MILITARY STANDARD

PHOTOGRAPHIC LENSES

TO ALL ACTIVITIES:

1. The following page of MIL-STD-150A has been revised and supersedes the page listed.

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
29	8 June 1961	29	12 May 1959

2. Retain this notice and insert before the table of contents.

611033—61—(1)

5.1.2.12.3 *Method 14 — Projected photographic resolving power.* This test is intended to be used primarily for enlarging lenses (type VI). A target plate of the required size containing resolving power targets (light lines on a dark background) and of the required range, and located as shown in Figure 8, with one set of the lines in tangential and the other set in radial direction, shall be placed in the object plane (film plane) of the lens to be tested. The targets shall be of high contrast. The target plate shall be evenly illuminated by light from a condensing source. If required, the light shall be filtered to the color required by placing a filter between the light source and the target plate. With the optical axis of the lens perpendicular to the target plate, the lens shall be focused at the designated magnification and aperture, and an exposure made on the designated photosensitive material. The photosensitive material shall be held flat in a plane perpendicular to the optical axis of the lens. The correct exposure shall be that which gives the maximum resolution at position B of Figure 8. The test plate is processed in the required manner. The resolving power shall be read by observing the dry test plate under suitable magnification. The figures referred to in measuring resolving power by this method are the lines per millimeter on the target plate. It is recommended that enlarging lenses be tested at a magnification of 1:2 using medium contrast glossy chlorobromide paper processed 1½ minutes in D72 developer, diluted 1:2 at 68° F.

5.1.2.12.4 *Method 15 — Projected visual resolving power.*[22] This test is intended to be used primarily for projection lenses (type VII). A test object of the required size containing high contrast resolving power targets (dark lines on light background) of the required range and placed as shown in Figure 8 shall be projected by means of the lens under test upon a matte, white, grainless screen. This screen shall be located at such a distance from the projector that unless otherwise specified the long dimension of the projected image will be at least 40 inches in order that the observer will have no difficulty in distinguishing the number of lines resolved. The resolving power of the lens at any point in the field is the largest number of lines per millimeter in the test object that an observer, close to the screen, sees definitely resolved (easily counted) in both radial and tangential directions in the projected image. Care shall be taken to insure that the screen is perpendicular to the optical axis of the projection lens, and that the lens is focused so that the image at the center of the test plate has maximum contrast. The projector used in this test may be a regular production model or a special test projector. The glass test object shall be flat and held concentric with and normal to the optical axis of the projection lens. The cone of light from the projection lamp through a condensing system shall completely fill the entrance pupil of the projection lens. The test object shall be uniformly illuminated.

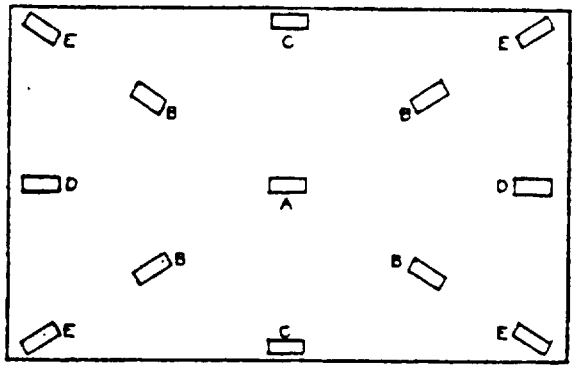

FIGURE 8. *Projected Resolving Power Test Plate*

5.1.2.13 *Astigmatism and curvature of field.*

5.1.2.13.1 *Method 16 — Resolving power target method.* By means of any of the methods for measuring resolving power specified in methods 11 through 15, resolving power

[22] American Standard Method for Determining Resolving Power of Lenses for Projectors for 35-mm. Slide Film and 3¼ x 4-inch Slides, PH3 .14-1947 (Revised 1962).

shall be determined for different positions of the test plate in the image space. The test plate or plates are exposed in small steps, at different distances along the optical axis of the lens. The length of each step depends upon the corrections, focal length, and aperture of the lens being tested. A sufficiently large number of steps shall be taken to insure at least three steps on each side of the best focus position for both radial and tangential lines at any angular position. Upon reading the targets, the position of best focus shall be determined (for radial and tangential lines separately) at which the resolution is a maximum at each angular setting. These focus positions are plotted against angular settings, and two curves representing the two image surfaces are obtained. The curve representing curvature of field is a median drawn between the two curves representing the image surfaces. (See 3.6.3.) The astigmatic difference is obtained by taking the difference in the focal setting at a specific angle for the two image surfaces.

5.1.2.13.2 *Method 17 — Nodal slide method.* This method may be used in lieu of method 16. In this method the lens to be tested shall be set up in front of a suitable collimator equipped with a target containing vertical and horizontal lines and centered so that the optical axis is parallel to the collimator axis and coincident with the axis of the observing microscope. The lens shall be moved along the microscope axis until the axis of rotation of the nodal slide intersects the rear node. The microscope shall be focused on the axial image and the position of the microscope noted. The lens shall then be rotated about the axis through the rear node and perpendicular to the optical axis of the lens. At multiples of angular positions of 1¼ degrees out to the edge of the field, the microscope shall be separately focused on the radial and tangential lines. The focal change from the axis position shall be noted at the angular field positions for the radial and tangential lines. To obtain curves such as specified in method 16, the factor $f(1-\cos\beta)/\cos\beta$ is subtracted from the microscope settings, and this difference is multiplied by the $\cos\beta$. If a flat field bar is used at the microscope it is not necessary to subtract the factor $f(1-\cos\beta)/\cos\beta$. When curves are obtained, the procedure for determining the curvature of field is the same as that in method 16.

5.1.2.14 *Color correction.* When the image quality is found satisfactory on the basis of other applicable tests, the color correction can also be considered as satisfactory. Direct measurements of color corrections may be needed when some special color requirements are to be met. These measurements may be specified in terms of minimum resolving power or limits on individual color corrections.

5.1.2.14.1 *Longitudinal chromatic aberration.*

5.1.2.14.1.1 *Method 18 — Photographic method.* Photographic resolving power measurmenents shall be made as specified in method 11 or 12, utilizing light of the colors designated, repeating the test for each color. The light used may be supplied by a monochromator or it may be filtered white light, as specified. The focus positions at which the maximum resolving power (AWAR unless otherwise specified) is obtained shall be determined for each color. The longitudinal color aberration for a particular color is the difference in focal setting for this color and white light, or for this color and a specified color. When the focal setting for the first color is greater than the focal setting for the reference color or white light, the longitudinal chromatic aberration is said to be positive. Generally, the reference color should be towards the red end of the spectral range under consideration.

5.1.2.14.1.2 *Method 19 — Nodal slide method.* When specified, a nodal slide optical