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OBSERVATION DEVICES

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Aberdeen Proving Ground, Maryland

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13. ABSTRACT Establishes test methods and techniques for testing non-electric optical instruments, such as observation telescopes or binoculars, which are designed to enable the user to see distant objects <u>not</u> clearly visible with the unaided eye. This TOP is <u>not applicable</u> for observation devices that incorporate electronic equipment, nor for optical instruments designed primarily for use as weapon sights, surveying instruments, or night vision aids.			

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U. S. ARMY TEST AND EVALUATION COMMAND
EXPANDED SERVICE TEST - SYSTEM TEST OPERATIONS PROCEDURES

AMSTE-RP-702-109

*Test Operations Procedure 10-3-106

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OBSERVATION DEVICES

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SECTION I
GENERAL

1. Purpose and Scope.

a. This test operations procedures (TOP) establishes test methods and techniques for conducting an expanded service test to determine whether the test item meets the criteria established in applicable materiel requirements documents and is suitable for use by the US Army.

b. The observation devices (test items) applicable for testing with this TOP are non-electric optical instruments, such as observation telescopes or binoculars, designed to enable the user to see distant objects not clearly visible with the unaided eye. These devices are used by soldiers in the field for general observation. In some cases the optics may include reticles or scales that enable the user to approximate angular measurements also.

*This TOP supersedes TOP 10-3-106, 25 February 1972.

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c. This TOP is not applicable for observation devices that incorporate electronic equipment, nor for optical instruments designed primarily for use as weapon sights, surveying instruments, or night vision aids. Test procedures for those types of instruments may be found in the following documents:

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- (1) TOP 3-3-110, Fire Control Materiel.
- (2) TOP 3-3-116, Sights, Direct Fire.
- (3) TOP 3-3-505, Speed and Precision of Lay.
- (4) TOP 3-3-600, Sights, Indirect Fire.
- (5) TOP 6-3-036, Combat Surveillance, Ground.
- (6) TOP 6-3-037, Target Detection and Acquisition Devices.
- (7) TOP 6-3-097, Night Observation Device.
- (8) TOP 10-3-110, Theodolites.

d. This procedure addresses a preoperational inspection to determine the physical characteristics and serviceability of the test item, a series of appropriate tests designed to examine the operational and functional performance characteristics, and an examination of the safety, human factors, and value engineering aspects of the test item. Testing will be conducted under simulated tactical conditions or conditions similar to those expected in the areas of intended operational use of the test item.

2. Background.

a. Military operations become more effective through the use of optical equipment that enhances visual surveillance. A variety of optical equipment has been developed that makes distant objects more visible or provides a magnified view of an area of interest. Typical of such equipment are binoculars, battery commander (BC) scopes, and spotting scopes.

b. Current observation equipment includes both monocular devices and binocular devices. Both types of devices enable the user to see distant objects not otherwise discernible, but the devices with binocular viewing also retain and enhance the natural stereoscopic vision provided by normal unaided eyesight.

1-a

c. As new or improved devices are developed, testing will be required to determine the suitability of the test item for Army use.

3. Equipment and Facilities. In addition to the equipment and facilities defined in the documents listed in Section II, the following are required:

- a. Target personnel and vehicles (para 7).
- b. Communications equipment (para 7).

SECTION II TEST PROCEDURES

4. Supporting Tests.

a. The procedures outlined in this TOP provide general guidance for the conduct of expanded service tests. Detailed specific procedures are dependent on the characteristics of the item being tested, and the stated criteria in applicable requirements documents.

b. In preparing for the test, the test officer should conduct the necessary administrative, personnel, and supply actions outlined in his test officer's manual or in the unit standard operating procedures (SOP). Sufficient pretest training must be accomplished to ensure test soldiers are equally familiar with the test and control items. The performance of the test item must not be degraded because it is new or the test troops are unfamiliar with it.

c. During each subtest, sufficient data must be collected to support valid conclusions. This goal may be constrained by limitations on the number of test items, time available for testing, manpower and funds available, or the support and control equipment available. When planning the test, the test officer should consult with methodology personnel (e.g., statistical analysts, experimental psychologists, human factors analysts) for assistance in selecting the best techniques for collecting meaningful and sufficient data to permit a statistically valid evaluation of the test item. Methodology personnel can advise and assist in determining the appropriate experimental design to include the techniques for random sampling, sample size required to evaluate the true performance, estimating average performance (or variability of performance) from a sample, comparing materials or products with respect to average performance (or variability of performance), number of test soldiers needed, and the number

of repetitions required for a specific exercise. Additional statistical guidance may be found in TOP 3-1-002, Confidence Intervals and Sample Size, and in National Bureau of Standards Handbook 91, Experimental Statistics.

d. Common Service TOPs, the tests defined in Section III, and other published documents to be considered in formulating an expanded service test plan are listed below. Additional reference material is in the Appendix.

<u>TEST SUBJECT TITLE</u>	<u>PUBLICATION NO.</u>
(1) Operator Training and Familiarization (refer to para 5)	10-3-501
(2) Safety	10-3-507
(3) Photographic Coverage	7-3-519
(4) Preoperational Inspection and Physical Characteristics (refer to para 6)	10-3-500
(5) Packaging and Containers	10-3-211
(6) Durability and Reliability	10-3-502
(7) Man Portability/Transportability	10-3-506
(8) Airdrop Operations	7-3-511 and 7-3-512
(9) Air Portability, Internal	7-3-515
(10) Maintenance Evaluation	10-3-504 and TECR 750-15
(11) Operational Performance (refer to para 7)	
(12) Adverse Conditions	3-3-524
(13) Human Factors Evaluation (refer to para 8)	10-3-505
(14) Value Analysis	TECR 700-1

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Operator Training and Familiarization.

a. Accomplish the procedures described in TOP 10-3-501. Ensure the test soldiers are equally familiar with the test and control items.

b. Review all safety procedures and hazards of the overall testing environment. Caution all test soldiers regarding viewing the sun or other sources of intense visible light with any binocular or telescope.

c. Instruct test soldiers in the capabilities, operation, and limitations of the test and control item, to include:

(1) Method of setting-up, dismantling, and packing the item in the field.

(2) Adjustments for magnification, field of view, and focus range.

(3) Proper use and choice of filters for various viewing conditions and observation missions.

(4) Any feature that could influence accuracy of data obtained under mission task conditions.

(5) Proper care and handling of an observation device in the field.

d. Familiarize test soldiers with trade terms and unique or state-of-the-art optical terminology not otherwise defined in the supplied instructional matter.

e. Ensure each test soldier understands the overall purpose of the expanded service test and the detailed procedures for individual tests.

6. Preoperational Inspection and Physical Characteristics. Accomplish the procedures described in TOP 10-3-500. The visual inspection of the test and control items should include but not be limited to the following considerations:

a. Optical parts should be examined with the aid of a magnifier. Lens surfaces should be free of scratches, pits, grayness, insufficient polish, chipped edges, and cracks. Cemented lenses should be inspected

for bubbles and blisters in the cement. Some lens surface defects can be detected without the aid of a magnifier by illuminating the surface at nearly grazing incidence. Poor polish, striae, and waviness can be detected in this manner.

b. Metal surfaces should be free from burrs and sharp edges. Material should be sound, of uniform quality and conditions, and free of seams, cracks, or other defects that may adversely affect the strength, endurance, or wear resistance of the item.

c. Reticle markings should be inspected for legibility; each number or letter should be legible, and all reticle lines should appear uniform in width and depth. Intersections of lines should appear to be sharp.

d. Workmanship should be of high quality consistent with instrument production standards and practices.

7. Operational Performance.

a. Objective. To determine the capability of the test item to provide visual assistance to observers in an operational environment.

b. Method.

(1) This subtest is designed to provide a realistic evaluation of the soldier/observation device combination in a tactical environment. Tactical field exercises should be conducted to provide influencing factors similar to those felt in combat, such as fatigue, noise, dust, smoke, dirt, rain, and morale. The field conditions should also add realism to the test environment through the effects of terrain, vegetation temperature, and simulated enemy weapons and tactics.

(2) The test soldiers will be presented with simulated tactical situations that require the test and control items to be used for observation tasks. The test soldiers will observe objects and events that depict situations the soldiers would be likely to encounter in the performance of their combat missions. These may include but need not be limited to the following:

(a) Reconnaissance patrols.

(b) Observation posts, to observe simulated enemy troops and materiel in tactical dispositions.

(c) Adjustment of mortar or artillery fires.

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(3) Other tactical field exercises adaptable to the above requirements may be found in TOP 1-1-046, Field Combat Test Exercises.

(4) To evaluate test item performance under various levels of illumination and weather conditions, test exercises will be conducted during both daylight and darkness and inclement weather that occurs during the test period.

(5) The tactical exercises should be designed to ensure all test item operational characteristics described in requirements documents or test directives are demonstrated to the most practical extent.

(6) Test soldiers should be equipped with fighting and existence loads and wear CB protective equipment as appropriate for the simulated tactical conditions. The test soldiers should operate the test item while barehanded, while wearing 5-finger gloves, while wearing arctic mittens, and while wearing CB protective equipment.

(7) The test item should be operated continuously for a period of time sufficient to allow a valid determination of whether it meets the prescribed requirements for durability and reliability. All operations should be performed in accordance with applicable instructions accompanying the test item.

(8) To evaluate the field of view, focus, and visual resolution range, the test item will be positioned at a bench mark in an area typical of normal field operations. Establish a communication net between the observer using the test item and targets consisting of personnel and vehicles. The observer will adjust the test item to obtain optimum definition and clarity at center field on stationary targets located at various distances from the bench mark. The observer will then have the target begin moving, some away from and some toward the bench mark. Using all controls and adjustments provided on the test item, the observer will track the targets as they move away from or toward the bench mark. As the resolution of the moving target becomes impaired, the observer will halt the target and determine its distance from the bench mark. These procedures will be repeated for different types of targets in all directions. The maximum and minimum distances are determined for adequate resolution, focus, and field of view.

(9) During the conduct of the field exercises, the soldiers using the test items should be closely observed to determine any indications of incompatibility between the test item and the protective clothing and equipment and any difficulties in using the test item. Determination will be made by observation, questionnaires, or interrogation of test soldiers as to whether the soldiers can properly use the test item for its intended function.

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(10) Weather condition (temperature, humidity, precipitation, windspeed and direction) and ambient light conditions should be recorded during the test period. If other than complete daylight, the amount of ambient light should be expressed in foot-candles.

c. Data Required.

(1) A description of the tactical exercises conducted to include date and time, location, dimensions of test area, simulated tactical situation, and observation task to be performed.

(2) Weather and light conditions as required by b(9), above.

(3) A description of the target installations.

(4) Maximum and minimum distances between bench mark and targets at impairment of visual resolution or focus.

(5) Number of test observations for each type target.

(6) A description of any difficulties encountered in use of the test and control items.

d. Analytical Plan.

(1) Any difficulties reported in use of the observation devices will be analyzed subjectively in comparing the test and control items.

(2) The recorded data for target resolution and focus distances and field of view will be arranged in tabular or graphic form and analyzed for test item capability. The total data will be further analyzed to determine if there are significant differences in operational capabilities between the test and control items, or between the test item and established criteria.

8. Human Factors Evaluation.

a. Accomplish the procedures described in TOP 10-3-505 to determine the degree to which the test item meets the human factors requirements stated in requirements documents and is suitable for Army use from the standpoint of compliance with standard human factors principles.

b. To facilitate this evaluation, consideration should be given to the following, as applicable to the particular test item:

- (1) Controls and indicators:
 - (a) Easy to operate and read.
 - (b) Clearly marked for function.
 - (c) Sufficient to maintain proper control of the test item.
- (2) Maintainability:
 - (a) Ease of locating malfunction and determining cause.
 - (b) Access to defective component.
 - (c) Ease of replacement or repair of malfunction.
- (3) Physical design affecting user comfort and ease of vision:
 - (a) Weight and dimensions suitable for being hand carried or worn on the person.
 - (b) Discomfort to user caused by eyepiece material.
 - (c) Eyepiece shield compatibility with personnel wearing spectacles.
 - (d) Confusion as a result of optical controls that operate in the opposite direction to the observed affect, e.g., focusing for distant objects by moving a control in rather than out.
 - (e) Misalignment or overtravel by operator caused by controls that have no "built-in" turning resistance.
 - (f) Misalignment by operator caused by critical controls not being protected by locks, guards, or recesses.
 - (g) Misalignment by operator personnel due to placement of controls, e.g., controls not accessible from normal operating position.
 - (h) Confusion to operator caused by critical controls not having positive "snap-action" tactile sensation when changing settings.
- (4) Performance characteristics:
 - (a) Poor collimation.

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- (b) A focus range not applicable to all Army personnel eyesight capabilities.
- (c) Poor color correction of lenses.
- (d) Excessive light loss resulting in dim images and eye strain.
- (e) Magnification too high for hand-held applications.
- (f) Excessive difference in binocular - half magnifications.
- (g) Brightness and suitability of display contrast, size of display, and freedom from vibration.
- (h) Compatibility of test item with items of the uniform or protective clothing and equipment.

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APPENDIX
REFERENCES

1. AR 70-10, Test and Evaluation During Research and Development.
2. FM 31-100 (Test), Surveillance, Target Acquisition, and Night Observation (STAND) Operations.
3. National Bureau of Standards Handbook 91, Experimental Statistics.
4. TECR 70-23, Equipment Performance Reports.
5. TECR 70-24, Documenting Test Plans and Reports.
6. TECR 310-3, TECOM Test Operations Procedures Style Manual.
7. TECR 310-6, TECOM Test Operations Procedures.
8. TECR 385-6, Verification of Safety of Materiel During Testing.
9. TECR 700-1, Quality Assurance; Value Engineering.
10. TECR 750-15, Maintenance Evaluation During Testing.
11. TOP 1-1-012, Classification of Deficiencies and Shortcomings.
12. TOP 1-1-045, General Supplies and Equipment Testing.
13. TOP 1-1-046, Field Combat Test Exercises.
14. TOP 3-1-002, Confidence Intervals and Sample Size.
15. TOP 3-3-110, Fire Control Materiel.
16. TOP 3-3-116, Sights, Direct Fire.
17. TOP 3-3-505, Speed and precision of Lay.
18. TOP 3-3-600, Sights, Indirect Fire.
19. TOP 6-3-036, Combat Surveillance, Ground.
20. TOP 6-3-037, Target Detection and Acquisition Devices.
21. TOP 6-3-097, Night Observation Devices.
22. TOP 10-2-106, Binoculars.
23. TOP 10-2-109, Telescopes.
24. TOP 10-3-110, Theodolites.