SECTION 2
CHAPTER 14
EARTHING AND BONDING OF AIRCRAFT
AND GROUND SUPPORT EQUIPMENT

INTRODUCTION

1. Electrical bonding of aircraft to earth has generally been aimed at protecting aircraft and personnel from the hazards associated with static electrical discharge. However, with utilisation of external power sources, electrical bonding to earth must also protect aircraft and personnel from the potential hazards associated with the electrical ground power supplies.

2. The latter concern has led to an extensive examination of the hazards and electrical bonding procedures, and this has resulted in a different approach to electrical bonding requirements. This approach emphasises the need to counteract the potential hazards associated with electrical ground power supplies. If protection against these is adequate then protection against the hazards associated with static electrical build-up and discharge is also adequate.

3. Increasing utilisation of electrically operated GSE, primarily mains powered equipment (240V, 50Hz), has highlighted the need to protect personnel against the potential hazards associated with this type of equipment.

4. The purpose of this chapter is to clearly present the approach that should be adopted in relation to electrical protection, bonding and earthing and to define the procedures to be employed. In particular the aims are:

   a. To describe the nature of the hazards associated with static electricity, ground power supplies and mains operated GSE.

   b. To specify the procedures to be used for electrical protection of personnel, and electrical bonding and earthing of aircraft and ground support equipment.

ELECTRICAL GROUNDING FOR AIRCRAFT SAFETY

Introduction

5. The following paragraphs provide maintenance personnel with the rationale behind the requirements for, and the detailed information required to carry out electrical safety grounding of aircraft. This includes grounding for both static electricity and the potential hazards associated with ground power supplies. The grounding methods presented make a clear distinction between static grounding and power grounding. The following definitions apply:

   a. **Static Ground.** An approved ground point with an impedance of less than 10,000 ohms referenced to earth.

   b. **Power Ground.** An approved ground point with an impedance of less than 10 ohms to the power system neutral.

6. Static grounding of aircraft is required whenever the aircraft is parked; including during refuelling, defuelling, hot refuelling, stores loading and whenever external power is connected.

7. All aircraft require externally generated electrical power supplies to facilitate servicing and maintenance. For safe use of these power supplies the aircraft must be correctly grounded. This grounding is to provide protection against the potential hazards of these external power supplies and is in addition to aircraft static grounding or earthing procedures.

8. There are two basic types of power supply available for supplying electrical power for aircraft servicing. They are:

   a. **Reticulated Power Supplies.** These are usually supplies peculiar to the aircraft or equipment, reticulated from another source and terminated in the hangar. From these, the power is fed to the aircraft. Typical supply values are 115/208V 400Hz AC and 28VDC.

   b. **Mobile Generating Sets.** These may be:

      1. engine driven generating sets;
      2. static rectifiers; and
      3. frequency changers.

External Power Supply System Characteristics

9. The use of external power supplies always involves two basic electrical characteristics:

   a. a voltage (potential) above earth mass potential to create the electrical pressure necessary to cause a current flow; and
b. a return path, normally at earth mass potential, to complete the electrical circuit.

10. The electrical cable used in sub para 9a. is termed the active or positive lead, and in sub para 9b. the neutral or negative lead.

11. External power supplies, both mobile and reticulated, are designed so that the return path from the aircraft load to the power source is always via the negative or neutral lead. However, parallel return paths can be established and it is these that provide the hazards associated with external power supplies.

12. The current flow in a return path will depend on the total resistance of the circuit and be in proportion to the resistance (and therefore currents) of other parallel paths. Not only may equipment operation be unbalanced by multiple return paths, but more importantly, personnel may sustain serious injury by becoming part of a return path.

13. All efforts are aimed at ensuring that, generally, only one return path is possible and that adequate safety measures are taken so that personnel are afforded the best possible protection from the potential hazards associated with external electrical power supplies.

### Mobile External Power Supplies

14. Mobile aircraft external power supplies are to have the output AC neutral lead and/or the DC negative lead connected to the chassis. A return path may be established if the chassis is bonded to the earth mass, consequently a general policy should require that the power source chassis is NOT bonded to the earth mass. This is illustrated in Figure 14–1.

15. GSE and safety interconnection leads are not designed to withstand a high value of continuous current flowing in the components that could form part of a parallel return path. In addition, the electrical instability engendered by multiple return paths, if these are established, is generally undesirable.

### Reticulated Aircraft External Power Supplies

16. Reticulated aircraft external power supplies have certain characteristics which set them apart from mobile power supplies, ie:

    a. very effective earthing of the source of the power at the mains or sub-mains earth/neutral link; and

    b. an extensive reticulation system is required to provide electrical power to the aircraft.

17. The above characteristics allow for supplementary return paths, ie earth loops to be established in parallel with the neutral or negative lead. Current flow will be proportional to the resistance of the return circuit. Under normal conditions the current flow is of an acceptably low value in the earth loops. This is due to the relatively high resistance between hangar floor earths and the earth/neutral link at the sub-mains.

18. The most acute hazard associated with reticulated power supplies serving hangar facilities is the possibility of the aircraft frame being connected to the hanger structure. In this situation, the earth loop will carry a greater proportion of the return current. This current flow will be greater still if the resistance of the power supply neutral or negative is high or the main return path is disconnected.

19. If earth loop currents are high, due to either incorrect earthing or faulty neutral/negative return leads, the following hazardous situations will exist when power is applied to the aircraft:

    a. arcing will occur when the safety interconnection lead is connected or disconnected; and

    b. personnel becoming part of this circuit will suffer electric shock.

20. For the above reasons it is imperative that all personnel ensure that correct earthing techniques are always employed.

### WARNING

Connection/disconnection of safety interconnection leads should not be made whilst reticulated external electrical power is applied to the aircraft.

21. Illustrated in Figure 14–2 and Figure 14–3 are the two static aircraft external power supply situations, and the correct connections to ensure equipment and personnel safety.
Figure 14–1 Mobile (Self Contained) Aircraft External Power Supply

Figure 14–2 Mobile Rectifier/Frequency Converter Aircraft External Power Supply

Figure 14–3 Reticulated Aircraft External Power
ELECTRICAL EARTHING AND BONDING PROCEDURES FOR AIRCRAFT AND GSE

Introduction

22. The following paragraphs contain the procedures and sequences to be used for electrical earthing and bonding of aircraft and ground support equipment. The observance of these procedures is recommended for personnel involved in aircraft ground handling and maintenance.

23. Correct electrical earthing and bonding procedures are essential to minimise the hazards associated with static electricity. Safety interconnection leads, which have been designed to provide this earthing and bonding for aircraft and equipment, must be connected correctly and in the proper sequence.

Aircraft Earthing Procedure

24. Unless otherwise directed by the specific aircraft documentation, a safety interconnection lead manufactured to the requirements detailed in this chapter is to be connected/disconnected using the following sequence:

a. The safety interconnection lead clamp is connected to a known serviceable earth reference point followed by the connector pin or clamp being attached to an appropriate location on the aircraft. The interconnection should exist at all times whilst the aircraft is parked.

b. Disconnection procedure is the reverse of the connection sequence ie. the connector pin or clamp is removed from the aircraft followed by the lead clamp removal from the earth reference point.

25. Any one of the configurations detailed in Figure 14–4, Figure 14–5, Figure 14–6 or Figure 14–7 may be used to earth the aircraft.

Bonding GSE to Aircraft

CAUTION
External electrical power supply units are NOT to be connected to an earth reference point, or interconnected to aircraft earth receptacles.

26. Personnel operating GSE in conjunction with aircraft are responsible for ensuring the proper sequence of earthing and bonding is observed and that the connections are correctly made.

Replenishing or Removing Flammable Fluids

NOTE
Whilst oxygen is classified as non-flammable, the dangers involved during aircraft oxygen replenishment dictate that oxygen should be treated as a flammable fluid. However, when replenishing airborne oxygen systems, bonding of the filling connector to the aircraft is not required.

27. Before replenishing an aircraft with flammable fluid or removing flammable fluid from an aircraft, the following bonding procedures and sequences are to be observed (Refer to the note following Paragraph 23 regarding operating from civilian airports):

a. Check that a safety interconnection lead is connected between a serviceable earth reference point and the aircraft.

b. Connect a safety interconnection lead from the GSE to the same earth reference point to which the aircraft is earthed.

c. Connect a safety interconnection lead from the GSE to an earth point on the aircraft.

d. Personnel involved in the operation are to touch an earthed conductor to themselves and their clothing to discharge any static electricity that they may have generated.

e. Before opening the inlet of the replenishment point, connect the replenishment hose bonding connector plug or clamp to an earth point adjacent to the fluid inlet.

28. After the replenishment connections have been removed at the completion of the operation, disconnect the bonding leads in the reverse sequence.

Replenishing or Removing Non-Flammable Fluids

29. The sequence for electrical bonding of GSE used for replenishing or removing non-flammable fluids from an aircraft is as follows:

a. Check that a safety interconnection lead is connected between a serviceable earth reference point and the aircraft, and;

b. Connect a safety interconnection lead from the GSE to the same earth reference point to which the aircraft is bonded.

NOTE
When operating at airports where earth points are unavailable, a bonding lead should be connected from the GSE to the aircraft. The GSE can then be connected and operated.
Servicing Aircraft with Flammable Fluids from Drums or Containers

30. Before replenishing an aircraft with flammable fluid from a drum or other container, or removing flammable fluids from an aircraft into a drum or other container, the following earthing and bonding procedures and sequences should be observed.

a. Check that a safety interconnection lead is connected between a serviceable earth reference point and the aircraft.

b. The drums or containers are to be bonded to each other with safety interconnection leads. (Leads as detailed in Figure 14–7 should be used).

c. Connect a safety interconnection lead between the bonded drums or containers and the same earth reference point to which the aircraft is earthed.

d. Connect a safety interconnection lead between the pumping unit (can be a tanker, fuel servicing unit or wheel or sled mounted centrifugal pumping unit) and the same earth reference point to which the aircraft and containers are connected.

e. Connect a safety interconnection lead between the bonded drums or containers and the pumping unit.

f. Connect a safety interconnection lead between the pumping unit and the aircraft.

g. Personnel involved in the fuelling operation are to touch an earthed conductor to themselves and their clothing to discharge any static electricity that they may have generated.

h. Prior to opening the inlet of the aircraft replenishment point, connect the hose connector plug or clamp to an earth point adjacent to the fluid inlet.

31. After the fuelling connections have been removed at the completion of the replenishment operation, disconnect the bonding leads in the reverse sequence.

Refuelling Aircraft from Hydrant Systems

32. Before refuelling an aircraft from a hydrant system, the following bonding procedures and sequence should be observed:

a. Check that a safety interconnection lead is connected between a serviceable earth reference point and the aircraft.

b. Connect a safety interconnection lead from the fuel servicing unit (FSU) to the same earth reference point to which the aircraft is earthed.

c. Before connecting the FSU supply hose to the hydrant supply point, connect the FSU supply hose bonding connector or clamp to an earth point adjacent to the hydrant supply point.

d. Connect a safety interconnection lead from the FSU to the aircraft.

e. Personnel involved in the fuelling operation are to touch an earthed conductor to themselves and their clothing to discharge any static electricity that they may have generated.

f. Before opening the inlet of the aircraft replenishment point, connect the FSU replenishment hose bonding connector plug or clamp to an earth point adjacent to the fuel inlet.

g. After the fuelling connections have been removed at the completion of the replenishment operation, disconnect the bonding leads in the reverse sequence.

Bonding Procedures to be Observed when Refuelling GSE

33. The following bonding procedures should be used when refuelling GSE on aircraft tarmac areas:

a. Ensure that GSE is inoperative and disconnected from the aircraft.

b. Connect a safety interconnection lead from the refuelling vehicle to the GSE.

c. Personnel are to touch an earthed conductor to themselves and their clothing to discharge any static electricity they may have generated.

h. Prior to opening the inlet of the GSE replenishing point, connect the replenishing hose bonding connector plug or clamp to an earth point adjacent to the refuelling inlet.

34. Aircraft of any nation that are to be serviced or replenished should be treated in accordance with the procedures detailed in this chapter.
AIRCRAFT AND GSE INTERCONNECTION HARDWARE

Introduction

35. The following paragraphs describe the interconnection hardware required to earth aircraft and GSE used to service aircraft.

Hardware to be Fitted to Aircraft

36. The requirement for aircraft earthing receptacles is based on the US Military Specification MIL-C-83413 and receptacle location as indicated at Paragraph 39.

37. The recommended earthing receptacle locations on aircraft are as follows:
   a. one receptacle at each inlet for aircraft fuel;
   b. one receptacle at each pylon hard-point or other attachment point for armament equipment; and
   c. one or more receptacles at points convenient for an interconnection lead between aircraft and earth mass.

Fluid Dispensing GSE

38. GSE used for dispensing fluids, (gases and liquids) except engine and hydraulic oil replenishing dollies, is to be fitted with interconnection hardware as detailed in Figure 14–4, Figure 14–5, Figure 14–6 or Figure 14–7. Specific interconnection hardware requirements for GSE dispensing flammable and non-flammable fluids are as follows:
   a. GSE Dispensing Flammable Fluids. GSE such as AVGAS and AVTUR tankers and underground fuel supply hydrant carts which dispense flammable fluids should be provided with two or more safety interconnection leads. Additionally, a safety interconnection lead should be provided at the delivery end of the fuel dispensing hoses, for connection to the aircraft. This lead should be a minimum of 122cm in length to allow connection to earth points that may be located a maximum of 104cm from the refuelling point.

b. GSE Dispensing Gaseous Oxygen. Gaseous oxygen carts should be provided with two or more safety interconnection leads. Whilst gaseous oxygen is classified as non-flammable, the dangers involved during aircraft oxygen replenishment dictate that oxygen should be treated as a flammable fluid. However, when replenishing airborne oxygen systems, earthing of the filling connector to the aircraft is not necessary.

c. GSE Dispensing Non-Flammable Fluids. GSE dispensing non-flammable fluids such as hydraulic rigs, air-conditioning carts, air supply carts and nitrogen gas replenishment trolleys, should be fitted with one safety interconnection lead.

GSE Supplying Electrical Power

39. GSE capable of supplying only electrical power to an aircraft is NOT to be fitted with safety interconnection leads. At no time is an item of GSE supplying external electrical power to an aircraft to be bonded to the earth mass.

CAUTION

The safety interconnection lead on multi-purpose GSE is to be used when the GSE is supplying replenishing fluid only. The lead is not to be connected when the GSE is supplying electrical power only, or when simultaneously supplying electrical power and replenishing fluid.

Multi-purpose GSE

40. When an item of GSE is capable of supplying both non-flammable fluids and electrical power to an aircraft, it should be fitted with one safety interconnection lead for bonding to an earth reference point. The GSE safety interconnection lead is connected to the earth reference point before dispensing hoses are coupled to the aircraft. (See caution above).
General Purpose GSE

**CAUTION**
Work stands used in conjunction with fuel tank maintenance should comply with the requirements of paragraph 41.

41. Work stands used in conjunction with fuel tank maintenance should be fitted with bonding leads to enable the stand to be connected to an earth point and bonded to the aircraft. The stand should also be fitted with a static discharge plate made of copper, zinc or zinc coated material. The plate should be welded to the handrail at the entrance to the stand and should be marked “Personnel Static Discharge Plate”.

42. Generally, stands, jacks, electronic test equipment, vacuum cleaners etc, whether mains power operated or not, need not be fitted with safety interconnection leads.

Safety Interconnection Leads

43. Safety interconnection leads used on aircraft and GSE should to conform to one of the configurations detailed in Figure 14–4, Figure 14–5, Figure 14–6 and Figure 14–7. Four configurations are provided to enable companies to utilise the type most appropriate for local requirements. In some cases fitment of streamers to fuel tanker interconnection leads may not be appropriate. Accordingly, the fitment of streamers to fuel tanker safety interconnection leads is left to the discretion of individual companies.

TESTING INTERCONNECTION LEADS

Introduction

44. The following paragraphs detail the test and inspection procedures that should be followed when servicing safety interconnection leads used to provide electrical bonding between GSE, aircraft and earth reference points.

Responsibilities and Periodicity

45. The testing of safety interconnection leads should be carried out by electrical tradesmen at six monthly intervals.

![Figure 14–4  Safety Interconnection Lead (Configuration 1)](image-url)
Figure 14–5  Safety Interconnection Lead (Configuration 2)

Figure 14–6  Safety Interconnection Lead (Configuration 3)

Figure 14–7  Safety Interconnection Lead (Configuration 4)
NOTES
(Refer to Figures 9–4 to 9–7)

1. Safety interconnection lead length should be determined by user requirements. (Maximum length 30 meters). Lengths are to be continuous. Splices are prohibited.
2. The maximum total resistance of the assembled lead should be:
   a. For leads less than 15 meters in length - 5 ohms.
   b. For safety interconnection leads, as fitted to fuel tankers, 15 to 30 meters - 10 ohms.
3. The streamer should be red, 50 ± 10 cm long, 8 ± 3 cm wide and have stencilled in white on both sides ‘REMOVE BEFORE FLIGHT’.
4. The streamer should be no more than 40 cm from the connector plug or grounding clip.
5. A reel may be used to facilitate storage of the interconnection lead.
6. Refer to Table 14–1 for component identification.

<table>
<thead>
<tr>
<th>Item No</th>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connector, Plug</td>
<td>M83413/4-1</td>
</tr>
<tr>
<td>2</td>
<td>Clip, Grounding, Electrical</td>
<td>M83413/7-1</td>
</tr>
<tr>
<td>3</td>
<td>Cable, Grounding, Insulated</td>
<td>B1054-300</td>
</tr>
<tr>
<td>4</td>
<td>Terminal Lug, Crimp Style, Insulated</td>
<td>MS25036-XXX (Dash number as appropriate)</td>
</tr>
<tr>
<td>5</td>
<td>Streamer, Rayon or Cotton</td>
<td>Local Manufacture</td>
</tr>
<tr>
<td>6</td>
<td>Sleeve (cut crimp end from terminal lug)</td>
<td>MS25036-XXX (Dash number as appropriate)</td>
</tr>
</tbody>
</table>

**Test Equipment**

46. The test equipment to be used is either:
   a. Resistance - Capacitance - Inductance Bridge, PN 250DA,
   b. Gossen Earth Tester, PN GEOHM2, 66; or
   c. a low voltage ohmmeter.

**Procedure**

47. Visually examine leads for deterioration of components.

48. Measure the resistance between the safety interconnection lead extremities with any of the items detailed in Paragraph 46. The maximum permissible resistance end-to-end is:
   a. For leads less than 15m in length, 5 ohms; or
   b. For safety interconnection leads, as fitted to fuel tankers, with lead lengths 15 to 30m 10 ohms.
49. Leads passing this test may be released for further use.
50. Unserviceable leads fitted with Clip Grounding, PN M83413/7-1, should be removed from service and repaired as follows:
   a. Withdraw roll pins and remove the steel jaw.
   b. Clean the mating surfaces of the steel jaws and aluminium handles with a wire brush.

NOTE
The cable, when new, has bright orange PVC insulation which fades in sunlight. Fading of this insulation in itself is not cause for replacement.
c. Smear mating surfaces with deoxidising product PN 50-851, and assemble clips using roll pin PN MS9048-007.

d. Check serviceability of cable and integrity of all electrical connections. Replace or repair as necessary.

e. Retest the safety interconnection leads in accordance with Paragraph 51.

51. Unserviceable leads not fitted with grounding clips are to be tested in accordance with Paragraph 53, steps d and e.

Recording Action

52. Safety interconnection leads should be marked with a serial number and tests are to be appropriately recorded. A suggested format for a log sheet is shown at Figure 14–8.

AIRCRAFT EARTHING RECEPTACLE INSPECTION PROCEDURE

Introduction

53. The following paragraphs detail the testing procedures for earthing receptacles fitted to aircraft.

<table>
<thead>
<tr>
<th>YEAR:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Lead No</th>
<th>Location</th>
<th>Inspection Date</th>
<th>Date</th>
<th>Resistance Readings</th>
<th>Rectification and Remarks</th>
</tr>
</thead>
</table>

56. **Visual Inspection.** Inspect for loosely mounted receptacles and evidence of corrosion on washers, lugs, nuts and the aircraft skin.

57. **Mechanical.** Tests are performed using stainless steel plug PN M83413/4-1. The plug is inserted in the receptacles being tested to ensure that the contact (spring) is seated in the plug detent.

58. **Withdrawal Force.** The longitudinal force required to remove the plug from the receptacle is 2.72 to 4.54kg. Less than 2.72kg indicates a weak or damaged receptacle contact (spring). (Ref. MIL-C-83413)
59. **Engagement.** There should be no free axial movement of the contact tip in the plug detent due to clearance between the contact (spring) tip and plug detent. Free axial movement indicates the contact is not maintaining connection with the plug.

60. **Electrical Resistance Tests.** Electrical resistance measurements to aircraft skin should be at a point where the aircraft skin is clean and unpainted. The DC resistance of cables, or test leads, including the plug used for making a specific resistance test, should be measured and subtracted from the reading for that specific test.

61. The DC resistance between earthing receptacles and the aircraft skin should be less than 0.1 ohm. Greater resistance indicates a defective receptacle contact (spring), loose receptacle mounting or defective bonding strap, if used.

62. The DC resistance between earthing receptacles (electrical interconnection through aircraft frame or skin) should be less than 1 ohm. Greater resistance indicates defective or insufficient bonding.

### GROUND EARTHING POINTS

#### Introduction

67. Ground earthing points are the connection points between aircraft or GSE and the earth mass. The point is constructed from a galvanised mild steel stake with a cast bronze head brazed to it. The assembly is driven into the ground, and, if the electrical resistance of the assembly to earth is within limits, it may be used to electrically bond aircraft and ground support equipment to earth mass.

68. Ground earthing points may be of two configurations, namely:

- a. standard ground earthing points, which are permanent installations; and
- b. temporary ground earthing points, which are for use when standard points are not available.

#### CAUTION

Ground earthing points other than those described below should not to be used for earthing aircraft.

#### Standard Ground Earthing Points

69. Standard ground earthing points, similar to the detailed drawing at Figure 14–9, should be located adjacent to aircraft parking positions. Ideally, sufficient points are to be available so that no more than one aircraft is connected to any one point; however, this requirement is not mandatory.

70. The installation of standard ground earthing points should be coordinated through aerodrome managers. Appropriate contractors should be made responsible for the installation and repair requirements. Testing of installed points should be conducted in accordance with Paragraph 81.

71. The rod and cap should be assembled by welding (brazing) with the rod projecting 25mm above the cap. When the rod has been driven into the earth mass so that the base of the cap is at the level of the hard-stand, the rod should then be cut off flush with the top of the cap.

72. The ground earthing point should be installed in such a manner that when the base of the cap has been driven to the level of the hard-stand there should be no lateral or vertical movement of the ground earthing point cap.

### TESTING GSE CONNECTION POINTS

#### Introduction

63. The following paragraphs detail the testing procedures for terminal connection points of safety interconnection leads that are fitted to GSE and refuelling equipment. Testing of safety interconnection leads is detailed in Paragraph 46.

#### Responsibilities and Periodicity

64. The testing of safety interconnection lead terminal connection points should be carried out by suitably qualified tradesmen.

#### Test Equipment

65. The test equipment to be used is either:

- a. Ohmmeter, PN T477W, or equivalent for areas where explosive vapours may be present; or
- b. Milliohmrometer, PN BT51, or equivalent for other areas.

#### Procedure

66. Test and inspection procedures for bonding connections are contained in Section 2, Chapter 13. The maximum permissible bonding resistance is 0.1 ohms.
Construction

73. A sample ground earthing point specifications are detailed in Figure 14–9 and Figure 14–10.

Temporary Ground Earthing Points

74. Temporary ground earthing points should be manufactured using one of the following methods:

a. Preferred Method. Made in the same form as a standard ground earthing point, (see Figure 14–9), except the minimum length is 50 cm.

b. Alternate Method. When the standard earth point shown in Figure 14–9 is not available, temporary earth points may be manufactured using a galvanised mild steel rod with a brass top plate as shown in Figure 14–10.

CAUTION
In all cases where temporary points are to be installed, the local authority controlling the airfield is to be contacted to ensure that underground services will not be interfered with.

75. Temporary earth points should be used when operating from remote airfields where suitable standard ground earthing points are not available.

76. Temporary earth points need not be used for in-transit stops at civil or remote airfields where standard ground earthing points are unavailable; however aircraft and refuelling vehicles (or containers) must still be appropriately bonded. (Refer Paragraph 22).

77. Installation, maintenance and testing of temporary ground earthing points should be conducted by appropriately trained personnel.

TESTING GROUND EARTHING POINTS

Introduction

78. Manual of Standards Part 139 – Aerodromes section 11.1.16 Ground Earth Points details the requirements for installation and testing of earthing points. All standard ground earthing points used for the earthing of aircraft and GSE are to be regularly, tested and inspected. The following paragraphs describe the procedures that are to be used for testing, marking and recording of test results.

Maintenance of Standard Ground Earthing Points

79. Maintenance Periodicities. The following periodicities should apply to the maintenance of newly installed and existing standard ground earthing points:

a. Newly Installed Ground Earthing Points - Resistance Measurement:

   (1) Immediately after installation. (or any replacement)

   (2) Six month after installation, or replacement.

   (3) Thereafter as part of Aerodrome Technical Inspection

b. Physical Inspection - Ground earthing points are to be physically inspected as part of the quarterly technical inspection to ensure that:

   (1) The ground earthing point is firmly connected to the earthing rod and seated on the pavement.

   (2) The earthing rod is firmly embedded in the ground.

   (3) The fins used for making the electrical connections are free from dirt, grease, paint or any other substances.

   (4) No ground earthing points have been buried or removed.
Figure 14–9  Standard Ground earthing Point

NOTE: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
Figure 14–10  Temporary Ground earthing Point

NOTE: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
Ground Earthing Check

80. Several methods may be used to measure the resistance of ground earthing points depending on the equipment used. The following method is recommended when using either a ‘Gossen Earth Tester’ Part No GEOHM or Part No GEOHM2:

a. Three Electrode Method. This is the preferred method of measuring the earth resistance of an ground earthing point. Using three collinear electrodes, (ie three ground earthing points A, B and C as shown in Figure 14–11), measure the resistance between each in turn. The resistance of earth point A is calculated from:

\[ RA = \frac{R_{AB} + R_{AC} - R_{BC}}{2} \]

Where:
RA is the resistance of reference point A
RAB is the resistance between points A and B
RAC is the resistance between points A and C
RBC is the resistance between points B and C

Serviceability of Ground Earthing Points

81. A serviceable ground earthing point is one having a resistance to earth mass of 10,000 ohms or less. Any point which has a resistance greater than 10,000 ohms is unserviceable and is to be serviced by authorised personnel.

Marking of Ground earthing Points

82. Serviceable ground earthing points should have a 15cm diameter circular white disc painted around the head.

83. Unserviceable ground earthing points that cannot immediately be repaired or replaced, the head of the ground earthing point must be either removed or marked with a 15cm diameter circle, painted red, to show it cannot be used.

Testing Temporary Ground earthing Points

84. Testing and recording requirements for temporary ground earthing points are as follows:

a. testing procedures are the same as those outlined in paragraph 80 for standard ground earthing points, except that either temporary or standard points may be used in the three electrode method;
<table>
<thead>
<tr>
<th>Earth Point Number</th>
<th>Location</th>
<th>Six Monthly Inspection (Include Date)</th>
<th>Biennial Resistance Reading (Include Date)</th>
<th>Rectification Details or Remarks</th>
</tr>
</thead>
</table>

*Figure 14–12  Suggested Format for Test and Inspection Log*
b. a point is to be classified serviceable if the resistance to earth is less than 10,000 ohms; and
c. points having a resistance in excess of 10,000 ohms are to be relocated and re-tested.

**NOTE**
Unserviceable temporary ground earthing points should not be left embedded in the ground under any circumstances.

**Log Books**

85. A log book should be maintained in which details of earthing point locations, identification numbers, periodical test figures, rectifications and re-tests are recorded. Inclusion of a plan of ground earthing point location should also be provided. Log books should be capable of retaining information for at least six (6) consecutive years. Figure 14–12 is a suggested layout for a log book.

**Helicopter Earthing Poles**

86. Helicopter earthing poles are used to earth helicopters while in the hover, prior to personnel contacting the aircraft during cargo hookup etc. Details of a helicopter earthing pole are shown Figure 14–13. Each earthing pole should be inspected for general cleanliness, corrosion and fraying or damage to leads. Carry out a continuity test between the pole tip and the earthing clip or spike to ensure that the resistance is no greater than 2 ohms. This inspection and test should be carried out monthly and recorded in a log.

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**Figure 14–13 Helicopter Earthing Pole**
MAINS OPERATED GSE

Introduction

87. Protection of personnel against electrical hazards associated with the use of mains powered GSE, ie soldering irons, drills, vacuum cleaners etc, is a significant aspect of aircraft earthing considerations. The mains earthing system will provide protection against hazards developing from internal faults in the equipment. However, when mains powered GSE is used inside aircraft there is a possibility of the aircraft structure becoming electrically live should the power lead become partially severed, or by other mischance the active conductor contacts the aircraft. In this event there is no guarantee that the protective circuit breaker/fuse would operate to disconnect the fault, owing to the possible high resistance to earth mass of the aircraft earth reference point.

Residual Current Devices, 250V, 50Hz

88. To provide protection for personnel in the event of a 250V, 50Hz, mains powered GSE equipment power lead shorting to an aircraft frame, core balanced residual current devices (RCD) are to be used wherever the type of GSE listed in paragraph 102, is operated in or near aircraft. The RCD’s are available in either a 10 amp or 15 amp current rating.

Use of Residual Current Devices

89. RCD’s are to be connected as close as possible, and directly to 240V 50Hz reticulated mains power outlets. This provides maximum protection of personnel in the event of damage to long trailing or extension leads.

Operation of 415V, 50Hz, Three Phase Mains Powered GSE

90. Protection of personnel using 415V, 50Hz, three phase mains powered GSE on aircraft would involve the installation of permanent three phase RCD’s on maintenance facility power distribution boards. On consideration of the size and types of GSE requiring 415V, three phase power, eg, hydraulic test rigs, large vacuum cleaners etc, operation of these items physically in or on an aircraft is extremely unlikely. Therefore there should be no need to introduce 415V, three phase RCD’s to existing installations unless warranted by specific circumstances in a particular area to ensure safety of personnel either using 415V, three phase equipment, or working in the immediate area.

91. Operation of 415V, three phase GSE, physically in or on an aircraft should be avoided. Also trailing leads supplying three phase power are not to be routed across aircraft, servicing stands or other GSE.