

Electrical Wiring Inspections

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AIRCRAFT ELECTRONICS
ASSOCIATION

Where Business Gets Done!

Who we are...

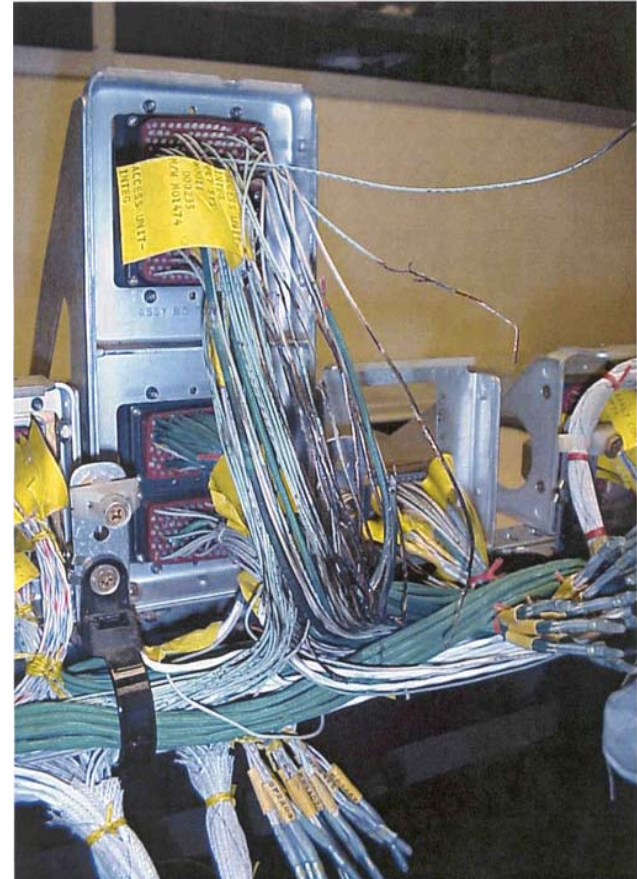
- The Aircraft Electronics Association (AEA) is a trade organization that represents over 1100 aviation businesses worldwide including:
 - Repair stations that specialize in maintenance, repair and installation of avionics and electronic systems in general aviation aircraft.
 - Instrument repair stations
 - Manufacturers of avionics equipment, instruments, aircraft, and test equipment;
 - Major distributors, and;
 - Educational institutions.

Presentation Content

- Historical Perspective
- FAA Initiatives (ATSRAC)
- The “What” of Aircraft Wiring Inspections
- The “How” of Aircraft Wiring Inspections

Catalyst for Change

- TWA – B747 – 1996
- Swissair – MD11 – 1998



Historical Data

- The problem exists across all types of aircraft:
 - TWA – B747 – 1996
 - Virgin – B747 - 1997
 - Swissair – MD11 – 1998
 - United – B767 – 1998
 - Air Canada – B767 – 2002
 - BA – B747 – 2002
 - etc

Historical Data

- A review of occurrences reported to UK CAA between 1997 – 2002 shows 221 events where damage or deterioration of electrical wiring was a causal factor

Historical Data

- This review contained the following occurrences:
 - HS125 – October 2002
 - J41 – January 2002
 - Falcon 900 – November 2001
 - J41 – June 2001
 - Learjet 35 – June 2001
 - J41 – May 2001
 - Cessna Citation – September 1999

Aging Transport Systems Rulemaking Advisory Committee (ATSRAC)

- TWA 800 accident 1996
- White House Commission: “The Aging Airplane Non-Structural Systems Program”
- 1998 Aging Transport Systems Rulemaking Advisory Committee (ATSRAC)

ATSRAC

- Task 1 WG, non-intrusive inspections came up with some 3,215 individual findings across 81 aircraft and 8 aircraft types.
 - Most frequent issues/findings:
 - Excessive lint, dust, debris etc.. (e.g.. fire hazard)
 - Inappropriate wiring repairs
 - Incorrect wire routing
 - Inappropriate clamping and wiring support

ATSRAC Definition of “Aging”

- “Age is not the sole cause of the wire degradation referred to as "aging.”
- The probability that maintenance interventions, contamination, improper repair, or mechanical damage has occurred to a particular wire system will increase over time.
- Therefore, with respect to transport airplane wire systems, "aging" includes not only the breakdown of inherent characteristics of wire as a function of time, but also the various degradation effects of maintenance interventions, contamination, improper repair, or mechanical damage.”

Additional ATSRAC Tasking

- ATSRAC Meeting – 23/24 January 2002 decided to accept a new tasking:
 - WG-10 tasked to review FAR 25 aircraft in FAR 91/135 operations to determine applicability of ATSRAC proposed rulemaking. (Included because of an NTSB recommendation out of the Learjet 35 (Payne Stewart) accident.)

General Observations From the Evaluations

- Aircraft overall in good condition
- Problem Areas
 - Wiring Repair
 - Routing of Modification Wiring
 - Clamping and Structural Contact
 - “Clean as you go” philosophy

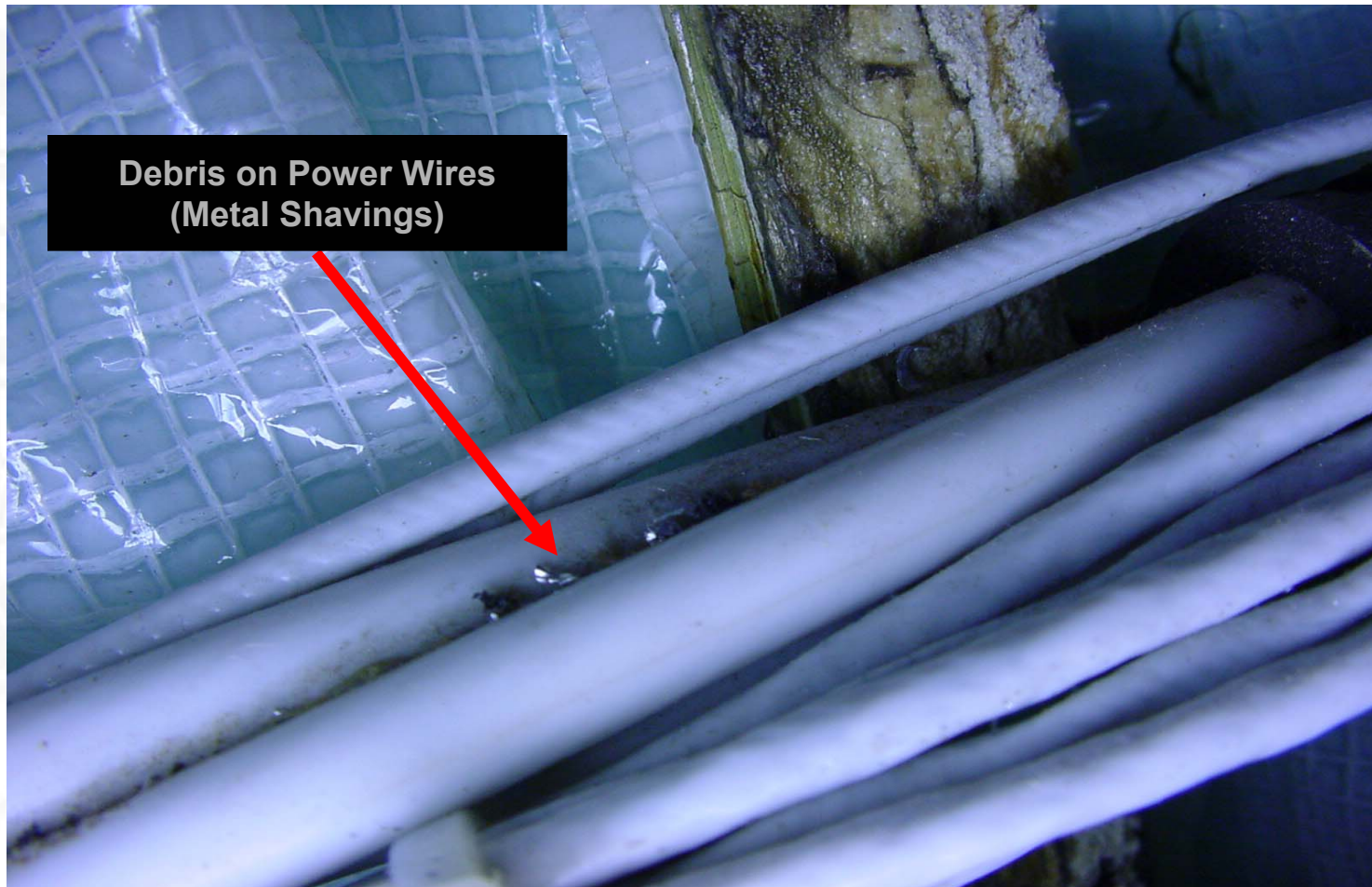
WG-10 Findings

- 39 Aircraft Inspected
- 8 Aircraft Models
- Findings?

WG-10 Findings

- 39 Aircraft Inspected
- 8 Aircraft Models
- 2256 findings (discrepancies)

Wiring Discrepancies



Debris on Power Wires
(Metal Shavings)

INSPECTION REQUIREMENTS

- What...
 - OEM Instructions for Continued Airworthiness (ICA)
 - OEM Maintenance Manual
- How...
 - IF not provided by OEM....
 - AC 43.13-1B ACCEPTABLE METHODS, TECHNIQUES, AND PRACTICES — AIRCRAFT INSPECTION AND REPAIR

AC 43.13-1B ACCEPTABLE METHODS, TECHNIQUES, AND PRACTICES — AIRCRAFT INSPECTION AND REPAIR

PURPOSE. This advisory circular (AC) contains methods, techniques, and practices acceptable to the Administrator for the inspection and repair of *nonpressurized areas* of civil aircraft, only when there are no manufacturer repair or maintenance instructions. This data generally pertains to minor repairs. The repairs identified in this AC may also be used as a basis for FAA approval for major repairs. The repair data may also be used as approved data, and the AC chapter, page, and paragraph listed in block 8 of FAA form 337 when:

- a. the user has determined that it is appropriate to the product being repaired;
- b. it is directly applicable to the repair being made; and
- c. it is not contrary to manufacturer's data.

CHAPTER 11. AIRCRAFT ELECTRICAL SYSTEMS

- SECTION 1. INSPECTION AND CARE OF ELECTRICAL SYSTEMS
- 11-1. GENERAL. The term “electrical system” as used in this AC means those parts of the aircraft that generate, distribute, and use electrical energy, including their support and attachments. The satisfactory performance of an aircraft is dependent upon the continued reliability of the electrical system.

CHAPTER 11. AIRCRAFT ELECTRICAL SYSTEMS

- SECTION 1. INSPECTION AND CARE OF ELECTRICAL SYSTEMS
- 11-1. GENERAL. ...
- *Damaged wiring or equipment in an aircraft, regardless of how minor it may appear to be, cannot be tolerated.*

CHAPTER 11. AIRCRAFT ELECTRICAL SYSTEMS

- SECTION 1. INSPECTION AND CARE OF ELECTRICAL SYSTEMS
- 11-1. GENERAL. ...
- Reliability of the system is proportional to the amount of maintenance received and the knowledge of those who perform such maintenance.
- It is, therefore, important that maintenance be accomplished using the best techniques and practices to minimize the possibility of failure.
- This chapter is not intended to supersede or replace any government specification or specific manufacturer's instruction regarding electrical system inspection and repair.

CHAPTER 11. AIRCRAFT ELECTRICAL SYSTEMS

- SECTION 1. INSPECTION AND CARE OF ELECTRICAL SYSTEMS
- 11-2. INSPECTION AND OPERATION CHECKS.
- Inspect equipment, electrical assemblies, and wiring installations for damage, general condition, and proper functioning ...
- Adjust, repair, overhaul, and test electrical equipment and systems in accordance with the aircraft and/or component manufacturer's maintenance instructions.
- Replace components of the electrical system that are damaged or defective with identical parts, with aircraft manufacturer's approved equipment, or its equivalent to the original in operating characteristics, mechanical strength, and environmental specifications.

CHAPTER 11. AIRCRAFT ELECTRICAL SYSTEMS

- A list of suggested problems to look for and checks to be performed are:
 - Damaged, discolored, or overheated equipment, connections, wiring, and installations.
 - Excessive heat or discoloration at high current carrying connections.
 - Misalignment of electrically driven equipment.

CHAPTER 11. AIRCRAFT ELECTRICAL SYSTEMS

- A list of suggested problems to look for and checks to be performed are:
 - Poor electrical bonding (broken, disconnected or corroded bonding strap) and grounding, including evidence of corrosion.
 - Dirty equipment and connections.
 - Improper, broken, inadequately supported wiring and conduit, loose connections of terminals, and loose ferrules.

CHAPTER 11. AIRCRAFT ELECTRICAL SYSTEMS

- A list of suggested problems to look for and checks to be performed are:
 - Poor mechanical or cold solder joints.
 - Condition of circuit breaker and fuses.
 - Insufficient clearance between exposed current carrying parts and ground or poor insulation of exposed terminals.
 - Broken or missing safety wire, broken bundle lacing, cotter pins, etc.

CHAPTER 11. AIRCRAFT ELECTRICAL SYSTEMS

- A list of suggested problems to look for and checks to be performed are:
 - Operational check of electrically operated equipment such as motors, inverters, generators, batteries, lights, protective devices, etc.
 - Ensure that ventilation and cooling air passages are clear and unobstructed.
 - Voltage check of electrical system with portable precision voltmeter.
 - Condition of electric lamps.
 - Missing safety shields on exposed high-voltage terminals (i.e., 115/200V ac).

WIRING INSTALLATION INSPECTION REQUIREMENTS

- AC 43.13-1B ACCEPTABLE METHODS, TECHNIQUES, AND PRACTICES — AIRCRAFT INSPECTION AND REPAIR
- CHAPTER 11. AIRCRAFT ELECTRICAL SYSTEMS
- 11-96. GENERAL. Wires and cables should be inspected for adequacy of support, protection, and general condition throughout.

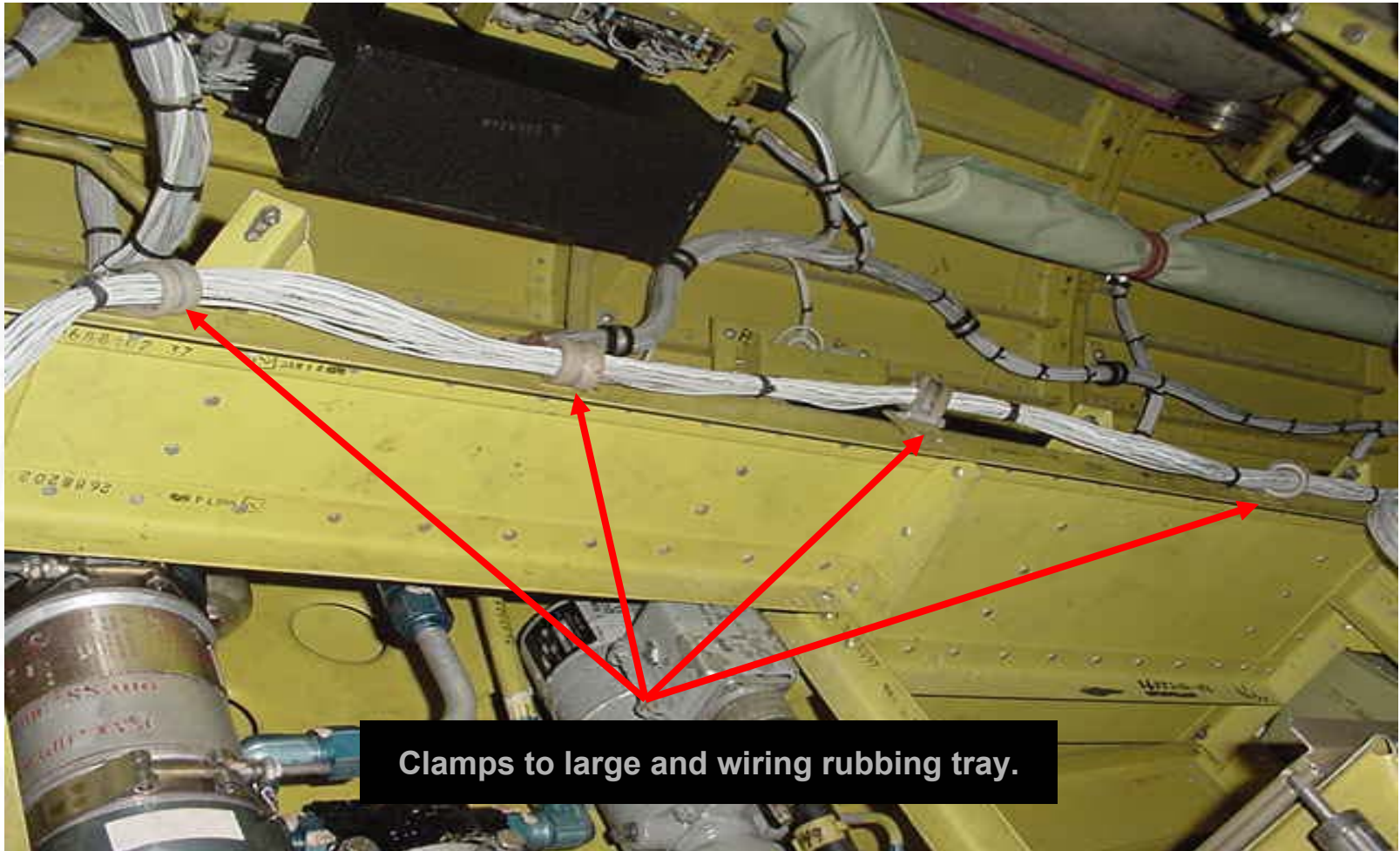
WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96.... aircraft wiring must be visually inspected for the following requirements:
 - Phenolic blocks, plastic liners, or rubber grommets are installed in holes, bulkheads, floors, or structural members where it is impossible to install off-angle clamps to maintain wiring separation.
 - Clamp retaining screws are properly secured so that the movement of wires and cables is restricted to the span between the points of support and not on soldered or mechanical connections at terminal posts or connectors.

WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96.... aircraft wiring must be visually inspected for the following requirements:
 - Wires and cables are supported by suitable clamps, grommets, or other devices at intervals of not more than 24 inches, except when contained in troughs, ducts, or conduits. .
 - Metal stand-offs must be used to maintain clearance between wires and structure.

Wiring Discrepancies



Clamps to large and wiring rubbing tray.

WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96.... aircraft wiring must be visually inspected for the following requirements:
 - Insulating tubing is secured by tying, tie straps or with clamps.
 - Do not use tapes (such as friction or plastic tape) which will dry out in service, produce chemical reactions with wire or cable insulation, or absorb moisture.
 - Ensure that wires and cables are routed in such a manner that chafing will not occur against the airframe or other components.

WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96.... aircraft wiring must be visually inspected for the following requirements:
 - Wire and cables are properly supported and bound so that there is no interference with other wires, cables, and equipment.
 - Wires and cables are adequately supported to prevent excessive movement in areas of high vibration.

Wiring Discrepancies

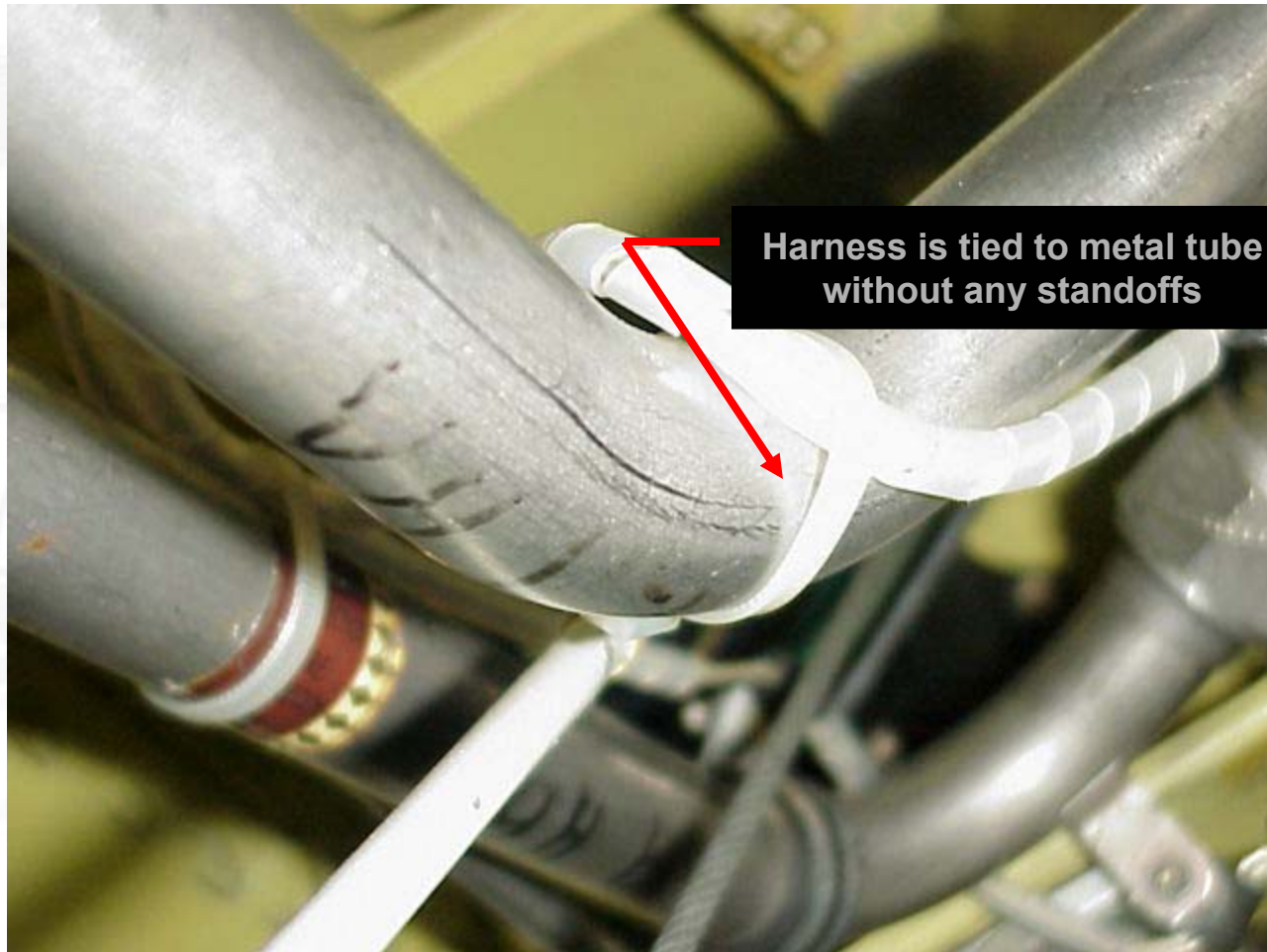


Connector not secure and laying on nose box.

WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96....aircraft wiring must be visually inspected for the following requirements:
 - Insulating tubing must be kept at a minimum and must be used to protect wire and cable from abrasion, chafing, exposure to fluid, and other conditions which could affect the cable insulation.
 - Do not use moisture-absorbent material as “fill” for clamps or adapters.
 - Ensure cable supports do not restrict the wires or cables in such a manner as to interfere with operation of equipment shock mounts.
 - Do not use tape, tie straps, or cord for primary support.
 - Make sure that drain holes are present in drip loops or in the lowest portion of tubing placed over the wiring.

Wiring Discrepancies



AIRCRAFT ELECTRONICS

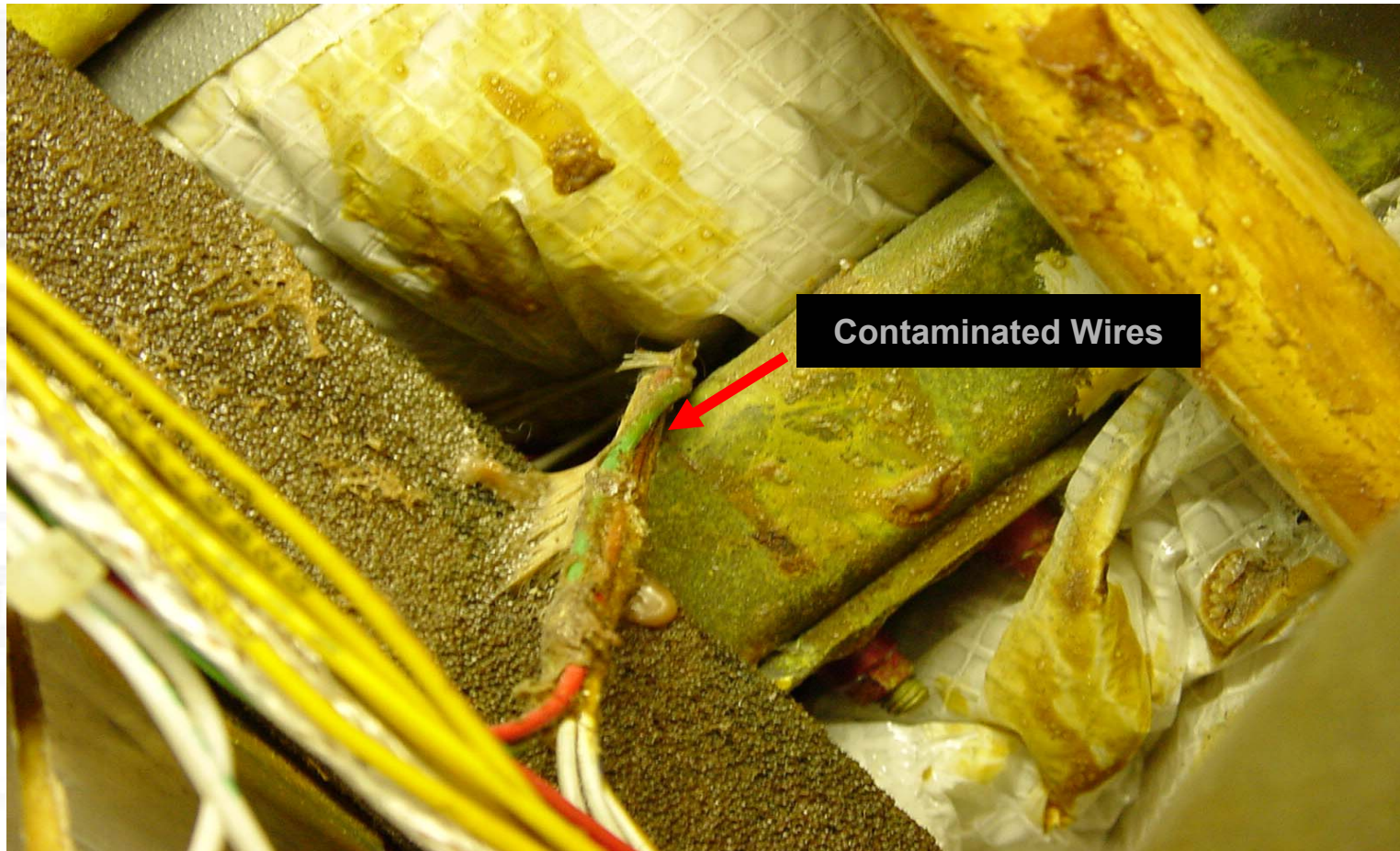
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WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96....aircraft wiring must be visually inspected for the following requirements:
 - Ensure that wires and cables are positioned in such a manner that they are not likely to be used as handholds or as support for personal belongings and equipment.
 - Ensure that wires and cables are routed, insofar as practicable, so that they are not exposed to damage by personnel moving within the aircraft.
 - Ensure that wires and cables are located so as not to be susceptible to damage by the storage or shifting of cargo.
 - Ensure that wires and cables are routed so that there is not a possibility of damage from battery electrolytes or other corrosive fluids.

Wiring Discrepancies



WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96.... aircraft wiring must be visually inspected for the following requirements:
 - Ensure that wires and cables are adequately protected in wheel wells and other areas where they may be exposed to damage from impact of rocks, ice, mud, etc.
 - Where practical, route electrical wires and cables above fluid lines and provide a 6 inch separation from any flammable liquid, fuel, or oxygen line, fuel tank wall, or other low voltage wiring that enters a fuel tank and requires electrical isolation to prevent an ignition hazard.
 - Wires and cables installed in bilges and other locations where fluids may be trapped are routed as far from the lowest point as possible or otherwise provided with a moisture-proof covering.

Wiring Discrepancies



Wire harness tied to fuel line

Wiring Discrepancies



Wire Bundle Tywrapped to Oxygen Line

WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96.... aircraft wiring must be visually inspected for the following requirements:
 - The minimum radius of bends in wire groups or bundles must not be less than 10 times the outside diameter of the largest wire or cable.
 - Ensure that RF cables, e.g., coaxial and triaxial, are bent at a radius of no less than 6 times the outside diameter of the cable.
 - Ensure that wires and cables, that are attached to assemblies where relative movement occurs (such as at hinges and rotating pieces; particularly doors, control sticks, control wheels, columns, and flight control surfaces), are installed or protected in such a manner as to prevent deterioration of the wires and cables caused by the relative movement of the assembled parts.

WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96.... aircraft wiring must be visually inspected for the following requirements:
 - Separate wires from high-temperature equipment, such as resistors, exhaust stacks, heating ducts, etc., to prevent insulation breakdown.
 - Insulate wires that must run through hot areas with a high-temperature insulation material such as fiberglass or PTFE.

Wiring Discrepancies



Wires riding hot air pipe

WIRING INSTALLATION INSPECTION REQUIREMENTS

- 11-96.... aircraft wiring must be visually inspected for the following requirements:
 - Ensure that wires and electrical cables are separated from mechanical control cables. In no instance should wire be able to come closer than 1/2 inch to such controls when light hand pressure is applied to wires or controls.
 - Ensure that unused wires are individually dead-ended, tied into a bundle, and secured to a permanent structure.

Useful Aging Systems References

- <http://www.mitrecaasd.org/atrac/index.html>
- <http://www.faa.gov/avr/arm/index.html>
- <http://www.academy.jccbi.gov/airdl/wiringcourse/>

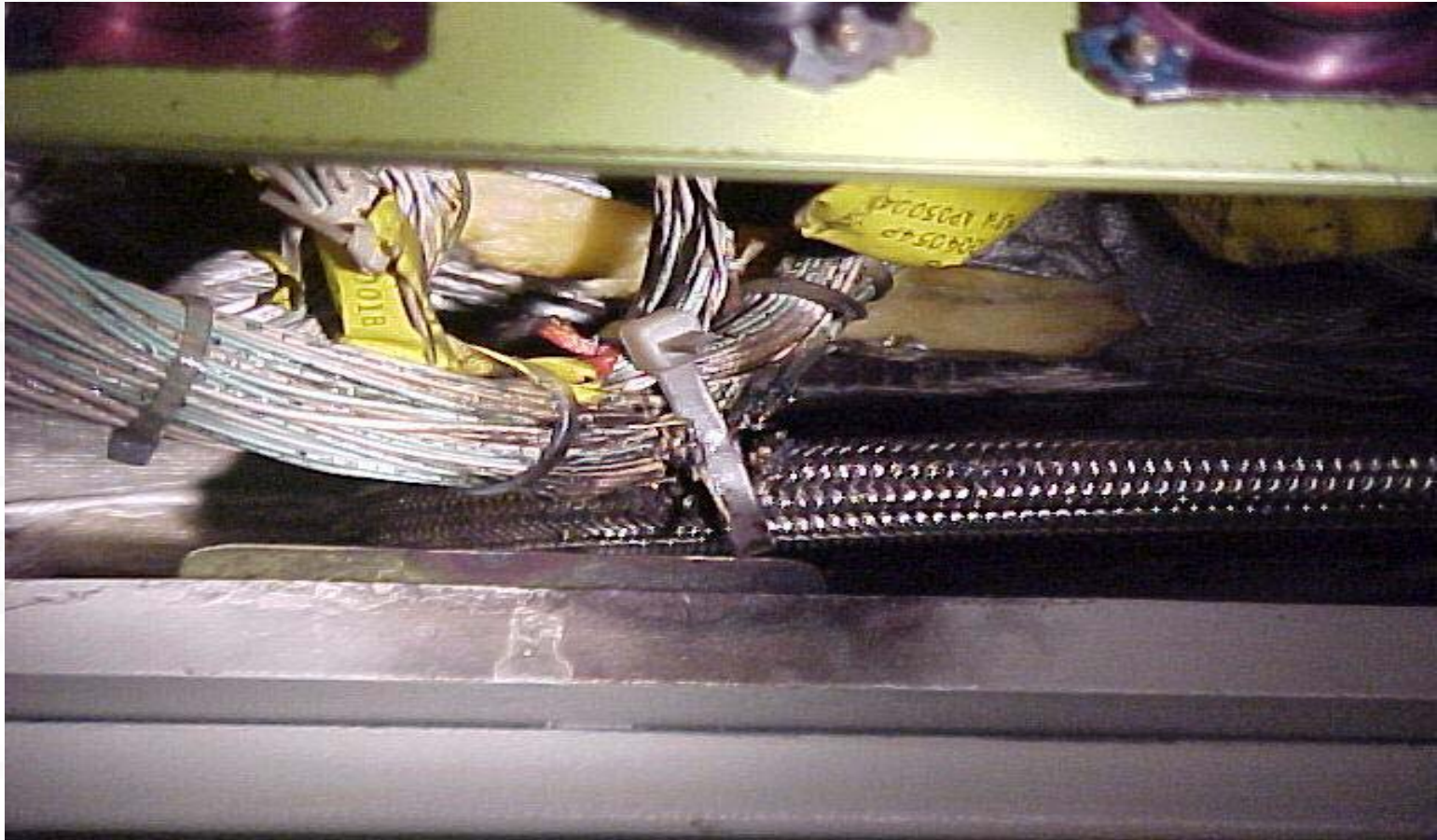


Thank You for Attending!

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Questions?



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