

**AIPS**  
**Airbus Process Specification**  
**Manufacturing and installation of**  
**optical fiber cables**

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## 1 Scope

This Airbus Process Specification defines the Engineering requirements for the manufacturing and installation of optical fiber cables.

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.

It shall be applied when mentioned in the relevant standard, material specification or 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 Directive – Airbus requirements for the management of hazardous substances.
AIPS07-01-001	Airbus Process Specification – Manufacturing and installation of cable harnesses.
AIPS07-01-003	Airbus Process Specification – Cable tying with NSA935401 or NSA8420.
AIPS07-06-002	Airbus Process Specification – Identification and marking on electrical installations.
AIPS07-07-002	Airbus Process Specification – Flexible textile sheaths EN6049-003 to EN6049-009, ASNE0559 and ABS0596 for external protection of electrical cables.
AIPS07-09-002	Airbus Process Specification – Electrical and optical tests of aircraft wiring (functional tests excluded)
AIPS07-11-002	Airbus Process Specification – Termination of ABS0929-003 and ABS0929-004 singleway optical connector onto ABS0963-003LF optical cable.
AIPS07-11-003	Airbus Process Specification – Installation of ABS1379-003 optical contact with ABS0963-003LF fibre optic cable.
AIPS07-11-004	Airbus Process Specification – Assembly of ABS1906 optical contact on ABS0963 type LF optical cable.
AIPS07-11-005	Airbus Process Specification – Insertion loss measurement on optical links.
AIPS07-11-006	Airbus Process Specification – Fibre optic technology – Cleaning requirements.
AIPS07-11-007	Airbus Process Specification – Fibre optic installations – Fault diagnosis.
EN9103	Aerospace series – Quality management systems – Variation management of key characteristics.
IEC60825-1	Safety of laser products – Part 1: Equipment classification and requirements.
IEC60825-2	Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)
IEC60825-14	Safety of laser products – Part 14: A user's guide.

### 3 Definition, applicability and limitations

#### 3.1 Definition

Not applicable.

#### 3.2 Applicability and limitations

This Airbus specification is applicable when called up in the drawing directly or through another document for the purpose given in the scope. When processing to AIPS07-11-001 is required, it shall be called up on the drawing by the words "AIPS07-11-001 – Manufacturing and installation of optical fiber cables".

This specification is applicable to the installation of optical fiber cables, bundles and harnesses during the lifetime of the aircraft.

Only the practices defined in this specification are authorized.

### 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.

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.

#### 4.1 Quality requirements

##### 4.1.1 Qualification of personnel

The supervisory staff shall ensure that all persons nominated for working with optical equipment or optical installations have the level of expertise required to perform the operations required complying with the necessary quality level.

##### 4.1.2 Qualification of tools and tooling

Tooling used for identification, marking, installation and tests shall be checked at agreed periods in compliance with prevailing instructions.

Any tool or equipment used for transporting optical cables, bundles or harnesses shall be designed so that protection is provided at all times to prevent damage occurring (free from sharp or protruding edges and abrasive materials, which may damage the various optical or electro-optical equipment)

#### 4.2 General precautions

To ensure the performance of optical links, key points are:

- Cleanliness of the optical end faces, as per AIPS07-11-006.
- Respect of the minimum bending radius (refer to sub-chapters 4.3.3.2 and 4.4.1)

Moreover, the following precautions have to be taken into account by operators (valid for manufacturing, transport storage, installation, and operation phases):

- Do not step or sit on the optical cables, bundles or harnesses.
- Prepared optical cables, bundles or harnesses shall not be dragged. They shall be carried manually or using a suitable handling system and should not be left on floors or walkways.
- Care shall be taken to avoid the possibility of objects falling on top of, or sliding equipment crushing, the optical cables, bundles and harnesses.
- Avoid contact between optical bundles and sharp edges (outside and inside A/C)
- If the surrounding structure is to be reworked or modified, fit adequate local protection to the bundles (split conduit etc.) in order to prevent all shocks and all Foreign Object Debris from entering the bundle (especially when the installation is routed under floor)
- Optical cables, bundles and harnesses should be stored in a dry place, protected from areas of high humidity and restricted to the cable specified storage temperature range.
- Optical harnesses and optical cables shall not be entangled. In case of entangled harnesses or cables, a special care shall be taken during untangling operation.
- Twisting of optical fiber bundles is not allowed on a straight bundle but slight rotation without stressing cables may be tolerated in order to facilitate the connection.
- When unrolled optical cables, bundles or harnesses, a special care shall be taken to avoid introducing twists in the cables.
- Additional ties required for handling, transfer, mock-up or other operations, may be coloured temporary ties (these ties shall be removed during installation on aircraft). Refer to sub-chapter 4.3.3.3 for tying and attaching bundles on A/C.

It is strictly prohibited to:

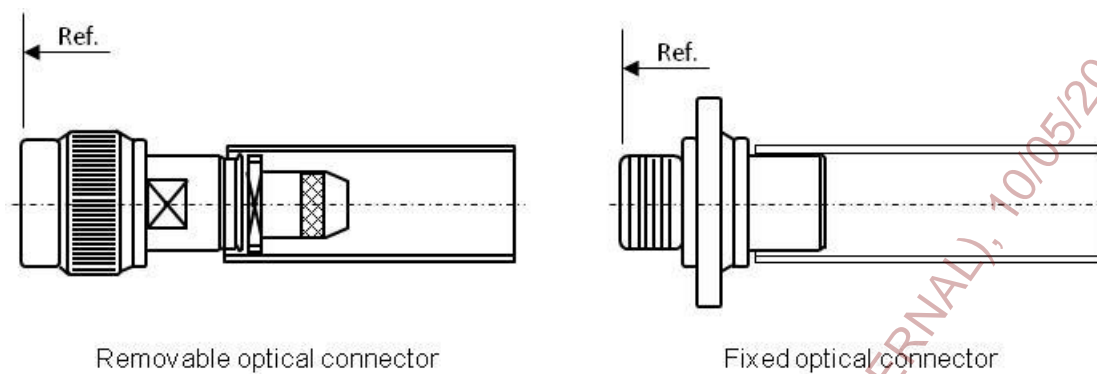
- Pull on the cables at the rear of the connectors as this may damage the contacts and the optical cables.
- Leave the optical cable, bundle or harness suspended without attachment and/or protection (to attach a support or for an operation on the structure)
- Use the optical cables, bundles or harnesses as handholds or as support for tools or equipment.
- Roll the cable around your fingers or your hand to get a better grip.

### **4.3 Technical requirements**

#### **4.3.1 Optical harness manufacturing**

##### **4.3.1.1 Optical harness length**

Reference for cable, bundle or harness length shall be in accordance with the figure 1 below:



**Figure 1: Length reference for optical cable, bundle or harness**

Length reference differs from the Definition Dossier wire length reference because it does not take into account the end fitting components.

NOTE: For dimensional tolerances for harness, refer to AIPS07-01-001.

#### **4.3.1.2 Stripping optical cable and installing optical contacts on fiber**

According to AIPS07-11-002, AIPS07-11-003 and AIPS07-11-004.

#### **4.3.1.3 Tying bundles in shops**

For in-line tying, refer to AIPS07-01-003.

Tying shall ensure:

- The shape of the bundle.
- The distribution of the mechanical loads across all cables.

In all cases, tying devices shall not damage:

- The tied harness.
- The adjacent harness.

#### **4.3.2 Optical harness pre-installation checks**

Before the installation of an optical harness, the following points shall be checked:

- The planned attachment points are installed and available.
- Structural rework in the routing area of the harness is not scheduled in a near future.
- The installation, routing and working areas are clean.
- The optical cable, bundle or harness is not damaged.
- The structure is protected (e.g.: Cross-beam holes)

### **4.3.3 Routing of optical cables, bundles on A/C**

#### **4.3.3.1 General precautions for optical cables or bundles routing**

- To avoid cable damages during installation operation, optical cables or bundles not yet installed shall be attached to adjacent bundle or structure.
- When installing optical harnesses, optical bundles shall be positioned on the supports or on electrical harness.
- In order to avoid contacts from items (which may cause abrasive wear), optical cables or bundles shall be held by loosened tying devices allowing position adjustment before definitive tightening.
- Optical cables shall be routed so as to avoid mechanical stresses on the connection points.
- When the optical harnesses are completely unrolled and connected, the tying devices shall be tightened to final torque value according to AIPS07-01-003 requirements.

#### **4.3.3.2 Bend radius**

For bend radius refers to AIPS07-01-001.

During the installation process or during maintenance, following the minimum bend radius shall prevent possible damage on the optical fiber cable.

On the optical fiber cable, if the bend radius is not fulfilled, the optical cable shall not be replaced but installation shall be reworked.

NOTE: After installation, all the optical fiber cables will be tested according to AIPS07-09-002. If the test results are not compliant, optical fiber cable shall be replaced.

Where necessary approved mechanical bend limiting components or tools may be used to ensure this bend radius.

#### **4.3.3.3 Tying and attaching bundles on A/C**

For optical cable/bundle, the last attachment (e.g.: Clamp or tying on bundle), shall be positioned between 200 mm and 300 mm from the connection.

##### **4.3.3.3.1 Optical cables, bundles or harnesses routing alone**

Optical cable shall be considered like all other types of cables.

##### **4.3.3.3.1.1 In a clamp or in a V support**

The installation shall be in accordance with the AIPS07-01-001 requirements.

##### **4.3.3.3.1.2 Optical cable can be installed on ramp**

The installation shall be in accordance with the AIPS07-01-001 requirements.

For harnesses along ramp in VUs and VEs or with diameter smaller than 5 mm, a specific principle is applicable.

#### 4.3.3.3.2 Optical cable integrated inside electrical bundles

The optical cables can be installed inside the bundle for basic design.

In this case the optical cable shall be considered like all other cables.

The cable or harness derivation shall be attached by two points to avoid stress and to follow bend radius requirements.

#### 4.3.3.3.3 Optical cable/bundle installed on top of the electrical bundles (out of clamp)

The tying pitch shall be between 150 mm and 200 mm.

NOTE: A minimum distance of 20 mm between two tying devices shall be respected in order not to stress the optical cable(s)

The tying device shall not damage an adjacent bundle.

#### 4.3.3.3.3.1 Harness fixed with clamps or V support

The optical cables shall be installed inside clamp.

Mechanical protection shall be added at attachment point level in accordance with the table 1 below.

**Table 1: Installation with clamps or V support**

Bundle composition	Bundle diameter	V support	Clamp
Optical Fiber and / or other types of wires	< 2,5 mm	YES	YES
	From 2,5 mm to 5 mm	YES	YES
	Between 5 mm and 35 mm	NO	According to AIPS07-01-001
	> 35 mm	YES	According to AIPS07-01-001

#### 4.3.3.4 Stowage area for bundle length control following drawing

During the management of the overlength, the minimum bend radius shall be observed.

Overlength management has to be provided in each interface area or when it is necessary.

For adjustable attachment points, use the same attachment principles described in AIPS07-01-001, as on the other parts of the harness.

#### 4.3.3.5 Protective conduit

In accordance with drawing, split textile conduit shall be used to protect an optical cable or bundle when there is a risk of mechanical wear.

When optical cable/bundle is protected by a split conduit, for connectors requiring spring effects between optical cables and contacts, it is prohibited to install tying device on the boot at the extremity of the optical cable. The conduit can be attached on the rear of the connector.

Temporary protection conduit may also be used during installation process.



#### 4.3.4 Connecting optical cables, bundles

##### 4.3.4.1 General precautions for optical connectors handling

- During installation, the connector shall be maintained in the optical cable axis to avoid stresses.
- All optical contacts and connectors of unconnected cables, bundles or harnesses shall be protected until connection.
- When connecting connectors, the operator shall never touch the optical end faces.
- If contact contamination has occurred, cleaning shall be done according to the process described in AIPS07-11-006.

**KC3** → An inspection of optical end faces and a cleaning if necessary shall be performed before each connection.

##### 4.3.4.2 Inserting/extracting removable optical contact

###### 4.3.4.2.1 Check for good locking

As described in the AIPS07-11-003, after inserting the optical contact into the connector housing, a check for good locking of the contact by lightly pulling the cable shall be performed at the rear of the connector.

**KC4** → The optical contacts shall not be inserted / extracted manually from connector.

NOTE: The use of the insertion / extraction tool is mandatory.

###### 4.3.4.2.2 Bayonet contact housing

Ensure that the connector body does not rotate when the optical contact is inserted into the housing and when the bayonet locking mechanism is being rotated.

###### 4.3.4.2.3 Spring retention contact housing

When inserting the optical contact into the connector housing, ensure that the keyed portion of the contact is aligned correctly in the contact housing without introducing a twist to the cable.

When removing the contacts from their housings ensure that no twisting of the cable occurs.

CAUTION: During extracting operation, the contacts shall never be stressed. If it is necessary, the last tying point can be removed to ensure a good extraction of the contact.

##### 4.3.4.3 Mating of optical connectors

When mating optical connectors, care shall be taken not to rotate the connector to locate the polarization key to prevent torsion stress on the contacts and cable.

##### 4.3.4.4 Drip loop for fluid contamination

The drip loop is applicable to the optical cable.

Special care shall be taken when introducing drip loops.

NOTE: The optical cable or bundle shall not exceed the minimum bend radius.

This drip loop shall allow the displacement (spring effect) of the optical contact when connection is performed to avoid mechanical stress on the contacts.

#### 4.3.4.5 Protecting unused cavities on multi-way connectors

Unused cavities shall be blanked off with contacts or dummy adaptor.

All unused optical contacts shall be sealed with a dummy adaptor or a filler plug.

#### 4.3.4.6 Protecting connection items

The optical end faces of the contacts shall be immediately and mandatory protected after installation into the connector by a protective cap.

Prevention of optical contact end faces contamination shall be achieved:

- On interface plates:

Protective dust caps shall be fitted immediately after disconnection and removed immediately prior to connection on all end items (optical contacts, optical connectors ...)

- On equipment:

Optical interconnects shall be stowed onto suitable dummy receptacles located close to the equipment immediately after disconnection. If dummy receptacles cannot be fitted due to confined areas, protections shall be added in accordance with above chapters.

Whenever necessary optical cables, bundles or harnesses shall be supported by tying devices to adjacent cable bundles or structure.

#### 4.3.4.7 Locking / Self-locking standard items

The tightening torque to be applied are those given in the specifications of the component.

Some products such as circular connectors are equipped with a locking indication (e.g.: Line or spot of white or red paint).

This locking indication shall not be visible after complete locking.

In vibration areas, all standard optical items shall be tightened and locked using a self-locking device.

Special care shall be taken during tightening operation because an insufficient tightening may imply a lack of optical signal transmission.

NOTE: Use of glue is forbidden.

#### 4.3.4.8 Installation of backshells on optical connectors

- When optical fiber cables are routed with a protection sleeve (split conduit), a backshell can be installed in order to maintain the sleeve and protect the cables up to the connector. However, the optical fiber cables shall not be attached to this backshell.
- The attachment of the sleeve to the backshell can be performed by a tying device (refer to AIPS07-07-002 for the implementation)

#### 4.3.5 Identification and marking

All the identification rules are detailed in AIPS07-06-002.

#### 4.3.6 Packaging optical cables and harnesses

After inspection, optical bundles shall be correctly stored in packaging guaranteeing the minimum bend radius, packed and labelled.

For label only refer to AIPS07-11-006.

The ends of the harnesses (connectors) shall be attached (lacing tape, cable tie, etc.) to the packaging to avoid any movement and stress on the optical cable or harness.

Dust caps shall be fitted to all interconnects or optical contacts as described in sub-chapter 4.3.4.5.

NOTE: A desiccant product shall be placed in the primary packaging to absorb condensation.

#### 4.3.7 Optical tests of optical aircraft installation

According to AIPS07-09-002, AIPS07-11-005 and AIPS07-11-007.

### 4.4 Quality instructions

#### 4.4.1 Storing optical bundles and harnesses

- Until time of use, optical cables and harnesses shall be carefully protected from dust, humidity and mechanical impacts.
- The optical cables shall be stored, bended, suspended or coiled as defined in the Product Standard.
- All end items (optical connectors, etc.) shall be protected by dust caps.
- Optical bundles shall be packaged in such a way that the portion which is installed first is the portion first accessible.
- Optical bundles shall not be twisted during the exit of its package.
- End connectors shall be secured during packaging, manufacturing and installation on aircraft to avoid constraint and non-conform curve radius at the level of back-shelves or on the last attachment point.

### 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.

The production organization is responsible to maintain specified quality, measured by the key characteristics stated in table 2.

**Table 2: Key Characteristic**

Product Key Characteristic			Process Key Characteristic		
No.	Designation	Requirement/ Limit	Sub.- No.	Designation	Requirement/ Limit
1	Inspection cleaning			An inspection of optical end faces and a cleaning if necessary shall be performed before each connection	According to AIPS07-11-006
2	Insertion/extraction removable optical contact			The optical contacts shall not be inserted/extracted manually from connector. The use of insertion/extraction tool is mandatory	The optical contact shall not be inserted/extracted by hand.

## 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

The shop shall perform the following series production inspections under serial conditions.

## 8 Rework

Not applicable.

## 9 Environment, health and safety

The manufacturing process shall be in line with Airbus Health and Safety and ecoefficiency 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)

## 9.1 Safety rules

According to IEC60825-1, IEC60825-2 and IEC60825-14 specifications.

- Terminated and un-terminated optical fiber cables can emit potentially hazardous light waves by infrared, ultraviolet, high intensity visible, and coherent light.  
This light may cause injury or permanent eye damage, therefore it is prohibited to directly view the end of an optical fiber; terminated optical fiber or connector, when transmitting or propagating energy.
- Before any maintenance or testing of an optical fiber cable, bundle or harness is undertaken, it shall be confirmed that the system is switched off and that no energy is being transmitted before any component disconnection is carried out.
- All equipment housing laser light sources shall be marked with the recognized symbol for lasers and include a warning label detailing the safety requirements to be taken.

## RECORD OF REVISIONS

Issue	Clause modified	Description of modification
1		New standard.
2 03/07		
3 12/08		Document framework updated.
4 04/12	All	New template and requirements updated.
5 11/14	2 4.3.3.1 4.3.3.2 4.3.3.3 4.3.3.3.1 4.3.3.3.1.1 4.3.3.3.1.2 4.3.3.3.2 4.3.3.3.3.1 4.3.3.3.3.2 Table 1 4.3.3.5 4.3.4.6 4.3.4.8 4.3.6 Table 2	ABS0963-003, ABS1339, EN6049-006 and NSA5516 have been removed. Reference updated and applicability and requirement removed. KC requirements removed. Updated. Updated. KC requirements removed and sub-chapter updated. KC requirements removed and sub-chapter updated. KC requirements removed. Title and KC requirements removed. Updated. New table (supersedes table 1 of the previous Issue) Updated. Last paragraph removed. Note removed. Reference to AIPS07-11-006 added. All KCs No. 1 and No.2, removed.