

INCH-POUND

MIL-M-63221A(AR)

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SUPERSEDING

MIL-M-63221(AR)

8 February 1979

MILITARY SPECIFICATION

MORTAR, 60MM: M224 (Without M64 Sight Unit)

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

NOTE: This weapon is a security item and is subject to security control during manufacture, shipment, and storage per AR 190-11, DoD Directive 5100.76 and WVAR 735-20.

1. SCOPE

1.1 Scope. This specification supports the acquisition of 60MM Mortar M224, consisting of Cannon M225, Biped M170, and Baseplates H7 and M8. This specification includes the minimum essential Engineering and Packaging Requirements, and the necessary Quality Assurance Provisions to determine that these requirements have been met.

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Armament Research, Development and Engineering Center, US Army Armament, Munitions and Chemical Command, ATTN: SMCAR-CCB-SC, Watervliet, N.Y. 12189-4050 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 1010

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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).

SPECIFICATIONS

MILITARY

MIL-L-3150	Lubricating Oil, Preservative, Medium
MIL-G-10924	Grease, Automotive and Artillery
MIL-C-13931	Cannon, General Specification for
MIL-L-14107	Lubricating Oil, Weapons, Low Temperature
MIL-P-14232	Parts, Equipment and Tools for Army Materiel, Packaging and Packing of
MIL-I-45607	Inspection Equipment, Acquisition, Maintenance and Disposition of

STANDARDS

MILITARY

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-1189	Bar Code Symbolology, Standard Department of Defense
MIL-STD-1190	Minimum Guidelines for Level C Preservation, Pavking, and Marking
MIL-STD-1235	Single and Multi-Level Continuous Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-2073-1	- DoD Materiel Procedures for Development and Application of Packaging Requirements

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.1.2 Other Government documents, drawings, and publications.

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The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DOCUMENT

United States Army

AR 385-11 - Ionizing Radiation Protection (Licensing, control, Transportation, Disposal, and Radiation Safety)

DRAWINGS (see 6.5)

	<u>Research, Development</u>	<u>Engineering</u>
<u>U.S. Army Armament Research, Development and Engineering Center (ARDEC)</u>		
EPL 11578990	- Engineering Parts List, Baseplate, 60MM Mortar: M8	
EPL 11579070	- Engineering Parts List, Baseplate, 60MM Mortar: M7	
EPL 11579080	- Engineering Parts List, Cannon, 60MM Mortar: M225	
EPL 11579090	- Engineering Parts List, Biped, 60MM Mortar: M170	
PDS P11579088	- Packaging Data Sheet; 60MM Mortar: M224	
SPI AM11579000	- Special Packaging Instruction; 60MM Mortar: M224	

PUBLICATIONS

MLQAP 11578990 - Master List of QAPs, Baseplate (Auxiliary); 60MM Mortar: MS

MLQAP 11579070 - Master List of QAPs, Baseplate; 60MM Mortar: M7

MLQAP 11579080 - Master List of QAPs, Cannon; 60MM Mortar: M225

MLQAP 11579090 - Master List of QAPs, Biped; 60MM Mortar: M170

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QAP-APPENDIX - General Quality Assurance Provisions
-WVA

(Copies of drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the Procuring Contracting Officer.)

2.2 Non-Government publications. The following document(s) 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)

ASTM D 3951 - Commercial Packaging, Practice for

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103-1137.)

(Non-Government standards and other publications are normally available from the organizations that prepare or 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 document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General requirements. The mortar and its components shall conform to the applicable drawings listed in Engineering Parts List EPL 11579080 (Cannon, 60MM Mortar: M225); 11579090 (Biped, 60MM Mortar: M170); 11579070 (Baseplate, 60MM Mortar: M7); and 11578990 (Baseplate, 60MM Mortar: M8), the requirements of this military specification, the applicable paragraphs of MIL-C-13931 as incorporated in this specification and all referenced documents (see 6.7). Any conflicts are to be resolved by means of the order of precedence (see 2.3).

3.1.1 Weight. The combined weight of the M225 Cannon, the M170 Biped, and the M7 Baseplate shall not exceed 44.7 pounds. The

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weight of the M8 Baseplate shall not exceed 3.75 pounds.

3.2 First article. The contractor shall submit a first article unless it is specifically waived in the contract (see 4.4 and 6.2). No first article requirements shall be waived without review and approval by the Procuring Contracting Officer (see 6.4).

3.3 Reliability and maintainability. The requirements for reliability and maintainability are found in APPENDIX.

3.4 Performance characteristics. The mortar shall perform the functions of firing the primer, sustaining pressure of the propellant charge, and launching the projectile in the required direction. All moving parts shall function smoothly without interference, erratic movement or malfunction.

3.4.1 Bipod: M170.

3.4.1.1 Elevating mechanism. The elevating mechanism shall function throughout the entire range of the adjusting screw. With the mortar set up in the firing position, backlash at the crank-handle shall not exceed 1/16 turn in any position of elevation or traverse. The device for locking the elevating mechanism into the traversing mechanism shall provide positive clamping action.

3.4.1.2 Traversing mechanism. The traversing mechanism shall function throughout the entire range of the adjusting screw. With the mortar set up in firing position, backlash of the traversing wheel assembly shall not exceed 1/12 turn in any position of traverse or elevation. The flat spring in the traverse handwheel shall provide a positive latch of the crank in both the open and folded positions.

3.4.1.3 Cross-leveling mechanism. The cross-leveling mechanism, incorporated in the left leg assembly, shall provide a smooth leveling adjustment throughout the adjusting range, and also a means for collapsing the biped. The sliding bracket, used for setting up or collapsing the biped, shall grip the sliding sleeve securely when the locking nut is tightened manually. The sleeve shall move smoothly on the leg-body when the adjusting grip is turned throughout its range of adjustment. Backlash of the cross-level grip shall not exceed 1/16 turn. When the locking nut is loosened, the bracket shall slide smoothly on the sleeve.

3.4.1.4 Shock absorber assembly. The shock absorbers shall extend 6 inches when the yoke is held stationary and a force of

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35.0 \pm 5.0 pounds is applied to the lower collar in a direction parallel and approximately on the same centerline as the shock assembly. When released, the shock absorbers shall return simultaneously in a slow, smooth and uniform manner. The two shock absorbers shall equalize the shock of firing M720 rounds.

3.4.2 Cannon: M225.

3.4.2.1 Handle mechanism. The handle mechanism, which contains the firing mechanism (i.e. sear assembly, trigger and selector), shall be firmly clamped to the tube and cap so that the sear lever properly engages the firing pin. The plunger and key in the carrying handle shall allow the carrying grip to be securely latched in both the open and the folded positions.

3.4.2.1.1 Firing mechanism. The selector on the handle mechanism shall be capable of being manually rotated between the T, S, and D modes without binding or erratic movement. When the selector is set in the D (Drop) mode, the round shall fire automatically when dropped into the mortar. When the selector is set in the S (Safe) mode, the firing mechanism shall not function when the trigger is squeezed and a round shall not be fired. When the selector is set in the T (Trigger) mode, the firing mechanism shall operate when the trigger is pulled with a force of 41.0 \pm 7.0 pounds applied perpendicular to the trigger at a distance of 3.75 inches from the centerline of the pivot. The trigger shall operate smoothly until the sear is released and the firing mechanism functions. When the trigger is released after firing, it shall return to its pre-firing position without any externally applied force. The firing mechanism shall provide adequate energy to the firing pin to fire the M35 primer.

3.4.2.1.2 Firing pin protrusion. Protrusion of the firing pin from the face of the boss in the basecap shall be:

<u>Selector mode</u>	<u>Protrusion (inches)</u>
D (Drop)	0.070 to 0.100, inclusive
S (Safe)	0.0 --
T (Trigger)	0.0
T (Trigger) when fired	0.090 to 0.100, inclusive

3.4.2.1.3 Range indicator assembly. With the cannon, biped, and baseplate assembled as a complete weapon, and with the barrel elevated to 1165 mils \pm 9 mils, and with the weapon cross-leveled, the ball in the range indicator shall be opposite the line signifying numeral 10 on the indicator "Charge 1" scale.

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- (1) Tritium contamination. There shall be no radiation contamination in excess of the limits specified AR 385-11.
- (2) Illumination check. The range indicator in the M225 Cannon shall be visually checked to ensure that the radioactive light sources are illuminating prior to final preservation and packaging.

3.4.3 Cannon bipod assembly. The cannon shall be clamped firmly to the collar assembly at the top of the bipod assembly when the knob on the collar assembly is hand tight.

3.4.3.1 Elevating and traversing adjustment torques. The torques required to adjust the elevating and traversing mechanisms of the mortar, set up at any elevation and with the bipod assembly clamped in either the forward or rearward position, shall be as follows:

	Adjustment torque (pound-inches)
Elevating screw - Elevate:	3.0 ± 2.0
Elevating screw - Depress:	2.25 ± 1.75
Traversing screw - Traverse right:	5.0 ± 3.0
Traversing screw - Traverse left:	3.5 ± 2.5

3.4.4 M7 baseplate assembly. The rotating cap in the baseplate shall move freely and smoothly throughout $\pm 360^\circ$ rotation.

3.4.5 M8 Auxiliary baseplate assembly. The baseplate latch assembly shall rotate freely about its pivot and shall securely lock the cannon to the baseplate when the baseplate latch assembly is closed and latched. The ball plungers shall fasten the baseplate securely in the folded position when the protrusion on the cannon basecap is inserted between the ball plungers.

3.5 Lubrication. All bearing and mating surfaces inside the elevating and traversing mechanism shall be coated with a thin film of grease conforming to MIL-G-10924. The firing mechanism shall be lubricated with oil conforming to MIL-L-14107, and the internal surfaces of the two shock absorber assemblies shall have oil applied conforming to MIL-L-3150.

3.6 Performance.

3.6.1 High Pressure resistance. The complete mortar (cannon,

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biped and M7 baseplate) shall be capable of withstanding the stresses of firing standard ammunition under service conditions. For proof firing, the mortar shall be capable of withstanding the stresses of firing the M720 cartridge developing a maximum chamber pressure of 9100 ± 300 psi at 70°F. The M8 auxiliary baseplate shall be capable of withstanding the firing of the M720 cartridge at charge 2. For simulated proof firing, the cannon barrel 11579093 shall be capable of withstanding a hydrostatic pressure of 9100 ± 300 psi for the first 12 inches of the barrel measured from the basecap end, and the entire length of the barrel shall be capable of withstanding a hydrostatic pressure of 8200 ± 300 psi at 70°F.

3.6.2 Functioning. There shall be no impairment in the functioning of the mortar components and baseplates during and after testing. All parts shall function without interference, erratic movements, or malfunction.

3.6.3 Bore enlargement. Enlargement of the bore resulting from firing no more than 8 rounds shall not exceed 0.002 inch. There shall be no indication of abnormal wear, damage, or deformation of the bore surface.

3.6.4 Material soundness. After completion of testing, all parts shall be free from cracks and fractures and shall comply with the soundness requirements specified on the applicable drawings.

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 any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 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 this specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for

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acceptance 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 inspection. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.4).
- b. Production Qualification Test (PQT) (see 4.5).
- c. Quality conformance inspection (see 4.6).

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the applicable test document, applicable paragraph(s) in the specification, or in the applicable drawing.

4.4 First article inspection. Unless otherwise specified in the contract (see 6.2), first-article mortars and components thereof shall be submitted for inspection in accordance with the contract and applicable item Quality Assurance Provisions (QAPs) .

4.4.1 First article sample. The first article sample shall be representative of the production processes to be used during quantity production.

4.4.2 Sample size. Unless otherwise specified, the first article sample shall be as specified in the contract (see 6.2).

4.4.3 Inspection provisions. Mortars and components selected for first article inspection shall be subjected to quality conformance inspections (see 4.6), proof acceptance (see 4.6.4), and any additional requirements listed in the contract (see 6.2). The results of the quality conformance inspection shall be used as the initial inspection records of the first article sample.

4.4.4 Testing. All first article testing shall be conducted by the Government or an agency specified by the Government. Tests listed in this specification shall not be integrated with other tests without written approval of the responsible product assurance element of the procuring agency.

4.5 Production Qualification Test. The requirements, tests, and test methods for PQT are contained in the APPENDIX.

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4.5.1 Reliability and maintainability testing. The requirements, tests, and test methods for reliability and maintainability are contained in the APPENDIX.

4.6 Quality conformance inspection. Quality conformance inspections are tabulated in TABLE I.

TABLE I. Quality conformance inspection.

	<u>Requirement</u>	<u>Examination and tests and test methods</u>
<u>Bipod mechanism</u>	3.4.1.1, 3.4.1.2, 3.4.1.3 3.4.3.1 3.4.1.4	4.6.3.1 4.6.3.1.1 4.6.3.2
Crank Torque		
Shock absorber		
<u>Firing mechanism</u>		
Functioning	3.4.2.1.1	4.6.3.3.1
Trigger force	3.4.2.1.1	4.6.3.3.2
Firing pin protrusion	3.4.2.1.2	4.6.3.3.3
<u>Range indicator</u>	3.4.2.1.3	4.6.3.4
Tritium contamination	3.4.2.1.3(1)	4.6.3.4.1
Illumination	3.4.2.1.3(2)	4.6.3.4.2
Cannon-bipod assembly	3.4.3	4.6.3.5
M7 baseplate	3.4.4	4.6.3.6
M8 baseplate	3.4.5	4.6.3.7
<u>High Pressure Resistance</u>	3.6.1	4.7.1, 4.7.2
<u>After proof firing</u>		
Functioning	3.6.2	4.6.4.2
Bore enlargement	3.6.3	4.6.4.3
Bore condition	3.6.3	4.6.4.4
Material soundness	3.6.4	4.6.4.5

4.6.1 Inspection provisions. Mortar assemblies, subassemblies, components and parts thereof shall be inspected to determine compliance with this specification, MIL-C-13931, QAPS listed in Master List of QAPS MLQAPS 11578990, 111579070, 11579080, 11579090, QAP APPENDIX-WVA, and any additional requirements specified in the contract (see 6.2).

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4.6.2.1 Lubrication. The Government representative shall witness assembly of the elevating, traversing and firing mechanisms and shock absorber assemblies to the extent necessary to assure compliance with the lubrication requirements of 3.5 (see 6.2).

4.6.1.2 Inspection approval stamp. The application of the inspection approval stamp shall be as specified in MIL-C-13931.

4.6.2 Special Inspection equipment (SIE). SIE used in the inspection of parts, components, sub-assemblies, and assemblies are listed on the item Quality Assurance Provisions.

4.6.2.1 Acquisition, maintenance, and disposition. Unless otherwise specified (see 6.2), responsibility for acquisition, maintenance, and disposition of inspection equipment shall be in accordance with MIL-I-45607.

4.6.2.2 Accuracy of standard measuring equipment. When commercial or modified commercial inspection equipment is used, it shall be capable of repetitive measurements to an accuracy of 10 percent of the total tolerance of the characteristic being inspected.

4.6.3 Examinations and tests.

4.6.3.1 Bipod mechanisms functional test. Each of the elevating, traversing, and cross-leveling mechanisms of each assembled mortar tested shall be manually operated a minimum of two complete cycles of operation to assure that the requirements of 3.4.1.1, 3.4.1.2, and 3.4.1.3 are complied with. Failure to comply with the requirements (i.e. any evidence of binding, scraping, rubbing, or interference, excessive play or backlash, erratic movement, and other malfunctions) shall be cause for rejection of the biped assembly.

4.6.3.1.1 Crank torque test. The torques applied to the cranks of the elevating and traversing mechanisms of each assembled mortar to elevate and depress and to traverse right and left shall be measured continuously during the operating cycles. Measurements shall be taken for a minimum of two cycles of operation for each mechanism. Torque measurement equipment shall be subject to approval by the Government representative. Maximum and minimum torques at any position in any cycle to elevate and depress and to traverse the cannon right and left conform with the requirements of 3.4.3.1. Failure of any mechanism to comply shall be cause for rejection of the biped assembly.

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4.6.3.2 Shock absorber assembly test. The shock absorber assembly of each assembled mortar shall be tested a minimum of two complete cycles by applying a force, measuring the extension of the piston rods, and then releasing the force. The location of the force vector and other test parameters shall be as specified in 3.4.1.4. Failure to comply with the requirements of 3.4.1.4 shall be cause for rejection of the biped assembly.

4.6.3.3 Firing mechanism tests.

4.6.3.3.1 Functioning. The firing mechanism of each assembled mortar shall function as specified in 3.4.2.1.1 when the selector is rotated to each of the "T" (TRIGGER), "S" (SAFE), and "D" (DROP) modes. Failure to function as specified or any evidence of accidental firing of the cartridge in the safe and trigger fire mode's, interference, binding, or erratic movement shall be cause for rejection of the cannon.

4.6.3.3.2 Trigger force test. With the selector on the handle mechanism set in the "T" (TRIGGER) mode, the firing mechanism of each assembled mortar shall be tested by measuring the force applied to the trigger required to actuate the firing pin by means of a spring scale. The location of the force vector and other test parameters shall be as specified in 3.4.2.1.1. Failure to comply with the requirements of 3.4.2.1.1 shall be cause for rejection of the cannon.

4.6.3.3.3 Firing pin protrusion. Firing pin protrusion of each assembled mortar shall be checked in each of the "T" (TRIGGER), "S" (SAFE), and "D" (DROP) modes using applicable inspection equipment referenced in the applicable Quality Assurance Provisions or other approved equivalent inspection equipment. Failure to comply with the requirements of 3.4.2.1.2 shall be cause for rejection of the cannon.

4.6.3.4 Range indicator assembly. The range indicator assembly of each assembled mortar shall be inspected under the conditions specified in 3.4.2.1.3 to determine compliance with the requirements 3.4.2.1.3. Failure to comply shall be cause for rejection.

4.6.3.4.1 Tritium radiation contamination. The examinations and tests for tritium radiation contamination shall be conducted in accordance with the applicable Army regulations and nuclear regulatory commission licensing regulations. Failure to comply with 3.4.2.1.3(1) shall be cause for rejection.

4.6.3.4.2 Illumination. The range indicator shall be visually checked in a dark environment to assure that the radioactive

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light sources are illuminating. Failure to comply with 3.4.2.1.3 (2) shall be cause for rejection.

4.6.3.5 Cannon Bipod assembly. Each canon bipped assembly shall be inspected under the conditions specified in 3.4.3 to determine compliance with the requirements of 3.4.3. Failure to comply shall be cause for rejection.

4.6.3.6 M7 baseplate assembly. Each M7 baseplate assembly shall be examined to determine compliance with the requirements of 3.4.4. Failure to comply shall be cause for rejection.

4.6.3.7 M8 Auxiliary Basplate assembly. Each M8 baseplate assembly shall be examined to determine compliance with the requirements of 3.4.5. Failure to comply shall be cause for rejection.

4.6.4 Proof acceptance. All mortars shall be proof accepted either by proof firing of mortars or cannons and, or by simulated proof firing of cannon barrels. Mortars to be proof fired, shall be tested by using the method of 4.7.1. Failure to comply with the requirements of 3.6 shall be cause for rejection. Cannon barrels to be simulated proof fired shall be tested by using the method of 4.7.2. Failure to comply with the applicable requirements of 3.6 shall be cause for rejection.

4.6.4.1 Proof sampling. Proof sampling of mortars shall be conducted as follows:

- a. Using plan CSP-1 of MIL-STD-1235, the Product Assurance Directorate, Watervliet Arsenal will designate the qualifying quantity (i) and sample frequency (f) in the contract (see 6.2).
- b. The first "i" quantity of mortars produced in the particular contract shall be proof fired at a proving ground. When the "i" quantity has been satisfied, sampling shall be put into effect using the sampling rate. All cannon barrels not proof fired shall be simulated proof fired.
- c. Successive production buys require a new "i" qualifying quantity when there is more than a 30 day lapse in production. When a new cannon or tube contractor is utilized or a change in process, material, or source of supply is made that would affect product uniformity, a new "i" quantity shall be fired.

4.6.4.2 Functioning. After proof firing, the elevating,

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traversing, and cross-leveling mechanisms, the shock absorbers, the firing mechanism, and the range indicator shall be inspected for proper functioning. Failure to comply with 3.6.2 shall be cause for rejection.

4.6.4.3 Bore enlargement. After proof firing no more than 8 rounds, the barrel bore diameters shall be measured with an air gage or other approved gage. Enlargement exceeding the limit specified in 3.6.3 shall be cause for rejection.

4.6.4.4 Bore condition. After proof firing, tube bore surfaces shall be examined with a borescope to determine the condition of the bore surface. Failure to comply with the requirements of 3.6.3 shall be cause for rejection.

4.6.4.5 Material soundness. After completion of proof firing or simulated proof firing, the cannon barrel assembly (tube and basecap) shall be magnetic particle tested in accordance with applicable drawings and specifications. After completion of proof firing, the aluminum baseplates shall be subjected to liquid penetrant inspection in accordance with applicable drawings and specifications. Failure of the material to comply with the requirements of 3.6.4 shall be cause for rejection.

4.6.5 Packaging inspection. Packaging inspection for the level designated in the contract, shall be performed in accordance with the applicable packaging data sheets and MIL-P-14232. Failure to comply with the packaging requirements shall be cause for rejection.

4.7 Methods of examination and tests.

4.7.1 Proof firing.

4.7.1.1 Physical measurement and inspection requirements.

- a. Bore diameter measurements and a borescope inspection shall be performed:
 - (1) Before firing, on the first ten barrels of any new contract; thereafter, one in 25.
 - (2) After firing, on all barrels.
- b. Magnetic particle inspection shall be performed:
 - (1) Before firing, on the first ten barrels (tube and basecap) of any new contract; thereafter, one in 25.

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(2) After firing, on all barrels.

- c. After proof firing, each firing pin protrusion shall be measured in accordance with 4.6.3.3.3.
- d. After firing, each baseplate shall be examined in accordance with 4.6.3.6 or 4.6.3.7 as applicable.

4.7.1.2 Proof firing procedure

- a. Each cannon (11579080) submitted for proof firing shall be tested by firing one 9100 \pm 300 psi pressure round at 70°F.
- b. Each mortar, bipped assembly and M7 baseplate submitted for proof firing shall be tested in accordance with Table II.
 - (1) Rate of fire shall not exceed one round per minute.
 - (2) While firing check for damage or deformation to weapon components.
 - (3) After firing the last round, the mortar will be inspected for deformation of the baseplate, evidence of erosion, looseness or interference of-parts, or any other defects which may have resulted from the proof firing.
- c. Each M8 baseplate submitted for proof firing shall be tested by firing one M720 round, charge 2, at a barrel elevation of 1065 mils.

TABLE II. Mortar proof firing schedule.

Round No.	Position of mount traversing mechanism	Pressure psi	Mortar elevation mils
1	Center	6000 \pm 300	1065
2	Max. right	8000 \pm 300	800
3	Center	9100 \pm 300	800
4	Max. left	8000 \pm 300	800

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4.7.2 Simulated proof firing procedure.

a. The cannon barrel (11579093) with clamp (11579040) and clamp ring (11579039) assembled shall be hydrostatic pressure tested to 9100 ± 300 psi at 70°F for the first 12 inches of the tube measured from the basecap end of the tube and the pressure shall be immediately released as soon as it is attained.

b. The cannon barrel with the clamp and clamp ring assembled shall be hydrostatic pressure tested to 8200 ± 300 psi at 70°F for the entire length of the tube and the pressure shall be immediately released as soon as it is attained.

c. After hydrostatic testing, physical measurement and inspection shall be performed in accordance with the following:

- (1) Bore diameter measurements and visual borescope inspection shall be performed on all barrels (tube with basecap attached) .
- (2) Magnetic particle inspection shall be performed on:
 - (a) all barrels (tube with basecap attached) with clamp rings (11579039) and clamps (11579040) removed.
 - (b) all clamp rings (11579039).
 - (c) all clamps (11579040).

5. PACKAGING

5.1 Cannon - Levels A, B and C Cleaning, drying, preservation, unit packaging and packing of cannon shall be in accordance with the requirements of Packaging Data Sheet (PDS) P11579088 and MIL-P-14232, and Special Packaging Instruction (SPI) AM11579000 and MIL-STD-2073-1, for the level of protection specified in the contract (see 6.2).

5.2 Repair parts, tools and equipment - Levels A, B, and C. Cleaning, drying, preservation, unit packaging and packing of repair parts, tools and equipment shall be in accordance with the applicable repair part/tool and equipment PDS and MIL-P-14232 or the applicable repair part/tool and equipment SPI and MIL-STD-2073-1 for the level of protection specified in the contract (see 6.2). When level C requirements are not shown on the PDS/SPI, Level C packaging shall be in accordance with MIL-STD-1190.

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5.2.1 Level X - Industrial packaging. Cleaning, drying, preservation, unit packaging and packing of repair parts, tools and equipment shall be in accordance with ASTM D3951 when industrial packaging is specified in the contract (see 6.2).

5.2.1.1 Quantity in Unit Package (QUP). When level C packaging in accordance with MIL-STD-1190 or industrial packaging of repair parts is specified in the contract, the QUP shall be the same as specified in the contract (see 6.2).

5.3 Marking of packages.

5.3.1 Levels A, B, and C. Marking of the unit package, intermediate packages, and exterior shipping containers shall be in accordance with MIL-STD-129. When specified (see 6.2), bar code marking shall be in accordance with MIL-STD-129 and MIL-STD-1189.

5.3.2 Level X - industrial. Marking of the unit package, intermediate packages, and exterior shipping containers shall be in accordance with ASTM D3951. When specified (see 6.2), bar code marking shall be in accordance with MIL-STD-129 and MIL-STD-1189.

6. NOTES

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

6.1 Intended use. The 60MM Mortar M224 specified herein is intended for use as a lightweight company mortar for close combat support.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number and date of the specification.
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1 and 2.2).
- c. Requirements for and the number of cannon, components thereof, or both to be submitted for first article by the contractor (see 3.2).
- d. The examinations and tests to be performed by the contractor and the examinations and tests to be performed by the Government.

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- e. All inspection and test data that is required.
- f. At whose expense a retest may be performed.
- g. Any additional or extended examinations and tests beyond the scope of this specification should be specified and identified as a separate item of the contract including, but not limited to, Production Qualification Test (PQT) (see 4.5). PQT testing shall be conducted on mortars, cannon, and critical assemblies and components when:
 - (1) A new contractor is utilized.
 - (2) A time lapse of one year has occurred since the item was last produced by the contractor.
 - (3) Significant changes have been made in a manufacturing process or material.
 - (4) A design change is made.

The determination to the significance of the action with regard to the requirement for testing shall be made by the Product Assurance element of the procuring activity. Critical assemblies are:

- (1) tube and basecap
 - (2) firing mechanism
 - (3) elevating mechanism assembly
 - (4) traversing mechanism assembly
 - (5) shock absorber assembly
 - (6) baseplate
- h. The serial numbers for the cannon and components.
- i. List of inspection equipment, responsibility for acquisition, maintenance, and disposition thereof, if other than as specified (see 4.6.2).
- j. Availability of inspection equipment from the Government.
- k. Extent of contractor's responsibility for Government furnished and for contractor-required final inspection equipment.
- l. Applicable acceptance test procedures.
- m. When a proof firing sampling plan is authorized, the

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proof firing sampling plan parameters: initial consecutive quantity (i), and sampling frequency (f) (see 4.6.4.1).

- n. Under what conditions simulated firing may be performed, the test equipment available, and the procedures to be followed.
- o. The levels of preservation, packaging, and packing required for cannon assemblies (see 5.1) and repair parts (see 5.2).
- p. When applicable, bar code marking requirements (see 5.3).
- q. When warranted, the application of MIL-Q-9858 or MIL-I-45208, as appropriate.
- r. Unless otherwise specified, the application of MIL-I-45607 and MIL-STD-45662.
- s. Replacement parts should be provided to Aberdeen Proving Ground and Watervliet Test Facilities to support the replacement of parts required after tenting.
- t. Reliability and Maintainability (RAM) tests and test methods shall be specified when required as part of PQT.

6.3 Consideration of Data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 3423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
-	-	-	-

The above DID's were those cleared as of the specification. The current issue of DOD 5010.12-L, Acquisition

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Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 First article. When first article inspection is required, the Procuring Contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first lot of production items, a standard production item from the contractor's current inventory (see 3.2), and the number of items to be tested as specified in 4.4.2 or otherwise required. The Procuring Contracting Officer should also 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. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Waivers and deviations. The Procuring Contracting Officer shall coordinate all requests for waiver or deviation to this specification with Benet Laboratories and the Product Assurance Directorate at Watervliet Arsenal.

6.6 Subject term (key word) listing.

Mortar, 60MM
Mortar, 60MM: M224
Cannon; 60MM Mortar: M225
Biped: M170
Baseplate; 60MM Mortar: M7
Baseplate; 60MM Mortar: M8

6.7 Drawings. Drawings listed in Section 2 of this specification under the heading "U.S - Army Armament Researchs Development and Engineering Center" (ARDEC) may also include drawings prepared by, and identified as Watervliet Arsenal, Ordnance Corps, Weapons Command, or U.S. Army Armament Research and Development Command, U.S. Army Armament, Munitions and Chemical Command, etc. Technical data originally prepared by these activities are now under the cognizance of ARDEC.

6.8 Changes from previous issue. Marginal notations are not

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used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:

Army-AR

Preparing activity:

Army-AR

(Project 1010-A141)

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APPENDIX

PRODUCTION QUALIFICATION TEST, RELIABILITY, AND
MAINTAINABILITY REQUIREMENTS AND INSPECTION METHODS
FOR MORTAR, 60MM: M224 (WITHOUT M64 SIGHT UNIT)

10. SCOPE

10.1 Scope. This APPENDIX details all requirements, inspection methods, and definitions necessary for Production Qualification Test (PQT), Reliability, and Maintainability. This APPENDIX is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Specifications, standards, and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those 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).

MILITARY

MIL-STD-721 - Definitions of Effectiveness Terms for
Reliability, Maintainability, Human Factors
and Safety

MIL-STD-882 - System Safety Program Requirements

30. REQUIREMENTS

30.1 PQT. PQT tests shall be conducted on cannon or critical assemblies or parts thereof when:

- a. A new contractor is utilized.
- b. A time lapse of one year has occurred since the item was last produced by the contractor.
- c. Significant changes have been made in a manufacturing process or material.
- d. A design change is made.

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If any mortar, critical assembly, or component part thereof fails PQT testing, then failure analysis shall be invoked (see 40.3).

30.1.1 Performance. The requirements for performance are contained in 3.4 of this specification.

30.1.2 Climatic. The cannon will be employed in all types of areas, terrain and climates in which the supported units may operate. This includes operation in geographical areas which include temperature extremes from +125°F to -50°F.

30.2 Reliability and maintainability. When specified in the contract (see 6.2), reliability and maintainability tests shall be conducted as part of PQT.

30.2.1 Reliability. The mortar with M7 baseplate firing M720 rounds shall have a Reliability of 2500 Mean Rounds Between Failure (MRBF) for the Operational Mode Summary (OMS) (see 30.2.2). Failures are defined in the scoring criteria for assessing the reliability requirements stated in 50.

30.2.2 Operational mode summary. The OMS consists of the following expected percentages of total rounds to be fired at all ranges during offensive and defensive operations:

- a. 10% of the total rounds fired from 0 to 1000 meters
- b. 36% of the total rounds fired from 1000 to 2000 meters
- c. 36% of the total rounds fired from 2000 to 3000 meters
- d. 18% of the total rounds fired from 3000 to 4000 meters

30.2.3 Charge requirements. The charges used in these firings will be that which allows the greatest degree of flexibility in range, elevation, and stability. A high percentage of high or low charges will not be construed as being representative. Rounds will be fired at the rate of 50 percent slow fire as in adjustment, and 50 percent at the rapid and sustained fire rate. For the 0 to 1000 meter range, firing shall be 50% charge 0 and 50% charge 1 and shall be performed at the following rates of fire (representative of the Close Defense Fire Mission):

- a. 30 rounds per minute for 1 minute.
- b. 15 rounds per minute for 10 minutes.
- c. 30 rounds per minute for 1 minute.

30.2.4 Maintenance ration. The maintenance ratio shall not be greater than one man-hour per 455 rounds fired during the service life of the weapon which includes the M224 Mortar and M64 Sight Unit. Manhours of maintenance include scheduled and

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unscheduled maintenance, but does not include daily crew checks and services.

30.2.5 Definitions.

30.2.5.1 RAM terms and definitions RAM terms and definitions used in this Appendix are in accordance with MIL-STD-721.

30.2 Failure definition. For the purpose of assessing reliability, a failure is defined as any malfunction which the operator or crew cannot, or is not authorized to, remedy by adjustment, repair, or replacement action within 1.5 minutes, using the controls, Basic Issue Items (BII), Items Troop Installed or Authorized (ITIA) and parts authorized to the crew, and which causes or would cause:

- a. Failure to commence firing, failure to continue firing, or degradation of performance capabilities below designated levels.
- b. A critical or catastrophic hazard to personnel or system as defined by MIL-STD-882. For simultaneous related malfunctions, only the primary malfunction will be counted against Mean Rounds Between Failure (MRBF).

40. INSPECTION METHODS

40.1 Production Qualification Test (PQT) When specified in the contract (see 6.2), first article mortars shall be subjected to PQT by a Government activity to assure compliance with the requirements of this specification and the contract.

40.1.1 Sample. The first article mortars shall be randomly selected from the first month's production. First article mortars and component parts thereof shall be representative of the production processes used during quantity production. When specified, these mortars shall be used for reliability and maintainability testing.

40.1.2 Inspection provisions. First article mortars shall be subjected to normal inspection per applicable item QAPs, quality conformance inspection (see 4.6); including proof acceptance (see 4.6.4), through proof firing and simulation testing.

40.1.2.1 Proof acceptance. First article mortars shall have successfully passed proof acceptance (see 4.6.4), through proof firing prior to commencement of PQT.

40.1.3 Tests. Unless otherwise specified herein or in the

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contract, first article mortar tests listed in this specification shall be performed in a fully operational mortar. All tests shall be conducted by the Government or any agency specified by the Government.

40.2 Reliability A reliability test shall be conducted on first article mortars, using the test method 40.6. If the requirements of 30.2 are not complied with, acceptance of the mortars shall be deferred and 40.4 applies.

40.3 Maintenance ratio The maintenance ratio shall be evaluated during reliability testing (see 40.2). If the requirements of 30.2.3 are not complied with, acceptance of the mortar shall be deferred and 40.5 applies.

40.4 Failure analysis. The contractor shall conduct a failure analysis by performing a dimensional, physical and visual examination of the component parts which are suspected to have caused the failure. Results shall be submitted to the Government for a failure cause determination. If it is determined that failure occurred because of deviation from specified dimensions or physical properties or both, the contractor shall accomplish, as applicable, the following action:

- a. Evaluate and correct the applicable production processes and procedures to prevent recurrence of the same defect in future production.
- b. Examine completely each assembled mortar and each partially assembled mortar and component parts thereof to ensure that material containing the same defect is purged from the inventory and not presented to the Government for acceptance.
- c. Submit the results of the failure analysis and the corrective actions taken to the Government for evaluation and approval of retest or continuation of test.

40.5 Final inspections. Upon completion of reliability testing, mortar components, bipod and baseplate shall comply with the requirements of 3.5.2.

40.6 Reliability testing method and Operational Mode Summary.

- a. A total of 4024 rounds shall be fired without a failure in order to demonstrate a reliability of 2500 Mean Rounds Between Failure with 80% confidence.

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- b. The firing and malfunction assessment shall be in accordance with 30.2.1.
- c. The rate of fire limits of TABLE III shall not be exceeded.

TABLE III. Rate of fire limits.

Rate of fire (rds./min.)	Charge				
	0	1	2	3	4
up to 20	sustained fire				
24	sustained fire				200* rds.
30	sustained fire			200* rds.	130* rds.

*After firing this number of rounds, allow barrel to cool.

50. SCORING CRITERIA

50.1 Basis. This scoring criteria is based on the reliability scoring procedure approved by the Department of the Army. was extracted from the "Scoring Criteria for Light Weight Company Mortar System for Mortar in Operational Mode" dated May 1974. The failure scoring procedure (see 50.2) provides for the use of the failure definition (see 30.2) which is amplified (see 50.1.1). Alternate modes of operation (50.1.2) and Degraded modes of operation (see 50.1.3) pertaining to the mortar provide additional failure scoring guidelines as specified in the "Scoring Criteria for Light Weight Company Mortar System for Mortar in Operational Mode" dated May 1974.

50.1.1 Failure definition amplification.

50.1.1.1 The following are not considered as reliability failures:

- a. Scheduled replacement of parts before failure.
- b. An incipient malfunction corrected during scheduled

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preventive maintenance on the part in question provided a higher level of maintenance is not necessary.

- c. A malfunction resulting from not following the prescribed operational or maintenance procedures or schedule dictated by the equipment manuals.
- d. A malfunction resulting from test item abuse, unrealistic operating conditions or accident.
- e. Actual or incipient malfunctions detected or corrected during initial technical inspections and incipient malfunction detected during final technical inspection.
- f. Malfunction involving ammunition.

50.1.1.2 The following are considered as failure candidates:

- a. A mortar malfunction detected and/or corrected during the correction of another failure provided the failures are totally unrelated.
- b. Corrected incipient mortar malfunctions not covered by 50.1.1, examples b and e.
- c. Mortar malfunctions resulting from lack of clarity of instruction or other fault in the maintenance test package.

50.1.2 Alternate modes of operation.

50.1.2.1 If a backup method of operation can be utilized which does not degrade current performance to unacceptable levels, no failure should be charged. If the backup mode also fails, only one system reliability failure is charged.

50.1.2.2 The following alternate modes of operation are available for the Light Weight Company Mortar System:

- a. Trigger mode firing.
- b. Small base plate (charge 0 and 1 only).

50.1.3 Degraded modes of operation. A certain amount of performance degradation must take place before a reliability failure can be assumed. Of course, if the mortar ceases to function, performance becomes unacceptable (i.e., non-existent); however, if performance is only degraded, then some threshold must be established to define where failures begin. The following allowable degradation thresholds have been established

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for the various performance parameters. Performance below these thresholds constitutes a failure. As long as performance remains above the threshold, or is returned above the threshold within a 1.5 minute maintenance period, no failure is charged.

- a. Time to fire the mission profile Shall not exceed 13.5 minutes.
- b. Handle malfunctions - Handle malfunctions, including the elevation indicator vial, which do not prohibit firing in the drop mode, will not be counted as a failure.

50.2 Failure scoring procedure. The following procedure provides the instructions for the use of the failure definition (see 30.2) for assessing reliability requirements of the Mortar, 60MM: M224 (see 30.2.1). These instructions assume that an incident or malfunction has occurred during test, and a record has been prepared against this action to the extent where it is necessary to determine the chargeability of the action. Incidents where the identification of a reliability failure is in doubt will be referred to a user-developer-tester Scoring Conference. The step-by-step instruction for using the failure Definition are as follows:

Step 1. Record the incident information when a malfunction of the cannon occurs or is detected (rounds on test item and system, description of incident, nature of maintenance action required, maintenance time in hours, maintenance manhours, etc.). Proceed to the next step, answering the question posed and taking action according to the answer given.

Step 2. Is this a scheduled replacement of parts before failure? If yes, do not charge a failure; if no, proceed to Step 3.

Step 3. Is this a malfunction resulting from not following the prescribed operational or maintenance procedures or schedule dictated by the equipment manuals? If yes, do not charge a failure; if no, proceed to Step 4.

Step 4. Is this a malfunction resulting from not following the prescribed operational or maintenance procedures or schedule dictated by the equipment manuals? If yes, do not charge a failure; if no, proceed to Step 5.

Step 5. Is this a malfunction resulting from abuse, unrealistic operating conditions or accident? If yes, do not charge a failure; if no, proceed to Step 6.

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Step 6. Is this an actual or incident malfunction detected during initial and final technical inspection? If yes, do not charge a failure; if no, proceed to Step 7.

Step 7. Is this an incipient malfunction corrected during scheduled preventive maintenance on the part in question, without use of a higher level of maintenance? If yes, do not charge a failure; if no, proceed to Step 8.

Step 8. Is this an incipient malfunction found during test that would not result in failure if testing were continued in the OMS to scheduled replacement or termination of the test program. If yes, do not charge a failure; if no, proceed to Step 9.

Step 9. Is this incident caused by another failure? If yes, do not charge a failure; if no, proceed to Step 10.

Step 10. Is this a malfunction that did or would cause a critical or catastrophic hazard to personnel or equipment as defined by MIL-STD-882. If yes, charge a failure; if no, proceed to Step 11.

Step 11. Is this a malfunction that did not or would not preclude the ability to commence or continue operation at acceptable levels for the current mode of operation in the operational mode summary (e.g. emplace mortar; load and fire at any range; change elevation, or direction; prepare mortar for march; or transport by man or vehicle) or for the mission profile (e.g., load and fire; lay and relay for correct azimuth and elevation)? If the answer is yes, do not charge a failure; if no, proceed to Step 12.

Step 12. Is this incident caused by ammunition malfunction? If yes, do not charge a failure; if no, proceed to Step 13.

Step 13. Is the operator/crew authorized and able to remedy the malfunction by adjustment repair, or replacement action within 1.5 minutes, using the controls, Basic Issue Items - (BII), Item Troop Installed, or Authorized (ITIA) and parts authorized to the crew? If the answer is yes, do not charge a failure; if no, proceed to step 14.

Step 14. Is an alternative mode of operation available which does not degrade the current performance beyond an acceptable level? (see 50.1.2). If yes, do not charge a failure; if no, charge a failure.

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Step 15. Is a degraded mode of operation available which does not lower the current performance beyond an acceptable level? (see 50.1.3). If yes, do not charge a failure; if no, charge a failure.

The above step-by-step procedure applies to failures occurring at all ranges and rates of fire. If the previous steps provide inconclusive evidence as to the chargeability or non-chargeability of a failure, the incident should be rechecked against the criteria 02 50.1. If categorization of the incident remains in doubt, defer classification to a user-developer-tester Scoring Conference.

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.

1. DOCUMENT NUMBER MTI-M-63221A(AR)		2. DOCUMENT DATE (YYMMDD) 22 JULY 1992	
3. DOCUMENT TITLE MORTAR, 60MM: M224 (Without M64 Sight Unit)			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets if needed.)			
5. REASON FOR RECOMMENDATION			
6. PREPARING ACTIVITY		7. DATE SUBMITTED (YYMMDD)	
a. NAME (Last, First, Middle Initial)		b. ORGANIZATION	
c. ADDRESS (Include Zip Code)		d. TELEPHONE (Include Area Code)	
		(1) Commercial (2) AUTOVON (If applicable)	
a. NAME Army Armament, Research and Development Center (ARDEC), ATTN: SMCAR-BAC-S		b. TELEPHONE (Include Area Code) (1) Commercial 201 724-6626 (2) AUTOVON 880-6626	
c. ADDRESS (Include Zip Code) Picatinny Arsenal, N.J. 07806-5000		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3486 Telephone (703) 756-2340 AUTOVON 289-2340	