

# ClearCurve® Multimode Fiber: End-Face Visual Effects

## Application Note

AN4260

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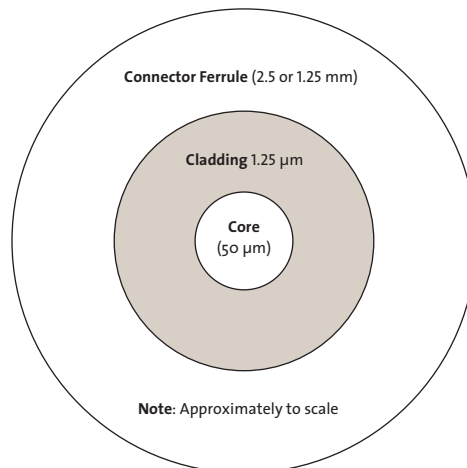
ISO 9001 REGISTERED

### Scope

This application note discusses the particular visual effects that may be encountered when viewing the end face of ClearCurve® multimode fiber. ClearCurve multimode fiber has industry-leading macrobending performance enabled by a unique index-of-refraction profile. This unique profile may appear slightly different than standard multimode fibers however it is a visual effect difference only and there are no negative functional impacts.

### Multimode Fiber: End-face Regions

Multimode fiber can be grouped into two main categories according to its core diameter: 50 and 62.5 micron ( $\mu\text{m}$ ). 50  $\mu\text{m}$  fiber possesses bandwidth and channel performance advantages over other multimode core sizes in today's LAN and data center installations.



### 50 $\mu\text{m}$ Multimode Fiber End-Face

Figure 1

Figure 1 depicts a schematic of a typical 50  $\mu\text{m}$  multimode fiber end-face viewed with a fiber scope. The cladding usually appears as a darker region outside the lighter core. Depending on the ambient lighting conditions, whether or not the connector is backlit, and the specific fiber scope used, the actual image viewed through a fiber scope may differ from Figure 1. However, the three regions in Figure 1 should be observable for 50  $\mu\text{m}$  fiber (regardless of its index of refraction profile). The main area for inspection is the core region, which carries the majority of the optical signal. The cladding region is a secondary indicator of the connector end-face polish quality.

Analyzing specific surface marks, defects and other polishing effects is beyond the scope of this document, but is generally defined by individual manufacturer and/or industry specifications (e.g. IEC/PAS 61300-3-35).

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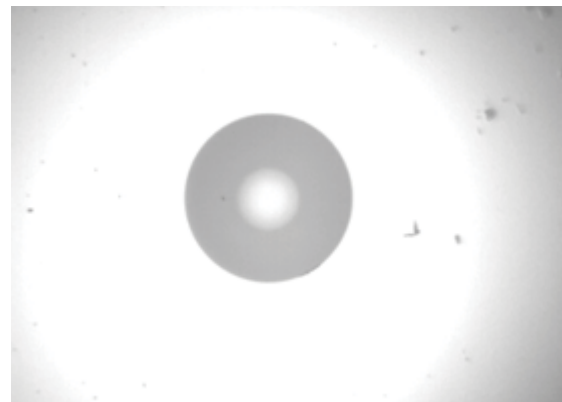
## End-face Visuals

Corning's ClearCurve multimode fibers are fully compatible with current industry standard multimode fibers, equipment, practices and procedures. The question may arise on how such fiber types will be observed during end-face visualization and how any appearance differences should be correctly interpreted. The answer, as it remains for any multimode fiber type, is that it depends on the ambient lighting conditions, the angle of incidence of the illumination light on the end-face, and the specific fiber scope used. If any differences are observed, it is important to distinguish between those that are inherent to the fiber design (i.e. those that do not degrade the connector performance) and those that are true functional defects, such as deep scratches that require further polishing. In the case of field microscopes and probes, no discernible differences are typically observed between ClearCurve multimode fiber and a conventional multimode fiber, as depicted in Figures 2 and 3.

If any difference is observed, it would most likely be a more intensely lit core in ClearCurve multimode fiber due to its ability to confine more light in the optical core compared with conventional multimode fibers.

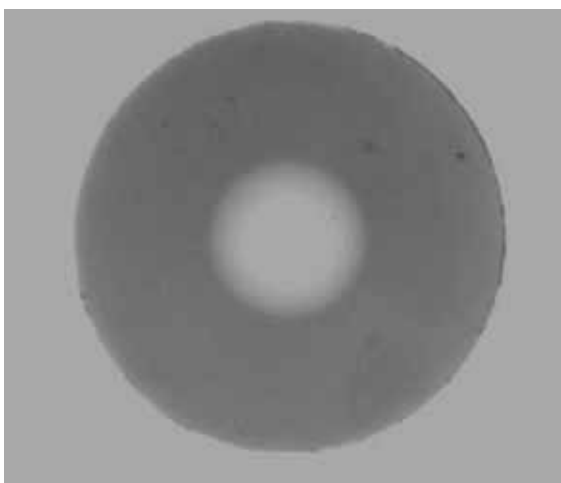


**Conventional 50 µm multimode fiber**  
Figure 2

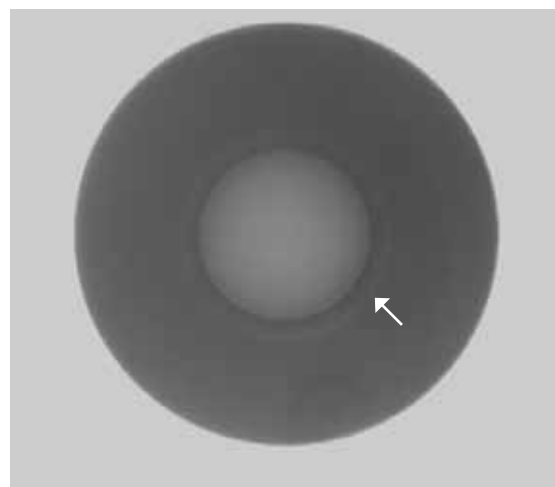


**ClearCurve 50 µm multimode fiber**  
Figure 3

In the case of bench scopes, and once again depending on the specific equipment and set-up used, a faint ring, or "halo" in the cladding region may become apparent in ClearCurve multimode fiber due to its different index-of-refraction (IOR) profile. Figures 4 and 5 depict two separate images for conventional and ClearCurve multimode fiber connector end-faces on a typical bench-top scope.



**Conventional 50 µm multimode fiber**  
Figure 4



**ClearCurve 50 µm multimode fiber**  
Figure 5

The arrow in Figure 5 depicts the location of the ring that may be visible with some bench-top scopes. This ring, or “halo effect”, is a by-product of the IOR profile that is designed into the cladding region of ClearCurve multimode fiber to improve bend-induced loss over conventional multimode fiber. Note that the ring is completely outside the light-carrying core region, which is the critical region of the fiber for transporting the optical signal. Figures 6 and 7 clearly illustrate the location of the ring relative to the core of ClearCurve multimode fiber.



**ClearCurve multimode fiber end-face (front-lit)**

Figure 6



**ClearCurve multimode fiber end-face (back-lit)**

Figure 7

Figure 6 is an image generated from a bench-top scope without injecting light into the fiber. Notice that the presence of the ring is outside the core region. Figure 7 is another image of the same fiber generated from the same bench-top scope with visible light entering and fully illuminating the core, indicating the relevant region for communication of optical signals. The ring is still clearly outside the 50  $\mu\text{m}$  region defined by the fully lit core.

### Summary of Interpreting Results

Interpreting end-face visual images generated from prevailing fiber scopes can be somewhat subjective and dependent on the characteristics of viewing equipment. Some scopes will highlight particular fiber characteristics differently than others. The intensity of illumination light, its projection angle relative to the fiber axis, and other related optical effects pertaining to all microscopes combine to contribute to the overall image present in the field of view. A unique ring or halo may appear in the cladding region of ClearCurve multimode fiber with some types of fiber end-face inspection equipment. The appearance of a ring or halo depends on the scattering of the illumination light from the instrument being used. In essence, the unique structure and materials that define the IOR profile for ClearCurve multimode fiber are responsible for this observed phenomenon. It is this unique IOR profile of ClearCurve multimode fiber that enables industry-leading macro-bending performance (7.5 mm radius), setting it apart from other multimode fiber types.

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