



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

**Subject: AIRCRAFT ELECTRICAL
WIRING INTERCONNECTION
SYSTEMS TRAINING PROGRAM**

Date: 08/02/02

AC No: 120-YY

Change:

Initiated By: WG8

DRAFT

Table of Contents:

1. <u>PURPOSE</u>	1
2. <u>APPLICABILITY</u>	2
3. <u>RELATED 14 CFR PARTS</u>	2
4. <u>ADVISORY CIRCULARS</u>	3
5. <u>REPORTS</u>	4
6. <u>OTHER DOCUMENTS</u>	4
7. <u>DEFINITIONS</u>	4
8. <u>BACKGROUND</u>	6
9. <u>OBJECTIVE</u>	7
10. <u>ESSENTIAL ELEMENTS FOR A TRAINING PROGRAM</u>	8
<u>APPENDIX A - ELECTRICAL WIRING INTERCONNECTION SYSTEM MINIMUM INITIAL TRAINING PROGRAM</u>	9
<u>APPENDIX B – CURRICULUM AND LESSONS PLAN</u>	10
<u>APPENDIX C - ELECTRICAL WIRING INTERCONNECT SYSTEM</u>	31

1. PURPOSE.

This Advisory Circular (AC) provides guidance for developing an enhanced Electrical Wiring Interconnection System (EWIS) training program. The guidance in this AC is based on recommendations submitted to the FAA from the Aging Transport Systems rulemaking Advisory Committee (ATSRAC). The guidance and recommendations in this AC are derived from the best practices training developed through extensive research by ATSRAC Industry Working Groups 5 and 8. This AC is an effort by the FAA to officially endorse these best practices and to dispense this information industry wide so the benefits of this information can be effectively realized. Adoption of the recommendations in this AC will result in a training program that will improve the

awareness and skill level of the aviation personnel in Electrical Wiring Interconnection System production, modification, maintenance, inspection, alterations and repair. This AC promotes a philosophy of training for all personnel who come into contact with aircraft Electrical Wiring Interconnection Systems as part of their job and tailors the training for each workgroup to their particular needs.

To fully realize the objectives of this AC, air carriers, air operators, type certificate holders, STC holders, maintenance providers, repair stations and persons performing field approval modifications or repairs, will need to rethink their current approach to maintaining and modifying aircraft wiring and systems. This may require more than simply updating maintenance manuals and work cards and enhancing training. Maintenance personnel need to be aware that aircraft Electrical Wiring Interconnection Systems should be maintained with the same level of intensity as any other system in the aircraft. They also need to recognize that visual inspection of wiring has inherent limitations. Small defects such as breached or cracked insulation, especially in small gage wire may not always be apparent. Therefore effective wiring maintenance combines visual inspection techniques with improved wiring maintenance practices and training.

2. APPLICABILITY.

This AC provides acceptable, but not inclusive, means of complying with the Federal Aviation Regulations. The information in this AC is based on lessons learned by ATSRAC Harmonized Working Groups, FAA, other regulatory authorities, manufacturers, airlines and repair stations.

The recommendations in this AC can be applied to any aircraft training program.

3. RELATED 14 CFR PARTS.

- a. Part 21, Certification Procedures for Products and Parts.
- b. Part 25, Airworthiness Standards, Transport Category Airplanes
- c. Part 43, Maintenance, Preventive Maintenance, Rebuilding, and Alteration
- d. Part 91, General Operating and Flight Rules.
- e. Part 119, Certification: Air Carriers and Commercial Operators.
- f. Part 121, Operating Requirements: Domestic, Flag, and Supplemental Operations.

- g. Part 125, Certification and Operations: Airplanes Having a Seating Capacity of 20 or More Passengers or a Maximum Payload Capacity of 6,000 pounds or More.
- h. Part 129, Operations: Foreign Air Carriers and Foreign Operators of U.S.-Registered Aircraft Engaged in Common Carriage.
- i. Part 135, Operating Requirements: Commuter and On-demand Operations.
- j. Part 145, Repair Stations

4. ADVISORY CIRCULARS.

- a. AC 20-53A, Protection Of Airplane Fuel Systems Against Fuel Vapor Ignition Due To Lightning
- b. AC 20-13, Protection Of Aircraft Electrical/Electronic Systems Against The Indirect Effects Of Lightning
- c. AC 25-16, Electrical Fault and Fire Protection and Prevention.
- d. AC 25.981-1B, Fuel Tank Ignition Source Prevention Guidelines
- e. AC 43-3, Nondestructive Testing in Aircraft.
- f. AC 43-4A, Corrosion Control for Aircraft.
- g. AC 43-7, Ultrasonic Testing for Aircraft.
- h. AC 43-12A, Preventive Maintenance.
- i. AC 43.13-1A, Acceptable Methods, Techniques and Practices--Aircraft Inspection and Repair.
- j. AC 43.13-1B, Acceptable Methods, Techniques and Practices for Repairs and Alterations to Aircraft.
- k. AC 43-204, Visual Inspection For Aircraft
- l. AC 65-15A, Airframe & Powerplant Mechanics Airframe Handbook, Chapter 11. Aircraft Electrical Systems

- m. AC 120-XX, Program to enhance aircraft Electrical Wiring Interconnection System maintenance

5. REPORTS.

- a. Aging Transport Systems Rulemaking Advisory Committee, Task 1, Task 2, Task 3, Task 4 and Task 5 Working Group Final Reports.
- b. Aging Transport Systems Rulemaking Advisory Committee, Task 6, Task 7 and Task 9 Working Group Final Reports.
- c. ATA Specification 117 (Wiring Maintenance Practices/Guidelines).
- d. National Transportation Safety Board, Safety Recommendation, September 19, 2000, A-00-105 through -108.

6. OTHER DOCUMENTS.

- a. ATA Operator/Manufacturer Scheduled Maintenance Development as revised, ATA Maintenance Steering Group (MSG-3), may be obtained from the Air Transport Association of America; Suite 1100: 1301 Pennsylvania Ave, NW; Washington, DC 20004-1707.
- b. Handbook Bulletin 91-15 "Origin and propagation of inaccessible aircraft fire under in-flight airflow conditions."

7. DEFINITIONS.

Arc tracking. A phenomenon in which a conductive carbon path is formed across an insulating surface. This carbon path provides a short circuit path through which current can flow. Normally the result of electrical arcing. Also referred to as "Carbon Arc Tracking", "Wet Arc Tracking", or "Dry Arc Tracking".

Combustible. The ability of any solid, liquid or gaseous material to cause a fire to be sustained after removal of the ignition source. The term is used in place of inflammable/flammable. It should not be interpreted as identifying material that will burn when subjected to a continuous source of heat as occurs when a fire develops.

Contamination. With regard to wiring contamination refers to either of the following situations:

- a. The presence of a foreign material that is likely to cause degradation of wiring.
- b. The presence of a foreign material that is capable of sustaining combustion after removal of ignition source.

Detailed Inspection (DET). An intensive examination of a specific item, installation or assembly to detect damage, failure or irregularity. Available lighting is normally supplemented with a direct source of good lighting at an intensity deemed appropriate. Inspection aids such as mirrors, magnifying lenses or other means may be necessary. Surface cleaning and elaborate access procedures may be required.

Functional Failure. Failure of an item to perform its intended function within specified limits.

General Visual Inspection (GVI). A visual examination of an interior or exterior area, installation or assembly to detect obvious damage, failure or irregularity. This level of inspection is made from within touching distance unless otherwise specified. A mirror may be necessary to enhance visual access to all exposed surfaces in the inspection area. This level of inspection is made under normally available lighting conditions such as daylight, hangar lighting, flashlight or drop-light and may require removal or opening of access panels or doors. Stands, ladders or platforms may be required to gain proximity to the area being checked.

Lightning/High Intensity Radiated Field (L/HIRF) protection. Is the protection of airplane electrical systems and structure from induced voltages or currents by means of shielded wires, raceways, bonding jumpers, connectors, composite fairings with conductive mesh, static dischargers, and the inherent conductivity of the structure, but may include aircraft specific devices, e.g., RF Gaskets.

Maintenance. As defined in 14 CFR 1.1 “maintenance means inspection, overhaul, repair, preservation, and the replacement of parts, but excludes preventive maintenance.” For the purposes of this advisory circular, it also includes preventive maintenance as described in both § 1.1 and 14 CFR part 43, Appendix A(c).

Maintenance Significant Item (MSI). Items identified by the manufacturer whose failure

- A. could affect safety (on ground or in flight) and/or
- B. is undetectable during operations, and/or
- C. could have significant operational impact, and/or
- D. could have significant economic impact.

Needling. The puncturing of a wire’s insulation to make contact with the core to test the continuity and presence of voltage in the wire segment.

Stand-alone GVI. A General Visual Inspection which is not performed as part of a zonal inspection. Even in cases where the interval coincides with the zonal inspection, the Stand-alone GVI shall remain an independent step within the work card.

Structural Significant Item (SSI). Any detail, element or assembly that contributes significantly to carrying flight, ground, pressure, or control loads and whose failure could affect the structural integrity necessary for the safety of the aircraft.

Swarf. British term used to describe the metal particles, generated from drilling and machining operations. Such particles may accumulate on and between wires within a wire bundle.

Electrical Wiring Interconnection System. An electrical connection between two or more points including the associated termination devices (e.g., connectors, terminal blocks, splices) and the necessary means for its installation and identification.

Zonal Inspection. A collective term comprising selected General Visual Inspections and visual checks that are applied to each zone, defined by access and area, to check system and power plant installations and structure for security and general condition.

8. BACKGROUND.

The NTSB has recommended that the FAA address all wiring issues identified in the Aging Systems Plan, either through rulemaking or through other means. The NTSB specifically cited the need for improved training of personnel to ensure adequate recognition and repair of potentially unsafe wiring conditions.

To address the issues identified in the Aging Systems Plan, in 1998 the FAA established the Aging Transport Systems Rulemaking Advisory Committee (ATSRAC). The ATSRAC provides the forum for the airlines, manufacturers, and other regulatory authorities to make recommendations to the FAA based on the Aging Systems Plan. This Advisory Circular addresses only the training program. It does not attempt to deal with the condition of the fleet's wiring, or develop performance tests for wiring. This advisory circular captures, in FAA guidance form, the aircraft wiring training program developed by ATSRAC. This includes a training syllabus, curriculum, training target groups and a matrix outlining training for each training group.

9. OBJECTIVE.

The objective of this electrical wiring interconnection system training program is to give the operators or maintenance repair organizations a model for the development of their own electrical wiring interconnection system training program. This will ensure that proper procedures, methods techniques, and practices are used when performing maintenance, preventive maintenance, inspection, alteration, repair, and cleaning of Electrical Wiring Interconnection Systems.

This program was developed for eight different target groups and may be used for the minimum requirements for initial and recurrent training (see training matrix). Depending on the duties some may fall into more than one target group and therefore must fulfill all objectives of the associated target groups.

The target groups are:

- 1 Qualified staff performing Electrical Wiring Interconnection Systems maintenance
These staff members are personnel who perform Electrical Wiring Interconnection Systems maintenance and their training is based on their job description and the work being done by them.
(e.g. FAA: electricians/avionics / A & P Technicians
JAA: Avionics skilled workers or Cat B2)
- 2 Qualified staff performing maintenance inspections on Electrical Wiring Interconnection Systems.
These staff members are personnel who perform Electrical Wiring Interconnection Systems inspections (but not maintenance) and their training is based on their job description and the work being done by them.

(e.g. FAA: Inspectors / A & P Technicians
JAA: Cat B2)
- 3 Qualified staff performing electrical/avionic engineering on in service aircraft
These staff members are personnel who are authorized to design Electrical Wiring Interconnection System installations, modifications and repairs.
(e.g. FAA/JAA: electric/avionic engineers)
- 4 Qualified staff performing general maintenance/inspections not involving wire maintenance.(LRU change is not considered wire maintenance)
These staff members are personnel who perform maintenance on aircraft that may require removal/reconnection of electrical connective devices
(e.g. FAA: A & P Technicians
JAA: Cat A or B1)
- 5 Qualified staff performing other engineering or planning work on in service aircraft
These staff members are personnel who are authorized to design mechanical/structure

systems installations, modifications and repairs, or personnel who are authorized to plan maintenance tasks.

6 Other service staff with duties in proximity to Electrical Wiring Interconnection Systems.

These staff members are personnel who's duties would bring them into contact/view of aircraft Electrical Wiring Interconnection Systems.

This would include, but not be limited to, aircraft cleaners, cargo loaders, fuelers, lavatory servicing personnel, deicing personnel, push back personnel.

7 Flight Deck Crew
(e.g. Pilots, Flight Engineers)

8 Cabin Crew

10. ESSENTIAL ELEMENTS FOR A TRAINING PROGRAM

a. Initial Training.

Initial training should be conducted for each designated work group.

The initial training for each designated work group is outlined in Electrical Wiring Interconnection System Minimum Initial Training Program - Appendix A.

Curriculum and Lesson Plans for each dedicated module are included in Appendix B.

The most important criteria is to meet the objectives of the Lesson Plans – Appendix B. (Using classroom discussion, computer based training or hands on practical training)

Assessment or achieving the objectives should be at the discretion of the training organization. (Such as written test, oral test or demonstration of skills)

Supporting documentation such as Advisory Circulars are an integral part of training and should be used to support development of the Curriculum and Lesson Plans

b. Refresher Training

Refresher training should be conducted in a period not to exceed two years. It could consist of a review of previously covered material plus any new material or revisions to publications. Refresher training will follow the Electrical Wiring Interconnection System Minimum Initial Training Program - Appendix A for that particular target group.

DRAFT AC 120-YY

**APPENDIX A – ELECTRICAL WIRING INTERCONNECTION SYSTEM
MINIMUM INITIAL TRAINING PROGRAM**

Please see: [Appendix A.xls](#)

APPENDIX B – CURRICULUM AND LESSONS PLAN

Table of Contents:

CURRICULUM AND LESSON PLANS	11
ELECTRICAL WIRING INTERCONNECTION SYSTEM CURRICULUM	11
ELECTRICAL WIRING INTERCONNECTION SYSTEM LESSON PLAN	14
MODULE A: GENERAL ELECTRICAL WIRING SYSTEM INTERCONNECTION PRACTICE	14
MODULE B: WIRING PRACTICES DOCUMENTATION	17
MODULE C: INSPECTION	19
MODULE D: HOUSEKEEPING	21
MODULE E: WIRE	24
MODULE F: CONNECTIVE DEVICES	27
MODULE G: CONNECTIVE DEVICES REPAIR	29

AGING TRANSPORT SYSTEMS RULEMAKING ADVISORY COMMITTEE
(ATSRAC)

CURRICULUM AND LESSON PLANS

ELECTRICAL WIRING INTERCONNECTION SYSTEM CURRICULUM

Overview

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

Objectives

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

- A. Know or demonstrate the safe handling of airplane electrical systems, Line Replaceable Units (LRU's), tooling, troubleshooting procedures, and electrical measurement.
- B. Know or demonstrate 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. Know or demonstrate the correct identification of different wire types, their inspection criteria, and damage tolerance, repair and preventative maintenance procedures.
- F. Know or demonstrate the procedures to identify, inspect and find the correct repair for typical types of connective devices found on the applicable airplane.
- G. Demonstrate the procedures for replacement of all parts of typical types of connective devices found on the applicable 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 on the persons experience, work assignment and operators policy.

MODULE A – GENERAL ELECTRICAL WIRING INTERCONNECTION SYSTEM PRACTICES :

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 .
6. Measurement and troubleshooting using meters.
7. LRU replacement general practices

MODULE B – WIRING PRACTICES DOCUMENTATION:

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:

1. Special Inspections -
2. Criteria and standards
3. Human factors in inspection
4. Zonal areas of inspection
5. Wiring System damage

MODULE D – HOUSEKEEPING:

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:

1. Identification, type and construction
2. Insulation qualities
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:

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:

1. Circular Connectors
2. Rectangular Connectors
3. Terminal Blocks-Modular
4. Terminal Blocks- Non-modular
5. Grounding Modules
6. Pressure Seals

ELECTRICAL WIRING INTERCONNECTION SYSTEM LESSON PLAN
MODULE A: GENERAL ELECTRICAL WIRING INTERCONNECTION
SYSTEM PRACTICE

Overview

Through Module A, the instructor lays the groundwork of safe effective maintenance and repair of the airplane Electrical Wiring Interconnection System (EWIS) and LRU removal and replacement, including BITE test, 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 Electrostatic Discharge Sensitive (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 can be used for the majority of the training. The following strategies can be used to expedite learning and are recommended to the instructor.

ESDS handling and protection.....Multi media/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 replacementAirplane manuals

**MODULE A – GENERAL ELECTRICAL WIRING INTERCONNECTION
SYSTEM PRACTICES:**

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 handling/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 calibration/certification
 - b. Determining calibration/certification requirements
 - c. Typical problems

5. Required wiring checks using the Troubleshooting Procedures and Charts -
 - 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 replacement general practices -

- a. Different retention devices
- b. Certification considerations (e.g. CAT 2/CAT3 Landing)
- c. LRU re-racking procedures
- d. “No Fault Found” data (airplane specific)
- e. Built in test equipment (BITE)

ELECTRICAL WIRING INTERCONNECTION SYSTEM LESSON PLAN
MODULE B: WIRING PRACTICES DOCUMENTATION

Overview

Through Module B, the instructor lays the groundwork for safe effective maintenance and repair of airplane Electrical Wiring Interconnection Systems. The intent of this module is to teach the person how to locate desired information in the Chapter 20 Wiring System 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 can be used for the majority of the training. The Chapter 20 Wiring Practices Manual, Electrical Standard Practices Manual, Wiring Diagram Manual, and other applicable documentation should 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)

ELECTRICAL WIRING INTERCONNECTION SYSTEM 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 (DET), Special Detailed Inspection (SDI), Zonal Inspection and Enhanced Zonal Analysis Procedure (EZAP).
2. Know the criteria and standards of inspection, so that the person knows which tools are used to ensure inspection procedures and standards are achieved which leads to all defects being found.
3. Know the effects of fatigue and complacency during inspection and how to combat their effects (Human Factors).
4. Know the specific zonal inspection requirements related to system affiliation and environmental conditions.
5. Recognize typical electrical wiring interconnection system damage, such as hot gas, fluid contamination, external mechanically induced damage, chafing, corrosion, signs of overheating of wire, wire bundles, connective and control device assemblies.

Strategies

Normal classroom lecture can be used for the majority of the training. ATA 117 video and color photos of actual Wiring System damage could be used to show typical problems found on the airplane. Examples of discrepancies should be made available to the student. AC 120-XX, Program to Enhance Aircraft Electrical Wiring Interconnection System Maintenance is recommended as a source of typical aircraft wiring installations and areas of concern.

MODULE C – INSPECTION

1. Special Inspections
 - a. General Visual Inspection (GVI)
 - b. Detailed Inspection (DET)
 - c. Special Detailed Inspection (SDI)
 - d. Zonal Inspection
 - e. 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. Electrical wiring interconnection system damage
 - a. Swarf / FOD / metal shavings
 - b. External mechanically induced damage
 - c. Hot gas
 - d. Fluid contamination
 - e. Vibration/chafing
 - f. Corrosion
 - g. Signs of overheating

ELECTRICAL WIRING INTERCONNECTION SYSTEM LESSON PLAN
MODULE D: HOUSEKEEPING

Overview

Through Module D, the instructor lays the groundwork for safe effective maintenance and repair of airplane Electrical Wiring Interconnection Systems, by teaching housekeeping strategies, so as to keep the Electrical Wiring Interconnection System free of contamination. 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 planning procedures to be followed, on Electrical Wiring Interconnection System Areas in different parts of the airplane.
5. Know the protection procedures and processes to protect the Electrical Wiring Interconnection System during maintenance and repair.
6. Know the process of cleaning Electrical Wiring Interconnection System during maintenance and repair.

Strategies

Normal classroom lecture can be used for the majority of the training. ATA 117 video and color photos of actual Electrical Wiring Interconnection System contamination could be used to show typical problems found on the airplane. Relevant Aircraft Maintenance Manual and/or Chapter 20 Wiring Practices procedures should be used. The ATSRAC Task Group 1, Non-Intrusive Inspection Final Report could be used to identify typical housekeeping issues. AC 120-XX, Program to Enhance Aircraft Electrical Wiring Interconnection System Maintenance is recommended as a source of typical aircraft wiring installations and areas of concern.

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 / beverage 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
 - 8) Pressure washing
- 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

ELECTRICAL WIRING INTERCONNECTION SYSTEM LESSON PLAN
MODULE E: WIRE

Overview

Through Module E, the instructor lays the groundwork for safe effective maintenance, alteration and repair of airplane Electrical Wiring Interconnection System 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. Know the correct installation practices for electrical bonds and grounds (airplane specific).

Strategies

Normal classroom lecture can be used for the majority of the training with hands-on practice for Section 6. Chapter 20 Wiring Practices, Wiring Diagram Manual and WDM Lists should 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 should be made available to the student. The ATSRAC Task Group 1, Intrusive Inspection Final Report could be used to identify typical wire issues. AC 120-XX, Program to Enhance Aircraft Electrical Wiring Interconnection System Maintenance is recommended as a source of typical aircraft wiring installations and areas of concern.

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 and limitations
 - 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
 - h. Heat shields and drip shields

5. Typical damage and areas found (airplane specific)
 - a. Vibration
 - b. Heat
 - c. Corrosion
 - d. Contamination
 - e. 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

ELECTRICAL WIRING INTERCONNECTION SYSTEM LESSON PLAN
MODULE F: CONNECTIVE DEVICES

Overview

Through Module F, the instructor lays the groundwork for safe effective maintenance, alteration and repair of airplane Electrical Wiring Interconnection 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. (airplane specific).
2. Know the various safety procedures, cautions and warnings prior to inspection.
3. Know the relevant visual 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 can be used for the majority of the training. The Chapter 20 Wiring Practices manual should be made available to the class so that hands-on use of the manual can be utilized. Connector identification, inspection and repair procedures should 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. AC 120-XX, Program to Enhance Aircraft Electrical Wiring Interconnection System Maintenance is recommended as a source of typical aircraft wiring installations and areas of concern.

MODULE F – CONNECTIVE DEVICES

1. General types and identification
 - a. Part number identification

- b. Reference tables
 - c. Specific connective devices 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

ELECTRICAL WIRING INTERCONNECTION SYSTEM 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 Electrical Wiring Interconnection 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 should 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. AC 120-XX, Program to Enhance Aircraft Electrical Wiring Interconnection System Maintenance is recommended as a source of typical aircraft wiring installations and areas of concern.

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

Appendix C

§ 25.1701 Electrical Wiring Interconnection System Definition

(a) For the purposes of this part, an electrical wiring interconnection system is defined as an electrical connection between two or more points including the associated termination devices and the necessary means for its installation and identification. This includes:

- (1) Wires and cables
- (2) Bus bars
- (3) Connection to electrical devices
- (4) Circuit breakers or other circuit protection devices
- (5) Connectors and accessories
- (6) Electrical grounding and bonding devices
- (7) Electrical splices
- (8) Materials used to provide additional protection for wires
- (9) Shield or braids
- (10) Conduits that have electrical termination for the purpose of bonding
- (11) Clamps and other devices used to route and support the wire bundle
- (12) Cable tie devices
- (13) Labels or other means of identification
- (14) Pressure seals associated with EWIS

(b) Electrical wiring interconnection system components inside shelves, panels, racks, junction boxes, distribution panels, back-planes of equipment racks including circuit board back-planes, wire integration units, etc. answering to the upper definition, is included.

(c) The mating connection at the termination point of the wire on those devices that are excluded from this definition is not included as part of the Electrical Wiring Interconnection System

(d) The following is excluded:

- (1) Wiring inside avionics equipment,
- (2) Equipment including non-required miscellaneous equipment qualified to environmental conditions and testing procedures approved by the Administrator other than those specifically included in this definition,
- (3) Equipment qualified to a technical standard order
- (4) Portable, carry on, or otherwise non-permanently mounted electrical equipment.
- (5) Fiber optics