the surface is changed so that the surface energy of the substrate is optimized for adhesion. Chemical treatments also increase the chances that hydrogen, dipole, van der Waals ionic and/or covalent bonding take place across the substrate/adhesive interface. A good test for adequate chemical treatment is to place a bead of water on the surface of the part and note if the water spreads so that the angle it forms with the surface is very small i.e., a large area is covered from just one drop of water.

A close relative to chemical treatments is plasma and corona surface treatments. These act in ways similar to chemical treatments with a low degree of hazardous waste generation. These treatments will not be presented in this technical brief. For further information on these techniques contact equipment manufacturers.

Mechanical abrasion is another means of surface preparation. This method of surface preparation has the advantage over chemical treatments in that the process and waste generated is much more benign. Mechanical abrasion in general works because it provides a clean surface, increases the actual bond area and may provide mechanical interlock between the substrate and adhesive.

Often these methods are not needed, since optimal adhesion is not always necessary for a successful application. However, at a minimum a cleaning method removing dirt and grease should be used.

II. Non-organic Substrates

Aluminum or aluminum Alloy:

a. Immerse 20 minutes at 65°C in a solution consisting of:

Material	Parts
Sodium bichromate	4.0 g
Sulfuric Acid (96%)	7.5 ml
Water	50.0 ml

Rinse thoroughly in deionized water. A dip in methanol will aid in room temperature air drying. Otherwise place in a clean air circulating oven for 30 minutes at 70°C.

b. Immerse parts for 10 minutes at 75°C in a solution of:

Material	Parts by weight
Water	130.0
Sodium metesilicate	30.0
Sodium Pyrophosphate	1.5
Sodium Hydroxide	1.5
Nacconal NR (Allied Chemical)	0.4

Rinse in water tap water or in a solution containing 2% volume nitric acid and water. Rinse again in water and dip in methanol to aid in air drying or hot air dry from water.
c. Grit blast or abrade with emery cloth followed by solvent degreasing.

Brass
a)Immerse parts for 1 to 2 minutes at room temperature in a solution of:

Material	Parts by weight
Water	100.0
Ammonium Persulfate	20.0

Rinse in water and air dry.
b. Grit blast or abrade with emery cloth followed by solvent degreasing.
c.
Cadmium
Cadmium surfaces should be plated with silver prior to bonding.

Ceramic Materials:
Ceramic materials do not normally require treatment. However, it may be prudent to dry or store in a dry environment prior to bonding. As with all materials a degreasing step is prudent with all surfaces to be bonded.

Chromium:
Etch 2 to 5 minutes at 90°C in the following:

Material	Parts by volume
Water	100.0
Concentrated HCL	85.0

Rinse in water and air dry.

Copper and Copper alloys:
a) Etch 1 to 2 minutes at room temperature in a solution of:

Material	Parts by volume
Ferric Chloride (37% by weight)	7.5
Water	100.0
Nitric Acid (Concentrated)	15.0

Rinse in water and air dry.
b)Immerse parts for 1 to 2 minutes at room temperature in a solution of:

Material	Parts by weight
Water	100.0
Ammonium Persulfate	20.0

Rinse in water and air dry.
b) Grit blast or abrade with emery cloth followed by solvent degreasing.

Glass:
Solvent degreasing is usually adequate however; improvements in adhesion can be made by sizing with coupling agents.

Gold:
Solvent degreasing is usually adequate. However, an adhesive that has been developed for adhesion to gold or gold plated surfaces should be used.

Lead, and/or Tin Solder:

Light abrasion followed by solvent degreasing is usually adequate however, degreasing should be thorough so that no residual additives such as flux remain.

Magnesium and Magnesium Alloys:

Same as the treatment for aluminum and aluminum alloy except it is much more important to bond parts immediately.

Nickel:

a) Immerse parts for 5 to 10 seconds at room temperature in a solution of concentrated nitric acid. Rinse with clean cool water and warm air dry.
b) Grit blast or abrade with emery cloth followed by solvent degreasing.

Silver:

Remove tarnish with a fine emery cloth and degrease or solvent wipe.

Mild Steel:

a) Immerse parts for 10 minutes at 60°C in a solution of:

Material	Parts by weight
Denatured ethanol	67
Orthophosphoric acid	33

Rinse in water tap water and then distilled water and hot air dry.

b) Immerse parts for 10 minutes at 75°C in a solution of:

Material	Parts by weight
Water	130.0
Sodium metesilicate	30.0
Sodium Pyrophosphate	1.5
Sodium Hydroxide	1.5
Nacconal NR (Allied Chemical)	0.4

Rinse in water tap water or in a solution containing 10% volume nitric acid and water. Rinse again in water and hot air dry.

c) Grit blast or abrade with emery cloth followed by solvent degreasing.

Stainless Steel:

a) Immerse parts for 10 minutes at 85°C in a solution of:

Material	Parts
Concentrated sulfuric acid	3.8 ml
Oxalic acid	8.4 g
Water	56.8 ml

Rinse in water tap water, brush off black deposit with a bristle brush and hot air dry.

b) Immerse parts for 10 minutes at 85°C in a solution of:

Material	Parts by weight
Water	130.0
Sodium metesilicate	30.0
Sodium Pyrophosphate	1.5
Sodium Hydroxide	1.5
Nacconal NR (Allied Chemical)	0.4

Rinse in water tap water or in a solution containing 10% volume nitric acid and water. Rinse again in water and hot air dry.

c) Grit blast or abrade with emery cloth followed by solvent degreasing.

Titanium and Titanium Alloys:

a) Immerse parts for 10 minutes at 50°C in a solution of:

Material	Parts by Weight
Concentrated nitric acid	30.0
Hydrofluoric acid (60%)	3.5
Water	68.0

Rinse in water tap water, brush off black deposit with a bristle brush and hot air dry.

b) Immerse parts for 10 minutes at 85°C in a solution of:

Material	Parts by weight
Water	130.0
Sodium metesilicate	30.0
Sodium Pyrophosphate	1.5
Sodium Hydroxide	1.5
Nacconal NR (Allied Chemical)	0.4

Rinse in water tap water or in a solution containing 5% volume nitric acid and water. Rinse again in water and hot air dry.

c) Solvent degreasing followed by grit blast or abrasion with emery cloth..

Tungsten and Tungsten Carbide:

a) Immerse parts for 10 minutes at 85°C in a solution of:

Material	Parts by weight
Water	15
Sodium Hydroxide	35

Rinse in water tap water. Rinse again in water and hot air dry.

b) Solvent degreasing followed by grit blast or abrasion with emery cloth.

Zinc and Zinc Alloys:

a) Immerse parts for 3 minutes at 25°C in a solution of:

Material	Parts by weight
Water	80
Hydrochloric acid (37%)	20

Rinse in water tap water. Rinse again in water and hot air dry.

b) Solvent degreasing followed by grit blast or abrasion with emery cloth.

III. Plastics

ABS:

Degrease in detergent solution, water rinse and roughen with an emery cloth.

Cellulose and derivatives:

Degrease in detergent solution, water rinse and roughen with an emery cloth. Dry well before bonding as cellulose has high water adsorption. Bond immediately after oven drying if possible.

Phenolic or Melamine Laminates:

Degrease in detergent solution, water rinse and roughen with an emery cloth.

Polyester Films (Mylar, Melinex) or Polyethylene terapthalate (PET):

a) Immerse parts for 10 minutes at 85°C in a solution of:

Material	Parts by weight
Water	80
Sodium Hydroxide	20

Rinse in water tap water. Rinse again in water and hot air dry.
b) Degrease in detergent solution, water rinse and roughen with an emery cloth.

Polyolefins (polyethylene, polypropylene):
a) Corona discharge, flame treatment or plasma etch are the optimum methods.
b) Immerse 20 minutes at room temperature in a solution consisting of:

Material	Parts by weight
Sodium bichromate	30
Sulfuric Acid (96%)	1000
Water	200

Rinse thoroughly in deionized water and hot air dry.

Polycarbonate:
a) Methanol or isopropyl alcohol wipe.
b) Degrease in detergent solution, water rinse and roughen with an emery cloth*.
* Scratches can adversely affect some polycarbonate properties.

Polytetraflouroethylene PTFE (Teflon):
Use commercially available Teflon etching (Tetraetch).

Polyester Resins:
a) Immerse parts for 15 minutes at 65°C in a solution of:

Material	Parts by weight
Water	80
Sodium Hydroxide	20

Rinse in water tap water. Rinse again in water and hot air dry.
b) Degrease in detergent solution, water rinse and roughen with an emery cloth.

Cautions:
Some of the surface preparation treatments use chemicals that have serious health effects unless used with extreme caution. As with all chemicals consult MSDS before using.
Organic Solvents must be handled with care since their use may raise a fire and or toxic hazard. Read the material safety data sheet before handling.
Acids and Sodium Hydroxide are aggressive (corrosive) chemicals Always wears protective clothing and face shield when using. Read material safety data sheets of all materials before using.
Never add water directly to an acid always add acid to water slowly

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