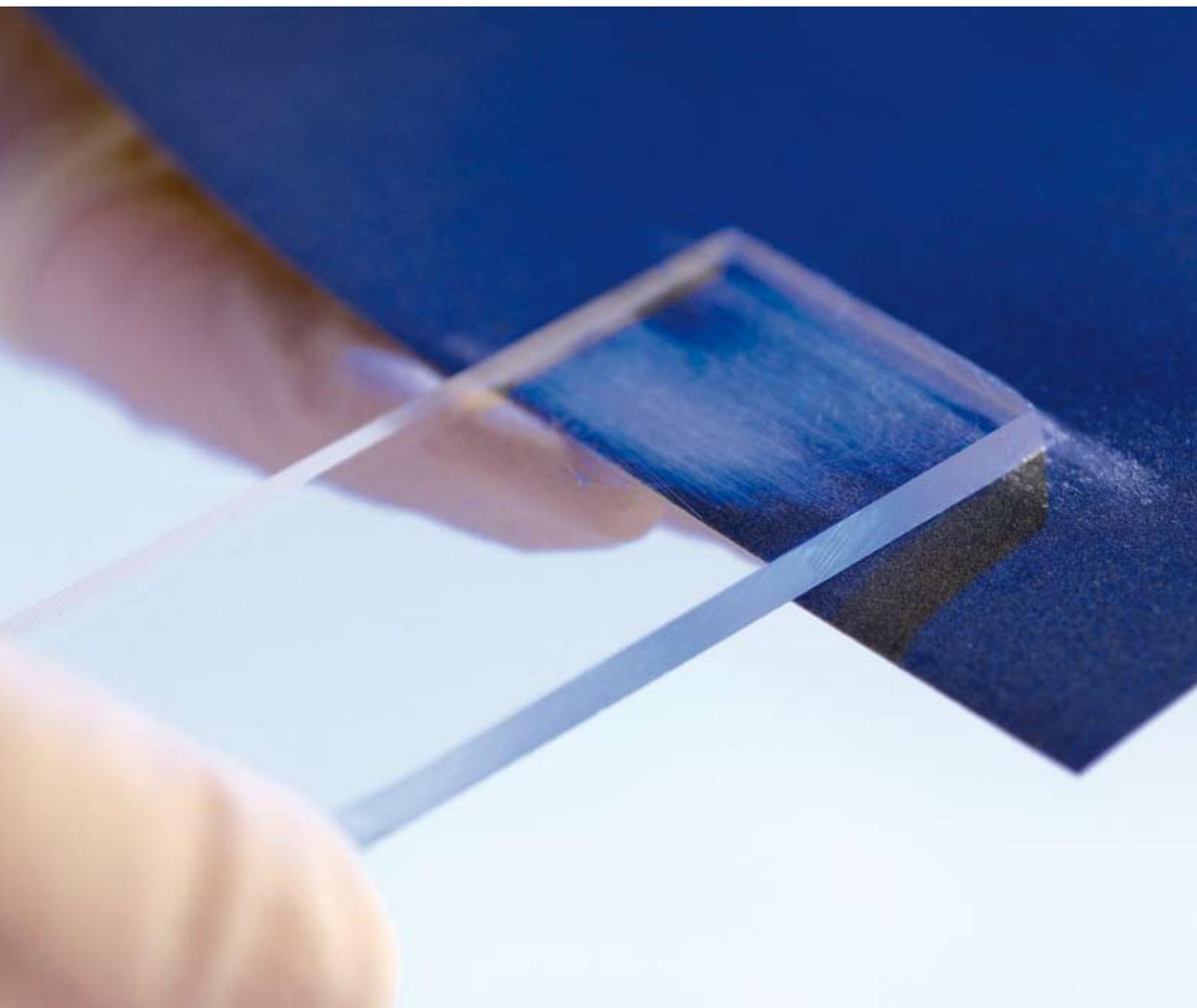


Araldite® bonding

Surface preparation and pretreatments

Working directions for the surface preparation essential for optimum adhesion between structural materials bonded with Araldite adhesives.

Araldite adhesives form extremely strong and durable bonds with plastics, metals, glass, rubber and many other materials. Designers in every sphere of industry increasingly find that bonding with Araldite provides the answer to production problems posed by new materials, new uses of existing materials, and new techniques and manufacturing methods.



Introduction

Araldite resins adhere firmly to most materials. Bonds of great strength are obtained after removal of grease and loose surface deposits, e.g. rust, from the surfaces to be joined, but when maximum strength is required a more thorough mechanical or a chemical pretreatment is recommended.

Surface preparation

Surfaces are prepared by one of the following pretreatment procedures (listed in order of increasing effectiveness).

1. Degrease only.
2. Degrease, abrade and remove loose particles.
3. Degrease and chemically pretreat

Care must be taken to avoid contaminating the surfaces during or after pretreatment. Wear clean gloves.

Contamination may be caused by finger marking – or by cloths which are not perfectly clean – or by oil – contaminated abrasives – or by sub-standard degreasing or chemical solutions. Contamination may also be caused by other work processes taking place in the bonding area. Particularly to be excluded are oil vapours from machinery, spraying operations (paint, mould release-agent, etc.) and processes involving powdered materials.

Whatever the pretreatment procedure used, it is good practice to bond the surfaces as soon as possible after completion of the pretreatment – i.e. when surface properties are at their best.

Note If the scheduling of bonding operations on multi-part assemblies causes delay between pretreatment and bonding, optimum surface properties may be preserved by priming the bond surfaces immediately after pretreatment.

Part 1 Degreasing

The removal of all traces of oil and grease from the surfaces to be bonded is essential. Degreasing by one of the four methods given below should be carried out even when the surfaces to be bonded appear clean.

Degreasing methods

Remove all traces of oil and grease as follows:

- (a) Suspend in a common degreasing solvent such as acetone, MEK, Ethanol or Iso-propanol solvent *vapour in a vapour degreasing unit. The unit may include a compartment to enable initial washing in the liquid solvent.

or

where a vapour degreasing unit is not available:

- (b) Immerse successively in two tanks each containing the same degreasing solvent. The first tank acts as a wash, the second as a rinse. When the solvent in the wash tank becomes heavily contaminated, the tank is cleaned out and refilled with fresh solvent.

This tank is then used for the rinse, and the former tank for the wash.

or

- (c) Brush or wipe the joint surfaces with a clean brush or cloth soaked in a commercial degreasing solvent. (For fine work, washing down with solvent applied by aerosol spray may be a more suitable alternative; this technique also ensures that the solvent used is clean.) Allow to stand for a minute or two to permit complete evaporation from the joint surfaces.

A wide range of proprietary solvent degreasing agents with low hazard ratings are now available. These should be used according to the manufacturers' instructions

or

- (d) **Detergent degreasing** Scrub the joint surfaces in a solution of liquid detergent. Wash with clean hot water and allow to dry thoroughly – preferably in a stream of hot air from, e.g. a domestic forced-air heater.

Note Non-ionic detergents give generally good results.

- (e) **Alkaline degreasing** is an alternative method to the detergent degreasing.

The ingredients may be selected from a wide range of compounds including sodium or potassium hydroxide, carbonates, phosphates, borates, complexing agents and organic surfactants. They can be used hot or cold with or without applied current. There should be very thorough washing, and possibly neutralisation to remove residual traces of alkaline cleaners. It is recommended to use proprietary products and follow manufacturers' instructions for use.

- (f) **Ultrasonic degreasing** may be employed when appropriate and is generally used for the preparation of small specimens.

Test for a clean bond surface

The water-break test is a simple method to determine whether the surface to be bonded is clean. It is best suited to metals. If a few drops of distilled water applied to the surface, wet the surface and spread – or if, on drawing the surface from distilled water, the water film does not break up into droplets – then the surface may be assumed to be free of contamination. Uniform wetting of the surface by distilled water indicates that it will probably be likewise wetted by adhesive.

It must be borne in mind that certain plastics, even when clean, may not be wetted by distilled water, but will be wetted by adhesive. Furthermore, satisfactory wetting gives no information as to the potential bond strength. At most it is a necessary – but not sufficient – requirement for the achievement of high bond strengths.

Part 2 Abrading

Lightly abraded surfaces give a better key to adhesives than do highly polished surfaces. Abrasion treatment, if carried out, must be followed by a further treatment to ensure complete removal of loose particles. For example:

- (a) Repeat the degreasing operation (degreasing liquids must be clean), or
(b) Lightly brush with a clean soft brush, or-preferably
(c) Blow with a clean dry (filtered) compressed-air blast.

Metal surfaces

Remove surface deposits, e.g. tarnish, rust or mill scale, preferably by blasting with sharp grit*. If grit-blasting equipment is not available or the metal is too thin to withstand blast treatment, then clean the joint surfaces with a wire brush, or with abrasive cloth or water-proof abrasive paper (alumina or silicon carbide abrasive, from 46 to 120 mesh). Wetting the wire brush – or the abrasive cloth or paper – assists removal of contaminants and reduces dust.

Dry, if necessary, and remove all loose particles.

Note Painted surfaces should be stripped of paint; otherwise the strength of the joint may be limited by comparatively low adhesion to metal.

*For most materials the preferred grits are fused alumina and, less commonly, silicon carbide (ferrous grits such as chilled iron must be restricted to mild steels and cast irons; their use on other metals may promote corrosion). Fused alumina is the abrasive almost invariably used for aluminium alloys and stainless steels. Silicon carbide is sharper, but it is more expensive and also more friable. Silicon carbide is used on certain special alloys liable to react adversely with any residual fused alumina at temperatures they may encounter in service. The use of silicon carbide can be advantageous when the materials to be abraded are either soft or extremely hard. Choice of grit size depends on various factors: the metal to be grit-blasted, the type of grit-blasting equipment, the pressure and angle of blast impact, and the time of treatment. Grits in the range of 46 to 120 mesh are suitable, but the optimum grit size for the work in hand can be determined only by trials. In general for soft materials the optimum grit size will be towards the fine end of the range.

Plastics and glass surfaces

Remove the surface layer of plastics surfaces to ensure elimination of all traces of release agent. As with metals, abrasion by grit-blasting (see notes on page 3) is in general the best method; the alternative is to use abrasive cloth or paper. After abrasion, remove all loose particles.

Note Removal of loose particles from plastics surfaces is best carried out by methods (b) or (c) above. Use of degreasing liquids on certain plastics may impair the key produced by the abrasion treatment.

Since plastics are poor heat conductors, care must be taken to keep blasting times as short as possible.

For pretreatment of composite materials cryoblasting may also be used which involves use of solid carbon dioxide pellets as the blasting medium.

Part 3 Pretreatments for particular materials

Most materials likely to require bonding in industrial practice are dealt with individually in the following pages – for index, see page 15. Engineers contemplating the bonding of materials not covered by this manual are invited to submit enquiries concerning appropriate pretreatments to our technical staff.

Special pretreatments for maximum bond performance

The surface preparation described above, i.e. degreasing alone or degreasing followed by abrasion and removal of loose particles, is sufficient for most adhesive work.

But to obtain maximum strength, reproducibility and long-term resistance to deterioration, a chemical or electrolytic pretreatment may be required – and examples of these special pretreatments are printed in blue in the following pages.

Metal adherend surfaces are rarely of pure metal, but are a combination of oxides, sulphides, chlorides and other atmospheric contaminants resulting in a surface which is mechanically weak. Acid etching is a well-established method of removing metallic scale, in favour of forming an oxide layer which is mechanically and chemically compatible with the adhesive. Hence, different acid treatments are applied to different metal adherends, for example, chromic acid for aluminium, sulphuric acid for stainless steel, and nitric acid for copper. Acid pretreatment can also be applied to certain plastics, e.g. chromic acid is used to surface treat polyolefins.

Anodising has been exploited extensively by the aerospace industry as a surface pretreatment for aluminium and titanium alloys. The purpose of anodising is to deposit a porous oxide layer on top of the oxide layer formed after etching. The porous oxide layer enables adhesive (or primer) to penetrate the pores readily to form a strong bond.

Application of a primer is another form of surface pretreatment mainly used for materials such as metals and ceramics. Generally, the primer is the final stage of a multistage pretreatment process. Some adherends have 'difficult to bond' surfaces (e.g. copper). The primer, which is formulated such that it represents a solvented version of the adhesive, readily wets the adherend. The adhesive, when applied to the primed surface, being chemically compatible, will establish a strong joint on curing.

Essentials for chemical pretreatments

Care must be taken in the preparation of chemical pretreatment solutions, not only because of the handling hazards*, but also because incorrect preparation may lead to bond strengths inferior to those that would have been obtained if there had been no chemical treatment.

Time of application is also critical: too short an application does not sufficiently activate the surfaces, whereas overlong application may build up chemical reaction products which interfere with adhesion.

On completion of a chemical pretreatment, thorough washing of the surfaces with plenty of clean water is standard practice. For the final rinse, the use of deionised (demineralised) water is recommended.

*Safety precautions must be strictly observed where chemical solutions are in use.

Metal

The wide range of individual alloys (and the variety of surface structures caused by heat treatments) within each metal group precludes standardising on one pretreatment for each. The following pretreatments are well established but on occasion a different pretreatment (not given here) may prove more effective. This can be shown only by comparative trials – using materials from the batch of metal components to be bonded and the type of Araldite adhesive specified for the work.

Additional data on pretreatment of metals is given in ISO 4588 and DEF standard 03-2/2. The recommendations given in this brochure for pretreatment of metals are in compliance with the above.

Aluminium and aluminium alloys

Anodised material Aluminium alloy anodised by the normal chromic acid or sulphuric acid methods and sealed, may be bonded after degreasing and light abrasion. Chromic acid or phosphoric acid anodised material has the optimum surface properties for bonding directly after completion of the anodising process. No pretreatment is needed, but the material must be bonded within a few hours anodising.

Hard anodised aluminium alloy requires stripping either by abrasive blasting or by etching in the sulphuric acid + sodium dichromate (or chromium trioxide) solution given below. Note: the unstripped metal is unsuitable for bonding.

Non-anodised material Degrease according to Part 1 – Degreasing. Then either abrade according to Part 2 – Abrading.

Or anodise with chromic or phosphoric acid as above

Cadmium

Degrease according to Part 1 – Degreasing (page 2). Then either abrade according to Part 2 – Abrading (page 3), **or electro-plate with silver or nickel.**

Cast iron

Degrease according to Part 1 – Degreasing (page 2). Then abrade according to Part 2 – Abrading (page 3).

Chromium

Degrease according to Part 1 – Degreasing (page 2). Then either abrade according to Part 2 – Abrading (page 3),
or etch in a solution of:

Concentrated hydrochloric acid (S.G. ca 1.18)	4.25 litres
Water	5 litres

Immerse for 1-5 minutes at 90-95°C, wash with clean cold running water, followed by clean hot water, and dry with hot air.

Note Prepare the solution according to the sequence specified on page 11 under Concrete – method 3.

Warning Concentrated hydrochloric acid is highly corrosive. Special care is required. See Part 5 – Caution.

Copper and copper alloys

Degrease according to Part 1-Degreasing (page 2). Then either abrade according to Part 2-Abrading (page 3),
or etch for 30 seconds at room temperature in a solution of:

Concentrated nitric acid (S.G. ca 1.42)	5 litres
Water	15 litres

Wash with clean cold running water. Do not allow to dry. Immerse for 2-3 minutes at 95-100°C in a solution of:

Sodium hydroxide	0.1kg
Sodium chlorite (NaCl technical)	0.6kg
Trisodium phosphate (Na₃ P₄O anhydrous)	0.2kg
Water	20 litres

Wash with plenty of clean cold water and dry promptly with a room temperature air stream.

(The use of hot air may cause staining of the surfaces.)

The above two-stage chemical pretreatment gives, in general, better bond strengths than the ammonium persulphate pretreatment below. This however offers the advantage of simplicity and the strengths obtained may be adequate for the work in hand.

Etch in a 25% solution of: Ammonium persulphate

Immerse for 30 seconds at room temperature, wash with plenty of clean cold water and dry promptly with a room temperature air stream. (The use of hot air may cause staining of the surfaces.)

Note Preparation of 25% ammonium persulphate solution: pour about 700ml of deionised water into a container with a 1,000ml calibration mark. Add 250 grammes of ammonium persulphate. Stir until the powder dissolves, then fill to the 1,000ml calibration mark with deionised water.

Warning Concentrated nitric acid is highly corrosive. Special care is required when handling. See Part 5 – Caution.

Galvanised surfaces

Pretreat as for Zinc and Zinc Alloys (page 8).

Gold

Degrease according to Part 1-Degreasing (page 2).

Lead

Degrease according to Part 1-Degreasing (page 2). Then either abrade according to Part 2-Abrading (page 3),

or etch in a solution of:

Concentrated nitric acid (S.G. ca 1.42)	1 litre
Water	9 litres

Immerse for 10 minutes at 45-55°C, wash with clean running water, followed by clean hot water, and dry with hot air.

Warning Concentrated nitric acid is highly corrosive. Special care is required when handling. See Part 5 – Caution.

Nickel and nickel alloys

Degrease according to Part 1-Degreasing (page 2). Then either abrade according to Part 2-Abrading (page 3), **or etch for 5 seconds in: Concentrated nitric acid (S.G. ca 1.42). Wash with clean cold running water, followed by clean hot water, and dry with hot air.**

Warning Concentrated nitric acid is highly corrosive. Special care is required when handling. See Part 5-Caution.

Silver

Degrease according to Part 1-Degreasing (page 2). Then abrade according to Part 2-Abrading (page 3).

Steel-mild

Degrease according to Part 1-Degreasing (page 2). Then either abrade according to Part 2-Abrading (page 3), **or etch in a solution of:**

Orthophosphoric acid (S.G. ca 1.7)	10 litres
Industrial methylated spirit	20 litres

Immerse for 10 minutes at 60°C, remove from the solution and then, under clean cold running water, brush off the black deposit with a stiff-bristle nylon brush. Absorb residual water by wiping with a clean cloth soaked with clean industrial methylated spirit or isopropanol. Heat for 1 hour at 120°C.

Warning Orthophosphoric acid is corrosive and requires special care in use. Refer to Part 5 - Caution.

Steel-stainless

Degrease according to Part 1-Degreasing (page 2). Then either abrade according to Part 2-Abrading (page 3), **or etch for 5-10 minutes at 55-65°C in a solution of:**

Oxalic acid ((COOH)₂·2H₂O)	5kg
Concentrated sulphuric acid (S.G. ca 1.83)	16 litres
Water	35 litres

Note: Prepare solution according to the sequence specified on page 5 under Aluminium and Aluminium Alloys. The oxalic acid will dissolve completely at the immersion temperature.

Prior conditioning (e.g. passivation) of the steel surface may delay the reaction between steel and etch solution. The etch treatment should be timed from the onset of the reaction.

Wash with clean cold running water, then remove the black deposit* by immersing for 5-20 minutes at 60-65°C in the sulphuric acid + sodium dichromate (or chromium trioxide) etch specified on page 5 under Aluminium and Aluminium Alloys.

Note Trials are recommended with the particular stainless steel to establish the optimum immersion conditions and proportions of the solution constituents. Baths in use for the pretreatment of aluminium alloys must not be used concurrently for the pretreatment of steel.

*Alternatively, remove the black deposit by brushing, under clean cold running water, with a stiff-bristle nylon brush, and dry with hot air. Highest bond strengths, however, are obtained after desmutting by the chemical treatment given above.

Warning Concentrated sulphuric acid and chromic acid are highly corrosive. Special care is needed when handling these chemicals. See Part 5-Caution

Titanium and titanium alloys

Degrease according to Part 1-Degreasing (page 2). Then either abrade according to Part 2-Abrading (page 3), **or etch for 1-2 minutes at room temperature in a solution* of:**

Concentrated nitric acid (S.G. ca 1.42)	9.5 litres
Hydrofluoric acid (S.G. ca 1.17)	0.85 litres
Water	40 litres

Wash with clean cold running water, then immerse for 2-3 minutes at room temperature in a solution* of:

Trisodium phosphate ($\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$)	1.75kg
Potassium fluoride ($\text{KF} \cdot 2\text{H}_2\text{O}$)	0.68kg
Hydrofluoric acid (S.G. ca 1.17)	1 litre
Water	40 litres

Wash with clean cold running water, immerse in clean deionised water† at 55-65°C for 15-20 minutes, remove, wash with clean cold running water (brush off any remaining deposit with a clean stiff-bristle nylon brush) and dry with hot air. The temperature of the hot water and air must not be greater than 65°C.

† Frequent renewing of the deionised water is recommended. Renewing is essential if turbidity appears.

Tungsten and tungsten carbide

Degrease according to Part 1-Degreasing (page 2). Then either abrade according to Part 2-Abrading (page 3),

or etch in a solution* of:

Caustic soda (sodium hydroxide)	15 kg
Water	35 litres

Immerse for 10 minutes at 80-90°C, wash with clean cold running water, followed by clean hot water, and dry with hot air.

* Use a stress-relieved mild-steel container.) Aluminium, tin and zinc-coated, galvanised or tinned ware are unsuitable for caustic soda.) Mixing procedure: slowly sprinkle while stirring, flake or pearl caustic soda onto the cold water. Continue stirring until the soda is dissolved.

Zinc and zinc alloys

Degrease according to Part 1 – Degreasing (page 2). Then either abrade according to Part 2 – Abrading (page 3), and apply the adhesive immediately.

Plastics

Thermosetting plastics: Mouldings, castings, laminates, etc can usually be bonded without difficulty. To ensure good bond strength, all soil and residual release agent must be removed from the joint surfaces before the Araldite adhesive is applied. The surfaces must either be abraded with emery cloth or grit-blasted, or they must be cleaned with a solvent such as acetone, methyl ethyl ketone, etc. Abrading or grit-blasting is recommended for mouldings since their surfaces may otherwise repel the adhesive.

Thermoplastics: Although these are often difficult to bond, the wide range of Araldite adhesives is providing a solution in most of the cases. This is especially ? for pretreated thermoplastics. However, certain types of thermoplastics permit... ..bond. Certain types permit only moderately successful bonding, and one and the same material may show considerable variation in properties determining the strength of a bond. Special adhesives have been developed, but they usually prove to be unserviceable when thermoplastics have to be bonded to materials such as wood, metal, etc. Araldite adhesives can be very useful in such cases even though their suitability for bonding thermoplastics is only limited. Pretreated thermoplastics for special applications (e.g. ski 'skins') are easily bonded with Araldite.

The grade of plastic and the manufacturing process used to make the component may influence the effectiveness of the chemical pretreatment. It is advisable to establish by trial whether the pretreatment is improved by adjusting the specified immersion time.

In addition to the normal mechanical and chemical methods of pretreatment, certain plastics can be pretreated using the following methods, all of which cause a change in the surface texture of the adherend. The change is brought about by the interaction of highly energised species with the adherend surface. These pretreatment methods have been applied to metals and in particular composites and plastics.

A low pressure plasma is an excited gas generated by applying a high frequency and high voltage between electrodes in a low pressure chamber. The advantage of this method is that it allows treatment of adherends by different plasmas of argon, ammonia, oxygen or nitrogen making the process suitable for a range of substrate types. Plasmas are generally used to activate the surfaces of adherends.

If instead, a plasma is created in air at atmospheric pressure, the air when ionised appears as a blue/purple glow with faint sparking, and is termed **a corona**. Corona treatments are usually applied for preparing thin polymer films and composite laminates.

The effect of **a flame treatment** is to oxidise the adherend, which produces polar groups creating a surface better suited to wetting by the adhesive. This method of surface pretreatment has been applied successfully to polyethylene/polypropylene. The variables of flame treatment include type of gas, gas/air (oxygen) ration, the rate of flow of mixture, exposure time and distance between flame and adherend.

All these methods have limited stability and vary from hours to weeks according to substrate. Suppliers of specialist equipment are listed on pages 18 and 19. Further information can be found in ISO 13895.

Cellulose plastics

Degrease with a commercial degreasing solvent or detergent solution – according to Part 1 – Degreasing (page 2). Then abrade according to Part 2 – Abrading (page 3).

Warm preferably for 1 hour at 100°C and apply the adhesive before the plastic cools completely to room temperature.

Decorative and industrial laminates

Degrease according to Part 1 – Degreasing (page 2). Then abrade according to Part 2 – Abrading (page 3).

Note: Certain grades of decorative laminates are supplied sanded and need no abrasion.

or Pretreat using Corona/Plasma treatment (see Part 6 – Suppliers).

Glassfabric laminates

Degrease according to Part 1 – Degreasing (page 2). Then abrade according to Part 2 – Abrading (page 3).

Alternatively, design the laminate so that a ‘tear ply’ of fine closeweave polyester fabric is placed at the surface to be bonded. (The ply becomes part of the laminate on curing.) Just prior to bonding, tear off the ply to expose a fresh clean bond surface on the laminate.

Note Fineweave polyester sailcloths are a suitable tear-ply material.

Polyamides (Nylon)

Degrease according to Part 1 – Degreasing (page 2). Ketone solvents can be used advantageously to degrease polyamide. Then either abrade according to Part 2 – Abrading (page 3),

or Pretreat using Corona/Plasma treatment (see Part 6 – Suppliers).

Polyacrylics

Degrease with alcohol solvent or detergent solution – according to Part 1 - Degreasing (page 2). Then abrade according to Part 2 – Abrading (page 3), and remove dust with alcohol solvent.

For optimal results, it is recommended to stress relieve the plastic by annealing.

Polycarbonate

Degrease with alcohol solvent (e.g. isopropanol) or detergent solution - according to Part 1 - Degreasing (page 2). Then abrade according to Part 2 - Abrading (page 3),

or Pretreat using Corona or Plasma treatment (see Part 6 – Suppliers).

Polyesters

Thermosetting (unsaturated) polyester resins – see Thermosetting Plastics.

Thermoplastic (polyteraphthlate) polyester mouldings and films:

Degrease according to Part 1 – Degreasing (page 2), using ketone solvents. Then either abrade according to Part 2 – Abrading (page 3),

or Pretreat by Corona or Plasma treatment. (See Part 6 – Suppliers.)

or Etch in a solution of:

Caustic soda (2kg) in water

8 litres

Immerse for 6 minutes at 75-85°C, wash with clean running cold water, followed by clean hot water, and dry with hot air. This treatment will give the best bond strengths

Note: Prepare the solution according to the sequence specified on page 8 under Tungsten and Tungsten Carbide.

Polyolefines (polythene, polypropylene)

Either lightly flame with a waving motion in an oxidising (i.e. blue – not yellow) gas flame until the surface is shiny. Natural gas is particularly suitable, but care must be taken to avoid overheating and melting. (see also page 9).

Proprietary primers for polypropylene are available which provide an alternative to flame, corona and chemical pretreatments described above.

Polyphenylene oxide and similar plastics

Degrease according to Part 1 – Degreasing (page 2), using alcohol solvents. Then either abrade according to Part 2 – Abrading (page 3).

Polystyrene

Degrease with alcohol solvent or detergent solution according to Part 1 – Degreasing (page 2). Then either abrade according to Part 2 – Abrading (page 3).

The following alternative procedure is more effective than the above but the solution is considerably less convenient to handle.

Or etch in a solution of:

Concentrated sulphuric acid (S.G. ca 1.83)

10 litres

Polyurethane

Degrease according to Part 1 – Degreasing (page 2). Then abrade according to Part 2 – Abrading (page 3).

or Pretreat with Corona/Plasma treatment (see Part 6 – Suppliers).

PTFE and similar fluorocarbon plastics*

Fluorocarbon plastics such as PTFE ('Fluon', 'Teflon') cannot normally be bonded in the untreated condition. There are, however, specialised processes (involving flame oxidation or exposure to dispersions of metallic sodium) for treating the surfaces of fluorocarbon plastics. PTFE already treated by such processes is available from various suppliers.

PTFE pretreated for bonding with Araldite is available in foil and sheet form from various firms. Names and addresses are available on request.

PVC

Degrease according to Part 1 – Degreasing (page 2), using Ketone or chlorinated solvents. Then abrade according to Part 2 – Abrading (page 3).

Thermosetting plastics (amino, diallyl phthalate, epoxy, phenolic, unsaturated polyester)

Degrease according to Part 1 – Degreasing (page 2), using ketone solvents. Then abrade according to Part 2 – Abrading (page 3).

Note: Laminated thermosetting plastics. See page 9.

Miscellaneous materials

Bricks and other fired non-glazed building materials

Degrease according to Part 1 – Degreasing (page 2). Brush with a wire brush and remove dust.

Carbon

Degrease according to Part 1 – Degreasing (page 2). Abrade with fine abrasive cloth or paper, and remove dust.

Ceramics

Degrease according to Part 1 – Degreasing (page 2). Abrade with a slurry of silicon carbide powder and water.

Concrete

Remove heavy grime and laitance by wire brushing. Degrease with detergent solution, according to Part 1 – Degreasing (page 3, section d).

Note: Where concrete is deteriorated and weak, the surface must be removed until sound concrete is exposed.

Even where concrete is sound, it should be pretreated wherever practicable by one of the following methods. Method 1 is more effective than 2, and 2 is more effective than 3.

- 1. Remove by mechanical scarification 3mm – or more – of all surfaces to be bonded, then remove dust preferably by vacuum cleaner; or**
- 2. Sand-blast about 1.5mm off all surfaces to be bonded, then remove dust preferably by vacuum cleaner; or**
- 3. Etch with 12% hydrochloric acid or sulphamic acid solution (1litre per square metre, spread by stiff- bristle brooms) until bubbling subsides (about 15 minutes). Wash with clean water by high-pressure hose until all slush is removed and the surface is neutral to litmus. Final rinsing with 1% ammonia solution followed by clean water is good practice – this ensures thorough neutralisation. Allow the surface to dry thoroughly. Remove dust preferably by vacuum cleaner.**

Note: Preparation of 12% hydrochloric acid solution: pour 2 litres of clean cold water into a clean polythene or earthenware container. While stirring the water, add 1 litre of concentrated hydrochloric acid (S.G. ca 1.18) in a slow steady stream. Preparation of 12% sulphamic acid solution: fill a calibrated clean polythene or earthenware container to the 8litre mark with clean warm water. Slowly sprinkle, with stirring, 1kg of sulphamic acid crystals onto the water. Continue stirring until the acid is completely dissolved. (The crystals do not dissolve in cold water).

Warning: Concentrated hydrochloric acid is a highly corrosive chemical. Particular care is needed when handling the acid. See Part 5 – Caution (page 14).

Earthenware

Degrease according to Part 1 – Degreasing (page 2). Then abrade according to Part 2 – Abrading (page 3).

Glass

Degrease according to Part 1 – Degreasing (page 2)*. Then abrade according to Part 2 – Abrading (page 3).
Either warm for 1/2 hour at 100°C and apply the adhesive before the glass cools completely to room temperature,

Graphite

Degrease according to Part 1 - Degreasing (page 2). Abrade with fine abrasive paper or cloth, and remove dust.

Jewels

Degrease according to Part 1 – Degreasing (page 2).

Leather

Degrease according to Part 1 – Degreasing (page 2). Roughen with abrasive paper and remove loose particles.

Plaster

Allow the surface to dry thoroughly. Smooth with fine abrasive paper or cloth, and remove dust.

Rubber

Degrease with trichlorotrifluoroethane or detergent solution – according to Part 1 – Degreasing (page 2). Then etch with modified bleach solution, with concentrated sulphuric acid depending on the type of rubber.

Modified bleach solution

Household bleach (standard type)	300ml
Concentrated hydrochloric acid (S.G. ca 1.18)	50ml
Water	10 litres

Immerse for 1-3 minutes at room temperature, wash with cold clean water, followed by clean hot water, and dry with hot air.

Note: Concentrated hydrochloric acid is a highly corrosive chemical. Particular care is needed when handling the acid.
See Part 5 – Caution (page 14).

Prepare the modified bleach solution by pouring the clean water into a clean container made of plastic, glass or similar inert ware. While stirring the water, add the concentrated hydrochloric acid in a slow steady stream. Then add the household bleach, stirring it thoroughly into the diluted acid. Never pour the household bleach into the acid (or the other way round) without adding the water first.

Fresh solution should be made up each day. The solution gives off chlorine: good ventilation is essential.

Sulphuric acid etch

Concentrated sulphuric acid (S.G. ca 1.83)

Immerse for 2-10 minutes at room temperature, wash with clean cold running water, followed by clean hot water, and dry with hot air.

Note: Immersion time depends on the rubber type and grade. For optimum surface properties, immersion should continue only until flexing the rubber produces fine crazing over the joint surfaces. Particular care is needed when handling concentrated sulphuric acid. See Part 5 – Caution (page 14).

Vertical surfaces may be treated with a paste prepared by adding sufficient barytes powder to the acid to prevent it from flowing.

The modified bleach solution is however considerably less hazardous to handle than concentrated sulphuric acid.

Rubber-silicone

Silicone rubbers, by their chemical nature, are unsuitable for bonding with Araldite adhesives.

Stonework

All the surfaces to dry thoroughly. Brush with a wire brush and remove dust.

Wood

Ensure the wood is dry. Plane – or abrade with glass paper and remove dust.

Note: The moisture content of the wood should not exceed 16%. Some hardwoods can be difficult to bond.

Part 4 Essentials for maximum bond strength

Araldite adhesives are simple to use, but to ensure successful bonding the directions given in the instructions supplied with the adhesive must be strictly observed.

In particular:

1. Resin and hardener must be correctly proportioned and thoroughly mixed together.
2. Joint surfaces must be degreased and, when necessary, pretreated.
3. Curing temperature and curing time must be correct.
4. Jigs or other fixtures must be used to prevent the bond surfaces from moving relative to one another during the curing process.
5. Though only light pressure is needed, it should be applied as evenly as possible over the whole bond area. Excessive pressure leaves the joint starved of adhesive.

Part 5 Caution

General

This manual lists many chemicals that require cautionary labelling under local legislation in many countries, e.g. UK legislation – Chemicals (Hazard Information on Packages) Regulations 1993. It is important to read, and fully understand, suppliers' technical and safety data sheets, making sure all precautions are in place before commencing work.

Acids, caustic soda, etc.

Concentrated acids, oxidising agents e.g. dichromates, and hot caustic soda solution are highly corrosive chemicals. Spillages and splashes can cause severe damage to eyes and skin, and attack ordinary clothing. Fine-particle mists resulting from the stirring or agitation of the solutions can present a severe respiratory hazard. Operators must wear personal protection e.g. goggles, protective clothing, respirators.

Important: Never pour water into acids. Always pour the acid in a slow steady stream into the water, with continuous stirring. Bear in mind that the handling hazard is intensified when the acid is hot.

Chromium Compounds

These materials have health hazards ranging from harmful to those that are highly toxic and carcinogenic. Ensure that the latest safety data is available for the particular compound chosen.

Sodium

Pieces of sodium react violently and may explode on contact with water, emitting flammable hydrogen gas. Sodium burns spontaneously in air and vapours ignite at room temperature. It also reacts explosively with many aqueous solutions and some organic solvents – mainly chlorinated hydrocarbons – and reacts vigorously with many others on heating. Sodium reacts incandescently with some (mostly halogenated) compounds. Mixtures of sodium and metal halides are sensitive to mechanical shock. Sodium is highly toxic and corrosive, causing severe thermal and caustic burns to tissues in the presence of moisture.

Araldite products

Araldite resins and hardeners are generally quite harmless to handle provided that certain precautions normally taken when handling chemicals are observed. The uncured materials must not, for instance, be allowed to come in contact with foodstuffs or food utensils, and measures should be taken to prevent the uncured materials from coming in contact with the skin, since people with particularly sensitive skin may be affected. The wearing of impervious rubber or plastic gloves will normally be necessary; likewise the use of eye protection. The skin should be thoroughly cleansed at the end of each working period by washing with soap and warm water. The use of solvents is to be avoided. Disposable paper towels – not cloth towels – should be used to dry the skin. Adequate ventilation of the working area is recommended. These precautions are described in greater detail in the Huntsman Advanced Materials Manual Hygienic Precautions for Handling Plastics Products of Huntsman Advanced Materials and in the Huntsman Advanced Materials Product Safety Data Sheets for the individual products. These publications are available on request and should be referred to for fuller information.

Part 6 Index to materials

The individual materials covered by this instruction manual are mainly those in common use in industry. Engineers contemplating the bonding of particular materials not listed below are invited to submit enquiries concerning appropriate pretreatments to our technical staff.

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EUROPE / AFRICA

Huntsman Advanced Materials
(Switzerland) GmbH
Klybeckstrasse 200 • P.O. Box
4002 Basel • Switzerland
Tel +41 61 966 41 20
Fax +41 61 966 35 19

INDIA / MIDDLE EAST

Huntsman Advanced Materials
(India) Pvt. Ltd
5th Floor, Bldg. No. 10
Solitaire Corporate Park
167, Guru Hargovindji Marg, Chakal
Andheri (East)
Mumbai - 400 093 • India
Tel +91 22 4095 1556 - 60
Fax +91 22 4095 1300/1400/1500

ASIA / PACIFIC

Huntsman Advanced Materials
(Hong Kong) Ltd
Suites 3 - 12, Level 41
Langham Place
8 Argyle Street • Kowloon • Hong Kong
Tel +852 2148 8800
Fax +852 2424 1741

AMERICAS

Huntsman Advanced Materials
Americas Inc.
10003 Woodloch Forest Drive
The Woodlands • Texas 77380 • USA
Tel +1 888 564 9318
Fax +1 281 719 4047

More detailed information about these products can be found on our website:
www.huntsman.com/adhesives

For any other information, please send an e-mail to:
advanced_materials@huntsman.com

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