Fundamentals
M7
MAINTENANCE PRACTICES

Rev.-ID: 1JAN2014
Author: WiM
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©LTT Release: Mar. 24, 2014

M7.3
Tools

EASA Part-66
CAT B1

Training Manual

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M7 MAINTENANCE PRACTICES

M7.3 TOOLS

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OPERATION, FUNCTION AND USE OF ELECTRICAL GENERAL TEST EQUIPMENT

Electrical Test Equipment

Bonding Connections

Bonding is the electrical interconnection of metallic parts (normally at earth potential) for the safe distribution of electrical charges and currents.

Bonding provides a means of protection against charges as a result of the build-up of precipitation, static and electrostatic induction (as a result of lightning strikes) or dropped out condensation water and so increases the safety of the aircraft and its occupants.

Bonding also reduces the possibility of electric shock from the electrical supply system, reduces interference with the functioning of essential services (radio communications and navigational aids) and provides a low-resistance electrical return path for electric current in earth-return systems.

The aircraft's grounding system is automatically connected to the ground upon landing via one wheel tire (normally nose wheel tire), which is impregnated with an electrically conducting compound.

Testing of Bonding Connections

When a bonding connection is to be made or renewed, it is essential that the conductor has the specified current-carrying capacity.

Braided copper or aluminum cords fitted at each end with connecting tags or lugs ('bonding jumpers') are used for bonding connections between moving parts or parts subjected to vibration.

All bonding connections must be properly locked to prevent intermittent contact which may be caused by vibration. Intermittent contact is worse than no contact at all.

Bonding connections must not interfere (either mechanically or electrically) with any associated or adjacent equipment, nor should they be excessively tight or slack.

Provided that all insulating materials (anodic finish, paint etc) are removed from contact faces before assembly, the following joints are considered self-bonding:

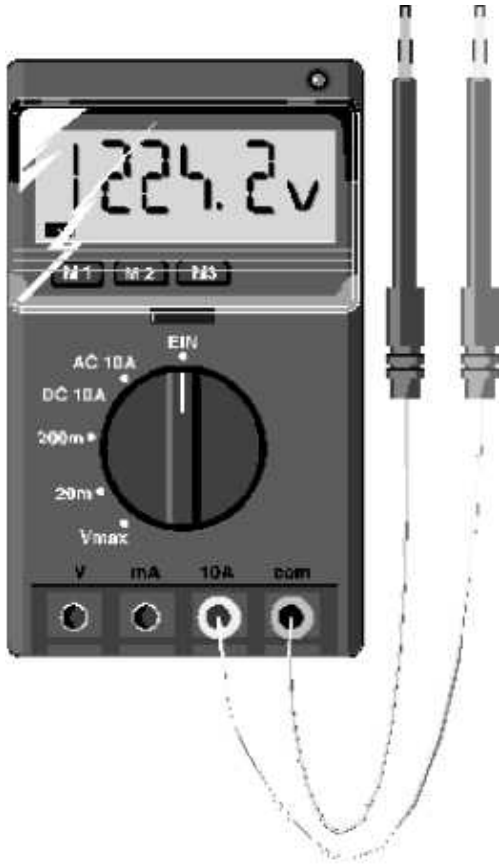
- metal-to-metal joints (threaded devices or rivets)
- most cowling fasteners, locking and latching mechanisms
- metal-to-metal door and panel hinges
- metal-to-metal bearings

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Milliohmmeter



Voltmeter

Figure 1 Electrical Test Instruments

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Resistance Values

The Civil Aviation Authority's requirements with regard to the maximum resistance values for the various conditions of bonding are summarized here.

Bonding Classification	Test Condition	Maximum Resistance
Primary	Between extremities of the fixed portions of aircraft of non-metallic or composite construction.	Estimated and declared by manufacturer.
	Between extremities of the fixed portions of metallic aircraft.	0,05 ohm
	Between bonded components and portions of main earth system to which they are connected.	
Secondary	Between metallic parts normally in contact with flammable fluids and main earth system, and also between the parts themselves.	1 ohm
	Between all isolated conducting parts which may be subject to appreciable electrostatic charging and the main earth system.	0,5 mohm or 0,1 mohm per sq ft surface area (whichever is the less)
	Between equipment supplied fromthe unearthed system, of any voltage, and the main earth system.	1 ohm
	Between equipment containing circuits carrying 50 volts (rms or dc) or more, and the main earth system.	

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Bond Testing (Cont)

Special test equipment, consisting of a meter and two cables each of specific length, is required for checking the resistance of bonding.

A meter commonly used consists of an ohmmeter operating on the current ratio principle and a single 1.2 volt nickel-alkaline cell housed in a wooden carrying case.

The associated cables are 60 feet and 6 feet in length and are fitted with a single-spike probe and a double-spike probe respectively.

ATTENTION: Prior to testing, a check should be made on the state of the cell by observing. This is the case if:

- A full-scale deflection of the meter is obtained when the two spikes of the 6–foot cable probe are shorted
- The meter reads zero when the two spikes of the 6–foot probe are shorted by the single spike of the 60–foot probe.

Method 1

1. The 60–foot cable should be connected to main earth (also known as the bond datum point) at the terminal points usually shown diagrammatically in the relevant Aircraft Maintenance Manual. Since the standard bonding tester lead is 60 feet, the measurement between the extremities of larger types of aircraft may have to be done by selecting one or more main earth points successively, in which case the resistance value between the main earth points should be checked before proceeding to check the remote point.
2. The 6–foot cable should be used to check the resistance between selected points, usually specified in the bonding test schedule or the Aircraft Maintenance Manual. When the two spikes of the test lead probe are brought into contact with the aircraft part, the test-meter will indicate, in ohms, the resistance of the bond.

Method 2

Alternatively, the four-terminal method of resistance measurement may be adopted with the appropriate miliohmeter *(see Fig 1)*.

The test leads may be in the form of duplex spikes *(see Fig 2)* or, when used in association with crocodile-type test leads, single spikes.

ATTENTION: In order to check that the instrument is functioning correctly, the two hand spikes should be placed on a low-resistance conductor with the potential spikes (P1 and P2) closely together *(see Fig 3)*. The result of this test should be a zero reading on the meter.

1. A test current (approx 2 amps) is supplied via the internal batteries and passed through the resistance via cables C1 and C2.
2. The voltage drop across the resistance is measured (P1 and P2) and compared with the current flowing. The resultant value is then displayed (normally digitally) on the meter.

ATTENTION: To ensure good electrical contact at the probe spikes, it may be necessary to penetrate or remove a small area of a non-conducting protective coating. Therefore any damage to the protective coating must be restored after the test.

Excessive Resistance

1. In the case of bonding jumpers, the connecting tag or lugs should be removed and the contacting faces thoroughly cleaned, using a slight abrasive if necessary. All traces of abrasive must be removed.

The connecting area should be sealed and treated with a surface protection as specified in the relevant drawing and specification.

2. If a holding bolt is the bonding connection, the bolt should be removed and the area under the bolt-head (or nut) cleaned and protected as above.
3. If the required bond value cannot be obtained at a structural joint, the advice of the manufacturer must be sought.

Important: Corrosion tends to form at a bonding or earth connection and is often the cause of excessive resistance.

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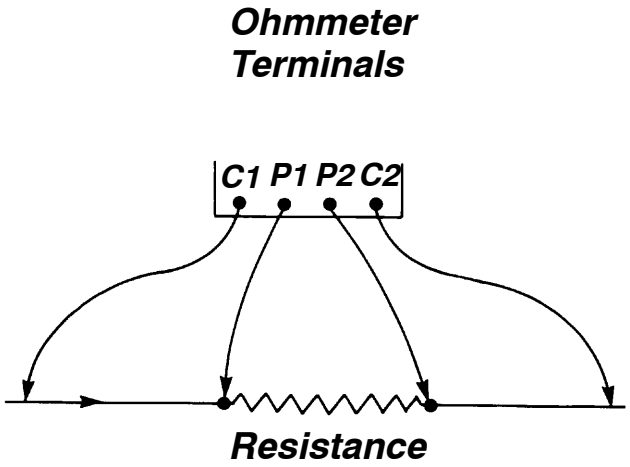
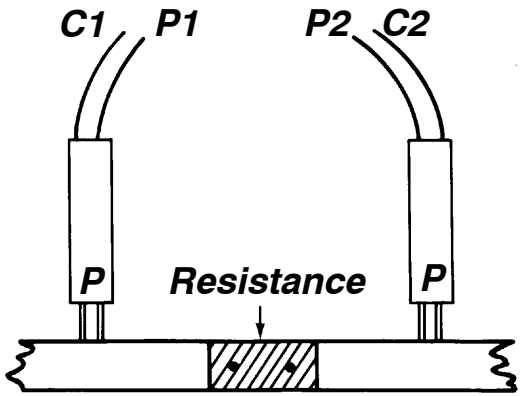


Fig 1: Four Terminal Resistance Measurement



Important: Observe position of potential spikes!

Fig 2: Duplex Hand Spikes

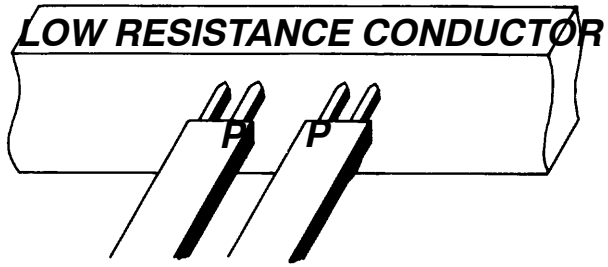


Fig 3: Test Position of Hand Spikes

Figure 2 Bond Testing Methods

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CONTINUITY TESTING

A concealed break in a cable core or at a connection may be found by using a continuity tester, which normally consists of a low-voltage battery (2.5 volts) and a test lamp or low-reading voltmeter.

Before testing, the main electrical supply should be switched off or disconnected. Check that fuses are intact and that there is no intermediate disconnection. Switches and circuit-breakers, as appropriate, should be closed to complete the circuit.

When carrying out a low-voltage continuity check, it is essential to work progressively through the circuit, commencing from the relevant fuse or circuit breaker and terminating at the equipment. Large circuits will probably have several parallel paths and these should be progressed systematically, breaking down as little as possible at plug and socket or terminal block connections.

MILLIVOLT DROP TEST

Excessive resistance in high-current carrying circuits can be caused by loose terminal connections, poorly swaged lead ends etc. Faults of this kind are indicated by low terminal voltage at the connections to the service load and by heating at a conductor joint.

If such faults are suspected, a millivolt drop test is recommended.

Continuously-rated circuits: The test should, whenever possible, be made with the normal operating current flowing, the power being derived from an external source.

Short-rated circuits: A suitable resistance or other dummy load should be used in lieu of the normal load and the current should be scaled down to avoid overheating.

The millivolt-meter should be connected to each side of the suspected joint and a note made of the volt drop indicated. The indicated reading should be compared with the figures quoted in the relevant publication (an approximate guide is 5 mV/10 amps flowing).

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