Chapter 9.1 GENERAL INFORMATION

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Scheme

CONTENTS OF SECTION 9 AND ASSOCIATED AIR PUBLICATIONS

Contents of Section 9

1. This Section contains information on the repair of all protective treatments for aircraft, either by content or by reference to associated Air Publications and specifications. Specific repairs for paint finishing schemes, however, apply only to local restoration, either following minor repairs to structure or necessitated by damage to relatively small areas of the protective treatment, since restoration of the complete paint finish is covered by A.P.2656A (*para.* 3 *and* 4).

2. General information on protective treatment, its application to various materials and the process specifications involved, together with references in which full details are published, are given in Scheme 9.1.2. Instructions for the repair of protective treatment for metal and wood components are given in Chap. 9.2 and 9.3, respectively. Chap. 9.4 contains repair schemes for the protective treatments used on materials other than metal and wood, such as the repair of neoprene finish on fibreglass laminate radomes (*Scheme* 9.4.1).

Relationship to A.P.2656A

3. This Section is complementary to A.P.2656A, Vol. 1 (External and Internal Finish of Aircraft), which contains detailed information on most aspects of finishes, including principles, storage, overall colour schemes, etc.

4. In general, the information contained in A.P.2656A is more appropriate to the restoration of the complete paint finishing scheme of an aircraft or major component, but, in some instances, instructions for local restoration of finish are repeated in both A.P.2656A and A.P.2662B for the convenience of airframe and surface worker tradesmen.

Associated publications

5. In addition to the information given in A.P.2656A, frequent references are made in schemes comprising this Section, to other Air Publications which contain detailed instructions on the use of specialized protective treatment processes applicable to ferrous metal, non-ferrous metal and plastic components. In some cases, process data and methods of application, which are given in these associated Air Publications, are repeated in the appropriate repair scheme in this publication for on-the-spot reference when the full information given in an associated publication is not required.

6. The additional publications referred to in para. 5 are listed, together with their titles and application, in Table 1 below.

Table 1. Associated Publications

A.P. No.	Vol. No.	Part No.	Title	Sect.	Chap.	Application
880A	1	—	Welding, Brazing and Soldering Principles and Practice	2	4	Anti-corrosion treatment after welding
880B	1	—	Electro-plating and Corrosion-resisting Processes	4	2 to 8	Detailed information on corrosion-resisting processes
1464B	1	2	R.A.F. Engineering—General Engineering	4	5 to 7	Detailed information on plastics, adhesives, glazing and sealing compounds
				4	10 to 13	Degreasing, cleaning, rust removal, protective materials and coating

Note . . .

A list of processes and a list of approved materials for protective treatments are included in Scheme 9.1.2.

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GENERAL INFORMATION ON REPAIR OF PROTECTIVE TREATMENT

Introduction

1. Protective treatment must be given to all parts of an aircraft during manufacture to prevent corrosion and deterioration of materials and, in accordance with current Service requirements, a very high standard of anti-corrosion protective treatment must be employed.

Standard of protective treatment

2. The minimum standard of protective treatment to which manufacturers must conform, during the design, development and production of aircraft, is laid down in A.P. 970, Vol. 1, Chap. 801. This document covers comprehensively the protective processes and materials to be used, and gives a list of appropriate specifications. An equivalent standard must be maintained during servicing and repairs throughout the life of all components, in accordance with the provisions of this publication, A.P.2656A, and the other publications listed in Scheme 9.1.1, which are based on the A.P.970 requirements.

Applicability of scheme

3. In this scheme, general information, which includes appropriate references to approved specifications and processes, is given to enable personnel to maintain the required standard of protective treatment during, and subsequent to, the repair of damage to structure or to the repair of damage to the protective treatment itself.

4. If a repair is effected under adverse conditions in which lack of facilities prevents the application of full standard protective treatment and it is therefore necessary for an authorised alternative process to be used for the material under repair, the affected area must be suitably marked to indicate that standard treatment must be applied as soon as conditions are favourable.

Exclusion of water

5. The necessity to prevent water or any other moisture from leaking or being driven into covered components of an aircraft either in flight or on the ground is of great importance. Care must be taken to ensure that all windows, panels, doors, etc., are effectively sealed against the ingress of water; particular care is necessary to prevent water from reaching electrical components and apparatus (*A.P.970, Vol. 1, Chap. 709*). Heat and sound-proofing materials must be protected from possible moistening through contact with liquids or condensate (*A.P.1464B, Vol. 1, Sect. 4, Chap. 7, refers*).

Drainage

6. Where it is not possible to prevent the entry of water into covered components because of the movement of control shafts, retractable members, etc., these compartments are designed to drain completely, and drain holes are provided on their lower surfaces to ensure that the accumulation of moisture can drain away freely. This requirement is essential in the vicinity of glued or reduxed joints, the drainage being so arranged that drained moisture does not enter other compartments.

7. The diameter of the drain holes should be between $\frac{1}{4}$ in. and $\frac{1}{2}$ in., and they must be free from internal raised lips or burrs; they must not be allowed to become blocked with flaked paint, dope or metal swarf. If new skinning has been fitted to a compartment during repair, the position of the drain holes must be noted and holes made in the same position on the new skin. The position of all drain holes is shown in the appropriate diagram in the general servicing chapter of the relevant aircraft Volume 1.

Covered compartments

8. Where plywood or fabric-covered compartments exist, the drain holes are formed from prefabricated plastic or celluloid eyelets which are doped to the undersurface and the plywood or fabric skin cut out of the space in the centre of the eyelets to provide the drainage. If a skin repair in the vicinity of the eyelets is necessary, the position of the original eyelets must be noted and new eyelets doped on the repaired skin in the appropriate positions.

Note . . .

When the eyelets have been fitted, care must be taken to ensure that clean cuts are made in the skin and that no rough edges are left on the inner rim of the cut-outs.

Pressurised compartments

9. The drainage of pressurised compartments is effected through the operation of drain valves or drain plugs fitted at the lowest level of the compartments. Their locations are shown in diagrams included with the descriptive chapters dealing with the particular compartment in the relevant aircraft Volume 1 and the periodicity of operation and servicing must be in accordance with that stipulated in the relevant aircraft servicing schedule.

Miscellaneous components

10. Exposed components which may trap water are provided with drain holes at their lowest level. The drain holes must be examined frequently to ensure that they are not blocked up. Provision is also made to ensure that any water or fluid which may tend to collect under loose floor boards or coverings is rapidly drained away.

Identification of existing protective finish

11. When assessing any repair to protective

treatment, it is necessary to know the type of final finish which exists on the component. It may be cellulose or synthetic finish and, if it is not marked with the letter C or S respectively, there is a risk that the wrong finishing medium may be used.

12. To make a quick check to determine the nature of the finish, rub the area with a clean cloth moistened with dope thinners (Ref. No. 33B/9428846 or 9426158). If the cloth is readily stained with the colour, the finish is cellulose; if the cloth is lightly stained only after vigorous rubbing, synthetic finish is indicated.

13. For normal repair use, cellulose finish should be applied to existing cellulose and synthetic finish to existing synthetic finish. If, however, cellulose is not available, synthetic finish may be applied to cellulose finish as a temporary treatment in an emergency, but the whole area should be cleaned off and a completely new cellulose finish effected as soon as possible.

Warning . . .

In no circumstances should cellulose finish be applied to existing synthetic finish as the cellulose would blister or remove the existing protective treatment and result in an unsatisfactory repair.

Applicability of protective treatment repairs to various materials

14. In the following Tables information is given on the applicability of various types of protective treatment and their repair. Table 1 contains information on approved processes and their application to the repair of the protective treatment of various materials. Table 2 comprises a comprehensive list of materials which may be used in the repair of protective treatment, and Table 3 is a reference table which indicates the various finishing schemes contained in A.P.2656A, Vol. 1.

Electrolytic action

15. Where two dissimilar metals are in bare contact and are also bridged by an electrolyte such as condensation, rain, sea water or any humid condition, electrolytic action can occur and cause corrosion additional to any tendency for either of the materials to corrode individually. Sea water and marine or industrial condensates contain salt or other chemicals which accelerate both electrolytic and individual corrosion.

16. The degree of electrolytic corrosion will vary according to the inherent electrical potentials of the two metals; that with the lower potential will tend to become corroded, whilst that with the higher potential will be protected and will not tend to corrode due to electrolytic corrosion, although the individual corrosive tendencies will always be present.

17. It is evident, therefore, that although the potential difference between the metals is the primary energiser of the corroding current, the magnitude of the potential is not always a reliable guide to the amount of corrosion that will occur in any particular contact.

18. In accordance with authorised current practice and as a positive means of preventing the corrosion of metals in contact, all metal joints, with the exception of those listed under the conditions given in Scheme 9.2.1, must be wet assembled with pigmented varnish jointing compound (*Table* 2) and an approved paint finish effected overall.

Safety precautions

19. Whenever metal cleaning processes, protective treatments or aircraft finishing schemes are applied, the necessary precautions must be taken to safeguard the health of personnel and to ensure that the metals being treated are not damaged during the progressing of the work. Information on safety precautions for processes is given in A.P.880B, Vol. 1, Sect. 1, Chap. 6.

GENERAL INFORMATION ON REPAIR OF PROTECTIVE TREATMENT (*Continued*)

TABLE 1

PROCESSES USED FOR PROTECTIVE TREATMENT

Item	Process	Material on which used	Specification	Air Publication reference
1	Anodising (anodic oxidation)	Aluminium based alloys	DTD.910	880B, Vol. 1, Sect. 4, Chap. 7
2	Aluminising	Ferrous metals of 20 s.w.g. and thicker	DTD.907	880B, Vol. 1, Sect. 4, Chap. 2
3	Cadmium plating	Ferrous metals	DTD.904	880B, Vol. 1, Sect. 3, Chap. 6
4	Chromate treatment for repairs of chromate film	Magnesium-based alloys	DTD.911	880B, Vol. 1, Sect. 4, Chap. 8
5	Chromium plating (hard)	Carbon and low-alloy steels	DTD.916	880B, Vol. 1, Sect. 3, Chap. 3
6	Cleaning metal before applying protective treatment	General application	DTD.901	2662B, Sect. 9, Chap. 9.2 and 880B, Vol. 1, Sect. 2, Chap. 1
7	Corrosion preventive processes	General application	—	880B, Vol. 1, Sect. 4, Chap. 2
8	Chromic/sulphuric acid pickling (cleaning)	Aluminium alloys (unanodised)	DTD.915	2656A, Vol. 1, Sect. 5, Chap. 1 & 880B, Vol. 1, Sect. 2, Chap. 1
9	Deoxidine 202	For cleaning and etching assembled aluminium alloy structure	DTD.900/4115	2656A, Vol. 1, Sect. 5, Chap. 1
10	Metallising (metal spray)	Ferrous metals of 20 s.w.g. and thicker	DTD.906	880B, Vol. 1, Sect. 4, Chap. 5
11	Nickel plating	Ferrous metals, according to requirement and copper-rich or aluminium-rich materials	DTD.905	880B, Vol. 1, Sect. 3, Chap. 2
12	Protection of magnesium-based alloys	Magnesium-based alloys	DTD.911	2656A, Vol. 1, Sect. 5, Chap. 2
13	Safety precautions for processes	General application	—	880B, Vol. 1, Sect. 1, Chap. 6
14	Selenious acid treatment for repair of chromate film	Magnesium-based alloys	DTD.911	2656A, Vol. 1, Sect. 5, Chap. 2
15	Sherardising	Medium and low tensile steels used in Class 3 components	DTD.908	880B, Vol. 1, Sect. 4, Chap. 4
16	Protection of external surfaces of plywood	Wooden aircraft construction	DTD.912	2662B, Sect. 9, Chap. 9.3

TABLE 2

MATERIALS USED FOR PROTECTIVE TREATMENT REPAIRS

Item No.	Reference No.	Material	Detail	Specification
1	33C/1264	Compound, pigmented varnish jointing	For application to faying surfaces of metal	DTD.369 (NATO Code No. S-72b), 900/4301, 900/4360 or 900/4488
2	33C/748 or 884	Deoxidine No. 202	For surface pre-treatment	DTD.900/4115
3	33C/892	Calcium chromate	For inhibitor cartridge	DTD.495
4	33G/597	Chromic acid crystals	For anodic treatment of aluminium alloys to DTD.910 and for cleaning magnesium alloys prior to chromate treatment to DTD.911	
5	33C/4	Concentrated sulphuric acid, Sp.Gr.1.84		CS.2530
6	32B/772, 9103608 to 9103612	Cork jointing, synthetic resin bonded		DEF.19
7	33B/–	Enamel, cellulose	Separate reference numbers for different colours	DTD.772
8	33A/–	Enamel, stoving, black		DTD.56 or 235
9	33B/–	Enamel, synthetic	Separate reference numbers for different colours	DTD.827
10	32B/–	Fabric, cotton, strip	Separate reference numbers for various widths	DTD.407
11	32B/147 or 614	Fabric, linen, plain	For covering airframe fuselage and aerofoil components	DTD.540
12	32B/751 to 758	Fabric, linen, strip, serrated edges		DTD.540
13	32B/556 or 569	Fabric, madapolam	For covering airframe plywood components	DTD.343
14	33A/9429341	Knotting solution		CS.1348
15	33B/1122-1123 or 33B/9429197-9429198	Magnesium alloy primer	For application to magnesium alloy after selenious acid treatment	DTD.911
16	34D/312	Methylated spirit, industrial		CS.1227
17	34D/211	Methylated spirit, mineralized		CS.609
18	33C/3,839 or 954	Nitric acid Sp.Gr.1.42	For acid chromate treatment to DTD.911	CS.2531
19	33B/1098-1099 or 33B/9429113, 9429114	Paint, finishing, pigmented lanolin resin, matt white	Protective coating for hulls and floats	DTD.420
20	33B/9429260	Paint remover, special	For removal of ester lubricant resistant finish in non-reduxed areas	DTD.756
21	33B/9429259	Paint remover, Type A.1	For general use including use in reduxed areas	DTD.226
22	33C/615 or 1388	Potassium dichromate	For acid chromate treatment to DTD.911	UK/AID/924

TABLE 2—(Contd.)

Item No.	Reference No.	Material	Detail	Specification
23	21F/611	Remote breathing apparatus		
24	23A/—	Respirator G.S.	For protection of personnel using paint removers, etc.	
	22G/1213	Respirator, half mask, Mk. 2		
25	23A/116	Respirator container Type E, MR.6		
	23A/237	Container, half mask respirator		
26	33C/943	Selenious acid crystals	For selenious acid treatment to DTD.911	
27	33C/1216	Solution, naphtha, coal tar	Degreasing agents for epoxy resin finishes Called up in DTD.901 for degreasing various metals	B.S.479
28	34D/246	Spirit, white		B.S.245
29	33C/1127	Steel wool, Grade 0	For cleaning surfaces affected by exhaust gases	
30	33A/595	Solution, bitumen		B.S.X9
31	33C/180	Soda, caustic, flake, commercial		
32	33B/9428859	Stoppers, oil base		
33	33B/9428846 or 9426158	Thinners, dope, anti-chill	For use as specification particular finishing schemes	DTD.843
34	33B/9428847 or 94228848	Thinners, synthetic finishes		DTD.840
35	33C/547 or 836	Trichlorethylene	For use in degreasing plants	B.S.580
36	33B/—	Paint, priming	For use according to finishing scheme	
37	34B/9100483	Rust Protective PX3		DTD.279
38	33C/645 to 648	Abrasives, paper, water-proof, silicon carbide		B.S.872
39	33A/—	Paint, anti-sulphuric	Separate reference numbers for different colours and sizes of containers	B.S.X19
40	5F/—	Tubing, insulating, varnished, L.T.		DTD.320
41	5F/—	Vulcanised fibre	For jointing purposes	DTD.37
42	33B/100 or 9429115	Zinc oxide		
43	33B/—	Etching primer, comprising:	For use as first coat of primer on clean, etched, clad aluminium alloy and on chromate-treated magnesium alloy surfaces in specified finishing schemes	DTD.868
44	33B/9429195	Accelerator		
45	33B/9429196	Base		
46	33C/—	Adhesive F.1, comprising:		
47	33C/1427	Adhesive F.1	For adhesion of fabric to plywood	DTD.900/4479
48	33C/1428	Catalyst F.C.1		
49	33C/1429	Thinners F.T.1		
50	8010-99-9434479	Primer	For battery stowages in Naval aircraft	DEF.1402
51	8010-99-9434481	Finish, black		
◄52	8010-99-2201813	Finish, grey	For battery stowages in Naval Wasp aircraft	DEF.1402

Note . . . *R.A.F. (A.P.1086) Ref. Nos. for items* 50 *and* 51 *are* 33*A*/9436188 *and* 9436190.►

TABLE 3

FINISHING SCHEMES CONTAINED IN A.P.2656A, VOL. 1

Item	Reference No.	Specification	Scheme
1		DTD.314	Finishing scheme, synthetic, matt
2		DTD.399	Finishing scheme, hydraulic fluid resistant
3		DTD.557	Paints, flexible, for coating overshoes on de-icing equipment
4	**Note . . .**	DTD.751	Doping scheme of low tautness
5		DTD.752	Doping scheme of medium tautness
6	The items comprising any finishing scheme listed in this Table are given, together with the appropriate reference numbers, in A.P.1086, Book 13, Section 33B. The reference number for each item will indicate the colour, size of container and whether applicable to home or overseas use.	DTD.753	Doping scheme of high tautness
7		DTD.754	Cellulose finishes and primer
8		DTD.766	Lightweight finishes
9		DTD.772	High gloss finishing scheme
10		DTD.785	Finishing scheme, cellulose, glossy black
11		DTD.827	High-speed finishing scheme (synthetic)
12		DTD.899	Cellulose finishing scheme, ester lubricant resistant
13		DTD.900/4079	Paints, heat resisting
14		DTD.900/4153	Painting scheme for radomes and suppressed aerials
15		DTD.900/4404	Two-part, cold-catalysed finishing scheme
16		DTD.900/4415	High-gloss, cold catalysed, ester lubricant resistant finishing scheme
17		DTD.900/4474	Paint system, T.T.16

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Chapter 9.2 PROTECTIVE TREATMENT REPAIRS FOR METALS

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GENERAL INFORMATION

Introduction

1. The information given in this Scheme has a general application and deals with the primary treatment of metals, corrosion, paint removers in non-reduxed and reduxed areas, protective finishes for metal parts, use of correct finishes, protection of faying surfaces, precautions to be taken when cleaning metals or applying etching, priming and finishing treatments and the use of protective clothing, gloves and respirators.

2. As shown on the contents page of Chap. 9.2, the repair of protective treatment on various metals and special items is contained in Scheme 9.2.2 *et seq.* and, included in each Scheme and appropriate to the type of metal to which it refers, detailed information is given on the method of removing the old treatment or corrosion, the application of the approved primary treatment and the approved protective finish.

General treatments applied to metals

4. Most metal parts used in aircraft construction are given a primary treatment, such as some form of plating or metallizing, which forms an anti-corrosive film on the surface of the metals. With the exceptions quoted in para. 5 and 6, the parts are then given further protection by an approved finishing scheme which involves the application of cellulose or synthetic paints or enamels.

5. On metal structures within main planes, tail planes and control surfaces, an anti-corrosive treatment of one coat of corrosion preventive PX3 (Ref. No. 34B/9100483) is used instead of a paint or enamel finish. This does not, however, apply to Naval aircraft or to other internal surfaces of all R.A.F. aircraft which must have these structures fully protected by an approved primer and matt finishing scheme.

6. Ball and roller bearings, articulated joints and other moving parts or components which are lubricated do not require any form of protective treatment.

Corrosion

7. The onset of corrosion is primarily caused by the exposure of unprotected metal surfaces to moisture or humid conditions. This incipient corrosion is greatly accelerated by the resultant electrolytic action which will occur when two dissimilar metals are in bare contact in the presence of moisture, especially sea water (*Chap.* 9.1, *Scheme* 9.1.2).

8. Materials found in a corroded condition during periodical or other examinations must be given fully comprehensive anti-corrosion treatment repairs according to the approved scheme for the affected metal provided, of course, that the depth of the corrosion does not exceed the applicable limits of permissible negligible damage given in the relevant aircraft Vol. 6. Immediate action must be taken to effect the repairs, as corrosion which is not fully treated will spread rapidly and result in unacceptable weakening of the structure and the consequent need for more extensive repairs to be made.

Identification of corrosion

9. Corrosion which occurs under cellulose or synthetic paint on the surface of metal-skin aircraft, which may be termed skin corrosion, can usually be identified by the cracking of the finishing coating and if the area surrounding the deteriorated finish is pressed with the fingers, the finish will tend to flake off and expose the bare metal.

10. If corrosion has affected any skins, immediate repair action must be taken (*para.* 8) as follows:—

(1) Clean out the corroded area by polishing it with wire wool after the paint finish has been removed.

(2) Check the depth of the cleaned-out area of the skin by laying a flexible steel rule, or a thin piece of spring steel, across the cavity and measuring the distance between the bottom of the rule and the lowest part of the depression with a feeler gauge.

Note . . .

The following table of tolerances may be used as a guide to the permissible depth of a corroded area.

S.W.G.	Thickness of material (inches)	Depth allowance below normal surface of skin (inches)
14	0·080	0·008
16	0·064	0·007
17	0·056	0·006
18	0·048	0·005
20	0·036	0·004

(3) Where the depth of corrosion exceeds the dimensions given in the table, the skin must be renewed by a local patch or insertion repair, or by a complete skin panel, according to the extent of the damage.

11. On aluminium-based light-alloy metals, corrosion will take the form of a white or grey powder which may be rubbed off the metal to expose the slightly rough, pitted surface. The magnesium-based alloys are similar in their corroded state but have a brown powder deposit as a means of identification of the corrosion. On bare ferrous metals, corrosion appears as rust or dry red powder, but on parts which are cadmium or zinc coated, a white deposit will be evident as the first sign of corrosion of the metal beneath the protective coating. On copper and copper-based alloys, a greenish-white deposit or coating known as verdigris will form and thus indicate incipient corrosion.

12. The corrosion of wrought aluminium alloys may be classified as either superficial or intercrystalline. Whilst the former is easily detected (*para.* 9) and can be remedied by a prescribed anti-corrosive treatment, the latter is more dangerous because it is not possible to effectively determine the depth of the corrosion except by the use of microscopic or electronic checking instruments. If it cannot be established beyond all doubt that the depth of corrosion is within the permissible limits quoted in the appropriate aircraft Vol. 6, the affected component must be renewed.

13. Intercrystalline corrosion does not normally occur in aluminium-coated aluminium alloy sheets or in magnesium-based alloys.

14. The protective coating of magnesium alloy structures must be examined frequently and protective treatment repairs effected as soon as possible after discovery of damage. This is necessary because of the high degree of susceptibility of magnesium to corrosion which is accentuated when the magnesium is in contact with another metal.

15. On aircraft designed for service in aircraft carriers or for Coastal Command duties, and on all aircraft and rotorcraft engaged in air-sea rescue duties, a higher degree of corrosion will be experienced in comparison with that of land-based aircraft not normally subjected to close contact with salt-water spray or marine atmosphere. Frequent cases occur in which the skin and riveting of the fuselage and main planes of these "sea-going" aircraft become corroded to a degree which renders the aircraft unserviceable. This condition is caused by the effect of sea-water spray or moisture or an atmosphere heavily laden with salt water, which attacks the protective finish of the metal and causes it to deteriorate; this is particularly noticeable around rivets and the surrounding skin where dissimilar metals with slightly different corrosion potentials are in contact and where corrosion will be accelerated by electrolytic action.

16. In all cases, therefore, it is an essential requirement that all protective treatment schemes must be kept in good repair according to the instructions given in the ensuing Schemes.

Paint removers

17. Where incipient corrosion of an aircraft component is discovered, immediate repair procedure must be effected and the protective finish removed from the affected area by the application of a suitable paint remover (*Scheme* 9.1.2, *Table* 2). It is necessary for the paint finish to be cleaned off over an area larger than that of the suspected corrosion so that the full extent of corrosive penetration may be clearly ascertained. In all probability, the paint remover will not shift the corrosion products and therefore some other agent, such as an approved corrosion remover, must be employed to destroy them (*para.* 23 *to* 36) and enable a correct assessment to be made of the depth of corrosion. The type of paint remover to be used must be in accordance with that given in the appropriate finishing scheme.

18. There are two types of paint remover approved for general Service use; Type A.1 to D.T.D. Spec. 226 for use on normal protective finishes and Paint Remover, Special to D.T.D. Spec. 756 for removing ester lubricant resistant finishes, including cold-curing, epoxy resin-based finishes. Detailed information on the use of these paint removers is given in A.P.1464B, Vol. 1, Part 2, Sect. 4, Chap. 14.

19. Both removers can adversely affect the anti-corrosion sealant (pigmented varnish jointing compound) used in the wet assembly of nearly all metal joints in Service aircraft. In addition, the special paint remover (*para.* 18) may contain methylene chloride which will have a deleterious effect on any joints bonded with metal-to-metal adhesive to D.T.D. Spec. 775, e.g., Redux joints. This is also applicable to wood-to-metal joints made with the same adhesive.

20. The removers may be used on any external part of an aircraft, *unless specific instructions to the contrary are given in the relevant aircraft Vol.* 6, provided that all metal-to-metal skin joints are positively masked with pressure-sensitive, adhesive paper masking tape to B.S. Spec. J.11 (Ref. No. 32B/1070, 1071 or 1072, according to the width required), that all access doors, drainage holes and other apertures are securely sealed and that all perspex windows and panels, plastic components, rubber seals and tyres are suitably protected.

21. If the use of paint remover is essential on internal structure, extreme care must be taken to ensure that all joints in the vicinity of the area to be cleaned off are adequately masked (*para.* 20) and that suitable absorbent protective material is provided, and so positioned, to prevent the fluid dripping or splashing on adjacent members of the structure during application.

22. When the paint finish has been softened, it must be completely removed and all traces of the paint remover cleaned off quickly, to prevent a deposit forming on the surface of the metal, with either primer thinners or cold water, according to the type of remover used, and the affected area thoroughly dried. The masking tape should then be stripped off and the finish beneath the tape removed by either mechanical or manual means. Paint remover must not be allowed to dry on the metal, otherwise it will be found very hard to remove the mixed finish and remover. While effecting this operation, it is essential to ensure that the primary protective treatment of the metal, such as anodic coating, chromate film or cadmium plating, is not damaged.

Note . . .

To ensure that drainage holes and other apertures which have been covered with masking tape are completely clear and permit full drainage and access when the tape has been removed, it is essential that ALL *pieces of tape are stripped from the structure and that a thorough examination is made, on the completion of the repair work, to confirm this has been done.*

Corrosion removers

23. When the protective finish has been removed from the surface of the metal (*para.* 17 *to* 22) and any degree of corrosion is revealed, the corrosion product must be cleaned off the surface with an approved remover appropriate to the type of metal to be treated. This may be done with the aid of a stiff brush, or with steel wool or very fine emery cloth (*if authorised at the discretion of the Senior Technical Officer or his deputy*), until all traces of incipient corrosion have been removed. The component must then be checked to ensure that the depth of corrosion has not exceeded that specified as negligible damage (*Scheme* 9.2.1, *para.* 10).

24. If the corrosion can be removed from a structure *in situ*, the approved remover should be applied by a brushing-light abrasive-swabbing process. This is the usual procedure adopted by User Units under normal circumstances but, where necessary under conditions of heavy superficial corrosion, and when the component is easily removable from the aircraft, an immersion process should be used, if any suitable type of bath is available, wherein the component should be immersed in an approved corrosion-remover solution. In either case, the decorroding solution must not be allowed to dry on the surface of the metal as the residues are difficult to remove by washing and may interfere with subsequent processing.

25. The various corrosion removers approved for Service use on specific types of metal are covered by D.T.D. and other specifications and their application is outlined in the ensuing paragraphs.

Aluminium and aluminium alloys

26. Deoxidine 202 to D.T.D. Spec. 900/4115 is the only corrosion remover approved for use on clad alloy structures and, prior to the application of this solution, the removal of the corrosion product should be aided by the use of a stiff brush or, if authorised, very fine emery cloth or steel wool.

27. The application of corrosion remover is not permissible on unclad aluminium alloy structure and where superficial corrosion has attacked any such structures, they must be renewed. This restriction is necessary due to the considerable danger of the corrosion product having become intercrystalline in form, thus tending to weaken the strength of a structure.

Magnesium and magnesium alloys

28. The removal of corrosion from these materials is to be effected in accordance with the provisions of D.T.D. Spec. 911, in which four types of corrosion remover are authorised for Service use.

29. For *in situ* work on isolated spots of corrosion and the subsequent repair of the chromate film on the structure, two approved methods are given as follows:—

(1) When the removal of the corrosion is to be followed by selenious acid treatment, a solution of chromic acid crystals and concentrated sulphuric acid should be used.

(2) If acid chromate treatment is to follow the application of corrosion remover, an acid chromate solution of potassium dichromate and concentrated nitric acid may be used as the corrosion remover.

30. Where corrosion occurs in more extensive areas, components must be removed from the aircraft and renewed if the depth of the corrosion product is greater than that specified as negligible damage in the relevant airframe Vol. 6. If, however, the depth of corrosion is within limits, the components should be immersed in separate baths containing the following boiling solutions of corrosion removers:—

(1) Caustic soda

(2) Chromic acid

(3) Hydrofluoric acid (a cold bath process).

31. For magnesium alloy structures affected by deep corrosion the normal procedure is for those items to be renewed, but where reconditioning of the components is considered necessary, they should be removed from the aircraft and given immersion treatment in separate baths containing the following solutions:—

(1) Caustic soda and sodium dichromate in a boiling condition

(2) Hydrofluoric acid in a cold condition.

32. For detailed information on the processes mentioned in para. 23 to 31, refer to the relevant Schemes contained within this chapter.

Steels

33. The corrosion removers approved for Service use on various types of steels must conform with the provisions of D.T.D. Spec. 901 and may be used as immersion or *in situ* swabbing application processes. In all cases of steel corrosion (rust), the depth of corrosion must always be the deciding factor

governing a question of renewal and only lightly rusted components should be treated with a corrosion remover to enable a component to remain in service. All rusted static and other steel components must be renewed, the new components being made with steel that is already cadmium plated or metalized.

34. For strong steels above 65 tons per sq. in. the removal of rust is confined to the cleaning of only very slightly rusted components with alkaline removers quoted in D.T.D. Spec. 901, Method 9. These consist of four closely similar proprietary brands approved for Service use, which are listed as follows:—

(1) D.T.D. 900/4508 Ferroclene H.T.400, de-rusting solution

(2) D.T.D.900/4543 Alka-Deox 114, de-rusting solution

(3) D.T.D.900/4547 Alkaline de-rusting solution S.830-39

(4) D.T.D.900/4559 Ardrox 185, de-rusting compound.

(1)–(4): Alkaline de-rusting and cleaning solutions for steel (non-electrolytic)

35. For non-surface hardened steels of less than 65 tons per sq. in. minimum specified ultimate tensile strength, a phosphoric acid de-rusting process to DEF. Spec. 38 should be employed. The process may be used by immersion or *in situ* swabbing.

36. In conjunction with DEF. Spec. 38 (which replaces Solution, Rust Removing, Type D and Type E to C.S. Spec. 2432 and 2433 respectively), DEF. Spec. 36 and 37 give information on the composition of the phosphoric acid solutions, with and without an inhibitor, to be used in the methods given in DEF. Spec. 38. The three specifications are listed as follows:—

DEF. 36 Phosphoric acid de-rusting solution, uninhibited

DEF. 37 Phosphoric acid de-rusting solution, inhibited

DEF. 38 The de-rusting of steel by phosphoric acid solutions.

Protective finishes for metal parts

37. When metal parts have received the appropriate primary treatment, they must be given, unless otherwise specified, a synthetic or cellulose protective coating to the correct D.T.D. specification, one of the finishing schemes listed in Scheme 9.1.2, Table 3, or an appropriate substitute, being applied.

Use of correct finishes

38. Before proceeding with any protective treatment repair, it is essential to identify the type of final finish that exists on the aircraft and to ensure that finish to the same D.T.D. specification is used (*Scheme* 9.1.2, *para.* 11 *to* 13 *refers*). The type and specification of the original finish is stencilled in prominent positions on all eternal components of an aircraft and, to this end, these must be checked.

Wet assembly

39. This is essential on all static joints, except those listed in para. 40, after the application of sufficient pigmented varnish jointing compound (D.T.D. Spec. 369) to the faying surface of built-up metal components and patches to skin, whether of the same or different materials, to produce a fillet at the joints. On flush repair patches, the fillet should be cleaned off the external surfaces of the repair but, where a repair introduces a patch raised above the level of the skin, the compound should be removed only sufficient to allow a triangular fillet to be formed between the edges of the patch and the original surface to act as an anti-corrosion preventive. In pinned or bolted joints, the jointing compound must be applied to both the shank and to the holes and in riveted joints it must be applied to the holes and to the countersunk surfaces. On surfaces subject to possible fuel or ester lubricant contamination, an approved jointing compound which is resistant to these fluids must be used instead of D.T.D.369.

40. In the following sub-paragraphs, information is given on the type of component or circumstances in which wet assembly with pigmented varnish jointing compound, or the approved alternatives, is not required:—

(1) Joints incorporating a rubber seal

(2) Joints made with an adhesive

(3) Internal surfaces. Where rust preventive PX3 to Spec. D.T.D.279 is used on internal surfaces, it should also be used as the jointing compound instead of the pigmented varnish to form the protective coating on the structure. It should be assembled wet (*para.* 39)

(4) Spot-welded joints

(5) Pressure-tight joints. The jointing compound used for pressure-tight joints in pressurised compartments must be selected from those specifically approved for this purpose.

(6) Screwed unions in fuel, oil, hydraulic and pneumatic systems.

(7) Integral tanks. Only compounds which are specifically approved for this purpose are to be used.

(8) Joints with oil grooves. Jointing compound is not to be used in close tolerance parts which have oil grooves or holes where jointing compound may interfere with the free flow of lubricant to the bearing surfaces. Such parts must be assembled after the application, to the static mating surfaces, of the lubricant normally used in service.

(9) Engine bay cowlings and small assemblies in the engine bay.

(10) Lockers, stowages and similar non-structural components on other than Naval aircraft.

Safety precautions

41. All necessary precautions to ensure the safety of personnel and equipment must be taken whenever protective treatment repairs are in hand.

42. Adequate fire-prevention precautions must always be taken where flammable materials are being used. In finishing or other protective schemes which involve the use of a catalyst, neither the catalyst nor the mixed finish should be allowed to come into contact with the skin or enter the eyes. Should this happen, however, the eyes must be irrigated with clear, cold water and the skin thoroughly drenched, medical attention being arranged immediately.

43. Where tautened, fabric-covered frame aircraft components are undergoing protective treatment repairs, precautions must be taken against electrostatic discharge, which might cause a fire, and also against fumes and draughts. These precautions are detailed in A.P.2656A, Vol. 1 (2nd Edn.), Sect. 2.

44. Paint removers may prove dangerous to the health of personnel using them and certain rigid safety precautions must be strictly observed, whenever these removers are being used.

45. A general service respirator with a Type E, Mk. 6 container, or a half-mask respirator and container, must be worn by all operators using paint removers in hangars, in forced-ventilation dope shops, or even in the open air, the containers being discarded after 8 hours' use and new containers substituted (*Scheme* 9.1.2, *Table* 1).

46. Fumes and spray mist from cellulose or synthetic aircraft finishes are injurious to the health of personnel if inhaled during paint spraying operations. When this type of work is likely to be of long duration and the inhalation of fumes and spray cannot be avoided by the use of a suitable ventilation system or a change of position of the operators away from the direction of drift, a half-mask respirator (Ref. No. 22G/1213) should be used, except under the circumstances given in the following paragraph.

47. It is preferable that paint removers or finish materials are not used in enclosed spaces. Where this is unavoidable, however, personnel must wear a remote breathing apparatus, by which means fresh air is drawn from an external source (*Scheme* 9.1.2, *Table* 2).

48. In addition to wearing a type of respirator or remote breathing apparatus, it is essential for all personnel to protect their hands, forearms and clothing. To ensure this protection, suitable protective clothing, including special gloves, must be worn to prevent any possibility of the paint removers or finish preparations being brought into contact with the hands, clothes, body or food. Any paint remover or aircraft finish containing a catalyst which is splashed on to the skin must be washed off with clean, cold water immediately (*para.* 42).

Repairs

49. The importance of preserving any form of protective finish is emphasized when it is realised that the repair of a damaged finish, however small, is a lengthy and difficult job which will invariably increase the period of unserviceability of an aircraft, especially when some forms of anti-corrosion treatment are beyond the scope of Service repair. It is necessary, therefore, that any specified finish must be preserved undamaged for as long as possible.

50. The anti-corrosion treatment of metal is applied with the object of preventing air and water or other corrosive elements from coming into contact with the bare metal and if the protective film or coating on the metal is scratched or broken in any way, not only will the exposed metal become corroded, but the corrosion product will tend to spread out and form under the existing protective film or coating. Great care must be taken, therefore, to prevent all metal surfaces from being scratched or otherwise damaged.

Repair of scratches or lightly damaged finishes

51. Provided that they do not penetrate to a greater depth, or are beyond the limits, of those specified in the negligible repair tables of the relevant aircraft Vol. 6, freshly-made scratches which penetrate the protective finish, or small damaged areas of finish which expose the bare metal, must be repaired immediately. The surface to be repaired must be thoroughly cleaned with the degreasing fluid approved for use with the type of finish existing on the metal, and the finish cleaned off with the approved paint remover. The area under repair must now be coated with an approved primer and the edges of the existing finish lightly feathered off with waterproof abrasive paper wrapped around a cork block until a smooth surface is obtained. The surface must now be given another coat of primer and then followed by the requisite number of coats of paint finish similar to that existing on the surrounding structure.

Extensive damage to finish

52. Where the protective finish has deteriorated or has sustained severe damage resulting in the protective film on the metal being removed, or corrosion of the metal has already occurred, an approved corrosion remover (*para.* 23 *to* 36) must be used to clean out the corrosion product prior to applying the primer (*para.* 51).

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9.2.2 REPAIR OF PROTECTIVE TREATMENT ON SPECIAL ITEMS

Applicability

1. This Scheme contains information on the anti-corrosion protection of miscellaneous items which require special treatment in addition to, or in lieu of, standard treatments and, therefore, are not included in Schemes 9.2.3 to 9.2.7. The protective treatment repairs for these items must be effected in accordance with the information given in this Scheme, A.P.880B, Vol. 1, and in A.P.2656A, Vol. 1 (2nd Edn.).

Treatment of tanks

2. The external surfaces of metal tanks must be protected by the standard treatment appropriate to the metal from which they are made. The internal surfaces must be left unprotected except as specified in para. 3 to 6 of this Scheme. Where tank repairs are necessary,it is essential that the protective treatment of the metal is restored to its original standard by the appropriate repair scheme. For detailed information on the repair of metal tank structure, refer to A.P.4117A, Vol. 1 and 6.

Fuel and oil tanks

3. On the completion of any tank repairs, the following protective treatment repairs should be effected:—

(1) Tinned-steel tanks are to be left unpainted on the internal surfaces and the external surfaces painted to the approved finishing scheme. All flux must be removed from the interior of tanks by thoroughly washing with hot water and completely drying with a hot-air blower or any other approved method.

(2) Aluminium-based alloy tanks must be anodised internally and externally after welding, or before riveting operations, and the internal surfaces left unpainted.

(3) Magnesium-based alloy tanks must be given acid chromate or selenious acid treatment, followed by magnesium alloy primer and an approved finishing scheme on the external surfaces. The internal surfaces must be left unpainted.

(4) In addition to the surface treatments of aluminium-based and magnesium-based alloy tanks, an inhibitor cartridge containing calcium chromate (Ref. No. 33C/892) to D.T.D. Spec. 495 must be fitted in all magnesium-based alloy tanks and in aluminium-based alloy tanks which are not provided with sumps, e.g., shallow wing tanks or integral tanks. The cartridge must be fitted in a position where any free water present in a tank will come into contact with the cartridge when the aircraft is in a standing position. If water is in contact with the cartridge, a thin, yellow sludge is liberated and will form a coating on the walls of a tank. This coating will prevent corrosive attack on the metal and should not be removed. The calcium chromate must be renewed according to the periodicity given in the relevant aircraft servicing schedule.

Methanol-water tanks

4. These tanks are made from a range of basic and alloy metals approved for tank construction (*A.P.4117A, Vol. 1 and Vol. 6, Sect. 7, Chap. 6*), the metal most suitable for the purpose being stainless steel, which is non-corrodible and therefore does not require protective treatment. At a later date, titanium may also be used; this material is also non-corrodible and does not require protective treatment.

5. Where other materials are used for the construction of this type of tank, they must be coated internally with an approved, special organic compound which will render the metal impervious to attack by methanol-water. Ordinary cellulose or synthetic paints are not suitable for this purpose and, if the special compound is not available, protective treatment repairs by a User Unit must be abandoned and the tanks renewed; the unserviceable tanks being returned for servicing at the appropriate Maintenance Unit or at the maker's factory.

6. When protective treatment repairs are necessary on the external surfaces of tanks other than those made from stainless steel or titanium, the paint scheme employed must be similar to that stencilled on the tank or quoted in the relevant aircraft Vol. 6.

Drinking water tanks

7. Tanks made from aluminium-based alloy must be anodised, or treated with Deoxidine 202,after welding or before riveting operations and then coated internally with clear varnish to D.T.D. Spec. 234. Repair of the tanks will usually be by renewal.

8. Where corrosion-resisting steel is used in the construction of these tanks, the internal surfaces of the tanks must be coated with clear varnish to D.T.D. Spec. 234. Repair of the tanks will usually be by renewal.

Note . . .

As clear varnish to D.T.D. Spec. 234 is not referenced in A.P.1086, Unit demands for this item must be submitted under Ref. No. 33B/N.I.V. and the varnish obtained from the appropriate Maintenance Unit.

Tank jointing materials

9. Rubberised fabric jointing materials used in the construction and repair of fuel, oil and water tanks must comply with the requirements of DEF. Spec. 19 or D.T.D. Spec. 295 or must be proprietary preparations approved for the purpose.

10. The overlap of the seams must always be completely and evenly filled by the jointing material and when necessary a scarfed joint may be employed to obtain an even thickness.

11. When jointing material to DEF. Spec. 19 is used in the construction and repair of water tanks, it must be coated with seaplane varnish (Ref. No. 33B/9428868 or 9428869) and allowed to dry before assembly.

REPAIR OF PROTECTIVE TREATMENT ON SPECIAL ITEMS—(Contd.)

Tank strap packings

12. As a general rule, the material used for tank strap packings is pressed wool felt to D.T.D. Spec. 590 (Ref. No. 32B/—, according to thickness), impregnated with zinc naphthenate to B.S. Spec. 2087 to give the necessary anti-corrosion protection between tankage, support and straps. Shaped hardwood blocks may be used to fill spaces between the straps and any elliptical-shaped tanks supported on flat surfaces. The blocks must be treated with an approved paint finish and proofed felt attached to the upper and lower surfaces of the blocks to prevent metal contact, before being fitted into position.

Packings between light-alloy piping and clips

13. Only the following materials are to be used as packings between light-alloy piping and clips:—

(1) Mould-resisting cork jointing material to DEF. Spec. 19 with or without liquid engine jointing compound.

(2) L.T. varnished insulating tubing to D.T.D. Spec. 320.

(3) Vulcanised fibre to D.T.D. Spec. 37.

Pipe clips and packing

14. All pipes, with the exception of those supplied as coils of tubing, must be given their final protective treatment before being clipped, with suitable packing material, in position on the aircraft. Tubing supplied in coils should be run into position and then painted *in situ*. Pipes used for conveying liquids or gases must not be painted internally.

Flexible end connections of metal pipes

15. Where flexible end connections are used on pipes, that portion of the metal pipe in contact with the flexible connection must be painted with a protective finish.

Use of leather

16. Contact between leather and metal parts is not permissible due to the high corrosion potential between the two materials. After any repairs to protective treatment on metal, therefore, it is essential that all adjacent leather items are arranged so that they are well clear of the metal. The common use of leather straps with metal buckles is not included in this requirement.

◄Accumulator stowages in Naval aircraft

17. Whenever alkali batteries/accumulators are fitted, the stowage area anti-corrosion protection is to be to DEF Spec. 1402 paint system. Aircraft with acid batteries/accumulators are to have their stowage areas protected with paint to DEF Spec. 1402 whenever refinishing of the area is necessary. If difficulty is experienced in removal of the existing acid-resisting paint then it is permissible to overpaint with an epoxy chromate leaching primer, e.g. Ref. No. 33B/2202444, prior to application of the DEF Spec. 1402 paint system.►

Flexible cables

18. Flexible cables, unless they are of stainless steel, are to be soaked in corrosion preventive PX3 to D.T.D. Spec. 279 (Ref. No. 34B/9100483) or PX9 to D.T.D. Spec. 663 (Ref. No. 34B/9100489) before being assembled in an aircraft. Where parts of any cable are in contact with pulleys and fairleads, the excess preventive fluid must be removed to prevent the adhesion of dust or grit.

Bonding

19. On completion of any repairs, all necessary bonding strips must be fitted to make good electrical contact with the bare metal. If the surrounding coating of paint finish forming the anti-corrosion protective is damaged during the assembly of electrical bonding, it must be repaired by the application of the required number of coats of the paint finish which exists on the surrounding structure. If the damage is extensive, the surface of the complete component should be thoroughly cleaned off and recovered with the number of coats of the paint finish required in the appropriate protective scheme.

20. After the bonding strips have been fitted, they must be given the protective treatment similar to that existing on the surrounding structure. If an anodised surface is deliberately broken to make a good electrical contact, the approved protective scheme for the metal in question must be applied over the contacting metals. If the original protective treatment was stove enamelling, an approved paint finish may be used to form a reliable protective treatment after assembly.

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9.2.3 REPAIR OF PROTECTIVE TREATMENT ON ALUMINIUM AND ALUMINIUM-BASED ALLOYS

Introduction

1. This Scheme contains information on the approved methods of providing an anti-corrosion film on the surfaces of aluminium and aluminium-based alloy structures, where specified, and the cleaning, degreasing, surface pre-treatment and repair of the protective treatment.

Anodic treatment

2. All aluminium or aluminium-based components, with the exception of those mentioned in subsequent paragraphs, must be thoroughly cleaned, anodically treated and then given a paint or other approved finish.

3. Primary structure made from forgings, stampings, bars and extrusions, or unclad components made from plate material of 0·25 in. thickness or greater, must be anodically treated in an approved bath containing a chromic acid electrolyte in accordance with DTD. Spec. 910, Sect. 2. This type of treatment must also be given to primary structure components made from clad plate when the cladding is completely or partially removed during fabrication.

4. The anodic treatment process to DTD. 910 is fully described in A.P.880B, Vol. 1, Sect. 4, Chap. 7 and consists, briefly, of the formation of a comparatively hard, non-corroding oxide film on the surfaces of the material being treated, the material being made the anode in an electrolytic cell containing dilute chromic acid.

5. The chromic acid bath process of anodic treatment, in addition to providing a protective film and promoting adhesion of paint finishing coatings, is used because it offers the best inspectional facilities, being suitable for the detection of cracks and flaws, etc., through the subsequent seepage of the coloured electrolyte from such defects, and also for providing a bonding surface for plastic jointing materials. This process is not suitable for composite parts which embody other materials *unless the latter are adequately "stopped off"* (i.e. covered with a suitable non-conductor such as an approved wax or lacquer, etc., on the surfaces to prevent electro-deposition thereon).

6. Clad aluminium alloy plate, sheet and strip material (originally known in the Services under the proprietary name of Alclad) must be used for repair work unless specific instructions for the use of a non-clad material are given in the relevant aircraft Vol. 6, except in an emergency such as a fly-in repair. If unclad material is used in an emergency, it must be replaced by clad material at the first opportunity.

7. On Naval aircraft, all aluminium alloy plate, sheet and strip material must be clad, even if subsequent machining or other work removes the cladding locally. In all such cases, anodic treatment is necessary to restore the protective film to the material surfaces.

Exceptions and special cases

Sheet or strip material

8. Components made from aluminium or clad aluminium alloy sheet or strip may be given one of the following treatments in place of anodising to D.T.D. Spec. 910, Sect. 2:—

(1) If the painting scheme to be applied does not embody an etching primer, the parts are to be treated, before painting, in accordance with the provisions of D.T.D. Spec. 915 or any other approved pickling or filming process.

(2) If the particular paint scheme embodies an etching primer, the parts need only be degreased in accordance with D.T.D. Spec. 901 prior to being painted.

(3) If components cannot be painted, they are to be anodically treated and chromate sealed in accordance with D.T.D. Spec. 910, Sect. 3.

Tubes

9. All tubular parts are to be treated as follows:—

(1) Structural tubing must be anodised externally and painted to an approved paint scheme externally and internally.

(2) Tubes supplied in coils need not be anodised but must be painted to an approved paint scheme externally after assembly in the airframe.

Bolts, pins, screws, bushes and similar assembly component parts

10. These are to be anodically treated before assembly and treated after assembly in common with the surrounding structure.

Rivets

11. These need not be anodised but are to be treated, during assembly, with the jointing compound appropriate to the type of joints involved and after assembly, in common with the surrounding structure.

Welded and riveted assemblies

12. When these assemblies are to be anodised, the anodic treatment is to be in accordance with the provisions of D.T.D. Spec. 910, Sect. 2 and effected in a bath employing a chromic acid electrolyte.

Pickling

13. The pickling process to D.T.D. Spec. 915 is a chromic/sulphuric acid treatment which is suitable only for unassembled sheet or strip material. It is an immersion process which will produce a surface etch on the metal (para. 23 to 25).

Deoxidine 202

14. For those assembled structures requiring *in situ* treatment prior to the application of a paint scheme, the Deoxidine 202 process (para. 16 to 19) is in general use. This process produces a lighter etch than the

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chromic/sulphuric acid treatment (*para.* 23 *to* 25). These processes are also described in A.P.2656A, Vol. 1. and Vol. 1 (2nd Edn.)

Note . . .

The Deoxidine 202 *process provides a chemically clean surface suitable for the application of a paint scheme, but does not provide an anti-corrosion film.*

Alocrom 1200

15. An approved compound, Alocrom 1200, in powder form to D.T.D. Spec. 900/4413, may be used if specified in the relevant aircraft Vol. 6 for local repair of the anodic film on aluminium and clad aluminium alloy components, which may either be repaired *in situ* or by removal from the aircraft. The application of the compound may be made by brush or spray, similar to Deoxidine 202, and details of the preparation and brush application are given in para. 20 to 22. Alocrom 1200 is primarily intended for the repair of anodic film on *unpainted* components.

Deoxidine 202 process

16. Deoxidine 202 (Ref. No. 33C/748 or 884), for surface pre-treatment, is a medium-bodied, light-grey fluid which may be applied to the metal by either brush or spray gun. Of the two methods, the former is the best one for the purpose and is approved for use in the Services because the desired heavy coating of Deoxidine can be more easily applied by brush. If spray gun technique is to be used to apply the Deoxidine, the standard nozzle of the gun must be replaced by a special stainless steel nozzle.

17. When brush application is employed, the Deoxidine should be poured into clean metal containers of suitable sizes to cope with the areas to be covered and once these containers have been used for Deoxidine they should be retained for this purpose to meet future requirements.

18. Any type of paint brush may be used for applying the Deoxidine but, when a large area has to be treated, a distemper brush should be used. Once the Deoxidine has been applied, it is not necessary to smooth out streaks or brush marks, provided that no uncoated metal is visible.

Application

19. The details of the process are as follows:—

(1) Remove all excessive deposits of oil or grease from the surface of the metal with a liquid degreasing agent made up from equal parts of naphtha solution and white spirit (*Scheme* 9.1.2, *Table* 2).

Note . . .

Light deposits of oil or grease will be removed by the application of the Deoxidine.

(2) Thoroughly dry the metal to ensure a clean surface.

(3) Brush on a heavy coat of Deoxidine in the same manner as a coat of paint is applied, ensuring that all parts of the metal surface are well covered.

Note . . .

If the Deoxidine requires thinning down before application, only methylated spirit should be used, not more than 10 *per cent being added. Industrial methylated spirit (Ref. No.* 34*D*/312) *is best for the purpose but, if this is not available, mineralized methylated spirit (Ref. No.* 34*D*/211) *may be used. In no circumstances should water be used as a thinner for Deoxidine because it retards the drying process and adversely affects the etching and grease-removing properties of the solution.*

(4) Allow the Deoxidine to remain on the surfaces of the metal for approximately 20 minutes, by which time, under good drying conditions, a loosely-adhering powder should have been formed; this will serve as an indication that the complete surface, including rivets, recesses and crevices, has been adequately treated. If uncoated parts of the metal surfaces are visible, these must be treated and a further 20 minutes allowed for the Deoxidine to dry.

Note . . .

If drying conditions are bad and the applied Deoxidine remains somewhat moist, it is not necessary for it to be left on the metal for a period longer than 20 *minutes.*

(5) Remove the Deoxidine deposit from the metal surface by swabbing it off with clean water. Ensure that all traces of Deoxidine are removed from seams, rivet crevices and recesses by using a stiff bristle brush; a jet of compressed air should be directed on to the structure to blow the residual water from crevices and thoroughly dry the surfaces.

(6) Apply a coat of the approved priming paint to the metal surface as soon as possible after the Deoxidine treatment has been completed.

Alocrom 1200 process

20. Alocrom 1200 compound (Ref. No. 33C/1476), listed in A.P.1086, Book 13, under the heading of "Powder", is a proprietary brand of surface pre-treatment (*para.* 15) which is similar in application to Deoxidine 202. The compound may be used for repairing damaged anodised films and has a superior corrosion resistance, when mixed with nitric acid and distilled water to form a solution, to Alocrom 100 which is designed for paint adhesion.

Note . . .

The Alocrom 1200 *solution is designed for use as an anodic film restorer on* UNPAINTED *surfaces only.*

Preparing the solution

21. To one gallon of distilled water in an acid-resistant container (stainless steel, plastic or rubber) add 3½ oz. of Alocrom 1200 powder, followed by ½ fluid oz. of concentrated nitric acid (Ref. No. 33C/839 or 954) and stir thoroughly until the powder is dissolved; a small amount of insoluble residue in the bottom of the container may be ignored.

WARNING . . .

Owing to the poisonous nature of the fumes generated during the mixing and application of Alocrom 1200 solution, these operations must be effected, whenever possible, in a well-ventilated building or a workshop ducted to carry away the fumes. Suitable protective clothing must be worn by personnel to prevent the solution contacting the skin (*Scheme* 9.2.1).

Application

22. The details of the application of Alocrom 1200 solution are given in the following sequence of operations:—

(1) Remove all excessive deposits of paint, grease or oil from the component or damaged *in situ* structure either by placing the component in the degreaser tank for a few minutes or, alternatively, by wiping the damaged area with a cloth soaked in trichlorethylene or any other approved cleaner.

(2) Using a suitable brush (a nylon-bristle tooth-brush, if possible) or a swab of cotton wool on the end of a stick of suitable working length, apply the solution to the affected area.

(3) Treat small areas individually, washing off any excess solution from the surrounding structure with cold water, immediately.

(4) Allow the solution to act on the affected surfaces for a period of from 2 to 7 minutes, according to the atmospheric temperature and the alloy being treated, until a light brown or golden iridescent film is produced.

(5) When the required soaking time has elapsed, wash off the solution from the surfaces to which it has been applied and thoroughly dry with a jet of compressed air or a warm-air dryer.

Note . . .

Thoroughly clean out the brush after use. If the solution has been applied by cotton wool swabs, these must be thoroughly washed before being discarded. This is a necessary precaution as swabs which are allowed to dry without being washed constitute a fire risk.

Chromic/sulphuric acid process

23. This immersion process to D.T.D. Spec. 915 is suitable only for the pre-treatment of unassembled aluminium alloy sheet and may not come within the scope of Service personnel. Metal which has been pre-treated in this manner will, however, be frequently encountered on Service aircraft and will be recognised by the considerably deeper surface etch that is produced when compared with that resulting from the Deoxidine 202 process.

24. The chromic/sulphuric acid immersion bath is a type of lead-lined tank, available in various sizes and capacities, which is designed to contain, in water, a solution of 5 per cent chromic acid by weight and 15 per cent sulphuric acid by volume. The whole solution, when mixed, is heated to the required operating temperature by an electrical immersion heater with a heat potential appropriate to the required tank capacity.

25. The details of the immersion process are as follows:—

(1) Degrease and clean the surfaces of the metal sheets by the trichlorethylene process (*A.P.*1464*B*, *Vol.* 1, *Part* 2, *Sect.* 3, *Chap.* 12) or by any other approved degreasing scheme or solvent.

(2) Immerse the metal sheets in the chromic/sulphuric acid bath for 20 minutes at a temperature between 43 and 65 deg. C, agitating the solution continuously throughout this period.

(3) Remove the metal from the bath and rinse it in clean, cold water, then in clean, hot water and finally dry it thoroughly in an oven or with a hot-air jet.

Note . . .

The treated surfaces of the metal must not be touched by hand after the rinsing and drying operations.

(4) Apply a coat of the approved primer to the treated surfaces as soon as the drying operation has been completed.

Safety precautions

26. The information on this subject contained in A.P.880B, Vol. 1, Sect. 1, Chap. 6 and Scheme 9.2.1 of this publication must be closely observed when the processes described in para. 16 to 25, and subsequent repairs to protective treatment, are in progress.

Repairs

27. On completion of the operations necessary to restore the protective film to the surface of the metal structure, protective treatment repairs to the paint finishing scheme must be effected as soon as possible after the first coat of an approved primer has dried.

28. The type of paint finish used for the repair must conform with that which exists on the surrounding structure (*Scheme* 9.2.1) and must be applied to the structure in accordance with the instructions appropriate to the finishing schemes contained in A.P.2656A, Vol. 1, 2nd Edition (Aircraft Surface Finishes and Markings).

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REPAIR OF PROTECTIVE TREATMENT ON MAGNESIUM AND MAGNESIUM-BASED ALLOYS 9.2.4

Introduction

1. The information given in this Scheme covers the approved methods of providing an anti-corrosive chromate film on magnesium and magnesium-based alloys. In addition, suitable instruction is given on the pre-treatment of damaged chromate film and on the repair of the paint finish.

General requirements

2. All components made from magnesium-based alloy must be degreased or cleaned, chromate treated and painted in accordance with the requirements of D.T.D. Spec. 911. The primer of the approved painting scheme must comply not only with the requirements of the paint specification but also with the special requirements of D.T.D. Spec. 911.

3. The type of primer and paint finish to be used on magnesium alloy components will depend on whether the aircraft to which these components are fitted uses ester lubricant engine oil or an ordinary approved engine oil. If the former oil is used, an ester lubricant resistant paint scheme to D.T.D. Spec. 899, 5555, 900/4414 or 900/4415 must be employed, but if no contamination by ester lubricant is likely, a paint scheme to D.T.D. Spec. 772 or 827 may be used. On Naval aircraft only, those which use ester lubricant oil must have the magnesium alloy components painted with two coats of primer and one coat of finish to D.T.D. Spec. 899 and those using an ordinary approved engine oil may have two coats of primer and one coat of finish to D.T.D. Spec. 772.

General information

4. Magnesium-based alloys are highly corrodible when exposed to the atmosphere, especially when this is very humid or laden with sea water or industrial salts, and the only satisfactory protective treatment which will prevent this form of deterioration in the metal and remain durable is the chromate treatment to D.T.D. Spec. 911.

5. The chromate treatment is an immersion process which produces a chromate film on the metal and is similar in appearance to varnish, varying in colour from black or a very dark brown to a golden brown according to the different alloy compositions.

6. Under normal circumstances, Service personnel are not required to use this immersion treatment but should the necessity arise, detailed information on the composition of the chromate bath, operating temperatures and immersion periods are given in A.P.880B, Vol. 1, Sect. 4, Chap. 8 and A.P. 2656A, Vol. 1 (2nd Edn.), Sect. 3.

7. Should the chromate film become damaged during the service life of magnesium-based alloy components on an aircraft, resulting in incipient corrosion forming on the surface of a component, or if repair work has been done on a component in which the film has been removed, the surface of the component must be repaired immediately by applying either selenious acid treatment (para. 15) or acid chromate treatment (para. 16). Both of these processes may be affected *in situ*. They are also described in A.P.2656A, Vol. 1 (2nd Edn.).

8. Although a satisfactory repair of the chromate film can be effected by either of the processes given in para. 15 and 16 of this Scheme, the anti-corrosive protection obtained by their application is not as durable as that given by the chromate immersion treatment to D.T.D. Spec. 911 and, therefore, every effort must be made to minimise the necessity for chromate film repairs arising.

9. As a precaution against electrolytic action occurring and thus accelerating corrosion (Scheme 9.1.2), magnesium-based alloy components must never be allowed to come into direct contact with wood structures. To ensure this, a zinc shim must be interposed between this alloy and the wood. in addition to the application of an approved pigmented varnish jointing compound or rust preventive (Scheme 9.2.1), during wet assembly.

Paint removal precautions

10. When old, deteriorated paint finish is being removed from the surfaces of magnesium-based alloy components, great care must be taken to avoid causing damage to the chromate film on the metal. A stiff brush should be used in preference to paint remover. If, however, an approved paint remover (Scheme 9.2.1) is used, the paint must be well softened before any attempt is made to scrape it away from the structure. An additional application of the paint-remover should be made and the softness of the paint assured rather than resorting to heavy scraping operations in a mistaken attempt to save time.

Safety precautions

11. The information given on this subject in Scheme 9.2.1 of this chapter must be closely observed to ensure the safety of personnel and equipment while the repair operations given in subsequent paragraphs are being effected. More detailed precautions are given in A.P.880B, Vol. 1, Sect. 1, Chap. 6.

12. When a selenious acid solution is being used, the fact must be realised that the acid fumes are toxic in nature and can be absorbed by the lungs; also dermatitis or other skin disorders may be caused by contact of the solution with unprotected skin. It is essential, therefore, that the following precautions are taken:—

(1) If the treatment is to be given in an enclosed space, adequate ventilation must exist or be provided and suitable washing facilities readily available.

(2) Containers must be kept in a locked stowage and only the required quantity mixed for any particular job.

(3) When the solution is being mixed, the operator must wear a respirator and rubber gloves.

(4) Before and during the application of the solution, the operator must wear rubber gloves and take care to keep the solution away from his skin and clothes.

(5) After use, all cotton wool or rags, used to apply the solution, must be burnt.

Note . . .
When using cotton wool or rags impregnated with acid solution, they must not be placed on any structural surfaces which are liable to attack by acid. They must be collected on a piece of glass or in a glass dish, or similar inert collector, until ready for disposal.

Repair of chromate film

13. During the repair of the paint finish of an aircraft, or when an aircraft has to be completely refinished, the external surfaces of all magnesium-based alloy structure must be thoroughly examined for damage to the chromate film or signs of incipient corrosion.

14. Where such damage is apparent and the removal of the structure for re-treatment by the chromate bath process to D.T.D. Spec. 911 is impracticable, the paint finish immediately surrounding the damaged area must be removed with a stiff brush or, if considered necessary, by the appropriate paint remover (para 10 and Scheme 9.2.1), and the chromate film repaired by one of the *in situ* processes given in the following paragraphs.

Selenious acid treatment

15. The sequence of operations for the repair of chromate film by the selenious acid process is as follows:—

(1) Remove the old paint finish with a stiff brush (para. 10) until a clear, uncorroded metal surface is visible. If possible, carefully feather the remaining edges of the finish around the affected area, using the appropriate paint thinners.

(2) Clean any corrosion products from the damaged area, first with a stiff brush and then by swabbing with a solution made up of 2 oz. of chromic acid crystals (Ref. No. 33G/597 or 1034) in one pint of water, acidified by the addition of eight drops of concentrated sulphuric acid (Ref. No. 33C/4).

(3) Wash thoroughly with clean water.

(4) Immediately after washing, swab with a solution of 2 oz. of selenious acid crystals (Ref. No. 33C/943) in one pint of water. This solution should be applied with cotton wool or soft rag tied to a suitable stick until a colour between black-brown to golden brown appears on the surface of the metal.

(5) Allow the surface to dry and, if the edges of the old paint finish have been feathered to produce a smooth surface around the damaged area (sub-para. (1)), apply, by brush, two coats of yellow magnesium alloy primer (Ref. No. 33B/1122 or 9429197), to the treated surface, allowing the first coat to dry completely before applying the second coat.

(6) If the feathering operation in sub-para. (1) was not possible, apply a first coat of yellow primer to protect the newly-formed anti-corrosion film. When the primer is completely dry, carefully feather the edges of the old finish with fine abrasive paper (Scheme 9.1.2, Table 2) until a uniformly smooth surface has been obtained, then apply a second coat of primer.

(7) When the second coat of primer is thoroughly dry, apply one or more coats of the approved paint finishing scheme, according to the requirement of the particular scheme.

Acid chromate treatment

16. The sequence of operations for the repair of damage to the chromate film by the acid chromate process is as follows:—

(1) Remove the old paint finish with a stiff brush (para. 10) until a clear, uncorroded metal surface is visible. If possible, carefully feather the remaining edges of the finish around the affected area, using the appropriate paint thinners.

(2) Remove any corrosion products from the damaged area, first with a stiff brush and then by swabbing with an acid chromate solution consisting of 3 oz. of potassium dichromate (Ref. No. 33C/615 or 1388) in $\frac{3}{4}$-pint of water to which $\frac{1}{4}$-pint of concentrated nitric acid, specific gravity 1.42 (Ref. No. 33C/839, home, or 954, overseas) has been added.

(3) Wash thoroughly with clean water.

(4) Apply a fresh swab of acid chromate solution for 10 to 15 seconds.

(5) Wash thoroughly and wipe the area until it is completely dry.

(6) Proceed with the operations detailed in para. 15 (5) to (7) inclusive.

Note . . .
The acid chromate solution must not be allowed to come into contact with the operator's skin or clothing (the safety precautions given in para. 12 (3) to (5) apply).

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REPAIR OF PROTECTIVE TREATMENT ON STEELS 9.2.5

Applicability

1. This Scheme deals with the application and repair of approved anti-corrosion treatments on various types of steel used in aircraft construction (*Scheme* 9.1.2, *Table* 1). For detailed information on the processes used for the protection of these metals, reference should be made to the appropriate Section and Chapter in A.P.880B, Vol. 1, or other relevant publications, listed in the above table.

General information

2. Most steel aircraft structural parts are classified as either primary (*Class* 1) or secondary (*Class* 2) structures and will therefore be cadmium plated, metallised with aluminium or sherardised, while parts which are subjected to heat, such as exhaust systems, are treated externally with an aluminising process or by nickel plating or, in some cases, by metallising with aluminium.

3. With the exceptions contained in subsequent paragraphs, all components made from carbon and low-alloy steels must be thoroughly cleaned by an approved process to D.T.D. Spec. 901 (*A.P.880B, Vol.* 1, *Sect.* 2, *Chap.* 1) and given one of the following treatments:—

(1) Cadmium plating followed by an approved paint scheme which contains an etching primer. This plating process must not be used on primary or secondary structures which are subjected in service to temperatures above 250 deg. C.

(2) Metallising with aluminium. This process is not suitable for use on light gauge components but, where its use is appropriate and is applied, the painting operation is not necessary, excepting on Naval aircraft, where it is a definite requirement.

(3) On tertiary (*Class* 3) structures, and on other parts subjected to temperatures above 250 deg. C, an approved phosphate treatment to Class 1, 2 or 3 of DEF. Spec. 29 should be employed, followed by the application of an approved painting scheme.

(4) Structures which have a tertiary classification, and auxiliary and drop fuel tanks, may be tin plated to D.T.D. Spec. 924 or made from tinned steel sheet to B.S. Spec. 20. These components must be painted with an approved protective painting scheme where necessary (*Scheme* 9.2.2). All flux must be removed from tin-coated steel parts by thorough washing, followed by complete drying.

Exceptions and special cases

Springs

4. Steel springs are exempt from the requirements of para. 3, but must always be given a protective treatment most suited to their design.

Mild steel exhaust systems

5. Parts comprising mild steel exhaust systems do not require a protective paint scheme to be applied, but must be given an appropriate anti-corrosion treatment as follows:—

(1) Manifolds and stub pipes are to be treated externally by the aluminising process or by nickel plating.

(2) Tail pipes and exhaust rings are to be treated externally by metallising with aluminium or by nickel plating.

Note . . .

All exhaust system components in contact must be of similar metallic finish. At no time should different metallic finishes be in contact. This precaution is necessary to prevent corrosion occurring through electrolytic action between dissimilar metals.

Gun components

6. Non-stainless steel gun components classified as airframe components and subject to abrasion, *e.g., deflector chutes, ammunition belt feeds and guides*, are to be treated with either a chemical blacking process or by sherardising, where appropriate. The former process produces a black oxide finish, the treated surfaces being finally covered with oil.

Bullet-proof steel components

7. These components require no extensive primary treatment but they must be thoroughly clean. A coating of paint to an approved paint scheme must be applied as protective treatment.

Bolts, pins, screws and bushes

8. These and similar non-stainless steel assembly components must be cadmium plated. After wet assembly, they must be treated with an approved anti-corrosion protective paint finish similar to that existing on the surrounding structure. Bolts used in contact with wooden structures must be made of stainless steel to B.S. Spec. S.80. Where, however, a bolt passes through both light alloy and wooden structures, the bolt and nut must be made of non-stainless steel material and cadmium plated.

Hinged Fittings

9. Hinges and working surfaces of hinged fittings in primary structures on Naval aircraft must be hard chromium plated. This plating process is described in A.P.880B, Vol. 1, Sect. 3, Chap. 3.

Plunger mechanisms

10. Ram rods, plunger tubes and similar components in contact with sealed glands must be protected against wear and corrosion by the hard chromium plating process (*para.* 9). The working surfaces are not to be painted.

Flexible cables

11. These are to be soaked in a lanolin

resin protective before assembly in an aircraft (*Scheme* 9.2.2 *refers*).

Exceptional parts

12. If the application of one of the treatments listed in para. 3 is impracticable before assembly, e.g., parts to be assembled by welding, then the assemblies are to be treated according to para. 3 requirements after fabrication. If this is also impracticable, the following treatments may be given:—

(1) External surfaces may be painted to an approved painting scheme only. This relaxation will not be allowed for engine mountings, which must be metallised with aluminium.

(2) Internal surfaces may be coated with either an approved painting scheme or a lanolin resin protective . This requirement does not apply to the internal surfaces of oleo strut components or completely sealed components provided that the sealing does not rely on an organic material or on the perfection of a metal-to-metal fit.

Non-corrodible steel components

13. On all aircraft other than Naval aircraft, non-corrodible steel parts require no protective treatment except wet assembly (*Scheme* 9.2.1). The parts should, however, be painted after assembly, where necessary, with an approved scheme which corresponds with that existing on the surrounding structure. On Naval aircraft, all non-corrodible steel parts except hinged fittings must be given one coat of primer and finish to the approved painting scheme for the aircraft type.

Processes

14. In the following paragraphs, brief details are given on the processes in current use for the anti-corrosion treatment of steel aircraft parts (*para.* 3).

Cadmium plating

15. This process, to D.T.D. Spec. 904, is used for the electro-deposition of a high-grade quality of cadmium on to the surfaces of ferrous metal components immersed in a plating tank. The electrolyte is a solution of cadmium cyanide and sodium cyanide in distilled water, the anodes being high-purity cadmium balls contained in wire cages and the articles to be plated being the cathodes. The operating temperature is thermostatically controlled in the bath by an electrical heating system, the bath being worked at a constant temperature within the range of 17 to 40 deg. C (62 to 104 deg. F). A warm solution is desirable and the thickness of the cadmium deposit must not be less than 0·0003 in. (*A.P.*880*B*, *Vol.* 1, *Sect.* 3, *Chap.* 6).

16. Cadmium plating is invariably used on Naval and "sea-going" aircraft components because it affords greater anti-corrosion protection against a salt-laden atmosphere.

17. Like zinc, cadmium is electro-positive to steel. If, therefore, the continuity of a cadmium coating on a steel component should be broken and the ferrous base exposed, the cadmium will corrode preferentially and, by deposition of the corrosion products on the exposed area, will stifle further attack at that location.

Metallising with aluminium

18. Metallising with aluminium is a process in which high-purity aluminium wire or powder is atomised and sprayed on to the surfaces of some steel structures which have been prepared by being blasted with steel grit. When the process has been completed in accordance with D.T.D. Spec. 906, the surface of the metal has a uniform, silvery appearance and will need no further protective treatment with a paint finish, except on Naval aircraft, where this is a requirement.

Sherardising

19. This is a cementation process to D.T.D. Spec. 908, used for zinc-coating the surfaces of ferrous metals as an anti-corrosion protective treatment. The process is effected by loosely packing a number of steel components to be treated, together with a measured quantity of zinc dust, in a drum or box and then slowly heating and rotating the charged container in a furnace, so that, during a period of not less than two hours, the mass is gradually and uniformly heated up to the processing temperature of 425 deg. C., which must then be closely maintained and the rotation of the container continued for a period of not less than 30 minutes. After the heat treatment, the container must be removed and placed in the open air to cool down slowly. The zinc coatings should be from 0·0003 in. to 0·0005 in. thick.

Aluminising

20. Aluminising is a process, covered by D.T.D. Spec. 907, which is used as a method of protecting steel components against oxidation through heat, e.g., exhaust pipes. The articles are blasted with steel grit and then sprayed with aluminium to form a coating at least 0·007 in. thick. The coated articles are covered with bituminous paint and heated to 800 deg. C., the treated surfaces being finally scratch brushed.

Phosphating

21. The phosphate process to DEF. Spec. 29 is approved for the rustproofing of certain ferrous metal components where anti-corrosion protective treatment by cadmium plating is impracticable.

22. The process is one in which the ferrous components are immersed in a hot solution of acid phosphates which, for a given period of time, reacts with, and chemically converts, the surfaces of the articles under treatment from the normal metallic condition into a metallic phosphate.

23. Ferrous metals which have been given the phosphate treatment appear to have

smooth and dense coatings which, in themselves, are insoluble in water, are chemically stable and inert and, unlike the base metal, are not subject to decomposition from exposure to the atmosphere. These coatings are, however, porous and absorbent and will, consequently, admit moisture to the base metal. The coatings are, therefore, incapable of appreciably protecting the underlying metal from atmospheric corrosion under even slightly humid conditions, but they endow the surfaces of the treated components with qualities particularly suited for the reception of some approved finishing medium such as oil or grease, lacquer, paint or enamel and which enhance the protective values of the finish. Detailed information on the process is given in A.P.880B, Vol. 1, Sect. 4, Chap. 3.

Nickel, chromium and tin plating

24. The anti-corrosion protective treatment of steel aircraft components by the use of any of these processes is fully described in A.P. 880B, Vol. 1, Sect. 3, Chap. 2, 3 and 7 respectively.

Repair of plated steel and finish

25. Freshly-made scratches and other minor damage to the plating or other approved protective finish, which is within the limits of negligible repair classification given in the relevant aircraft Vol. 6 and shows no signs of incipient corrosion, must be thoroughly cleaned (*Scheme* 9.2.1) and given immediate anti-corrosion treatment appropriate to the type of structure involved, using an approved primer and painting scheme.

26. Where there is evidence that corrosion exists on any plated steel components, all affected parts must be removed and returned to the appropriate servicing unit for replating or other approved protective treatment repair, new components being fitted as replacements. *In all cases, the renewal of steel parts must always be made with steel that is already plated by the same process as that which existed on the items removed, thus bringing the replacement up to the original standard.*

Repair of metallised or sherardised components

27. Minor damage to these components, which is within the limits of that quoted in the relevant aircraft Vol. 6, may be repaired in the same manner as that given in para. 24. Extensively damaged coatings or corroded components must be dealt with as in para. 25.

Welded repairs of metallised steel components

28. Before welding repairs are commenced on steel components which have been metallised, the aluminium coating must be removed with a solution of caustic soda. One part of caustic soda (Ref. No. 33C/180) should be dissolved in two parts of water (*by weight*) and the solution applied by brush or from a container with a tap and feed pipe. The solution must not be allowed to come into contact with the skin or clothing of personnel, who should observe the precautions given in Scheme 9.2.1, where applicable, to ensure safety. Any surplus solution must be washed off the components (and surrounding structure, if the welding operation is to be effected *in situ*) which must then be thoroughly dried.

29. On completion of the welding operations, the exposed surfaces of the metal must, if possible, be re-metallised and then treated with an approved painting scheme appropriate to the type of structure involved. If, however, the re-metallising process cannot be effected, the metal surfaces need only be treated with the approved painting scheme. The treated area should then be taped over and the tape painted red to show that the surfaces must be re-metallised at the first opportunity.

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Exhaust gas corrosion

30. Engine exhaust gases contain chemical salts and acids which are highly corrosive to fabricated parts made from non-corrosion-resisting steel. Painted and plated surfaces of this type of steel are also affected, but not so rapidly as unpainted or unplated surfaces.

31. The corrosion products are deposited in the form of a readily-visible, greyish coating on the aircraft surfaces over which the exhaust stream flows and, if they are not frequently cleaned off, will eat into the protective finish of the metal and cause incipient corrosion. The deposits must, therefore, be removed by wiping off with white spirit and a clean rag, taking all necessary precautions, *having due regard to the fire risk involved*, and then washing down the affected area with an approved detergent, finally drying off and polishing the surface as necessary.

32. If blistering or deterioration of the paint finish has occurred, the affected area must be completed, rubbed down and the metal surface closely examined for signs of corrosion. If no corrosion is evident, the metal surface must be re-finished with the approved primer and paint finishing scheme, to correspond with the surrounding structure.

33. The regular removal of the exhaust deposits should eliminate the possibility of the metal surfaces becoming corroded and after the removal of all weathered and hardened deposits, any fresh deposits which are found must be removed regularly by washing down with an approved detergent.

Note . . .

*All cases of corrosion occurring on metal surfaces are to be reported on Form A.*21 *for aircraft of the Royal Navy and on Form* 1022 *for aircraft of the Royal Air Force. Repair of the component and its protective finish, or the renewal of the component, must be noted on the relevant Form* 700.

9.2.6 REPAIR OF PROTECTIVE TREATMENT ON COPPER AND COPPER-BASED ALLOYS

Introduction

1. This Scheme contains information on the methods of removing the existing protective treatment, and the approved treatment required for the repair of protective treatment on copper and copper-based alloy components.

General information

2. Components made from these metals require only a thorough cleaning to restore the surfaces to their own original anti-corrosion protective film.

3. No further anti-corrosive treatment is normally necessary, but where copper or copper-based alloy components are in contact with dissimilar metals, with the attendant danger of corrosion through electrolytic action occurring (*Scheme* 9.1.2), the components made from the former metals must be cadmium plated (*Scheme* 9.2.5). As an alternative for R.A.F. aircraft only, the tin plating process may be used.

Removal of existing coating and corrosion

4. The existing protective treatment and any incipient corrosion products should be removed in the following sequence of operations:—

(1) Wash the components thoroughly with soap and water or any approved detergent.

(2) Degrease with trichlorethylene (Ref. No. 33C/547 or 836) or any approved paint remover (*Scheme* 9.2.1).

(3) If corrosion of any parts of the components is evident, remove this with an approved corrosion remover (*Scheme* 9.2.1)

(4) Thoroughly clean and dry the components after operations (2) and/or (3) have been completed. The operation must be in accordance with D.T.D. Spec. 901 and this standard is given in A.P.880B, Vol. 1, Sect. 2, Chap. 1.

Primary treatment

5. No primary treatment is necessary except in the circumstances given in para. 3.

Protective treatment

6. Any approved paint finishing scheme appropriate to the type of metal from which the components are made may be applied as a protective treatment. Where possible, the paint scheme should coincide with that which exists on the surrounding structure. If necessary, the metal of the components may be left bare provided that they are kept in a polished condition.

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REPAIR OF PROTECTIVE TREATMENT ON TITANIUM AND TITANIUM-BASED ALLOYS 9.2.7

Introduction

1. The contents of this Scheme give information on the amount of protective treatment required on titanium and its alloys.

General requirement

2. Titanium and titanium-based alloys require no protective treatment except as shown in the following paragraphs.

Paint finish

3. When titanium base materials are to be painted to a camouflage paint scheme or for other reasons, the painting scheme employed must be to an approved stoving scheme or to an approved air drying scheme based on an etching primer.

Contacts with other metals

4. Where titanium base materials are in contact with carbon and low-alloy steels, aluminium base material or magnesium base material, the titanium must be given protective treatment to obviate the danger of corrosion occurring due to electrolytic action (*Scheme* 9.1.2). The titanium must be cadmium or zinc plated to the requirements of D.T.D. Spec. 904 or 903 respectively, the plating processes being fully described in A.P.880B, Vol. 1, Sect. 3, Chap. 6 (cadmium plating) and Chap. 8 (zinc plating).

5. When necessary, an approved painting scheme may be used on top of the plated material.

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REPAIR OF DEF. SPEC.1117 PROTECTIVE FINISH ON METAL WALKWAYS

9.2.8

Introduction

1. The information contained in this Scheme deals with the repair of the non-slip paint finish used on external walkway surfaces of metal aircraft. It does not embrace repairs to walkways covered with synthetic rubber or rubberized fabric sheeting secured to the surfaces with adhesive.

2. The paint finish to DEF. Spec. 1117 is referenced in A.P.1086 as Ref. No. 33A/9421214, paint, non-slip, brushing, dark Admiralty grey, provisioned in 1 gall. cans. It must be applied by brush only, as a 2-coat finish over etching primer to D.T.D. Spec. 868.

3. The specified primer comprises paint, priming, etching, *accelerator*, Ref. No. 33B/9429195, and paint, priming, etching, *base*, Ref. No. 33B/9429196, the two fluids being mixed together in equal proportions by volume to provide the etching primer. The pot life of the mixture is 8 hours and only sufficient for use within this time should be prepared. The primer may be applied by brush or spray; if necessary, thinners to D.T.D. 843 may be added to the primer, but this is exceptional.

Note . . .

When the etching primer is being mixed, or during its application by spray, suitable precautions (Scheme 9.2.1) *must be taken by personnel to avoid breathing the spray or contaminating the skin or clothing.*

4. The methods of effecting minor repairs to worn or slightly damaged walkway protective finish are contained in the following paragraphs of this Scheme. For detailed descriptive matter and information on the methods used for the complete renewal of primer and non-slip paint, refer to A.P.2656A, Vol. 1 (*2nd Edition*), Sect. 5, Chap. 1 and 2, respectively.

Repair of worn paint finish on walkway

5. On a walkway surface which is already coated with an approved non-slip paint, but which has become damaged by wear and normal usage, making necessary an improvement of the non-slip properties, the affected surface must be scuffed to remove any rough particles of the existing paint which are not adhering firmly and then thoroughly cleaned with white spirit to B.S. Spec. 245 (Ref. No. 34D/246, N.A.T.O. Code No. S—752). If any bare metal is visible on the surface of the walkway at this stage of the repair, it must be suitably pre-treated and coated with primer to D.T.D. Spec. 868 (*para.* 7) before the non-slip paint finish is brushed on.

6. When the surface is thoroughly clean and dry, brush on the first coat of non-slip paint finish to DEF. Spec. 1117 and allow it to dry for approximately 45 minutes, when it should then be touch-hard and ready to take the second coat. This should be applied in a direction at right-angles to that in which the first coat was brushed. By so doing, more even distribution of the paint is achieved and the most satisfactory finish is provided. Both coats of finish should be applied lightly and evenly with a well-filled brush without repeatedly working the brush over the surface.

Repair of local damage to complete finish

7. When the finish on an external walkway surface has become worn so that the bare metal is visible on isolated portions of the surface, thus causing it to be too smooth to provide an adequate non-slip walkway for personnel, each affected area must be cleaned off separately and a new surface finish painted on as follows: —

(1) Thoroughly clean the metal surface of the affected areas with an approved paint remover (*Scheme* 9.2.1), cleaning off the paint finish over an area greater than that of the bare metal to ensure that no incipient corrosion is present beneath the surrounding finish, in each case.

(2) As soon as the affected areas have been cleaned off, carefully feather the edges of all existing paint finish so that a smooth surface is obtained throughout.

(3) Depending on the type of metal being treated, apply Deoxidine 202, Alocrom 1200, selenious acid or acid chromate treatment to aluminium or magnesium alloy surfaces, in accordance with the instructions given in Scheme 9.2.3 and 9.2.4.

Note . . .

On steel or titanium surfaces, no pre-treatment process is necessary other than cleaning the metal with an approved degreasing solution, the primer and paint finish being applied as soon as the metal has been cleaned and dried.

(4) Immediately after the pre-treatment operation has been completed, apply one coat of freshly-mixed primer (*para.* 3 *and* 4) and allow it to dry. The primer should normally be sprayed on to the surface, but where a spray is not available the primer may be brushed on.

Note . . .

The drying time for both spray or brush application is approximately 60 *minutes, but may vary according to the atmospheric temperature and the place in which the repair work is being done. If, for instance, the aircraft is being repaired in an enclosed space under a controlled temperature, the*

drying time will be considerably less than if the work is done in the open air.

(5) When the etching primer is thoroughly dry, brush on the first coat of non-slip paint finish and allow about 45 minutes for it to become dry enough to apply the second coat. The paint must be lightly and evenly applied with a well-filled brush without repeatedly working the brush over the surface.

(6) As soon as the first coat of paint has dried completely, apply the second coat in a direction at right-angles to that in which the first coat was applied (*para.* 6).

Note . . .
Great care must be taken, when applying the second coat, to avoid lifting the paint of the first coat, therefore the paint must be brushed on very lightly.

(7) Allow from 2 to 3 hours to elapse before the repaired areas on a walkway are handled and approximately 24 hours before they are considered fully dry and hard enough to tread on.

Repair of extensively damaged walkway protective finish

8. Where structural damage to a walkway has been sustained and necessitates the complete renewal of the non-slip paint finish on new or repaired metal skin, the new finishing scheme must be applied in the following sequence of operations:—

(1) Clean the bare metal with an approved degreasing solution appropriate to the metal being treated (*Schemes* 9.2.1 *and* 9.1.2, *Table* 2).

(2) Where the edges of existing paint finish are adjacent to the new or repaired metal skin, these must be feathered until a smooth, even surface is obtained.

(3) Apply an approved pre-treatment process appropriate to the metal skin under repair (*para.* 7 (3)) and clean the skin thoroughly to give a smooth, dry surface.

(4) Repeat operations (4) to (7) of para. 7 to complete the repair.

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Chapter 9.3 PROTECTIVE TREATMENT REPAIRS FOR WOOD

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GENERAL INFORMATION

Introduction

1. This Scheme contains information which is generally applicable to the repair of the protective covering on aircraft wooden structures, particularly those which are constructed with fabric-covered plywood to form the skinning of fuselage compartments, main planes, tail units or control surfaces on some types of aircraft.

2. For detailed information on the methods of repair, refer to the relevant aircraft Vol. 6, A.P.2656A, Vol. 1, Sect. 10, Sect. 8 of this publication or to the ensuing Schemes comprising this Chapter, as appropriate.

General appreciation

3. All wooden framework structures carrying fabric covering must be protected from deterioration by the application of an approved primer and cellulose paint scheme or an approved alternative treatment. External plywood surfaces must be covered with the type of fabric appropriate to the structure, secured with tautening dope or an adhesive and finished in accordance with the requirements of D.T.D. Spec. 912 (*A.P.2656A, Vol. 1, Sect. 10*).

4. The internal surfaces of plywood-covered components and hollow wooden members normally need protection only where a coloured finish is required. Where, however, the pressure sealing of plywood and solid wood edges of components forming a pressure cabin inner skin is under repair, the pores of the wood must be sealed with Plyceal and a 50-50 mixture of Bostik 1751 and 1790, the latter being applied to all joints after the Plyceal has thoroughly dried out. No protection is necessary on any surface which is to be glued.

5. The end grain of members such as spars fitted inside plywood-covered components are to be coated with an approved bituminous paint or alternatively, with a sealing compound approved for the purpose and authorised for use in the relevant aircraft Vol. 6.

6. On aircraft with plywood-skinned pressure cabins, the edges of the plywood not subject to pressurization must be well coated with an approved waterproofing cellulose paint.

7. The direct application of an approved cellulose paint finish to bare plywood will result in lack of adhesion because the surface is too smooth to allow the finish to be retained permanently. To provide a key, therefore, for the adhesion of the finishing coats of cellulose protective and also to increase the resistance of the surface to moisture, the plywood surfaces must be covered with fabric secured by an approved adhesive.

8. The types of fabric and adhesive (*Scheme* 9.1.2, *Table* 2) which are available for the protection of plywood are as follows: —

Fabric

Light cotton fabric (Madapolam) to D.T.D. Spec. 343.

Cotton fabric strip, with serrated edges, to D.T.D. Spec. 407.

Plain linen fabric to D.T.D. Spec. 540.

Linen fabric strip, with serrated edges, to D.T.D. Spec. 540.

Adhesives

Adhesive F.1 to D.T.D. Spec. 900/4497, comprising: —

Adhesive F.1.
Catalyst F.C.1.
Thinners F.T.1.

Transparent tautening dope to D.T.D. Spec. 751.

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Precautions

9. When the F.1 adhesive solution is being mixed or applied, the following precautions must be rigidly observed:—

(1) Water or solvents of any kind must not be allowed to enter vessels containing F.C.1 catalyst.

(2) When handling the catalyst, great care must be taken to ensure that it does not contact the skin or eyes. If, however, the skin is affected, it must be thoroughly washed with soap and water immediately. Should the catalyst enter the eyes, immediate and prolonged irrigation with clean water must be effected and urgent medical attention arranged.

(3) If mixed adhesive is allowed to contaminate the hands and harden, its removal is very difficult. Although this contamination is not particularly harmful, and the stain will eventually wear off, rubber gloves should be worn to prevent any such occurrence when preparing and using the adhesive.

(4) All empty catalyst containers must be neutralised by filling them with a 10 per cent solution of washing soda and allowing them to soak for 24 hours.

(5) The mixed adhesive must be applied only by brush; the use of a spraying technique is not permissible due to the danger of the spray mist entering the eyes of personnel.

Note . . .

No repairs involving the use of F.1 adhesive should be commenced on a surface previously treated with transparent dope until all traces of the earlier treatment have been removed.

Repairs

10. The requirements for repairing damage to the protective finish of plywood and fabric-covered plywood aircraft components are described in Schemes 9.3.2.

9.3.2 REPAIR OF LOCAL DAMAGE TO PROTECTIVE TREATMENT ON WOODEN COMPONENTS

Introduction

1. The information contained in this Scheme covers the methods used for the repair of local damage involving worn, deteriorated or torn protective treatment in fabric-covered plywood components with a cellulose or, where applicable, a synthetic paint finish, and the removal of paint finishes from wooden components generally.

Removal of paint finish from fabric

2. Before repairs to protective treatment are commenced the existing finish must be removed. On a fabric-covered plywood component, cellulose paint finish which has become worn or has otherwise deteriorated, leaving the fabric intact and in good condition, should be removed by the application of Thinners, Dope, Anti-chill to D.T.D. Spec. 843 (*Ref No.* 33*B*/9428846 *or* 9426158, *according to size of container required*). This solvent acts both as a cleaner and a remover.

3. The fluid must be carefully applied to the affected area by a well-soaked, soft cloth and the surface rubbed and cleaned off until only a very thin film of the original dope is left on the fabric. When this condition is reached and the surface has been allowed to dry, fresh coats of the appropriate cellulose finish should be applied as instructed in para. 6.

4. If a synthetic finish exists on the fabric, it should be cleaned off with Thinners, Synthetic Finishes, to D.T.D. 96 or 840 (*Ref. No.* 33*B*/9431497–9431498 *or* 33*B*/9428847–9428848, *according to the size of the container required and the specification of the solvent*), using the same method of removal as in para. 3.

Note . . .
The safety precautions detailed in Scheme 9.2.1 *should be rigidly observed during the operations necessitating the use of the dope solvents.*

Removal of paint from wood components

5. Painted wooden components may be cleaned off to reveal the bare wood by using any approved paint remover or dope solvent as described in the following sequence of operations:—

(1) Clean off all traces of oil, grease and dirt from the area in which the paint is to be removed by washing it thoroughly with soap and hot water. Alternatively, an approved de-greasing fluid, such as dope thinners (*para.* 2 *and* 4), may be used for this purpose.

(2) If the component has been cleaned with soap and water, allow it to thoroughly dry out before proceeding with the next operation.

(3) When the component is dry, apply, by brush, a liberal coating of paint remover, Type A to D.T.D. Spec. 226 (*Ref. No.* 33*B*/9429259), ensuring that all surfaces, crevices and corners are well covered.

(4) Allow the paint remover (or, if used as a possible alternative, dope solvent) to remain on the wood for 10 to 20 minutes, according to the surrounding temperature, frequently testing the surface of the paint for softness during this period.

Note . . .
The paint remover must not be permitted to dry on the surface of the paint, otherwise the removal of the paint will be very difficult and probably necessitate a further application of the solution.

(5) When the paint has softened sufficiently, carefully scrape it off the surfaces of the component, where necessary, and then smooth down with fine abrasive paper.

Note . . .
The fumes from the paint remover are toxic and therefore the safety precautions given in Scheme 9.2.1 *must be strictly observed.*

Local repair of paint finish on fabric

6. If the cellulose or synthetic paint finish has been worn away locally during service, leaving the fabric in good condition, proceed as follows: —

(1) Clean off the affected area as detailed in para. 2 to 4.

(2) Apply three or four even coats of aluminium non-tautening finish, each coat being allowed to dry thoroughly before the next coat is applied. When the last coat is dry, one or two coats of pigmented non-tautening camouflage finish should be applied if necessary. If a glossy finish is required, one or two coats of transparent cellulose finish should be sprayed on.

Note . . .
The new coats of finish must be to the same specification as that which exists on the surrounding surface.

Local repair of fabric covering and finish

7. Where the fabric covering of plywood has sustained damage, the necessary repair should be effected in the following sequence of operations:—

(1) Cut back the damaged fabric clear of the affected area.

(2) Mark out and trim the fabric to leave a neat square or rectangular section of bare plywood.

Note . . .

When cutting the fabric, the knife must not be allowed to bear on the plywood, therefore a strip of thin-gauge metal should be inserted between the plywood and the fabric. This precaution is necessary to prevent the knife cutting through the plywood and causing further damage of a serious nature.

(3) Scrape and smooth down the surface of the plywood with fine abrasive paper and remove the resultant dust, filling in all holes or crevices with an approved stopper.

(4) Cut a new piece of Madapolam fabric as an insert to butt squarely against the trimmed edges of the existing fabric cut-out.

(5) Secure the fabric insert to the plywood surface by the application of either transparent dope of low tautness to D.T.D. Spec. 751 (*para.* 8) or Adhesive F.1 to D.T.D. Spec. 900/4497 (*para.* 9) according to the requirement given in the relevant aircraft Vol. 6.

(6) Apply the appropriate paint finishing scheme to the fabric after the final coat of the approved adhesive has dried.

Note . . .

If a synthetic paint finishing scheme is used on the damaged surface, the finish must be removed from an area extending for 2 to 3 inches beyond the damage. This precaution obviates the possibility of cellulose finish being applied to a synthetic base (Scheme 9.1.2, warning). The synthetic finish should be removed with a soft rag soaked with the approved thinners (para. 4) and by careful rubbing with waterproof abrasive paper (Scheme 9.1.2, Table 2).

Securing fabric to plywood with transparent dope

8. This method of attachment should be effected in the following sequence of operations:—

(1) Brush a full coat of the transparent dope on to the prepared surface and allow it to dry.

(2) Brush or spray on a second coat of dope and allow it to dry.

(3) Lay the cut Madapolam fabric in position on the surface of the plywood to be covered and dope the centre of the patch into place under natural tension, smoothing out all creases with a wooden scraper or a fabric pad.

(4) Working out from the centre, apply more dope to the fabric and, ensuring that all air bubbles are excluded from between the fabric and the surface of the plywood, press the remainder of the fabric insert into position so that its edges butt against the edges of the existing fabric, using either a wooden scraper or a fabric pad damped in dope thinners (*para.* 2).

Note . . .

The dope must be applied as a full, wet coat and worked right through the fabric, otherwise adhesion will be inadequate.

(5) When the fabric is satisfactorily positioned and the previous coat of dope has dried, apply another full, wet coat of dope and work it well in with the brush, ensuring that an even application is made all over the surface being repaired.

Note . . .

Where large areas are being treated, they should have the dope applied in sections and each section smoothed out progressively with a fabric pad, damped with the appropriate dope thinners, before the next section is commenced. Particular attention must be given to securing an even merging at the edges of the sections and ensuring complete penetration of the dope at the joints in the fabric covering.

(6) Dope serrated tape, of the appropriate width, into position over the adjoining edges, seams and apertures of the fabric. The area to be covered with the tape must be given a full, wet coat of dope, the tape being fitted in natural tension and the smoothing-out process repeated throughout.

Note . . .

Ensure that complete penetration of the dope through the tape has been effected.

(7) Apply the specified paint finishing scheme in accordance with current requirements.

Securing fabric to plywood with Adhesive F.1

9. Before commencing work on this process, the precautions given in Scheme 9.3.1 must be observed. Reference numbers for the adhesive, thinners and catalyst are included in Table 2 of Scheme 9.1.2.

Preparing the adhesive

10. The operator must wear rubber gloves and the adhesive, thinners and catalyst should be mixed to form a solution as follows:—

(1) For attaching fabric to plywood, add 10 parts by volume of Thinners F.T.1 to 10 parts by volume of Adhesive F.1 and mix thoroughly.

Note . . .

For attaching serrated tape to fabric, a thicker mix is required, therefore a smaller proportion of thinners should be used.

(2) Add 1 part by volume of the Catalyst F.C.1 to the existing mix and stir the whole mixture thoroughly until it forms a brown solution.

Note . . .

(1) *The thinners must always be mixed with the adhesive first and the catalyst added afterwards. The correct proportion of catalyst to adhesive must always be strictly maintained.*

(2) *The solution, when mixed, must be used without delay and no more should be prepared than can be used in one day. If, however, any solution remains after the completion of a repair and is not required for use on other work before the end of the day, the surplus must always be disposed of, in accordance with current procedure, and not retained in anticipation of its later use.*

Application of adhesive to fabric

11. This should be effected in accordance with the instructions given in the following sequence of operations: —

(1) Brush on to the exposed plywood surface, one coat of the mixed adhesive and allow it to dry for 30 minutes.

(2) Brush a second coat of the mixed adhesive over the same area, leave it until it becomes tacky and then smooth down the free edges of the existing fabric.

(3) Using a fabric pad, lay the fabric insert patch in position under natural tension, starting at the top edge and spreading downwards and outwards on both sides; ensure that no creases, wrinkles or air bubbles are formed and that the warp and weft of the fabric are straight.

(4) During operation (3), cut and fit the fabric around any projections. If necessary, due to the fabric stretching while being fitted, trim the edges of the patch so that they butt squarely against the edges of the existing fabric.

Note . . .

The fabric must be correctly positioned initially as subsequent lifting and repositioning is not possible.

(5) When the fabric has been positioned, apply a further coat of adhesive over the new area, brushing it well into the fabric; leave it to dry for approximately 20 minutes.

(6) Remove all surface imperfections with a wooden scraper. Finally rub down the surface again with a fabric pad damped with Thinners F.T.1.

Application of adhesive to serrated tape

12. To obtain the best adhesion of the tape to the fabric, it should be applied as soon as possible after the fabric has been secured (*para.* 11 (5)). The same procedure as that given in para. 11 should be effected, except that the application of the two initial coats of adhesive is unnecessary.

13. During the application of the adhesive and the positioning of the tape, the fabric may tend to lift from the plywood surface when being handled. Should this occur, the fabric must be padded back into position with a fabric pad damped in Thinners F.T.1.

14. When all taping operations are finished, allow the complete repair to dry for 24 hours and then apply the specified paint finishing scheme in accordance with current requirements.

Repair of protective on plywood pressure cabin skins

15. Where repairs to the plywood skins of some aircraft pressure cabins are necessary, the protective coating on the plywood must be renewed to ensure that the pressure sealing and waterproofing properties, especially on the edges and joints, are restored after repair. The protective treatment repairs should be effected as instructed in para. 16 and 17.

Pressure sealing of cockpit inner skin

16. After repairs to the inner skin of the cockpit have been completed, the pressure sealing of the skin must be effectively secured as follows: —

(1) Clean all grease and dirt from the surface of the plywood with an approved de-greasing fluid.

(2) Completely seal the pores of the plywood by brushing on a full coat of Plyceal to D.T.D. Spec. 900/4285 (*Ref. No.* 33*B*/9428898), or any other approved sealing compound.

(3) Allow the Plyceal sealant to dry thoroughly and then brush on a full coat of a 50-50 mixture of Bostik 1790 and Bostik 1751 to D.T.D. Spec. 900/4058 (*Ref. No.* 33*C*/1138 *and* 1390, *respectively*) over all joints.

Waterproofing non-pressurized plywood edges

17. The procedure for waterproofing the fuselage plywood outer skin edges which are not subject to pressurization is as follows: —

(1) Clean all grease and dirt from the edges to be treated, with an approved degreasing fluid.

(2) Brush on an even coat of water repellent, brushing well into the end grain of the plywood.

(3) Allow the repellent ample time to dry thoroughly, then secure the Madapolam fabric and serrated tape with dope or Adhesive F.1 (*para.* 8 *to* 13) according to the requirement.

(4) When the material used in sub-para. (3) has completely dried, apply the specified paint finishing scheme in accordance with current requirements.

Note . . .
The repellent should be a cellulose paint with good waterproofing qualities.

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Chapter 9.4 ◀ PROTECTIVE TREATMENT REPAIRS FOR MISCELLANEOUS MATERIALS ▶

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9.4.1

REPAIR TO NEOPRENE FINISH ON RADOMES

Purpose of neoprene finish

1. The neoprene finish is used to protect the glass fibre structure from damage. Rain erosion, or pitting of the surface due to the aircraft flying at comparatively high speeds through rain, is a common form of damage. Considerable pitting of the fibreglass has occurred on unprotected radomes after only two minutes flying at approximately 400 knots through heavy rain. For this reason, neoprene is used to help to prevent damage to the radome, but is itself susceptible to damage. Since the effect of rain erosion is most noticeable on surfaces at 90 deg. to the line of flight, neoprene is sometimes applied only on the nose portion, particularly on aircraft with large radomes. In general, belly-type radomes are only used on slower aircraft and neoprene is often unnecessary.

Thickness limits

2. The limits of ± 0·001 inches, on the nominal total thickness of primer and finish of 0·011 inches, appear by normal standards to be very strict, but this stringency is necessary since these values form a compromise between the requirements for minimum blocking and deflection of radar waves and the requirements for protective purposes. The top limit is the maximum thickness acceptable from the point of view of efficiency of the radar and the lower limit is the minimum thickness that will give reasonable protection to the fibreglass structure, particularly with reference to rain erosion.

Thickness control

3. Control on thickness of the finished repair is maintained by means of a check-plate and/or templates and by the smooth appearance of the repaired area which should blend in with the contours of the surrounding neoprene. The *Check-plate*, preferably of scrap fibreglass smoothed with garnet paper, should be flat, have truly parallel faces and be of sufficient length to allow smooth coats of primer and finish to be applied. The thickness of the plate should be checked by micrometer and the plate should then be ◀cleaned with toluol or toluene and allowed to dry.▶ As each coat of primer and finish is applied to the repair, a similar coat should be applied to the check-plate. When the repair is approaching completion, the thickness of the neoprene on the plate should be checked by micrometer, which must be used lightly to prevent compression of the neoprene. A *Template* may be manufactured from any convenient material but the edge should be smooth and the template must be used carefully to avoid further damage to neoprene. The template should overlap sufficiently on to the surrounding neoprene to ensure a good 'base' and light chalk marks should be made on the surround to ensure correct relocation during shaping of the template and also during checking of the repair. The template may be rough-shaped by comparison with a 'complete' radome, but it is advisable to finish by checking, with a feeler or rod of the appropriate thickness, that the gap between the template and fibreglass in the cleaned up area is constant, and equal to the thickness of the existing neoprene coating.

4. The finished repair should present a smooth appearance and should blend in with the contours of the surrounding neoprene. When applying the finish, considerable care will be needed to keep the newly applied neoprene within the repair area and prevent the formation of ridges round the edges. Thus, a repair of *rectangular shape* will be more satisfactory than a circular or oval shape, since it will be possible to run parallel to the edges with a flat brush. This will minimize the trouble due to dragging. If a rectangular shape is used behind the nose of the radome, a diagonal (*not two sides*) should be parallel to the aircraft centre-line so that the repair does not present a 'full' edge to the airstream.

Surface finish

5. The neoprene must not be covered by paint, at any time. The difference in elasticity between neoprene and paint is so great that, if applied, the paint would crack after a very short time due to temperature changes or rain impact and would be quickly followed by damage to the neoprene itself. Other reasons are that the neoprene and paint might be chemically unsuitable or the paint might affect the efficiency of the radar.

6. As supplied, the solution, neoprene A.C. is a light tan colour but, after application, the coating will develop a deep brown or black colour during the first two or three days of ageing at the appropriate temperature.

Curing temperatures, time and equipment

7. The temperature for the primer must not be less than 18 deg. C but this should not present much difficulty since the total time required for application and drying of the two coats is two hours. The curing temperature range for the finish, however, is 25 ± 5 deg. C (68—86deg. F) and this must be maintained for not less than seven days after application of the final coat. This period may be reduced only on the authority of the appropriate technical officer, unless a shorter period is quoted in the aircraft Vol. 6. With suitable modifications, the local manufacture equipment for accelerated gluing described in A.P.2662A Schemes 3106, 3107, 3108 and

REPAIR TO NEOPRENE FINISH ON RADOMES—*continued*

3109 and A.3, A.4 and A.5 in the Appendix may be adapted to provide the required temperatures. Either thermostatic control or direct control in conjunction with temperature measurement should be applied. Direct contact between the heating equipment and the wet surface should be prevented and, if the radiant heat reflector method is used, the reflector edges should be padded to prevent further damage to the existing neoprene and also to act as a partial heat 'seal'. The heat supplied by the reflector can be varied by the use of bulbs of different wattages and by providing suitable ventilation holes with simple swing covers. A reflector containing a bank of bulbs could be used for large areas.

Materials required

8. The materials required for repairs are as follows:—

Section and Ref. No.	*Description*
33C/1282	Primer, Boscolite 9252
33C/1436	Toluol
	or
◀33C/1392	Toluene▶
33C/1352	Solution, neoprene A.C., 1801C
33C/1353	Accelerator, 983C
▶◀	
33B/927	Stripper
33C/1433	Garnet paper, No.00–100
33C/1434	Garnet paper No. 0–80

Thinning of primer

9. The primer should be thinned with ◀toluol or toluene to the stage at which it can be smoothly applied by brush. Equal volumes of primer and toluol or toluene will normally▶ give the required consistency.

Mixing of finishing compound

10. One part, by volume, of accelerator should be added to twelve parts of solution, neoprene A.C. 1801C, and the mixture stirred thoroughly, but formation of air bubbles ◀should be avoided. If necessary, toluol or toluene used as a thinner may be added to▶ produce the required consistency but more coats will be needed to give the correct total thickness of neoprene. The mixture has a pot life of only approximately eight hours at 25 deg. C and the life decreases at higher temperatures. As the drying time for each application is between 1 and 1½ hours and approximately ten coats of undiluted mixture are required, only sufficient mixture for approximately six coats should be prepared at a time. Even within the period of the pot life the mixture thickens and thereby increases the tendency for air bubbles to be trapped during application.

Note . . .

The accelerator is usually supplied in pre-measured packages containing 47·5 *c.c. This is the correct amount for mixing with one pint of solution, neoprene A.C.*

Recording of neoprene repairs

11. The location of previous neoprene repairs may not be visible on the external surface of the radome after curing. If the total number of repairs permissible is limited, or a given minimum spacing is quoted in the aircraft Vol. 6, the location and extent of all repairs must be recorded. After completion of a repair, the inner surface of the radome should be marked, using paint (*Ref No.* 33*B*/1059) to D.T.D.772 (*metallic paint e.g. silver finish must not be used*), with a white line ⅛ in. wide. This line should enclose an area accurately corresponding to the repaired area on the outer surface. The letters 'R' (*repair*) and 'N' (*neoprene*) should be painted inside the area so enclosed. When the neoprene is completely stripped off and renewed, however, recording is unnecessary.

Recording of fibreglass/neoprene repairs

12. If the fibreglass structure is repaired and the neoprene is subsequently repaired locally, two marking lines will be required since the neoprene repair will be larger than that of the fibreglass. Use of a single line, enclosing an area the size of the neoprene repair would unduly restrict future fibreglass repairs. In this case, the letter 'N' will be painted in the space between the double lines. The letters and numbers to be painted in the inner ring are defined in Scheme 1.5.2, Recording of Fibreglass Repairs. An outer ring should not be painted if the neoprene on the radome is completely renewed after the fibreglass repair.

PROCEDURE FOR NEOPRENE REPAIRS

13. Read the instructions in the relevant aircraft Vol. 6. Examine the inside of the radome for possible recording of previous repairs. If previous repairs are in evidence, check the limitations on numbers, extent and minimum spacing to ensure that another repair is permissible. In this connection, it may be possible to overcome minimum spacing difficulties by stripping off the neoprene containing a previous repair and making a single large repair. The repair procedure itself is as follows:—

(1) Remove the neoprene from the damaged area, exposing the fibreglass, cutting or scraping with a sharp knife to produce a regular shape, taking care not to damage the fibreglass. Ensure that good adhesion is maintained between existing neoprene and fibreglass all round the cleaned-out area.

WARNING . . .

If the radome itself is found to be damaged when the neoprene has been removed, the fibreglass must be repaired before new neoprene is applied. Almost invariably, radomes are so relatively thin due to the need for minimum radar

REPAIR TO NEOPRENE FINISH ON RADOMES—*continued*

obstruction that they are only just able to meet strength requirements. Therefore, damage even to one lamination of fibreglass will result in reduction of the reserve factor below the basic value of 1·0 (Sect. 1, Chap. 1.2.1).

(2) Smooth the fibreglass to an even matt surface with No. 00–100 garnet paper, at the same time chamfering the edges of the neoprene. If the fibreglass itself has been repaired, raised weave or other inequalities should be removed using No. 0–80 garnet paper first, then No. 00–100 garnet paper.

(3) Remove all dust from the area, wiping with a clean, lint-free cloth damped ◀with toluol or toluene. Allow this to▶ dry completely.

(4) Brush one coat of primer, suitably thinned (*para.* 9), evenly over the area including the chamfered edges. All strokes should be made in one direction, for example from left to right, without overlap but this should be achieved without the formation of dry streaks, air bubbles or pin-holes. Allow to dry at a temperature of not less than 18 deg. C for one hour.

(5) Apply a second coat of primer, brushing at right-angles to the first coat, and again allow to dry at a temperature of not less than 18 deg. C for one hour.

(6) Not less than 1 hour and not more than 48 hours after application of the second coat of primer, apply the first coat of mixed finishing compound (*para.* 10). A full brush should be used and the strokes should be made in one direction only, from wet to dry, avoiding the formation of streaks, bubbles and pin holes. It should be noted that brushing over undried compound applied on previous strokes will result in dragging. Allow to dry at a temperature of 25 ±5 deg. C for between 1 and 1½ hours.

(7) After an interval of not less than 1 hour, but not more than 1½ hours, apply a second coat of finishing compound, brushing at right angles to the first coat. Allow to dry as before.

(8) Apply further coats as necessary to produce the required total thickness of primer and finish of 0·011 ± 0·001 inches (*para.* 2, 3 *and* 4), brushing at right-angles to the previous coat and allowing the correct drying time on each occasion.

Note . . .

The minimum and maximum permissible times for application of the finish are approximately 10 *and* 15 *hours respectively. Since the finishing cannot be left half-completed overnight, the repair procedure should be planned accordingly.*

(9) Allow the finish to dry and cure in a dust-free atmosphere at a temperature of 25±5 deg. C for not less than seven days, unless a shorter period is authorised in the aircraft Vol. 6 or by the appropriate technical officer.

(10) Brushes should be cleaned in acetone (*Ref. No.* 33C/1156) immediately after use.

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