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TECHNICAL REPORT

Fibre optic interconnecting devices and passive components – Part 01: Fibre optic connector cleaning methods

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS –

Part 01: Fibre optic connector cleaning methods

FOREWORD

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IEC 62627, which is a technical report, has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
86B/2902/DTR	86B/2940/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS –

Part 01: Fibre optic connector cleaning methods

1 Scope

This technical report is intended to emphasize the need for cleaning fibre optic connections as well as describing some of the current tools and methods available for proper cleaning. In addition, the report includes a definition of practices that are not recommended. This technical report explains the need to visually inspect plug endfaces but it does not address the inspection criteria, which are covered in another standard.

NOTE This technical report only covers single fibre plug-adaptor plug or plug-active device configurations, but the same principles apply to plug-socket configurations and multi-fibre ferrules.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
exposed plug endface
EPE
typically, a fibre optic plug that is held in the hand such as the end of a patchcord

NOTE The ferrule is exposed to the air and is not confined within an alignment sleeve of a bulkhead adaptor or device port. The endface of the plug is easy to access and can be brought into contact with the cleaning material.

2.2
port
open fibre optic alignment sleeve which contains a fibre optic plug endface to which a fibre optic plug may be mated

NOTE In the case of a bulkhead adaptor, it is the open side of the adaptor after a fibre optic plug has been inserted into one side. In the case of an optical device, it is the opening into which a user of the device will plug a patch cord. The mating side of a port can only be accessed through the alignment sleeve. Therefore the cleaning material must be brought to the endface through the alignment sleeve.

2.3
bulkhead adaptor
a component in which two or more plugs may be mated

NOTE It has one or more alignment sleeves in which two or more ferrules are aligned.

3 General

3.1 Need for cleaning of fibre optic connections

3.1.1 General

Contamination is the most common source of problems in optical networks. A single particle located on the core of a single mode fibre can cause significant back reflection, attenuation and fibre damage.

With increased data rates, it has become increasingly important to ensure that all plugs and adaptors are inspected and if necessary cleaned before mating. This means that both sides

of a connection and the inside of adaptor sleeve should be inspected and if necessary cleaned before making the connection. This applies to test equipment and test cords as well as network components. New plugs shall be inspected and if necessary cleaned as well. Inspecting and cleaning every connection every time is the best assurance of a reliable optical network.

3.1.2 High power levels

High power levels may be experienced in transmission fibres, particularly where Raman amplifiers are used – pump power levels of one Watt (+30 dBm) or more may be present in the core of the fibre giving an energy density equivalent to 12,5 GW/m^2 for a single mode core with an effective area of 80 μm^2. Also high power levels may be used for information transmission in DWDM (Dense Wavelength Division Multiplexing) systems, where high power systems may have 100 mW to 1 W total signal power. When optical power of this magnitude is transmitted within a single mode fibre, any contamination on the endface of a fibre optic plug will be heated to extremely high temperatures resulting in possible vaporization of the contaminate and melting of the glass, thereby destroying the integrity of the connection and requiring a complete replacement of the connection components.

3.1.3 High data rates

With the onset of high data rate systems at gigabit data rates and above, cleaning multimode fibre optic plugs has become much more important. In the past, at slower data rates (10 Mb/s and 100 Mb/s), the use of LEDs as the light source and the larger size of the multimode core allowed for "some" contamination without noticeable network performance degradation. Equipment power budgets were typically in the range of 10 to 15 dB. Now with data rates at 1 Gb/s, 10 Gb/s and higher data rates the allowable channel insertion loss may be as low as 2,35 dB for example. Also, the use of VCSELs means that plug cleanliness is necessary to assure minimal back reflection thereby assuring system performance.

3.2 What is the source of contamination?

3.2.1 Mishandling

Mishandling of a plug endface is the most common source of contamination. Accidentally touching the endface will spread skin oil or hand lotion across the endface. Accidentally brushing the plug endface on clothing can leave skin oil or other oil previously absorbed by the fabric, lint generated from the material, particles held in the fabric or surfactants from previous cleaning of the garment. Leaving a fibre optic port or plug endface unprotected from the environment subjects the endface to environmental sources of contamination as discussed below.

Typical examples of contamination are shown in Figure 1.

IEC 1806/10

1a) Clean plug wiped on T-shirt

IEC 1807/10

1b) Clean plug wiped on jeans

Figure 1 – Typical examples of contamination

3.2.2 Environmental sources

Environmental sources of contamination are too numerous to catalogue completely. Building materials are a common contributor to fibre optic plug contamination; sawdust, sheet plaster dust and paint fumes are all potential contributors. Pollutants in the air can find their way onto plug endfaces. In dry climates airborne dust particles will find their way onto plug endfaces. In very damp humid areas, airborne contaminates can condense on the plug endface. Considering fibre optic applications exist in military, medical, oil and gas and manufacturing industries, the variety of potential contaminants becomes very large.

3.2.3 Contamination travels

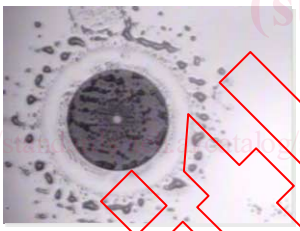
Contamination travels between plugs, as illustrated in the images in Figure 2. The insertion of a contaminated plug into a port will spread that contamination to the mated endface, which in turn will spread the contamination to the next plug that is plugged into the port. Below are pictures of the results of mating a clean plug with a contaminated plug.

IEC 1808/10

2a) Plug A before mating

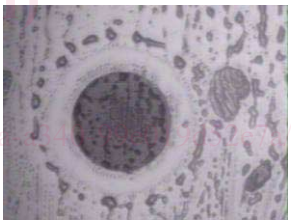
IEC 1809/10

2b) Plug B before mating



IEC 1810/10

2c) Plug A after mating



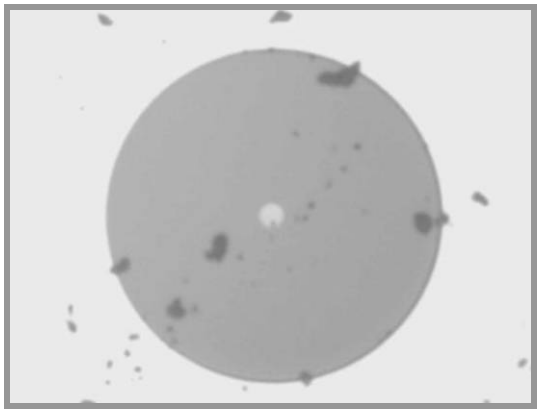
IEC 1811/10

2d) Plug B after mating

Figure 2 – Results of mating

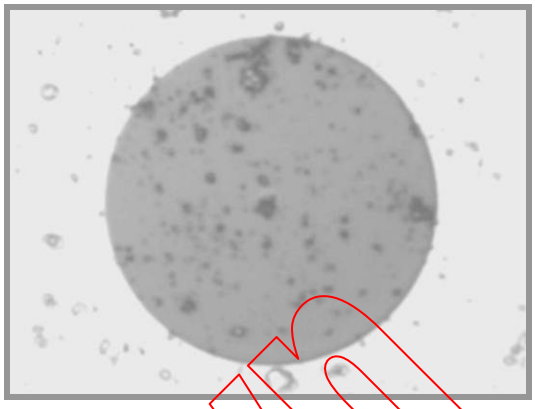
3.2.4 Contamination migration

Contamination can migrate toward the core, as shown in Figure 3. Initial contamination outside the core zone can be broken up by mating and travel toward or onto the fibre core.



IEC 1812/10

3a) Initial contamination



IEC 1813/10

3b) After 4th mating

Figure 3 – Contamination migration

3.3 What do I need to clean?

3.3.1 Fibre optic patch cord

If you are installing a fibre optic patchcord in your network, even a brand new one (right out of the package), the plug endfaces on both ends of the patch cord should be inspected and if necessary cleaned before mating. A new patch cord is not necessarily clean. It is most likely that it was clean when tested at the manufacturing plant but can become contaminated before you open the package to install the fibre optic cord.

3.3.2 Plug endfaces

If you are using a bulkhead adaptor to mate two plugs you should inspect and, if necessary, clean the plug endfaces on both sides and the inside of the sleeve of the adaptor before inserting them into the adaptor. If you cannot remove a plug from an adaptor to clean it, then the end-face shall be inspected and if necessary cleaned while it is in the alignment sleeve.

3.3.3 Testing or trouble shooting

If you are testing or troubleshooting your network, you will need to inspect and clean all plugs before mating. These connections include test equipment ports, adaptors, test cord plug endfaces and any ports into which you will be plugging the test cord. Every connection, every time, needs to be inspected and if necessary cleaned.

3.4 What are the effects of contamination?

3.4.1 Signal degradation

Example signal degradation (increased attenuation and back reflection) is shown in Figure 4.