

TECHNICAL REPORT



**Fibre optic active components and devices – Reliability standards –
Part 4: Guidelines for optical connector end-face cleaning methods for
receptacle style optical transceivers**

IEC TR 62572-4:2020

<https://standards.iteh.ai/catalog/standards/sist/22da6ad6-ae4f-486c-97a0-1e44c719c53b/iec-tr-62572-4-2020>



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – RELIABILITY STANDARDS –

Part 4: Guidelines for optical connector end-face cleaning methods for receptacle style optical transceivers

FOREWORD

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IEC TR 62572-4, which is a Technical Report, has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) addition of terms and definitions on multifibre connector interface optical transceivers;
- b) addition of cleaning methods for multifibre connector interface type optical transceivers;

c) updating URLs for reference websites.

The text of this Technical Report is based on the following documents:

Draft TR	Report on voting
86C/1661/DTR	86C/1681/RVDTR

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

A list of all parts in the IEC 62752 series, under the general title *Fibre optic active components and devices – Reliability standards*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

High speed internet communication systems and subscriber systems have spread rapidly owing to the increased capacity of data communication. In these systems, receptacle style optical transceivers such as SFP (small form factor pluggable) and XFP (10-Gbit/s small form factor pluggable), which can be mounted and removed during transmission systems operation, are widely used. Optical receptacles of optical transceivers are connected to optical connector plugs of optical patch cords, and optical signals are transmitted and received through these optical receptacles. Pluggable optical transceivers are typically of small size and low cost, and their designs are often simplified. Therefore, the internal structure, especially the receptacle structure, tends to vary between optical transceiver manufacturers.

Generally, to maintain high reliability of optical connections, the optical connector end-face needs to be cleaned. The Technical Report on cleaning of optical connector plugs and optical adaptors, IEC TR 62627-01 [1]¹, proposed by Japan, was published in August 2010 and revised in January 2016.

There are, however, no standard cleaning methods for the optical receptacles of optical transceivers. It is a concern that the failure of optical transceivers due to damage and contamination of the optical receptacle end-face can lead to failure in optical network systems.

Multifibre connectors, like the multi-fibre push-on (MPO) connector – see IEC 61754-7 (all parts) [2] – have been widely used in data centres as fibre-to-fibre connections since the early 2010's. They are now also used as optical interfaces in optical transceivers, such as QSFP (quad small form factor pluggable) and CFP (C form factor pluggable) transceivers.

The physical structure of the optical interfaces in transceivers with MPO connectors is significantly different from that of transceivers with single fibre connectors, such as SC connectors (see IEC 61754-4 [3]) and LC connectors (see IEC 61754-20 [4]). Therefore, it was decided to revise this document by adding information on cleaning methods for MPO interface receptacle style optical transceivers.

IEC 62572-4:2013 was based on OITDA TP12/TP-2012, and this edition is based on OITDA TP12/AD-2019 [5].

¹ Numbers in square brackets refer to the Bibliography.

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – RELIABILITY STANDARDS –

Part 4: Guidelines for optical connector end-face cleaning methods for receptacle style optical transceivers

1 Scope

This part of IEC 62572, which is a Technical Report, provides guidelines for optical connector end-face cleaning methods for receptacle style optical transceivers. It includes details about handling receptacle style optical transceivers, internal structures of optical transceivers, information on cleaning tools and machines, applicable cleaning methods, and cleaning procedures.

Receptacle style optical transceivers as well as optical fibre patch cords are handled by operators and maintenance staff of optical network systems. This document can be used as a guideline to prepare instruction manuals for the operators and maintenance staff of optical network systems.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 stub

polished short ferrule, including optical fibre inside, mounted in a receptacle style optical transceiver

Note 1 to entry: The stub is connected to an optical connector plug of an optical patch cord.

3.2 stub type optical transceiver

receptacle style optical transceiver with a stub

3.3 lens type optical transceiver

receptacle style optical transceiver without a stub, optically coupling an optical semiconductor device to an optical connector plug of an optical patch cord with converging optical beams by a lens or lenses

3.4

plate contact type optical transceiver

receptacle style optical transceiver without a stub connected by contacting a flat or convex plate (glass or plastic) to an end-face of an optical connector plug of an optical patch cord

3.5

multifibre ferrule type optical transceiver

receptacle style optical transceiver with a multifibre ferrule connecting to a multifibre connector plug

EXAMPLE 1 MT multifibre ferrule (see IEC 61754-5 [6]).

EXAMPLE 2 MPO multifibre connector plug – see IEC 61754-7 (all parts) [2].

3.6

no ferrule type multifibre optical transceiver

receptacle style optical transceiver without a stub and a multifibre ferrule, optically coupling an optical semiconductor device to a multifibre connector plug of an optical patch cord

3.7

optical transceiver

optical module functioning as an optical transmitter and an optical receiver

Note 1 to entry: There are two types of optical interfaces: single-fibre connector and multifibre connector.

3.8

reel type cleaner

optical connector plug end-face cleaning tool consisting of a cleaning cloth rolled and packed in a cassette box and a small window for cleaning

3.9

stick type cleaner

swab type cleaner

optical connector receptacle and optical connector adaptor end-face cleaning tool consisting of a cleaning cloth attached to the top of a stick

3.10

pen type cleaner

optical connector receptacle and optical connector adaptor end-face cleaning tool consisting of a tape-shaped cleaning cloth on the top of a tool that moves and cleans

3.11

gas and vacuum type cleaning machine

optical connector end-face cleaning machine that injects and extracts volatile liquid solvent (gas) from a nozzle

3.12

air duster

canned air

cleaning tool that blows compressed air from the nozzle of a can

3.13

dust cap

protective cover or cap attached to an optical connector plug, optical connector adaptor, or optical receptacle when the optical connector is not connected

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4 Application of receptacle style optical transceivers and influence of contamination on optical connector end-face

4.1 Application of receptacle style optical transceivers

Almost all optical receptacle style transceivers are a pluggable type. Pluggable optical transceivers are often attached to the front panels of optical network equipment. For installation and maintenance, pluggable optical transceivers (as well as patch cords) are mounted and removed from optical network equipment by operators and maintenance staff of optical network systems.

When optical components and modules with connector plugs are mounted in optical network equipment by equipment manufacturers, the environment (temperature, humidity and dust) in optical network equipment factories is generally well controlled, and precautions are taken to assure that components are kept clean. However, environments in which optical network systems operate, such as central office, data centres and computer rooms, are not generally as clean as those in the equipment factories. In these environments, dust or condensation can be introduced onto the optical connector end-faces of optical transceivers.

4.2 Influence of contamination on optical connector plugs

Optical signals propagate within or slightly outside of the core of optical fibres, the diameter of which is very small, typically from about 9 µm to around 50 µm. If a very small particle of dust of a few micrometres (µm) in size is deposited on an optical fibre core of an optical connector plug, the optical connector might not achieve its designed optical performance (loss and return loss), which can adversely impact the performance of the optical network system in which it is used. Cleaning of optical connector plugs is important and is described in IEC TR 62627-01 [1]. IEC TR 62627-05 [7] summarizes the relationship observed between contamination of optical connector end-faces and optical performance (loss and return loss).

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4.3 Transferring of contamination

Optical connector plugs and optical connector receptacles can be mated many times, and they can also be mated to different connectors. When the end-face of an optical connector plug is contaminated, that contamination can be transferred to the optical receptacle to which it is mated. Moreover, that contamination can be transferred from the receptacle to another optical connector plug to which it is mated. Contamination can be spread from one component to another like an infection. Therefore, it is most important to prevent contamination of the optical connector end-face and to clean the end-face when contaminated.

4.4 Influence of contamination of optical connector for optical transceivers

Contamination of the optical connector end-face of receptacle style optical transceivers can impact optical performance in the same way that contamination of optical connector plugs impacts optical performance. The International Electronics Manufacturing Initiative (iNEMI) presented a paper at the Warsaw meeting of IEC/SC 86B in April 2012 that illustrates the impact of contamination on transmitter/receiver optical subassemblies (TOSA/ROSA) [8].

5 Care in handling of receptacle style optical transceivers

5.1 General

Clause 5 describes general care in handling of receptacle style optical transceivers. It is advisable to follow the manufacturer's operating manuals or instructions, where provided.

5.2 Storage of receptacle style optical transceivers

Receptacle style optical transceivers should be stored so as to protect the device from static electric discharge, dust, mechanical shock, and vibration and should also be kept within a

specified temperature and humidity range. During storage, dust caps should be placed on optical receptacles to prevent contamination.

5.3 Installation of receptacle style optical transceivers

Pluggable type receptacle style optical transceivers are used on the front panels of optical network equipment. When a pluggable type optical transceiver is mounted while network equipment is operating, the optical transceiver is driven by electrical power coming through the electrical pins of the transceiver. Dust caps should be put on optical receptacles when mounting on operating equipment to prevent eye damage to maintenance staff as well as to prevent contamination of the transceiver.

5.4 Connection of optical connector plugs to receptacle style optical transceivers

Optical connector plugs are connected to the optical receptacles of an optical transceiver after mounting on equipment. Dust caps should be removed just before the optical connector plugs are connected. Care should also be taken to prevent dust from entering the optical receptacle. Optical connector plug end-faces should be inspected and cleaned if contamination is observed. After optical connector plug end-faces are inspected and found to be in compliance with the specified visual inspection requirements, the optical connector plugs are connected to the optical receptacles of the transceivers. Optical receptacle end-faces are more difficult to clean than optical connector plug end-faces. Moreover, there are several different internal structures of optical receptacles of optical transceivers, and applicable cleaning methods will differ depending on these internal structures. To prevent transferring of contamination, as described previously, optical connector plugs should be inspected and cleaned as needed.

5.5 Removing of receptacle style optical transceivers

When optical transceivers are removed from equipment, optical connector plugs should be disconnected first, dust caps should then be placed on both the optical receptacles and the optical connector plugs, and only then should the optical transceivers be removed from the equipment.

5.6 Action in case of abnormality

When the performance of network equipment is degraded to the point at which it fails to function properly, and it is determined that failure has been caused by an optical transceiver, the optical transceiver should be removed and analysed. After removing the failed transceiver, the optical receptacle end-faces should be inspected. There is danger of eye damage if the end-faces are directly observed while still mounted to operating equipment and the transmitter is emitting optical radiation. Annex D shows examples of optical connector receptacle end-face visual inspection equipment. When contamination is observed on the end-faces of optical receptacles, it should be cleaned by appropriate cleaning methods depending on the internal structure of the receptacles. If the internal structure is not distinguishable, it should not be cleaned, or cleaned only by an air duster.

6 Cleaning tools and machines

6.1 General

It is well known that reel type cleaners work well for cleaning optical connector plug end-faces. However, it is more difficult to clean optical receptacle end-faces because the end-faces are located in the bottom of small diameter holes.

IEC TR 62627-01 gives general information on optical cleaning methods and cleaning tools and machines for optical connector plug end-faces. The typical cleaning method for connector plug end-faces is rubbing the end-face with a cloth. As rubbing can produce a static electric charge, which can hold contamination, it is recommended to use an optical connector cleaner with cloth that has been processed so that it will not create a static electric charge on the end-face. Lint-