

MIL-M-63221(AR)

FEBRUARY 8, 1979

## MILITARY SPECIFICATION

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

This specification is approved for use by the U. S. Army Armament Research and Development Command and is available for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 This specification covers one type of lightweight company mortar M224 consisting of cannon M225, bipod M170, and baseplates M7 and M8.

## 2. APPLICABLE DOCUMENTS.

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of the specification to the extent specified herein.

## SPECIFICATIONS

Federal

VV-L-800 - Lubricating Oil, General Purpose, Preservative

Military

MIL-G-10924 - Grease, Automotive and Artillery

MIL-C-13931 - Cannons, 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

MIL-L-50778 - Liquid Scintillation System for Radioactive Fire Control

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

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## STANDARDS

Military

- MIL-STD-109 - Quality Assurance Terms and Definitions.
- MIL-STD-721 - Definitions of Effectiveness Terms for Reliability, Maintainability, Human Factors, and Safety
- MIL-STD-882 - System Safety Program for Systems and Associated Subsystems and Equipment.
- MIL-STD-1235 - Single and Multi-Level Continuous Sampling Procedures and Tables for Inspection by Attributes.

## DRAWINGS

U.S. Army Armament Research and Development Command

- EPL F11579070 - Engineering Parts List, Baseplate, 60MM Mortar: M7
- EPL D11578990 - Engineering Parts List, Baseplate, 60MM Mortar: M8
- EPL F11579090 - Engineering Parts List, Bipod, 60MM Mortar: M170
- EPL F11579080 - Engineering Parts List, Cannon, 60MM Mortar: M225
- PDS P11579088 - Packaging Data Sheet; 60MM Mortar: M224

U.S. Army Armament Materiel Readiness Command

- DL 11579070 - Index of Inspection Equipment, Baseplate; 60MM Mortar: M7
- DL 11578990 - Index of Inspection Equipment, Baseplate; 60MM Mortar: M8
- DL 11579090 - Index of Inspection Equipment, Bipod; 60MM Mortar: M170
- DL 11579080 - Index of Inspection Equipment, Cannon; 60MM Mortar: M225
- MLSQAP 11579070 - Master List of SQAPS, Baseplate; 60MM Mortar: M7
- MLSQAP 11578990 - Master List of SQAPS, Baseplate; 60MM Mortar: M8
- MLSQAP 11579090 - Master List of SQAPS, Bipod; 60MM Mortar: M170
- MLSQAP 11579080 - Master List of SQAPS, Cannon; 60MM Mortar: M225
- SQAP-APPENDIX-WVA - General Supplementary Quality Assurance Provisions for Cannon, Mounts and Related Parts

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

## 3. REQUIREMENTS.

3.1 First article. When specified in the contract, the contractor shall submit a first article. Unless otherwise specified (see 6.1.1), the first article shall be included in the first article unit pack (see 5.1).

3.2 General requirements. The cannon, bipod, baseplates and the parts thereof shall conform to the applicable drawings listed in Engineering Parts List EPL: F11579080 (Cannon, 60MM Mortar: M225); F11579090 (Bipod, 60MM Mortar: M170); F11579070 (Baseplate, 60MM Mortar: M7); D11578990 (Baseplate, 60MM Mortar: M8), to this specification, and to MIL-C-13931.

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3.2.1 Weight. The combined weight of the M225 Cannon, M170 Bipod and M7 Baseplate shall not exceed 44.75 pounds. The weight of the M8 Auxiliary Baseplate shall not exceed 3.75 pounds.

### 3.2.2 Reliability and maintainability.

3.2.2.1 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 4.8.3). Failures are defined in 3.2.2.3. The scoring criteria for assessing the reliability requirements are stated in the APPENDIX.

3.2.2.1.1 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:

- 10% of the total rounds fired from 0 to 1000 meters
- 36% of the total rounds fired from 1000 to 2000 meters
- 36% of the total rounds fired from 2000 to 3000 meters
- 18% of the total rounds fired from 3000 to 4000 meters

3.2.2.1.2 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 representative. Rounds will be fired at the rate of 50 percent slow fire as in adjustment, and 50 percent at the rapid and sustained rates. 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

3.2.2.2 Maintenance ratio. 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 unscheduled maintenance but does not include daily crew checks and services.

### 3.2.2.3 Definitions.

3.2.2.3.1 RAM terms and definitions. Reliability and maintainability terms and definitions used in this specification are in accordance with MIL-STD-721.

3.2.2.3.2 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: 1) Failure to commence firing, failure to continue firing, or

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degradation of performance capabilities below designated levels. 2) 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 MRBF.

3.3 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.

3.3.1 Bipod: M170.

3.3.1.1 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.

3.3.1.2 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 1/16 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.

3.3.1.3 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 bipod. The sliding bracket, used for setting up or collapsing the bipod, 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.

3.3.1.4 Shock absorber assembly. The shock absorbers shall extend 6 inches when the yoke is held stationary and a force of  $35.0 \pm 5.0$  pounds is applied to the lower collar in a direction parallel and approximately on the same centerline as the shock absorber rods. 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.

3.3.2 Cannon: M225.

3.3.2.1 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 folded positions.

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3.3.2.1.1 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.

3.3.2.1.2 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

3.3.2.1.3 Range indicator assembly. With the cannon, bipod, and baseplate assembled as a complete weapon, and with the barrel elevated to  $1165 \text{ mils} \pm 9 \text{ mils}$ , 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.

(1) External tritium contamination - Prior to final preservation and packaging, tritium shall not be present on the external surfaces of the handle mechanism on the M225 Cannon in excess of 1000 disintegrations per minute/100 sq. cm.

(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.

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

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

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Adjustment  
torque (inch pounds)

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

3.3.4 M7 baseplate assembly. The rotating cap in the baseplate shall move freely and smoothly throughout 360° rotation.

3.3.5 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.

3.4 Lubrication. All bearing and mating surfaces inside the elevating and traversing mechanisms 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 VV-L-800.

### 3.5 Performance.

3.5.1 High pressure resistance. The complete mortar (cannon, bipod 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 tube (11579055) shall be capable of withstanding a hydrostatic pressure of 14,700 + 300 psi for the first 12 inches of the tube measured from the basecap end, and the entire length of the tube shall be capable of withstanding a hydrostatic pressure of 8200 + 300 psi, at 70°F.

3.5.2 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.

3.5.3 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.

3.5.4 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.

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#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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 the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 The inspections set forth in the specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of his responsibility for assuring that all supplies submitted to the Government for acceptance conform to all requirements of the contract.

4.2 Quality Assurance terms and definitions. Quality assurance terms and definitions used in this specification are in accordance with MIL-STD-109.

4.3 Classification of inspections. The inspection requirements specified herein are classified as follows:

1. First article inspection (see 4.5)
2. First article initial production test (see 4.6)
3. Quality conformance inspection (see 4.7)

4.4 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with test conditions specified on the drawings or applicable paragraphs of the specification.

4.5 First article inspection. Three first article units shall be submitted for inspection in accordance with the contract. The first article units shall be representative of the production processes to be used during quantity production.

4.5.1 First article sample.

4.5.1.1 Sample size. Three units shall be randomly selected from the first month's production.

4.5.1.2 Inspection provisions. Items selected as first article units shall be subjected to quality conformance inspections (see 4.7), proof acceptance (see 4.7.4), and any additional requirements listed in the contract (see 6.1.1.b.6). The results of the quality conformance inspection shall be used as the initial inspection records of the first article sample.

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4.5.2 Testing. All 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 the written approval of the responsible product assurance element of the procuring agency.

4.6 First article initial production test. When specified in the contract (see 6.1.1.b.6), first article mortars shall be subject to initial production testing by a Government activity to assure compliance with the requirements of this specification. These mortars shall have successfully passed proof acceptance (see 4.7.4) prior to the commencement of first article initial production testing.

4.6.1 Reliability. A Reliability test shall be conducted on the three first article mortars, using the test method of para. 4.8.3. If the requirements of 3.2.2.1 are not complied with, acceptance of the mortars shall be deferred and 4.6.3 applies.

4.6.2 Maintenance ratio. The maintenance ratio shall be evaluated during reliability testing (see 4.8.3). If the requirements of 3.2.2.2 are not complied with, acceptance of the mortar shall be deferred and para. 4.6.3 applies.

4.6.3 Failure analysis. The contractor shall conduct a failure analysis by performing a dimensional, physical and visual examination of the components 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 assembled mortars and partially assembled mortars and components 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.

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

4.7 Quality conformance inspection.

4.7.1 Inspection provisions. Mortar assemblies, subassemblies, components and parts thereof shall be inspected to determine compliance with this specification, MIL-C-13931; SQAPS listed in: Master LSQAP 11579080, Master LSQAP 11579090, Master LSQAP 11579070, Master LSQAP 11578990, and SQAP APPENDIX-WVA.

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4.7.1.1 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 3.4 (see 6.1.2).

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

4.7.2 Inspection equipment. Data lists containing drawing numbers of inspection equipment used in the inspection of parts, components, sub-assemblies, and assemblies are listed in DL 11579080, DL 11578990, DL 11579070, and DL 11579090.

4.7.2.1 Acquisition, maintenance, and disposition. Unless otherwise specified (see 6.1.1), responsibility for acquisition, maintenance, and disposition of inspection equipment shall be in accordance with MIL-I-45607.

4.7.2.2 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.

4.7.3 Examinations and tests.

4.7.3.1 Bipod mechanisms functional test. The elevating, traversing, and cross-leveling mechanisms of each assembled mortar shall be manually operated a minimum of two complete cycles of operation on each of the three mechanisms to assure that the requirements of 3.3.1.1, 3.3.1.2, and 3.3.1.3 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 bipod.

4.7.3.1.1 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 3.3.3.1. Failure of any mechanism to comply shall be cause for rejection of the bipod.

4.7.3.2 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 3.3.1.4. Failure to comply with the requirements of 3.3.1.4 shall be cause for rejection of the bipod.

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4.7.3.3 Firing mechanism tests.

4.7.3.3.1 Functioning. The firing mechanism of each assembled mortar shall function as specified in 3.3.2.1.1 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 modes, interference, binding, or erratic movement shall be cause for rejection of the cannon.

4.7.3.3.2 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 3.3.2.1.1. Failure to comply with the requirements of 3.3.2.1.1 shall be cause for rejection of the cannon.

4.7.3.3.3 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 Index Inspection Equipment DL 11579080 or other approved equivalent inspection equipment. Failure to comply with the requirements of 3.3.2.1.2 shall be cause for rejection of the cannon.

4.7.3.4 Range indicator assembly. The range indicator assembly of each assembled mortar shall be inspected under the conditions specified in 3.3.2.1.3 to determine compliance with the requirements 3.3.2.1.3. Failure to comply shall be cause for rejection.

4.7.3.4.1 Tritium contamination. Tritium contamination test shall be performed by wiping the handle with filter paper moistened in distilled water. The wiping shall be performed with moderate finger pressure. The damp filter paper shall be placed in a container with the proper portion of scintillation liquid. The scintillating system used to measure contamination must be calibrated and meet the minimum requirement of MIL-L-50778. The read out shall be within 10% of the known standard value when counted to a total of 2000 disintegrations. The actual test for determining contamination is performed by placing the container into the scintillation system. Failure to comply with 3.3.2.1.3 (1) shall be cause for rejection.

4.7.3.4.2 Illumination. The range indicator shall be visually checked in a dark environment to assure that the radioactive light sources are illuminating. Failure to comply with 3.3.2.1.3 (2) shall be cause for rejection.

4.7.3.5 Cannon-bipod assembly. Each cannon bipod assembly shall be inspected under the conditions specified in 3.3.3 to determine compliance with the requirements of 3.3.3. Failure to comply shall be cause for rejection.

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4.7.3.6 M7 baseplate assembly. Each M7 baseplate assembly shall be examined to determine compliance with the requirements of 3.3.4. Failure to comply shall be cause for rejection.

4.7.3.7 M8 Auxiliary baseplate assembly. Each M8 baseplate assembly shall be examined to determine compliance with the requirements of 3.3.5. Failure to comply shall be cause for rejection.

4.7.4 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 4.8.1. Failure to comply with the requirements of 3.5 shall be cause for rejection. Cannon barrels to be simulated proof fired shall be tested by using the method of 4.8.2. Failure to comply with the applicable requirements of 3.5 shall be cause for rejection.

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

a. Using plan CSP-1 of MIL-STD-1235 with an AQL of 1.0, the Product Assurance Directorate, Watervliet Arsenal will designate the qualifying (i) quantity and sample (f) frequency in the contract (see 6.1.1.g).

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.

4.7.4.2 Functioning. After proof firing, the elevating, 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 3.5.2 shall be cause for rejection.

4.7.4.3 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 3.5.3 shall be cause for rejection.

4.7.4.4 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 3.5.3 shall be cause for rejection.

4.7.4.5 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.

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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 3.5.4 shall be cause for rejection.

4.7.5 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.

4.8 Methods of examinations and tests.4.8.1 Proof firing.4.8.1.1 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.
- (2) After firing, on all barrels.

c. After proof firing, each firing pin protrusion shall be measured in accordance with 4.7.3.3.3.

d. After firing, each baseplate shall be examined in accordance with 4.7.3.6 or 4.7.3.7 as applicable.

4.8.1.2 Proof firing procedure.

a. Each cannon (11579080) submitted for proof firing shall be tested by firing one  $9100 \pm 300$  psi pressure round.

b. Each mortar and M7 baseplate shall be tested in accordance with table I.

- (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.

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TABLE I. Mortar proof firing schedule.

Round No.	Position of mount traversing mechanism	Pressure psi	Mortar elevation mils
1	Center	6000 $\pm$ 300	1066
2	Max. right	8000 $\pm$ 300	800
3	Center	9100 $\pm$ 300	800
4	Max. left	8000 $\pm$ 300	800

#### 4.8.2 Simulated proof firing procedure.

a. Prior to assembling the basecap to the tube, 12 inches of the basecap end of the tube shall be hydrostatic pressure tested to 14,700  $\pm$  300 psi for no more than 1 minute. Internal packing shall be used for pressure sealing and the thread on the outside diameter of the tube shall not be used for capping or sealing.

b. After assembling the basecap to the tube the entire length of the barrel shall be hydrostatic pressure tested to 8200  $\pm$  300 psi for no more than 1 minute.

c. After testing, a physical measurement and inspection shall be performed in accordance with 4.8.1.1.

#### 4.8.3 Reliability testing. - 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.

b. Firing schedule and malfunction assessment shall be in accordance with 3.2.2.1

c. The rate of fire limits of table II shall not be exceeded.

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TABLE II. 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.

## 5. PACKAGING.

5.1 First article. When required in the contract, a first article package shall be submitted in accordance with 3.1. Items shall be unit packaged for the level of protection specified in the contract and packed Level B in accordance with the applicable packaging data sheet or MIL-P-14232. Marking shall be as specified on the packaging data sheet.

5.2 Mortar. The mortar shall be packaged, packed and marked in accordance with the requirements of packaging data sheet P11579088 for the level of protection specified in the contract (see 6.1).

5.3 Repair parts, tools and equipment. The items shall be unit packaged, packed and marked in accordance with the applicable packaging data sheet and MIL-P-14232 for the level of protection specified in the contract (see 6.1).

## 6. NOTES.

6.1 Ordering data. Procurement documents should specify the following:

### 6.1.1 Procurement requirements.

- a. Title, number and date of this specification.

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b. Requirements for submission of the first article (see 3.1 and 4.5) and the shipping instructions for first article unit pack (see 3.1 and 5.1).

(1) The contract should designate the examinations and tests to be performed by the contractor and the examinations and tests to be performed by the Government.

(2) The contract should specify the sample size (i.e., the number of units) of the first article.

(3) The contract should designate the inspection and test data that is required to be furnished the Government when the contractor is required to perform either or both examinations and tests.

(4) The contract should designate at whose expense a retest may be performed.

(5) The contract should specify that the acceptable first article shall be delivered in accordance with the terms of the contract, or

(6) 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. Tests may be conducted on mortars or critical assemblies or components when: (1) a new contractor is utilized, (2) a time lapse has occurred since the item was last produced by the contractor, (3) significant changes have been made in a manufacturing process or material, or (4) a design change is made. The determination as 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: (a) tube and basecap, (b) firing mechanism, (c) elevating mechanism assembly, (d) traversing mechanism assembly, (e) shock absorber assembly, (f) baseplate.

c. The serial numbers for the cannons.

d. List of inspection equipment, responsibility for acquisition, maintenance, and disposition thereof, if other than as specified (see 4.7.2).

e. Availability of inspection equipment from the Government.

f. Extent of supplier's responsibility for Government-furnished and for supplier-required final inspection equipment.

g. Complete proof acceptance test procedures including frequency of testing and other applicable proof acceptance test procedures in order to determine acceptance (see 4.7.4).

h. The contract should specify under what conditions simulated proof firing may be performed, the test equipment available, and the procedures to be followed.

i. The levels of preservation packaging and packing required (see 5.2).

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j. Packaging instructions for repair parts (see 5.3).

k. Radioactive material - Prospective bidders should be cognizant of the need for a Nuclear Regulatory Commission License governing the procurement, possession, handling and shipping of radioactive material.

6.1.2 Contract data requirements. Data requirements, such as monthly reports of results of final inspection and performance testing results, certification that grease and oils used conform to requirements of 3.4, and other applicable data to be delivered to the contracting officer shall be as specified on DD Form 1423 ("Contract Data Requirements List"), as part of the contract.

Custodian:

Army-AR

Preparing activity

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Project No. 1010-A097

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APPENDIX

## APPENDIX

### SCORING CRITERIA FOR ASSESSING RELIABILITY REQUIREMENTS OF MORTAR, 60mm: M224

#### 10. SCOPE

10.1 Scope. This appendix provides reliability assessors guidelines for the consistent classification of failures for assessing the reliability requirements of the Mortar, 60mm: M224.

#### 20. APPLICABLE DOCUMENTS

##### PUBLICATIONS

Scoring Criteria for Light Weight Company Mortar System for Mortar in Operational Mode dated May 1974.

#### 30. SCORING CRITERIA

30.1 Basis. This scoring criteria is based on the reliability scoring procedure approved by the Department of the Army. It 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 30.2) provides for the use of the Failure definition (see 3.2.2.3.2) which is amplified (see 30.1.1). Alternate modes of operation (30.1.2) and Degraded modes of operation (see 30.1.3) 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.

##### 30.1.1 Failure definition amplification.

30.1.1.1 The following are not considered as reliability failures:

1. Scheduled replacement of parts before failure.
2. An incipient malfunction corrected during scheduled preventive maintenance on the part in question provided a higher level of maintenance is not necessary.
3. A malfunction resulting from not following the prescribed operational or maintenance procedures or schedule dictated by the equipment manuals.
4. A malfunction resulting from test item abuse, unrealistic operating conditions or accident.
5. Actual or incipient malfunctions detected or corrected during initial technical inspections and incipient malfunction detected during final technical inspection.

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## 6. Malfunctions involving ammunition.

## 30.1.1.2 The following are considered as failure candidates:

1. A mortar malfunction detected and/or corrected during the correction of another failure provided the failures are totally unrelated.
2. Corrected incipient mortar malfunctions not covered by 30.1.1 examples 2 and 5.
3. Mortar malfunctions resulting from lack of clarity of instruction or other fault in the maintenance test package.

30.1.2 Alternate modes of operation.

30.1.2.1 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.

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

1. Trigger mode firing.
2. Small base plate (charge 0 and 1 only).

30.1.3 Degraded modes of operation. A certain amount of performance degradation must take place before a 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 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.

1. Time to fire the mission profile shall not exceed 13.5 minutes.
2. 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.

30.2 Failure scoring procedure. The following procedure provides the instructions for the use of the Failure definition (see 3.2.2.3.2) for assessing reliability requirements of the Mortar, 60mm: M224 (see 3.2.2.1). 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

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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 any event related to the operational malfunction of the Mortar occurs or is detected (rounds on test item, 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. Was the maintenance test package correct? 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.

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.

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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 30.1.2). If yes, do not charge a failure; if no, charge a failure.

Step 15. Is a degraded mode of operation available which does not lower the current performance beyond an acceptable level? (see 30.1.3). 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 of 30.1. If categorization of the incident remains in doubt, defer classification to a user/developer/tester Scoring Conference.

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