

Application Note Fiber Video Scope – Field of View Considerations

Overview

IEC 61300-3-35 is a standards document issued by the International Electro-technical Commission. It outlines acceptable methods for performing inspection on a fiber endface and for determining if the endface is suitable for use in an optical system. This document will serve as an overview of inspection scope specifications which must be met according to the IEC 61300-3-35 standard.

Field of View and Magnification

The most common misconception about the IEC document is that it outlines magnification levels which must be provided by the inspection scope. The terms “200X” and “400X” have been used by inspection equipment manufacturers for years, with the numbers being attributed to the IEC document. In fact, the IEC document makes no mention of either 200X or 400X magnification. Further complicating matters (beyond the initial misconception regarding the importance of magnification in general) is the idea that 400X is better than 200X when discussing inspection scopes.

Rather than magnification, the IEC document instead outlines how much of the fiber endface must be viewable when using the camera microscope. The area on the endface which is viewable when using a microscope is called the “Field of View” (FOV) of that microscope.

From IEC 61300-3-35 Ed. 1.0 (page 7):	“Microscope systems...shall be calibrated for use in either low or high resolution applications”	Sec. 4.4.1
	“[Low resolution microscope systems shall have]...a field of view of at least 250µm ^[2] .”	Sec. 4.4.2
	“[High resolution microscope systems shall have]...a field of view of at least 120µm ^[2] .”	Sec. 4.4.3

GVIS400

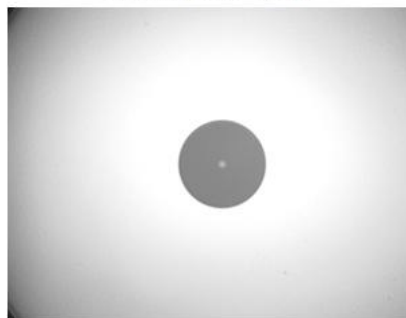
High Resolution System
FOV: 860µm x 640µm



Exceeds IEC Standards
for FOV

GVIS300

High Resolution System
FOV: 630µm x 440µm



Exceeds IEC Standards
for FOV

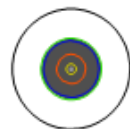
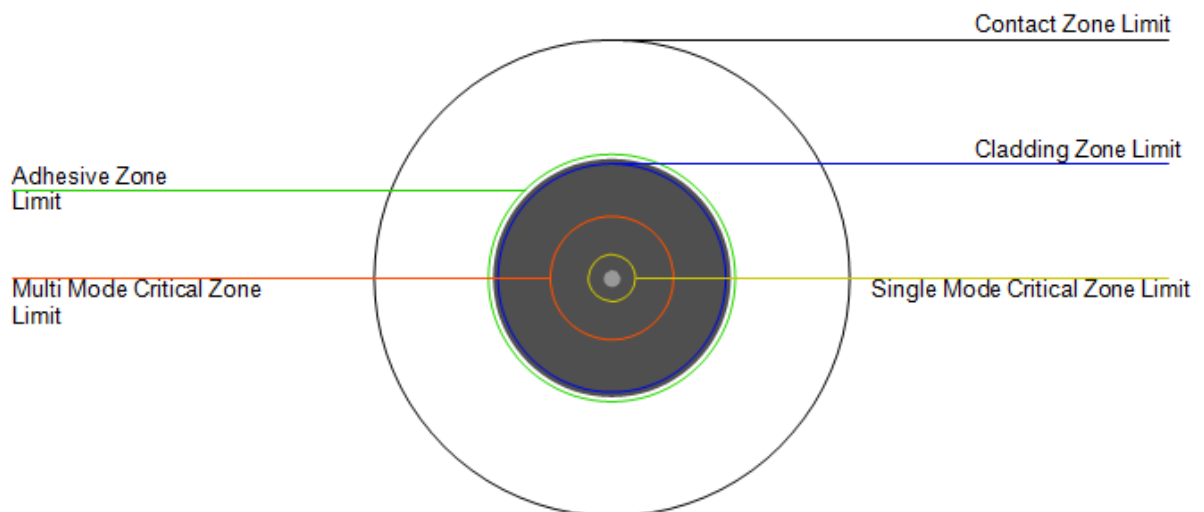


Why FOV?

Meeting minimum FOV requirements ensures that the proper zones on the fiber endface are shown. The IEC document outlines four zones on the fiber endface. In order for a fiber connector endface to pass any kind of inspection (automated or manual), each zone must be free of debris and defects which exceed certain sizes and/or quantities for that zone. The diameter of each zone is listed in the table below. All of these circular zones are centered directly in the middle of the fiber core.

Zone	Diameter (Single Mode Fiber)	Diameter (Multi Mode Fiber)
A (Critical)	0 to 25 μ m	0 to 65 μ m
B (Cladding)	25 to 120 μ m	25 to 120 μ m
C (Adhesive)	120 to 130 μ m	120 to 130 μ m
D (Contact)	130 to 250 μ m	130 to 250 μ m

Sec. 5.1



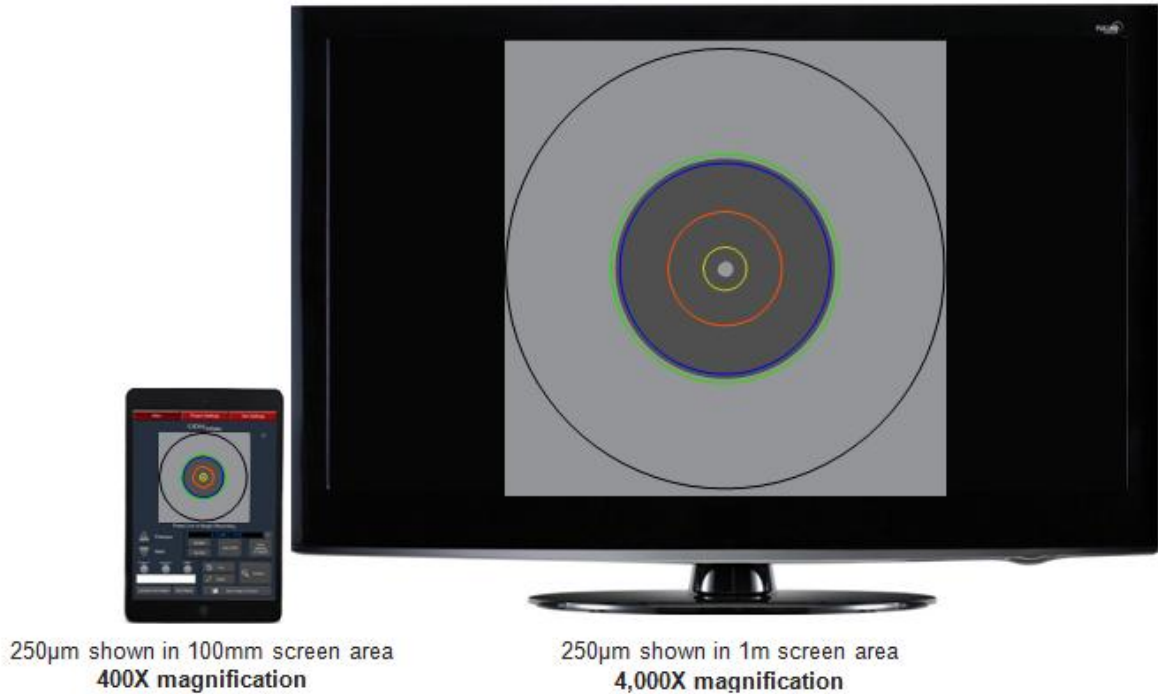
The image at left shows the relative size of the IEC zones compared to the full diameter of a 1.25mm fiber endface.

Note that the IEC document does not specify any zones which may identify defects or debris farther out than the contact zone.



Why Not Magnification?

Magnification is a term which expresses how much larger an image appears to the eye. A one-micron area can be blown up ten-thousand times and will thus be “10,000X” magnified, but the area shown will still only be one micron in diameter. In the example below, a 250 micron image (minimum acceptable FOV for low-resolution systems) is shown “magnified” on two separate screens.



As shown above, the same area has different magnification levels depending on how it is displayed. This example proves that magnification level is arbitrary and thus is immaterial. The viewable area, however, is firmly set regardless of screen size and thus provides a workable, scalable standard (as the IEC document intends).

Benefits of Large FOV

It is highly recommended that technicians use inspection scopes with a larger field of view than the minimum required by the IEC. There are two main reasons why this is important:

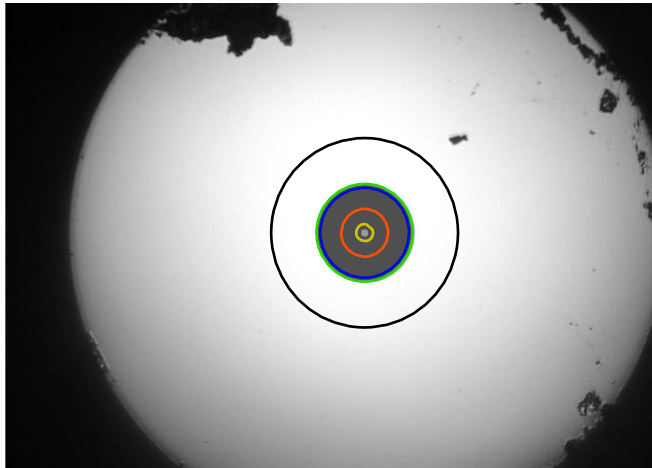
1. Cleaning procedures should take the entire ferrule into consideration.
2. Damage to ferrules and connectors may affect functionality, even when outside the IEC zones.



Cleaning and FOV

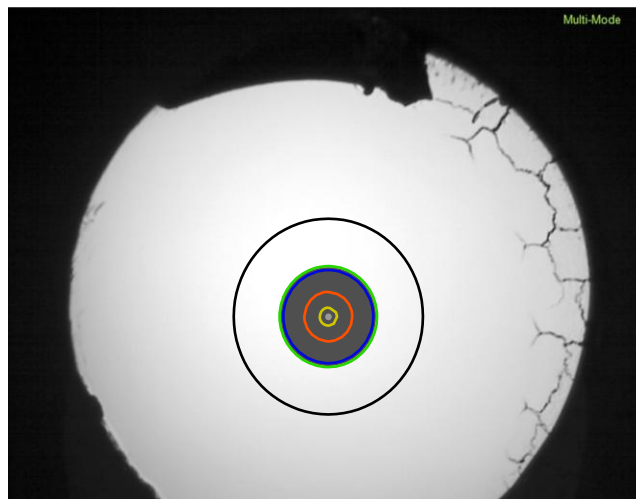
As shown earlier in this document, the IEC 61300-3-35 standard only specifies zones extending to a diameter of 250 microns centered on the fiber core. The general idea when scoping and cleaning fiber is to remove debris from that area, which then makes the fiber viable for use.

The problem with that process is that debris outside of the IEC zones will not be considered. Debris on the periphery of the fiber endface can move to the center of the connector very easily when the fiber is inserted into a bulkhead. When using a scope with a wider FOV, debris outside the IEC zones can be cleaned to eradicate this common issue. See image below: the IEC zones are clear, but there is significant loose debris just outside the contact zone and on the edge of the connector.



Ferrule Damage and FOV

There are factors other than debris in the IEC zones which may cause a fiber connector to fail. In the example below, the ferrule has been damaged and should not be used in any fiber optic system. Cracks in the ferrule can expand through thermal cycling and eventually enter the IEC zones. With a wide FOV, technicians can verify that the entire fiber connector is viable for use in the optical network.





Summary

1. The IEC 61300-3-35 document defines standards for fiber inspection scope hardware and for determining fiber viability using that hardware.
2. The IEC document makes **no** mention of magnification levels in respect to how many “times” (i.e. 200X, 400X) the image is magnified.
3. The IEC document **does** set forth minimum field of view (FOV) requirements inspection systems. These are $250\mu\text{m}^2$ for low resolution systems and $120\mu\text{m}^2$ for high resolution systems.
4. The VIS series of inspection scopes far exceeds the FOV standards in the IEC 61300-3-35 document.
5. The IEC document does not provide criteria for any part of the fiber endface outside of the largest $250\mu\text{m}^2$ zone.
6. Scope users should be aware that larger a FOV provides quality assurance benefits beyond those outlined in the IEC specification. Namely, a larger FOV informs the user if special cleaning procedures should be used, or if a fiber connector is inappropriate for use (for reasons other than debris in the IEC zones).