Designation: F2696 – 14

Standard Practice for Inspection of Aircraft Electrical Wiring Systems[1]

This standard is issued under the fixed designation F2696; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers basic inspection procedures for electrical wiring interconnect systems for aircraft electrical wiring systems.

1.2 This practice is not intended to replace any instructions for continued airworthiness published by the aircraft or accessory manufacturer or type design holder.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *Military Standard:*[2]

MIL-C-85049 Connector Accessories, Electrical, General Specification for

2.2 *FAA Guidance Material:*[3]

FAA Advisory Circular 33.4-3 Instructions for Continued Airworthiness; Aircraft Engine High Intensity Radiated Fields (HIRF) and Lightning Protection Features

2.3 *SAE Documents:*[4]

SAE ARP1870 Aerospace Systems Electrical Bonding and Grounding for Electromagnetic Compatibility and Safety

SAE Aerospace ARP5583 Guide to Certification of Aircraft in a High Intensity Radiated Field (Hirf) Environment

3. Terminology

3.1 *Acronyms:*

3.1.1 *EWIS*—electrical wiring interconnection system

3.1.2 *HIRF*—high-intensity radiated fields

3.1.3 *ICA*—instructions for continued airworthiness

3.1.4 *LRU*—line-replaceable unit

3.1.5 *MS*—military standard

3.1.6 *MTBF*—mean time between failures

3.1.7 *PTFE*—polytetrafluoroethylene

3.1.8 *RF*—radio frequency

3.1.9 *STC*—supplemental type certificate (Federal Aviation Administration)

4. Significance and Use

4.1 The term “electrical system” as used in this practice means those parts of the aircraft that generate, distribute, and use electrical energy, including their support and attachments.

4.2 The satisfactory performance of an aircraft is dependent upon the continued reliability of the electrical system.

4.3 Damaged wiring or equipment in an aircraft, regardless of how minor it may appear to be, cannot be tolerated. It is, therefore, important that maintenance be accomplished using the best techniques and practices to minimize the possibility of failure.

4.4 When inspecting and evaluating EWIS, improper wiring, routing, or repairs shall be corrected regardless of the origin of the error.

4.5 This practice is not intended to supersede or replace any government specification or specific manufacturer’s instruction regarding electrical system inspection and repair

5. Causes of Wire Degradation

5.1 The following are considered the principal causes of wiring degradation and should be used to help focus maintenance programs:

5.1.1 *Vibration*—High-vibration areas tend to accelerate degradation over time resulting in “chattering” contacts and intermittent symptoms. High vibration of tie-wraps or string ties can cause damage to insulation. In addition, high vibration will exacerbate any existing wire insulation cracking.

[1] This practice is under the jurisdiction of ASTM Committee F39 on Aircraft Systems and is the direct responsibility of Subcommittee F39.02 on Inspection, Maintenance, and Repair.

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[2] Available from the U.S. Government Printing Office, Superintendent of Documents, Stop: SSOP, Washington, DC 20402-0001.

[3] Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, http://www.faa.gov.

[4] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

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5.1.2 *Moisture*—High-moisture areas generally accelerate corrosion of terminals, pins, sockets, and conductors. Note that wiring installed in clean, dry areas with moderate temperatures appears to hold up well.

5.1.3 *Maintenance*—Scheduled and unscheduled maintenance activities, if done improperly, may contribute to long-term problems and degradation of wiring. Metal shavings and debris have been discovered on wire bundles after maintenance, repair, or alteration work has been performed. Extra attention shall be given to EWIS inspections around areas of previous aircraft maintenance, repair, or alterations.

5.1.4 *Repair*—Since wire splices are more susceptible to degradation, arcing, and overheating, extra care shall be given when inspecting repaired wiring.

5.1.5 *Alterations*—Alterations introduce another area for enhanced scrutiny for similar reasons as repairs. In addition, an alteration may not be documented in the aircraft Instructions for Continued Airworthiness and therefore need independent inspection and a concern for proper wiring, attachments, mounting, and wiring routing.

5.1.6 *Indirect Damage*—Events such as pneumatic duct ruptures or duct clamp leakage can cause damage that, while not initially evident, can later cause wiring problems. When events such as these occur, surrounding EWIS shall be carefully inspected to ensure that there is no damage or potential for damage evident. Indirect damage caused by these types of events may be broken clamps or ties, broken wire insulation, or even broken conductor strands. In some cases, the pressure of the duct rupture may cause wire separation from the connector or terminal strip.

6. Procedure

6.1 *Inspection and Operation Checks*—Inspect equipment, electrical assemblies, and wiring installations for damage, general condition, and proper functioning to ensure the continued satisfactory operation of the electrical system. Adjust, repair, overhaul, and test electrical equipment and systems in accordance with the recommendations and procedures in the aircraft or component manufacturer's maintenance instructions or both. Replace components of the electrical system that are damaged or defective with identical parts, aircraft manufacturer's approved equipment, or its equivalent to the original in operating characteristics, mechanical strength, and environmental specifications. A list of suggested problems to look for and checks to be performed are:

6.1.1 Damaged, discolored, or overheated equipment, connections, wiring, and installations;

6.1.2 Excessive heat or discoloration at high-current-carrying connections;

6.1.3 Misalignment of electrically driven equipment;

6.1.4 Poor electrical bonding (broken, disconnected, or corroded bonding strap) and grounding, including evidence of corrosion;

6.1.5 Dirty equipment and connections;

6.1.6 Improper, broken, inadequately supported wiring and conduit, loose connections of terminals, and loose ferrules;

6.1.7 Poor mechanical or cold solder joints;

6.1.8 Condition of circuit breaker and fuses;

6.1.9 Insufficient clearance between exposed current-carrying parts and ground or poor insulation of exposed terminals;

6.1.10 Broken or missing safety wire, broken bundle lacing, cotter pins, and so forth;

6.1.11 Operational check of electrically operated equipment such as motors, inverters, generators, batteries, lights, protective devices, and so forth;

6.1.12 Condition of electric lamps; and

6.1.13 Missing safety shields on exposed high-voltage terminals (that is, 115/200 V ac).

6.2 *Functional Check of Standby or Emergency Equipment*—An aircraft should have functional tests performed at regular intervals as prescribed by the manufacturer.

6.3 *Bus Bars*—Annually check bus bars for general condition, cleanliness, and security of all attachments and terminals. Grease, corrosion, or dirt on any electrical junction may cause the connections to overheat and eventually fail. Bus bars that exhibit corrosion, even in limited amounts, shall be disassembled, cleaned and brightened, and reinstalled.

6.4 *Generating System*—Inspect generator(s)/alternator(s) for general condition, cleanliness, and security of attachment and terminals. Any sign of overheating terminals or wiring is reason for rejection. Inspect drive belts for condition and wear. Replace any belt showing signs of abnormal wear or overheating. Inspect brushes for proper condition and wear patterns. Inspect brush holders for condition and signs of arcing or overheating. Inspect voltage regulation components and wiring for condition and security. Inspect generator(s)/alternator(s) warning system for condition and operation.

6.5 *Battery Inspection*—Battery inspection procedures vary with the types of chemical technology and physical construction. Always follow the battery manufacturer's approved procedures. Battery performance at any time in a given application will depend upon the battery's age, state of health, state of charge, and mechanical integrity.

6.5.1 *Aircraft Battery Inspection:*

6.5.1.1 Inspect battery sump jar (if installed) and lines for condition and security.

6.5.1.2 Inspect battery terminals and quick-disconnect plugs and pins for evidence of corrosion, pitting, arcing, and burns. Clean as required. Inspect battery cables for condition and signs of chafing.

6.5.1.3 Inspect battery drain and vent lines for restriction, deterioration, and security. Battery drain areas shall be checked for signs of structure corrosion.

6.5.1.4 Routine preflight and postflight inspection procedures shall include observation for evidence of physical damage, loose connections, and electrolyte loss.

6.5.1.5 Perform capacity performance test of battery per manufacturer's instructions to ensure continued airworthiness.

6.5.1.6 Inspect battery warning system components (if installed) for condition and operation.

6.5.1.7 For nickel-cadmium battery installations, inspect battery temperature sensing, over-temperature warning, and battery failure-sensing systems for proper operation. Inspect

the means for disconnecting the battery(ies) for the charging source in the event of an over-temperature condition.

6.6 *Emergency Power Supply/Battery Inspection:*

6.6.1 Emergency power supplies or batteries shall be inspected and functionally tested per the manufacturer instructions.

6.6.2 Perform capacity performance tests of batteries per manufacturer's instructions to ensure continued airworthiness.

6.6.3 Inspect installations for condition, security, and routing of wiring.

6.7 *Electrical Switch Inspection:*

6.7.1 Special attention should be given to electrical circuit switches, especially the spring-loaded type, during the course of normal airworthiness inspection. An internal failure of the spring-loaded type may allow the switch to remain closed even though the toggle or button returns to the OFF position. During inspection, attention should also be given to the possibility that an unapproved switch substitution may have been made.

6.7.1.1 With the power off, suspect aircraft electrical switches should be checked in the ON position for opens (high resistance) and in the OFF position for shorts (low resistance) with an ohmmeter. A power-on check can be made by checking the voltage drop across the switch. A voltage drop across the switch indicates abnormal internal resistance of the switch contacts.

6.7.1.2 Any abnormal side-to-side movement of the switch should be an alert to imminent failure even if the switch tested was shown to be acceptable with an ohmmeter.

6.7.1.3 When a switch is activated, it should have a noticeable detent feel when switched. If a switch does not have a detent feel when switching, it is suspect and further inspection shall be done before considering it airworthy. Any switch with a soft or spongy feel when switched shall be replaced.

6.7.1.4 Each installed switch shall be labeled to indicate its operation and the circuit controlled.

6.8 *Wires, Cables, and Clamps*—Wires and cables shall be inspected for adequacy of support, protection, and general condition throughout. The desirable and undesirable features in aircraft wiring installations are listed in the following and indicate conditions that may or may not exist. Accordingly, aircraft wiring shall be visually inspected for the following requirements. (**Warning—**For personal safety and to avoid the possibility of fire, turn off all electrical power before starting an inspection or performing maintenance of the aircraft electrical system.)

6.8.1 Wires and cables are supported by suitable clamps, grommets, or other devices at intervals of not more than 24 in. (61 cm), except when contained in troughs, ducts, or conduits. The supporting devices shall be of a suitable size and type with the wires and cables held securely in place without damage to the insulation. Inspect wire and cable clamps for proper tightness. Where cables pass through structure or bulkheads, inspect for proper clamping and grommets. Inspect for sufficient slack between the last clamp and the electronic equipment to prevent strain at the cable terminals and to minimize adverse effects on shock-mounted equipment.

6.8.2 Mechanical standoffs shall be used to maintain clearance between wires and structure. Using tape or tubing is not acceptable as an alternative to standoffs for maintaining clearance.

6.8.3 Phenolic blocks, plastic liners, or rubber grommets are installed in holes, bulkheads, floors, or structural members where it is impossible to install off-angle clamps to maintain wiring separation. Inspect the EWIS to ensure separation between the wire and the hole, bulkhead, floor, or structural member.

6.8.4 Wires and cables in junction boxes, panels, and bundles are properly supported and laced to provide proper grouping and routing.

6.8.5 Clamp-retaining screws are properly secured so that the movement of wires and cables is restricted to the span between the points of support and not on soldered or mechanical connections at terminal posts or connectors.

6.8.6 Wire and cables are properly supported and bound so that there is no interference with other wires, cables, and equipment.

6.8.7 Wires and cables are adequately supported to prevent excessive movement in areas of high vibration.

6.8.8 Insulating tubing is secured by tying, tie straps, or with clamps.

6.8.9 Continuous lacing (spaced 6 in. (15 cm) apart) is not used except in panels and junction boxes where this practice is optional. When lacing is installed in this manner, outside of junction boxes, it shall be removed and replaced with individual loops.

6.8.10 Do not use tapes (such as friction or plastic tape) that will dry out in service, produce chemical reactions with wire or cable insulation, or absorb moisture.

6.8.11 Insulating tubing shall be kept at a minimum and shall be used to protect wire and cable from abrasion, chafing, exposure to fluid, and other conditions that could affect the cable insulation. However, the use of insulating tubing for support of wires and cable in lieu of standoffs is prohibited.

6.8.12 Do not use moisture-absorbent material as "fill" for clamps or adapters.

6.8.13 Ensure that wires and cables are not tied or fastened together in conduit or insulating tubing.

6.8.14 Ensure cable supports do not restrict the wires or cables in such a manner as to interfere with operation of equipment shock mounts.

6.8.15 Do not use tape, tie straps, or cord for primary support.

6.8.16 Ensure that drain holes are present in drip loops or in the lowest portion of tubing placed over the wiring.

6.8.17 Ensure that wires and cables are routed in such a manner that chafing will not occur against the airframe or other components.

6.8.18 Ensure that wires and cables are positioned in such a manner that they are not likely to be used as handholds or as support for personal belongings and equipment.

6.8.19 Ensure that wires and cables are routed, insofar as practicable, so that they are not exposed to damage by personnel moving within the aircraft.

6.8.20 Ensure that wires and cables are located so as not to be susceptible to damage by the storage or shifting of cargo.

6.8.21 Ensure that wires and cables are routed so that there is not a possibility of damage from battery electrolytes or other corrosive fluids.

6.8.22 Ensure that wires and cables are adequately protected in wheel wells and other areas in which they may be exposed to damage from impact of rocks, ice, mud, and so forth. (If rerouting of wires or cables is not practical, protective jacketing may be installed.) This type of installation shall be held to a minimum.

6.8.23 Where practical, route electrical wires and cables above fluid lines and provide a 6-in. (15-cm) separation from any flammable liquid, fuel, or oxygen line, fuel tank wall, or other low-voltage wiring that enters a fuel tank and requires electrical isolation to prevent an ignition hazard. Where 6-in. (15-cm) spacing cannot practically be provided, a minimum of 2 in. (5 cm) shall be maintained between wiring and such lines, related equipment, fuel tank walls, and low-voltage wiring that enters a fuel tank. Such wiring shall be closely clamped and rigidly supported and tied at intervals such that contact between such lines, related equipment, fuel tank walls, or other wires would not occur assuming a broken wire and a missing wire tie or clamp. If questions arise regarding proper spacing, the wire routing and clamping should be verified against the aircraft type design.

6.8.24 Ensure that a trap or drip loop is provided to prevent fluids or condensed moisture from running into wires and cables dressed downward to a connector, terminal block, panel, or junction box.

6.8.25 Ensure that wires and cables installed in bilges and other locations where fluids may be trapped are routed as far from the lowest point as possible or otherwise provided with a moisture-proof covering.

6.8.26 Ensure that wires are separate from high-temperature equipment, such as resistors, exhaust stacks, heating ducts, and so forth, to prevent insulation breakdown. Wires that must run through hot areas shall be protected with a high-temperature insulation material such as fiberglass or polytetrafluoroethylene (PTFE). Avoid high-temperature areas when using cables having soft plastic insulation such as polyethylene because these materials are subject to deterioration and deformation at elevated temperatures. Many coaxial cables have this type of insulation.

6.8.27 Ensure the minimum radius of bends in wire groups or bundles is not be less than ten times the outside diameter of the largest wire or cable, except that at the terminal strips where wires break out at terminations or reverse direction in a bundle. Where the wire is suitably supported, the radius may be three times the diameter of the wire or cable. Where it is not practical to install wiring or cables within the radius requirements, the bend shall be enclosed in insulating tubing. The radius for thermocouple wire shall be done in accordance with the manufacturer's recommendation and shall be sufficient to avoid excess losses or damage to the cable.

6.8.28 Ensure that radio frequency (RF) cables, for example, coaxial and triaxial, are bent at a radius of no less than six times the outside diameter of the cable.

6.8.29 Ensure that wires and cables that are attached to assemblies in which relative movement occurs (such as at hinges and rotating pieces, particularly doors, control sticks, control wheels, columns, and flight control surfaces) are installed or protected in such a manner as to prevent deterioration of the wires and cables caused by the relative movement of the assembled parts.

6.8.30 Ensure that wires and electrical cables are separated from mechanical control cables. In no instance should wire be able to come closer than ½ in. (1 cm) to such controls when light hand pressure is applied to wires or controls. In cases in which clearance is less than this amount, adequate support shall be provided to prevent chafing.

6.8.31 Ensure that wires and cables are provided with enough slack to meet the following requirements:

6.8.31.1 Permit ease of maintenance;

6.8.31.2 Prevent mechanical strain on the wires, cables, junctions, and supports;

6.8.31.3 Permit free movement of shock and vibration mounted equipment; and

6.8.31.4 Allow shifting of equipment, as necessary, to perform alignment, servicing, tuning, removal of dust covers, and changing of internal components while installed in aircraft.

6.8.32 Ensure that unused wires are individually dead-ended, tied into a bundle, and secured to a permanent structure. Each wire should have strands cut even with the insulation and a pre-insulated closed end connector or a 1-in. (2.5-cm) piece of insulating tubing placed over the wire with its end folded back and tied.

6.8.33 Ensure that all wires and cables are identified properly at intervals of not more than 15 in. (38 cm). Coaxial cables shall be identified at both equipment ends.

6.9 *Terminals and Terminal Blocks*—Inspect to ensure that the following installation requirements are met:

6.9.1 Insulating tubing is placed over terminals (except pre-insulated types) to provide electrical protection and mechanical support and is secured to prevent slippage of the tubing from the terminal.

6.9.2 Terminal module blocks are securely mounted and provided with adequate electrical clearances or insulation strips between mounting hardware and conductive parts, except when the terminal block is used for grounding purposes.

6.9.3 Terminal connections to terminal module block studs and nuts on unused studs are tight.

6.9.4 Evidence of overheating and corrosion is not present on connections to terminal module block studs.

6.9.5 Physical damage to studs, stud threads, and terminal module blocks is not evident. Replace cracked terminal strips and those studs with stripped threads.

6.9.6 The number of terminal connections to a terminal block stud does not exceed four unless specifically authorized.

6.9.7 Shielding shall be dead-ended with suitable insulated terminals.

6.9.8 All wires, terminal blocks, and individual studs are clearly identified to correspond to aircraft wiring manuals.

6.9.9 Inspect terminations to ensure terminals are of the proper size and properly crimped.

6.10 *Fuses and Fuse Holders*—Inspect as follows:

6.10.1 Check security of connections to fuse holders.

6.10.2 Inspect for the presence of corrosion and evidence of overheating on fuses and fuse holders. Replace corroded fuses and clean or replace fuse holders. If evidence of overheating is found, check for correct rating of fuse.

6.10.3 Check mounting security of fuse holder.

6.10.4 Inspect for replenishment of spare fuses used in flight. Replace with fuses of appropriate current rating only. There shall be one spare fuse of each rating or 50 % spare fuses of each rating, whichever is greater.

6.10.5 Inspect for exposed fuses susceptible to shorting. Ensure that, if a cover is required, the cover is of a nonconducting material.

6.10.6 Inspect for proper labeling of all fuses.

6.10.7 Inspect for all fuses that control essential-to-safety-in-flight loads for accessibility and identification to flight crew during flight.

6.11 *Circuit Breakers:*

NOTE 1—Circuit breakers that have a tendency to open circuits frequently, require resetting more than normal, or are subject to nuisance tripping should be replaced. Investigate the reason for the failure before considering their replacement.

6.11.1 Inspect circuit breakers for mounting security and condition. Breakers with broken or missing parts shall be replaced.

6.11.2 Inspect circuit breaker connections for signs of overheating and security of hardware connections. Inspect wiring and terminals connecting to the circuit breaker for condition and signs of overheating.

6.11.3 Cycle circuit breaker, with power off, to check for signs of proper detent action. Circuit breakers that have a soft or spongy feel during cycling indicate worn or failed conditions and may indicate an unairworthy part. Contact the circuit breaker manufacture for pass/fail criteria.

6.11.4 Inspect for proper labeling of all circuit breakers.

6.11.5 Resettable circuit breakers should be periodically cycled with no load to enhance contact performance by cleaning contaminants from the contact surfaces. Unless specified in the aircraft or component maintenance instructions, it is recommended that each resettable circuit breaker be pulled and reset as part of the aircraft annual inspection.

6.12 *Connectors*—Ensure reliability of connectors by verifying that the following conditions are met or that repairs are affected as required.

6.12.1 Inspect connectors for security and evidence of overheating (cause of overheating shall be corrected) and exteriors for corrosion and cracks. Also, wires leading to connectors shall be inspected for deterioration as a result of overheating. Replace corroded connections and overheated connectors.

6.12.2 Ensure installation of cable clamp (reference MIL-C-85049) adapters on applicable MS connectors, except those that are moisture proof.

6.12.3 See that silicone tape is wrapped around wires in MS3057 cable clamp adapters so that tightening of the cable clamp adapter cap provides sufficient grip on the wires to keep tension from being applied to the connector pins.

6.12.4 Ensure unused plugs and receptacles are covered to prevent inclusion of dust and moisture. Receptacles shall have metal or composite dust caps attached by their normal mating method. Plugs may have a dust cap similar to the ones above or have a piece of polyolefin shrink-sleeving shrunk over the connector, starting from the backshell threads, with a tail sufficiently long enough to doubleback over the connector and be tied with polyester lacing tape behind the coupling nut. The cable identification label shall be visible behind the connector or a tag should be attached identifying the associated circuit or attaching equipment. The connector shall be attached to the structure by its normal mounting means or by the use of appropriate clamps.

6.12.5 Ensure that connectors are fully mated by checking position and tightness of coupling ring or its alignment with fully mated indicator line on receptacle, if applicable.

6.12.6 Ensure that the coupling nut of MS connectors is safe tied, by wire or other mechanical locking means, as required by applicable aircraft instructional manuals.

6.12.7 Ensure that moisture-absorbent material is not used as "fill" for MS3057 clamps or adapters.

6.12.8 Ensure that there is no evidence of deterioration such as cracking, missing, or disintegration of the potting material.

6.12.9 Identical connectors in adjacent locations can lead to incorrect connections. When such installations are unavoidable, the attached wiring shall be clearly identified and shall be routed and clamped so that it cannot be mismatched.

6.12.10 Connectors in nonpressurized areas shall be positioned so that moisture will drain out of them when unmated. Wires exiting connectors shall be routed so that moisture drains away from them.

6.13 *Junction Boxes, Panels, Shields, and Microswitch Housings*—Examine housing assemblies to ascertain the following:

6.13.1 Verify that one or more suitable holes, about ⅜-in. (0.1-cm) diameter, but not less than ⅛-in. (0.3-cm) diameter, are provided at the lowest point of the box, except vapor-tight boxes, to allow for drainage with the aircraft on the ground or in level flight.

6.13.2 Verify that vapor-tight or explosion-proof boxes are externally labeled VAPOR-TIGHT or EXPLOSION-PROOF.

6.13.3 Verify that boxes are securely mounted.

6.13.4 Verify that boxes are clean internally and free of foreign objects.

6.13.5 Verify that safety wiring is installed on all lid fasteners on J-boxes, panels, shields, or microswitch housings that are installed in areas not accessible for inspection in flight, unless the fasteners incorporate self-locking devices.

6.13.6 Verify that box wiring is properly aligned.

6.13.7 Verify that there are no unplugged, unused holes (except drainage holes) in boxes.

6.14 *Conduit—Rigid Metallic, Flexible Metallic, and Rigid Nonmetallic*—Inspection of conduit assemblies should ascertain that:

6.14.1 Conduit is relieved of strain and flexing of ferrules.

6.14.2 Conduit is not collapsed or flattened from excessive bending.

6.14.3 Conduits will not trap fluids or condensed moisture. Suitable drain holes shall be provided at the low points.

6.14.4 Bonding clamps do not cause damage to the conduit.

6.14.5 Weatherproof shields on flexible conduits of the nose and main landing gear and in wheel wells are not broken; that metallic braid of weatherproof conduit is not exposed; and that conduit nuts, ferrules, and conduit fittings are installed securely.

6.14.6 Ends of open conduits are flared or routed to avoid sharp edges that could chafe wires exiting from the conduit.

6.15 *Junctions*—Ensure that only aircraft-manufacturer-approved devices, such as solderless-type terminals, terminal blocks, connectors, disconnect splices, permanent splices, and feed-through bushings are used for cable junctions. Inspect for the following provisions:

6.15.1 Electrical junctions shall be protected from short circuits resulting from movement of personnel, cargo, cases, and other loose or stored materials. Protection shall be provided by covering the junction, installing them in junction boxes, or by locating them in such a manner that additional protection is not required, and so forth.

6.15.2 Exposed junctions and buses shall be protected with insulating materials. Junctions and buses located within enclosed areas containing only electrical and electronic equipment are not considered as exposed.

6.15.3 Electrical junctions shall be mechanically and electrically secure. They shall not be subject to mechanical strain or used as a support for insulating materials, except for insulation on terminals.

6.16 *Identification Placards on Electrical Equipment*—Inspect for worn or missing placards.

6.17 *Minimum Wire Bend Radii*—The minimum radii for bends in wire groups or bundles shall not be less than ten times the outside diameter of their largest wire. They may be bent at six times their outside diameters at breakouts or six times the diameter where they shall reverse direction in a bundle, provided that they are suitably supported.

6.17.1 RF cables shall not bend on a radius of less than six times the outside diameter of the cable.

6.17.2 Care shall be taken to avoid sharp bends in wires that have been marked with the hot-stamping process.

6.18 *Slack*—Wiring shall be installed with sufficient slack so that bundles and individual wires are not under tension. Wires connected to movable or shock-mounted equipment shall have sufficient length to allow full travel without tension on the bundle. Wiring at terminal lugs or connectors shall have sufficient slack to allow two reterminations without replacement of wires. This slack shall be in addition to the drip loop and the allowance for movable equipment. Normally, wire groups or bundles shall not exceed ½-in. (1-cm) deflection between support points, as shown in Fig. 1. This measurement may be exceeded provided there is no possibility of the wire group or bundle touching a surface that may cause abrasion. Sufficient slack shall be provided at each end to:

6.18.1 Permit replacement of terminals,

6.18.2 Prevent mechanical strain on wires, and

6.18.3 Permit shifting of equipment for maintenance purposes.

6.19 *Bonding Inspection*—Inspect for the following:

6.19.1 If there is evidence of electrical arcing, check for intermittent electrical contact between conducting surfaces that may become a part of a ground plane or a current path. Arcing can be prevented either by bonding or by insulation if bonding is not necessary.

6.19.2 The metallic conduit shall be bonded to the aircraft structure at each terminating and break point. The conduit bonding strap shall be located ahead of the piece of equipment that is connected to the cable wire inside the conduit.

6.19.3 Bond connections shall be secure and free from corrosion. Check bolt and screw bond connections for proper maximum and minimum torque. Loose connections can cause poor and ineffective electrical connections.

6.19.4 Bonding jumpers shall be installed in such a manner as not to interfere in any way with the operation of movable components of the aircraft.

6.19.5 Self-tapping screws shall not be used for bonding purposes. Only standard threaded screws or bolts of appropriate size shall be used.

6.19.6 Exposed conducting frames or parts of electrical or electronic equipment shall have a low-resistance bond of less than 2.5 milliohms to structure. If the equipment design includes a ground terminal or pin, which is internally connected to such exposed parts, a ground wire connection to such terminal will satisfy this requirement. Refer to manufacturer's instructions.

6.19.7 Bonds shall be attached directly to the basic aircraft structure rather than through other bonded parts.

6.19.8 Bonds shall be installed to ensure that the structure and equipment are electrically stable and free from the hazards of lightning, static discharge, electrical shock, and so forth. To ensure proper operation and suppression of radio interference from hazards, electrical bonding of equipment shall conform to the manufacturer's specifications.

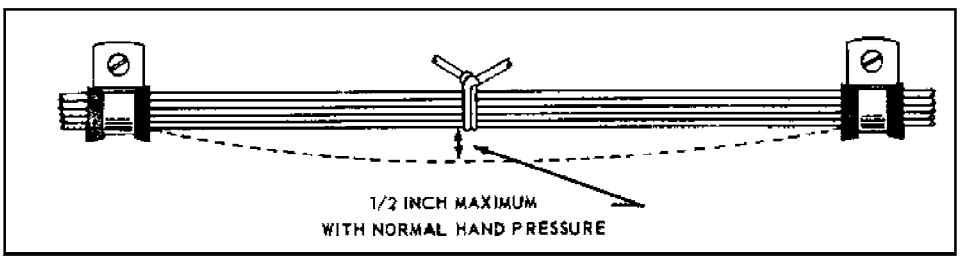

FIG. 1 Slack Between Supports

6.19.9 If the validity of a bond is in question, measurements shall be performed to determine if the measured resistance values meet the basic requirements.

6.19.10 Inspect bonding points to ensure appropriate washers are used when bonding aluminum or copper to dissimilar metallic structures so that any corrosion that may occur will be on the washer.

7. High Intensity Radiated Fields (HIRF)

7.1 High-intensity radiated fields protection provides the aircraft and its systems an effective method to reduce the effects of electromagnetic radiation from disrupting electrical and avionic systems. Effective maintenance and inspection programs are required to ensure the airworthiness of the design. Properly designed grounding and bonding methods make up a large portion of many HIRF protection systems on general aviation aircraft. Other methods used on general aviation aircraft include shielding (airframe and system components), wire shielding, and filtering. New designs have begun to also use fiberoptics as a design method of avoiding HIRF interference.

7.1.1 The primary purpose of the HIRF inspection program is to maintain the integrity of the HIRF protection design throughout the life of the aircraft. As with any system, as the aircraft ages, attention shall be focused on degradation of any installed system. The scope of any HIRF maintenance and inspection program will be directly related to the detail of the HIRF protection system installed.

7.1.2 A typical HIRF protection system consists of the following elements:

7.1.2.1 *Aircraft Structure*—Proper electrical bonding between structural components,

7.1.2.2 *Electrical Wiring Installation*—Consists of solid or braided shielding and connectors, and

7.1.2.3 *Equipment Protection*—Component cases and electronic protection.

7.1.3 Inspection personnel shall avoid disturbing the HIRF protection system components as much as possible during routine maintenance tasks of the aircraft. If HIRF protection system components must be moved or removed during maintenance, the manufacturer's assembly and repair instructions shall be followed to ensure the system is restored to the original condition.

8. Inspection of the HIRF Protection System

8.1 Inspection personnel shall use the manufacturer's service information and ICA to perform inspection of the HIRF protection system. Standard practices may not apply to electrical/electronic components that are part of the HIRF protection design.

8.2 Visual inspection is the primary method to determine the airworthiness of the HIRF protection system.

8.3 Inspection program should identify all HIRF protection system components including bonding/grounding connections, wire shielding, connectors, and so forth. Proper inspection techniques or electrical tests should be specific to address all airworthiness critical areas.

8.4 Repair of any system component that fails an electrical measurement test shall conform to manufacturer's instructions. If maintenance instructions are not available, any repair should require engineering approval.

8.5 Inspection personnel shall be aware of any modification to the HIRF protection component without adequate engineering approvals. Modification without proper engineering approvals shall be addressed.

8.6 Inspection personnel shall look for any rerouting of HIRF protection wiring components as this may reduce or eliminate the effectiveness of the protection.

9. Keywords

9.1 aircraft electrical wiring system; electrical system; electrical wiring system; inspection; wire

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