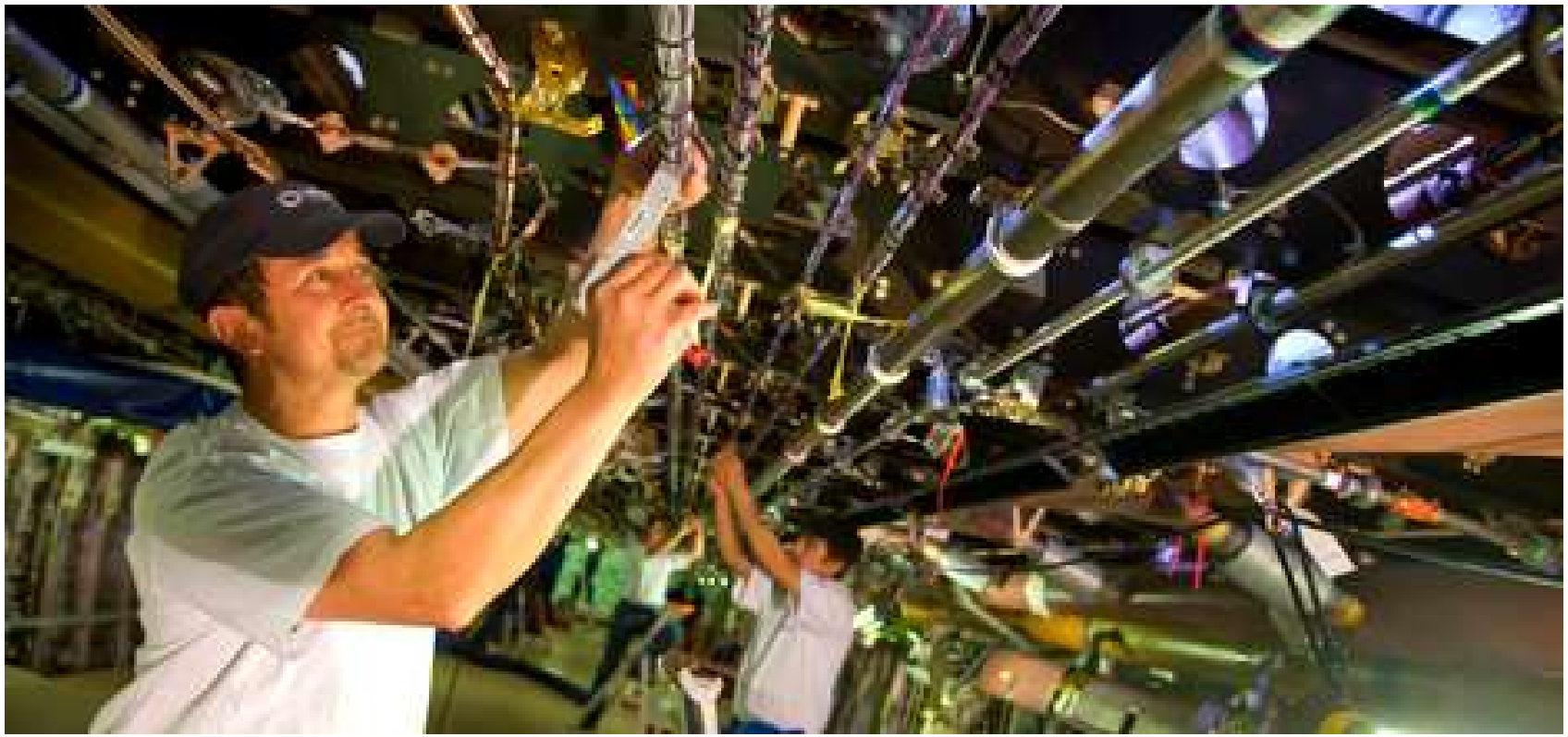
Enhanced Electrical Wiring and Interconnection System (EWIS) Training



Content

1. The Regulatory Requirements

2. EWIS Best Practices

Background

Enhanced Airworthiness Program for Airplane Systems/Fuel Tank Safety { EAPAS (EWIS) I FTS)

1988
Aloha
Flt 243

1991
FAA
Aging
Aircraft
Program

1996
TWA
Flt 800

1998
SwissAir
Flt 111

EAPAS Timeline

Background

The concern for Electrical Wiring Interconnection System (EWIS) was substantially raised in high profile following two very dramatic and significant aviation accidents:

The first accident affecting flight was **TWA 800** which exploded and broke up in mid-air in the sea next to long island New York in 1996.

The second affecting flight was **Swiss Air 111** in 1998.

TWA800 https://www.youtube.com/watch?v=HuHZ26jR2mo
Swiss Air 111 https://www.youtube.com/watch?v=OjCBKDOeMuQ
Aloha Flt 243 https://www.youtube.com/watch?v=uUfSw2EpSX8

Background

TWA 800

Background

Reconstruction of Swiss Air 111

Background

Aging Transport System Rulemaking Advisory Committee (ATSRAC) was created after TWA 800 to :

- **Expand Aging aircraft program to include non-structural systems**
- Including insufficient wiring maintenance

ATSRAC Findings:

- **Insufficient wiring maintenance areas found by inspections:**
- Deterioration
- Corrosion
- Improper installations
- Improper repairs
- Contamination of wiring

Background

- Conclusions from ATSRAC to create FAA final rule:

  - Current maintenance practices do not address wiring components (EWIS)
  - Wiring Inspection criteria was too general
  - Not enough detail in maintenance instructions to identify improper wiring installations and repairs

- Manufacturers develop a required inspection program for electrical wiring interconnection systems/operators to perform required inspections by a specified date.

The US Regulation

It is now a regulatory requirement under FAR 121.1111 (for US operators) and FAR 129.111 (for foreign operators) that-

- **After March 10, 2011, no operator may operate an airplane unless the maintenance program for that airplane includes inspections and procedures for electrical wiring interconnection systems (EWIS).**
- **The proposed EWIS maintenance program changes must be based on EWIS instructions for Continued Airworthiness (ICA) that have been developed in accordance with the requirement and approved by FAA.**
- **After March 10, 2011, before returning an airplane to service after any alterations for which EWIS ICA are developed. the operator must include in the airplane s maintenance program inspections and procedures for EWIS based on those ICA.**

Note : Instructions for Continued Airworthiness (ICA) Maintenance Data

Repair Station

- As a Repair Station (maintenance organization), the organization must understand the EWIS requirement of the operators and follow the EWIS Instruction for Continued Airworthiness.
- The organization must know where to find the relevant information, understand and use the information for the maintenance of the airplane.

Electrical Wiring Interconnection System (EWIS)

By definition of FAR25 25.1701-

a) As used in this chapter, electrical wiring interconnection system (EWIS) means any wire, wiring device, or combination of these, including termination devices, installed in any area of the airplane for the purpose of transmitting electrical energy, including data and signals, between two or more intended termination points. This includes:

1) Wires and cables.
2) Bus bars.
3) The termination point on electrical devices, including those on relays, interrupters, switches, contactors, terminal blocks and circuit breakers, and other circuit protection devices.
4) Connectors, including feed-through connectors.
5) Connector accessories.
6) Electrical grounding and bonding devices and their associated connections.
7) Electrical splices.
8) Materials used to provide additional protection for wires, including wire- insulation, wire sleeve, and conduits that have electrical termination for the purpose of bonding.
9) Shields or braids.
10) Clamps and other devices used to route and support the wire bundle.
11) Cable tie devices.
12) Labels or other means of identification.
13) Pressure seals.
14) EWIS components inside shelves, panels, racks, junction boxes, distribution panels, and back-plates of equipment racks, including, but not limited to, circuit board back-planes, wire integration units, and external wiring of equipment.

Electrical Wiring Interconnection System (EWIS)

b) Except for the equipment indicated in paragraph (a)(14) of this section, EWIS components inside the following equipment, and the external connectors that are part of that equipment, are excluded from the definition in paragraph (a) of this section:

1) Electrical equipment or avionics that are qualified to environmental conditions and testing procedures when those conditions and procedures are –
   i. Appropriate for the intended function and operating environment, and
   ii. Acceptable to the FAA.
2) Portable electrical devices that are not part of the type design of the airplane. This includes personal entertainment devices and laptop computers.
3) Fiber optics.

EWIS Instructions for Continued Airworthiness (ICA)

According to FAR 121.1111 and 129.111,

- **The proposed EWIS maintenance program changes must be based on**

EWIS Instructions for Continued Airworthiness (ICA) that have been developed in accordance with the requirement and approved by the FAA.

- **The requirement for EWIS ICA for existing airplanes is detailed in Appendix H of FAR 25 - H25.5(a)(1) and (b).**

EWIS Instructions for Continued Airworthiness (ICA)

According to H25.5(a)(1) -

The maintenance and inspection requirements for the EWIS is developed with the use of an Enhanced Zonal Analysis Procedure (EZAP) that includes:

i. Identification of each zone of the airplane.
ii. Identification of each zone that contains EWIS.
iii. Identification of each zone containing EWIS that also contains combustible materials.
iv. Identification of each zone in which EWIS is in close proximity to both primary and back-up hydraulic, mechanical, or electrical flight controls and lines.

EWIS Instructions for Continued Airworthiness (ICA)

v. Identification of -
   A. Tasks, and the intervals for performing those tasks, that will reduce the likelihood of ignition sources and accumulation of combustible material, and
   B. Procedures, and the intervals for performing those procedures, that will effectively clean the EWIS components of combustible material if there is not an effective task to reduce the likelihood of combustible material accumulation.

vi. Instructions for protections and caution information that will minimize contamination and accidental damage to EWIS, as applicable, during performance of maintenance, alteration, or repairs.

EWIS Instructions for Continued Airworthiness (ICA)

According to H25.5(b):

The EWIS ICA developed in accordance with the requirements of H25.5(a)(1) must be in the form of a document appropriate for the information to be provided, and they must be easily recognizable as EWIS ICA. This document must either contain the required EWIS ICA or specifically reference other portions of the ICA that contain this information.

EWIS Instructions for Continued Airworthiness (ICA)

in addition to H25.5(a)(1) & (b), the EWIS ICA for new airplane seeking type certification must also follow the requirement for H25.4 and additional requirement H25.5(a)(2) to 25.5(a)(5)

EWIS Instructions for Continued Airworthiness (ICA)

H25.4 *Airworthiness Limitations section.*

a) The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth —

1) Each mandatory modification time, replacement time, structural inspection interval, and related structural inspection procedure approved under §25.571.
2) Each mandatory replacement time, inspection interval, related inspection procedure, and all critical design configuration control limitations approved under §25.981 for the fuel tank system.
3) Any mandatory replacement time of EWIS components as defined in section 25.1701.
4) A limit of validity of the engineering data that supports the structural maintenance program (LOV), stated as a total number of accumulated flight cycles or flight hours or both, approved under §25.571. Until the full-scale fatigue testing is completed and the FAA has approved the LOV, the number of cycles accumulated by the airplane cannot be greater than 1/2 the number of cycles accumulated on the fatigue test article.

EWIS Instructions for Continued Airworthiness (ICA)

b) If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads: “The Airworthiness Limitations section is FAA-approved and specifies maintenance required under §§43.16 and 91.403 of the Federal Aviation Regulations, unless an alternative program has been FAA approved.”

EWIS Instructions for Continued Airworthiness (ICA)

For H25.5(a)(2) to (5)

2) Acceptable EWIS maintenance practices in a standard format.
3) Wire separation requirements as determined under §25.1707.
4) Information explaining the EWIS identification method and requirements for identifying any changes to EWIS under §25.1711.
5) Electrical load data and instructions for updating that data.

Key Messages

- The aircraft maintenance program includes inspections and procedures for EWIS using Enhanced Zona! Analysis Procedures (EZAP) to identify risks in different zones of the aircraft.
- The aircraft maintenance program will identify the task and its interval for reduction of ignition sources and accumulation of combustible material, and procedures for cleaning EWIS components.
- The EWIS ICA will include instructions for protection and caution information to minimize contamination and accidental damage to EWIS.
- Wiring needs to be treated as an important SYSTEM in an aircraft. EWIS is NOT just for wiring and connectors. It includes protection materials, shields, clamps, cable tie, labels and pressure seals.

The EASA Regulation

For EASA, an amendment to Part-66 M7 has been made to include EWIS.

The continuation training program for Part-145 Certifying Staff has to include EWIS training requirements. Reference AMCs include :

AMC 20-21	Programme to enhance airplane Electrical Wiring Interconnection System (EWIS) maintenance
AMC 20-22	Airplane Electrical Wiring Interconnection System Training Programme
AMC 20-23	Development of Electrical Standard Wiring Practices documentation

EWIS Best Practices

A. General Electrical Wiring Interconnection System Practices
B. Wiring Practices Documentation
C. Inspection
D. Housekeeping
E. Wire
F. Connective Devices
G. Connective Device Repair

GENERAL ELECTRICAL WIRING INTERCONNECTION SYSTEM PRACTICES

General Safety Awareness

- The major hazards associated with electricity are

  "Electrical Shock, Fire and Explosion"

- Electrical shock occurs when the body contacts an energized electrical circuit
- Fire and explosion are caused by overcurrent, which can be further divided into short circuit and overload
  - Short circuit: the circuit is abnormal with very low impedance
  - Overload: The circuit is normal but the load is exceeded the normal level

Safety Practices

Make sure the power is off before performing the maintenance task

Open the applicable circuit breakers and switches.

Obey the standard safety practices

Pay attention to signage of all WARNINGS and CAUTIONS.

Circuit isolation

Before working on wiring system, isolate the circuit by:

1. Identify the system circuit breakers.

2. Open the system circuit breakers.

3. Install collar to lock out the circuit breakers.

4. Install warning tags on the circuit breakers.

ESDS device handling and protection

ESDS stands for Electro-Static Discharge Sensitive

ESDS component is affixed with an ESDS label

Do not touch the connector pins by hand. Your body static electricity can cause component internal failure.

ESDS device handling and protection

Use ESDS cap (conductive cap, black in color) to protect the connector

ESDS device handling and protection

Antistatic device can reduces, dampens, or inhibits electrostatic discharge.

Antistatic wrist strap is used to safely ground a person working on very sensitive electronic equipment, to prevent the buildup of static electricity on their body. The strap consists of an elastic band of fabric with fine conductive fibers woven into it, attached to a wire with a clip on the end to connect it to a ground conductor.

ESDS maintenance practices can be found in **AMM ATA 20** *w*

Tools and Equipment

- All tooling, measuring devices or test equipment mus be in accordance with the applicable Aircraft Maintenance Manual pertaining to the aircraft type that is being worked.

Tooling Description, Operation, Inspection and Application

All precision tools, measuring devices or test equipment that are used on aircraft, engines or components to determine serviceability, limits, rig, adjustment or proper servicing, that because of there nature, can have deviations inaccuracy, will be referred to as calibrated tools.

Acceptable tools should have a label or code showing the validity.

Always verify the calibration / certification status and serviceability before use.

Tooling Description, Operation, Inspection and Application

Electrical measurement task using multimeters must closely adhered to the Aircraft Maintenance Manual.

CAUTION: SOME EWK ITEMS CAN NOT BE TESTED USING SELF-CONTAINED POWER SOURCES LIKE MULTIMETERS **“INDUCED** VOLTAGE CAN DAMAGE EWIS!" FOLLOW AMM INSTRUCTION

line-replaceable unit LRU

A line-replaceable unit LRU is a modular component of an airplane, ship or spacecraft that is designed to be replaced quickly at an operating location (1st line). An LRU is usually a sealed unit such as a radio or other auxiliary equipment.

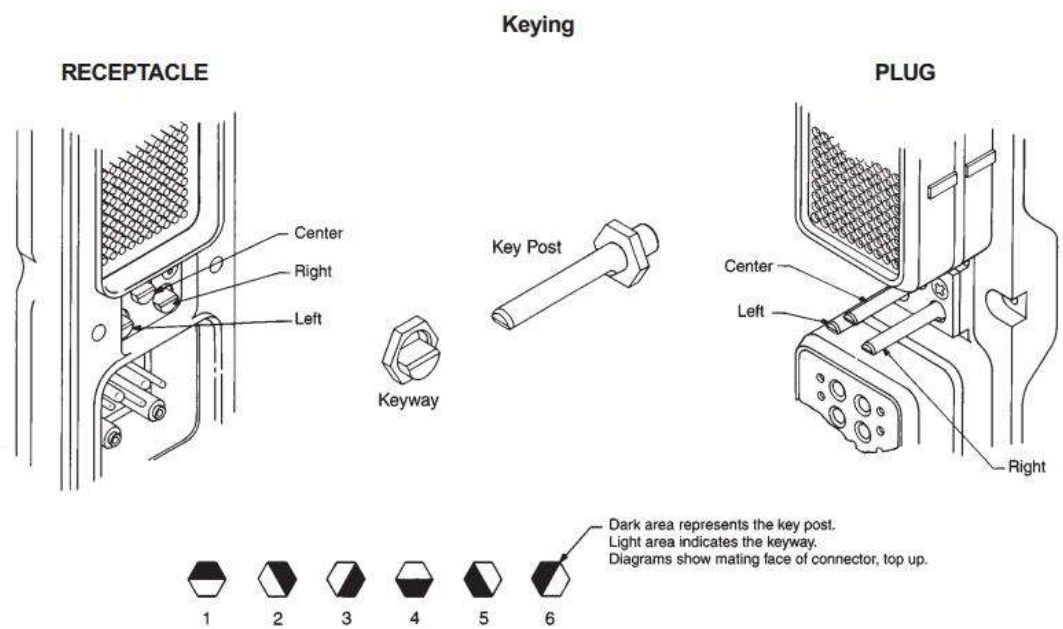
LRUs can improve maintenance operations, because they can be stocked and replaced quickly from distributed nearby on-site inventories, restoring the mobile systems to service, while the failed (unserviceable) LRU is undergoing complicated repair and overhaul actions in other support locations (lines). Because of their modularity, LRUs also can contribute to reducing system costs and increase quality, by centralizing development across different models of vehicles.

LRU replacement general practices

- Remove the LRU from the rack
- Visual inspect it for external damage
- Check the connector and pins for a sign of corrosion, bent pins, or any other damage
- Re-install the LRU and perform the test in accordance with AMM

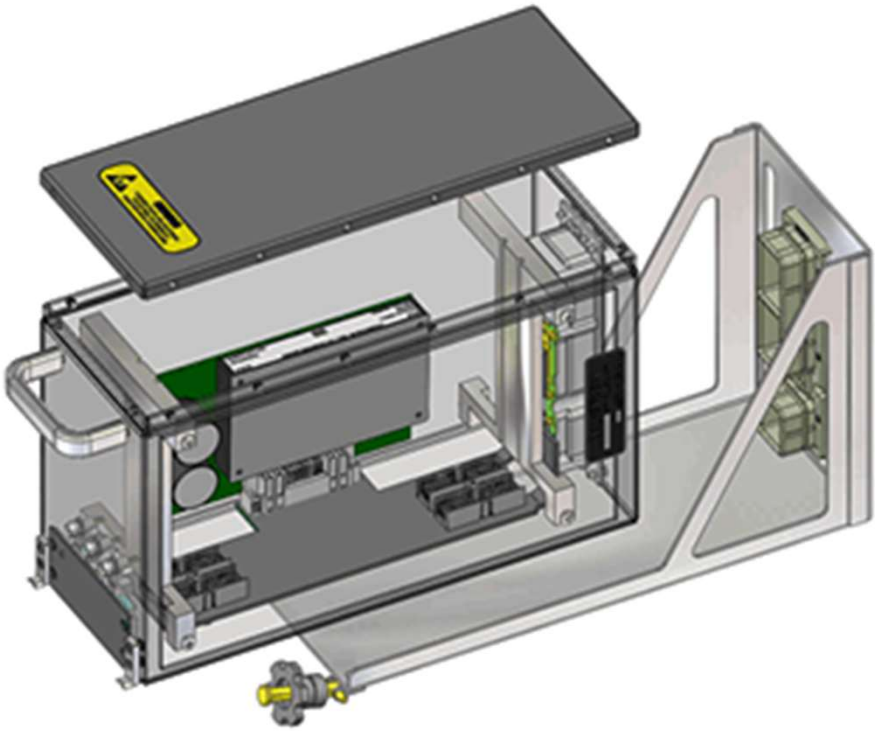
LRU Handling

Different avionic LRU's are often housed in cabinets of the same size, which could cause installation error. To prevent it, a connector has an indexing pin at an angle that matches only one LRU.
Unless all pins line up with connector holes, the LRU cannot be pushed in.
Prevent damage avoid forcing a LRU into a rack.



Indexing Pins Prevent Error

LRU Handling



Indexing Pins Prevent Error

WIRING PRACTICES DOCUMENTATION

Wiring Practices Documentation

	Boeing	Airbus
Standard Practices (ATA Chapter 20)	- Standard Wiring Practices Manual (SWPM)	- Electrical Standard Practices Manual (ESPM)
Wiring Diagram	- Wiring Diagram Manual (WDM)	-Aircraft Wiring Manual (AWM)
Other documentations	- System Schematic Manual (SSM) - Fault Isolation Manual (F1M)	- Aircraft Schematic Manual (ASM) - Trouble Shooting Manual (TSM)

Manual Structure/Overview

The structure of standard wiring practices is as follow: 20 - XX - XX Chapter - Section - Subject

Refer to applicable standard practices manual for table of content

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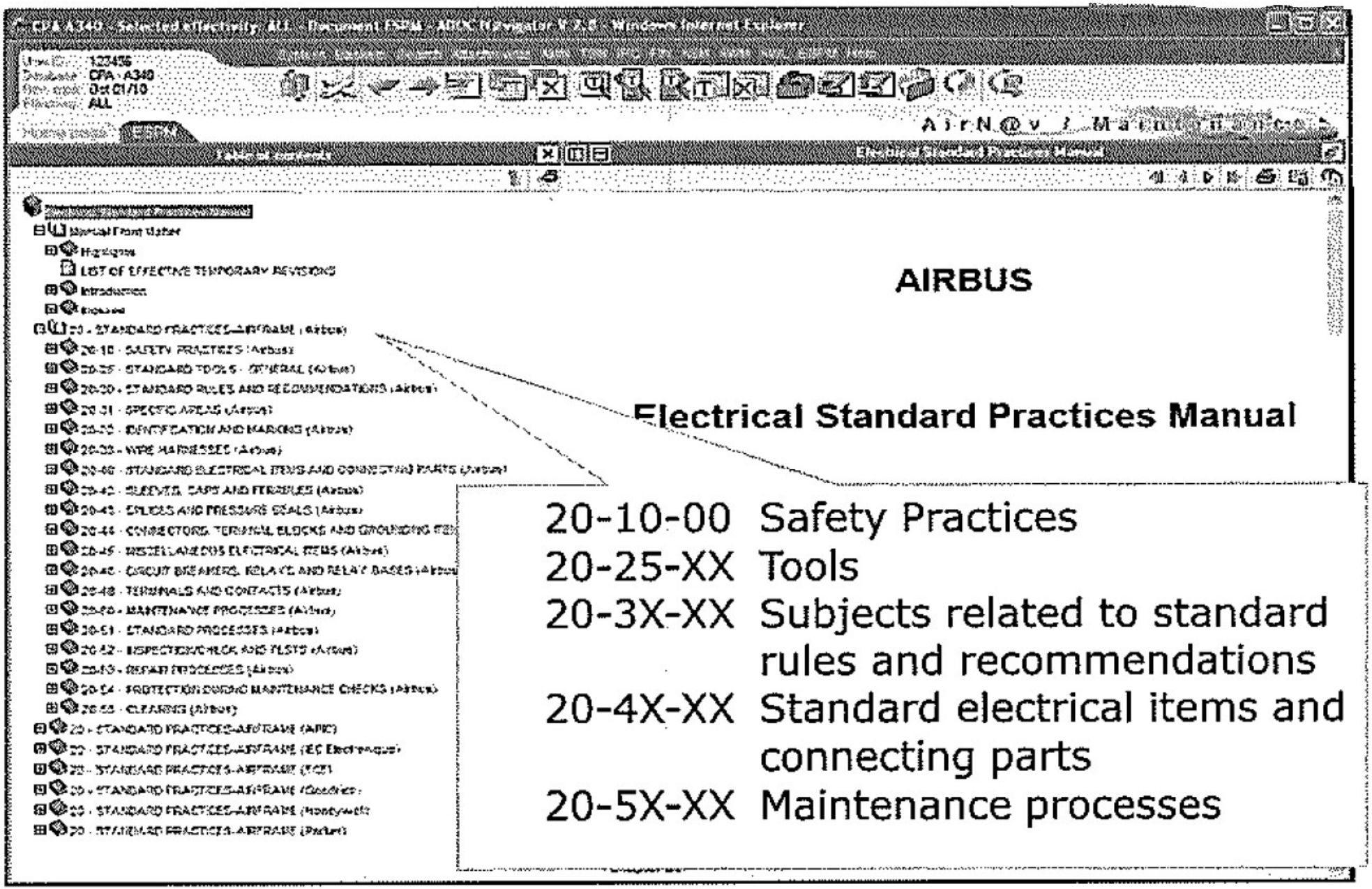
STANDARD WIRING PRACTICES MANUAL

CHAPTER 20

CHAPTER SECTION SUBJECT	TITLE
20-00	GENERAL DATA
20-00-08	PROTECTION DURING MAINTENANCE
20-00-10	SAFETY PRACTICES
20-00-11	MATERIALS
20-00-12	CONTACT CRIMP TOOL CROSS REFERENCE
20-00-13	WIRE TYPE CODES
20-00-14	STANDARD WIRE TYPE REPLACEMENT
20-00-15	WIRE INSULATION REMOVAL
20-00-16	OUTER DIAMETER OF WIRE
20-02	FIRE PROTECTION ZONES AND ENVIRONMENTAL AREAS
20-02-10	AIRPLANE FLAMMABLE LEAKAGE ZONES
20-02-20	AIRPLANE TEMPERATURE AREAS
20-02-30	AIRPLANE VIBRATION AREAS
20-10	WIRING INSTALLATION
20-10-04	CLEANING OF WIRE HARNESSES
20-10-06	INSPECTION OF WIRING
20-10-11	WIRING ASSEMBLY AND INSTALLATION CONFIGURATIO
20-10-12	WIRE HARNESS SUPPORTS

Sections	Topics
00	General Information
10	Wire Harness Assembly and Installation
11-14	Specific System Wire Harnesses
20	Electrical Bonds and Grounds
23	Rolls Royce 777 Power Plant
24	Pratt and Whitney 4000/777 Power Plant
25	Lightning and EMI Shielding
30	Terminal Lugs and Splices
35	Terminations of Specific Cables
41	ESDS
51-53	Coax, Twinax, and Triax Connectors
60	General Connector Data and Procedures
61	Front-Release Circular Connectors
62	Special Purpose Connectors
63	Rear-Release Circular Connectors
64	Small Special Purpose Connectors
71	Rack and Panel Connectors
72	General Purpose Rectangular Connectors
73	Flat Cable Connectors
81	Relay Sockets
82	Printed Circuit Board Connectors
83	Terminal Junction Systems
84	Switches
90	Terminal Junction Systems

SWPM Table of Content



ESPM Table of Content

Chapter Index

The Cross-Reference index (CRI) of SWPM Front Matter allows technicians to locate specific contents effectively.
It is an alphanumeric list (0-9, A-Z) of the following wire system component data :

- Part names
- Part numbers
- Suppliers
- Assembly procedures
- Installation procedures
- Other related information

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STANDARD WIRING PRACTICES MANUAL

e.g. P/N A-8985-1

CHAPTER 20

A

1

A-4135()-13(), LIGHT, GRIMES-HONEYWELL 20-40-12
A-4135()-1810(), LIGHT, GRIMES-HONEYWELL 20-40-12
A-4135()-1820(), LIGHT, GRIMES-HONEYWELL 20-40-12
A-4135()-1864(), LIGHT, GRIMES-HONEYWELL 20-40-12
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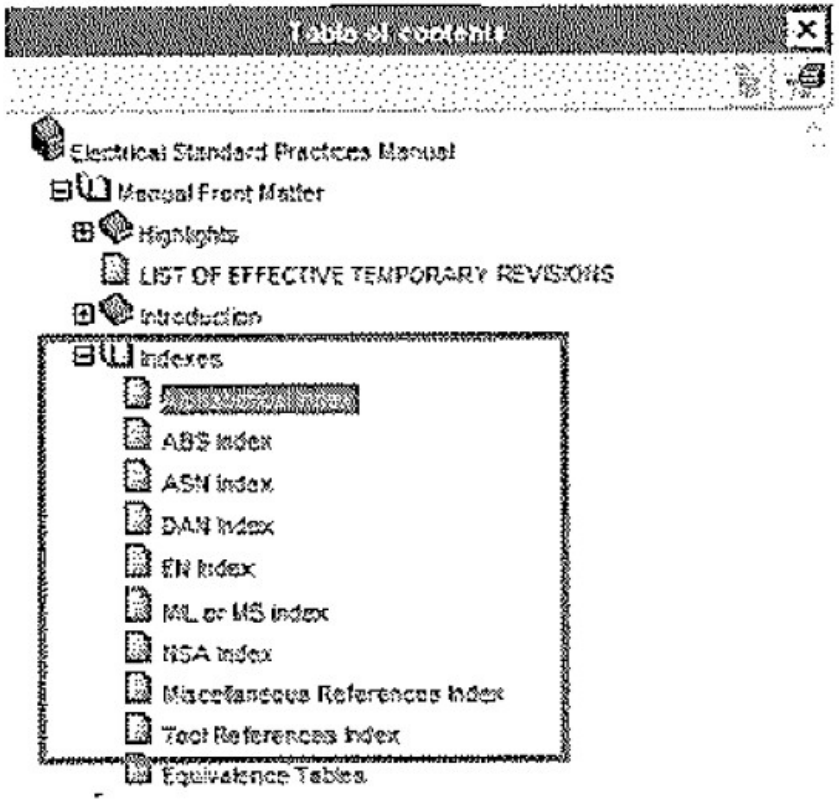
A-8985-4, LIGHT, GRIMES-HONEYWELL 20-84-10
A-8985-5, LIGHT, GRIMES-HONEYWELL 20-84-10

2

SWPM Cross Reference Index

Chapter Index

- In **ESPM**, topics can be searched using:
  - Alphabetical Index
  - Standard P/N Index



2 ABS Index

ABS	TOPIC NUMBER	VENDOR NAME
ABS0053	(Ref. 20-25-13)	
ABS0053	(Ref. 20-32-21)	
ABS0053		
ABS0054		
ABS0054		
ABS0057		
ABS0058		
ABS0061		
ABS0061		
ABS0061		
ABS0064		
ABS0065		
ABS0067		
ABS0068		
ABS0079		
ABS0080		
ABS0084		
ABS0086		
ABS0090		
ABS0090		
ABS0092		
ABS0096		
ABS0122		

1 Alphabetical Index

A

MAIN KEY WORD	SECONDARY KEY WORD	TOPIC NUMBER
Abbreviations	Introduction	(Ref. 00-INTRO)
ABS	P/N Index	(Ref. 20-00-00)
ACRATORK	Torque wrench	(Ref. 20-25-55)
AD	Cable Specific Stripping Procedure	(Ref. 20-25-13)
AD, ADA	Cable Description and Identification	(Ref. 20-32-21)
	Cable Repair - General	(Ref. 20-53-20)
	Repair of Aluminum Cables	(Ref. 20-53-25)
Adapter	Strait	(Ref. 20-44-31)
ADB,ADC,ADD,ADE	Cable Description and Identification	(Ref. 20-32-21)
	Cable Repair - General	(Ref. 20-53-20)
	Repair of Aluminum Cables	(Ref. 20-53-25)
Aging	Checks	(Ref. 20-52-13)
AK,AKA,AKB	Cable Description and Identification	(Ref. 20-32-21)
	Cable Repair - General	(Ref. 20-53-20)
	Repair of Standard Cables	(Ref. 20-53-21)
Allocation	Relays	(Ref. 20-46-50)
	Splices for wire repairs	(Ref. 20-53-23)
Aluminum	Terminal Nickel plated	(Ref. 20-48-12)
	Repair of Aluminum Cables	(Ref. 20-53-25)
AMP	Hand crimping tools	(Ref. 20-25-22)
	Hydraulic hand crimping tools	(Ref. 20-25-23)
	Hydraulic crimping tools	(Ref. 20-25-24)
	Insertion/Extraction tools	(Ref. 20-25-41)

ESPM Index examples

Important Data and Tables

- Important data and tables can be found in individual subject.

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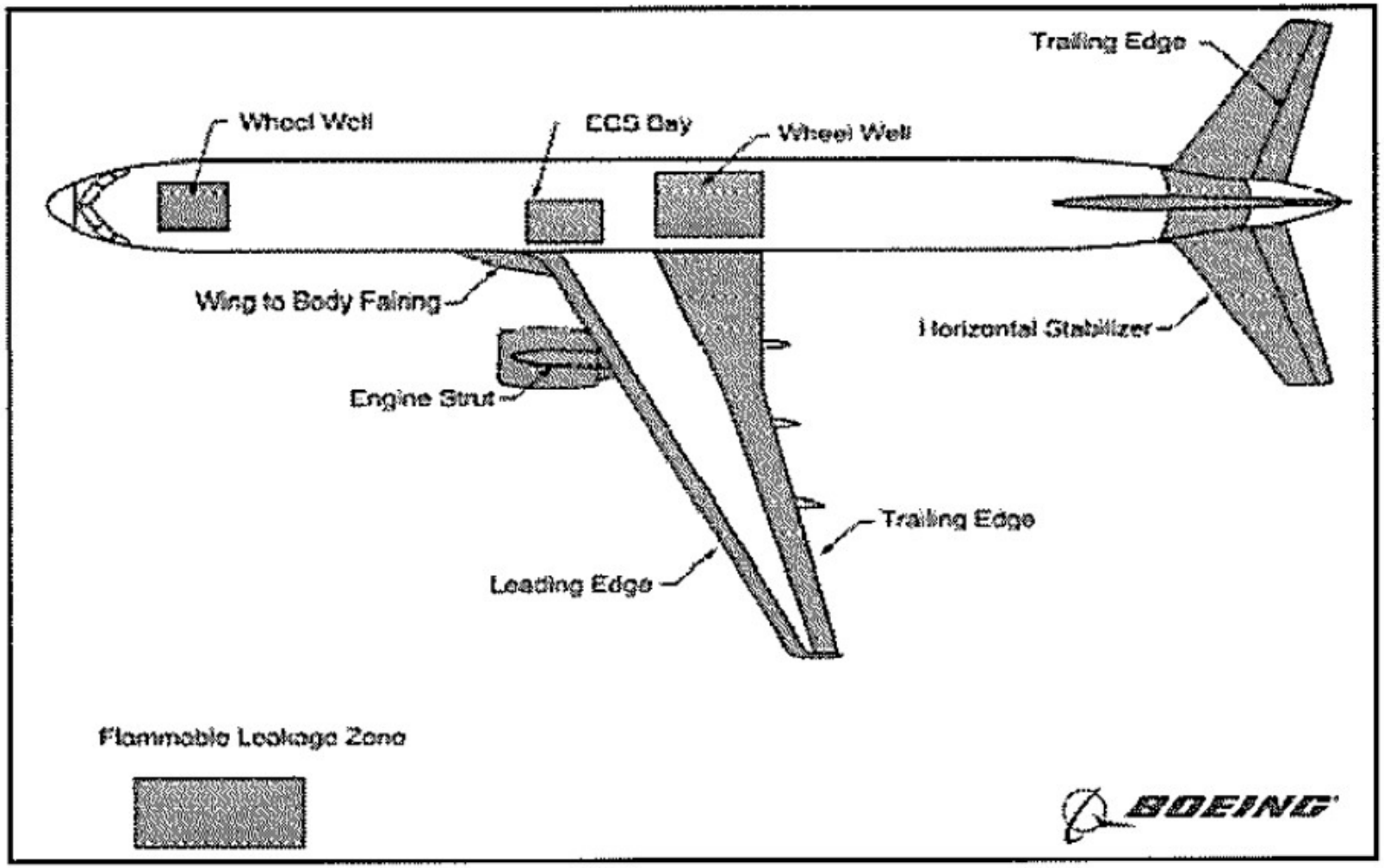
ASSEMBLY OF BENDIX PT()CE AND PC()CE SERIES CONNECTORS

Paragraph		Page
1.	PART NUMBERS AND DESCRIPTION	1
	A. Connector Part Numbers	1
	B. Contact Part Numbers	1
2.	INSERT CONFIGURATIONS	2
	A. Bendix PC()CE and PT()CE Series Connectors	2
3.	CONNECTOR DISASSEMBLY	6
	A. Contact Removal	6
4.	CONNECTOR ASSEMBLY	7
	A. Contact Assembly	7
	B. Contact Insertion	8
	C. Installation of Spare Contacts	8
	D. Installation of Seal Plugs or Seal Rods	9
5.	APPROVED TOOL SUPPLIERS	9
	A. Contact Removal Tools	9
	B. Contact Crimp Tools	9
	C. Contact Insertion Tools	10

Environmental Conditions

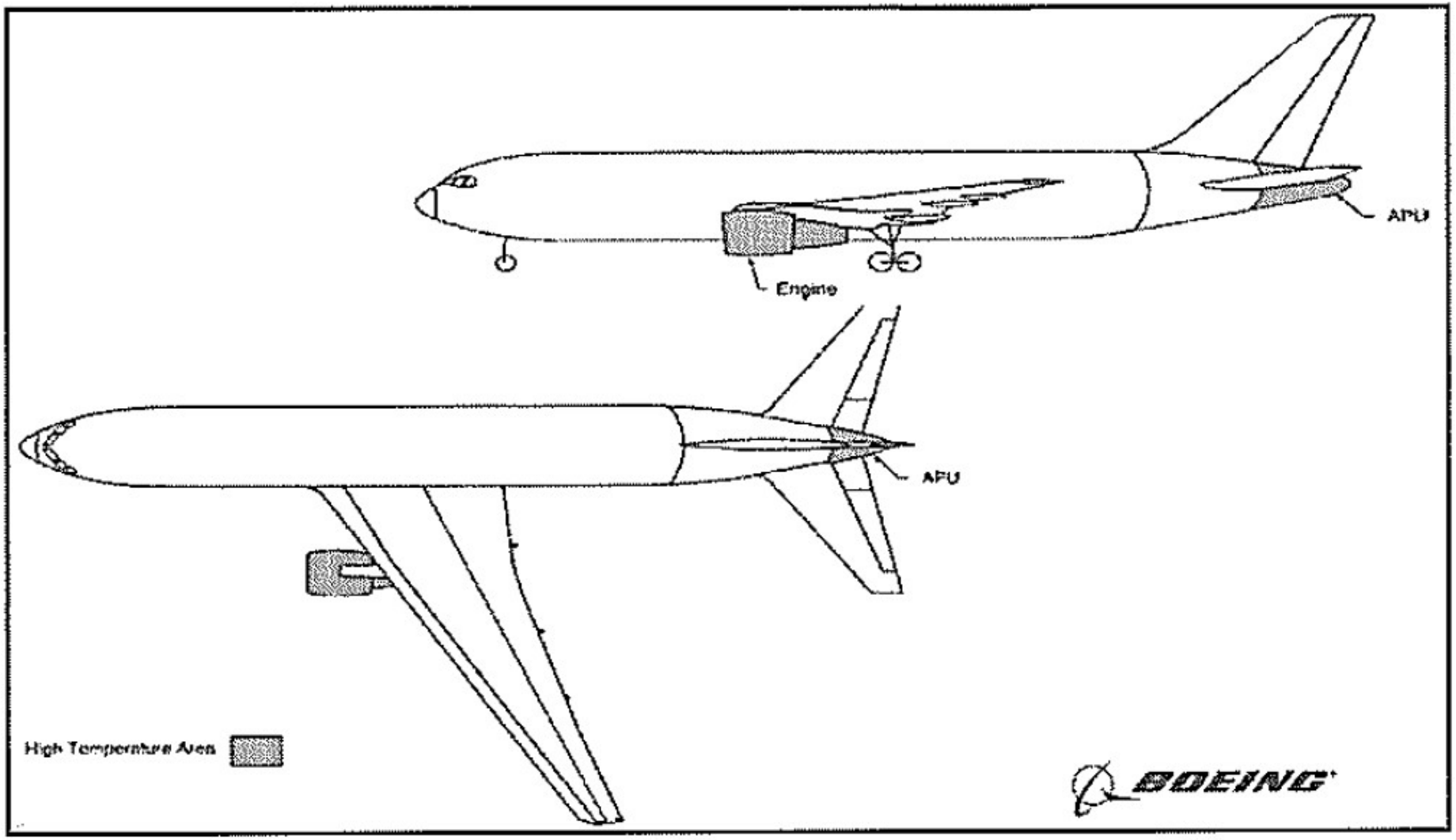
- Pressurization
- Fuel Vapors
- Temperature
- Vibration
- Fluids

Environmental Conditions



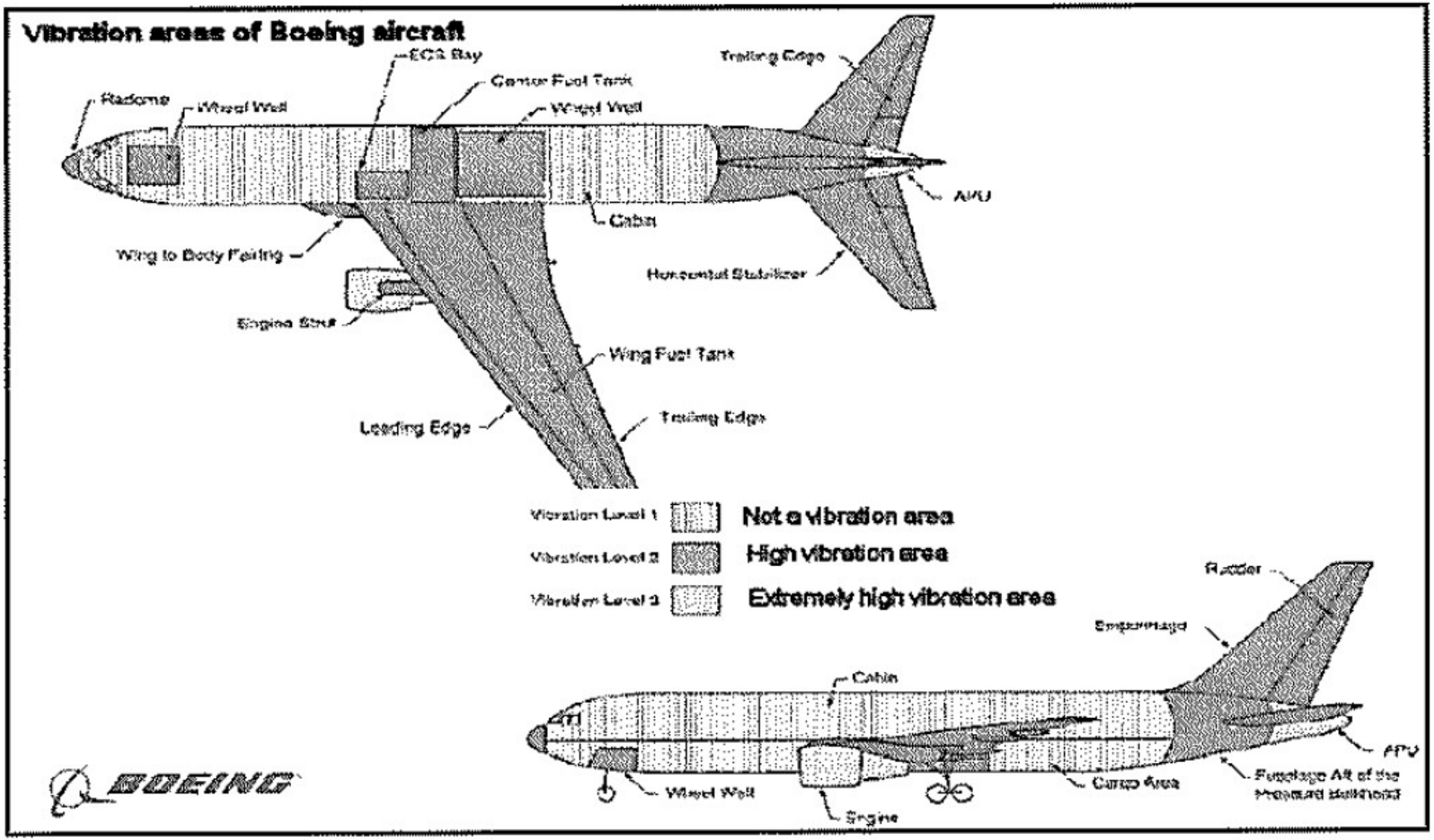
Airplane Flammable Leakage Zones (SWPM 20-02-10)

Environmental Conditions



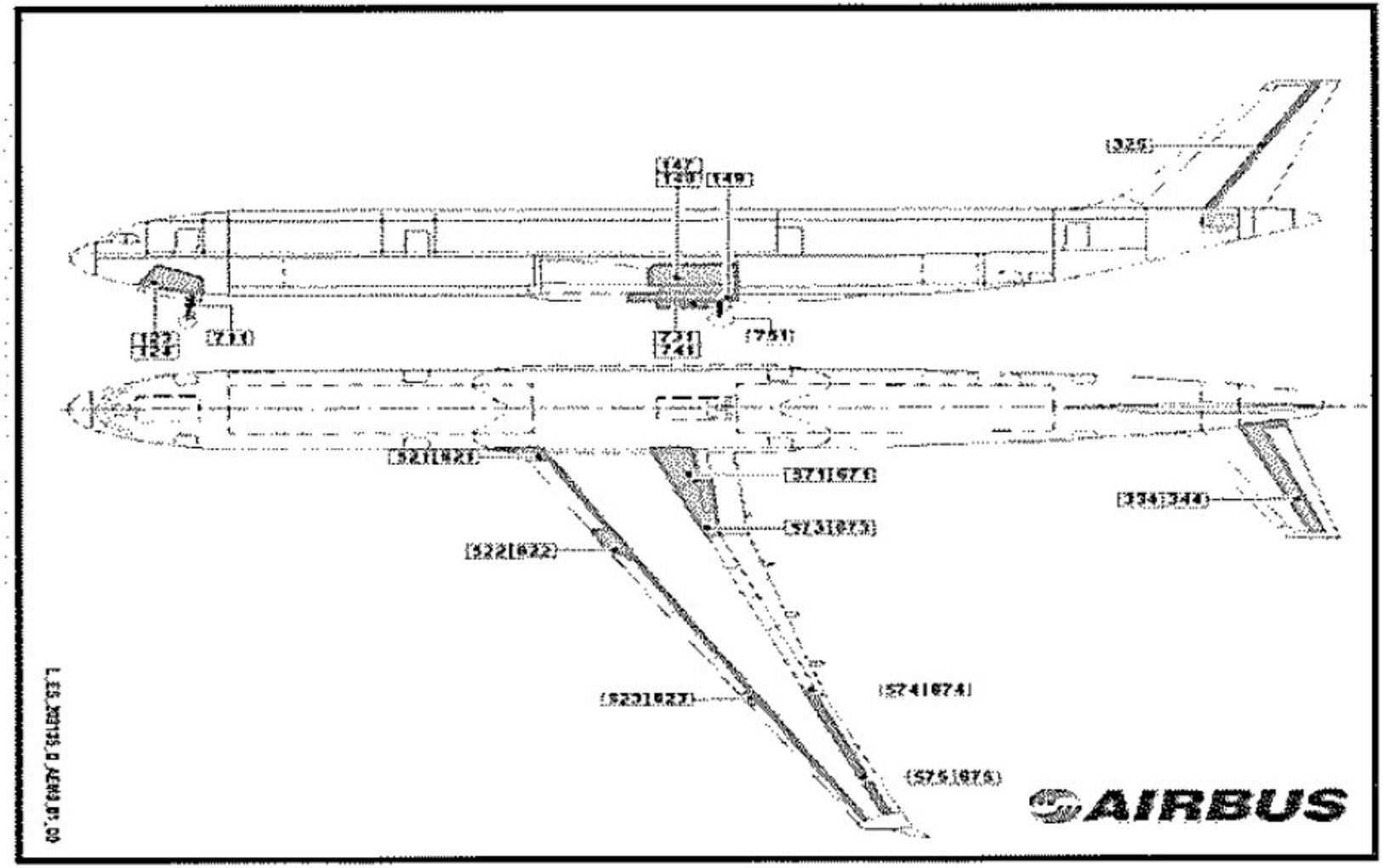
Airplane Temperature Areas (SWPM 20-02-20)

Environmental Conditions



Airplane Vibration Areas (SWPM 20-02-30)

Environmental Conditions



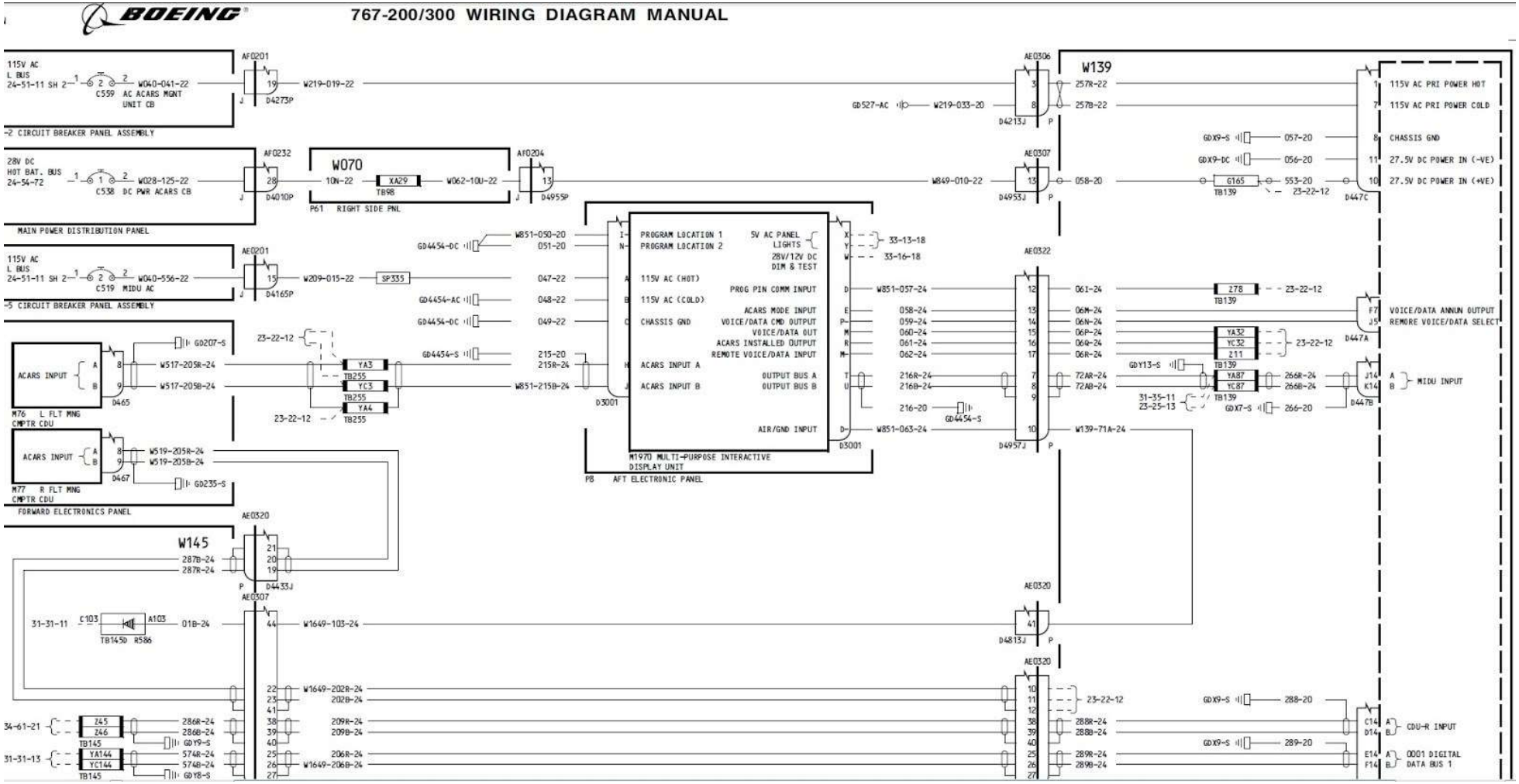
Environmental Classes (ESPM 20-31-35)

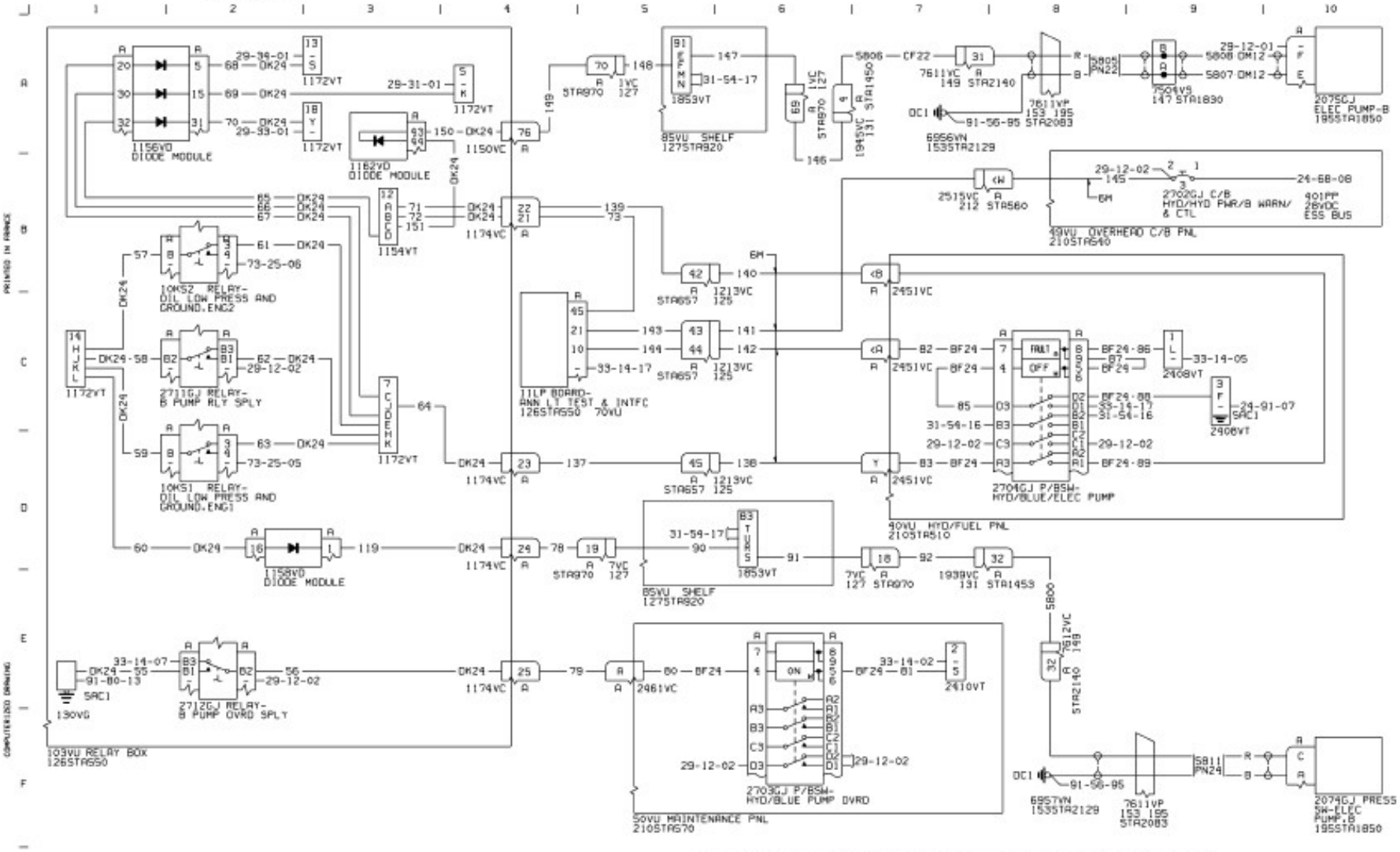
AIRBUS Environmental Classes

SWPM 20-31-40

- 20-31 - SPECIFIC AREA
  - 20-31-00 - SPECIFIC A
  - 20-31-30 - SPECIFIC A
  - 20-31-31 - PRESSURI
  - 20-31-32 - SKYDROL
  - 20-31-33 - VIBRATIO
  - 20-31-34 - HOT AREA
  - 20-31-35 - SWAMP A
  - 20-31-36 - FUEL ARE
  - 20-31-37 - FIRE AREA
  - 20-31-40 - ELECTRI
    - General
    - A300/A310 Electric
    - A319/A320/A320 E
    - A330/A340 Electric
    - A380 Electrical Item
    - Miscellaneous Elect

AIRCRAFT AREAS	A330/A340 ELECTRICAL ITEMS						
	CABLES	CONNECTION		ELECTRO-MECANICAL ITEMS	CONDUITS	ATTACHMENT	IDENTIFICATION
		CONNECTORS	TERMINAL LUG	LIGHTS, SWITCHES		BRACKETS, CLAMPS, LACING TAPE NSA6420 CABLE TIE NSA935401	LABELS, SLEEVES
HOT AREAS T° > 100°C	GENERALLY CF FEEDERS, DG	NAS1599	Cu/Ni	NOT APPLICABLE	GENERALLY NSA935005 SHIELDED CONDUIT Cu/Ni + END FITTING Al/Ni/Cad	GENERALLY CLAMPS NSA5516 NO FEEDERS: SAME AS PRESSURIZED AREAS + LACING TAPE IN PYLON	VU + HARNESS SAME AS PRESSURIZED AREA REQUIREMENTS
SWAMP AREAS	LANDING GEAR BAY: CF LEADING TRAILING & TRAILING EDGE: DK	NAS1599	Cu/Ni	SEALED VERSION	GENERALLY NSA935005 SHIELDED CONDUIT CU/Ni + END FITTING INOX	- CLAMPS NSA5516 NO - CABLE TIES	ON STRUCTURE: E0479 METALLIC HARNESS EXTREMITY: E0245
FUEL AREAS	CF	NAS1599	Cu/Ni	NOT APPLICABLE	ASNE0432	- CLAMPS NSA5516 NF - CABLE TIES	ON STRUCTURE: E0479 METALLIC HARNESS EXTREMITY: E0245
FIRE AREAS	GENERALLY CF & DK CRITICAL CIRCUIT - FIRE CABLE DL OR DJ	GENERALLY EN2997 Alu OR INOX CRITICAL CIRCUIT: INOX - FOR ELECTRO-MAGNETIC PROTECTION: REF VERSION	Cu/Ni	NOT APPLICABLE	GENERALLY NSA935005 SHIELDED CONDUIT Cu/Ni + END FITTING INOX	NSA5516 NO + LACING TAPE	ON STRUCTURE: E0479 METALLIC HARNESS EXTREMITY: E0245


BOEING
767-200/300 WIRING DIAGRAM MANUAL
115V AC L BUS 24-51-11 SH 2
C559 AC ACARS MGNT UNIT CB
-2 CIRCUIT BREAKER PANEL ASSEMBLY
28V DC HOT BAT. BUS 24-54-72
C538 DC PWR ACARS CB
MAIN POWER DISTRIBUTION PANEL
115V AC L BUS 24-51-11 SH 2
C519 MIDU AC
-5 CIRCUIT BREAKER PANEL ASSEMBLY
ACARS INPUT
M76 L FLT MNG CMPTR CDU
M77 R FLT MNG CMPTR CDU
FORWARD ELECTRONICS PANEL
W070
P61 RIGHT SIDE PNL
PROGRAM LOCATION 1
PROGRAM LOCATION 2
115V AC (HOT)
115V AC (COLD)
CHASSIS GND
ACARS INPUT A
ACARS INPUT B
5V AC PANEL LIGHTS
28V/12V DC DIM & TEST
PROG PIN COMM INPUT
ACARS MODE INPUT
VOICE/DATA CMD OUTPUT
VOICE/DATA OUT
ACARS INSTALLED OUTPUT
REMOTE VOICE/DATA INPUT
OUTPUT BUS A
OUTPUT BUS B
AIR/GND INPUT
M1970 MULTI-PURPOSE INTERACTIVE DISPLAY UNIT
P8 AFT ELECTRONIC PANEL
W139
115V AC PRI POWER HOT
115V AC PRI POWER COLD
CHASSIS GND
27.5V DC POWER IN (-VE)
27.5V DC POWER IN (+VE)
VOICE/DATA ANNUN OUTPUT
REMORE VOICE/DATA SELECT
MIDU INPUT
W145
CDU-R INPUT
DDDI DIGITAL DATA BUS 1



NOTE : UNLESS OTHERWISE SPECIFIED PREFIX ALL WIRE IDENTIFICATION WITH ATA 2912
UNLESS OTHERWISE SPECIFIED ALL WIRES ARE CF24 GAUGE
UNLESS OTHERWISE SPECIFIED ALL ROUTES ARE 1M

NWM 291204 W 01021 AA

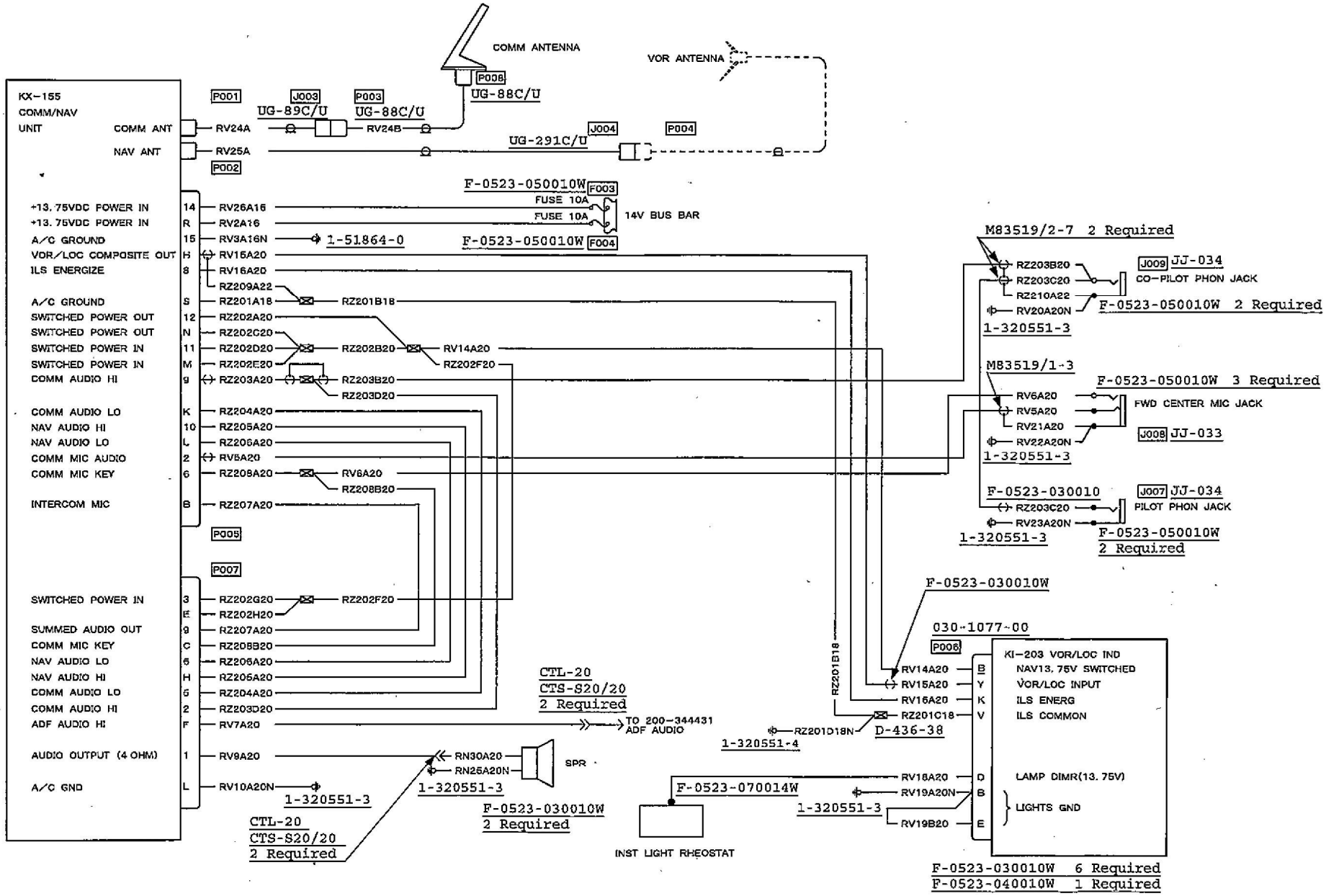
EFFECTIVITY
ALL

AXM

HYDRAULIC POWER
BLUE MAIN HYDRAULIC POWER
WARNING/INDICATING

29-12-04

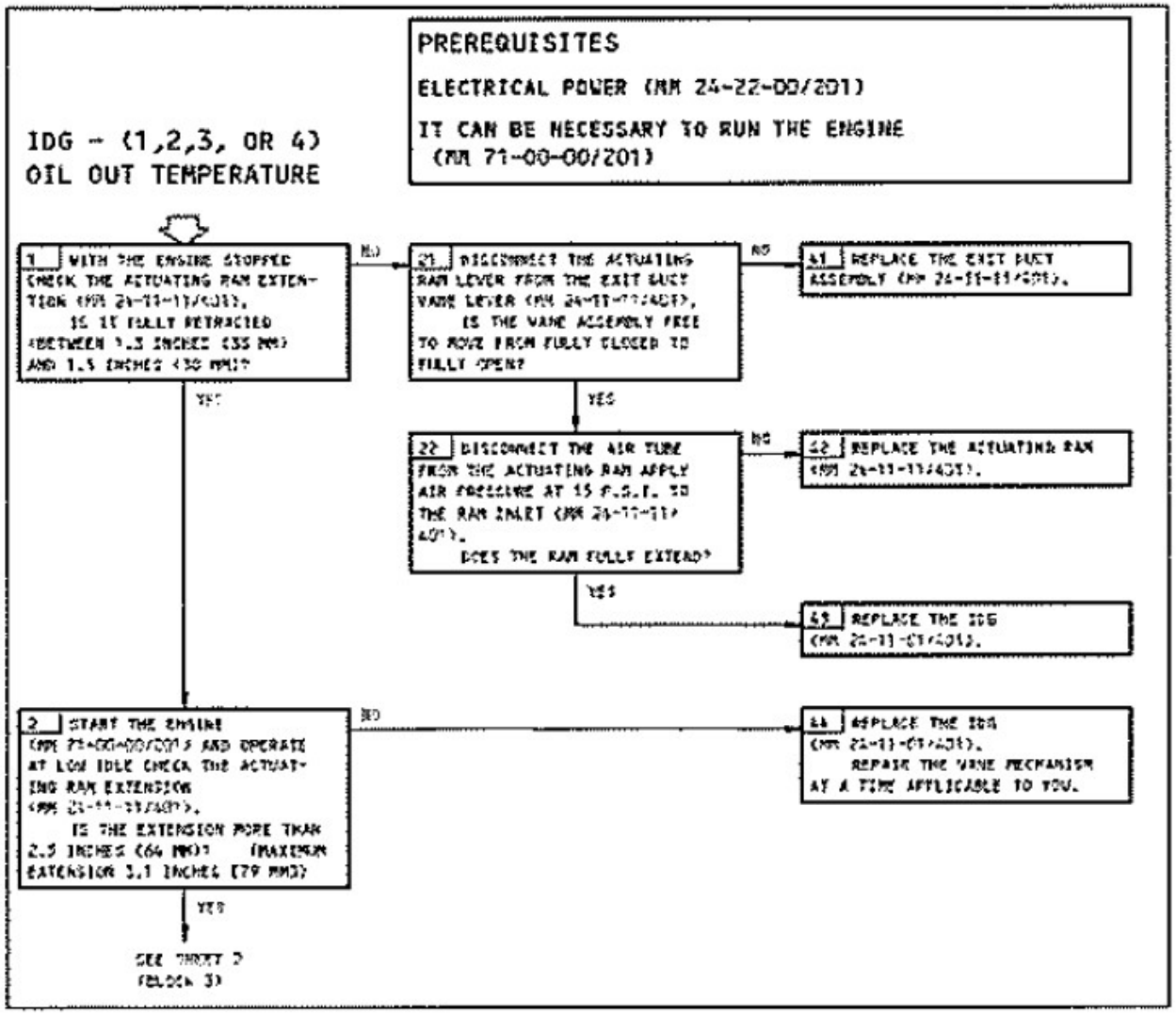
Page 1
Aug 01/05


KX-155
COMM/NAV
UNIT
COMM ANT
NAV ANT
P001
P002
J003
P003
P008
COMM ANTENNA
VOR ANTENNA
UG-89C/U
UG-88C/U
UG-88C/U
RV24A
RV24B
RV25A
J004
P004
UG-291C/U
F-0523-050010W F003
FUSE 10A
FUSE 10A
14V BUS BAR
F-0523-050010W F004
+13.75VDC POWER IN
+13.75VDC POWER IN
A/C GROUND
VOR/LOC COMPOSITE OUT
ILS ENERGIZE
A/C GROUND
SWITCHED POWER OUT
SWITCHED POWER OUT
SWITCHED POWER IN
SWITCHED POWER IN
COMM AUDIO HI
COMM AUDIO LO
NAV AUDIO HI
NAV AUDIO LO
COMM MIC AUDIO
COMM MIC KEY
INTERCOM MIC
P005
P007
SWITCHED POWER IN
SUMMED AUDIO OUT
COMM MIC KEY
NAV AUDIO LO
NAV AUDIO HI
COMM AUDIO LO
COMM AUDIO HI
ADF AUDIO HI
AUDIO OUTPUT (4 OHM)
A/C GND
RV26A16
RV2A16
RV3A16N
1-51864-0
RV16A20
RV16A20
RZ209A22
RZ201A18
RZ201B18
RZ202A20
RZ202C20
RZ202D20
RZ202B20
RV14A20
RZ202F20
RZ202E20
RZ203A20
RZ203B20
RZ203D20
RZ204A20
RZ205A20
RZ206A20
RV6A20
RZ208A20
RV6A20
RZ208B20
RZ207A20
RZ202G20
RZ202F20
RZ202H20
RZ207A20
RZ208B20
RZ206A20
RZ205A20
RZ204A20
RZ203D20
RV7A20
RV9A20
RV10A20N
1-320551-3
CTL-20
CTS-S20/20
2 Required
TO 200-344431
ADF AUDIO
RN30A20
RN25A20N
1-320551-3
SPR
F-0523-030010W
2 Required
CTL-20
CTS-S20/20
2 Required
M83519/2-7 2 Required
RZ203B20
RZ203C20
RZ210A22
RV20A20N
J009 JJ-034
CO-PILOT PHON JACK
F-0523-050010W 2 Required
1-320551-3
M83519/1-3
F-0523-050010W 3 Required
RV6A20
RV5A20
RV21A20
RV22A20N
FWD CENTER MIC JACK
J008 JJ-033
1-320551-3
F-0523-030010
J007 JJ-034
RZ203C20
RV23A20N
PILOT PHON JACK
1-320551-3
F-0523-050010W
2 Required
F-0523-030010W
030-1077-00
P006
RZ201B18
RV14A20
RV15A20
RV16A20
RZ201C18
RZ201D18N
D-436-38
1-320551-4
KI-203 VOR/LOC IND
NAV13.75V SWITCHED
VOR/LOC INPUT
ILS ENERG
ILS COMMON
RV18A20
RV19A20N
RV19B20
LAMP DIMR(13.75V)
LIGHTS GND
F-0523-070014W
1-320551-3
INST LIGHT RHEOSTAT
F-0523-030010W 6 Required
F-0523-040010W 1 Required

Troubleshooting procedures and charts

- The troubleshooting procedures of wiring systems can be referred to the Fault Isolation Manual (Boeing) or Troubleshooting Manual (Airbus).

Troubleshooting procedures and charts



Fault Isolation Manual – Fault Trees

Troubleshooting procedures and charts

TASK 24-00-00-810-810-A
Failure of the IDG 2 Oil-Out Temperature Bulb or its Wiring

1 Possible Causes
- wiring
- GCU-2 (1XU2)
- IDG (4000XU)

2 Job Set-up Information

3 Fault Confirmation

Subtask 24-00-00-740-052-A

A. Test
Do the BITE test of the EPGS AMM 24-41-00-740-801

[illegible]

4. Fault Isolation

Subtask 24-00-00-810-057-A

A If the BITE test gives the maintenance message IDG2 (E2-4000XU) OIL OUT TEMP
- do a check of the wiring for open circuit or short to ground between the pins B/7, B/8 of the IDG 2 and the pins A/8A, A/9B of the GCU-2 Ref. ASM 24-21-02

(1) If the wiring is not correct:
- repair it

(2) If the wiring is correct:
- do a check of the resistance between the pins B/7 and B/8 of the IDG 2 (90 to 110 ohms).

(a) If the resistance value is in the specified limits:
- replace the GCU-2 (1XU2), AMM 24-22-34-000-801 and AMM 24-22-34-400-801

Troubleshooting Manual

Exercise:

A wire was found on an B747-400 aircraft with wire mark W4750-540-22.

Using WDM and SWPM, identify :

* Equipment numbers of the connector
* Wire type code
* Part number of wire

INSPECTION

Levels of inspection

General Visual Inspection (GVI)

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

Levels of inspection

Cont's

- no requirement for equipment removal or displacement.
- Paint and/or sealant removal is not necessary and should be avoided.
- The area to be inspected is clean.
- Any potential effect on adjacent system installations should also be considered, particularly if these include wiring.

Levels of inspection

Detailed Inspection (DET)

- An intensive examination of a specific item, installation or assembly to detect damage, failure or irregularity.
- Available lighting is normally supplemented with a direct source of good lighting at an intensity deemed appropriate. Inspection aids such as mirrors, magnifying lenses or other means may be necessary. Surface cleaning and elaborate access procedures may be required.
- A DET can be more than just a visual inspection since it may include tactile assessment in which a component or assembly is checked for tightness/security.

Levels of inspection

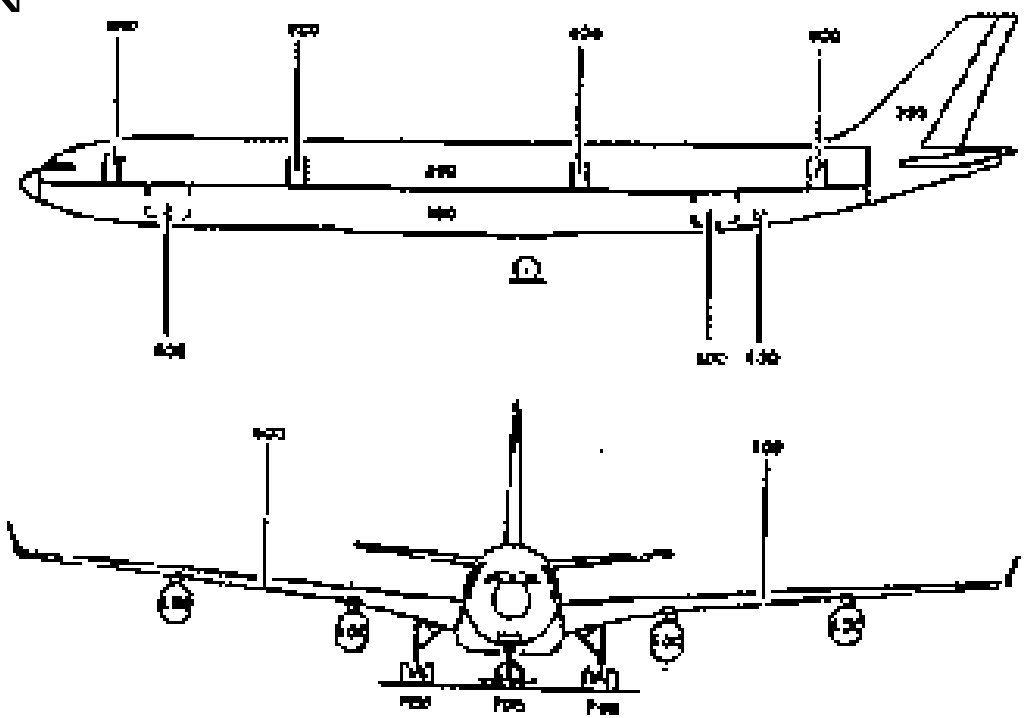
Zonal Inspection

- A collective term comprising selected GVI and visual checks that are applied to each zone, defined by access and area, to check system and powerplant installations and structure for security and general condition.
- A zonal inspection is essentially a GVI of an area or zone to detect obvious unsatisfactory conditions and discrepancies. Unlike a stand-alone GVI, it is not directed to any specified component or assembly.

Zonal areas of inspection

Major zones are identified as follows:

100 FUSELAGE LOWER SECTION
200 FUSELAGE TOP SECTION
300 STABILIZERS
400 NACELLES
500 LEFT WING
600 RIGHT WING
700 LANDING GEAR
800 DOORS



Guidance for Zonal Inspections

The following items are typical EWIS degradation Items:

1. Wire/Wire Harnesses
2. Connectors
3. Switches
4. Ground Points
5. Bonding braid/bonding jumper 8. Wire clamps or brackets
7. Supports (rails or tubes/conduit)
8. Circuit Breakers, Contactors or Relays

Enhanced Zonal Analysis Procedures (EZAP)

- Identify applicable and effective tasks to minimize accumulation of combustible materials.
- Address wiring installation discrepancies that may not be reliably detected by inspections in existing maintenance programs.
- Enhancement of current Zonal Inspection Program, if any.

Human factors in inspection

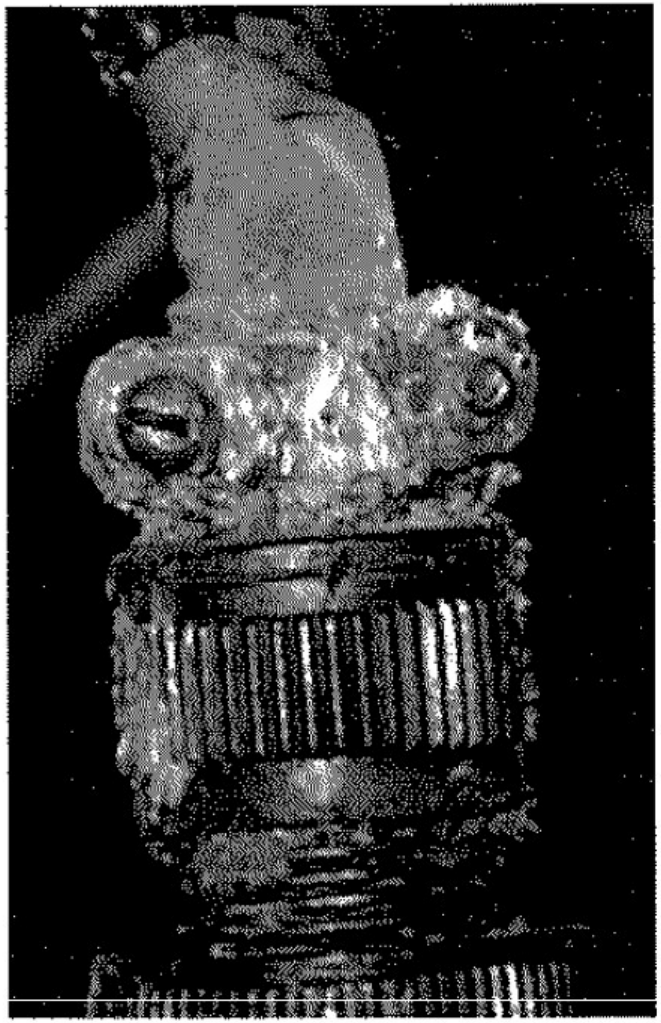
The seven most common human factors related to maintenance errors are :

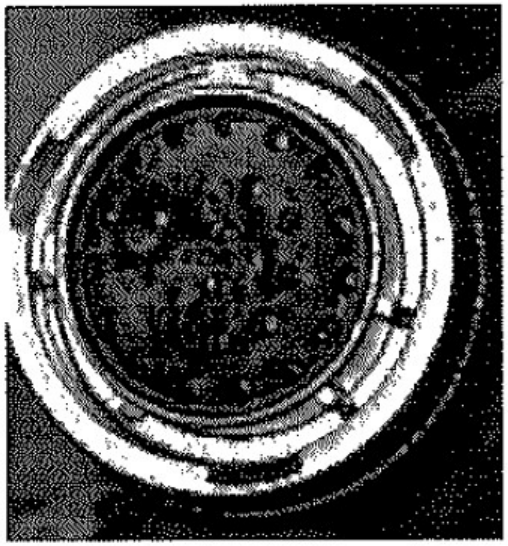
1. Physical health
2. Fatigue
3. Time constraints
4. Peer pressures
5. Complacency
6. Personal stress
7. Workplace distractions

Wiring installation and areas of concern

- Clamping points
  - damaged clamps, clamp cushion migration, improper clamp and tie wrap installation
- Connectors
  - Worn environmental seal, loose connectors, missing seal plugs, lack of strain relief
- Terminations
  - Mechanical damage, corrosion, heat damage, contamination, lose of originally torque value, heat discoloration, dust, dirt

Wiring installation and areas of concern





Corroded connector

Wiring installation and areas of concern

- <u>Backshells</u>

- Damage, lack of strain relief, improper build-up sleevings and Conduits Damage of cut and dent

- <u>Grounding points</u>

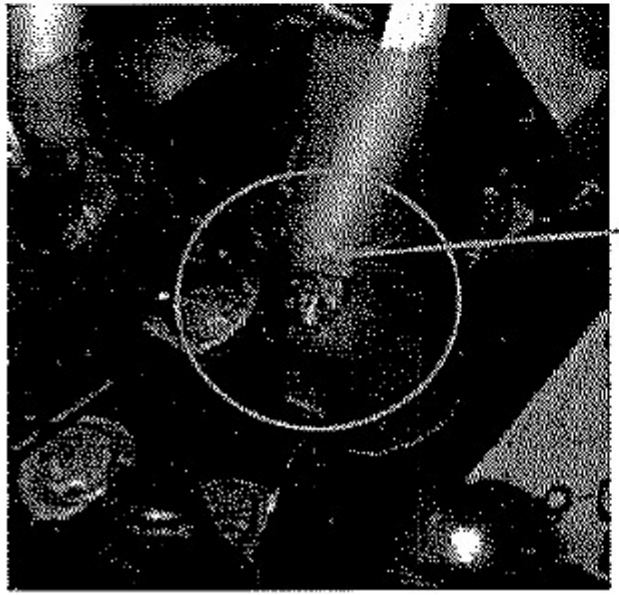
- Security, condition, cleanliness, corrosion

- <u>Splices</u>

- Vibration, mechanical damage, corrosion, heat damage, contamination, deterioration

Wiring installation and areas of concern

Broken connector backshell



Damaged protective sleeve

Wiring installation and areas of concern

- Wire raceways and bundles
- Wings
- Engine, pylon, and nacelle
- Accessory compartment and equipment bays
- APU (Auxiliary Power Unit)
- Landing gear and wheel wells
- Electrical panels and LRU (Line Replaceable Units)
- Batteries
- Power feeders

Wiring installation and areas of concern

- Under galleys, lavatories, and cockpit
- Fluid drain plumbing
- Fuselage drain
- Cargo bay/underfloor
- Wiring subject to movement
- Access panels
- Under doors
- Under cockpit sliding windows
- Areas where wiring is difficult to access

Wire degradation

- The following items are considered principal causes of wire degradation:
  - Vibration, Moisture or Heat
  - Indirect damage - cross coupling effects associated with other faulty system
  - Contamination - solid and fluid
  - Maintenance error - work practices, norms, housekeeping, awareness,...

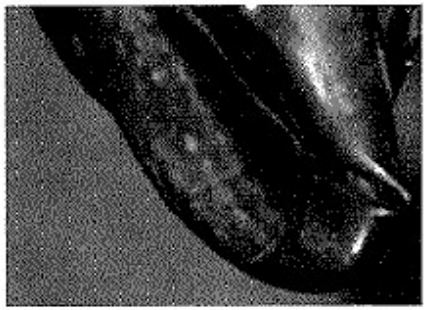
Overheated wire

Wiring system damage

Wire bundles chafe structure or other components

Wiring damage due to over-tightening of plastic tie strap

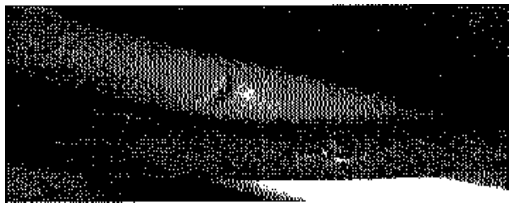
Wire bundles not supported or clamped



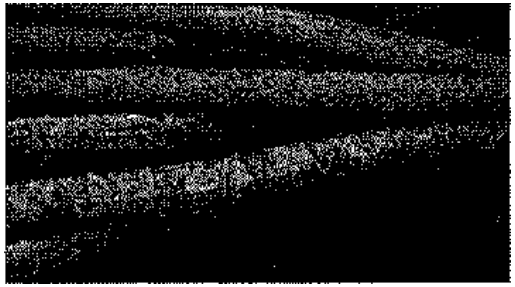
Improper wire bundle bend radius

Wiring system damage

Dryness and cracking of wire insulation in high heat area



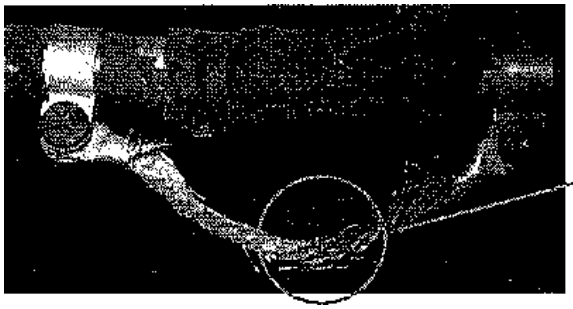
Nicks and scrapes



Wire insulation cracking and breaches due to engine, APU, or hydraulic oil

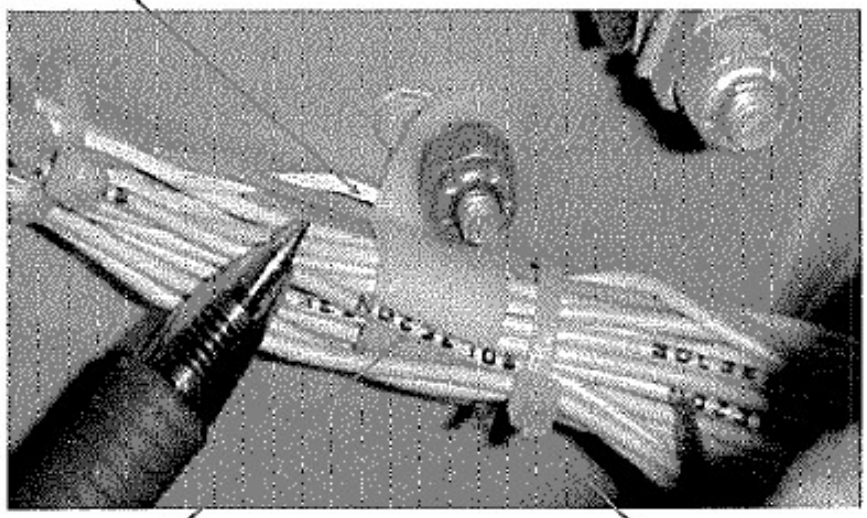
Wire not clamped properly

Wiring system damage



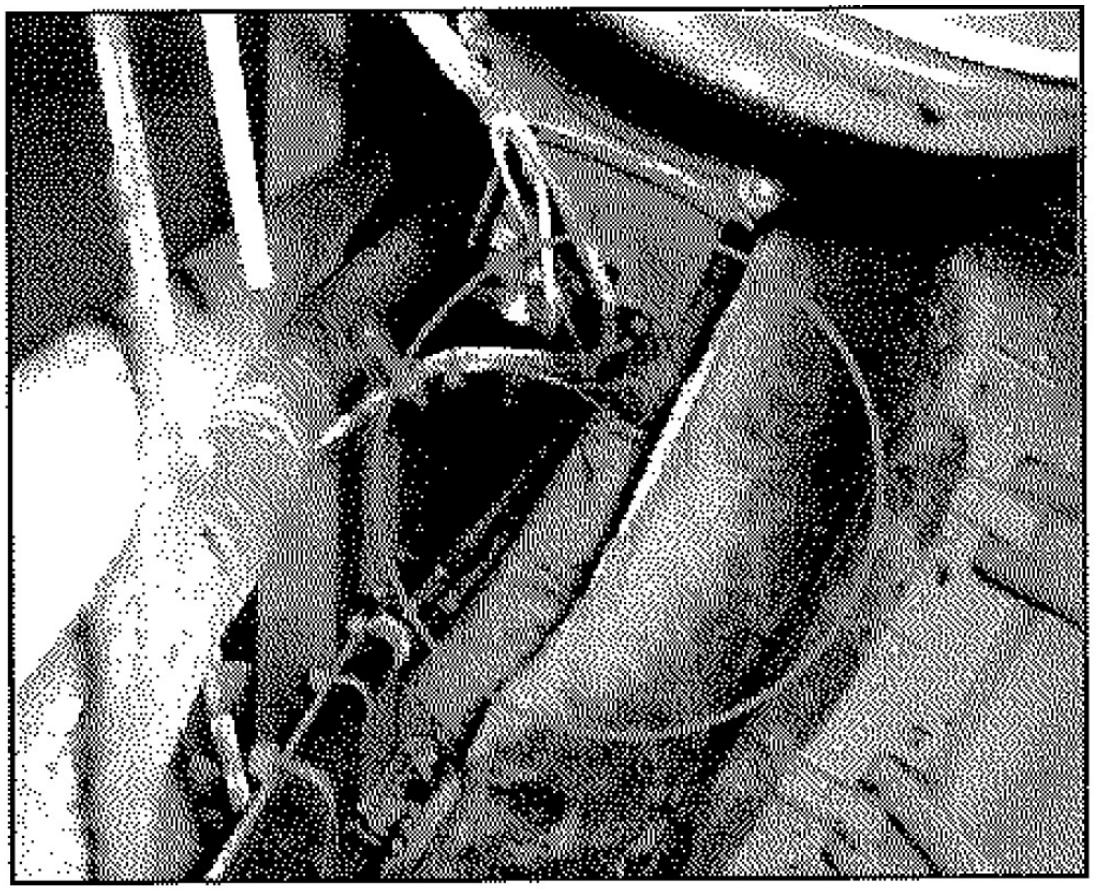
Broken bonding braid

Corroded grounding point



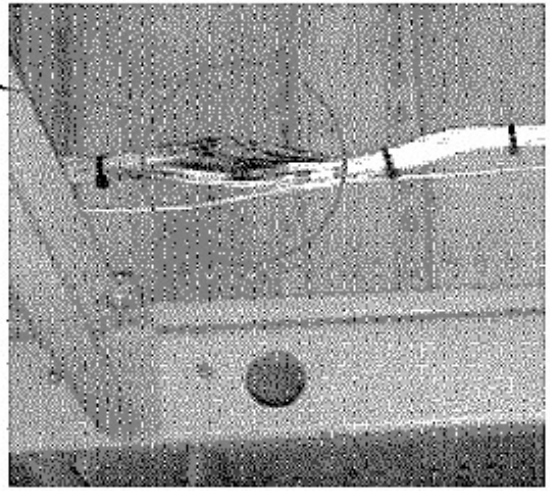
Typical wiring damage

Extensive damage to cargo hold after a fluid leak onto an electrical module. This resulted in arcing and started a fire in the cargo hold insulation blanket.

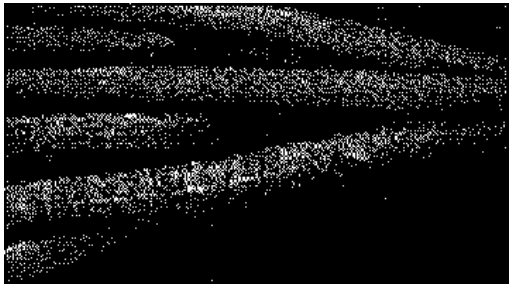


Typical wiring damage

Over-tightening of plastic cable tie causing wire insulation damage and resulted in arcing



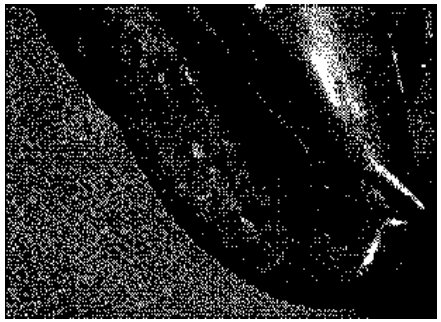
Dryness and cracking of wire insulation in high heat area



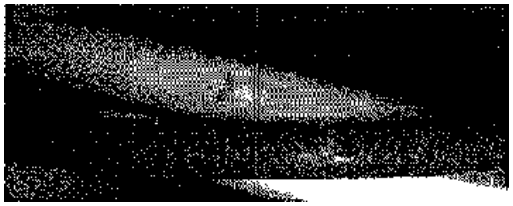
Wire insulation cracking and breaches due to engine, APU, or hydraulic oil

Typical wiring damage

Wiring damage due to over-tightening of plastic tie strap



Improper wire bundle bend radius

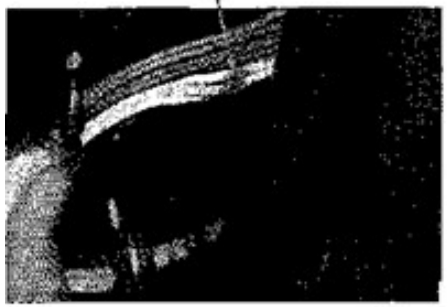


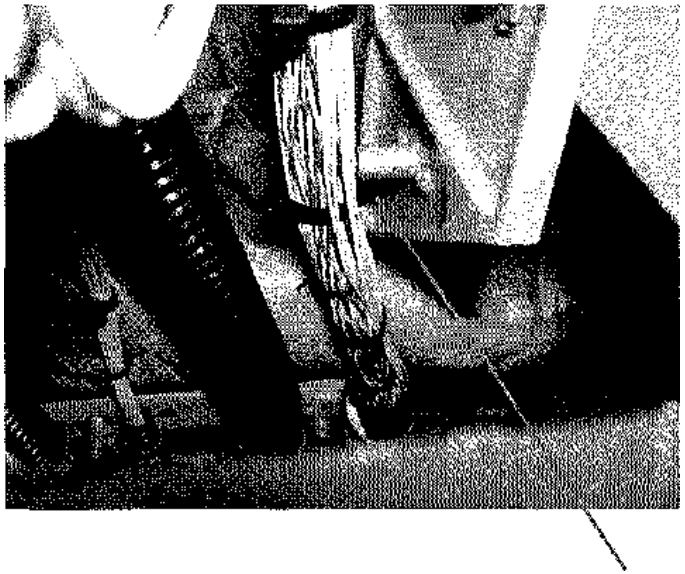
Nicks and scrapes

Wire not clamped properly

Typical wiring damage

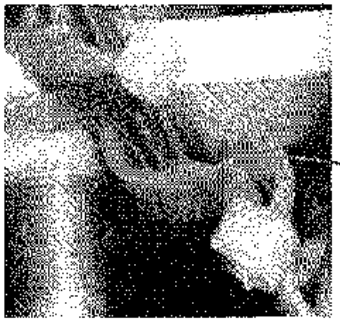
A small witness mark may be an indicator of something much more significant...





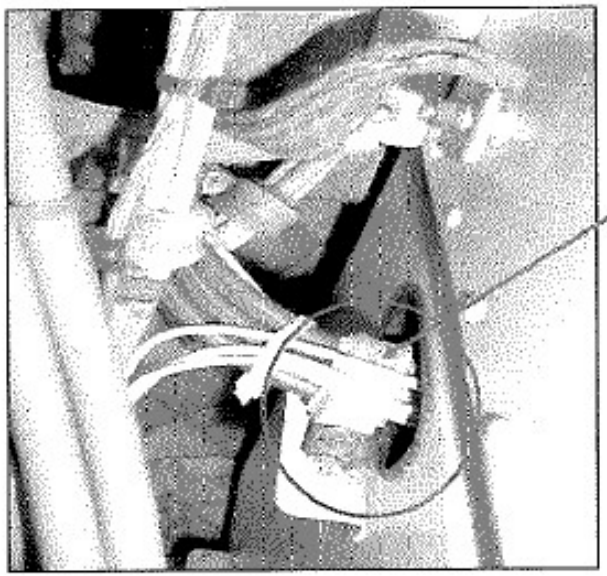
Wire chafe along the standoff due clamp not installed

Typical wiring damage



Incorrect clamp size

Clamp cushion damaged

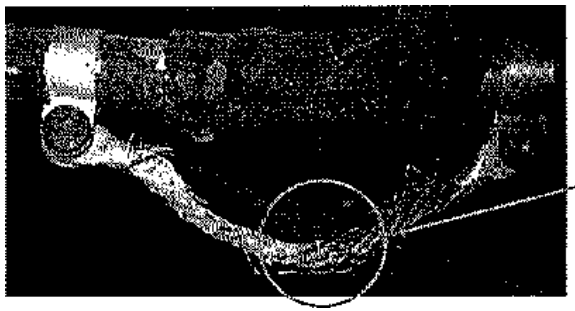


Wire installed bypass the wire clamp

Typical wiring damage

Wire bundles chafe structure or other components

Wire bundles not supported or clamped



Broken bonding braid

Corroded grounding point

HOUSEKEEPING

Sources of Contamination

- **External Sources**

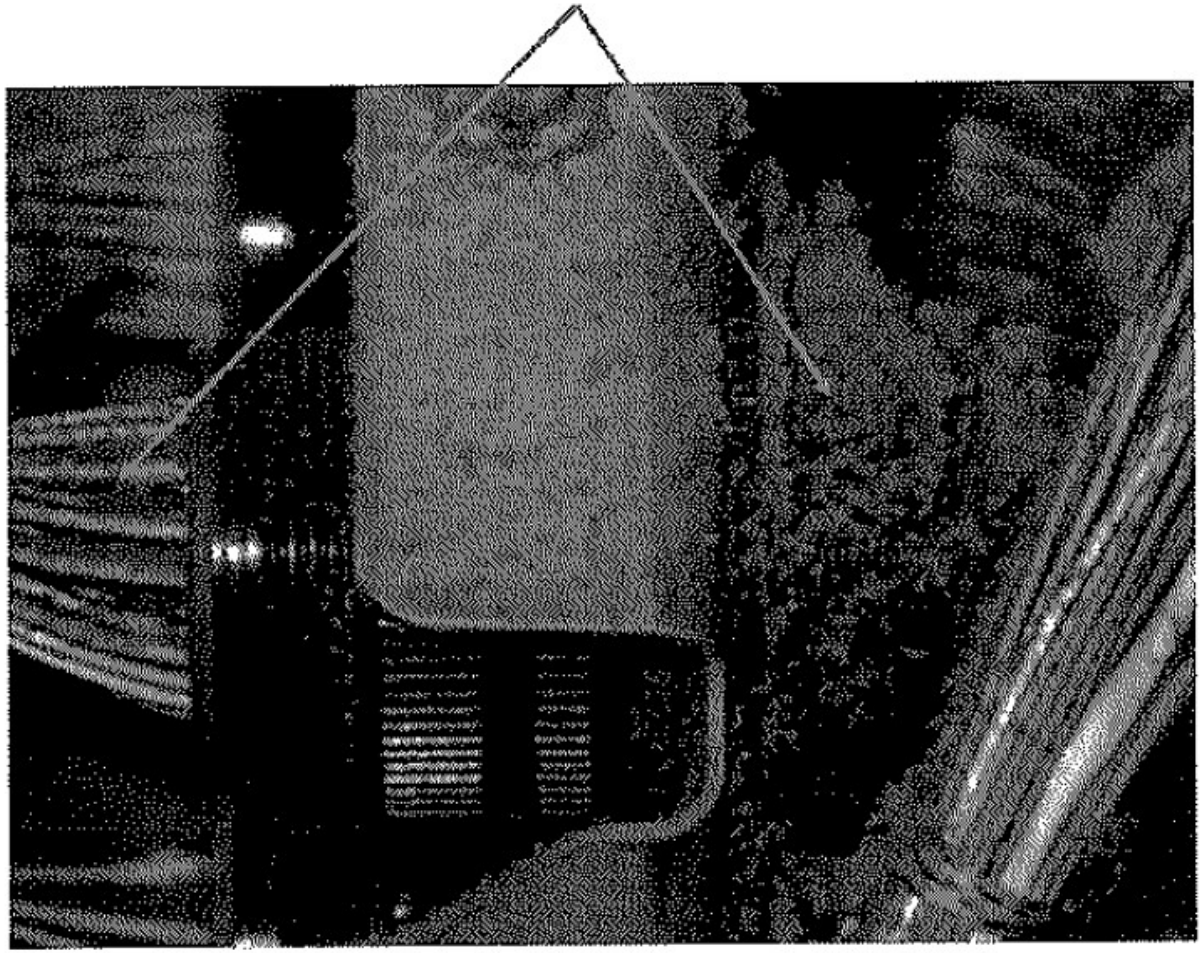
  - Air, Rain, snow, ice…

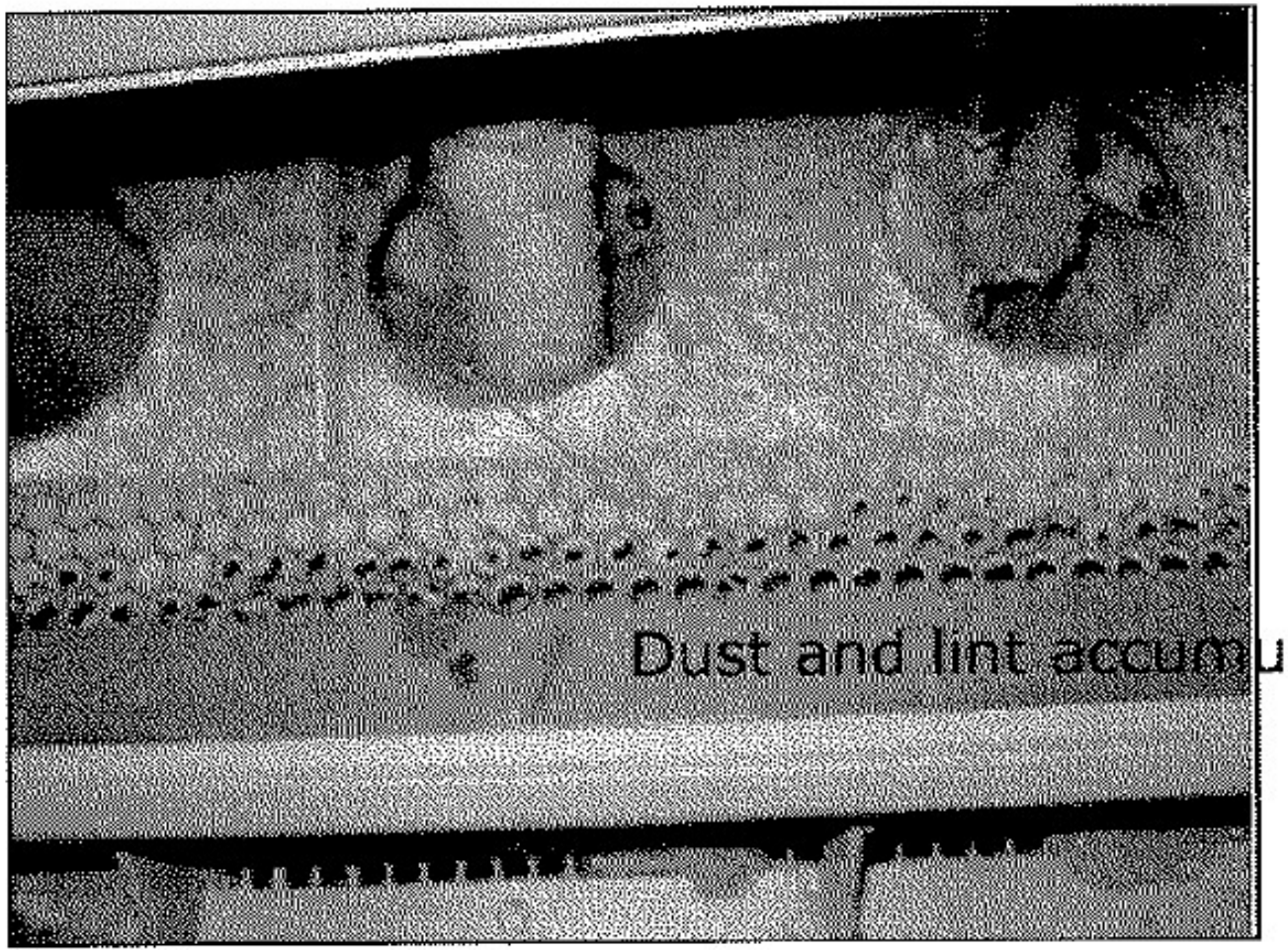
- **Internal Sources**
  - Spillage hazardous material in cargo bay
  - Spillage of food, beverages in cabin and galley
  - Engine, APU, hydraulic oil, lubrication grease corrosion prevention compound, toilet fluid,….
  - Lint and dust accumulations

- **Other sources**

  - Paint, paint stripper, debris or swarf, foreign objects

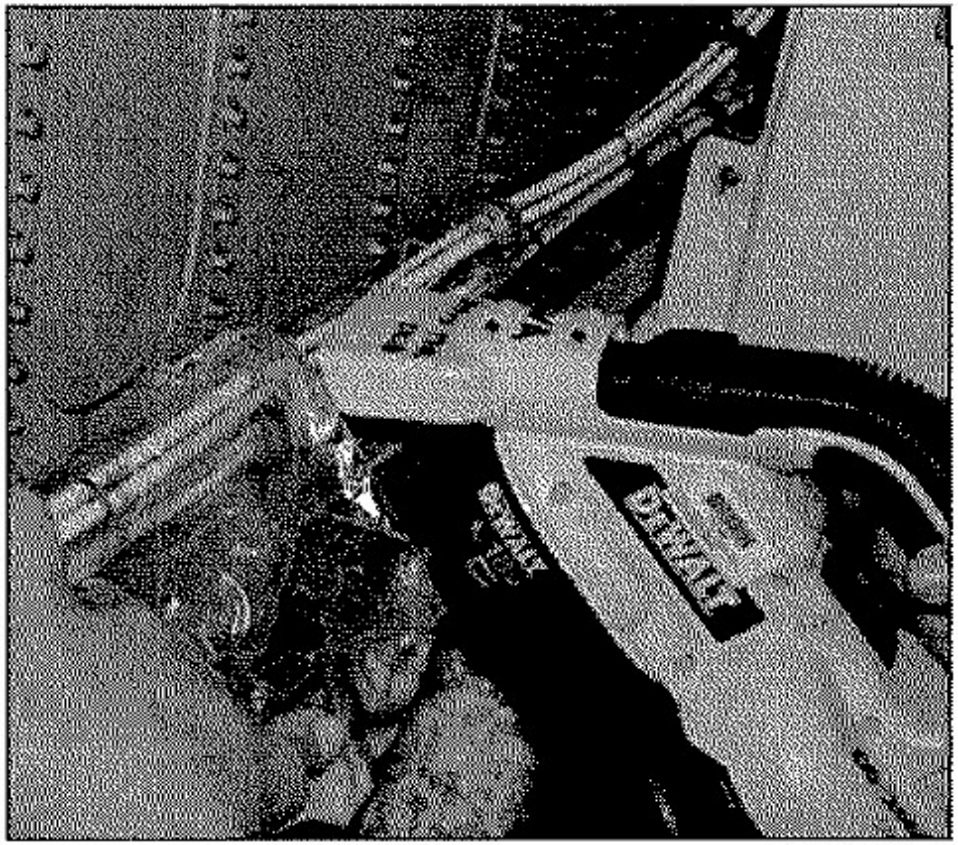
Dirt and dust accumulation



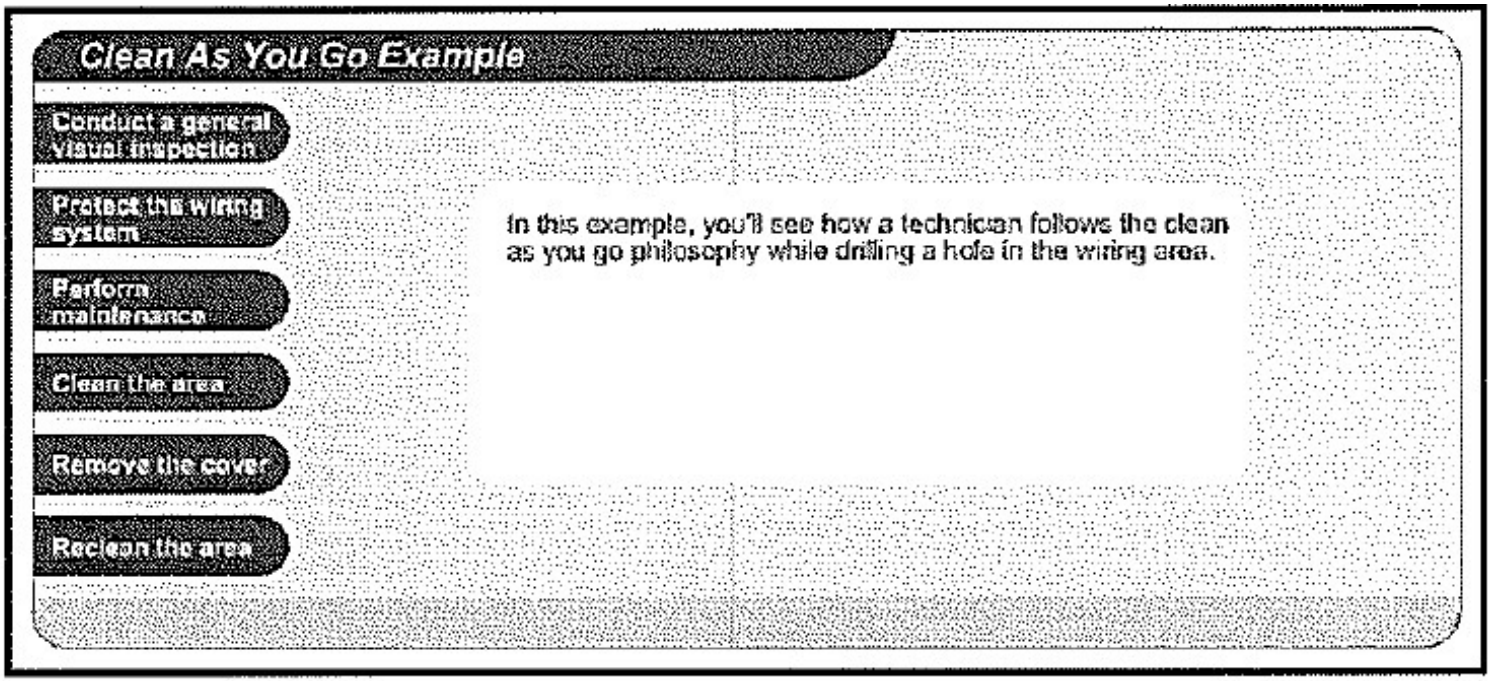


Dust and lint accumulation

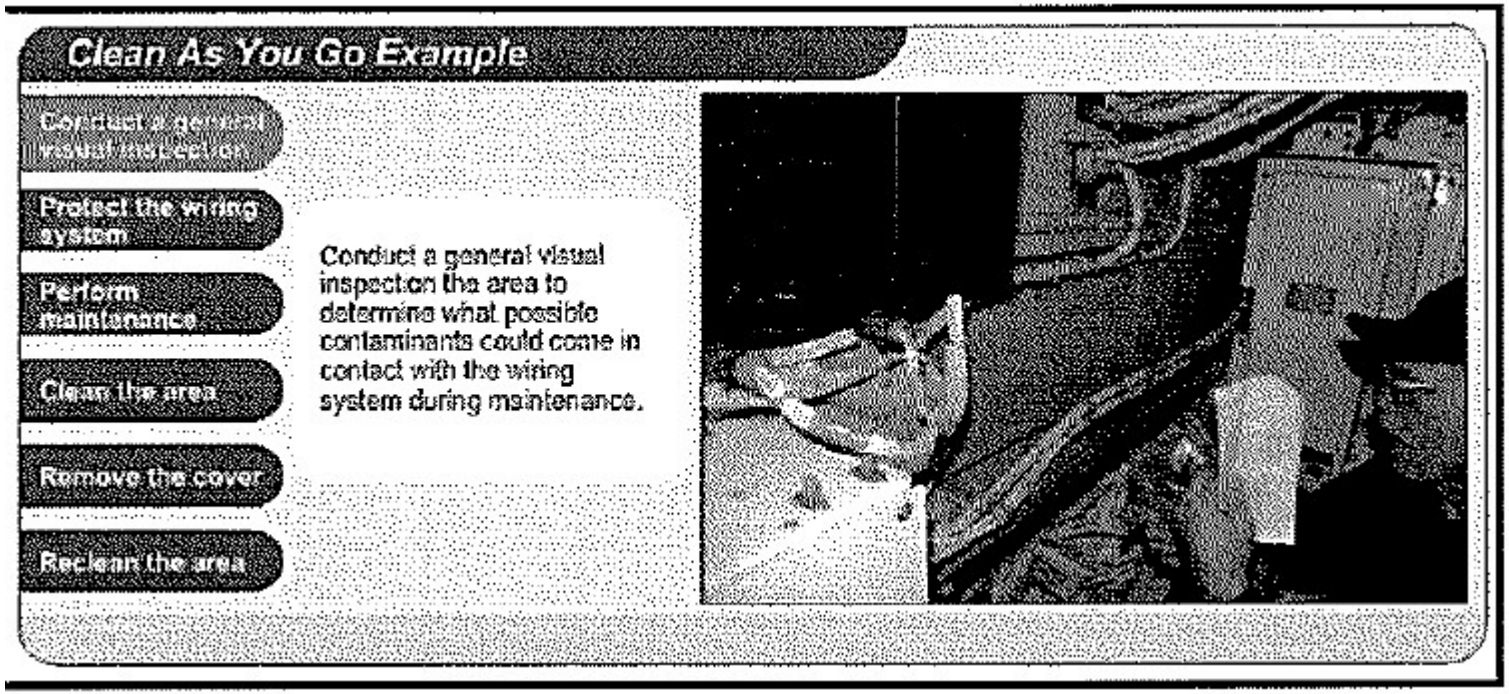
“Clean As You Leave” Philosophy



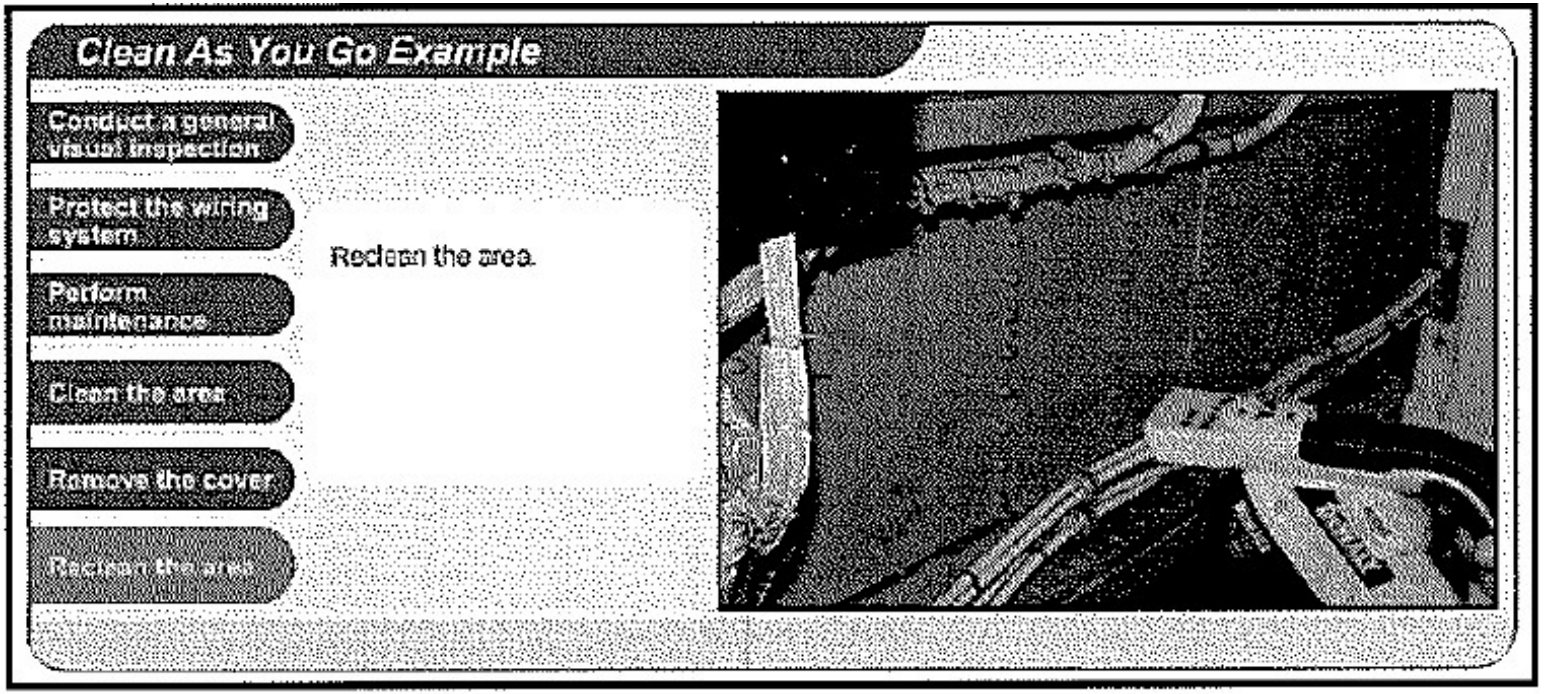
“Clean As You Leave” Philosophy



"Clean As You Leave" Philosophy



"Clean As You Leave" Philosophy



Contamination Protection planning

- Elements of protection plan
  - Identification
    - Identify the location of potential damage of component
  - Initial Cleaning
    - Remove existing debris or contaminants
  - Protection
    - Cover all components in the surrounding area
  - Follow-up cleaning
    - Remove contaminants or debris during and after maintenance or modification work
  - Protection Removal
  - Inspection

Maintenance Procedures	Protection Plan Elements					
	Identification	Initial Cleaning	Protection	Follow-up Cleaning	Protection Removal	Inspection
Structure Modification or Repair	Identify components and areas at risk to metal shavings and debris from machining	Remove any residue or debris from surfaces and crevices	Mask off bundles, plug holes, lay plastic sheeting where applicable, contain off work area	Remove metal shavings from plastic sheeting with vacuum	Roll plastic from top to bottom	Verify that all metal shavings have been removed
Fluid Release Repair	Identify components and areas at risk to fluid spill, fall, or spray	Remove any fluid residue from surfaces and crevices	Mask off bundles, plug holes, lay plastic sheeting where applicable, contain off work area	Use appropriate cleaning material based on type of spillage	Roll plastic from top to bottom	Verify that all spilled or sprayed fluids have been removed
Lavatory Fluid Release Repair	Identify components under lavatory that are at risk to spill	Remove any fluid residue from surfaces and crevices	Mask off bundles, plug holes, lay plastic sheeting below lavatory area	Remove any fluid residue using isopropyl alcohol	Roll plastic from top to bottom	Verify that all spilled fluid has been removed
Structural Corrosion Removal	Identify components and areas at risk to metal shavings and corrosion products from grinding	Remove any residue or debris from surfaces and crevices	Mask off bundles, plug holes, lay plastic sheeting where applicable, contain off work area	Remove metal shavings and corrosion debris from plastic sheeting with vacuum	Roll plastic from top to bottom	Verify that all debris has been removed
Power plant	Inspect for any existing leaks, damage, and hot surfaces	Remove any oil from surfaces and crevices	Untie wire bundles and protect exposed connectors if removing LRU	Remove any oil using isopropyl alcohol	Redo wire bundles and reconnect LRU	Verify that all fluid and oil has been removed

Protection Planning Variable Chart

Protection during aeroplane maintenance and repair

- The focus of protection is to prevent contaminants from contacting wire harnesses
- Protection procedures are difference based on:
  - Type of contamination
  - Location of maintenance procedures
  - Access to maintenance area

Protection and Caution

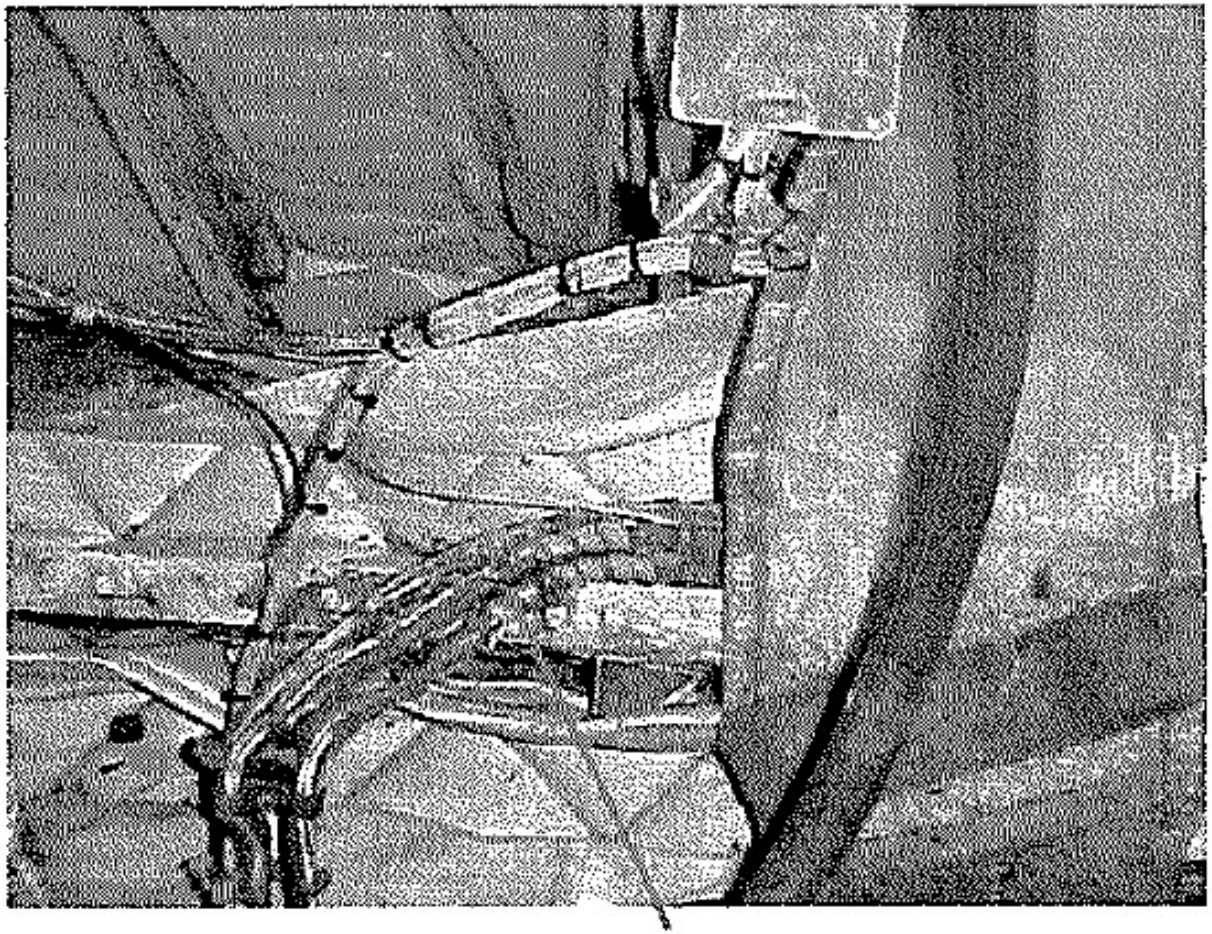
- Installation, repair, modification of wiring
  - Exercise extreme care, use proper procedures for wire selection, routing/separation, clamping configuration, use of splices, repair or replacement of protective coverings, pinning/de-pinning of connectors
- Structural repair, STC, modifications
  - Protect wiring from mechanical damage by tools or equipment
  - Cover debris field
- Aircraft de-icing or anti-icing
  - Direct spaying fluid on electrical components causing contamination

Protection and Caution

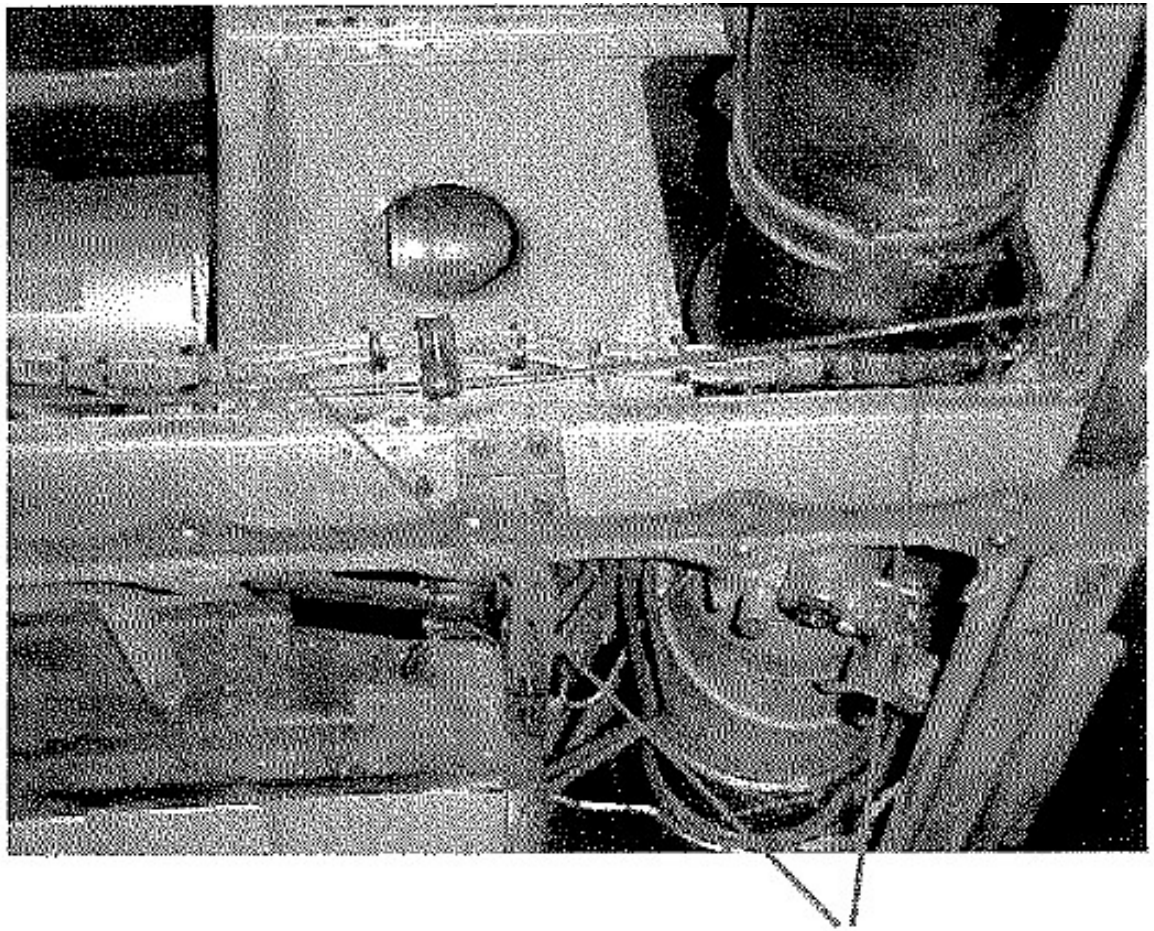
- Inclement weather
  - Keep doors/panels closed to prevent ingress of snow rain, excessive moisture
- Component removal/installation
  - Avoid excessive handling and movement; use appropriate connector pliers; cap connectors
- Pressure washing
  - Do not direct spray on electrical components and wiring
- Cleaning of EWIS in situ
  - Follow proper procedures
  - Avoid unnecessary wiring displacement or disturbance

Protection and Caution

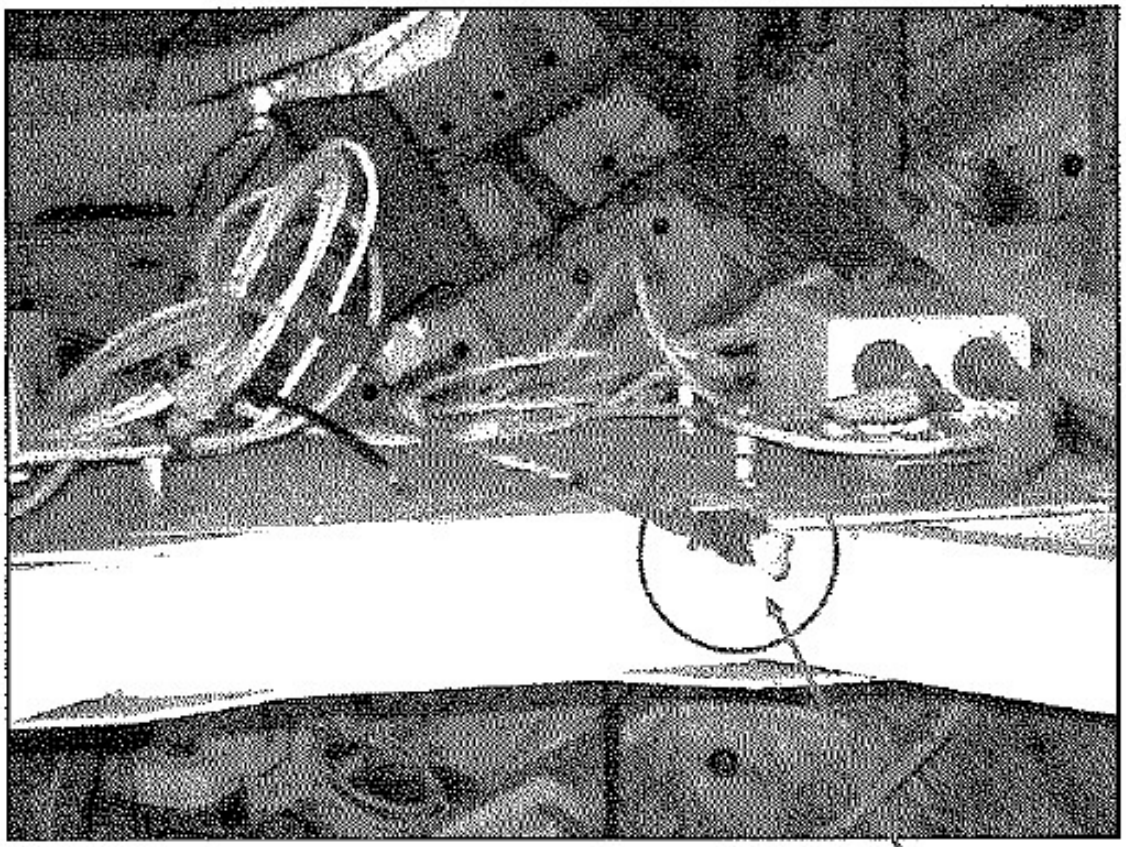
- Working on waste/ water systems
  - Cover exposed electrical components and wiring
- Servicing, modifying, or repairing oil systems, hydraulic systems
  - Avoid any fluids, foreign material, debris from reaching electrical components and wiring
- Entering zones
  - prevent damage to adjacent or hidden electrical components and wiring; avoid using wire bundle as handhold, lamp-hold, steps and support
- Application of corrosion prevention compound (CPC)
  - Prevent CPC direct contact with wire and components



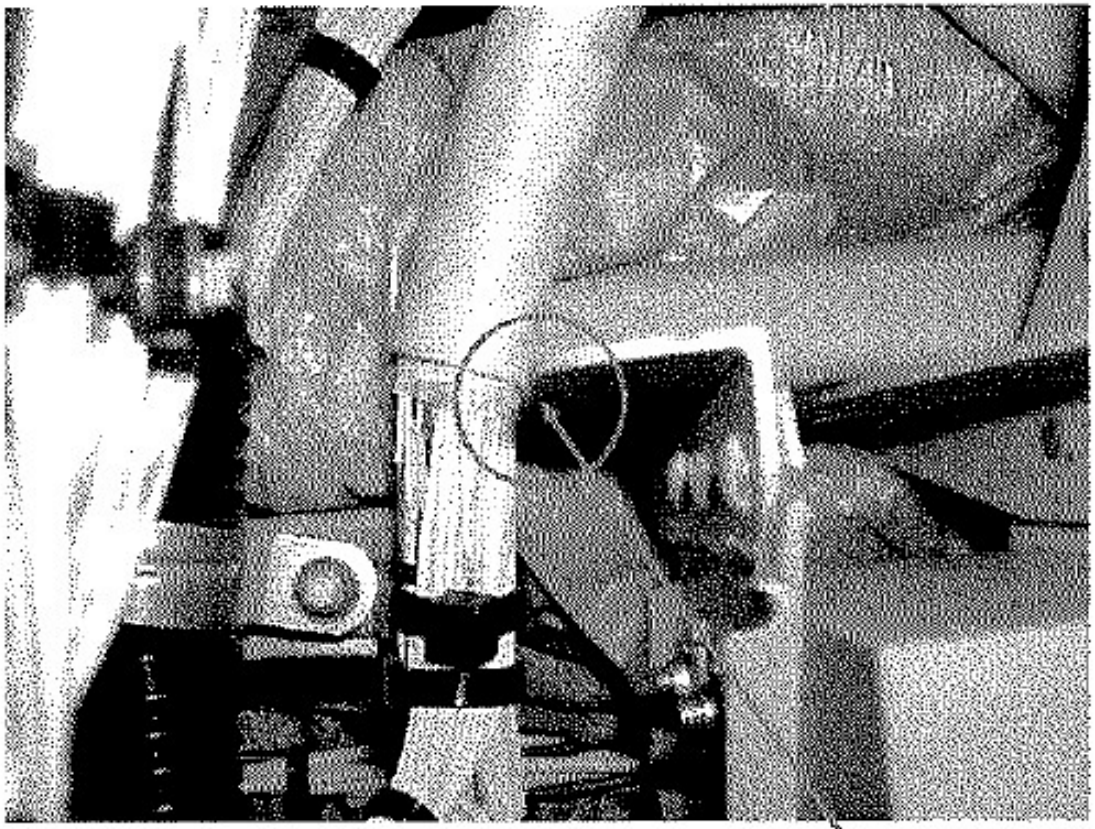
Wire bundle in contact with the rib. Wire bundle not covered during maintenance.



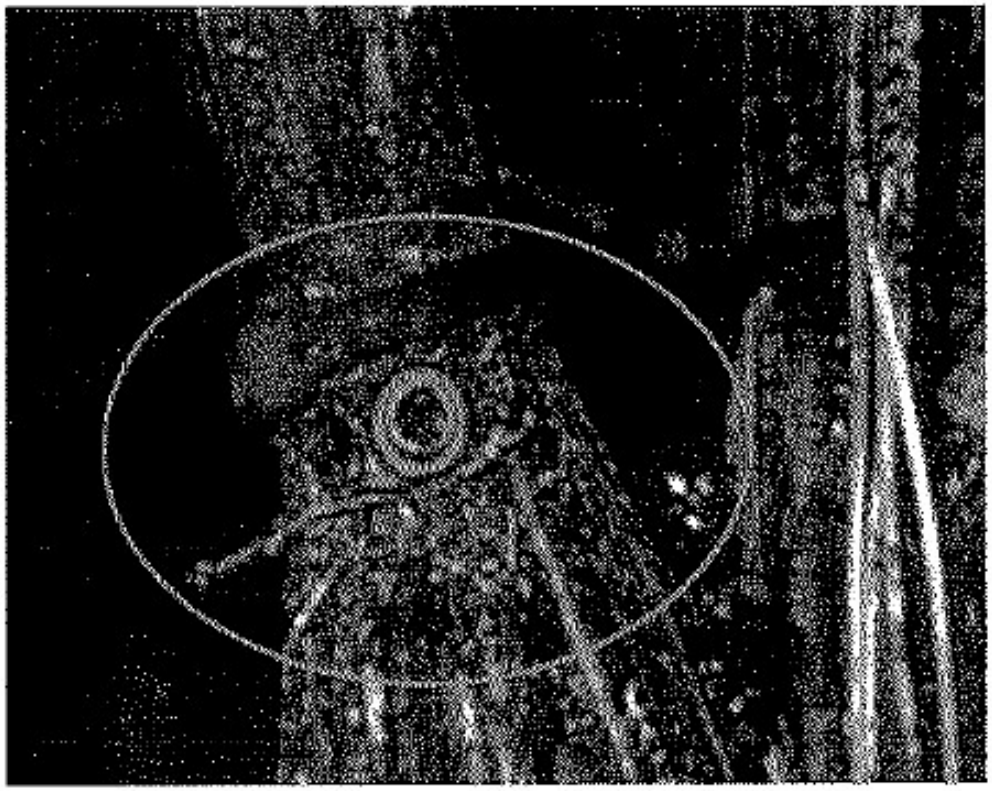
Wire bundle soaked with corrosion protection fluid



Connector not properly protected



Wire chafe along the bracket due clamp not installed



Dust, metal shavings, and other debris on wire bundles

Cleaning Process

1. Identify the wire harness components and equipment that must be cleaned.
2. Open the circuit breakers and switches for the wire harness and the equipment that must be cleaned.
3. Make sure that the applicable wire harness are de-energized.
4. Get access to the contamination

Cleaning Process(con't)

5. Select the appropriate cleaning method in accordance with Standard Practices Manuals.
   - cleaning materials
   - cleaning procedures
6. Remove the contamination
7. Make sure the wire harness components and clamps are clean and fully dry
8. Assemble and install the wire harness to return to initial condition.

Cleaning Process(con't)

- Example of cleaning materials:
  - Alcohol
  - Isopropyl
  - Aqueous Cleaner
- Care must be taken to protect the personnel and components
- Aware the use and disposal of flammables liquids

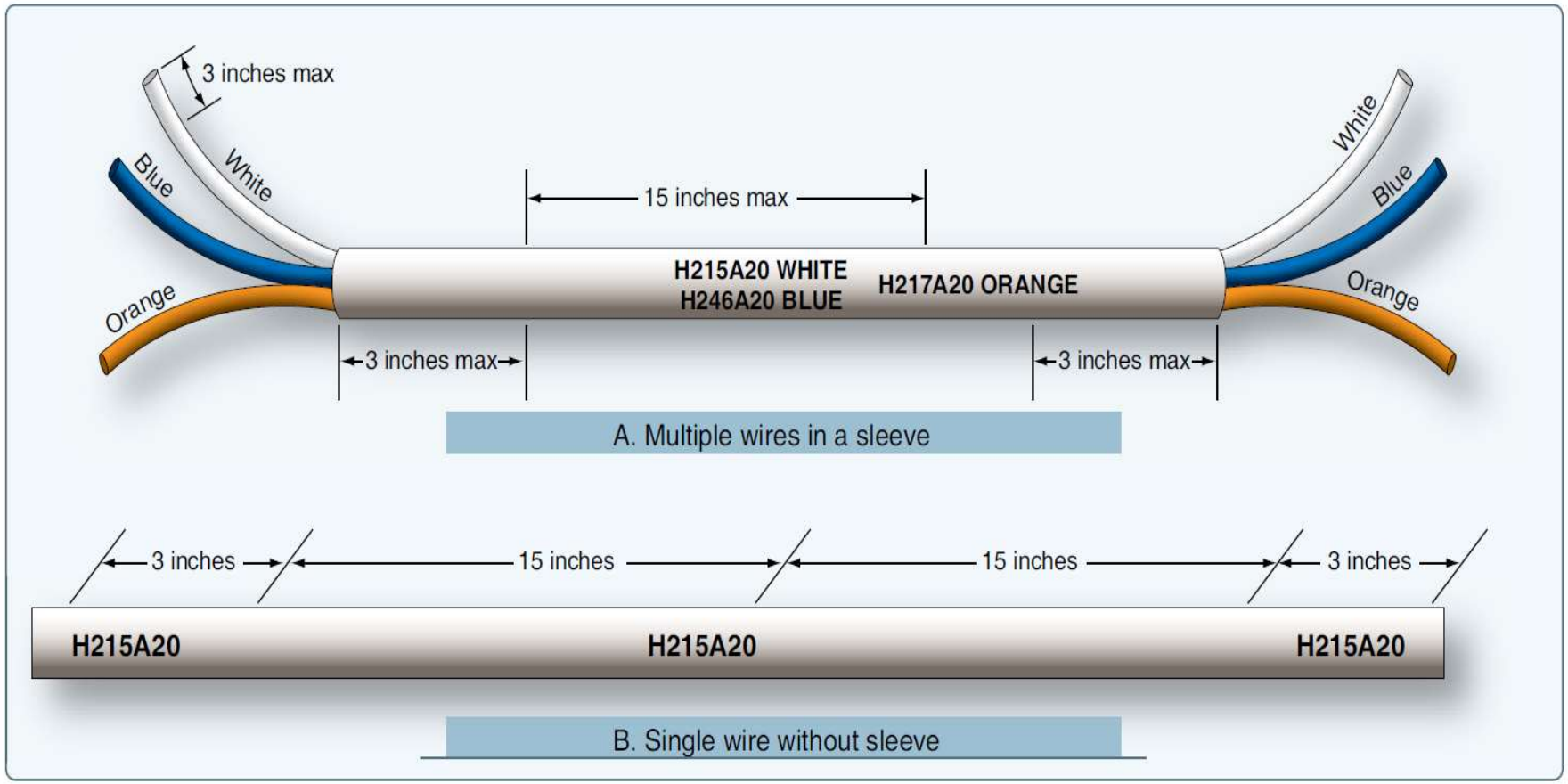
WIRE

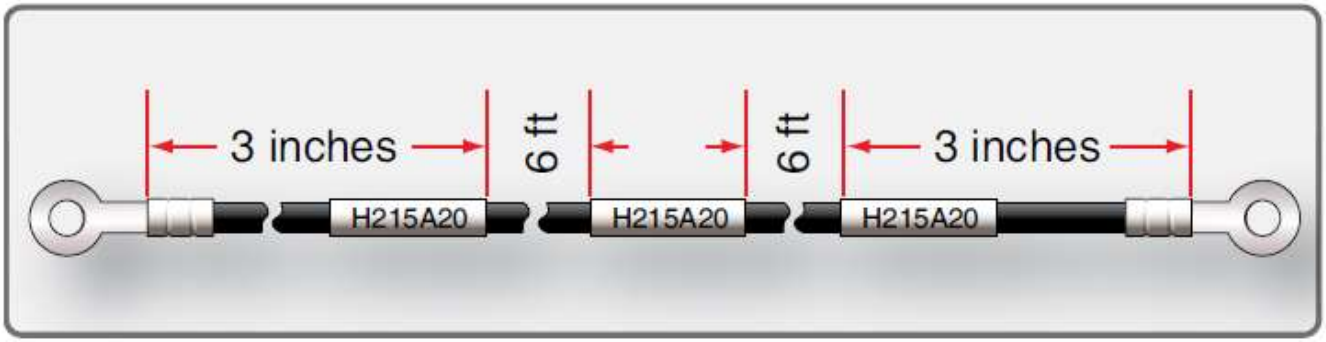
Identification/Type and Construction

- A wire installed on aircraft must include:
  - Part number
  - Wire mark
- A Part Number is:
  - printed by manufacturer
  - used to identify type of wire
    - Example:

      BMS13-48 T32 C03 G020 - 004

Identification/Type and Construction





Identification/Type and Construction

- Wire mark is:
  - printed by technicians
  - Usually consist of three parts:

Examples:

W2531-014-022

Bundle no. wire no. wire gauge

OR

ATA2322-04-CF24

ATA Chapter wire no. type & wire gauge

Identification/Type and Construction

- Laser wire printer

Identification/Type and Construction

Wire size		Sleeving size	
AN #	AL #	No.	Nominal ID (inch)
24		12	0.085
22		11	0.095
20		10	0.106
18		9	0.118
16		8	0.113
14		7	0.148
12		6	0.166
10		4	0.208
8	8	2	0.263
6	6	0	0.330
4	4	$^3/_8$ inch	0.375
2	2	$^1/_2$ inch	0.500
1	1	$^1/_2$ inch	0.500
0	0	$^5/_8$ inch	0.625
00	00	$^5/_8$ inch	0.625
000	000	$^3/_4$ inch	0.750
0000	0000	$^3/_4$ inch	0.750

Recommended size of identification sleeving

Identification/Type and Construction

- Correlated with **Wiring Diagram Manual** to provide information such as :

- Systems connected
- Connectors
- Length of wire
- Wire gauge

- The wire mark can also be used to find **wire type code**, which is used to search for P/N of new wire

Insulation Qualities

Although there are many different types of wire used on aircrafts, a wire typically consists of two parts:

- Insulation layer
- Conductors

Some wire also include metal shield for EMI and HIRF protection.

Insulation Qualities

Insulation layer

- Provide mechanical protection, electrical insulation, and may include other physical protection. E.g. heat, chemical resistance
- Example of insulator material: Telfon, PTFE Conductor
- To fulfill different purpose, the construction of wire vary by:
  1. No. of conductor
  2. Wire gauge size (diameter of wire)
- Example: Tinned copper, aluminium

Insulation Qualities

Different types of wire have different damage limit, depends on its construction.

Refer to Standard Practices for the individual damage limit and methods for repair.

Insulation Qualities

- **PTFE (TEFLON)** - (mil spec 22759/12)
  - *Desirable properties*: 260°C thermal rating, low-smoke/non-flame, high flexibility
  - *Limitations*; Cut-through resistance, "creep" at temperature
- **ETFE (TEFZEL)** - (mil spec 22759/16)
  - *Desirable properties:* chemical resistance, abrasion resistance, ease of use
  - *Limitations:* high temperature, cut-through, thermal rating (150°C)
- **PI [Aromatic Polyimide (KAPTON)] -** (mil spec 81381)
  - *Desirable properties:* abrasion/cut-through, low-smoke/non-flame, weight/space
  - *Limitations:* arc-track resistance, flexibility
- **Composite (TKT) -** (mil spec 22759/80-92)
  - *Desirable properties:* high temperature rating (260°C), cut-through resistance, arc-track resistance
  - *Limitations*: outer layer scuffing

Inspection Criteria and Standards of Wire/Wire Bundle

- Wire bundle/wire bundle or wire bundle/structure contact/chafing
- Wire bundle sagging or improperly secured
- Wires damaged (obvious damage due to mechanical impact, overheat, localized chafing, etc.)
- Lacing tape and/or ties missing/incorrectly installed
- Wiring protection sheath/conduit deformity or incorrectly installed
- End of sheath rubbing on end attachment device Grommet missing or damaged

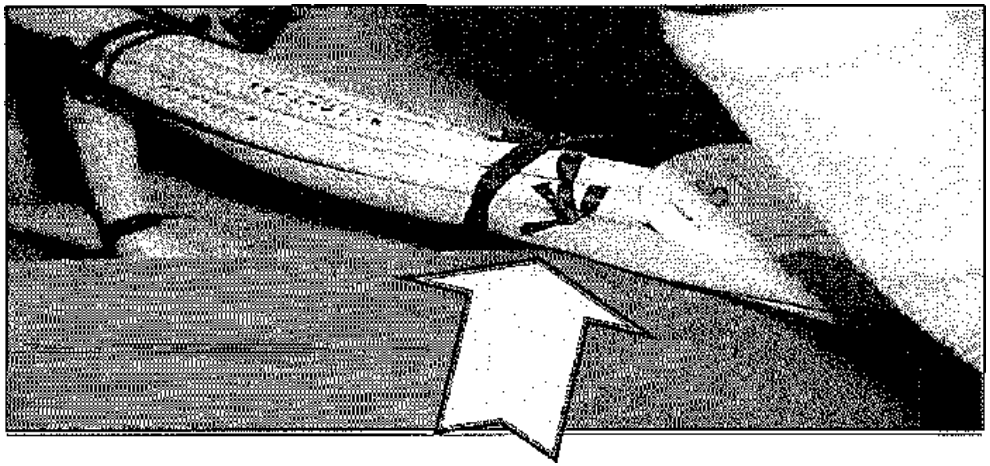
Insulation Qualities

Relative Ranking	Most desirable →			Least
	1	2	3	4
Weight	PI	ETFE	COMP	PTFE
Temperature	PTFE	COMP	PI	ETFE
Abrasion resistance	PI	ETFE	COMP	PTFE
Cut-through resistance	PI	COMP	ETFE	PTFE
Chemical resistance	PTFE	ETFE	COMP	PI
Flammability	PTFE	COMP	PI	ETFE
Smoke generation	PI	COMP	PTFE	ETFE
Flexibility	PTFE	ETFE	COMP	PI
Creep (at temperature)	PI	COMP	PTFE	ETFE
Arc propagation resistance	PTFE	ETFE	COMP	PI

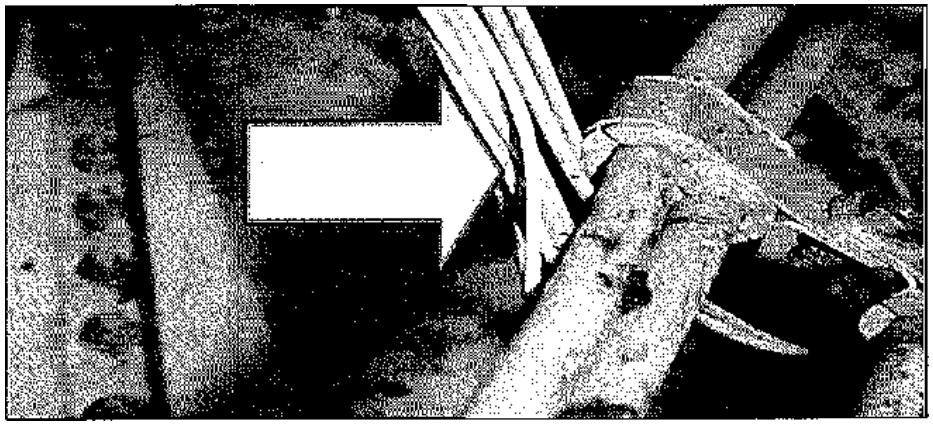
Inspection Criteria and Standards of Wire/Wire Bundle (con't)

- Dust and lint accumulation
- Surface contamination by metal shavings/swarf
- Contamination by liquids
- Deterioration of previous repairs (e.g., splices)
- Deterioration of production splices
- Inappropriate repairs (e.g., incorrect splice)
- Inappropriate attachments to or separation from fluid lines

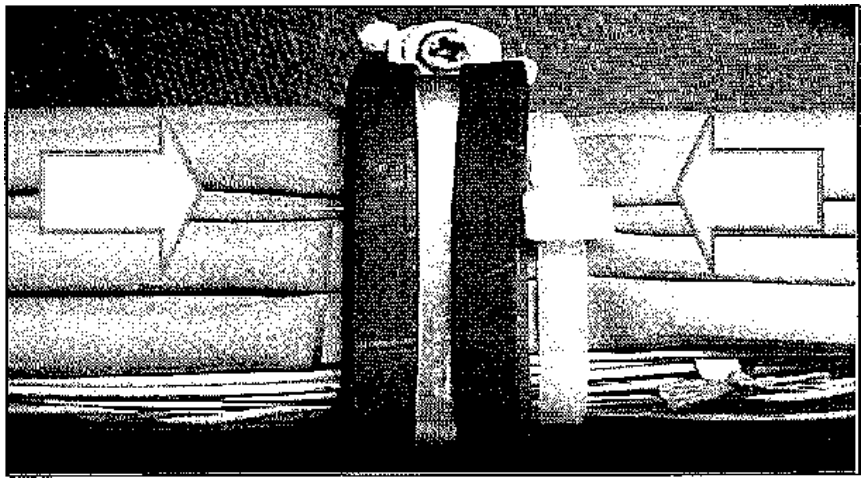
Some wiring installation problems



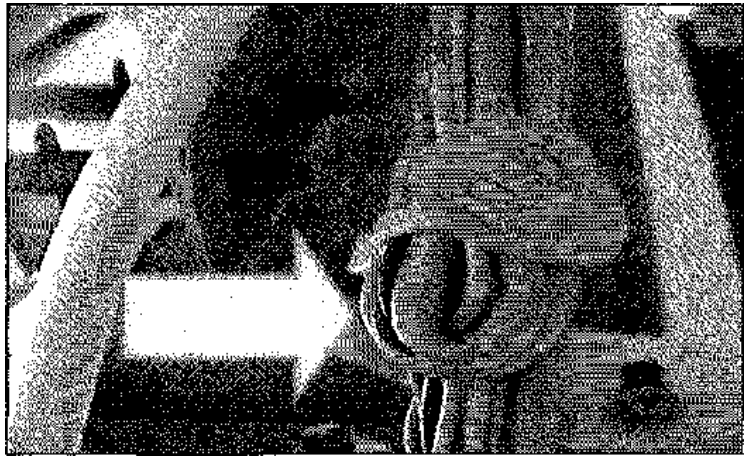
Wire bundle riding over structure



Wiring un-tied and riding on pipelines



Heat discoloration

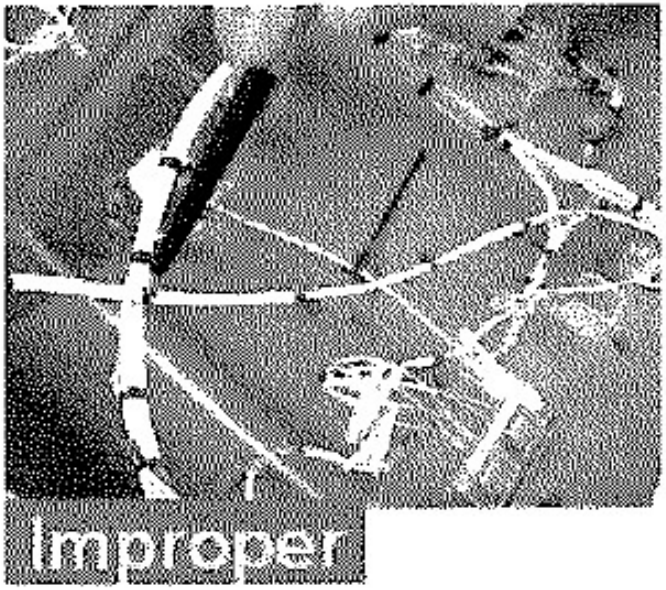


Bend radii problem - less than 3 times the diameter of the wire bundle

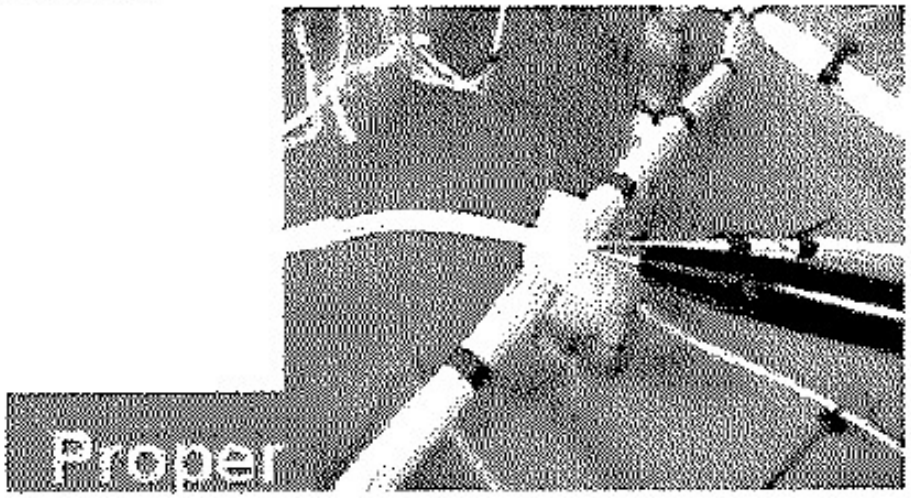
Wire Bundle Installation Practices

- During installation of wire bundle, there are many practices we should follow to prevent wire degradation.
- Some of the practices are listed in the following slides.

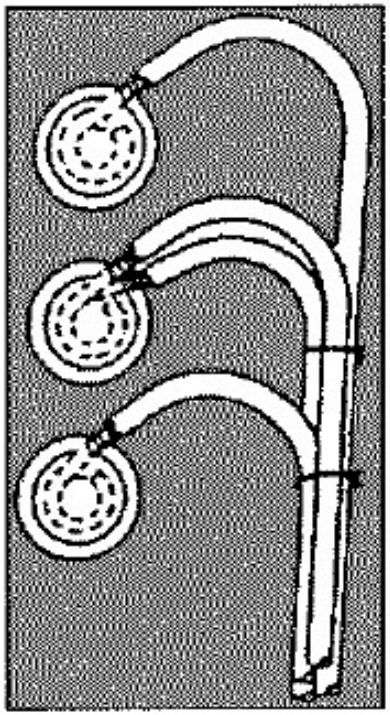
Wire Bundle Installation Practices

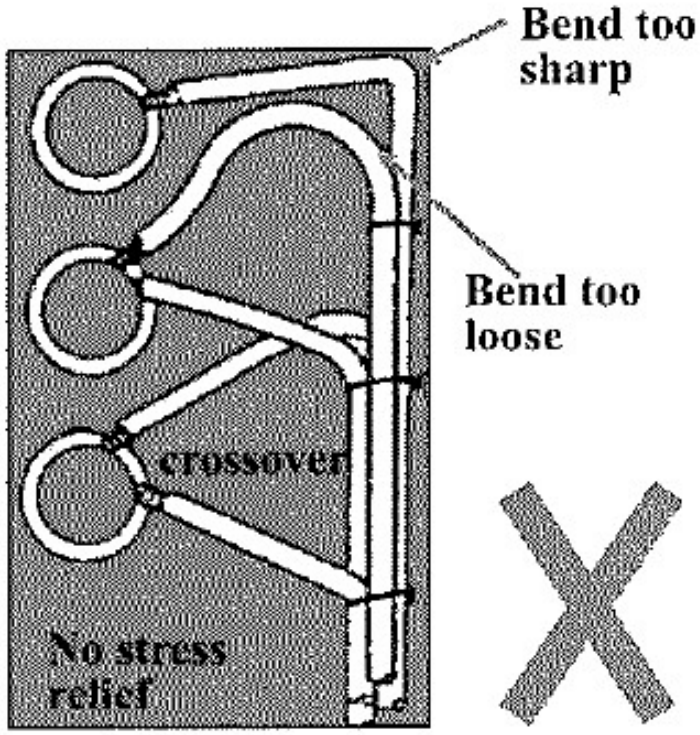


Wire bundles that cross should be secured together to avoid chafing.



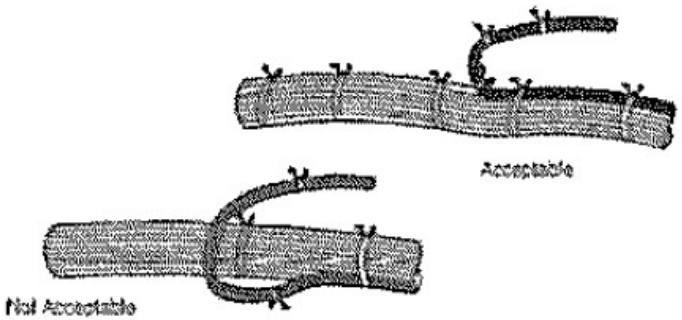
Wire Bundle Installation Practices



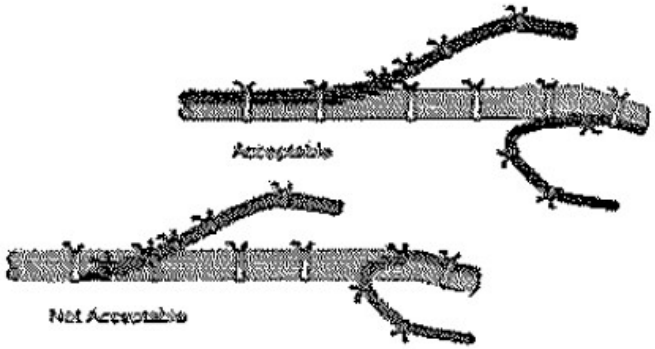


- Proper wire installation.

Wire Bundle Installation Practices

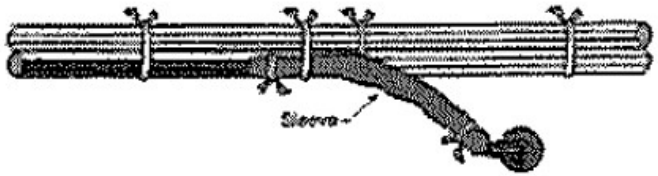


SINGLE BREAKOUT ON A WIRE HARNESS



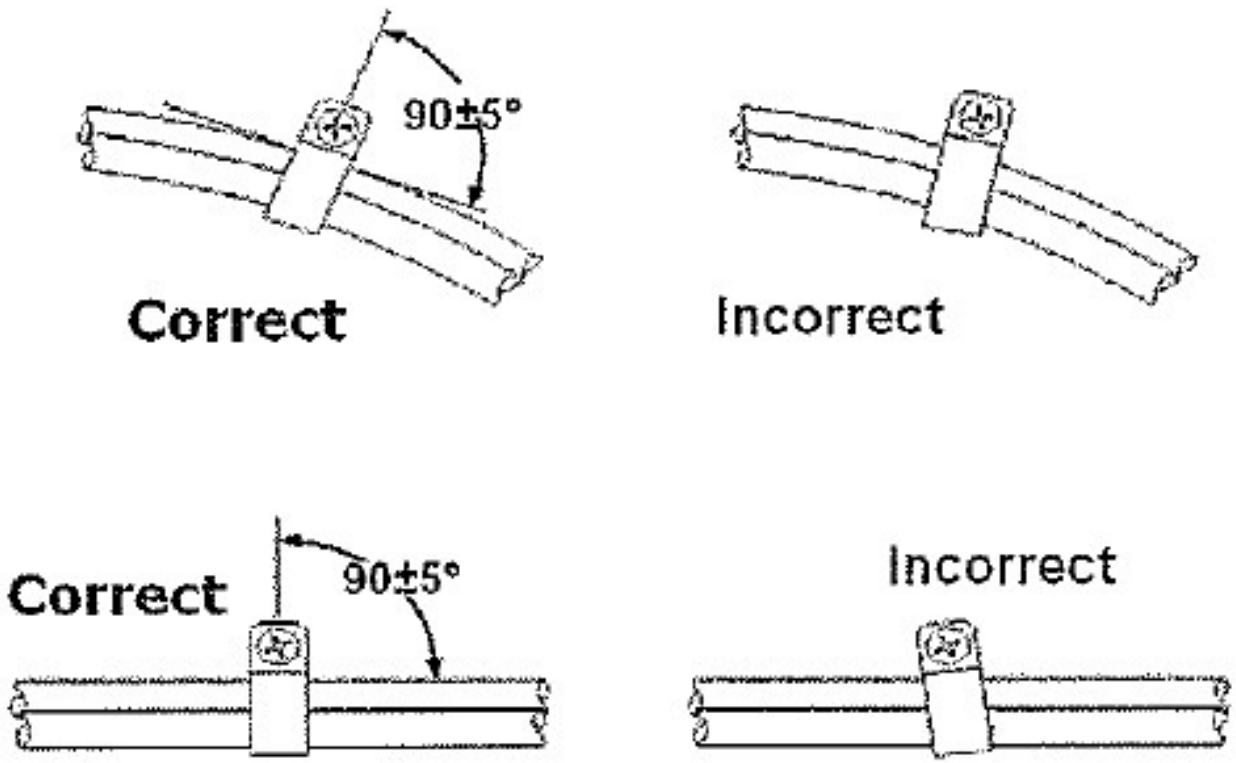
MULTIPLE BREAKOUTS ON A WIRE HARNESS

CROSSOVER AREA PROTECTION WITH TAPE



CROSSOVER AREA PROTECTION WITH A SLEEVE

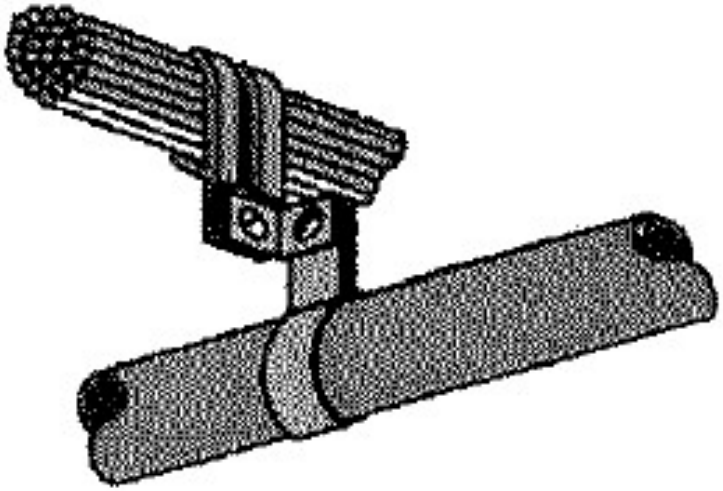
Wire Bundle Installation Practices



Wire Bundle Installation Practices

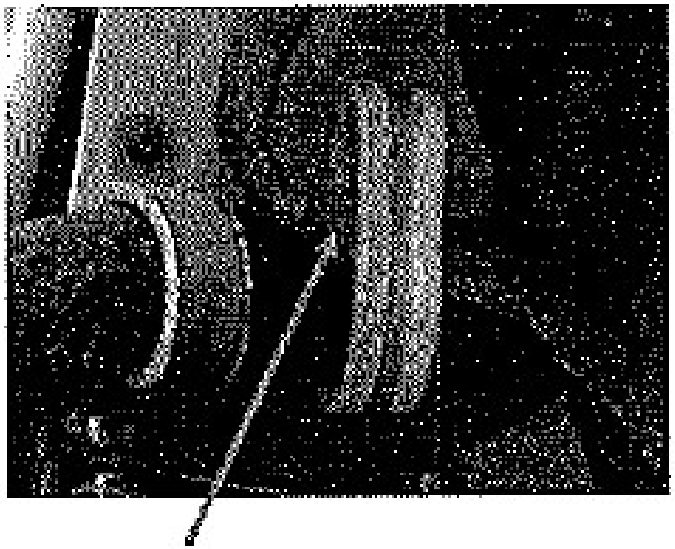
- Sufficient separation between wire bundle and flammable liquid, fuel, or oxygen line.

- It can be done using mechanical support, such as clamps as shown.

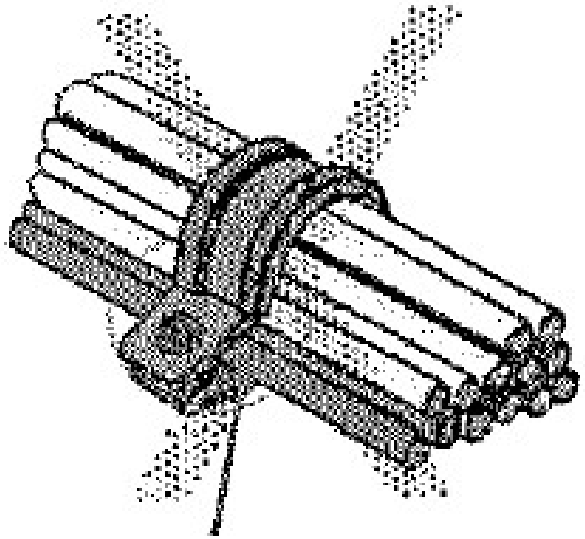


Wire Bundle Installation Practices

- Never use clamp with wrong size



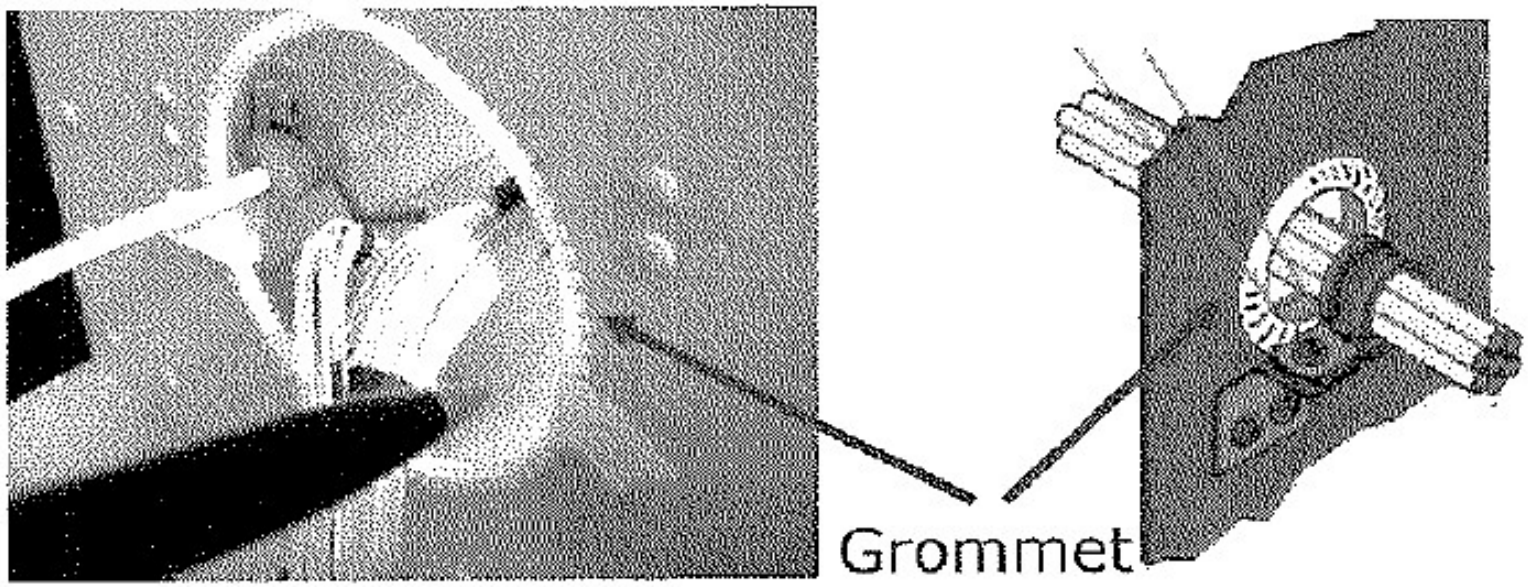
Clamp too big,
loosen bundle



Clamp too small,
pressure to wire

Wire Bundle Installation Practices

- If there are not enough clearance between structure and bundle, a grommet should be inserted.



Maintenance and Repair Procedures

- Conditions for repair of damaged electrical wire or cables can be found in Standard Practices Manuals.
- All maintenance technicians must refer the manuals in all instances for correct repair procedures.

Exercise:

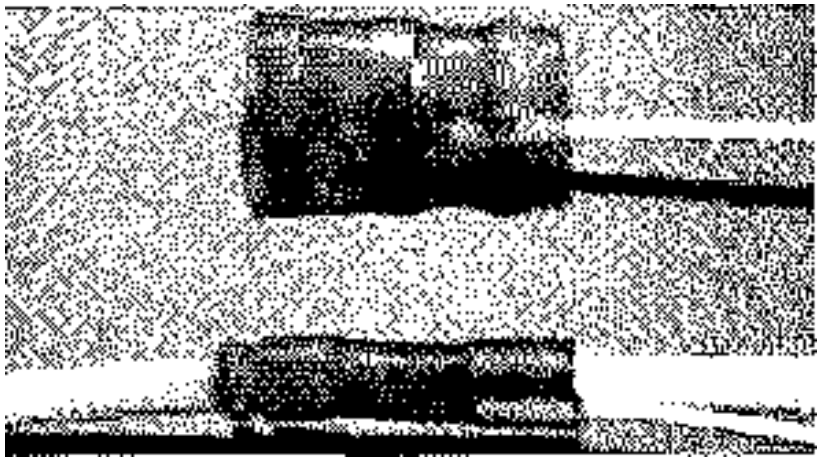
A 0.2 inch cut is found on the outer layer of PTFE Tape into the primary insulation of a unshielded wire (Part Number: BMS 13-60 T01 C01 G20)
Refer to SWPM :

* Check if repair is necessary.

• Where are Temperature classification found?

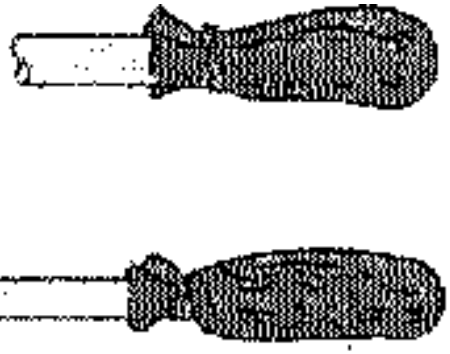
Sleeving

- Different types of sleeving are used in aircraft for special purposes:
  - Shrinkable sleeve
  - Flexible sleeve
  - Screen braid grounding sleeve
  - Solder sleeve

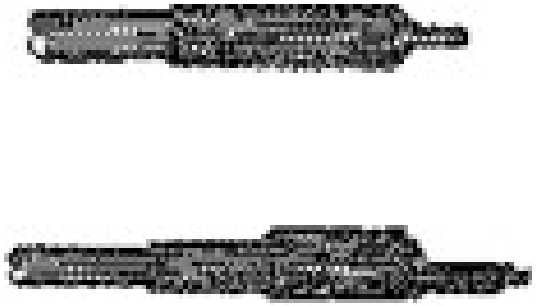


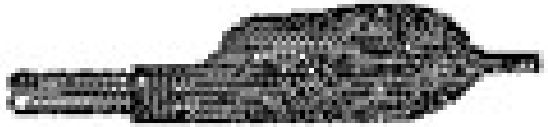
Unused wire - termination and storage

- Use suitable sleeves to protect wires which are not used.



Flexible sleeve





Heat shrinkable sleeve

Electrical bonding and grounds

- Primary bonding (Structure)
  - supplied by all the conductive structural parts (fuselage, wings, control surfaces, nacelles, landing gears, etc.) of the aircraft to collect high energy (as caused by lightning).

- Secondary bonding (Systems grounding)
  - supplied by the other conditions of conductibility related to electrical potentials in the aircraft and specially:
  - Current return through aircraft ground return,
  - Electrostatic potential circulation and discharging,
  - Bonding of different shieldings and equipment,
  - Protective bonding against electric shock if the insulation is defective.
  - To prevent spark ignition of flammable vapors.

Electrical bonding and grounds(con't)

- Always refer to standard practices manual for inspection procedures.
- Make sure the resistance of bonding does not exceed the maximum permitted value.

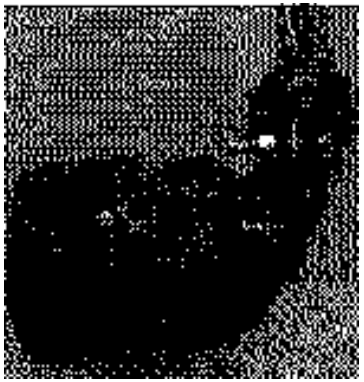
CONNECTIVE DEVICES

General type and identification

- There are different types of connectors:

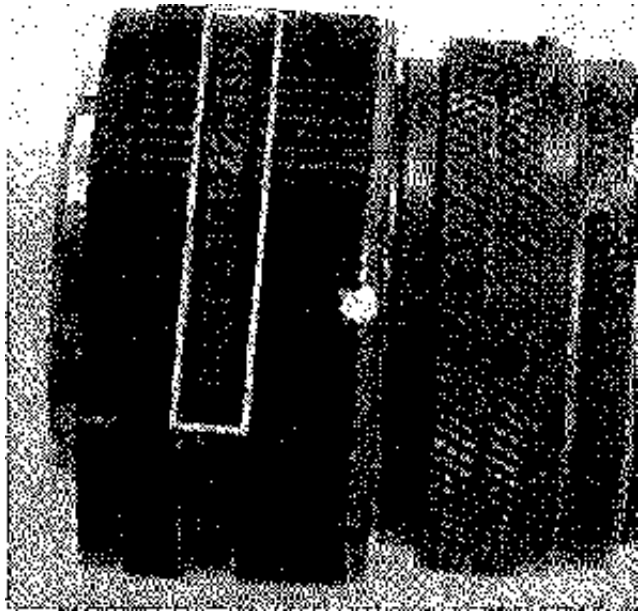
- Circular type
- Rectangular
- Module blocks

- Selected to provide maximum degree of safety and reliability given electrical and environmental requirements



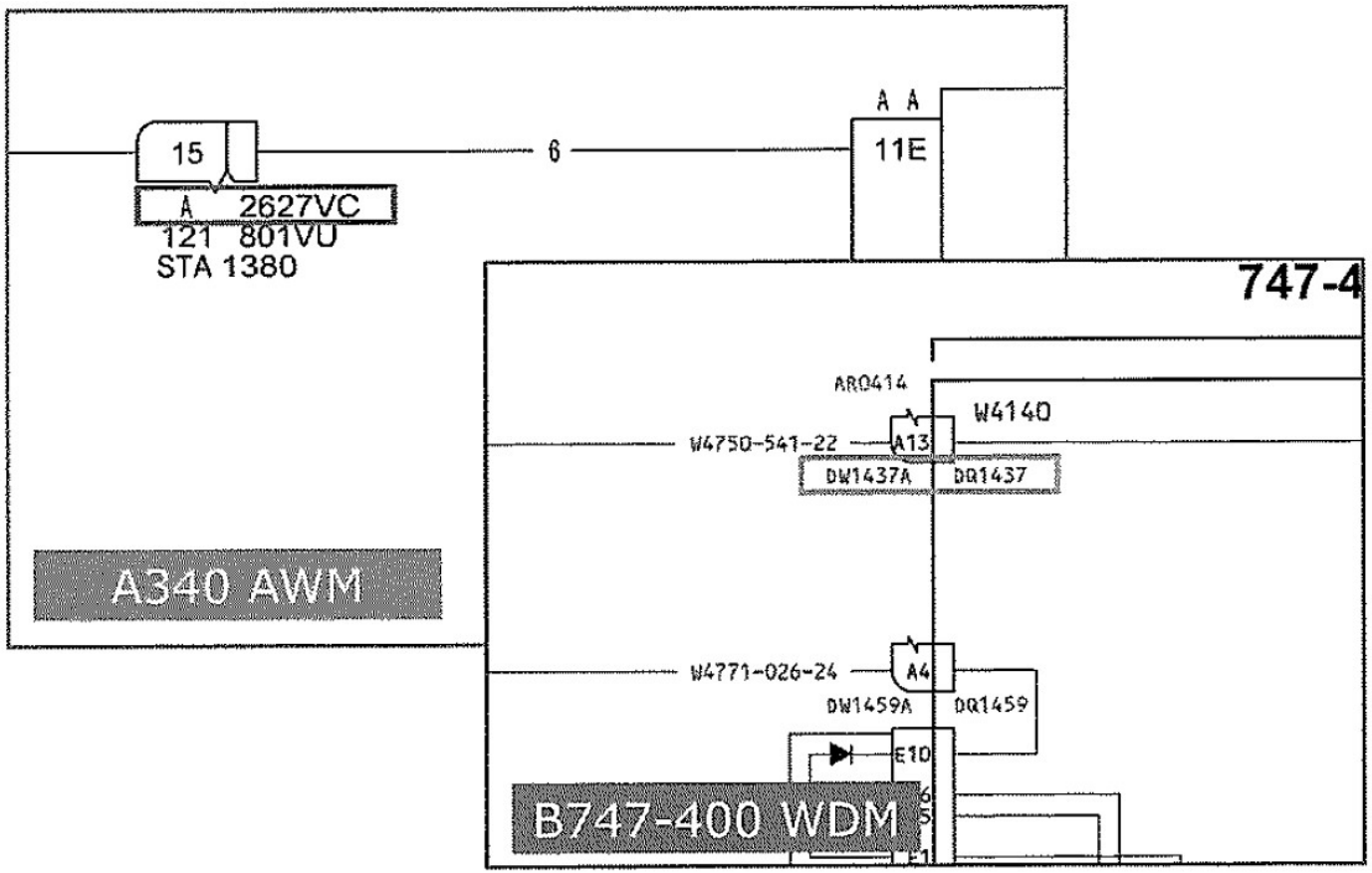
General type and identification

- Connector type can be identified by its part number.



General type and identification

- Connectors are marked with equipment number in Wiring Diagram.



Cautions and Protections

Working on a high voltage electrical /electronic system presents hazards such as:

- Electrical shock on contact with energized wiring
- Short circuits caused by metal tools dropped across electrical connections/ conductors
- Explosions caused by electrical sparks in the presence of flammable vapors.

Cautions and Protections

CAUTION: DO NOT CUT OR CAUSE DAMAGE TO THE STRANDS OF THE CONDUCTOR. THE MECHANICAL STRENGTH OF THE WIRE CAN BE DECREASED AROUND THE CONNECTOR.

CAUTION: MAKE SURE THAT THE END OF THE INSULATION ISEQUAL AND SYMMETRICAL AROUND THE CIRCUMFERENCE OFTHE CONDUCTOR. UNWANTED INSULATION IN THE CRIMP JOINT OF A CONNECTOR CAN INCREASE THE ELECTRICAL RESISTANCE.

CAUTION: MAKE SURE THAT THE BASE METAL OF THECONDUCTOR CANNOT BE SEEN AROUND THE CONNECTOR.CORROSION OF THE CONDUCTOR CAN OCCUR.

Visual Inspection Procedures

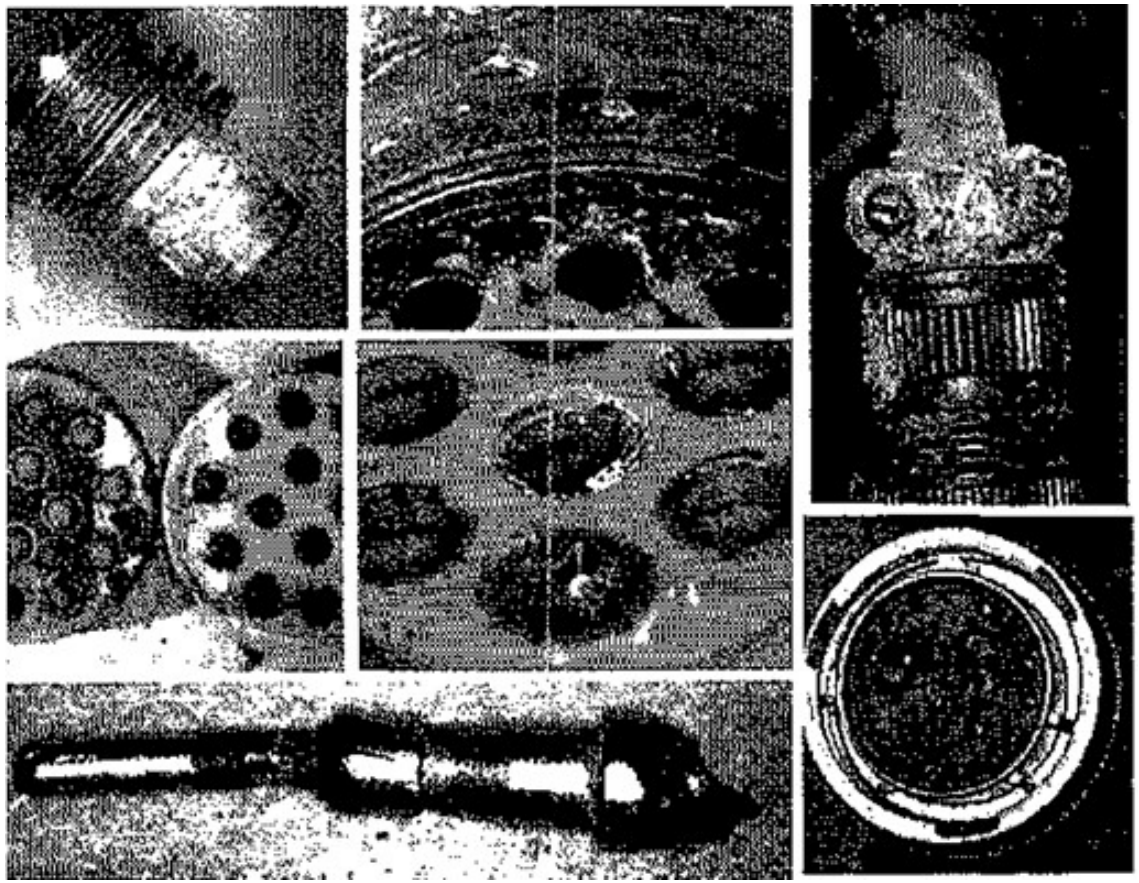
The following are the guidelines for connectors Inspection:

- External corrosion on receptacles
- Backshell tail broken
- Rubber pad or packing on backshell missing
- No backshell wire securing device
- Fool proofing chain broken
- Missing or broken safety wire

Visual Inspection Procedures(con't)

- Discoloration/evidence of overheat on terminal lugs/blocks
- Torque stripe misalignment
- Worn environmental seals
- Loose connectors
- Missing seal plugs
- Missing dummy contacts
- Lack of strain relief on connector grommets
- Connector pin corrosion

Typical Damage Found



Repair Procedures

When damaged connector is found:

1. Identify problem of connector e.g. corroded
2. Identify connector
3. Locate relevant data using Standard Practices Manual:
   - Tools
   - Materials
   - Repair Procedures
4. If the connector cannot be repaired, replace by new connector.

CONNECTIVE DEVICE REPAIR

CONNECTIVE DEVICE REPAIR

- The following slides demonstrate the procedures for replacement of typical types of connectors found on the aircrafts, which include:
  - Circular Connectors
  - Rectangular Connectors
  - Terminal Blocks (Modular/Non-modular)
  - Grounding Modules
  - Pressure Seals

CONNECTIVE DEVICE REPAIR

CONNECTIVE DEVICE REPAIR

- Always refer to Standard Practices for the latest information of repair procedures.

- For Boeing aircraft, technicians can locate the reference materials in the SWPM using connector part number.

Example: Searching for Circular Connectors type

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STANDARD WIRING PRACTICES MANUAL

ASSEMBLY OF CONNECTORS WITH FRONT RELEASE CONTACTS

Paragraph		Page
1.	PART NUMBERS AND DESCRIPTION	1
A.	Backshell Assembly Part Numbers	1
B.	Necessary Materials	1
2.	CONNECTOR DISASSEMBLY	2
A.	Disassembly of the Backshell Components	2
B.	Contact Removal	2
C.	Removal of Seal Plugs and Seal Rods	2
3.	CONNECTOR ASSEMBLY	3
A.	Contact Assembly	3
B.	Contact Insertion	4
C.	Seal of an Empty Contact Cavity	6
4.	BACKSHELL ASSEMBLY	6
A.	Assembly of a Strain Relief Clamp	6
B.	Assembly of a Single Leg Strain Relief Clamp	6
C.	Assembly of a Conduit Adapter	6
D.	Installation of a Convoluted Tube	6

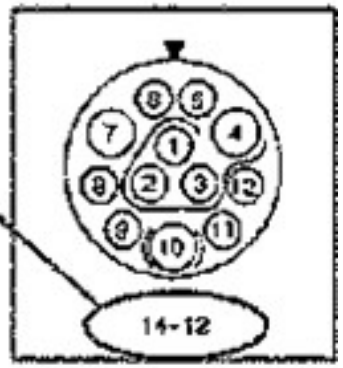
Example: Searching for Circular Connectors type (2)

Insert Configuration	Contact Cavity		Reference
	Count	Size	
14-12	3	16	Figure 65
	9	20	
14-15	15	20	Figure 66

Contact Size	Contact Type	Finish	Boeing Standard	Color Code	
				Band	Color
Contact Type 2020	Pin	Rhodium	BACC47CN1	1	Red
		Gold	BACC47CN1A	1	Red
		Localized Gold	BACC47CN1S	1	Red
				2	Black
	Socket	Gold	BACC47CP1A	1	Red
		Localized Gold	BACC47CP1S	1	Red
				2	Black
		Rhodium	BACC47CP1T	1	Red

Wire Size (AWG)	Contact Size	Crimp Tool				
		Basic Unit		Locator		Code
		Part Number	Setting	Part Number	Color	
20	2020	M22520/1-01	4	M22520/1-02	Red	F
		M22520/2-01	7	M22520/2-02	-	E
	1610	M22520/1-01	5	M22520/1-02	Blue	L
	1212	M22520/1-01	6	M22520/1-02	Yellow	M

Crimp Tool Selection



Insert Configuration

Exercise

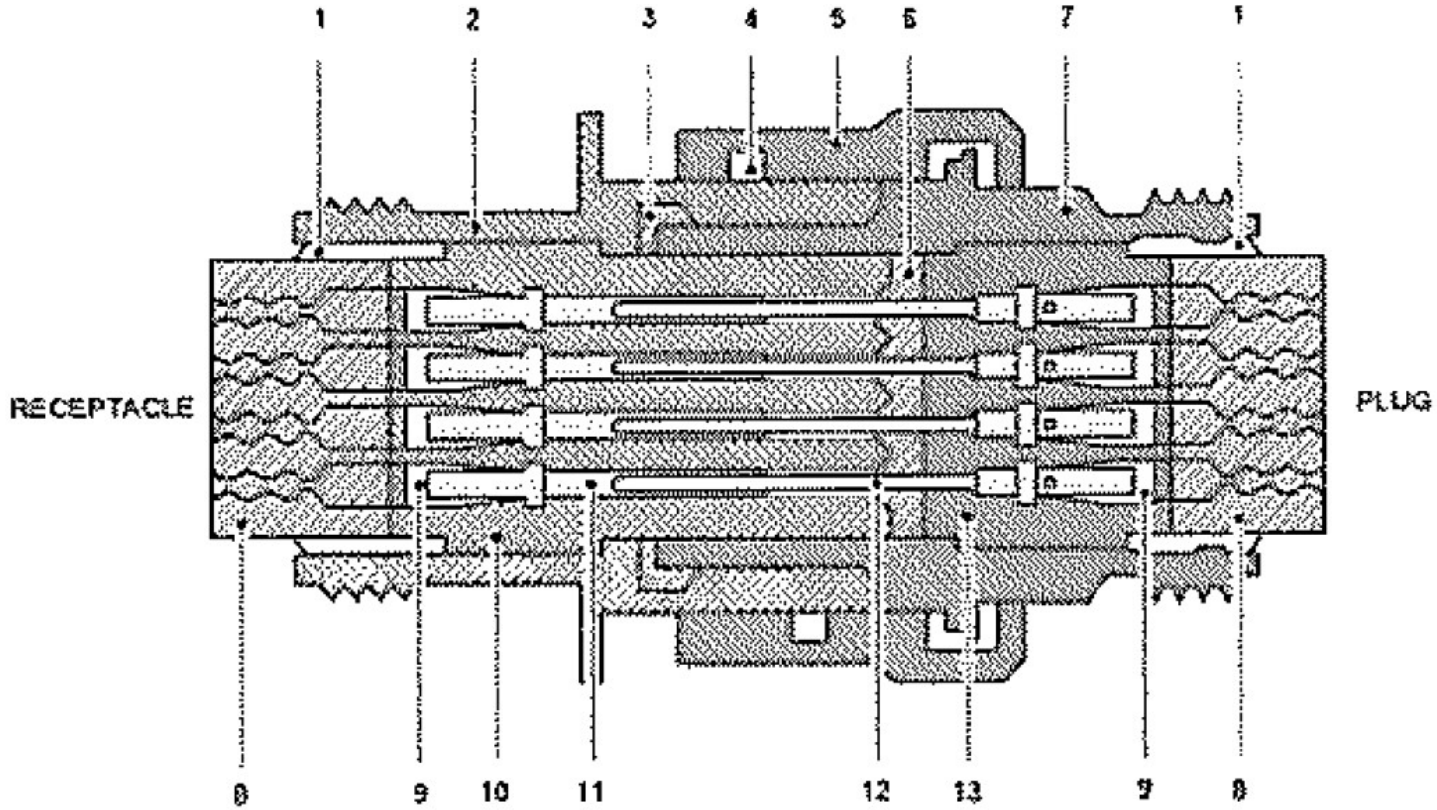
On a B767 aircraft, a connector was found damage. The details are as follow:

- Equipment Number: D5028P
- Connector Part Number: ZZY-A012D18-14P
- Damage: Pin #10 is bent

Identify the following from the SWPM:

- Contact size
- Contact part number
- Recommended crimp tool & insertion tools

Circular Connectors

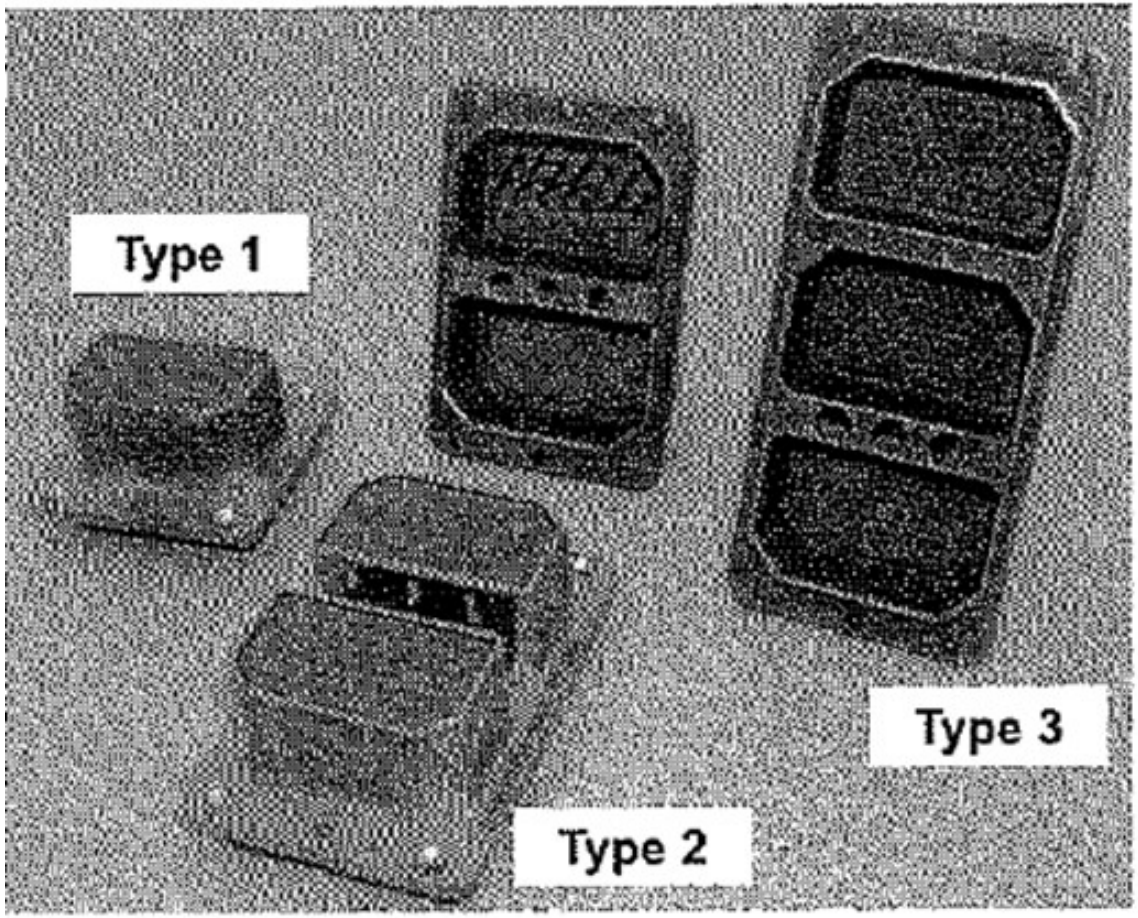


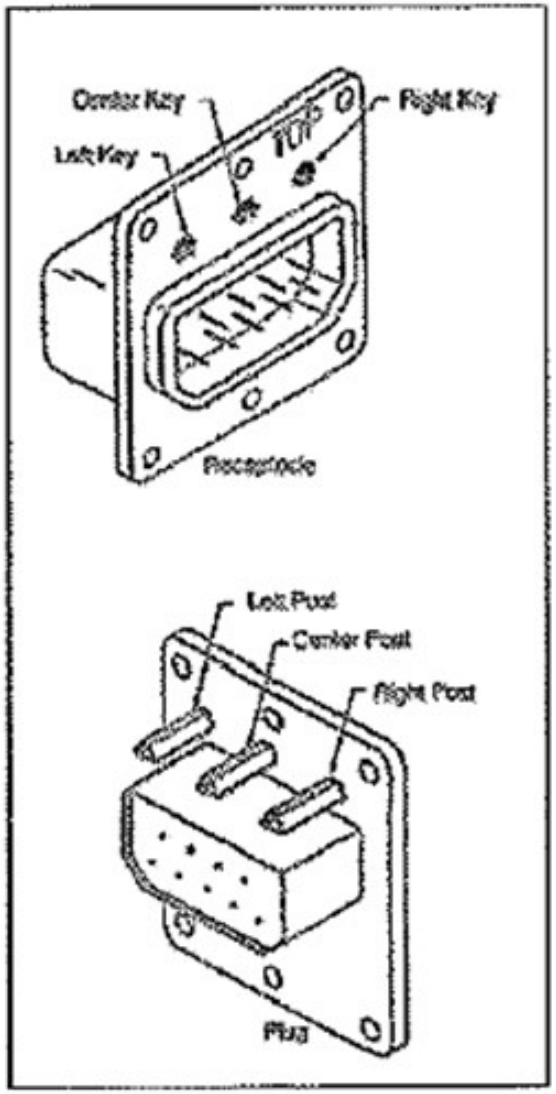
1 - SEALANT
2 - RECEPTACLE SHELL/HOUSING
3 - SEAL
4 - LOCATING PLUG
5 - COUPLING NUT
6 - INTERFACE SEAL
7 - PLUG SHELL/HOUSING
8 - REAR SEAL OR GROMMET
9 - CONTACT RETENTION CLIP
10 - FEMALE INSULATOR
11 - FEMALE (SOCKET) CRIMP CONTACT
12 - MALE (PIN) CRIMP CONTACT
13 - MALE INSULATOR

Circular Connectors

DAMAGE CASES	DAMAGE ASSESSMENT	REPAIR SCHEME
REAR SEAL OR GROMMET	- TORN - NICKED - CRACKED	REPLACE THE CONNECTOR
SHELL OR HOUSING	- CRACKED - CHIPPED - BROKEN - BACK THREADS DAMAGED	REPLACE THE CONNECTOR
HARD INSULATOR	-CRACKED -CHIPPED	REPLACE THE CONNECTOR
INTERFACES OR COUPLING SEAL	- TORN	REPLACE THE CONNECTOR
CONTACT RETENTION CLIP	- TURNED OVER - BROKEN - POOR LOCKING	REPLACE THE CONNECTOR
LOCATING DEVICE	- DISTORTED - BROKEN - WORN	REPLACE THE CONNECTOR
LOCATING DEFECTIVE	-INOPERATIVE	REPLACE THE DEFECTIVE CONNECTOR (MALE OR FEMALE)= (PIN OR SOCKET)
CONNECTOR CONTAMINATOIN BY	- FLUID - DUST	REF. CLEANING PROCESS CHAPTER
BLANKING PLUG/ PROTECTIVE COVER	-LOST	INSTALL BLANKING PLUG

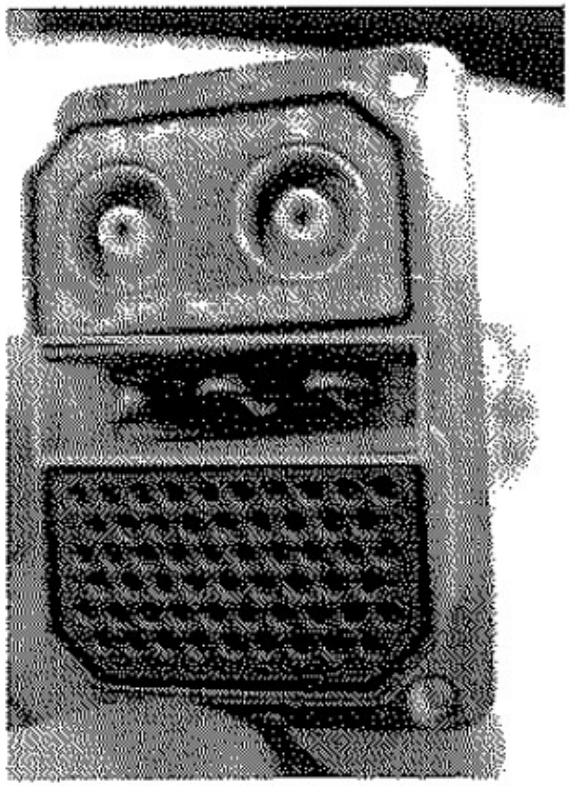
Rectangular Connectors





Rectangular Connectors

Rectangular Connectors



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STANDARD WIRING PRACTICES MANUAL

ITT CANNON DPX, DPD, AND DPA CONNECTORS

B. DPX Connectors

POLARIZATION POST POSITIONS
Figure 134

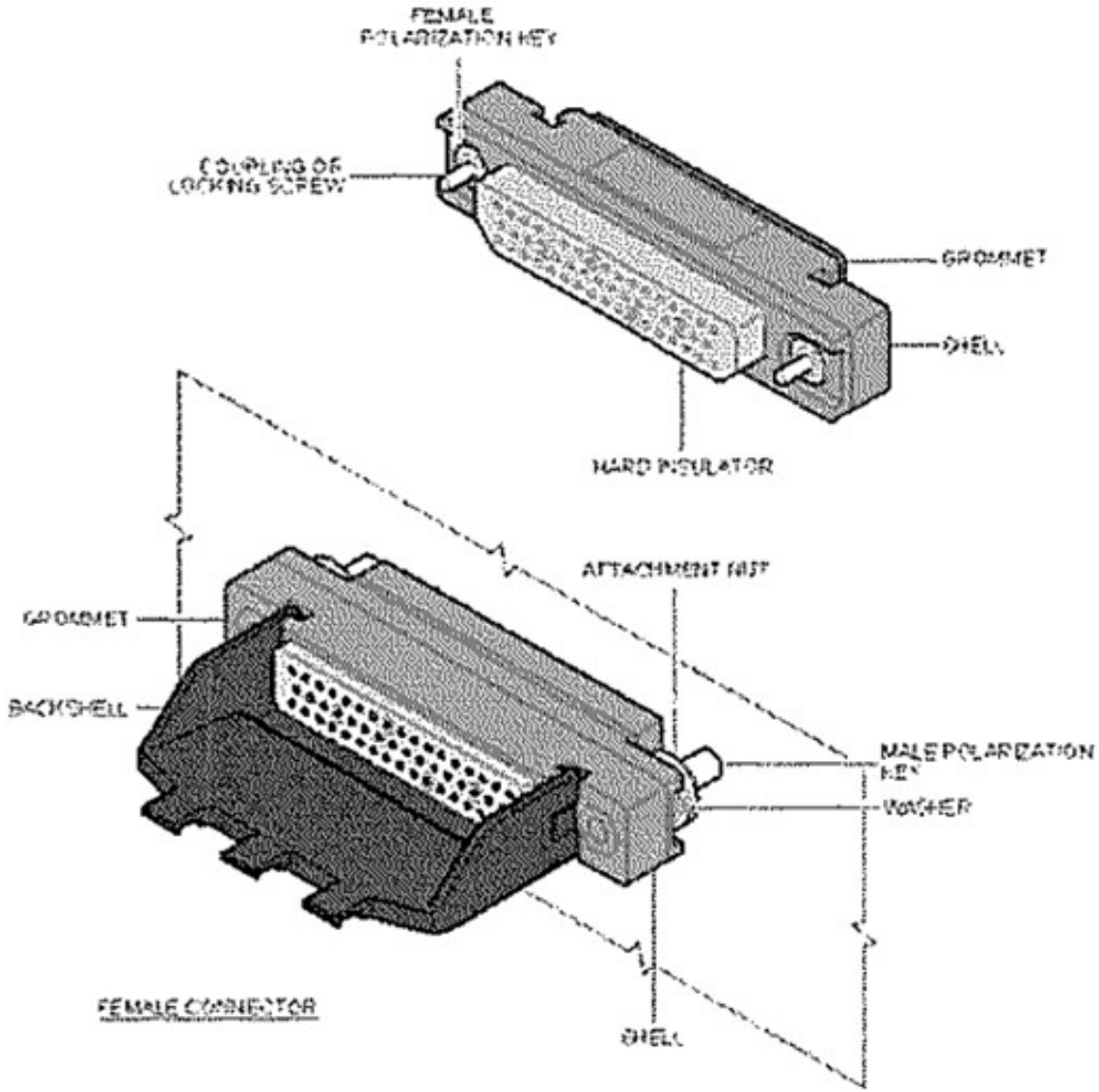
NOTE: For the plug, the dark area shows the polarization post. For the receptacle, the dark area shows the solid part of the polarization key

Table 56
CONNECTOR POLARIZATION - POST AND KEY POSITIONS

Code	Receptacle Shell Key			Plug Shell Post		
	Left	Center	Right	Left	Center	Right
01	4	4	3	1	1	1
02	4	4	3	2	1	1
03	4	4	2	3	1	1
04	4	4	1	4	1	1
05	4	4	6	5	1	1
06	4	4	5	6	1	1

Connector Polarization

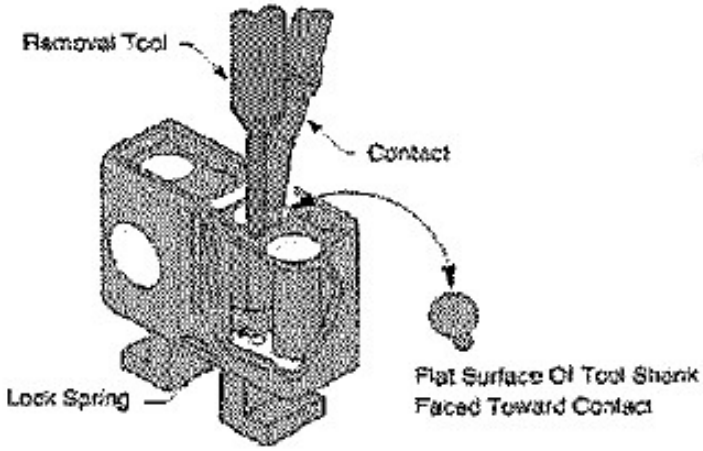
Rectangular Connectors



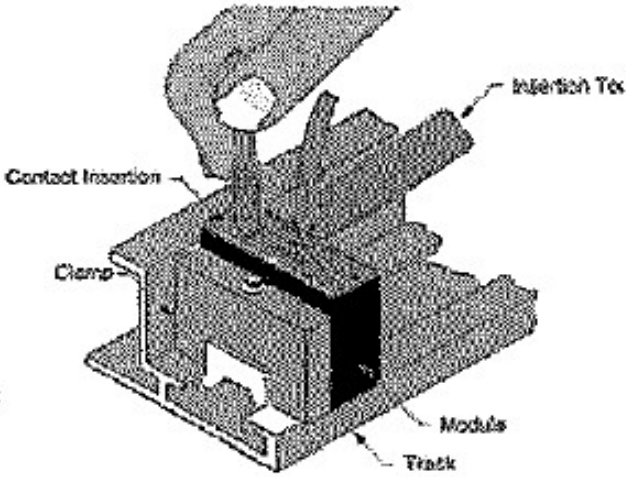
Rectangular Connectors

DAMAGE CASES	DAMAGE ASSESSMENT	REPAIR SCHEME
REAR SEAL OR GROMMET	- TORN - NICKED - CRACKED	REPLACE THE CONNECTOR
SHELL OR HOUSING	- CRACKED - CHIPPED - BROKEN - BACK THREADS DAMAGED	REPLACE THE CONNECTOR
HARD INSULATOR	- CRACKED - CHIPPED	REPLACE THE CONNECTOR
INERFACES OR COUPLING SEAL	- TORN	REPLACE THE CONNECTOR
CONTACT RETENTION CLIP	- TURNED OVER - BROKEN - POOR LOCKING	REPLACE THE CONNECTOR
LOCATING DEVICE	- DISTORTED - BROKEN - WORN	REPLACE THE CONNECTOR
LOCATING DEFECTIVE:	- INOPERATIVE	REPLACE THE DEFECTIVE CONNECTOR (MALE OR FEMALE)= (PIN OR SOCKET)
CONNECTOR CONTAMINATOIN	- FLUID - DUST	REF. CLEANING PROCESS CHAPTER
BLANKING PLUG/ PROTECTIVE COVER	- LOST	INSTALL BLANKING PLUG

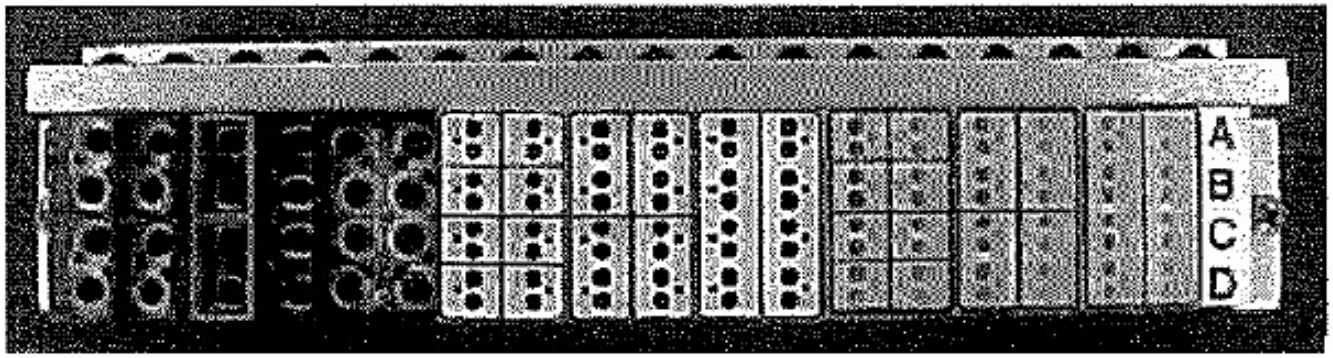
Terminal Blocks



CONTACT REMOVAL



CONTACT INSERTION



Terminal Blocks

S280W555 – ()

Basic Number

Configuration Details

16 = Ground Module with Size 14 Contact Cavities
16S = Ground Module with Size 14 Contact Cavities
20 = Ground Module with Size 16 Contact Cavities
1() = Terminal Module with Size 16 Contact Cavities
2() = Terminal Module with Size 14 Contact Cavities
4() = Electronic Rack Ground Module with Size 16 Contact Cavities
5() = Track with Ground Module with Size 16 Contact Cavities
6() = Track
700 to 749 = Resistor Module
750 to 799 = Diode Module

S280W555-() TERMINAL JUNCTION SYSTEM PART NUMBER STRUCTURE

RB ()X ()–X

Basic Number

Part Type

Configuration

GB = Ground Module
TB = Terminal Module
MT = Track
GT = Ground Track
R = Resistor Module
D = Diode Module

BURNDY TERMINAL JUNCTION SYSTEM PART NUMBER STRUCTURE

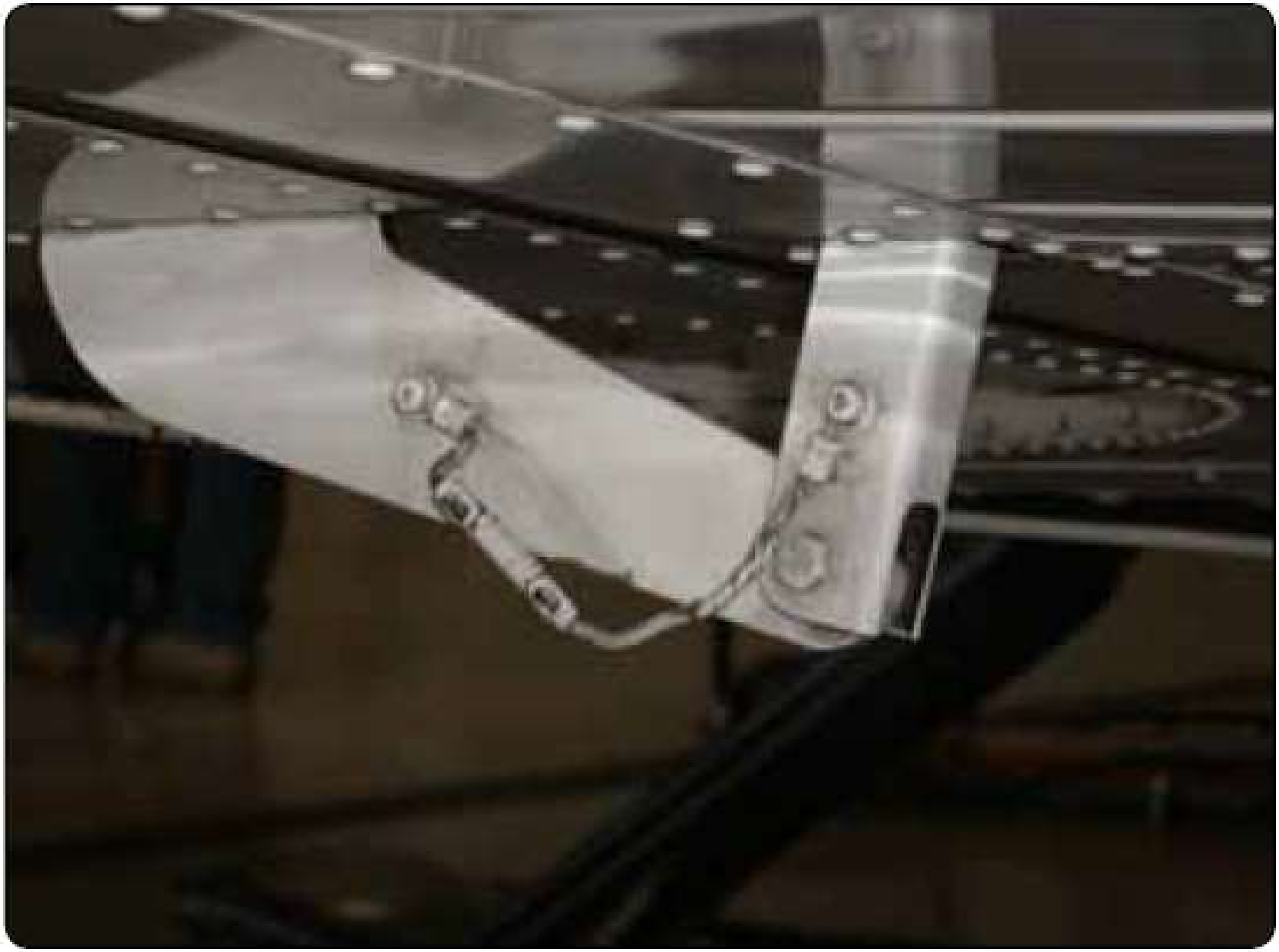
Terminal Blocks

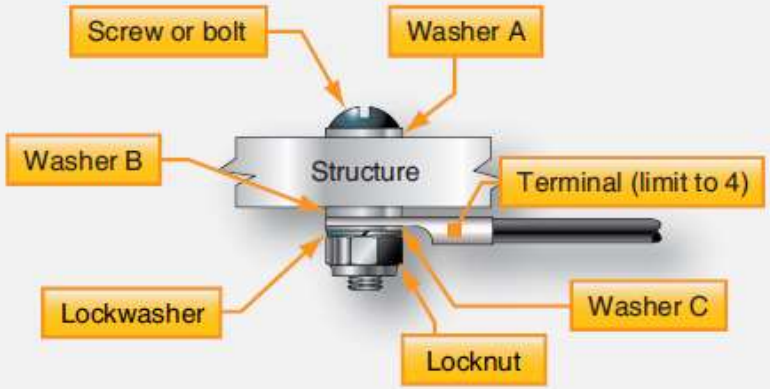
According to ESPM, if a terminal block, either modular or non-modular terminal was found not in the correct condition, it must be replaced with a component with the same P/N or with an equivalent P/N.

DAMAGE CASES	DAMAGE ASSESSMENT	REPAIR SCHEME
INSULATING BODY	- CRACKED - CHIPEED - BROKEN - ATTACHMENT DAMAGED	REPLACE THE GROUNDING MODULE
CONTACT RETENTION CLIP	- TURNED OVER - BROKEN - POOR LOOKING	REPLACE THE GROUNDING MODULE
SEAL	- DAMAGED - LOST	CHANGE TIE SEAL

Ground Wires

Bonding Jumpers





Structure	Screw or bolt and nut plate	Locknut	Washer A	Washer B	Washer C
Aluminum Terminal and Jumper					
Aluminum alloys	Cadmium-plated steel	Cadmium-plated steel	Cadmium-plated steel or aluminum	None	Cadmium-plated steel or aluminum
Magnesium alloys	Cadmium-plated steel	Cadmium-plated steel	Magnesium-alloy	None or magnesium alloy	Cadmium-plated steel or aluminum
Cadmium-plated steel	Cadmium-plated steel	Cadmium-plated steel	Cadmium-plated steel	Cadmium-plated steel	Cadmium-plated steel or aluminum
Corrosion-resisting steel	Corrosion-resisting steel or Cadmium-plated steel	Cadmium-plated steel	Corrosion-resisting steel	Cadmium-plated steel	Cadmium-plated steel or aluminum
Tinned Copper Terminal and Jumper					
Aluminum alloys	Cadmium-plated steel	Cadmium-plated steel	Cadmium-plated steel	Aluminum alloys[2]	Cadmium-plated steel
Magnesium alloys[1]					
Cadmium-plated steel	Cadmium-plated steel	Cadmium-plated steel	Cadmium-plated steel	none	Cadmium-plated steel
Corrosion-resisting steel	Corrosion-resisting steel or cadmium-plated steel	Cadmium-plated steel	Corrosion-resisting steel	none	Cadmium-plated steel

[1]Avoid connecting copper to magnesium.
[2]Use washers with a conductive finish treated to prevent corrosion, such as AN960JD10L.

Grounding Modules

DAMAGE CASES	DAMAGE ASSESSMENT	REPAIR SCHEME
INSULATING BODY	- CRACKED - CHIPEED - BROKEN - ATTACHMENT DAMAGED	REPLACE THE GROUNDING MODULE
CONTACT RETENTION CLIP	- TURNED OVER - BROKEN - POOR LOOKING	REPLACE THE GROUNDING MODULE
SEAL	- DAMAGED - LOST	CHANGE TIE SEAL

Pressure Seals

DAMAGE CASES	DAMAGE ASSESSMENT	REPAIR SCHEME
REAR SEAL OR GROMMET	- TORN - NICKED - CRACKED	REPUCE THE CONNECTOR
SHELL OR HOUSING	- CRACKED - CHIPPED - BROKEN -BACK THREADS DAMAGED	REPLACE THE CONNECTOR
HARD INSULATOR	- CRACKED - CHIPPED	REPUCE THE CONNECTOR
CONNECTOR CONTAMINATION BY	- FLUID - DUST	REF. CLEANING PROCESS CHAPTER

Good Practice

When performing maintenance, repair, or alternation on or around aircraft EWIS, keep in mind:

protect, clean as you go

Reference

- EASA AMC 20-21, 20-22 and 20-23
- FAA AC 120-94
- Alteon "Airplane Wiring Systems”

END