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DEPARTMENT OF DEFENSE
HANDBOOK

GUIDELINES FOR INSPECTION OF AIRCRAFT ELECTRICAL WIRING INTERCONNECT SYSTEMS

This handbook is for guidance only. Do not cite this document as a requirement.

AMSC N/A FSC 6145

FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense (DoD).

2. This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.

3. This handbook is a guide for aircraft Electrical Wiring Interconnect System (EWIS) inspection. In case of conflict between the aircraft/platform-specific maintenance manual and this handbook, the platform specific manual will take precedence. Not all possible wire systems factors have been addressed. This handbook captures in one document, under suitable subject heading, fundamental installation criteria guidelines. The opportunity to focus on a single document results in substantial savings to the Government.

4. All aircraft are filled with miles of wiring and hundreds of wiring devices that connect and transfer power and signals to and from electrical components. Virtually all aircraft systems rely heavily on some type of wiring for safe operation. Much like the structural components of an aircraft, the health and integrity of the EWIS can be significantly compromised due to premature aging, damage, and failure of wiring insulation. It is integral to the overall maintenance and sustainment of all aircraft that the EWIS be treated as a system and as a system be afforded the same level of importance as the aircraft structure and other critical flight control systems.

5. The majority of aircraft wiring in military service is of a thin-walled construction, and by its very nature, is susceptible to mechanical damage. However, there are several factors that may contribute to premature aging, damage, and failure of wiring insulation, including but not limited to:

a. Wire/Bundle location (Severe Wind and Moisture Problem (SWAMP) Areas)
b. Temperature cycling
c. Contamination
d. Improper installation
e. Mishandling
f. Poor maintenance practices
g. Lack of effective inspection and maintenance training
h. Battle damage

6. This handbook was prepared by, and is regularly updated through, the cooperative efforts of Government and industry. Applicable documents are listed in each individual guideline. Additional information regarding aerospace vehicle wiring requirements are found in SAE-AS50881 “Aerospace Vehicle Wiring.” Copies of SAE-AS50881 are available from the Society of Automotive Engineers at the address given in section 2 of this handbook.

7. When a Joint Service manual is referenced throughout this document, the Navy equivalent is listed in each guideline. For other services’ technical manual numbers, refer to table I. See 2.2 for information on how to obtain copies of maintenance manuals referenced in this handbook.

TABLE I. Topic and tri-service maintenance manual cross reference.

Manual Topic	Navy	Air Force	Army	USMC
General Wiring	01-1A-505-1	1-1A-14	1-1500-323-24-1	01-1A-505-1
Circular Connectors	01-1A-505-2	00-25-255-1	1-1500-323-24-2	01-1A-505-2
Rectangular Connectors	01-1A-505-3	00-25-255-2	1-1500-323-24-3	01-1A-505-3
Fiber Optics	01-1A-505-4	1-1A-14-4	1-1500-323-24-4	01-1A-505-4
Soldering/ESD	01-1A-23	00-25-259	5895-45/1C	5895-45/1D
Corrosion Program and Corrosion Theory	01-1A-509-1	1-1-689-1	1-1500-344-23-1	01-1A-509-1
Avionics and Electronics Cleaning and Corrosion Prevention/Control	01-1A-509-3	1-1-689-3	1-1500-344-23-3	01-1A-509-3

8. Comments, suggestions, questions or additional information on this document should be addressed to: Naval Air Warfare Center Aircraft Division, Code 4L8000B120-3, Highway 547, Lakehurst, NJ 08733-5100 or by email to michael.sikora@navy.mil. The technical content contained in this handbook has been provided by NAVAIR Wiring Systems Branch AIR 4.4.5.3 (48298 Shaw Road Bldg. 1461, Patuxent River, MD 20670-1161) and through the Joint Service Wiring Action Group (JSWAG) email: jswag@navy.mil; web site: http://www.navair.navy.mil/jswag.

CONTENTS

1. SCOPE 1
2 . APPLICABLE DOCUMENTS 1
3. DEFINITIONS 2
4. GENERAL GUIDELINES 5
5. DETAIL GUIDELINES 5
6. NOTES 5
GUIDELINE 1 6
INTRODUCTION AND INSPECTION TECHNIQUES 6
GUIDELINE 2 8
INCOMING WIRE INSPECTION FROM THE SUPPLY SYSTEM 8
GUIDELINE 3 11
INSULATION INSPECTION 11
GUIDELINE 4 14
CONNECTOR MATING INSPECTION 14
GUIDELINE 5 17
COAXIAL CABLE INSTALLATION INSPECTION 17
GUIDELINE 6 19
PROPER CAPPING AND STOWAGE OF CONNECTORS 19
GUIDELINE 7 22
PROPER MARKING OF WIRE/FIBER OPTIC AND CABLE HARNESSES 22
GUIDELINE 8 24
MECHANICAL STRIPPING WIRE INSPECTION 24
GUIDELINE 9 28
MECHANICAL STRIPPING/SHIELDING REMOVAL INSPECTION 28

CONTENTS

GUIDELINE 10 30
THERMAL/LASER STRIPPING CABLE JACKET INSPECTION 30
GUIDELINE 11 32
HARNESS ROUTING INSPECTION 32
GUIDELINE 12 34
CABLE HARNESS COVERING OR PROTECTION INSPECTION 34
GUIDELINE13 38
CABLE HARNESS BEND RADIUS INSPECTION 38
GUIDELINE 14 40
PRIMARY SUPPORT CABLE CLAMP INSPECTION 40
GUIDELINE 15 47
WIRE/HARNESS CLEARANCE INSPECTION 47
GUIDELINE 16 49
SPOT TIE/LACING TAPE/CORD INSPECTION 49
GUIDELINE 17 54
HARNESS DRIP LOOP INSPECTION 54
GUIDELINE 18 56
TIE DOWN STRAP, PLASTIC, SELF-CLINCHING (ZIP TIE) INSPECTION 56
GUIDELINE 19 58
EMI SHIELD WRAP-AROUND REPAIR INSPECTION 58
GUIDELINE 20 60
SHIELD CRIMP RING INSPECTION 60

CONTENTS

GUIDELINE 21 62
CONTACT CRIMP INSPECTION 62
GUIDELINE 22 64
TERMINAL LUG CRIMP INSPECTION 64
GUIDELINE 23 67
SPLICE INSPECTION 67
GUIDELINE 24 70
SOLDER SLEEVE/SHIELDING TERMINATION INSPECTION 70
GUIDELINE 25 72
SOLDER INSPECTION 72
GUIDELINE 26 74
BONDING STRAP/JUMPER INSPECTION 74
GUIDELINE 27 76
LOCK WIRE/SAFETY CABLE INSPECTION 76
GUIDELINE 28 80
TERMINAL BOARD, GROUND STUD, AND BACKSHELL INSPECTION 80
GUIDELINE 29 84
CONNECTOR INSPECTION 84
GUIDELINE 30 88
CONNECTOR STRAIN RELIEF INSPECTION 88
GUIDELINE 31 90
CONNECTOR BACKSHELL INSPECTION 90

CONTENTS

GUIDELINE 32 92

PRESERVATION OF CONNECTOR COMPONENT INSPECTION 92

GUIDELINE 33 95

CIRCUIT BREAKER INSPECTION 95

CONCLUDING MATERIAL 98

1. SCOPE

1.1 Guidelines applicable to aircraft Electrical Wiring Interconnect Systems (EWIS). This handbook provides guidance and lessons learned in the inspection of EWIS. This handbook is for guidance only and cannot be cited as a requirement. If it is, the contractor does not have to comply.

1.2 Re-dating. Although individual guidelines are reviewed and updated or validated at least once every eighteen months, guidelines are not re-dated unless technical changes are made.

1.3 Method of reference. Guidelines contained herein should be referenced by specifying this handbook and the guideline number for guidance only.

1.4 Interrelationship of guidelines. Each guideline is intended to cover some discipline in the inspection of EWIS, such as a procedure, a process, or the selection and application of parts and materials. Many of these disciplines, however, cannot retain a clear-cut separation or isolation from others so that when guidelines of MIL-HDBK-522 are referenced in a specification some guidelines will undoubtedly have a direct interrelationship with other guidelines. This interrelationship should be taken into consideration when referencing these guidelines.

2. APPLICABLE DOCUMENTS

2.1 Individual guidelines. See section 2 of each individual guideline for a listing of applicable documents. Documents referenced in the individual documents apply to the extent specified herein.

(Copies of military documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2 Copies of maintenance manuals. Copies of maintenance manuals NA 01-1A-505-1 thru -4, may be obtained by DoD employees and uniformed users by going to the NATEC site https://mynatec.navair.navy.mil/ and using their Common Access Card (CAC) to access the documents. Commercial entities requesting copies of these documents should reference this site for maintenance manual access via the freedom of information act requests.

2.3 Industry addresses. Addresses for obtaining documents referenced in the guidelines but not obtainable from the Government are as follows:

NEMA — National Electrical Manufacturers Association
1300 North 17th Street Suite 1752
Roslyn, Virginia 22209
Online: http://www.nema.org

SAE — Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, PA 15096-0001 USA
Online: http://www.sae.org

3. DEFINITIONS

3.1 Airborne, space, aerospace. "Airborne" denotes those applications peculiar to aircraft and missile or other systems designed for operation primarily within the earth's atmosphere; "space" denotes application peculiar to spacecraft and systems designed for operation near or beyond the upper reaches of the earth's atmosphere; and "aerospace" includes both airborne and space applications.

3.2 Bend radius. Maximum amount a wire, cable, fiber, or fiber cable can be bent without causing damage. Usually called minimum safe bending radius.

3.3 Bird Cage. Defect in stranded wire where the strands in the stripped portion between the covering of an insulated wire and a soldered connection (or an end-tinned lead) have separated from the normal lay of the strands.

3.4 Bonded assembly. Connector assembly in which the components are bonded together using an electrically appropriate adhesive in a sandwich type structure. Provides sealing against moisture and other environmental conditions which weaken electrical insulating properties.

3.5 Chamfer. Funnel type angle on the inside edge of the barrel entrance of a connecter insert and/or socket contact, which permits easier insertion of a pin contact into the barrel.

3.6 Coaxial cable. Cable consisting of two cylindrical conductors with a common axis. The two conductors are separated by a dielectric. The outer conductor or shield, normally at ground potential, acts as a return path for current flowing through the center conductor and prevents energy radiation from the cable. The outer conductor is commonly used to prevent external radiation from affecting the current flowing in the inner conductor. The outer conductor consists of woven strands of wire or is a metal sheath.

3.7 Conduit. Tube or trough in which insulated wires and cables are run.

3.8 Connector. Describes all interface devices, either plug or receptacle, used to provide rapid connect/disconnect service for electrical cable and wire interconnections. A fixed connector is used for attachment to a rigid surface, while a free connector mates with the wire or cable. Connectors used in military applications generally fall into three broad categories: single contact coaxial connectors, circular multi-contact connectors, and rectangular multi-contact connectors.

3.9 Discrepancy. A clearly identifiable deviation from the original design of the system as identified in the source data.

3.10 Dust Cover. Item that is specifically designed to cover the mating end of a connector for mechanical and/or environmental protection.

3.11 Electrical Wiring Interconnect System (EWIS). Known as aircraft wiring, is defined as any wire, fiber optic link, wiring or fiber device, or a combination of these items (including

terminations) installed in any area of the aircraft for the purpose of transmitting electrical energy, signals, or data between two or more electrical end points.

3.12 Electromagnetic Interference (EMI). Frequency spectrum of electromagnetic radiation extending from subsonic frequency to X-rays. Shielding materials for the entire EMI spectrum are not readily available.

3.13 Environmentally sealed. Device that is provided with gaskets, seals, grommets, potting, or other means to keep out moisture, dirt, air, or dust which might reduce performance. Does not include non-physical environments such as Radio Frequency (RF) and radiation.

3.14 Grommet. Rubber seals that are placed in the cable side of a connector with hole patterns that correspond to the insert configuration. The wires entering the rear of the connector go through the grommet and are affixed to the contacts. Inside the rubber grommet are one or more seals which hold themselves against the wire and prevent moisture and dirt from entering the contact cavity.

3.15 Harness. Assembly of wires and/or cables arranged so they may be installed or removed as a unit.

3.16 Heat shrinkable. Term describing tubes, sleeves, caps, boots, films, or other forms of plastic which shrink to encapsulate, protect, or insulate connections, splices, terminations, and other configurations with the application of heat. Heat shrinkable sleeves are typically defined in SAE-AMS-DTL-23053.

3.17 Lacing tape. Flexible, flat fabric tape for tying harnesses and wire bundles, securing of sleeves and other items, and general lacing and tying applications. Available in various materials and impregnants.

3.18 Lay. Lay of any helical element of a cable is the axial length of a turn of the helix of that element. Among the helical elements of a cable may be each strand in a concentric-lay cable or each insulated conductor in a multi-conductor cable. Lay is often referred to as pitch.

3.19 Lay, direction of. Direction in which the strands or a conductor or components in a cable pass over the top of the bundle as they recede from an observer looking along the axis of the conductor or cable. Termed right hand or left hand (see lay).

3.20 Marker tape. Tape laid parallel to the conductors under the sheath in a cable, imprinted with the manufacturer's name and the specification to which the cable is made.

3.21 Plating. Overlaying of a thin coating of metal on metallic components to improve conductivity, provide for easy soldering, or prevent rusting or corrosion.

3.22 Polyimide. High temperature thermoplastic resins available as molded parts, injection molding compounds, glass reinforced compression molding compounds, potting and encapsulating compounds, and plastic film and coatings for fabrics and wire. Polyimides have a wide range of physical and mechanical properties including high resistance to oxidative degradation, weathering,

radiation, and all chemicals except strong bases; excellent resistance to abrasive and frictional wear; and excellent mechanical and electrical properties which can be retained during continuous use at 480 degrees F (248.9 degrees C) in air.

3.23 Potting. Process of completely enclosing an article in an envelope of liquid dielectric material which then changes to a solid. Potting is performed to improve and protect the electrical functions of the unit. The compound acts as a dielectric and provides strain relief and protection to the unit from the environment.

3.24 Routing. Path followed by a cable or conductor.

3.25 Safety wire. Securing wire used to prevent the loosening or vibrating free of the attached part.

3.26 Severe Wind and Moisture Problem (SWAMP) areas. Areas such as wheel wells, wing folds, areas near wing flaps, and areas directly exposed to extended weather conditions are considered SWAMP areas on aerospace vehicles.

3.27 Spiral wrap. Term given to describe the helical wrap of a tape or thread over a core.

3.28 Strand. One of the wires or groups of wires of any stranded conductor.

3.29 Strand lay. Distance of advance of one strand of a spirally stranded conductor, in one turn, measured axially (see lay).

3.30 Stranded conductor. Conductor composed of a group of wires or of any combination of groups of wires. The wires in a stranded conductor are usually twisted or braided together.

3.31 Stress relief chamfer. Predetermined amount of slack to relieve tension in components to avoid stress between terminations.

3.32 Stripping wire. Removal of a predetermined portion of insulation without affecting the mechanical or electrical characteristics of the conductor or the remaining insulation.

3.33 Tape, pressure sensitive. Pressure sensitive tapes contain an adhesive coating applied to the backing material which allows the backing to be positioned with application of pressure only. The use of an activator such as heat, solvent, or water is not required. The two primary functions of electrical pressure sensitive tapes are holding and insulating. These tapes are commonly adhered to conductors or other insulating devices and serve the purpose of holding or anchoring them in a desired manner.

3.34 Tape wrap. Term denoting a spirally or longitudinally applied tape material wrapped around the wire, either insulated or uninsulated, and used as an insulation or mechanical barrier.

3.35 Terminal. Metal wire termination devices designed to handle one or more conductors, to be attached to a board, bus, or block with mechanical fasteners, or clipped on. Types include ring,

tongue, spade, flag, hook, blade, quick-connect, off-set, and flanged. Special types include taper pin, taper tab, and others, either insulated or non-insulated.

3.36 Terminal lug. Device designed to be affixed, usually at one end, to a post, stud, chassis, or similar device, and with provision for attachment of an electrical conductor(s) in order to establish an electrical connection.

4. GENERAL GUIDELINES

4.1 Application. The guidelines contained herein are intended to provide guidance applicable to EWIS, unless otherwise indicated in the guideline.

4.2 Use of selection and application standards. When a selection and application standard is referenced in a guideline, the devices or parts selected should conform to the applicable military and or commercial specifications referenced in the standard.

5. DETAIL GUIDELINES

5.1 Individual guidelines for EWIS inspection. The individual guidelines for EWIS are located after section 6.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The guidelines in this document are intended to provide information on the proper tools and procedures for repairing and maintaining the EWIS.

6.2 Subject term (key word) listing.

Circular connectors
Corrosion prevention
Electronics cleaning
Fiber Optics
Maintenance procedures
Pressure sensitive tape
Rectangular connectors
Severe Wind and Moisture Problem Areas
Soldering
Stress relief chamfer

GUIDELINE 1

INTRODUCTION AND INSPECTION TECHNIQUES

1. Purpose. This guideline demonstrates proper inspection techniques used when working with the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 004 01	Aircraft Wiring System Inspection.
Work Package 028 00	Protective Devices Installation and Repair Practices.

3. Definitions.

3.1 See section 3 of this handbook.

4. General guidelines.

4.1 General inspection guidelines. The following tools and techniques should be used when performing inspections on EWIS:

a. To prevent electrical shock, ensure electrical power is off before commencing inspection.

b. A mirror and a flashlight should be used (see figure 1-1).

> NOTE: A bright white light (not red or night vision green) with an incandescent (conventional) bulb has been shown to be the most effective in identifying discrepancies. LED light bulbs are not recommended for inspections.

c. When inspecting EWIS areas, it is important to inspect the areas behind, under, and on top of all EWIS components. Areas that are hidden from view should be inspected using a mirror and flashlight.

d. If debris or contaminants are covering the wire system and components to be inspected, clean to a level where a thorough inspection can be performed (see table I for service specific manual for cleaning).

e. Inspect entire wiring system in the zone, panel, or opening.

f. Use a consistent approach for each zone (e.g., left to right, top to bottom) and repeat for subsequent zones to be inspected.

g. Record each discrepancy as identified in that zone.

h. Correct all discrepancies as soon as possible starting with the safety discrepancies first.

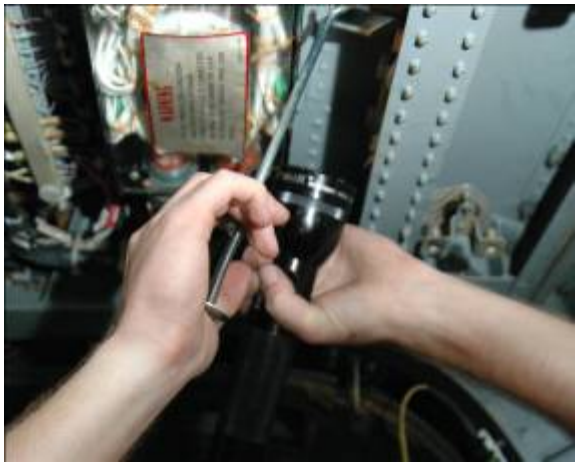
i. Document uncorrected findings in applicable aircraft forms/logbooks for correction at the next scheduled maintenance opportunity.

j. Additional information regarding inspection practices and techniques is available in NA 01-1A-505-1, Work Packages 004 01 and 028 00.

5 Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

Acceptable
Proper tools for inspecting EWIS: Flashlight and mirror.



Acceptable
Proper use of a mirror and flashlight inspecting a wiring harness.

FIGURE 1-1. EWIS inspection tools.

GUIDELINE 2

INCOMING WIRE INSPECTION FROM THE SUPPLY SYSTEM

1. Purpose. This guideline demonstrates incoming wire inspection criteria for wire used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 004 00	Wire Characteristics, Replacement and Inspection Techniques.

3. Definitions.

3.1 See section 3 of this handbook.

4. General guidelines.

4.1 General inspection guidelines. The following steps should be followed when inspecting incoming wire received from the supply system:

a. Visually examine the wire marking or label to confirm that it is legible.

b. Visually inspect wire for physical damage such as nicks, cuts, burrs, abrasion, etc. (see figure 2-1).

c. Visually inspect both ends of wire by stripping off the last one inch of wire insulation, untwist strands and closely examine conductor for any signs of corrosion.

d. Verify that both exposed ends of the wire and cable are terminated using a termination cap or environmental splice shrink sleeve when not in use on the spool to prevent wicking of moisture or conductor corrosion.

e. Verify that qualified wires are received from the supply system on spools and are marked every six or twelve inches (see figures 2-2 and 2-3). Refer to the applicable Qualified Products List (QPL) for approved wiring system components. Copies of QPLs are available from the ASSIST database at https://assist.daps.dla.mil/quicksearch/ or http://www.navair.navy.mil/qpl/default.aspx.

f. Additional information regarding incoming wire inspection is available in the NA 01-1A-505-1, Work Package 004 00.

5. Detail guidelines. This is section is not applicable to this guideline.

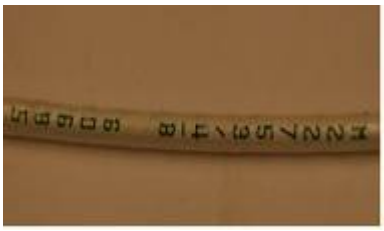
6. Notes. This is section is not applicable to this guideline.

		
Acceptable Typical wire conductor without any corrosion.	**Unacceptable** Broken strands and signs of corrosion on conductor/shielding.	**Unacceptable** Severe corrosion on wire conductor.

FIGURE 2-1. Examples of acceptable and unacceptable conductors.

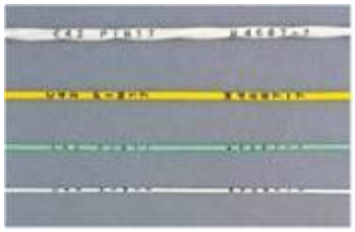
		
Acceptable Wire is received from supply on a spool with identification label.	**Unacceptable** Wire received from supply in an unusable condition. Wire is not on a spool.	**Unacceptable** Wire received from supply in an unusable condition. Wire is in several short segments.

FIGURE 2-2. Examples of acceptable and unacceptable wire received from supply system.



Acceptable
QPL wire with proper CAGE and part number markings from the manufacturer.

Unacceptable
No wire marking on wire.



Unacceptable
Incorrect wire marking. Does not have proper CAGE and part number.

FIGURE 2-3. Examples of acceptable and unacceptable wire marking.

GUIDELINE 3

INSULATION INSPECTION

1. Purpose. This guideline demonstrates wire or cable insulation inspection criteria for wire and cable used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 004 01	Aircraft Wiring System Inspection.
NA 01-1A-505-4	Aircraft Fiber Optic Cabling Manual.
Work Package 014 01	Emergency Repairs (Army and Navy Only).

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection and repair guidelines. The following steps should be followed when inspecting and repairing wire insulation.

a. Examine wire or cable insulation for physical damage or damage due to heat or exposure to fluids (see figure 3-1). Examples include, but are not limited to:

1. Cracking, peeling, chafing, or flaking of insulation.

2. Radial cracking (along cabling circumference).

3. Heat damage: melting, scorching, charring and blistering.

4. Fluid/moisture effects: swelling, blistering or cracking.

5. Mechanical damage due to installation or removal of equipment, crew movement, shifting cargo, which causes crushed, cut, stretched or missing wires or cables.

b. Examine polyimide insulation that is routed through SWAMP areas, dry areas, and for heat and arcing damage (see figure 3-2).

1. Inspect polyimide insulated wiring that is routed through SWAMP areas for missing, flaking, or peeling topcoat from insulated wire or cable. If any of these types of damage are found, they are considered a discrepancy. In addition, inspect wire harnesses for exposure to contaminants such as oil, fuel, and hydraulic fluid saturation, and if present, determine the source and correct.

2. Inspect polyimide insulated wiring in/through dry areas for missing, flaking, or peeling topcoat. If there is no evidence of damaged or deteriorated insulation under the

topcoat, the condition of the wire insulation is considered to be acceptable. If there is deterioration of insulation, it is considered a discrepancy.

3. Inspect the polyimide wire for damage due to overheating and arcing.

a. Verify that the insulation sleeve is not darkened or opaque brown.

b. Examine cable insulation to confirm that it is not melted, blistered, or charred.

c. Repair the wire as follows:

c. Repair or replace any wire or section having insulation which shows signs of cracking, peeling, melting, scorching, charring, blistering, or swelling. Also repair or replace any wire with insulation that is crushed, cut, chafed, stretched, missing, flaking, deteriorating, or shows evidence of abrasion or fluid saturation, excluding polyimide topcoat. Any overheated or arced section of wire should be removed and replaced. See NA 01-1A-505-1 and the platform specific manual for wire repair procedures and guidance.

d. Additional information regarding insulation inspection is available in the NA 01-1A-505-1, Work Package 004 01. Information regarding the inspection of fiber optic cables and insulation is available in NA 01-1A-505-4, Work Package 014 01.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

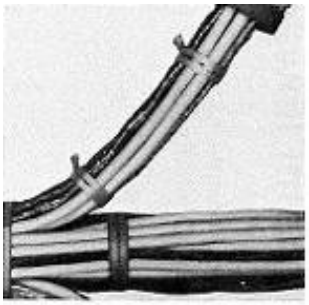
Acceptable
Insulation is not damaged, chafed, or flaking.

Unacceptable
Radial crack in the insulation.

Acceptable
Polyimide/Kapton insulation topcoat flaking shows degradation, but serviceable since no bare conductor exposed.

Unacceptable
Polyimide/Kapton insulation removed, exposed bare conductor. Damaged wire section requires repair or replacement.

FIGURE 3-1. Examples of insulation in acceptable and unacceptable condition.



Acceptable
Serviceable wire harness with no signs of damage.

Unacceptable
Arc tracking

Unacceptable
Overheating seen as a discoloration of the insulation (brown) compared to the white insulated wire.

Unacceptable
Overheating seen at the splice termination.

FIGURE 3-2. Examples of an undamaged wiring harness and wire damaged due to arc tracking and overheating.

GUIDELINE 4

CONNECTOR MATING INSPECTION

1. Purpose. This guideline provides criteria for inspecting connectors used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

MIL-DTL-38999	Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification for.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual
Work Package 004 01	Aircraft Wiring System Inspection.
Work Package 010 00	Harness Installation.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. The following steps should be followed when inspecting connectors used in the EWIS:

a. Before coupling the connector, examine the mating halves for:

1. Properly seated contacts.

2. Confirm that all cavities are filled with contacts (except unused cavities for coaxial contacts).

3. Verify that there are no bent contacts.

4. Confirm that unwired cavities are fitted with the proper sealing plugs.

5. Verify that the applicable backshell, if required, is tightened on connector, and where cable clamp is used, saddle bars are tightened.

b. After examination and mating, verify connector has locked or is tight, depending on type. When a threaded connector has no indicator line, make certain that it has been sufficiently tightened. If the connector has a mating indicator line, the following procedure should be followed:

1. Check for proper location of the red, locked indicator band on MIL-DTL-38999 series 3 connectors. If the red band is properly located and the connector is fully mated, the red band is not visible. If the connector is fully mated and the red band is visible, two conditions may apply (see figure 4-1):

a. The red band has been mislocated on the receptacle but the connection system otherwise functions as designed.

b. The red band is correctly located on the receptacle or plug but red band is mis-located on mating connector half due to allowable tolerances defined in MIL-DTL-38999K. This condition has been corrected in MIL-DTL-38999L, but these connectors may still be in the supply system. If this condition exists, use the steps given in this guideline to confirm that the connector is properly mated and mark the connector as shown in figure 4-2.

c. If the connector has a bayonet system, the following procedure should be followed:

1. The bayonet system employs three locking pins spaced 120 degrees apart on the outside perimeter of the receptacle.

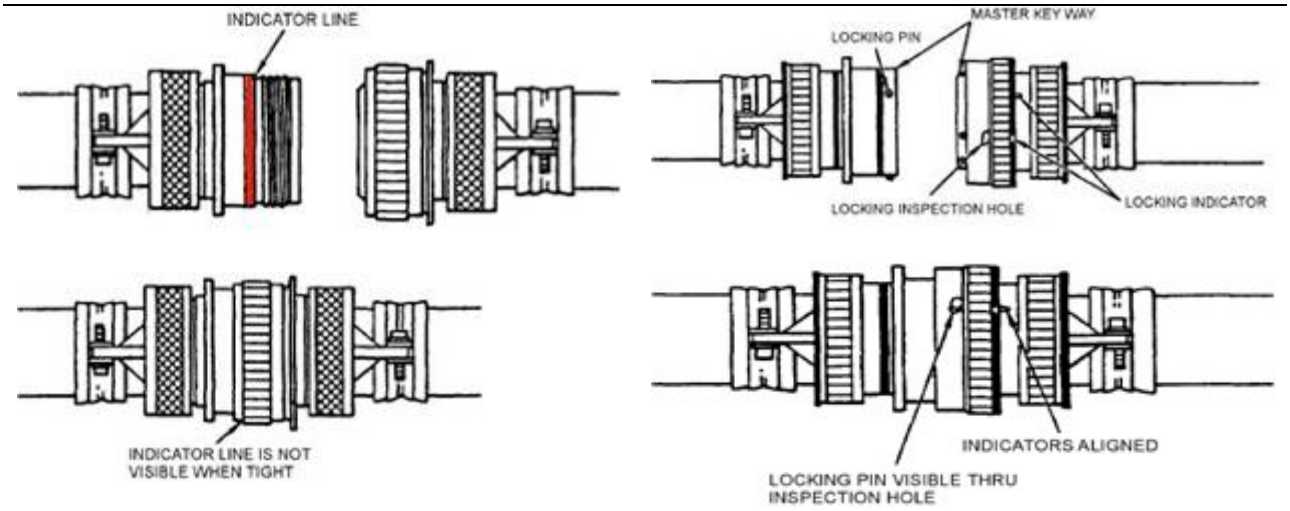
2. Make sure that all locking pins of the coupling are engaged.

3. When connected, verify that the locking pins are visible through the inspection holes. The locking pins are usually colored white or blue.

d. Additional information regarding connector mating inspection is available in NA 01-1A-505-1, Work Packages 004 01 and 010 00.

5 Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

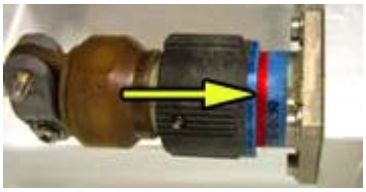


Acceptable **Acceptable**

FIGURE 4-1. Example of correctly mated connectors using a red locked indicator band and locking pin with inspection hole.

Acceptable
Upon successful system functional test (all applicable systems pass), a yellow stripe is marked on the receptacle.

Acceptable
Plug indicating a known mislocated red band on an otherwise functional receptacle.



Unacceptable
The red band is visible and has no yellow marking stripe.

FIGURE 4-2. Examples of marking yellow stripes on connectors.

GUIDELINE 5

COAXIAL CABLE INSTALLATION INSPECTION

1. Purpose. This guideline provides criteria for the inspection of coaxial cable installed in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 006 00	Radio Frequency (RF) Cable Chracteristics and Replacements.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting cable harnesses that include coaxial cables the following items should be checked:

a. Cable clamps and spot ties used on coaxial cables should be examined to confirm that they are not excessively tight. Only A-A-52083 or A-A-52084 lacing tape/tie string should be used for tying wire and cable bundles containing coaxial cables. Figure 5-1 shows the proper use of lacing tape/tie string.

b. Confirm that coaxial cable is routed as directly as possible.

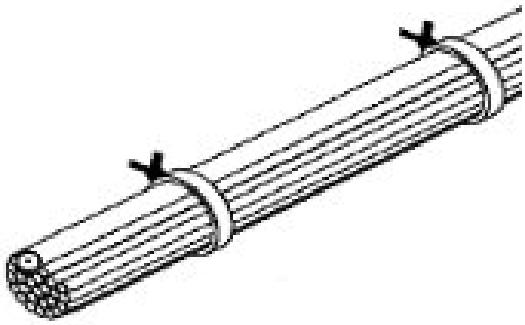
c. Verify that the minimum bend radius requirements are not violated (if none noted, use 10 times the diameter of the largest cable in the harness) (see figure 5-1).

d. Confirm that unnecessary or sharp bends are avoided to preserve the cable's dielectric integrity.

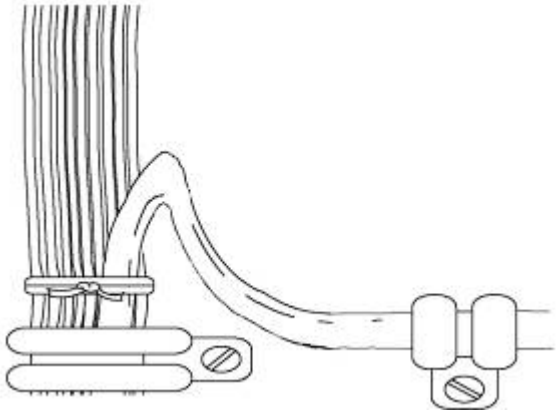
e. Additional information regarding coaxial cable inspection is available in NA 01-1A-505-1, Work Package 006 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.



Acceptable
Cable using A-A-52083 or A-A-52084 lacing tape



Unacceptable
Coax cable with an excessive bend radius

FIGURE 5-1. Examples of acceptable use of lacing tape and a coaxial cable with excessive bend radius.

GUIDELINE 6

PROPER CAPPING AND STOWAGE OF CONNECTORS

1. Purpose. This guideline provides inspection criteria and procedure for the proper capping and stowing of connectors used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
A-A-59163	Insulation Tape, Electrical, Self Adhering Unsupported Silicone Rubber.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 007 00	Connectors, Wiring and Harness Stowage for Operational and Non-operational Aircraft.
Work Package 026 00	Connector Cleaning and Preservation.
NA 01-1A-505-4	Aircraft Fiber Optic Cabling Manual.
Work Package 012 02	Dust Cover Preparation and Capping Methods.
SAE-AS21919	Clamp, Loop Type, Cushioned, Support. (DoD adopted)
SAE-AS81765/4	Insulating Components, Molded, Electrical, Heat Shrinkable Fluoroelastomer, Flexible, Crosslinked. (DoD adopted)

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When fiber optic and electrical connectors are capped or stowed in the EWIS, the following procedures should be followed:

a. If fiber optic termini are installed in the connectors used in the EWIS, refer to NA 01-1A-505-4 for identification and follow-on maintenance procedures.

b. If electrical connectors are being examined for proper capping or covering using pressure sensitive tape, the following actions should be taken:

1. Ensure that the connector is clean and the exterior has corrosion preventative compound sparingly applied. See NA 01-1A-505-1, Work Package 026 00 for further information.

2. Ensure that an authorized capping method is employed based on application (operational/non-operational) and duration (short/long term).

a. Metal cap/plug. When inspecting a connector using a metal cap or plug, verify that the connector is clean and that a military standard protective metal cover is used (see figure 6-1).

b. Plastic connector covers are only to be used in aircraft undergoing depot maintenance, off aircraft maintenance and for shipping (see figure 6-1).

CAUTION:
Plastic connector covers are a Foreign Object Damage (FOD) hazard and are not to be used on aircraft.

c. When inspecting heat shrinkable end caps, confirm that SAE-AS81765/4 end caps are being used.

d. Plastic bags should not be used to cap and stow connectors.

3. When examining connectors wrapped with pressure sensitive tape verify that the connectors have been cleaned and preserved. Also, confirm that A-A-59163, type II tape is being used and that the connectors are secured with A-A-52083 or A-A-52084 lacing tape/tie string, when necessary (see figure 6-1).

4. When inspecting connectors secured to adjacent structure or harnesses, confirm that they are secured using cushioned SAE-AS21919 clamps or A-A-52083, or A-A-52084 tie string/lacing tape.

c. Additional information regarding connector capping and stowage is provided in NA 01-1A-505-1, Work Packages 007 00 and 026 00. Information on the capping and stowage of fiber optic connectors is provided in NA 01-1A-505-4, Work Package 012 02.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

				
Acceptable Typical metal or composite protective cover.	**Acceptable** Tape wrapped connector.	**Acceptable** AD89503-01-## Tape wrap with heat shrinkable cap over tape for long term stowage in SWAMP areas.	**Unacceptable** Plastic bag used to cap and stow connector.	**Unacceptable** Plastic Dust Cap; not for operational aircraft; authorized only for aircraft in depot maintenance or off aircraft for shipping and storage.

FIGURE 6-1. Examples of acceptable and unacceptable connector capping and stowage methods.

GUIDELINE 7

PROPER MARKING OF WIRE/FIBER OPTIC AND CABLE HARNESSES

1. Purpose. This guideline provides inspection criteria on the proper marking of wire and cable used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 008 00	Wire, Cable, and Harness Marking.
NA 01-1A-505-4	Aircraft Fiber Optic Cabling Manual.
Work Package 003 03	Marking Methods and Labels.

3. Definitions.

3.1 See section 3 of this handbook.

4. General guidelines. The following procedures should be followed when inspecting and marking wire and fiber optic cable and harnesses.

a. Unless otherwise specified in the maintenance manual of the aircraft being serviced, the circuit identification codes should be printed on sleeves or tags and installed during repair or replacement of the wire, cable, or harness. Marking labels are not required for wire 6 inches or shorter.

b. Examine cabling/wire harness to confirm that:

1. Harness marking labels are visibly installed every 3 feet throughout length of harness.

2. Harness marking labels are installed within 12 inches of termination point.

3. Harness markings are after the last clamp.

4. Marking labels have been heat shrunk onto harness or secured with lacing tape A-A-52083 or A-A-52084 (see figure 7-1).

c. If after examining the harness, labels are missing, print and affix new marking labels.

d. When marking fiber optic cable harnesses, the following methods should be used:

1. Direct marking is accomplished by printing on the cable bundle or cable harness outer covering. Direct marking should be done at intervals not longer than 3 inches along the cable harness entire length.

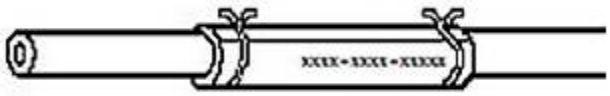
2. Indirect marking is accomplished by printing a heat shrinkable sleeve and installing the printed sleeve on the individual cables, cable bundle or cable harness outer covering. Indirect marked individual cables should be identified with printed sleeves within 12 inches of the cable termination.

3. There should be a label within six inches of a fiber optic connection port. The text and border should be violet and the background color yellow (see figure 7-2).

e. Additional information regarding the proper marking of wire and fiber optic and cable harnesses is provided in the NA 01-1A-505-1, Volume 1, Work Package 008 00 and NA 01-1A-505-4, Work Package 003 03.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.



Acceptable
Wire marking example using lacing tape.

Unacceptable
Non-heat shrinkable wire marking tape is not secured with lacing tape/tie string.

FIGURE 7-1. Examples of acceptable and unacceptable wire marking with and without lacing tape.

Acceptable
WRA Label. This label is usually found within 6 inches from the fiber optic connection point. Text and border color is violet and the background color is yellow.

Acceptable
Cable that is marked within 12 inches of the termination point.

FIGURE 7-2. Examples of acceptable fiber optic label and cable marking.

GUIDELINE 8

MECHANICAL STRIPPING WIRE INSPECTION

1. Purpose. This guideline provides criteria on inspecting wire used in the EWIS after using a mechanical stripping device.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 009 00	Wire and Cable Stripping.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting or repairing wire stripped using a mechanical stripping device, the following procedures should be followed:

a. Visually inspect the wire and determine if any of the following unacceptable conditions exist (see figures 8-1 and 8-2):

1. Nicked or cut strands.

2. Frayed insulation.

3. Broken wire strands.

4. Bird-caged strands. If untwisting or bird-caging occurs, correct and reshape conductor strands by twisting the strands in the same direction as the normal lay of the wire. It is recommended that the conductor be twisted only by hand. If pliers are required due to the size of the strands, caution should be taken to prevent damage to the conductor. The conductor should not be over-twisted.

b. Visually inspect the wire insulation to determine if it has been damaged during wire stripping. When examined (see figure 8-3):

1. The insulation should not be punctured, crushed, or cut by the tool.

2. The insulation deformation should not exceed 20 percent of the insulation thickness.

3. The insulation should not have gouges, ragged edges, be loose, nor be frayed.

4. The end of the insulation should be cut as squarely and cleanly as required to meet any soldering or crimping requirements.

WARNING:
Care should be exercised when smoothing insulation or twisting conductors as nicked, frayed, or broken strands can cause injury.

5. Insulation damage (inter-tape, or frayed) should not to exceed 1/32 inch or 50% of the insulation's outside diameter, whichever is greater.

c. Additional information regarding the inspection of wire stripped using mechanical wire strippers is provided in NA 01-1A-505-1, Work Package 009 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

		
Acceptable Wire insulation removed without disturbing the normal lay of the wire, as shown. Wire strands are free of nicks or cuts.	**Unacceptable** Strands, retwisted and overlapping each other, as shown, will result in increased stress and difficulty in forming a mechanical joint.	**Unacceptable** Wire strands that are retwisted in excess of their normal lay exert increased stress and may break.

FIGURE 8-1. Examples of acceptable and unacceptable wire stripping.

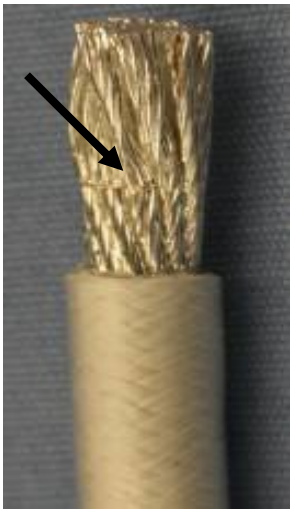
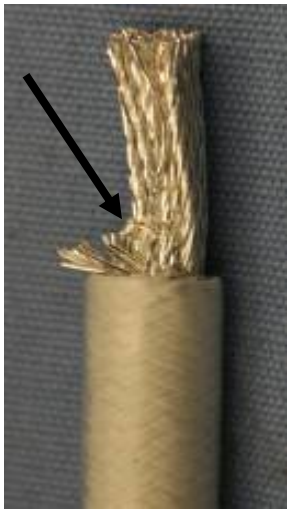
			
Acceptable Normal lay of strands, disturbed during stripping operation, may be re-twisted to the original wire lay, if strands have not been damaged.	**Unacceptable** Wire strands show evidence of a ringed condition (arrow) caused by stripper blades. Outer strands are weakened and may break.	**Unacceptable** Several wire strands are cut (arrow). This condition may be the result of placing the wire in the wrong hole size of the mechanical stripper.	**Unacceptable** Wire strands are bird-caged, due to misalignment of wire and stripping blades.

FIGURE 8-2. Examples of wire strands in acceptable and unacceptable condition after wire stripping.

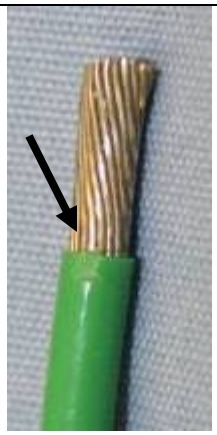
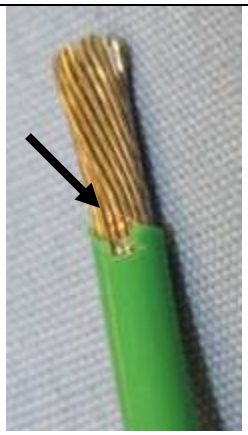
			
Acceptable Wire stripped with mechanical strippers, which shows no evidence of damage to either the insulation or the wire strands.	**Acceptable** Although wire insulation appears to be cut or split, close examination shows that only the outer coating is damaged and does not exceed 1/32 inch or 50% of insulation's thickness (whichever is greater).	**Unacceptable** The insulation has been pinched by the mechanical strippers. This condition was caused by using too small hole/setting of the mechanical stripper.	**Unacceptable** Wire strands are nicked, due to misalignment of wire and stripping blades. Nicked strands reveal base metal and may break.

FIGURE 8-3. Examples of wire insulation in acceptable and unacceptable condition after wire stripping.

GUIDELINE 9

MECHANICAL STRIPPING/SHIELDING REMOVAL INSPECTION

1. Purpose. This guideline provides criteria for inspecting cables with shielding after they have been stripped using a mechanical stripping device.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 009 00	Wire and Cable Stripping.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When mechanically stripped shielded cable is inspected, the following procedure should be followed (see figure 9-1):

a. Verify that there are no nicks or cuts on the shielding or inner wire insulation or the conductor.

b. Verify that the shielding is uniformly trimmed and shows no evidence of unraveling.

c. Additional information regarding the inspection of shielded cables stripped using mechanical strippers is provided in NA 01-1A-505-1, Work Package 009 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

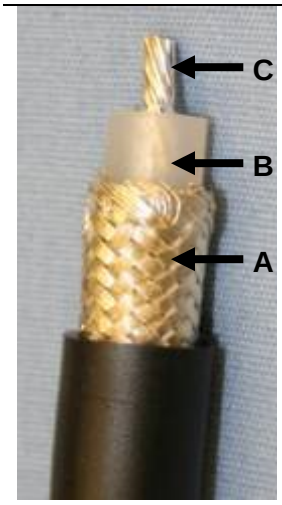
			
Acceptable After stripping there should be no nicks or cuts on the shielding (A) or inner wire insulation (B) or the conductor (C).	**Unacceptable** Shielding has been cut unevenly, indicating poor trimming technique. Shielding strands have spread apart, making installation of solder sleeve difficult. Strands may puncture solder sleeve during shrinking.	**Unacceptable** Cut shielding strands, as shown, are caused during outer insulation removal.	**Unacceptable** Nicked inner wire insulation occurs during shielding removal.

FIGURE 9-1. Examples of acceptable and unacceptable mechanical stripping of shielded cable.

GUIDELINE 10

THERMAL/LASER STRIPPING CABLE JACKET INSPECTION

1. Purpose. This guideline provides criteria for inspecting wire after using a thermal/laser stripping device.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 009 00	Wire and Cable Stripping.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. Figure 10-1 shows cable in acceptable and unacceptable condition after stripping using a thermal or laser stripper. When inspecting cable jackets that have been stripped using a thermal or laser stripper, the following procedure should be followed:

a. Verify that there are no nicks or cuts on the shielding or inner wire insulation or the conductor.

b. Verify that the shielding is uniformly trimmed and shows no evidence of unraveling.

c. Verify that the any insulation flash remaining from the stripping operation has been removed.

d. Verify that none of the topcoat farther than 1/16-inch from strip point has peeled.

e. Verify that there has been no contact made by the wire with thermal stripper beyond the stripping area.

f. Verify that there has been no burning or charring of the cable jacket.

g. Additional information regarding the inspection of shielded cables stripped using thermal/laser strippers is provided in NA 01-1A-505-1, Work Package 009 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

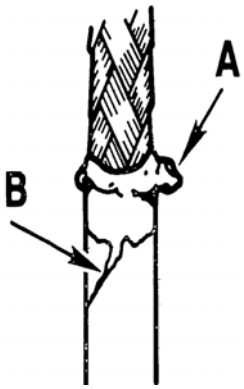
			
Acceptable Jacket should have a minimum of edge flash, as shown, with no damage to the jacket. Slight charring and discoloration of jacket is acceptable.	**Unacceptable** (A) Insulation flash (arrow) has not been removed. (B) Peeling of topcoat farther than 1/16-inch from strip point is unacceptable.	**Unacceptable** Contact with thermal stripper beyond the stripping area has caused the jacket to melt (arrow), exposing shielding strands.	**Unacceptable** Burned or charred jacket, as shown, is the result of excessive heat application.

FIGURE 10-1. Examples of acceptable and unacceptable stripping of shielded cable by thermal/lasers strippers.

GUIDELINE 11

HARNESS ROUTING INSPECTION

1. Purpose. This guideline provides criteria for inspecting proper harness routing of wires and cables that make up the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 010 00	Harness Installation.
NA 01-1A-505-4	Aircraft Fiber Optic Cabling Manual.
Work Package 012 01	General Practices for Cable Harness Installation.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting harness routing in aircraft, the following procedures should be followed.

a. Confirm that individual wires in a bundle are uniformly arranged and of the same length (see figure 11-1).

b. Confirm that the wire length is short enough so that there are no wire loops where individual wires can be easily damaged (see figure 11-1).

c. Ensure that cabling is routed so that relative motion does not result in abrasion between wires with dissimilar insulation.

d. Confirm that any wiring of dissimilar insulation that crosses over or under other wires is secured using A-A-52083 or A-A-52084 string tie or lacing tape to prevent chafing before and after the crossover, but not on the crossover point. This is especially important in the case of polyimide insulation when it is in contact with other insulation types.

e. Ensure that sufficient slack exists for full extension of shock mounts or vibration isolators on cabling affixed or connected to shock/vibration protected equipment.

f. Confirm that sufficient slack exists to permit maintenance access.

g. Ensure that bundles are secured to exhibit a smooth appearance, without protruding wires which can be snagged or damaged.

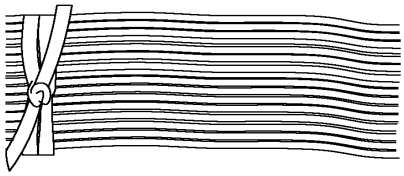
h. Confirm that there are no twisted wires under spot ties (see figure 11-2).

i. Ensure that any fiber optic cabling below fluid carrying lines is routed at an angle (not parallel) to the lines.

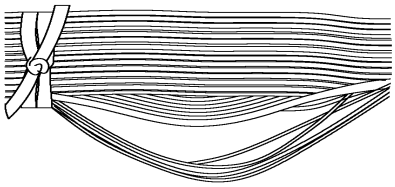
j. Additional information regarding the inspection of cable harness routing is provided in NA 01-1A-505-1, Work Package 010 00 and NA 01-1A-505-4, Work Package 012 01.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

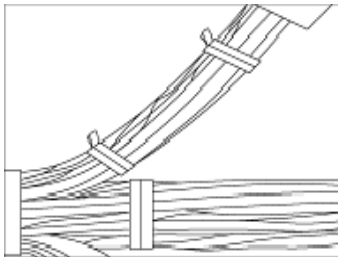


Acceptable
Individual wires in a wire bundle should be uniformly arranged and of the same length. Varying lengths of wire will increase the bundle diameter.

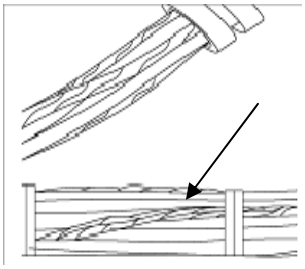


Unacceptable
Excessive wire length has formed loops that can easily be damaged and has increased the bundle diameter.

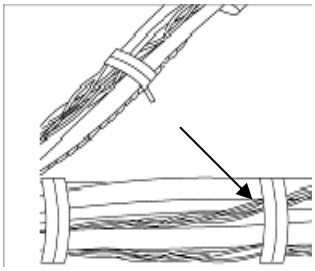
FIGURE 11-1. Examples of acceptable and unacceptable wires in a wire bundle.



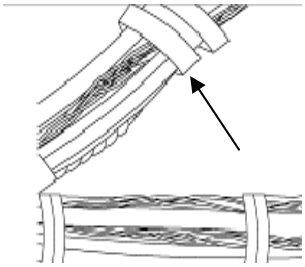
Acceptable
Wires in a harness should run straight and parallel to each other, as shown. Although some minor wire crossing is permitted, wires should never cross each other under a spot tie or clamp.



Acceptable
Wires (arrow) are shown crossing over the top of other wires. However, the crossover does not occur under a spot tie or clamp.



Unacceptable
The twisted wires (arrow) are shown crossing another wire underneath a spot tie. Damage to insulation may result.



Unacceptable
The twisted wires (arrows) have crossed over the top of the other wires, under the clamp. Damage to individual wires may occur.

FIGURE 11-2. Examples of acceptable and unacceptable wires in a wiring harness that are straight and twisted.

GUIDELINE 12

CABLE HARNESS COVERING OR PROTECTION INSPECTION

1. Purpose. This guideline provides criteria for inspecting cable harness coverings and abrasion protection.

2. Applicable documents. The documents listed below are those applicable to this guideline.

A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 010 00	Harness Installation.
SAE-AS21919	Clamp, Loop Type, Cushioned Support. (DoD adopted)

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting and repairing cable harness covering and protection, the following procedures should be followed:

a. Examine cable harness covering (convoluted tubing or cable wrap) for:

1. Loosening or fraying.

2. Proper support using rigid conduit or SAE-AS21919 cable clamps (see figure 12-1).

3. Proper installation of spot tie on convoluted tube wrapped harness and spiral wrap (see figures 12-1 and 12-2).

4. Secured wrap ends are spot tied using lacing tape (A-A-52083, or A-A-52084) (see figure 12-2).

5. Twisting of harness covering (see figure 12-2).

b. Examine cable harness for chafing where wire or cable:

1. Is routed near structural members and equipment (see figure 12-3).

2. Crosses over/under other wiring.

3. Passes through lightening holes. If found, cover all feed throughs with an edge grommet and wire bundle or harness in lightening hole (see figure 12-3).

4. Moves/flexes when door(s) is opened/closed.

5. Passes over or near hinged areas.

6. Turns or bends near components and at connector backshells flexed during removal and installation of components.

7. Around generator power wiring routing areas.

8. At conduit exit points (see figure 12-1).

c. Examine wire routing to determine if a minimum clearance of 3/8 inch can be maintained. If so, the harness should be wrapped with Teflon spiral chafe wrap or chafe pad and secured with lacing tape/tie string. Minimum clearance distances may vary between aircraft types and applications; if no specific guidance is available, a 3/8 inch clearance should be employed. If the minimum 3/8 inch clearance cannot be maintained, the following should be used: T12T for 1/8 in. diameter (NSN: 9330-01-201-0658), T25T for 1/4 in. diameter (NSN: 9330-01-169-5995), and T50T for 1/2 in. diameter (NSN: 9330-01-179-0242).

d. Examine places where wire bundles come into contact with sharp edges. If found, sharp edges should be covered with Teflon sheet (see figure 12-4).

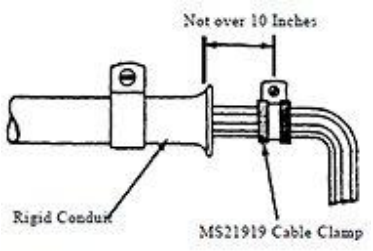
e. Examine locations where wiring comes may come into contact with bolts. If found, apply polysulfide sealant to bolt head or install domed nut cover over applicable nut (see figure 12-4).

f. Examine places where wiring harnesses come into contact with abrasive surfaces. If found, Teflon tape with a minimum 50 percent overlap should be used on these wiring harnesses. Spot ties should be used on each end of the tape to prevent unraveling. Teflon sheet or other chafe protection may also be used (see figure 12-4).

g. Additional information regarding the inspection of cable harness covering or protection is provided in NA 01-1A-505-1, Work Package 010 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.



Acceptable
This is an example of how a wire harness should be supported after exiting a rigid conduit.

Acceptable
Correct installation of spot tie on a convoluted tube wrapped harness with a clamp.

Unacceptable
Spot tie not installed on spiral wrap. The spiral wrap is loosened and unraveling.

FIGURE 12-1. Examples of acceptable and unacceptable cable harness support and protection.

Acceptable
Proper installation of harness covering.

Unacceptable
Improper twisting of harness covering.

Unacceptable
No spot tie on harness covering.

FIGURE 12-2. Examples of acceptable and unacceptable wires in a wiring harness that are straight and twisted.

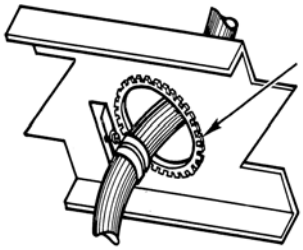
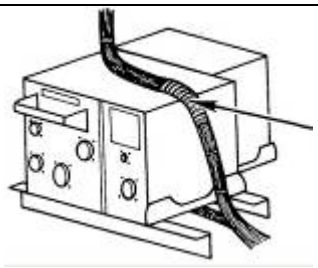
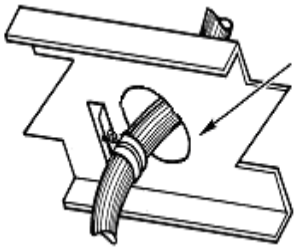
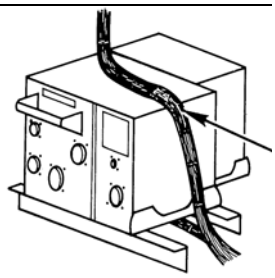
			
Acceptable All feed throughs with edge grommet (arrow). Center bundle/harness in lightening hole.	**Acceptable** Wire harnesses is re-routed and secured to provide adequate clearance. When minimum clearance or better is not achieved, it should be wrapped with Teflon spiral chafe wrap, or chafe pad and secured with lacing tape/tie string.	**Unacceptable** Missing edge grommet.	**Unacceptable** Harness is routed on sharp edge of structure. Cable insulation will be damaged due to aircraft vibration.

FIGURE 12-3. Examples of acceptable and unacceptable routing of cables in feed throughs and aircraft structures.

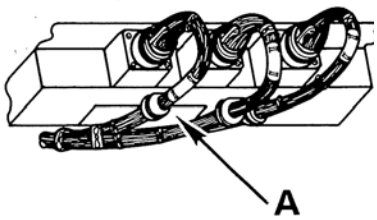
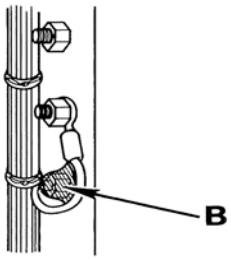
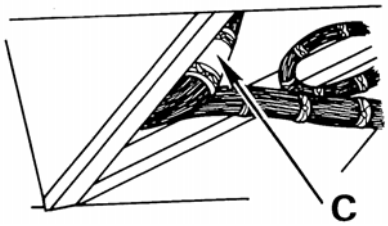
		
Acceptable (A) Maintain positive clearance and sharp edges covered with Teflon sheet P5100C04 (NSN: 9330-01-110-8972) when harness is within 3/8″ of sharp edges.	**Acceptable** (B) Polysulfide sealant applied to bolt head since it may come in contact with wire harness or install domed nut cover over applicable nut.	**Acceptable** (C) Teflon tape with a minimum 50% overlap should be used on wire harnesses that may come in incidental contact with abrasive surfaces. Spot ties should be used on each end of the tape wrap to prevent unraveling. Teflon sheet or other chafe protection product may also be used.

FIGURE 12-4. Examples of acceptable use of Teflon sheet and polysulfide sealant.

GUIDELINE 13

CABLE HARNESS BEND RADIUS INSPECTION

1. Purpose. This guideline provides criteria for inspecting cable harness bend radius in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 010 00	Harness Installation.
NA 01-1A-505-4	Aircraft Fiber Optic Cabling Manual.
Work Package 012 01	General Practices for Cable Harness Installation.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. The following procedures should be followed when inspecting the bend radius of electrical and fiber optic cables and harnesses.

a. Confirm that wires individually routed and supported have a minimum bend radius ten times the outside diameter of the wire. At the point an individual wire breaks out from a group, harness, or bundle, the minimum bend radius should also be ten times the outside diameter of the wire provided the wire is suitably supported by a clamp (see figure 13-1).

b. Verify that wires used as shield terminators or jumpers, when required to reverse direction, have a minimum bend radius three times the wire diameter at the reversal point provided the wire is suitably supported by a clamp.

c. Examine fiber optic cable and harnesses for the following two types of bend diameter considerations:

1. Short-term. The short-term bend diameter applies during handling and installing. When the short-term bend diameter is not specified:

a. Use a value of eight times the cable diameter for simplex, tight buffer cable (i.e., four times the cable diameter if working in terms of cable bend radius).

b. Use a value of 20 times the cable diameter for simplex, loose tube cable (e.g., 2 mm diameter loose tube cable results in a 40 mm cable bend diameter).

c. Use a value of 20 times the tube diameter for convoluted tube or conduit (e.g., 1⁄2 inch convoluted tubing results in a 10 inch cable bend diameter).

2. Long-term. The long-term bend diameter applies to the completed installation. When the long-term bend diameter is not specified:

a. Use a value of 16 times the cable diameter for simplex, tight buffer cable (i.e., eight times the cable diameter if working in terms of cable bend radius).

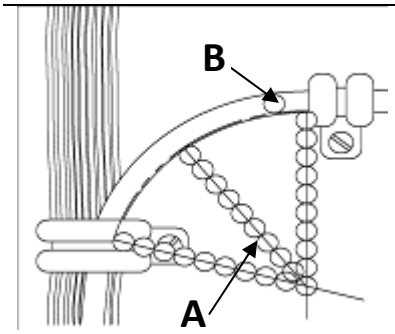
b. Use a value of 20 times the cable diameter for simplex, loose tube cable.

c. Use a value of 20 times the tube diameter for convoluted tube or conduit.

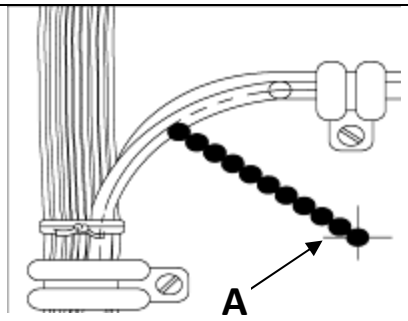
d. Additional information regarding cable harness bend radius inspection is provided in NA 01-1A-505-1, Volume 1, Work Package 010 00 and NA 01-1A-505-4, Work Package 012 01.

5. Detail guidelines. This section is not applicable to this guideline.

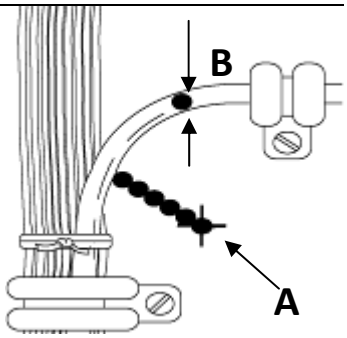
6. Notes. This section is not applicable to this guideline.



Acceptable
Wires and cables should have a minimum bend radius (A) of ten times the diameter of the largest wire insulation (B) contained in the bundle.



Acceptable
The bend radius shown (A) measures slightly more than 10 times the diameter of the largest wire in the harness breakout.



Unacceptable
The radius (A) of the wire breakout measures only 6 times the wire diameter (B). Excessive stress is exerted on wires installed with sharp bends.

FIGURE 13-1. Examples of wires and cables with acceptable and unacceptable bend radius.

GUIDELINE 14

PRIMARY SUPPORT CABLE CLAMP INSPECTION

1. Purpose. This guideline provides criteria for inspecting cable harness primary support cable clamps used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 010 00	Harness Installation.
NA 01-1A-505-4	Aircraft Fiber Optic Cabling Manual.
Work Package 012 01	General Practices for Cable Harness Installation
SAE-AS21919	Clamp, Loop Type, Cushioned Support. (DoD adopted)

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting clamps used in the EWIS, the following procedure should be used:

a. Examine the clamp as follows:

1. Confirm that the SAE-AS21919 primary support clamp part number has a “W” in the part number if it is a wedge type clamp.

2. Inspect the base or wedge of cushion material to ensure wires are not pinched in metal band (see figure 14-1).

3. Ensure clamps are not too large or too small for wire bundle on which they are installed (see figure 14-2).

4. Confirm that no plastic clamps are used where ambient temperature may exceed 185 °F.

5. Confirm that there are no loose, broken, or deteriorated cushion clamps, lacing tape, ties, strap ties, or loose or damaged bundle clamp support brackets present.

6. Verify that all clamps used are able to withstand the environment that they are exposed to.

7. Confirm that there are no deformed clamps and that there are no cracks in the metal portion, particularly at the bolt location (see figure 14-3).

8. Verify that metal cushion clamps are used as primary means to support fiber optic cabling.

9. Confirm that lacing tape and tie string in accordance with A-A-52083 or A-A-52084 is used only for secondary support.

10. Verify that wire harnesses are held firmly and fill the clamp completely (see figures 14-4 and 14-5).

11. Confirm that clamping of wire harnesses does not distort the clamp or crush the wires (see figure 14-4).

12. Confirm that clamps are secure enough to prevent harness movement and chafing.

13. Verify that the clamp does not compress the wire while maintaining continuous contact throughout the clamp.

14. Confirm proper clamp tightness by following all wire/harness runs and lightly shaking at all clamp or support devices. Inspect for proper torque by attempting to rotate clamp around bolt/screw axis. If not tight, length may be improper or bolt bottomed out.

15. Examine clamp for proper thread protrusion from the back of the clamp. Three to five threads are optimum (2 minimum).

16. Ensure airframe clips, nut plates and brackets do not have loose rivets or fasteners.

17. Verify that the space between clamps is not greater than 24 inches (see figures 14-5 and 14-6).

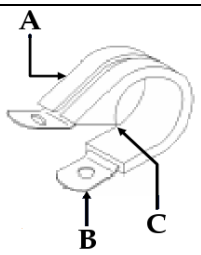
18. Confirm that fuel lines have not been used to support wire harnesses (see figure 14-5).

b. Figure 14-7 illustrates the different parts of clamps used for single, double harness clamping, and multi-harness wiring.

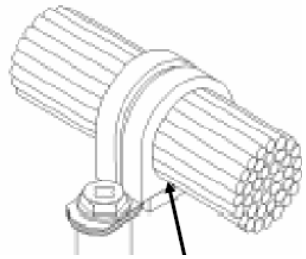
c. Additional information regarding the correct usage of clamps to support electrical cables is provided in NA 01-1A-505-1, Work Package 010 00 and fiber optic cables is provided in NA 01-1A-505-4, Work Package 012 01.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

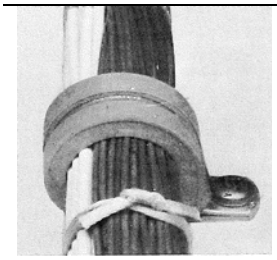


Acceptable
(A) Rubber cushion. (B) Clamp tabs. (C) Wedge.

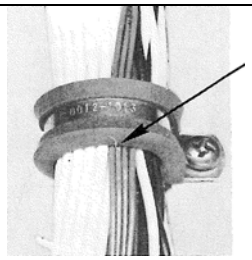


Acceptable
Verify no pinched wires at the wedge.

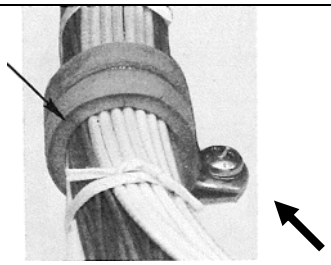
FIGURE 14-1. Examples of acceptable clamps and clamp installation.



Acceptable
Wire harness that is held firmly and fills the clamp completely. Clamp does not distort the clamp or crush the wires. Clamp is secure enough so that the harness does not move and there is no chafing.

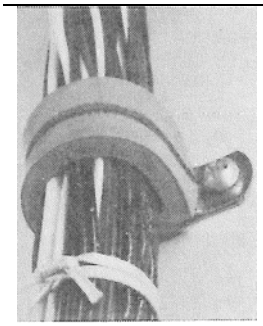


Unacceptable
Wires are compressed tightly into clamp, decreasing bundle below normal diameter. Visible evidence of tight clamping may be a curved contour of the rubber cushion (arrow).

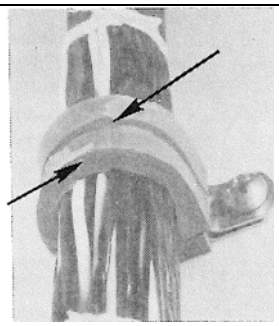


Unacceptable
The clamp shown is too small for wire harness. The large wire harness will not permit the mounting tabs to meet when installed (arrow).

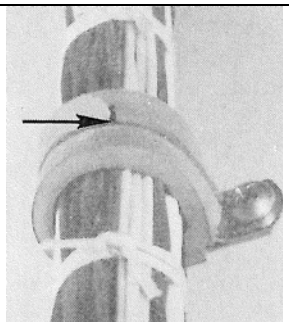
FIGURE 14-2. Examples of clamps that are properly and improperly installed on wire bundles.



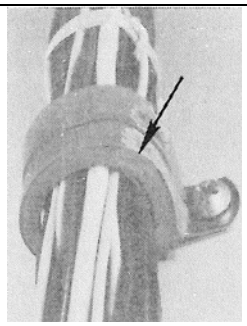
Acceptable
The rubber cushion should be free from gouges that expose the metal clamp, and from cuts or cracks.



Acceptable
Slight abrasions and minor imperfections (arrows) are acceptable provided there is no exposed metal or sharp indentation which may develop into cracks.

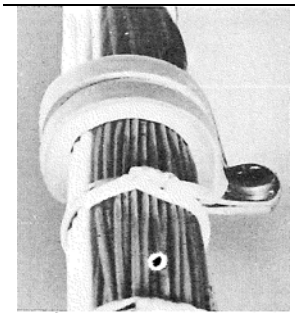


Unacceptable
Cushion is weakened by cut (arrow). Cut will tend to propagate and increase cushion separation.

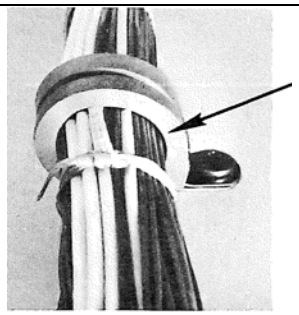


Unacceptable
The metal clamp has been exposed by a gouge (arrow).

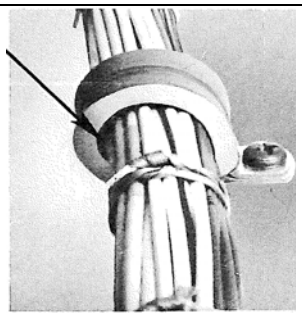
FIGURE 14-3. Examples of clamps in acceptable and unacceptable condition.



Acceptable
Wire harness should be held firmly within the clamp to prevent excessive wire movement.



Acceptable
Although wire clamp is not completely tight, (arrow) it contacts enough of the wire bundle to assure firm grip and prevent harness movement.



Unacceptable
Wire bundle is not held tightly by the clamp (arrow). Too large a clamp, used as shown, will not provide a snug grip. Chafing of the wires may occur.

FIGURE 14-4. Examples of acceptable and unacceptable installation of clamps to prevent wire chafing.

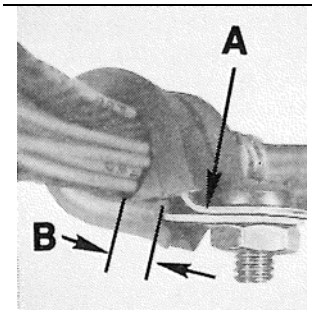
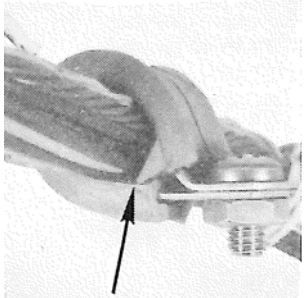
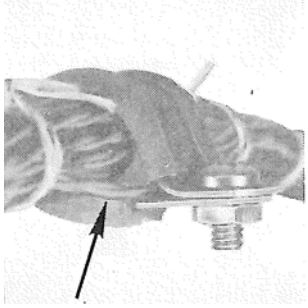
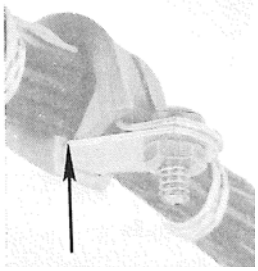
			
Acceptable Cable clamps should fit the wire bundle snugly when completely tightened. The mounting flanges should close together (A) and the cushion wedge (B) should overlap the cushion, as shown.	**Acceptable** Although clamp appears loose, it is snug enough to hold bundle securely. Mounting flanges are closed tight and cushion wedge is contacting lower cushion (arrow) preventing contact of wire with bare clamp.	**Unacceptable** Clamp fits snugly and flanges are closed properly. However when clamp was being closed, wires were trapped between wedge and lower cushion (arrow) and could contact bare clamp.	**Unacceptable** Clamp appears to be loose which may allow movement of wire bundle. Also, the rubber cushion has slipped and wires are in contact with bare clamp (arrow).

FIGURE 14-5. Examples of acceptable and unacceptable clamp tightening.

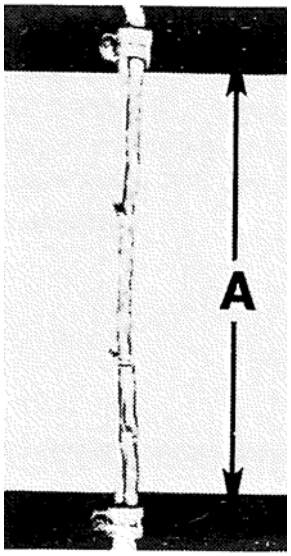
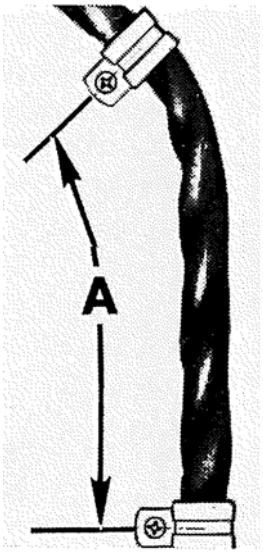
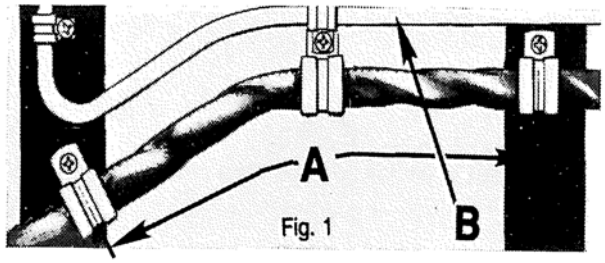
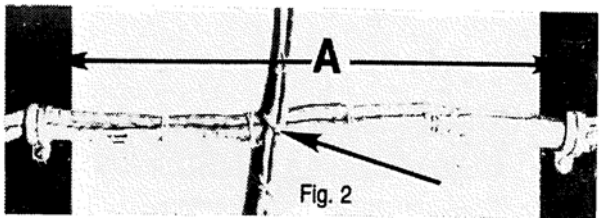
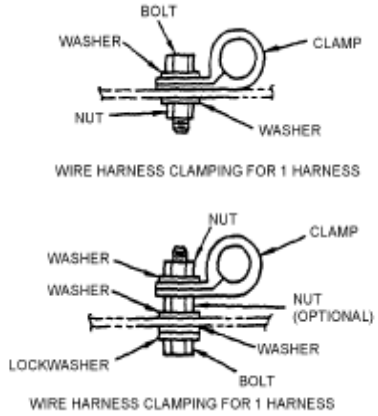
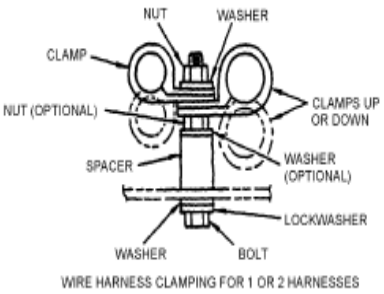
		 
Acceptable Where dictated by design, cable support clamps may be a maximum of 24 inches apart (A). Wire harnesses should not be supported by other harness assemblies or by fuel lines or other nonstructural members.	**Acceptable** Cable clamps are within the maximum spacing. Clamp spacing (A) is measured along the contour of the harness, as shown.	**Unacceptable** Fig. 1 - Harness is supported by fuel lines (B). Structurally supported clamps are located more than 24 inch maximum clamp spacing allowable (A). Fig. 2 - Harness is spot tied to another harness (arrow) for support because of the excess spacing (A) between clamps. This is not adequate support.

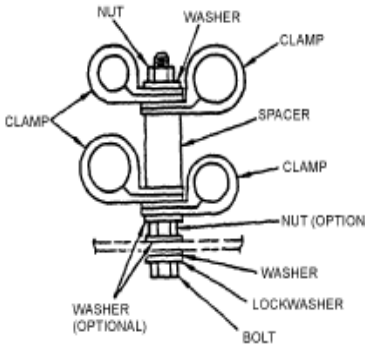
FIGURE 14-6. Examples of acceptable clamp spacing and unacceptable use of fuel lines and spot ties as a means of support.



Typical single harness clamping



Typical two harness clamping
(Top and bottom clamping commonly referred to as marriage clamping.)



Typical multi harness wiring
(Side by side clamping commonly referred to as butterfly clamping.)

FIGURE 14-7. Acceptable hardware mounting configurations for clamps.

GUIDELINE 15

WIRE/HARNESS CLEARANCE INSPECTION

1. Purpose. This guideline provides criteria for inspecting wire or harness clearances.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 010 00	Harness Installation.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting wire and cable harness clearance, the following guidance should be followed:

a. Clearance from structure, surfaces, and equipment. There should be a minimum of ½ inch clearance. If not, then a minimum ⅜ inch clearance is acceptable where approved anti-chafing material is used. Examples of where these minimum clearances can exist include the distance between:

1. Wiring and linkages, throttle controls, boxes, covers, structures, control cables, and component mounting hardware (see figure 15-1).

2. Terminal lugs between other lugs, adjacent components and nearby structures at contactors, circuit breakers, relays, power control relays, and terminal boards.

b. Clearance between wiring and fluid carrying lines. The following should be considered when inspecting the wiring and fluid carrying lines that are close together.

1. There should be a minimum 2-inch clearance between wiring and fluid carrying lines, tubes and equipment. This separation between wiring and fluid carrying lines is not required when a conduit, bulkhead or other continuous structure separates cabling from fluid lines (see figure 15-2).

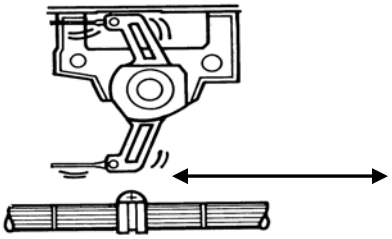
2. Wires should be routed above the fluid lines.

3. Wiring should not be attached to fluid carrying lines, tubes, and equipment unless they require electrical connections (unless specifically authorized so as to maintain positive separation). If not, then a minimum one half inch clearance is acceptable if a clamp (or other positive means) is used to separate the wire or harness from the fluid line.

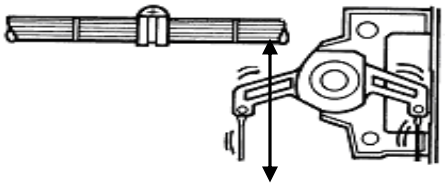
c. Additional information regarding the inspection of wire and harness clearances is provided in NA 01-1A-505-1, Work Package 010 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

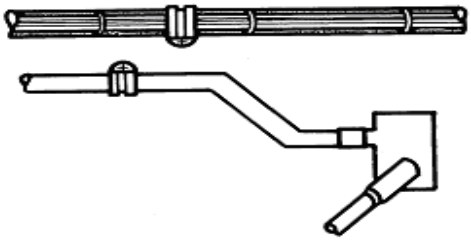


Acceptable
Secure wire harness to avoid moving parts and high temperature ducts or equipment.

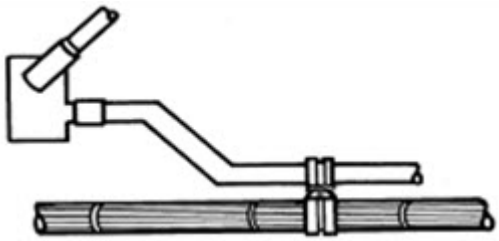


Unacceptable
Reposition wire harness to prevent harness from being damaged by mechanical linkage during travel.

FIGURE 15-1. Examples of acceptable and unacceptable placement of wire harnesses near equipment and linkage.



Acceptable
Cables, wires, and harnesses should maintain a separation of not less than 2 inches from lines carrying flammable fluids (e.g., fuels, hydraulic fluid, coolant). Where drawing requirements are less than 2 inches, the cable should be rigidly supported and covered with suitable electrical insulation material.



Unacceptable
Cables, wires and harnesses should not be clamped or tied to fluid lines. Cable harness should be routed above fluid lines.

FIGURE 15-2. Examples of acceptable and unacceptable placement of wires, cables, and harnesses near fuel lines.

GUIDELINE 16

SPOT TIE/LACING TAPE/CORD INSPECTION

1. Purpose. This guideline provides criteria for using or inspecting secondary support spot tie/lacing tape used in the EWIS system.

2. Applicable documents. The documents listed below are those applicable to this guideline.

A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 010 00	Harness Installation.
NA 01-1A-505-4	Aircraft Fiber Optic Cabling Manual.
Work Package 012 01	General Practices for Cable Harness Installation.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When using lacing tape or tie string in the EWIS the following procedures should be followed:

a. Secure wire bundle using lacing tape/tie string (in accordance with A-A-52083 or A-A-52084). Tie a clove hitch and square knot; trim off squarely to a minimum of ⅜ inch length. Do not overtighten lacing tape on the wires, as insulation may be damaged, especially if coaxial wires are contained therein (see figures 16-1 and 16-2).

b. Lace or tie bundles tightly enough to prevent slipping, but not so tightly that the cord or tape cuts into or deforms the insulation. Be especially careful when lacing or tying coaxial cable, which has a soft dielectric insulation between the inner and outer conductors.

c. Spot ties should be uniformly spaced, and located every 3″ to 6″ throughout the length of the harness. The spacing of spot ties used should be as indicated in table 16-1 (see figure 16-3).

TABLE 16-1. Correct spot tie spacing.

Wire bundle diameter	Spot Tie Spacing	
	Max	Not less than
up to ½″	4″	3″
½″ to 3″	5″	3″
3″ & larger	6″	3″

d. Spot ties should not be closer to the clamp than a distance equal to the width of the clamp (see figure 16-4).

e. When applying ties to fiber optic cables, the ties should not be tied too tightly.

CAUTION:

Applying lacing ties too tightly can lead to degraded optical performance or fiber breakage. Use extreme caution when applying lacing tape to assure that the ties do not deform the cable, cable bundles, or cable harness.

f. When inspecting fiber optic harnesses, the following should be considered:

1. Ties should not be used on the part of a cable group or bundle located inside a conduit.

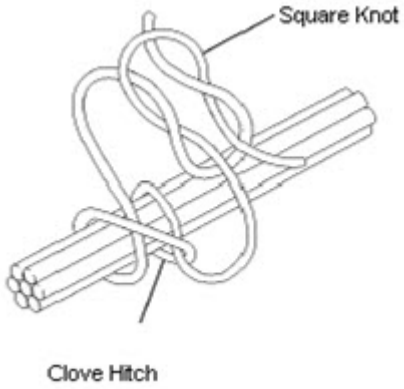
2. Continuous lacing may not be used for secondary support of fiber optic cable, cable bundles, or cable harness.

3. Plastic cable straps are prohibited for use as secondary support.

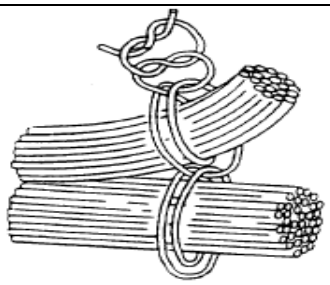
g. Additional information regarding the inspection of lacing tapes and spot ties used with electrical cables is provided in NA 01-1A-505-1, Work Package 010 00 and for fiber optic cables in NA 01-1A-505-4, Work Package 012 01.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

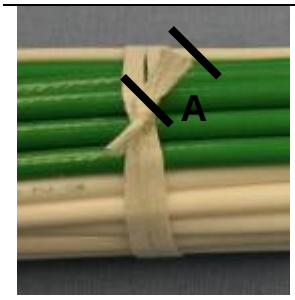


Acceptable
Clove hitch followed by a square knot.



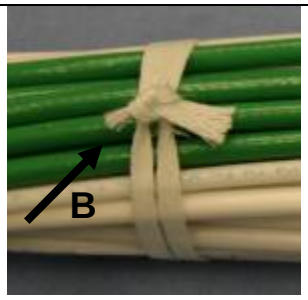
Acceptable
Breakout of bundle into two separate bundles. Wrap cord around wire group or bundle, as shown. Make a clove hitch followed by a square knot with an extra loop. Trim free ends of cord between ¼″ to ½″ minimum.

FIGURE 16-1. Examples of acceptable use of lacing tape.



Acceptable
The ends of the tying material should be approximately even in length, cut square at the ends and measure between 1/4″ and 1/2″ from the knot as shown (A).

Acceptable
The cut ends of the knot are uneven in length indicating poor trimming technique. However, the length of both ends are within the allowable limits.



Unacceptable
The tying material is trimmed short of the required 1/4″ (B) minimum length.

Unacceptable
The loose ends of the spot tie knot have been trimmed closer than the 1/4″ minimum requirement.

FIGURE 16-2. Examples of acceptable and unacceptable tying of lacing tape.

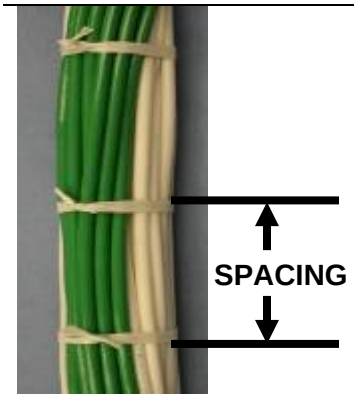
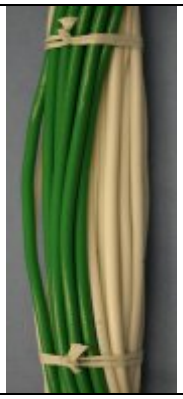


Illustration of spacing of spot ties (see table 16-1).

Acceptable

Unacceptable



Unacceptable

The maximum allowable spot tie spacing has been exceeded. Wires cannot be contained neatly. Loose wires may be damaged.

FIGURE 16-3. Examples of acceptable and unacceptable spot tie spacing.

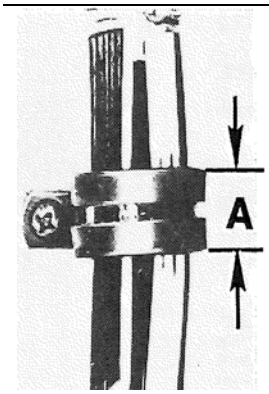
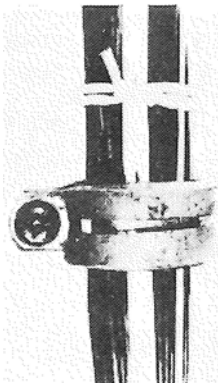
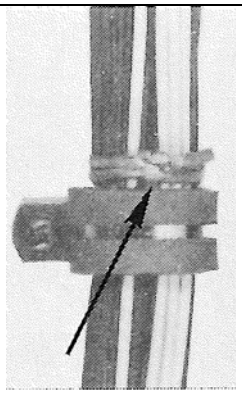
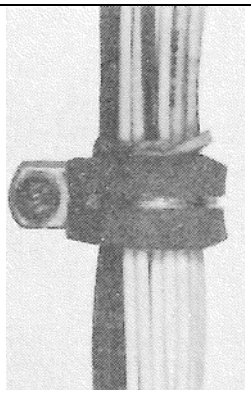
			
Acceptable Spot ties are closer to the clamp than a distance equal to the width of the clamp (A). This will allow the wire bundle to be supported by the clamp, as shown.	**Acceptable** Spot tie wrap is located at a distance, from the clamp, equal to the clamp width. Bundle is able to conform to the shape of the clamp.	**Unacceptable** Spot tie has been positioned too close to clamp, resulting in the cut end of the spot tie being pinched by the clamp (arrow).	**Unacceptable** The cable has been placed over the spot tie. When tightened, the clamp will press the tie down into the wire insulation causing serious damage.

FIGURE 16-4. Examples of spot ties correctly located and located too close to a cable clamp.

GUIDELINE 17

HARNESS DRIP LOOP INSPECTION

1. Purpose. This guideline provides criteria on inspecting cable harness drip loop.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 010 00	Harness Installation.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting drip loops used in EWIS wiring, the following should be examined:

a. Wiring should be examined for proper drip loop installation. Wiring dressed down to a connector should have a drip loop/trap to prevent fluids or condensation from running down the wiring into the connector. A drip loop should also be installed between the connector and the first primary support. Figure 17-1 provides examples of acceptable and unacceptable drip loops. If a drip loop is present, it should be inspected as follows:

1. Verify drainage hole in tape or tubing (if installed) is at the lowest point. If none exists, create drainage hole.

2. Ensure hole is open and no fluids are present.

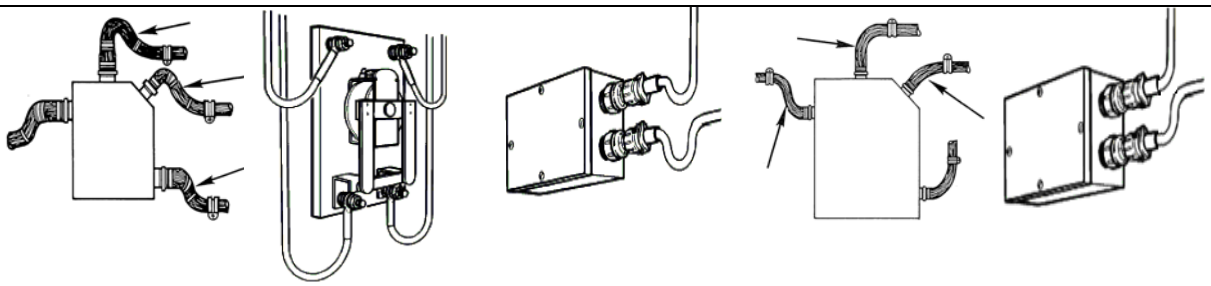
3. Verify drainage hole in tape or (if specified) in convoluted tubing at lowest point; if none exists, create drainage hole.

NOTE: Potted connectors do not require a drip loop.

b. Additional information regarding the inspection of drip loops is provided in NA 01-1A-505-1, Work Package 010 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.



Acceptable **Acceptable** **Acceptable** **Unacceptable** **Unacceptable**

Draining, in both on-ground and in-flight conditions, should be provided in wires and cables at electrical and electronic components.

No drip loop provided. Any moisture collected will run straight into the connector and/or components.

FIGURE 17-1. Examples of acceptable and unacceptable drip loops.

GUIDELINE 18

TIE DOWN STRAP, PLASTIC, SELF-CLINCHING (ZIP TIE) INSPECTION

1. Purpose. This guideline provides criteria on inspecting plastic tie down straps used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 010 00	Harness Installation.
SAE-AS33681	Strap, Tiedown, Electrical Components, Identification, Adjustable, Self-Clinching Plastic, Type II, Class 1. (DoD Adopted)

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting SAE-AS33681 plastic tie down straps (tie wraps, cable straps or zip ties) used in EWIS, they should be examined for the following:

a. Brittleness. If brittle plastic tie straps are found, replace strap with approved lacing tape (i.e., A-A-52083 or A-A-52084), unless specifically required to use plastic tie strap by the aircraft maintenance manual. Only remove as many as required to affect the applicable repair.

b. Proper installation. This includes plastic straps that are too tight or too loose straps and straps where the tie tip is too long. If improperly installed tie straps are found, replace them with approved lacing tape (i.e., A-A-52083 or A-A-52084), unless specifically required to use plastic tie strap by aircraft maintenance manual. Only remove as many as required to affect the applicable repair (see figure 18-1).

c. Improper cutoff (excess material from strap or not cut flush with boss head) (see figures 18-1 and 18-2).

d. Confirm that plastic tie down straps are used only in approved areas of the aircraft. Plastic straps are not approved for use in areas of high vibration, SWAMP, inside cable harnesses, or areas exceeding 185 °F (85 °C).

e. Verify that only black is used in areas exposed to sunlight (UV radiation).

f. Verify that plastic tie down straps are not used in FOD-critical areas such as above flight controls and high vibration areas.

g. Additional information regarding the inspection of tie down straps and plastic, self-clinching zip ties is provided in NA 01-1A-505-1, Work Package 010 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

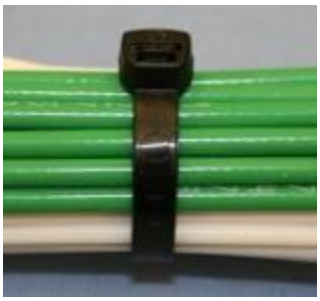
		
Acceptable Proper installation of a plastic tie down strap installed on a harness.	**Unacceptable** Plastic tie is installed too tight and is compacting wire insulation on a coaxial cable.	**Unacceptable** Plastic tie tip is cut too long and is not flush with the boss and could cause harm to personnel or equipment.

FIGURE 18-1. Examples of acceptable and unacceptable plastic tie strap installation.

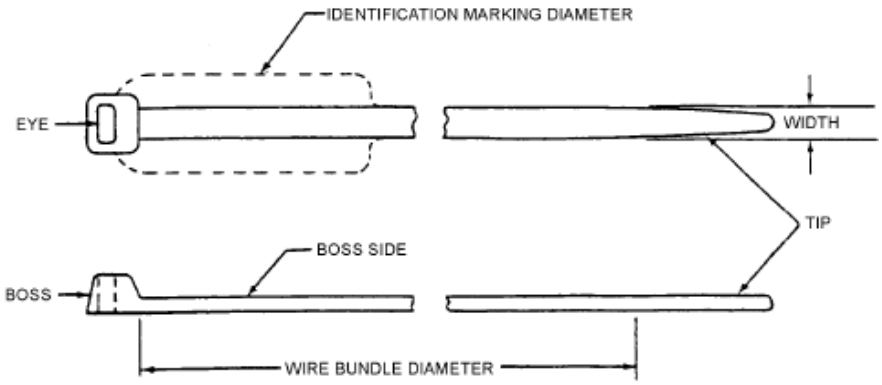


FIGURE 18-2. Illustration of parts of plastic tie straps.

GUIDELINE 19

EMI SHIELD WRAP-AROUND REPAIR INSPECTION

1. Purpose. This guideline provides criteria on inspecting EMI shield wrap-around repair when this repair is present in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
A-A-59163	Insulation Tape, Electrical, Self Adhering Unsupported Silicone Rubber.
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 011 00	Open and Overbraided Harness Repair.
SAE-AS85049/93	Connector Accessories, Electrical, Termination, Shield Split Support Ring, Composite, Nonenvironmental, Straight, Category 7. (DoD Adopted)
SAE-AS85049/128	Connector Accessories, Electrical Backshell, Shield Band, Category 7 (For AS85049/82-/90, /93, /109-/117 Accessories). (DoD Adopted)

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting EMI shield wrap used in the EWIS the following should be considered:

a. Ensure a minimum 90° overlap of metal braid and Nomex layer (see figure 19-1and figure 19-2). White tracer indicates the maximum operating diameter. If the required overlap is applied, the tracer should not be exposed. Verify proper diameter wrap is selected for the application.

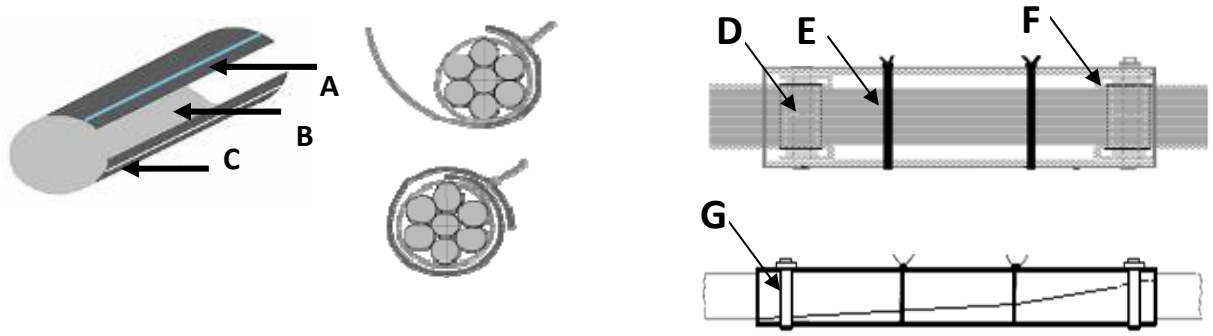
b. Ensure proper twisting on harness. The twist should be on average 1 to 2 turns per yard of the wire bundle. Secure with lacing and tying tape (A-A-52084, or A-A-52083) every 2 +/-0.5″.

NOTE: The EMI shield type sleeving has a blue tracer in the center to differentiate it from the unshielded version (Round-it 2000NX), and it also serves as a means of identifying the amount of twist in the sleeving.

c. Additional information regarding the inspection of EMI shield wrap is provided in NA 01-1A-505-1, Work Package 011 00.

5. Detail guidelines. This section is not applicable to this guideline.

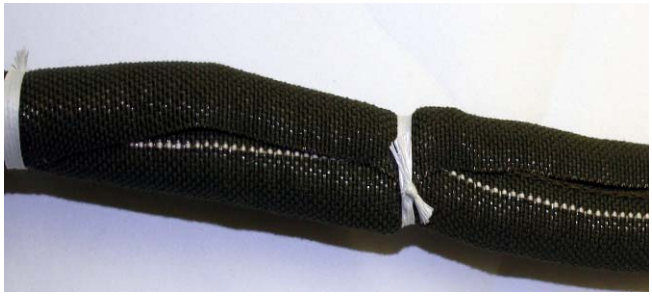
6. Notes. This section is not applicable to this guideline.



(A) External layer: Nomex for mechanical Protection. (B) Internal layer: Flat braid in nickel plated copper for EMI Protection. (C) White tracer indicating the maximum operating diameter. If the required overlap is applied, the tracer should not be exposed.	Ensure 90° overlap of both the metal braid layer and the Nomex layer.	Wraparound repair using EMI metal bands with the required sleeve twist and overlap requirements. (D) Split Ring (M85049/93-XX) (E)Spot Tie (A-A-52083 or A-A-52084). (F) Self-sealing tape A-A-59163, Type II. (G) EMI metal band (Part No. M85049/128-1, or -2).

FIGURE 19-1. Illustration of EMI wraparound braid and examples of proper installation.

Acceptable
Properly installed EMI wrap around with correct twists and blue tracer showing.



Unacceptable
Improper twisting of harness covering. White tracer showing indicates inadequate minimum overlap required.

FIGURE 19-2. Examples of EMI wrap around in acceptable and unacceptable condition.

GUIDELINE 20

SHIELD CRIMP RING INSPECTION

1. Purpose. This guideline provides criteria for inspecting a shield crimp ring after installation in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 015 00	Shield Terminations.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. Crimped on shield termination ferrule is designed to contain and terminate the cable shielding, allowing up to 1/16 inch of shielding material to protrude past outer ring. Figure 20-1 shows proper and improper installation of shield termination ferrules.

a. Additional information regarding the inspection of shield crimp rings is provided in NA 01-1A-505-1, Work Package 015 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

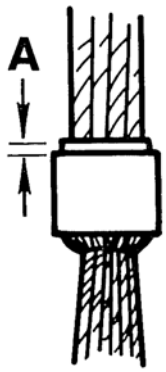
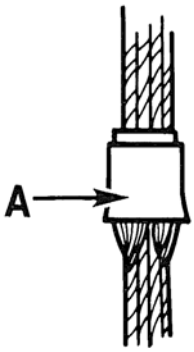
			
Acceptable (A) Inner ring aligned with outer ring, or may extend past outer ring by 1/32 inch. Shielding protrudes 1/16 to 1/32 inch past outer ring.	**Unacceptable** No shielding protrudes beyond outer ring. There is not enough shielding in contact surface between inner and outer ring.	**Unacceptable** Inner ring extends beyond maximum allowed, resulting in reduction of crimp contact surface and insufficient crimp.	**Unacceptable** (A) Outer ring is not completely formed because of improper positioning in crimp tool.

FIGURE 20-1. Examples of shield termination ferrules in acceptable and unacceptable condition.

GUIDELINE 21

CONTACT CRIMP INSPECTION

1. Purpose. This guideline provides criteria for inspecting contact crimps.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 013 00	Contacts, Terminals, Splices, and Caps.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting crimped contacts used in the EWIS, the following procedure should be followed:

a. Verify the contact is crimped properly. Note that it is possible to have the crimp indents deform the inspection hole of a crimp contact. This is acceptable if the crimp does not inhibit the inspection hole (see figure 21-1).

b. Verify that crimp indents are uniform (see figure 21-2).

c. Confirm that the conductor is visible around the barrel and the inspection hole.

d. If insulation gap is greater than 1/64″, trim conductor as required. If insulation gap is too small, trim insulation as required.

e. Confirm that wire insulation has not been damaged from stripping operation (see figure 21-2).

f. Additional information regarding the inspection of contact crimps can be found in NA 01-1A-505-1, Work Package 013 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

		
Acceptable Crimp indents deform the inspection hole boundary but do not inhibit the visibility of the conductor.	**Acceptable** Crimp indent enters the inspection hole. Conductor is visible through the deformed hole.	**Unacceptable** Crimp indents have deformed the inspection hole such that the conductor is not visible.

FIGURE 21-1. Examples of acceptable crimp indents and their location with the inspection hole.

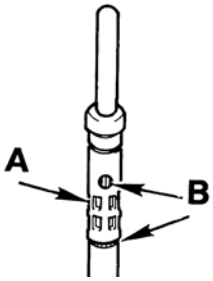
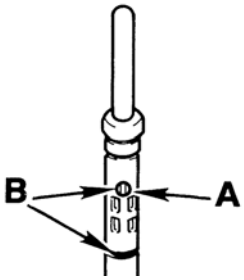
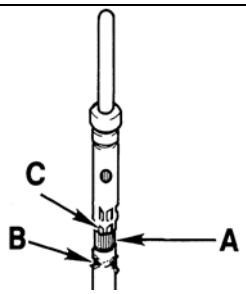
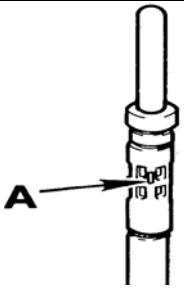
			
Acceptable (A) Proper contact crimp. Crimp indents are uniform. (B) The conductor is visible around the barrel and in the inspection hole.	**Acceptable** (A) The crimp borders the inspection hole but does not intrude into the hole. (B) The conductor is visible in the inspection hole and around the end of the barrel.	**Unacceptable** (A) Gap between the wire insulation and the crimp barrel exceeds 1/32″ maximum allowable. Strip length too long. (B) Wire insulation damage from the stripping tool. (C) The contact was improperly positioned in the tool. The crimp has occurred on the end of the barrel.	**Unacceptable** (A) The contact was improperly positioned in the tool. The crimp has occurred over the inspection hole. The conductor is not visible in the inspection hole.

FIGURE 21-2. Examples of acceptable and unacceptable contact crimps.

GUIDELINE 22

TERMINAL LUG CRIMP INSPECTION

1. Purpose. This guideline provides criteria on inspecting terminal lug crimps used in EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 013 00	Contacts, Terminals, Splices, and Caps.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. In order to verify that the terminal lugs are crimped properly when used in the EWIS, terminal lugs should be examined as follows:

a. Check that the wire insulation is inserted in the support area of the terminal barrel (see figure 22-1).

b. Confirm that the conductor is extended through the terminal barrel.

c. Verify that stripped wire ends are flush to terminal stop with not more than 1/32 inch is protruding (see figure 22-2).

d. Confirm that the crimp indent is centered in the terminal wire barrel.

e. Verify that individual terminal lugs have been completely insulated, but no insulation is present in the wire barrel.

f. Confirm that conductor insulation has been inserted into the insulation support area of the terminal lug barrel.

g. Verify that the amount of insulation stripped from the wire is not excessive, such that conductors extend into the hardware mounting area.

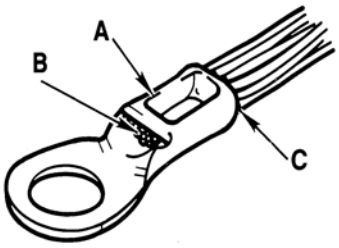
CAUTION:

In cases where the wire insulation diameter is small enough to enter the conductor crimp barrel area of the terminal lug, care should be used to prevent crimping over insulation.

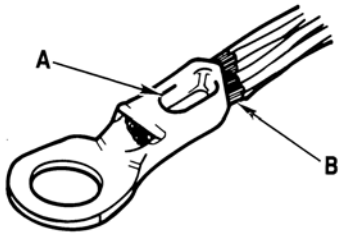
h. Additional information regarding the inspection of terminal lug crimps is provided in NA 01-1A-505-1, Work Package 013 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.



Acceptable
(A) Lug has been properly positioned in tool.
(B) Stripped wire ends are flush to terminal stop (not more than 1/32″ inch protruding).
(C) No insulation is in barrel.



Unacceptable
(A) Lug improperly positioned in tool resulted in deformation of terminal with crimp indent not centered on barrel.
(B) Excessive wire strip length.

FIGURE 22-1. Examples of acceptable and unacceptable crimping of terminal lugs.

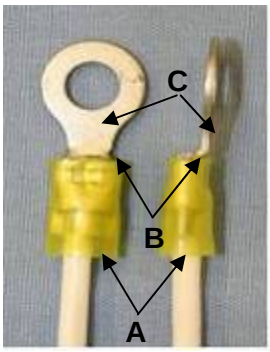
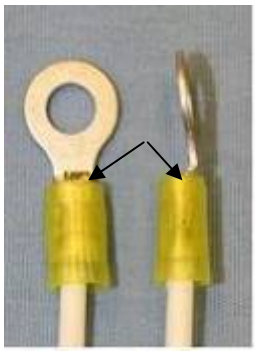
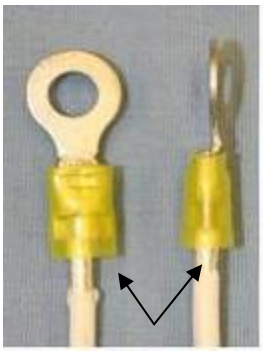
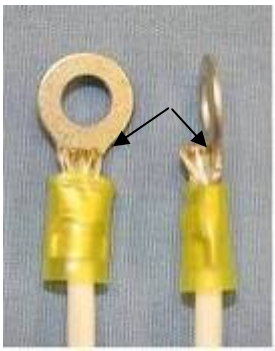
			
Acceptable (A) Conductor insulation should be inserted within support area of the terminal barrel. (B) Stripped conductor extends fully through the terminal barrel, as shown, with no more than 1/32 inch protruding. (C) No conductors extend into hardware mounting area.	**Unacceptable** Terminal lug and wire were not completely inserted into the crimping tool. Front end of barrel has been pinched (arrow), causing insufficient crimp on conductor.	**Unacceptable** Conductor insulation (arrow) has not been inserted into the insulation support area of the terminal lug barrel. Excessive strip length.	**Unacceptable** Conductor (arrow) extends into hardware mounting area. Excessive strip length.

FIGURE 22-2. Examples of acceptable and unacceptable wire installation in terminal lugs.

GUIDELINE 23

SPLICE INSPECTION

1. Purpose. This guideline provides criteria for inspecting splices used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 014 00	Wire and Cable Splicing and Repair.
SAE-AS50881	Wiring, Aerospace Vehicle. (DoD Adopted)
SAE-AS81824	Splices, Electric, Permanent, Crimp Style, Copper, Insulated, Environment Resistant. (DoD adopted)

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting splices used in the EWIS, the following should be verified:

a. If multiple splices are installed in a single harness, verify that splices are staggered in area as much as available space will permit; also, if wires are shielded, stagger shield ferrules.

b. Confirm that splices are not installed in a fuel tank or within 12 inches entering or exiting a fuel tank (see SAE-AS50881 for further information).

c. Verify that not no splices have been installed under support clamps.

d. Confirm that splices are not installed in an area of high flexibility in the harness.

e. Verify the in-line splice (SAE-AS81824) and stub splices are crimped properly:

> NOTE: A splice is acceptable if sealant has flowed out of end sleeve. In order for an in-line splice to be properly crimped, the following should exist (see figures 23-1 and 23-2):

1. Conductor should be centered in the nest.

2. Check that crimp is on the side containing the inspection hole.

3. Check that no wire is protruding from end of crimp barrel.

4. Confirm that individual in-line splices and stub splices have been completely insulated.

f. Additional information regarding splice inspection is provided in NA 01-1A-505-1, Work Package 014 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

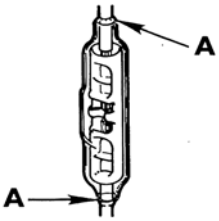
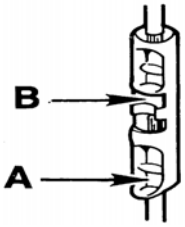
		
Acceptable Wires should be flush with front end of splice barrel and the conductor butted against the splice center stop. Crimp indent of both wires is on the side containing the inspection hole.	**Acceptable** Wire conductor must be visible through insulation sleeving. (A) Melted sealing bands flowed out of both ends of the sleeve.	**Unacceptable** (A) Crimp not centered on splice barrel. (B) Top wire conductor is not visible or butted against splice center stop.

FIGURE 23-1. Examples of acceptable and unacceptable in-line splices.

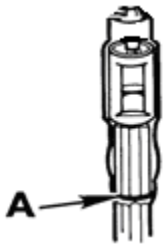
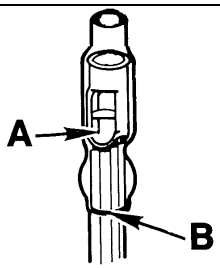
	
Acceptable Crimp is centered on barrel (A) Sealant flowed out of end of sleeve.	**Unacceptable** (A) Crimp is not centered on barrel because of improper positioning in tool. (B) Sealant did not flow out of end of sleeve.

FIGURE 23-2. Examples of acceptable and unacceptable stub splices.

GUIDELINE 24

SOLDER SLEEVE/SHIELDING TERMINATION INSPECTION

1. Purpose. This guideline provides criteria for inspecting solder sleeve/shielding terminations used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 015 00	Shield Terminations.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting solder sleeves and shielding terminals, the minimum and maximum solder flow should be verified (see figure 24-1):

a. For acceptable minimum solder flow, the following should be present:

1. Slight traces of dull red color (thermal indicator).

2. Solder has lost all original shape.

3. Sealant inserts have melted and flowed along wires.

4. Shield and lead contours are visible.

5. A definite fillet is visible between lead and shield.

b. For acceptable maximum solder flow, the following should be present.

1. Dull red color has disappeared.

2. Slight traces of dull red color (thermal indicator) in sealant insert area are acceptable.

3. Sealant inserts have melted and flowed out along wires.

4. A definite fillet is clearly visible between lead and shield.

5. Joint area is visible despite browning of sleeve.

c. When there is insufficient heat during the soldering process, unacceptable solder flow results. In this situation, the following can be observed when inspecting the solder flow:

1. Dull red color (thermal indicator) is clearly visible.

2. Original shape of solder perform is clearly visible.

3. Meltable sealing inserts have not flowed.

4. Contour of braid and/or lead is blocked by solder.

d. When there is too much heat used during the soldering process, unacceptable solder flow results. In this situation, the following can be observed when inspecting the solder flow:

1. Joint area is not visible because of severe darkening of the outer sleeve.

2. Solder fillet is not visible along lead and shield interface.

3. Wire insulation damaged outside of sleeve.

e. Additional information regarding inspection of solder sleeves and shield terminations is provided in NA 01-1A-505-1, Work Package 015 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

Acceptable
Minimum Solder Flow

Acceptable
Maximum Solder Flow

Unacceptable
Insufficient heat. Solder band not melted.

Unacceptable
Overheated

FIGURE 24-1. Examples of solder sleeves that have acceptable and unacceptable solder flow.

GUIDELINE 25

SOLDER INSPECTION

1. Purpose. This guideline provides criteria on inspecting solder contacts and joints in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 016 00	Soldering.
NA 01-1A-23	Standard Maintenance Practices Miniature/Microminiature (2M) Electronic Assembly Repair.
Work Package 020 00	Introduction to Lead-Free Solder.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines.

> NOTE: The following guideline applies to conventional, tin-lead solder applications. For lead-free solder applications, refer to NA 01-1A-23, Work Package 020 00.

Figure 25-1 provides examples of acceptable and unacceptable soldering.

a. When inspecting solder joints in the EWIS, a good solder joint has the following characteristics:

1. A good solder joint will have a bright silvery appearance, with smooth fillets and feathered, not sharp, edges.

2. The entire joint will be covered with a smooth, even coat of solder, and the contour of the joint will be visible.

3. The insulation is properly cut.

b. When inspecting solder joints in the EWIS, a poor solder joint has the following characteristics. If any of the following exists, it is cause for rejection.

1. The solder joint has a dull gray, chalky, or granular appearance (evidence of a cold joint).

2. The solder joint has hair cracks or irregular surface (evidence of a disturbed joint).

3. The solder joint has grayish, wrinkled appearance (evidence of excessive heat).

4. The solder joint is partially exposed joint (evidence of insufficient solder).

5. Scorched wire insulation or burned connector inserts are present.

6. Globules, drips, or tails of solder are present.

7. The insulation has any of the following damage. If any of these conditions are present, they are cause for rejection.

   a. Insulation is charred, burned, or blistered.

   b. Insulation is frayed or has an uneven appearance.

c. Additional information regarding the inspection of soldering is provided in NA 01-1A-505-1, Work Package 016 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

Acceptable
Good solder quantity with no spillage.

Unacceptable
Insufficient solder quantity wire uncovered wire stands.

Unacceptable
Excess solder flow with protrusions.

FIGURE 25-1. Examples of acceptable and unacceptable soldering.

GUIDELINE 26

BONDING STRAP/JUMPER INSPECTION

1. Purpose. This guideline provides criteria for inspecting bonding/jumper straps used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 017 00	Bonding and Grounding.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting bonding straps and jumpers used in the EWIS, the following should be examined (see figure 26-1):

a. 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.

b. Confirm that bond connections are secure and free from corrosion.

c. Verify that bonding jumpers are installed in such a manner as not to interfere in any way with the operation of movable components of the aircraft.

d. Inspect bonding jumper condition and verify that jumpers are not frayed or kinked.

e. Confirm that self-tapping screws are not be used for bonding purposes. Only standard threaded screws or bolts of appropriate size should be used.

f. Confirm that bonds are attached directly to the basic aircraft structure rather than through other bonded parts.

g. Verify that the resistance across a bonding or grounding jumper is 0.1 ohm or less. This test is made after the mechanical connection is completed, and consists of a milliohm-meter reading of the resistance between the cleaned areas of the object and the structure. Refer to the platform/aircraft manual for specific installation and test requirements (see figure 26-2).

h. Additional information regarding the bonding straps and jumpers is provided in NA 01-1A-505-1, Work Package 017 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

Acceptable

Proper bonding strap applied.

Unacceptable

Frayed and broken bonding strap.

Unacceptable

Wrong orientation and frayed bonding strap.

FIGURE 26-1. Examples of bonding straps in acceptable and unacceptable condition.

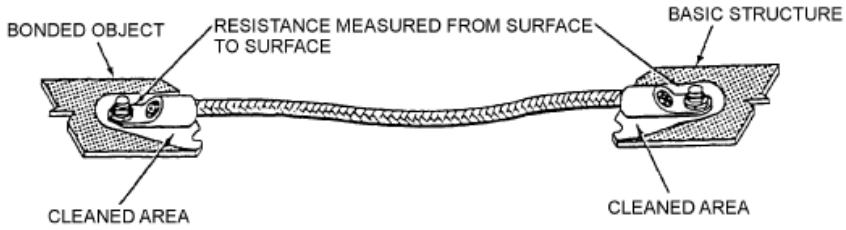


FIGURE 26-2. Bonding resistance test setup.

GUIDELINE 27

LOCK WIRE/SAFETY CABLE INSPECTION

1. Purpose. This guideline provides criteria for inspecting lock wire and safety cable connectors used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 018 00	Lockwiring, Shear Wiring, and Safety Cables.
SAE-AS4536	Lock Wire.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When lock wire and safety cable used in the EWIS are inspected, the following should be examined:

a. Verify that a pigtail of 3 to 6 twists remains after completion of lock wiring. Lock wire should be twisted in a clockwise direction, with 8 to 10 twists per inch so that the applicable shell of the connector being secured is pulled toward the tightening direction (see figure 27-1).

b. Confirm that lock wire in accordance with SAE-AS4536 is routed in the most direct way to the tightening position, is taut, and shows no evidence of nicks, kinks, or breaks (see figure 27-2).

c. Confirm that the wire has not been over twisted and that there are no broken wires (see figure 27-2).

d. Verify that safety cable is used for any shear or breakaway applications. Safety cable needs to be installed with a calibrated tool which is supplied by the safety cable manufacturer for the purpose of applying tension to the cable, crimping the ferrule, and cutting the excess cable without allowing loss of tension (see figure 27-3).

e. Minimize mixing of lock wire and safety cable.

f. Routing of safety cable may vary from that of lock wire in order to achieve a proper installation.

g. Additional information regarding lock wire and safety cable inspection is provided in NA 01-1A-505-1, Work Package 018 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

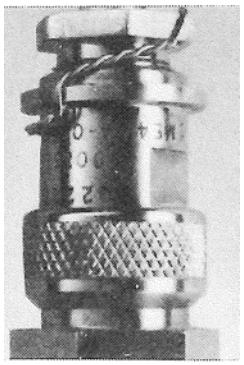
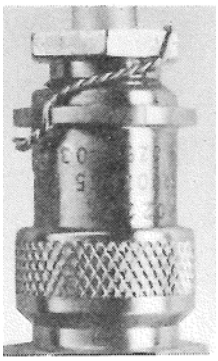
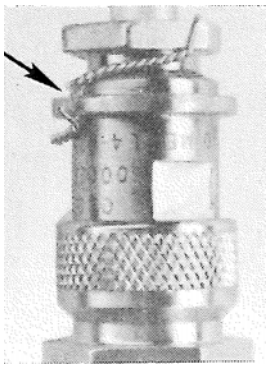
		
Acceptable Lock wire is twisted clockwise, as shown. A pigtail of 3 to 6 twists remains after completion of safety wiring.	**Unacceptable** Lock wire has been over twisted. Excessive twists may cause a wire break.	**Unacceptable** Excessive twists have resulted in a broken wire (arrow). This is caused by the extreme stress of over twisting wires.

FIGURE 27-1. Example of acceptable and unacceptable installation of lock wire.

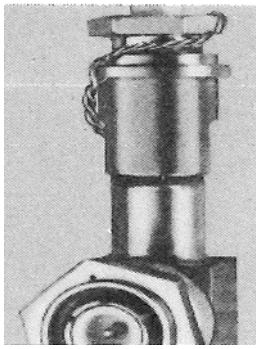
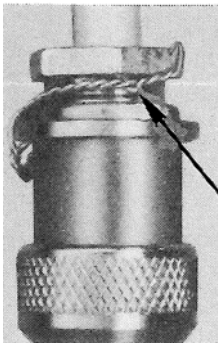
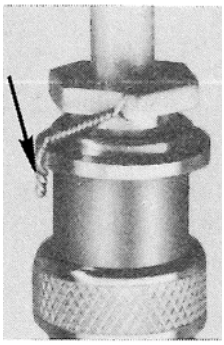
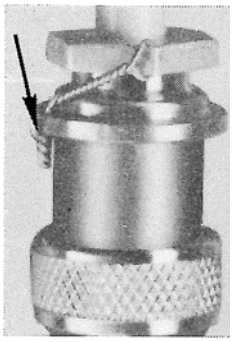
			
Acceptable Lock wire is routed in the most direct way to the tightening position, be taut and show no evidence of nicks, kinks, or breaks.	**Unacceptable** Kinked lock wire (arrow) should be removed and replaced. A kinked strand transfers the stress load to the remaining strand and may result in lock wire failure.	**Unacceptable** Wire is over twisted and shows evidence of nicks (arrow) which may fracture and result in loss of lock wire tension.	**Unacceptable** The broken wire (arrow) is the result of over twisting during application.

FIGURE 27-2. Examples of lock wire that is directly routed and unacceptable due to kinks and over twisting.

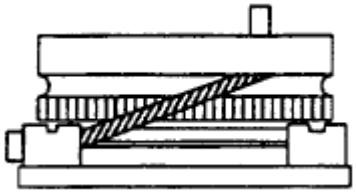
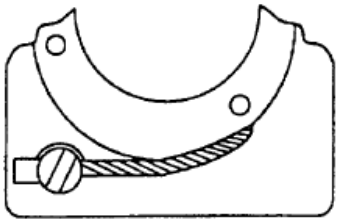
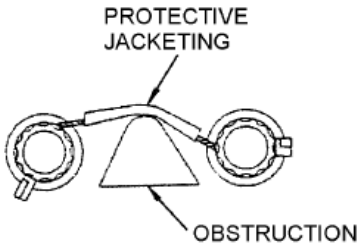
		
Acceptable Safety cable may be used as a substitute for lock wire on electrical equipment and connectors in aircraft to prevent accidental loosening caused by vibration. Safety cable may be used on threaded parts, such as connector coupling mechanisms, backshells, strain relief components, relays, other electrical components, and equipment covers/panels.	**Acceptable** Safety cable installed on a single jam nut receptacle. Safety cable may be installed from a fastener as shown above or it may require the use of a self-looping safety cable.	**Acceptable** A tubular jacket is installed where it may come into contact with other surfaces which may damage the safety cable or may be damaged by the safety cable.

FIGURE 27-3. Examples of acceptable safety cable installations.

GUIDELINE 28

TERMINAL BOARD, GROUND STUD, AND BACKSHELL INSPECTION

1. Purpose. This guideline provides criteria for terminal board, ground stud, and backshell inspections.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 019 00	Bus Bar and Terminal Board.
MIL-A-46146	Adhesives-Sealants, Silicone, RTV, Noncorrosive (for use with Sensitive Metals and Equipment).
NASM25440	Washers for use With Aircraft Aluminum Terminals. (DoD adopted)

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting terminal boards and ground studs, the following items should be examined:

a. Follow all wire/harness runs and lightly shake at all clamp or support devices. Inspect for proper torque by attempting to rotate clamp around bolt/screw axis. If not tight, length may be improper or bolt bottomed out.

b. Examine for proper thread protrusion from the back of the clamp. Three to five threads are optimum (2 minimum).

c. Confirm airframe clips/nut plates and brackets do not have loose rivets or fasteners.

d. Ensure that exposed terminals are covered using protective covers, or in SWAMP areas are sealed/potted.

e. Confirm that the proper selection of washer material plating is compatible with terminal plating to prevent damage (cadmium is usually preferred).

f. Inspect terminal board mounting and connections for the following:

1. Confirm that no more than four terminal lugs, or three terminal lugs and one bus are connected to one terminal stud.

2. Verify that terminal lugs with various diameters are stacked with the largest outer diameter on the bottom and the smallest on top.

3. Confirm that terminal lugs have been selected by stud diameter.

4. Verify that terminal lugs are sufficiently tight but not over tightened so that the terminal lug or stud is deformed or damaged.

5. Check the wires connected to the terminal board to confirm that the wires have a maximum ¾″ ±¼″ bend radius (see figure 28-1).

6. Confirm that all wires exit straight from terminal lugs (see figure 28-1).

7. Verify that any exposed mounting hardware of terminal strip is potted or sealed with suitable potting compound (i.e. MIL-A-46146) or Thixoflex (Part No. TG2010FR-50).

8. Confirm that a marking sleeve is attached after the bundle is formed.

9. Verify that terminal lugs are positioned so that bending is not required to remove fastening screw or nut.

10. Confirm that terminal lugs are positioned so that movement will tend to tighten the nut.

11. Verify that copper terminal lugs do not have spacers or washers between the tongues of terminal lugs.

12. Confirm that aluminum terminal lugs have the tongue or total number of tongues sandwiched between two NASM25440 flat washers. Spacers or other washers are not permitted between the tongues.

13. When two lugs are attached to one side of a stud, verify that the lugs are installed back-to-back (see figure 28-2).

14. When the maximum of three lugs is installed on one side, confirm that a space washer is placed between back-to-back lugs and the third lug (see figure 28-2).

15. Verify that stud hardware is stacked in the following order: flat washer, lock washer, and nut (see figure 28-1).

g. When inspecting backshells, the following items should be checked:

1. Confirm that an additional flat washer has been placed underneath the backshell ground screw head.

2. Verify that if two to four ground wires are to be attached to the backshell, they will be equally distributed between the two ground screws.

3. Confirm that there are no more than four lugs (two on each side) attached to each backshell.

h. Additional information regarding inspection of terminal boards, ground studs and backshells is provided in NA 01-1A-505-1, Work Package 019 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

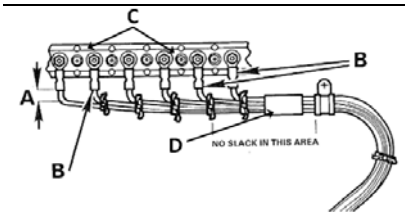
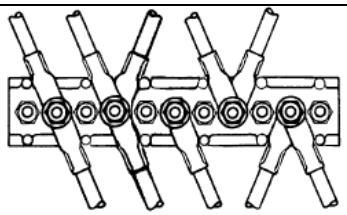
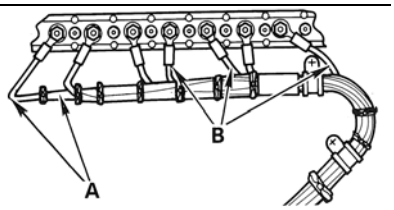
		
Acceptable (A) Wire length should be ¾″ ±¼″ maximum plus bend radius. (B) All wires exit straight from terminal lug. (C) Exposed mounting hardware of terminal strip is potted or sealed with suitable potting compound. (D) Marking sleeve is attached after bundle is formed.	**Acceptable** All terminals should be placed so that movement will tighten nut as shown.	**Unacceptable** (A) Excessive wire length, and bend radius. (B) No stress relief at termination, insufficient wire length.

FIGURE 28-1. Examples of acceptable and unacceptable wire length, bend radius, and terminal placement.

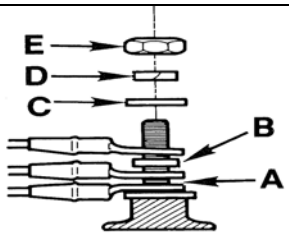
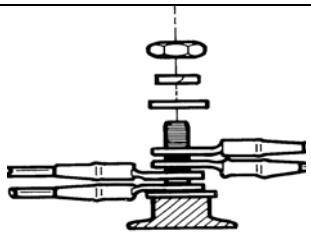
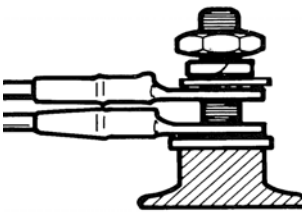
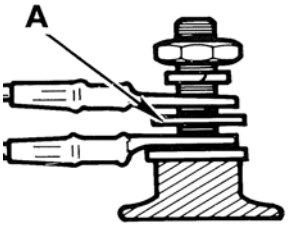
			
Acceptable (A) Two lugs are attached to one side of a stud, the lugs are installed back-to-back. Three lugs are on one side, a space washer is placed between (A) back-to-back lugs and (B) the third lug. Stud hardware is stacked in the following order: (C) flat washer, (D) lock washer, (E) nut.	**Acceptable** When four lugs are installed, they will be grouped in pairs, back-to-back, on opposite sides of the studs.	**Unacceptable** The lugs are not back-to-back as required. This places stress on the ring tongue creating cracks and fractures.	**Unacceptable** Improper hardware stack up. (A) Flat washer should be on top of the top lug. No washer required between just two back-to-back lugs.

FIGURE 28-2. Examples of acceptable and unacceptable installation of terminal lugs and associated hardware.

GUIDELINE 29

CONNECTOR INSPECTION

1. Purpose. This guideline provides criteria on inspecting connectors used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 020 00	Military Standard Electrical Connectors.
SAE-AMS-DTL-23053	Insulation Sleeving, Electrical, Heat Shrinkable, General Specification for. (DoD adopted)

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. Figure 29-1 shows the different parts that make up electrical connectors. When inspecting connectors used in the EWIS, the following items should be examined:

a. Inspect the opening of the strain relief clamp, backshell saddle, or cabling at rear grommet seals.

b. Evaluate the condition of the mating and accessory threads.

c. Inspect the plating for corrosion or flaking.

d. Confirm that receptacles with mounting holes contain all mounting hardware.

e. When inspecting connectors with grommet seals, the following should be examined as follows (see figures 29-2 and 29-3):

1. Verify that there are no chips, gouges, or other damage in or extending from chamfered areas, which might interfere with the ability of the seal to do its job.

2. Confirm that wire outside diameter is within tolerances defined in the applicable connector specification. The proper wire diameter is necessary to meet the sealing requirements. If the wire outside diameter is undersized, wire may be built up with heat shrinkable sleeving (SAE-AMS-DTL-23053) to the correct size.

3. Verify wires entering connectors and terminal blocks; grommet seals do not distort the seal so as to create a gap between the wire and the seal. All wires should extend straight out from the connector, as shown, so that a gap is not created (see figure 29-4).

f. Only disassemble a fiber optic connector for maintenance or troubleshooting. Fiber optic connectors should not be unmated for inspection only.

g. Fiber optic connector inspections should always be done before mating any connector to verify all mating fiber optic ferrule end faces are clean and free of damage. Inspection detects ferrule end face pollutants and damage. Existing pollutants and damage on an unmated connector (plug or receptacle) can easily be transferred to the mating connector.

h. Additional information regarding inspection of connectors is provided in NA 01-1A-505-1, Work Package 020 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

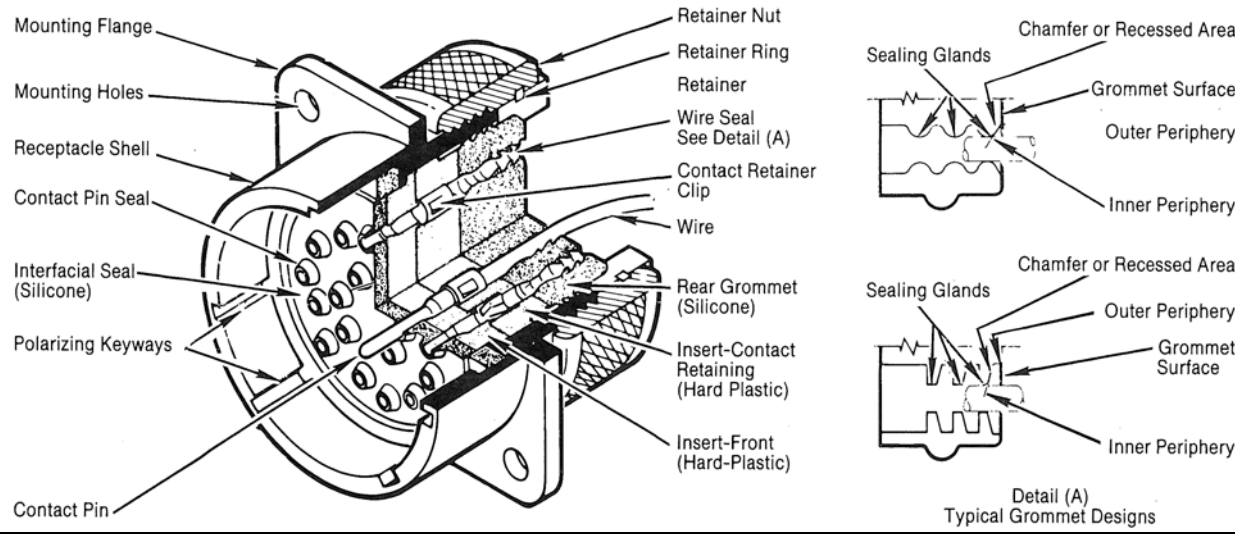
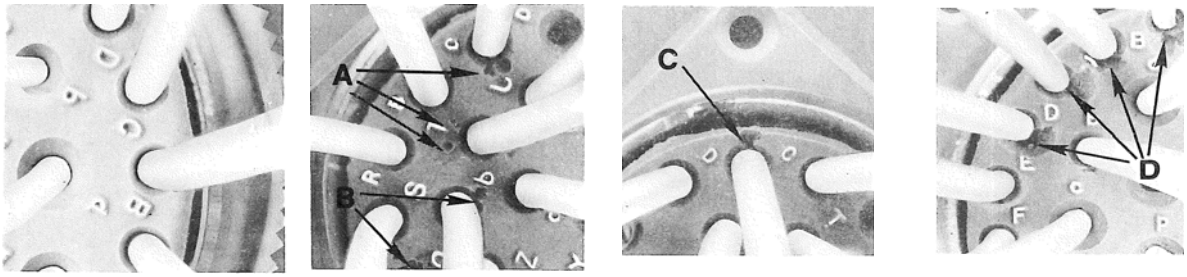
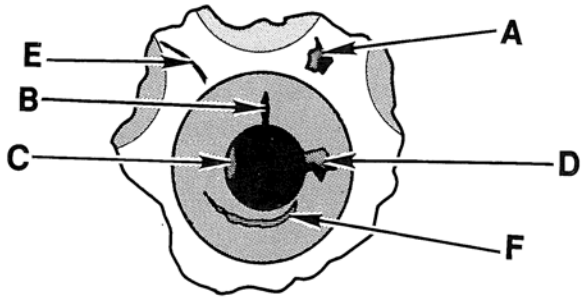


FIGURE 29-1. Illustration of connector components.

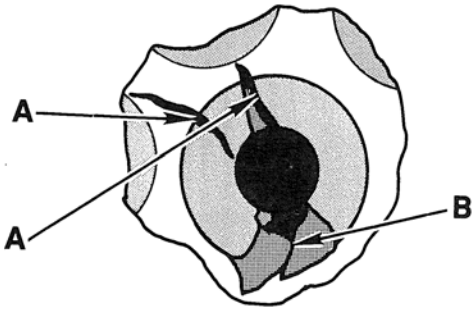


Acceptable The connector grommet has no surface gouges that extend to the wire or below the bottom of the chamfer (first sealing gland).	**Acceptable** Although gouges appear on the grommet surface (A) and in the chamfer area (B), none extend to the base of the chamfer.	**Unacceptable** The gouge (C) extends through the chamfered area and comes in contact with the wire. The sealing ability of the grommet is reduced.	**Unacceptable** The large deep gouges (D) extend below bottom of the chamfer, and destroy the sealing capability of the grommet.

FIGURE 29-2. Examples of connector grommets in acceptable and unacceptable condition.



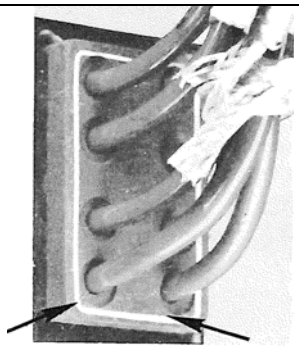
Acceptable
Any ONE imperfection: (A) Chip, nick or gouge, (B) Split crack through the sealing gland but not extending out of the recessed or chamfered area, (C) Mold Flash, (D) Chip, nick or gouge through the sealing gland but not out of the recessed or chamfered area, (E) Split or crack, (F) Chip, nick, or gouge not through the sealing gland.



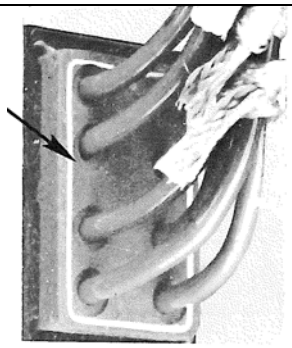
Unacceptable
(A) Split or crack extending out of the recessed or chamfered area, (B) Chip, nick, or gouge extending out of the recessed or chamfered area. May be repairable using standard repair procedures.

FIGURE 29-3. Examples of grommets with different levels of damage.

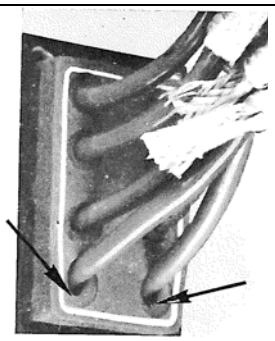
Acceptable
Wires entering connectors and terminal blocks; grommet seals do not distort the seal. All wires extend straight out from the connector.



Acceptable
Normal flexing of wires may exert pressure against the grommet (arrows), but slight distortion of the seal is not enough to create a gap between the seal and wire.



Unacceptable
Although the wires are routed at a proper angle, one wire has been pulled back sharply during spot tie installation.
A very large gap (arrow) is the result.



Unacceptable
Wires do not come straight out of the grommet and have distorted the seal. The result is large gaps (arrows).
Contaminants and moisture can enter the terminal block.

FIGURE 29-4. Examples of acceptable wire installation in connector and terminal blocks.

GUIDELINE 30

CONNECTOR STRAIN RELIEF INSPECTION

1. Purpose. This guideline provides criteria for inspecting the connector strain relief in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

MIL-I-22444	Insulation Tape, Electrical, Self-Bonding, Silicone Rubber Treated Bias Weave Or Sinusoidal Weave Glass, Cable Splicing, Naval Shipboard. (Inactive for New Design)
NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 024 00	Connector Accessories.
A-A-59163	Insulation Tape, Electrical, Self Adhering Unsupported Silicone Rubber.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. Figure 30-1 provides examples of acceptable and connector strain relief. When inspecting connector strain relief in the EWIS, the following steps should be used:

a. Examine cabling for adequate re-termination slack.

b. Verify that the cable has the proper bending radius.

c. Confirm that the cable has proper bending when exiting the backshell on a multiple termini connector (circular type).

d. Ensure that there is a minimum of two wraps of silicone rubber tape cushion (A-A-59163, or MIL-I-22444) centered securely under the cable clamp.

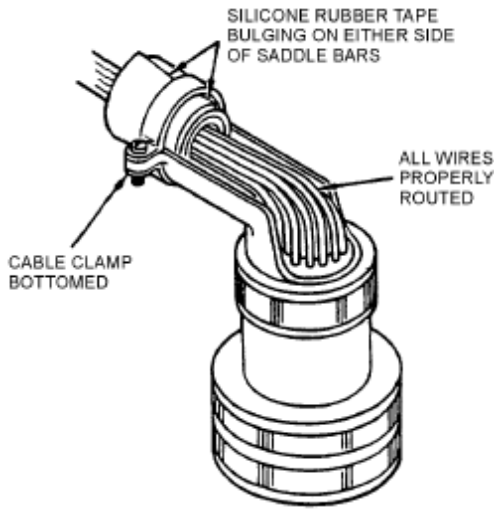
e. Confirm that cable clamp and attaching hardware are installed.

f. Verify that bending of cabling exiting a backshell occurs at the cable strain relief or once outside the backshell.

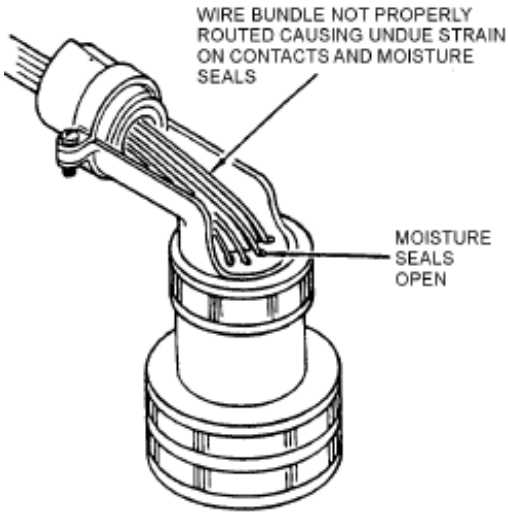
g. Additional information regarding inspection of connector strain relief is provided in NA 01-1A-505-1, Work Package 024 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.



Acceptable
Wire exits sealing glands perpendicular to the grommet for ¼″ prior to any wire bend. Does not induce stress on sealing glands. Provides environmental seal around wire.



Unacceptable
The short wires in back of connector (arrow) produce excess stress on contact crimp joint and sealing glands. Distorts sealing gland, prohibiting environmental seal.

FIGURE 30-1. Examples of acceptable and unacceptable connector strain relief.

GUIDELINE 31

CONNECTOR BACKSHELL INSPECTION

1. Purpose. This guideline provides criteria for inspecting the electrical connector backshells used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance.
Work Package 024 00	Connector accessories.
MIL-I-22444	Insulation Tape, Electrical, Self-Bonding Silicone Rubber Treated Bias Weave Or Sinusoidal Weave Glass, Cable Splicing, Naval Shipboard. (Inactive for New Design)

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. Figure 31-1 shows the different parts that make up non-environmental, environmental and EMI backshells. When inspecting backshells used in the EWIS, the following steps should be taken:

a. Confirm that all components are present and installed in the correct order and harness orientation so that minimum bend radius are met.

b. Verify that the backshell is tightened by applying a clockwise force as viewed from the connector rear.

c. Confirm that silicone tape or backshell tape (MIL-I-22444, part number RL6000SA) is applied under strain relief if the harness is smaller than the strain relief opening where the rubber grommet is not installed.

d. Additional information regarding inspection of connector backshells is provided in NA 01-1A-505-1, Work Package 024 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

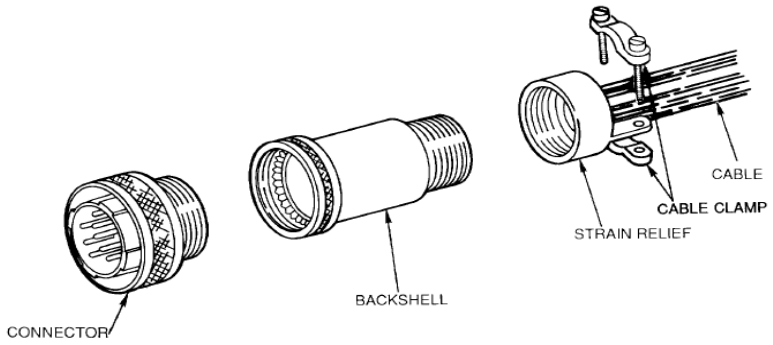


FIGURE 31-1A. Non-environmental backshell assembly.

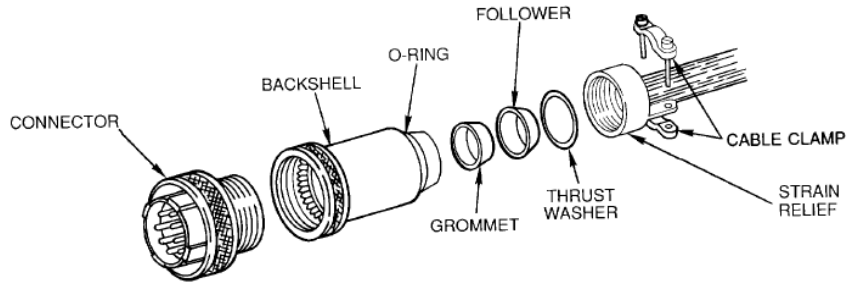


FIGURE 31-1B. Environmental backshell assembly.

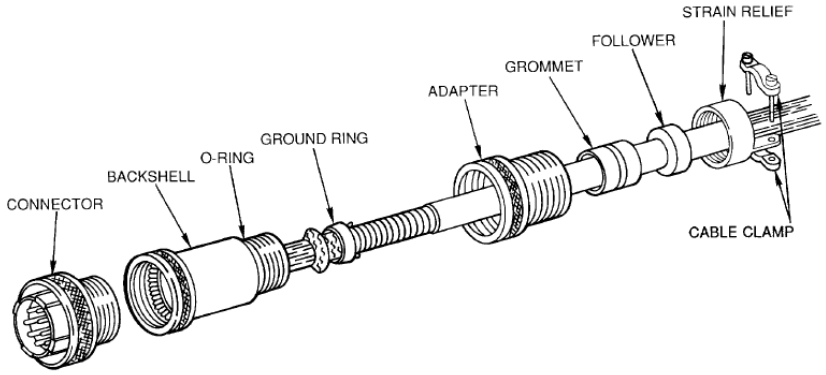


FIGURE 31-1C EMI backshell assembly.

FIGURE 31-1. Components of non-environmental, environmental, and EMI backshells.

GUIDELINE 32

PRESERVATION OF CONNECTOR/COMPONENT INSPECTION

1. Purpose. This guideline provides criteria on inspecting connector/component preservations used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 025 00	Potting and Sealing Connectors, Electeical Cable Assemblies, and Electrical Components.
NA 01-1A-509-1	Corrosion Program and Corrosion Theory
NA 01-1A-509-3	Avionic Cleaning and Corrosion Prevention/Control
A-A-52083	Tape, Lacing and Tying, Glass.
A-A-52084	Tape, Lacing and Tying, Aramid.
MIL-A-46146	Adhesives-Sealants, Silicone, RTV, Noncorrosive (For Use With Sensitive Metals And Equipment).

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. Figure 32-1 provides examples of connectors in acceptable and unacceptable condition. When installing potting compound to seal components and terminations and inspecting locations where potting has been applied, the following steps should be taken:

a. Steps for potting or sealing connectors are as follows (see figure 32-2):

1. Clean all surface areas to be sealed with cleaning compound.

2. Use the dual wrap kit (part number AD28500-36-36-8) to install Stretch Seal (inner layer) and Self-fusing Silicone tape (outer layer) and secure with A-A-52083 or A-A-52084 lacing tape. Stop StretchSeal (Part No. AD89503-01-36) approximately 2 inches past end of back shell (pink color).

3. Install Self-fusing Silicone Tape (Part No. AD59163-01-36) (grey color) and ensure 50 percent overlap over the top of the StretchSeal tape. Stretch the tape during application to ensure a tight fit when complete. Secure with lacing tape (such as A-A-52083 or A-A-52084).

b. When potting or sealing terminations the following steps should be taken (see figure 32-2):

1. Confirm that affected surface areas to be sealed are clean (use cleaning compound as required).

2. Ensure air cavities or voids are removed.

3. Apply 1/8 inch thick uniform spread of potting compound. Sealing compound in accordance with MIL-A-46146 or Thixoflex (Part No. TG2010FR-50) should be used.

4. When filling cavities avoid air entrapment by using a fine pointed nozzle and start filling from the bottom up.

c. When inspecting the preservation of connectors which contain either electrical contacts only or both electrical contacts and fiber optic termini and their associated components, the following items should be examined:

1. Confirm that no preservatives or solvents (including corrosion prevention compounds (CPC), solvents or lubricants) have been applied to contacts.

2. Verify that preservatives have been applied to connector shell only.

3. Inspect the connector for the following types of corrosion, which are common to avionics equipment used on military aircraft: uniform surface attack, galvanic (dissimilar metals), pitting, crevice (concentration cell), inter-granular, stress, erosion (see figure 32-1).

4. Metal components should be inspected for:

a. Flaking or loosening of corrosion deposits/powder that can spread to adjacent surfaces and eventually the ferrule end faces.

b. Pitting, erosion, or cracking that can interfere with connector mating or compromise environmental sealing.

d. Additional information regarding the preservation of connectors and their components is provided in NA 01-1A-505-1, Work Packages 025 00, NA 01-1A-509-1 and NA 01-1A-509-3.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.

		
Acceptable Serviceable connector.	**Unacceptable** Connector corrosion with connector degraded until broken.	**Unacceptable** Another example of corrosion on a connector.

FIGURE 32-1. Examples of connectors that are in acceptable and unacceptable condition.

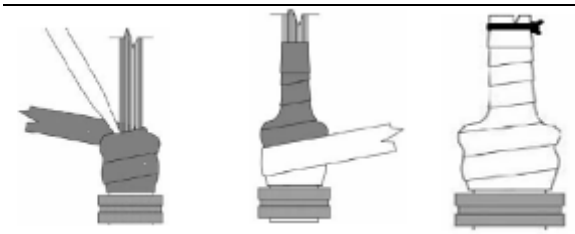
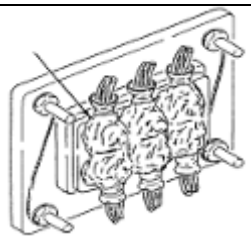
	
Acceptable Dual Wrap Kit (AD28500-36-36-8) installed properly using self-leveling green (Part No. HT3326-5FR-50), StretchSeal (inner layer) and Self-fusing Silicone tape (outer layer), secured with lacing tape.	**Acceptable** Thin coat (1/8-inch thick) of polyurethane removable sealant, sealing compound or MIL-A-46146.

FIGURE 32-2. Examples of the correct usage of dual wrap and polyurethane removable sealant.

GUIDELINE 33

CIRCUIT BREAKER INSPECTION

1. Purpose. This guideline provides criteria for inspecting circuit breakers used in the EWIS.

2. Applicable documents. The documents listed below are those applicable to this guideline.

NA 01-1A-505-1	Joint General Series Wire Maintenance Manual.
Work Package 028 00	Protective Devices.

3. Definitions.

3.1 See section 3 of this handbook.

4. General inspection guidelines. When inspecting standard thermal circuit breakers, the following steps should be taken:

a. All circuit breakers should be mechanically cycled three times yearly to improve reliability by removing wiper corrosion. With no electrical power applied, pull the button out and push the button in. Any unusual force (too little or too much) required to disengage or engage the button may indicate that a faulty breaker and breaker should be replaced.

b. Verify that the circuit breaker is in an untripped state.

c. Confirm that the current (amperage) indicator on end of actuator is legible and correct for the circuit in which it is used.

d. Verify orientation of amperage indicator is correct relative to panel of installation.

e. Inspect push-button for cracks or deterioration and inspect case for cracks, deterioration, discoloration and burn marks.

f. Verify that there are no foreign objects present that could cause physical damage or electrical shorts.

g. Check leads of wires for burn marks and physical damage. Also, check for broken wire strands at the wire terminations.

h. Examine the circuit breakers for burn marks on the insulating barrier material of three phase circuit breakers.

i. Inspect circuit breakers and around the circuit breaker for corrosion, discoloration and hot spots on all metal parts, including buss bars.

j. Ensure all circuit breaker connecting hardware is tight and secure and verify correct line and load connection.

k. Confirm that the circuit breaker does not have a history of tripping. A tripped breaker may be faulty, may be in a faulty circuit, or may be improperly applied.

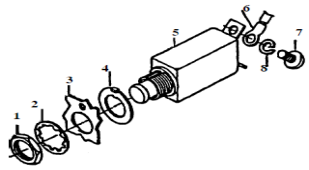
l. Inspect the circuit breaker boot for splits or deterioration. Do not remove the boot except for inspection.

m. If any circuit breaker does not meet the inspection criteria in a through m, the circuit breaker should be replaced.

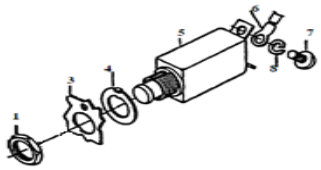
n. Additional information regarding the preservation of circuit breakers is provided in NA 01-1A-505-1, Work Package 028 00.

5. Detail guidelines. This section is not applicable to this guideline.

6. Notes. This section is not applicable to this guideline.



Acceptable
1. Nut
2. Lock washer
3. Panel
4. Key washer
5. Circuit Breaker
6. Terminal
7. Screw
8. Lock washer



Unacceptable
Missing Lock Washer (item 2)

Unacceptable
Screw too long and is causing damage to circuit breaker housing.

FIGURE 33-1. Examples of circuit breakers in acceptable and unacceptable condition.

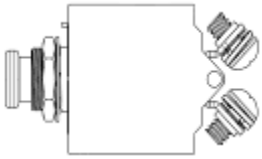
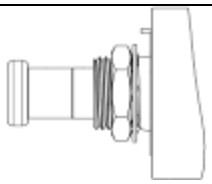
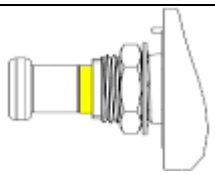
		
Acceptable Non-trip indicated circuit breaker.	**Unacceptable** Thermal trip indication	**Unacceptable** Arc fault trip indication

FIGURE 33-2. Examples of arc fault circuit breakers in non-tripped and tripped status.

CONCLUDING MATERIAL

Custodians:
Army - CR
Navy - AS
Air Force - 84
DLA - CC

Preparing activity:
Navy - AS

(Project 6145-2010-036)

Review activities:
Army - AR, AV, MI, TE
Navy - EC, OS, SH
Air Force - 19, 85

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.daps.dla.mil.