

APPENDIX B

AIRCRAFT WIRING SYSTEMS CURRICULUM AND LESSON PLANS

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AGING TRANSPORT SYSTEMS RULEMAKING ADVISORY COMMITTEE (ATSRAC)

CURRICULUM AND LESSON PLANS

WIRING SYSTEMS CURRICULUM

Overview

This training is targeted to the person who performs airplane maintenance, inspections, alterations or repairs on structure and/or wiring systems. After training the person is able to properly evaluate the wiring system and effectively use the manufacturers Chapter 20 Wiring System overhaul manual for that airplane. This must include; wiring system condition, applicable repair schemes, wiring modifications and ancillary repairs to wiring systems and components. All of the training components are integrated to maintain wiring system quality and airworthiness in the airplane.

Objectives

Depending on the modules taught, the person demonstrates competency in the following skills:

- A. Demonstrate the safe handling of airplane electrical systems, Line Replaceable Units (LRU's), tooling, troubleshooting procedures, and electrical measurement.
- B. Know the construction and navigation of the applicable airplane wiring system overhaul or wiring practices manual
- C. Know the different types of inspections, human factors in inspections, zonal areas and typical damages.
- D. Know the contamination sources, materials, cleaning and protection procedures.
- E. Demonstrate the correct identification of different wire types, their inspection criteria, and damage tolerance, repair and preventative maintenance procedures.
- F. Know the procedures to identify, inspect and find the correct repair for typical types of connective devices found on the person's airplane.
- G. Demonstrate the procedures for replacement of all parts of typical types of connective devices found on the person's airplane.

Scope

The course is to be used by training providers for all maintenance persons at any stage in their careers. The person can be trained to the appropriate level using the applicable modules, depending the persons experience, work assignment and operators policy. The time stated for each module is a minimum.

MODULE A – INTRODUCTION: 4 hours

- 1. Safety practices
- 2. Electrostatic Discharge Sensitive (ESDS) Device handling and protection
- 3. Tools, special tools and equipment
- 4. Verify calibration/certification of instruments, tools, and equipment
- 5. Required wiring checks using the Troubleshooting Procedures and Charts (incl. No Fault Found Data)
- 6. Measurement and troubleshooting using meters.
- 7. LRU replacement general practices

MODULE B – WIRING PRACTICES DOCUMENTATION: 5 hours

1. Chapter 20 structure/overview
2. Chapter 20 cross-reference Index
3. Chapter 20 important Data and Tables
4. Wiring Diagram Manual
5. Other Documentation as applicable

MODULE C – INSPECTION: 3 hours

1. General Visual Inspection (GVI), Detailed Inspection (DI) and Special Detailed Inspection (SDI), Zonal Inspection, Enhanced Zonal Analysis Procedure (EZAP)
2. Human factors in inspection
3. Zonal areas of inspection
4. Wiring system damage

MODULE D – HOUSEKEEPING: 3 hours

1. Airplane external contamination sources
2. Airplane internal contamination sources
3. Other contamination sources
4. Contamination protection planning
5. Protection during airplane maintenance and repair
6. Cleaning processes

MODULE E – WIRE: 6 hours

1. Identification, type and construction
2. Insulation damage limits
3. Inspection criteria and standards of wire and wire bundles
4. Wire bundle installation practices
5. Typical damage and areas found (airplane specific)
6. Maintenance and repair procedures
7. Sleeving
8. Unused wires-termination and storage
9. Electrical bonding and grounds

MODULE F – CONNECTIVE DEVICES: 3 hours

1. General types and identification
2. Cautions and protections
3. Visual inspection procedures
4. Typical damage found
5. Repair procedures

MODULE G – CONNECTIVE DEVICE REPAIR: 6 hours

1. Circular Connectors
2. Rectangular Connectors
3. Terminal Blocks-Modular

4. Terminal Blocks- Non-modular
5. Grounding Modules
6. Pressure Seals

WIRING SYSTEMS LESSON PLAN MODULE A: INTRODUCTION

Overview

Through Module A, the instructor lays the groundwork of safe effective maintenance and repair of the airplane wiring systems and LRU removal and replacement, including BITE, without damage to the airplane or injury to the student.

The Instructor may vary the depth and scope of the topics to be covered, depending on the type of airplane to be maintained and skills of the persons.

Objectives

After this module is complete the student is able to demonstrate the following skills:

1. Know the safety procedures of normal and non-normal maintenance procedures so the person can protect him/herself and the airplane.
2. Recognize ESDS equipment and demonstrate standard anti-static procedures so that no damage occurs to that equipment.
3. Demonstrate the correct use of hand tools including specialized and automated tools and equipment.
4. Verify the calibration of electrical measuring instruments, tools and equipment so that correct maintenance procedures may be carried out.
5. Demonstrate the process and procedures to successfully use the Troubleshooting Procedures and charts of current airplane faults and know re-occurring problems causing "No Fault Found" on removed LRU's.
6. Demonstrate the correct use of electrical meters for measuring voltage, current, resistance, continuity, insulation and short to ground.
7. Know the removal and replacement techniques so that no damage will occur to the LRU or airplane connector.

Strategies

Normal classroom lecture is used for the majority of the training. The following strategies can be used to expedite learning and are recommended to the instructor.

Electrostatic Discharge Sensitive (ESDS) Device handling and protection.....Video/Training Aids
 Calibration/certification of instruments, tools, and equipment.....Company Policy
 Wiring checks using the Troubleshooting Procedures and Charts.....Airplane manuals
 Measurement and troubleshooting using meters.....Meters and circuits
 LRU removal and replacement.....Airplane manuals

MODULE A - INTRODUCTION:

1. Safety practices
 - a. Current is lethal - First aid
 - b. Applying power to the airplane

- c. Isolating the circuit
 - d. Airplane warnings
 - e. Human Factors

- 2. Electrostatic Discharge Sensitive (ESDS) Device handling and protection
 - a. Sources of electrostatic discharge
 - b. Soft and hard failures
 - c. ESDS safety procedures
 - d. ESDS packing procedures

- 3. Tools, special tools and equipment
 - a. General hand tools
 - b. Specialized tools
 - c. Automated tools and equipment

- 4. Verify calibration/certification of instruments, tools and equipment
 - a. Tools requiring certification
 - b. Determining certification requirements
 - c. Typical problems

- 5. Required wiring checks using the Troubleshooting Procedures and Charts and “No Fault Found”.
 - a. Troubleshooting procedures manual (all chapters)
 - b. Aircraft Maintenance Manual/ Illustrated Parts Catalog
 - c. Wiring schematics / Troubleshooting graphics
 - d. Wiring diagrams
 - e. The process of troubleshooting
 - f. Testing of LRU connectors
 - g. Troubleshooting exercises
 - h. Company “No Fault Found” policy and data

- 6. Measurement and troubleshooting using meters
 - a. Voltage, current and resistance
 - b. Continuity
 - c. Insulation
 - d. Short to ground
 - e. Loop impedance.

- 7. LRU removal and replacement techniques
 - a. Different retention devices
 - b. Certification considerations (e.g. CAT 2/CAT3 Landing)
 - c. LRU re-racking procedures
 - d. Built in test equipment (BITE)

WIRING SYSTEMS LESSON PLAN MODULE B: WIRING PRACTICES DOCUMENTATION

Overview

Through Module B, the instructor lays the groundwork for safe effective maintenance and repair of airplane wiring systems. The intent of this module is to teach the person how to locate desired information in the Chapter 20 Wiring Systems overhaul manual, Wiring Diagram Manual and other applicable documentation. The Instructor may vary the depth and scope of the topics to be covered, depending on the type of airplane to be maintained and skills of the persons.

Objectives

After this module is complete the person is able to demonstrate the following skills:

1. Know the applicable Sub-Chapters and Section to follow during normal and non-normal electrical maintenance procedures.
2. Demonstrate the use of the Cross-Reference Index, Chapter Table of Contents, and Subject Tables of Contents so as to find specific material within each sub-chapter and section.
3. Demonstrate the use of the associated tables for replacement of wire, connective devices and contacts, and associated components, including approved replacements.
4. Demonstrate the use of the Wiring Diagram Manual.
5. Demonstrate the use of other Documentation (as applicable).

Strategies

Normal classroom lecture is used for the majority of the training. The Chapter 20 Wiring Practices Manual, Wiring Diagram Manual, and other applicable documentation will be made available to the class so that hands-on exploration of the material can be achieved.

MODULE B - WIRING PRACTICES DOCUMENTATION:

1. Chapter 20 structure/overview
 - a. Table of contents
 - b. Sub-Chapter titles
 - c. Section Structure
 - d. General procedures.
2. Chapter 20 Cross-Reference Index
 - a. Cross-reference index – Alphanumeric
 - b. Cross-reference index – Standard Part number
 - c. Cross-reference index – Suppliers
 - d. Equivalence tables – Std Part Numbers EN-ASN-NSA
3. Chapter 20 Important Data and Tables
 - a. Contact crimp tools, insertion/extraction tools
 - b. Wire Insulation removal tools
 - c. Electrical cable binding
 - d. Wire type codes and part numbers identification
 - e. Connective devices types and contacts
 - f. Terminal blocks and terminations
 - g. Terminal blocks modules, grounding modules and contacts

- h. Cleaning procedures
 - i. Repair procedures
4. Wiring Diagram Manual (WDM)
 - a. Front matter
 - b. Diagrams
 - c. Charts
 - d. Lists
 5. Other Documentation (as applicable)

WIRING SYSTEMS LESSON PLAN MODULE C: INSPECTION

Overview

Through Module C, the instructor lays the groundwork for safe effective maintenance and repair of airplane wiring systems, by teaching the skills of inspection so as to identify wiring system damage. The Instructor may vary the depth and scope of the topics to be covered, depending on the type of airplane to be maintained and skills of the persons.

Objectives

After this module is complete the person is able to demonstrate the following skills:

1. Know the [different types of inspections](#): General Visual Inspection (GVI), Detailed Inspection (DI), Special Detailed Inspection (SDI), Zonal Inspection and Enhanced Zonal Analysis Procedure (EZAP), criteria and standards so that the person knows which tools are used to ensure inspection procedures and standards are achieved which leads to all defects being found.
2. Know the effects of fatigue and complacency during inspection and how to combat their effects (Human Factors).
3. Know the specific zonal inspection requirements related to system affiliation and environmental conditions.
4. Recognize typical wiring system damage, such as hot gas, fluid contamination, external mechanically induced damage, chafing and corrosion of wire, wire bundles and connective devices assemblies.

Strategies

Normal classroom lecture is used for the majority of the training. ATA 117 video and color photos of actual wiring systems damage could be used to show typical problems found on the airplane. Examples of discrepancies will be made available to the student.

MODULE C – INSPECTION

1. General Visual Inspection (GVI), Detailed Inspection (DI), Special Detailed Inspection (SDI), Zonal Inspection and Enhanced Zonal Analysis Procedure (EZAP)
2. criteria and standards
 - a. Tools
 - b. Criteria/standards
 - c. Procedures of inspection
3. Human Factors in Inspection

- a. Fatigue
 - b. Complacency
4. Zonal areas of inspection
- a. Zonal areas of inspection
 - b. Zonal inspection procedures and standards
5. Wiring system damage
- a. Swarf / FOD / metal shavings
 - b. External mechanically induced damage
 - c. Hot gas
 - d. Fluid contamination
 - e. Vibration/chafing
 - f. Corrosion

WIRING SYSTEMS LESSON PLAN MODULE D: HOUSEKEEPING

Overview

Through Module D, the instructor lays the groundwork for safe effective maintenance and repair of airplane wiring systems by teaching housekeeping strategies. This will keep the wiring system free of contamination and if contamination is found, techniques on removal or cleaning. The Instructor may vary the depth and scope of the topics to be covered, depending on the type of airplane to be maintained and skills of the persons.

Objectives

After this module is complete the person is able to demonstrate the following skills:

1. Recognize external contamination and other damage due to external environmental conditions.
2. Know the airplane internal contamination sources, so that inspection processes can be effectively carried out and contamination damage easily recognized.
3. Recognize other possible contamination sources.
4. Know the procedures and processes to protect wiring systems during maintenance and repair.
5. Know the procedures to be followed when carrying out repairs on wiring systems in different parts of the airplane.
6. Know the process of cleaning wiring systems during maintenance and repair.

Strategies

Normal classroom lecture is used for the majority of the training. ATA 117 video and color photos of actual wiring systems contamination could be used to show typical problems found on the airplane. Relevant Aircraft Maintenance Manual and/or Chapter 20 Wiring Practices procedures will be used. The ATSRAC Task Group 1, Non-Intrusive Inspection Final Report could be used to identify typical housekeeping issues.

MODULE D – HOUSEKEEPING

1. Airplane external contamination sources
 - a. De-ice fluids
 - b. Water and rain
 - c. Snow and ice
 - d. Miscellaneous (e.g. cargo spillage)
 - e. Air erosion

2. Airplane internal contamination sources
 - a. Hydraulic oils
 - b. Engine and APU oils
 - c. Fuel
 - d. Greases
 - e. Galleys and toilets
 - f. Lint/Dust
 - g. Bleed air and hot areas
 - h. Hazardous materials

3. Other contamination sources
 - a. Paint
 - b. Corrosion inhibitor
 - c. Drill shavings / Swarf
 - d. Foreign objects (screws, washers, rivets, tools, etc.)
 - e. Animal waste

4. Contamination protection planning
 - a. Have a plan / types of plan / area mapping
 - b. Protection and Caution Recommendations
 - c. Procedures
 - d. Keep cleaning

5. Protection during airplane maintenance and repair
 - a. Recommended general maintenance protection procedures
 - b. Recommended airframe repair protection procedures
 - c. Recommended powerplant repair protection procedures

6. Cleaning Processes
 - a. Fluid contamination
 - 1) Snow and ice
 - 2) De-ice fluid
 - 3) Cargo spillage
 - 4) Water and rain
 - 5) Galleys
 - 6) Toilets water waste
 - 7) Oils and greases

 - b. Solid contamination
 - 1) Drill shavings / Swarf
 - 2) Foreign objects (screws, washers, rivets, tools, etc.)

 - c. Environmental contamination
 - 1) Lint and dust
 - 2) Paint
 - 3) Corrosion inhibitor

4) Animal waste

**WIRING SYSTEMS LESSON PLAN
MODULE E: WIRE**

Overview

Through Module E, the instructor lays the groundwork for safe effective maintenance, alteration and repair of airplane wiring systems by teaching wire selection and inspection strategies. The Instructor may vary the depth and scope of the topics to be covered, depending on the type of airplane to be maintained and skills of the persons.

Objectives

After this module is complete the person is able to demonstrate the following skills:

1. Demonstrate the procedure used to identify specific wire types using the airplane manuals.
2. Know from approved data different insulation types and their relative qualities.
3. Know the inspection criteria for wire and wire bundles.
4. Know the standard installation practices for wire and wire bundles (airplane specific).
5. Know typical damage that can be found (airplane specific).
6. Demonstrate the repair procedures for typical damage found on the student's type of airplane.
7. Demonstrate the procedures to fitting differing types of sleeving (airplane specific).
8. Know the procedures for termination and storage of unused wires.
9. Demonstrate the correct installation practices for electrical bonds and grounds (airplane specific).

Strategies

Normal classroom lecture is used for the majority of the training with hands-on practice for Section 6. Chapter 20 Wiring Practices, Wiring Diagram Manual and WDM Lists will be made available to the class so that hands-on use of the manual can be utilized so that wire identification, inspection, installation and repair procedures can be fully explored. Examples of wire discrepancies will be made available to the student. The ATSRAC Task Group 1, Intrusive Inspection Final Report could be used to identify typical wire issues.

MODULE E – WIRE

1. Identification, type and construction
 - a. Wire type codes – alphanumeric
 - b. Wire type codes – specification and standard part number
 - c. Wire type codes – specified wire and alternate
 - d. Manufacturer identification

2. Insulation qualities
 - a. Types of insulation
 - b. Typical insulation damage
 - c. Carbon Arcing

3. Inspection criteria and standards of wire and wire bundles
 - a. Inspection of individual wiring
 - b. Inspection of wire bundles

4. Wire bundle installation practices
 - a. Routing
 - b. Segregation rules
 - c. Clearance
 - d. Clamp inspection
 - e. Clamp removal and fitting
 - f. Conduit types and fitting
 - g. Raceways

5. Typical damage and areas found (airplane specific)
 - a. Vibration
 - b. Corrosion
 - c. Contamination
 - d. Personnel traffic passage

6. Maintenance and repair procedures
 - a. Wire damage assessment and classification
 - b. Approved repairs - Improper repairs
 - c. Shielded wire repair
 - d. Repair techniques
 - e. Terminals and splices
 - f. Preventative maintenance procedures

7. Sleeving
 - a. Identification sleeves
 - b. Shrink sleeves
 - c. Screen braid grounding crimp sleeves
 - d. Screen braid grounding solder sleeves

8. Unused wires - termination and storage
 - a. Termination – End caps
 - b. Storage and attachment

9. Electrical bonding and grounds
 - a. Inspection standards
 - b. Primary Bonding (HIRF protection)
 - c. Secondary Bonding (System grounding)
 - d. Lightning strikes

WIRING SYSTEMS LESSON PLAN MODULE F: CONNECTIVE DEVICES

Overview

Through Module F, the instructor lays the groundwork for safe effective maintenance, alteration and repair of airplane wiring systems by teaching the identification, inspection and repair of connective devices found on the airplane. The Instructor may vary the depth and scope of the topics to be covered, depending on the type of airplane to be maintained and skills of the persons.

Objectives

After this module is complete the person is able to demonstrate the following skills:

1. Know the general types and positive identification of connective devices and pressure seals (airplane specific).
2. Know the various safety procedures, cautions and warnings prior to inspection.
3. Know the relevant inspection procedures for each type of connector so that any internal or external damage can be found.
4. Recognize typical external and internal damage to the connector.
5. Demonstrate where to find the relevant repair schemes from Ch. 20 for connector repair.

Strategies

Normal classroom lecture is used for the majority of the training. The Chapter 20 Wiring Practices manual will be made available to the class so that hands-on use of the manual can be utilized. Connector identification, inspection and repair procedures will be fully explored. Color photographs of typical external damage and internal damage could be used to show problems on the airplane. The ATSRAC Task Group 1, Non-Intrusive Inspection and Intrusive Inspection Final Report, Chapter 7, could be used to identify typical connector issues.

MODULE F – CONNECTIVE DEVICES

1. General types and identification
 - a. Part number identification
 - b. Reference tables
 - c. Specific connective devices and pressure seal chapters
2. Cautions and protections
 - a. Safety precautions
 - b. Maintenance precautions
3. Visual inspection procedures
 - a. Installed inspection criteria
 - b. Removed inspection criteria
4. Typical damage found
 - a. Exterior damage
 - b. Internal damage

5. Repair procedures
 - a. Finding the correct section
 - b. Finding the correct part
 - c. Finding the correct tooling
 - d. Confirming the correct repair

WIRING SYSTEMS LESSON PLAN MODULE G: CONNECTIVE DEVICES REPAIR

Overview

Through Module G, the instructor lays the groundwork for safe effective maintenance, alteration and repair of airplane wiring systems. This module is primarily a hands-on class, emphasizing the repair and replacement of connective devices found on the airplane. This list can be used to cover typical connectors for airplanes, and can be adjusted to suit training requirements. The Instructor may vary the depth and scope of the topics to be covered, depending on the type of airplane to be maintained and skills of the persons.

Objective

After this module is complete the person will have the following skills.

1. Demonstrate the replacement of components for circular connectors.
2. Demonstrate the replacement of components for rectangular connectors.
3. Demonstrate the replacement of components for terminal blocks-modular.
4. Demonstrate the replacement of components for terminal blocks-non-modular.
5. Demonstrate the replacement of components for grounding modules.
6. Demonstrate the replacement of pressure seals

Strategies

This class is primarily a hands-on class to give the student motor skills in the repair of connective devices from their airplane. The Chapter 20 Wiring Practices Manual and the appropriate connective devices will be made available to the class so repair procedures can be fully explored. Photographs of typical internal conditions and external damage could be made available. It is recommended that MODULE F: CONNECTORS should precede this module.

MODULE G – CONNECTIVE DEVICES REPAIR

1. Circular Connectors
 - a. Disassembly
 - b. Back-shell maintenance
 - c. Contact extraction and insertion
 - d. Contact Crimping
 - e. Assembly and strain relief
2. Rectangular Connectors
 - a. Disassembly
 - b. Back-shell maintenance
 - c. Contact extraction and insertion
 - d. Contact Crimping
 - e. Assembly and strain relief
3. Terminal Blocks - Modular
 - a. Disassembly
 - b. Contact extraction and insertion
 - c. Contact Crimping

- d. Assembly and strain relief
- 4. Terminal Block – Non-modular
 - a. Disassembly
 - b. Terminal Lug Crimping
 - c. Terminal Lug Stacking
 - d. Assembly, torque and strain relief
- 5. Grounding Modules
 - a. Disassembly
 - b. Contact extraction and insertion
 - c. Contact Crimping
 - d. Assembly and strain relief
- 6. Pressure Seals
 - a. Disassembly
 - b. Maintenance
 - c. Assembly and strain relief