

INCH-POUND

MIL-A-12560H(MR)
AMENDMENT 3
27 September 2000
SUPERSEDING
AMENDMENT 2
26 July 1991

MILITARY SPECIFICATION

ARMOR PLATE, STEEL, WROUGHT, HOMOGENEOUS
(FOR USE IN COMBAT-VEHICLES AND FOR AMMUNITION TESTING)

This amendment forms a part of MIL-A-12560H(MR), dated 28 November 1990, and is approved for use by the Army Research Laboratory, Department of the Army and is available for use by all Departments and Agencies of the Department of Defense.

PAGE 1

* 1.2, first sentence: Delete "shall" and substitute "should."

* Add as new paragraphs:

"1.2.4 Class 4. Wrought armor plate which is heat treated to higher hardness levels than class 1 armor plate to develop maximum resistance to penetration."

"1.2.5 Class 4a. Wrought armor plate tempered to attain a minimum through hardness of HRC 47 (BHN 442)."

"1.2.6 Class 4b. Wrought armor plate tempered to attain a maximum through hardness of HRC 41 (BHN 381)."

PAGE 2

* 2.2: Add two non-Government Standard reference documents.

* Add the following to the list of ASTM references:
"ASTM E 140 Standard Hardness Conversion Tables for Metals"

Add the following after the parenthetical source statement below the ASTM address:

"SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE J406 — Methods of Determining Hardenability of Steels

(Applications for copies should be addressed to Aerospace Material Specifications, 400 Commonwealth Drive, Warrendale, PA 15096)."

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PAGE 3

* Add as new paragraph:

"3.2.2.1 Hardenability index (class 4 armor plate). An average hardenability index (D_I) shall be calculated for class 4 armor plate (see 6.1.4). This D_I calculation method utilizes a series of hadenability factors for each alloying element in the composition (see SAE J406).

* 3.2.3: Add the following at the end of the paragraph: "Class 4 armor plate shall be heat treated to higher hardness levels than class 1 armor plate to develop maximum resistance to penetration."

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* Add new paragraph

"3.2.5.1.1 Class 4 armor plate. "Surface hardness is required on every plate to insure quality and uniformity of product. In addition, first article samples must be tested for through hardness to verify that they are within the HB range specified in 1.2.5 and 1.2.6. Respective diameters of the Brinell hardness impression taken on an individual plate shall not vary by more than 0.15mm. Each lot shall be tested for through hardness. Acceptance for Class 4a material requires a minimum through hardness of HRC 47 (HB 442). Acceptance for class 4b material requires a maximum through hardness HRC 41 (HB 381)."

3.2.5.2: Add the following at the end of the paragraph:

"The Charpy value for class 4 armor plate shall be greater than 20 ft•lb (27 J)for all thickness."

* 3.2.6: Delete and substitute:

"3.2.6 Ballistic requirements. Ballistic requirements for class 1, 3 and 4 wrought homogeneous armor plate shall be in accordance with the appendix of this specification. Class 2 armor plate shall not be subject to ballistic test requirements. When a complete penetration can not be obtained for either class 1 or class 4 armor material, the following rule shall be in effect until a new ballistic acceptance round can be utilized. When four (4) partial penetrations are above the minimum requirement for the specific thickness, the material shall be certified as acceptable with a V_{50} (which obviously can not be specified) above the minimum requirement."

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* Table IV, title: After "Class 1" insert "and class 4."

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4.4.2.4: Change the first sentence to read: "All plates $\frac{1}{2}$ inch and greater in thickness shall be examined ultrasonically."

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PAGE 16

- * 4.6.2.1 Hardness tests on impact test specimens. Insert after the paragraph title the following sentence:

"Samples for all classifications shall be examined on a lot by lot basis."

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- 4.6.5.2: Subparagraph (d): Change the last sentence to read:
"All discontinuities shall be evaluated using a frequency of 2.25 megahertz (MHz)."

PAGE 19

- * 6.1, line 2: After "and" insert "/or."
- * 6.1, line 3: Delete "may" and substitute "should."
- * Add as new paragraph:

"6.1.4 Class 4. Provision for this new class 4 type of armor plate is the result of an Army Research Laboratory (ARL) Research & Development (R&D) Program. The information related to this study was published in a Technical Report, ARL-TR-1347 dated April 1997, entitled Improved Rolled Homogeneous Armor (IRHA) Steel Through Higher Hardness ^{1/}. The R&D study illustrated enhanced ballistic performance with the use of increased hardness levels for maintaining tougher and more ductile characteristics. This new classification was developed to use in combat vehicles (3/4" to 6") and tank construction. Class 4 material provides higher ballistic protection than class 1 material against conventional hard steel core AP projectiles, such as, the 0.50 cal, APM2. Class 4 material also provides greater ballistic protection than class 1 material against very hard and brittle tungsten carbide penetrators, such as, the 20 mm API M602. In semi-infinite or appliqué-type armor configurations, class 4 material erodes heavy metal (DU or tungsten alloys) long-rod penetrators more efficiently than class 1 material. Approximately 22% and 14% less penetration was observed on this class 4 armor at HRC 48 (HBN 451) and HRC 40 (BHN 371), respectively in the ARL R&D study."

PAGE 26

- * APPENDIX 40.1.2 (b), line 2. There is a typographical error in line 2.
Delete "2.7.5.1 inches" and substitute "2.751 inches".

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The attached insertable replacement pages listed below are replacements for stipulated pages. When the new pages have been entered in the document, insert the amendment as the cover sheet to the specification.

<u>Replacement page</u>	<u>Page replaced</u>
7	Reprinted without change
8	8

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

Custodian:
Army - MR

Preparing activity:
Army - MR

Review activities:
Army - AR, AT, AV, TE
DLA - IS

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plate hardness makes painting necessary. All plate markings shall be highlighted with a highly visible yellow or orange border such as fluorescent paint or highlighted with a special white paint intended to delineate and highlight stamping. The primary plate rolling direction shall be identified. Manufacturers supplying armor to be used for proving ground testing of ammunition are required to:

a. Mark each class 3 plate with one foot square blocks showing thickness at the center of each block. The acceptance of each plate will be based on these measurements meeting the thickness requirements set forth in table V.

b. Stamp each plate "HOMO, CLASS 3, MIL-A-12560, plate No. , heat No. ." Stamping shall be approximately 1/2 inch high letters to a depth approximately 1/16 inch. Location of stamping for all plates will be in the upper right hand corner.

3.2.9 Information required. A statement showing the product analysis of each melt and complete details of the heat treatment of each lot shall be furnished for the files of the procuring activity. All elements of the chemical composition shall be shown in the statement, including special additives or hardening agents, whether shown in table I or not.

3.2.10 Workmanship.

3.2.10.1 Surface imperfections. The top and bottom surface of each plate shall be free from the following surface defects: slivers, laps, checks, seams, blisters, snakes, cold shuts, cracks, burning, and laminations (see 6.4). The surface of each plate shall be such that mill scale or oxidation product shall not interfere with determination of acceptability. Imperfections listed above which are of such a nature as to affect the fabrication of the material, are causes for rejection.

3.2.10.1.1 Depth of imperfections. The depth of rolled-in scale, scale pitting, mechanical gouges, or snakes shall not exceed 0.015 inch and shall not reduce the steel thickness below the allowable minimum. Isolated individual pits over 0.015 inch deep but not over 0.03 inch deep and not within 6 inches of each other and which do not violate the minimum allowable thickness, as specified in the applicable drawings and fabrication documents, are acceptable.

3.2.10.2 Edge preparation. Thermal cutting shall be permitted after final heat treatment provided the procedure, which may include grinding after thermal cutting, is such that no cracks develop on any thermally cut edge whether detected by nondestructive inspection, or as agreed upon in the contract. The heat affected zone of thermally cut plates (up to and including 1/2-inch in thickness) shall not exceed 1.2 times the plates thickness from the cut edge. For plates over 1/2-inch thick, the heat affected zone shall not exceed 5/8-inch from the cut edge. In order to have the heat affected zone exceed these limits approval shall be obtained from the procuring activity.

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TABLE III. Thickness tolerances for Class 1 and Class 2 armor plates up to 2" thick inclusive.

Thickness tolerances in inches over and under ordered thickness $\frac{1}{2}$ for a single plate 2 inches and under in thickness $\frac{2}{2}$

Tolerances over and under ordered thickness for widths given											
Specified Thickness Inches	to 60"	60" to 72" excl.	72" to 84" excl.	84" to 96" excl.	96" to 108" excl.	108" to 120" excl.	120" to 132" excl.	132" to 144" excl.	144" to 168" excl.	168" to 182" excl.	182" and over
$\frac{1}{4}$	$\frac{2}{2}$.016	.016	.019	.019	.023	----	----	----	----	----
$\frac{5}{16}$.016	.019	.019	.019	.023	.026	----	----	----	----
$\frac{3}{8}$.016	.019	.019	.023	.023	.026	----	----	----	----
$\frac{7}{16}$.016	.019	.019	.023	.026	.026	.031	----	----	----
$\frac{1}{2}$.016	.016	.019	.019	.023	.026	.031	.036	----	----
$\frac{9}{16}$.019	.019	.019	.023	.026	.031	.031	.036	----	----
$\frac{5}{8}$.019	.019	.019	.023	.026	.031	.031	.036	----	----
$\frac{11}{16}$.019	.019	.019	.023	.026	.031	.031	.036	----	----
$\frac{3}{4}$.019	.019	.023	.023	.026	.031	.039	.043	----	----
$\frac{13}{16}$.023	.023	.023	.026	.031	.031	.039	.043	----	----
$\frac{7}{8}$.023	.023	.026	.026	.031	.036	.039	.043	----	----
$\frac{15}{16}$.023	.023	.026	.026	.031	.036	.043	.048	----	----
1		.026	.026	.026	.026	.026	.031	.036	.048	----	----
1- $\frac{1}{16}$.026	.026	.026	.031	.031	.036	.043	.048	----	----
1- $\frac{1}{8}$.026	.026	.026	.031	.031	.039	.043	.048	----	----
1- $\frac{3}{16}$.031	.031	.031	.031	.036	.043	.048	.053	----	----
1- $\frac{1}{4}$.031	.031	.031	.036	.036	.043	.048	.053	----	----
1- $\frac{5}{16}$.031	.031	.031	.036	.036	.043	.053	.058	----	----
1- $\frac{3}{8}$.031	.031	.031	.036	.039	.048	.053	.058	----	----
1- $\frac{7}{16}$.036	.036	.036	.036	.043	.048	.058	.063	----	----
1- $\frac{1}{2}$.036	.036	.036	.039	.043	.048	.058	.063	----	----
1- $\frac{9}{16}$.036	.036	.036	.039	.043	.053	.058	.070	----	----
1- $\frac{5}{8}$.036	.036	.036	.043	.048	.053	.063	.070	----	----
1- $\frac{11}{16}$.039	.039	.039	.043	.048	.058	.063	.070	----	----
1- $\frac{3}{4}$.039	.039	.039	.043	.048	.058	.068	.078	----	----
1- $\frac{13}{16}$.043	.043	.043	.048	.053	.058	.068	.078	----	----
1- $\frac{7}{8}$.043	.043	.043	.048	.053	.063	.068	.078	----	----
1- $\frac{15}{16}$.043	.043	.043	.048	.053	.063	.076	.084	----	----
2		.043	.043	.043	.048	.053	.063	.076	.084	----	----

$\frac{1}{2}$ For intermediate thickness, the tolerance of the closer specified gage shall apply. In case of mid-point, the tolerance for lower gage or interpolated value shall apply.

$\frac{2}{2}$ When plates under 60" are rolled double width, the equivalent wider plate tolerances shall apply.