

INCH-POUND

MIL-PRF-32317 (AR)

10 March 2009

PERFORMANCE SPECIFICATION

CARTRIDGE, 7.62MM: ARMOR PIERCING - M993

This specification is approved for use by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification describes the performance requirements and verification methods for the Cartridge, 7.62MM: armor piercing, M993 for use in 7.62MM weapons (see 6.1).

1.2 Army-type designator. The Army-type designator M993 referenced in this specification is of Army origin and does not reflect a particular design (see 6.16).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 or 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following 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 cited in the solicitation or contract (see 6.2).

Comments, suggestions, or questions on this document should be addressed to: Commander, U.S. Army ARDEC, ATTN: RDAR-QES-E, Picatinny, New Jersey 07806-5000 or e-mailed to ardecstdzn@conus.army.mil. Since contact information can change, you may want to verify the currency of this information using ASSIST Online database at <http://assist.daps.dla.mil>.

AMSC N/A

FSC 1305

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INTERNATIONAL STANDARDIZATION AGREEMENTS

AOP-7	Manual of Data Requirements and Tests for the Qualification of Explosive Materials for Military Use
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FEDERAL STANDARDS

FED-STD-595/37038	Colors used in Government procurement/ Black
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DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-372	Cleaning Compound, Solvent (For Bore of Small Arms and Automatic Aircraft Weapons)
MIL-PRF-2104	Lubricating oil, (ICE, T)
MIL-PRF-14107	Lubricating Oil, Weapons, Low Temperature
MIL-DTL-46100	Armor, Plate, Steel, Wrought High Hardness
MIL-M-63314	Machine Gun, 7.62mm, M240
MIL-PRF-63460	Lubricant, Cleaner and Preservative Weapons and Weapon Systems (Metric)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-286	Propellants, Solid: Sampling
MIL-STD-636	Visual Inspection Standards for Small Arms Ammunition through Caliber .50
MIL-STD-650	Explosives: Sampling, Inspection, and Testing
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-1168	Ammunition Lot Numbering
MIL-STD-1916	DOD Preferred Methods for Acceptance of Product

(Copies of these documents are available online at <http://assist.daps.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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

DEPARTMENT OF DEFENSE TECHNICAL BULLETIN

TB 700-2	Department of Defense Explosives Hazard Classification Procedures
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(This document is available online at https://www3.dac.army.mil/es/documents/TB700_2.pdf, or from the Chairman, Department of Defense Explosives Safety Board, Room 856C, Hoffman Building 1, 2461 Eisenhower Avenue, Alexandria, VA 22331-0600.)

U.S. ARMY ARDEC DRAWINGS

7553221	Pin, Firing, 7.62mm, 9mm, Cal 30 and Cal 50
7643674	Classification Cartridge Case Defects
10520006	Ball, 3.94 oz
12956134	Cartridge, 7.62mm, Armor Piercing, M993
12960962-18	Box, Ammo Marked and Packed

(Copies of these drawings may be requested online at: pica.Drawing.Request@conus.army.mil or from U.S. Army ARDEC, ATTN: RDAR-AIS-TD, Picatinny, NJ 07806-5000.)

ARDEC PUBLICATIONS

APSL	Army Propellant Surveillance Laboratory for Propellant Stabilizer
SCATP-7.62MM	Ammunition Ballistic Acceptance Test Methods, Test Procedures for 7.62mm Cartridges

(Application for copies should be addressed to Quality Engineering and System Assurance, U.S. Army, ARDEC, Picatinny, NJ 07806-5000, ATTN: RDAR-QEM-D or email QESA-QEM-D@conus.army.mil)

US ARMY DEVELOPMENTAL TEST COMMAND

INTERNATIONAL TEST OPERATIONS PROCEDURE (ITOP)

ITOP-1-2-601	Laboratory Vibration Schedule
ITOP-4-2-601	Drop Tower Tests for Munitions
ITOP-4-2-602	Rough Handling

TEST OPERATIONS PROCEDURE (TOP)

TOP-2-2-614	Toxic Hazards Test for Vehicles and Other Equipment
TOP-2-2-710	Ballistic Test of Armor Materials
TOP-3-2-045	Automatic Weapons, Machine Guns, Hand and Shoulder Weapons
TOP-4-2-604	Range Firing of Small Arms Ammunition
TOP-4-2-827	Time of Flight and Ballistic Coefficient

(Copies of these documents may be ordered from the US Army Developmental Test Command, ATTN: Publications, 314 Longs Corner Road, Aberdeen Proving Ground, MD 21005-5005, or online at <http://www.dtc.army.mil/publications/topsindex.aspx>.)

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ARMY TECHNICAL MANUALS

TM 60A-1-1-31 Explosive Ordnance Disposal (EOD) Procedures

(Copies are available from EOD Division, Bldg 2172, Indian Head, Maryland, 20640, or online at <https://www.logsa.army.mil/etms/online.htm>)

NAVAL SURFACE WARFARE CENTER INSTRUCTIONS

NAVSEAINST 8020.19 Instruction for Electrostatic Discharge (ESD) Safety Program

(Request copies from: Commander Indian Head Division, Naval Surface Warfare Center 101 Strauss Avenue Code 660, Indian Head, MD 20640-5035, or contact john.deiter@navy.mil)

ENVIROMENTAL PROTECTION AGENCY (EPA)

33/50 Program The Final Record; Box 1 - 17 Targeted Chemicals

(Copies of the publication are available from <http://www.epa.gov> or United States Environmental Protection Agency, (7408), Washington, DC 20460)

BUREAU OF MINES REPORT (BOM)

Bureau of Mines Report of Laboratory Equipment and Test Procedures
Investigations 5624 for Evaluating Explosivity of Dusts

(BOM Reports may be ordered at: <http://www.cdc.gov/niosh/mining/aboutus/ordering.htm>, or from NIOSH, Pittsburgh Library, Cochran Mill Road, P.O. Box 18070, Pittsburgh, PA 15236)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, 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 Design verification. When specified (see 6.2), a sample of cartridges shall be subjected to design verification as specified in TABLE I and II and 4.2.

3.1.1 Product uniformity. Key characteristics of the design of the cartridge for which product uniformity is essential to assure the required performance, safety and reliability shall be identified, and their acceptable variability limits shall be established during design verification.

3.1.2 Product baseline. Successful completion of design verification shall constitute the product baseline. Once the product baseline is established, any change of design, material or

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manufacturing process shall require a new design verification to establish a new product baseline.

3.2 First article. When specified (see 6.2), a sample of the cartridges shall be subjected to first article inspection in accordance with the technical provisions herein (see 4.3).

3.2.1 Physical configuration audit. A sample of the cartridges shall be subjected to a configuration audit of physical characteristics established by the product baseline.

3.3 Conformance inspection. When specified (see 6.2), a sample shall be subjected to conformance inspection in accordance with the technical provisions herein (see 4.4)

3.4 Interface and interoperability requirements.

3.4.1 Cartridge identification. The cartridge shall be clearly identified as armor piercing by marking in accordance with drawing no.12956134. The cartridge head shall be stamped with the initials of manufacturer or recognized trade name, and the last two numbers of the year of manufacture.

3.4.2 Interface and Compatibility. The cartridge shall be compatible with the M240 series machine gun and M24 Rifle. The cartridge shall be capable of being linked with M13 links loaded, chambered and fired in the M240 machine gun and M24 Rifle, and extracted after firing without binding or use of undue force, without damage to the weapon and without cartridge-induced malfunctions.

3.4.3 Primer sensitivity. The value of the average height (h) and standard deviation (s) of the height of fire functioning by a 3.94 ± 0.02 ounce steel ball shall be such that $h + 5(s)$ shall be not greater than 15 inches and $h - 2(s)$ shall be not less than 3 inches.

3.5 Operating requirements.

3.5.1 Pressure

3.5.1.1 Chamber pressure at ambient temperature. The average chamber pressure of the cartridges conditioned and fired at ambient temperature shall be not greater than 55,115 psi (380 MPa). Neither the chamber pressure of an individual cartridge nor the average chamber pressure plus three standard deviations of chamber pressure shall exceed 58,016 psi (400 MPa) (see 6.14).

3.5.1.2 Chamber pressure at hot and cold temperatures. The average chamber pressure of cartridges conditioned and fired at hot or cold temperatures shall not be greater than 60,917 psi (420 MPa). The average chamber pressure for the conditioned cartridges shall not vary by more than +7,252 psi (50 MPa) or -14,504 psi (-100 MPa) from the average chamber pressure of the cartridges tested at ambient (see 6.14).

3.5.1.3 Port pressure at ambient temperature. The average port pressure of the cartridges conditioned and fired at ambient temperature shall be not greater than 12,328 psi (85 MPa) or less than 8,702 psi (60 MPa) (see 6.14).

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3.5.2 Velocity

3.5.2.1 Velocity at ambient temperature. The average velocity of the cartridges conditioned and fired at ambient temperature measured at 78 ft (24 m) from the muzzle of the weapon, shall be within ± 33 fps (± 10 mps) of the velocity determined during design verification. The standard deviation of the velocities shall be not greater than 33 fps (10 mps) (see 6.14.)

3.5.2.2 Velocity at hot and cold temperatures. The average velocity of cartridges conditioned and fired at hot or cold temperatures, shall not increase by more than 150 fps (46 mps) or decrease by more than 249 fps (76 mps) with respect to the average velocity of cartridges conditioned at ambient (see 6.14).

3.5.3 Action time. The action time (overall primer ignition, propellant burning, plus the time taken for the bullet to exit the barrel) of the cartridge conditioned and fired at hot, cold or ambient temperatures shall not exceed 4 milliseconds (see 6.14).

3.5.4 Cyclic rate. The cartridges shall function in the M240B machine gun at an average cyclic rate between 650 and 850 rpm when conditioned and fired at hot, cold, or ambient temperatures (see 6.14).

3.5.5 Noise level. The mean maximum peak sound pressure level of the cartridge when fired from a M240B machine gun shall be not greater than 170 decibels with a B-duration of not greater than 20 milliseconds, at typical shooter position.

3.5.6 Bullet integrity. The projectile of the cartridge shall not burst or fragment in the barrel or in flight. No part shall strip from the projectile when the cartridge is fired.

3.5.7 Penetration. For each test below, the projectile of the cartridge shall penetrate 7mm thick High Hardness Armor (HHA) plate, in accordance with MIL-DTL-46100, creating a hole through which daylight can be seen.

3.5.7.1 Penetration at 546.8 yards. The bullet of the cartridge shall be capable of penetrating the HHA plate at 0 degrees obliquity at a minimum range of 546.8 yards (500 meters).

3.5.7.2 Penetration at 716.3 yards. The bullet of the cartridge shall be capable of penetrating the HHA plate at 0 degrees obliquity at a minimum range of 716.3 yards (655 meters) with a success rate of not less than 50%.

3.5.8 Dispersion. The cartridges when fired in ten round groups from an accuracy test weapon, at targets set at a distance of 600 yards (549 meters) from the muzzle, shall exhibit an average mean radius not to exceed 6.0 inches (15.2cm).

3.5.9 Accuracy. When fired from a M240B machine gun at a target situated 109.3 yards (100 m) from the muzzle, the extreme spread shall be not greater than 11.8 inches (30 cm).

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3.5.10 Ballistic match. The cartridge shall exhibit a ballistic match to the M62 tracer cartridge over 765.7 yards (700 m) range. A ballistic match is defined as a radial difference equal to or less than ± 0.5 mils.

3.5.11 Bullet extraction. The force required to separate the bullet from the cartridge case shall not be less than 60 lbs (267 Newtons).

3.5.12 Function and casualty. The cartridge shall function without casualty when fired at ambient, hot, cold, extreme hot and extreme cold temperatures in the M240B machine gun and at ambient, hot and cold in the M24 rifle (see 6.14).

3.5.13 Reliability. When fired at ambient temperature from an M240B machine gun, the mean rounds between stoppages (MRBS) shall be not less than 4500.

3.5.14 Residual stress. The cartridge case shall not split when subjected to a solution of mercurous nitrate in accordance with SCATP 7.62mm for a period of fifteen minutes.

3.6 Environmental requirements.

3.6.1 Waterproofness. The cartridge shall be waterproofed and tested against either requirement below:

a. Bubble test. The cartridge shall not release more than one bubble of air when subjected to a positive internal pressure 7.5 pounds per square inch (psi) of water for 30 seconds minimum.

b. Firing test. After cartridges have been submerged in ambient water for 24 hours (minimum of 1 inch of water above the cartridges), then fired, the average velocity of the cartridges shall not have a difference greater than ± 30 fps from the average velocity obtained from the velocity test of 3.5.2.1.

3.6.2 Sequential rough handling. The cartridge shall be safe to fire and exhibit no degradation in performance and reliability after withstanding transportation and rough handling conditions:

- a. Secured-cargo vibration
- b. Cartridges, packaged in accordance with the packaging provisions of the contract, dropped 2.1 meters.
- c. Loose cargo bounce test
- d. 1.5 meter unpackaged drop

3.6.3 Twelve meter (Forty foot) drop. When packaged in accordance with the packaging provisions of the contract, the cartridge shall not detonate or burn, lose propellant, and shall be safe to handle for disposal when subjected to the 12 meter (40 foot) drop without injury to personnel.

3.6.4 Long term high temperature storage. The cartridge shall show no signs of degradation and shall be safe to handle and fire after being subjected to 28 days of continuous

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heating at $140 \pm 2^\circ\text{F}$ ($60 \pm 1.1^\circ\text{C}$). The cyclic rate shall not change by more than 15 percent from the cyclic rate established during F&C testing.

3.6.5 Long term low temperature storage. The cartridge shall be safe to fire after being subjected to 28 days continuous cooling at $-40 \pm 2^\circ\text{F}$ ($-40 \pm 1.1^\circ\text{C}$). The cyclic rate shall not change by more than 15 percent from the cyclic rate established during the F&C test.

3.6.6 Thermal shock. The cartridge shall exhibit no evidence of corrosion and shall be safe to fire and function after exposure to alternately high and low temperature extremes of $160 \pm 3^\circ\text{F}$ to $-70 \pm 2^\circ\text{F}$ ($71.1 \pm 1.7^\circ\text{C}$ to $-56.6 \pm 1.1^\circ\text{C}$). The cyclic rate shall not change by more than 15 percent from the cyclic rate established during the F&C test.

3.6.7 Temperature and humidity. The cartridge shall be safe to fire and function after being subjected to a 10-day temperature/humidity cycle. The cyclic rate of fire shall not change by more than 15 percent from the cyclic rate established during the F&C test.

3.6.8 Salt spray. The cartridge shall be safe to fire after being subjected to a 5 percent salt spray (fog) for 48 hours.

3.6.9 Cook-off. A cartridge inserted into the chamber of an M240B machine gun, following the firing of 280 cartridges in the weapon, shall not cook-off. In addition, the cartridge shall not deform to the extent that clearing of the weapon is difficult.

3.6.10 Electrostatic Discharge (ESD) Personnel-borne. The cartridges shall withstand 25.0 ± 1.2 kilovolts electrostatic discharge without burning, exploding or becoming unsafe to handle when tested in accordance with 4.7.10. Test to be performed at ambient (see 6.14).

3.6.11 Electrostatic Discharge Helicopter-borne. The cartridges shall withstand 300 ± 15 kilovolts electrostatic discharge without burning, exploding, or becoming unsafe to handle when tested in accordance with 4.7.11. Test to be performed at ambient temperature (see 6.14).

3.6.12 Chemical compatibility. The cartridge shall function safely in the M240B machine gun and M24 Rifle after exposure to commonly encountered chemicals in the field.

3.7 Ownership and support requirements.

3.7.1 Safety. The cartridge shall not create any hazards that would adversely impact the health, safety, and performance of the user/operator. Hazards include, but are not limited to, misfires, delayed ignition, cook-off, cartridge case stuck inside chamber, projectile lodged in-bore, excessive low or high muzzle velocity and ruptured cartridge cases.

3.7.2 Final hazard classification (FHC). The M993 cartridge shall comply with the following Hazard Classification.

DOD Hazard Class/Div:	<u>1.4</u>
DOD Hazard Compatibility Group:	<u>C</u>
DOT Hazard Class:	<u>1.4C</u>

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3.7.3 Energetic material qualification. The energetic material used in the cartridges shall be qualified for the intended military use by the Army Service Qualification Authority (see 6.8)

3.7.4 Energetic materials compatibility. All energetic materials (explosives, propellants, and pyrotechnics) utilized must be compatible with all combinations of directly contacting energetic and non-energetic materials.

3.7.5 Propellant stability. All propellant shall be stable over a minimum time period of twenty (20) years.

3.7.6 Pyrotechnic sensitivity. All pyrotechnic materials shall be insensitive to initiation during routine shipping, handling and storage.

3.7.7 Toxic fumes. The toxic fumes produced by the cartridge shall not exceed those produced by firing similar quantities of 7.62mm M80 ball ammunition by greater than 15%.

3.7.8 Surface Danger Zone. The cartridge, when fired, shall fall within the boundaries of the established Surface Danger Zone established during design verification.

3.7.9 Barrel erosion. The average life per barrel of 3 barrels shall not be less than 8,000 rounds on an M240B machine gun.

3.7.10 Explosive Ordnance Disposal (EOD). When specified (see 6.4), the cartridge shall undergo an EOD disposal test during design verification by EOD personnel in accordance with EOD procedures prescribed by Army TM 60A-1-1-31.3.6

3.7.11 Ammunition lot numbering. Ammunition lot numbering shall be assigned in accordance with MIL-STD-1168.

3.7.12 Demilitarization. The cartridge shall be able to be demilitarized in accordance with procedures in the Small Arms Technical Manual DMWR 9-1300-0017-D1. The use of hazardous materials as specified in Environmental Protection Agency (EPA) 33/50 Program - The Final Record; Box 1 - 17 Targeted Chemicals shall be avoided (see 6.2)

3.7.13 Workmanship. The parts of the cartridge shall be free of cracks, splits, perforations, rust, burrs and foreign matter. The cleaning method used shall not be injurious to any parts, nor shall the parts be contaminated by any cleaning agent. Cartridge shall be free of scratches and sharp edges which may affect performance or result in personnel injury.

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4. VERIFICATION

TABLE I. Requirement/verification cross reference matrix

<u>METHOD OF VERIFICATION</u> 1 – Demonstration 2 – Examination 3 – Test		<u>CLASSES OF VERIFICATION</u> A – Design verification B – First article inspection C – Conformance inspection						
Section 3 Requirement		Verification Methods			Verification Class			Section 4 Verification Procedures
		1	2	3	A	B	C	
3.1	Design verification	X	X	X	X			4.2 & Table II
3.1.1	Product uniformity	X	X	X	X	X	X	4.2.1
3.1.2	Product baseline	X	X	X	X			4.2.2
3.2	First article		X	X		X		4.3 & Table III
3.2.1	PCA			X		X	X	4.3.1
3.3	Conformance inspection		X	X	X	X	X	4.4, Table IV
3.4.1	Cartridge identification		X	X	X	X	X	4.5.1
3.4.2	Interface and compatibility		X	X	X	X	X	4.5.2
3.4.3	Primer sensitivity			X	X	X	X	4.5.3
3.5.1.1	Chamber pressure at ambient			X	X	X	X	4.6.1.1
3.5.1.2	Chamber Pressure at hot and cold			X	X	X	X	4.6.1.2
3.5.1.3	Port pressure at ambient			X	X	X	X	4.6.1.3
3.5.2.1	Velocity at ambient			X	X	X	X	4.6.2.1
3.5.2.2	Velocity at hot and cold			X	X	X	X	4.6.2.2
3.5.3	Action time			X	X	X	X	4.6.3
3.5.4	Cyclic rate			X	X			4.6.4
3.5.5	Noise level			X	X			4.6.5
3.5.6	Bullet integrity			X	X	X	X	4.6.6
3.5.7.1	Penetration at 546.8 yds			X	X	X	X	4.6.7.1
3.5.7.2	Penetration at 716.3 yds			X	X			4.6.7.2
3.5.8	Dispersion			X	X	X	X	4.6.8
3.5.9	Accuracy			X	X			4.6.9
3.5.10	Ballistic match			X	X			4.6.10
3.5.11	Bullet extraction			X	X	X	X	4.6.11
3.5.12	Function and casualty (F&C)			X	X	X	X	4.6.12
3.5.13	Reliability (F&C)			X	X			4.6.13
3.5.14	Residual stress			X	X	X	X	4.6.14
3.6.1	Waterproofness			X	X	X	X	4.7.1
3.6.2	Sequential rough handling			X	X			4.7.2
3.6.3	Twelve meter (forty foot) drop			X	X			4.7.3
3.6.4	Long term high temp storage			X	X			4.7.4
3.6.5	Long term low temp storage			X	X			4.7.5
3.6.6	Thermal shock			X	X			4.7.6
3.6.7	Temperature and humidity			X	X			4.7.7
3.6.8	Salt Spray			X	X			4.7.8
3.6.9	Cook off			X	X			4.7.9
3.6.10	ESD Personnel-borne			X	X			4.7.10

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TABLE I. Requirement/verification cross reference matrix – continued

<u>METHOD OF VERIFICATION</u>		<u>CLASSES OF VERIFICATION</u>						
1 – Demonstration 2 – Examination 3 – Test		A – Design verification B – First article inspection C – Conformance inspection						
Section 3 Requirement		Verification Methods			Verification Class			Section 4 Verification Procedures
		1	2	3	A	B	C	
3.6.11	ESD Helicopter-borne			X	X			4.7.11
3.6.12	Chemical compatibility			X	X			4.7.12
3.7.1	Safety	X			X			4.8.1
3.7.2	Final hazard classification			X	X			4.8.2
3.7.3	Energetic materials qualification			X	X			4.8.3
3.7.4	Energetic materials compatibility		X		X			4.8.4
3.7.5	Propellant stability			X	X			4.8.5
3.7.6	Pyrotechnic sensitivity			X	X			4.8.6
3.7.7	Toxic Fumes			X	X			4.8.7
3.7.8	Surface Danger Zone			X	X	X	X	4.8.8
3.7.9	Barrel erosion			X	X	X		4.8.9
3.7.10	EOD	X			X			4.8.10
3.7.11	Ammunition lot numbering		X				X	4.8.11
3.7.12	Demilitarization			X	X			4.8.12
3.7.13	Workmanship		X		X	X	X	4.8.13

4.1 Classification of verification. The inspection requirements specified herein are classified as follows:

- a. Design verification (see 4.2)
- b. First article inspection (see 4.3)
- c. Conformance inspection (see 4.4)

4.1.1 Classification of characteristics. For examinations and tests cited herein; critical, major, and minor characteristics are defined in accordance with MIL-STD-1916.

4.2 Design verification. When specified, a sample of the M993 cartridge and its components shall undergo design verification by examination, analysis, demonstration and tests in accordance with TABLE II. The quantity of cartridges submitted for design verification shall be 85,626 M993 rounds plus any as required.

4.2.1 Product uniformity of key characteristics. Verify by examination of objective evidence and analysis that key characteristics have been identified and variability limits have been established.

4.2.2 Product baseline. Verify by examination of objective evidence that the product baseline has been established and is complete.

4.2.3 Design verification rejection. If any item of the sample fails to comply with the design verification requirements specified in TABLE II, the sample shall be rejected, and the design shall not be verified.

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TABLE II. Design verification tests and inspection

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993				DRAWING NO. 12956134	
EXAMINATION OR TEST <u>1/</u>	CONFORMANCE CRITERIA			REQUIREMENT PARAGRAPH	INSPECTION METHOD/ PARAGRAPH REFERENCE
	QTY	Acc	Rej		
Examination for defects <u>2/</u>				3.1, 3.4	4.2, 4.5
Critical defects	100%	0	1	Table V	
Major defects (101-104)	100%	0	1	Table V	
Major defects (105-121)	Level IV	0	1	Table V	
Minor defects	Level II	0	1	Table V	
Product uniformity	As required			3.1.1	4.2.1
Primer Sensitivity	50			3.4.4	4.5.4
Pressure	<u>4/</u>			3.5.1	4.6.1
a. Chamber - Cold	90			3.5.1.2	4.6.1.2
b. Chamber and Port - Ambient	90			3.5.1.1, 3.5.1.3	4.6.1.1, 4.6.1.3
c. Chamber - Hot	90			3.5.1.2	4.6.1.2
Velocity	<u>4/</u>			3.5.2	3.5.2
a. Cold	90			3.5.2.2	4.6.2.2
b. Ambient	90			3.5.2.1	4.6.2.1
c. Hot	90			3.5.2.1	4.6.2.2
Action time	<u>4/</u>			3.5.3	4.6.3
a. Cold	90			3.5.3	4.6.3
b. Ambient	90			3.5.3	4.6.3
c. Hot	90			3.5.3	4.6.3
Cyclic Rate	<u>3/</u>			3.5.4	4.6.4
a. Cold	900			3.5.4	4.6.4
b. Ambient	1,800			3.5.4	4.6.4
c. Hot	900			3.5.4	4.6.4
Noise	5			3.5.5	4.5.5
Bullet Integrity	<u>3/</u>			3.5.6	4.5.6
a. Cold	600	0	1	3.5.6	4.5.6
b. Ambient	2,000	0	1	3.5.6	4.5.6
c. Hot	600	0	1	3.5.6	4.5.6
Penetration				3.5.7	4.6.7
a. At 546.8 yards	20	0	1	3.5.7.1	4.6.7.1
b. At 716.3 yards	200	100	101	3.5.7.2	4.6.7.2

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TABLE II. Design verification tests and inspection – continued

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993				DRAWING NO. 12956134	
EXAMINATION OR TEST 1/	CONFORMANCE CRITERIA			REQUIREMENT PARAGRAPH	INSPECTION METHOD/ PARAGRAPH REFERENCE
	QTY	Acc	Rej		
Dispersion	180			3.5.8	4.6.8
Accuracy	180			3.5.9	4.6.9
Ballistic match	30			3.5.10	4.6.10
Bullet extraction	50	0	1	3.5.11	4.5.10
Function and casualty (F&C)				See Table VIII	
a. Extreme cold	3,000	<u>5/</u>		3.5.12	4.6.12
b. Cold	900	<u>5/</u>		3.5.12	4.6.12
c. Ambient	3,000	<u>5/</u>		3.5.12	4.6.12
d. Hot	900	<u>5/</u>		3.5.12	4.6.12
e. Extreme hot	3,000	<u>5/</u>		3.5.12	4.6.12
Reliability <u>3/</u>	45,000	<u>6/</u>		3.5.13	4.6.13
Residual stress	50	0	1	3.5.14	4.6.14
Waterproof	50	<u>8/</u>		3.6.1	4.7.1
Sequential Rough Handling	1600			3.6.2	4.7.2
Twelve meter drop	600			3.6.3	4.7.3
Long Term High Temperature Storage	250			3.6.4	4.7.4
Long Term Low Temperature Storage	250			3.6.5	4.7.5
Thermal shock	200			3.6.6	4.7.6
Temperature and Humidity	120			3.6.7	4.7.7
Salt Spray	120			3.6.8	4.7.8
Hot Chamber Effects (Cook Off)	281			3.6.9	4.7.9
ESD Personnel-borne	20	0	1	3.6.10	4.7.10
ESD Helicopter-borne	10	0	1	3.6.11	4.7.11
Chemical Compatibility	390			3.6.12	4.7.12
Safety	As required			3.7.1	4.8.1
Final Hazard Classification	As required			3.7.2	4.8.2
Energetic Mat. qualification	As required			3.7.3	4.8.3
Energetic Mat. Compatibility	As required			3.7.4	4.8.4
Propellant Stability	As required			3.7.5	4.8.5
Pyrotechnic Sensitivity	As required			3.7.6	4.8.6
Toxic Fumes	500			3.7.7	4.8.7
Surface Danger Zone	400			3.7.8	4.8.8

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TABLE II. Design verification tests and inspection – continued

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993				DRAWING NO. 12956134	
EXAMINATION OR TEST <u>1/</u>	CONFORMANCE CRITERIA			REQUIREMENT PARAGRAPH	INSPECTION METHOD/ PARAGRAPH REFERENCE
	QTY	Acc	Rej		
Barrel erosion	24,000		<u>7/</u>	3.7.9	4.8.9
Explosive Ordnance Disposal (EOD)	As required			3.7.10	4.8.10
Demilitarization	As required			3.7.12	4.8.12
Workmanship	-			3.7.13	4.8.13

NOTES:

1/ If no accept reject criteria is expressed, the design represented by the sample shall be rejected if the cartridges fail to comply with the applicable requirement.

2/ Level II or Level IV refers to Verification Level II or Verification Level IV respectively of Table II Attributes Sampling Plans in MIL-STD-1916.

3/ This test shall be carried out in conjunction with Function and Casualty testing at hot, cold and ambient temperatures. It shall be identified when that particular test is going to be conducted prior to the actual Function and Casualty testing.

4/ These tests will be done simultaneously.

5/ Refer to Table VI for accept/reject criteria.

6/ Refer to Table VII for accept/reject criteria.

7/ Barrel erosion, shall not be included in the firing defect count.

8/ Firing method: If the sample does not meet the requirement the lot shall be rejected.
Bubble Method: The test plan shall be: Sample 50 Accept 0 Reject 1

4.3 First article inspection. When specified in the contract, a sample of the cartridges shall be subjected to first article verification in accordance with TABLE III. The quantity of cartridges submitted for first article shall be 2,775 M993 rounds.

4.3.1 Physical configuration audit. A physical configuration audit (PCA) shall be performed on five sets of components, subassemblies and assemblies. There shall be no discrepancies between the samples and their corresponding configuration descriptions (drawings, specifications, etc.)

4.3.2 First article rejection. If any assembly, component or test specimen fails to comply with any of the applicable requirements, the first article sample shall be rejected.

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TABLE III. First article tests and inspection

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993				DRAWING NO. 12956134	
EXAMINATION OR TEST <u>1/</u>	CONFORMANCE CRITERIA			REQUIREMENT PARAGRAPH	INSPECTION METHOD/ PARAGRAPH REFERENCE
	QTY	ACC	REJ		
Examination for defects <u>2/</u>					
Critical defects	100%	0	1	Table V	
Major defects (101-104)	100%	0	1	Table V	
Major defects (105-121)	Level IV	0	1	Table V	
Minor defects	Level II	0	1	Table V	
Product uniformity	As required			3.1.1	4.2.3
Primer Sensitivity	50			3.4.3	4.5.4
Pressure	<u>3/</u>			3.5.1	4.6.1
a. Chamber - Cold	30			3.5.1.2	4.6.1.2
b. Chamber and Port - Ambient	30			3.5.1.1, 3.5.1.3	4.6.1.1, 4.6.1.3
c. Chamber - Hot	30			3.5.1.2	4.6.1.2
Velocity	<u>3/</u>			3.5.2	3.5.2
a. Cold	30			3.5.2.2	4.6.2.2
b. Ambient	30			3.5.2.1	4.6.2.1
c. Hot	30			3.5.2.1	4.6.2.2
Action time	<u>3/</u>			3.5.3	4.6.3
a. Cold	30			3.5.3	4.6.3
b. Ambient	30			3.5.3	4.6.3
c. Hot	30			3.5.3	4.6.3
Bullet Integrity	<u>4/</u>			3.5.6	4.5.6
a. Cold	300	0	1	3.5.6	4.5.6
b. Ambient	600	0	1	3.5.6	4.5.6
c. Hot	300	0	1	3.5.6	4.5.6
Penetration at 546.8 yards	20			3.5.7.1	4.6.7.1
Dispersion	90			3.5.8	4.5.20
Bullet Extraction	25	0	1	3.5.11	4.6.11
Function and casualty (F&C)				See Table VIII	
a. Cold	600	<u>5/</u>		3.5.13	4.6.13
b. Ambient	1,200	<u>5/</u>		3.5.13	4.6.13
c. Hot	600	<u>5/</u>		3.5.13	4.6.13
Residual Stress	50	0	1	3.5.14	4.6.14
Waterproofness	50	<u>6/</u>		3.6.1	4.7.1

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TABLE III. First article tests and inspection - continued

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993	DRAWING NO. 12956134
<p>NOTES:</p> <p><u>1/</u> If no accept reject criteria is expressed, the design represented by the sample shall be rejected if the cartridges fail to comply with the applicable requirement.</p> <p><u>2/</u> Level II or Level IV refers to Verification Level II or Verification Level IV respectively of Table II Attributes Sampling Plans in MIL-STD-1916.</p> <p><u>3/</u> These tests will be done simultaneously.</p> <p><u>4/</u> This test shall be carried out in conjunction with Function and Casualty testing at hot, cold and ambient temperatures. It shall be identified when that particular test is going to be conducted prior to the actual Function and Casualty testing. All Function and Casualty defects observed in other ballistic tests, shall be included in the defect count. The lot shall be rejected if the number of specified defects is greater than the acceptance number in Table IV.</p> <p><u>5/</u> Refer to Table VI for accept/reject criteria.</p> <p><u>6/</u> Firing Method: If the sample does not meet the requirement the lot shall be rejected. Bubble Method: The test plan shall be: Sample 50 Accept 0 Reject 1</p>	

4.4 Conformance inspection. When specified (see 6.2), sample cartridges and components shall undergo conformance inspection by examination, analysis, demonstration and tests as specified in TABLE IV. The quantity of cartridges submitted for conformance inspection shall be 1,520 M993 rounds.

4.4.1 Lot formation. Lot formation shall conform to requirements of MIL-STD-1916, and lot numbering shall be in accordance with MIL-STD-1168. The cartridge lot shall contain:

- a. Cartridges cases from one unchanged process and from one manufacturer.
- b. Bullets from one unchanged process and one manufacturer
- c. Primers from one lot interfix number and one manufacturer.
- d. Propellant from no more than two lot numbers and from one manufacturer

4.4.2 Classifications of characteristics. For all conformance inspections the same sample specimen may be used for all non-destructive examinations or tests. Known character defects are classified in TABLE V. Inspection sampling requirements for critical, major and minor characteristics are defined in MIL-STD-1916. Unless specified otherwise, Inspection Level IV shall be used for all characteristics defined as Majors and Inspection Level II for all Minor characteristics; Critical characteristics shall be addressed in accordance with MIL-STD-1916.

4.4.3 Conformance rejection If any assembly, component or test specimen fails to comply with any of the applicable requirements, the conformance sample shall be rejected.

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TABLE IV. Conformance tests

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993				DRAWING NO. 12956134	
EXAMINATION OR TEST	CONFORMANCE CRITERIA			REQUIREMENT PARAGRAPH	INSPECTION METHOD/ PARAGRAPH REFERENCE
	Qty	Acc	Rej		
Examination for defects <u>1/</u>					
Critical defects	100%	0	1	See TABLE V	
Major defects (101-104)	100%	0	1	See TABLE V	
Major defects (105-121)	Level IV	0	1	See TABLE V	
Minor defects	Level II	0	1	See TABLE V	
Product uniformity	As required			3.1.1	4.2.3
Primer Sensitivity	25			3.4.3	4.5.4
Pressure	<u>2/</u>			3.5.1	4.6.1
a. Chamber - Cold	20			3.5.1.2	4.6.1.2
b. Chamber and Port - Ambient	20			3.5.1.1, 3.5.1.3	4.6.1.1, 4.6.1.3
c. Chamber - Hot	20			3.5.1.2	4.6.1.2
Velocity	<u>2/</u>			3.5.2	3.5.2
a. Cold	20			3.5.2.2	4.6.2.2
b. Ambient	20			3.5.2.1	4.6.2.1
c. Hot	20			3.5.2.1	4.6.2.2
Action time	<u>2/</u>			3.5.3	4.6.3
a. Cold	20	0	1	3.5.3	4.6.3
b. Ambient	20	0	1	3.5.3	4.6.3
c. Hot	20	0	1	3.5.3	4.6.3
Bullet Integrity	<u>3/</u>			3.5.6	4.5.6
a. Cold	300			3.5.6	4.5.6
b. Ambient	600			3.5.6	4.5.6
c. Hot	300			3.5.6	4.5.6
Penetration at 546.8 yards	20	0	1	3.5.7.1	4.6.7.1
Dispersion	90	<u>4/</u>		3.5.8	4.5.20
Bullet Extraction	25	<u>4/</u>		3.5.11	4.6.11
Function and casualty (F&C)				See Table VIII	
a. Cold	300	<u>5/</u>		3.5.13	4.6.13
b. Ambient	600	<u>5/</u>		3.5.13	4.6.13
c. Hot	300	<u>5/</u>		3.5.13	4.6.13

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TABLE IV. Conformance tests - continued

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993				DRAWING NO. 12956134	
EXAMINATION OR TEST	CONFORMANCE CRITERIA			REQUIREMENT PARAGRAPH	INSPECTION METHOD/ PARAGRAPH REFERENCE
	Qty	Acc	Rej		
Residual stress	50	<u>4</u> /		3.5.14	4.6.14
Waterproof	50	<u>6</u> /		3.6.1	4.7.1

NOTES:

1/ Level II or Level IV refers to Verification Level II or Verification Level IV respectively of Table II Attributes Sampling Plans in MIL-STD-1916.

2/ These tests will be done simultaneously. If any action time failures occur the lot is rejected, no retest is allowed. Alternatively, failure of port pressure, chamber pressure, or velocity to meet their specific requirement allows a retest. This retest of the entire test shall be performed with double the sample. If any portion of this test fails, the lot is rejected.

3/ This test shall be carried out in conjunction with Function and Casualty testing at hot, cold and ambient temperatures. Any evidence of irregular holes on the paper screens shall be cause for rejection of the lot subject to testing a second sample, double the first sample. Any evidence of irregular holes in the second sample shall be cause to reject the lot.

4/ Failure of the cartridges to comply with the applicable requirement shall be cause for a retest consisting of double the sample of the first test. If the requirement is not met for this retest, the lot is rejected.

5/ Refer to Table VI for accept/reject criteria. All Function and Casualty defects observed in other ballistic tests shall be included in the defect count. The lot shall be rejected if the number of specified defects exceeds the acceptance number in Table VI, First Article and Lot Acceptance. If the number of defects is equal to or less than the reject number specified, a second sample, consisting of double the first sample shall be selected and the entire test may be retested. The lot shall be rejected if the specified defect totals equal or exceed the reject numbers. No retests are permitted for Critical defects.

6/ Firing Method: If the sample does not meet the requirement a second sample, double the first sample, may be tested. If this sample does not meet the requirement, the lot is rejected.

Bubble Method: The test plan shall be:

First Sample	50	Accept 2	Reject 10
Second Sample	100	Accept 9	Reject 10

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TABLE V. Inspections by classification of characteristics

CARTRIDGE, 7.62MM: ARMOR PIERCING, M993			DRAWING NO. 12956134	
CLASSIFICATION	EXAMINATION OR TEST <u>1/</u>	CONFORMANCE CRITERIA <u>3/</u>	REQUIREMENT PARAGRAPH	INSPECTION METHOD/ PARAGRAPH REFERENCE
<u>Critical</u>				
1	Case split in K, L, or M location (6)	100%	3.4.2	Visual/Gage
2	Case split in S, or J location when loss of powder occurs (6)	100%	3.4.2	Visual/Gage
3	Perforated case (7)	100%	3.4.2	Visual/Gage
4	Weight under minimum <u>2/</u>	100%	3.4.2	Gage
5	Primer above flush	100%	3.4.2	Visual/Gage
<u>Major</u>				
101	Primer missing (32)	100%	3.4.2	Visual/gage
102	Primer inverted (34)	100%	3.4.2	Visual/gage
103	Primer cocked (33)	100%	3.4.2	Visual/gage
104	Case split in I, S or J location with no loss of powder	100%	3.4.2	Visual/gage
105	Corroded or stained (if etched) case (2)	Level IV	3.4.2	Visual
106	Round head (4)	Level IV	3.4.2	Visual
107	Dented case (5)	Level IV	3.4.2	Visual
108	Draw scratch in case (if applicable) (8)	Level IV	3.4.2	Visual
109	Beveled underside of head (10)	Level IV	3.4.2	Visual
110	Scaly metal on case (if applicable) (12)	Level IV	3.4.2	Visual
111	No chamfer on head (rim) (13)	Level IV	3.4.2	Visual
112	Loose primer (35)	Level IV	3.4.2	Visual/Manual
113	Diameter of extractor groove, max, incorrect	Level IV	3.4.2	Gage
114	Diameter of head, incorrect	Level IV	3.4.2	Gage
115	Thickness of rim, incorrect	Level IV	3.4.2	Gage
116	Length to shoulder datum, incorrect	Level IV	3.4.2	Gage
117	Depth of primer, incorrect	Level IV	3.4.2	Gage
118	Primer cup missing	Level IV	3.4.2	Visual
119	Overall length, max, incorrect	Level IV	3.4.2	Gage

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TABLE V. Inspections by classification of characteristics - continued

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993			DRAWING NO. 12956134	
CLASSIFICATION	EXAMINATION OR TEST <u>1/</u>	CONFORMANCE CRITERIA <u>3/</u>	REQUIREMENT PARAGRAPH	INSPECTION METHOD/ PARAGRAPH REFERENCE
120	Cartridge identification marking missing/incorrect	Level IV	3.4.2	Visual
121	Profile and alignment, incorrect	Level IV	3.4.2	8648501
122	Missing slug in bullet <u>4/</u>	Level IV	3.4.2	Gage
<u>Minor</u>				
201	Discolored, dirty, oily or smeared waterproofing (1) (if applicable)	Level II	3.4.2	Visual
202	Draw scratch in case (8)	Level II	3.4.2	Visual
203	Dented case	Level II	3.4.2	Visual
204	Scratch in case (9)	Level II	3.4.2	Visual
205	Scaly metal on case (12)	Level II	3.4.2	Visual
206	Fold, wrinkle, buckle or bulge in case (14, 15,16 17)	Level II	3.4.2	Visual
207	Head stamp missing or illegible (18)	Level II	3.4.2	Visual
208	Defective head (19)	Level II	3.4.2	Visual
209	No waterproofing material primer pocket joint (37)	Level II	3.4.2	Visual
210	Defective crimp (primer) (38)	Level II	3.4.2	Visual
211	Diameter of extractor groove, min, incorrect	Level II	3.4.2	Gage
212	Workmanship	Level II	3.7.13	Visual

NOTES:

1/ Numbers in parenthesis after defect descriptions refer to visual standards in MIL-STD-636.

2/ Prior to design verification testing, it shall be established that the minimum charge required precluding the possibility of a bullet in bore. Cartridges containing less than this minimum charge are critically defective.

3/ Level II or Level IV refer to Verification Level II or Verification Level IV, respectively, of Table II Attributes sampling plans in MIL-STD-1916.

4/ Examination for this may be performed by either weighing the overall cartridge or an inspection method that can determine directly if the lead slug is present.

5/ Any requirement not applicable to the design shall be removed for the design verification approval (see 6.2)

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TABLE VI. Function and casualty firing defect criteria

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993									DRAWING NUMBER 12956134
Defect Description	Criteria <u>1/</u>								Classification
	Design Verification <u>2/</u>				First Article		Lot Acceptance <u>3/</u>		
	M24		M240B		M240B		M240B		
	Acc	Rej	Acc	Rej	Acc	Rej	First Sample	Cumulative Sample	
Bullet in bore	0	1	0	1	0	1	0	1	Critical
Misfire - weight under minimum	0	1	0	1	0	1	0	1	Critical
Misfire - contaminated propellant <u>4/</u>	0	1	0	1	0	1	0	1	Critical
Misfire - no vent hole or obstruction	1	2	1	2	1	2	1	2	Major
Misfire - contaminated primer	1	2	1	2	1	2	1	2	Major
Misfire - low output primer	1	2	1	2	1	2	1	2	Major
Misfire - other <u>5/</u>	1	2	1	2	1	2	1	2	Major
Primer defects:									
a. Perforation in the primer cup caused by the firing pin <u>6/</u>	60	61	227	228	24	25	18	45	Minor
b. Perforation in the primer cup not caused by the firing pin	1	2	1	2	1	2	1	2	Major
c. Escape of gas around the primer cup									
(1) Total number allowed	60	61	227	228	69	70	34	78	Minor
(2) More than 50% of periphery	38	39	194	195	39	40	28	58	Major
d. Blown primer (Primer separates from casehead and primer pocket is grossly distorted)	1	2	1	2	1	2	1	2	Major
e. Primer that falls out of pocket on retraction of the bolt	1	2	1	2	1	2	1	2	Major
Case casualties <u>7/</u>									
a. Longitudinal split									
(1) Case base (L)	0	1	0	1	0	1	0	1	Critical
(2) Through case base (M)	0	1	0	1	0	1	0	1	Critical
(3) Body (K) extending to case base	0	1	0	1	0	1	0	1	Critical
(4) Upper body (J)	1	2	2	4	1	2	1	2	Major
(5) Neck and shoulder (I or S)	30	31	119	120	44	45	22	55	Minor
b. Circumferential rupture									

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TABLE VI. Function and casualty firing defect criteria - continued

CARTRIDGE, 7.62MM: ARMOR PIERCING- M993									DRAWING NUMBER 12956134
Defect Description	Criteria <u>1/</u>								Classification
	Design Verification <u>2/</u>				First Article		Lot Acceptance <u>3/</u>		
	M24		M240B		M240B		M240B		
	Acc	Rej	Acc	Rej	Acc	Rej	First Sample	Cumulative Sample	
(1) Complete	0	1	0	1	0	1	0	1	Critical
(2) Partial – case base (L)	0	1	0	1	0	1	0	1	Critical
(3) Partial – body (K)	0	1	0	1	0	1	0	1	Critical
(4) Partial – neck, shoulder, or upper body (I, S or J)	1	2	1	2	1	2	1	2	Major
Stoppage attributable to ammo	1	2	1	2	1	2	1	2	Major
Failure to extract	1	2	3	4	0	1	0	-	Major
Detached material	1	2	1	2	1	2	1	2	Major

Notes:

1/ All stoppages observed in all firing tests, with the exception of the Reliability Test, which are attributable to the ammunition with the exception of misfire and complete rupture shall be included.

2/ For design verification and first article inspection, if the function and casualty defects plus firing defects observed in all other tests exceed the acceptance number, the qualification sample shall be rejected.

3/ For conformance testing. The lot shall be rejected when function and casualty defects plus firing defects observed in all other tests exceed the acceptance number for the cumulative sample in TABLE VI. If the number defects found in the first test exceeds the acceptance number, a second sample, consisting of double the quantities specified for the function and casualty test, shall be fired. If the total number of defects in the combined first and second samples exceeds the acceptance number for the cumulative sample, the lot shall be rejected. If, in testing a second sample, defects other than those for which the second sample is being tested occur to the extent that the acceptance number for the cumulative sample is exceeded, the lot shall be rejected.

4/ After a misfire occurs, if contaminated propellant is considered to be the source, further analysis shall be done to determine if that was the definite cause.

5/ Each cartridge that misfires shall be disassembled and examined for the presence of a vent, or any obstruction in the vent hole area that can be designated as the cause for the misfire. If the vent hole is missing or obstructed, the sample shall be rejected. If the vent hole is present, the cartridge shall be examined for evidence of a low output primer caused by either contamination or a lightweight primer.

6/ If one defect is found in the first sample the firing pin of the specified weapon(s), in which the defect occurred, shall be replaced by a new firing pin. If an additional primer perforation is found, the design shall be rejected.

7/ For location of defects indicated by letters in parentheses, see drawing 7643674.

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TABLE VII. Reliability firing defect criteria with M240B machine gun

CARTRIDGE, 7.62MM: ARMOR PIERCING, M993		DRAWING NUMBER 12956134	
Defect Description	M240B Criteria		
	Accept	Reject	Classification
Bullet in bore	0	1	Critical
Misfire - weight under minimum	0	1	Critical
Misfire - contaminated propellant <u>1/</u>	0	1	Critical
Misfire - no vent hole or obstruction	1	2	Major
Misfire - contaminated primer	1	2	Major
Misfire - low output primer	1	2	Major
Misfire - other <u>2/</u>	1	2	Major
Primer defects:			
a. Perforation in the primer cup caused by the firing pin <u>3/</u>	1	2	Minor
b. Perforation in the primer cup not caused by the firing pin	1	2	Major
c. Escape of gas around the primer cup			
(1) Total number allowed	637	638	Minor
(2) More than 50% of periphery	551	552	Major
d. Blown primer (Primer separates from casehead and primer pocket is grossly distorted)	1	2	Major
e. Primer that falls out of pocket on retraction of the bolt	1	2	Major
Case casualties <u>4/</u>			
a. Longitudinal split			
(1) Case base (L)	0	1	Critical
(2) Through case base (M)	0	1	Critical
(3) Body (K) extending to case base	0	1	Critical
(4) Upper body (J)	2	4	Major
(5) Neck and shoulder (I or S)	339	340	Minor
b. Circumferential rupture			
(1) Complete	0	1	Critical
(2) Partial – case base (L)	0	1	Critical
(3) Partial – body (K)	0	1	Critical
(4) Partial – neck, shoulder, or upper body (I, S or J)	1	2	Major
Stoppage attributable to ammo <u>5/</u>	1	2	Major
Failure to extract	3	4	Major
Detached material	1	2	Major

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TABLE VII. Reliability firing defect criteria with M240B machine gun - continued

CARTRIDGE, 7.62MM: ARMOR PIERCING, M993	DRAWING NUMBER 12956134
<p>Notes:</p> <p>1/ After a misfire occurs, if contaminated propellant is considered to be the source, further analysis shall be done to determine if that was the definite cause. If so an investigation shall be performed to determine the root cause of the contamination.</p> <p>2/ Each cartridge that misfires shall be disassembled and examined for the presence of a vent, or any obstruction in the vent hole area that can be designated as the cause for the misfire. If the vent hole is missing or obstructed, the sample shall be rejected. If the vent hole is present, the cartridge shall be examined for evidence of a low output primer caused by either contamination or a lightweight primer.</p> <p>3/ If one defect is found in the first sample the firing pin of the specified weapon(s), in which the defect occurred, shall be replaced by a new firing pin. If an additional primer perforation is found, the design shall be rejected.</p> <p>4/ For location of defects indicated by letters in parentheses, see drawing 7643674.</p> <p>5/ All stoppages observed in all firing tests, which are attributable to the ammunition with the exception of misfire and complete rupture shall be included. These numbers of defects shall be used to determine MRBS.</p>	

4.5 Interface and interoperability verification

4.5.1 Cartridge identification. The cartridge identification shall be verified by visual inspection. The bullet tip shall be black in color, and shall be verified using FED-STD-595/37038 color chip.

4.5.2 Interface and compatibility Interface and compatibility of the cartridges shall be verified by successful completion of tests in TABLE IV, V, and VI.

4.5.3 Primer sensitivity. Test in accordance with the SCATP-7.62mm, Chapter 4, Primer Sensitivity Test Procedure, utilizing the ball and firing pin identified on drawings 10520006 and 7553221 respectively.

4.6 Operating requirement. All ballistic testing shall be examined against Table VI. For any ballistic test except function and casualty, where the occurrence of a firing defect prevents the obtaining of a valid result for the characteristic being tested, the defect shall be observed. The particular test for which the round was fired shall not be penalized. A replacement round shall be fired to obtain the data for the test.

4.6.1 Pressure.

4.6.1.1 Chamber pressure at ambient temperature. The test samples shall be conditioned at the specified test temperature in Section 3.5.1.1. The test shall be conducted in accordance with SCATP-7.62, chapter 1, Electric Pressure, Velocity, and Action Time (EPVAT).

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4.6.1.2 Chamber pressure at hot and cold temperatures. The test samples shall be conditioned at the specified test temperatures in Section 3.5.1.2. The test shall be conducted in accordance with SCATP-7.62mm, chapter 1, Electric Pressure, Velocity, and Action Time (EPVAT).

4.6.1.3 Port pressure at ambient temperature. The test samples shall be conditioned at the specified test temperatures in Section 3.5.1.3. The test shall be conducted in accordance with SCATP-7.62mm, chapter 1, Electric Pressure, Velocity, and Action Time (EPVAT).

4.6.2 Velocity.

4.6.2.1 Velocity at ambient temperature. The test samples shall be conditioned at the specified test temperatures in Section 3.5.2.1. The test shall be conducted in accordance with SCATP-7.62, chapter 1, Electric Pressure, Velocity, and Action Time (EPVAT).

4.6.2.2 Velocity at hot and cold temperatures. The test samples shall be conditioned at the specified test temperatures in Section 3.5.2.2. The test shall be conducted in accordance with SCATP-7.62mm, chapter 1, Electric Pressure, Velocity, and Action Time (EPVAT).

4.6.3 Action time. The test samples shall be conditioned at the specified test temperatures in Section 3.5.3. The test shall be conducted in accordance with SCATP-7.62mm, chapter 1, Electric Pressure, Velocity, and Action Time (EPVAT).

4.6.4 Cyclic rate. The cyclic rate shall be measured using a recorder capable of measuring to an accuracy of at least ± 2 percent of the true rate of fire. The cyclic rates (rounds fired per minute) shall be measured using an approved procedure during each function and casualty test conditioned at temperatures specified in Section 3.5.4.

4.6.5 Noise. The Noise test shall be conducted in accordance with TOP 1-2-608 paragraph 4.2 with the M240B machine gun. Testing shall be conducted in an area free of any sound-reflecting surfaces within 49 meters. For all test firings, the shooter shall fire from the prone position from the shoulder. Three microphones shall be placed:

- a. 5 meters to the rear of the weapon's muzzle
- b. 5 meters to the left of the weapon
- c. 5 meters away 45° left/rear of the weapon's muzzle

Simultaneous analysis of impulse noise levels shall be made at the three locations. In addition evaluation of the impulse noise levels shall be made at the shooter's ear (left ear, weapon fired right-handed). With the exception of the shooter's ear position, all distances are from the weapon's muzzle. Five single shots of test ammunition and five rounds of standard M80 Ball ammunition shall be fired single shot.

4.6.6 Bullet integrity. Test in accordance with SCATP-7.62mm, Chapter 1, Stripping Test Procedure. All irregular perforations shall be measured. All irregular perforations greater than 1/10 inch shall be classed as defects.

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4.6.7 Penetration. This test shall be performed using the specified armor plate. The test shall only be performed at temperatures above 20°F.

4.6.7.1 Penetration at 546.8 yd. (500 meters). This portion of the test shall be performed in accordance with SCATP-7.62mm, Chapter 1, Penetration Test Procedure. The projectiles of the cartridges shall create a hole in the HHA through which light may be seen. The sample shall be rejected if one round fails to penetrate the plate.

4.6.7.2 Penetration at 716.3 yd. (655 meters) for R50 test. This portion of the test shall be performed in accordance with TOP 2-2-710 for an R50 test utilizing the Langley method of sensitivity testing for range determination. If the resultant R50 range is less than the required distance, the design shall be rejected.

4.6.8 Dispersion. The test shall be conducted in accordance with SCATP-7.62mm, Chapter 1, Dispersion Test Procedure. For the Design Verification test use three accuracy test barrels, and for each barrel use six ten-round targets for a total of sixty rounds per barrel. For First Article and Lot Acceptance tests use three test barrels and for each barrel use three ten-round targets. The rounds shall be fired at a target located at a range of 600 yards (549 m). The barrel shall be secured to a slave breech mechanism mounted on a test stand. The ammunition shall be conditioned at ambient (see 6.14). A minimum of three rounds shall be fired to warm and sight each barrel prior to test. Prior to firing any test cartridges, ten M80 reference ammunition shall be fired at a ten-round target to baseline each accuracy barrel. Target scoring shall be performed using an acoustical scoring system or paper targets.

4.6.9 Accuracy. Three M240B machine guns shall be mounted individually in a hard mount test fixture. Each weapon shall be tested in accordance with the procedures outlined in MIL-M-63314, paragraph 4.5.6. The weapon shall be sighted in on a paper target located 109.3 yards (100 m) from the muzzle of the weapon. A maximum of five warming rounds shall be fired from each weapon to warm and foul the weapon prior to testing. Six ten-round targets of ammunition shall be fired in a ten-round continuous burst from each weapon with the target being changed prior to the next firing. Target scoring shall be performed using the acoustical scoring system or paper target. The horizontal and vertical coordinates of impact are used to calculate various dispersion parameters.

4.6.10 Ballistic match. Thirty cartridges shall be tested in accordance with the procedures in TOPs 4-2-604 and 4-2-827. Ten cartridges shall be fired from each of three 7.62mm accuracy barrels set at an elevation of 15°. A radar system shall be positioned adjacent to the mount with the antenna aligned to the line of flight. The radar shall be capable of tracking the rounds for a minimum of 5 seconds. Data shall be recorded a minimum of every 80 ft (25 m). The test shall be repeated with standard M62 cartridges. Ballistic results of the cartridges shall be averaged and analyzed to determine whether the trajectory of the M993 rounds matches the trajectory of the M62 rounds at ranges out to 765.7 yards (700 m). To be acceptable, the difference between the vertical trajectory of the M993 cartridge and the M62 cartridges shall be no greater than .5 mil over the entire range.

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4.6.11 Bullet extraction. The cartridge shall be tested in accordance with SCATP-7.62mm, Chapter 1, Bullet Extraction Test Procedure. The rate of travel of the test machine head shall be from 3 inches to 6 inches per minute.

4.6.12 Function and casualty. Function and casualty tests shall be conducted in accordance with SCATP-7.62mm, Chapter 1, Function and Casualty Test Procedure. The test shall be performed in accordance with TABLE VII.

TABLE VIII. Function and casualty testing

Design Verification			
<u>Temperature /1</u>	<u>Testing Weapons</u>	<u>Rounds Fired From Each Weapon</u>	<u>Total Rounds</u>
Extreme Cold	Three M240B	1,000	3,000
Cold	Three M240B & Three M24	200 each M240B & 100 each M24	900
Ambient	Three M240B & Three M24	400 each M240B & 200 each M24	1,800
Hot	Three M240B & Three M24	200 each M240B & 100 each M24	900
Extreme Hot	Three M240B	1,000	3,000
First Article			
<u>Temperature /2</u>	<u>Testing Weapons</u>	<u>Rounds Each Weapon</u>	<u>Total Rounds</u>
Extreme Cold	N/A	N/A	N/A
Cold	Two M240B	300 each M240B	600
Ambient	Two M240B	600 each M240B	1,200
Hot	Two M240B	300 each M240B	600
Extreme Hot	N/A	N/A	N/A
Conformance			
<u>Temperature /2</u>	<u>Testing Weapons</u>	<u>Rounds Each Weapon</u>	<u>Total Rounds</u>
Extreme Cold	N/A	N/A	N/A
Cold	One M240B	300 each M240B	300
Ambient	One M240B	600 each M240B	600
Hot	One M240B	300 each M240B	300
Extreme Hot	N/A	N/A	N/A
Notes:			
<p><u>1/</u> For extreme high and low temperature three M240B machine guns, shall be cleaned and lubricated with CLP for each weapon, and both the ammunition and weapons shall be placed in a climatic-chamber facility and conditioned to extreme hot or cold temperature for a minimum of four hours. The weapons shall be fired in 200 round cycles; the first one hundred round belt shall be fired in ten round bursts every 6 seconds and the second round belt shall be fired in twenty five round bursts every 15 seconds. A minimum two hour dwell time shall be observed between each cycle to allow the weapon to return to the conditioned temperature. The weapon cyclic rate shall be measured after the fifth and sixth bursts during the first hundred rounds of each cycle. All weapon stoppages shall be recorded and the MRBS calculated for each type weapon. The MRBS for this test shall not show a degradation of function (at a .05 significance level) from the results of the Reliability test. All cases shall be inspected for defects in accordance with Table VI, Design Verification Test (see 6.14).</p>			
<p><u>2/</u> For first article and conformance testing the weapons shall not be temperature conditioned, only the ammunition.</p>			

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4.6.13 Reliability. The Reliability test shall be performed in accordance with ITOP 3-2-045, paragraph 4.3.2, and SCATP-7.62mm, Chapter 1, Function and Casualty Test Procedure. Three M240B machine guns shall be used to perform this test. Prior to testing, each weapon shall be cleaned and lubricated with cleaner, lubricant, preservative (CLP) MIL-PRF-63460.

a. The test shall consist of firing 45,000 rounds of linked ammunition from three weapons in 200-round cycles; two 100 round belts. The cartridges shall be linked using the M13 link. 15,000 rounds shall be fired in each of three weapons. Prior to testing, the barrels assigned to each weapon shall be pneumatically gauged.

b. The weapons shall be cleaned, inspected and lubricated at 4000-round intervals and shall be re-lubricated at 2000-round intervals.

c. For this test, the M240B shall be fired from the M122 tripod. The test firings shall be accomplished in 75 cycles using two 100-round belts of ammunition per barrel per cycle. The first 100 rounds of each cycle shall be fired in ten-round bursts every six seconds. The second 100 rounds shall be fired in twenty-five round bursts every fifteen seconds. The barrels of the weapons shall be forced air-cooled after each 200 round cycle is fired. Weapon cycle rate of fire shall be measured for the fifth and sixth bursts during the first 100 rounds of cycles no. 1, 10, 20, 30, 40, 50, 60, 70, and 75.

d. Muzzle velocity and yaw shall be measured prior to testing, and on the first 20 rounds of every fifth cycle. Muzzle velocity shall be recorded using muzzle velocity radar. Yaw shall be recorded using a paper target, located 82 ft (25 m) from the muzzle of the weapon. At any time, if the velocity drops more than 200 fps or the rounds show excessive yaw, the barrel in question shall be replaced.

e. All rounds fired in this test shall be visually inspected for ammunition defects listed in Table VII, Reliability Test.

All ammunition related stoppages shall be noted and used to calculate the MRBS. There shall be no stoppages due to the interface between the cartridge and the M13 link. The MRBS for the M240B machine gun shall be calculated.

4.6.14 Residual stress.

a. Cartridges with brass cases. Test in accordance with SCATP-7.62mm, Chapter 1, Section 11, Mercurous Nitrate Test Procedure

b. Cartridges with polyethylene cases. Immerse the test samples in the detergent. Seal the detergent coated samples in a polyethylene bag to minimize evaporation and place them in an aluminum tray. Place the tray with the sealed bags of test samples in an oven set at $160^{\circ}\text{F} \pm 5^{\circ}\text{F}$ for seven days. After seven days, remove the tray from the oven and cool for one hour. Rinse the inert test samples in running water to remove the detergent. Dry with clean rags or paper towels. Coat the surfaces with machinist's dye and wipe with rags or towels, removing all excess dye

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from the surfaces. Examine the surfaces for cracks, splits and crazing using a 7-power eye loop or magnifying glass.

c. Cartridges with cases of other materials. Test in accordance with procedures approved by the Government appropriate for the materials(s) used to manufacture the cartridge (see 6.2).

4.7 Environmental requirements.

4.7.1 Waterproofness. Verification for the waterproof requirement shall be performed by either of the following methods. Note: If the selected method of the Waterproof test is not passed, it is not permissible to perform the other test method for acceptance.

a. Bubble test. The bubble test shall be conducted in accordance with the SCATP-7.62MM, Chapter 1, Waterproof Test Procedure.

b. Firing test. A sample of 50 cartridges shall be submerged for 24 hours in water at ambient temperature in a horizontal position to a depth such that there is a minimum of one inch of water above the highest point of the cartridge. The cartridges shall then be removed from the water, wiped dry and placed in a temperature controlled room or chamber at ambient for a minimum of two hours. The velocity test shall then be conducted in accordance with the SCATP-7.62MM, Chapter 1, Waterproof Test Procedure. The average velocity of the sample cartridges shall be compared to the average velocity obtained from the velocity test of 4.6.1. The difference shall be less than 30 fps.

4.7.2 Sequential rough handling. Prior to the start of the sequential rough handling tests, cartridges shall be packaged in accordance with drawing 12960962-18 and shall be linked only with M993 ammunition. Eight hundred rounds, one wire-bound box, shall be conditioned at 160°F (71.1°C) and eight hundred rounds conditioned at -58°F (-50°C). The sequential ruggedness testing consists of the following tests in order of occurrence: packaged transportation-vibration (secured-cargo vibration), 7 foot packaged drop, packaged loose-cargo vibration, and 5 foot individual drop. A sample of two hundred rounds, one M19A1 container, shall be withdrawn after each test phase. These sample rounds shall be replaced by dummy rounds of equal weight, packed the same way as the test rounds. The sample test rounds shall then be subjected to the function and casualty in accordance with SCATP-7.62mm, Chapter 1, Section 10, Function and Casualty Test Procedure. The rounds shall be fired at ambient from an M240B machine gun. Failure of the rounds to safely function shall be cause for the rejection of the proposed design. Failures include vent hole missing or obstructed, bullet remaining in bore, complete circumferential rupture, partial circumferential rupture in the K and/or L section, detached material and uncontrolled rate of fire.

The mean round between stoppages (MRBS) shall be determined by totaling the rounds and ammunition related stoppages from all of the phases of the sequential rough handling test. MRBS shall be determined for rounds fired at high temperature and at low temperature. If the MRBS shows a significant decrease (5% level of significance) from the results of the Function

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and Casualty test at ambient temperature, the design shall be rejected. (If, at any time during the test, the box and/or wire become damaged or unusable they may be replaced.)

a. Transportation-vibration phase (secured-cargo). Testing shall be in accordance with ITOP 1-2-601. One Wire-bound box (800 test cartridges) shall be temperature-conditioned at $160^{\circ}\text{F} \pm 3^{\circ}\text{F}$ for a minimum of 16 hours or until complete temperature soak prior to being subjected to secured-cargo vibration. A like number of cartridges shall be temperature conditioned at $-58^{\circ}\text{F} \pm 2^{\circ}\text{F}$ for a minimum of 16 hours prior to being subjected to secured-cargo vibration. The cartridges shall be reconditioned for a minimum of 16 hours between axes of vibration, except when two axes of vibration are conducted sequentially within the same day. When the latter occurs, the cartridges shall be moved directly from one test orientation to the next. The time the cartridges are out of temperature for movement between the conditioning chamber and the test cell, as well as during the test setup, shall be regained in conditioning at a 1:1 ratio prior to the start of testing. The conditioning and vibration chamber temperatures shall be maintained within $\pm 3^{\circ}\text{F}$ of the required test temperature. The wire-bound box shall be subjected to the secured-cargo vibration simulation in each of their three major orthogonal axes (vertical, transverse, and longitudinal). The vibration schedules used shall represent the secured-cargo transportation modes for a typical field/mission transport scenario over secondary and cross-country road surfaces as described in ITOP 1-2-601, Appendix B, Table B-1.

The first vibration schedule shall represent the vibration environment on the cargo bed of a composite of tactical vehicles consisting of the M127 12-ton semi trailer, M813 and M814 5-ton trucks, M36 2-1/2-ton truck, Commercial Utility Cargo Vehicle (CUCV) M1008 1-1/4-ton truck, the High-Mobility Multipurpose Wheeled Vehicle (HMMWV) M998 1-1/4-ton truck, and the Heavy Expanded Mobility Tactical Truck (HEMTT) M985 10-ton truck. This test shall represent 800 kilometers (km) of secured-cargo transport per axis.

The second vibration schedule shall represent the off-road conditions on the cargo bed of the 1/4-ton M416 and the 1-1/2-ton M105A2 two-wheeled trailer. The composite two wheeled trailer vibration environment shall simulate 25km of secured-cargo transport per axis.

The third vibration schedule shall represent the environment on the cargo bed of the M548 tracked vehicle. This M548 tracked vehicle vibration environment represents 25km of the transport per axis.

At the completion of each axis of vibration, the exterior surfaces of the boxes shall be visually inspected for damage. After all axes of all vibration have been performed, one container shall be removed from the box, examined, opened and the cartridges shall be visually inspected. The two hundred cartridges shall then be removed from the container and subjected to function and casualty testing as specified. Two hundred dummy rounds shall then be packed into the container and the container placed back in the box for further testing.

b. 2.1 Meter Drop. The 2.1 meter drop test shall be conducted in accordance with ITOP 4-2-602, Appendix 2.1 Meter Drop. Six hundred test cartridges and 200 hundred dummy cartridges shall be temperature-conditioned to $160^{\circ}\text{F} \pm 3^{\circ}\text{F}$ (the same number of cartridges temperature-conditioned to $-58^{\circ}\text{F} \pm 2^{\circ}\text{F}$) for a minimum of 6 hours or complete temperature soak prior to being drop tested. After conditioning, one container shall be removed from the wire-bound box and subjected to the drops. The container shall be subjected to one drop in each of the

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following orientations: bottom down, left side down and right side down. The drops shall be made from a quick-release hook attached to an overhead hoist at the prevailing outside air temperature. The test items shall be allowed to fall freely onto an armor plate, 3 inches thick, supported by 18 inches of crushed stone.

The container shall be visually inspected after each drop for any damage. The container shall then be opened and the cartridges shall be inspected for damage. The two hundred cartridges, removed from each temperature phase, shall be subjected to function and casualty testing as stated. Two hundred dummy cartridges shall then be packed into the container and replaced in the box. The box shall now contain four hundred test rounds and four hundred dummy rounds.

c. Loose-cargo (packaged) vibration. Testing shall be conducted in accordance with ITOP 4-2-602, Appendix Loose Cargo Test. Four hundred test cartridges and four hundred dummy cartridges shall be conditioned at $160^{\circ}\text{F} \pm 3^{\circ}\text{F}$ and an equal number shall be conditioned at $-58^{\circ}\text{F} \pm 2^{\circ}\text{F}$. Cartridges for each temperature environment shall be conditioned for a minimum of 16 hours or until a complete temperature soak prior to loose-cargo testing.

The laboratory test shall represent 120km of loose-cargo transport during off-road transport. The table shall be operated, shafts in phase, in a circular motion with a constant displacement of 1 inch, double amplitude (DA), at a speed of 300 rpm, thus producing a table acceleration of 1.3 gravitational accelerations (g's). The container shall be tested for 15 minutes in each of two orientations: transverse and longitudinal. For the longitudinal axis, the container shall be placed on the table with the longitudinal axis of the container parallel to the transverse axis of the table surface. For the transverse axis, the container shall be placed on the table with the longitudinal axis of the container parallel to the longitudinal axis of the table surface.

A wooden or hard solid retaining fence section shall be placed around the perimeter of a section of the bed of the package tester to prevent the containers from falling off the table and shall be positioned so that free space of approximately 1 inch exists on all sides of the container.

The box shall be visually inspected after each phase of vibration for any damage. After the completion of the vibration phases, one container shall then be removed from the box, opened and the cartridges shall be inspected for damage. The two hundred cartridges shall be removed from the container and subjected to function and casualty testing as stated. The remaining 200 test cartridges, from each temperature environment, shall then be subjected to the five foot unpackaged drop test.

d. 1.5 meter unpackaged drop. Testing shall be conducted in accordance with ITOP 4-2-602, Appendix 1.5 meter unpackaged drop.

From the last container taken from the box, a random sample of one hundred twenty (120) cartridges, from each temperature environment, shall be removed from their respective container, delinked, and subjected to the individual bare cartridge drops; twenty rounds nose down, twenty base down, twenty 45° nose down, twenty 45° base down, and twenty horizontal. The drop procedure, equipment, and impact surface shall be the same previously described for the 7 foot drop test. In addition, 20 cartridges, from each temperature environment, shall be

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dropped once in each of the five orientations. The cartridges shall be visually examined after each drop. The cartridges shall then be linked together and subjected to the function and casualty testing as stated.

4.7.3 Twelve-meter (Forty foot) packaged drop. The 12-meter (forty foot) drop test shall be conducted in accordance with TOP 4-2-601, Appendix 12.2 meter drop test. The cartridges shall be packaged in accordance with drawing 12960962-18 and shall be linked only with M993 ammunition. A minimum of three fully loaded containers shall be temperature conditioned for a minimum of 16 hours or until complete temperature soak at each of the following temperatures extreme cold, ambient, and hot. Each container shall be subjected to a single 40ft drop in the normal shipping orientation. The drop shall be made from a quick-release hook attached to an overhead hoist and shall be made at the prevailing outside air temperature. The container shall be allowed to fall freely onto the impact surface. The container and test ammunition shall be visually inspected for damage and a determination made of suitability for safe handling and disposal. The criteria for acceptance shall be that the rounds are deemed safe to handle and dispose of following the test (see 6.14).

4.7.4 Long term high temperature storage. The cartridges shall be subjected to a 28 day continuous heating test. Two hundred fifty (250) cartridges shall be placed in a climatic-chamber and conditioned to $140^{\circ} \pm 3^{\circ}\text{F}$ ($60 \pm 1.7^{\circ}\text{C}$) for 28 days. The cartridges are then inspected for any visual signs of deterioration. The cartridges are stored under standard ambient room temperature for 48 hours. After that period, the ammunition shall be fired from an M240B MG in the 10 round burst mode. The cyclic rate of fire shall be compared to the cyclic rate of fire obtained during the function and casualty test. The cyclic rate shall be within 15 percent of the rate obtained during function and casualty. Failure of the rounds to safely function (exhibit a critical defect) shall be cause for rejection.

4.7.5 Long term low temperature storage. The cartridges shall be subjected to a 28 day continuous cooling test. Two hundred fifty (250) cartridges shall be placed in a climatic-chamber and conditioned to $-40^{\circ} \pm 2^{\circ}\text{F}$ ($-40 \pm 1.1^{\circ}\text{C}$) for 28 days. The cartridges are then inspected for any visual signs of deterioration. The cartridges are stored under standard ambient room temperature for 48 hours. After that period, the ammunition shall be fired from an M240B MG in the 10 round burst mode. The cyclic rate of fire shall be compared to the cyclic rate of fire obtained during the function and casualty test. The cyclic rate shall be within 15 percent of the rate obtained during function and casualty. Failure of the rounds to safely function (exhibit a critical defect) shall be cause for rejection.

4.7.6 Thermal shock test. The thermal shock test shall be conducted in accordance with MIL-STD-810, test method 503.3. Two hundred (200) test cartridges shall be subjected to thermal shock. The test samples shall be placed inside an environmental chamber set at $-70^{\circ} \pm 2^{\circ}\text{F}$ ($-56.7 \pm 1.1^{\circ}\text{C}$) for initiation of thermal shock test sequence. At the completion of the first 4 hour cycle, the cartridges shall be transferred to a high temperature chamber set at $160^{\circ} \pm 3^{\circ}\text{F}$ for a 4 hour cycle. This process shall be repeated until 6 cycles (48 hours of exposure) are completed. The cartridges shall be visually inspected for any signs of deterioration. The cartridges shall then be stored under standard ambient room temperature for 48 hours. At the conclusion of the 48 hours storage, the sample cartridges shall be visually inspected for evidence

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of corrosion. The test cartridges shall then be function fired from an M240B MG in 10 round burst mode. The cyclic rate of fire shall be compared to the cyclic rate of fire obtained during the function and casualty test. The cyclic rate shall be within 15 percent of the rate obtained during function and casualty. Failure of the rounds to safely function (exhibit a critical defect) shall be cause for rejection.

4.7.7 Temperature/humidity test. Two hundred (200) test cartridges are placed in the temperature-humidity chamber on a stainless steel, wire mesh rack. The chamber temperature and relative humidity (RH) are raised to $120^{\circ}\pm 2^{\circ}\text{F}$ and 30 ± 10 percent RH over a two hour period. This temperature- humidity environment is maintained for 24 hours, following which the chamber temperature is decreased to ambient and RH is increased to 50 ± 10 percent, over two hour duration. This temperature-humidity environment is maintained for 24 hours, following which the RH is raised to 95 ± 10 percent over a one hour period while maintaining a chamber temperature of ambient. The cartridges are then exposed to ten cycles (240 hours) of the temperature-humidity conditions in TABLE IX below:

TABLE IX. Storage Schedule for 24-hour Humidity Test Cycle

<u>Duration Phase</u>	<u>Temperature °F</u>	<u>Relative Humidity</u>	<u>Hour</u>
I	Gradually increase to $105^{\circ}\pm 3^{\circ}$ and	90 ± 5	2
II	Maintain at $105^{\circ}\pm 3^{\circ}$ and	90 ± 5	16
III	Gradually decrease to from 105° to $70 \pm 2^{\circ}$ and increase to 105°	95 ± 5	2
IV	Maintained at $105 \pm 3^{\circ}$ and	95 ± 5	4

A fifty (50) round sample shall be withdrawn from the chamber after each of the third, fifth, eighth, and tenth cycles of the test and visually inspected for any evidence of deterioration or corrosion. The cartridges shall then be fired from an M240B machine gun in the 10 round burst mode. The cyclic rate of fire shall be compared to the cyclic rate of fire obtained during the function and casualty test. The cyclic rate shall be within 15 percent of the rate obtained during function and casualty. Failure of the rounds to safely function (exhibit a critical defect) shall be cause for rejection.

4.7.8 Salt Spray (fog) exposure. The sample shall be subjected to the salt-fog test in accordance with Method 509 of MIL-STD-810. After 48 hours of exposure to the 5 percent mixture, the sample shall be examined. One hundred twenty (120) rounds shall then be loaded into links and fired from the M240B machine gun in 10 round burst mode. Failure of the rounds to safely function (exhibit a critical defect) shall be cause for rejection.

4.7.9 Cook-off. Cook-off testing shall be conducted in accordance with TOP 3-2-045, paragraph 4.2, using an M240B machine gun. The barrel the weapon shall be instrumented to measure barrel temperatures in accordance with TOP 3-2-045 paragraph 4.2.1-b. The time to cook-off or 30 minutes (min.), whichever occurs first shall be recorded. The ambient range temperature and barrel temperature shall be measured for information only.

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Two hundred eighty (280) M993 rounds shall be fired at the rate of 20 rounds every 6 seconds. The 281st M993 test round, shall not be able to fire, in accordance with TOP 3-2-045 paragraph 4.2.1-d. When chambered in the weapon, the round shall remain in the chamber for 30 minutes. If the M993 round cooks off prior to 30 minutes, the test shall be considered a failure.

4.7.10 Electrostatic Discharge(ESD) Personnel-borne. If cartridges are made with case material other than brass, these tests shall be conducted in accordance with NAVSEAINST 8020.19 test procedures and parameters. The test shall be conducted at ambient temperature and relative humidity of ambient atmosphere shall be no greater than 50%. The test devices and ammunition shall be pre-conditioned for not less than 24 hours at ambient temperature and relative humidity of ambient atmosphere no greater than 50% (see 6.14).

4.7.11 Electrostatic Discharge(ESD) helicopter-borne. If cartridges are made with case material other than brass, these tests shall be conducted in accordance with NAVSEAINST 8020.19 test procedures and parameters. The test shall be conducted at ambient temperature and relative humidity of ambient atmosphere shall be no greater than 50%. The test devices and ammunition shall be pre-conditioned for not less than 24 hours at ambient temperature and relative humidity of ambient atmosphere no greater than 50% (see 6.14).

4.7.12 Chemical compatibility. Test shall be performed in accordance with TOP 3-2-609, Chemical Compatibility. The following procedure shall be followed:

- a. Thirty (30) cartridges shall be immersed into each assigned chemical in TABLE X below for one hour at a depth of one inch above the case rim with the cartridge laid horizontally to the chemical. After one hour, the cartridges are removed, set base down in a storage rack and allowed to drain naturally for 24 hours.
- b. After the 24-hour dripping period, the cartridges shall be wiped of the assigned chemical, and inspected for abnormalities.

The firing sequence shall be as follows: One hundred twenty (120) cartridges that were not exposed to any chemicals shall be fired in a M240B machine gun. The thirty sample cartridges from each required chemical, as designated in Section 3.5.12 shall then be loaded in a thirty round belt and fired in the M240B MG in a thirty round burst. If functioning problems are encountered with any of the test conditions, the weapon shall be inspected, cleaned and an additional 120 rounds fired. The criteria shall be considered met if no safety problems are observed.

TABLE X. Chemical compatibility

<u>Specification</u>	<u>Material</u>
a. MIL-PRF-372	Cleaning compound, solvent
b. MIL-PRF-14107	Lubricating oil, (LAW)
c. MIL-PRF-63460	Lubricant, (CLP)
d. MIL-PRF-2104	Lubricating oil, (ICE, T)

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4.8 Ownership and support requirements.

4.8.1 Safety. Verification of projectile material shall be accomplished by examination during design verification (see 6.2).

4.8.2 Final hazard classification. Compliance with the FHC requirements shall be validated during design verification (see 6.2). In addition, tests shall be in accordance with TB 700-2. The following tests, as defined in TB 700-2, UN Test Series 6 shall be used:

- a. Single package test
- b. Stack test
- c. External fire test
- d. Thermal stability
- e. 12 meter drop test

4.8.3 Energetic material qualification. Objective evidence that the Army Qualification Authority has qualified all energetic materials shall be examined (see 6.2 & 6.8).

4.8.4 Energetic material compatibility. Compatibility tests shall be conducted in accordance with Method 504.1.1 of MIL-STD-650 or Method 408.1.1 of MIL-STD-286. Compatibility is demonstrated when results reflect negligible reactivity.

4.8.5 Propellant stability.

a. Stability analysis. Propellant stabilizer analysis shall be conducted in accordance with the Army Propellant Surveillance Laboratory (APSL) test methods for the specific propellant stabilizer (see 6.10). Propellant with stabilizer values of 0.30% or less shall not be used.

b. Moisture and Total Volatiles. The test shall be performed two times using the oven method listed in MIL-STD-286, section 101.2.2. Propellant that does not meet manufacturing specifications for moisture and total volatiles shall not be used.

4.8.6 Pyrotechnic sensitivity. Pyrotechnic sensitivity tests shall be conducted in accordance with the test procedures listed in AOP-7 (Edition 2 Rev 1).

4.8.7 Toxic fumes. The toxic fume test shall be conducted in accordance with TOP 2-2-614 paragraph 5.1. Each M240B machine gun shall be cleaned and lubricated prior to testing. The weapon to be fired shall be placed in a test fixture enclosed in a sealed toxic fumes chamber. All firing shall be done remotely. Five valid trials shall be obtained from each type of weapon. Each trial for the M240B machine gun shall consist of 100 rounds fired in 10 round bursts. Toxic fumes levels shall be recorded during and after the firing of the weapon until the concentrations have declined to an acceptable level. The emission of carbon monoxide (CO), ammonia (NH₃), sulfur dioxide (SO₂), and nitrous oxides (NO_x) shall be measured for each trial fired. The test chamber shall be cleaned of spent brass and vacuumed between trials. Testing shall be repeated using standard ammunition for comparison. The results of the toxic fume test shall be approved by the Surgeon General.

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4.8.8 Surface Danger Zone. The surface danger zone test shall be conducted using a 7.62mm accuracy test barrel. Test firings shall be conducted against an armor plate and sand at the 109.4 yard (100 meter) range. The impact angles and number of data points for each media are shown in TABLE XI below:

TABLE XI. Surface danger zone test matrix

Impact Media		Impact Angle, deg				
		3	5	10	15	20
Armor Plate	Data Points	-	75	50	75	50
Sand	Data Points	25	50	50	25	50

The 7.62mm accuracy barrel shall be installed on a V-block recoil mechanism mounted to a Frankford Rest. The center of the accuracy barrel shall be aligned along the established LOF. A variable angle test table shall be positioned 109.4 yards from the muzzle of the accuracy barrel (measurement made from muzzle to the trunnion of the table), perpendicular to the LOF. A Rolled Homogeneous Armor (RHA) plate shall be tack welded to the table with the center of the plate passing through the LOF and the trunnion. All positions shall be surveyed and the height of the accuracy barrel to the center of the trunnion of the variable table shall be measured to within 1 inch.

A Ricochet Radar head or equivalent shall be used to measure the impact and exit velocities as well as the ricochet angles of the projectiles. The radar head shall be positioned appropriately to allow for maximum coverage of the expected ricochet cone. All rounds shall be fired single shot from the accuracy barrel. An electronic theodolite shall be used to locate the impacts on the plate in relation to the radar position. A reflector shall be positioned on the impact point, and, with the theodolite aligned to the impact point, a laser range finder (LRF) shall be used to determine the position of the impact relative to the radar head. The drag and trajectory results, minimum impact and exit velocity, the elevation and azimuth exit angle results shall be determined.

Testing shall be repeated using sand. The sand shall be Unimin's Accusand 20/30, unless otherwise specified. The moisture level and density of the sand shall be determined at the beginning of each day's firings.

4.8.9 Barrel erosion. The test shall be conducted in accordance with SCATP-7.62mm, Chapter 1, Barrel Erosion Test Procedure with the exception that the test shall be conducted with three weapons, with 8,000 rounds per weapon, for a total of 24,000 rounds. Firing in any barrel shall be terminated when either the velocity drops 200 ft/sec or more or when the bullets from twenty percent or more of the cartridges in any burst show yaw exceeding 15° at 82 ft (25 m) from the muzzle.

4.8.10 Explosive ordnance disposal (EOD). The following M993 cartridge samples shall be provided to the EOD Technology Division for EOD design verification tests, as specified in the contract (see 6.2):

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- a. One sample cartridge and one cutaway cartridge with technical information (giving detailed operation and functioning descriptions).
- b. Three - 90 degree inert cutaway models.
- c. Six - inert models.

4.8.11 Ammunition lot numbering. Visually verify that an ammunition lot number has been applied to each lot as described in MIL-STD-1168.

4.8.12 Demilitarization. One unit shall be chosen and demilitarized in accordance with procedures in the Small Arms Technical Manual DMWR 9-1300-0017-D1 (see 6.2 & 6.15).

4.8.13 Workmanship. All test cartridges shall be visually inspected for the defects listed in TABLE V. The criteria for grading defects shall be in accordance with MIL-STD-636.

5. PACKAGING

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

6. NOTES

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

6.1 Intended use. The M993 Armor Piercing Cartridge is intended for use in the M24 Rifle and the M240B machine gun. The armor piercing cartridges procured to this specification are military unique because there is no commercial market for armor piercing cartridges.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification and all reference documents cited in section 2 or referenced in section 6.
- b. Requirements for submission of design verification sample when required (see 3.1).
- c. Requirements for submission of first article sample when required (see 3.2)
- d. Provision for submission of Inspection Equipment Designs, test equipment, and procedures.
- e. Provisions for submission of acceptance inspection results for each lot of ammunition presented to the Government.

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- f. Packaging requirements. See 5.1 and applicable contract requirements. Packaging drawing 12960962-18 or 12960962-20 has been qualified for the required hazard classification and is one method of packaging that may be used.
- g. EOD test when required (see 3.7.10).
- h. Information needed to satisfy the requirements for qualification of energetic materials by the Army Service Qualification Authority, see 6.10. This information can be obtained in the desktop guide titled Explosive Hazard Classification Requirements for Performance Specifications that is available from RDAR-QES-C.
- i. Requirements for submission of ammunition data cards in accordance with MIL-STD-1168.
- j. Certificate of conformance that the projectile will not contain any toxic heavy metals or other hazardous materials (see 6.14)
- k. Requirements for submission of the Material Safety Data Sheet (MSDS). (see 4.8.2)
- l. Requirements for submission of component lot sizes.
- m. Requirements for submission to waive design verification defects not applicable to the contractor's design.
- n. When specified, submission of the technical data package (TDP) should be sent to US Army ARDEC, Picatinny, NJ 07806-5000, Attention: RDAR-MEM-I, for evaluation.
- o. Requirements for submission should be made for residual stress test procedures on cases other than brass or polyethylene.
- p. Requirements for submission of analysis if alternative demilitarization is done.

6.3 Acceptance inspection equipment (AIE). Provisions concerning the AIE used to verify the requirements of this specification should be specified in the contract.

6.4 EOD qualification. Qualification for EOD by the Army requires that it must be demonstrated that the design is capable of being rendered safe and disposed of in all field environments. This task, addressed in the contract, requires samples to be tested to EOD procedures, design information and test data. Point of contact for further information on EOD qualification can be obtained from Commander, US Army RDECOM-ARDEC, ATTN: RDAR-AEX, Picatinny, NJ 07806-5000.

6.5 Definitions

6.5.1 Action time. Action time is defined as the sum of the primer ignition time, propellant burning time, and the time taken by the bullet to reach the gas port.

6.5.2 Interfix. A commodity made to one unchanged design which encompasses unchanged drawing(s), material(s) and specification(s), manufactured by a specific manufacturing process by a single manufacturer at a single location.

6.5.3 Keyholing. Keyholing is defined as any projectile yaw exceeding 15 degrees.

6.5.4 Reliability. For the purpose of this specification, the following measure of reliability should be used:

$$\text{Reliability} = 1 - \frac{\text{Number of stoppages (ammunition related)}}{\text{Number of rounds fired}}$$

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6.6 Submission of alternative conformance provisions. All proposed alternative conformance provisions should be submitted to the Government for evaluation/approval as directed by the contracting activity.

6.7 Inspections to be performed. Lot testing requirements, if necessary, for explosive materials unique to the cartridge, should be provided by the ARDEC Safety Office through the contracting agency prior to contract award.

6.8 Energetic material qualification information. Qualification of energetic materials by the Army Qualification Authority requires demonstration that the energetic material meets the requirements of AOP-7 and STANAG 4170.. This task is addressed in the statement of work in the contract. Points of contact for the Army Qualification Authority can be obtained from Commander, US Army ARDEC, ATTN: RDAR-QEM-C, Picatinny, NJ 07806-5000.

6.9 Surface Danger Zone. Data must be generated to develop a Surface Danger Zone for the cartridge (see 4.8.8).

6.10 Propellant stability. Methods for the propellant stabilizer analysis can be obtained from AMSTA-AR-WEE.

6.11 Rationale for Critical Defects listed in Table V.

<u>Defect</u>	<u>Rationale</u>
Case split in K, L or M location	Escape of hot propellant gases through breech could cause injury to shooters face or damage the weapon
Case split in I, S or J location when there is the potential for loss of propellant	Loss of propellant could cause a bullet in bore. A bullet in bore is likely to result in weapon damage or injury to the shooter.
Perforated Case	Loss of propellant could cause a bullet in bore. A bullet in bore is likely to result in weapon damage or injury to the shooter.
Low propellant weight	Low propellant weight causes bullet in bore. A bullet in bore is likely to result in weapon damage or injury to the shooter.
Primer above flush	A primer that is not flush has the possibility of accidental firing and can cause injury to any surrounding parties.

6.12 Rationale for Critical Firing Defects listed in Tables VI, VII and VIII.

<u>Defect</u>	<u>Rationale</u>
Misfire due to contaminated propellant	Contaminated propellant can cause a bullet in bore by only partial ignition of the propellant by the hot primer gases and then not being able to sustain propellant burning once the bullet leaves the case which increases the volume and the effect of the hot primer gas is dissipated.
Bullet in bore	A bullet in bore has historically been treated as a critical defect. The concern with a bullet in bore is that if the next cartridge is fired, the obstruction presented by the bullet in bore will cause a rapid build up of pressure resulting in high combustion gases being released from the chamber and receiver with the potential to rupture the weapon with gas hazards and flying debris.

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<u>Defect</u>	<u>Rationale</u>
Partial rupture, body (K) or head (L) or complete rupture	The shooter can be burned by hot gases that escape from the area of the cartridge case and are vented out of the weapon in the area of the shooters face

6.13 Subject term (key word) listing.

- Small Arms
- 7.62mm Ammunition
- M240B machine gun

6.14 Temperature. The following describes the temperature conditions for this specification.

<u>Extreme Cold:</u>	$-55^{\circ}\text{F} \pm 2^{\circ}$ ($-48.3^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$)
<u>Cold:</u>	$-65^{\circ}\text{F} \pm 2^{\circ}$ ($-53.9^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$)
<u>Ambient:</u>	$70^{\circ}\text{F} \pm 2^{\circ}$ ($21.1^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$)
<u>Hot:</u>	$125^{\circ}\text{F} \pm 2^{\circ}$ ($51.7^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$)
<u>Extreme Hot:</u>	$155^{\circ}\text{F} \pm 2^{\circ}$ ($68.3^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$)

The ammunition will be conditioned at the respective temperatures for not less than 4 hours (not less than 2 hours for ambient). Unless otherwise specified, the conditioned ammunition may be fired at ambient temperature. The conditioned ammunition (other than ambient) will not be exposed to ambient temperature conditions for more than 5 minutes unless specified. If the conditioned ammunition is exposed for specified time, the ammunition must be reconditioned for a minimum of 4 hours.

6.15 Demilitarization. A list of toxic heavy metals and other hazardous materials is contained in EPA 33/50 Program - The Final Record; Box 1 - 17 Targeted Chemicals. Copies of the publication are available from <http://www.epa.gov> or United States Environmental Protection Agency, (7408), Washington, DC 20460.

6.16 Army-type designator. The appearance of type designators in contracts, invitation to bid, specifications, drawings, etc. does not in itself constitute official type designation assignment. Only those type designators approved and issued in full accordance with the Type Designator assignment provisions of MIL-STD-1464 are considered officially assigned. Government direction for appropriate nomenclature will be provided following Design Verification.

Custodian:
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NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil>