An Apparatus for Fast Inspecting and Cleaning Connector

Paul Huang, Jose M. Castro, Thomas Sedor, Rick Pimpinella, Bulent Kose, Brett Lane
Fiber Research Labs, Jack Caveney Innovation Center, Panduit Corp., Tinley Park, Illinois Tinley Park, IL
yuh@panduit.com

Abstract: In this paper, we present a novel apparatus that can inspect and clean the end face of the fiber-optic connector without the need to switch the connector from one tool to another.
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1. Introduction

Fiber optic links are susceptible to dust, oil, and other contaminants on the mating connector face [1]. Therefore, verifying that the connector end face is cleaned before a connection is important during the network installation. The degree of cleanliness can be determined using a fiber inspection microscope. For example, if the dust on the connector's end face is too large to pass the requirement of the standard [2], it needs to be cleaned. A reel-type one-click cleaner is a standard tool for cleaning optical connectors or receptacles, as shown in Fig.1.

Fig.1. reel-type one-click cleaners

The cleaning and inspection operation is performed separately in the visual inspection microscope or cleaner devices described above. However, a device that can do both cleaning and inspecting almost simultaneously without disconnecting the device under test is not available in the market. Therefore, there is a need for such a device, which can enable more reliable installation of optical interconnects while reducing time and saving costs.

2. A new apparatus for fast inspecting and cleaning MPO connector

A fiber inspection microscope typically consists of an illuminator, a lens, and a camera sensor, as shown in Fig.2. These visual inspection systems could either have a manual focus or autofocus functionalities which can automatically center, focus, capture images, and analysis of the contamination of the connector end face.

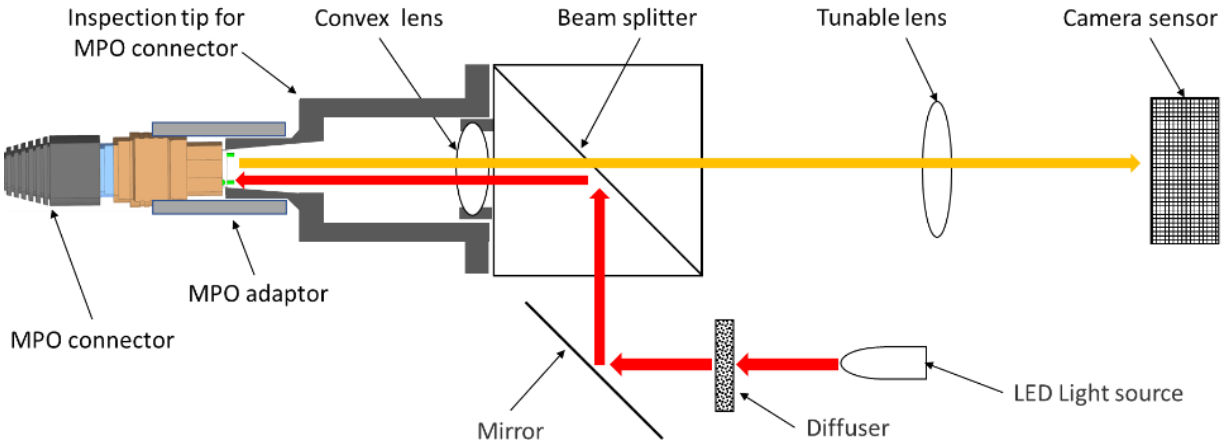

Fig.2 a microscope for connector inspection

As we can see from Fig. 2, there is no space to insert the one-click cleaner to clean the MPO connector under inspection. To clean that MPO connector, usually, we need to remove the MPO connector from the inspection microscope, insert it into an MPO adaptor, and insert the one-click cleaner from the other side to clean its end face.

However, if we add a moveable mirror to fold the optical path from the microscope by 90 degrees, the one-click cleaner can enter the MPO adaptor after pushing the moveable mirror away.

Our solution is shown in Fig.3(a), a moveable mirror is attached to a hinge and is pushed to rotate clockwise by the spring inside the hinge. The mirror is limited by a stop so that it forms an angle of 45 degrees with the optic axis of the microscope. When the moveable mirror remains at this angle, the microscope can see the MPO connector's end face, and the system continues to work in inspection mode. If dust is found on the end face of the MPO connector, the user can push the one-click cleaner down along the guiding slot for cleaning access. The cleaner will force the moveable mirror to rotate counter-clockwise so the cleaner can reach the MPO connector end face, as shown in Fig.3(b). When the user releases the one-click cleaner, the moveable mirror retracts, and the user can inspect the end face of the MPO connector once again to see if the dust has been removed.

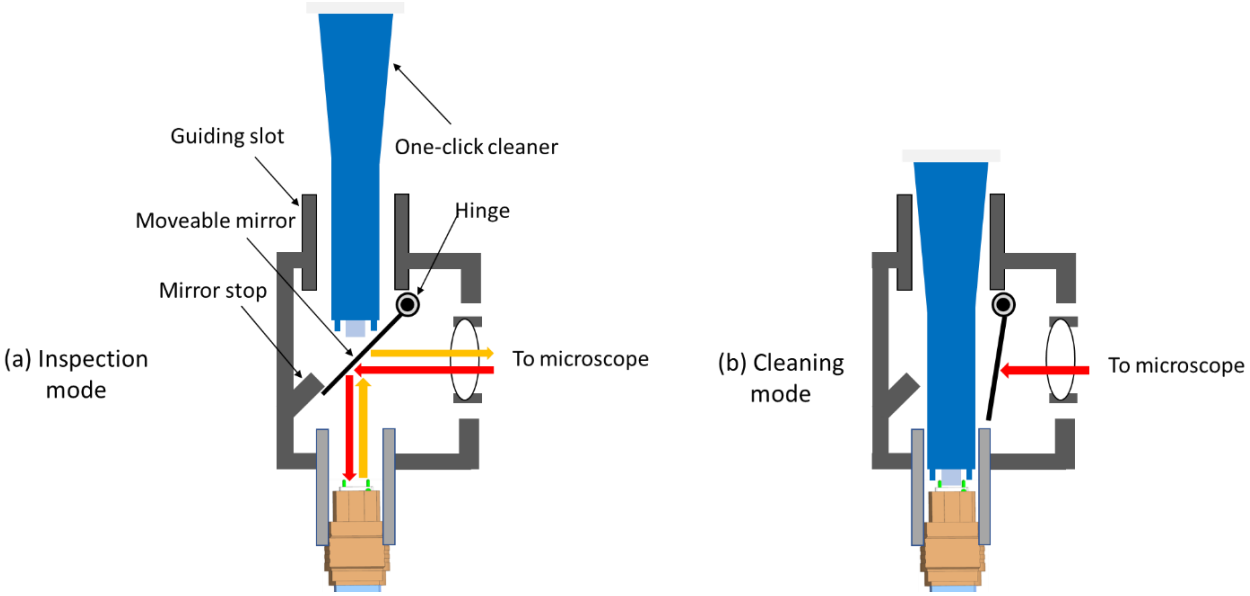

Fig.3. a system that can perform both inspection and cleaning of the MPO connector

To build such a system that can fast inspect and clean a connector, we need to develop an inspection microscope that can check the MPO end face in a short time at first. To overcome the slow speed of most commercial MPO inspection microscopes that need to inspect the fibers one by one due to their narrow field of view, we built a wide-view inspection microscope that can view the whole MPO connector end face in one image in real time. The microscope prototype is shown in Fig.4(a). This microscope has a field of view covering an MPO connector's 12 or 24 fibers. To further extend its field of view, we align the MPO connector in the diagonal direction of the camera sensor so that the microscope can also see the two pinholes of the MPO connector, as shown in Fig.4(b).

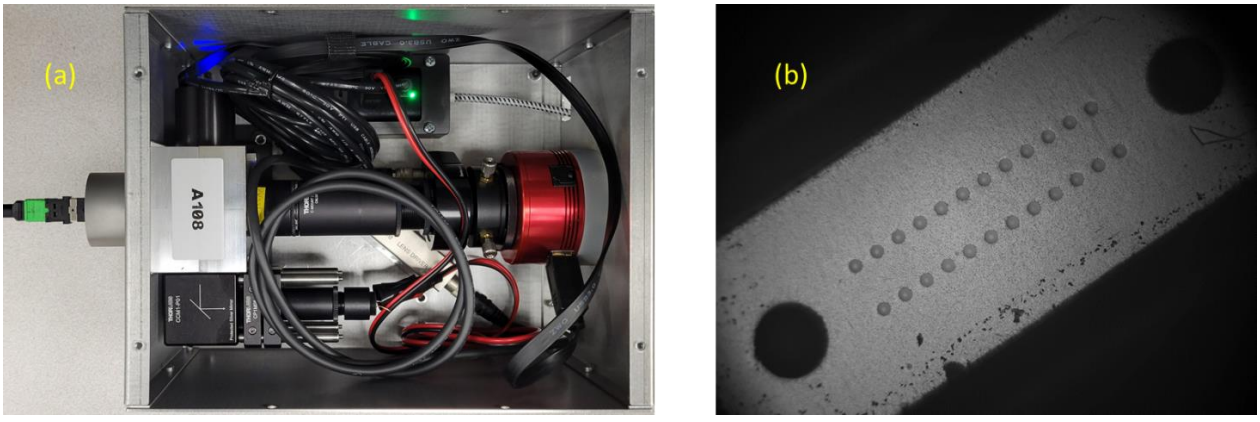

Fig.4(a) microscope prototype, (b) MPO end face image taken by the microscope

Furthermore, we built the prototype of a moveable mirror system that can be attached to the wide-view microscope, as shown in Fig.5. It enables the microscope to inspect and clean an MPO connector without switching the connector from one tool to another.

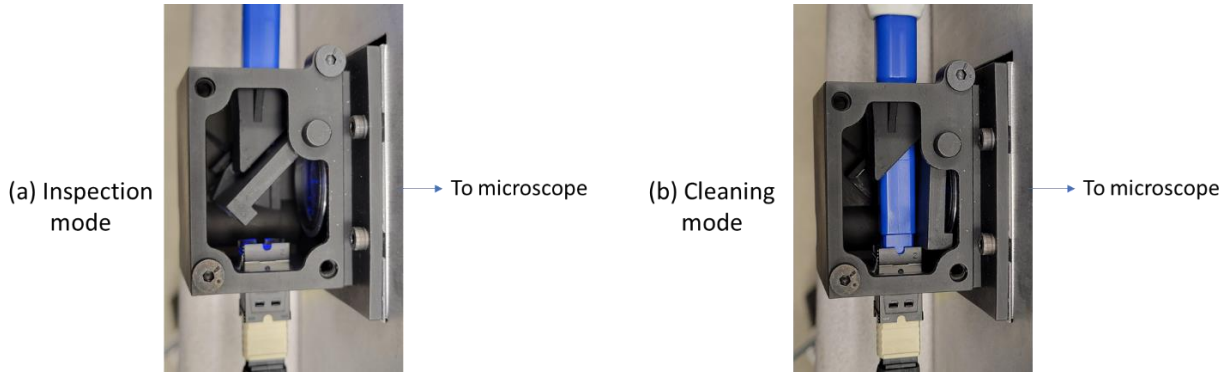

Fig.5 prototype of a moveable mirror system enabling a microscope to both inspect and clean the MPO connector

Fig.6(a) shows the microscope picture when a dirty MPO connector with a fingerprint is inserted into the inspection tool. Fig.6(b) shows the microscope picture when the user pushes the one-click cleaner to access the MPO connector. Fig.6(c) shows the microscope picture of the MPO connector after cleaning. The MPO connector is typically cleaned after one round of inspection with a single cleaner insertion. This saves time and labor costs on inspection and cleaning. Moreover, if one cleaner insertion is insufficient to clean a connector, the user can perform several inspection rounds to certify end face cleanliness. Hence, utilizing this inspection and cleaning system will further reduce the time and labor on these connectors that need multiple cleaning.

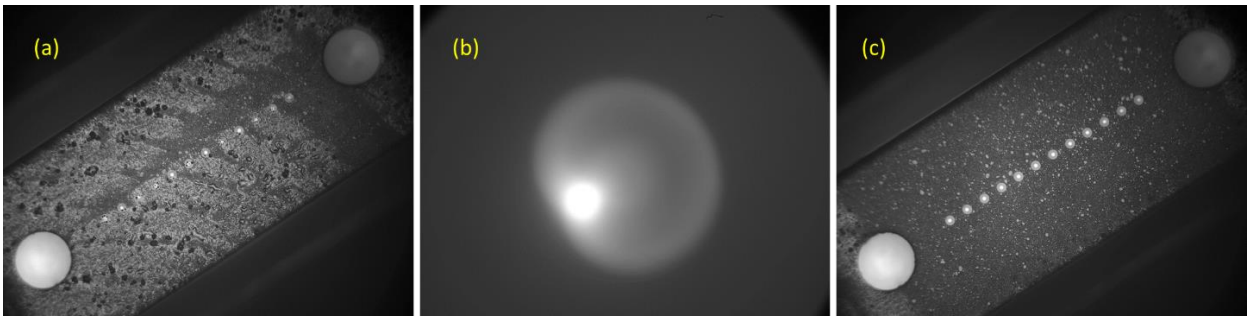

Fig.6(a) microscope picture of the end face of a dirty connector, (b) microscope picture when the apparatus is cleaning the connector end face, and (c) microscope picture of the end face of the cleaned connector

3. Discussion, Summary, and Conclusions

We designed and built a novel apparatus with a moveable mirror attached to an inspection microscope. It allows the user to inspect and clean the MPO end face without switching the MPO connector from the inspection microscope to the cleaning tool, saving time and manufacturing costs. Such a system is not limited to MPO connectors but should also work for single fiber connectors. It could work manually and as an automatic inspection and cleaning system in mass production.

4. References

[1] T. Berdinskikh, J. Bragg, E. Tse, J. Daniel, P. Arrowsmith, A. Fisenko, S. Mahmoud, "The contamination of fiber optics connectors and their effect on optical performance', in Technical digest series of OFC 2002, Anaheim, California, March 17- March 22, 2002, pp. 617-618.
[2] IEC 61300-3-35:2022, Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-35: Examinations and measurements - Visual inspection of fibre optic connectors and fibre-stub transceivers