Magnification & Field of View (FOV)

Since the early manufacturers of fiber optic connector Video Microscopes introduced inspection probes to the market, the specification "Magnification" (for example 400x, or 200x) has been used and abused by people throughout the industry.

When Lightel entered this market in 2003, we began to make a concerted effort to correct this erroneous concept. Instead of using "Magnification", we use "Field of View (FOV) to specify this probe performance aspect. In recent years we have been pleased to find that more and more people have come to use this far more accurate term. But due to the long-term use of the earlier misleading phrases, many people today are still confused with the statements made about 400x probes or 200x probes.

Let's take a closer look.

1. Magnification:

In the fiber optic industry, there exist two types of microscopes for viewing fiber optic connector end-faces: Optical Microscopes (i.e. direct view) and Video Microscopes. The magnification of an Optical Microscope is straightforward and can be easily understood based on the traditional definition in an OPTICS system. But in a Video Microscope, the connector end-face image information is converted from an OPTICS domain to a VIDEO SIGNAL domain, then to an IMAGE DISPLAY on a monitor screen. The total magnification in a video microscope thus becomes the product of the optical magnification and the magnification contributed by the video system. Because the latter depends on the ratio of the display screen size to the camera sensor size the total Magnification in any video system is screen size dependent, so specifying "Magnification" for a microscope probe alone (without mention of the display screen) does not make any sense.

As an example, let's estimate what size screen would be needed to actually reach so-called 400x. Using the typical 4:3 screen ratio when we finish the calculations, we discover it would require about a 7" diagonal screen to yield a 400x magnification.[1] This has not generally been considered the optimal size for a portable video microscope!

2. Field of View:

When people talk about "Magnification" 400x or 200x, they often really mean the size of the fiber area compared to the entire viewing zone. Under 400x, the fiber area occupies a greater portion of the viewing zone than that under 200x. In other words, the fiber under 400x looks more zoomed-in (or more magnified) than 200x.

The Field of View (FOV) directly defines the size of the object field which can be viewed through a microscope. For example, 400□m x 300□m is a typical FOV spec for fiber optic connector video inspectors. With this FOV parameter, it is straightforward to picture the image of a 125□m fiber on the screen.

FOV is entirely determined by the design parameters within the microscope probe, including the overall Optical Magnification and the sensing area of the imaging sensor (CCD or CMOS). So, the FOV is an independent spec for a probe, unrelated to the display screen.

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[1] For 400x, we need the fiber diameter shown on the screen as ≥ 50mm (=0.125mm x 400). Remember that the viewing zone must be extended from the fiber. So, if you choose ≥*2* (*The viewing zone dimension / The fiber diameter)*, the screen dimension should be at minimum 100mm. For a 4:3 screen, the screen diagonal would then be ≥ 167mm (=50*2/3*5), or ~7".

3. Conclusion

Although FOV and magnification are qualitatively related (smaller FOV corresponds to higher magnification and vise versa), FOV offers meaningful information about the microscope itself without any screen dependence.

The International Electrotechnical Commission (IEC) recommended a field of view of **at least** 300µm [IEC 61300-3-35] when viewing a connector end-face. Under a typical FOV of 400µm x 300µm (factor of *2.4* to the fiber diameter), the screen must be ~8" in order to reach a total "Magnification" 400x (as calculated in Section 1). Using common screen sizes like 3.5", 2.5", or 1.8", you would technically obtain ~180x, 130x, or 90x respectively. So in conclusion, "Magnification" is an improper specification when used for a video microscope probe. Classifying video microscopes as 400x and 200x is even more misleading!