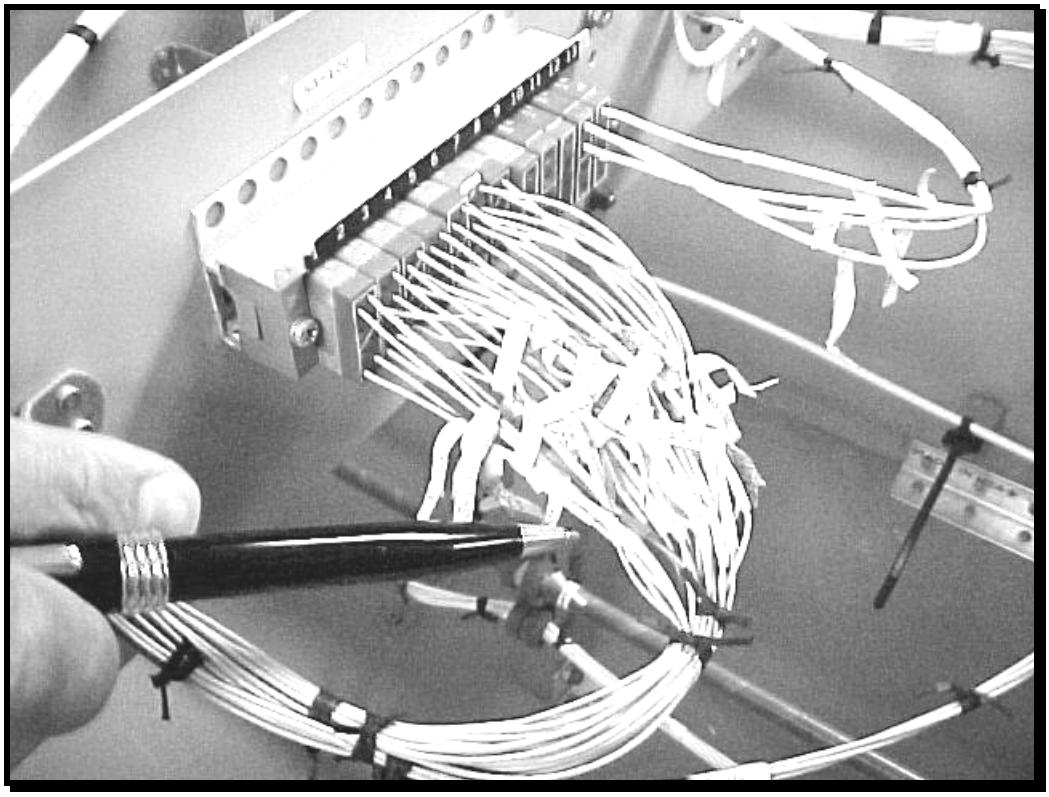
Participant Guide

Aircraft Wiring Practices

An Interactive Training and Self-Study Course (25827)



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Aircraft Wiring Practices

Introductory Materials

Course Orientation

About This Course

Aircraft Wiring Practices is designed to update participants about a wide variety of wiring issues. Through the two-day (four hours per day) Interactive Training format, ***Brett Portwood****, FAA Technical Specialist, Safety and Integration*, and ***Massoud Sadeghi****, Aging Systems Program Manager,* will provide you with the basic concepts of ***Aircraft Wiring Practices***, a course that provides an overview of the aging wiring history, an update on current FAA guidance, detailed information on AC 43.13-1b, AC 25-16, wire separation, and Instructions for Continued Airworthiness, and a review of what to look for on wiring diagrams and wiring installation drawings.

Who Is the Target Audience?

This course is designed for new and experienced Systems and Propulsion Transport Aircraft engineers who require enough knowledge of wiring to be able to review data submitted by manufacturers.

Who Are the Instructors?

Brett Portwood is the FAA Technical Specialist for Safety and Integration. Brett has 11 years experience with the FAA in certification of transport avionics systems, including fly-by-wire flight guidance systems, flight management systems, and electronic displays. As a Technical Specialist, he provides expertise in safety assessment methods and associated integration issues.

Brett Portwood

Brett is active in the FAA's Aging System Program, ATSRAC, and wiring installation and maintenance practices. He assisted with the investigation (aircraft wiring) of the MD-11 Swissair 111 accident. He worked with Boeing to develop wiring practices workshops for FAA certification engineers and inspectors. Brett also was the FAA representative on the SAE S-18 System

Safety Assessment commitee that authored ARP 4761, *Guidelines and Methods of Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment.*

Prior to joining the FAA, Brett spent 12 years performing fault/failure analyses for industry and the Navy nuclear program.

Mr. Portwood has a BS degree in Physics from San Diego State University and has published professional papers on system safety assessment methods.

Massoud Sadeghi

Massoud Sadeghi is the FAA Transport Aging Systems Program Manager responsible for implementing improvements in the requirements of design, installation, mainenance, repair, and certification processes for airplane wiring. Massoud's previous FAA responsibilities include: SAE, ARAC, certification, validations, and policy and rulemaking in the areas of electrical systems, HIRF, and lightning.

Prior to the FAA, Massoud's industry experience included Boeing Military Airplanes (Wichita), re-engine, upgrading electrical systems, and rewiring military airplanes (KC-135s); McDonnell Douglas, designing new electrical systems for the new MD-90; and Boeing (Seattle), designing new electrical systems for the new 777s. Before college, Massoud did electrical wiring of commercial and residential buildings.

Mr. Sadeghi has taught college technical classes and company classes on Modern Aircraft Electrical Systems. He has both a BS and MS in Electrical Engineering from the University of Missouri-Columbia.

What Will You Learn?

After completing this course you will be able to —

- Apply the concepts/aspects of aging wiring.
- Identify wiring factors used when approving wiring diagrams.
- Identify the main purpose of reviewing wiring installation drawings and the wiring factors used when approving these installation drawings.
- Describe the requirements for Instructions for Continued Airworthiness as they relate to wiring.

The purpose of this course is to deliver a detailed presentation of all aspects of aging wiring. It covers applicable 14 CFRs, policy, and industry practices in the area of wiring. It will introduce primary factors associated with wire degradation. The course will also include TC/STC data package requirements, wire selection/protection, routing, clamping, splicing, and termination practices, along with various examples, pictures, mockups, videos, etc. The course includes wiring maintenance concepts (e.g., cleans as you go), including how to perform a wiring general visual inspection.

How Will This Course Help You On-the-Job?

Given appropriate wiring materials to review for certification, after completing this course you should be able to —

- Describe the major factors of wiring degradation and list the characteristics of aging wiring.
- Identify and use the current FAA wiring regulations and guidance.
- Determine if the circuit breakers, conductors, and connectors are sized appropriately.

- Determine if the type of wiring protection is appropriate for a given environment.
- Determine if the number and type of clamps, the feed throughs/pass throughs, and conduits selected are appropriate.
- Evaluate the routing of the wire to ensure it has been done in an optimum manner to prevent damage.
- Identify what wiring information has to be in the Instructions for Continued Airworthiness.

Self-Assessment

Self-Assessment Questions

The instructor will ask you at the begining of the presentation to respond to the following questions about aircraft wiring practices.

During the live broadcast, use the keypad to answer these questions.

1. What are the critical factors in addition to vibration that impact wiring degradation?
   a. Moisture, heat, improper installation.
   b. Improper installation, heat, length.
   c. Moisture, age, resistance.
   d. Heat, age, length.

2. What is the minimum bend radius for unsupported wire?
   a. 3 times the largest diameter of the wire or cable in a bundle.
   b. 3 times the smallest diameter of the wire or cable in a bundle.
   c. 10 times the largest diameter of the wire or cable in a bundle.
   d. 10 times the smallest diameter of the wire or cable in a bundle.

3. AC 25-16 is about
   a. electrical load analysis.
   b. electrical fault and fire detection.
   c. wire routing.
   d. wire maintenance and repair.

4. What is the primary function of the circuit breaker in an aircraft?

   a. To remove power from aircraft systems.

   b. To protect aircraft equipment.

   c. To protect aircraft wiring.

   d. To protect electrical power sources.

5. What is a key factor used in selecting wire?

   a. Marking method.

   b. Breaker size.

   c. Elasticity.

   d. Voltage drop.

6. Wire current-carrying capacity decreases with altitude.

   a. True.

   b. False.

7. What is the primary purpose of conduits?

   a. Facilitation of fluid drainage from wire bundles.

   b. Ease of wire routing.

   c. Protection of wire bundles against atmospheric pressure.

   d. Mechanical protection of wires and cables.

8. During the build up of terminal studs, a cadmium-plated washer is

   a. required for high vibration areas.

   b. required for high temperature areas.

   c. required when stacking dissimilar materials.

   d. not required.

9. To ensure proper integrity and health of an aircraft wiring system, the Instructions for Continued Airworthiness must be submitted for
   a. aircraft with extended range operation within 60 days after certification.
   b. aircraft with extended range operation prior to certification.
   c. all aircraft within 60 days after certification.
   d. all aircraft prior to certification.

10. In addition to reviewing the wire installation drawings, an FAA engineer or designee should perform a first-of-a-model general wiring compliance inspection.
   a. True.
   b. False.

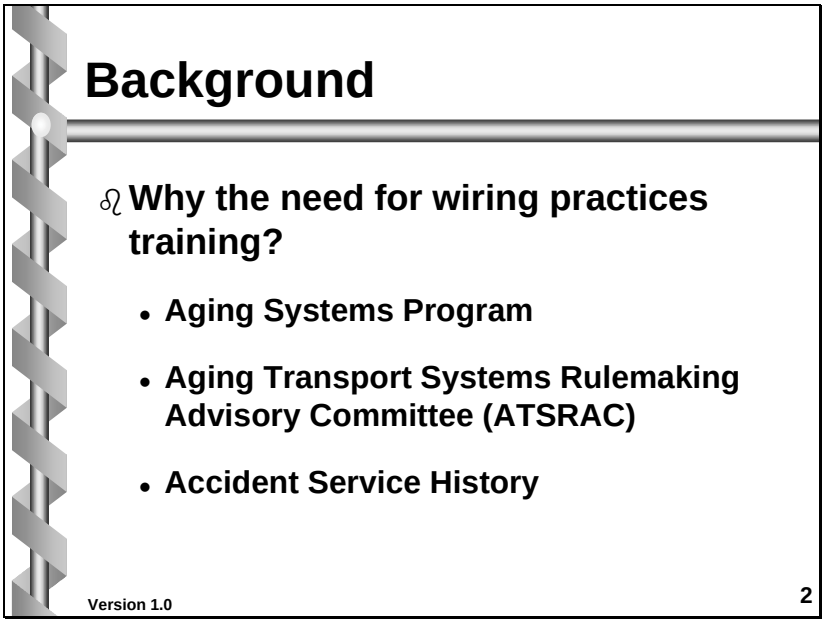
11. When reviewing the wire installation drawing, ensure that
   a. connector pin numbers are specified for all terminations.
   b. wire routing is specified end to end.
   c. standard practices are referenced for all wire routing.
   d. at least the safety-critical wire routing is clearly specified.

12. Check all items that should be submitted (as a minimum) as part of the wiring installation data package.
   a. Wiring separation diagram.
   b. Wire installation drawing.
   c. Wiring diagram.
   d. Wiring repair manual.
   e. Instructions for Continued Airworthiness.

Aircraft Wiring Practices

Course Materials

I. Background



A. Introduction

1. Historically, wiring was installed without much thought given to the aging aspects:

   a) Fit and forget.

b) Unanticipated failure modes and their severity.

(1) Arc tracking.

(2) Arcing.

(3) Insulation flashover.

2. Maintenance programs often did not address these aging aspects. Service history also indicates that Foreign Object Damage (FOD) such as drill shavings, caustic liquids, etc. does cause wiring degradation that can lead to wiring faults.

B. Aging Systems Program

1. Addresses a recommendation from the White House Commission on Aviation Safety to add non-structural systems to the aging aircraft program.

a) FAA using a data-driven approach to address safety concerns.

b) Data collected from research and development, various inspections, service history review and surveys of industry.

c) Analysis of the data will result in revisions to maintenance programs, training programs and improved design solutions