

# *FAA Wiring Policy Briefing*



NM-01-04

Amdt 25-102

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# *Wiring Practices and New Wiring Policy Briefings*

- Overview
  - Provide Background Information
  - Brief new and emerging wiring certification policy, NM-01-04 and Amndt 25-102
  - Questions

# *Major Topics Covered*

- Background
  - How did we get here ??
- New Wiring Policy
  - NM-01-04, Amdt 25-102
- Briefing Plan
  - Purpose
  - Milestone Review
  - Program Goals

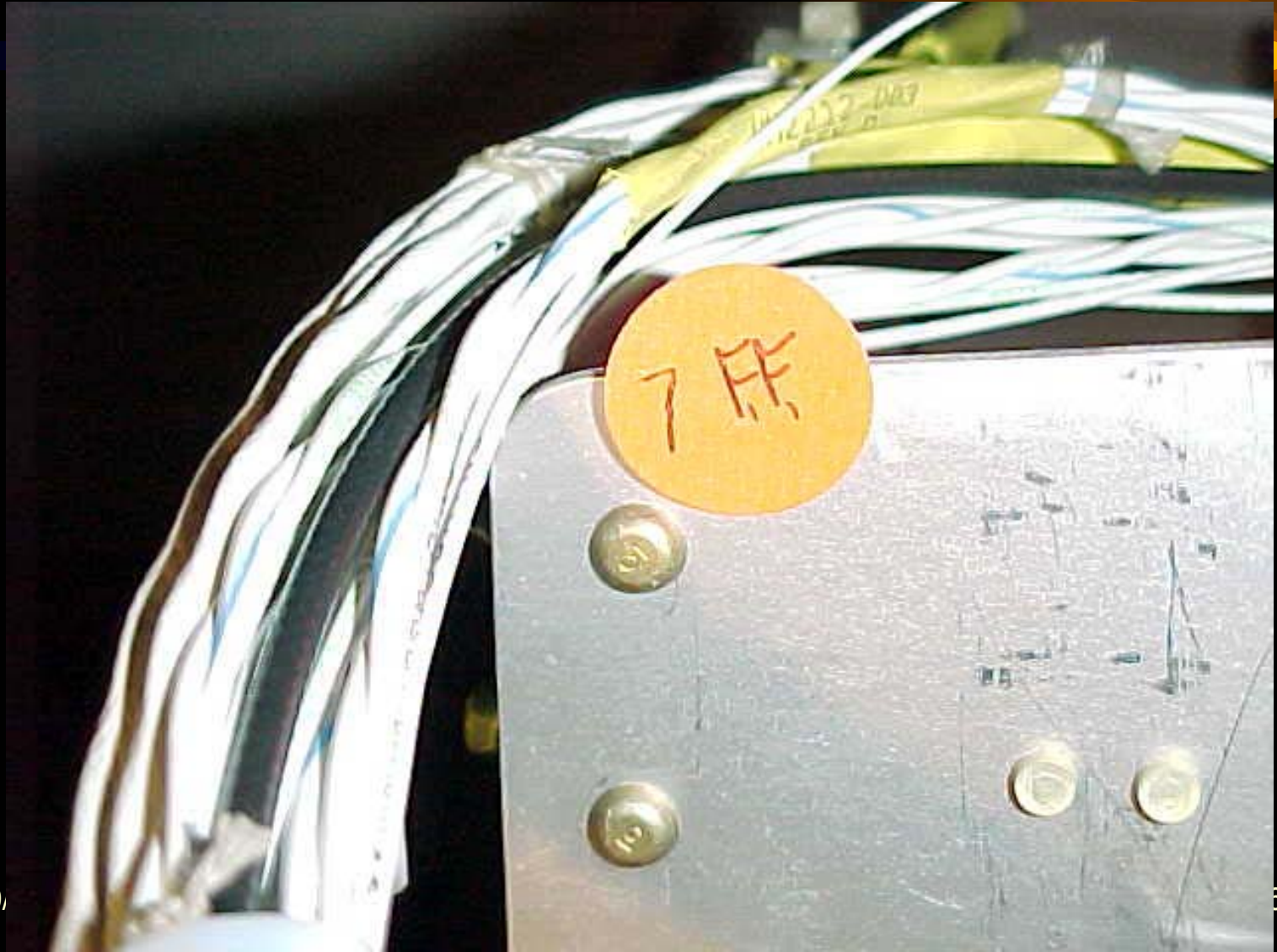
# *In-Service Wiring Clamping and Tie-wrap Problem- Example*



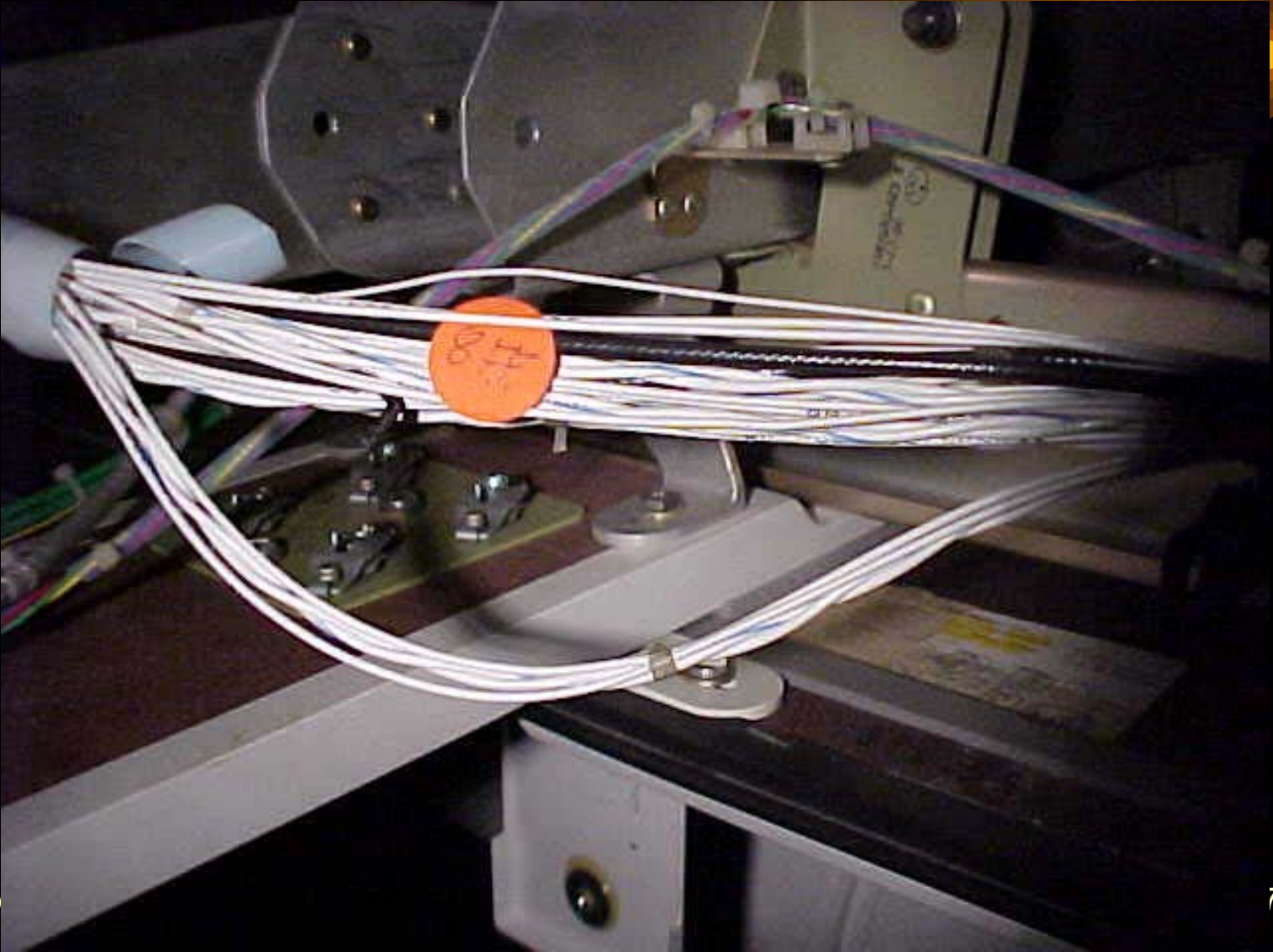
# *In-Service Wiring Clamping and Tie-wrap Problem Example*



# *Routing/Chafing In-Service Examples*



# *Routing/Chafing In-Service Examples*



# *Bend Radius Problem In-Service Example*



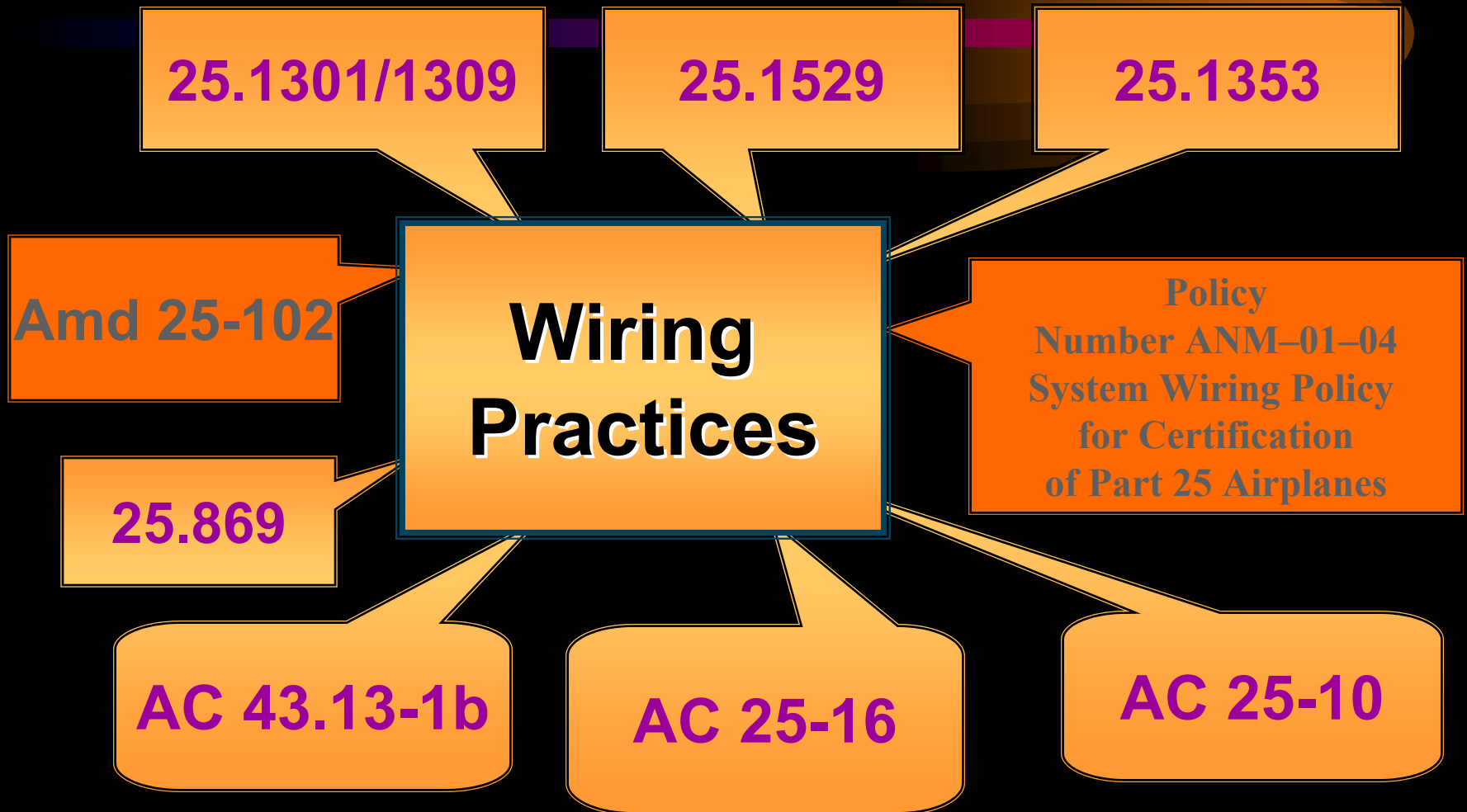
# *Coil and Stow In-Service Example*



# *New Wiring Regulations and Policy*

- NM-01-04: System Wiring Policy for Certification of Part 25 Airplanes
- Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance and Inspection Requirements
  - Amndt 25-102: Revises 25.981 to address fuel tank vapor ignition sources

# Current FAA Guidance



# *FAA Policy Statement Number ANM-01-04*

## *Summary of Policy*



- **This notice announces the FAA's policy with respect to the type design data needed for the certification of wiring installed on transport category airplanes.**
- **The policy is necessary to correct deficiencies associated with design data and ICAs involving airplane system wiring for TCs, STCs and design changes**

# *FAA Policy ANM-01-04 - Ambiguous Definition of Configuration*

- Design data should **NOT** leave the installation to the discretion of the installer.
- Routing of wiring should follow the criteria established by the FAA in the certification basis, as reflected in the holder's original or subsequently approved type design.
- Installation drawings / instructions should completely define the required routing and installation with sufficient detail to allow repeatability of the installation.

*FAA Policy ANM-01-04*  
*Modifications compatible with Original Type*  
*Design Standards*

- Installation / routing practices should be compatible with the certification standards established for the original type design.
- Modifiers and installers should use the airplane manufacturer's maintenance manuals as the primary source of wiring installation information, when available.

# *FAA Policy ANM-01-04*

## *Modifications compatible with Original Type Design Standards*

- **If** airplane manufacturer's maintenance manuals are not available, then the applicant may be required to:
  - **Obtain or determine the applicable OAM standards**
  - **Physically inspect airplane to ensure compatibility**
  - **Develop processes and procedures to address compatibility**

# *FAA Policy ANM-01-04*

## *Modifications compatible with Original Type Design Standards*

- **Wire bundles containing critical wiring identified by the original manufacturer may be required to be isolated from other systems**
  - **STC modifiers should know or be able to determine these standards**

# *FAA Policy ANM-01-04*

## *System Safety Assessment*

- **Should assess the effects of wiring failure on airplane**
  - collocated wiring bundles
  - smoke and/or fire events
- **Should also assess the effects on existing wiring safeguards such as wire separation**
  - May require understanding OAM's wire installation practices

*FAA Policy ANM-01-04*  
*Specific Installation Drawings Instead of*  
*General References*

- **Applicants are to provide definitive drawings instead of merely statements such as “install in accordance with industry standard practices,” or “install in accordance with AC 43.13.”**
- **FAA considers such statements inadequate because the standard practices cannot define the precise location or routing of the wiring.**

*FAA Policy ANM-01-04*  
*Instructions for Continued Airworthiness*

- **Need to address 25.1529 for wiring**
- **Visual inspections may not be adequate for wiring routed in metal or opaque conduits, wire in high vibration areas, or wire located in difficult to inspect areas.**
  - **Removal for inspection**  
or
  - **Non-visual inspection techniques**

# *Impacts of Amd 25-102 on Wiring Installation Approvals*

- Amd 25-102
  - NOT just applicable to fuel system wiring
  - SSA Requirement to address ignition sources
    - Non fuel system related wiring impacts
      - Wiring near fuel tank walls
      - Wiring Low Voltage (intrinsically safe) wiring that penetrates the fuel tank.

## *Amdt 25-102*

- Amends CFR Part 21, 25, 91, 121, 125, 129
  - Part 25; Amd 25-102- Revises 25.981 to address all new TCs, ATCs, and STCs
    - No PAX or payload limits
  - Part 91, 121, 125, 129; Adds fuel tank system maintenance and inspection requirements for critical control configuration items

# *Amdt 25-102 Impacts on Wiring*

- Ignition Source Prevention
- Based on CFR 25.901, 25.981(a) & (b)
  - single failures, single failures in combination with each latent failure condition not shown to be extremely remote, and from all combinations of failures not shown to be extremely improbable
  - identify critical design configurations for incorporation into ICA

# *Amdt 25-102 Impacts on Wiring*

- Two major areas of concern:
  - Wiring installed near low voltage Fuel Quantity Indication System (FQIS) wiring which penetrates the fuel tank wall
  - Wiring installed near or at the fuel tank wall which can fail and cause breach or fuel tank wall to reach 400 degrees F

# *Wire Separation*

- Separation of new wiring to FQIS wiring
  - Difficult to achieve
  - Designs vary among manufacturers
  - Many considerations to address
    - induced currents
    - physical arcing/fire failures
  - Should be established by the applicant

# *Wire Separation*

- Separation Considerations (FQIS)
  - electrical characteristics
  - installation features
  - slack tolerances
  - probable installation variances
  - operating environment
  - wire bundles fires

# Wire Separation

- Is there a default separation value such that a detailed analysis is not necessary ??
  - One inch for conducted transients
  - Six inches for physical effects of high power wiring
    - 2 inches may be adequate if bundle is rigidly supported and tied at intervals such that a wire break coupled with a broken/missing clamp or tie would not result in wire touching FQIS wiring
    - Use of fire proof barrier demonstrated to withstand chafing and arcing/flashover burn-through

# *Wiring Near Fuel Tanks*

Electrical wiring that is not intrinsically safe.

The recommended method of protection is to remove all such wiring from the fuel tank, fuel vapor spaces, and locations adjacent to conductive walls of these compartments. If this cannot be done, then provide for each circuit a combination of :

- Differential ground fault protection
- Robust shielding
- Life limited parts
- Flight crew and maintenance procedures limiting reset of circuit protection

# *Wiring Near Fuel Tanks*

## Electrical wiring that is not intrinsically safe (continued)

### Problems:

- Conductive conduits or shields must provide protection from multiple resets of the ground fault protection without ignition
- Ground fault protection must be free from false activation
- Procedures and physical means to prevent reset of ground fault protection
- Difficult to determine the condition of wiring in conduit
- Series electrical arcs must be contained by shields, conduit, or connectors until detected

# *Documenting Compliance*

- NM-01-04 and Amdt 25-102
  - Certification Plan Items
    - Means of compliance
      - compliance checklist
    - Documentation
      - SSA and applicable test results
      - Wiring Diagrams
      - Wiring Installation Drawings
      - Photographs
      - References to OAM wiring standards or equivalent
      - 25.1529 Instruction for Continued Airworthiness
        - Includes Critical Configuration Control Items for Amdt 25-102 Compliance

# *Data Package Level of Detail*

- Strain relief evidence for wire terminations
- Wire termination details (e.g. connectors, mod block, terminal lug stack-up, torque requirements, etc.)
- Shielding/grounding details
- Amdt 25-102 Considerations (Non fuel related systems)
  - Separation from low voltage wiring that enters the fuel tank
  - Separation from fuel tank walls, if necessary.
- Separation from existing wire bundles to address:
  - EMI conductance from other sources
  - EMI influence on other sources
  - Wire bundle arcing/fire common cause events

# *Data Package Level of Detail*

- All wire direction changes – including bend radii
- Wiring passing through bulkheads, lightening holes, etc.
- Clamping, stand-offs, tie-wrapping, and conduits and/or protective sleeving
- 3-dimensional locations of attachment points
- Reference to original aircraft type design wiring practices or compatible standards
- Special maintenance requirements (25.1529 requirement)
- Wire markings
- Wire size
- Wire/breaker sizing methods or reference
- Unused or excess wiring securing details

# *Data Package Level of Detail*



- A combination of diagrams, drawings, photographs and/or instructions, as necessary, can demonstrate compliance

# *Documenting Compliance*

- **NM-01-04 and Amdt 25-102**
  - **Engineering Compliance Inspection**
    - Recommend performing on first of a model/first of a design basis
    - In addition to normal conformity inspection
    - Performed by FAA or designee familiar with proposed design and FAA wiring policy
    - Applicant establishes means of documenting

# *FAA Wiring Practices Job Aid*

- Based on Mandatory FAA Training for Systems and Propulsion Engineers
- Available on the internet via the FAA Home Page
  - Click on Certification of Aircraft
    - Click on Transport Airplanes
      - Click on Aircraft Wiring Practices
- Can download all material
- A video course on Aircraft Wiring is available through OPI at 1-800-443-3827 or

# *FAA Wiring Practices Job Aid*

- Background
- Electrical Loads
- Breaker/Wire Sizing
- Wire Routing
- Clamping
- Tie-wraps
- Bend radii
- Splicing
- Wire terminations
- Grounding & Bonding
- Wire Marking
- Connectors
- Conduits
- Wire Insulation
- Wire Separation
- ICA
- Documentation

# *Wiring Practices and New Wiring Policy Briefings*



Any Questions .....??

# Thank You

