MIL-A-62473A(AT)
30 March 1984
SUPERSEDING
MIL-A-62473(AT)
24 January 1984

MILITARY SPECIFICATION

ARMOR: ALUMINUM-ARAMID, LAMINATE-COMPOSITE

This specification is approved for use by US Army Tank-Automotive Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the bonding of an aluminum plate to an aramid laminate pad to form a composite armor plate.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

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 Command, ATTN: DRSTA-GSS, Warren, MI 48090, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

FSC 9535

SPECIFICATIONS
MILITARY

MIL-C-5541	- Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
MIL-S-8802	- Sealing Compound, Temperature-Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion.
MIL-P-23377	- Primer Coating, Epoxy-Polyamide, Chemical and Solvent Resistant.
MIL-A-46027	- Armor Plate, Aluminum Alloy, Weldable 5083 and 5456.
MIL-P-46593	- Projectile: Calibers, .22, .30, .50, and 20mm, Fragment Simulating.
MIL-L-62474(AT)	- Laminate: Aramid-Fabric-Reinforced, Plastic.

STANDARDS
MILITARY

MIL-STD-662	- Ballistic Acceptance Test Method for Personal Armor Material.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article. Unless otherwise specified, the contractor shall furnish test-size armor plates (see 3.3.2) which shall be subjected to first article inspection (see 4.3). First article inspection samples, properly marked with identifying information shall be representative of the units to be furnished to the Government. All subsequent armor plates delivered to the Government shall conform to these samples in all of their pertinent physical and performance attributes. Any change in the type or manufacturer of the bonding agent or change in the method of bonding shall require a resubmittal of the first article.

3.2 Materials. Materials shall be as specified herein and in referenced specifications, standards and drawings. Materials shall be free of defects which adversely affect performance or serviceability of the finished product (see 4.1.1).

3.2.1 Qualified products. The contractor shall be responsible for using materials from Qualified Products Lists (QPLs) where applicable. Contractor's inspection records shall specifically list all QPL items by number and date of the QPL, name of supplier and part or drawing number(s). When materials are approved as qualified products, but not yet listed on the QPL, the contractor shall list the products by number and date of the approved document and name of supplier(s) (see 4.1.1).

3.2.2 Aluminum component. The aluminum component of the armor plate shall be aluminum alloy 5083 conforming to MIL-A-46027 (see 4.1.1).

3.2.3 Aramid laminate component. The aramid fabric-reinforced plastic laminate component of the armor plate shall conform to MIL-L-62474(AT) (see 4.1.1).

3.2.4 Bonding agent. The sealing compound used to bond the aluminum component to the aramid laminate component shall conform to type I or II, class B-2 of MIL-S-8802 (see 4.1.1).

3.3 Construction (fabrication).

3.3.1 Aluminum plate surface preparation. All surfaces of the aluminum alloy plate shall be thoroughly cleaned to remove all traces of surface contaminants. Subsequently the plate shall be prepared as follows (see 4.4.3):

a. Sand-blast the bonding surface, or

b. (1) Clean and treat the aluminum plate in accordance with class 1A of MIL-C-5541.

(2) Prime with epoxy conforming to MIL-P-23377. Dry film thickness shall be not less than 0.0010 inch [0.025 millimeters (mm)] and not more than 0.0015 inch (0.038 mm).

3.3.1.1 Cleanliness. After preparation in accordance with 3.3.1, the aluminum plate shall be kept in a dust, dirt and moisture-free environment. The surface to be bonded shall not come in contact with hands or fingers (see 4.4.3).

3.3.2 Component dimensions.

3.3.2.1 Test component dimensions. Components shall be manufactured to the following dimensions (see 4.4.3):

a. Aluminum plate (for test samples)
24 inch x 24 inch (610 x 610 mm) x thickness as specified or applicable drawing or acquisition document.

b. Aramid laminate pad (for test samples)
20 inch x 20 inch (508 mm x 508 mm) x number of plies as specified on applicable drawing or acquisition document.

c. Bonded armor plate (for test samples)
The aramid laminate pad shall be bonded to the aluminum plate so that there is a 2 inch (51 mm) border all around. For the test sample the thickness of the aluminum plate and number of aramid plies shall be as specified on the drawing or order (see 6.2).

3.3.2.2 Production component dimensions. Component dimensions for armor plates produced for delivery under the contract shall be in as specified on the drawing or acquisition document (see 6.2).

3.3.3 Bonding of components.

3.3.3.1 Time element. The aramid laminate pad shall be bonded to the aluminum plate within 24 hours of surface treatment (see 4.4.3).

3.3.3.1.1 Peel-ply removal. The peel-ply is to be removed from the bonding surface of the aramid laminate pad just prior to application of the bonding agent conforming to 3.2.4 (see 4.4.3).

3.3.3.2 Surfaces. Bonding surfaces shall be re-checked for cleanliness prior to application of bonding agent. Either mating surface shall have a uniform thickness, 0.06 inch + 0.03, -0 inch (1.5 mm + 0.76, -0 mm), of the bonding agent applied over the entire area of the bonding surface. The bonding agent shall have been thoroughly mixed in accordance with manufacturer's instructions (see 4.4.3).

3.3.3.3 Mating. The components shall be mated and placed under pressure in a holding device capable of exerting a uniform pressure on the assembly (see 4.4.3).

3.3.3.4 Curing. The mated parts shall be kept under pressure as specified in the applicable drawing in the holding device and cured for not less than 24 hours, in ambient conditions of 77 degrees Fahrenheit (°F) $\pm$ 2°F [25 degrees Celsius (°C)]. Higher temperatures up to 130°F (54°C) may be used to hasten cure, provided ballistic requirements are met (see 3.4.1 and 4.4.3).

3.4 Performance.

3.4.1 Ballistic resistance. The aluminum-aramid composite armor for the thickness and plies indicated shall meet the ballistic requirements of table I (see 4.4.4).

TABLE I. Ballistic requirements.

Minimum Required Ballistic Limits CAL .50 (207 Grains) Fragment Simulating Projectile (FSP) * at 0° Obliquity			
Aluminum-Aramid Composite-Armor Thickness			
Aluminum	Aramid (Plies)	Projectile	V_{50} Protection Ballistic Limit **
0.375 in (9.53 mm)	26	Cal. 50 FSP	2800 FT/Sec (853 m/s)

* In accordance with MIL-P-46593.

** Average of three ballistic limits, each made on a separate composite armor specimen.

3.5 Finished armor. There shall be no visual evidence of improperly bonded areas in the completed product (see 4.4.2.1).

3.6 Workmanship. Workmanship shall be of such quality as to assure that armor plates furnished under the specification are free of defects that compromise, limit, or reduce performance in intended use (see 4.4.2.1).

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 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 Materials. To determine conformance to 3.2 through 3.2.4, inspection and material certification records shall be maintained by the contractor. Records shall be subject to review by the Government and shall include date, part, or characteristic identification, inspection results, and disposition of lot (accepted or rejected). Corrective action taken on noted defects shall be subject to approval by the Government.

4.1.2 Parts and components. Parts, components and assemblies shall be inspected for conformance to requirements of applicable drawings, specifications and standards. When applicable, inspection shall also be in accordance with Quality Assurance Provisions (QAPs).

4.2 Classification of inspection:

a. First article inspection (see 4.3).
b. Quality conformance inspection (see 4.4).
   1. Examination (see 4.4.2).
   2. In-process examination (see 4.4.3).
   3. Control test (see 4.4.4).

4.3 First article inspection. First article inspection shall be performed on preproduction or initial production samples as specified (see 6.2). Approval of the first article sample by the Government shall not relieve the contractor of the obligation to supply armor plates that are fully representative of those inspected as a first article sample. First article inspection shall be carried out on 4 test-size samples having the dimensions specified in 3.3.2. The contractor shall conduct, all in-process examinations as specified in the written application inspection procedure (see 4.4.3), as well as visual examinations for proper workmanship (see 4.4.2.1). The samples will then be forwarded to the test site designated by the acquisitioning activity (see 6.2). The Government will test the samples against the requirements of 3.4.1. Testing shall be in accordance with MIL-STD-662. Any changes or deviation of the production units from the first article sample shall be subject to the approval of the contracting officer.

4.3.1 First article inspection failure. Failure of any first article sample to pass specified examinations or tests shall be cause for refusal by the Government to accept the product or conduct additional inspections until the faults identified have been corrected on all armor plates produced.

4.4 Quality conformance inspection.

4.4.1 Sampling.

4.4.1.1 Lot formation. An inspection lot shall consist of all the armor plate assemblies of one type and part number, from an identifiable production period, from one manufacturer, submitted at one time for acceptance.

4.4.1.2 Sampling for examination. All armor plate assemblies shall be examined (see 4.4.2.1).

4.4.2 Quality conformance examinations.

4.4.2.1 Visual examination. To determine conformance to 3.5 and 3.6, armor plate assemblies shall be visually examined for proper workmanship.

4.4.2.2 Examination failure. If any armor plate fails to pass any examination specified herein, the Government will stop acceptance until evidence has been provided by the contractor that corrective action has been taken.

4.4.3 In-process examination. To determine conformance to 3.3.1 through 3.3.3.4, the contractor shall initiate, perform and document on an essentially continuous basis, an in-process procedure consisting of process controls and examination criteria satisfactory to the Government.

4.4.4 Control test. During each four month interval of armor fabrication, the Government shall randomly select three ballistic test samples. The contractor shall forward the samples to the test site designated by the acquisitioning activity (see 6.2). The Government will test the samples against the requirements of 3.4.1. Testing shall be in accordance with MIL-STD-662.

4.4.4.1 Control test failure. Failure of the control samples to meet the requirements of the control test shall be cause for the Government to stop acceptance of armor plate until the cause of failure(s) is identified, corrective action is taken by the contractor and approved by the Government.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, packing, and marking. Preservation, packaging, packing, and marking shall be in accordance with the applicable packaging standard or packaging data sheet specified by the acquisitioning authority (see 6.2).

6. NOTES

6.1 Intended use. The aluminum-aramid composite armor furnished under this specification is intended for use as an armor system for the Armored Combat Earthmover M9 ACE.

6.2 Ordering data. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. If first article shall be preproduction or initial production (see 4.3).
c. Name and address of Government test site (see 4.3 and 4.4.4).
d. Selection of applicable levels of preservation, packaging, packing and marking (see 5.1).
e. Thickness of aluminum and number of plies of aramid for test components (see 3.3.2).

Custodian:
Army - AT

Preparing activity:
Army - AT

Project No. 9535-A026

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