

## High-Precision Dual-Core Ferrule

### 1. INTRODUCTION

The 2-fiber ferrule is a key element in DWDM optical modules. Although 2-fiber ferrules made of zirconia ceramics have been widely used for some time, high-precision dual-core ferrules made of resin have been developed by Furukawa Electric. They are more easily mass-produced and therefore realize cost reductions. Precision molding techniques using the epoxy resin that has a proven track record in MT ferrules have made possible an attractive product offering numerous features.

In the following we describe the features of this high-precision dual-core ferrule, as well as an example of a product in which it may be used.

### 2. FEATURES

Compact size, low insertion-loss, high reliability and low price are essential in the optical modules used in DWDM systems. The high-precision dual-core ferrule developed by Furukawa Electric on the basis of extending the precision molding and material techniques used for MT ferrules, offers the following features.

- High reliability, easy mass-producibility and low cost are compatible thanks to the use of epoxy resin that has a proven track record in MT ferrules.
- The fiber arrangement pitch can be designed freely taking advantage of the feature of resin molding, such as narrow pitch or wide pitch including not only 250  $\mu\text{m}$ , in compliance with dimensions demanded from optical modules.
- Miniaturization of optical modules is especially advantageous in areas where a narrow pitch such as 0.127 mm is characteristic.
- High reliability to temperature change, humidity, etc.
- Selection of material for the outside sleeve is free. For example, when carrying out direct YAG welding at a module, the material appropriate for the purposes, such as SUS304, can be chosen. And since a simple cylindrical shape is used, the outside sleeve is easily machined and the required size accuracy is also easily achieved. Photo 1 shows a typical high-precision dual-core ferrule. Small size and narrow pitch are realized, with a full length of 9 mm, outer diameter of 1.8 mm, and pitch between fibers of 0.127 mm.

### 3. APPLICATIONS

Applications of this high-precision dual-core ferrule include 2-fiber collimators, pumping modules, optical circulators, optical switches, and so on. In the following we focus on an optical multiplexing module (WDM combiner) for a Raman amplifier as a product in which the high-precision dual-core ferrule may be used. Figure 1 shows the structure of a WDM combiner for a Raman amplifier. Light of two different wavelengths is combined at the common port by a combination of a dual-core ferrule and LWPF.

The depth direction change of the pitch between the two fibers, the fiber hole pitch, fiber hole accuracy, etc. are essential parameters for making this configuration low-loss. Each parameter can be easily optimized by producing the dual-core ferrule by resin molding. Compared to a conventional WDM combiner, the reduction in loss realized was significant: 0.3dB or less (see Figure 2).

Moreover, in terms of high power tolerance, it was confirmed that the characteristic stabilized at 3 W for 2000 h and 3 W + 3 W for 500 h, and showed high reliability. Figure 3 shows the results of a test at 3 W + 3 W for 500 h.

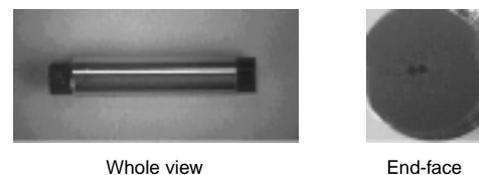


Photo 1 Typical high-precision dual-core ferrule.

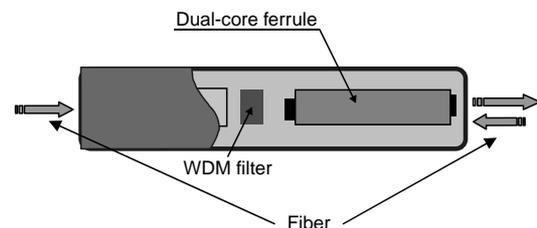


Figure 1 Structure of wavelength combiner.

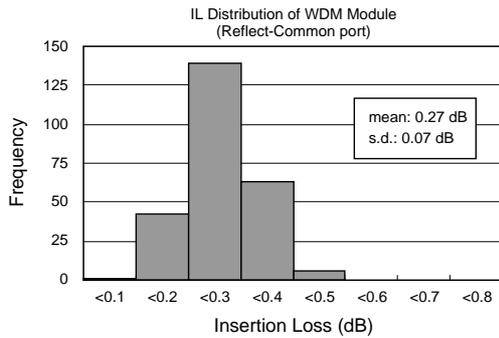
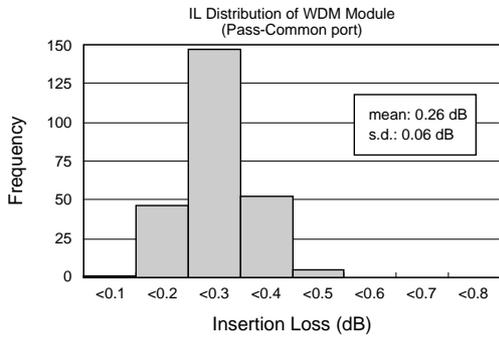


Figure 2 Insertion loss characteristics.

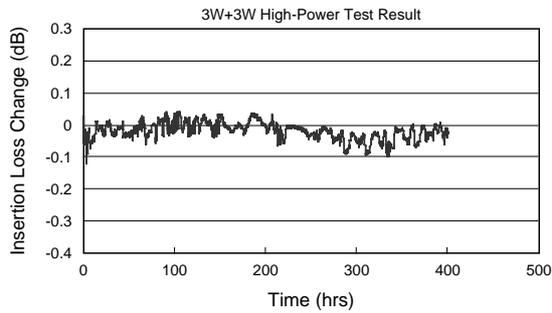


Figure 3 3 W + 3 W high power test result.

#### 4. CONCLUSION

The high-precision dual-core ferrule developed in this work is applicable to various needs for the optical devices indispensable to DWDM systems, and particularly the 2-fiber collimator. Construction of DWDM systems with high flexibility is achieved at low cost by employing the features of this product to maximum effect.

For more information, please contact:

Assembly Production Engineering Sec., Interconnect Components Dept., FITEC Interconnectivity Div.

TEL: +81-436-42-1674

FAX: +81-436-42-9355