

INCH-POUND

MIL-DTL-46540C(AR)
3 MAY 2006
 SUPERSEDING
 MIL-C-46540B(AR)
 14 June 1976

DETAIL SPECIFICATION

CASE, CARTRIDGE: 20MM, M103

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 Case, Cartridge: 20MM, M103 for use with 20 millimeter ammunition (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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

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

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 ASSIST online database at <http://assist.daps.dla.mil>.

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(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.

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

7553815	Case, Cartridge, 20mm, M103
7258817	Cartridge, 20mm, Target Practice, M55A2
1575AS300	Cartridge, 20mm, Target Practice, PGU-27/B
7258801	Classification of Defects for Case, Cartridge, 20mm, M103 and M103B1

(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.

ASTM INTERNATIONAL

ASTM E18 - Standard Test Methods for Rockwell Hardness and
Rockwell Superficial Hardness of Metallic Materials

(Copies of this document are available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.)

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.

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3.3 Head rim thickness, maximum. The maximum head rim thickness of each cartridge case shall be in accordance with drawing D7553815.

3.4 Hardness. The cartridge case shall comply with the hardness requirements of drawing D7553815.

3.5 Residual stresses. The cartridge case shall be free of residual stresses to the degree detectible by the mercurous nitrate test.

3.6 Neutrality. The cartridge case surface shall be free of acids and alkalis.

3.7 Function and casualty. The cartridge case shall function without casualty (see Table V).

3.8 Workmanship. All parts and assemblies shall be fabricated, loaded, and assembled in a thorough workmanlike manner. They shall be free of foreign matter such as corrosion, corrosive residue, stains, dirt, grease, oil, lint, chips, slivers, shavings and trim sections and free of defects, such as metal flaws, folds, wrinkles, splits, cracks, dents and perforations. Exterior surface coatings shall be continuous; however, light scratches not exposing base material may be permitted.

4. VERIFICATION

TABLE I. Requirement/verification cross reference matrixMETHOD 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	Head rim thickness				X		X	X	4.4.1
3.4	Hardness					X	X	X	4.4.2
3.5	Residual stresses					X	X	X	4.4.3
3.6	Neutrality					X	X	X	4.4.4
3.7	Function and casualty					X	X	X	4.4.5
3.8	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 4030 M103 cartridge cases shall be subjected to first article verification inspections and tests with quantities in accordance with Table II and Table IV.

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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	Conformance Criteria		Requirement Paragraph	Inspection Method	Defect Classification
	Sample	Acc/Rej			
Examination for defects	125	0/1	3.2/3.8	Table IV	Table IV
Head rim thickness, maximum	4030	0/1	3.3	4.4.1	Major
Hardness	5	0/1	3.4	4.4.2	Major
Residual stress	25	0/1	3.5	4.4.3	Major
Neutrality	10	0/1	3.6	4.4.4	Major
Function and Casualty	4000	0/1	3.7	4.4.5	Table V

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.

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 6.9).

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

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TABLE III. Conformance inspection

Examination or Test	Conformance Criteria		Requirement Paragraph	Inspection Method	Defect Classification
	Sample	Acc/Rej			
Examination for defects	Table IV	0/1	3.2/3.8	Table IV	Table IV
Head rim thickness, maximum	100%	see 1/	3.3	4.4.1	Major
Hardness	5	see 2/	3.4	4.4.2	Major
Residual stress	25	0/1	3.5	4.4.3	Major
Neutrality	10	0/1	3.6	4.4.4	Major
Function and Casualty 3/	400	Table V	3.7	4.4.5	Table V

Notes:

1/ A cartridge case that fails to comply with the head rim thickness requirement shall be rejected.

2/ If two or more units of the sample fail to comply with the hardness requirement, the lot shall be rejected. If one unit of the sample fails to comply with the requirement, a second sample of 10 cartridge cases shall be randomly selected from the lot and tested. The lot shall be rejected if a total of two or more cartridge cases of the combined first and second samples fail to comply. Failure is defined as any individual hardness number obtained that does not comply with the drawing hardness pattern position requirement.

3/ The lot shall be rejected if any malfunction or casualty occurs in number equal to or greater than the applicable "Rej" number. If malfunctions or casualties occur in excess of the applicable "Acc" number, but less than the applicable "Rej" number, a second sample of 800 cartridges randomly selected from the lot shall be tested. The lot shall be rejected if in the combined samples malfunctions or casualties occur in number equal to or greater than the applicable "Rej" number.

TABLE IV. Examination for defects

Cartridge Case, Dwg. 7553815				
Classification	Examination or Test	Conformance Criteria	Requirement Paragraph	Inspection Method 1/, 2/
<u>Critical</u> 1	Split or perforated case	100%	3.2	AAIE
<u>Major</u>				
101	Metal defective	Level IV	3.2	Visual
102	Flash hole missing or obstructed	Level IV	3.2	Visual
103	Corrosion	Level IV	3.8	Visual
104	Oil or grease	Level IV	3.8	Visual
105	Head configuration	Level IV	3.2	Visual
106	Thickness, head rim, min	Level IV	3.2	Gage
107	Perpendicularity case head with datum surface	Level IV	3.2	Gage
108	Chamfer, head rim, missing	Level IV	3.2	Visual
109	Length of flat on head rim, min	Level IV	3.2	Gage
110	Diameter of head, min	Level IV	3.2	Gage
111	Diameter, primer pocket	Level IV	3.2	Gage
112	Depth, primer pocket	Level IV	3.2	Gage
113	Runout, primer pocket with datum surface	Level IV	3.2	Gage
114	Diameter, extractor groove, max	Level IV	3.2	Gage
115	Width, extractor groove, min	Level IV	3.2	Gage

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TABLE IV. Examination for defects - Continued

Classification	Examination or Test	Conformance Criteria	Requirement Paragraph	Inspection Method <u>1/</u> , <u>2/</u>
<u>Major</u>				
116	Wall thickness, first location from inside head surface	Level IV	3.2	Gage
117	Wall thickness, second location from inside head surface	Level IV	3.2	Gage
118	Inside diameter, mouth, min	Level IV	3.2	Gage
119	Profile and alignment, max	Level IV	3.2	Gage
120	Length to 0.942 basic diameter, min	Level IV	3.2	Gage
121	Total length, max	Level IV	3.2	Gage
122	Diameter, body taper at location near head, min	Level IV	3.2	Gage
123	Diameter, body taper at 1.7500 location, min	Level IV	3.2	Gage
124	Diameter, body taper at location near shoulder, min	Level IV	3.2	Gage
<u>Minor</u>				
201	Foreign matter other than oil, grease or corrosion	Level II	3.8	Visual
202	Scratch (other than draw scratch)	Level II	3.8	Visual
203	Fold or wrinkle	Level II	3.8	Visual
204	Radius at mouth of primer pocket missing or not tangent to pocket side wall	Level II	3.2	Visual
205	Wall thickness at mouth	Level II	3.2	Gage
206	Total length, min	Level II	3.2	Gage
207	Diameter, extractor groove, min	Level II	3.2	Gage
208	Width, extractor groove, max	Level II	3.2	Gage
209	Web thickness	Level II	3.2	Gage
210	Diameter, flash hole	Level II	3.2	Gage
211	Diameter, head, max	Level II	3.2	Gage
212	Inside diameter, mouth, max	Level II	3.2	Gage
213	Weight	Level II	3.2	Gage
214	Length to 0.942 basic diameter, max	Level II	3.2	Visual
215	Marking incorrect, incomplete or unidentifiable dent	Level II	3.8	Visual

Notes:

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

2/ 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.

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TABLE V. Casualties

Defect Description <u>1/</u>	Acc	Rej	Classification
Failure to chamber <u>1/</u>	0	1	Critical
Failure to extract <u>2/</u>	0	1	Critical
Blown primer <u>3/</u>	0	1	Major
Splits and ruptures <u>4/</u>			
Splits:			
I or S	6	17	Minor
J	2	12	Minor
K, L, or M	0	1	Critical
Rupture, partial			
S, J, or K	1	6	Minor
L	0	1	Critical
Circumferential rupture, complete	0	1	Critical
Detached metal <u>5/</u>	0	1	Major

Notes:

1/ The case lot will not be penalized if malfunction cannot be shown to have resulted from a defective case.

2/ A fired sample cartridge case remaining in the chamber after the normal extraction cycle will be classed defective, unless it can be shown that the malfunction was caused by a defective weapon.

3/ The sample cartridge case shall be classed defective only if it is evident by visual inspection that both the primer pocket and case head are enlarged and deformed.

4/ Refer to drawing C7258801 and SCATP-20 for classifying splits and ruptures resulting from the function and casualty test. If a split or partial rupture extends into two or more defined areas, only the most severe defect criterion of Table V for the areas involved shall be used.

5/ The case lot will not be penalized if malfunction cannot be shown to have resulted from a defective case. There must be evidence of detached metal from fired case exterior. The lot will not be penalized for the detachment of metal shavings from the projectile crimped area of the case interior.

4.4 Method of inspection.

4.4.1 Head rim thickness, maximum. The equipment design shall provide controls that will assure rejection of defective cartridge cases (see 6.8).

4.4.2 Hardness. The cases of the test samples shall be sectioned as shown on drawing D7553815. The head sections will have approximately parallel surfaces finished to 63 microinches or finer, care being taken not to change the hardness in obtaining this finish. Four determinations each shall be made at the indicated body and neck positions for each sample case, two on each half on the interior as shown. Two determinations each shall be made at the indicated head position as shown for each sample case. The method of test shall be in accordance with ASTM E18-67, Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials.

4.4.3 Residual stresses. The method of test shall be as specified in SCATP-20 for case mercurous nitrate test.

4.4.4 Neutrality. The method of testing cartridge cases for acidity and alkalinity shall be as follows using red and blue sensitive litmus paper. Neutral distilled water will be used to moisten the paper

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and the case to provide adhesion. The litmus paper will be handled with forceps to prevent contamination from fingers. Smoking should not be permitted in the vicinity of test since tobacco smoke will turn red litmus blue. Pieces of red and blue sensitive litmus paper will be placed in several locations both on the interior and exterior of the case. A definite color change is defined as the color produced when blue litmus is immersed for thirty seconds in one thousandth normal (.001N) hydrochloric or sulfuric acid, or when red litmus is immersed for thirty seconds in one thousandth normal (.001N) sodium hydroxide. Litmus paper is considered of sufficient sensitivity if it shows change in color when immersed for 45 seconds, with stirring, in five ten thousandths normal (0.0005N) solutions of the corresponding acid or alkali mentioned.

4.4.5 Function and casualty. The method of test shall be as specified in SCATP-20. The test sample cases shall be assembled as Cartridge, 20MM, Target Practice, M55A2, conforming to drawing D7258817; or Target Practice, PGU-27, conforming to drawing 1575AS300. The sample test cartridges shall be fired, at ambient temperature, in bursts of 50 rounds in the quantities and weapons as specified in the table below. The gun barrels shall be at ambient temperature at the beginning of the test and shall be cooled to ambient temperature after each 100 rounds.

TABLE IV. Function and casualty testing

<u>Accepted cases will be used in</u>	<u>M61 Weapon</u>	<u>M39 Weapon</u>
20mm PGU Ammunition:	400	
All other 20mm Ammunition:	200	200 <u>1/</u>
Case First Article Test:	2000	2000 <u>2/</u>

Notes:

1/ Customers, through the procuring activity, may modify this requirement and base acceptance of cartridge cases that will be used to fulfill their orders on the firing of 400 rounds in the M61 Gun.

2/ Customers, through the procuring activity, may modify the first article test and base acceptance on the firing of 4000 rounds in the M61 Gun.

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 these cartridge cases are intended for ammunition to be used in U.S Army, Navy, Marines and Air Force 20mm automatic gun systems that have been designed for firing cartridges having the M103 type case configuration.

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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 cartridge cases may be required by the test facility (see 4.2). Tests may be performed concurrently on the sample cartridge cases 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 Head rim thickness. The contractor should propose a procedure for examining head rim thickness, maximum that should be approved by the government. Test procedures should be sent to: US Army ARDEC, AMSRD-AAR-QEM-F, Picatinny, NJ 07806-5000.

6.9 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.

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6.10 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.

6.11 Critical defects.

6.11.1 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 6.11.3). In addition, in an aircraft application, due to the weapon's proximity to the user a hangfire will also present a safety hazard due to fragmentation and shrapnel from the weapon and the round.

6.11.2 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 6.11.3). When used in an aircraft application, due to the barrel's proximity to the user a projectile remaining in bore will also present a safety hazard due to fragmentation and shrapnel from the barrel and the round.

6.11.3 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 V. Critical defect justifications

Critical Defect	Justification
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.
Split, K, L or M	When the next round is chambered, it will jam the feed mechanism of the weapon and cause weapon stoppage.
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.

6.12 Subject term (key words) listing.

Cartridge Cases

20 millimeter

Custodian: Army-AR

Preparing activity: Army-AR
(Project 1305-2006-003)

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>