Chapter 2.1 GENERAL INFORMATION

LIST OF CONTENTS

Scheme

2.1.1 Introduction

2.1.2 Types of specification in common use

2.1.3 Sectional list of British Standards for aircraft

2.1.4 Ranges covered by D.T.D. specification numbers

INTRODUCTION

Scope of Section 2

1. Section 2 provides the information on materials, processes and specifications which may be required during the repair of airframes in the Services. Chapter 2.1 describes the purpose and origins of specifications and the relationships between the different types of specifications in common use. Chapters 2.2, 2.3 and 2.5 include the corresponding general information on materials and processes in addition to details of individual materials, processes and specifications. Chapter 2.4 covers alternative metallic materials and processes which may be used, subject to aircraft A.P., Vol. 6 approval if necessary, when the original design materials or processes are not available or cannot be utilised for repair due to lack of associated facilities.

2. The information on Processes in Section 2 relates only to those processes, such as heat treatment, which affect the properties of the materials. Protective Treatment processes contained in Section 9 and in A.P.2656A are not repeated in Section 2.

Definition of Specification

3. A specification is a statement of the set of conditions that an item or procedure must satisfy and the qualities it must possess to ensure that it will fulfil a required function. The statement may consist of a schedule, drawing or text, or a combination of these items. The specification may relate to the design, constitution, condition, performance, appearance or method of preparation or application, or any combination of these qualities and may be complete in itself or may call up other specifications.

4. Light alloy sheet materials in the D.T.D. range, e.g. D.T.D.746, provide good examples of specifications covering several essential qualities. The design aspect is covered by stipulation of thickness tolerances on basic material and cladding, etc., constitution and condition by quotation of exact percentages of specific ingredients and the state of heat treatment respectively, and the requirements for minimum permissible strength, ductility, resistance to corrosion, etc., relate to performance.

5. By contrast D.T.D.775, "Adhesive Suitable for Joining Metals", only stipulates that the material shall consist of a synthetic resin solution and powder, and does not specify particular types of resin and the proportions of the ingredients. Thus any one of several different resins could satisfy the specification provided that the single performance requirement of a given joint strength is achieved.

Functions of a specification

6. A specification firstly provides a pattern for the control of qualities to ensure that the item covered by the specification will satisfy all appropriate conditions of use and secondly ensures standardisation so that, in general, all items produced or applied in accordance with the given specification will be interchangeable. The relative degrees of importance of these two functions depend on the nature of the item or procedure. As examples, achievement of a given minimum joint strength is the major factor in the case of D.T.D.775 (*para.* 5), whilst the basic purpose of A.S. specifications is the standardisation of small components.

Control of qualities

7. The specification provides the pattern for the control of qualities and its complementary procedure, inspection, provides the actual control. In all forms, inspection consists purely of comparison of an item or procedure against the pattern provided by the specification, at all appropriate stages.

Combination of specifications

8. Many of the specifications associated with aircraft call up other specifications to avoid unnecessary repetition of requirements. A repair scheme in an aircraft Vol. 6 specifies repair dimensions but calls up a B.S. or D.T.D. specification to ensure that the quality of the sheet material is satisfactory. The rivets required for the repair are called up under another specification, probably an A.S. sheet. The A.S. sheet specifies the type of rivet head and the rivet dimensions, but again relies upon a B.S. or D.T.D. specification for control of the rivet material.

Types of specifications

9. General information on the various types of specification in common use on Service aircraft is given in Scheme 2.1.2. Further general information on B.S. and D.T.D. specifications is provided in Schemes 2.1.3 and 2.1.4 respectively.

★ ★ ★

Basic specifications

1. Many specifications, such as general engineering Standards, are in such common use that the term "specification" is not normally associated with them, except perhaps by a producer of the items concerned. Examples of this type of specification are screw threads and, even more basic in form, Standard Wire Gauge. In the latter case the specification consists solely of a list of S.W.G. numbers, each of which represents a specific thickness of sheet material or diameter of wire. Specifications of this type are usually incorporated in more comprehensive specifications for aircraft use. For example, specification D.T.D.710A, "Aluminium-coated Aluminium Alloy Sheets and Coils to Close Tolerances", reproduces the S.W.G. numbers and defined thicknesses and expands these basic S.W.G. requirements by introducing the manufacturing tolerances appropriate to each thickness, in addition to stipulating performance and other requirements.

Standardisation Design Memoranda (Air Series)

2. S.D.M.(A) are issued by the Ministry of Supply and cover a wide range of comparatively small aircraft components and equipment. The basic purpose of S.D.M.(A) is to standardise the most suitable component for a given purpose, aircraft manufacturers being required to employ components listed in S.D.M.(A) in preference to all other similar items for all designs of military aircraft.

3. Design Memoranda (A) act as specifications only in the sense of specifying which items are to be used to perform particular functions. They do not contain the design or other information necessary for the production of the items. In the majority of cases the S.D.M.(A) call up items covered by specifications such as B.S., A.S., A.G.S., or aircraft manufacturers' own designs.

4. As stated in para. 2, S.D.M.(A) are concerned only with present and future aircraft designs. Consequently, an S.D.M. is cancelled when it no longer meets the requirements for new aircraft designs, irrespective of the usage of the component on existing aircraft. The aircraft operator is therefore more interested in the specifications covered in the following paragraphs than in S.D.M.(A).

Specifications issued as series

5. The following paragraphs briefly describe the fields covered by various types of specification in general Service use, the authorities responsible for the issue of the different series and the relationships between the different types. Where appropriate, the methods used to signify amendments or new issues are quoted.

British Standards

6. The authority for issue of specifications in the B.S. series is the British Standards Institution. British Standards are issued for a very wide range of subjects, many of which are outside the field of engineering. As the Standards applicable to aircraft (*Scheme* 2.1.3) are used for both civil and military aircraft, they are issued on a long-term basis. Thus a subject must be of stable design, of proven reliability and of reasonably wide application and the requirement for the subject must have a satisfactory expectation of life, before the introduction of a Standard can be considered. Consequently other types of specification, such as D.T.D. specifications (*para.* 8), form a major source for the British Standards aircraft series to which they are transferred as appropriate.

B.S. numbering system

7. General British Standards are identified by the prefix B.S., followed by a serial number, and year of issue, e.g. B.S.2915:1957. The majority of requirements used for aircraft items, however, are contained in the sectional list of Standards entitled "Aircraft Materials and Components" (*Scheme* 2.1.3). Since aircraft subjects are more liable to active amendment and are more numerous than items in any other single field covered by British Standards, a different numbering system is used. The prefix B.S. is followed by the issue number, then the letter or letters indicating the aircraft list group to which the item belongs and finally the serial number within the group, e.g. B.S. 3 T 50. In the case of the first issue of a Standard, however, the issue number is omitted, e.g. B.S. A 120. Scheme 2.1.3 shows the identification letters for the various groups.

D.T.D. Specifications

8. These specifications are issued by the Ministry of Supply to cover new arisings when, in general, it is known or anticipated that more than one manufacturer or user will be involved but the requirements are not of sufficiently general application at the time to justify the issue of British Standards. The notable exception to this rule is D.T.D. 900, Proprietary Materials and Processes, which is used to provide Ministry of Supply approval firstly for items or processes not in sufficient demand to justify the issue of an individual specification and secondly for cases in which the manufacturers refuse to allow details of the basic specification to be divulged. The "specification" in the D.T.D. 900 list thus consists only of a title; details of the material or process are not published. If subsequent demand for an item or process in the first category increases, an individual specification may be issued and the appropriate D.T.D.900/— series specification or specifications will then be cancelled.

Subjects covered by D.T.D. Specifications for airframes

9. The D.T.D.1000-1999 series contains requirements for aircraft components but is

concerned with general matters, such as protective coverings and treatments for components, not with detailed design as in the cases of A.G.S. and A.S. items. All other D.T.D. airframe specifications deal with processes and materials. Scheme 2.1.4 shows the groups into which the D.T.D. specifications are divided.

D.T.D. numbering and amendment system

10. Unlike the B.S. range, D.T.D. specifications do not have a group identification letter preceding the serial number, but simply take the form "D.T.D. 710". If a specification is amended, the existing issue is cancelled and the new issue is given a suffix letter, the letter A indicating the second issue, B the third and so on. Thus D.T.D. 710A is the second issue of D.T.D. 710. In the case of a material, the amendment necessitating alteration of the issue of the specification seldom affects the strength and other properties of the material itself and hence it is customary for aircraft Air Publications to quote only the basic specification number, the suffix letter being omitted to avoid unnecessary amendment of the A.P.s. Therefore when a D.T.D. specification for a material is quoted in an aircraft A.P., Vol. 1 or 6, it can be assumed that the use of the latest issue of the specification is automatically implied, but that material produced to an earlier issue may be used, unless a specific instruction to the contrary is given. In the case of a process specification, an amendment resulting in a new issue may affect the User by alteration of procedure or of materials required for the process, but, in general, will be in the form of a permissible alternative and not as mandatory change.

11. The D.T.D.900 series, being only titles (*para.* 5), are not liable to amendment and consequently the serial numbers do not bear suffix letters. A number in this series takes the form D.T.D.900/1234. When a proprietary material or process covered by this series is materially modified, the revised item is issued as a new "specification" with an entirely different serial number. The basic number 900 bears a suffix letter, however, and this letter is changed each time the overall list is amended. As indicated in para. 10, this suffix is seldom quoted.

A.S. and A.G.S. Specifications

12. Both Air Standards (A.S.) and Aircraft General Stores (A.G.S.) are controlled and issued by the Society of British Aircraft Constructors (S.B.A.C.) for both civil and military aircraft use. They cover the detailed design of comparatively small items and components for airframes, aero-engines and accessories.

13. A.G.S. specifications were formerly controlled and issued by the Ministry of Supply basically for military aircraft use and, having been in existence for many years before the A.S. series was introduced, contain many items which, if issued for the first time under present circumstances, would automatically fall into the A.S. category. Thus no definite distinction can be made between the range of items covered by each series although the present policy tends to the issue of proprietary items (*i.e. items for which production is controlled by one approved manufacturer*) as A.G.S. and standardised items as A.S. For example, Chobert rivets are to A.G.S. specifications and standard solid rivets are in the A.S. series. It is intended that A.G.S. items shall be gradually abolished.

Transfer to British Standards

14. Both A.S. and A.G.S. items are liable for transfer to the British Standards if they fulfil the general conditions quoted in para. 6. Due to the "proprietary" nature of new A.G.S. items, however, it is unlikely that these items will be considered for transfer.

Numbering systems

15. Many specifications in the A.S. and A.G.S. series are multiple in the sense that they cover ranges of items which have similar basic patterns but vary in detailed dimensions, etc. As an example of the numbering identification used, the basic A.S. serial number indicates a particular type of rivet and its material and a second code number indicates the detailed dimensions of the required item, e.g. A.S.2227-405 is a snap head rivet, of L.69 material, $\frac{1}{8}$ in. dia. and $\frac{5}{16}$ in. long.

Manufacturers' standards

16. Most aircraft manufacturers produce drawings (*specifications*) for items standardised within their own organisations. Originally, these standards covered a very wide field, but the increase in numbers of national standards such as B.S., A.S. and A.G.S. has obviated the need for many of these. Consequently manufacturers' standards, for military aircraft, tend to be confined to items for which no national standards exist, such as rolled, drawn and extruded sections of the types normally included in Part 1, Chap. 1 of the aircraft A.P., Vol. 6.

Numbering systems

17. Each aircraft firm or group operates its own system of identification, but the basis of the majority of systems is a letter and serial number identification of the form S.S.262, D.H.A.912, V.G.S.215, etc.

D.E.F. Specifications

18. The Ministry of Defence issues DEF specifications for materials, processes and

procedures which are required for use by more than one Service. The purpose of this is to produce interchangeability of supplies between the Services, resulting in overall economy in terms of production and provisioning time. The Ministry of Defence also acts as a link between the U.K. Services and those of other N.A.T.O. countries, with a view to international standardisation of as much equipment and procedure as possible.

19. At present there appears to have been no positive move to transfer to the DEF range the bulk of D.T.D. specifications probably because these primarily affect airborne equipment only and are therefore too stringent and consequently too expensive for application to general equipment. However, D.T.D. specifications are equally applicable to R.A.F., R.N. and Army aircraft, and therefore fulfil the basic qualifications, for DEF issue, of use by more than one Service. Consequently, they may be transferred to the DEF range in the future.

20. Apart from fuels and lubricants, etc., the only DEF specifications which may, at present, apply to aircraft refer to chemical items such as paints and rust preventatives, which have been transferred from the C.S. series.

C.S. items

21. These are Chemical specifications issued by the Ministry of Supply and, although occasionally called up for use on aircraft, are not primarily intended for this purpose.

★ ★ ★

SECTIONAL LIST OF BRITISH STANDARDS FOR AIRCRAFT

Group identification letters

1. The sectional list of British Standards for Aircraft Materials and Components is divided into the following groups for identification purposes :—

A. Bolts, etc.
B. Brass, copper, etc.
D. Dope and ingredients.
E. Electrical.
F. Fabric, etc.
G. Electrical equipments and indicating instruments.
K. Cast iron.
L. Aluminium and light alloys.
M. Miscellaneous.
PL. Plastics.
R. Radio equipment.
S. Steels.
SP. Standard details.
T. Tubes.
V. Timber, glues, etc.
W. Wires, wire ropes, etc.
X. Paints and varnishes.

2. Amplification of the contents of the groups applicable to airframes is given in subsequent paragraphs for the groups for which the titles are not entirely self-explanatory.

A. Bolts, etc.

3. This group includes standards for steel, aluminium alloy and brass bolts and nuts, with various forms of head, etc. The majority of the items have unified threads and, where appropriate, unified hexagons. Since unified forms are being introduced to provide international standardisation, British Standards are more appropriate for these items than A.S., A.G.S., etc. Machine and grub screws are also included in this group.

F. Fabric, etc.

4. In addition to fabric, F standards apply to cords, ropes, thread, webbing, fibre and rubber sheets.

L. Aluminium and light alloys

5. These standards cover the range of aluminium, aluminium alloy and magnesium alloy materials in the form of sheets, bars, forgings, castings, extruded sections, tubes, and wires and tubes for rivet manufacture. It should be noted that the standards in this series relating to rivets apply only to the material used for making the rivets, not to the actual design. Although it is normal practice to refer to B.S. L 37 or L 69 "rivets", the actual design of the rivets in terms of types of rivet, types of head, dimensions, etc., is covered by A.S., A.G.S., or B.S. SP specifications.

M. Miscellaneous

6. This group contains standards for materials such as graphited wax and silica gel, but also includes recommended practices such as: B.S. 2 M 23, Identification scheme for aircraft pipe lines.

PL. Plastics

7. B.S. PL 1 is a standard for Synthetic Resin Mouldings for Aircraft. In view of the increasing use of synthetic resins for insulating and structural purposes, this group is expected to expand considerably.

S. Steels

8. As in the case of light alloys, steel standards apply to materials and not to fabricated components.

SP. Standard details

9. The term "details" refers to small components such as fork joints, shackles, turnbuckles, cotter pins, washers, grommets, cable-end assemblies, eye-bolts, rivets, etc. In this group, the standard for rivets (e.g. B.S. SP 68 to 71) apply to the rivet design, not to the material as in the "L" group.

★ ★ ★

D.T.D. 1 to 899

1. This block of numbers covers specifications for the constitution, performance, appearance or design of all types of aircraft materials and of processes directly related to materials. Design, as applied to materials, refers to such considerations as thicknesses and tolerances of metal sheets, the number of threads per inch warp and weft in fibreglass cloth, etc. Performance refers to strength and other mechanical properties, ability to withstand corrosion, etc. Constitution refers to the nature and proportions of the various ingredients of a compound substance.

2. No particular policy of allocation of groups of numbers for different materials was applied to the specifications in this series. They were issued, in the majority of cases, in numerical sequence purely in the order of preparation, although a few small groups of related items do exist due to the concurrent preparation of the associated specifications.

3. Many of the specifications in this series have been cancelled either due to lack of demand, to the issue of more advanced specifications or to transfer to British Standards. When a specification is cancelled, however, the number is not used again as this practice would cause considerable confusion and would be dangerous in many instances. Consequently, after the issue of D.T.D. 899, another series of numbers was required, and the 5,000 to 5,599 series was allocated (*para.* 12).

D.T.D. 900 series

4. The D.T.D. 900 specification is used to promulgate Ministry of Supply approval for proprietary materials and processes, the term "proprietary materials and processes" being defined as "materials and processes not covered by a standard specification accepted by the Ministry of Supply for aircraft purposes". These materials or processes are not covered by standard specifications because either the items are not, at the time, in sufficient demand to justify the issue of standard specifications or the manufacturers concerned refuse, for commercial reasons, to allow general publication of the contents of the proprietary specifications affected. In consequence, a considerable amount of duplication exists in the 900 series, due to the production by more than one manufacturer of materials and processes to meet the same new requirement.

5. The present range of numbers allocated to the 900 series is D.T.D. 900/4,000 to 900/4,999. Although, for convenience, the series is divided into three separate lists covering Metallic Materials, Non-Metallic Materials and Processes respectively, the approval (*serial*) numbers are not allocated in blocks to these sections, but are issued individually in direct sequence as the need arises, irrespective of the subject.

6. The information in D.T.D. 900 for any given material or process listed, consists only of the "approval number" (*serial number*), the trade or identifying name of the material or process, the extent of approval and the manufacturer's name and address. "Extent of approval" refers to the stated purpose or purposes for which approval has been granted for the item to be used on aircraft. If a manufacturer subsequently wishes to modify the material or process, or to use it on aircraft for a different purpose, he must first obtain re-approval from the Ministry of Supply.

D.T.D. 901 to 999

7. The specifications in this series apply to processes such as anti-corrosion processes, cleaning processes for metals prior to the application of protective treatments, etc.

D.T.D. 1,000 to 1,999

8. This series contains specifications dealing with general requirements for aircraft components, as distinct from materials. Unlike A.S., A.G.S., and B.S. SP items, however, the specifications do not refer to the detailed initial design of the components but to the general aspects such as coverings for pipes, fuel tanks, etc.

D.Eng.R.D. 2,000 to 2,999

9. These apply to aero-engines, propellers, fuels and oils, and are therefore outside the scope of this publication.

D.T.D. 3,000 to 3,999

10. This series is divided into six groups, all of which apply to aero-engines.

11. The numbers 4,000 to 4,999 have been omitted from the individual D.T.D. specification range to avoid confusion with the D.T.D. 900 series (*para.* 5).

D.T.D. 5,000 to 5,500

12. With the completion of the 1 to 899 series and the consequent need for a new batch of numbers for materials and related processes, a policy of partial segregation was adopted. The numbers 5,000 to 5,500 were allocated to Metallic Materials and Related Processes only. Non-metallic materials are covered by the series 5,501 to 5,599 (*para.* 14).

13. A further breakdown has been made within the new metallic materials series by the allocation of the final figures in the specification serial numbers to different

RANGES COVERED BY D.T.D. SPECIFICATION NUMBERS (continued)

groups of metals. Thus numbers ending in 1, e.g. D.T.D. 5,001, 5,011, 5,021, apply to wrought magnesium alloy sheets, tubes and bars. Similarly 5,010, 5,020, 5,030, etc., cover aluminium alloy plates and sheets. The number 5,000, however, has been reserved for a special purpose. The full breakdown is given in the following table:—

Number allocation in the 5,000 to 5,500 series

Numbers ending in :—	Corresponding metallic materials
1	Wrought magnesium alloy sheets, tubes, bars
2	Steels and irons, non-stainless
3	Titanium and titanium alloys
4	Aluminium alloy bars, forgings, extruded sections, tubes
5	Magnesium and magnesium alloy ingots, castings
6	Steels and irons, stainless
7	Nickel and nickel-base alloys
8	Aluminium alloy ingots, castings
9	Miscellaneous metals and processes
10	Aluminium and aluminium alloy plates and sheets

★ ★ ★

D.T.D. 5,501 to 5,599

14. As stated in para. 12, this series is allocated to Non-Metallic Materials and Related Processes.

Chapter 2.5. NON-METALLIC MATERIALS AND PROCESSES

LIST OF CONTENTS

Scheme

2.5.1 ... ... *Introduction*

2.5.2 ... ... *Araldite AY 103 epoxy resin*

2.5.3 ... ... *Araldite 121N epoxy resin*

INTRODUCTION

General

1. The schemes in this chapter are prepared on the basis that non-metallic materials and processes which have a wider field than can be suitably contained in a specific repair scheme, shall be completely covered for all repair applications. In detailed repair schemes reference to Chapter 2.5 will be made as necessary.

Safety precautions

2. When using synthetic resins there is a risk of contracting a form of dermatitis unless certain approved safety rules are carefully observed; these rules, which are given in A.P.1464B, Vol. 1, Part 2, Sect. 4, Chap. 9, should be made known to all personnel using synthetic resins. The apparent immunity which one person may have when working on a particular process without observing the required safety precautions cannot be taken to indicate that another person will have a similar immunity.

★ ★ ★

ARALDITE AY 103 EPOXY RESIN

WARNING . . .

Hardener HY 951 and the uncured mixture of hardener and resin may prove injurious to sensitive skins, to the extent of causing dermatitis, and care must be taken to prevent these materials from touching the hands or any other parts of the body. Suitable barrier creams must be used and, additionally, rubber gloves should be worn if the adhesive is being handled over a long period. General precautions when using synthetic resins are to be found in A.P.1464B, Vol. 1, Part 2, Sect. 4, Chap. 9. Particular precautions are detailed in this Scheme.

Aircraft applications

1. Araldite AY 103 (Ref. No. 33C/1371) in conjunction with hardener HY 951 (Ref. No. 33C/1172) has a very wide range of application but in aircraft repair work the resin is used mainly as an adhesive, a filler, or a protective treatment. As an adhesive it will effectively unite metal (particularly aluminium, chromium and magnesium), wood, resins (epoxy, polyester, melamine, and phenolic), rubber (not silicone rubber), carbon, glass, asbestos and ceramics. The resin is resistant to corrosion, does not absorb water and has very good electrical insulating properties.

Constituents

2. Araldite AY 103 (approved to D.T.D. 900/4365) is a syrupy liquid which, when mixed with the hardener, HY 951 (approved to D.T.D.900/4440), is shortly transformed into a hard, transparent solid. Setting may be allowed to take place at room temperature or the setting time can be reduced by accelerated heating. The resin is not subject to a solvent and the shrinkage due to setting is very slight.

Pre-treatment of materials

3. To ensure that an Araldite bond may attain its maximum strength it is essential to remove all grease from the mating surfaces. The use of trichlorethylene (A.P.1464B, Vol. 1, Part 2, Sect. 3, Chap. 12 and Sect. 4, Chap. 10) or Teepol (Ref. No. 33C/1129) will usually prove adequate for degreasing. After the use of Teepol the surfaces must be washed thoroughly and dried off without further contamination.

Note . . .

When degreasing plastics, such as Perspex or polystyrene, only aqueous solutions like Teepol may be used. However, in the case of flexible P.V.C. it is permissible to remove excess plasticiser from the surface with trichlorethylene.

4. After degreasing it is necessary to abrade or etch the mating faces of the joint; sanding or wire brushing is usually adequate. Do not abrade stainless steel with metallic agents; alumina grit cloth or silicon carbide waterproof paper are quite suitable. If there is any possibility of the prepared faces being contaminated with grease during abrading, then degreasing must be repeated.

5. Etching, or chemical pickling, produces an excellent surface for adhesion and can be considered adequate preparation without abrasion but where maximum bond strength is required it is safer to abrade the surface before etching. Table 1 lists the appropriate etching treatment for a variety of repair materials.

Note . . .

After etching and washing, take particular care to avoid contaminating the prepared surfaces.

Safety precautions

6. When working with Araldite and hardener the correct barrier cream to be used is "Water miscible barrier cream" (Ref. No. 33D/373). It is important to prevent the hardener, or a mixture of hardener and resin, from drying on the surface of the skin; where contact has occurred the area should be thoroughly cleansed with Swarfega (Ref. No. 33D/—). Sulphite soap alone is not considered adequate when using Araldite.

Preparation of adhesive

7. The proportion of Araldite to hardener, which must be carefully controlled, is as follows:—

	Parts by weight	Parts by volume
Araldite	100	100
Hardener	8—10	9½—12

ARALDITE AY 103 EPOXY RESIN—*continued*

TABLE 1. Etching treatments

Material	Solution and immersion time (Chemical ratios are quoted by weight)
Aluminium and aluminium alloys	Sulphuric acid (conc.) ... ... 27 parts Sodium bichromate ... ... 7 parts Water ... ... 65 parts Immerse for 30 min. at 60—65 deg.C. Wash with cold water and dry below 40 deg.C.
Chromium	Hydrochloric acid (conc.) ... 1 part Water ... ... 1 part Immerse for 1—5 min. at 90 deg.C., wash and dry.
Copper and copper alloys	Ferric chloride (42 per cent)... 15 parts Nitric acid (conc.) ... ... 30 parts Water ... ... 197 parts Immerse for 1—2 min. at room temperature. Wash and dry.
Glass	Hydrofluoric acid (40 per cent) 20 parts Water ... ... 80 parts Immerse for 5 min. at room temperature. Wash and dry. Warming glass before applying adhesive is advantageous.
Magnesium	Sodium hydroxide ... ... 10 parts Water ... ... 80 parts Immerse for 5 min. at 72 deg.C. then wash. Follow the above by etching for 3 min. at room temperature in:— Chromic acid (CrO_3) ... 10 parts Water ... ... 100 parts Sodium sulphate ... ... 0·05 parts Wash and dry.
Nickel	Etch for 5 sec. in concentrated nitric acid at room temperature, then wash and dry.
Polythene and Polypropylene	Sulphuric acid (conc.)... ... 100 parts Potassium bichromate ... 5 parts Immerse for 1 hr. at room temperature, wash and dry carefully. As an alternative lightly "flame" with a Bunsen burner.
Polytetrafluorethylene (P.T.F.E.)	With considerable caution, immerse the plastic in a 2 per cent solution of sodium in liquid ammonia, then quench in water and dry.
Rubber (natural)	Treat the surface for 2—10 min. with concentrated sulphuric acid, then wash and dry. Flexing the rubber should reveal superficial hair cracks, which is the desired condition. The time of immersion will vary with the grade of rubber.
Rubber (synthetic, not silicone)	Use sulphuric acid as for natural rubber although it may be desirable to increase the time of immersion. If minute cracks do not appear with flexing, treat with concentrated nitric acid until the required surface effect is obtained. Finally wash and dry.
Steel (mild)	Phosphoric acid (conc.) ... 50 parts Methylated spirit ... ... 50 parts Immerse for 10 min. at 60 deg.C., then wash and dry.
Steel (stainless) 1.	Hydrofluoric acid (40 per cent) 2 parts Nitric acid (conc.) ... ... 13 parts Immerse for 5 min. at room temperature, then wash. Passivate the etched surfaces for ½ hour in a 20—30 per cent chromic acid solution at 40—50 deg.C., then wash and dry.
2.	Alternatively:— Oxalic acid ... ... 10 parts Sulphuric acid (conc.) ... 10 parts Water ... ... 8 parts Immerse for 10 min. at 88 deg.C., then wash and dry.
Titanium	Treat as stainless steel.
Zinc	Phosphoric acid (conc.) ... 5 parts Water ... ... 95 parts Immerse for 5 min. at room temperature, then wash and dry.

When well mixed, the adhesive normally has a life of approximately three hours at room temperature, but as the constituents are exothermic (i.e., they give off heat when combined) it is undesirable to mix more than about 4 oz. at a time otherwise the additional heat will reduce the usable life of the mixture.

Application

8. Spread a thin layer of the adhesive with the aid of a spatula, brush or roller on both surfaces to be bonded and close the joint within 30 minutes. The glue line thickness should be from 0·002 in. to 0·008 in. to obtain the best results. Keep the joint lightly clamped or otherwise supported while the adhesive cures. Curing times are as follows:—

24 hours at 20 deg.C. (68 deg.F.)
or 3 hours at 60 deg.C. (140 deg.F.)
or 20 min. at 100 deg.C. (212 deg.F.)

9. Bonding strengths are quite satisfactory when curing at room temperatures but maximum strengths are obtained by giving the adhesive a short post-cure at a higher temperature. Allow extra time for an assembled joint to reach the required temperature.

Cleaning equipment

10. Containers, brushes, spatulas or rollers should be washed with acetone or cellulose thinners before the resin hardens. As recommended at para. 6, particular care must be taken to remove any particle of resin which may settle on the skin.

Storage life

11. When stored separately in a cool, dry place, the resin and hardener have a shelf life of at least 12 months. The hardener is hygroscopic and will deteriorate if allowed to absorb water, for this reason the container should be effectively stoppered.

★ ★ ★

ARALDITE AV 121 EPOXY RESIN

WARNING . . .

Hardener HY 951 and the uncured mixture of hardener and resin may prove injurious to sensitive skins, to the extent of causing dermatitis, and care must be taken to prevent these materials from touching the hands or any other parts of the body. Suitable barrier creams must be used and, additionally, rubber gloves should be worn if the adhesive is being handled over a long period. General precautions when using synthetic resins are to be found in A.P. 1464B, Vol. 1, Part 2, Sect. 4, Chap. 9. Barrier creams and cleaning agents are detailed in this Scheme.

Aircraft applications

1. Araldite AV 121 (Ref. No. 33C/1451), previously referred to as Araldite 121 N, in conjunction with hardener HY 951 (Ref. No. 33C/1372), previously referred to as hardener 951, is used as a gap-filling, cold-setting adhesive for bonding metals, glass, plastics, rubber, ceramics, etc. It is particularly suitable for bonding coarse materials and for joints where the gap along the joint is of irregular width. In aircraft repair work AV 121 is particularly useful for filling local depressions in the external surfaces of skin panels where the maintenance of contour is essential. In general, the resin is resistant to corrosion and does not absorb water, its shear strength is good but considerably less than Araldite AY 103 which is covered in Scheme 2.5.2.

Constituents

2. Araldite AV 121 (approved to D.T.D. 900/4566) is a mineral-filled resin paste which, when mixed with a low-viscosity hardener HY 951 (approved to D.T.D.900/4365) is transformed into a solid at room temperature. The setting process takes about 24 hours at 68 deg. F. Setting may be accelerated by heating and, in fact, a short post-cure at a higher temperature is desirable to obtain the maximum bond strength. The resin retains its strength up to a temperature of 158 deg. F. (70 deg. C).

Pre-treatment of materials

3. All mating surfaces must be thoroughly degreased before the adhesive is applied and in most instances abrading or chemical etching is also desirable to achieve maximum bond strength; the techniques are identical with those specified for Araldite AY 103 and reference must be made to Scheme 2.5.2, para. 3 to 5 inclusive, for this information.

Safety precautions

4. When using Araldite AV 121 and hardener HY 951 it is essential to use a protective barrier cream which is fully effective against this type of adhesive. Water miscible barrier cream, Ref. No. 33D/373 is approved for this purpose but should it not be available, Kerodex 71 (formerly B.W.2) or Rosalex No. 9, which are both N.I.V. items, would prove satisfactory. It is important to prevent the hardener, or a mixture of hardener and resin, from drying out on the surface of the skin; if contact with the unprotected skin does occur the affected area must be thoroughly cleansed with Swarfega (Ref. No. 33D/–). Sulphite soap, which is mentioned in A.P.1464B, is not considered adequate when using Araldite.

Preparation of adhesive

5. The weighing of resin and hardener must be accurate and the mixing must be thorough if maximum strength is to be achieved. When mixed, the adhesive has a pot life of 1 to 1½ hrs. at room temperature, depending upon the quantity mixed; the larger the quantity mixed the shorter the pot life, this is because the constituents are exothermic (i.e. they give off heat when combined), the rise in temperature results in an accelerated setting time. It is suggested that no more than 4 oz. should be mixed at a time unless a shortened pot life is acceptable. The proportion of constituents is:—

Araldite AV 121	100 parts by weight.
Hardener HY 951	4–4½ parts by weight.

Application

6. As an adhesive, spread a thin layer of the mixture by spatula or knife on both surfaces to be bonded and close the joint within half an hour. Remove excess mixture with a knife previously dipped in solvent (e.g. acetone). Keep the joint lightly clamped or otherwise supported while the mixture cures. When used as a filler, apply the mixture by spatula or putty-knife and smooth down the surface before allowing it to cure. When hot-curing, prevent the mixture from running off vertical surfaces by using masking tape. After the mixture has fully cured it may be feathered down to the adjacent surface by filing or sand-papering. The curing times are as follows:—

24 hr. at 20 deg. C (68 deg. F)
or 2–3 hr. at 60 deg. C (140 deg. F)
or 10–20 min. at 100 deg. C (212 deg. F).

7. Bonding strengths are quite satisfactory when curing at room temperature but to obtain the best results the adhesive should be given a short post-cure at a higher temperature. When applying extra heat, allow adequate time for the assembly to reach the required heat before timing the final cure. As an indication of the improved results of a

post-cure it is claimed that the average shear strength of a 16 s.w.g. aluminium alloy, ½ in. lap joint, at room temperature, differs as follows:—

	lb/in.²
(1) Cured for 24 hrs at room temp.	1,300
(2) Cured for 30 min. at 100 deg. C.	2,000

8. If lack of success is experienced with the adhesive it is most likely due to one or more of the following:—

(1) Incorrect proportion of mixture

(2) Inadequate stirring of mixture

(3) Failure to degrease the mating sufaces

(4) Failure to etch and/or abrade the mating surfaces

(5) Glue starvation, due to excessive pressure on the assembled joint.

(6) Incorrect cure times and temperatures.

Note . . .

When considering the technique for a glued joint the desirable situation is to produce a bond in shear, not one where the surfaces tend to peel apart.

★ ★ ★

Cleaning equipment

9. Containers, spatulas knives, etc. should be washed with acetone or cellulose thinners before the resin hardens.

Storage life

10. The hardener is hygroscopic and will deteriorate if allowed to absorb moisture, for this reason the container should be effectively stoppered. When the resin and the hardener are stored separately in a cool, dry place, they should have a shelf life of at least 12 months. Test pieces should be prepared if the effectiveness of the adhesive is in doubt. The information in para. 7 should assist in carrying out a test.