

Guide for inspecting electrical wiring installations

Rev B

Project number		MIDO tracking Number	
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This guide has been developed from the FAA Policy Statement Number ANM-01-04, titled “System Wiring Policy for Certification of Part 25 Airplanes”. Any conformity inspection performed for installation of electrical assemblies, wires, harnesses etc, should follow this guidance. The questions and or statements should be used as memory joggers that can affect how a conformity inspection is accomplished by the FAA inspector or designee. Should the answer be negative it will be necessary to note that on the conformity inspection report 8100-1 and request corrective action.

- A. The type and quality of data required for type design data packages and requirements for Instructions for Continuing Airworthiness are indicated in the regulations in section § 21.31 “Type design”. Section § 21.33(b), also provides additional insight as to the contents of the type design data package. Paragraph B and C below defines the two types of design approvals and the degree to which the inspections should be accomplished.

- B. Multiple approvals are approvals used for modifications that may be installed on any airplane of a specific type. These approvals require design data to define the installation so that it may be duplicated on another airplane by an installer. It is FAA’s policy to require that type design data for multiple approvals include the following:
 - 1. Do drawings completely define the configuration, material, and production processes necessary to produce each part in accordance with the certification basis of the product?
 - 2. Do drawings reference specification applicable to the installation of electrical components, harnesses?
 - 3. Do drawings completely define the location, installation, and routing, as appropriate, of all equipment in accordance with the certification basis of the product?
 - 4. If the modification being approved is a change to a type certificated product is the modification equivalent to and compatible with the previously approved type design standards?

- D. One-only approvals are approvals specific to the modification of only one aircraft by serial number. These modifications are often referred to as “one-only approvals.” For one-only approvals, duplication of the installation is not necessary and following (different) data standards may include:
 - 1. The use of photographs and other similar data to document the modification.
 - 2. Does the wiring diagrams and installation drawings contain the necessary information for proper installation.
 - 3. Do drawings adequately and clearly define the configuration of the model to be certificated?

E. Drawing review:

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1. Do drawings completely define specific routing and installation of wiring on the aircraft?
2. Do drawings or specifications identify specific clamping methods?
3. Verify that drawings do not leave the installation of the wiring to the discretion of the installer.
4. Are the installation and routing practices compatible with the standards established for in the original type design?
5. Do installation drawings and instructions completely define the required routing and installation with sufficient detail to allow repeatability of the installation?
6. Verify that drawings do not reference standard practices or other general guidance for installation details.
7. Verify that drawings do not include statements such as “install in accordance with industry standard practices,” or “install in accordance with AC 43.13.” (The FAA considers such statements inadequate because the standard practices cannot define the precise location or routing of the wiring)
8. Verify that drawings do not provide an abbreviated version of the installation and routing specifications that are used in the maintenance manuals. (These specifications may not be readily available to modifiers. This can result in “inadvertent non-compliance” with certification requirements)
9. Verify that guidance that is general in nature does not offer installers multiple options for compliance.
10. Do the drawings include a complete definition of the parts, including wiring and wire installation hardware, which clearly and completely identify, shape, material, production processes, any other properties affecting strength or functionality of each part, and the arrangement of each part in the final assembly?
11. Do drawings identify the material specification, heat treat, corrosion protection or other finish, and any other important characteristic of each part subject to test or analysis for showing compliance with the airworthiness requirements.
12. Do the drawings show, wire separation, wire types, wire bundle sizes, brackets, and clamping requirements?
13. Does the applicant use Original Aircraft Manufacturer (OAM) design standards and/or practices for a given installation? If so is the OAM specification shown on the drawing?

F. Specification review:

1. Verify that manufacturing process specifications are included referenced in the drawing pertaining to wiring installation details.

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2. Does the specification show acceptable measurements between wire harnesses and structure to prevent chaffing? The specification should not make references such as wires should not contact sharp surfaces, such statements are ambiguous and leave interpretation to the installer.
3. Does the specification require grommets or other protective devices to be installed to prevent chaffing of structure?
4. Does the applicant provide wiring diagrams showing source and destination of all airplane wiring associated with equipment installation?
5. Has the applicant included detailed requirements for the items in Paragraph G below? If not are the requirements covered in the drawings or wire diagrams?
6. Does the specification call out a clean as you go policy to protect the wires?

G. Installation inspections:

Support and clamping methods -

1. Are plastic tie wraps installed using a special clamping tool to ensure adequate tautness?
2. Are wire bundles sagging beyond drawing limits?
3. Are electrical wires properly supported by an adequate number of clamps in high vibration areas?
4. Are wire bundles containing critical wiring identified by the original manufacturer isolate from other systems?
5. Are stand-offs used to maintain clearance between wires and structure?
6. Are wires supported by suitable clamps, grommets, or other devices at intervals of not more than 24 inches?
7. Are supporting devices of a suitable size and type used with wire / cables to securely hold them in place without damage to wire or wire insulation?
8. Verify that clamps are not pinching the wires?
9. Are open-faced nylon clamps properly installed with tie wraps to secure the wires?

Protection methods-

8. Verify that wires or wire bundles are not chaffing the structure or sharp edges.
9. Verify that wire bundles are not installed in areas of contamination that affects the continued safe operation of the airplane.

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10. Are wire bundles that cross-secured together to avoid chafing?
11. Does the installation of wires minimize the exposure to damage by maintenance crews or shifting cargo?
12. Are wires protected in wheel wells and other exposed areas?
13. Are wires protected from moving objects, i.e. control cables, seat motors, actuators, pull rods, bell cranks, etc).
14. Is unused wiring properly terminated with exposed conductors capped (insulated) and secured to bundle?
15. Are grommets installed correctly to prevent chaffing of structure?
16. Are drip loops used to properly drain fluids or condensed moisture?
17. Is there enough slack in the wire to allow follow on maintenance and to prevent mechanical strain?
18. Have wires been protected and has all foreign objects been removed from the wire installation area (i.e. drill shavings, screws, nuts, etc)?
19. Does the wire installation avoid battery electrolytes or other corrosive fluids?
20. If needed, are electrical connectors properly safety wired, especially in high vibration areas?

Routing, splicing and locating methods-

19. Are electrical wires adequately routed in metal or opaque conduits especially in high vibration areas?
20. Are conduit ends properly covered to prevent fluids and FOD from entering?
21. Are unused wires ends properly capped, stowed, and secured per the drawing or specification?
22. When splicing wires into one another, is the proper size (gauge) wire being used?
23. Are wire bundles positioned in locations to eliminate or minimize the use as a handhold, step, or support?
24. Are wires routed above fluid lines, if practicable?
25. Are minimum bend radius being maintained as called out in the design drawing or specification?

H. Existing wiring inspection:

1. Is there any evidence of overheating that can be seen on the existing wiring in the modified area?

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2. Do replacement wires have the same shielding characteristics as the original wire, such as shield optical coverage and resistance per unit length?
3. Verify modification and replacement wires are not installed outside the bundle shield.
4. Is there evidence of chemicals (oil, hydraulic fluid, blue water, etc) on existing wires? If so, is the contamination being removed before the new wires are added?
5. Are existing wires and conduits in the modification affected area replaced when:
 - A. They show evidence of being crushed or kinked?
 - B. The shield on shielded wire is frayed and/or corroded?
 - C. Wire shows evidence of breaks and cracks, dirt, or moisture which has damaged the wires?

I. Terminal connections:

1. Are electrical terminal strips mounted in areas so loose metallic objects cannot fall across terminal?
2. Verify dissimilar metals in terminal stack-ups are not used to prevent corrosion? (i.e. cadmium washer between aluminum and copper terminals are used to prevent corrosion)
3. Are individual grounding brackets attached to aircraft structure with a proper metal-to-metal bond?
4. Verify there are no more than 4 lugs and a bus bar per stud.
5. Are aluminum lugs crimped to aluminum wires only?
6. Are certified crimping tools used and is it listed in the specification?
7. Are lock washers used, if required, and are they the correct size?
8. Are terminal assemblies properly torqued to specification requirements?
9. Are wires stripped to the dimension shown in the process specification?
10. Are terminal lugs deformed or bent beyond specification limits? (Bending straight terminal lugs more than one time causes the lugs to break or crack)
11. Are wire connectors clocked in accordance with the drawing?

J. Wire Marking:

1. Are wire markings legible in size, type, and color?
2. Are wire markings directly on wire or indirectly (sleeve/tag)?

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3. Are wires bundles installed so the part markings are readable without removing clamps, ties, or supporting devices?
4. Have wire markings damaged the wire insulation? *Some wire manufacturers use hot markers to ID wire bundles; such methods may damage the insulation exposing the copper conductor.*
5. Are wires identified with the wire type, circuit, and gauge size?

