Chapter 12

BONDING AND SCREENING

BONDING

Bonding is the process of electrically connecting the metal parts of an aircraft so that they will collectively form an integral electric unit. This creates a very low-resistance path for current from any one part of the structure to any other part.

Electrostatic charges (static electricity) are acquired by the different parts of an aircraft during flight. Should the potential difference increase to a very high voltage or contact between these parts occur, sparking (arcing) will take place, which in turn may create problems in sensitive electronic circuits and hinge joints. This is an obvious case for ensuring that all metal parts and components of an aircraft are always at the same electrical potential. To achieve this a conductive link (ie. a bond) is connected across joints and components in the metal airframe.

The specific purposes of bonding are to:

a) provide a low resistance path to the airframe (earth return circuit) which eliminates the need for a return wire.

b) reduce intermittent static discharge which could interfere with electronic equipment by providing a connection to the static wicks.

c) reduce static interference and lightning strike damage to flap, trim and control surface hinges, by causing the current to flow through the bond and not the bearings, and to

d) prevent the build up of static charges which could result in sparking and risk of fire.

METHODS OF BONDING

All Metal Aircraft

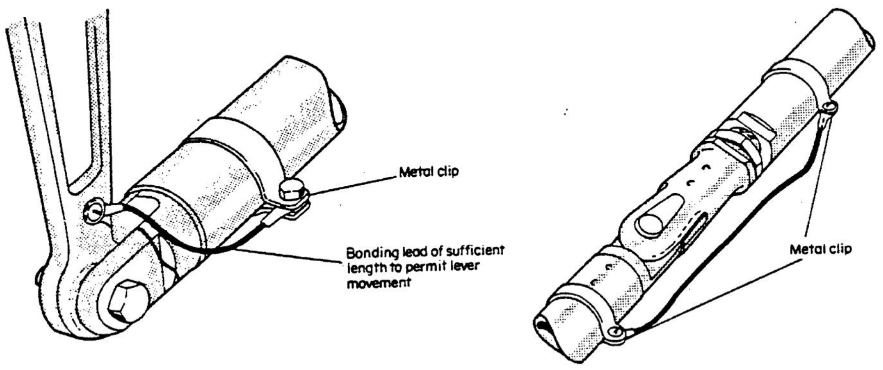
Bonding is a relatively simple matter in aircraft where the primary structure, including mainplanes and tail unit, is wholly metal. The structure itself forms the necessary continuous connection or bond, and the required continuity between the primary bond and such components as seats and tanks, is generally assured if clean metal-to-metal joints, protected from corrosion and incapable of making intermittent contact, are used to fix the various metallic components. External bonding is required only for moving components, such as control surfaces, trimming tabs, and shock mounted equipment. the electrical continuity through lubricated pivots or bearings can never be of a very high order, and it must necessarily be supplemented in some cases, by flexible bonding strips, is a short length of metal braid or metal strip with a terminal at each end attached to the structure and the moving unit. Where lengths of piping are joined together by means of rubber or other flexible connections, continuity throughout the run of piping is preserved by brass contact strips which are held in metallic contact with the pipes at either side of the connections by clamps or clips.

Composite Aircraft

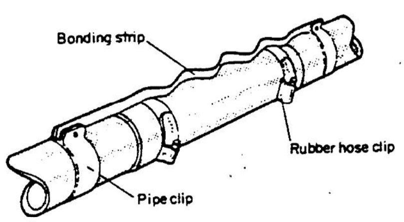
Some types of aircraft have the fuselage largely constructed from processed wood or glass fibre, whilst some composite are of part metal construction. In non metal or part metal sections, a full conducting network must be provided to link the metal parts of the aircraft with the fuselage components so that all are maintained at the same electrical potential.

To make a bonding network in a composite aircraft, copper strips are disposed symmetrically around the fuselage, extend throughout its length and are connected together at the fore and aft extremities. Fixed components are connected to the main bond by copper branch strips, while pipes, controls, are similarly connected through copper braids to permit the necessary degree of freedom of movement.

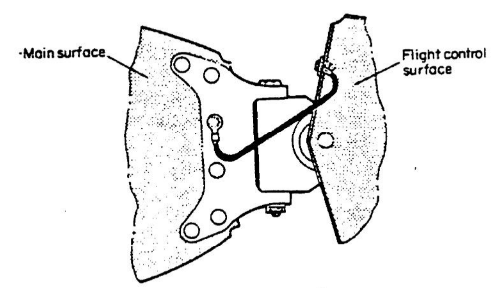
Warning: Temporary bonding connections must never be makeshift jobs: they must be thoroughly sound and not liable to breakage while fueling is in progress. Remember that a static charge may build up very rapidly to an electrical potential sufficiently high to cause dangerous sparking.



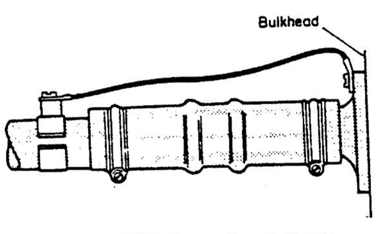
(a) Levers and control rods



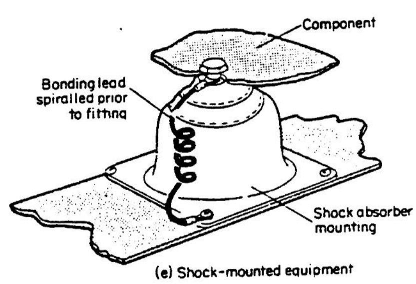
(b) Pipes with non-metallic couplings



(c) Flight control sufaces



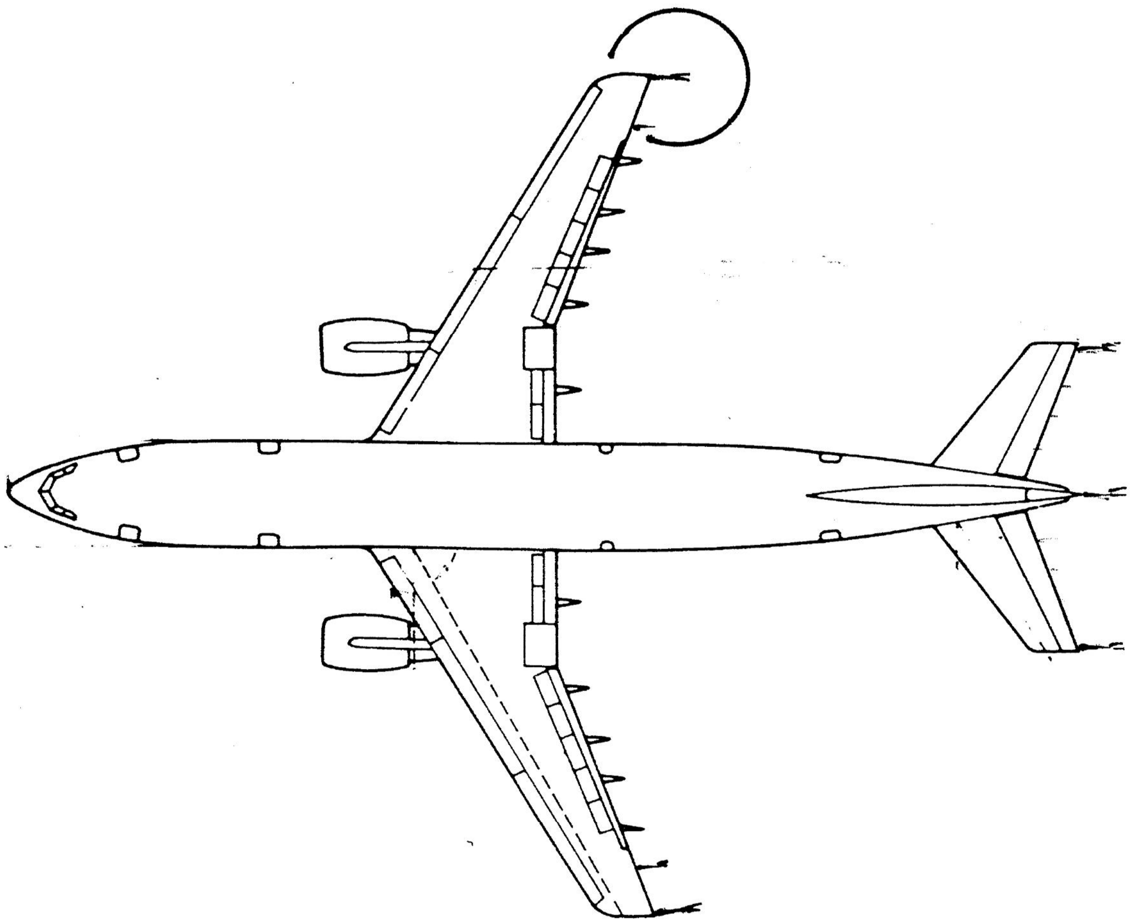
(d) Flexible coupling at bulkheads



(e) Shock-mounted equipment

Static Wicks

Static wicks are fitted to the trailing edges of main planes and control surfaces and on the wing or tailplane tips. They cut down radio interference by continuous static brush discharge to atmosphere through the "teased" floating end of the cotton wick. If not fitted, the static discharge during flight will be intermittent and may spark and produce high frequency interference.



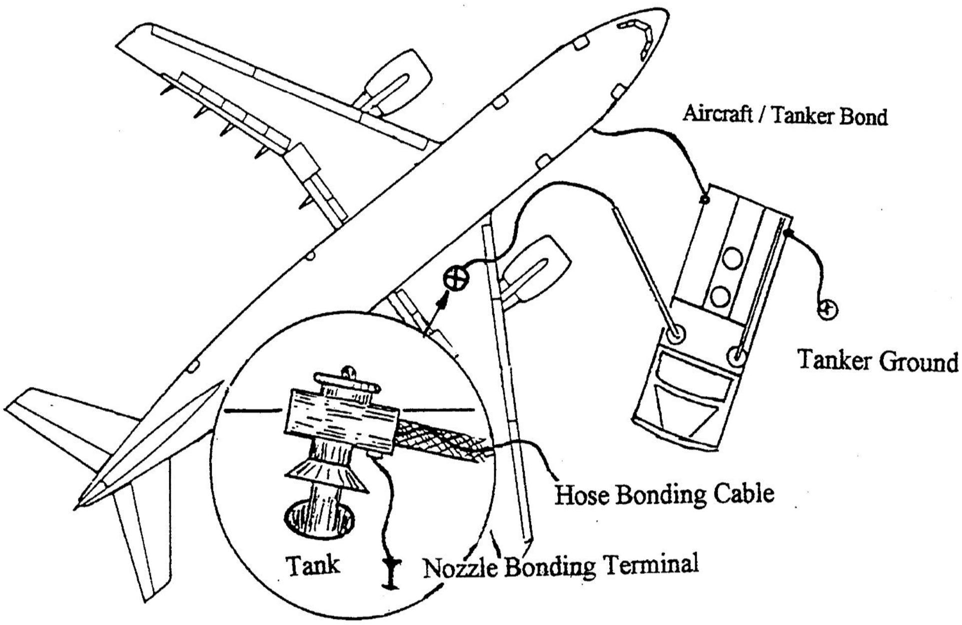
STATIC WICKS ALLOW DISCHARGE FROM TRAILING EDGES

Ground Contact

To ensure that no static electrical charge, with its risk of sparking, remains on metal parts of the aircraft, the main bond must be brought into instantaneous electrical contact with the ground as the aircraft touches down. This is achieved by fitting conducting tyres, made from a special rubber compound, which have comparatively low electrical resistance. The tyre is in contact with the main bond through the oleo system and any static charge held by the airframe is dissipated to earth on landing.

REFUELING PRECAUTIONS

Fires may be caused during fueling or defueling through the generation of static electricity. Liquid fuels are generally good insulators, and they readily accumulate electrical charges due to friction when in motion. Rubbing contact with other materials, particularly when these are also insulators, produces a similar effect; rubber compounds and chamois leather are good examples. The charge induced,depends upon the rate of flow and the nature and disposition of the rubbing surfaces. The amount of static charge depends upon the electrical capacity of the objects affected and the resistance of the leakage paths available for the dispersion of the charge. Where suitable paths are not provided, voltages sufficiently high to cause sparking to adjacent objects at lower potential occur. In dry atmospheric conditions met with in tropical climates or associated with intense cold, the voltages attained are very high owing to the resistance of any possible leakage paths.



BEFORE REMOVING FUEL TANK CAPS, EARTHING MUST BE COMPLETED.

The likelihood of the existence of pockets of explosive fuel vapour in the confined spaces of an aircraft during and after refueling must always be kept in mind. In view of the danger of igniting this vapour by electrically-produced sparks, as may occur at switch contacts, no electrical apparatus in the aircraft is to be operated while refueling or defuelling is in progress and nor until the interior of the aircraft has been effectively ventilated.

SCREENING

Screening or shielding, is a metal covering applied to wiring and equipment to eliminate interference with radio reception. The shielding is bonded to the main structure at frequent intervals. The word shielding is also applied to the process of enclosing wires or electric units with metal. The purpose of shielding is to cause any transmitter energy to be induced in the shield metal rather than in parts, or wires, where it would cause interference. Shielding is used when one unit must be protected from the effects of an HF current in an adjacent unit, or when a cable is to be protected from radio-frequency (RF) noise.

Shielding is accomplished by installing wires or cables in rigid or flexible conduit or by providing the wire with a braided metal outer sheath. The conduit must be bonded to the aircraft structure to be effective. Protection for both mechanical and electrical interference is accomplished in this manner.

The following devices all require some level of screening.

- (a) High tension and low tension ignition wiring.
- (b) Direct current generators.
- (c) All direct current motors that may be required to operate continuously during flight.
- (d) Slip-rings running in excess of 200 RPM.
- (e) High and low tension booster coils.
- (f) Apparatus making and breaking a circuit at a rate exceeding 10 cycles per second.

Screening of the ignition system used on piston engine must be very comprehensive if it is to be really effective, and in most cases a shielded harness, designed specifically for the particular type of engine, forms an integral part of the engine equipment.