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SEM Performance Standard Instructions

Catalog Number: 53130

1. Magnification calibration is straightforward. Specimen dimensions are specified in microns so magnification can be measured directly from photomicrographs in millimeters. Keep in mind the possibility of camera reduction ratios. It will be necessary to use large spot size for good definition at low magnifications.

2. The layout of this device is easy to remember. Start by using the sales brochure as a map. Simple stage maneuvers will allow the next range of interest to be placed in the field of view quickly.

3. The eight-point star in the upper right-hand corner of the specimen makes it possible to visualize where magnification center and scan rotation center occurs.

4. Pincushion or barrel distortion can easily be visualized by selecting any of the grid areas. The squares in these areas have reasonable edges. A straight edge placed upon a micrograph should easily touch all grid boundaries within the accuracy of the etching process. Any evidence of bowing would be considered distortion. Checking at various magnifications will verify if these conditions exist in the optics. Measuring along the X and Y or the X plus Y-axis will show geometry errors.

5. Depth of field measurements can be done with any of the grids; however, the ten-micron grid may be most useful. Tilting the specimen to 89° and looking across the bars will give calibrated measurements away from focus.

6. Tilt correction is best done using the circles, since perfect correction is not available, circles will allow you to visualize the best position of scan rotation vs. tilt correction for give KV and working distance.

7. Dynamic focus performance is best done in conjunction with tilt correction calibration. This will assure Y scan alignment along the vertical axis.

8. Orthagonality and linearity tests use the eight-point star. The intersecting angles of this device are 45°. They should remain that regardless of scan rotation or scan speed settings. Any deviation between the 90° intersection of the X and Y lines on the star should be interpreted as orthagonality errors usually due to the column scan coils, the display scan coil or an electronic problem in the deflection amplifiers or their power supplies.

9. Stage motion tests are accomplished using either the five-point star or for more critical tests use an appropriate set of cross hairs.

10. Video performance can be measured by placing the 5-micron squares in the center of the field of view and reducing the magnification until all detail on this target disappears. This will be the lower limit of

display definition. Changing scan speed during this test will show if the video electronics have the capability to produce an equal quality image at fast visual scan rates as well as slow record rates. Remember the faster the scan the more demand on the video electronics. Moving the squares to the edge of the screen and repeating this test will prove the quality of the cathode ray tubes. Astigmatism on CRT's is most noticeable at high deflection angles and, there, the definition is poorest.

Video loop stability is defined as any variation of the entire image formation system and the test is accomplished this way: Select the 10 micron squares, specimen tilt 0°, place a silicon window of the specimen in the center of the scanned raster, at 100x adjust the focus to the point that a noticeable defocus occurs, set the magnification to 100Kx, adjust signal and gain to produce a gray raster. Photograph this raster, it should show uniform gray from top to bottom, any variation is some sort of electron image system instability. If noticeable bands or lines occur, turn off the electron gun supply, readjust the brightness of the record CRT and photograph another blank raster. If variation remains, problems in the video detector through the display amplifiers are indicated. If the variation disappears, problems exist in the electron optics system. These could possible be: poor specimen ground, improperly saturated filament, scintillator in poor condition, a non-grounded X-ray collimator or something similar in the immediate specimen area, contamination in the optics or electron gun, or instability in the alignment circuits or lenses. These are general suggestions to aid in diagnosis of problems and do not necessarily cover all optical instability that could be encountered.

Additional information can be gained about the scanning system such as: do the spaces between the squares show any compression at TV or other fast scanning speeds, which would indicate a mismatch between the scan and display system. Circles should remain round with 360° of scan rotation if the specimen is perpendicular to the beam, if not, this would indicate a gain error in one or more axis of the scan system. If instead there is a center wobble, this would indicate an improper zero condition in one or more of the scan amplifiers.

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This performance standard was designed to be an all-around standard for SEM's. A leading semiconductor manufacturer using the latest photolithography techniques built it to exacting specifications. Each performance standard has been compared to standard supplied by the National Bureau of Standards. A Certificate of Accuracy traceable to the NBS standard is provided. Ladd Research believes that the information contained on this specimen is as nearly correct as currently portrayed on this device. We would like to suggest the National Bureau of Standards as a source for absolute calibration standards.