INSTRUCTIONS FOR THE USE OF NBS STANDARD REFERENCE MATERIAL 1010 MICROCOPY RESOLUTION TEST CHART

The useful reduction ratio of a microcopying camera is limited by the nature of the material to be copied, the resolving power of the lens, the resolving power of the photographic material, inaccuracy of focusing, vibration, and systematic relative motion of the optical image with respect to the photographic material. The resolution test chart is issued to assist in standardizing the evaluation of the performance of microcopying systems. The test patterns are made up of black lines on a white background, the lines being 24 times their width, and the lines and spaces being of equal width. The patterns range in spatial frequency from 1 to 10 lines per millimeter. Each pattern is made up of two groups of 5 parallel lines, the lines in the two groups being oriented perpendicular to one another. The number associated with each pattern is the number of lines per millimeter on that pattern.

To measure the resolving power of the microcopying system, place one chart in the center of the camera field, one at the center of a long side, and another at a corner. Orient the last two so that one group of lines is directed toward the center of the field. Photograph the charts in the same manner as documents and examine the processed films with a microscope, using a magnification from $\frac{1}{3}$ to 1 times the number of lines per millimeter to be observed. For example, to view 100 lines per millimeter, the magnification should be between 30 and 100.

If the camera is slightly out of focus, the copy of the chart may have other than 5 lines in some groups. This is "spurious resolution" and is sometimes accompanied by failure to resolve at one spatial frequency when apparent resolution occurs at a higher frequency. If there is no evidence of "spurious resolution," find the smallest pattern in which the lines can be counted with certainty. The number on that pattern multiplied by the reduction ratio is the measured resolving power of the system in lines per millimeter. For example, if the finest resolved pattern is marked "4.0" and the reduction ratio is 29, the resolving power is 116 lines per millimeter.

Away from the center of the field, the resolution of lines directed toward the center is often not equal to the resolution at right angles to that direction because of lens aberrations. If the patterns perpendicular to one another are not equally resolved at the center of the field, one should suspect camera vibration or other image motion with respect to the film.

(Over)

The resolution required to copy type depends upon the size of type, the reduction ratio, and the quality of reproduction required. For most practical purposes; R, the resolving power in lines per millimeter; e, the height in millimeters of the lower case "e" in the type to be copied; r, the reduction ratio; and q, an arbitrary "quality index", are related by the following equation.

$$R = \frac{qr}{e}$$

For excellent copy, in which the details of type are clearly defined, q must be 8 or more. If q is assigned a value of 5, the copy may be read without difficulty although serifs and fine details of type are not clear. If q is 3, the copy may be read with difficulty, the letters e, c, and o being partly closed.

In 1963, the resolution chart was slightly modified. Space was left in the center so that a 10 times reduction of the chart could be placed there by anyone desiring to extend the spatial frequency to 100 lines per millimeter. The patterns from 2 to 10 lines per millimeter are in an array that may be used as an abridged chart. Although the form of the patterns is unchanged, the dimensions of the new charts conform accurately to the nominal values.