



AEROSPACE RECOMMENDED PRACTICE

ARP6283™

Issued 2018-01
Reaffirmed 2024-10

In-Service Fiber Optic Inspection, Evaluation and Cleaning, Best Practices, Physical Contact Termini

RATIONALE

The Aerospace industry has always required the highest standards of workmanship to be maintained. To ensure that the Aerospace fiber optics industry adopts these same high standards, it is essential that best practice methods and processes are followed for the in-service inspection, evaluation and cleaning of physical contact (PC) fiber optic interconnect components (termini, alignment sleeves and connectors), test equipment and test leads.

ARP6283 has been reaffirmed to comply with the SAE Five-Year Review policy.

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1. SCOPE

This document provides recommended best practice methods and processes for the in-service inspection, evaluation and cleaning of all physical contact (PC) fiber optic interconnect components (termini, alignment sleeves and connectors), test equipment and test leads for maintainers qualified to the approved aerospace fiber optic training courses developed in accordance with ARP5602 or ARINC807. This document also provides a decision-making disposition flowchart to determine whether the fiber optic components are acceptable for operation. For definitions of individual component parts refer to ARP5061.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR6031	Fiber Optic Cleaning
ARP5061	Guidelines for Testing and Support of Aerospace, Fiber Optic, Inter-Connect Systems
ARP5602	A Guideline for Aerospace Platform Fiber Optic Training and Awareness Education
AS5675	Characterization and Requirements for New Aerospace Fiber Optic Cable Assemblies - Jumpers, End Face Geometry, Link Loss Measurement, and Inspection

2.2 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ANSI Z136.4	Recommended Practice for Laser Safety Measurements for Hazard Evaluation
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2.3 ARINC Publications

Available from ARINC, 2551 Riva Road, Annapolis, MD 21401-7435, Tel: 410-266-4000, www.arinc.com.

ARINC 805	Fiber Optic Test Procedures
ARINC 807	Fiber Optic Training Requirements

2.4 IPC-Association Connecting Electronics Industries

Available from IPC, 3000 Lakeside Drive, 309 S, Bannockburn, IL 60015, Tel: 847-615-7100, www.ipc.org.

IPC-8497-1	Cleaning Methods and Contamination Assessment for Optical Assembly
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2.5 U.S. Government Publications

Copies of these documents are available online at <http://quicksearch.dla.mil>.

MIL-DTL-38999 Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, or Breech Coupling), Environment Resistant with Crimp Removable Contacts or Hermetically Sealed with Fixed, Solderable Contacts, General Specification for

MIL-PRF-64266 Connectors, Fiber Optic Circular and Rectangular, Plug and Receptacle Style, Multiple Removable Genderless Termini, Environment Resisting General Specification for

MIL-PRF-29504 Termini, Fiber Optic Connector, Removable, General Specification For

2.6 Other Publications

Telcordia GR-326-CORE Generic Requirements for Single-mode Optical Connectors and Jumper Assemblies

3. SAFETY

Care should be taken to ensure that there is no active light source on the other end of the interconnect fiber end face being viewed. Fiber-optic light sources generally emit infrared light which is not visible to the naked eye. Viewing a connector end face that is radiating infrared light with an optical microscope can temporarily or permanently damage your eye.

It is the responsibility of every employer to preserve, so far as is reasonably practicable, the health, safety, and welfare of all employees. Common hazards often include chemicals, optical power, fiber fragments, environmental, explosive.

Employers should ensure safety data sheets (SDS), first aid kits, and eye wash stations are available in all areas where fiber optic work is being conducted. Fume hoods should be utilized where applicable.

General awareness of working around aircraft and other potentially explosive environments is a consideration when utilizing any arc fusion splicers, curing ovens, ultrasonic cleaners, heat guns or other electrical or electronic devices.

In addition, all employees have a duty of care to their work colleagues. It is the responsibility of every employee while at work to take reasonable care for his/her own health and safety and that of other persons who may be affected by his acts or omissions at work with regard to:

3.1 Handling

Care should be taken when handling fibers. Flying glass fragments are often the result of cutting and cleaving operations and often go unnoticed. Glass fibers are small enough to puncture the skin and can remain under the skin surface. Besides being an irritant, fragments of glass fibers are not easily seen and can be difficult to remove.

Eating and drinking in the fiber workplace increases the risk of accidental ingestion of glass fibers and must not be permitted. In addition, fiber fragments can adhere to skin oils so after working with fibers, individuals must ensure that their hands are thoroughly washed prior to coming into contact with the face or eyes.

During installation and repair, all snipped or cleaved pieces of optical glass fibers must be placed in appropriate dedicated disposal containers. Pieces of fiber collected on adhesive tape must be disposed in an approved sharps container (a container that stores any device or object that may puncture or lacerate the skin). Fiber waste must never be placed in ordinary garbage for routine disposal. Cables with exposed fiber ends must be adequately protected or positioned to preclude accidental skin puncture or eye damage.

3.2 Eye Safety

Permanent eye damage can occur if exposed to high intensity light sources. Maintainers are unable to manually determine the nature or level of the optical power therefore; the following practices should always be adopted:

- Under no circumstance should a fiber optic connector end-face, fiber optic terminus end-face, prepared optical fiber or fractured optical fiber be viewed directly until it is confirmed that there is no transmitted power through the fiber.

- Do not inspect active fiber optic systems with optical magnifying scopes.
- Protective end caps and connector covers should always be kept on all unmated connectors.
- Wherever possible protective eyewear should be worn when preparing optical fibers for termination.

Refer to ANSI Z136.4 for further information regarding eye safety and light source hazards.

3.3 Hazardous Materials

All SDS information should be made available and appropriate safety and handling procedures used when working with chemicals and other hazardous materials. Unless otherwise specified or allowed in writing by the end-user, the equipment should make no use of Lithium (Li) or Mercury (Hg) batteries, radioactive materials, asbestos, hexavalent chromium, or any other designated toxic material.

3.4 Visual Fault Locator

A visual fault locator (VFL) is a visible red laser in a handheld device designed to inject light energy into a fiber and used to check the integrity of the optical link. Do not point the VFL at the eyes. Use caution when examining connectors with inspection scopes; ensure that the VFL is not connected to the fiber cable being examined. When possible ensure that aircraft systems are de-energized or optically isolated during test or maintenance, and ensure that the VFL is authorized for use on the specific platform and that all safety precautions are adhered to.

3.5 Reflectometer

Fiber optic reflectometry is a method where light pulses are injected into an optical fiber and the reflected light is used to characterize the optical fiber to identify events within the optical link, or length of optical fiber. Two methods are currently used, Optical Time Domain Reflectometry (OTDR) and Optical Frequency Domain Reflectometry (OFDR). Use caution when examining connectors with inspection scopes; ensure that the reflectometer is not connected to the fiber cable being examined. When possible ensure that aircraft systems are de-energized or optically isolated during test or maintenance, and ensure that the reflectometer is authorized for use on the specific platform and that all safety precautions are adhered to.

3.6 Foreign Object Debris

Fiber optic installation and maintenance may produce large quantities of debris, including packaging, wipes, fibers, and swabs which can lead to foreign object debris (FOD). It is essential that all work areas are thoroughly policed and cleaned throughout the process part

4. INSPECTION

This section defines the requirements and methods for performing unaided and aided inspection and evaluation of the entire physical interconnect assembly, alignment mechanisms, and the individual fiber optic termini. All harnesses and connectors must be inspected prior to mating, this includes new 'out of the bag' assemblies. An operator should never assume the termini end faces are clean until they have been properly inspected.

4.1 Unaided Visual Inspection

Unaided visual inspection is limited to evaluating the amount of contamination that is visible to the naked eye on mated and unmated connectors and encompasses the entire physical interconnect assembly. The initial overall inspection is performed prior to demating to determine whether there is any external contamination that needs to be removed prior to demating the connectors. All visible contamination must be removed before the interconnect is demated to prevent cross-contamination of the termini and associated internal workings of the interconnect component parts.

4.1.1 Mated Interconnects

The outer surface of a mated pair of connectors should be inspected for the following effects:

- Type of contamination
- Level of contamination
- Physical damage to the outer parts of the connector bodies
- Flaking of outer surface coatings
- Integrity of any locking capabilities (e.g.,) wire locking holes

4.1.2 Unmated Interconnects

An unmated inspection focuses on the physical interconnect assembly that was not visible while mated as well as the fiber optic termini, and includes:

- Interfacial seals
- Connector insert
- Area between the connector body and locking ring (free plug)
- Exposed termini
- Alignment sleeve assemblies
 - Removable
 - Fixed e.g., MIL-DTL-38999 III with MIL-PRF-29504 termini

4.1.3 Termini

A fiber optic terminus is the element of a fiber optic interconnect that retains and aligns the optical fiber. Inspection of termini end faces and associated alignment sleeve retention mechanisms.

4.2 Aided Inspection

4.2.1 Evaluation

This section provides the user with indicators of what the differences are between low-level and heavy contamination on both mated and unmated interconnects, and provides the decision processes required to select the appropriate cleaning method.

4.2.2 Aided Visual Inspection

Aided visual examination utilizes equipment specifically designed for the inspection of fiber optic terminus end faces and associated alignment mechanisms (e.g.,) alignment sleeves. The equipment can be broken down into two main categories, handheld magnifying inspection equipment, and video inspection equipment. Details of both types are provided in Section 5.

4.2.3 Levels of Contamination

This section defines the various levels of contamination that can be found on fiber optic interconnect assemblies.

4.2.3.1 Low-Level Contamination

Low-level contamination can be classified as loose particles that are easily removed using compressed air or a brush for mated connectors or, loose particles, finger marks, and debris within an unmated connector body, alignment sleeve and terminus ferrule and end face that can be easily removed using appropriate cleaning tools and optical grade cleaning solvent.

4.2.3.2 Heavy Contamination

Heavy contamination can be classified as heavy, compacted contaminants e.g. brake dust, heavy coverage of runway de-icer or other external products that cannot be easily removed using compressed gas or light brushing. It may comprise of large particles or embedded contaminants on a terminus end face, or heavy concentrations of loose particles in the unmated connector assembly body.

4.2.4 Examples of Contamination

Figure 1 shows an example of a clean multimode fiber optic terminus end face. Figures 2 to 9 show examples of various types of end face contamination.

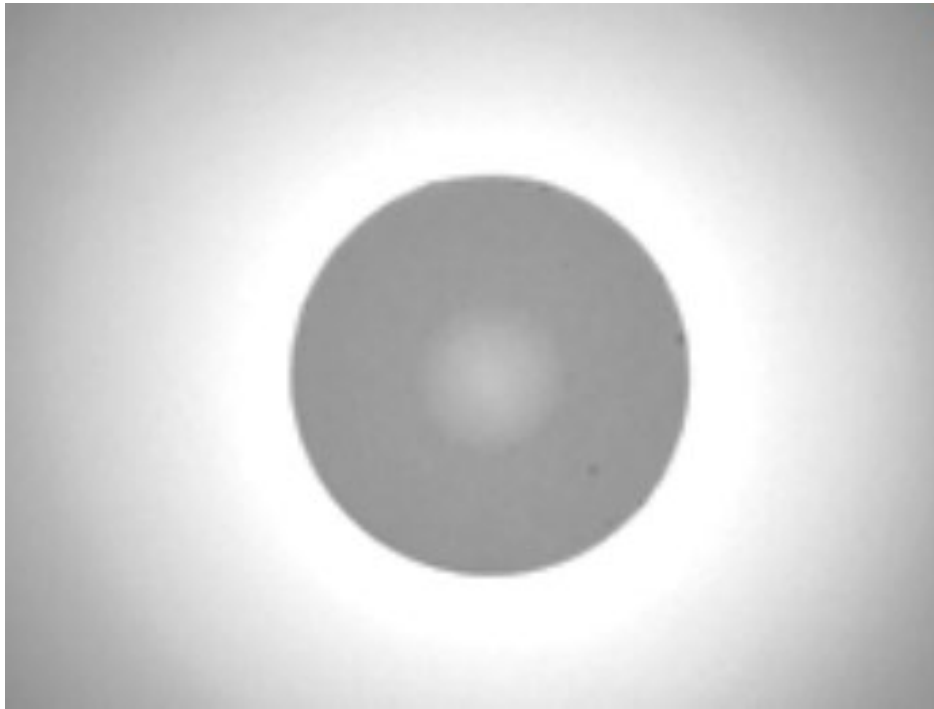


Figure 1 - Example of a clean multimode fiber optic terminus end face

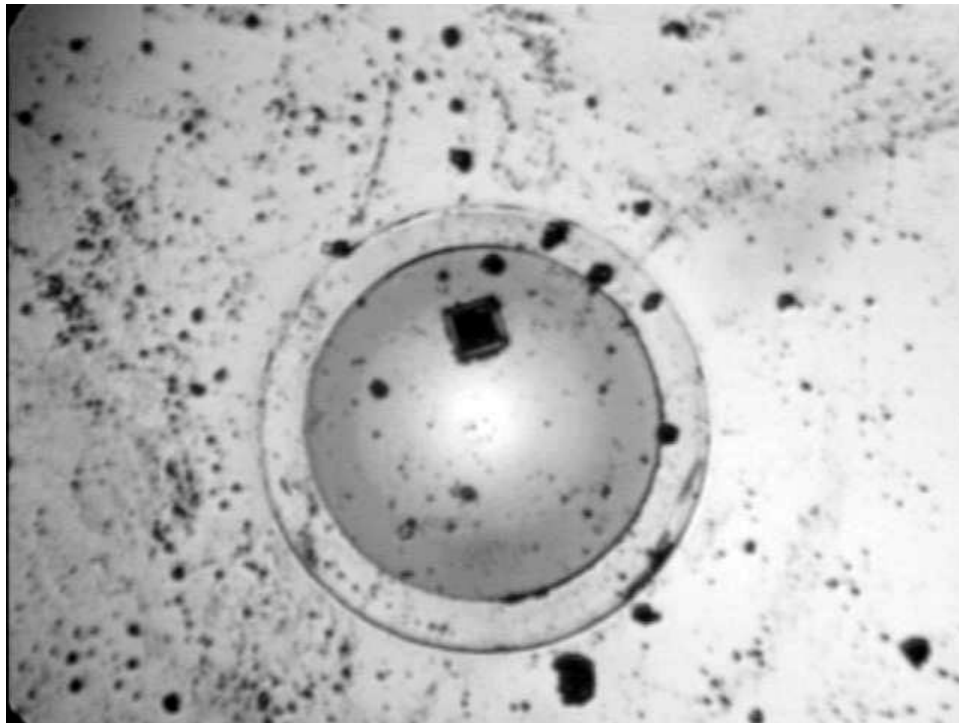


Figure 2 - End face contaminated with dry salt water deposits

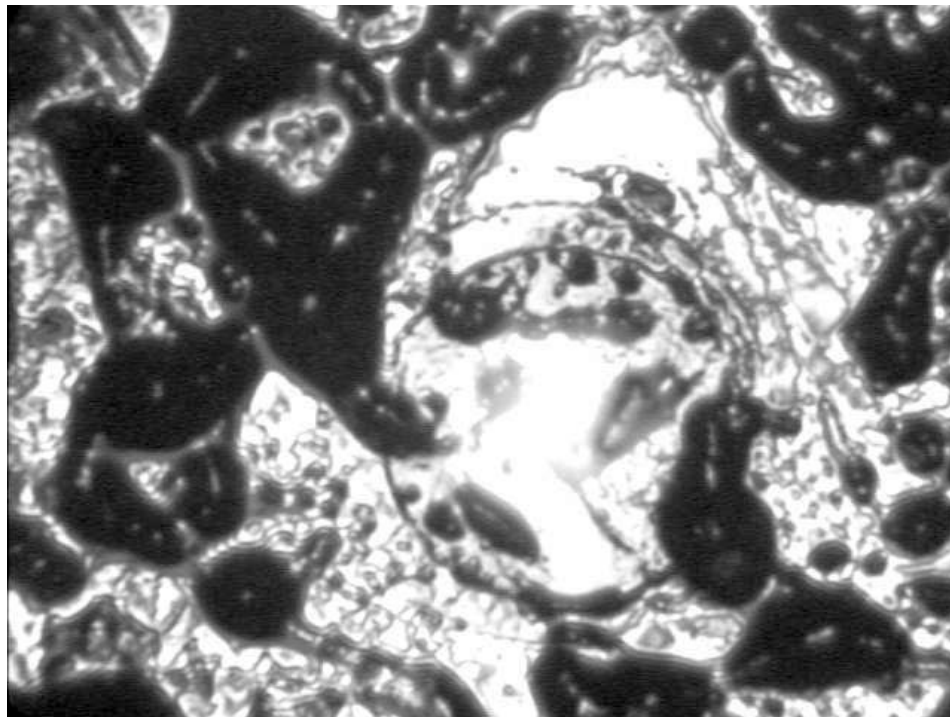


Figure 3 - End face contaminated with instrument grease

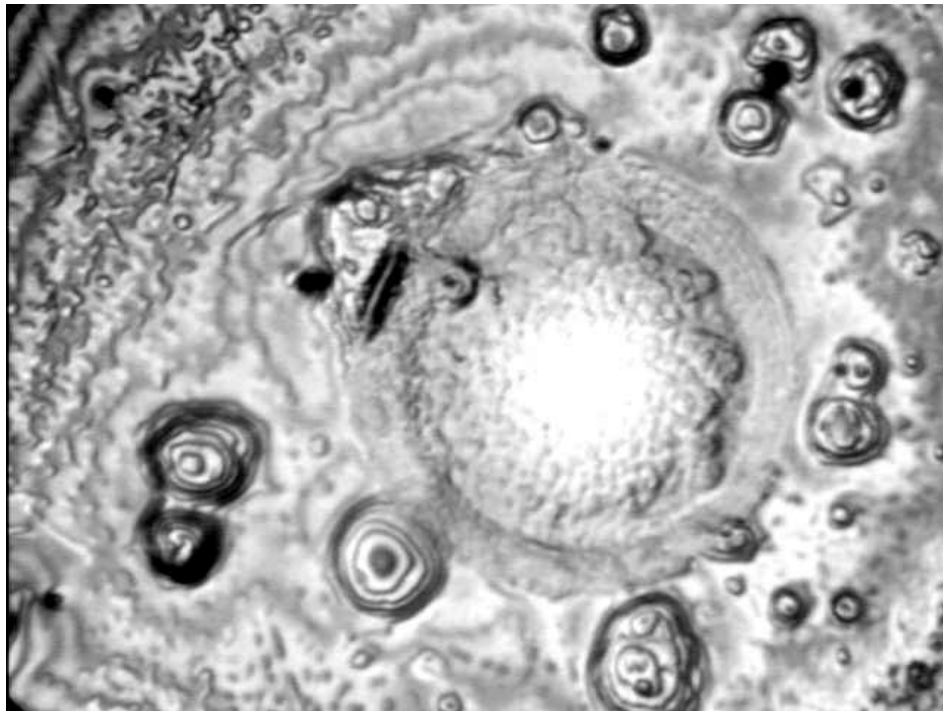


Figure 4 - End face contaminated with aircraft cleaning compound

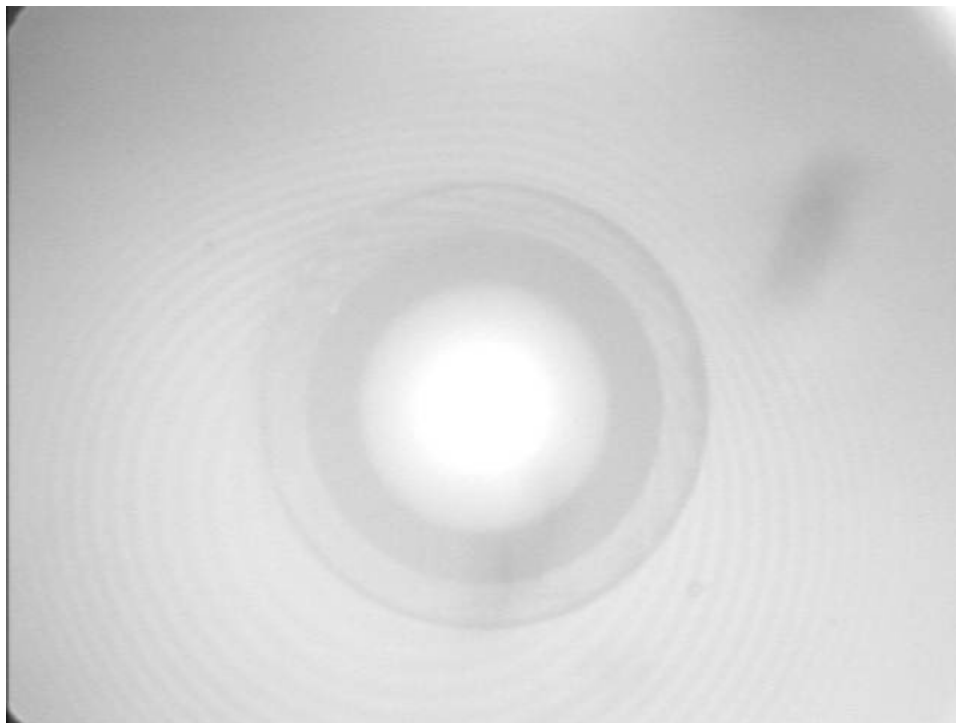


Figure 5 - Endface contaminated with Synthetic hydraulic oil