Leco® Met-Tips Ideas for Metallographic Procedures

No. 1

# Calibration of Video Measuring Systems and Microscope Reticles

The fact that one has a Video Measuring System, or a Reticle disc that fits into an eyepiece, does not put him in the position of measuring. He must have a stage micrometer to calibrate the value of each increment on the micrometer disc, or the Picture Elements (Pixels) of the Video System, before any attempt is made to measure.

**Calibrate a Video Measuring System**

Place a stage micrometer on the microscope in a horizontal orientation. The stage micrometer can be in either metric or English units. Focus the image of the stage micrometer on the monitor, and rotate it until the lines of the micrometer are parallel with the right and left edges of the guard frame of the video system. Enter the calibration mode. Normally, you will be asked the distance that you are using to calibrate. Count the number of complete stage micrometer divisions visible on the screen and multiply by the distance per division. This is usually marked on the micrometer as 0.01 mm or 0.001 inch. Enter it in the format that you will want for your results, i.e. if you want results in mm, you would enter 100 $\mu$m as 0.1. If you want results in $\mu$m, you would enter 100. The Video system then presents you with two computer generated lines. Take the left hand line and move it so that it's inside edge is placed on the left hand edge of the leftmost stage micrometer line. Then take the right hand line and place it so that its inside edge is placed coincident with the left hand edge of the rightmost stage micrometer line. You must ensure that the following three conditions are met:

1. The distance you enter as the calibration distance is correct.
2. That you use the *inside* edges of the computer generated lines
3. That you use the *same* (right OR left) *edge* of each of the stage micrometer lines.

After placing the lines, proceed to the next calibration step as indicated in the dialog box. This will usually require you to rotate *the stage micrometer* by 90°, aligning and focusing as above, and then repeating the horizontal procedure while using the top and bottom of the guard frame for alignment. This will determine the aspect ratio of the video camera.

This procedure must be repeated for each possible magnification combination that may be used, and labels should be assigned to ensure proper hardware setup prior to measurement.

**Example of Video System Calibration**

An instrument with a 100X objective and a video camera with coupler is used. The stage micrometer is graduated in 0.01 mm increments.

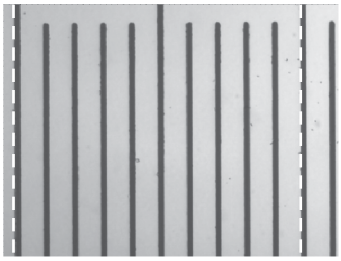

***Figure 1.***

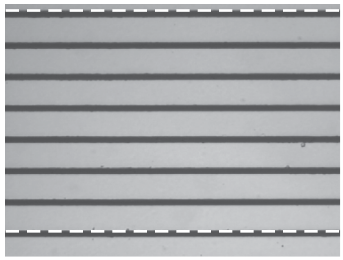

***Figure 2.***

As shown in figure 1, 10 divisions on the stage micrometer are easily visible. Enter the distance to be calibrated as either 100 (if results in $\mu$m are desired) or 0.1 (if results in mm are desired). Place the Video system calibration lines as shown.

Rotate the stage micrometer (see figure 2) and repeat the above procedure. Note, you will usually have to use a smaller distance in the vertical direction. In this example, 0.07 mm is used.

## LECO Certified Stage Micrometers (Accredited to ISO 17025 by A2LA)

ACCREDITED 1845.01 CALIBRATION

| Interval | Measured ($\mu$m) | Correct ($\mu$m) | Cumulative ($\mu$m) | Uncertainty ($\mu$m) |
|---|---|---|---|---|
| 60-70 $\mu$m | 9.997 | 0.003 | 69.932 | 0.548469555 |
| 90-100 $\mu$m | 10.02 | -0.02 | 99.951 | 0.775584716 |

When measurement results must be traceable, use a certified stage micrometer. An excerpt from a calibration certificate is shown above. In the examples above, the values from the certificate would be used rather than the nominal values: 69.932 $\mu$m rather than 70 $\mu$m for the vertical calibration, and 99.951 $\mu$m rather than 100 $\mu$m for the horizontal calibration.

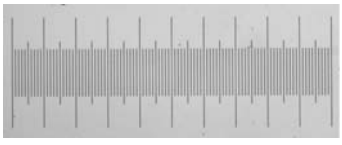

***Figure 3. LECO Part No. 860-256-110 Traceable Metric Stage Micrometer (Smallest division 0.01 mm)***

***Figure 4. LECO Part No. 860-257-110 Traceable English Stage Micrometer (Smallest division 0.001 inch)***

Repeat the procedure for each objective and magnification combination, assigning a clear and unique label to each. The system will not warn if you select the wrong calibration for your hardware settings.

**Installing a Micrometer Disc**
The eyepiece will usually have a holder for the reticle which may be removed by unscrewing it from the bottom of the eyepiece. Examination of the holder will show a recessed shelf on the top of the holder. Place the reticle onto this shelf so that the numbers may be read in the normal manner. Do not touch the reticle or allow dust to contaminate it as foreign matter on this reticle will be visible in the field of view. Reinstall the holder with the reticle into the eyepiece.

**Calibrate Micrometer Disc**
Place a stage micrometer on the microscope. The stage micrometer can be in either metric or english units. Focus through the eyepiece containing the micrometer disc and rotate the eyepiece until the scale on the disc is parallel with, but slightly above, the scale on the stage micrometer. Move the stage micrometer horizontally until one of the lines on the left is in complete coincidence with one of the lines on the eyepiece disc. Then move the eye to the right to find another set of lines that are completely matched. If a perfectly coincidental set of lines cannot be found on the right side, you must estimate to a fraction of a division. Divide the total distance spanned on the stage micrometer by the number of lines on the eyepiece disc required to span this distance to obtain the value of each increment on the eyepiece disc.

**Example of Reticle Calibration**
A micrometer disc is placed in a 10X eyepiece and a 10X objective is used. The stage micrometer is graduated in 0.001 inch increments.

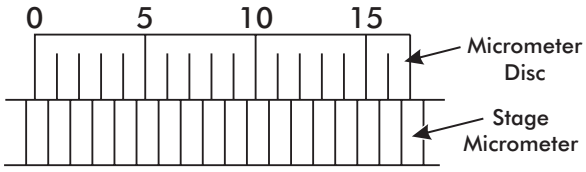


***Figure 5. Each division on stage micrometer = 0.001 inches***

As shown in figure 5, it requires 14 divisions on the micrometer disc to span 0.015 inches on the stage micrometer (15 divisions x 0.001 inches).

The total stage micrometer units times unit size divided by total micrometer disc units will give the value of each increment on the micrometer disc.

$$\frac{15 \times 0.001}{14} = \frac{0.015}{14} = 0.00107 \text{ inches}$$

Therefore, each division on the micrometer disc using the 10X objective is 0.00107 inches. This should be done for each objective used on a microscope, and a table set up as follows.

**Table 1**

| **Objective** (Each Micrometer Disc Increment) | | | | |
|---|---|---|---|---|
| | **Inches** | **Mils** | **MM** | **Microns** |
| 5X | 0.00214 | 2.14 | 0.054 | 54 |
| 10X | 0.00107 | 1.07 | 0.027 | 27 |
| 20X | 0.000535 | 0.54 | 0.014 | 14 |
| 40X | 0.000267 | 0.27 | 0.007 | 7 |

The micrometer disc with a fixed scale is used only for approximate measurements, since exact fractional values cannot be used. For exact measurements, the filar measuring eyepiece is recommended.

**Drum Measurement Calibration**
Calibration of the drum measurements on a filar measuring eyepiece is accomplished in the same manner as for a micrometer disc. The moveable cross-hair is positioned on a line to the extreme left on the stage micrometer. Micrometer drum value is noted and recorded. The micrometer drum is turned and the cross-hair moved to a line on the extreme right on the stage micrometer. One should traverse as many stage micrometer units as are visible in the field of view. The new micrometer drum measurement is again recorded. The first drum measurement is subtracted from the second drum measurement to obtain total drum movement. The number of stage micrometer units times the unit value is divided by the total micrometer drum movement to obtain the value of each increment on the micrometer drum. This is done for each objective used and a table set up as in Table 1.

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