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

PROJECTION SET, MOTION PICTURE

1. OBJECTIVE*

This document provides test methodology and testing techniques necessary to determine the technical performance and safety characteristics of motion picture projection sets and their associated tools and equipment as described in the Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), Technical Characteristics (TC's), and as indicated by the particular design and to determine the test item's suitability for service tests.

2. BACKGROUND

A motion picture projector should be capable of projecting a reasonably accurate image from the source, without also projecting annoying flicker, unsteadiness, or noise. If required, it should also be capable of delivering an audio reproduction free from hiss, garble and other annoyances. It is desirable to determine the accuracy with which the motion picture projector meets these requirements, as well as determining other operating characteristics.

All motion picture projectors are essentially similar. They all use as a source a long narrow film, which consists of a number of sequential still pictures. Each of these transparent still pictures is called a frame. A light source shines through each transparent picture onto a projection lens. The lens system then focuses the image on a screen. After projecting the frame for a small fraction of a second, a shutter obscures the light path so that no light is emitted from the projector. During this dark period, the film transport mechanism advances the film to the next frame. The shutter then removes itself from the light path, and the process repeats. Sophistications to this basic operation include collimating lenses and parabolic reflectors to increase the light flux, ventilating fans to cool the film, a shutter which reduces the apparent flicker, and other desirable innovations.

Motion picture projectors which reproduce audio information may use an optical or magnetic reproduction system. The magnetic system is not unlike a tape recorder. Fields in the metallic oxide sound track of the moving film induce varying currents in the magnetic playback device. The optical system uses a separate light source which shines through the sound track of the moving film onto a photosensitive device. In one method, varying transmission densities in the sound tract modulate the light intensity, which produces varying currents in the photosensitive device circuit. In either the optical or magnetic sound reproduction system, the varying electrical currents are amplified and applied to loudspeakers. Synchronization between sound and

*This MTP is intended to be used as a basic guide in preparing actual test plans for the subject equipment. Specific criteria and test procedures must be determined only after careful appraisal of pertinent QMR's, SDR's, TC's and any other applicable documents.

picture is automatically obtained by placing the sound track on the same film as the picture frames.

3. REQUIRED EQUIPMENT

a. Scales.
b. Measuring Tape.
c. Tilting Test Table.
d. Instruments to measure angles.
e. Film Tension Gauge.
f. Stop Watch.
g. Light Meter.
h. Photo-Sensitive Device.
i. Test Films, as specified.
j. Oscilloscope.
k. Resistive, Non-Inductive Load having a resistance equal to the IKC impedance magnitude of the speaker voice coil.
l. Thermocouple.
m. Audio Signal Generator.
n. Frequency Selective Voltmeter.
o. Sound Level Meter.
p. VTVM.
q. Warble Frequency Signal Source.
r. Variable Voltage, Variable Frequency Power Source.
s. Vibration Table.
t. Drop Test Facility
u. Environmental Test Facilities

4. REFERENCES

A. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
B. USATECOM Regulation 700-1, Value Engineering.
C. USATECOM Regulation 705-4, Equipment Performance Report.
D. USAGETA Document, Human Factors Evaluation Data for General Equipment (HEDGE).
E. AMCP 706-134, Maintenance Guide For Design.
F. MIL-STD-150A, Photographic Lenses.
G. MIL-STD-461, Electromagnetic Interference Characteristics, Requirements for Equipment.
MIL-STD-462, Electromagnetic Inteference Characteristics, Measurements of.
MIL-STD-810B, Environmental Test Methods.
American National Standards Institute PH 22.43-1961, 16 mm Cycle Flutter Test Film, Photographic Type.
American National Standards Institute PH 22-44-1963, 16 mm Multifrequency Test Film, Photographic Type.
American National Standards Institute PH 22-45-1962, 16 mm 400 Cycle Signal-Level Test Film, Photographic Type.
American National Standards Institute PH 22-57-1963, 16 mm Buzz Track Test Film, Photographic Type.

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N. American National Standards Institute S1.4-1961, Specification for General Purpose Sound Level Meters.
O. American National Standards Institute Z57.1-1954, Method to Determine Flutter Content of Sound Recorders and Reproducers.
P. American National Standards Institute PH 22.80, Specification for Scanning Beam Uniformity Test Film for 16mm Motion Picture Sound Reproducers.
Q. American National Standards Institute PH 22.42, Specification for 16mm Sound Focusing Test Films, Photographic Type A.

NOTE: The above Standards are American National Standard Institute documents available commercially. Films conforming to these standards, in addition to other test films, can be obtained from the Society of Motion Picture and Television Engineers.

R. Society of Motion Picture and Television Engineers RP20, Society of Motion Picture and Television Engineers, Specification for 16 mm Registration Test Film.
S. MTP 6-2-245, Recording and Reproducing Equipment, Tape.
T. MTP 10-2-500, Physical Characteristics.
U. MTP 10-2-501, Operator Training and Familiarization.
V. MTP 10-2-502, Durability.
W. MTP 10-2-503, Transportability.
X. MTP 10-2-505, Human Factors Evaluation.
Y. MTP 10-2-507, Maintenance Evaluation.
Z. MTP 10-2-508, Safety.
AA. MTP 10-2-511, Quality Assurance.

5. SCOPE

5.1 SUMMARY

This MTP describes the following tests:

a. Preparation for Test - A determination of the physical condition of the test item upon arrival, its physical characteristics, and procedures of operator training and familiarization for the test item.

b. Technical Performance - An evaluation of the technical characteristics of the test item.

c. Electromagnetic Compatibility - An evaluation to determine the degree to which the test item produces radiated or line conducted interference.

d. Durability - An evaluation to determine the test item capability of retaining original performance characteristics following extended operation.

e. Transportability - An evaluation to determine the ability of the test item to withstand the shock and vibration which it will experience during normal handling and transporting.

f. Environmental - An evaluation to determine the ability of the test item to resist pnysical damage and to function properly after exposure to the extremes of environment.

g. Maintenance - An evaluation to determine and appraise the test item's maintenance characteristics and requirements, a verification and appraisal

of its malfunctions, an evaluation of the test item's associated publications and other common and special support elements (maintenance test package), an appraisal of the test item's design for maintainability (AMCP 706-134: accessibility, ease of maintenance, standardization, and interchangeability), an evaluation of component and system durability and reliability, and the calculation of indicators which express the effects of appropriate preceding aspects.

h. Safety - An evaluation to determine the safety characteristics of the test item.

i. Human Factors Evaluation - An evaluation of the man-item relationship during operation, maintenance, and transport of the test item including design deficiencies which affect operability and the noise level generated.

j. Value Analysis - An evaluation to determine whether the test item contains unnecessary, costly, or "nice-to-have"features which could be eliminated without affecting technical performance and safety characteristics.

k. Quality Assurance - A study to determine the quality of the test item.

5.2 LIMITATIONS

This document primarily relates to those projectors that optically reproduce audio information. The projectors using magnetic reproduction should be subjected to all the tests in this document except those relating specifically to optical reproducers. The magnetic reproduction capability should be evaluated in accordance with MTP 6-2-245.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Initial Inspection

Upon receipt of the test item at the test site, the test item shall be subjected to the following procedures:

a. Visually inspect the test item package(s) and record the following:

1) Evidence of packaging damage or deterioration
2) Identification markings, including:

a) Name of contractor
b) Number and date of contract
c) Date of manufacture
d) Other markings pertaining to the test item

b. Weigh and measure the individual package(s) of the test item and its accessories and record the following:

1) For each shipping package:

a) Contents
b) Weight

c) Length, width, and height
d) Cubage

2) For entire test item:

a) Weight
b) Cubage

c. Unpack the test item; visually inspect it, and record the following where applicable:

1) Type and adequacy of packing material
2) Evidence of defects in:

a) Manufacturing
b) Material
c) Workmanship

3) Evidence of damage
4) Evidence of wear

NOTE: Make use of photographs, diagrams and narration to indicate the condition of the test item.

d. Presence of instruction plates, if applicable, including:

1) Identification, name and serial number
2) Caution instructions
3) Service instructions

e. Existence of shortages

6.1.2 Physical Characteristics

Determine and record physical characteristics of the projector as described in the applicable sections of MTP 10-2-500 and the following:

a. Test item nomenclature and serial number
b. Dimensions for individual projector components and complete projector:

1) Weight
2) Length, height, and width

c. Electrical characteristics as specified on the equipment, including:

1) Voltage
2) Current
3) Wattage

d. Distinguishing characteristics:

1) Film size of projector (i.e., 35mm, cinerama, 8mm, 16mm)
2) Type of projector (by type of sound track i.e. no sound track, optical sound track, magnetic sound track)
3) Type of threading (i.e. manual, automatic)
4) Lens:

   a) F-number
   b) Angular field
   c) Focal length

5) Other distinguishing characteristics

6.1.3 Operator Training and Familiarization

Orient test personnel using the criteria of MTP 10-2-501 and record all pertinent data.

6.1.4 Test Item Preparation

Perform the following:

a. Remove all protective material and preservatives.
b. Lubricate all components as required by the applicable maintenance instructions or lubrications orders.

6.2 TEST CONDUCT

NOTE: 1. All equipment failures shall be reported in accordance with USATECOM Regulation 705-4.
2. For brevity only 16mm test films are listed in the test, however, the test procedures are applicable to all sizes of projectors and applicable test films are available from the society of Motion Picture and Television Engineers.
3. Testing personnel shall comply at all times with the safety regulations governing the operation of all test items and test equipment.

6.2.1 Technical Performance

6.2.1.1 Physical Stability

Prepare the projector for operation, using the maximum size film reels, with film. Place the projector on a table capable of tilting in all directions at any angle with the vertical and perform the following:

a. Tilt the table in any given direction until the projector begins to slide or tip over. Record the table angle.
b. Repeat step a for all directions.
c. While operating the projector, tilt it in any given direction until it no longer operates correctly. Record the angle.
d. Repeat step c for all directions.

e. Operate the horizontal tilt control on the projector and record the following:

1) Number of hands required to adjust tilt.
2) Maximum tilt.
3) Ability to select desired tilt, i.e. to place projected image where desired.
4) Ease of operating tilt control.

f. Determine and record whether motor vibrations visibily affect the projected image.

6.2.1.2 Film Reel Combinations and Film Tension

a. Prepare the projector for operations, using the maximum size film reels, with film.
b. Operate the projector and observe and record any malfunctions induced by the use of the reel combination.
c. Near the beginning of the reel of film measure and record the tension imposed on the film:

1) By the take-up reel
2) By the brake tension of the feed reel

d. Repeat step c at least twice, once at the middle and once near the end of the film.
e. Repeat steps a through d for each possible combination of film reel sizes.

6.2.1.3 Rewind Time

Mount on the projector the largest reel of film it will accept. Rewind the film, and perform the following:

a. Record the size of reel used.
b. Measure and record the time required to rewind (a wrist watch with a sweep second hand is sufficiently accurate).
c. Inspect the film for and record any evidence of damage.
d. Observe the rewind operation to ensure that no part of the picture area or sound track contacts any stationary metal part.

6.2.1.4 Framing Mechanism

Operate the projector and perform the following:

a. Move the framing mechanism so that the projected frame is moved to its lowest point.
b. Mark the position of the framing mechanism at the film.
c. Measure and record the height of the projected image and the distance from the top of the projected image to the top of the frame.
d. Move the framing mechanism so that the projected frame is moved

to its highest point.

e. Measure and record the following:

1) Distance the framing mechanism has moved (at the film).
2) Distance from the bottom of the projected image to the bottom of the frame.

f. Center the frame, operate the projector, and observe and record any indication of picture "creep", i.e. a slowly moving frame.

6.2.1.5 Image Quality of Projection Lens

Operate the projector using colored film. View the image from a distance equal to twice the width of the projected image and perform the following:

a. Record any evidence of haze.

b. Record any instances of color fringing--colored light at the edges of image objects (e.g. red fringes of light around a hand).

c. Observe fine detail in the projected image for evidences of blur.

NOTE: For a more detailed lens evaluation, remove it from the projector and perform the applicable sections of MIL-STD-150A.

6.2.1.6 Light Output

a. Ready the projector for operation.

b. Project a film on a screen, at a distance from the projector so that the width of the projected image is 40". Place the screen perpendicular to the optical axis. Focus the image on the screen.

c. Outline the projected image area on the screen for future reference. Remove the film.

d. Divide the projected image area into 12 equal areas, as in Figure 1.

e. Measure the direct (not reflected) illumination at the center of each square in the plane of the screen.

NOTE: This measurement can be made with a photo-electric light meter corrected with filters to approximate the spectral sensitivity of the human eye. Other methods exist; the method used is not critical. While making this measurement, all lenses shall be clean and in proper adjustment.

f. Note bands or patches of uneven light distribution.

g. Measure the short dimension of the projected image.

6.2.1.7 Corner to Center Illumination Ratio

Focus the projector on the film plane and position the projector so that the projected image area is 40 inches wide. Perform the following:

a. Measure the illumination (direct) in the center of the projected image area.

1	2	3	4
5	6	7	8
9	10	11	12

Figure 1. Light Output Image Area.

b. Measure the illumination (direct) in each corner of the projected image area (two inches from the top or bottom and two inches from the side).

NOTE: Use a light meter that has only one photoelectric cell. Use a filter that approximates the spectral vision of the human eye.

c. Observe the projected image area and record evidence of bands or patches differing in color or brightness.

6.2.1.8 Flicker

a. Place a photosensitive device (i.e. phototube, photo-transistor, etc), in the center of the projected image area.

b. Apply the output signal from the photosensitive device to the vertical plates of an oscilloscope.

c. Thread the projector with test film which has been overexposed to point where each frame consists of a clear area instead of a picture.

d. Operate the projector with this test film.

e. Adjust the oscilloscope horizontal sweep to obtain a rectangular wave-form trace (the corners may be rounded).

f. Record time measurements at the zero intensity axis of the trace to obtain the pulse widths of the high pulses and the low pulses. Measure several pulses of each type (high and low) to determine whether the widths are constant in time.

g. Record the frames per second rate at which the projector feeds film through the film gate (as specified in the draft technical manuals or instructions).

6.2.1.9 Picture Unsteadiness

Determine the vertical and horizontal picture unsteadiness using a test film and methods as described in the Society of Motion Picture and Television Engineers (SMPTE) Standard RP20.

NOTE: The standard military projector film size is 16mm. For a 16mm film size projector, use a test film conforming to SMPTE Standard RP20.

6.2.1.10 Travel Ghost

Determine the presence or absence of travel ghost using the appropriate test film and test methods.

NOTE: For the standard military projector film size of 16mm, use test film conforming to SMPTE Standard RP20.

6.2.1.11 Location of Film in Image Plane of Lens

a. Project a film containing fine detail in all four corners of the projected image upon a screen.
b. View the projected image at a distance from the screen equal to twice the projected image width.
c. Record any evidence of difference in sharpness of focus among the four corners of the projected image.

6.2.1.12 Film Speed

Measure and record the film speed with a stroboscope, tachometer, other accurate means, or as follows:

a. Pass a suitable length of film containing a known number of frames through the projector and record the number of frames.
b. Measure and record the time of passage with a stop watch.

6.2.1.13 Film Life

NOTE: During this test, close the test room and otherwise guard against dust.

a. Obtain a 12 foot loop of newly processed and lubricated sound and picture film in good condition, having a shrinkage not greater than 0.3 percent.
b. Thread this film through all parts of the projector mechanism that touch the film during normal operation.
c. Support the return loop of the film as near normal position as possible by free-running idlers as follows:

1) The idlers shall have a negligible tendency to damage the film.
2) The idlers shall impose normal operating strain on the film.

d. Pass the loop through the projector mechanism (with the lamp burning) 2000 times. Replace splices as necessary.
e. Project the film upon a screen and record the following:

1) Visible image degradation
2) Audible sound degradation

f. Examine the perforations and record visual evidence of damage.

g. Record the life of ten splices.

6.2.1.14 Noise

a. Mount the projector in free field conditions on a small stand such that it can be turned on a vertical axis through the picture operature.
b. Place the microphone of a sound level meter as follows:

1) Three feet from the vertical axis
2) In a horizontal plane passing through the picture aperature

NOTE: The sound level meter shall comply with ANSI standard S1.4 with the meter at the curve A setting.

c. Operate the projector as normal, using film.
d. Measure and record the sound level in front of the projector (on the longitudinal axis of the picture aperture).
e. Rotate the projector by 45 degree intervals and repeat the measurements of step d.

6.2.1.15 Flutter

NOTE: For the purposes of this document, flutter is defined as frequency deviations of reproduced sounds (from their original frequencies). Percent flutter is the root mean square deviation from average frequency expressed as a percent of average (arithmetic mean) frequency.

a. Thread a suitable flutter test film through the projector.

NOTE: 16mm test film conforming to ANSI Standard PH 22.43-1961 is available from the Society of Motion Picture and Television Engineers (SMPTE), as are appropriate test films in other film sizes.

b. Determine and record the percent flutter in accordance with ANSI Standard Z 57.1-1954.

6.2.1.16 Scanning Beam

a. Determine the lateral positioning by passing a buzz track test film (conforming to ANSI PH 22.57-1963) through the projector, and perform the following:

1) Adjust the projector until both signals are inaudible, if this is possible.
2) If both signals are always heard, adjust them for equal intensity.
3) Record which of the above two procedures was used.

b. Determine uniformity of illumination intensity using test film

and methods as described in ANSI Standard PH 22.80.

c. Determine the azimuth adjustment using a test film conforming to ANSI Standard PH 22.42 and by performing the following:

1) Pass the test film through the projector.
2) Measure and record the output from each of the three sections with a vu(db) meter.
3) Adjust the projector so that the middle section output is not less than the output from the other two sections. Record any difficulties encountered.

d. Determine the optical frequency response characteristic by performing the following:

1) Terminate the amplifier in a resistive (non-inductive) load having a resistance equal to the 1KC impedance magnitude of the loudspeaker.
2) Pass through the projector a multifrequency test film that conforms to ANSI Standard PH 22.44-1963.
3) Focus the scanning light on the film; position the amplifier gain and tone controls at "normal".
4) Measure the power output at each frequency.
5) Repeat step d4 with the sound track on the other side of the film.
6) If necessary, adjust the equalization in the soundhead for best results, and repeat the test. Record the position of the equalization adjustment.

6.2.1.17 Temperature Rise of Projector Housing

a. Attach thermocouples to the projector housing near the following:

1) Projection lamp (do not attach thermocouples to the top cover)
2) Drive motor
3) Amplifier
4) All other sources of heat

b. Place the projector in a room with the temperature at the maximum rated ambient temperature for the projector. Record the ambient temperature.

c. Operate the projector, lamps and all other sources of heat at the nominal rated line voltage for two hours.

d. Measure and record the housing temperature as indicated by the thermocouples.

6.2.1.18 Adequacy of Projector Ventilation

a. Operate the projector, the lamp, and all other sources of heat as follows:

1) At nominal rated line voltage
2) At maximum rated ambient operating temperature

3) Continuously, for ten hours

b. Record any evidence of improper operation.

c. Examine the projector and projection lamp for damage caused by excessive heating. Record any evidences of lamp envelope bulging or other heat damage.

6.2.1.19 Operating Temperatures

6.2.1.19.1 High Temperature - Perform the following:

a. Place the projector in a room with the ambient temperature at the maximum operating temperature of the test item and permit the projector to reach thermal equalibrium.

b. After the temperature of the test item has stabilized, operate the test item continuously for eight hours as follows:

1) At nominal rated line voltage
2) At maximum rated ambient operating temperatures
3) With the light source energized

c. Observe and record any evidence of improper operation.

d. At the end of the operation period, inspect the test item and record evidence of damage due to heat.

6.2.1.19.2 Low Operating Temperature - Perform the following:

a. Place the projector in a room with the ambient temperature at the minimum operating temperature and permit the projector to reach thermal equilibrium.

b. Operate the projector as follows:

1) At nominal rated line voltage
2) At minimum operating temperature

c. Observe and record any evidence of improper operation.

6.2.1.20 Line Frequency and Voltage Variation

a. Successively start and stop the projector as follows:

1) Twenty times at minimum rated line voltage and frequency as specified in draft technical manuals.
2) Twenty times at maximum rated line voltage and frequency.

b. Observe and record any evidence of improper operation during the start and stop operations of step a.

c. Perform the light output (paragraph 6.2.1.6) and the amplifier power output (paragraph 6.2.1.21.1) evaluations under the following conditions:

1) While operating the projector at minimum rated line voltage

and frequency.
2) While operating the projector at maximum rated line voltage and frequency.
3) While operating at line frequencies of 8 percent above and below normal (at nominal rated line voltage).

6.2.1.21 Amplifier Power Output

6.2.1.21.1 Preparation for Test - Perform the following:

a. Position the tone controls of the audio amplifier for normal response.
b. Pass a 400 - cycle test film, that conforms with ANSI Standard PH 22.45 - 1962, through the projector.
c. Using a sound level meter adjust the volume control for an attenuation of 20db.
d. Disconnect the speaker and apply the audio amplifier output to a non-inductive resistive load having a resistance equal to the 1KC impedance magnitude of the loudspeaker voice coil.
e. Attach a signal generator having not more than 0.3 percent harmonic distortion to the amplifier input.

6.2.1.21.2 Test Conduct - Perform the following:

a. Energize the projector light source.
b. Apply an input signal of 100 cps to the projector amplifier and measure the harmonic content across the load with a frequency selective voltmeter. Record the following:

1) Power output at the fundamental frequency.
2) Power output at each harmonic (continue to measure additional harmonics until no readable or significant output is obtained).

c. Repeat step b for each of the following input signals 400, 1KC, 2KC, 3KC, 5KC and 7KC.

6.2.1.22 Volume Control

a. Apply the audio amplifier output to a non-inductive, resistive load, having a resistance equal to the 1KC impedance magnitude of the loudspeaker voice coil.
b. Set the volume control for maximum attenuation and measure and record the output across the load with a voltmeter.
c. Rotate the volume control 10 degrees or by an increment suitable for plotting attenuation vs degrees rotation and measure the output across the load. Record the following:

1) Amount of volume control rotation
2) Amplifier output

d. Repeat step c until the volume control has been rotated to the

minimum attenuation position.

e. Operate the projector using the loudspeaker. Vary the volume control rapidly and repeatedly back and forth between full clockwise and full counterclockwise. Listen for and record any evidence of volume control caused audible sound, especially "scratchy" sounds.

6.2.1.23 Tone Control

a. Apply the audio amplifier output to a non-inductive, resistive load, having a resistance equal to the 1KC impedance magnitude of the loudspeaker voice coil.

b. Attach a signal generator having a range from 50 cps to 10KC and constant voltage output to the amplifier input.

NOTE: The range should be extended for projection with a higher or lower range.

c. Attach a suitable instrument to monitor the amplifier output:

NOTE: Since this evaluation results in a determination of relative response as a function frequency, it does not matter which parameter is measured (i.e. voltage, power current). Probably voltage measurements will usually be most convenient.

d. Position the tone control at full counterclockwise.

e. Vary the input frequency by suitable increments and measure the amplifier output. Record the following for each input frequency:

1) Input frequency
2) Amplifier output

f. Repeat step e for each of the following tone control settings:

1) "Normal" (as placarded on the projector).
2) At least 4 intermediate points (two CCW and two CW from "normal")

6.2.1.24 Output Voltage Regulation

a. Apply the audio amplifier output to a non-inductive, resistive load having a resistance equal to the 1KC impedance magnitude of the loudspeaker voice coil.

NOTE: The value of speaker voice coil impedance indicated on the speaker or in the literature is usually the 1KC impedance magnitude.

b. Apply the 1KC input signal (to the amplifier) of sufficient amplitude to allow the amplifier to develop its rated power into the load.

c. Measure and record the voltage across the load.

d. Remove the load; measure and record the voltage on the amplifier output.

6.2.1.25 Dynamic Range

a. Operate the projector as follows:

1) No film.
2) Motor running.
3) Tone controls at "normal" (as placarded) setting.
4) Volume control set for +32db gain in excess of that required to produce rated output when using the 400 cycle test film.
5) The audio amplifier output applied to a non-inductive, resistive load having a resistance equal to the 1KC impedance magnitude of the loudspeaker voice coil.

b. Measure the output of the audio amplifier across the load.

6.2.1.26 Loudspeaker Evaluation

a. Power handling capacity:

1) Select representative program material having peaks equal to the rating of the loudspeaker. Measure the program material peaks with an oscilloscope to affirm peak value.
2) Apply this program material to the loudspeaker.
3) Listen for and record any evidences of distortion, spurious noises or rattles which appreciably impair the quality of the music or speech input.

b. Minimum output sound pressure:

1) Set up the loudspeaker under free field conditions.
2) Apply a warble signal (over the frequency band of from 800 to 1250 cps) to the loudspeaker.

NOTE: The warble signal power shall be 80% of the rated amplifier output. The signal shall be warbled through the specified band with a linear change of frequency on a logarithmic scale with respect to time.

3) Measure and record the sound pressure level at a point 10 feet from the speaker, and on the sound axis.

c. Loudspeaker output sound pressure distribution:

1) Apply the warble signal to the speaker, in free field conditions, as in step b above.
2) Measure and record the sound pressure level at a point 45° off the sound axis in the horizontal plane.
3) Measure and record the sound pressure level at a point 20° off the sound axis in the vertical plane.

d. Frequency Response Characteristic:

1) Apply the constant voltage signal of a variable frequency sine wave generator to the speaker voice coil. (The voltage amplitude shall be equal to the 800 to 1250 cps warble frequency signal voltage amplitude that corresponds to 20% of the rated speaker power capacity.)
2) Vary the input signal frequency by suitable increments from 50 cps to 10KC and measure the free field sound pressure on the loudspeaker sound axis, at a distance of ten feet from the speaker.
3) Record the following for each input frequency:

    a) Input frequency
    b) Sound pressure

e. Load Characteristics:

1) Impress the warble signal, described in step b.2 across the loudspeaker voice coil. (The voltage amplitude shall be variable from zero to that value that corresponds to 80% of rated speaker power input.)
2) Vary the input signal from zero to 80% of rated speaker power by steps of 10%. At each value of voltage, perform the following:

    a) Measure and record the voltage.
    b) Measure and record the speaker sound pressure output on the sound axis, ten feet from the speaker, in free field conditions.
    c) Measure and record the current drawn by the speaker voice coil.

f. Endurance:

1) Impress a warble frequency signal of 500 cps across the speaker voice coil for 75 continuous hours. The power of the warble signal shall be 80% of the rated speaker power capacity.
2) Increase the warble band from 500 to 2500 cps at the same power input and continue to operate the loudspeaker for an additonal 25 hours.
3) Apply normal program material to the loudspeaker. Listen for and record any evidences of distortion, spurious noises, or rattles which appreciably impair the quality of the music or speech input.

6.2.1.27 Distortion from Film

a. Pass the 400 cycle test film, conforming to ANSI Standard PH 22.45-1962, through the projector.
b. Position the tone control for normal response.
c. Terminate the audio amplifier in a non-inductive, resistive load having a resistance equal to the 1KC impedance magnitude of the speaker voice coil.

d. Measure and record the fundamental and total harmonic output with a frequency selective voltmeter.

6.2.2 Electromagnetic Compatibility

Determine the electromagnetic compatibility of the test item with other equipment by performing the applicable procedures of MIL-STD-462.

6.2.3 Durability

Perform the applicable section of MTP 10-2-502 and the following:

a. Operate the projector for 1000 continuous hours as follows:

1) Apply the audio amplifier to a resistive load having a resistance equal to the 1KC impedance magnitude of the loudspeaker voice coil.
2) Adjust the volume control so that the amplifier delivers 80% of its rated power to the resistive load.
3) Supply the projection lamp with 90% of its rated voltage; energize the projection lamp (leave it on for the 1,000 hours).
4) Replace lamps and tubes as they burn out. Record elapsed time and tube (lamp) identification in all cases.
5) Lubricate the projector as required by draft technical manuals or instructions.

b. At the conclusion of the 1000 hours, repeat the technical performance tests of paragraph 6.2.1.

c. Disassemble the projector and examine each part for wear.

d. Subject the rewind mechanism to the weights and tensions that simulate rewinding of the largest reel of film the projector accomodates. Test the rewind mechanism for a length of time that in actual operation would have allowed rewinding of one million feet of film. Record any malfunctions.

6.2.4 Transportability

Perform the applicable sections of MTP 10-2-503 and the following:

a. Pack the complete projection set in its transit case(s).

b. Raise the case(s) 18 inches above a concrete floor. Drop the cases with their bases parallel to the floor.

c. Examine the equipment for loosening of nuts, bolts and screws, breakage of tubes, and other damage.

d. Operate the projector and observe for any differences in operation.

e. Secure the test item (ready for operation) to a vibration table. Vibrate the table as follows:

1) Along each of the three principal axes with simple harmonic motion.
2) From 5 to 35 cps at a total amplitude between .006 and .016 inch.

3) Maintain the vibration for two minutes at each integral frequency.

f. Choose the integral frequency which seemed most likely to be damaging and vibrate the projector at that frequency as follows:

1) Along each of the three principal axes with simple harmonic motion.
2) At a total amplitude of 0.03± 0.006 inch.
3) For one hour on each axis.

g. After vibrating the test item, examine it for mechanical loosenings, operate the test item and record evidence of degraded operation performance.

h. The technical manual shall be reviewed or consulted for proper procedures for tying down and lifting, and transporting the item by various media. Any inadequacy of instructions should be reported by EPR.

6.2.5 Environmental

Perform the following:

a. Cycle the projector in its transit case through the temperature and humidity cycle of MIL-STD-810B (Method 518) unless otherwise specified by the QMR's, SDR's, or other developmental requirements.

b. Remove the projector from its transit case and wipe off any excess moisture.

c. Determine the detrimental effects on the test item by performing the following:

1) Allow the projector to return to room temperature and humidity.
2) Inspect the projector for corrosion, mechanical binding, or mechanical looseness.
3) Operate the projector under normal conditions to determine if there has been any change in its operating characteristics.

6.2.6 Maintenance

Evaluate the maintenance-related factors of the test item as described in MTP 10-2-507 with emphasis on the following:

a. Organizational (O), Direct Support (F), and General Support (H) Maintenance requirements.
b. Operator through General Support Maintenance Literature.
c. Repair parts.
d. Tools.
e. Test and handling equipment.
f. Calibration and maintenance facilities.
g. Personnel skill requirements.
h. Maintainability.
i. Reliability.

j. Availability

6.2.7 Safety

NOTE: Comply with the safety release requirements of USATECOM regulation 385-6.

Throughout the test evaluate the safety features of the test item by performing the applicable sections of MTP 10-2-508. Testing personnel shall note and record the following:

a. Dangerous or unsafe conditions resulting from inadequate safety features.
b. Dangerous or unsafe features on test item.
c. Adequacy of safety features/devices of the test item.
d. Suggestions to improve existing safety precautions.
e. Temperatures of the test item case or body which could be considered unsafe or dangerous.

6.2.8 Human Factors Evaluation

Throughout the test evaluate the human factors design of the test item by performing the applicable sections of MTP 10-2-505 and the following:

a. Prepare man/item tasks checklists using the criteria of Human Factors Evaluation Data for General Equipment (HEDGE) section IV A to assist personnel in evaluating the man/item performance. The evaluation shall include the following:

1) Ease of operating test item.
2) Accessibility of controls and visibility of indicators.
3) Adequacy of instruction markings.
4) Determination and evaluation of the tendency of any protrusions, sharp edges, or moving parts to snag or cut clothing of user or passerby or to damage packaging container or materials.
5) Acceptability of sound level of operating test item.

b. Each task evaluated shall be rated as follows:

1) Satisfactory _____
2) Unsatisfactory _____
3) N/A _____
4) Comments _____

6.2.9 Value Analysis

Value Analysis of the test item is made to determine whether the test item has any non-functional, costly, or "nice-to-have" features as stated in USATECOM Regulation 700-1.

a. During operation and maintenance of the projector, observations

will be made to determine whether the test item incorporates any features that could be eliminated without compromising their performance, reliability, durability, or safety. Record the identification of their features.

b. During conduct of the test, users will be informally questioned regarding any features of the test item, that may be eliminated without decreasing the functional value of the projector. All user comments regarding value analysis will be recorded in the daily log.

c. The test team members will study the test item during use and will comment separately in the daily log on elimination of unnecessary features, using their experience and background with respect to value analysis.

6.2.10 Quality Assurance

Determine the quality of the test item as described in the applicable sections of MTP 10-2-511.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Initial Inspection

Record the following:

a. For the test item package(s):

1) Evidence of packaging damage or deterioration
2) Identification markings:

a) Name of contractor
b) Number and date of contract
c) Date of manufacture
d) Other pertinent markings

3) For each shipping package:

a) Contents
b) Weight, in pounds
c) Overall dimensions, in feet and inches of:

(1) Length
(2) Width
(3) Height

d) Cubage, in ft^3

b. For the entire test item:

1) Weight, in pounds
2) Cubage, in ft^3

c. Type and adequacy of packing material
d. For the test item:

1) Defect in:

a) Material
b) Construction
c) Workmanship

2) Evidence of damage
3) Evidence of wear
4) Presence of:

a) Identification plate
b) Caution instruction plate
c) Service instruction plate

5) Shortages

6.3.1.2 Physical Characteristics

Record data collected as described in the applicable sections of MTP 10-2-500 and the following:

a. Test item nomenclature and serial number
b. For the individual projector components:

1) Weight in pounds
2) Dimensions, in feet and inches of:

a) Length
b) Height
c) Width

c. Electrical Characteristics as specified on the equipment, including:

1) Voltage, in volts
2) Current, in amperes
3) Wattage, watts

d. Distinguishing Characteristics:

1) Film size of projector, in mm.
2) Type of projector by type of sound track (i.e. no sound, optical, or magnetic).
3) Type of threading (i.e. manual or automatic).
4) For the lens:

a) F-number
b) Angular field
c) Focal length

5) Other distinguishing characteristics

6.3.1.3 Operator Training and Familiarization

Record personnel data collected as described in the applicable sections of MTP 10-2-501.

6.3.2 Test Conduct

6.3.2.1 Technical Performance

6.3.2.1.1 Physical Stability -

Record the following:

a. For the minimum angle in each direction at which the projector slides or tips:

1) Angle of tilt, in degrees
2) Direction of tilt

b. For the minimum angle, in each direction, at which the projector no longer operates correctly:

1) Angle of tilt, in degrees
2) Direction of tilt

c. For the horizontal tilt control:

1) Number of hands required
2) Maximum tilt, in degrees
3) Ability to select desired tilt
4) Ease of operating tilt control

d. Evidence of motor vibrations visibly affecting the projected image.

6.3.2.1.2 Film Reel Combinations and Film Tension -

Record the following reel size combination:

a. Sizes of reels used
b. Evidence of projector malfunction due to the reel combination
c. For film tension measurements:

1) Position on film (beginning, middle or end)
2) Tension imposed upon the film, in ounces by

a) Take-up reel
b) Feed reel.

6.3.2.1.3 Rewind Time -

Record the following:

a. Size of reel used
b. Time to rewind reel, in minutes
c. Evidence of film damage due to rewind
d. Evidence of film contacting stationary metal parts during rewind

6.3.2.1.4 Framing Mechanism -

Record the following:

a. For the projected image:

1) Height of image, in inches.
2) With the framing mechanism at the lowest height, distance from top of the projected image to the top of the frame, in inches.
3) With the framing mechanism at the highest point, distance from the bottom of the projected image to the bottom of the frame, in inches.

b. Distance which the framing mechanism moves, in inches
c. Evidence of creep during normal operation

6.3.2.1.5 Image Quality of Projection Lens -

Record evidence of the following:

a. Haze
b. Color fringes at the edge of image objects
c. Blur in the fine detail (e.g. difficulty in reading print)
d. Data as required by MIL-STD-150A, if applicable

6.3.2.1.6 Light Output -

Record the following:

a. For the illumination at the center of each square:

1) Identification number of square
2) Direct illumination level, in lumens

b. Evidence of bands or patches of uneven light distribution
c. Length of the shortest dimension of the projected image, in inches

6.3.2.1.7 Corner to Center Illumination Ratio -

Record the following:

a. For each illumination measurement:

1) Location of measurement
2) Illumination level, in lumens

b. Evidence of bands or patches differing in color or brightness

6.3.2.1.8 Flicker -

Record the following:

a. Pulse widths, in seconds, of:

1) High pulses
2) Low pulses

b. Number of frames per second at which the projector is operating

6.3.2.1.9 Picture Unsteadiness -

Record the degree of horizontal and vertical picture unsteadiness.

6.3.2.1.10 Travel Ghost -

Record evidence of travel ghost.

6.3.2.1.11 Location of Film in Image Plane of Lens -

Record any evidence of difference in sharpness of focus among the four corners of the projected image.

6.3.2.1.12Film Speed -

Record the film speed as measured by a stroboscope, tachometer, or as follows:

a. Number of frames on the test film
b. Time required for test film to pass through the projector

6.3.2.1.13 Film Life -

Record the following:

a. Evidence of image degradation
b. Evidence of sound degradation
c. Evidence of degradation of film perforation
d. Length of life of ten splices

6.3.2.1.14 Noise -

Record the following for each measurement made:

a. Noise level.

b. Location of measurement with respect to the longitudinal axis of the projector.

6.3.2.1.15 Flutter -

Record the flutter data collected as described in ANSI Standard 257.1-1954.

6.3.2.1.16 Scanning Beam -

Record the following:

a. Whether or not the projector could be adjusted for no audio output during lateral positioning evaluation.
b. Degree of non-uniformity in illumination intensity.
c. The output levels from each of the three sections after adjusting the azimuth adjustment for the best response.
d. For the optical frequency response characteristics:

1) Orientation of test film (forward or reversed)
2) Frequency of test film
3) Power output for each test frequency

6.3.2.1.17 Temperature Rise of Projector Housing -

Record the following:

a. Ambient temperature in °F.
b. Temperature of the projector housing in °F at the following locations:

1) Projector lamp
2) Drive motor
3) Amplifier
4) All other sources of heat

6.3.2.1.18 Adequacy of Lamphouse Ventilation -

Record the following:

a. Ambient temperature, in °F
b. Line voltage used
c. Evidence of improper operation
d. Damage caused to the projector components by excessive heating

6.3.2.1.19 Extreme Operating Temperature -

Record the following:

a. Ambient temperature of chamber, if °F
b. Line voltage used

c. Evidence of improper operation
d. Evidence of damage, if any

6.3.2.1.20 Line Frequency and Voltage Variation -

Record the following:

a. For the start and stop tests:

1) Line voltage, in volts
2) Line frequency, in cps
3) Evidence of improper operation

b. For the light output and amplifier power output:

1) Line voltage, in volts.
2) Line frequency, in cps.
3) Light output data recorded as described in paragraph 6.2.1.6.
4) Amplifier power output data recorded as described in paragraph 6.2.1.21.2.

6.3.2.1.21 Amplifier Power Output -

Record the following for each input signal frequency:

a. Input signal frequency, in cps
b. Power output at the fundamental frequency
c. For each measurable harmonic frequency:

1) Frequency, in cps
2) Power output

6.3.2.1.22 Volume Control -

Record the following:

a. For each power output measurement:

1) Volume control setting
2) Amplifier power output measurement

b. Evidence of volume control caused audible sound

6.3.2.1.23 Tone Control -

Record the following for each tone control setting:

a. Tone control setting (normal, full CW, full CCW, etc)
b. For each input frequency:

1) Input frequency

2) Amplifier output

6.3.2.1.24 Output Voltage Regulation -

Record the following:

a. Voltage across the load, in volts
b. Voltage at the amplifier without the load, in volts

6.3.2.1.25 Dynamic Range -

Record the audio amplifier output across the load.

6.3.2.1.26 Loudspeaker Evaluation -

Record the following:

a. For power handling capacity:

1) Oscilloscope measured peak of the program material.
2) Evidences of impaired speaker quality

b. The measured output sound pressure level produced by 800 to 1250 cps warble at the following locations:

1) Directly in front of the test item
2) 45° off the sound axis in the horizontal plane
3) 20° off the sound axis in the vertical plane

c. For the frequency response evaluation:

1) Input frequency
2) Sound pressure

d. For the load characteristics evaluation:

1) Input voltage, in volts
2) Sound pressure output
3) Current drawn by the speaker voice coil, in amps

e. Evidence of degradations which appreciably impair the quality of the music or speech output at the end of the endurance test.

6.3.2.1.27 Distortion from Film -

Record the following:

a. Fundamental output
b. Total harmonic output

6.3.2.2 Electromagnetic Compatibility

Record data collected as described in the applicable sections of MIL-STD-462.

6.3.2.3 Durability

Record data collected as described in the applicable sections of MTP 10-2-502 and the following:

a. Identify of lamp and tubes which fail
b. Elapsed time since lamp or tube was replaced
c. Time between lubricant procedures
d. All malfunctions and repairs made
e. Technical performance data collected as described in paragraph 6.2.1
f. Evidence of part wear
g. Malfunction of the rewind mechanism

6.3.2.4 Transportability

Record data collected as described in the applicable sections of MTP 10-2-503 and the following:

a. At the completion of the drop test:

1) Evidence of loosening nuts, bolts, and screws, breakage of tubes or other damage.
2) Changes in the operation of the test item.

b. At the completion of the drop test:

1) Evidence of mechanical loosening
2) Change in the operation of the test item

c. Adequacy of instructions for proper tying down, lifting and transporting the test item.

6.3.2.5 Environmental

Record the following:

a. Evidence of corrosion, mechanical binding or mechanical looseness
b. Change in the test item performance

6.3.2.6 Maintenance

Record data collected as described in the applicable sections of MTP 10-2-507.

6.3.2.7 Safety

Record data collected as described in the applicable sections of MTP 10-2-508 and the following:

a. Dangerous or unsafe conditions resulting from inadequate safety features.
b. Dangerous or unsafe features on the test item.
c. Adequacy of safety features/devices.
d. Suggestions to improve existing safety precautions.
e. Temperatures of the test item case or body which could be considered unsafe or dangerous.

6.3.2.8 Human Factors Evaluation

a. Record data collected as described in the applicable sections of MTP 10-2-505.
b. Retain the completed HEDGE checklists.

6.3.2.9 Value Analysis

Record the following throughout the test:

a. Non-functional or unnecessary features
b. Test personnel comments

6.3.2.10 Quality Assurance

Record data collected as described in the applicable sections of MTP 10-2-511.

6.4 DATA REDUCTION AND PRESENTATION

Data obtained during the conduct of the test shall be summarized, making use of photographs and charts as appropriate. Test data for each equipment item tested shall be obtained, summarized and evaluated as required.

Data obtained for each operational performance characteristic shall be compared with technical performance characteristics specified in the QMR's, SDR's, or other developmental criteria.

In additon to charts and photographs, presentation shall include narrative reports on all phases of the test.

6.4.1 Technical Performance

6.4.1.1 Physical Stability

Display the data as appropriate.

6.4.1.2 Film Reel Combination and Film Tension

Display the data as appropriate.

6.4.1.3 Rewind Time

Display the data as appropriate.

6.4.1.4 Framing Mechanism

Display the data as appropriate.

6.4.1.5 Image Quality of Projection Lens

Display the data as appropriate.

6.4.1.6 Light Output

a. Average the twelve center of square illumination measurements.
b. Multiply this average center of square illumination (in foot candles) by the image area (in square feet) to obtain light output in lumens.

6.4.1.7 Corner to Center Illumination Ratio

a. Average the corner illuminations to obtain average corner illumination.
b. Divide average corner illumination by center illumination to obtain corner to center illumination ratio.

6.4.1.8 Flicker

a. Calculate and display the pulse width variance for both the high and low pulses.
b. Calculate the total period of one frame,

$$T = \frac{1}{\text{frames/sec}},$$

where frames/sec, is the rate at which the projector passes film through the film gate.

c. Determine how may high-low pulse combinations occur during T, where a high-low pulse combination is the combination of a high pulse and the adjacent low pulse.
d. Flicker is the number of light flashes per frame, which is the same as the number of high-low pulse combination occurring during T. Display flicker as the number of flashes per frame.

6.4.1.9 Picture Unsteadiness

Record evaluation made as to degree of picture unsteadiness.

6.4.1.10 Travel Ghost

Display evidence of travel ghost.

6.4.1.11 Location of Film in Image Plane of Lens

Display evidences of corner detail sharpness differences.

6.4.1.12 Film Speed

Display film speed (frames per second) as measured by a stroboscope, tachometer, or other speed measuring instrument. Alternatively, perform the following:

a. Divide the known number of frame by the amount of seconds measured to pass the film.
b. Display this quantity, in frames per second, as the film speed.

6.4.1.13 Film Life

Display the following as appropriate:

a. Visible image degradation
b. Audible sound degradation
c. Physical film damage
d. The average life of the splice (the arithmetical mean of the life of the ten splices).

6.4.1.14 Noise

Display the measured noise levels, giving complete information of measurement. Comment as appropriate on the irritability of projector noise during test conduct (conduct of all tests).

6.4.1.15 Flutter

Display the percent flutter, as determined in accordance with ANSI Standards Z57.1-1954.

6.4.1.16 Scanning Beam

Display the following:

a. Lateral positioning - Whether or not projector can be adjusted so that it does not reproduce either signal of the buzz track test film conforming to ANSI Standards PH 22.57-1963.
b. Uniformity of Intensity.
c. Azimuth Adjustment - Difficulties encountered when making the adjustment.
d. Optical Frequency Response Characteristics-Graph, label, and display power output vs. test frequency for each of the two film orientations.

6.4.1.17 Temperature Rise of Projector Housing

Display the temperature rise at the hottest spot on the projector housing, after two hours of continuous operation at maximum rated ambient temperature.

6.4.1.18 Adequacy of Lamphouse Ventilation

Display evidences of heat damage to the lamphouse after ten continuous hours of operation at maximum rated ambient operating temperature.

6.4.1.19 Low Operating Temperature

Display evidences of improper operation when operating at minimum rated ambient operating temperature.

6.4.1.20 Line Frequency and Voltage Variation

Display the results of the Light Output and the Electrical Power and distortion evaluations for each of the following conditions:

a. Minimum rated line voltage and frequency
b. Maximum rated line voltage and frequency
c. Line voltage and frequencies eight percent above and below nominal

6.4.1.21 Amplifier Power Output

Determine percent output harmonic content for each test frequency as follows:

a. Sum the power outputs at each of the harmonic frequencies. Label the sum S (in db).
b. Calculate percent harmonic distortion using the following formula:

$$\text{Percent harmonic distortion} = \frac{S \times 1007\%}{\text{Power output of fundamental}}$$

c. Label and display percent harmonic distortion for each of the test signals.

6.4.1.22 Volume Control

Graph the volume control attentuation vs angular position. Display as appropriate. Indicate evidences of volume control caused noise in the audio reproduction system (sometimes called a "scratchy pot").

6.4.1.23 Tone Control

Graph and display amplifier output (relative output response vs. frequency) for the tone control test settings.

NOTE: All curves may be drawn on the same graph sheet for easy comparison; label each curve by the position of the tone control.

6.4.1.24 Output Voltage Regulation

Label and display the two measured voltage values.

6.4.1.25 Dynamic Range

Label and display the measured output as appropriate.

6.4.1.26 Loudspeaker Evaluation

a. Power handling capacity - Describe evidences of impaired speakers.
b. Minimum output sound pressure - Display the result.
c. Loudspeaker output sound pressure distribution - Label and display the data.
d. Frequency response characteristic - Graph output sound pressure vs. frequency and display as appropriate.
e. Load characteristics - Graph sound pressure output vs. power input and display.
f. Endurance - Describe evidences of impaired speaker quality.

6.4.1.27 Distortion from Film

Determine percent harmonic content of the 400 cycle test frequency as follows:

a. Sum the power outputs at each of the harmonic frequencies. Label the sum S (in db).
b. Calculate percent harmonic distortion using the following formula:

$$\text{Percent harmonic distortion} = \frac{S \times 100\%}{\text{Power output of fundamental}}$$

6.4.2 Electromagnetic Compatibility

Present data as directed by MIL-STD-462.

6.4.3 Durability

Present data as described in MTP 10-2-502.

6.4.4 Transportability

[illegible]t data as directed in MTP 10-2-503.

6.4.5 E[illegible]mental

Described damage and degradation of test item performance cuased by adverse environmental conditions.

6.4.6 Maintenance

Present data as directed in MTP 10-2-507.

6.4.7 Safety

a. Present data as directed in MTP 10-2-508.
b. Prepare a Safety Release Recommendation in accordance with USATECOM

Regulation 385-6 based on the data collected in paragraph 6.3.2.7.

6.4.8 Human Factors Evaluation

Present data as described in MTP 10-2-505.

6.4.9 Value Analysis

Summarize any observations relative to the elimination of unnecessary features.

6.4.10 Quality Assurance

Present data as directed by MTP 10-2-511.

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13. ABSTRACT

This Engineering Test Procedure describes test methods and techniques for evaluating the technical performance and characteristics of Motion Picture Projection Sets relative to the criteria established in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other applicable design requirements and specifications. The evaluation also serves to ascertain the suitability of the item to undergo service test for use by the US Army.

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