

INCH-POUND

MIL-DTL-45225F(MR)  
22 April 1998  
SUPERSEDING  
MIL-A-45225E(MR)  
30 January 1987

## DETAIL SPECIFICATION

### ALUMINUM ALLOY ARMOR, FORGED

This specification is approved for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers forged aluminum alloy armor, die forgings from 3/4 inch up to and including 3 inches in thickness for type I, class A forgings, and from 3/4 inch up to and including 4 inches for type I, class B forgings. Type II forging thicknesses should be as specified (see 6.2).

1.2 Classification. Forgings furnished under this specification are furnished in one of the following types and classes.

Type I - Weldable forgings

Class A - Non-heat treatable

Alloy 5083  
Alloy 5456

Class B - Heat treatable

Alloy 7039  
Al-Zn-Mg

Type II - Non-weldable forgings

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, US Army Research Laboratory, Weapons and Materials Research Directorate, ATTN: AMSRL-WM-M, Aberdeen Proving Ground, MD 21005-5069 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents 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 documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

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

## STANDARDS

## DEPARTMENT OF DEFENSE

## MIL-STD-662 - V50 Ballistic Test For Armor

(Unless otherwise indicated, copies of the standard listed above are available 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 the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- B557 Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
- E34 Chemical Analysis of Aluminum and Aluminum-Base Alloys
- E227 Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to Plane-Technique
- E607 Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere
- E716 Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis
- E1251 Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Argon Atmosphere, Point-to-Plane, Unipolar Self-Initiating Capacitor Discharge

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959).

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

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## 3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order (see 6.2) and before production has commenced, samples of the specified item shall be made available to the contracting officer or his authorized representative for approval in accordance with 4.3.1. The approval of the first article samples authorizes the commencement of production but does not relieve the supplier of responsibility for compliance with all applicable provisions of this specification. The first article samples and test forgings shall be manufactured by the process proposed for use on production.

3.2 Chemical composition. Chemical composition of type I forgings shall be within the limits shown in table I. Type II material shall be as specified in the contract or on the drawings.

3.3 Mechanical properties. Unless otherwise specified (see 6.2), the mechanical properties of type I forgings shall meet the requirements of table II, when tests are conducted as specified in 4.8.2. Type II forgings shall meet the mechanical property requirements specified in the contract or on the drawing. If mechanical properties different from the values shown in table II or any other properties are required, the ballistic requirements must then be negotiated (see 3.4).

3.4 Ballistic requirements. Each ballistic test forging shall be proof fired for resistance to penetration by determining a ballistic limit protection, BL(P), at 0° obliquity. The minimum required ballistic limit for type I, class A material shall be determined from the values shown in tables V, VI, VII and VIII. The minimum required ballistic limit for type I, class B material, and type II materials shall be determined from the values shown in tables IX, X, XI, XII and XIII. In those cases where the BL(P) is within + 10 fps of the minimum required value for the measured average thickness (to the nearest 0.005 inch), an interpolation of the appropriate table will be performed. The average plate thickness, computed to the nearest 0.001 inch, will be used to determine the minimum required ballistic limit.

3.5 Thermal processing, type I.

3.5.1 Class A. After final strain hardening performed during the forging process, any thermal processing exceeding 200°F performed on the forging, excluding fabrication by welding, will necessitate re-verification for conformance with 3.3 and 3.4. Deviation from this requirement shall be subject to review and approval by the procuring activity.

3.5.2 Class B. Heat treatment shall be such that the material shall meet the requirements of this specification.

3.6 Dimensional tolerances. The forgings shall conform to the shape and dimensions specified on the drawings within any variations stated herein.

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TABLE I. Chemical composition (percent).

Alloy	Silicon, max.	Iron, max.	Copper, max.	Manga- nese	Mag- nesium	Chro- mium	Zinc max.	Tita- nium, max.	Zirco- nium, each, max.	Others total, max.	Alum- inum <sup>1/</sup>
5083	0.40	0.40	0.10	0.40 1.0	4.0- 4.9	0.05- 0.25	0.25 max.	0.15	-	0.05	0.15 Rem.
5456	<u>2/</u>	<u>2/</u>	0.10	0.50- 1.0	4.7- 5.5	0.05 0.20	0.25 max.	0.20	-	0.05	0.15 Rem.
7039	0.30	0.40	0.10	0.10- 0.40	2.3- 3.3	0.15- 0.25	3.5- 4.5	0.10	-	0.05	0.15 Rem.
Al-Zn-Mg	0.30	0.40	0.10	0.10- 0.70	2.0- 3.8	0.06- 0.25	3.5- 5.0	0.10	0.20	0.05	0.15 Rem.

1/ By difference.2/ Silicon 0.25 percent maximum and iron 0.40 percent maximum.TABLE II. Mechanical properties.<sup>1/</sup>

Alloy	Direction	Thickness, inches	Tensile strength, min., Ksi	Yield strength, 0.2% offset, min., Ksi	Elongation, min. percent
Type I					
Class A	Longitudinal	0.750 to 3.000, incl.	42.0	33.0	7
	Transverse	0.750 to 3.000, incl.	40.0	32.0	4
Class B	Longitudinal	0.750 to 4.000, incl.	57.0	48.0	8
	Transverse	0.750 to 4.000, incl.	54.0	45.0	4

1/ See 6.9.

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3.7 Marking for identification. Each forging shall be marked in at least one location in characters not less than 3/8 inch high with the following information. Impression stamping shall not be used, except in areas designated by the drawing.

- a. Manufacturer's name, trademark or both.
- b. Number of this specification.
- c. Type, class, alloy designation, and temper.
- d. Army part or drawing number.
- e. Lot number.

3.7.1 Ballistic test forgings. First article and acceptance and ballistic test forgings shall be marked with the information in 3.7. In addition, first article forgings shall be marked "PRE" and acceptance test forgings marked "ACC". This marking shall be impression stamped in at least two opposing locations in letters not less than 1/2-inch high.

3.8 Information required on ballistic test forgings. Unless otherwise specified in the contract or purchase order, a ballistic test report shall be submitted with each ballistic test plate or forging containing the information as specified in MIL-STD-662.

3.9 Workmanship. The forgings shall be uniform in quality and free from blisters, fins, seams, laps, and cracks.

#### 4. VERIFICATION

4.1 Clarification of inspections. The inspection requirements specified herein are classified as conformance inspection (see 4.2).

4.2 Conformance inspection. Test for acceptance of individual lots consist of testing all requirements specified in section 3. Verification conformance inspection is in accordance with the provisions herein.

4.2.1 Government test activity. Ballistic tests shall be performed at a government test activity selected by the procuring activity (see 6.2).

4.3 Classification of inspection. Inspection shall be classified as follows:

- a. First article inspection.
- b. Conformance inspection (acceptance).

4.3.1 First article inspection. First article inspection shall consist of the following:

- a. Chemical analysis (see 3.2 and 4.7.3).
- b. Mechanical properties (see 3.3 and 4.8.2).
- c. Ballistic tests (see 3.4 and 4.8.3).
- d. Dimensions (see 3.6 and 4.6.2).
- e. Identification marking (see 3.7 and 4.6.1).
- f. Workmanship (see 3.9 and 4.6.1).

4.3.2 Conformance (acceptance) inspection. Lot acceptance inspection shall consist of the following:

- a. Chemical analysis (see 3.2 and 4.8.1).
- b. Mechanical properties (see 3.3 and 4.8.2).
- c. Ballistic tests (see 3.4 and 4.8.3).
- d. Dimensions (see 3.6 and 4.6.2).
- e. Identification marking (see 3.7, 3.7.1, and 4.6.1).

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- f. Workmanship (see 3.9 and 4.6.1).
- g. Preparation for shipment (see 4.6.3 and section 5).

4.3.2.1 Chemical analyses records. When chemical analyses records are in compliance with 4.5.2.1, certification to the alloy chemical limits of table I is acceptable.

4.4 Lot. A lot shall consist of forgings of the same shape, alloy and processing submitted for inspection as a unit, provided that the lot does not exceed 25,000 pounds or 300 forgings, whichever is less.

#### 4.5 Sampling.

4.5.1 First article testing. At least three sample forgings shall be submitted for ballistic and mechanical testing. If the forging size is too small for removal of tensile test specimens from the ballistic sample, three additional forgings shall be furnished.

4.5.1.1 Chemical composition. For type I forgings, a certification of compliance with the limits shown in table I shall be furnished with the test forgings. For type II forgings, a certification of compliance with the chemical composition limits stated in the contract shall be furnished with the test forgings.

4.5.1.2 Mechanical properties. One longitudinal and one transverse tension test specimen shall be removed from each forging. If size permits, this may be the same forging that is used for ballistic tests. Location and type of specimens shall be as specified in 4.7.4.

4.5.1.3 Ballistic tests. For each configuration that the manufacturer has under contract, three or more forgings shall be submitted for ballistic tests. Prior to submission of the forgings, the tester and the contractor will discuss, using a drawing of the forgings, the ballistic test conditions; namely, forging thickness, impact area and projectile type. The number of forgings, or forging sections needed for first article ballistic acceptance testing will be determined. Modifications, cutting, welding and bracketing will be determined as needed for test mounting.

#### 4.5.2 Acceptance tests.

4.5.2.1 Chemical compositions, ingot analysis. At least one sample shall be taken from the molten metal representing one group of ingots poured as a unit from the same source of molten metal. Complete ingot analysis records shall be available to the government at the ingot producer's facility.

4.5.2.2 Chemical composition, finished product analysis. When sampling has not been made in accordance with 4.5.2.1, one sample shall be taken for each 4,000 pounds or less in each lot in accordance with ASTM E34 and ASTM E716.

4.5.2.3 Mechanical properties. One forging for tension test shall be selected from each lot. One longitudinal and one transverse tension test specimen shall be removed from the forging. If size permits, this may be the same forging that is used for ballistic tests.

4.5.2.4 Ballistic tests. From each lot, one forging shall be submitted for ballistic test. (See paragraph 4.5.1.3 for supplementary information).

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4.6 Examination.

4.6.1 Visual. Each forging shall be carefully examined to determine compliance with the identification marking (see 3.7) and workmanship (see 3.9) requirements.

4.6.2 Dimensional. For each acceptance lot, representative forgings shall be selected in accordance with table III and examined to determine compliance with requirements of 3.6.

TABLE III. Sampling for dimensional examination.

Number of forgings in lot	Number of forgings in sample
Up to 50, incl.	5
51 to 130, incl.	10
131 to 300, incl.	15

4.6.3 Preparation for shipment. Prior to shipment, examination shall be made to determine compliance with section 5.

4.7 Test specimens.

4.7.1 Rejection. Unless otherwise specified (see 6.2) where one or more test specimens fail to meet the requirements of the specification the lot represented by the specimen or specimens shall be subject to rejection.

4.7.2 Retest. When no sampling plan is provided or approved by the procuring agency (see 6.2) and where there is evidence that indicates that the specimen was not representative of the lot of material, and when the detail specification does not otherwise specify, at least two specimens shall be selected to replace each test specimen which failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be subject to rejection.

4.7.3 Chemical composition. Samples for chemical analysis shall be prepared in accordance to test methods specified in ASTM E34 or ASTM E716.

4.7.4 Mechanical properties. Tension test specimens shall conform to the dimensions of the standard 0.500 inch round specimen (figure 8) of ASTM B557. If the forging dimensions prevent the use of the standard 0.500 inch round specimen, the largest of the subsize proportional specimens shown in figure 8 of ASTM B557, which can be obtained, shall be used. Longitudinal tension test specimens shall be taken with the long axis parallel to the direction of maximum metal flow. Transverse specimens shall be taken with the long axis perpendicular to the direction of maximum metal flow. Actual location shall be as specified on the drawing or in the contract or order (see 6.2).

4.8 Test procedures.

4.8.1 Chemical composition. Chemical analysis shall be conducted in accordance with one or more of ASTM E34, E227, E607, E716, and E1251.

4.8.2 Mechanical properties. The mechanical properties shall be determined in accordance with ASTM B557.

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4.8.3 Ballistic tests.

4.8.3.1 Forging thickness measurement. The average thickness of the forging shall be the mean of at least 4 thickness measurements read to the nearest 0.001 inch. These measurements shall be made in regions of uniform thickness as close as possible to the intended point of impact of projectiles within the area required to provide ballistic protection as shown on the drawing. The average thickness, to the nearest 0.001-inch, shall be used to determine the required protection ballistic limit.

4.8.3.2 Ballistic tests. Ballistic test forgings shall be tested at locations specified on the drawings or in the contract or order (see 6.2), at the government testing activity designated by the procuring activity. The forgings shall be at  $70^{\circ} + 10^{\circ}\text{F}$  when ballistically tested. Forgings shall be tested in accordance with the thickness ranges shown in table IV. The forging thickness used by the ballistic test agency to determine the required minimum protection ballistic limit shall be the measured thickness of the forging. The test forgings may be machined at the location specified for testing provided that such machining shall not cause the forgings to fall outside the thickness limits for the thickness range as specified in table IV.

TABLE IV. Ballistic test forgings.

Nominal design thickness specified on drawing, (inches)		Projectile to be used
Class A	Class B	
0.705-1.100	0.750-1.030	Cal. .50 FSP
1.101-1.700	1.031-1.500	Cal. .30 APM2
1.101-1.700	1.031-1.500	20mm FSP
1.701-3.000	1.501-3.000	Cal. .50 APM2
-	3.001-3.425	Cal. .57 AP

4.9 Rejection and retest.

4.9.1 First article. Failure of the first article test forgings to meet the requirements of the examinations and tests listed in 4.3.1 indicates failure of the product.

4.9.1.1 Retests. Resubmission of first article samples shall not be made until the manufacturer has made necessary corrections in the processing of the material to the satisfaction of the procuring activity. Forgings submitted for retest shall be marked R1, R2 and R3 in addition to the requirements of 3.7.

4.9.2 Acceptance.

4.9.2.1 Examination. A production lot shall be rejected for failure to meet the visual, dimensional and preparation for delivery requirements when examined in accordance with 4.6.

4.9.2.2 Tests. A production lot shall be rejected for failure to meet any of the test requirements when tested in accordance with 4.7 and 4.8.

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4.9.2.3 Retests.

4.9.2.3.1 Chemical composition and mechanical properties. Retests shall be conducted in accordance with ASTM B557, test methods of ASTM E34, or E607, E227, and E1251 of ASTM E716.

4.9.2.3.2 Ballistics. If test forgings representing the lot fail to meet the ballistic requirements, the manufacturer has the following options: Immediately upon notification of the failure, the manufacturer may:

(1) submit two additional test forgings from the same lot for ballistic retest at own expense, or

(2) first reprocess the lot and then submit two test forgings from the reprocessed lot, or

(3) scrap the lot and submit a forging representing a new lot for acceptance.

If any of these options are chosen and ballistic retest forgings meet the requirements, then the lot represented is acceptable. If the manufacturer chooses option (1) and one or both of the retest forgings fail, the manufacturer may reprocess the lot and submit two forgings from the reprocessed lot. If one of these fail the lot is rejected. If option (3) is chosen and the test forging fails, the manufacturer may again resort to any one of the three options.

4.10 Reduced testing. At the discretion of the procuring activity, the amount of testing may be reduced provided the results on consecutive lots indicate that a uniform product meeting the testing requirements is being produced, and providing the manufacturer agrees to maintain the same manufacturing procedures. The manufacturer when eligible for reduced or audit testing may at his option, continue to submit one ballistic test plate or forging per lot of material. The test facility shall only test the non-required test plates or forgings upon manufacturer's loss of reduced testing eligibility.

## 5. PACKAGING

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

## 6. NOTES

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

6.1 Intended use. The aluminum alloy armor forgings covered by this specification are military unique. The forgings are used in military vehicles to protect the operator and passengers against small arms fire and shrapnel.

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6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Mechanical properties, thickness, and chemical composition of type II forgings (see 1.1, 3.2, and 3.3).
- c. Type, class and alloy (see 1.2).
- d. DoDISS and supplement issue specified in the solicitation (see 2.2).
- e. When first article is required (see 3.1).
- f. Mechanical property requirements of type I forgings if different from table II (see 3.3).
- g. Drawings, dimensions, and tolerances (see 3.6).
- h. Marking for identification (see 3.7, and 3.7.1).
- i. Ballistic test report (see 3.8).
- j. Destination of test forgings (see 4.2.1, 6.3).
- k. Locations of tension test specimens (see 4.7.4).
- l. Locations for determination of ballistic limits (see 4.8.3).
- m. Packaging requirements (see 5.1).

6.3 Ownership of ballistic test forgings.

6.3.1 First article and acceptance test forgings. First article and acceptance test forgings that comply with the requirements of this specification are considered as part of the lot of forgings that they represent, and ownership of them passes to the government with acceptance of that lot. First article and acceptance test forgings that fail to comply with the requirements of this specification are considered as part of the lot they represent and remain the property of the manufacturer as does the rejectable lot which they represent.

6.3.1.1 Failure of forgings. At the time of shipment of the first article and acceptance test forgings, the government test activity should be informed by the manufacturer, in writing, as to the disposition of first article and acceptance test forgings which fail the test. If instructions for disposal of the tested forgings are not received after 15 days, the testing activity will exercise the prerogative of disposing of the material.

6.4 Ballistic tests. Testing should be in accordance with MIL-STD-662, V50 Ballistic Test For Armor, except that nothing in this procedure should be construed to supersede or invalidate the requirements of this specification.

6.4.1 Temperature conditioning. Prior to the test, the test item(s) will be temperature conditioned at least eight hours. Thermostatic control will be such that the average temperature of the item during the test should be  $72 \pm 15^{\circ}\text{F}$  ( $22 \pm 8^{\circ}\text{C}$ ).

6.4.2 Ballistic limit protection, BL(P).

6.4.2.1 Normal circumstances. The BL(P) should consist of an equal number of fair impact complete and partial penetration velocities attained by the up-and-down firing method. All BL(P)'s should be computed using the highest partial penetration velocities and the lowest complete penetration velocities. Firing should continue until either a 4-round BL(P) having a maximum velocity spread of 60 fps or a 6-round BL(P) having a maximum velocity spread of 90 fps has been attained, whichever comes first in the normal sequence of firing. If both occur simultaneously, the 6-round BL(P) will be reported.

6.4.2.2 Large zone of mixed results. In the event that the zone of mixed results (difference between the high partial penetration velocity and the low complete penetration velocity, the partial penetration velocity being higher than the low complete penetration velocity) exceeds 90 fps, the firing data will be compared with the specification minimum ballistic requirements. If the lowest

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complete penetration velocity is equal to or above the minimum specified ballistic limit velocity for the forged thickness, the ballistic limit will be computed on the basis of 4-rounds or 6-rounds using the smallest possible velocity spread. If the lowest complete penetration velocity is below the minimum allowable ballistic limit velocity then testing will continue until a 10 round ballistic limit has been attained using the smallest possible velocity spread. Ten round ballistic limits should be reported as such in a ballistic test report as specified in MIL-STD-662.

6.4.2.3 Reduction of large velocity gap in borderline cases. If the ballistic limit which has been attained is within  $\pm 10$  fps of the minimum allowable ballistic limit and a gap exists which is greater than 25 fps, then another round, or rounds, will be fired to reduce the gap to 25 fps or less. The ballistic limit will then be recomputed using the above criteria. The recomputed BL(P) will be reported as the BL(P) of the plate (in borderline cases a reduction of the gap between the high partial penetration velocity and the low complete velocity should result in a better evaluation of the BL(P)).

6.5 Mechanical properties to ballistic requirements. The minimum mechanical properties specified (see 3.3) may not assure that aluminum armor forgings meet the specified ballistic requirements (see 3.4).

6.6 Stress Corrosion. To prevent failure in service due to stress corrosion, care should be exercised in design and fabrication to minimize sustained surface tensile stresses in the transverse direction. Any machining performed on the forgings supplied according to this specification should be closely controlled and the procuring activity should specify protective measures, when necessary, such as shot peening, buttering, etc., to curtail any possibility of stress-corrosion cracking. No alkaline etching should be permitted.

#### 6.7 Definitions.

6.7.1 Complete penetration, (CP). A complete penetration occurs when the impacting projectile, or any fragment thereof, or any fragment of the test specimen perforates the witness plate, resulting in a crack or hole which permits light passage when a 60 watt, 110 volt bulb is placed proximate to the witness plate.

6.7.2 Contractor. The term "contractor" is defined as the organization having a direct contract with the procuring activity.

6.7.3 Contracting officer. The term "contracting officer" means the person executing a contract on behalf of the government, and any other officer or civilian employee who is properly designated contracting officer; and the term includes, except as otherwise provided, the authorized representative of a contracting officer acting within the limits of his authority.

6.7.4 Fair impact. An impact may be considered fair when an unyawed fragment simulator or test projectile strikes an unsupported area of the target material at a specified obliquity at a distance of at least two projectile diameters from any previous impact or disturbed area resulting from an impact, or from any crack, or from any edge of the test specimen.

6.7.5 Gap A gap is the difference in fps between the high partial penetration velocity and the low complete penetration velocity used to compute the ballistic limit when the high partial penetration velocity is lower than the low complete penetration velocity.

6.7.6 Manufacturer. The term "manufacturer" is defined as the organization actually performing the operations covered by this specification.

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6.7.7 Partial penetration, (PP). Any impact which is not a complete penetration may be considered a partial penetration.

6.7.8 Procuring activity. The term "procuring activity" is that activity of the government which actually initiates the request for procurement and maintains the records of the procurement.

6.7.9 Witness plate. A thin sheet located behind and parallel to the ballistic test sample which is used to detect penetrating projectiles or spall.

6.8 Metric units. When metric dimensions are required, units for inch, pounds, pounds per square inch and feet per second may be converted to the metric equivalent by multiplying them by the following conversion factors:

English	Multiply by	Equals	Metric SI unit
inch	0.0254	=	meter (m)
pounds per square inch	0.0068947	=	pascal (PA)
pounds	0.45359	=	kilogram (Kg)
feet per second	0.3048	=	meter per second (m/s)

Note: Conversion factors are in accordance with standard metric practice.

#### 6.9 Subject term (key word) listing.

Ballistic limit  
Class A material  
Class B material  
Type II material

Custodian:  
Army - MR

Preparing activity:  
Army - MR

Review activities:  
Army - AR, AT, TE

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TABLE V. Minimum ballistic limits (protection at 0° obliquity) for type I, class A material using caliber .50 FSP.<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
0.650	1290	0.820	1910	0.990	2585
0.660	1325	0.830	1950	1.000	2625
0.670	1360	0.840	1985	1.010	2670
0.680	1395	0.850	2025	1.020	2710
0.690	1430	0.860	2065	1.030	2755
0.700	1465	0.870	2105	1.040	2795
0.710	1500	0.880	2140	1.050	2840
0.720	1540	0.890	2180	1.060	2885
0.730	1575	0.900	2220	1.070	2930
0.740	1615	0.910	2260	1.080	2970
<sup>2/</sup> 0.750	1650	0.920	2300	1.090	3015
0.760	1685	0.930	2340	<sup>3/</sup> 1.100	3060
0.770	1725	0.940	2380	1.110	3100
0.780	1760	0.950	2420	1.120	3140
0.790	1800	0.960	2460	1.130	3180
0.800	1835	0.970	2500	1.140	3220
0.810	1875	0.980	2545	1.150	3260

<sup>1/</sup> FSP denotes fragment simulating projectile.

<sup>2/</sup> Spec. requirements for this test start at ordered thickness of 0.750 inches.

<sup>3/</sup> Spec. requirements for this test end at ordered thickness of 1.10 inches.

NOTE: Thickness less than (see footnote <sup>2/</sup>) and greater than (see footnote <sup>3/</sup>) is a requirement for undersize or oversize forgings.

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TABLE VI. Minimum ballistic limits (protection at 0° obliquity) for type I, class A material using 20 mm FSP.<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
1.031	1324				
<sup>2/</sup> 1.101	1468	1.485	2235	1.625	2534
1.350	1979	1.490	2245	1.630	2545
1.355	1988	1.495	2256	1.635	2556
1.360	1997	1.500	2266	1.640	2568
1.365	2006	1.505	2276	1.645	2579
1.370	2016	1.510	2286	1.650	2591
1.375	2025	1.515	2296	1.655	2602
1.380	2034	1.520	2307	1.660	2614
1.385	2043	1.525	2317	1.665	2626
1.390	2052	1.530	2327	1.670	2637
1.395	2062	1.535	2338	1.675	2649
1.400	2071	1.540	2348	1.680	2661
1.405	2080	1.545	2359	1.685	2673
1.410	2090	1.550	2370	1.690	2685
1.415	2099	1.555	2380	1.695	2697
1.420	2108	1.560	2391	<sup>3/</sup> 1.700	2709
1.425	2118	1.565	2402	1.705	2721
1.430	2128	1.570	2412	1.710	2733
1.435	2137	1.575	2423	1.715	2745
1.440	2147	1.580	2434	1.720	2757
1.445	2156	1.585	2445	1.725	2770
1.450	2166	1.590	2456	1.730	2782
1.455	2176	1.595	2467	1.735	2794
1.460	2186	1.600	2478	1.740	2807
1.465	2196	1.605	2489	1.745	2819
1.470	2205	1.610	2500	1.750	2832
1.475	2215	1.615	2511		
1.480	2225	1.620	2522		

<sup>1/</sup> FSP denotes fragment simulating projectile.

<sup>2/</sup> Spec. requirements for this test start at ordered thickness of 1.101 inches. Interpolation is done to determine the requirement for thickness between 1.031 and 1.350 inches.

<sup>3/</sup> Spec. requirements for this test end at ordered thickness of 1.700 inches.

NOTE: Numbers above (see footnote <sup>3/</sup>) are requirements for oversize forgings.

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TABLE VII. Minimum ballistic limits (protection at 0° obliquity) for type I, class A material using .30 Caliber AP, M2.<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
1.031	1814				
<sup>2/</sup> 1.101	1880	1.485	2245	1.620	2367
1.350	2115	1.490	2249	1.625	2371
1.355	2120	1.495	2254	1.630	2375
1.360	2125	1.500	2259	1.635	2379
1.365	2129	1.505	2263	1.640	2384
1.370	2134	1.510	2267	1.645	2388
1.375	2140	1.515	2272	1.650	2393
1.380	2145	1.520	2276	1.655	2397
1.385	2150	1.525	2281	1.660	2401
1.390	2154	1.530	2286	1.665	2406
1.395	2159	1.535	2291	1.670	2410
1.400	2164	1.540	2296	1.675	2415
1.405	2169	1.545	2300	1.680	2419
1.410	2174	1.550	2305	1.685	2423
1.415	2178	1.555	2309	1.690	2427
1.420	2183	1.560	2313	1.695	2432
1.425	2188	1.565	2318	<sup>3/</sup> 1.700	2436
1.430	2193	1.570	2323	1.705	2440
1.435	2198	1.575	2327	1.710	2445
1.440	2202	1.580	2332	1.715	2449
1.445	2207	1.585	2336	1.720	2453
1.450	2211	1.590	2341	1.725	2457
1.455	2216	1.595	2345	1.730	2462
1.460	2221	1.600	2350	1.735	2467
1.465	2226	1.605	2354	1.740	2471
1.470	2231	1.610	2359	1.745	2475
1.475	2235	1.615	2363	1.750	2479
1.480	2240				

<sup>1/</sup> AP, M2 denotes armor piercing model 2 projectile.

<sup>2/</sup> Spec. requirements for this test start at ordered thickness of 1.101 inches. Interpolation is done to determine the requirement for thickness between 1.031 and 1.350 inches.

<sup>3/</sup> Spec. requirements for this test end at ordered thickness of 1.700 inches.

NOTE: Numbers above (see footnote <sup>3/</sup>) are requirements for oversize forgings.

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TABLE VIII. Minimum ballistic limits (protection at 0° obliquity) for type I, class A material using caliber .50 AP, M2 projectile.<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
1.675	1808	1.875	1968	2.080	2100
1.680	1812	1.880	1972	2.085	2102
1.685	1816	1.885	1976	2.090	2105
1.690	1820	1.890	1980	2.095	2108
1.695	1824	1.895	1984	2.100	2111
1.700	1828	1.900	1988	2.105	2114
<sup>2/</sup> 1.701	1829	1.905	1991	2.110	2116
1.705	1832	1.910	1995	2.115	2119
1.710	1836	1.915	1999	2.120	2122
1.715	1840	1.920	2003	2.125	2125
1.720	1844	1.925	2007	2.130	2127
1.725	1848	1.930	2011	2.135	2130
1.730	1852	1.935	2015	2.140	2133
1.735	1856	1.940	2019	2.145	2136
1.740	1860	1.945	2023	2.150	2138
1.745	1864	1.950	2027	2.155	2141
1.750	1868	1.955	2030	2.160	2144
1.755	1872	1.960	2032	2.165	2147
1.760	1876	1.965	2035	2.170	2149
1.765	1880	1.970	2038	2.175	2152
1.770	1884	1.975	2041	2.180	2155
1.775	1888	1.980	2043	2.185	2158
1.780	1892	1.985	2046	2.190	2160
1.785	1896	1.990	2049	2.195	2163
1.790	1900	1.995	2052	2.200	2166
1.795	1904	2.000	2054	2.205	2168
1.800	1908	2.005	2057	2.210	2171
1.805	1912	2.010	2060	2.215	2174
1.810	1916	2.015	2063	2.220	2176
1.815	1920	2.020	2066	2.225	2179
1.820	1924	2.025	2069	2.230	2182
1.825	1928	2.030	2072	2.235	2184
1.830	1932	2.035	2074	2.240	2187
1.835	1936	2.040	2077	2.245	2190
1.840	1940	2.045	2080	2.250	2193
1.845	1944	2.050	2083	2.255	2195
1.850	1948	2.055	2086	2.260	2198
1.855	1952	2.060	2088	2.265	2201
1.860	1956	2.065	2091	2.270	2203
1.865	1960	2.070	2094	2.275	2206
1.870	1964	2.075	2097	2.280	2209

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TABLE VIII. Minimum ballistic limits (protection at 0° obliquity) for type I, class A material using caliber .50 AP, M2 projectile (cont'd).<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
2.285	2211	2.495	2248	2.705	2363
2.290	2214	2.500	2250	2.710	2366
2.295	2217	2.505	2253	2.715	2369
<sup>3/</sup> 2.300	2217	2.510	2256	2.720	2371
2.305	2217	2.515	2259	2.725	2374
2.310	2217	2.520	2261	2.730	2377
2.315	2217	2.525	2264	2.735	2380
2.320	2217	2.530	2267	2.740	2382
2.325	2217	2.535	2270	2.745	2385
2.330	2217	2.540	2272	2.750	2388
2.335	2217	2.545	2275	2.755	2391
2.340	2217	2.550	2278	2.760	2393
2.345	2217	2.555	2281	2.765	2396
2.350	2217	2.560	2283	2.770	2399
2.355	2217	2.565	2286	2.775	2402
2.360	2217	2.570	2289	2.780	2404
2.365	2217	2.575	2292	2.785	2407
2.370	2217	2.580	2294	2.790	2410
2.375	2217	2.585	2297	2.795	2413
2.380	2217	2.590	2300	2.800	2415
2.385	2217	2.595	2303	2.805	2418
2.390	2217	2.600	2305	2.810	2421
2.395	2217	2.605	2308	2.815	2424
2.400	2217	2.610	2311	2.820	2426
2.405	2217	2.615	2314	2.825	2429
2.410	2217	2.620	2316	2.830	2432
2.415	2217	2.625	2319	2.835	2435
2.420	2217	2.630	2322	2.840	2437
2.425	2217	2.635	2325	2.845	2440
2.430	2217	2.640	2327	2.850	2443
2.435	2217	2.645	2330	2.855	2446
2.440	2217	2.650	2333	2.860	2448
2.445	2220	2.655	2336	2.865	2451
2.450	2223	2.660	2338	2.870	2454
2.455	2226	2.665	2341	2.875	2457
2.460	2228	2.670	2344	2.880	2459
2.465	2231	2.675	2347	2.885	2462
2.470	2234	2.680	2349	2.890	2465
2.475	2237	2.685	2352	2.895	2468
2.480	2239	2.690	2355	2.900	2470
2.485	2242	2.695	2358	2.905	2473
2.490	2245	2.700	2360	2.910	2476

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TABLE VIII. Minimum ballistic limits (protection at 0° obliquity) for type I, class A material using caliber .50 AP, M2 projectile (cont'd).<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
2.915	2479	2.980	2514	3.045	2550
2.920	2481	2.985	2317	3.050	2553
2.925	2484	2.990	2520	3.055	2556
2.930	2487	2.995	2523	3.060	2558
2.935	2490	<sup>4/</sup> 3.000	2525	3.065	2561
2.940	2492	3.005	2528	3.070	2564
2.945	2495	3.010	2531	3.075	2567
2.950	2498	3.015	2534	3.080	2569
2.955	2501	3.020	2536	3.085	2572
2.960	2503	3.025	2539	3.090	2575
2.965	2506	3.030	2542	3.095	2578
2.970	2509	3.035	2545	3.100	2580
2.975	2512	3.040	2547		

<sup>1/</sup> AP, M2 denotes armor piercing model 2 projectile.

<sup>2/</sup> Spec. requirements for this test start at ordered thickness 1.701 inches.

<sup>3/</sup> Ballistic limit requirements have not been developed over this 0.145 inch thickness range of 2.300 inches to 2.445 inches.

<sup>4/</sup> Spec. requirements for this test end at ordered thickness 3.000 inches.

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TABLE IX. Minimum ballistic limits (protection at 0° obliquity) for type I, class B material and type II material using a caliber .50 FSP.<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
0.700	1550	0.815	1996	0.930	2560
.705	1567	.820	2018	.935	2587
.710	1584	.825	2040	.940	2615
.715	1602	.830	2063	.945	2643
.720	1620	.835	2085	.950	2672
.725	1638	.840	2108	.955	2700
.730	1656	.845	2131	.960	2730
.735	1675	.850	2154	.965	2759
.740	1693	.855	2178	.970	2788
.745	1712	.860	2201	.975	2818
<sup>2/</sup> .750	1731	.865	2225	.980	2849
.755	1750	.870	2249	.985	2879
.760	1770	.875	2274	.990	2910
.765	1789	.880	2299	.995	2941
.770	1809	.885	2324	1.000	2972
.775	1829	.890	2349	1.005	3004
.780	1849	.895	2374	1.010	3036
.785	1870	.900	2400	1.015	3069
.790	1890	.905	2426	1.020	3102
.795	1911	.910	2452	1.025	3135
.800	1932	.915	2479	<sup>3/</sup> 1.030	3168
.805	1953	.920	2505	1.035	3202
.810	1975	.925	2532	1.040	3236
				1.045	3270

<sup>1/</sup> FSP denotes fragment simulating projectile.

<sup>2/</sup> Spec. requirements for this test end at ordered thickness of 0.750 inches.

<sup>3/</sup> Spec. requirements for this test end at ordered thickness of 1.030 inches.

NOTE: Thickness less than (see footnote <sup>2/</sup>) and greater than (see footnote <sup>3/</sup>) is a requirement for undersize or oversize forgings.

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TABLE X. Minimum ballistic limits (protection at 0° obliquity) for type I, class B material and type II material using a 20 mm FSP.<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
1.000	1401	1.175	1694	1.355	2054
1.005	1409	1.180	1703	1.360	2065
1.010	1416	1.185	1712	1.365	2075
1.015	1424	1.190	1721	1.370	2087
1.020	1432	1.195	1731	1.375	2098
1.025	1440	1.200	1740	1.380	2109
1.030	1447	1.205	1749	1.385	2120
<sup>2/</sup> 1.031	1449	1.210	1758	1.390	2131
1.035	1455	1.215	1768	1.395	2142
1.040	1463	1.220	1778	1.400	2154
1.045	1471	1.225	1787	1.405	2165
1.050	1479	1.230	1797	1.410	2177
1.055	1487	1.235	1807	1.415	2189
1.060	1495	1.240	1816	1.420	2200
1.065	1504	1.245	1826	1.425	2212
1.070	1512	1.250	1836	1.430	2224
1.075	1520	1.255	1846	1.435	2235
1.080	1528	1.260	1855	1.440	2247
1.085	1537	1.265	1865	1.445	2259
1.090	1545	1.270	1875	1.450	2271
1.095	1553	1.275	1885	1.455	2283
1.100	1562	1.280	1896	1.460	2295
1.105	1570	1.285	1906	1.465	2308
1.110	1579	1.290	1916	1.470	2320
1.115	1587	1.295	1926	1.475	2332
1.120	1596	1.300	1937	1.480	2345
1.125	1605	1.305	1947	1.485	2357
1.130	1613	1.310	1957	1.490	2369
1.135	1622	1.315	1968	1.495	2382
1.140	1631	1.320	1978	<sup>3/</sup> 1.500	2395
1.145	1640	1.325	1989	1.505	2407
1.150	1649	1.330	2000	1.510	2420
1.155	1658	1.335	2010	1.515	2433
1.160	1666	1.340	2021	1.520	2446
1.165	1675	1.345	2032	1.525	2459
1.170	1685	1.350	2043	1.530	2471

<sup>1/</sup> FSP denotes fragment simulating projectile.<sup>2/</sup> Spec. requirements for this test start at ordered thickness of 1.031 inches.<sup>3/</sup> Spec. requirements for this test end at ordered thickness of 1.500 inches.NOTE: Thickness less than (see footnote <sup>2/</sup>) and greater than (see footnote <sup>3/</sup>) is a requirement for undersize or oversize forgings.

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TABLE XI. Minimum ballistic limits (protection at 0° obliquity) for type I, class B material and type II material using a caliber .30 AP, M2 projectile.<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
1.000	2046	1.185	2261	1.370	2458
1.005	2052	1.190	2266	1.375	2463
1.010	2058	1.195	2272	1.380	2468
1.015	2064	1.200	2277	1.385	2473
1.020	2070	1.205	2283	1.390	2478
1.025	2076	1.210	2288	1.395	2483
1.030	2082	1.215	2294	1.400	2488
<sup>2/</sup> 1.031	2083	1.220	2299	1.405	2493
1.035	2088	1.225	2305	1.410	2498
1.040	2094	1.230	2310	1.415	2503
1.045	2100	1.235	2316	1.420	2508
1.050	2106	1.240	2321	1.425	2513
1.055	2112	1.245	2326	1.430	2518
1.060	2118	1.250	2332	1.435	2523
1.065	2124	1.255	2337	1.440	2528
1.070	2130	1.260	2343	1.445	2533
1.075	2136	1.265	2348	1.450	2538
1.080	2141	1.270	2353	1.455	2543
1.085	2147	1.275	2359	1.460	2548
1.090	2153	1.280	2364	1.465	2553
1.095	2159	1.285	2369	1.470	2558
1.100	2165	1.290	2375	1.475	2563
1.105	2171	1.295	2380	1.480	2568
1.110	2176	1.300	2385	1.485	2573
1.115	2182	1.305	2390	1.490	2577
1.120	2188	1.310	2395	1.495	2582
1.125	2193	1.315	2401	<sup>3/</sup> 1.500	2587
1.130	2199	1.320	2406	1.505	2592
1.135	2205	1.325	2411	1.510	2597
1.140	2210	1.330	2416	1.515	2602
1.145	2216	1.335	2422	1.520	2607
1.150	2222	1.340	2427	1.525	2612
1.155	2227	1.345	2432	1.530	2616
1.160	2233	1.350	2437	1.535	2621
1.165	2239	1.355	2442	1.540	2626
1.170	2244	1.360	2447	1.545	2631
1.175	2250	1.365	2452	1.550	2635
1.180	2255				

<sup>1/</sup> AP, M2 denotes armor piercing model 2 projectile.

<sup>2/</sup> Spec. requirements for this test start at ordered thickness of 1.031 inches.

<sup>3/</sup> Spec. requirements for this test end at ordered thickness of 1.500 inches.

NOTE: Thickness less than (see footnote <sup>2/</sup>) and greater than (see footnote <sup>3/</sup>) is a requirement for undersize or oversize forgings.

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TABLE XII. Minimum ballistic limits (protection at 0° obliquity)  
for type I, class B material and type II material using a  
caliber .50 AP, M2 projectile.<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
1.450	1921	1.620	2060	1.795	2194
1.455	1925	1.625	2064	1.800	2198
1.460	1929	1.630	2068	1.805	2201
1.465	1933	1.635	2072	1.810	2205
1.470	1938	1.640	2075	1.815	2209
1.475	1942	1.645	2079	1.820	2212
1.480	1946	1.650	2083	1.825	2216
1.485	1950	1.655	2087	1.830	2220
1.490	1954	1.660	2091	1.835	2223
1.495	1958	1.665	2095	1.840	2227
1.500	1962	1.670	2099	1.845	2231
<sup>2/</sup> 1.501	1963	1.675	2103	1.850	2234
1.505	1967	1.680	2107	1.855	2238
1.510	1971	1.685	2110	1.860	2242
1.515	1975	1.690	2114	1.865	2245
1.520	1979	1.695	2118	1.870	2249
1.525	1983	1.700	2122	1.875	2253
1.530	1987	1.705	2136	1.880	2256
1.535	1991	1.710	2130	1.885	2260
1.540	1995	1.715	2134	1.890	2263
1.545	2000	1.720	2137	1.895	2267
1.550	2004	1.725	2141	1.900	2271
1.555	2008	1.730	2145	1.905	2274
1.560	2012	1.735	2149	1.910	2278
1.565	2016	1.740	2153	1.915	2281
1.570	2020	1.745	2157	1.920	2285
1.575	2024	1.750	2160	1.925	2289
1.580	2028	1.755	2164	1.930	2292
1.585	2032	1.760	2168	1.935	2296
1.590	2036	1.765	2171	1.940	2299
1.595	2040	1.770	2175	1.945	2303
1.600	2044	1.775	2179	1.950	2306
1.605	2048	1.780	2183	1.955	2310
1.610	2052	1.785	2186	1.960	2313
1.615	2056	1.790	2190	1.965	2317

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TABLE XII. Minimum ballistic limits (protection at 0° obliquity)  
for type I, class B material and type II material using a  
caliber .50 AP, M2 projectile (cont'd).<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
1.970	2320	2.165	2454	2.360	2581
1.975	2324	2.170	2457	2.365	2584
1.980	2328	2.175	2461	2.370	2587
1.985	2331	2.180	2464	2.375	2590
1.990	2334	2.185	2467	2.380	2594
1.995	2338	2.190	2471	2.385	2597
2.000	2342	2.195	2474	2.390	2600
2.005	2345	2.200	2477	2.395	2603
2.010	2349	2.205	2481	2.400	2606
2.015	2352	2.210	2484	2.405	2609
2.020	2355	2.215	2487	2.410	2612
2.025	2359	2.220	2491	2.415	2616
2.030	2362	2.225	2494	2.420	2619
2.035	2366	2.230	2497	2.425	2622
2.040	2369	2.235	2500	2.430	2625
2.045	2373	2.240	2504	2.435	2628
2.050	2376	2.245	2507	2.440	2631
2.055	2380	2.250	2510	2.445	2634
2.060	2383	2.255	2513	2.450	2638
2.065	2386	2.260	2517	2.455	2641
2.070	2390	2.265	2520	2.460	2644
2.075	2393	2.270	2523	2.465	2647
2.080	2397	2.275	2526	2.470	2650
2.085	2400	2.280	2530	2.475	2653
2.090	2404	2.285	2533	2.480	2656
2.095	2407	2.290	2536	2.485	2659
2.100	2410	2.295	2539	2.490	2662
2.105	2414	2.300	2542	2.495	2665
2.110	2417	2.305	2546	2.500	2668
2.115	2420	2.310	2549	2.505	2672
2.120	2424	2.315	2552	2.510	2675
2.125	2427	2.320	2555	2.515	2678
2.130	2431	2.325	2559	2.520	2681
2.135	2434	2.330	2562	2.525	2684
2.140	2437	2.335	2565	2.530	2687
2.145	2441	2.340	2568	2.535	2690
2.150	2444	2.345	2571	2.540	2693
2.155	2447	2.350	2575	2.545	2696
2.160	2451	2.355	2578	2.550	2699

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TABLE XII. Minimum ballistic limits (protection at 0° obliquity)  
for type I, class B material and type II material using a  
caliber .50 AP, M2 projectile (cont'd).<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
2.555	2702	2.715	2798	2.875	2890
2.560	2705	2.720	2800	2.880	2893
2.565	2708	2.725	2803	2.885	2896
2.570	2711	2.730	2806	2.890	2898
2.575	2714	2.735	2809	2.895	2901
2.580	2717	2.740	2812	2.900	2904
2.585	2720	2.745	2815	2.905	2907
2.590	2723	2.750	2818	2.910	2910
2.595	2726	2.755	2821	2.915	2913
2.600	2729	2.760	2824	2.920	2915
2.605	2732	2.765	2827	2.925	2918
2.610	2735	2.770	2830	2.930	2921
2.615	2738	2.775	2832	2.935	2924
2.620	2741	2.780	2835	2.940	2927
2.625	2744	2.785	2838	2.945	2930
2.630	2747	2.790	2841	2.950	2932
2.635	2750	2.795	2844	2.955	2935
2.640	2753	2.800	2847	2.960	2938
2.645	2756	2.805	2850	2.965	2941
2.650	2759	2.810	2853	2.970	2944
2.655	2762	2.815	2856	2.975	2946
2.660	2765	2.820	2858	2.980	2949
2.665	2768	2.825	2861	2.985	2952
2.570	2771	2.830	2864	2.990	2954
2.675	2774	2.835	2867	2.995	2957
2.680	2777	2.840	2870	<sup>3/</sup> 3.000	2960
2.685	2780	2.845	2873	3.005	2963
2.690	2783	2.850	2876	3.010	2966
2.695	2786	2.855	2879	3.015	2969
2.700	2789	2.860	2881	3.020	2972
2.705	2792	2.865	2884	3.025	2975
2.710	2795	2.870	2887	3.030	2978

<sup>1/</sup> AP, M2 denotes armor piercing model 2 projectile.

<sup>2/</sup> Spec. requirements for this test start at ordered thickness of 1.501 inches.

<sup>3/</sup> Spec. requirements for this test end at ordered thickness of 3.000 inches.

NOTE: Thickness less than (see footnote <sup>2/</sup>) and greater than (see footnote <sup>3/</sup>) is a requirement for undersize or oversize forgings.

## MIL-DTL-45225F(MR)

TABLE XIII. Minimum ballistic limits (protection at 0° obliquity)  
for type I, class B material and type II material using a  
caliber .57 AP projectile.<sup>1/</sup>

Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps	Thickness, inches	Required BL(P)fps
2.900	2655	3.075	2774	3.250	2890
2.905	2659	3.080	2778	3.255	2894
2.910	2662	3.085	2781	3.260	2897
2.915	2666	3.090	2784	3.265	2900
2.920	2669	3.095	2788	3.270	2904
2.925	2673	3.100	2791	3.275	2907
2.930	2676	3.105	2794	3.280	2910
2.935	2680	3.110	2797	3.285	2914
2.940	2683	3.115	2801	3.290	2917
2.945	2687	3.120	2804	3.295	2920
2.950	2690	3.125	2807	3.300	2924
2.955	2694	3.130	2811	3.305	2927
2.960	2697	3.135	2814	3.310	2930
2.965	2701	3.140	2817	3.315	2934
2.970	2704	3.145	2821	3.320	2937
2.975	2708	3.150	2824	3.325	2940
2.980	2711	3.155	2827	3.330	2944
2.985	2715	3.160	2830	3.335	2947
2.990	2718	3.165	2834	3.340	2950
2.995	2722	3.170	2837	3.345	2954
3.000	2725	3.175	2840	3.350	2957
<sup>2/</sup> 3.001	2726	3.180	2844	3.355	2960
3.005	2728	3.185	2847	3.360	2964
3.010	2731	3.190	2850	3.365	2967
3.015	2735	3.195	2854	3.370	2970
3.020	2738	3.200	2857	3.375	2974
3.025	2741	3.205	2860	3.380	2977
3.030	2745	3.210	2864	3.385	2980
3.035	2748	3.215	2867	3.390	2984
3.040	2751	3.220	2870	3.395	2987
3.045	2755	3.225	2874	3.400	2990
3.050	2758	3.230	2877	3.405	2994
3.055	2761	3.235	2880	3.410	2997
3.060	2765	3.240	2884	3.415	3000
3.065	2768	3.245	2887	3.420	3004
3.070	2771			<sup>3/</sup> 3.425	3007

<sup>1/</sup> AP denotes armor piercing projectile.

<sup>2/</sup> Spec. requirements for this test start at ordered thickness of 3.001 inches.

<sup>3/</sup> Spec. requirements for this test end at ordered thickness of 3.425 inches.

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