BOEING 747

# SERVICE LETTER

Customer Services Division

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**SUBJECT:** INSPECTION OF WIRING ON HIGH TIME AIRPLANES

**MODEL:** 747

**APPLICABILITY:** All 747-SP-100-200-300 Aircraft

**REFERENCE:** D6-54446, Chapter 20, Standard Wiring Practices Manual

**SUMMARY:**

This service letter discusses inspection recommendations for airplane wiring and highlights wiring components and areas that may experience degradation during long term operation of 747 airplanes.

**BACKGROUND:**

Boeing has been requested by operators to provide guidance on areas of wiring that warrant special attention on high time 747 airplanes. On all wiring repair and modifications the reference document is the authoritative guide. Overall, Boeing has found that most airplane wiring exceeds the economic design goal of the airplane. The current high time 747 exceeds 95,000 flight hours and many more exceed 50,000 flight hours. Boeing generally does not recommend special general wiring inspections unless a fault is experienced or an area is disturbed for other reasons.

**DISCUSSION:**

Based on observations during surveys of hightime airplanes, Boeing believes the following are the principal causes of wiring degradation. Photo examples of many items are shown in Attachment 1 to aid personnel when doing wiring inspections:

**Vibration** – Vibration in conjunction with other factors is felt to be a leading cause of wiring degradation.

**Maintenance** – Improper rework can contribute to long term problems and wiring degradation. Repairs made by line maintenance can have limited durability and should be redone at convenient maintenance opportunities. Repairs done per the reference document are considered permanent and should not require rework.

**Indirect Damage** – Events, such as pneumatic duct ruptures, can cause damage that, while not initially evident, can later cause wiring problems.

**Chemical Contamination** – Boeing takes great effort to make wire and associated components impervious to chemical contaminants. However, to maintain required properties of wiring components, they are not impervious to all chemicals. To gain resistance to one class of chemicals, a basic resistance to other classes of chemicals is sometimes reduced. Hydraulic fluid requires special consideration, as it is a common cause of wiring component degradation. Hydraulic fluid is very damaging to connector grommets and wire bundle clamps, this can lead to indirect damage such as arcing and chafing. Wiring that may have been exposed to hydraulic fluid should be given special attention during wiring inspections. Connector cleaning instructions are found in Section 20-60-01 of the reference document. Other common chemicals can potentially cause degradation of electrical components. i.e fuel, corrosion inhibiting compounds (BMS 3-23), waste system chemicals, cleaning agents, and de-icing fluids.

**General Maintenance** – As a general rule, wiring that is undisturbed will have less degradation than wiring that is reworked. As wiring and components become more brittle with age this effect becomes more pronounced.

**Heat** – Wiring that is not designed for high temperatures and is exposed to heat can accelerate degradation. Even low levels of heat can degrade wiring over long periods of time. This type of degradation is sometimes seen on engines, in galleys, and behind lights.

The following are the types of installations that merit special attention during wiring inspections. Examples of the following are also shown in Attachment 1:

**Clamping points** – Wire chafing is aggravated by damaged clamps, clamp cushion migration or improper clamp installations.

**Connectors** – Worn environmental seals, missing seal plugs, missing dummy contacts, or lateral pressure on connector grommets can compromise connector integrity and allow contamination to enter the connector, leading to corrosion or grommet degradation.

**Terminations** – Terminal lugs and splices are susceptible to mechanical damage, corrosion, heat damage and chemical contamination. Also, the build up and nut torque on large-gauge wire studs is critical to their performance.

**Backshells** – Wires may break at backshells due to excessive flexing, static pressure, or missing build-up.

**Sleeving and Conduits** – Damage to sleeving and conduits, if not corrected, will often lead to wire damage.

Following are locations that could be included in a special inspection of high time 747 airplane wiring. The first three are in high vibration areas. Attachment 2 suggests specific areas for inspection and was adapted from an inspection developed by an operator. The inspection was used during refurbishment and Section 41 modification of their airplanes:

**Wings** – The wing leading edge and pylons are the areas that experience a difficult environment for wiring installations. The wing leading edge wiring is exposed

whenever the leading edge flaps are extended. The area that is the most susceptible to damage lies between the inboard and outboard engines. The inboard section of the wing experiences less flexing and there is very limited wiring outboard of the outboard engine.

**Engine and Nacelle Area** – This area experiences high vibration, heat, frequent maintenance, and is susceptible to chemical contamination.

**Landing Gear** – This area is exposed to severe external environmental conditions in addition to vibration and chemical contamination. Because of regular landing gear maintenance and associated routine inspections, this area should not generally require other special inspections for wiring.

**Electrical Panels** – Panel wiring is particularly prone to broken wires and damaged insulation when these high density areas are disturbed during major modifications and refurbishments. One repair facility has found that wire damage was minimized by tying wiring to wooden dowels. This reduced wire disturbance during section 41 modification. This repair facility also removes entire disconnect brackets, when possible, instead of removing individual receptacles.

**Power feeders** – Operators may find it advantageous to inspect splices and terminations for signs of over-heating. If any signs of overheating are seen the splice or termination should be replaced. This applies to galley power feeders in addition to the main and APU generator power feeders

One frequently encountered hindrance to inspections is dirt and grime. The reference document recommends several materials for cleaning electrical connectors. Wire may be cleaned with chemicals like isopropyl alcohol, as listed in the reference document, section 20-60-01. (Note: Many cleaning agents are flammable.) For wire inspections, a soft cloth, such as a cotton glove, can be used to clean individual wires. With any cleaning process, care should be taken not to remove wire markings and I.D. tape. In addition, airplanes are often pressure washed with a general purpose detergent. Moderate pressure and a general purpose detergent are not harmful to wiring, but water under high pressure can penetrate components such as connectors and splices. Moisture penetration into components tends to increase with elevated water temperatures.

In conclusion, Boeing believes that the wiring on high time 747 airplanes is holding up exceptionally well. Wiring damage is hard to predict but some areas of wiring experience degradation more frequently.

**BOEING ACTION:**

This service letter is the result of Boeing observations recorded during surveys of high time 747 airplanes and a survey of selected operators. Boeing will continue to observe the condition of wiring on high time airplanes and welcomes operator input on this subject. Boeing will update this service letter as additional knowledge is gained.

**SUGGESTED OPERATOR ACTION:**

The above information is provided for general guidance. Special inspections should be conducted as deemed appropriate by each operator, based on airplane maintenance experience. Any discrepancies found should be repaired per the reference document.

**INDUSTRY SUPPORT INFORMATION:**

Warranty remedies are not available for the inspection and repair procedures given in this service letter.

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Attachments