Civil Aeronautics Administration
Aviation Safety Bulletin

ASB No: 98-053/M **Dec, 2009**

Subject：

Aircraft Wiring Inspection And Maintenance.

Background：

Wiring related problems have been causal factors for several major aircraft accidents (TWA 800, Swissair 111) and have been contributing causal factors to other accidents. Due to this, some manufacturers in conjunction with their oversight authorities are investigating the feasibility of expanding the aging aircraft programs to include electrical wiring, connectors and harnesses. Until this feasibility study is completed, the CAA recommends that all operators provide maintenance training/recurrent training in the inspection techniques outlined below and emphasize the importance of proper wiring inspections and maintenance. Particular attention should be given to exposed wire bundles in vulnerable areas, i.e. landing gear bays, engine compartments and control surface actuators that are subject to debris causing chafing within the wire bundles.

Recommendation：

Training should be detailed enough for maintenance personnel to competently inspect wiring and detect, as a minimum, the following list of failure modes.

1. Aging and Stress Failure: Two forms of aging influence insulation failure: repeated accumulation of damage from excessive intermittent stress and progressive deterioration of the strength property of the insulation.
2. Bending: Most accepted best practice manuals suggest that all attempts should be made to ensure that the bend radius of a wire is at least 10 times greater than its diameter. Tighter bend radii will place additional strain on the wire, which may present itself as cracks in the surface insulation.

3. Chafing: Common chafing can result from: loose supports and restraints; unrestrained cross over bundles; loosely bundled conductors with different insulation surfaces; P clamp with excessive pressure or guard missing; loose cable rubbing over a stanchion, frame, edge of lightening hole, etc.; peculiarities of installation; bundles installed in fore and aft direction dragged during acceleration/deceleration and from elongation/ contraction of airframe due to pressure changes; and cross-hull direction of vibration resonance with wire; cable touching relatively vibrating or stationary stanchions, etc.; and from mixing wiring types.
4. Clamps, Ties and Lacing: Wire can be so tightly compressed that an indentation of the insulation can form at the entrance that leads to failure of the insulation. Similar failures can occur when plastic ties that have too sharp an edge or are excessively tightened. Lacing on bundles can develop a similar mode of insulation failure if too much tension is applied in the lacing process.
5. Delamination: When the bonding material fails to hold together the successive wraps of insulation, this is known as delamination. Wrapping of high performance materials is a means to significantly increase the thermal and mechanical performance of wire insulation.... Failure of the bonding material can lead to reduced abrasion resistance or the ingress of contaminates, such as fluids, which may reach the conductor, leading to electrical shorting or corrosion.
6. Insulation Cracks & Splicing: Much of the wire in an aircraft runs from support point-to-support point with moderate curvature. This type of insulation failure can take several forms, including use of non-environmental splices, that allows water, dirt, and other fluids forming a conducting path into the splice, incorrect crimping, and using incorrect size splice.
7. Open Wire Failure: This is when there is a break of the conductor of the wire and electrical energy is no longer able to be transferred from one end of a wire to the other. Some insulation’s will actually maintain their integrity longer than the conductor from repeated stresses (such as bending).

8. Parallel Arcing: In a parallel arc, the current goes from one wire directly to the structure (ground) or a second wire that is at a different voltage. The current in the arc does not go through the “complete” circuit and therefore is not limited by the load; the arc is in "parallel" with the load. Only the resistance in the arc, the resistance of wire and the internal impedance of the power source limit the current in the arc.
9. Series Arcing: Series arcing starts with a poor connection of the conductors due to a loose terminal or crimp, corrosion, or dirt in a connection. This leads to the connection between the current-carrying wire and terminal being made and broken repeatedly, sometimes many times a second.
10. Whiskering: A phenomenon that draws minute tin spikes from copper alloy wiring through small holes in the insulation that seek other conductors nearby.