

AD 717540

20 April 1966

TECP 700-700
Materiel Test Procedure 3-2-814*
Aberdeen Proving Ground

U.S. ARMY TEST AND EVALUATION COMMAND
COMMON ENGINEERING TEST PROCEDURE

OPTICAL COLLIMATION OF RANGE FINDERS

1. OBJECTIVE

The objective of this document is to instruct personnel in the techniques of obtaining and recording collimation data during engineering testing in order to determine the ability of the instrument to remain collimated within eyestrain criteria and specification requirements.

2. BACKGROUND

Stereoscopic range finders contain two separate telescope systems so positioned that the operator views the same field with both eyes simultaneously in much the same manner as with binoculars. (See Fig. 1) Collimation is a measure of the parallelism between the rays emerging from the left and right eyepieces.

Changes in collimation are most likely to occur during shipment of the instrument from the factory, during its installation in the turret, after large temperature changes or high shock loading, or as a result of replacing end windows. Large angular deviations from parallel can prevent fusion of the two images by the operator and cause eyestrain after short periods of use. In addition, if collimation errors are not maintained within specification requirements reliable range accuracy data cannot be assured.

3. REQUIRED EQUIPMENT

- a. Double Collimator, 18-C-1279-25 or equivalent
- b. Collimator mounting Brackets and Fixtures
- c. 2000 Yard Range
- d. Square Target

4. REFERENCES

None

5. SCOPE

5.1 SUMMARY

This pamphlet describes the procedures to be followed in measuring collimation errors, the instrumentation used, and the tolerances to be

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observed in evaluating discrepancies. Included in the procedure are the steps to be taken in correcting collimation errors that exceed specifications.

5.2 LIMITATIONS

None

6. PROCEDURE

6.1 PREPARATION FOR TEST

Parallelism in range finders is measured with a double collimator, such as an 18-C-1279-25 (sometimes referred to as a "double policeman"), mounted at the eyepiece assemblies. (See Fig. 2) The instrument consists of two rigidly aligned parallel optical systems, each having accurately positioned reticles in the form of grids. Each grid division subtends an arc of five minutes.

The end housings of the range finder shall be checked for proper installation and cleanliness. They shall then be installed in accordance with the approved procedure for the particular instrument. Mounting surfaces must be clean and free of burrs, locating keys or wedges properly aligned, and retaining bolts tightened in alternating sequence using appropriate torques.

Suitable brackets and fixtures shall be fabricated to enable accurate positioning of the collimator at the range finder eyepieces so that it is perpendicular to the eye lens planes. (See Fig. 2)

A clearly defined square target, the range of which is between one and two thousand yards, shall be selected. The actual distance must be known to within plus or minus one division of the range finder range scale.

6.2 TEST CONDUCT

Properly center the collimator, set the interpupillary distance of the range finder eyepieces at 65 millimeters and set the range finder scale exactly at the target distance. The diopter adjustment for each eye shall be set to produce maximum distinctness of the target image as seen through the collimator.

Position the target image, using the manual turret and gun controls, in the left optical system so that the edges coincide with the principal axes of the collimator grid. (See Fig. 3) This establishes the index position.

Inspect the image of the target as it appears in the right optical system and record the deviation from the index position, already established for the left system. The direction of deviation is defined as plus or minus dipvergence (ordinate), and convergence or divergence (abscissa).

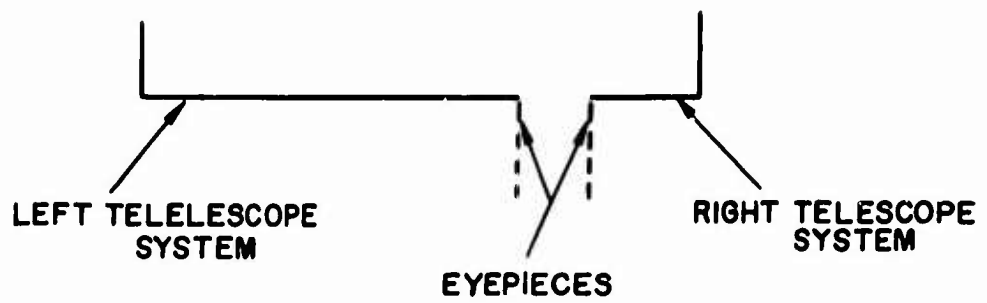


FIGURE 1. OPTICAL SYSTEM EMPLOYED IN STEREOSCOPIC RANGE FINDERS

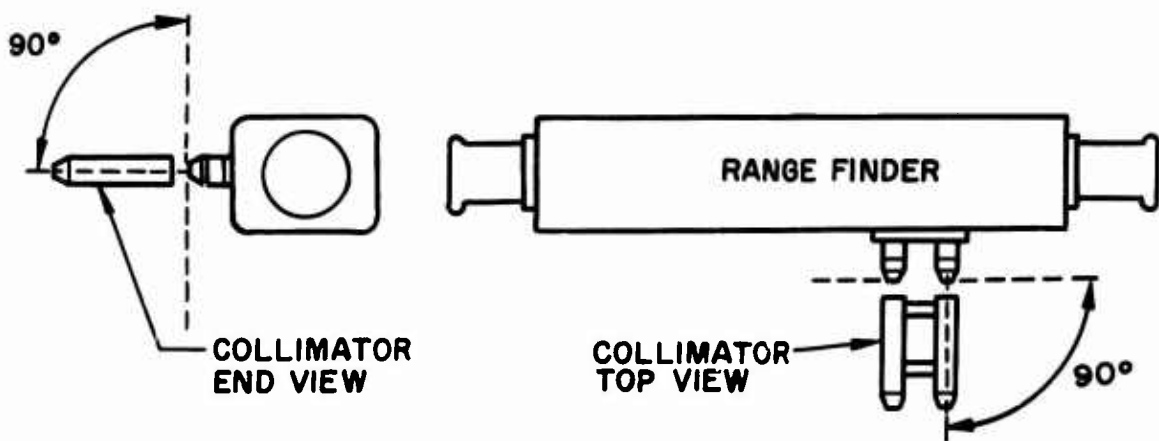


FIGURE 2. POSITIONING OF DOUBLE COLLIMATOR

Dipvergence is the deviation from the horizontal (abscissa) as measured on the vertical (ordinate). When the line of sight is below the target, the image appears above the abscissa, requiring a plus (raising) correction. When the line of sight is above the target, the image appears below the abscissa requiring a minus (lowering) correction.

Convergence and divergence are deviations from the vertical (ordinate) as measured on the horizontal (abscissa). Under the prepared set-up the line of sight of the right optical system must converge, slightly for the image in the right optical system to be coincident with the image of the left optical system. When the line of sight of the right optical system over convergences, going to the left of the target, the resulting image appears to the right of the ordinate. To compensate for the converging line of sight the right optical system must be corrected to the right in a divergent direction. Conversely when the line of sight of the right optical system does not converge toward the target (is to the targets right; diverges) the image appears to the left of the ordinate and must be compensated for in a convergent direction.

Figure 4 illustrates various combinations of direction required for correction (dipvergence, convergence or divergence).

In the example shown in Figure 3, the target observed by the right eye in the upper right quadrant (I) is 10 minutes right (convergence) and 15 minutes above (plus dipvergence) the position of the left image. Variation of the target in the lower left quadrant (III) is 20 minutes left (divergence) and 15 minutes below (minus dipvergence) the left image. The required direction for correction would be opposite the indicated deviation (e.g. plus correction for a minus dipvergence and a divergent correction for a convergent error).

End windows must be capable of being replaced under combat conditions without causing loss of collimation exceeding tolerances. (See par. 6.4) This shall be checked for all range finders by removing and replacing the end windows one at a time, and checking the variations by the method described.

6.3 TEST DATA

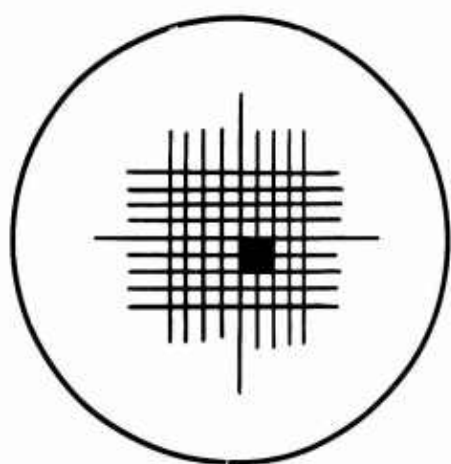
The following data shall be recorded during conduct of this test:

- a. Dipvergence Correction (PLUS)
- b. Dipvergence Correction (MINUS)
- c. Abscissa Correction (Divergence to right; convergence to left)

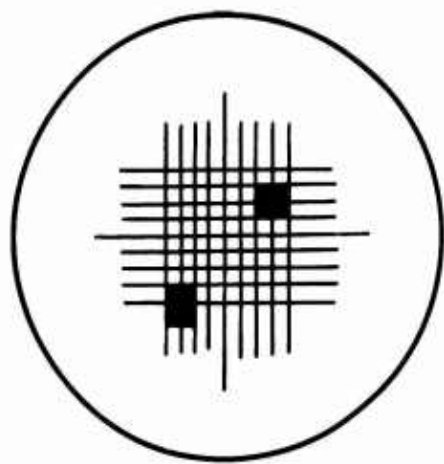
All of the above parameters shall be measured as deviations from the index position.

6.4 DATA REDUCTION AND EVALUATION

To be considered satisfactory, collimation tolerances shall

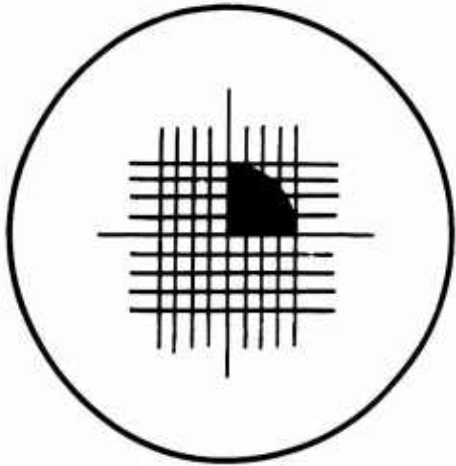


LEFT FIELD

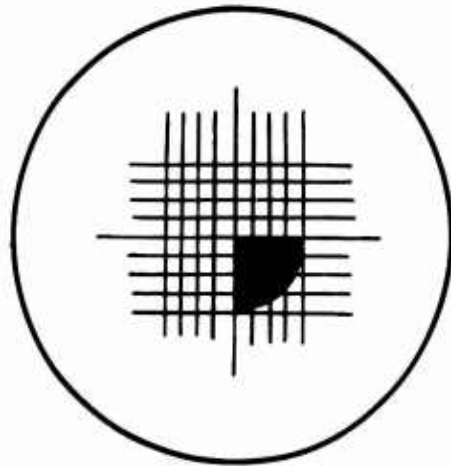


RIGHT FIELD

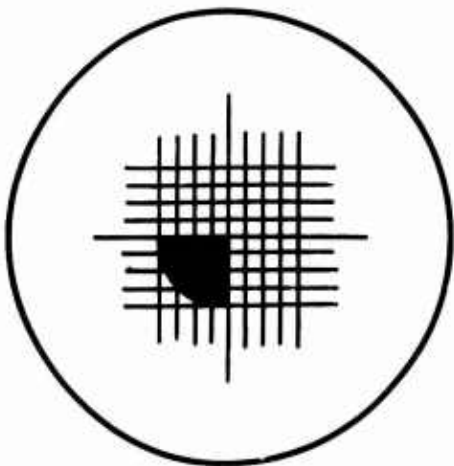
FIGURE 3. VIEW OF TARGET THROUGH COLLIMATOR GRID



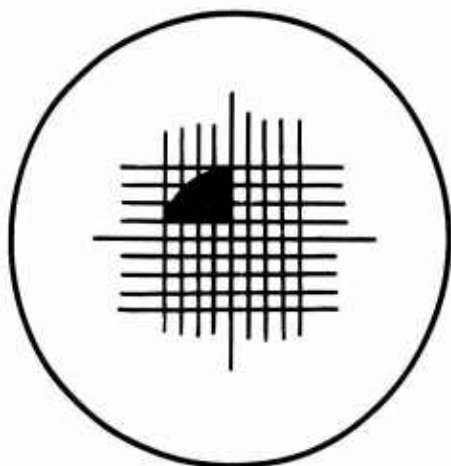
**PLUS DIPVERGENCE
DIVERGENCE**



**MINUS DIPVERGENCE
DIVERGENCE**



**MINUS DIPVERGENCE
CONVERGENCE**



**PLUS DIPVERGENCE
CONVERGENCE**

4. COMBINATIONS OF DIPVERGENCE, DIVERGENCE, AND CONVERGENCE

not exceed ± 15 minutes divergence, 30 minutes convergence, and 0 minutes divergence.

Range finders having variations in collimation exceeding prescribed tolerances shall be handled as follows:

a) End housings shall be repositioned according to accepted procedures and collimation again checked. If unsuccessful in securing acceptable results, the end housings shall be replaced.

b) If the discrepancy persists, make optical adjustments. This shall be attempted only by qualified personnel who are familiar with the procedure for the particular instrument concerned.

c) If the above correction measures fail, the instrument shall be returned to the manufacturer for factory examination.