METRIC
MIL-DTL-11352K(AT)
01 April 2013
SUPERSEDING
MIL-DTL-11352J(AT)
22 September 2010

DETAIL SPECIFICATION

BLOCK, VISION: BULLET-RESISTANT (METRIC)

This specification is approved for use by the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC), Research, Development and Engineering Command (RDECOM), 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 bullet-resistant vision blocks of two different types of construction, designed for use in combat type vehicles. In addition, this specification covers vision blocks with and without laser protection filters (see 6.1).

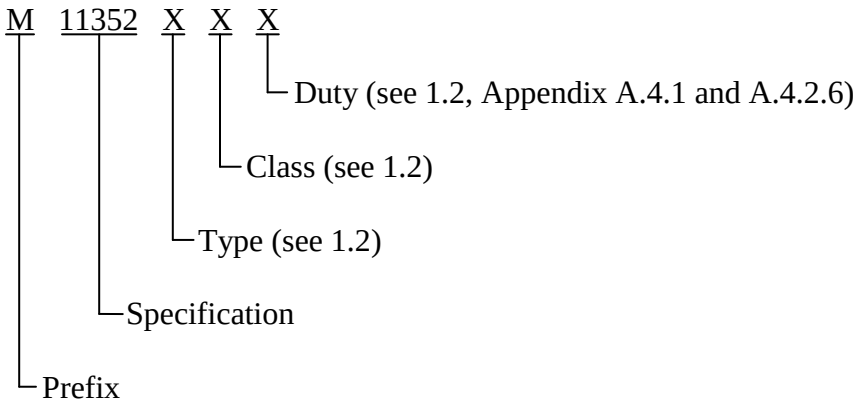
1.2 Classification. Vision blocks covered by this specification are to be of the following types, classes, and duties (see 6.2 and 6.5.1). All classes and duties are applicable to types I and II:

Type I	- Steel cased
Type II	- Plastic cased
Class 1	- All-glass laminated construction
Class 2	- Composite-laminated glass-plastic construction
Class 3	- Transparent, laminated plastic construction
Duty A	- Light (see 6.5 1)
Duty B	- Medium (see 6.5.1)
Duty C	- Heavy (see 6.5.1)

Comments, suggestions, or questions on this document should be addressed to U.S. Army RDECOM, Tank Automotive Research, Development and Engineering Center, ATTN: RDTA-EN/STND/TRANS MS #268, 6501 E. 11 Mile Road, Warren, MI 48397-5000 or emailed to usarmy.detroit.rdecom.mbx.tardec-standardization@mail.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

AMSC N/A FSC 25GP

1.3 Part or identifying number (PIN). The PINs to be used for vision blocks acquired to this specification are created as shown below:



2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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 requirements of documents cited in sections 3, 4, or 5 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 cited in the solicitation or contract (see 6.2).

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-53039	-	Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant
MIL-PRF-62422	-	Filter, Laser Hazard Protection
MIL-DTL-64159	-	Camouflage Coating, Water Dispersible Aliphatic Polyurethane, Chemical Agent Resistant

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-810	-	Environmental Test Methods and Engineering Guidelines

(Copies of these documents are available from https://assist.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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 these documents are those cited in the solicitation or contract (see 6.2).

ASTM INTERNATIONAL

ASTM C1036	-	Standard Specification for Flat Glass
ASTM E308	-	Standard Test Method for Computing the Colors of Objects by Using the Commission Internationale del 'Eclair (CIE) System

(Copies of these documents are available from www.astm.org or ASTM International, P.O. Box C700, West Conshohocken, PA 19428-2959.)

SAE INTERNATIONAL

SAE AMS-L-P-391	-	Plastic Sheets, Rods and Tubing, Rigid Cast, Methacrylate (Multiapplication)

(Copies of this document are available from www.sae.org or SAE Customer Service, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Materials. Materials shall be as specified herein, on applicable drawings, and in applicable specifications. Materials not designated on drawings and not covered specifically by this or referenced specifications shall be the prerogative of the contractor as long as all articles submitted to the Government fully meet requirements specified herein (see 4.6.1).

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 Glass. Prior to lamination, the individual glass plies shall conform to ASTM C1036 for type 1, class 1 and quality 1 glass. The glass shall be free of color to the

extent that a standard white target shall appear unchanged in color when viewed through a thickness of 2 centimeters (cm) [0.79 inch (in.)] (see 4.6.1).

3.2.3 Plastic. The plastic plies shall meet the requirements of SAE AMS-L-P-391 for type 1, grade A plastic, except that the material need not be acrylic (see 4.6.1).

3.2.4 Adhesive sealing compound. The adhesive sealing compound shall be silicones, epoxies, or other sealants meeting the environmental, ballistic, and other pertinent requirements of this specification, or as specified on the applicable drawing. After application and curing, the compound shall be waterproof and shall adhere to both materials. It shall be non-shrinking and shall fill the space between the block and the case assembly. The compound shall be unaffected by fresh or sea water and shall not flow or become tacky at 71 degrees Celsius (°C) [160 degrees Fahrenheit (°F)] (see 4.6.1).

3.3 Design and construction. The design and construction of the vision blocks shall be as specified herein and on the applicable drawings (see 6.2). Vision blocks shall have not less than five interior plies excluding laser and spall protection elements (see 4.6.1 and 4.6.2).

3.3.1 Assembly details. The outboard ply of the vision block shall be positioned in the rigid case so that the acute angle is located within 1.6 millimeter (mm) (0.063 in.) from the adjacent edge of the case. The thickness of the sealing compound between the block and case shall be 1.6±0.4 mm (0.063±0.016 in.) at all ground edges of the block. The outside edges of the case shall have a radius of 0.8±0.4 mm (0.031±0.016 in.), and all sharp edges of the block shall be chamfered to 0.8 to 1.6 mm (0.031 to 0.063 in.) prior to assembly in the case (see 4.6.1 and 4.6.2).

3.3.2 Case. The case for the vision block shall be either metal or plastic as specified in 3.3.2.1 and 3.3.2.2 (see 4.6.1).

3.3.2.1 Metal case (type I). The metal case for vision blocks shall be in accordance with applicable drawing (see 4.6.1).

3.3.2.2 Plastic case (type II). The plastic case for vision blocks shall be of a glass fiber base, epoxy resin, low pressure laminated, non-electrical material which is heat resistant to 260 °C (500 °F) or it shall be as specified on the applicable drawing. The material thickness shall be 2.16±0.25 mm (0.085±0.010 in.) (see 4.6.1).

3.4 Operating requirements. Each vision block shall provide the following functional, operational, and performance capabilities.

3.4.1 Photopic transmittance. For vision blocks without laser protection filters, the photopic transmittance shall be greater than 75 percent (%) unless otherwise specified on applicable drawings. The photopic transmittance of vision blocks with laser filters shall be greater than 42% (see 4.6.3.1).

3.4.2 Optical density. For vision blocks with laser filters, the optical density requirements for specific wavelength ranges shall be as specified in MIL-PRF-62422 (see 4.6.3.2).

3.4.3 Resolving power. Resolving power, over all areas that are 6.4 mm (0.250 in.) or more from the inner edges of the vision block case, shall be sufficient to permit detection of an angular separation of 75 seconds of arc (see 4.6.3.3 and 6.5.3).

3.4.4 Ballistic resistance. The vision block shall withstand the impact of the applicable type of projectile (see 4.6.3.4).

3.5 Interface requirements. Each item shall accommodate the following inputs and interfaces.

3.5 1 Interchangeability. Interchangeability tolerance should permit parts, subassemblies and assemblies to be used in their parent assemblies without regard to the source of supply or manufacturer. Parts, subassemblies and assemblies having the full range of dimensions and characteristics permitted by the specification governing the part, subassembly or assembly should be usable as replacement items without selection and without departure from the specified performance guidelines of the parent items (see 4.6.2).

3.6 Support and ownership.

3.6.1 Finish. Metal cases shall be cleaned in accordance with an appropriate method for the material being used and given a zinc phosphate spray application of not less than 1615 milligrams per square meter (mg/m^2) (0.0053ounces per square foot (oz/ft^2)). The case shall be primed with an alkyd, corrosion-inhibiting, lead and chromate free primer coating, containing no more than 420 grams per liter (g/L) (3.5 pounds per gallon (lb/gal)) of volatile organic compounds. A finishing coat shall be applied, chemical agent resistant, in accordance with MIL-DTL-64159 or MIL-DTL-53039, conforming to the color and infrared reflectance characteristics (see 4.6.2).

3.6.2 Identification marking. The identification marking shall identify the vision block number and provide a number for each item in accordance with the instructions on the item drawing. The marking shall not impair optical characteristics of the vision block (see 4.6.2).

3.7 Operating environment requirements. The vision block shall operate under the following environmental conditions, without degradation in performance.

3.7.1 Temperature fluctuation resistance. The vision block shall withstand exposure to temperature extremes, from minus (-) 54 to plus (+) 71 °C (-65 to +160 °F) without cracking or showing signs of distortion and shall subsequently meet the requirements of 3.4.1, 3.4.2, and 3.4.3 (see 4.6.4.1).

3.7.2 Low temperature. The vision block shall meet the requirements of 3.4.1, 3.4.2, and 3.4.3 and shall show no indication of moisture build-up, bond separation or other forms of image degradation after being exposed to a temperature of -54 °C (-65 °F) for a period of 24 hours after stabilization (see 4.6.4.2).

3.7.3 High temperature. The vision block shall show no indication of moisture build-up, bond separation or other forms of image degradation after being exposed to three 24-hour cycles of the hot, dry temperature profile. Subsequently, the vision block shall meet the requirements of 3.4.1, 3.4.2, and 3.4.3 (see 4.6.4.3).

3.7.4 Basic shock. The vision block shall show no evidence of physical damage and shall meet the requirements of 3.4.1, 3.4.2, and 3.4.3 after being exposed to three sawtooth wave shock pulses applied in both directions along each of the three mutually perpendicular axes. The peak amplitude of each pulse shall be 40 gravity units (g) for 11 milliseconds (ms) duration (see 4.6.4.4).

3.7.5 Gun fire shock. The vision block shall show no evidence of physical damage and shall meet the requirements of 3.4.1, 3.4.2, and 3.4.3 after being exposed to three gun fire shock pulses applied in both directions along each of the three mutually perpendicular axes (see 4.6.4.5).

3.7.6 Vibration. The vision block shall meet the requirements of 3.4.1, 3.4.2, and 3.4.3 after being subjected to vibration levels for a total of 3 hours in each of the three mutually perpendicular axes at an ambient temperature of 60 °C (140 °F). At the conclusion of the test, the vision block shall be returned to room ambient temperature and show no evidence of physical damage (see 4.6.4.6).

3.7.7 Humidity resistance. The vision block shall evidence no delamination, or other physical deterioration after being exposed to the relative humidity and air temperature profiles, and subsequently, shall meet the requirements of 3.4.1, 3.4.2 and 3.4.3 (see 4.6.4.7).

3.7.8 Corrosion resistance. The vision block shall meet the requirements of 3.4.1, 3.4.2, and 3.4.3 and shall show no evidence of bond separation, corrosion or other physical damage after being exposed to a salt fog solution for 48 hours (see 4.6.4.8).

3.7.9 Weathering resistance. The vision block shall evidence no delamination or other physical deterioration when exposed to not less than 350 hours of simulated sunshine, and shall subsequently meet the requirements of 3.4.1, 3.4.2, and 3.4.3 (see 4.6.4.9).

4. VERIFICATION

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

a. First article inspection (see 4.2)
b. Conformance inspection (CI) (see 4.3)

4.2 First article inspection. Unless otherwise specified (see 6.2), the Government shall select eight vision blocks produced under the production contract for first article inspection. First article sample shall include all of the verifications of table I.

TABLE I. Classification of inspections.

Title	Requirement	Inspection	First article	Conformance		
				Exam	Tests	
					Sampling	100%
Materials, design and construction	3.2 thru 3.3.2.2	4.6.1 and 4.6.2	X	X		
Operating requirements	3.4	4.6.3				
Photopic transmittance	3.4.1	4.6.3.1	X		X	
Optical density	3.4.2	4.6.3.2	X			X
Resolving power	3.4.3	4.6.3.3	X		X	
Ballistic resistance 1/	3.4.4	4.6.3.4	X			
Interface requirements	3.5					
Interchangeability	3.5.1	4.6.2	X	X		
Support and ownership	3.6					
Finish	3.6.1	4.6.2	X	X		
Identification marking	3.6.2	4.6.2	X	X		
Operating environment requirements	3.7					
Temperature fluctuation resistance	3.7.1	4.6.4.1	X			
Low temperature	3.7.2	4.6.4.2	X			
High temperature	3.7.3	4.6.4.3	X			
Basic shock	3.7.4	4.6.4.4	X			
Gun fire shock	3.7.5	4.6.4.5	X			
Vibration	3.7.6	4.6.4.6	X			
Humidity resistance	3.7.7	4.6.4.7	X			
Corrosion resistance	3.7.8	4.6.4.8	X			
Weathering	3.7.9	4.6.4.9	X			

1/ Ballistic resistance test shall be conducted on Government proving ground, unless otherwise specified.

4.2.1 First article test sequence. First article tests shall be conducted on the sample in accordance with the test sequence specified in table II.

TABLE II. Order of tests.

Title	Requirement	Test
Photopic transmittance 1/	3.4.1	4.6.3.1
Optical density 1/	3.4.2	4.6.3.2
Resolving power 1/	3.4.3	4.6.3.3
Temperature fluctuation resistance	3.7.1	4.6.4.1
Weathering resistance	3.7.9	4.6.4.9
Humidity resistance	3.7.7	4.6.4.7
Corrosion resistance	3.7.8	4.6.4.8
Ballistic resistance	3.4.4	4.6.3.4

1/ These tests shall be repeated after samples have successfully completed 4.6.4.1 through 4.6.4.9 tests.

4.3 Conformance inspection (CI). CI shall include the examination of 4.6.2 and the tests of 4.6.3 and 4.6.4 as specified in table I. Noncompliance with any of the specified requirements in sections 3 and 4 shall be cause for rejection of the sample and the inspection lot.

4.3.1 Sampling plan. Unless otherwise specified (see 6.2), the sampling plan specified herein shall be used.

4.3.1.1 Sample. The sample for CI examination and test shall be randomly selected from the inspection lot in accordance with table III.

TABLE III. Sampling plan for conformance.

	Sample size		
	Examination		
Inspection lot size	Major	Minor	Test
2 to 8	*	5	*
9 to 15	13	5	13
16 to 25	13	5	13
26 to 50	13	5	13
51 to 90	13	7	13
91 to 150	13	11	13
151 to 280	20	13	20
281 to 500	29	16	29
501 to 1200	34	19	34
1201 to 3200	42	23	42
3201 to 10 000	50	29	50
10 001 to 35 000	60	35	60
35 001 to 150 000	74	40	74
150 001 to 500 000	90	40	90
500 001 and over	102	40	102

* Indicates entire lot must be inspected (100% inspection)

4.3.2 Examination. The sample selected in accordance with 4.3.1.1 shall be examined and defects classified as specified in table IV (see 4.6.2).

TABLE IV. Classification of defects.

Category	Defect	Method of examination
Critical	Optical density (see 3.4.2).	SIE 1/
Major:		
101	Dimensions affecting interchangeability, out of tolerance (see 3.3).	SIE
Minor:		
201	Dimensions not affecting interchangeability, out of tolerance (see 3.3).	SIE
202	Improper construction (see 3.3).	Visual
203	Improper assembly details (see 3.3.1).	Visual and SIE
204	Improper finish (see 3.6.1).	Visual
205	Improper marking (see 3.6.2).	Visual

1/ SIE = Standard Inspection Equipment

4.3.3 Tests. The sample selected in accordance with 4.3.1.1 shall be subjected to the tests specified in table I. The acceptance number in all cases is zero.

4.3.4 Laser filter test. Each vision block with a laser filter shall be subjected to the optical density test specified in table I (see 3.4.2).

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

4.4.1 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 (see 6.2) for alternatives that replace verifications required by this specification.

4.5 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be conducted under the following conditions:

a. Air temperature: 23±10 °C (73±18 °F)
b. Barometric pressure: 725 (+50/-75) mm [28.5 (+2/-3) in.] mercury (Hg)
c. Relative humidity: 50±30%

4.6 Methods of inspection.

4.6.1 Materials, design and construction. Conformance to 3.2 through 3.3.2.2 shall be determined by inspection of contractor records providing proof or certification that design, construction, processing, and materials conform to requirements. Applicable records shall include drawing, specification, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data.

4.6.2 Examination. Conformance to 3.3, 3.3.1, 3.5.1, 3.6.1, and 3.6.2, shall be determined by examination for the defects listed in table IV. Examination shall be visual or by measurement with SIE.

4.6.3 Operating requirements verification.

4.6.3.1 Photopic transmittance. To determine conformance to 3.4.1, the vision block shall be tested in accordance with the following:

a. Apparatus. One of the following systems shall be utilized:
   (1) Constant current tungsten lamp, monochrometer, and detector
   (2) Double beam spectrophotometer
   (3) Pritchard type photometer
b. Measurement. The wavelength range for this measurement is 380 nanometers (nm) to 760 nm. Photopic transmittance shall be derived from multiplying measured spectral transmission data, taken every 10 nm or less, by the photopic luminous efficiency values and the output characteristics of CIE source C or A (see ASTM E308). Photopic transmittance shall be measured along the optical axis using Commission Internationale del ′Eclair (CIE) iluminant C or A.
c. Calculation. The photopic transmittance (P.T.) is derived from:

$$X = \sum_{380}^{760} T(\lambda)S(\lambda)V(\lambda)d\lambda \qquad \text{and} \qquad Y = \sum_{380}^{760} S(\lambda)V(\lambda)d\lambda$$

P.T. = X/Y

where,

Σ = The mathematical summation symbol
λ = wavelength
$T(\lambda)$ = Filter transmission with wavelength
$S(\lambda)$ = CIE source C or A characteristic (1931)
$V(\lambda)$ = Photopic visibility function (1931)
$d\lambda$ = 10 nm intervals or less

4.6.3.2 Optical density. To determine conformance to 3.4.2, all vision blocks with laser filters shall be tested using the apparatus specified in 4.6.3.1. The optical density of each laser protected vision block shall be measured along the optical axis. Optical density shall be measured along the optical axis at wavelengths of 694 nm and 1064 nm. The measurement system shall be traceable to the National Institute of Standards and Technology (NIST) through a calibrated absorption type neutral density filter for nominal optical densities of 3 and 4. The measurement system shall be capable of measuring the NIST traceable filters to an accuracy of ±0.1 optical density (O.D).

a. Calculations.
(1) Transmission (T) at each wavelength is:

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

(2) The O.D. is defined as:

$$O.D. = \log (1/T)$$

4.6.3.3 Resolving power. To determine conformance to 3.4.3, a resolution test shall be standard and shall be performed using one of the resolving power charts (see figure 5). An auxiliary telescope is used to obtain sufficient magnification. A resolving power chart shall consist of four sets of lines, all sets either entirely three or entirely four lines at 45 degree steps (horizontal, vertical, and two at 45 degrees). The three line sets shall contain lines that are five times as long as they are wide. The four line sets shall contain lines that are seven times as long as they are wide. The widths of lines and spaces shall be equal. The lines may be either black on a white background, or white on a black background. There shall be an identifying numeral in the center of the four sets of lines. The contrast shall be 100:1 minimum. The chart of appropriate dimensions may be located in a collimator, or it may be viewed directly. In the latter case, the chart shall be at least 2 M^2 feet from the telescope objective, where M is the power of the vision block being tested. The angular subtense of a chart is measured in seconds and equals arc tangent 2W/X, where W is the width of a chart line and X is either collimator focal length or distance from chart to vision block under test. The vision block under test is aligned so the chart is in the center of the field. The auxiliary telescope is added and oriented to again center the chart. With the diopter scale of the auxiliary telescope at zero, the vision block under test shall be focused on the numeral in the resolving power target. In reading resolution, the auxiliary telescope may be focused plus (+) or minus (-) 1/8 diopter for each of the four meridians. All four test meridians shall have the correct line count. The limit of resolution is reached when individual lines within the pattern are no longer clearly separated.

4.6.3.4 Ballistic resistance. To determine conformance to 3.4.4, eight of each type, class, duty, and part number vision blocks shall be forwarded to a place designated by the Government for testing. Testing shall be conducted in accordance with applicable provisions of Appendix A to this specification (see 6.2, 6.5.2 and A4.2.6).

4.6.4 Operating environmental requirements verification.

4.6.4.1 Temperature fluctuation resistance. To determine conformance to 3.7 1, the vision block shall be subjected to a temperature of -54±3 °C (-65±5 °F) for 12 hours and shall then be stabilized at room temperature and placed in an oven for a period of 12 hours with the oven temperature stabilized at 71±2 °C (160±3 °F). The vision block shall then be removed from the oven, stabilized at room temperature and examined for defects. Upon examination, samples that pass this test shall be subjected to the test specified in 4.6.4.9.

4.6.4.2 Low temperature. To determine conformance to 3.7.2, the vision block shall be placed in a temperature chamber in a manner that will simulate its actual use, and the following steps shall be performed:

a. The internal chamber temperature shall be lowered to a storage temperature of -54 °C (-65 °F) and maintained for a period of 24 hours after stabilization.
b. The internal chamber shall be adjusted to the lowest temperature under which the vision block is designed to be used and maintained until temperature stabilization is reached.
c. The vision block shall be returned to standard ambient conditions and stabilized.
d. The vision block shall then be tested as specified in 4.6.3.1, 4.6.3.2 and 4.6.3.3 and shall be checked for any indication of moisture, bond separation or other defects.
e. At the conclusion of this test, the vision block shall be returned to 23±10 °C (73±18 °F).

NOTE: The rate of temperature change (steps a, b, and c) may be the maximum obtainable by the chamber, but shall not exceed 10 °C (18 °F) per minute.

4.6.4.3 High temperature. To determine conformance to 3.7.3, the vision block shall be exposed to a hot and dry temperature profile shown in table V for a total period of 72 hours divided into three 24 hour cycles. The humidity during test shall be less than 10%. After the exposure to the temperature profile, the vision block shall be stabilized at 60 °C (140 °F) and then tested, as specified in 4.6.3.1, 4.6.3.2, and 4.6.3.3 and checked for any moisture, bond separation or other defects.

4.6.4.4 Basic shock. To determine conformance to 3.7.4, three shocks in each direction shall be applied along three mutually perpendicular axes of the vision block (total of 18 shocks). The shock pulse shape shall be of a sawtooth form in accordance with figure 1, of amplitude 40 g and a time duration of 11 ms. At the conclusion of the test, the vision block shall be tested as specified in 4.6.3.1, 4.6.3.2 and 4.6.3.3 and checked for any physical damage.

4.6.4.5 Gun fire shock. To determine conformance to 3.7.5, three shocks in each direction shall be applied along three mutually perpendicular axes of the vision block (total of 18 shocks). The shock pulse shape shall be half sine wave form in accordance with figure 2 of amplitudes and duration as specified in table VI. At the conclusion of the test, the vision block shall be tested as specified in 4.6.3.1, 4.6.3.2 and 4.6.3.3 and checked for any physical damage.

TABLE V. Temperature profile.

Time (hours)	Temperature °C	(°F)	Time (hours)	Temperature °C	(°F)
0100	35	(95)	1300	69	(156)
0200	34	(94)	1400	70	(158)
0300	34	(94)	1500	71	(160)
0400	33	(92)	1600	70	(158)
0500	33	(92)	1700	67	(153)
0600	33	(91)	1800	63	(145)
0700	36	(97)	1900	55	(131)
0800	40	(104)	2000	48	(118)
0900	44	(111)	2100	41	(105)
1000	51	(124)	2200	39	(103)
1100	56	(133)	2300	37	(99)
1200	63	(145)	2400	35	(95)

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

4.6.4.6 Vibration. To determine conformance to 3.7.6, the vision block shall be mounted, in a manner that will simulate its actual use, and vibrated along each axis in accordance with the test levels specified in table VII and as shown in figure 3 for a frequency range from 5 to 500 to 5 Hz applied within a sweep time of 15 minutes for a maximum cycling time of 3 hours. The frequency of applied vibration shall be swept over the specified range logarithmically in accordance with figure 4. The specified sweep time is that of an ascending plus a descending sweep and is twice the ascending sweep time shown in figure 4 for the specified range. When vision block resonances below 5 Hz are measured or expected, the test curve shall be extended to 2 Hz and the sweep time shall be 18 minutes (2 to 500 Hz). At the conclusion of the test, the vision block shall be tested in accordance with 4.6.3.1, 4.6.3.2 and 4.6.3.3 and checked for any damage or defect.

TABLE VII. Vibration levels.

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

4.6.4.7 Humidity resistance. To determine conformance to 3.7.7, the vision block shall be exposed to a total of 48 hours (two 24-hour cycles) to the humidity profile shown in

table VIII. Prior to the test the vision block shall be conditioned at 38 °C (100 °F) and not more than 50% relative humidity for 24 hours. After the test the vision block shall be conditioned at 23 °C (73 °F) and not more than 50% relative humidity for 24 hours. Subsequently, the vision block shall be tested in accordance with 4.6.3.1, 4.6.3.2 and 4.6.3.3 and checked for any moisture build-up, bond separator or other degradation.

TABLE VIII. Humidity and temperature profile.

Time (hours)	Air temperature °C	(°F)	Relative humidity percent (%)
0100	37	(100)	95
0200	37	(100)	95
0300	37	(100)	95
0400	37	(100)	95
0500	37	(100)	95
0600	37	(100)	95
0700	41	(105)	81
0800	43	(110)	66
0900	49	(120)	55
1000	54	(130)	44
1100	60	(140)	37
1200	60	(140)	37
1300	66	(150)	30
1400	71	(160)	23
1500	71	(160)	23
1600	66	(150)	30
1700	66	(150)	30
1800	60	(140)	37
1900	54	(130)	44
2000	49	(120)	66
2100	41	(105)	81
2200	37	(100)	95
2300	37	(100)	95
2400	37	(100)	95

4.6.4.8 Corrosion resistance. To determine conformance to 3.7.8, the vision block shall be tested in accordance with the salt fog test described in method 509, procedure I of MIL-STD-810, or equivalent (see 4.4.1). Subsequently, the vision block shall be tested in accordance with 4.6.3.1, 4.6.3.2, and 4.6.3.3 and checked for any physical damage.

4.6.4.9 Weathering resistance. To determine conformance to 3.7.9, the vision block shall be tested as specified in 4.6.4.9.1 and 4.6.4.9.2.

4.6.4.9.1 Apparatus. The equipment used for this test and the simulated sunshine shall be in accordance with method 505, procedure II of MIL-STD-810, or equivalent (see 4.4.1).

4.6.4.9.2 Procedure. The assembled vision block shall be set-up in the test apparatus and tested in accordance with method 505, procedure II of MIL-STD-810 or equivalent (see 4.4.1). Temperature of the specimens shall be maintained at 46±3 °C (115±5 °F), for test period. At the conclusion of the test, the vision block shall be tested as specified in 4.6.3.1, 4.6.3.2 and 4.6.3.3 and checked for any physical damage. Upon examination, samples that pass this test shall be subjected to the humidity resistance of 4.6.4.7.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. 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. Vision blocks covered by this specification are intended to provide direct vision for vehicle personnel and minimize injury of personnel resulting from small caliber projectiles. Type I and II vision blocks are intended to be interchangeable. This specification covers vision blocks with and without laser protection filters. The vision blocks are military unique because they are used in combat areas only and have no commercial application.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Specific type, class and duty required (see 1.2).
c. If required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
d. When first article inspection is required and guidance (see 3.1 and 4.2, and 6.3).
e. Applicable drawing number (see 3.3).
f. If sampling plan is other than as specified (see 4.3.1).
g. If there are any verification alternatives (see 4.4.1)
h. If inspection conditions are other than as specified (see 4.5).
i. Destination for ballistic samples (see 4.6.3.4).
j. Packaging requirements (see 5.1).

6.3 First article. When requiring a first article inspection, contracting documents should provide specific guidance to offerors (see 6.2). 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 I and their designated frequency based on a risk assessment for the procurement.

6.5 Definitions.

6.5.1 Duty. Duty (see 1.2), as used herein, is defined as a measure of the degree of ballistic resistance required of the vision block and should be indicated as A, B, or C with suffixes, as appropriate, on the applicable drawing. Reference Appendix A (see 4.6.3.4).

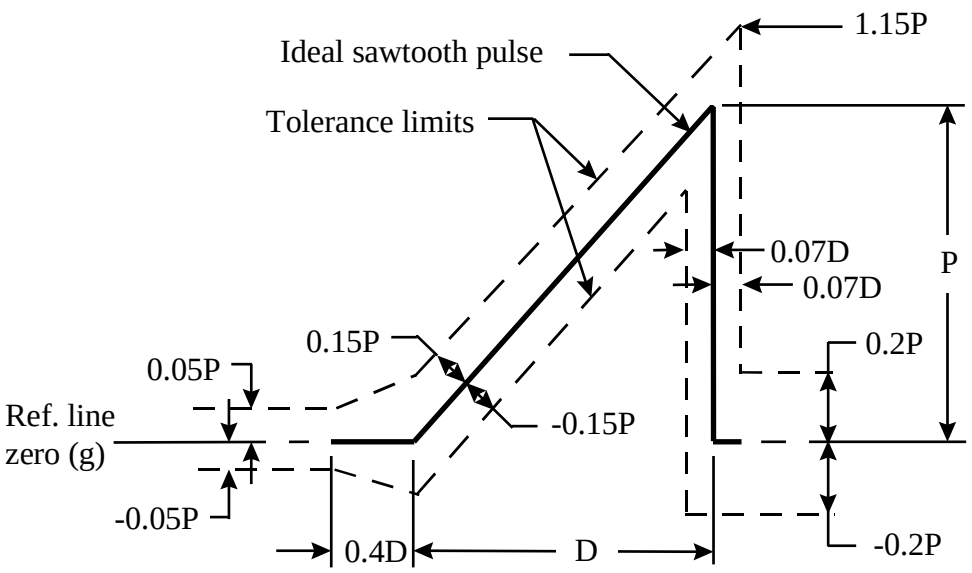
6.5.2 Ballistic failure. Ballistic failure is defined as any evidence of performance by a spall (secondary projectile from the rear face of the vision block), or by part of the projectile itself, of a 0.05 mm (0.002 in.) thick sheet of aluminum foil placed 102 mm (4 in.) to the rear of, and parallel with, the rear face of the vision block.

6.5.3 Resolving power. Resolving power is a measure of the optical performance. The resolving power is the angular subtense (in seconds of arc) of a series of parallel bars that can just be resolved. Resolving power is measured by viewing charts containing parallel bars of appropriate equal spacings.

6.6 Subject term (key word) listing.

Ballistic test
Composite
Fair impact
Laminated
Photopic transmittance

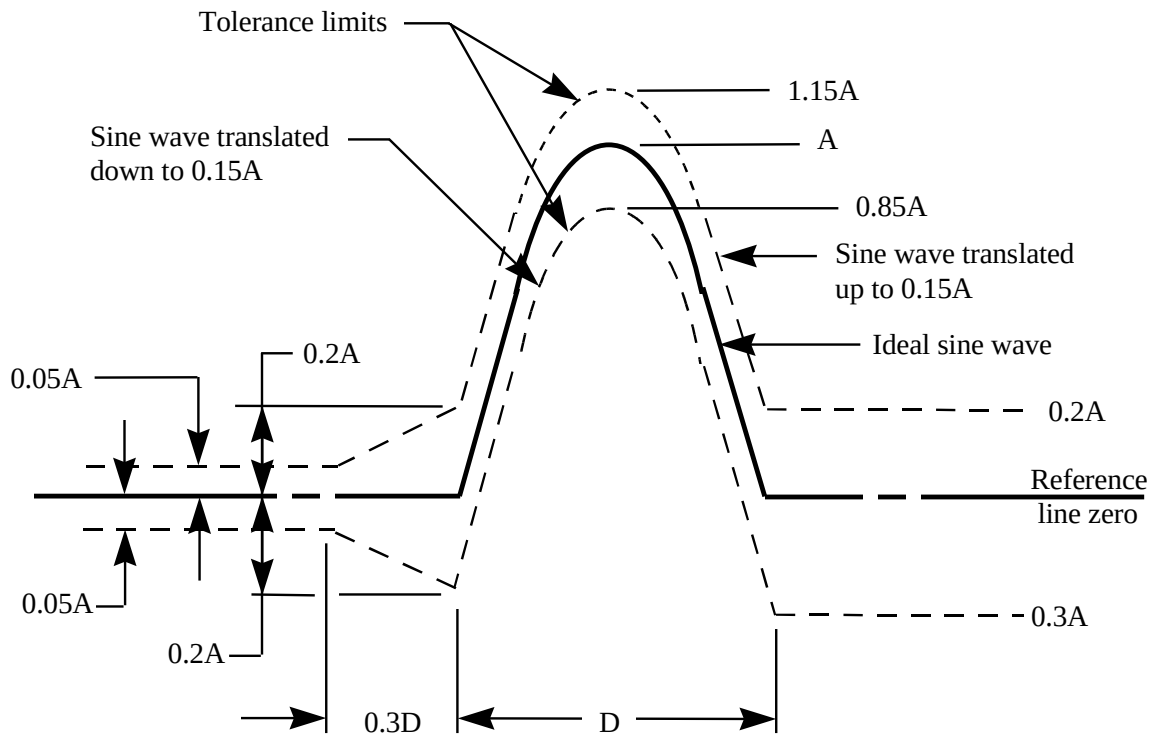
6.7 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.



P = Peak value = 40 g
D = Nominal duration = 11 ms

NOTE: The oscillogram shall include a time about 3D long with a pulse located approximately in the center. The peak acceleration magnitude of the saw-tooth pulse is P and its duration is D. The measured acceleration pulse shall be contained between the broken line boundaries and the measured velocity change (which may be obtained by integration of the acceleration pulse) shall be within the limits of $V_i + 0.1V_i$, where V_i is the velocity-change associated with the ideal pulse, which equals 0.5PD. The integration to determine velocity change shall extend from 0.4D before the pulse to 0.1D after the pulse.

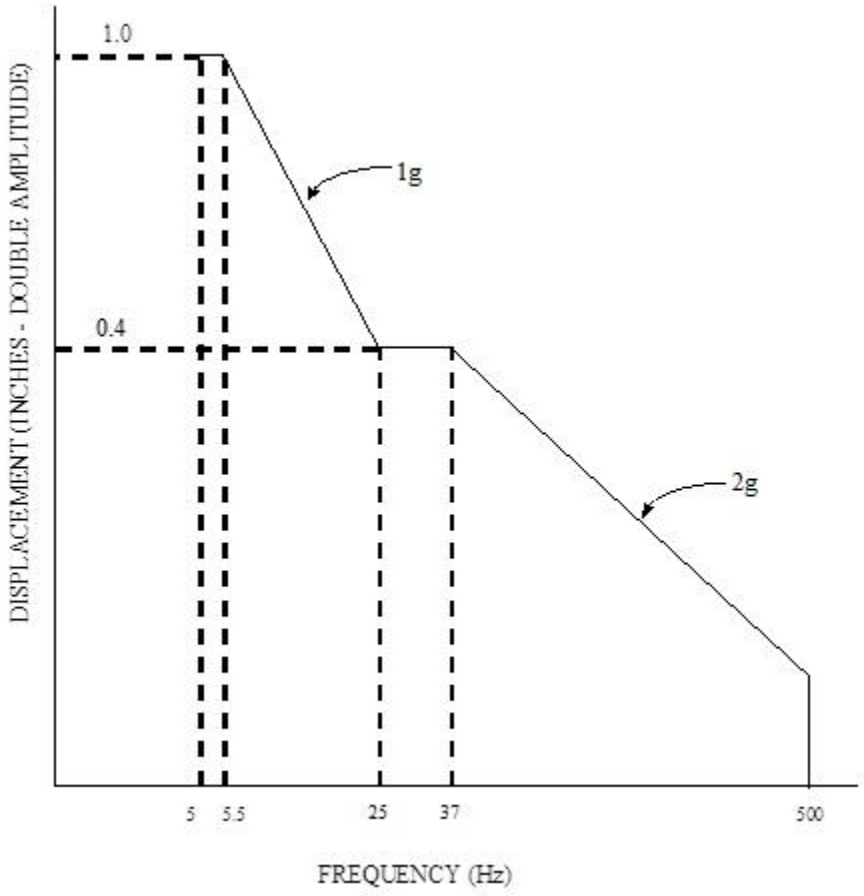
FIGURE 1. Terminal-peak saw-tooth shock pulse configuration and tolerance limits.



A = Peak value = 30 g
D = Nominal duration = 11 ms

NOTE: The oscillogram shall 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 its duration is D. The measured acceleration pulse shall be contained between the broken line boundaries and the measured velocity change (which may be obtained by integration of the acceleration pulse) shall be within the limits of $V_i + 0.1V_i$, where V_i is the velocity-change associated with the ideal pulse, which equals $2AD/\pi$. The integration to determine velocity change shall extend from 0.4D before the pulse to 0.1D after the pulse.

FIGURE 2. Half-sine shock pulse configuration and tolerance limits.



NOTES:
1. Acceleration levels: +9 g.
2. The curve shall be extended to 2 Hz when test item resonances below 5 Hz are expected.

FIGURE 3. Vibration test curves for equipment installed in ground vehicles.

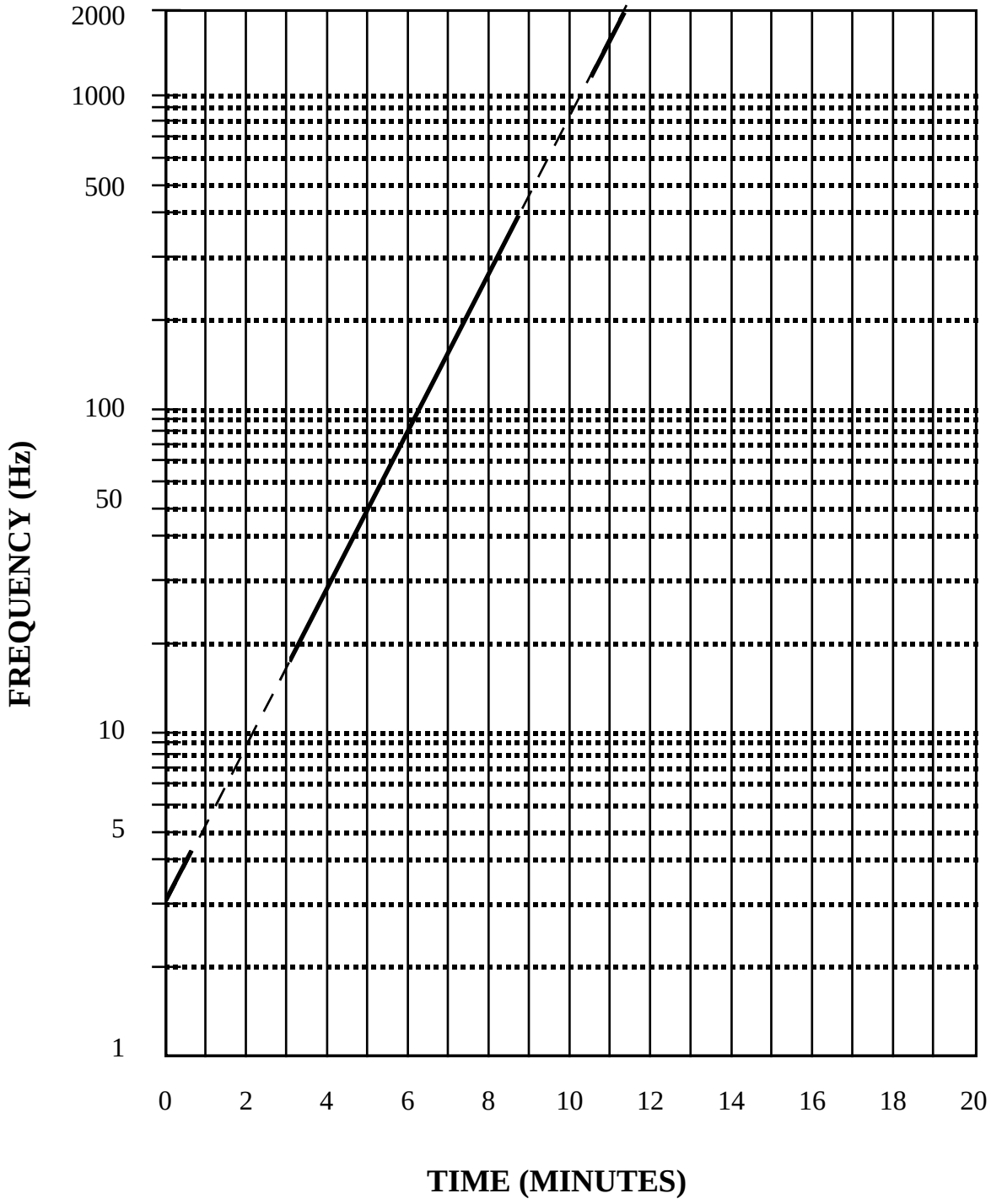


FIGURE 4. Logarithmic sweep.

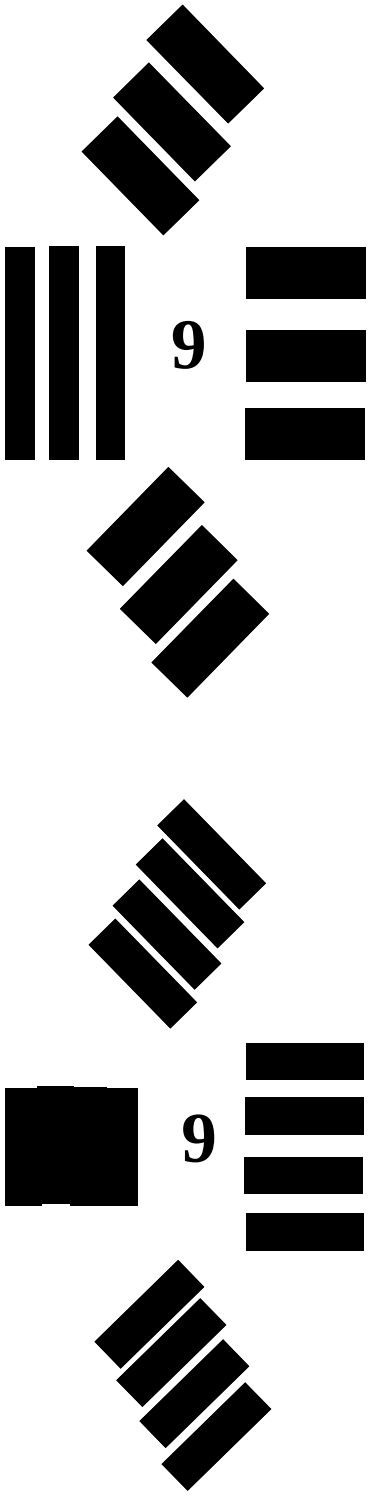


FIGURE 5. Resolving power chart (for illustration purposes only).

BALLISTIC TESTING OF VISION BLOCKS

A.1 SCOPE

A.1.1 Scope. This appendix covers the requirements for ballistic testing of vision blocks. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

A.2 DEFINITIONS

A.2.1 Fair impact. An impact located fully on the front transparent surface of a vision block within desired location. No contact with metal surrounding the front transparent surface of the block is allowed.

A.2.2 Protection complete penetration CP(P). A penetration in which the projectile, or one or more fragments of the projectile or the vision block, pass beyond the rear surface of the vision block and perforate a 0.051 mm (0.002 in.) aluminum foil sheet placed 102 mm (4 in.) behind and parallel to the rear surface of the vision block.

A.2.3 Partial penetration PP(P). Any fair impact that is not a complete penetration shall be considered a partial penetration.

A.3 REQUIREMENTS

A.3.1 Ballistic test duties. Ballistic tests are divided into three duties as follows:

Duty A	- Caliber .30 AP M2
Duty A1	- Caliber .30 AP M2
Duty A2	- Caliber .30 AP M2
Duty B	- Caliber .50 AP M2
Duty B1	- Caliber .50 AP M2
Duty C	- 14.5-MM AP-I BS-41
Duty C1	- 14.5-MM AP-I BS-41
Duty C2	- 20-MM HVAP-T M602
Duty C3	- 20-MM HVAP-T M602

The duty of ballistic test required shall be specified by the procuring activity.

A.3.2 Ballistic test procedures.

A.3.2.1 Mounting. Vision blocks will be securely mounted for ballistic test in a cupola or other simulating fixture of the type to be used in the intended service application. Obliquity of

the front surface of the vision block being tested will be equivalent to that present when installed in the vehicle for which intended.

A.3.2.2 Acceptance lot. Eight vision blocks shall be submitted to represent each acceptance lot. A lot will be judged acceptable on ballistic test when five vision blocks receive a fair impact at the required striking velocity which results in a partial penetration. A complete penetration of any fair impact shall be cause for rejection of the lot.

A.3.2.3 Impact. Before ballistic test all blocks to be impacted shall be conditioned to a temperature of 21±5.5 °C (70±10 °F).

A.3.2.4 Location for impact. The desired location for each impact is within one third of the distance up from the bottom edge to the top edge of the vision block face.

A.3.2.5 Penetration. To determine whether a complete penetration has occurred (0.051 mm (0.002 in.) aluminum foil is placed 102 mm (4 in.) behind and parallel to the rear face of each block during test. A complete penetration, as determined by this witness material is defined in A.2.2.

A.3.2.6 Striking velocities. The required striking velocities in meters per second (m/s) and feet per second (ft/s) for each duty of ballistic test defined in A.3.1 are given below. These velocity requirements apply unless a special requirement has been established in an applicable contract or drawing by the cognizant Government agency.

Duty A	- 710+12 m/s (2330+40 ft/s)
Duty A1	- 845+12 m/s (2775+40 ft/s)
Duty A2	- 884+12 m/s (2900+40 ft/s)
Duty B	- 895+12 m/s (2935+40 ft/s)
Duty B1	- 924+12 m/s (3030+40 ft/s)
Duty C	- 957+12 m/s (3140+40 ft/s)
Duty C1	- 1000+12 m/s (3281+40 ft/s)
Duty C2	- 1055+12 m/s (3460+40 ft/s)
Duty C3	- 1103+12 m/s (3617+40 ft/s)

The striking velocities listed above apply to the projectiles specified for each respective duty of ballistic test in A.3.1.

Custodian:
Army - AT

Preparing Activity:
Army - AT

(Project 25GP-2013-001)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.