METRIC

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MILITARY SPECIFICATION

BLOCK, VISION: BULLET-RESISTANT (METRIC)

This specification is approved for use within the US 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 bullet-resistance 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 shall be of the following types, classes, and duties as specified (see 6.2). 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.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-T, 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 25GP

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

Duty A	- Light (see 6.4.3).
Duty B	- Medium (see 6.4.3).
Duty C	- Heavy (see 6.4.3).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards 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 Defense Index of Specifications and Standards (DODISS) and Supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS
FEDERAL

L-P-391	- Plastic Sheets, Rods and Tubing, Rigid Cast, Methacrylate (Multiapplication).
TT-C-490	- Cleaning Methods for Ferrous Surface and Pretreatments for Organic Coatings.
TT-P-664	- Primer Coating, Synthetic Rust-Inhibiting, Laquer-Resisting.

MILITARY

MIL-G-174	- Glass Optical
MIL-O-13830	- Optical Components for Fire Control Instruments: General Specifications Governing the Manufacture, Assembly, and Inspection of.
MIL-P-25421	- Plastic Materials, Glass Fiber Base-Epoxy Resin, Low Pressure Laminated.
MIL-C-46168	- Coating, Aliphatic Polyurethane, Chemical Agent Resistant.
MIL-P-53030	- Primer Coating, Epoxy, Water Reducible, Lead and Chromate Free.
MIL-C-53039	- Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant.
MIL-F-62422	- Filter, Laser Hazard Protection.

STANDARDS
MILITARY

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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Defense Printing Service Detachment Office, Bldg. 4D (Customer Service), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publication. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DODISS specified 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 C1036	- Standard Specification for Flat Glass.
ASTM E308	- Standard Test Method for Computing the Colors of Objects by Using the CIE System.

(Application for copies of ASTM should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Non-Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a vision block shall be subjected to first article inspection (see 6.3) in accordance with 4.4.

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 compatible with the application, performance and environmental requirements specified herein (see 4.7.1).

3.2.1 Recycled, virgin and reclaimed materials. There are no requirements for the exclusive use of virgin materials. The use of recycled or reclaimed (recovered) materials is acceptable provided that all other requirements of this specification are met (see 6.4.1).

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 and shall meet the color requirements of MIL-G-174 for glass index of refraction less than 1.60 (see 4.7.1).

3.2.3 Plastic. The plastic plies shall meet the requirements of L-P-391 for grade 1 plastic, except that the material need not to be acrylic (see 4.7.1).

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 4.7.1).

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 4.7.1 and 4.7.2).

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) (1/16 inch) 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 (1/16 inch ± 1/64 inch) at all ground edges of the block. The outside edges of the case shall have a radius of 0.8 ± 0.4 mm, (1/32 ± 1/64 inch) and all sharp edges of the block shall be chamfered to 0.8 to 1.6 mm (1/32 to 1/16 inch) prior to assembly in the case (see 4.7.1 and 4.7.2).

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 4.7.1 and 4.7.2).

3.3.2.1 Metal case (type I). The metal case for vision blocks shall be in accordance with applicable drawing (see 4.7.1 and 4.7.2).

3.3.2.2 Plastic case (type II). The plastic case for vision blocks shall be of material conforming to type II, class I of MIL-P-25421, or as specified on the applicable drawing. The material thickness shall be 2.16 ± 0.25 mm (0.085 ± 0.010 inch) (see 4.7.2).

3.4 Performance.

3.4.1 Photopic transmittance. For vision blocks without laser protection filters, the photopic transmittance shall be greater than 75% unless otherwise specified on applicable drawings. The photopic transmittance of vision blocks with laser filters shall be greater than 42%. Photopic transmittance shall be measured along the optical axis using CIE illuminant C or A (see 4.7.3.1).

3.4.1.1 Optical density. For vision blocks with laser filters, the optical density requirements for specific wavelength ranges shall be as specified in 3.5.1 of MIL-F-62422. The optical density of each laser protected vision block shall be measured along the optical axis (see 4.7.3.1.1).

3.4.2 Resolving power. Resolving power, over all areas that are 6.4 mm (1/4 inch) 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 4.7.3.2).

3.4.3 Ballistic Resistance. The vision block shall withstand the impact of the applicable type of projectile (see 4.7.3.3).

3.4.4 Environmental.

3.4.4.1 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, 3.4.1.1 and 3.4.2 (see 4.7.3.4.1).

3.4.4.2 Low temperature. The vision block shall meet the requirements of 3.4.1, 3.4.1.1, and 3.4.2 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 (hr) after stabilization. At the conclusion of this test, the vision block shall be returned to 23 $\pm$ 10°C (73 $\pm$ 18°F) (see 4.7.3.4.2).

3.4.4.3 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-hr cycles of the hot, dry temperature profile shown in table I with a relative humidity less than 10% during exposure. Subsequently, the vision block shall meet the requirements of 3.4.1, 3.4.1.1 and 3.4.2 (see 4.7.3.4.3).

3.4.4.4 Basic shock. The vision block shall show no evidence of physical damage and shall meet the requirements of 3.4.1, 3.4.1.1 and 3.4.2 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 4.7.3.4.4).

TABLE I. Temperature profile.

Time (hr)	Temperature (°C)	(°F)	Time (hr)	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

3.4.4.5 Gun fire shock. The vision block shall show no evidence of physical damage and shall meet the requirements of 3.4.1, 3.4.1.1 and 3.4.2 after being exposed to three gun fire shock pulses applied in both directions along each of the three mutually perpendicular axes in accordance with the levels specified in table II (see 4.7.3.4.5).

TABLE II. 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

3.4.4.6 Vibration. The vision block shall meet the requirements of 3.4.1, 3.4.1.1 and 3.4.2 after being subjected to the vibration levels shown in table III for a total of 3 hr 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 4.7.3.4.6).

Table III. Vibration levels.

Frequency, Hertz (Hz)	Amplitudes (g)		
	Vertical	Latitudinal	Longitudinal
5 to 25	± 1.0	± 1.0	± 1.0
25 to 37	0.03 (peak to peak)	± 1.0	± 1.0
37 to 500	± 2.0	± 1.0	± 1.0

3.4.4.7 Humidity resistance. The vision block shall evidence no delamination, or other physical deterioration after being exposed to two 24-hr cycles of the relative humidity and air temperature profiles shown in table IV and subsequently, shall meet the requirements of 3.4.1., 3.4.1.1 and 3.4.2 (see 4.7.3.4.7).

TABLE IV. Humidity and temperature profile.

Time (hr)	Air temperature (°C)	(°F)	Relative humidity (%)
0100	37.3	100	95
0200	37.3	100	95
0300	37.3	100	95
0400	37.3	100	95
0500	37.3	100	95
0600	37.3	100	95
0700	40.5	105	81
0800	43.3	110	66
0900	48.9	120	55
1000	54.4	130	44
1100	60.0	140	37
1200	60.0	140	37
1300	65.5	150	30
1400	71.1	160	23
1500	71.1	160	23
1600	65.5	150	30
1700	65.5	150	30
1800	60.0	140	37
1900	54.4	130	44
2000	48.9	120	66
2100	40.5	105	81
2200	37.3	100	95
2300	37.3	100	95
2400	37.3	100	95

3.4.4.8 Corrosion resistant. The vision block shall meet the requirements of 3.4.1, 3.4.1.1, 3.4.2 and shall show no evidence of bond separation, corrosion or other physical damage after being exposed to a salt fog solution for 48 hr (see 4.7.3.4.8).

3.4.4.9 Weathering resistance. The vision block shall evidence no delamination or other physical deterioration when exposed to not less than 350 hr of simulated sunshine, and shall subsequently meet the requirements of 3.4.1, 3.4.1.1 and 3.4.2 (see 4.7.3.4.9).

3.5 Finish. The vision block shall be cleaned and treated in accordance with type I of TT-C-490, and primed in accordance with TT-P-664. A finishing coat shall be applied, chemical agent resistant, in accordance with MIL-C-46168 or MIL-C-53039, conforming to the color and infrared reflectance characteristics (see 4.7.1 and 4.7.2).

3.6 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 4.7.2).

3.7 Workmanship. Workmanship shall be of a quality which will assure that all glass and plastic plies and all cases are free of warpage, cracks and scratches, or any other defects which may affect serviceability or performance. All plies shall be uniform in color and transparency. All fabrication surface chips larger than 6.4 mm (1/4 inch) originating at the edge of the glass shall be cause for rejection, other chips shall be stoned (see 4.7.2).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform or witness any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of section 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance shall comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.2 Classification of inspections:

a. First article inspection (see 4.4).
b. Quality conformance inspection (QCI) (see 4.5).
(1) (a) Examination (see 4.5.2).
(b) Tests (sampling) (see 4.5.3).
(2) 100% tests (see 4.5.5).
c. Control tests (see 4.6).

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

a. Air temperature: 23 ± 10°C (73 ± 180°F)
b. Barometric pressure: 725 + 50 millimeters mercury (mm Hg)
- 75
[28.5 + 2 inches mercury (in Hg)]
- 3
c. Relative humidity: 50 ± 30%

4.4 First article. Unless otherwise specified (see 6.2), the Government shall select eight vision blocks produced under the production contract for first article inspection. First article samples shall be inspected as specified in table V. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply vision blocks that are fully representative of those inspected as a first article sample. Any changes or deviation of the production units from the first article sample shall be subject to the approval of the contracting officer. All non-destructive tests shall be performed prior to ballistic resistance testing, which shall be conducted by the Government, unless otherwise specified.

TABLE V. Classification of inspection.

Title	Requirement	Inspection	First Article	Quality Conformance			
				Exam	Tests		Control
					Sampling	100%	
Materials and construction	3.2 thru 3.2.4 and 3.5	4.7.1	X				
Defects(see 4.5.2 and table VIII)	3.3 thru 3.3.2.2 and 3.5 thru 3.7	4.7.2	X	X			
Photopic transmittance	3.4.1	4.7.3.1	X		X		X
Optical density	3.4.1.1	4.7.3.1.1	X			X	X
Resolving power	3.4.2	4.7.3.2	X		X		X
Ballistic resistance 1/	3.4.3	4.7.3.3	X				
Temperature fluctuation resistance	3.4.4.1	4.7.3.4.1	X				X
Low temperature	3.4.4.2	4.7.3.4.2	X				X
High temperature	3.4.4.3	4.7.3.4.3	X				X
Basic shock	3.4.4.4	4.7.3.4.4	X				
Gun Fire shock	3.4.4.5	4.7.3.4.5	X				
Vibration	3.4.4.6	4.7.3.4.6	X				
Humidity resistance	3.4.4.7	4.7.3.4.7	X				
Corrosion resistance	3.4.4.8	4.7.3.4.8	X				
Weathering	3.4.4.9	4.7.3.4.9	X				
Packaging	5.1	4.7.4	X				

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

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

TABLE VI. Order of tests.

Photopic Title	Requirement	Test
Photopic transmittance 1/	3.4.1	4.7.3.1
Optical density 1/	3.4.1.1	4.7.3.1.1
Resolving power 1/	3.4.2	4.7.3.2
Temperature fluctuation resistance	3.4.4.1	4.7.3.4.1
Weathering resistance	3.4.4.9	4.7.3.4.9
Humidity resistance	3.4.4.7	4.7.3.4.7
Corrosion resistance	3.4.4.8	4.7.3.4.8
Ballistic resistance	3.4.3	4.7.3.3
Packaging	5.1	4.7.4

1/ These tests shall be repeated after samples have successfully completed 4.7.3.4.1 through 4.7.3.4.8 tests.

4.4.2 First article inspection failure. Deficiencies found during, or as a result of, first article inspection shall be cause for rejection of the first article sample until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiency. Any deficiency found during, or as a result of the first article inspection, shall be evidence that all items already produced prior to completion of the first article inspection are similarly deficient unless contrary evidence satisfactory to the contracting officer is furnished by the contractor. Such deficiencies on all items shall be corrected by the contractor. The Government will not accept products until first article inspection is completed to the satisfaction of the Government.

4.5 QCI. QCI shall include the examination of 4.5.2 and the tests of 4.5.3 and 4.5.5. Noncompliance with any of the specified requirements in sections 3 and 5 shall be cause for rejection of the sample and the inspection lot.

4.5.1 Sampling plan. Unless otherwise specified (see 6.2), the sampling plan specified herein shall be used. See 6.4.4 for definitions of sampling inspection terms.

4.5.1.1 Lot formation. An inspection lot shall consist of all vision blocks of a single type, class, style and part identification number (PIN), from an identifiable production period, from one manufacture, from one manufacturing location, submitted at the same time for acceptance.

4.5.1.2 Sample. The sample for QCI examination and tests shall be randomly selected from the inspection lot in accordance with table VII.

TABLE VII. Sampling plan for QCI.

QCI sampling plan			
Inspection lot size	Sample size		
	Examination		Test
	Major	Minor	
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
3.201 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)			

4.5.2 Examination. The sample selected in accordance with 4.5.1.2 shall be examined and defects classified as specified in table VIII (see 4.7.2). The acceptance number in all cases is zero.

4.5.3 Tests. The sample selected in accordance with 4.5.1.2 shall be subjected to the tests specified in table V. The acceptance number in all cases is zero.

4.5.4 QCI failure. Any item that fails to conform to any specified requirement shall be rejected; any failure (one or more) of the selected sample in either the Major/Minor categories or test for the appropriate inspection lot size shall constitute a failure of the entire lot. The rejected item(s) may be repaired or corrected and resubmitted for inspection. If the contractor utilizes sampling inspection as an element of his inspection system, rejected inspection lots may be resubmitted for

acceptance if the contractor performs 100 percent inspection on the lot for those characteristics which were defective and resulted in rejection of the lot and removes all defective units or obtains procuring activity approval to resample the lot due to the insignificance of the defects. Resubmitted lots shall be kept separate from new lots and shall be clearly identified as resubmitted lots.

TABLE VIII. Classification of defects.

Category	Defect	Method of examination
Critical	Optical density (see 3.4.1.1).	SIE 1/
Major		
101	Dimensions affecting interchangeability, out of tolerance (see 3.3).	SIE
102	Faulty workmanship affecting performance (see 3.7).	Visual
Minor		
201	Dimensions not affecting interchangeability, out of tolerance (see 3.3).	SIE
202	Improper adhesive sealing compound (see 3.2.	Visual
203	Improper construction (see 3.3)	Visual
204	Improper assembly details (see 3.3.1)	Visual and SIE
205	Improper finish (see 3.5)	Visual
206	Improper marking (see 3.6)	Visual
207	Faulty workmanship affecting appearance (see 3.7)	Visual

1/ SIE = Standard Inspection Equipment.

4.5.5 100% test. Each vision block with a laser filter shall be subjected to the optical density test (see 3.4.1.1) specified in table V.

4.5.5.1 Test failure. Failure of the item to pass the QCI tests shall be cause for the Government to refuse acceptance of the item. Any item containing one or more defects either shall not be submitted for Government acceptance or shall be corrected and re-examined or retested and resubmitted without defects for Government acceptance. Resubmitted items shall be kept separate from new items and shall be clearly identified as resubmitted items.

4.6 Control tests. Control tests shall be conducted on one vision block per two hundred units consecutively produced, except that not more than two tests shall be performed in a six month period, nor less than one test in a twelve month period. The vision block shall be subjected to the control tests specified in table V.

4.6.1 Failure. Failure of any vision block to pass any of the specified control tests shall be cause for the Government to refuse acceptance of the production quantity represented, until action taken by the contractor to correct defects and prevent recurrence has been approved by the Government.

4.7 Methods of inspection.

4.7.1 Materials, design and construction. Conformance to 3.2 through 3.2.4 and 3.5 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, and test reports.

4.7.2 Examination. Conformance to 3.3 through 3.3.2.2 and 3.5 through 3.7 shall be determined by examination for the defects listed in table VIII. Examination shall be visual or by measurement with SIE.

4.7.3 Performance tests.

4.7.3.1 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 Commission Internationale del'Eclair (CIE) source C or A (see ASTM E308).

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,

$\sum$ = 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

4.7.3.1.1 Optical density. To determine conformance to 3.4.1.1, all vision blocks with laser filters shall be tested using the apparatus specified in 4.7.3.1. 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 $\pm$ 0.1 OD.

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 optical density (O.D.) is defined as:

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

4.7.3.2 Resolving power. To determine conformance to 3.4.2, the resolution over all the specified areas of the vision block case shall be adequate to permit detection of angular separation of 75 seconds of arc, when tested for resolution test in accordance with MIL-O-13830.

4.7.3.3 Ballistic resistance. To determine conformance to 3.4.3, 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 and 6.4.3).

4.7.3.3.1 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 inch) thick sheet of aluminum foil placed 102 mm (4 inches) to the rear of, and parallel with, the rear face of the vision block.

4.7.3.4 Environmental.

4.7.3.4.1 Temperature fluctuation resistance. To determine conformance to 3.4.4.1, the vision block shall be subjected to a temperature of -54 $\pm$ 3°C (-65 $\pm$ 5°F) for 12 hr and shall then be stabilized at room

temperature and placed in an oven for a period of 12 hr 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 4.7.3.4.9.

4.7.3.4.2 Low temperature. To determine conformance to 3.4.4.2, 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 hr 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 4.7.3.1, 4.7.3.1.1. and 4.7.3.2 and shall be checked for any indication of moisture, bond separation or other defects.

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.

4.7.3.4.3 High temperature. To determine conformance to 3.4.4.3, the vision block shall be exposed to a hot and dry temperature profile shown in table I for & total period of 72 hr divided into three 24-hr 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 4.7.3.1, 4.7.3.1.1 and 4.7.3.2 and checked for any moisture, bond separation or other defects.

4.7.3.4.4 Basic shock. To determine conformance to 3.4.4.4, 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 4.7.3.1, 4.7.3.1.1, and 4.7.3.2 and checked for any physical damage.

4.7.3.4.5 Gun fire shock. To determine conformance to 3.4.4.5, 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 II. At the conclusion of the test, the vision block shall be tested as specified in 4.7.3.1, 4.7.3.1.1 and 4.7.3.2 and checked for any physical damage.

4.7.3.4.6 Vibration. To determine conformance to 3.4.4.6, 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 III 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 hr. 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 2 Hz). At the conclusion of the test, the vision block shall be tested in accordance with 4.7.3.1, 4.7.3.1.1 and 4.7.3.2 and checked for any damage or defect.

4.7.3.4.7 Humidity resistance. To determine conformance to 3.4.4.7, the vision block shall be exposed to a total of 48 hr (two 24-hr cycles) to the humidity profile shown in table IV. Prior to the test the vision block shall be conditioned at 38°C (100°F) and not more than 50% relative humidity for 24 hr. After the test the vision block shall be conditioned at 23°C (73°F) and not more than 50% relative humidity for 24 hr. Subsequently, the vision block shall be tested in accordance with 4.7.3.1, 4.7.3.1.1, 4.7.3.2 and checked for any moisture build-up, bond separation or other degradation.

4.7.3.4.8 Corrosion resistance. To determine conformance to 3.4.4.8, the vision block shall be tested in accordance with the salt fog test described in method 509, procedure I of MIL-STD-810. Subsequently, the vision block shall be tested in accordance with 4.7.3.1, 4.7.3.1.1 and 4.7.3.2 and checked for any physical damage.

4.7.3.4.9 Weathering resistance. To determine conformance to 3.4.4.9, the vision block shall be tested as specified in 4.7.3.4.9.1 and 4.7.3.4.9.2.

4.7.3.4.9.1 Apparatus. The equipment used for this test and the simulated sunshine shall be in accordance with method 505, procedure II of MIL-STD-810.

4.7.3.4.9.2 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. 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 4.7.3.1, 4.7.3.1.1 and 4.7.3.2 and checked for any physical damage. Upon examination, samples that pass this test shall be subjected to the humidity resistance test of 4.7.3.4.7.

4.7.4 Inspection of packaging.

4.7.4.1 Materials and processes. The Government inspector shall initially and at unscheduled intervals inspect all materials and processes involved in the preparation for delivery to determine conformance to the

requirements of section 5. Any evidence of deviation from specified requirements shall be cause for refusal to conduct further inspection until objective evidence has been provided by the contractor that corrective action has been taken.

5. PACKAGING

5.1 Preservation, packaging, packing, and marking. Preservation, packaging, packing, and marking for the desired level shall be in accordance with the applicable packaging requirements specified by the contracting authority (see 6.2).

6. NOTES

(This section contains information of a general or explanatory nature that 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.

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. Issue of DODISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
d. Whether first article is required (see 3.1).
e. If responsibility for inspection is other than as specified (see 4.1).
f. If inspection conditions are other than as specified (see 4.3).
g. If sampling plan for QCI is other than as specified (see 4.5.1).
h. Destination for ballistic samples (see 4.7.3.3).
i. Selection of applicable level and packaging requirement (see 5.1).

6.3 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a first article sample, a first production item, or a standard production item from the contractor's current inventory and the number of items to be tested as specified in 4.4 and 4.4.1. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product

which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Definitions.

6.4.1 Recovered materials. "Recovered materials" means material that have been collected or recovered from solid waste (see 6.4.2).

6.4.2 Solid waste. "Solid waste" means (a) any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and (b) other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial commercial, mining and agricultural operations and from community activities. It does not include solid or dissolved material in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Clean Water Act, (33 U.S.C. 1342 et seq.), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) (Source: Federal Acquisition Regulations. section 23.402).

6.4.3 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 shall be indicated as A, B, or C with suffixes, as appropriate, on the applicable drawing. Reference Appendix A (see 4.7.3.3).

6.4.4 Definitions of terms used in sampling inspection.

a. Classification of defects. A classification of defects is the enumeration of possible defects of the unit of product classified according to their seriousness. A defect is any nonconformance of the unit of product with specified requirements. Defects will normally be grouped into one or more of the following classes: critical, major and minor. Also, defects may be grouped into other classes, or into subclasses within these classes.

b. Critical defects. A critical defect is a defect that judgement and experience indicate would result in hazardous or unsafe conditions for individuals using, maintaining, or depending upon the product, or a defect that judgement and experience indicate is likely to prevent performance of the tactical function of a major end item such as a ship, aircraft, tank, missile, or space vehicle.

c. Critical defective. A critical defective is a unit of product which contains one or more critical defects and may also contain major and/or minor defects.

d. Defective. A defective is a unit of product which contains one or more defects.

e. Formation of lots or batches. The product shall be assembled into identifiable lots, sublots, batches, or in such other manner as may be prescribed. Each lot of batch shall, as far as it is practicable, consist of units of product of a single type, grade, class, size, and composition, manufactured under essentially the same conditions, and at essentially the same time.

f. Lot of batch. The term lot or batch shall mean "inspection lot" or "inspection batch", i.e., a collection of units or product from which a sample is to be drawn and inspected any may differ from a collection of units designated as a lot or batch for other purposes (e.g., production, shipment, etc.).

g. Lot or batch size. The lot or batch size is the number of units of product in a lot or batch.

h. Major defect. A major defect is a defect, other than critical, that is likely to result in failure, or to reduce materially the usability of the unit of product for its intended purpose.

i. Major defective. A major defective is a unit of product which contains one or more major defects, and may also contain minor defects but contains no critical defect.

j. Minor defect. A minor defect is a defect that is not likely to reduce materially the usability of the unit of product for its intended purpose, or is a departure from established standards having little bearing on the effective use or operation of the unit.

k. Minor defective. A minor defective is a unit of product which contains one or more minor defects but contains no critical or major defect.

l. Presentation of lots or batches. The formation of the lots or batches, lots or batch size, and the manner in which each lot or batch is to be presented and identified by the supplier shall be designated or approved by the responsible authority. As necessary, the supplier shall provide adequate and suitable storage space for each lot or batch, equipment needed for proper identification and presentation, and personnel for all handling of product requirement for drawing of samples.

m. Representative sampling. When appropriate, the number of units in the sample shall be selected in proportion to the size of sublots or subbatches, or parts of the lot of batch, identified by some rational criterion. When representative sampling is used, the units from each part of the lot or batch shall be selected at random.

n. Sample. A sample consists of one or more units of product drawn from a lot or batch, the units of the sample being selected at random without regard to their quality. The number of units or product in the sample is the sample size.

o. Sampling plan. A sampling plan indicates the number of units of product from each lot or batch which are to be inspected (sample size or series of sample sizes) and the criteria for determining the acceptability of the lot or batch (acceptance and rejection numbers).

p. Time of sampling. Samples may be drawn after all the units comprising the lot of batch have been assembled, or samples may be drawn during assembly of the lot or batch.

q. Preservation, packaging, and packing which will afford adequate protection against corrosion, deterioration, and damage during shipment, handling, indeterminate storage, and worldwide redistribution.

r. Preservation, packaging, and packing which will afford adequate protection against corrosion, deterioration, and damage during known storage conditions for periods normally not exceeding 1 year.

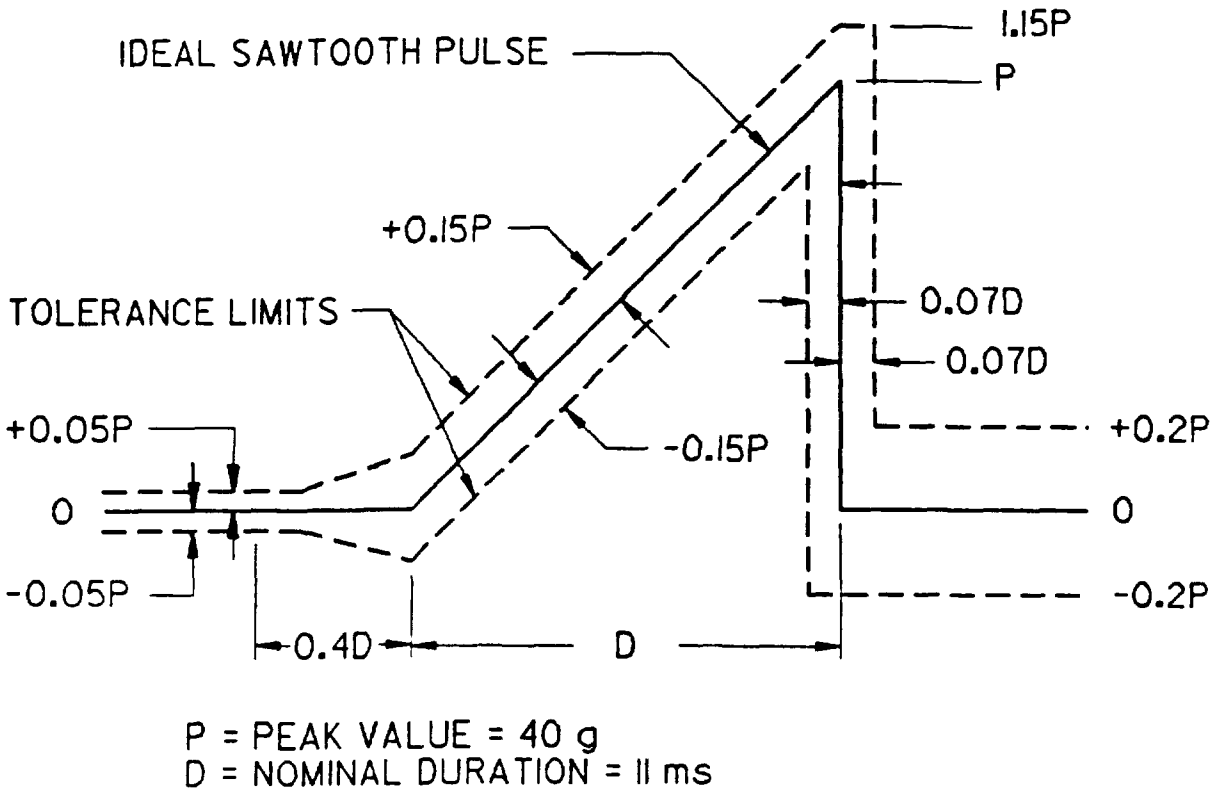
s. Preservation, packaging, and packing which will afford adequate protection against corrosion, deterioration, and damage during shipment from supply source to the first receiving activity for immediate use (vendor to user).

6.5. Subject term (key word) listing.

Bullet-resistant, block, vision
Bullet-resistant, vision block
Vision block
Vision block, bullet resistant

6.6 SI values. Dimensions and properties in SI units are primary. Dimensions and properties in inch-pounds units are shown as approximate equivalents of the primary units.

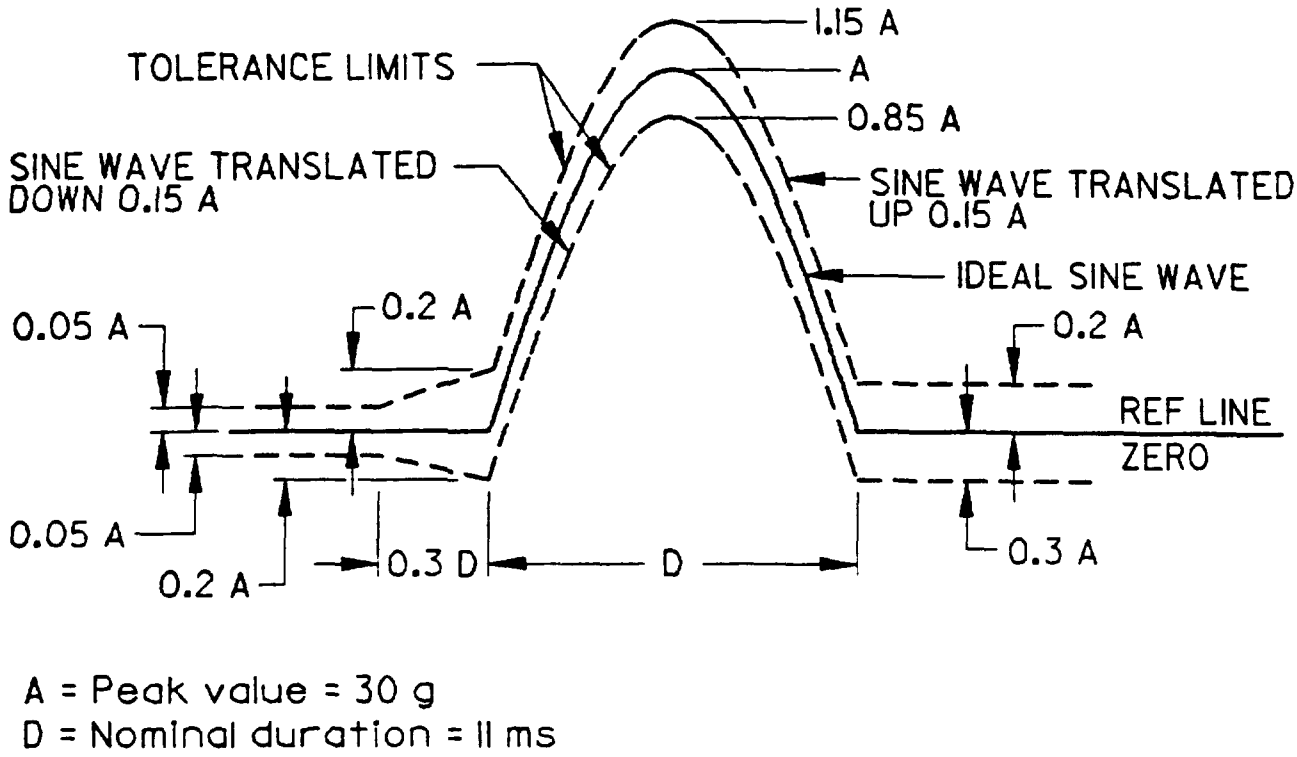
6.7 AMC policy on AQLs/LTPDs. This specification is certified to be in compliance with current Army Material Command (AMC) policy for the elimination of AQLs/LTPDs (Acceptable Quality Levels/Lot Tolerance Percent Defectives) from military specifications.



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 sawtooth 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 $V_1 \pm 0.1\ V_1$ where V_1 is the velocity-change associated with the ideal pulse which equals 0.5 PD. The integration to determine velocity change shall extend from 0.4D before the pulse to 0.1D after the pulse.

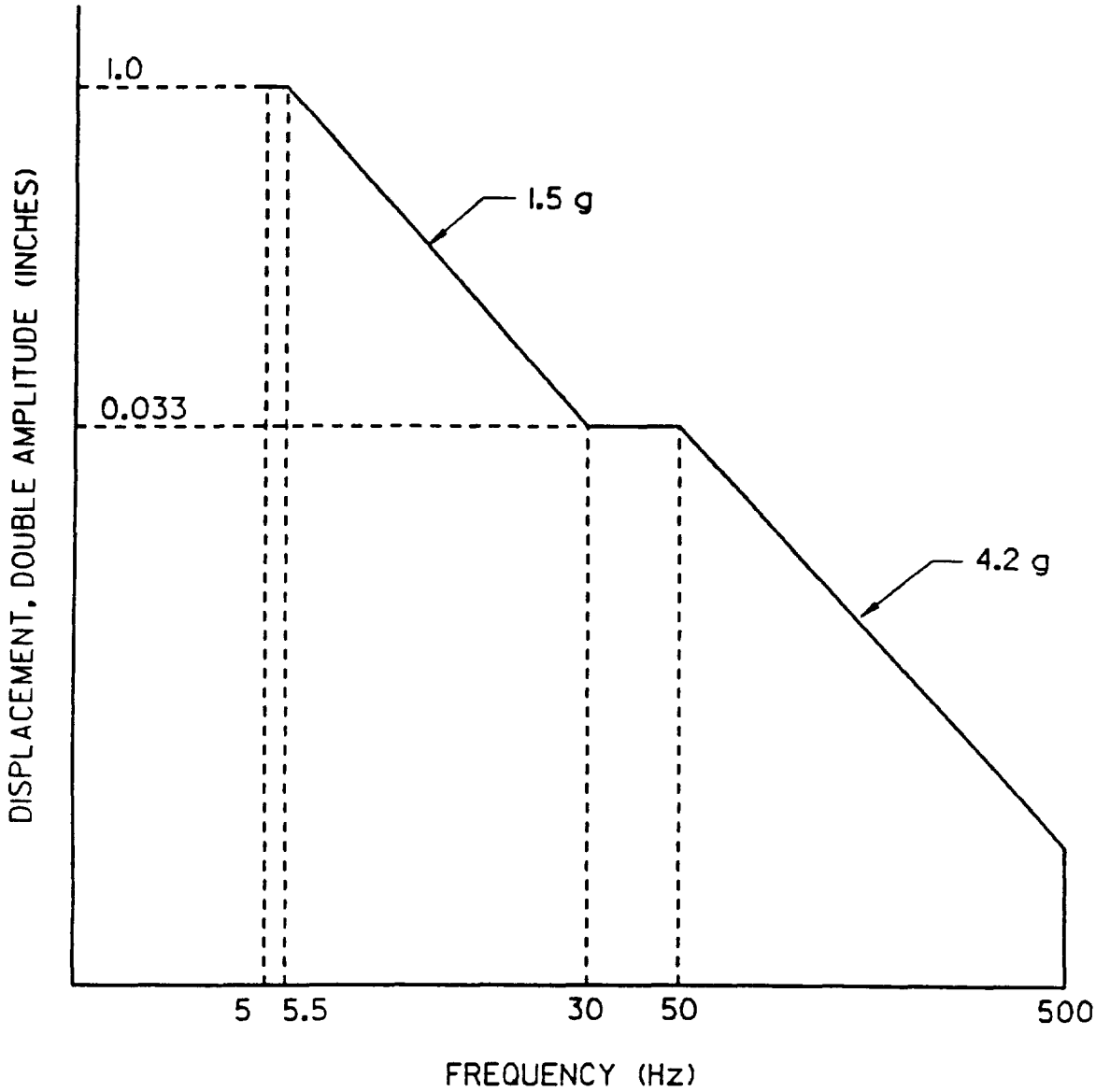
FIGURE 1. Terminal-peak sawtooth shock pulse configuration and tolerance limits.



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 $V_1 \pm 0.1\ V_1$ where V_1 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 its 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.

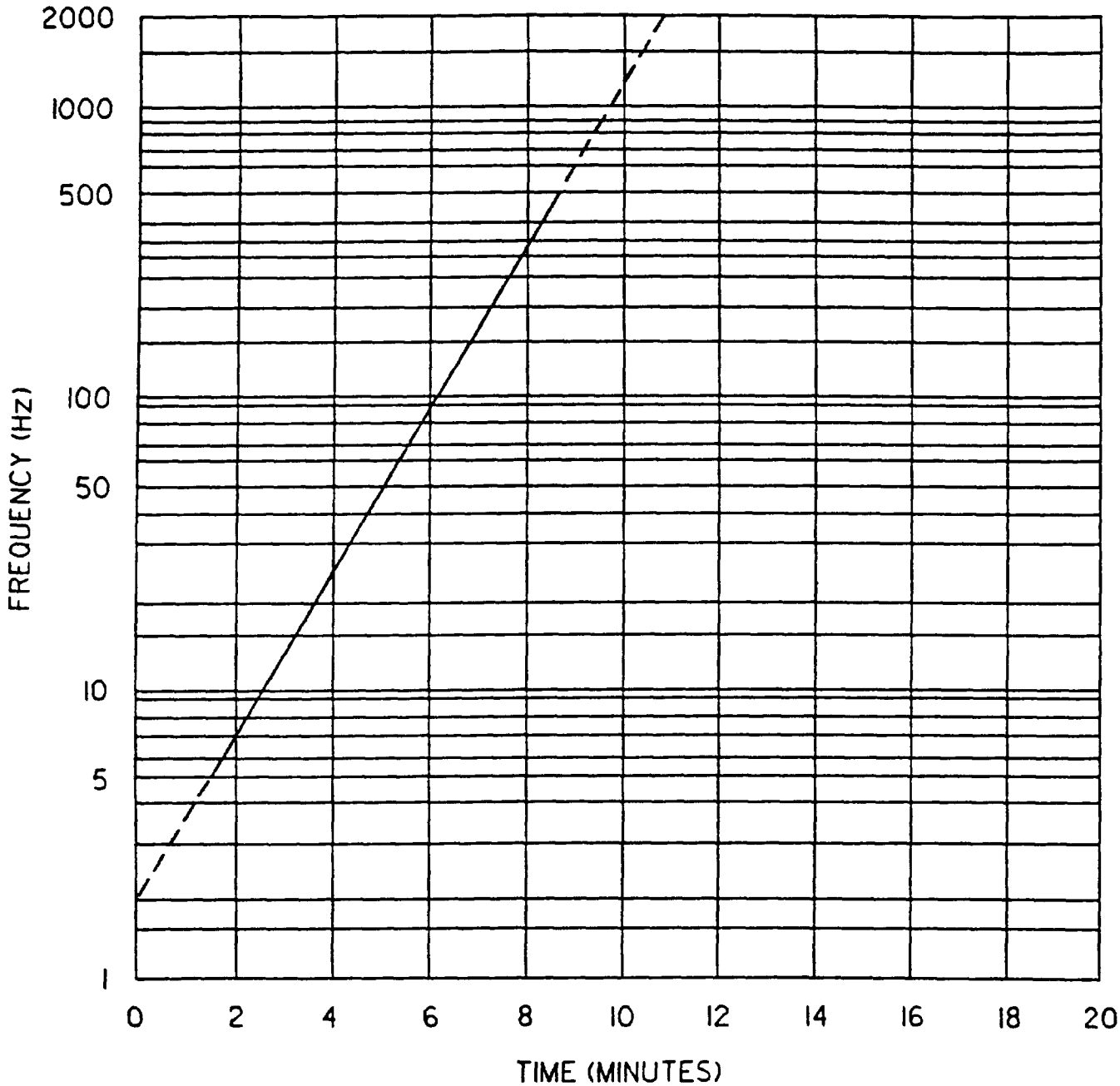


FIGURE 4. Logarithmic sweep.

APPENDIX A

Ballistic Testing of Vision Blocks

10. SCOPE

10.1 Scope. This appendix covers the requirements for ballistic testing of vision blocks.

20. DEFINITIONS

20.1 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.

20.2 Protection Complete Penetration, CP(P). A penetration in which the projectile, or one or more fragments of a projectile or the vision block, pass beyond the rear surface of the vision block and perforate a 0.002 inch aluminum foil sheet placed 4 inches behind and parallel to the rear surface of the vision block.

20.3 Partial Penetration, PP(P). Any fair impact that is not a complete penetration shall be considered a partial penetration.

30. REQUIREMENTS

30.1 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.

40. BALLISTIC TESTS

40.1 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.

APPENDIX A

Ballistic Testing of Vision Blocks

40.2 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.

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

40.4 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.

40.5 To determine whether a complete penetration has occurred, 0.002 inch aluminum foil is placed 4 inches behind and parallel to the rear face of each block during test. A complete penetration, as determined by this witness material is defined in 20.2.

40.6 The required striking velocities in meters per second (m/s) and foot per second (ft/s) for each duty of ballistic test defined in 30.1 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 30.1.

Custodian:
Army - AT

Preparing Activity:
Army - AT

Project No. (25GP-0006)

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, 6, and 7

3 The preparing activity must provide a reply within 30 days from receipt of the form

NOTE This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements

FSC 25GP

I RECOMMEND A CHANGE:	1 DOCUMENT NUMBER	2 DOCUMENT DATE (YYMMDD)
	MIL-B-11352A(AT)	950322

3 DOCUMENT TITLE
Block, Vision: Bullet-Resistant (Metric)

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 (2) AUTOVON
c ADDRESS (Include Zip Code) Commander U.S. Army Tank-automotive and Armaments Command, Attn: AMSTA-TR-T 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