White Paper

The importance of cleanliness when handling fibre

excel
without compromise.

One of the most basic and important procedures for the maintenance of fibre optic systems is to clean the fibre optic equipment.

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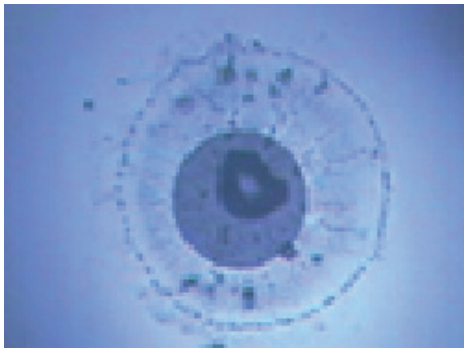
Any contamination in the fibre connection can cause failure of the component or failure of the whole system. Even microscopic dust particles can cause a variety of problems for optical connections. In a survey carried out by Fluke Networks they claim that 85% of the failing links can be attributed to 'end-face contamination'.

To illustrate this it can be compared to a typical human hair which is between 50 and 75 micron. A dust particle can be as little as 9 micron and is pretty much impossible to see without a microscope. Despite this it could completely block a single mode fibre core, and if trapped between two fibre faces it can even scratch the glass, damaging the end-face. If this happens then at best it will require the careful and time consuming process of being polished out and, at worst, it will have to be replaced.

Furthermore, with high power lasers now in use, if the contamination remains in place when the laser is turned on it can actually be burned into the end-face to such an extent that it cannot be polished out.

Whilst this may seem extreme consequences, each time you disconnect and re-connect a fibre connector problems can be re-introduced; a statement backed by a study carried out by NEMI (National Electronics Manufacturing Initiative)

The study showed that mating caused loose contaminants to spread. Through connection, a significant amount of the particles were transferred from the contaminated connector to the clean reference connector in a pattern similar to that seen on the contaminated connector.



Even the use of 'dirty' dust caps can have a significant impact on the 'cleanliness' of the fibre installation. The oil from human skin can also have a dramatic effect when viewed under a microscope.

A recent incident was reported claiming that fibre cable was failing after less than 10 years of use, when it shouldn't degrade at all over this period of time. The first clue to the culprit of the problem was that the building and cabling infrastructure had transferred ownership on two separate occasions during this time. Each time, there was a massive opportunity to introduce contamination, which in reality is what had occurred.

There are many excellent documents which cover the correct procedure for cleaning and inspecting fibre optic end-faces, however we should always defer to the standards if they are available. In February 2010 the British Standards Institute published BS EN 61300-3-35 Examinations and

Visual requirements for PC polished connectors, single mode fibre, RL ≥ 45 dB

Zone name	Scratches	Defects
A: core	None	None
B: cladding	No limit ≤ 3 µm None > 3 µm	No limit < 2 µm 5 from 2 µm to 5 µm None > 5 µm
C: adhesive	No limit	No limit
D: contact	No limit	None => 10 µm

NOTE 1 For scratches, the requirement refers to width.

NOTE 2 No visible subsurface cracks are allowed in the core or cladding zones.

NOTE 3 All loose particles should be removed. If defect(s) ae non-removable, it should be within the criteria above to be acceptable for use.

NOTE 4 There are no requirements for the area outside the contact zone since defects in this area have no influence on the performance. Cleaning loose debris beyond this region is recommended good practice.

NOTE 5 Structural features that are part of the functional design of the optical fibre, such as microstructures, are not considered defects.

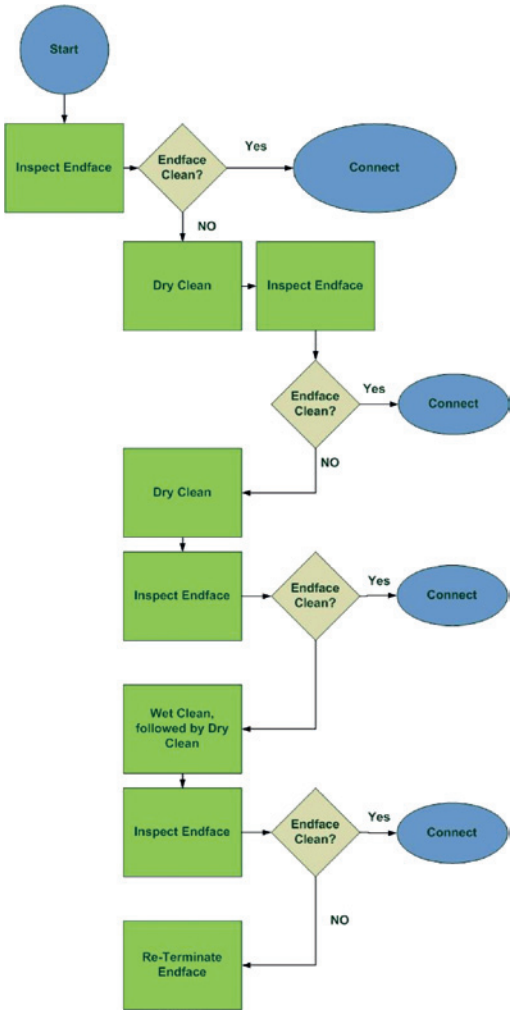
continued overleaf

Measurements-Fibre optic connector end-face visual and automated inspection. This document outlines the criteria for the number and details of the scratches and defects that can appear on the end-face, both in the core and cladding areas. The following is a table taken from the document that outlines the limits for single mode with a return loss of ≥45dB.

Cleaning Methods

There are a range of cleaning products on the market and it is almost a case of you pay your money and make your choice. The two most popular are the cassette type cleaners such as Cletops or the Pen/Swab type. Whatever the choice, it is important to follow the correct procedure/instruction. Failure to do so could lead to even more contamination being introduced.

The following is a flow chart outlining the suggested process for cleaning fibre connectors.



Conclusion

Cleaning fibre is not a mystery it just requires some common sense and a little thought before the cleaning process starts. There are, of course, some warnings that must be noted.

Here are just a few of the dos and don'ts:

- Never touch the end-face of the fibre connectors - natural body oil can be a major cause of contamination
- Always keep a protective cap on unplugged fibre connectors – protection from both damage and contamination
- Do not clean bulkhead connectors without a way of inspecting them – how else will you know whether the cleaning is successful?
- Always store unused protective caps in a sealed container - they can also be a major source of contamination if not stored in a clean environment.
- Never re-use any tissue, swab or cleaning cassette reel
- Never touch any portion of tissue or swab where alcohol was applied – you could be introducing both dirt and body oil
- Never use a wet cleaning method without a way of dry cleaning immediately afterwards - the wet process can leave a harmful residue that is hard to remove when it dries

Finally, be warned:

Ensure all the fibre connectors you intend to clean are disconnected. And **NEVER** look into a fibre with either a fibre microscope or the naked eye when the lasers are on.

This White Paper has been produced by Paul Cave, Technical Manager, on behalf of Excel.

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