INCH-POUND

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SUPERSEDING
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DETAIL SPECIFICATION

CARTRIDGE, 20MM: MULTIPURPOSE, TRACE SELF-DESTRUCT, M940

Reactivated after 3 May 2006 and may be used for new and existing designs and acquisitions.

This specification is approved for use by the US Army Armament Munitions and Chemical Command, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the Cartridge, 20MM: Multipurpose, Trace Self Destruct, M940, for applications in different Air Defense systems. Certain requirements for the ammunition are based on the end system application (see 6.1).

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).

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-A-12560	-	Armor Plate, Steel, Wrought, Homogeneous (for use in Combat-Vehicle Ammunition Testing)
MIL-A-70625	-	Automated Acceptance Inspection Equipment Design, Testing and Approval, of

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1916	-	DOD Preferred Methods for Acceptance of Product

Comments, suggestions, or questions on this document should be addressed to: Commander, U.S. Army ARDEC, ATTN: AMSRD-AAR-AIS-SS, Picatinny, New Jersey 07806-5000, or ardec-stdzn@pica.army.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIT online database at http://assist.daps.dla.mil.

AMSC N/A FSC: 1305

MIL-STD-651	-	Visual Inspection Standards for 20MM Ammunition and Components
MIL-STD-1168	-	Ammunition Lot Numbering and Ammunition Data Card

(Copies of federal and military specifications, standards and handbooks are available online at http://assist.daps.dla.mil/quicksearch/ or 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.

US ARMY DEVELOPMENTAL TEST COMMAND

TEST OPERATING PROCEDURES

TOP 2-2-710	-	Ballistic Test of Armor Materials

(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.)

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT, AND ENGINEERING CENTER (ARDEC) PUBLICATIONS

SCATP-20	-	Ammunition Ballistic Acceptance Test Methods, Test Procedures for 20mm Cartridges

(This publication is available from US Army ARDEC, AMSRD-AAR-QEM-F, Picatinny, NJ 07806-5000.)

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT, AND ENGINEERING CENTER (ARDEC) DRAWINGS

12551767	Cartridge 20mm MPT-SD, M940
12551768	Projectile
12551770	Projectile Body Assembly, Charged
12551772	Nose Assembly, Charged
12551774	Projectile Body Assembly, Tracer
7258801	Classification of Defects for Case, Cartridge, 20mm, M103, M103A1, and M103B1
11075284	Primer Resistance Test Circuit
11075229	Barrel, Test, 20mm Gain Twist

(Copies of these drawings may be requested on line at Drawing-Request@pica.army.mil or from US Army ARDEC, AMSRD-AAR-AIS-TD, Picatinny, NJ 07806-5000.)

2.3 Non-Government publications. The following documents 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.

GENERAL DYNAMICS – ARMAMENTS AND TECHNICAL PRODUCTS
DRAWINGS (CAGE CODE: 05606)

799E749-10 Barrel, 20mm Test Fixture

(Copies of these drawings may be ordered from General Dynamics Armament and Technical Products, Burlington Technology Center, 128 Lakeside Avenue, Burlington, VT 05401-4985.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified, a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Parts and subassemblies. Materials, parts and assemblies shall comply with requirements specified on the applicable drawings and referenced specifications.

3.3 Projectile torque. The projectile shall withstand a minimum torque of 10 inch pounds without movement.

3.4 Projectile extraction. The force necessary to extract the projectile from the cartridge case shall be 1100 to 2800 pounds, inclusive.

3.5 Contamination of energetic components. Extreme care shall be exercised to avoid contamination of propellant by oil, grease, moisture or other foreign matter.

3.6 Electrical resistance of primed case. The electrical resistance of the primed case shall not be less than 500 ohms or more than 1,200,000 ohms. Primed cases shall be tested 100% in process for electrical resistance subsequent to primer crimping and waterproofing.

3.7 Pressure. The average peak chamber pressure of the sample cartridges plus three sample standard deviations (σ), with ammunition conditioned at 68°F to 72°F, shall not exceed values listed for the barrels specified in the table below (see 6.8).

Test Barrel Drawing (Barrel Length)	Pressure (pounds per square inch)
11075229 (60 inches)	60,500
799E749-10 (79 inches)	54,500

3.8 Velocity. The average velocity of the sample cartridges conditioned at 68°F to 72°F shall be as specified in the table below for the given barrel at 78 feet from the muzzle of the gun. In all cases the sample standard deviation (σ) shall not exceed 30 feet per second (see 6.8).

Test Barrel Drawing (Barrel Length)	Velocity (feet per second)
11075229 (60 inches)	3,350 ± 45
799E749-10 (79 inches)	3,450 ± 45

3.9 Action time. The action time of the individual sample cartridges and average action time plus four sample standard deviations (σ) shall not exceed the values listed below from -65°F to 145°F (see 6.8).

Test Barrel Drawing (Barrel Length)	Action time (milliseconds)
11075229 (60 inches)	4.0
799E749-10 (79 inches)	4.5

3.10 Function and casualty. The cartridge shall function without casualty when fired in the M61 and M168, 20mm Automatic gun.

3.11 Dispersion. The average mean radius of 10 round shot group shall not exceed 15 inches at a minimum range of 547 yards.

3.12 Projectile trace. The projectile shall exhibit a visible trace against a dark background for a minimum of 4.1 seconds at -65°F and a minimum of 3.8 seconds at 145°F.

3.13 Projectile self-destruct. The projectile shall self-destruct between 4.1 and 7.3 seconds during uninterrupted flight from the muzzle at -65°F and between 3.8 and 7.0 seconds at 145°F.

3.14 Arming sensitivity

3.14.1 Short range. The projectile shall function on a 0.080 inch thick aluminum target plate at 210 ± 10 yards from the muzzle at -65°F to 145°F and 0° obliquity.

3.14.2 Long range. The projectile shall function on a 0.080 inch thick aluminum target plate at 2180 ± 10 yards from the muzzle at -65°F to 145°F and 0° obliquity.

3.15 Detonation delay. The projectile shall function on a 0.080 inch thick aluminum target at 210 ± 10 yards from the muzzle with a delay not less than 8 inches or more than 24 inches.

3.16 Fragmentation. The projectile body shall provide no less than 8 perforations in the last witness sheet of the target array.

3.17 Penetration. The projectiles of the sample cartridges, conditioned at 68°F to 72°F shall exhibit an R_{50} of 547 yards minimum against 3/8 inch rolled homogeneous armor (RHA) having a nominal Brinell Hardness of 360 (conforming to MIL-A-12560) at 45° ± 2° obliquity.

3.18 Waterproofness. There shall be no evidence of water entry into the propellant of the cartridge and cartridge shall function following exposure. The average velocity of the wet sample cartridges conditioned at 68°F to 72°F shall not vary from the average velocity of the dry sample cartridges by more than 100 fps.

3.19 Workmanship. All parts and assemblies shall be fabricated, loaded, and assembled in a thorough workmanlike manner. They shall be clean and free of burrs, sharp edges, cracks, scratches, dents, folds, wrinkles, buckles, dirt, grease, oil, rust, and other foreign matter. Exterior surface coatings shall be continuous; however, light scratches not exposing base material may be permitted.

4. VERIFICATION

TABLE I. Requirement/verification cross reference matrix

METHOD OF VERIFICATION
N/A - Not applicable
1 - Analysis
2 - Demonstration
3 - Examination
4 - Test

CLASSES OF VERIFICATION
A - First article
B - Conformance

Section 3 Requirement		Verification Methods					Verification Class		Section 4 Method
		N/A	1	2	3	4	A	B	
3.1	First Article				X	X	X		4.2
3.2	Parts and subassemblies				X		X	X	Table IV
3.3	Projectile torque					X	X	X	4.4.1
3.4	Projectile extraction					X	X	X	4.4.2
3.5	Contamination of energetic components				X		X	X	4.4.3
3.6	Electrical resistance of primed case					X	X	X	4.4.4
3.7	Pressure					X	X	X	4.4.5
3.8	Velocity					X	X	X	4.4.5
3.9	Action time					X	X	X	4.4.6
3.10	Function and casualty					X	X	X	4.4.7
3.11	Dispersion					X	X	X	4.4.8
3.12	Projectile trace					X	X	X	4.4.9
3.13	Projectile self-destruct					X	X	X	4.4.9
3.14	Arming sensitivity					X	X	X	4.4.10
3.15	Detonation delay					X	X	X	4.4.11
3.16	Fragmentation					X	X		4.4.12
3.17	Penetration					X	X		4.4.13
3.18	Waterproofness					X	X	X	4.4.14
3.19	Workmanship				X		X	X	Table IV

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

a. First article inspection (see 4.2)
b. Conformance inspection (see 4.3)

4.2 First article inspection. When specified, a sample of 668 M940 projectiles and cartridge components as identified in Table II shall be subjected to first article verification inspections and tests with quantities in accordance with Table II and Table IV.

4.2.1 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.

TABLE II. First article inspection

Examination or Test 1/	Conformance Criteria		Requirement Paragraph	Inspection Method	Defect Classification
	Sample	Acc/Rej			
Examination for defects					
Projectile body assembly, tracer	125	0/1			
Projectile body assembly, charged	125	0/1			
Nose assembly, charged	125	0/1	3.2/3.19	Table IV	Table IV
Projectile	125	0/1			
Cartridge	668	0/1			
Projectile torque	20	0/1	3.3	4.4.1	Major
Projectile extraction 6/	20	0/1	3.4	4.4.2	Major
Contamination of energetic components 2/, 6/	20	0/1	3.5	4.4.3	Major
Electrical resistance of primed case 2/, 6/	20	0/1	3.6	4.4.4	Major
Pressure 4/	20	0/1	3.7	4.4.5	Major
Velocity 4/	20	0/1	3.8	4.4.5	Major
Action time 8/					
-65° ± 5°F	20	0/1	3.9	4.4.6	Critical
145° ± 5°F	20	0/1			
Function and Casualty 7/, 8/					
-65° ± 5°F	100	0/1	3.10	4.4.7	Table V
145° ± 5°F	100	0/1			
Dispersion	50	0/1	3.11	4.4.8	Major
Projectile trace (burn time) 5/, 8/					
-65° ± 5°F	100	0/1	3.12	4.4.9	Major
145° ± 5°F	100	0/1			
Projectile self-destruct 5/, 8/					
-65° ± 5°F	100	0/1	3.13	4.4.9	Major
145° ± 5°F	100	0/1			
Arming sensitivity 3/, 8/					
210 yards -65° ± 5°F	10	0/1			
70° ± 2°F	10	0/1			
145° ± 5°F	10	0/1	3.14	4.4.10	Major
2100 yards -65° ± 5°F	10	0/1			
70° ± 2°F	10	0/1			
145° ± 5°F	10	0/1			
Detonation delay 3/, 8/					
210 yards -65° ± 5°F	10	0/1			
70° ± 2°F	10	0/1	3.15	4.4.11	Major
145° ± 5°F	10	0/1			
Fragmentation	29	0/1	3.16	4.4.12	Major
Penetration 17/	29	0/1	3.17	4.4.13	Major
Waterproofness	20	0/1	3.18	4.4.14	Major

See Notes after Table III

4.3 Conformance verification.

4.3.1 Conformance inspection. The sample cartridges shall be subjected to conformance verification in accordance with Table III and Table IV.

4.3.2 Classification of characteristics. Critical, major and minor characteristics are defined in MIL-STD-1916.

4.3.3 Inspection lot formation. Lot formation shall be in accordance with MIL-STD-1916. Lot numbering shall be in accordance with MIL-STD-1168. In addition, each cartridge lot offered for acceptance shall contain:

a. Primers from no more than three lot numbers from one lot interfix from one manufacturer.
b. Projectiles from one lot interfix from one manufacturer.
c. Cartridge cases from one interfix from one manufacturer.

4.3.4 Conformance rejection. If any sample fails to comply with the conformance inspection requirements, the lot shall be rejected.

4.3.5 Examinations and tests. The attribute sampling plan required for the examination for defects in Table IV shall be in accordance with the attribute sampling plan of MIL-STD-1916, using Verification Level IV for major characteristics and Level II for minor characteristics unless otherwise noted. One hundred percent inspection shall be used on all critical characteristics. The lot shall be suspended if a malfunction or casualty not covered by this specification occurs in any firing test (see 6.10).

4.3.6 Alternative conformance acceptance. Unless otherwise specified, alternate conformance procedures may be proposed (see 6.2).

TABLE III. Conformance inspection

Examination or Test 1/	Conformance Criteria		Requirement Paragraph	Inspection Method	Defect Classification
	Sample	Acc/Rej			
Examination for defects Projectile body assembly, tracer Projectile body assembly, charged Nose assembly, charged Projectile Cartridge	Table IV	 0/1 0/1 0/1 0/1 0/1	3.2/3.19	Table IV	Table IV
Projectile torque	20	see 10/	3.3	4.4.1	Major
Projectile extraction 6/	20	see 9/	3.4	4.4.2	Major
Contamination of energetic components 2/, 6/	20	0/1	3.5	4.4.3	Major
Electrical resistance of primed case 2/, 6/	20	0/1	3.6	4.4.4	Major
Pressure 4/	20	see 12/	3.7	4.4.5	Major
Velocity 4/	20	see 11/	3.8	4.4.5	Major
Action time 8/ -65° ± 5°F 145° ± 5°F	 20 20	 0/1 0/1	3.9	4.4.6	Critical
Function and Casualty 7/, 8/ -65° ± 5°F 145° ± 5°F	 100 100	 Table V Table V	3.10	4.4.7	Table V
Dispersion	50	see 14/	3.11	4.4.8	Major
Projectile trace (burn time) 5/, 8/ -65° ± 5°F 145° ± 5°F	 86 86	 see 15/ see 15/	3.12	4.4.9	Major
Projectile self-destruct 5/, 8/ -65° ± 5°F 145° ± 5°F	 86 86	 see 15/ see 15/	3.13	4.4.9	Major
Arming sensitivity 3/, 8/ 210 yards -65° ± 5°F 70° ± 2°F 145° ± 5°F	 5 5 5	 see 16/ see 16/ see 16/	3.14	4.4.10	Major
Detonation delay 3/, 8/ 210 yards -65° ± 5°F 70° ± 2°F 145° ± 5°F	 5 5 5	 see 16/ see 16/ see 16/	3.15	4.4.11	Major
Waterproofness	20	see 13/	3.18	4.4.14	Major

Notes:

1/ MIL-STD-651 shall apply in defining and evaluating cartridge visual defects. Table V shall be used in defining and evaluating cartridge firing defects. The lot shall be rejected if in any firing test one or more of the following casualties occur:

a. Misfire associated with e or f of Note 3/, Table V.
b. Projectile remaining in bore.
c. Metal parts separation, except rotating band separation.
d. Premature projectile functioning.

2/. For verification inspection, primed cases that do not meet the requirement of 3.6 shall be classed as defective. The propellant from the primed cases shall be inspected for contamination and weighed. The lot shall be rejected if the recovered propellant does not meet the contamination requirement of 3.5, or if any cartridge contains less than 500 grains of propellant.

3/ Projectile sensitivity and detonation delay tests are to be conducted simultaneously.

4/ Velocity and pressure readings shall be recorded in a single test.

5/ In each temperature phase, projectile trace and projectile self-destruct are to be conducted simultaneously.

6/ Test may be conducted using same sample cartridges.

7/ If a test weapon fails to comply with the minimum cyclic rate during a normal burst operation or is found to be defective during or at the end of burst, the test shall be suspended and Government approval sought for a new test. The cyclic rate of each burst shall not be less than 3,000 shots per minute in the gun. The cyclic rate for each burst shall be recorded.

8/ The cartridges shall be conditioned for a period of not less than six hours after the conditioning chamber has established at the specified test temperature. Timing for the conditioning period shall start when the chamber has stabilized following the sample being place in the conditioning chamber.

9/ Failure of two or more sample cartridges to comply with the minimum requirement shall cause rejection of the lot. If one cartridge of the sample fails to comply with the minimum requirement, a second sample of 20 cartridges shall be tested. The lot shall be rejected if two or more cartridges of the combined sample fail to comply with the minimum requirement.

10/ Failure of two or more sample cartridges to comply with the specified torque requirement shall cause rejection of the lot. If one cartridge of the sample fails to comply, a second sample of 20 cartridges shall be tested. The lot shall be rejected if two or more cartridges of the combined sample fail to comply with the applicable requirement

11/ If the sample fails to comply with either or both requirements a retest sample of 40 cartridges shall be tested. The lot shall be rejected if the retested samples fail to comply with the applicable requirement(s).

12/ If the sample fails to comply with the specified requirements, a retest sample of 40 cartridges shall be tested. The lot shall be rejected if the retested samples fail to comply with the applicable requirement(s).

13/ If the average wet velocity fails to comply with the applicable requirement, a retest sample of 40 cartridges shall be tested. The lot shall be rejected if the average velocity of the wet samples differs by more than 100 feet per second from the average velocity of 40 additional dry samples fired to establish a new base of comparison. The lot shall not be penalized for failure of the last named sample cartridges to comply with the requirements of 3.18.

14/ If the average mean radius of the sample cartridges exceeds the applicable requirement, a retest sample of 100 cartridges shall be tested. The lot shall be rejected if the average mean radius of 10 retest dispersion targets exceeds the applicable requirements.

15/ For lot acceptance, each temperature phase shall be considered individually. Failure of three or more first sample cartridges to comply with the requirement shall cause rejection of the lot. If 2 cartridges of the first sample fail to comply with the requirement, a second sample of 86 cartridges shall be tested for

that temperature phase. The lot shall be rejected if four or more cartridges of the combined first and second samples fail to comply with that temperature phase test requirement.

16/ For acceptance, each temperature phase shall be considered individually. Failure of two or more sample cartridges to comply with the applicable requirement shall cause rejection of the lot. If one cartridge of the sample fails to comply with the applicable requirement, a second sample of 10 cartridges shall be tested. The lot shall be rejected if two or more cartridges of the combined sample fail to comply with the applicable requirement.

17/ Due to the nature of the Langlie Sampling Technique, the R_{50} may be determined with a lesser or greater number of cartridges than the sample size required, as determined by the test results.

TABLE IV. Examination for defects

Projectile Body Assembly, Tracer, Dwg. 12551774 1/				
Classification	Examination or Test	Conformance Criteria	Requirement Paragraph	Inspection Method 2/, 3/
Critical	None defined	N/A	N/A	N/A
Major				
101	Seal missing or perforated	100%	3.2	Gage
102	0.06 depth from metering disc seat to tracer igniter, min (prior to insertion of seal and metering disc)	100%	3.2	Gage
103	Metering disc missing	Level IV	3.2	Visual
104	Metering disc crimp defective	Level IV	3.2	Visual
105	Foreign matter	Level IV	3.19	Visual
106	Tracer mixture consolidation pressure	Level IV	3.2	Gage
107	Tracer and igniter mixtures consolidation pressure	Level IV	3.2	Gage
Minor				
201	Poor workmanship	Level II	3.19	Visual
Projectile Body Assembly, Charged, Dwg. 12551770				
Classification	Examination or Test	Conformance Criteria	Requirement Paragraph	Inspection Method 2/
Critical	None defined	N/A	N/A	N/A
Major				
101	0.525 depth, mouth to incendiary mix	Level IV	3.2	Gage
102	0.865 depth, mouth to HE mix	Level IV	3.2	Gage
103	propellant and comp A-4 consolidation pressure	Level IV	3.2	Gage
Minor				
201	Poor workmanship	Level II	3.19	Visual

TABLE IV. Examination for defects - Continued

Nose Assembly, Charged, Dwg. 12551772				
Classification	Examination or Test	Conformance Criteria	Requirement Paragraph	Inspection Method 2/
Critical	None defined	N/A	N/A	N/A
Major				
101	0.218 height of third incendiary increment	Level IV	3.2	Gage
102	First increment consolidation pressure	Level IV	3.2	Gage
103	Second increment consolidation pressure	Level IV	3.2	Gage
104	Third increment consolidation pressure	Level IV	3.2	Gage
Minor				
201	Poor workmanship	Level II	3.19	Visual
Projectile, Dwg. 12551768				
Classification	Examination or Test	Conformance Criteria	Requirement Paragraph	Inspection Method 2/, 3/
Critical	None defined	N/A	N/A	N/A
Major				
101	Crack in projectile	100%	3.2	Gage
102	Loose nose	Level IV	3.2	Manual
103	0.015 runout nose to datum A	Level IV	3.2	Gage
104	2.597 max, nose to rear of rotating band	Level IV	3.2	Gage
105	3.775 max, overall length	Level IV	3.2	Gage
Minor				
201	0.007 max gap between nose and body	Level II	3.2	Gage
202	Protective coating damaged or incomplete	Level II	3.2/3.19	Visual
203	Poor workmanship	Level II	3.19	Visual
Cartridge, 20mm MPT-SD, M940, Dwg. 12551767				
Classification	Examination or Test	Conformance Criteria	Requirement Paragraph	Inspection Method 2/, 3/
Critical				
1	Split or perforated case	100%	3.2	AAIE
Major				
101	Case to projectile crimp missing	100%	3.2	Gage
102	Chamber gage failure (profile and alignment, max)	100%	3.2	Gage 4/
103	0.002 depth of primer seating	Level IV	3.2	Gage
104	6.615 total length, max	Level IV	3.2	Gage
105	Improper or incomplete crimp (case-projectile)	Level IV	3.2/3.19	Visual
106	Corrosion	Level IV	3.2	Visual
107	Head configuration	Level IV	3.2	Visual
108	Metal slivers on head face	Level IV	3.19	Visual
109	Loose primer	Level IV	3.2	Manual
110	Inverted primer	Level IV	3.2	Visual
111	Crack, split or dent in nose cap	Level IV	3.2/3.19	Visual
Minor				
201	Waterproofing missing around primer	Level II	3.2	Visual
202	Lacquer on primer button	Level II	3.2/3.19	Visual
203	Primer crimp missing or incomplete	Level II	3.2	Visual
204	Rotating band damage	Level II	3.2	Visual

TABLE IV. Examination for defects - Continued

Classification	Examination or Test	Conformance Criteria	Requirement Paragraph	Inspection Method 2/
Minor				
205	Cartridge case damaged	Level II	3.2	Visual
206	Marking misleading or unidentifiable	Level II	3.2/3.19	Visual
207	Projectile protective coating damaged or incomplete	Level II	3.2/3.19	Gage
208	0.007, max gap between nose and projectile body	Level II	3.2	Visual
209	Foreign matter, except corrosion	Level II	3.19	Visual
210	Poor workmanship	Level II	3.19	Visual

Notes:

1/ If the crimp closure is not pressed tightly against the metering disc for 360° or the metering disc can be moved manually, the assembly shall be classed defective.

2/ MIL-STD-651 shall apply in defining and evaluating cartridge visual defects.

3/ Automated acceptance inspection equipment (AAIE) shall be used to perform all critical defect inspections. AAIE shall be in accordance with MIL-A-70625 and approved by the government.

4/ A dead weight load of sixty pounds maximum may be used to insert the cartridge in the gage.

4.4 Method of inspection.

4.4.1 Projectile torque. The cartridge shall be marked with a light scratch extending axially across the nose, body, rotating band and onto the case neck. Then the cartridge shall be placed in the applicable fixture specified herein and the inch pound torque shall be applied slowly to the projectile. Observation shall be made for movement of the projectile with respect to the misalignment in the scratch mark. This test is a non-destructive test.

4.4.2 Projectile extraction. The cartridge shall be placed in the applicable fixture specified and the tension force specified shall be applied. The projectile must separate from the cartridge case in the range specified. The method of test shall be as specified in SCATP-20.

4.4.3 Contamination of energetic components. After completion of test specified in 4.4.2, each of the cartridges tested shall be examined visually for contamination as described in SCATP-20. In addition, cartridges shall be examined visually for the presence of moisture in the form of condensation in the cartridge case or on the propellant.

4.4.4 Electrical resistance of primed case.

4.4.4.1 Testing. The primed case shall be tested for the applicable requirement using Government approved equipment and circuitry specified on Dwg. 11075284 to measure the resistance of the primer.

4.4.4.2 Verification. A battery operated volt-ohm-ammeter shall be used to measure the resistance of the primer in each primed cartridge case from 4.4.2. In measuring the resistance, the equipment shall not apply a current greater than 1.4 milliamperes. Prior to use, test meters shall be tested for maximum short circuit current over the range of resistances that will be experienced during measurements. The applied current shall be limited as necessary to avoid primer functioning. Features of

the meter not required for resistance verification should be disabled. In addition, the meter shall be capable of being calibrated, the battery power shall be 9 volts or less, and the accuracy ± 2% or better.

4.4.5 Pressure and velocity. The method of test shall be as prescribed in SCATP-20, except that pressure data will be obtained by utilizing piezoelectric pressure transducers (see 6.9). Any smoothing of the pressure signal shall be accomplished using a filter frequency of not greater than 5 kilohertz.

4.4.6 Action time. The method of test shall be as prescribed in SCATP-20, except that the test weapon shall be instrumented to also record the velocity and pressure of the hot and cold temperature firings. This data is collected for informational purposes only and shall be included in the firing records for each lot.

4.4.7 Function and casualty. The method of testing shall be in accordance with SCATP-20. The test sample shall be fired in bursts of 50 cartridges in the M168 or M61 cannon. The weapon barrels shall be at ambient temperature at the beginning of the test and cooled to ambient after each 100 rounds.

TABLE V. Casualties

Defect Description 1/	Accept	Reject	Cumulative Reject	Classification
Fire “out of battery” 2/	0	1	N/A	Major
Misfire 3/	0	1	N/A	Major
Failure to chamber	0	1	N/A	Critical
Failure to extract	0	1	N/A	Critical
Projectile remaining in bore	0	1	N/A	Critical
Primer missing or button missing from primer	0	2	2	Major
Primer leak	9	20	25	Minor
Longitudinal case split 4/				
I or S	10	21	31	Minor
K	0	2	2	Major
J	4	9	11	Minor
L or M	0	1	N/A	Critical
Circumferential rupture, partial 4/				
S, J, or K	4	9	11	Major
L	0	1	N/A	Critical
Circumferential rupture, complete 4/	0	1	N/A	Critical
Detached metal 5/	0	1	N/A	Major
Complete or partial separation of rotating band having band seat knurling imprint 6/	0	3	3	Major
Rotating band separation having greater than 0.5 inch and without band seat knurling imprint 6/	1	4	6	Minor
Metal parts separation, except rotating band separation 7/	0	1	N/A	Major
Premature burst 8/	0	1	N/A	Major

Notes:

1/ Defect definitions are contained in SCATP-20.

2/ A cartridge shall be classed defective if it fires, due to delayed ignition, after the bolt has been unlocked and extraction has been initiated or completed.

3/ Misfiring test cartridges, excepting those from the waterproofness test (Table II and Table III), shall be retested in accordance with the method of 4.4.6. If a cartridge fails to function in this test, examinations shall be conducted for the following conditions:

a. Excessive primer seating depth
b. Metal slivers across primer insulator.
c. Electrical continuity.
d. Missing or obstructed case vent.
e. Missing or insufficient primer composition or propellant.
f. Partially burned or contaminated primer composition or propellant.

The lot shall not be penalized if condition a is observed, however, the condition shall be reported for information. The "Acc" number shall be zero and the "Rej" number three, for misfires associated with conditions b, c, or d. The second sample for evaluation of misfires associated with conditions b, c, or d shall consist of the function and casualty second sample (see Table II and Table III). The lot shall be rejected if either condition e or f is observed. Misfire(s) occurring in the waterproofness test shall be handled in accordance with SCATP-20.

4/ See Dwg. 7258801 for classifying splits and ruptures in fired cartridge cases. If a longitudinal split or circumferential rupture (partial) extends into two or more defined areas, only the most severe defect criterion for the areas involved shall apply.

5/ Metal sheared or missing from the fired cartridge case exterior, such as rim or neck shears, shall be classed as a defect. Shavings of metal from the interior wall of the case neck, in the crimped area, will not be classed as detached metal.

6/ For classification as a defect, there must be evidence by recovery of the band, or portion thereof, or by holes in the fragmentation screens. Normal band fringing or slivering will not be classed as a defect.

7/ Separation or breakup of projectile parts, except rotating band separation, as evidenced by recovery of the parts or fragments or holes in the fragmentation screens shall be classed as a defect.

8/ A premature burst is considered to have occurred if the round functions in the gun bore or during uninterrupted flight at a distance less than 200 yards from the gun muzzle.

4.4.8 Dispersion. The method of test and measurement of targets shall be in accordance with SCATP-20. For lot acceptance testing the specified range may be modified with a minimum range of 200 yards. For ranges other than 547 yards, the average mean radius shall be altered in direct proportion to the modified range. For first article acceptance testing, dispersion testing shall be performed at a distance not less than the minimum required range of 547 yards.

4.4.9 Projectile trace and self-destruct. Projectile trace and self-destruct test shall be conducted simultaneously. The test method shall be as specified in SCATP-20. Projectile trace and self-destruct time shall begin at cartridge ignition and continue until end of the tracer burn or at self-destruct, whichever comes first. Observation shall be from near the gun position.

4.4.10 Arming sensitivity. The sensitivity test shall be conducted by firing the sample cartridges at a 0.080 inch 2024-T3 aluminum target plate. No impact shall be less than 3 calibers from the edge of the sheet or less than 1 caliber between holes. Cardboard witness panels shall be placed at 4 and 6 feet behind the target plate. A valid projectile function is defined as a fragment signature on the witness panels indicating projectile breakup.

4.4.11 Detonation delay. The detonation delay shall be measured by plate array. The detonation delay on a multi-plate array is determined by placing corrugated cardboard sheets at 4 feet and 6 feet behind the target plate and tracing a minimum of 3 fragment paths back to the center of detonation. The detonation plate shall be 0.080 inch thick 2024-T3 aluminum and shall meet the requirements of 3.15. Premature detonation is considered to be the occurrence of any of the following:

a. Any detonation within the weapon.
b. Any detonation within 200 yards of uninterrupted flight from the weapon.

4.4.12 Fragmentation. The fragmentation test shall utilize a 10 plate multiple plate target with an 0.080 inch thick detonation plate of 2024-T3 aluminum placed 210 $\pm$ 10 yards from the muzzle. The nine witness sheets shall be placed 8 inches apart. The witness sheets shall be 0.040 inch thick 2024-T3 aluminum. The last witness sheet shall be 72 inches from the detonation plate (see 3.16). Cartridges shall be conditioned at $70^{o} \pm 2^{o}$F and fired from a test barrel.

4.4.13 Penetration. The test shall be conducted in accordance with TOP 2-2-710, and the R_{50} shall be determined by the Langlie Sampling Technique. All cartridges shall be conditioned at $70^{o} \pm 2^{o}$F and fired from a test barrel. The position of the target shall be varied in order to obtain the desired target range. All cartridges will be tested at service velocity. For each target, estimate an upper and lower limit of range that shall provide a reasonable certainty that the R_{50} will occur somewhere between these selected limits. Fire the first cartridge at the target positioned at a range midway between these two limits. Continue testing until the R_{50} is statistically established. A 0.040 inch 2024-T3 aluminum witness panel shall be positioned six inches behind and parallel to the target to determine if the penetration has occurred.

4.4.14 Waterproofness. The method of test shall be as prescribed in SCATP-20.

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 contractor 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. This item is military unique, and this specification covers the assembly of the M940 20mm multipurpose, trace self destruct cartridge for use in the M61 type automatic cannon system.

6.1.1 Barrel use. Two different length barrels exist for the M61 type gun systems: the historical 60 inch barrel of the M61/M168 systems, and the 79 inch barrel of the Land-based Phalanx Weapon System. Interior ballistic requirements for the M940 cartridges are tailored to the system used. In Section 3, the applicable requirements are identified by the test barrel that will be used for acceptance of the configuration in accordance with the table below. Interior ballistic requirements may vary by application.

COAI	DODIC	NSN	Test Barrel
13011323	AB07	1305-01-534-2702	799E749-10 1/
12551785	A710	1305-01-283-2134	11075229

1/ CAGE Code 05606

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification and all reference documentation cited in this specification (see 2.2.1).
b. Requirements for submission of first article: A first article sample, either in part or complete (Table II), may be required for the commencement of production after the award of a new contract, a change in production venue, a process change for any part or subassembly, or after a production stoppage in excess of 90 days as directed by the government contracting officer.
c. Requirement for submission of inspection equipment designs and manufacturing process.
d. Requirement and provisions for submission of test data as required.
e. Provisions for the inclusion of MIL-STD-1168, Ammunition Data Cards on DD form 1423, Contract Data Requirement List.
f. Provisions for critical characteristic controls.
g. Serialization requirements, if applicable.
h. Critical inspection equipment requirement.
i. Quality Conformance inspection, other than specified in Section 4 of this specification.
j. Applicable National Stock Number.
k. Lists of drawings, publications and specifications, showing applicable revision dates.
l. Certificate of conformance for each lot or shipment of product, if applicable.
m. Place of inspection, if not at place of manufacture.
n. Government Furnished Material or Equipment

6.3 Automatic acceptance inspection equipment (AAIE). Provision concerning the AAIE used to verify the requirements of this specification should be specified in the contract if applicable.

6.4 Submission of inspection equipment designs for approval. Submit copies of designs as required to: Commander, US Army ARDEC, Attn: AMSRD-AAR-QEM-F, Picatinny, NJ 07806-5000. This address will be specified on the Contract Data Requirements List, DD Form 1423 in the contract.

6.5 Firing tests. In order to minimize inspection costs, the firing tests will be performed after the sample has been provisionally accepted for all other requirements. Additional cartridges may be required by the test facility (see 4.2). Tests may be performed concurrently on the sample cartridge provided that the test results are not affected by this procedure to minimize testing costs.

6.6 Test validity. If for any reason the test activity considers that the test conditions have detrimentally affected the test results, the test activity may request the Government to declare the test invalid and authorize a new test.

6.7 Intermediate point inspection. The classification of defects identifies the defect characteristics for acceptance inspection. It may be necessary to modify the sequence of inspection stations to best suit the manufacturing process. Inspection for defect characteristics which will be hidden or altered by subsequent processing operations (including unrelated operations), should be scheduled to prevent premature acceptance which could be detrimental to the attainment of optimum product quality of the end item.

6.8 Standard Deviation. Standard deviation (σ) should be calculated from the following formula or other approved formula:

$$\sigma = \sqrt{\frac{\sum \left(X_i - \overline{X}\right)^2}{n-1}}$$

where: X_i = Each individual value

$\overline{X}$ = Sample arithmetic mean

n = Sample size

6.9 Pressure testing. The contractor should propose a procedure for obtaining pressure data utilizing piezoelectric pressure transducers that should be approved by the government. Test procedures should be sent to: US Army ARDEC, AMSRD-AAR-QEM-F, Picatinny, NJ 07806-5000.

6.10 Malfunction or casualty not covered by this specification. If a lot is suspended due to a malfunction or casualty not covered by this specification, the lot should be referred to the contracting officer.

6.11 Changes from previous issues. Asterisks and marginal notes are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

6.12 Critical defects.

6.12.1 Hangfire. A hangfire occurs when action time of a round is sufficiently long that the bolt unlocks before the projectile leaves the muzzle of the barrel. This results in unrestrained combustion and possible firing of the projectile out of battery. This could cause massive damage to the weapon system and weapon stoppage (see 6.12.3).

6.12.2 Projectile remaining in bore. A bullet in bore occurs when a projectile engages the rifling of a barrel and travels some distance, but does not exit the barrel. This allows another cartridge to be fired into the stuck projectile, causing catastrophic failure to the weapon system and weapon stoppage (see 6.12.3).

6.12.3 Weapon stoppage. Due to the stand alone nature of the Land-based Phalanx Weapon System, when an ammunition defect prevents the weapon from functioning, this is considered a Mission Failure.

TABLE VI. Critical defect justifications

Critical Defect	Justification
Action time	Long enough action time will result in a hangfire.
Split or perforated case	This will cause propellant loss and could prevent full opturation, causing gas blow-by in the chamber. Either could result in a projectile remaining in bore.
Failure to chamber	This will jam the feed mechanism of the weapon and cause weapon stoppage.
Failure to extract	When the next round is chambered, it will jam the feed mechanism of the weapon and cause weapon stoppage.
Projectile remaining in bore	This will result in weapon stoppage, see definition above.
Longitudinal case split, L or M	When the next round is chambered, it will jam the feed mechanism of the weapon and cause weapon stoppage.
Circumferential rupture, partial, L	When the next round is chambered, it will jam the feed mechanism of the weapon and cause weapon stoppage.
Circumferential rupture, complete	When the next round is chambered, it will jam the feed mechanism of the weapon and cause weapon stoppage.

6.13 Subject term (key words) listing.

Multipurpose
Nose Fuzes
Incendiary Ammunition
Bursting Charges
Electric Primers
Trace
20 millimeter
Ammunition
M940
Projectiles
MP-T-SD
Armor Piercing Ammunition
Self-Destruct
Explosives

Custodian: Army-AR

Preparing activity: Army-AR
(Project 1305-2006-002)

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