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DETAIL SPECIFICATION

PERISCOPE, TANK

This specification is approved for use by the U.S. Army Tank-automotive and Armaments Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the laser protected tank periscope assemblies. Unless otherwise specified herein, these items will be referred to as "periscopes". These periscopes are used as unity vision devices in combat type vehicles.

1.2 Classification. Periscopes will be identified as follows (see 6.2):

Army Drawing	Item	PIN dash number (see 6.5)
12357792	- Periscope, Tank: M27E4	-1
12357794	- Periscope, Tank: M37E1	-2
12357840	- Periscope, Tank: Laser Protective - M1 Commander Short	-3

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A FSC 1240

Army Drawing	Item	PIN dash number (see 6.5)
12357841	- Periscope, Tank: Laser Protective - M1 Commander Tall	-4
12357846	- Periscope, Tank: Laser Protection - M1 Driver Short	-5
12357848	- Periscope, Tank: Laser Protective - M1 Driver Wide	-6
12357850	- Periscope, Tank: M26E1	-7
12357908	- Periscope, Tank: Laser Protective - 15° Uplook	-8
12357909	- Periscope, Tank: Laser Protective - 20° Uplook	-9
12357918	- Periscope, Tank: M17E4	-10
12370033	- Periscope, Tank: Driver's M45E4	-11
12370322	- Periscope, Tank: M47E1	-12
12370393	- Periscope, Tank: M17CE1	-13

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirement documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-6083	- Hydraulic Fluid, Petroleum Base for Preservation and Operation.
MIL-H-46170	- Hydraulic Fluid, Rust Inhibited, Fire Resistant Synthetic Hydrocarbon Base.
MIL-PRF-62422	- Filter, Laser Hazard Protection.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-130	- Identification and Marking of U.S. Military Property.
MIL-STD-810	- Environmental Test Methods and Engineering Guidelines.(see 4.5.1)

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

NUCLEAR REGULATORY COMMISSION (NRC)

Code of Federal Regulations (CFR)	- Title 10, Parts 30 and 40.

(Copies of the Code of Federal Regulations (CFR) are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

DRAWINGS

12357792	- Periscope, Tank: M27E4.
12357794	- Periscope, Tank: M37E1.
12357840	- Periscope, Tank: Laser Protective - M1 Commander Short.
12357841	- Periscope, Tank: Laser Protective - M1 Commander Tall.
12357846	- Periscope, Tank: Laser Protective - M1 Driver Short.

12357848	- Periscope, Tank: Laser Protective - M1 Driver Wide.
12357850	- Periscope, Tank: M26E1.
12357908	- Periscope, Tank: Laser Protective - 15° Uplook.
12357909	- Periscope, Tank: Laser Protective - 20° Uplook.
12357918	- Periscope, Tank: M17E4.
12370033	- Periscope, Tank: Driver's M45E4.
12370322	- Periscope, Tank: M47E1.
12370393	- Periscope, Tank: M17CE1.

(Copies of these drawings are available from the U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E308	- Standard Practice for Computing the Colors of Objects by Using the CIE System (DoD Adopted).

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGIES (NIST)

NIST, Neutral Density Filters Pamphlet.

(Copies of NIST publications may be obtained from the National Institute of Standards and Technology, Standards and Codes Info; Room A163 Bldg 411, Gaithersburg, MD 20899.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIRMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.3.

3.2 Materials. Materials shall be as specified herein, in applicable standards and specifications and on applicable drawings (see 4.5.1).

3.2.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.2.2 Hazardous materials. Asbestos, Cadmium, and radioactive material will not be used in this item. Radioactive material is defined by CFR, Title 10, Parts 30 and 40, and other radioactive material in which the radioactivity is greater than 0.002 microcuries per gram or 0.01 microcuries total activity for the item.

3.2.3 Dissimilar metals. Contact between dissimilar metals which encourages galvanic action shall be avoided.

3.3 Design and construction. The laser protected tank periscopes shall be manufactured in accordance with the applicable drawing to the periscope specified (see 6.2) and all drawings pertaining thereto from the following (see 4.5.1):

12357792	12357850
12357794	12357908
12357840	12357909
12357841	12357918
12357846	12370033
12357848	12370322
	12370393

3.4 Operating requirements. Each control unit shall provide the following functional, operational, and performance capabilities.

3.4.1 Optical characteristics.

3.4.1.1 Resolution. The periscope shall permit resolution of a test pattern subtending one (1) minute of arc within the resolving area as specified in the applicable drawing listed in 3.3.

3.4.1.2 Spherical power. Spherical power shall be within the range of minus (-) 0.50 to plus (+) 0.25 diopter.

3.4.1.3 Astigmatism. Astigmatism shall not exceed 0.25 diopter.

3.4.1.4 Photopic transmission. The photopic transmission of laser protected periscopes, excluding M1 periscopes, shall be equal to or greater than 36 percent (%). The photopic transmission of M1 periscopes shall be equal to or greater than the value specified below. The photopic transmission shall be measured at 0 ±2 degrees incidence:

Periscope	Nomenclature	Photopic transmission
12357840	Commander's Side	29%
12357841	Commander's Front	24%
12357846	Driver's Side	33%
12357848	Driver's Front	33%

3.4.1.5 Optical density. The optical density requirements for specific wavelength ranges shall be as specified in MIL-PRF-62422, or equivalent. The optical density shall be measured at 0 ±2 degrees (°) incidence.

3.4.1.6 Angular deviation. With the periscope held on its mounting surface in a horizontal plane, an incident ray entering normal to the entrance window shall exit the exit window within ±1° of the angle specified on the applicable drawing.

3.4.2 Cleaning spray.

3.4.2.1 Vehicle exterior cleaning spray. The assembly shall meet the performance requirements of 3.4.1 and shall show no evidence of damage after the portion of the assembly above the sealing surface is exposed to a water jet or steam spraying a commercial alkali steam cleaning solution, immediately followed by a cold water rinse.

3.4.2.2 Vehicle interior cleaning spray. The assembly shall meet the performance requirements of 3.4.1 and shall show no evidence of damage after the portion of the assembly below the sealing surface is exposed to a jet spray of tap water.

3.4.3 Chemicals. The assembly shall meet the performance requirements of 3.4.1 after exposure to vapors of and in direct contact with the following materials for 48 hours minimum:

a. Diesel fuel grade 1 and 2, aviation turbine fuels grade JP-4 or JP-5 and regular automotive leaded gasoline. Hydraulic fluid per MIL-PRF-6083, or equivalent and MIL-H-46170, or equivalent.

3.5 Interface requirements. The assembly shall conform to the interface envelope dimensions, mounting and electrical interfaces in the applicable drawing (see 4.8).

3.6 Support and ownership requirements. Each control unit shall possess the following life cycle ownership characteristics.

3.6.1 Bubbles and inclusions. Bubbles and inclusions (excepting lint) in the clear aperature shall not exceed 0.040 inch (in.) (1 millimeter (mm)) in maximum diameter and the total projected areas (perpendicular to the light path) of all bubbles and inclusions shall not exceed 0.50% of the cross-sectional area of the bonded body perpendicular to the light path. Maximum permissible inclusions are listed in table I (excepting lint):

TABLE I. Maximum Permissible Inclusions.

	Diameter in inches (mm)				
Periscope	0.040 (1)	0.030 (0.8)	0.020 (0.5)	0.010 (0.3)	0.005 (0.1)
M1 driver (all)	3	10	12	48	92
M1 commander (all)	3	10	12	48	92
15° uplook	3	10	12	48	92
20° uplook	3	10	12	48	92
12357918	3	10	12	48	92
12357792, 12357794 12357850, 12370033 12370322, 12370393	5	10	21	81	332

More than the maximum combination of bubbles and inclusions shall not be permitted although a lesser number than permissible is found in one area.

3.6.2 Lint. No lint particles in the clear aperature shall exceed 0.25 in. (6.4 mm) in projected length (perpendicular to the light path). Not more than one such lint particle shall be permitted. No additional lint particles shall exceed 0.125 in. (3.2 mm) in projected length. The cross-sectional area of all lint particles shall be computed on the basis of 0.003 in. (0.08 mm) width and shall be included in the computation of total projected area. The total projected length (in.) of all lint particles shall not exceed the following:

M1 short driver - 0.75 in. (19 mm)
M1 wide driver - 1.35 in. (34.3 mm)
M1 tall commander - 1.35 in.
M1 short commander - 0.75 in.
12357908, 12357909, 12357918 - 0.75 in.
12357792, 12357794, 12357850, 12370033, 12370322, 12370393 - 1.35 in.

3.6.3 Cleanliness. The optical surfaces of completed instruments shall be clean and free of condensates and volatile substances when examined in accordance with method specified in 4.9.3. Dust retention grease shall not be used except with specific authorization of the responsible technical activity.

3.6.4 Identification and marking. All items shall be individually identified and marked in accordance with MIL-STD-130, or equivalent and as specified in the applicable drawings.

3.6.5 Safety. The assemblies shall pose no physical hazards to personnel installing or operating the periscope.

3.7 Operating environment requirements. Each control unit shall operate under the following environmental conditions without damage or loss of performance.

3.7.1 Temperature.

3.7.1.1 Low temperature. The periscope shall meet the requirements of 3.4.1.1, 3.4.1.4 and 3.4.1.5, 3.7.6, respectively after exposure of 24 hours to a temperature of -65 degrees Fahrenheit (°F) (-54 degrees Celsius (°C)). Following the -65°F exposure and with the temperature returned to 73 ±18°F (23 ±8°C), the unit shall show no indication of moisture build-up, bond separation, or other forms of image degradation.

3.7.1.2 High temperature. The periscope shall meet the requirements for 3.4.1.1, 3.4.1.4, and 3.4.1.5, 3.7.6, respectively after exposure to three 24 hour cycles of the hot, dry temperature profile as given in Table II with the humidity no greater than 10% during the exposure. After exposure to the temperature profile but prior to testing, the unit shall be stabilized at 160°F (71°C), and shall show no indication of moisture build-up, bond separation to high temperature test, the unit shall be at a minimum of 160°F (71°C), and shall show no indication of moisture build-up, bond separation, or other forms of image degradation.

TABLE II. Hot climatic temperature test.

Time	°F (°C)	Time	°F (°C)
0100	95 (35)	1300	156 (69)
0200	94 (34)	1400	158 (70)
0300	94	1500	160 (70)
0400	92 (33)	1600	158
0500	92	1700	153 (68)
0600	91 (33)	1800	145
0700	97 (36)	1900	131 (55)
0800	104 (40)	2000	118 (48)
0900	111 (44)	2100	105 (41)
1000	124 (51)	2200	103 (39)
1100	133 (56)	2300	99 (37)
1200	145 (63)	2400	95

3.7.1.3 Mirror and window lamination. The unit shall show no evidence of bond failure when subjected to the temperatures specified in 3.7.1.1 and 3.7.1.2.

3.7.2 Humidity. The periscope shall exhibit no indication of moisture buildup, bond separation, or other forms of image degradation when exposed to two 24 hour cycles of humidity test with 50% maximum relative humidity. Prior to the test, the unit shall be conditioned at 100°F (38°C) and after the test at 73°F (°C). Subsequently the periscope shall meet the requirements for 3.4.1.1, 3.4.1.4, 3.4.1.5, and 3.7.6.

3.7.3 Salt fog. The periscope shall meet the requirements for 3.4.1.1, 3.4.1.4, 3.4.1.5, and 3.7.6 after exposure to the salt fog test specified in MIL-STD-810 or equivalent.

3.7.4 Vibration. The periscope shall be subjected to sinusoidal vibration along each axis. The sinusoidal cycling time shall be a total of 3 hours in each of three perpendicular axes at an ambient temperature of 140°F. Subsequently the periscope shall meet the requirements for 3.4.1.1, 3.4.1.4, 3.4.1.5 and 3.7.6.

3.7.5 Shock.

3.7.5.1 Basic shock. The periscope shall meet the requirements for 3.4.1.1, 3.4.1.4, 3.4.1.5, and 3.7.6, after exposure to the basic shock test that incurs a total of 18 shocks in each direction shall be applied along three mutually perpendicular axes of the periscope.

3.7.5.2 Gun fire shock. The periscope shall meet the requirements for 3.4.1.1, 3.4.1.4, 3.4.1.5, and 3.7.6, after exposure to the gun firing shock test total of 18 shocks in each direction shall be applied along three mutually perpendicular axes of the periscope.

3.7.6 Submergence. No water leakage shall occur through the equipment seal and assembly as the equipment is retained on its mounting surface during test.

3.7.7 Fungus. The assembly shall not support fungal growth when exposed to inoculation by spraying external surfaces with spore suspension.

3.7.8 Weathering. After meeting the performance and environmental requirements, the periscope shall be capable of meeting the requirements of 3.4.1.5, 3.7.1.3, 3.7.8.1, 3.7.8.2, and 3.7.8.3, and shall be otherwise functional and undamaged subsequent to exposure.

3.7.8.1 Resolution (modified). The periscope shall meet the requirement of 3.4.1.1, except that resolution shall be within 75 seconds of arc.

3.7.8.2 Spherical power (modified). The periscope shall meet the requirements of 3.4.1.2, except that spherical power shall be within the range of -0.60 to +0.30 diopter.

3.7.8.3 Astigmatism and light transmission (modified). The periscope shall meet the requirements of 3.4.1.3 and 3.4.1.4, except that astigmatism and light transmission shall not be degraded in excess of 20% of the value recorded prior to weathering tests.

4 VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.3).
b. Conformance inspection (CI) (see 4.4).

4.2 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed in accordance with the following conditions:

a. Temperature: 73 $\pm$18°F (23 $\pm$8°C)
b. Relative humidity: Uncontrolled room ambient.
c. Atmospheric pressure: Site pressure.

4.3 First article inspection. First article inspection shall be performed on six (6) periscopes when a first article sample is required (see 3.1). First article sample shall be inspected as specified in table III. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply periscopes that are fully representative of those inspected as a first article sample. Any changes or deviations of the production units from the first article sample shall be subject to the approval of the contracting officer (see 3.1).

4.4 Conformance inspections (CI). CI shall include the examination of 4.4.2 and the tests of 4.4.3. Noncompliance with any of the specified requirements in sections 3 and 5 shall be cause for rejection.

TABLE III. Verification Methods.

Title	Requirement	Inspection	First article						CI		
										Tests	
			1	2	3	4	5	6	Exam	sampling	100 %
Materials, design and construction	3.2, 3.3	4.5	X	X	X	X	X	X			
Operational requirements	3.4	4.7									
Optical characteristics:	3.4.1	4.7.1									
Resolution	3.4.1.1	4.7.1.1	X	X	X	X	X	X		X	
Spherical power	3.4.1.2	4.7.1.2	X	X	X	X	X	X		X	
Astigmatism	3.4.1.3	4.7.1.3	X	X	X	X	X	X		X	
Photopic transmission	3.4.1.4	4.7.1.4	X	X	X	X	X	X		X	
Optical density	3.4.1.5	4.7.1.5	X	X	X	X	X	X			X
Angular deviation	3.4.1.6	4.7.1.6	X	X	X	X	X	X		X	
Cleaning spray	3.4.2	4.7.2									
Vehicle exterior	3.4.2.1	4.7.2.1	X	X	X						
Vehicle interior	3.4.2.2	4.7.2.2	X	X	X						
Chemicals	3.4.3	4.7.3					X				
Interface requirements	3.5	4.8	X	X	X	X	X	X	X		
Support and ownership requirement	3.6	4.9									
Bubbles and inclusions	3.6.1	4.9.1	X	X	X	X	X	X		X	
Lint	3.6.2	4.9.2	X	X	X	X	X	X		X	
Cleanliness	3.6.3	4.9.3	X	X	X	X	X	X			X
Identification marking	3.6.4	4.9.4	X	X	X	X	X	X	X		
Safety Inspection	3.6.5	4.9.5							X		
Operating environment requirements	3.7	4.10									
Temperature:	3.7.1	4.10.1									
Low temperature	3.7.1.1	4.10.1.1	X	X	X						
High temperature	3.7.1.2	4.10.1.2	X	X	X						

TABLE III. Verification Methods continued.

Title	Requirement	Inspection	First article						CI		
									Exam	Tests	
			1	2	3	4	5	6		sampling	100 %
Mirror and window laminations	3.7.1.3	4.10.1.3	X	X	X					X	
Humidity	3.7.2	4.10.2	X	X	X						
Salt fog	3.7.3	4.10.3	X	X	X						
Vibration	3.7.4	4.10.4	X	X	X						
Shock	3.7.5	4.10.5	X	X	X						
Basic shock	3.7.5.1	4.10.5.1	X	X	X						
Gunfire shock	3.7.5.2	4.10.5.2	X	X	X						
Submergence	3.7.6	4.10.6	X	X	X						X
Fungus	3.7.7	4.10.7	X	X	X						
Weathering	3.7.8 thru 3.7.8.3	4.10.8				X	X	X			

4.4.1 Sampling inspection. The sampling plan shall be as specified in the contact (see 6.2).

4.4.2 Examination. The sample selected in accordance with 4.4.1 shall be examined as specified in table III. The examination shall be visual, tactile, or with standard inspection equipment.

4.4.3 Tests (sampling). The sample selected in accordance with 4.4.1 shall be subjected to the tests specified in table III.

4.4.3.1 100% test. Each periscope shall be subjected to the tests specified in table III.

4.5 Materials, design and construction. Conformance to 3.2 and 3.3 shall be determined by inspection of contractor records providing proof of certification that design, construction, processing and materials conform to requirements. Applicable records shall include drawings specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data.

4.6 Verification methods. Acceptable verification methods included in this section are visual inspection, and measurement, sample tests, full-scale demonstration tests, simulation, modeling engineering evaluation, component properties analysis, and similarity to previously-approved or previous-qualified designs.

4.6.1 Verification alternatives. The manufacturer may propose alternative test methods, techniques, or equipment, including the application of statistical process control, tool control, or cost effective sampling procedures to verify performance. See the contract for alternatives that replace verification methods required by this specification.

4.7 Operating requirement verification.

4.7.1 Optical characteristics. The test to determine compliance with mirror and window laminations, lint, bubbles and inclusions shall be made by viewing the periscope through the exit, or entrance, window against a uniformly illuminated translucent ground glass field (or equivalent) having a brightness of approximately 300 foot candles.

4.7.1.1 Resolution. The resolution shall be performed utilizing a holding medium to support the periscope during the test, a diopter with a magnification of at least three power (3x) and a resolving power chart. The resolving power chart shall represent the angular subtense for the seconds of arc specified in 3.4.1.1, and shall contain four line sets as shown in figure 1. The chart of appropriate dimensions may be located in a collimator or it may be viewed directly. The diopter's eyepiece shall be focused to its reticle to accommodate the individual inspector's eye. Using the diopter, the target shall be resolved in each of the four meridians, and the diopter for each meridian shall be recorded. This operation shall be repeated in nine regions of the clear aperture, three readings approximately 1.5 in. (38 mm) from each end and three readings in the center. The total spread of the four readings obtained in each of the nine areas shall not exceed 0.25 diopter.

4.7.1.2 Spherical power. The average of the horizontal and vertical target focus readings obtained in each of the nine areas, as outlined in 4.7.1.1, shall be in accordance with the spherical power requirement of 3.4.1.2.

4.7.1.3 Astigmatism. The algebraic difference in focus between the horizontal and vertical target focus readings obtained in each of the nine areas, as outlined in 4.7.1.1, shall be in accordance with the astigmatism requirement of 3.4.1.3.

4.7.1.4 Photopic transmission (PT) measurement. The periscope shall be measured at 0 $\pm$2 degrees incidence and shall be tested in accordance with the following:

a. Apparatus. One of the following systems shall be utilized:

(1) A constant current tungsten lamp
A monochromator
A detector
(2) A double beam spectrophotometer
(3) A Pritchard type photometer

b. Measurement. The preferred wavelength range for this measurement is 380 nanometer (nm) to 760 nm: any range that includes the range 400 nm to 700 nm is acceptable. Photopic transmission shall be derived from multiplying measured spectral transmission data, taken every 5 nm at 0 ±2 degrees incidence along the optical axis of the periscope, by the photopic luminous efficiency values that make up the standard human eye curve established by the Commission Internationale del'Eclair (CIE) (see ASTM E308).

c. Calculation.

The PT is derived from:

$$X = \sum_{380}^{760} T(w)\, S(w) V(w) dw \qquad Y = \sum_{380}^{760} S(w)\, V(w)\, dw$$

$$PT = x/y$$

Where,

w = Wavelength
T(w) = Filter transmission characteristics
S(w) = CIE source A characteristic (1931)
V(w) = Photopic visibility function (1931)
dw = 5 nm intervals

4.7.1.5 Optical density measurement using a spectrophotometer. The periscope shall be measured at 0 ±2 degrees incidence and shall be tested in accordance with the following:

a. Apparatus. One of the following systems shall be used:

(1) A constant current tungsten lamp
A monochromator
A detector
(2) A double beam spectrophotometer

For either system, the light incident on the periscope shall have a collimated beam diameter of 10 ±3 mm ($1/e^2$) and the system shall be calibrated over the optical density range of 3 through 4 using neutral density filters traceable to the National Institute of Standards and Technology (NIST). Prior to testing, system alignment shall be verified by measuring the periscope's transmission or optical density at an unattenuated wavelength (approximate range 500-550 nm).

b. Calculations.

(1) Transmission (T) at each wavelength is:

$$T = \frac{\text{Radiance with the periscope in the optical train}}{\text{Radiance without periscope in optical train}}$$

(2) The optical density (O.D.) is:
O.D. = log (1/T)

4.7.1.6 Angular deviation. The applicable drawing, the periscope shall be mounted vertically and shall be viewed through the exit window with an observation telescope placed normal to the exit window and equipped with a centercross-hair reticule. Horizontal lines on a wall chart shall be viewed representing the upper and lower angular deviation limits. The observed cross hair must fall between the upper and lower deviation limits. Alternate method (1): a light collimator can be used in place of the wall chart. Alternate method (2): a hene laser can be used in place of the observation telescope.

4.7.2 Cleaning spray.

4.7.2.1 Vehicle exterior cleaning spray. The portion of the assembly above the sealing surface shall be exposed to a water jet or stream spray using high grade commercial cleaning agents that meet the environmental and performance requirements of this specification. The jet shall be applied perpendicular to and at a distance no closer than one ft (30.5 centimeter (cm)) nor farther than 2 ft (61 cm) from the component surface at a cleaning rate of 1 square foot per minute (ft^2/min) (0.093 square meter per minute (m^2/min)) for a period of 10 minutes. The water jet shall be derived from a nozzle having an orifice diameter of 0.25 in. (0.6 cm) and a nozzle pressure of 110 pounds per square inch gage (psig) (758 kPa). Immediately following the cleaning, the periscope shall be subjected to a cold water rinse air dried and subsequently shall be subjected to and pass the performance tests of 3.4.1.

4.7.2.2 Vehicle interior cleaning spray. The portion of the assembly below the sealing surface shall be exposed to a jet spray of tap water applied perpendicular to and at a distance no closer than one foot nor farther than 2 ft from the component surface at a cleaning rate of 1 ft^2/min for a period of 10 minutes. The water jet shall be derived from a nozzle having an orifice diameter of 0.25 in. and a nozzle pressure of not more than 25 psig (172 kPa). After the periscope has been air dried, the assembly shall be subjected to and pass the performance tests of 3.4.1.

4.7.3 Chemicals. The assembly shall be exposed to the vapors of and direct contact with the chemicals specified in 3.4.3 for a period of 48 hours minimum. The periscope to be tested shall be placed on an open rack suspended in a sealed container. Prior to closure of the container each chemical shall be successively sprayed onto all exterior surfaces in sufficient volume to begin run off. The container will be sealed for 48 hours minimum. After exposure the assembly shall be subjected to and pass the performance tests of 3.4.1.

4.8 Interface requirements verification. Verify the envelope dimensions and mounting interface by measurement and placement, and the electrical interface by connection and disconnection of cables and connectors, in the existing location on different types of fully tracked combat vehicles.

4.9 Support and ownership requirements verification.

4.9.1 Bubbles and inclusions. Periscopes shall be inspected for bubbles and inclusions under brilliant illumination such as outlined in 4.7.1. The distribution and size of bubbles and inclusions shall conform to 3.6.1.

4.9.2 Lint. The test for lint shall be performed on the periscopes at the same time that the test for bubbles and inclusions of 4.9.1 is being performed. The length of the lint particles shall conform to the requirements of 3.6.2. The total projected area of any lint particles shall be computed as stated in 3.6.2 and shall be added to the total area found in 4.9.1. The periscopes shall then be subjected to and pass the test of 4.7.1.

4.9.3 Cleanliness. Each optical system exit and entrance window exterior surface shall be examined with the unaided eye.

4.9.4 Identification and marking. Verify the presence of the required markings on the assembly. After performing all environmental tests in 4.10, re-inspect the assembly markings for readability.

4.9.5 Safety Inspection. Inspect periscopes for hazardous burrs, nicks, sharp edges, foreign materials, or other imperfections that pose physical danger to an installer/operator.

4.10 Operating environmental requirement verification. Unless otherwise specified herein, the applicable test methods and procedures of MIL-STD-810, or equivalent shall apply (see 3.7). Note that the optical performance tests of 3.4.1 shall be performed after completing the required series of environmental tests. Conducting optical performance tests between environmental tests is optional.

4.10.1 Temperature.

4.10.1.1 Low temperature. The periscope shall be placed in a temperature chamber and subjected to the low temperature test as specified in MIL-STD-810, method 502.3, procedure I. A temperature of -65 degrees Fahrenheit (°F) (-54 degrees Celsius (°C)) shall be maintained for a period of 24 hours. At the conclusion of this time, the unit shall be returned to 73 ±18°F (23 ±8°C). The unit shall show no indication of moisture buildup, bond separation or other forms of image degradation and shall meet the requirements of 3.7.1.3. The periscope shall then be subjected to and pass the tests specified in 4.7.1.1, 4.7.1.4, 4.7.1.5 and 4.10.6.

4.10.1.2 High temperature. The periscope shall be exposed to three 24 hour cycles of the hot, dry temperature profile as given in table II. Relative humidity shall be not greater than 10% during exposure. After exposure to the temperature profile but prior to testing for light transmission, resolution and submergence, the unit shall be at a minimum of 160°F (71°C) and shall show no indication of moisture buildup, bond separation, or other forms of image degradation and shall meet the requirements of 3.7.1.3. The periscope shall then be returned to normal ambient temperature and pass the tests specified in 4.7.1.1, 4.7.1.4, 4.7.1.5 and 4.10.6.

4.10.1.3 Mirror and window laminations. The laminations of the mirrors and windows shall be visually inspected in accordance with 4.7.1 for compliance with 3.7.1.3. The appearance of any bubbles, blisters, cracks or separations exceeding the limitations of 3.6.1 in the clearance aperature shall be considered evidence of bond failure.

4.10.2 Humidity. The periscope shall be exposed to two 24 hour cycles of the humidity profile given in table IV. Prior to the test, the unit shall be conditioned at 100°F (38°C) and 50% maximum relative humidity for 24 hours. After the test, the unit shall be conditioned at 73°F and 50% maximum relative humidity for 24 hours. After exposure, the unit shall exhibit no indication of moisture buildup, bond separation, or other forms of image degradation. The periscope shall then be subjected to and pass the tests specified in 4.7.1.1, 4.7.1.4, 4.7.1.5, and 4.10.6.

4.10.3 Salt fog. The periscope shall be tested in accordance with the salt fog test described in Method 509.3, Procedure 1 of MIL-STD-810. Subsequently, the periscope shall be subjected to and pass the tests in accordance with 4.7.1.1, 4.7.1, 4.7.1.5, and 4.10.6 and checked for any delaminations or physical damage.

TABLE IV. Humidity profile test.

Time (hrs)	Air temperature		Relative humidity
	Degrees F	Degrees C	Percent (%)
0100	100	37.8	95
0200	100	37.8	95
0300	100	37.8	95
0400	100	37.8	95
0500	100	37.8	95
0600	100	37.8	95
0700	105	40.5	81
0800	110	43.3	68
0900	120	48.9	55
1000	130	54.4	44
1100	140	60	37
1200	140	60	37
1300	150	65.6	30
1400	160	71.1	23
1500	160	71.1	23
1600	150	65.6	30
1700	150	65.6	30
1800	140	60	37
1900	130	54.4	44
2000	120	48.9	55
2100	105	40.5	81
2200	100	37.8	95
2300	100	37.8	95
2400	100	37.8	95

4.10.4 Vibration. The periscope shall be rigidly mounted to a vibration table and shall be subjected to sinusoidal vibration along each axis in accordance with figure 2 and table V. The sweep time shall be 15 minutes for the sweep frequency range of 5-500-5 Hz. Sweep time shall be increased by 3 minutes if test frequencies go to 2 Hz. The frequency of applied vibration shall be swept over the specified range in accordance with figure 3. The specified sweep time is that of an ascending plus descending sweep and is twice the ascending time shown in figure 3 for the specified range. The sinusoidal cycling time shall be a total of 3 hours in each of three perpendicular axes at an ambient temperature of 140°F. At the conclusion of the test, the periscope shall be returned to room ambient temperature (see 4.2) and pass the tests in accordance with 4.7.1.1, 4.7.1.4, 4.7.1.5, and 4.10.6.

TABLE V. Vibration levels.

Frequency (Hz)	Amplitudes (g)		
	Vertical	Latitudinal	Longitudinal
5 - 5.5	±0.5 in. (peak to peak)	±0.5 in. (peak to peak)	±0.5 in. (peak to peak)
5.5 - 25	±1 in. (peak to peak)	±1 in. (peak to peak)	±1 in. (peak to peak)
26 - 37	±0.02 in. (peak to peak)	±0.02 in. (peak to peak)	±0.02 in.(peak to peak)
37 - 500	±2	±2	±2

4.10.5 Shock. A shock testing machine capable of producing the magnitude and duration of shock specified in 4.10.5.1 and 4.10.5.2 shall be used.

4.10.5.1 Basic shock. The periscope shall be rigidly mounted to a shock table and three half sine wave shocks in each direction shall be applied along three mutually perpendicular axes of the periscope (total of 18 shocks). Peak amplitude shall be 30 ±3 g for 11 ±1.1 ms duration in accordance with figure 4. The periscope shall then be subjected to and pass the tests of 4.7.1.1, 4.7.1.4, 4.7.1.5 and 4.10.6.

4.10.5.2 Gun fire shock. The periscope shall be rigidly mounted to a shock table and three half sine wave shocks in each direction shall be applied along three mutually perpendicular axes of the periscope (total of 18 shocks) in accordance with figure 4 and table VI. At the conclusion of this test, the unit shall show no evidence of physical damage. The periscope shall then be subjected to and pass the tests 4.7.1.1, 4.7.1.4, 4.7.1.5 and 4.10.6.

TABLE VI. Gun fire shock levels.

Amplitude (g)	Duration (ms)	Axis
100 ±10	1.0 ±0.1	Vertical
55 ±5.5	1.7 ±0.2	Latitudinal
225 ±22.5	0.5 ±0.05	Longitudinal

4.10.6 Submergence. The mounting surface of the periscope shall be submerged in the water, 3 +0.75, -0 in. (76 +19, -0 mm) depth measured between the water surface and sealing surface, and remain for five (5) minutes and then shall have no moisture allowed through its seals or bonds. After submergence, the periscope shall exhibit no indication of internal moisture buildup. Verify that there is insufficient leakage to form a drop (see 6.6.1).

4.10.7 Fungus. The periscope shall be tested in accordance with MIL-STD-810, Method 508.4, except that after inoculation the periscope shall be exposed to ambient air temperatures of 80 to 84°F (27 to 29°C) at relative humidity between 96 to 100% for a 28 day duration. In lieu of the performance of MIL-STD-810 fungus test, a certificate of compliance with supporting data may be provided attesting that the assembly is constructed of materials that will not support fungal growth (see 6.2).

4.10.8 Weathering test. This test shall be conducted upon completion of all the other tests specified in 4.10 through 4.10.7. The periscope shall be subject to the environmental conditions and the weathering tests specified below, the test cycle shall be approved by the acquisitioning activity prior to test initiation. The periscope shall be subjected to and pass the tests specified in accordance with 4.7.1.1 (modified), 4.7.1.2 (modified), 4.7.1.3 (modified), optical density 4.7.1.5, and mirror and window lamination 4.10.1.3.

a. No less than 350 hours of simulated sunshine. Heat intensity shall be 160 ±5°F (71 ±2°C) at the geometric center of the periscope. The spectral energy distribution of simulated sunshine shall be in accordance with method 505.3 of MIL-STD-810.
b. No less than 420 hours steady state hot-humid exposure at 110 ±10°F (43 ±6°C) relative humidity 70 ±10%.
c. No less than 420 hours of cold exposure at 20 ±5°F (-7 ±4°C).
d. Simulated sunshine shall include ultraviolet and be cycled in accordance with Method 505.3, Procedure 1 of MIL-STD-810 except the diurnal cycle hot-dry temperature shall have a peak temperature of 160 ±5°F at the geometric center of the periscope. Heat intensity shall be controlled by adjustment of the light source to periscope distance and shall not be achieved by varying voltage to the source.
e. Environmental conditions a and b shall be cycled so that conditions shall not exceed 10 hours duration, and condition c shall be maintained for minimum of 72 continuous hours.
f. No test exposure shall be followed by a like exposure. For the duration of the test, the periscope shall be exposed to air, the test chamber, ozone and shall not be purged with any inert gas.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. Periscopes covered by this specification are intended for use as unity vision devices in combat type vehicles. The periscope convert by this inspection are military unique because they are used on military vehicles only and have no commercial application.

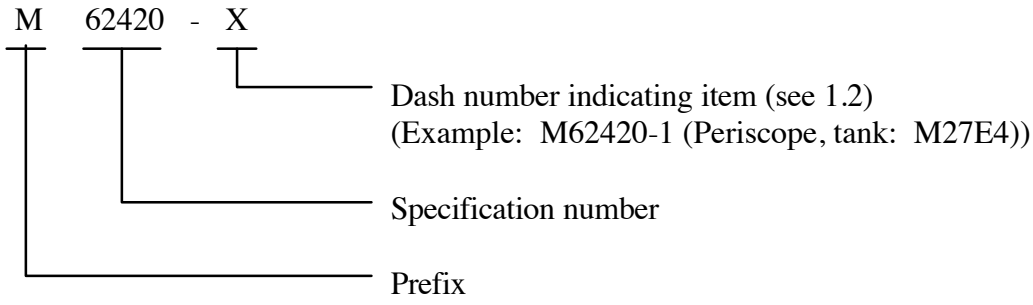
6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.
b. Classification (see 1.2).
c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
d. When first article is required (see 3.1).
e. Item name and drawing number (see 3.3).
f. If other inspection conditions are required (see 4.2).
g. Sampling inspection (see 4.4.1).
h. If a certificate of compliance may be substituted for fungus testing (see 4.10.7).
i. Packaging requirements (see 5.1).

6.3 First article. When requiring a first article inspection, contracting documents should provide specific guidance to offerors. This guidance should cover whether the first article is a first article sample, a first production item, or the number of test items. These documents should also include specific instructions regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Pre-solicitation documents should provide Government waiver rights for samples for first article inspection to bidders offering a previously acquired or tested product. Bidders offering such products who wish to rely on such production testing must furnish evidence with the bid that prior Government approval is appropriate for the pending contract.

6.4 Conformance inspection. Affordable conformance inspection with confidence varies depending upon a number of procurement risk factors. Some of these factors include: Contractor past performance, Government schedules and budget, product material and design maturity, manufacturing capital equipment and processes applied, the controlled uniformity of those processes, labor skill and training, and the uniformity of measuring processes and techniques. During the solicitation, contracting documents should indicate those tests desired from table III and their designated frequency based on a risk assessment for the procurement.

6.5 Part identification number (PIN). The PINs to be used for periscopes acquired to this specification are created as follows:



6.6 Definitions.

6.6.1 Leaks. The following definitions for leaks apply (see 4.10.6):

a. Weep: Any non-recurring evidence of fluid beyond the seal or joint.

b. Seep: Any recurring evidence of fluid beyond the seal or joint that results in an accumulation of more than 0.05 cm^2 volume.

c. Droplet: Any recurring evidence of fluid beyond the seal or joint that results in an accumulation of more than 0.05 cm^2 volume that does not fall.

d. Drop: A drop is defined as a volume of 0.05 cm^2.

e. Drip: Any recurring evidence of fluid beyond the seal or joint where a droplet or more forms and falls.

6.7 Subject term (key word) listing.

Light (photopic) transmission
Optical density
Photopic (light) transmission
Resolution
Spherical power

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

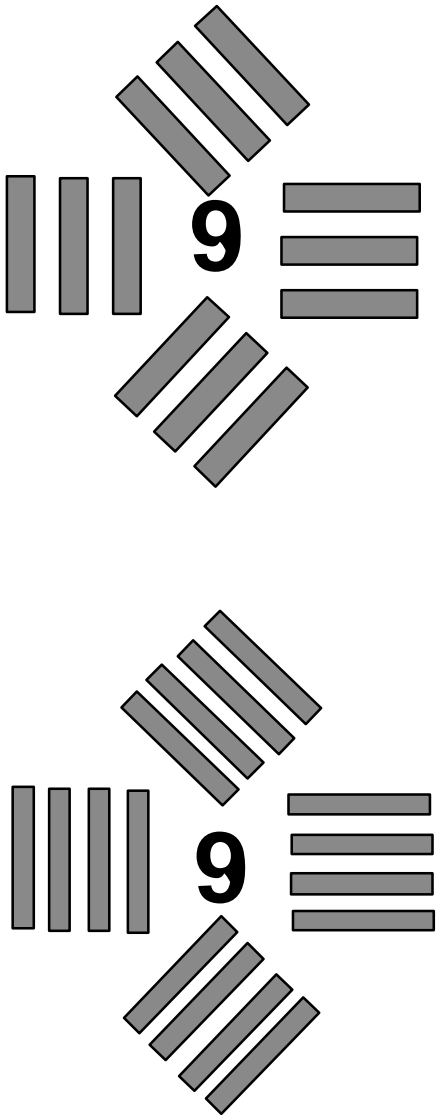
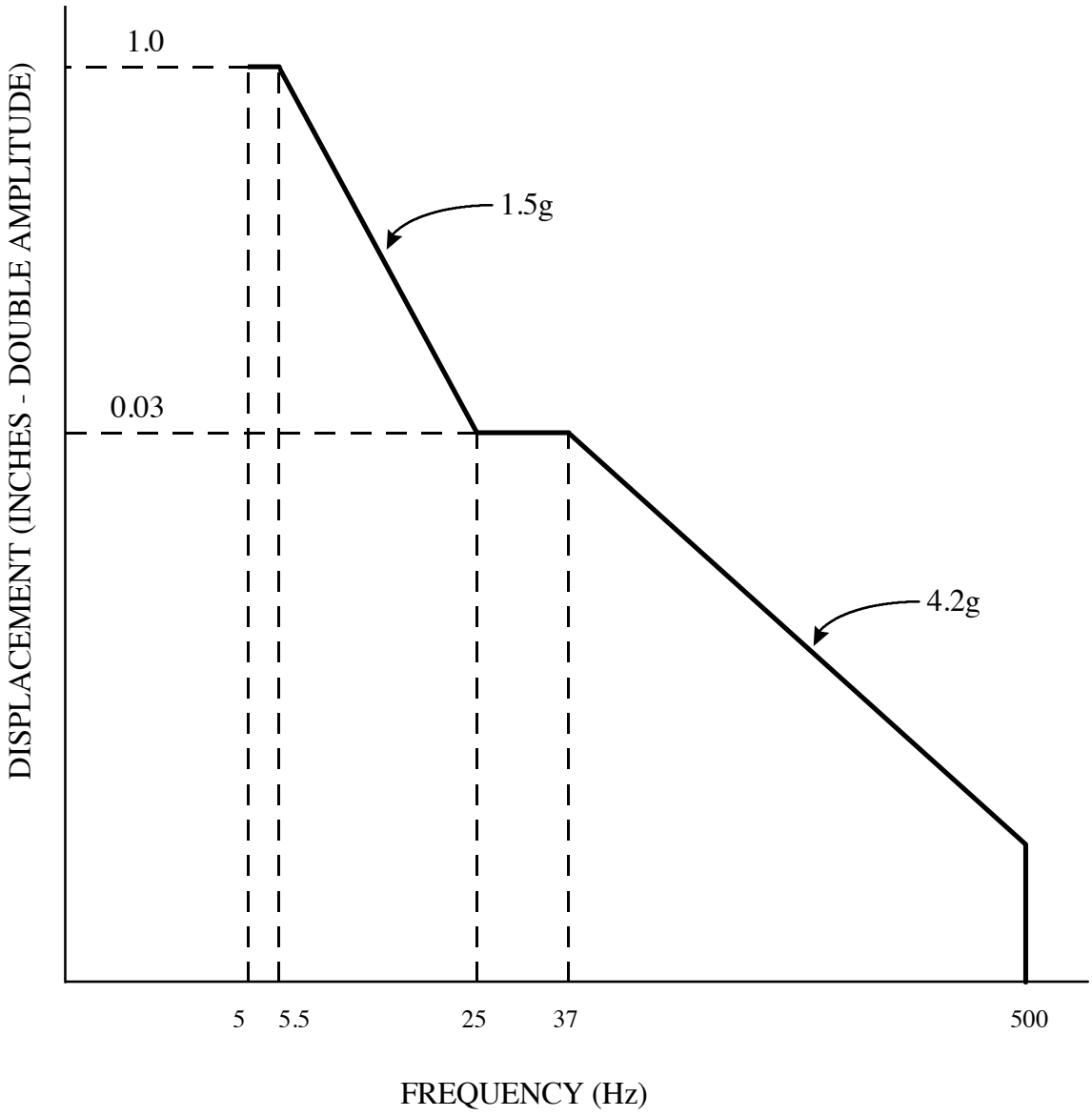


FIGURE 1. Line sets.



NOTE: All curves will be extended to 2 Hz when test item resonances below 5 Hz are expected.

FIGURE 2. Vibration test curve.

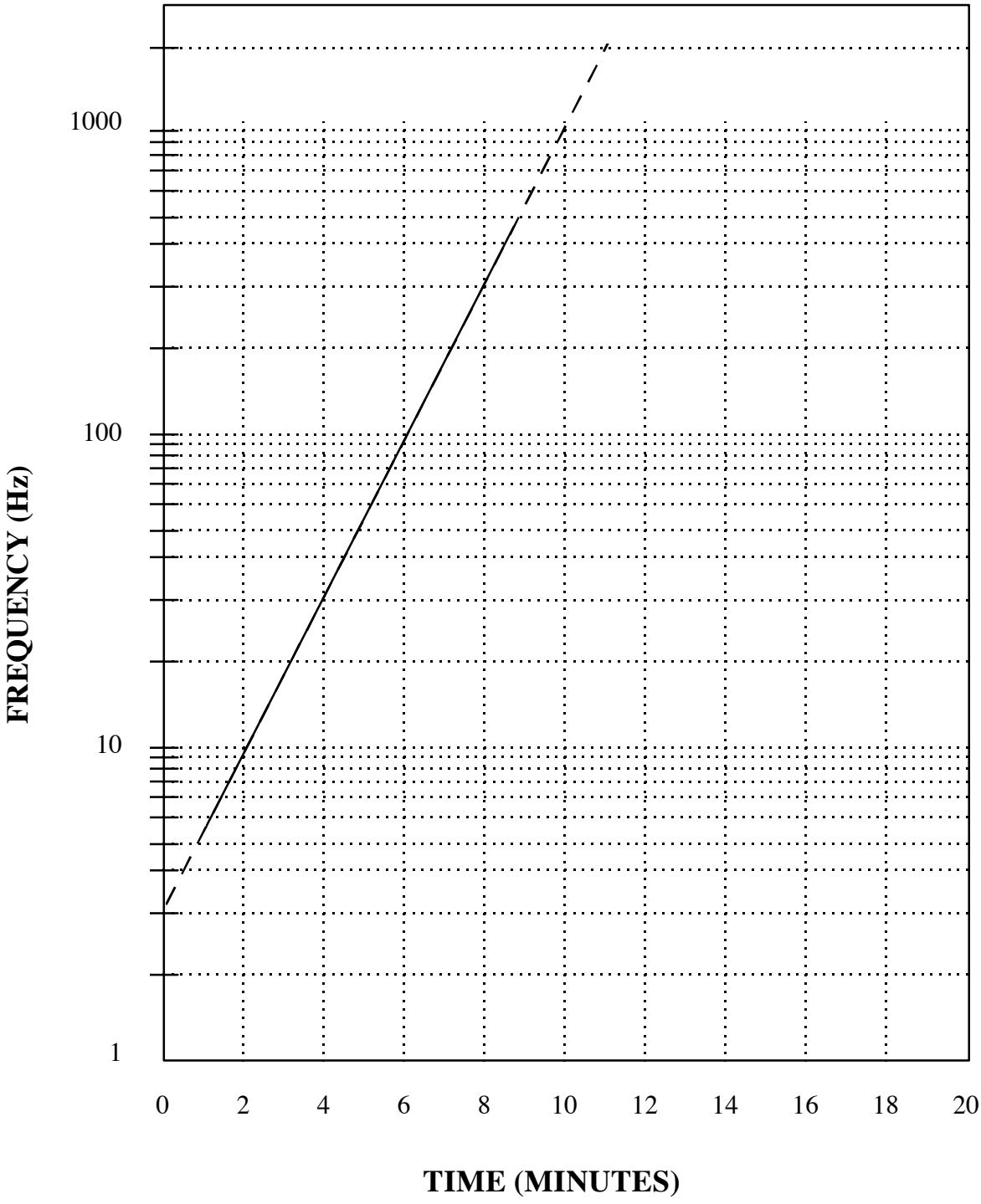
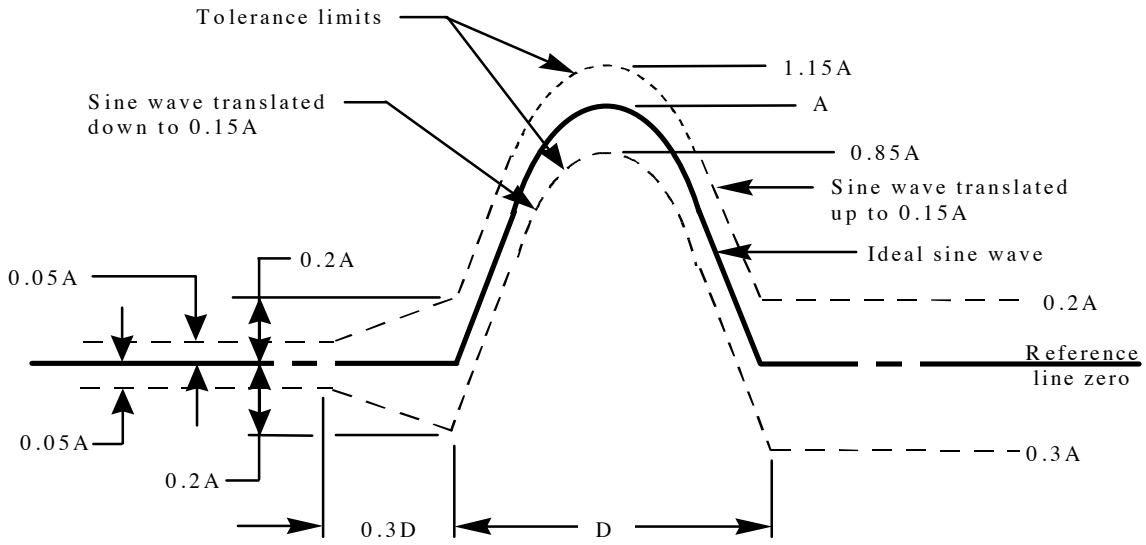


FIGURE 3. Logarithmic sweep.



A = Peak value = 30 ±3 g for 4.10.5.1.
See table VI for 4.10.5.2.
D = Nominal duration = 11 ms. For 4.10.5.1
See table VI for 4.10.5.2

NOTE: The oscillogram will include a time about 3D long with a pulse located approximately in the center. The acceleration amplitude of the ideal half sine pulse is A and it's duration is D. The measured acceleration pulse will be contained between the broken line boundaries and the measured velocity change (which may be obtained by integration of the acceleration pulse) will be within the limits of $V_i \pm 0.1\ V_i$ where V_i is the velocity-change associated with the ideal pulse which equals 2 AD/w. The integration to determine velocity change will extend from 0.4D before the pulse to 0.1D after the pulse.

FIGURE 4. Half sine shock pulse configuration and its tolerance limits.

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(Project 1240-0045)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE *(YYMMDD)*
	MIL-DTL-62420B(AT)	980904

3. DOCUMENT TITLE PERISCOPE, TANK

4. NATURE OF CHANGE ***(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)***

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(If applicable)*	7. DATE SUBMITTED *(YYMMDD)*

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE *(Include Area Code)*
	(1) Commercial (810) 574-8745 (2) AUTOVON 786-8745
c. ADDRESS *(Include Zip Code)* Commander U.S. Army Tank-automotive and Armaments Command ATTN: AMSTA-TR-E/BLUE Warren, MI 48397-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403 Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340