

**AIPS**  
**Airbus Process Specification**

**Manufacturing and installation of cable harnesses**

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## 1 Scope

This Airbus Process Specification defines the Engineering requirements for the manufacturing and installation of cable harnesses.

This specification does not give detailed instructions; these are given in the Process Instructions (PI) / Airbus Process Instruction (API) and the Work Instructions.

This specification shall not be used as an inspection document.

The Definition Dossier is the technical reference. Where a conflict exists between this document and Definition Dossier, information given by the Definition Dossier shall take precedence.

It shall be applied when mentioned in the relevant standard, material specification or Definition Dossier but shall not precedence the harness routing defined in the Definition Dossier.

## 2 Normative references

Only normative references cited in the text are listed hereafter.

The latest issue of the publication referenced shall be used.

A1091	Airbus requirements for the management of hazardous substances.
ABS0678	Aerospace series – Support Cable.
ABS0887	Aerospace series – Braided conduit lightweight PEEK unequipped or braided with or without mechanical protection.
ABS1088	Aerospace series – Bracket, cable asymmetric.
ABS1105	Aerospace series – Pin, special, for insulation blankets.
ABS1144	Aerospace series – Bracket, cable separator, combinable.
ABS1339	Aerospace series – Clamp, plastic with rubber cushion.
ABS1378	Aerospace series – Seal, pressure, conductive, for electrical cables, Operating temperatures -55 °C to +105 °C.
ABS1526	Aerospace series – Spacer, double, for cable bundle.
ABS1571	Aerospace series – Seal, pressure, conductive composite for electrical cables, operating temperatures -55°C to +105°C.
ABS2031	Aerospace series – Pin, fire resistant.
ABS2195	Aerospace series – Clamp - attachment, plastic.
AIPS01-02-008	Airbus Process Specification – Torque tightening of screws, bolts and nuts.
AIPS02-04-001	Airbus Process Specification – Application of corrosion preventive temporary protective compounds.
AIPS07-01-002	Airbus Process Specification – General requirements for the insertion and extraction of removal contacts in electrical connecting systems.
AIPS07-01-003	Airbus Process Specification – Cables tying.
AIPS07-01-004	Airbus Process Specification – Tightening procedures for electrical equipment.
AIPS07-01-006	Airbus Process Specification – Electrical bonding.
AIPS07-01-009	Airbus Process Specification – Attachment of cables in backshell of connectors.
AIPS07-01-013	Airbus Process Specification – Shielded overbraiding of electrical harnesses developed for A380 Program.
AIPS07-01-014	Airbus Process Specification – Shielded lightweight conduits, manufacturing and production assembly instructions for electrical cable harnesses.
AIPS07-01-022	Airbus Process Specification – Installation of ESN flexible junctions, cables and raceways
AIPS07-01-024	Airbus Process Specification – Installation of Raceways in Wings

AIPS07-02-001	Airbus Process Specification – General requirements for the stripping of electrical cables.
AIPS07-05-005	Airbus Process Specification – Assembly and connection of rail mounted terminal modules NSA937901.
AIPS07-05-042	Airbus Process Specification – Installation of cables brackets and supports.
AIPS07-05-046	Airbus Process Specification – Assembly process of pressure seal ABS1378.
AIPS07-05-050	Airbus Process Specification – Assembly and connection of terminal blocks.
AIPS07-05-062	Airbus Process Specification – Assembly process for pressure seals ABS1571.
AIPS07-06-002	Airbus Process Specification – Identification and marking on electrical installations.
AIPS07-07-002	Airbus Process Specification – Installation of flexible textile sleeves ABS0125, ABS0596-003, ABS1552, ABS2413, ABS2418, ASNE0559 and EN6049-033 to EN6049-009 for external protection of electrical cables.
AIPS07-07-004	Airbus Process Specification – Drainage of conduits NSA935805, NSA935806, ASNE0432 and ABS0887.
AIPS07-07-005	Airbus Process Specification – Installation of wrap around electrical sleeving EMI protection EN4674-003 and EN4674-004.
AIPS07-07-007	Flexible Fishnet Sleeve ABS1867 for electrical tying
AIPS07-08-003	Airbus Process Specification – Allowed tolerances on electrical installation for A380 and A400M Programs.
AIPS07-08-004	Airbus Process Specification – Repair of electrical cables.
AIPS07-08-005	Airbus Process Specification – Cleaning of electrical components.
AIPS07-08-006	Airbus Process Specification – Allowed tolerances on electrical installations for A350 Program.
AIPS07-10-001	Airbus Process Specification – Brazing of electrical connections
AS21919	Clamp, loop type, cushioned support.
ASNA5107	Tape – Reinforced silicone, self-adhesive.
ASNE0432	Conduit – Electrical flexible lightened tight bend radius.
ASNE0688	Spacers for cable bundles.
EN9103	Aerospace series – Quality management systems - Variation management of key characteristics.
NSA5510	Supporting plates and locking type fasteners for control units and miscellaneous.
NSA5516	Clamp – attachment, protected.
NSA8420	Tape – lacing, wiring and tubing.
NSA935805	Conduit – electrical, flexible, with normal bend radius.
NSA935806	Conduit – electrical, flexible, with tight bend radius.
RTCA DO-160	Environmental Conditions and Test Procedures for Airborne Equipment.

### 3 Definition, applicability and limitations

#### 3.1 Definition

**Table 1: Definitions**

Term	Definition
Arcing	<p>A phenomenon of electrical origin generating an over current (with or without an electric arc), which causes local deterioration of one or more cables (conductor and insulation) by thermal effect.</p> <p>The origin of this phenomenon is direct contact:</p> <ul style="list-style-type: none"> <li>- between at least two conductors (cable core)</li> <li>- of a conductor with the structure</li> <li>- with different electric voltages.</li> </ul> <p>The over current then appears in the damaged circuit thus causing the protection device located upstream (circuit-breaker, fuse, ...) to trip.</p> <p>The duration is a few milliseconds to a few tenths of a second.</p>
Attachment device	All the means used to attach harnesses (e.g.: Clamp, V-support, etc.). Attachments on ramp or backshell are considered as an attachment mean too.
Bracket	Fixed supports for harness attachment.
Bundle	Group of wires/cables tied together.
Cable	Two or more insulated conductors contained in a common covering, or two or more insulated conductors twisted or moulded together without a common covering.
Electrical protection	Protection (i.e.: conduit, sleeve or other device) qualified to contain an internal and/or external electrical shock (e.g.: short-circuit, arcing). These protections could also be used as mechanical protection (e.g.: PTFE conduits).
EMI protection	Protection (i.e.: shielding or other device) qualified to protect electrical wire, cables or bundles against Electro-Magnetic Interference.
Fire area	Area exposed to risk of fire (e.g.: 2D fire zone).
Fuel Vapour Zone	Fuel Vapour Zone (RTCA DO-160): "An environment in which flammable mixtures could be expected to occur as a result of a fault causing spillage or leakage and where an explosive atmosphere may be present".
Harness	Group of bundles.
Hazardous area	Area exposed to fluid ingress.
Hot area	Area exposed to temperature that could exceed 120°C.
Hydraulic area	Area where hydraulic liquid could be present (e.g.: hydraulic bay).
Localised Area	Restrictive area where the basic segregation rules (regarding dedicated routing & distance) could not be observed due to space or industrial constraints.
Mechanical protection	Protection (i.e.: conduit, sleeve or other device) qualified to limit external aggressions and to avoid direct chafing on the electrical wiring.
Short-circuit	Over-current (with or without an electric arc), which causes local deterioration of one or more cables (conductor and insulation) by thermal effect. The origin is generally a direct contact between at least two conductors (cable core) or of a conductor with the structure with different electric voltages. The short-circuit duration is short (a few milliseconds to a few tens of a second). Deterioration depends on the power flowing in the circuit. Cable damage generally does not exceed 50 mm (25 mm on either side of the defect point).

Term	Definition
Tying	Is a mean to attach cables together (with or without conduit), between attachment devices.
Un-pressurised not protected area	Un-pressurised area (without protective device) exposed to external hazards, such as the wing leading edge.
Un-pressurised protected area	Un-pressurised area (with protective device) excluding external hazards, such as Section 19.
Vibration area	Area exposed to high vibration phenomena, such as the pylon
Wire	Single means of electrical interconnection consisting of a conductor within an insulating surround.

Table 2: Nomenclature / Abbreviations

Abbreviation	Meaning
ABB	Adhesive Bonded Bracket
ABS	Airbus Standard
A/C	Aircraft
AC	Alternating Current
AFDX	Avionics Full Duplex Ethernet Switched
AIPS	Airbus Process Specification
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio INC
ASN	Aerospatiale Norme
ATA	Air Transport Association of America
AWG	American Wire Gauge
CAN	Controler Area Network
CDS	Component Delivery Specification
DC	Direct Current
EFCS	Electrical Flight Control System
e.g.	For example
EIRD	Equipment Installation Requirements Document
EMC	Electro Magnetic Compatibility
ESN	Electrical Structure Network
ESPM	Electrical Standard Practices Manual
FIN	Functional Item Number
FOD	Foreign Object Damage
FTI	Flight Test Installation
i.e.	That is
LH	Left hand
MIL	Military Standard
MMEL	Master Minimum Equipment List

Abbreviation	Meaning
MS	Military
N/A	Not applicable
NSA	Norme Sud Aviation
OBB	Over Braided Bundle
PTFE	Poly Tetra Fluoro Ethylene
SWAMP	Severe Wind And Moisture Problem
TDD	Technical Design Directives
TN	Technical Note
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VOC	Voltage Open Circuit
VU, VN, VT, VC, VG, VP, VH	Electrical Reference

### 3.2 Applicability and limitations

This Airbus specification is applicable when invoked by the Definition Dossier directly or through another document for the purpose given in the scope. When processing to AIPS07-01-001 is required, it shall be invoked on the Definition Dossier by the words "AIPS07-01-001 – Manufacturing and installation of cable harnesses".

## 4 Engineering requirements

Engineering requirements are minimum requirements specified by Responsible Engineering to ensure optimal performance of the manufacturing process.

All Engineering requirements have to be met and controlled in production.

### 4.1 Performance Requirements

Manufacturing and installation of cables harnesses shall be in accordance with design office Definition Dossier.

For installation purposes, AIPS07-08-003 for A380 and A400M Programs and AIPS07-08-006 for A350 Program could be applied where required in the Definition Dossier.

The segregation between routes defined on the Definition Dossier shall be observed along the complete route. When retrofitting (adding cables) on aircraft, segregations shall be observed.

### 4.2 General precautions

Precautions to be taken:

- Do not step, sit or lie on the bundles.
- When bundles are moved, they shall be carried and not dragged (manually or using a handling system). Protect sharp edges and through holes with foam or non-abrasive plastic fittings when bundles are routed near to or through these on installation.
- Avoid contact between bundles and sharp edges.
- Observe cable minimum bend radius at each manufacturing and installation step.

If the surrounding structure has to be reworked or modified, fit adequate protection over the bundles (sheath, sleeve, etc.) in order to prevent foreign bodies from entering the bundle (especially, under floor installation).

The bundles shall be kept constantly clean. In order to follow this requirement:

- Avoid all contact with hydraulic or cleaning fluids, chips or cutting oils.
- Movable foreign bodies shall be vacuum-cleaned. Traces of oil, hydraulic fluid or sealant shall be thoroughly cleaned off.
- It is forbidden to hang items such as test bundles, torches or any instruments on the bundles.

Cleaning products shall be in compliance with those defined in AIPS07-08-005.

Damaged cables shall be replaced or repaired in accordance with AIPS07-08-004.

There are several categories of products:

- Cables.
- Electrical items.
- Routing items.

All cables shall be identified in accordance with AIPS07-06-002.

The electrical items are all items which are involved in the making of an electric contact or all items related to the connection of a conductor to this electrical contact (e.g.: connectors, terminal blocks, indicator lights, relay bases, sockets, pins, lugs, or shielding terminations, etc.).

The routing items are all items used to attach, tie or make the wiring. Attachment devices, insulating extrusions, raceways, sleeves or conduits used for electrical purposes are included in these products.

The tools and tooling used for the manufacture of bundles shall be suitable for the electrical standard items, and shall be in accordance with the relevant AIP's (see § 2).

Manufacturing tools shall be inspected periodically in compliance with prevailing directives.

The tooling tables used for the manufacture of bundles shall be free from sharp or protruding edges and shall not be made from abrasive materials which may damage the electrical equipment.

### **4.3 Utilization priority, storage and handling rules**

#### **4.3.1 Quality requirements for premises**

The premises used in a permanent way or temporarily for the manufacture or the storage of electrical bundles shall be healthy, free from of high conditions of humidity, heat, grease, dust and FOD.

#### **4.3.2 Components**

All standard items should be stored in their own original packaging until used.

A special care shall be taken in order to segregate aluminium contacts and copper electrical components.

When the manufacturing date code is given, the batches shall be used in the order to use the oldest ones first.

Comply with component time limitations established by the supplier.

It is recommended to not start a new batch until the previous batch has been completely used up.

If several batches are stored together in the same storage area, they shall be clearly identified and distinguished one from an other.



### 4.3.3 Bundles packaging

Bundle packaging shall be such that:

- It does not modify the electrical characteristics of the bundle,
- It prevents all premature ageing and corrosion during storage,
- It does not pull on the cables at the rear of the connectors,
- It prevents from damages,
- It fulfils the relevant CDS's.

Until they are installed, the bundles shall be carefully stored in racks or crates provided for this purpose, away from dust, humidity and mechanical shocks (constantly kept clean).

Special attention shall be taken during storage and manipulation, it is strictly prohibited to fold or suspend bundles.

Harnesses shall be placed on a flat surface.

All end fittings (connectors, ground modules, lugs.... etc.) shall be protected, refer to related AIP's for solutions to be applied.

## 4.4 Technical requirements

### 4.4.1 Harnesses length

For A318/A319/A320/A321 Programs, harness length is under manufacturing responsibility (work-order team).

For all other programs, the design office defines the harness length (included over lengths, drip loops, etc...), in the Definition Dossier.

When a repair affecting the cable length is performed before delivery, a concession shall be raised.

For repair of cables refer also to AIPS07-08-004.

#### 4.4.1.1 Branch length measuring and derivation position reference

Branch lengths references are given in the figure below:

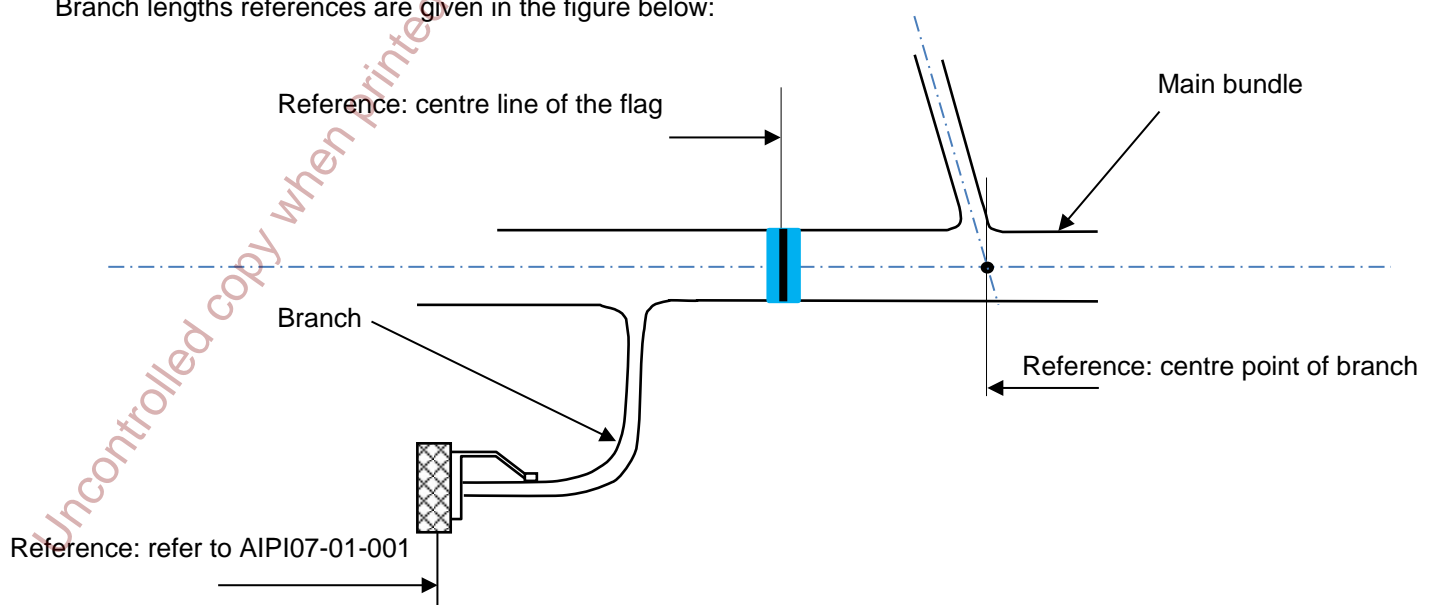


Figure 1: Datums position references

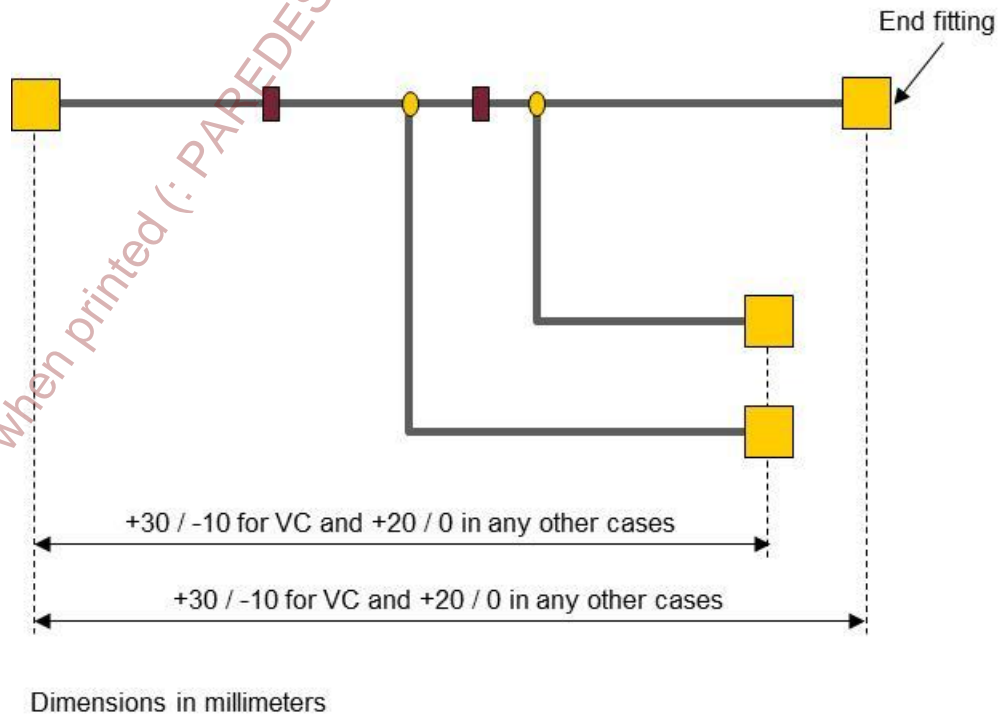
#### 4.4.1.2 Dimensional tolerances of harnesses manufacturing for serial A/C

According to table and figures below.

**Table 3: Dimensional tolerances of harnesses**

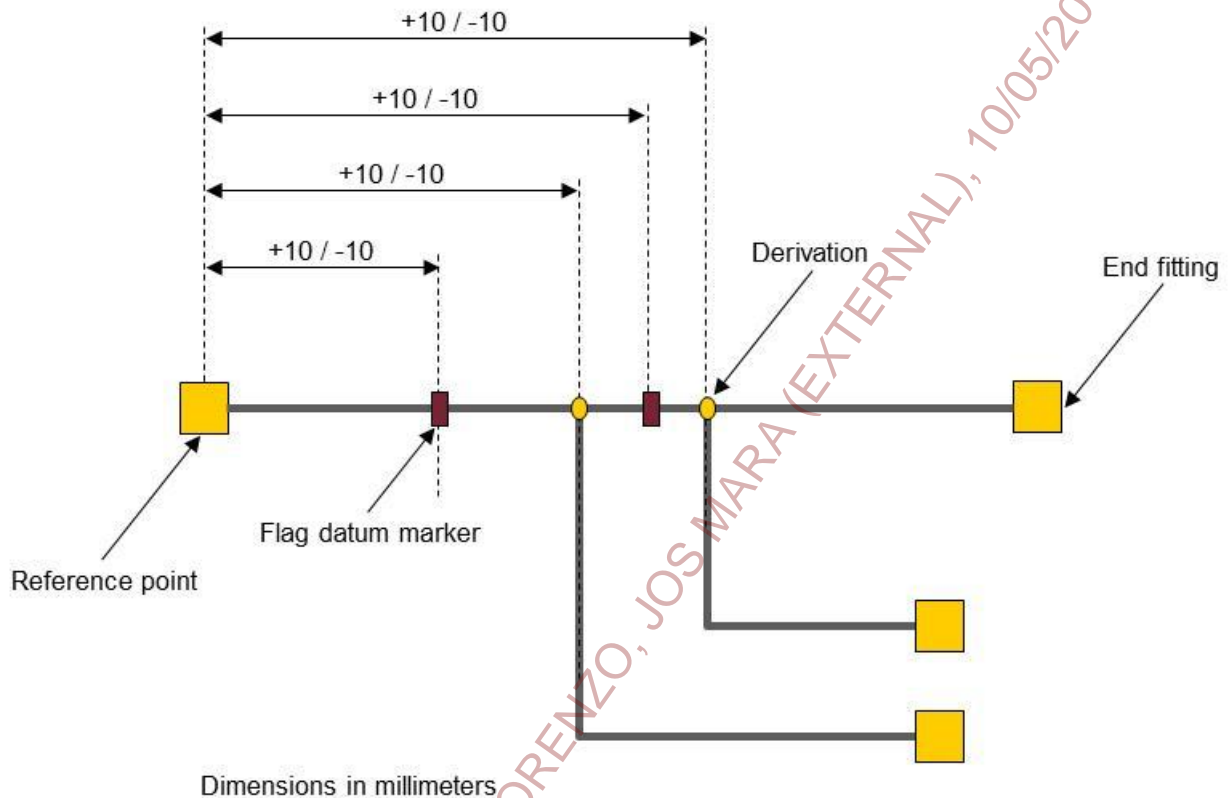
Description		General allowance tolerances	Specific tolerances for OBB	Comments
Between 2 ends	For VC	+ 30 mm - 10 mm	Refer to AIPS07-01-013	The lengths given on Definition Dossier already include over length necessary for cable repair and drip loops with a low point
	Others cases	+ 20 mm 0 mm		
Between 1 reference point and 1 derivation		+10 mm - 10 mm		
Position of flag datum marker regarding reference point (see note)		+10 mm - 10 mm	+10 mm - 10 mm	---

NOTE: When a harness is composed of several branches, tolerance length of each branch shall not affect the tolerance length between two ends provided in table above.



There shall be one reference point per harness. This could be either one end or one flag datum marker.

**Figure 2: Tolerances applicable to harness lengths**



**Figure 3: Tolerances applicable to flag datum markers and to derivations**

#### 4.4.2 Connector

##### 4.4.2.1 Electrical termination manufacturing

###### 4.4.2.1.1 Cutting cables

The cutting tool shall not modify the initial characteristics of the cable.

###### 4.4.2.1.2 Stripping cables

For stripping cables refer to AIPS07-02-001.

###### 4.4.2.1.3 Crimping contacts on cable

The crimping of contacts on cables is defined in the AIPS's related to contacts.

###### 4.4.2.1.4 Brazing contact on cable

For solder contacts on cable refer to AIPS07-10-001.

###### 4.4.2.1.5 Insertion/extraction of removable contacts

It is standard practice for the operator to check that, whenever a contact is inserted, it is locked in its cavity.

Refer to AIPS07-01-002.

#### 4.4.2.1.6 Twisted cables

In order to:

- Facilitate connection,
- Respect cable bend radii,
- Avoid stress at connection level,
- Improve the check made on the contact locking,

twisted cables shall be untwisted before connecting to connectors or modules.

For twisted routes, untwisting length shall respect the untwisting length given in the Definition Dossier / relevant AIPS's.

#### 4.4.3 Backshell

Backshell is acting as a strain relief and shall insure that:

- No stress could occur on contacts,
- Conduits are sufficiently maintained.

##### 4.4.3.1 Backshell orientation

Backshell orientation shall be in accordance with the Definition Dossier.

##### 4.4.3.2 Conduit termination on backshell

Conduits (convoluted, split or shrink) shall be attached to the backshell.

The termination of the conduit shall not make contact with the connector grommet:

- For conduit, refer to AIPS07-07-002 and AIPS07-07-005.
- For over braided bundles, refer to AIPS07-01-013 and AIPS07-01-012.
- For shielded conduit, refer to AIPS07-01-014.

#### 4.4.4 Protection of connections

##### 4.4.4.1 Insulation and protection of contacts

When crimped end fittings are not inserted into the connection, they shall be protected.

Connection items in full provision shall be sealed and protected.

##### 4.4.4.2 Unused connectors/stowage connectors

When connectors are unused, they shall be protected (e.g.: protective cap/stowage connector) in accordance with Definition Dossier.

##### 4.4.4.3 Insulation of terminals lugs

Insulation of terminal lugs is described in the relevant AIPS's.

##### 4.4.4.4 Sealing of connector

The outer diameter of the cable shall be adapted to the grommet cavity diameter. A shrink sleeve may be applied in order to comply with this requirement.

When sealing of connection is required by design office (e.g.: "E" code as defined in the relevant document) the following principles defined in table below shall be applied.

**Table 4: Use of sealing plugs and dummy/male contacts**

Program	Non sealed connection (e.g.: without "E" code)		Sealed connection (e.g.: with "E" code)	
	Sealing plugs	Dummy contacts or male contacts	Sealing plugs	Dummy contacts or male contacts
A318/A319/A320/A321 A330/A340	NO	YES	YES	YES
A380 – A400M	NO	YES	YES	YES
A350	NO	YES	YES (except inside VU)	YES

Dummy or male contact shall be installed on connector side equipped with wired male contacts.

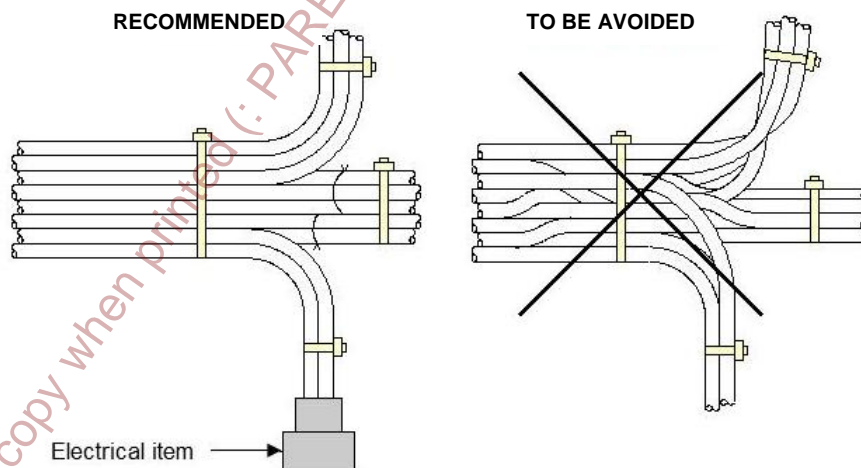
NOTE: For non suitable dummy or male contact refer to AIP107-01-001.

#### 4.4.5 Make-up of bundles

To ease installation and maintenance:

- Cables passing through the bundle shall be avoided,
- Tangled or crossing cables shall be avoided,
- Cables protruding beyond the bundle are unacceptable.

NOTE: Relative movement of cables at crossing level shall be avoided wherever possible; where it could not be avoided cables shall be secured with appropriate tying devices.

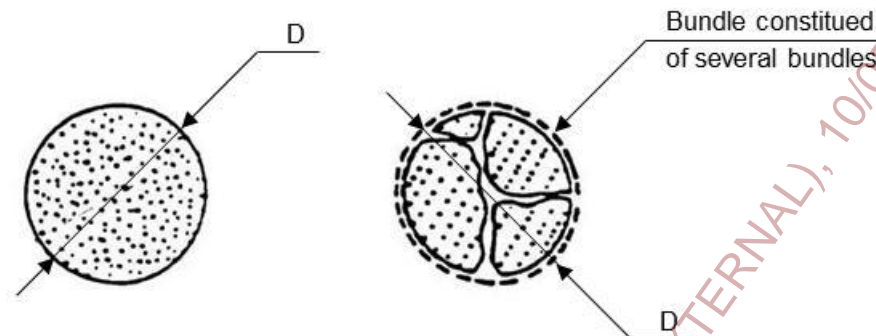
**Figure 4: Bundle combing**

As described in figure above, a particular attention shall be taken for derivations to ensure correct combing.

##### 4.4.5.1 Bundle shape diameter

The final shape of a harness constituted of several branches/cables/bundles shall be as close as possible from a circular shape. This shall be ensured by using tying devices (refer to AIPS07-01-003).

The resulting bundle diameter shall not exceed 50 mm.



**Figure 5: Bundle diameter**

NOTE1: In exceptional cases, bundle diameter could exceed 50 mm with design office specialist agreement.

NOTE2: For bundle shape installed inside raceway, refer to AIPS07-01-022/024.

#### **4.4.5.2 Swelling of bundles**

The diameter variation (difference between minimum and maximum diameter) of a tied bundle composed of same number of cables shall not be greater than 20% of its minimum diameter.

#### **4.4.5.3 Tying of harnesses**

##### **4.4.5.3.1 General use of tying device**

Tying method of harnesses shall be in accordance with the Definition Dossier and environmental constrains.

Tying device shall not damage the tied harness or adjacent harnesses.

Special attention shall be taken in order to avoid mechanical stress at contact level.

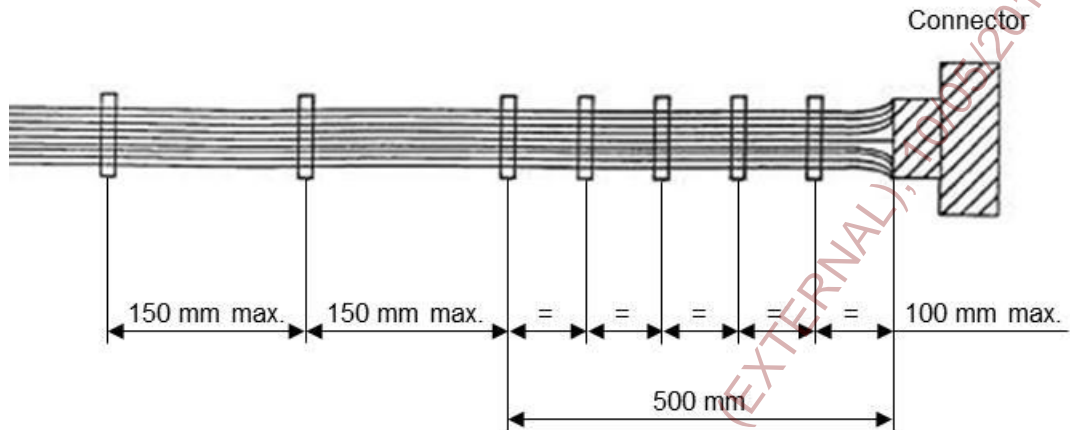
Non aggressive tying device (e.g.: lacing tape) shall be used:

- Where cable to cable tie head contact could occur (e.g.: at confined interface plate areas),
- Inside split conduits where necessary (e.g.: digit F),
- Where cable tie head could reduce the equipment/VU removal (e.g.: head hooked on structure).

##### **4.4.5.3.2 In-line tying**

The bundle shall be tied along its length with specified regular intervals:

- In general the tying device maximum pitch shall be 150 mm see figure below.
- Over 500 mm near connections, the tying device maximum pitch shall be 100 mm. The first tying device (closer to the connector) shall be installed in such a way there is no mechanical stress at connection level see figure below.
- For harnesses installed on ramps the tying device minimum pitch shall be 75 mm.
- For high density routing areas the non-aggressive tying device maximum pitch shall be 50 mm.
- For co-routed bundles at manufacturing level each bundle shall be tied separately with non-aggressive tying device (e.g.: lacing tape) with a 300 mm maximum pitch. The complete resulting harness shall be tied, with a regular pitch of 150 mm maximum.
- For co-routed bundles at installation level on A/C, each bundle shall be tied separately with non-aggressive tying device (e.g.: lacing tape) with a 150 mm maximum pitch. The complete resulting harness shall be tied, between attachment points with a maximum pitch of 300 mm.



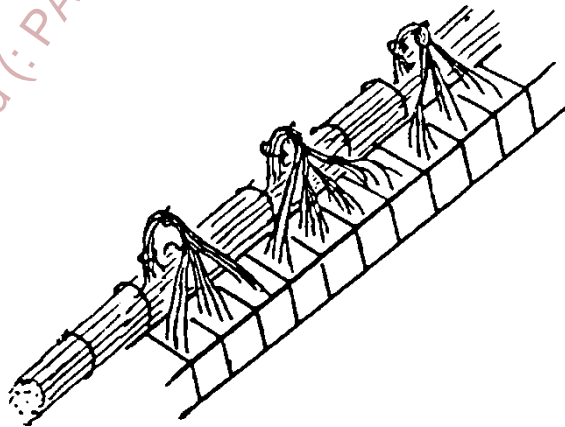
**Figure 6: General pitch for straight bundles**

NOTE 1: In accordance with Definition Dossier in line tying could also be insured by fishnet sleeve refer to AIPS07-07-007.

NOTE 2: The tying device used for securing protection tape and placards could be taken into account in the general pitch of the bundle (excepted for the FIN labels at extremities).

NOTE 3: Tying pitch shall not be used to manage harness slack.

For bundles leading to terminal modules, cables shall be grouped in dedicated derivations in accordance with the Definition Dossier, this grouping should be from 2 to 4 modules. Ungrouping could be accepted in accordance with Definition Dossier.

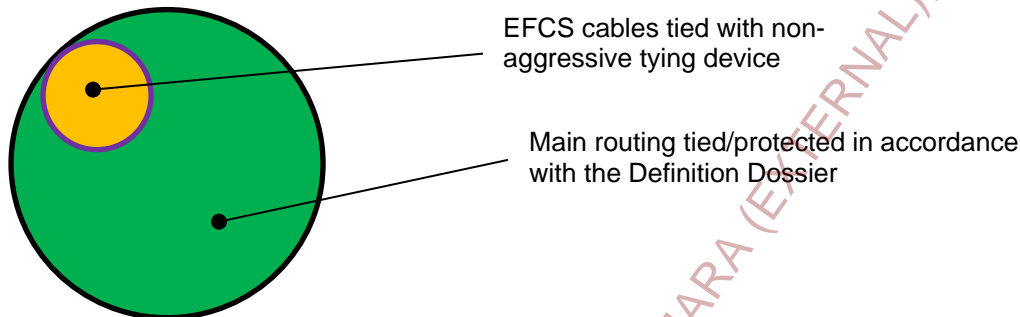


**Figure 7: Tying at VT module level**

#### 4.4.5.4 EFCS bundle

EFCS bundles (digit F), shall be made up and tied separately, and then integrated into the main bundle in accordance with the specifications given in sub-chapter 4.4.5.3.1.

The addition of any EFCS cable on the periphery of the EFCS bundle is prohibited.



**Figure 8: EFCS bundle integration**

NOTE 1: When EFCS cables are installed inside a dedicated conduit they shall not be tied.

NOTE 2: For EFCS on A350 refer to 4.4.7.

#### 4.4.5.5 Twisting

Harnesses should not be twisted in straight sections.

When cable twisting appears at connection level (e.g. due to wrong lug orientation) then a special attention shall be taken in order to avoid:

- Straining of the cable when twisting during connection,
- Stress on connection.

When a bundle acts as a hinge (e.g.: Cargo doors, VU doors...), it shall be twisted (3 or 4 turns/meter max) in order to provide suitable bundle movements clarification in accordance with the hinge kinematic.

#### 4.4.5.6 Small wire tying

Where one or a few number of small gauge cables are included into a bundle made of large gauge cables (e.g.: VOC wire into P-route), the protruding of the small gauge cables shall be avoided.

#### 4.4.5.7 Spare wires

When spare wires are used they shall be protected at each ends.

Spare wire shall be tied on the bundle using non aggressive tying device (e.g.: lacing tape) and respecting the bend radius of the cable.



#### 4.4.6 Assembly of electrical standard items

Electrical standard items installed on cables (e.g.: splices, solder sleeves), shall be easily accessible, visible, identified (in accordance with Definition Dossier), in order to be inspected or replaced.

Contact between two electrical standard items should be avoided.

They shall not be located inside convoluted conduits or inside connector backshells.

NOTE: In exceptional cases, the installation of solder sleeves are allowed inside the closed backshell, in accordance with Definition Dossier.

The electrical standard item shall not be installed too close to the connectors to allow the connection and disconnection of the contacts. Refer to the relevant AIPS's for distances to be respected.

The minimum distance between the rear of the connection and the electrical standard items shall take into account the backshell removal for contact disconnection.

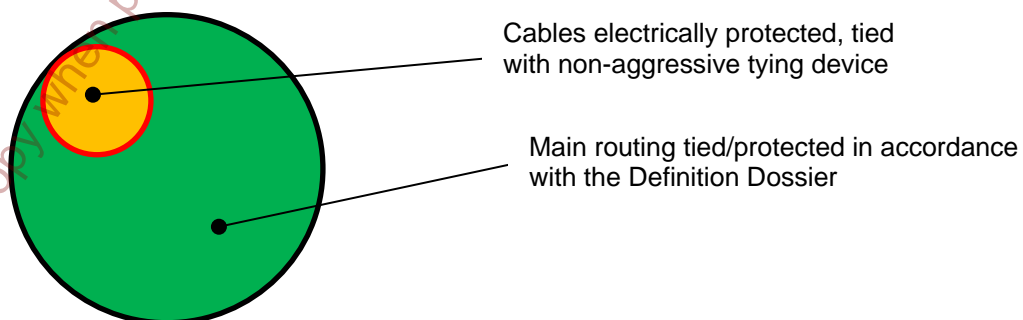
#### 4.4.7 Protection of harnesses

The protections to be applied on main harnesses are described in the Definition Dossier.

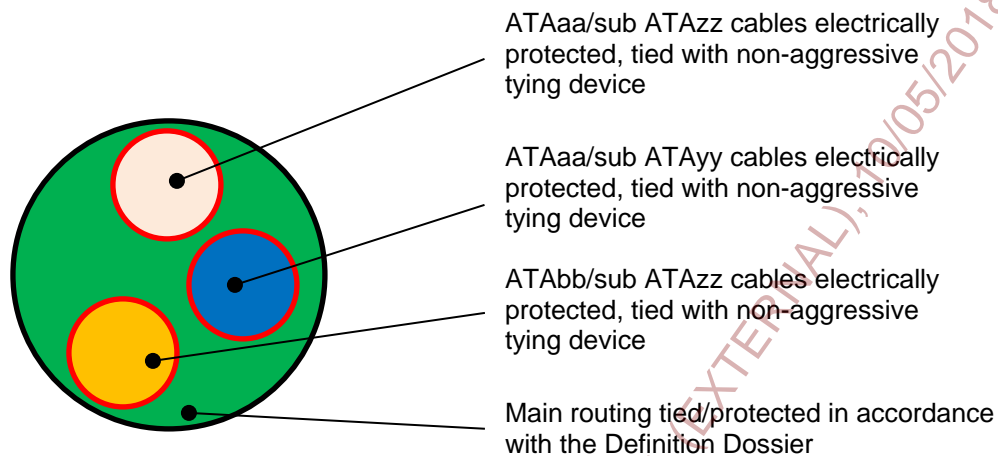
G, Y and V digit routings (e.g.: 1MG, 2MY, 1MV...) shall be individually electrically protected on the entire length (e.g.: by convoluted conduit or open sleeve).

**Table 5: Protection of digitized routes**

Digit	Legacy	A380/A400M	A350
G and Y	Electrically protected Refer to Figure 9	Electrically protected with ATA/Sub ATA partition refer to Figure 10	Electrically protected Refer to Figure 9
V	N/A	N/A	Electrically protected with ATA/Sub ATA partition refer to Figure 10



**Figure 9: Basic partition**



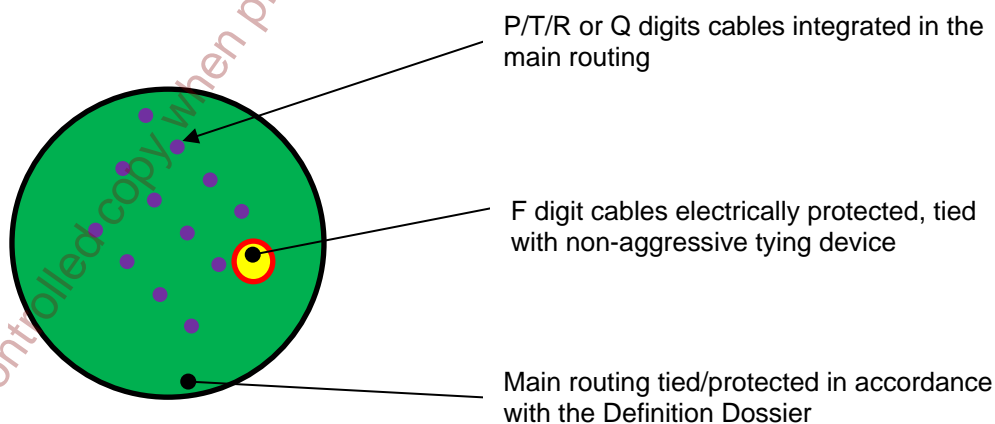
**Figure 10: ATA/sub ATA partition**

For A350 Program, F and X digits should be electrically protected/tied separately.

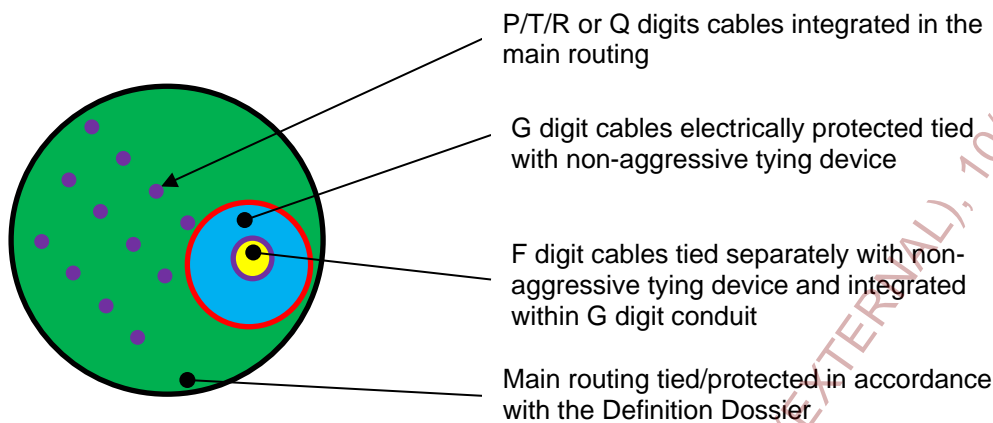
- F digit routed with P, T, R or Q digits shall be electrically protected. F digit could be tied separately and integrated in the G digit conduit,
- X digit shall be electrically protected where co-routed with M routes.

**Table 6: Partition of F and X digits for A350 only**

Digit	Protection
F not routed with P/T/R or Q digits(with or without G digit)	Tied separately refer to Figure 8
F routed with P/T/R or Q digits and without G digit	Electrically protected refer to Figure 11
F routed with P/T/R or Q digits and with G digit	Tied separately and integrated in a G digit conduit refer to Figure 12
X	Electrically protected when co-routed with M route refer to Figure 9



**Figure 11: F routed with P/T/R or Q without G digit**



**Figure 12: F routed with P/T/R or Q with G digit**

NOTE1: Electrical protection is applicable in any condition (even where main routing is electrically protected).

NOTE 2: When EFCS cables are installed inside a dedicated conduit they shall not be tied.

#### **4.4.7.1 Protection by convoluted conduit**

Conduits shall be in one-piece.

Connection of two conduits without joiner is not acceptable.

Each end of PEEK convoluted conduit shall not damage the bundle.

##### **4.4.7.1.1 Closed conduit maximum filling**

Closed conduits shall never be filled above 80% of their inner section. When the length of the conduit exceeds 2 m, filling percentage shall not exceed 60% of their inner section, unless specified in the Definition Dossier.

NOTE: Routes protected by convoluted conduit, for segregation purpose (digits), the section of the convoluted conduit shall be adapted to the bundle diameter.

##### **4.4.7.1.2 Addition of cables inside conduit**

In all closed convoluted conduits, except those shorter than 500 mm and those where all the cables have a disconnectable end (connectors, terminal blocks, etc.), an electrical wire (gauge DR18 copper wire) shall be installed inside the conduit to be used as a draw wire.

##### **4.4.7.1.3 Tying of convoluted conduits**

When conduit is integrated in the bundle, it should be visible and accessible.

#### 4.4.7.1.4 Spare conduit

Spare conduit shall be installed like other conduits:

- With dedicated routing attached inside dedicated attachment devices,
  - Tied with the main bundle and attached with the main bundle attachment devices,
- in accordance with Definition Dossier.

In exceptional cases, in confined areas and in accordance with the Definition Dossier, when spare conduit could not be attached inside attachment devices, the spare conduit could be stopped before the attachment device and attached directly on the bundle.

The main bundle shall be protected at the end of the conduit level.

#### 4.4.7.2 Protection by split conduits

Split conduits shall be installed according to the Definition Dossier and AIPS07-07-002.

#### 4.4.7.3 Protection by shielded conduits or over-braiding bundle

##### 4.4.7.3.1 Shielded bundles or over-braiding bundle

Shielded bundle or over braided bundle shall be installed according to the Definition Dossier and AIPS07-01-013/AIPS07-01-014/AIPS07-07-002/AIPS07-07-005.

##### 4.4.7.3.2 Mechanical protection of cables at conduit extremities

Cables shall be mechanically protected at the ends of

- Shielded conduits
- Rigid conduits
- ABS0887 convoluted conduits

#### 4.4.8 Corrosion protection

In order to avoid any corrosion defect, a corrosion inhibitor AV15 type III shall be applied:

- On shielded conduits ends for A318/A319/A320/A321 and A330/A340 Programs,
- On some electrical components in accordance with Definition Dossier for A380 and A350 Programs.

NOTE1 : When applying inhibitor AV15 type III in accordance with Definition Dossier the application on the adjacent electrical components (harness, connectors,...) is acceptable.

NOTE2 : The corrosion inhibitor shall not be applied in Hot areas.

For corrosion inhibitor application, refer to AIPS02-04-001.

#### 4.4.9 Harnesses installation

Flag Datum Markers and derivations could be positionned with a tolerance of  $\pm 15$  mm during installation, unless specified in the Definition Dossier.

Flag datum markers should be considered as a support for bundle installation on A/C, but bundle routing on A/C shall be in line with bundle routing defined in the Definition Dossier.

The position of flag datum markers should be agreed between design office and manufacturing.

Bundles shall be routed and connected so that the identification and connection labels are clearly visible.

Harnesses shall be routed so as not to generate abnormal mechanical stresses:

- At the connection level,
- Along the routing.

Bundles and connections shall not be under tension after connection.

Electrical standard in-line items shall not be positioned under attachment devices, and not in a dynamic or curved portion of a bundle.

Unprotected cables shall not be directly attached on non protected metallic surface (structure, overbraiding...).

Standard items in contact with ATA87/89/92 bundles (e.g. attachment devices, tying devices, conduits, etc.) shall withstand areas constraints.

#### **4.4.9.1 Protection during installation / removal phases**

##### **4.4.9.1.1 Protection of bundles during installation / removing**

Harness installation requires special attention.

Bundles should be installed after all mechanical operations have been performed in the concerned areas.

Temporary protections should be used on the bundles to avoid contact or chafing with structures.

The protections shall be removed progressively during final attachment on aircraft.

In confined areas, bundles shall be protected during installation phase.

The bundles shall be kept permanently clean. Inside bundles raceways and boxes, all loose foreign bodies (rivets, metallic chips, nuts, lock-wire, etc.) shall be vacuum-cleaned.

Traces of oil, hydraulic fluid and sealant shall be carefully cleaned with solvent see AIPS07-08-005.

Additional specific tying devices required for handling, transfer, mock-up or other purposes, could be temporarily used. These temporary tying devices shall be removed before A/C delivery.

It is prohibited to pull on the bundle behind connections to avoid damage on contacts and cables.

It is prohibited to leave the bundle suspended even temporarily (for attachment to an attachment device or an operation on the structure).

##### **4.4.9.1.2 Protection of end fittings pending connection**

Wired and unconnected end-fitting items shall be temporarily protected and insulated until connection on the aircraft.

End-fitting items shall be stored on bundles.

Protections shall be removed just before connection.

For ferry flight, end-fitting items shall be protected. In this case, the stored bundle shall be secured: no relative movement in regard of fixed bundles and no contact with structure.

For flight-tests and after A/C delivery, protections shall be in accordance with the Definition Dossier. No temporary protection shall be kept inside the A/C.

##### **4.4.9.1.3 Protection of surrounding items during installation**

During harness installation on A/C, precautions shall be taken to avoid damage of the surrounding items (e.g.: insulation blanket shall be secured).

#### 4.4.9.1.4 Anticorrosion products (e.g.: ARDROX) application on structure

Before application of anticorrosion product on the A/C structure, following electrical items shall be protected:

- All unconnected electrical connection items: all types of connectors, lugs, modules, contacts, relays, etc.
- Unsealed connected electrical items: connectors, relay, modules not equipped with sealing plugs, grounding modules (VG/VH), terminal blocks (VT), etc,
- Bundles (sleeved or not),
- The drain hole or holes of convoluted conduits and equipped shielded conduits,
- Bonding leads.

Other electrical items (shielded conduit fittings, connected sealed connectors, ground points made....) do not need to be protected when applying anticorrosion products.

NOTE: Application of anticorrosion product inside racks (VU) is not allowed.

#### 4.4.9.2 Fasteners

Fasteners shall be in accordance with the Definition Dossier.

Fastener torque values to be applied shall be in accordance with AIPS01-02-008, AIPS07-01-004 and Definition Dossier.

The screw length size code shall be the smallest size complying with the entire thread of the nut completely screwed.

This suitable screw length size code shall be chosen within a maximum range of  $\pm 2$  in comparison to the size code given by the Definition Dossier.

NOTE: The position of the washer is defined in the Definition Dossier.

Fastener installed on spacer plate shall be visible through the inspection hole.

#### 4.4.9.3 Attachment devices

Attachment devices shall be in accordance with the Definition Dossier.

In any case:

- In first priority the attachment device size shall be adapted to the bundle diameter/shape,
- The bundle shall not slide in the attachment device,
- Cables shall not be pinched inside the attachment device
- The bundle shall not be deformed,
- Attachment device shall not damage the bundle.

#### 4.4.9.3.1 G-route bobbin installation

The suitable metallic clamp smallest size shall be chosen taking into account that the tongue, after tightening, passes the screw head.

In the case where the tongue is longer than 15 mm, it shall be secured.

For specific G-route bracket installation, refer to AIPS07-05-042.

Contact between cable and the metallic clamp is forbidden.

Special attention shall be taken when inserting the cable feeder within the bobbin, in order not to damage the bobbin tab.

When bobbins are installed on G routes, longitudinal translation of the bobbins on the feeders cables shall be avoided.

#### 4.4.9.3.2 Clamps

When the size code -00 is specified in Definition Dossier, the manufacturing shall choose the clamp size adapted to the bundle diameter.

For P clamps, except ABS1339, when the size code given in the definition dossier does not match the bundle diameter, manufacturing could use the suitable size code within a range of  $\pm 2$  size codes.

For ABS1339 clamp, when the size code given in the definition dossier match the minimum/maximum allowable diameter of the size clamp, manufacturing could use the suitable size code within a range of  $\pm 1$  size code.

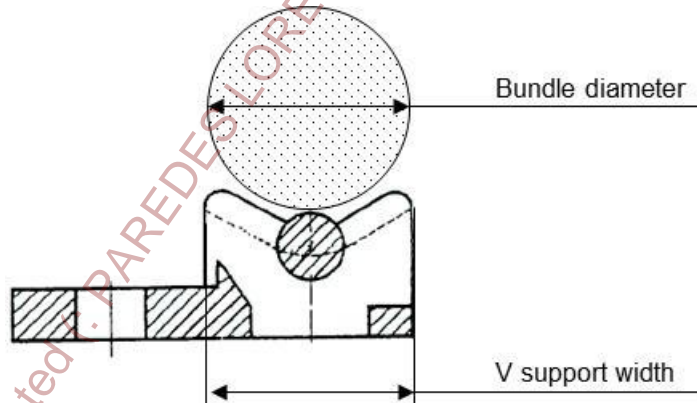
**NOTE:** Bundle diameter represented within the Definition Dossier is given for information and shows a full provision diameter.

#### 4.4.9.3.3 Cable supports

The bundle shall be attached to cable support (e.g.: V support) by a tying device.

Tying device, shall be tightened in accordance with AIPS07-01-003.

When V supports are used, the diameter of the bundles should not exceed the width of the V support, as shown in figure below.



**Figure 13: Maximum bundle diameter in V support**

For other cable support types refer to AIPS07-05-042.

#### 4.4.9.4 Ramps

##### 4.4.9.4.1 Bundle attachment on ramps

Relative movement between the ramp and the bundle shall be avoided.

The tying device for bundle attachment shall not be aggressive for bundles.

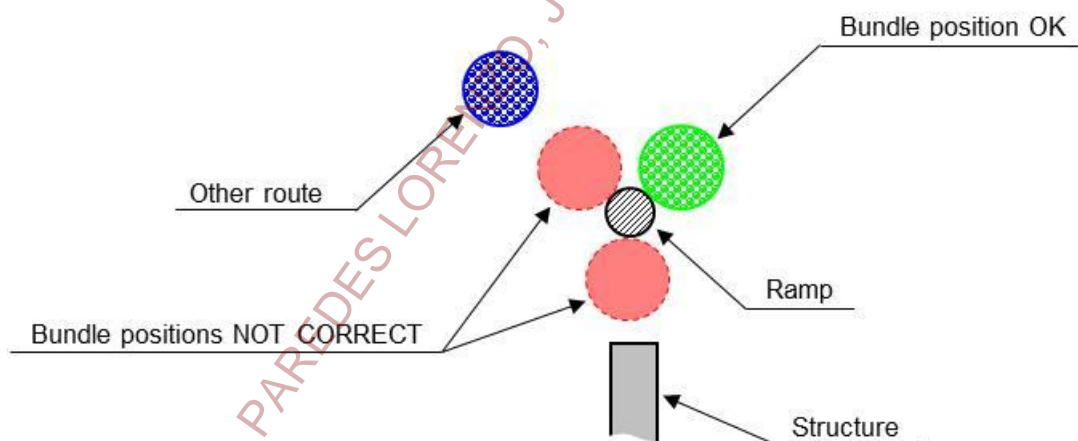
This principle is applicable to bundles routing on the ramp axis and bundles routing across the ramp axis.

When bundles route on ramp, the ramp shall remain visible/accessible after complete installation of bundles.

Bundle installation on ramp shall be in accordance with the Definition Dossier.

Ramps should be used for drip loops or over length management next to interfaces.

If the bundle position is not clearly defined in the Definition Dossier, the bundle shall be located as far as possible from adjacent structure, screws and other bundles, as shown in the figure below.



**Figure 14:** Bundle positioning on ramp

NOTE: Attachment of bundle on stirups use the same design principles/processes than on ramps.

##### 4.4.9.4.2 Clipped ramp installation on V support

Clipped ramp shall be clipped into specific V support and shall be blocked at each ends by lacing tape.

#### 4.4.9.5 Bundle attachment on rod

After bundle installation on rod, the position of bundle shall be in accordance with Definition Dossier, located as far as possible from adjacent structure, screws and other bundles.

No relative movement of bundle attachment on the rod is permitted after bundle installation.

A mechanical protection between the rod and the attachment device shall be used.



#### 4.4.9.6 Additional protection

**Table 7: Additional protection for attachment devices**

Attachment device	Program	
	A380 Program and subsequent	Before A380 Program
NSA5516 (code N) and AS21919 (normal type)	Mechanical protection shall be added: <ul style="list-style-type: none"> <li>On all non mechanically protected bundles.</li> <li>To insure an efficient grip between the bundle and the clamp by adapting: <ul style="list-style-type: none"> <li>the bundle diameter with the clamp size.</li> <li>the bundle shape to the clamp (e.g.: multiple bundle attached in the same clamp).</li> </ul> </li> </ul>	Mechanical protection shall be added: <ul style="list-style-type: none"> <li>To insure an efficient grip between the bundle and the clamp by adapting: <ul style="list-style-type: none"> <li>the bundle diameter with the clamp size.</li> <li>the bundle shape to the clamp (e.g.: multiple bundle attached in the same clamp).</li> </ul> </li> <li>For dynamic bundle last attachment points.</li> <li>For stressed non protected bundles.</li> <li>P routes non protected bundles.</li> </ul>
NSA5516 (code B) (box cushion type) and NSA5515	Mechanical protection should be added: <ul style="list-style-type: none"> <li>To insure an efficient grip between the bundle and the clamp by adapting: <ul style="list-style-type: none"> <li>the bundle diameter with the clamp size.</li> <li>the bundle shape to the clamp (e.g.: multiple bundle attached in the same clamp).</li> </ul> </li> </ul>	
ABS1339 ABS2195	Mechanical protection should be added: <ul style="list-style-type: none"> <li>To insure an efficient grip between the bundle and the clamp by adapting: <ul style="list-style-type: none"> <li>the bundle diameter with the clamp size.</li> <li>the bundle shape to the clamp (e.g.: multiple bundle attached in the same clamp).</li> </ul> </li> <li>Avoid pinched cables.</li> </ul>	
V supports	Mechanical protection shall be added: <ul style="list-style-type: none"> <li>When bundle diameter is greater than the width of the V support.</li> <li>When bundle diameter is smaller or equal to 5 mm.</li> </ul> Mechanical protection could also be added to insure an efficient grip between the bundle and the support by adapting the bundle shape to the support (e.g.: multiple bundle attached in the same support).	
Other attachment devices	Mecahnical protection should be added depending on the means of te bundle attachement e.g.: <ul style="list-style-type: none"> <li>Bundle attachment with only cable tie is considerd like a V support</li> <li>Bundle inside platic clamp is considered like ABS1339/2195 clamps</li> </ul>	

##### 4.4.9.6.1 Route containing 1 or 2 wires

For routes consisting of:

- 1 wire of 20 or 22 or 24 gauge (not acceptable for 26 gauge), or
- 1 bifilar cable of 22 or 24 or 26 gauge, or
- 2 wires of 22 or 24 or 26 gauge, or
- 1 wire of 20 gauge and 1 wire of 22, 24 or 26 gauge,

and which might be exposed to maintenance activities (handhold or footstep) during in-service maintenance, shall be mechanically protected.

Maintenance areas to be considered are the areas where electrical installation is not protected by:

- Lining,
- Structure,
- Conduit,
- Or other protection means.

NOTE: This mechanical protection shall not be applied:

- To wires linked to grounding/bonding points (VN, VH or VG),
- To wires connected at interface connectors (VC) between the last attachment and the connector.

#### **4.4.9.7 Conduits attachment (not applicable for shielded conduit and over braided bundle)**

Convolute conduits shall be attached at each end.

Convolute conduits shall not be crushed after attachment.

Non convolute conduits shall be attached to at least one end.

Conduit attachment could either be made:

- By an attachment device,
- On a ramp,
- On a backshell.

The conduit shall protrude at each attachment extremity of open backshell at attachment level, without contact with the rear of the connector.

NOTE: After installation on aircraft, drain holes shall be provided in convolute conduits (NSA935805, NSA935806, ASNE0432 and ABS0887), in accordance with AIPS07-07-004.

#### **4.4.9.8 Fragile cable installation**

##### **4.4.9.8.1 Coaxial cable/bundle**

Special attention shall be taken during installation to avoid crushing of the coaxial cables.

At connection level, special care shall be applied in order to avoid any constraints at contact level.

If necessary, a mechanical protection could be added around a coaxial cable/bundle inside the attachment device in accordance with AIPS07-01-001.

##### **4.4.9.8.2 QuadraX cable**

QuadraX cable could be installed inside electrical harnesses like other cables but a special attention shall be taken in order to avoid:

- Cable pinching/damages,
- Straining of the cable when twisting during connection,
- Twisting and stress at contact level.

For QuadraX acceptance criteria refer to AIPS07-08-004.

#### 4.4.9.9 Harnesses co-routing

When several non protected harnesses are routed together, the shape and grip of the resulting harness at attachment device level shall be ensured by addition of reinforced black tape.

Removal of reinforced black tape from existing bundle should be avoided.

#### 4.4.10 Structure feedthroughs protection

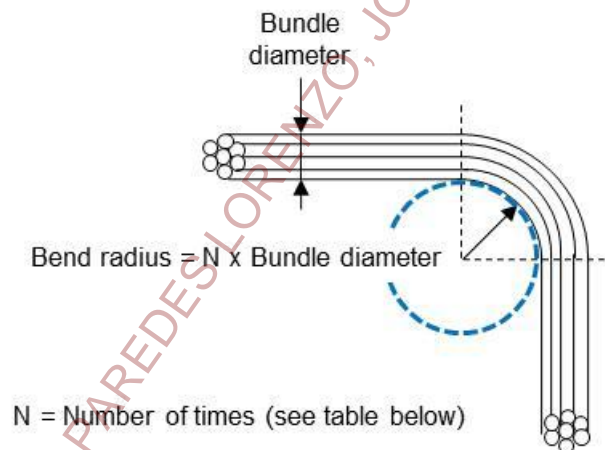
When required in the Definition Dossier, specific protection shall be installed.

#### 4.4.11 Cables and bundles minimum bend radius

Bundles/cables bend radius shall be in accordance with the Definition Dossier.

Minimum bend radius is applicable to the inner edge of the cable/bundle.

The minimum bundle bend radius shall not be lower than the minimum allowable radius of each cable inside the bundle.



**Figure 15: Bend radius**

Following values are given for information.

**Table 8: Bundle/wire bend radius value**

Outer diameter of the bundle/wire	Route									
	G	P	M, S	D	X	R	T, U, V	Q		
< 5 mm	6x (for G route in bobbin configuration)	11x	10x	11x	11x	10x	10x	6x		
< 7 mm			8x	8x		8x				
< 10 mm		11x	6x	6x	8x	6x	8x			
< 13 mm					6x		6x			
< 20 mm		9x			6x		6x			
≥ 20 mm		6x								

For G routes in bundle configuration minimum bend radii shall be:

- For bundle diameter < 24 mm → 11 times bundle diameter,
- For bundle diameter ≥ 24 mm and < 31 mm → 8 times bundle diameter,
- For bundle diameter ≥ 31 mm → 6 times bundle diameter.

If bend radii of table above could not be respected then:

- For each single wire/cable, the minimum bend radius of table below shall be respected.
- And
- Minimum bend radius of the bundle shall be 6 times the outer bundle diameter.

**Table 9: Wire / Cables bend radius value**

<b>Wires / Cables AWG</b>	<b>Minimum Bend Radii</b>
Single wires 26 to 10	6x
Single wires 8 to 4	8x
Single wires 3 to 0000	11x
Wires with high voltage (≥ 230 VAC or 270 VDC)	11x
Optical cables	10x
Coaxial cables	10x
Databus cables	10x
Quadrax static	6x
Quadrax dynamic	11x

NOTE: 10x means the minimum bend radius shall be 10 times the outer bundle/cable's diameter.

#### **4.4.12 Drip loop**

A drip loop shall be shaped before each connection in accordance unless specified otherwise in the Definition Dossier.

The cable/bundle shall be routed by a point lower than the connection, as shown in the figure below.

NOTE: Drip loop shall not generate mechanical stress on connections.

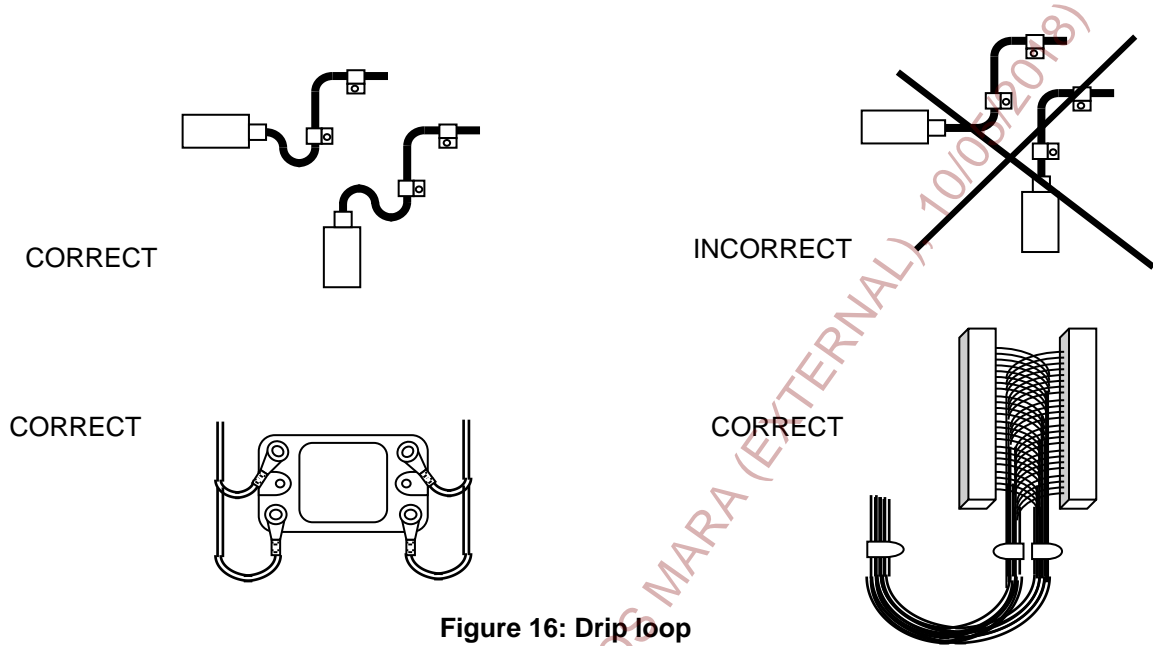


Figure 16: Drip loop

#### 4.4.13 Over length management

Stowage areas are defined in the Definition Dossier.

For G and X routes, on A350 Program, it is forbidden to make complete loops to manage the over length of cables and bundles.

For A350 Program and followings, it is forbidden to make complete loops with coaxial cables and it is not recommended for the other programs unless authorised by system engineers (e.g.: radio altimeter).

For adjustable attachment points, the same attachment devices as on the other parts of the harness shall be used.

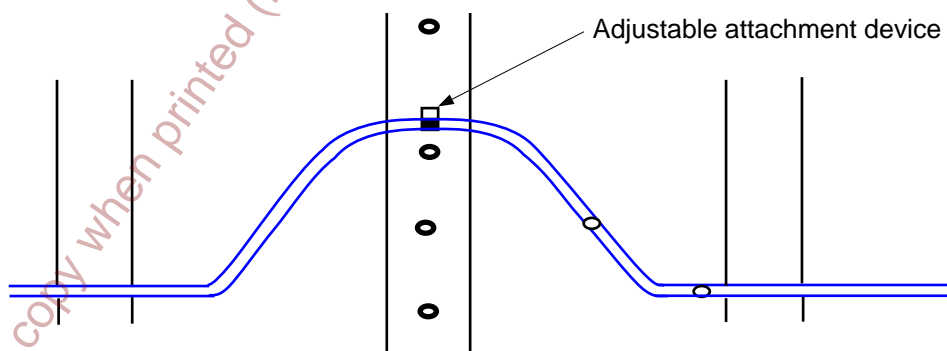


Figure 17: Over length management by adjustable attachment devices

#### 4.4.14 Contact between bundles and insulating blanket

When a bundle comes into contact with insulating blanket studs (e.g.: ABS1105) a cutting of the studs shall be agreed between electrical installation and insulation responsible.

The cutting has to be carried out by the insulation responsible only, in order to ensure a sufficient stud minimum length.

Insulation studs ABS2031 (burn-through resistant) shall not be cut.

In case of contact between bundle and insulation stud the installation of a shorter stud could be an alternative and shall be agreed between electrical installation and insulation responsible.

**Table 10: Contact between routes and insulation blankets**

Program	Routes G and E	Routes X	Routes P	Routes M, D, S, R, T, U and V
A350	Not allowed (see note)	Not allowed (see note)	Not allowed (see note)	Contact allowed
Other programs	Not allowed (see note)	N/A	Contact allowed	Contact allowed

NOTE: Smooth contact could be accepted if a thermal barrier is provided.

#### 4.4.15 Use of separators

In all cases the use of separators shall be specified in the Definition Dossier (location and type).

In exceptional cases, separators not required in the Definition Dossier could be added by manufacturing team to guarantee punctual segregations between routes.

When the addition of separators by manufacturing becomes recurrent, it shall be introduced in the Definition Dossier.

Separators are not considered as attachment device and shall not be used to manage over length or to avoid contact with environment.

The loss of separator shall be taken into account. A minimum clearance of 10 mm with environment after the separator loss shall be insured.

Separator shall not be used between other non electric ATA systems and electrical bundles.

Separators shall not be used on dynamic bundles.

NOTE 1: For G, P, X routes and only for A350 and A400M Programs, addition of separator shall be validated by manufacturing quality or Design Office specialist.
















NOTE 2: For all programs addition of separator on EFCS routes (not defined in the Definition Dossier) shall be validated by manufacturing quality and Design Office specialist.

NOTE 3: Separators are not suitable on leaky line.

NOTE4: When adding ABS1144 / ABS1526 / ASNE0688 separators on coax cables, separators shall be considered as V supports, for coax cables protection to be applied. Refer to AIP107-01-001.

The table below, provides for information the use of separators according to A/C zoning and type of routes.

Table 11: Use of separators

Zones	Routes G	Routes P (for all programs) and Routes X (for A350 Program)	Other routes
Hot zones	<p>Knot NSA8420-5</p>  <p>Bracket ABS1088</p>  <p>NSA5516CB in butterfly configuration</p> 	<p>NSA5516CB / ABS2195 in butterfly configuration</p>   <p>Knot NSA8420-5</p> 	
Unpressurised zones / Pressurised zones outside VU	<p>Knot NSA8420-5</p>  <p>Bracket ABS1088</p>  <p>NSA5516CB / ABS2195 in butterfly configuration</p>  	<p>ABS1339 in butterfly configuration</p>  <p>Knot NSA8420-5</p> 	<p>ABS1144</p>  <p>ABS1339 in butterfly configuration</p> 
Pressurised zones in VU	Not recommended		<p>ABS1526 / ASNE0688</p> 

#### **4.4.16 Positioning and coupling of connectors**

##### **4.4.16.1 Circular connectors**

The circular connectors orientation shall be in accordance with the Definition Dossier. For standard orientations refer to the relevant AIPS's.

##### **4.4.16.2 Rectangular connectors**

The rectangular connectors orientation shall be in accordance with the Definition Dossier. For standard orientations refer to the relevant AIPS's.

##### **4.4.16.3 Terminal blocks / modules installation**

Modules shall be installed inside rail, module 1 conveniently located at one rail end:

- When the rail is in vertical position, module 1 shall be installed on the top,
- When the rail is in horizontal position, module 1 shall be installed on the left, when operator is facing the terminal.

NOTE 1: If the operator could see the terminal block from 2 directions, priority is given to the position looking forward and from the aircraft centre-line.

NOTE 2: For assembly and connection of terminal blocks, see AIPS07-05-005.

##### **4.4.16.4 Connection on terminal blocks**

For the connection on terminal blocks, refer to AIPS07-01-004.

###### **4.4.16.4.1 Bending of lugs**

Aluminium lugs shall not be bent.

Copper lugs could be bent once only with a minimum bend radius insuring that the lug shall not be pinched (check that there is no crack).

Maximum angle through which the copper lugs may be bent is:

- 30° for gauges 10 to 0000,
- 45° for gauges 12 to 24.

When it could not be avoided, copper lugs for wire gauges 10 to 24 should be bent through 90°.

The original lug shape shall remain after lug bending (no other deformation).

###### **4.4.16.4.2 Lug installation on grounding / bonding point**

Electrical bonding points shall be carried out in accordance with AIPS07-01-006.

Electrical grounding points are installed with the same processes than bonding points.



#### 4.4.17 Protected bundle inside pressure seal

When bundles protected by conduits pass inside pressure seal, the conduit shall be interrupted as close as possible to the pressure seal.

In some exceptional cases, as defined in Definition Dossier, some cables could be protected inside pressure seal.

Contact between conduit and pressure seal shall be avoided (not applicable for ABS1571, ABS1378, refer to note 3).

NOTE 1: When several conduits are installed on the bundle, a distance of 10 mm maximum between pressure seal and conduits is acceptable.

NOTE 2: For shielded bundles, refer to AIPS07-01-012, AIPS07-01-013 and AIPS07-01-014.

NOTE 3: Refer to AIPS07-05-046 and AIPS07-05-062. Conduits shall penetrate 10 mm into the pressure seal body.

#### 4.4.18 Routing of monitoring cables on circuit breakers

Monitoring cables between adjacent circuit breakers shall be held face-to-face at each unit (one cable on either side of the circuit breaker concerned) and the two cables of each circuit breaker shall be held to their own power cables.

The circuit breaker monitoring circuit cables shall not be in contact with metal parts (cable connecting items on circuit breaker or electrical distribution shunts).

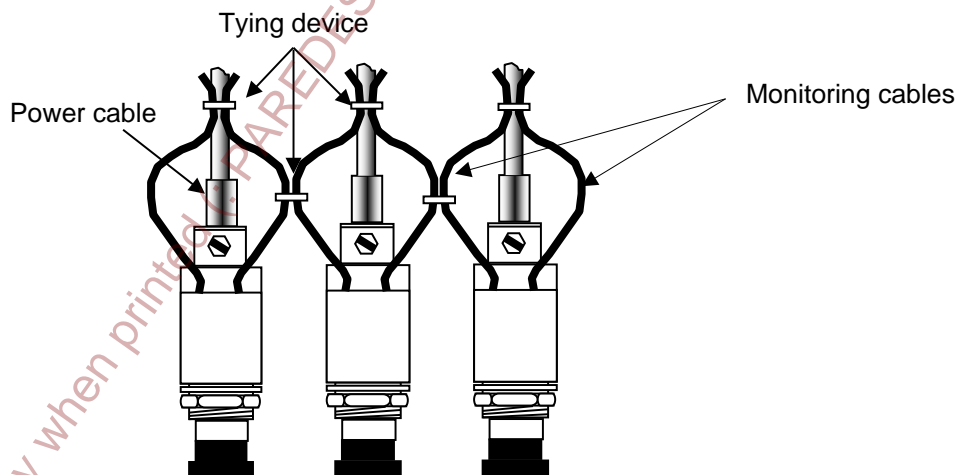


Figure 18: Monitoring cables attachment on circuit breakers

#### **4.4.19 Tightening torque, attachment and locking of electrical components**

##### **4.4.19.1 Tightening torque**

The torque to be applied is given in the product or component specifications or data sheets.

The AIPS07-01-004 and AIPS01-02-008, gives the methods for torque application and torque values for the most currently used equipment.

NOTE: All modification of torque values shall be validated by the Design Office.

##### **4.4.19.2 Locking procedure**

When required in the Definition Dossier, electrical components shall be locked either by:

- Lock-wire.
- Locking compound.

##### **4.4.19.3 Locking of backshells**

For locking of backshells refer to AIPS07-01-009.

##### **4.4.19.4 Locking of shielded bundles**

Shielded conduit backshells shall be locked on connector, bulkhead or pressure seal by lock-wire or self-locking device (locking compound shall not be used).

##### **4.4.19.5 Locking of terminal blocks**

The locking process is described in AIPS07-05-050.

##### **4.4.19.6 Locking of module end clamps**

In vibration areas, module end clamps shall be locked by lock-wire.

Module end clamps connected to EFCS wirings shall be locked by lock-wire except when these modules are located inside VU's in all areas.

When terminal block modules are located above the mechanical flight control system module end clamps shall be locked by lock-wire.

The locking process is described in AIPS07-05-005.

##### **4.4.19.7 Circuit breaker clips**

For anti-push down circuit breakers operation indication clips shall be used:

- White safety clip in case of full provision during flight operations,
- Red safety clip in case of flight operation under MMEL (Master Minimum Equipment List) or ground operating conditions,  
If clip locking is required in the Definition Dossier, lock-wire shall be used,
- Clips shall not be distorted during the lock-wire installation.

**4.4.19.8 Locking of coaxial connector**

Coaxial plugs with thread couplings shall be locked with lock-wire.

**4.4.19.9 Visual check of locking**

Some products, such as circular or rectangular connectors, are equipped with a locking display (e.g.: line).

The following means are considered as locking display:

- Blue ring on connectors
- Self-locking screw nut
- Self-locking washer

If the locking display does not exist additional locking display shall be added:

- Paint mark,
- Lock wire.

The red frangible paint shall be between a fixed structure and the movable locking item and systematically visible after application.

On A350 specific green frangible paint shall be applied to electrical ESN connections with blue protective varnish.

Refer to AIPS07-01-004 for visual indication after screw and nut tightening.

NOTE: For current carrying screwed fastenings made with cables sections  $\geq 5 \text{ mm}^2$  (gauge 10 and below) red frangible paint shall be applied. Also valid for Bus Bars.

**Table 12: Locking display application**

Components	Locking method	Locking visualisation
Self locking with locking display	Self locking	Locking display
Self locking without locking display	Self locking	Red frangible paint
No Self Locking components	Lock-Wire	N/A
	Locking compound	Red frangible paint
Quick fasteners (see note 1)	Self locking	White or black line
ESN standard junction	Self locking	Green frangible paint (see note 2)
ESN quick junction	Self locking	Paper seal
NOTE 1: This process is not applicable for quick-release fasteners NSA55110-1 type and quick-release fastener with cruciform shape.		
NOTE 2: Green frangible paint applied on standard junction when tests are completed.		

**4.4.19.10 Locking of VU hinges**

When electrical panels / VU doors are equipped with hinges the hinge axis shall be locked in translation.

**4.4.20 Specific case of Flight Test Installation (FTI)**

Where Flight Test Installation splices (e.g.: "JIFFY") are installed, the IN (Normal Installation) bundle shall be mechanically protected (e.g.: orange open sleeve).

#### 4.5 Key Characteristic

Key Characteristics acc. to EN9103 are defined by responsible engineering based on a risk analysis for parts manufactured by this process. Key characteristics shall be defined on product level and if necessary also on process level.

They shall be subject to variation control by production organization according to EN9103.

Key Characteristics do not relieve the production organization from meeting all engineering requirements defined in this document.

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Table 13: Key Characteristic

Product Key Characteristic			Process Key Characteristic		
No.	Designation	Requirement / Limit	Sub.-No.	Designation	Requirement/ Limit
1	Harness length		1.1	Respect the dimensional tolerances of harnesses.	+30 mm / -10 mm between 2 ends (for VC) +20 mm / 0 mm between 2 ends (in other cases)
			1.2		+10 mm / -10 mm between 1 reference point and 1 derivation
2	Flag datum marker and derivation positions		2.1	Tolerance for position of flag datum marker and derivations regarding reference point.	+10 mm / -10mm
			2.2	Flag Datum Markers and derivations could be positionned with a tolerance of ± 10 mm during installation on A/C.	+15 mm / -15 mm
3	Backshell		3.1	Backshell is acting as strain relief.	No effort at contact level
			3.2		Conduits attachment
4	Cables		4.1	Cables passing through the bundle shall be avoided.	Bundle combing
			4.2	Tangled or crossing cables shall be avoided.	
			4.3	Cables protruding beyond the bundle are unacceptable.	
5	Bundle		5.1	The bundle diameter shall not exceed 50 mm.	Bundle diameter < 50 mm
			5.2	Bundles and connections shall not be under tension after connection.	No stress on cables and connections
			5.3	The diameter variation (difference between minimum and maximum diameter) of a tied bundle composed of same number of cables shall not be greater than 20% of its minimum diameter.	20% of the minimum bundle diameter.
6	Electrical standard items		Contact between two items shall be avoided.		No contact between two items

Product Key Characteristic			Process Key Characteristic		
No.	Designation	Requirement / Limit	Sub.-No.	Designation	Requirement/ Limit
7	Tying device		Non aggressive tying device shall be used: <ul style="list-style-type: none"> <li>Where cable to cable tie head contact could occur (e.g.: at confined interface plate areas),</li> <li>Inside split conduits where necessary (e.g.: digit F),</li> <li>Where cable tie head could reduce the equipment/VU removal (e.g.: head hooked on structure)..</li> </ul>		Use of tying device
8	Harness protection		8.1	Refer to Table 5	G, Y and V digits routings protections
			8.2	Refer to Table 6	F digit protection
9	Supports		9.1	The screw length size code shall be the smallest size complying with the entire thread of the nut completely screwed.	The entire thread of the nut completely screwed
			9.2	Fastener installed on spacer plate shall be visible through the inspection hole.	Fastener visible through spacer plate inspection hole
10	Metallic clamps		10.1	Metallic clamp shall be tightened so that no feeder cable could slide in the bobbin.	No feeder cable sliding in the bobbin
			10.2	Contact between cable and the metallic clamp tongue is forbidden.	No contact between feeder cable and metallic clamp tongue
11	Attachment devices		11.1	Efficient grip between the bundle and the attachment device.	No bundle sliding
			11.2	No cables shall be pinched between by the attachment device.	No cables pinched
12	Ramps		The ramp shall remain visible/accessible after complete installation of bundles		Ramp visibility and accessibility
13	Single cable minimum bend radii		Refer to table 8		Cable bend radius
14	Separators		14.1	Separators shall not be used to manage over length or avoid contact with structure.	Use of separators
			14.2	Separators shall be defined in the Definition Dossier	Seapartor in the Definition Dossier

Product Key Characteristic			Process Key Characteristic		
No.	Designation	Requirement / Limit	Sub.-No.	Designation	Requirement/ Limit
15	Conduits		15.1	Convolute conduits shall not be crushed.	Conduit not crushed
			15.2	Conduits shall protrude at each extremity.	Conduits protruding
			15.3	Convolute conduits shall be in one-piece.	Convolute conduits in one-piece
16	Quadrax cable		16.1	Avoidance of: – Straining of the cable when twisting during connection. – The amount of twisting and stress on the contact.	No constraints at contact level
			16.2	Cable pinching/damage shall be avoided	Minimum quadrax cable bend radius respected
17	Drip loop		A drip loop shall be shaped before each connection in accordance with Definition Dossier		Drip loop shaped
18	Lugs		18.1	Aluminium lugs shall not be bent.	Aluminium lugs not bent
			18.2	Copper lugs could be bent once only with a minimum bend radius insuring that the lug shall not be pinched	No cracks on Copper lug after bending
19	Circuit breakers		The circuit breaker monitoring circuit cables shall not be in contact with metal parts.		No contact (circuit breaker / metal parts)
20	Coaxial connectors		Coaxial plugs with thread couplings shall be locked with lock-wire.		Lock-wire installed
21	Module end attachment devices		21.1	Module end attachment devices used on wirings of Electrical Flight Control Systems shall be locked by lock-wire except when these modules are located inside VU's in all areas.	Lock-wire installed
			21.2	When terminal block modules are located above the mechanical flight control system module end attachment devices shall be locked by lock-wire.	Lock-wire installed
22	Locking display		Refer to Table 12		Locking display application
23	Screwed fastenings		For current carrying screwed fastenings made with cables sections $\geq 5 \text{ mm}^2$ (gauge 10 and above) red frangible paint shall be applied. Also valid for Bus Bars.		Red frangible paint
24	VU hinges		When electrical panels / VU doors are equipped with hinges the hinge axis shall be locked in translation.		Hinge axis locked in translation

## 5 Technical qualification

The Technical Qualification shall be performed, according to the relevant Airbus Procedure.

## 6 First part qualification

Not applicable.

## 7 Series production inspection

Not applicable.

## 8 Rework

Adding cables in bundles shall not modify the basic design principles (manufacturing and installation) of the initial electrical installation.

Added cables shall be fully integrated into the basic existing bundles (EFCS or not). The basic partitions shall be respected (dedicated tying or protections).

As far as possible, existing conduits shall be used. Spare conduits could also be used in non accessible areas.

Additional cables could be either placed under or over the flag datum markers. If these cables are placed over the markers, masking the identification on these markers shall be avoided.

When basic installation is installed in a pressure seal the segregation of added cables shall be in accordance with Definition Dossier.

When basic installation is installed in a passing through device, added cables shall be installed:

- In unused spare hole when existing
- In added dedicated hole with a minimum edge distance of 5 mm,
- In the enlarged existing of the same system hole.

When using spare holes or added dedicated hole the furthest distance from a hole holding a different system shall be respected.

NOTE 1: It's forbidden to use metallic tools to remove or to add cables inside bundles.

NOTE 2: Where tape is used for harness repair, red tape shall be used in order to identify the repair.

## 9 Environment, health and safety

The manufacturing process shall be in line with Airbus Health and Safety and Eco efficiency policies.

Compliance with A1091 shall be ensured for all materials, substances and/or articles implemented during process.

In particular, targeted substances according to A1091 shall not be used, if a safer alternative is available.

Uses made of all substances involved in the process shall be documented in Safety Data Sheet as required by REACH regulation (Registration Evaluation and Authorization of Chemicals).



## RECORD OF REVISIONS

Issue	Clause modified	Description of modification
1		New standard.
2 06/99		Standard completely revised.
3 01/05		Standard completely revised.
4 10/06		Standard completely revised.
5 06/09		Standard completely revised.
6 04/10		Standard completely revised.
7 11/11		Standard completely revised.
8 09/13		Template updated and Standard completely revised.
9 03/16		Standard completely revised
10 03/17		Standard completely revised