CHAPTER 8

BONDING AND SCREENING

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Introduction

1. The metal components of an aircraft structure, and its fixed fittings are connected together to form a completely bonded system of constant low resistance and uniform potential which minimises the risk of damage by lightning strikes and prevents potential differences being set up by static charges on adjacent metal components. Components and conductors which are the source of radio interference fields are enclosed in metal screens or braided metal sheaths respectively which are bonded to the main earth system of the aircraft. These screens or sheaths eliminate couplings between adjacent circuits and also provide a path of low impedance to return stray r.f. currents to their source.

BONDING

General

2. During flight the metal structure of an aircraft receives static charges due to friction with the atmosphere and by the transference of charges from passing cloud formations. Since the bonded fittings and structural components form a single, low resistance conductor, static charges and discharges between the aircraft and the atmosphere have the effect of varying the potential of the complete structure.

3. The uniform potential of the aircraft structure during flight may differ considerably with that of the ground and provision is made to equalize the aircraft and earth potentials through the medium of

conductive landing wheels or alternative means which are designed to dissipate any difference in potential during the landing run.

4. Static charges may be generated by the flow of gases or fluids through metal pipelines of an aircraft installation. It is essential therefore that all such piping and the metal connections of non-metallic pipes should be connected to the main earth system through low resistance bonds.

Aircraft bonding systems

5. The bonding, or main earth, system of metal aircraft is formed by the metal skin and connected structural components and fixed fittings which provide a direct continuous path for lightning strikes and afford protection to personnel and equipment from static potentials.

6. Aircraft of composite construction are fitted with copper bonding strips in the non-metallic parts of the structure and have lightning strike plates on the surface of the extremities of the fuselage, wings, tailplane, fins and rudders excepting where components of metal construction meet the requirement. The bonding strips are connected to metal structural components and to the lightning strike plates to form the main earth system.

7. Aircraft in which the primary structure is non-metallic have a number of flat copper strips along the entire length of the fuselage which are connected together at each end and have similar strips fitted transversely at intervals along their length. The transverse strips are connected to the longitudinal strips to form a Faradays cage and thus provide protection against lightning strikes and static potentials.

8. The wings, tailplanes and control surfaces of aircraft of non-metallic construction are fitted with copper bonding strips and these, together with lightning strike plates in all the positions detailed in para. 6, are connected to the main earth system of the fuselage.

Note . . .

The fitting of flexible jumper leads across the bearings of control surfaces is no longer an aircraft design requirement. The bearings themselves provide a direct path for lightning strikes and electrical continuity sufficient to dissipate static charges set up on the bonded control surface.

9. Components having surfaces exterior to the airframe structure are bonded to the main earth system in all aircraft; additionally, in composite or non-metallic aircraft, bonding is required on components which are located close to the exterior of the cage formed by the copper bonding strips. Bonding connectors are provided at fuel filling points on all aircraft to enable connection to be made between the supply hose and the aircraft fuel system. Reference should be made to Vol. 1 of the relevant Aircraft Handbook for details of the bonding and main earth systems of individual types of aircraft.

SCREENING

10. Cables carrying alternating or interrupted direct current may set up external electric fields capable of causing radio frequency interference with adjacent circuits. The use of suitably earthed screened cable prevents such interference by eliminating the coupling between the circuits and providing a low impedance return path for stray r.f. voltages.

11. Electronic components and other equipment which could generate or be adversely affected by external electric fields are enclosed in earthed metal boxes or mesh screens which damp or neutralize r.f. currents and so prevent the transmission of energy to or from the enclosed components.

12. The effects of electro-magnetic fields cannot be reduced by the foregoing methods but may be minimised by avoiding loops in cables and routing the wiring so that it does not come within the specified distance of equipment that could be adversely affected by such fields. Interference from magnetic components can only be prevented by locating the items a distance from equipment they could affect or by enclosing the magnetic components in a screen or high permeability, ferro-magnetic metal to provide a low reluctance return path for the flux. Such screening is seldom, if ever, used in aircraft installations.

SERVICING

13. Routine servicing consists of periodic examinations of bonding and screening for security of connections and signs of deterioration or corrosion. The resistance between the main earth system and the bonded components and screens should be measured in accordance with the instructions and at the periods prescribed in the relevant Aircraft Servicing Schedule.

14. A bonding tester (Ref. No. 5G/2126) is provisioned for the measurement of bonding and screening connections in aircraft. The tester is described in A.P.4343J, Vol. 1, Sect. 3, Chap. 3 and comprises an ohmmeter which is powered by an alkaline battery and has a scale range of 0 to 0·1 ohm. A 60 ft test lead, terminating in a single contact prod for attachment to the reference point, and a double contact prod for making contact with the bonding being tested, are supplied with the tester. Care should be taken to avoid damage to thin metal components when piercing protective coatings for the purpose of bonding tests.

15. Where it is necessary to remove protective covering from the surface of components during the servicing of bonding connections, a scraping tool should be used to avoid scratching the metal surface. On completion of the bonding, the protective coating should be replaced in accordance with the details contained in Vol. 1 of the relevant Aircraft Handbook.

16. Further information on bonding and screening is contained in A.P.1464D, Vol. 1, Part 2, Sect. 1, Chap. 5.

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