

MIL-C-85717(AS)

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MILITARY SPECIFICATION

CARTRIDGE, 20 MILLIMETER, SEMI-ARMOR PIERCING

HIGH EXPLOSIVE INCENDIARY, PGU-28/B

This specification is approved for use within the Naval Air Systems Command, Department of the Navy and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE.

1.1 Scope. This specification establishes the requirements for the manufacture and acceptance of the 20 millimeter (mm) Semi-armor Piercing, High Explosive Incendiary (SAPHEI) Cartridge, referred to herein as the "cartridge".

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

Military

MIL-A-12560

Armor Plate, Steel, Wrought,
Homogenous (For Use In and For
Combat Vehicles Ammunition Testing).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, Systems Engineering and Standardization Department (SESD), Code 93, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N3931

FSC 1305

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MIL-P-85723

Projectile, 20mm Semi-Armor Piercing
High Explosive Incendiary, PGU-28/B.

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	Marking for Shipment and Storage.
MIL-STD-644	Visual Inspection Standards and Inspection Procedures for Inspection of Packaging, Packing and Marking of Small Arms Ammunition.
MIL-STD-651	Visual Inspection Standards for 20mm Ammunition and Components.
MIL-STD-810	Environmental Test Methods.
MIL-STD-882	System Safety Program Requirements.
MIL-STD-1167	Ammunition Data Cards.
MIL-STD-1168	Lot Numbering of Ammunition.
MIL-STD-1235	Single and Multilevel Continuous Sampling Procedures and Tables for Inspection by Attributes.

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DOCUMENTS

Naval Air System Command
(Code Ident 30003)

AR-68/47	20mm Ammunition, M50 Series (Belted With Links) MK 7 MOD 0 or MK 7 MOD 1, in Container M548.
AR-68/48	20mm Ammunition, M50 Series (Loose), in Container M548.

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DRAWINGS

Naval Air Systems Command
(Code Ident 30003)

1575AS100 Cartridge, 20mm Semi-Armor Piercing
High Explosive Incendiary PGU-28/B.

1575AS101 Projectile.

Department of the Army
(Code Ident 19201)

C7258801 Classifications of Defects, for
Case, Cartridge, 20mm, M103, M103A1
and M103B1.

7259023 Cartridge, 20mm, High Explosive
Incendiary, M56A3.

7553815 Case, Cartridge, 20mm M103.

PUBLICATIONS

Code of Federal Regulations

49 CFR 100-199 Hazardous Materials Regulations,
Department of Transportation.

US Army Material Command

AMCR 715-505 Ammunition Ballistic Acceptance Test
Methods, Volume 8, Test Procedures
for 20mm Cartridges.

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

2.1.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS.

3.1 Item description. The cartridge PGU-28/B shall be an all-up-round consisting of: a 20mm SAPHEI projectile, a M103 cartridge case with a MS2A3B1 electric primer and WC867 ball propellant.

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3.2 Characteristics.

3.2.1 Performance.

3.2.1.1 Chamber pressure. The average chamber pressure (\bar{X}) plus 0.84 times the average range (R) shall be not greater than 60,500 pounds per square inch (psi) at 68 to 72 degrees Fahrenheit ($^{\circ}$ F).

3.2.1.2 Action time. The action time of the cartridge, conditioned at -65 to $+160^{\circ}$ F, shall be not greater than 4.0 milliseconds (ms).

3.2.1.3 Velocity. The average velocity of the cartridges, conditioned at 68 to 72° F shall be 3410 ± 50 feet per second (fps) at 78 feet ± 3 inches from the muzzle. The sample standard deviation shall be not greater than 40 fps.

3.2.1.4 Accuracy. The average mean radius of all target impacts resulting from sample cartridges, conditioned at 68 to 72° F, shall be not greater than 15 inches at a range of 500 yards.

3.2.1.5 Projectile extraction. The force necessary to extract the projectile from the cartridge case shall be not greater than 2,800 pounds nor less than 1,100 pounds.

3.2.1.6 Projectile torque. The projectile shall withstand a minimum torque of not less than 10 inch-pounds without rotational movement as specified on Drawing 1575AS100.

3.2.1.7 Projectile detonation.

3.2.1.7.1 Projectile sensitivity. The projectile shall detonate upon impact with a target of 0.063 ± 0.005 inch thick 2024-T3 aluminum plate at 0 ± 10 degrees obliquity at a distance of 600 ± 3 feet.

3.2.1.7.2 Detonation delay. The projectile shall detonate upon impact with a target of 0.080 ± 0.005 inch thick 2024-T3 aluminum plate at 0 ± 10 degrees obliquity at a distance of 600 ± 3 feet with a delay not less than 8 inches or greater than 24 inches.

3.2.1.7.3 Projectile fragmentation. The projectile detonation shall provide not less than 8 penetrations in the last witness sheet of the specified target.

3.2.1.8 Penetration. The projectile shall demonstrate a probable ballistic limit (PBL) velocity of not greater than 2786 fps when fired against 0.375 inch armor (conforming to MIL-A-12560) at an obliquity of 45 degrees to the flight path of the projectile.

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3.2.1.9 Electrical resistance. The electrical resistance of the primed case shall be not greater than 1.2 Megohm nor less than 1000 ohms.

3.2.1.10 Function and casualty. The cartridge shall function at 68 to 72°F and the projectile shall detonate without firing defects or casualties.

3.2.2 Environmental conditions. The cartridges shall meet the performance requirements of this specification after having been subjected to the environments specified in 3.2.2.1 and 3.2.2.2.

3.2.2.1 Waterproofness. After conditioning at 68 to 72°F the average velocity of projectiles of the sample cartridges submitted to the waterproofness test shall not vary from the average velocity of unexposed cartridges by more than 100 fps.

3.2.2.2 Salt fog. The cartridge shall show no evidence of rust or corrosion that will cause pitting or damage to the cartridge case on projectile after exposure to salt fog. Discoloration of the cartridge case or projectile shall not constitute failure.

3.3 Design and construction.

3.3.1 Production drawings. The cartridge shall be fabricated and assembled in accordance with Drawing 1575AS100.

3.3.2 Standards of manufacture.

3.3.2.1 Propellant contamination. The propellant shall be free from contamination.

3.4 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.4 and 6.3).

3.5 System safety. System safety shall assure safety for all personnel and equipment during all phases of test and operations, including storage, packaging, handling and transportation. System safety engineering and management activities shall be in accordance with MIL-STD-882 (see 6.2.2).

3.6 Reliability. The cartridge shall have a performance of not more than one failure per 250,000 rounds. The cartridge shall be considered to have failed for the purpose of cartridge reliability if any of the following occurs during any test or examination:

- a. A premature ignition, hangfire or misfire.
- b. A projectile structural failure.
- c. A failure that causes an armament system failure.

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3.7 Workmanship. All parts and assemblies shall be fabricated, loaded, and assembled in a manner that will assure compliance with all requirements of this specification. They shall be free of burrs, sharp edges, cracks, scratches, dents, folds, wrinkles, buckles, dirt, grease, oil, rust and other foreign matter. The cleaning method used shall not be injurious to any parts, nor shall the parts be contaminated by the cleaning agents. Exterior surface coatings shall be continuous. Light scratches shall not exceed the defect criteria specified in 4.8.2. All required marking and stamping shall be neat and clearly defined.

4. QUALITY ASSURANCE PROVISIONS.

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order (see 6.2.1), the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of Sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

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

- a. First article inspection (see 4.4).
- b. Quality conformance inspection (4.5).

4.3 Inspection conditions. Unless otherwise specified herein, all inspection shall be performed in accordance with the test conditions specified in 4.3.1 through 4.3.4.2.

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4.3.1 Calibration of instrumentation. To establish a reference baseline for testing the multipurpose cartridge specified herein, PGU-17/B 20mm target practice cartridges shall be used. Twenty cartridges from the reference lot shall be fired from the standard barrel and test stand and the data recorded. Holes shall be drilled in accordance with AMCR 715-505 to obtain the chamber pressure. The velocity and action time shall also be recorded. The data shall be compared with the original lot acceptance test data of the reference lot. A baseline (X_B) pressure and velocity shall be established. This baseline shall require consultation and acceptance by the Government (see 6.2.2).

4.3.2 Daily reference. During the tests of the cartridge, a minimum of 10 M55 cartridges per day are fired to establish a daily reference (X_D) pressure and velocity.

4.3.3 Ballistic variation. Ballistic variation X for pressure and velocity between the reference baseline and the daily reference is calculated as follows:

$$X = X_B - X_D$$

Where:

X_B = Reference baseline

X_D = Daily reference

The computed ballistic variation X for pressure and velocity is utilized in 4.6.1.1 and 4.6.1.3 to establish corrected performance.

4.3.4 Computations.

4.3.4.1 Standard deviation. Where computation of a sample standard deviation is specified for determination of lot acceptance, the method of computation will be:

$$S = \sqrt{\frac{\sum(X_i - \bar{X})^2}{n}} \quad \text{or equal}$$

Where: X_i = each individual value

\bar{X} = sample arithmetic mean

n = sample size

4.3.4.2 Range. Where computation of the average Range (\bar{R}) is specified, the individual values shall be recorded in subgroups of 5 in the order in which they are observed. The ranges for the subgroups will be added and the sum of the ranges shall be divided by the number of subgroups to determine the \bar{R} .

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4.4 First article inspection. Unless otherwise specified in the contract or purchase order, the contractor shall furnish a first article sample of 600 cartridges to the testing activity designated in the contract or purchase order for first article inspection and approval (see 6.3). First article approval is valid only on the contract under which it is granted, unless specifically extended by the contracting activity to other contracts. The first article sample shall be manufactured using the same methods, materials, processes, and procedures proposed for production. Any production prior to approval of the first article samples, shall be at the risk of the contractor. After approval of the first article sample changes in material, processes, procedures, or design shall require prior written approval from the contracting activity and requalification may be required. First article sample lot identification shall be in accordance with MIL-STD-1168.

4.4.1 First article test sequence. The tests listed in Table I shall be performed on the first article sample in accordance with the test methods prescribed in 4.6 (see 6.2.2). Except as otherwise specified herein, the tests shall be conducted with samples at 68 to 72°F. Approval shall be based upon examination of the complete sample for visual and dimensional characteristics listed in 4.5.3 and the tests listed in Table I. Tests may be performed in any sequence. The combining of tests shall be permitted (see 6.6).

4.4.2 First article sample rejection. Inability of the sample to comply with the requirements of the drawings and specifications shall be cause for sample disapproval. Determination as to acceptability of any first article sample shall be based upon results of initial test only and no second tests shall be permitted on that first article. The acceptance and rejection criteria for the first article sample shall be as specified in Table I. All first article units shall be inspected 100 percent for critical defects.

4.4.3 First article sample failure criteria. Failure criteria shall be as defined herein during the examinations, and the tests of Table I shall be used to verify conformance to the applicable acceptance and rejection criteria.

4.5 Quality conformance inspection.

4.5.1 Submission of product. The product shall be submitted in accordance with MIL-STD-105 or MIL-STD-1235, as applicable.

4.5.1.1 Production lot. The production lot shall be not less than 25,000 cartridges and not more than 100,000 cartridges. A lot shall consist of:

- a. Cartridges loaded by one manufacturer using a projectile as specified in MIL-P-85723, in one unchanged process, in accordance with the same drawings and drawing revisions and the same specifications and specification revision.
- b. Like parts and assemblies (cases, primers, projectiles) having one manufacturer's symbol and one interfix number.
- c. Propellant from one lot.

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TABLE I. First article inspection.

Examination or test	No. of sample units	Accept and reject	Requirement paragraph	Paragraph reference and inspection method
<u>Projectile, Assembly,</u> 20mm SAPHEI (Drawing 157AS101)				
Examination for defects	125	Acc - 0 Rej - 1	3.7	Table II
<u>Case, cartridge,</u> (Drawing 7553815)				
Examination for defects	125	Acc - 0 Rej - 1	3.7	Table III
<u>Cartridge,</u> 20mm PGU-28/B (Drawing 1575AS100)				
Examination for defects	125	Acc - 0 Rej - 1	3.7	Table IV
Chamber pressure	20 ¹ / ₁	Acc - 0 Rej - 1	3.2.1.1	4.6.1
Action time	20 ¹ / ₁	Acc - 0 Rej - 1	3.2.1.2	4.6.2
Velocity	20 ¹ / ₁	Acc - 0	3.2.1.3	4.6.3
Accuracy	40	Acc - 0	3.2.1.4	4.6.4
Projectile extraction	30 ² / ₁	Acc - 1 Rej - 2	3.2.1.5	4.6.5
Projectile torque	30	Acc - 1 Rej - 2	3.2.1.6	4.6.6
Projectile sensitivity	20 ² / ₁	Acc - 0 Rej - 1	3.2.1.7.1	4.6.7.1

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TABLE I. First article inspection. (Continued).

Examination or test	No. of sample units	Accept and reject	Requirement paragraph	Paragraph reference and inspection method
Detonation delay	20 ^{2/}	Acc - 0 Rej - 1	3.2.1.7.2	4.6.7.2
Fragmentation	20 ^{2/}	Acc - 0 Rej - 1	3.2.1.7.3	4.6.7.3
Penetration	40	Acc - 0	3.2.1.8	4.6.8
Function and casualty	150 ^{3/}	-----	3.2.1.10	4.6.10
Waterproofness	40 ^{1/}	Acc - 0 Rej - 1	3.2.2.1	4.6.12.1
Salt fog	50	Acc - 0 Rej - 1	3.2.2.2	4.6.12.2
Propellant contamination	30 ^{2/}	Acc - 0 Rej - 1	3.3.2.2	4.6.11

^{1/} Ammunition shall be conditioned at 68 to 72°F.

^{2/} Quantity combined for tests.

^{3/} The sample shall be rejected if malfunctions or firing casualties in excess of the "Accept" number on Table VI occur.

4.5.1.2 Lot identification. Each cartridge and each packed ammunition lot shall be identified in accordance with applicable drawings and MIL-STD-1168, supplemented as directed by the contracting activity. Each packed lot shall further be identified by a national stock number assigned by the contracting activity.

4.5.2 Sampling. A 100-percent examination shall be performed by the contractor for all critical defects. Examination for major and minor defects shall be performed as specified herein. Each part and each assembly found to be defective shall be rejected.

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4.5.2.1 Sampling and acceptance criteria. The sampling plans and procedures shall be in accordance with MIL-STD-105 or MIL-STD-1235 or approved contractor sampling plans. To determine product acceptability, major or minor defects as listed herein shall be considered either collectively on a class basis or on an individual basis. However, where major defects are considered collectively on a class basis, the acceptance number for any individual defect of the class shall be limited by the assigned Acceptable Quality Level (AQL) for individual defect associated with the class (see 4.2.2.1.1c). In addition, where three or less defects appear in a classification or where MIL-STD-1235 is used, sampling plans applicable to a class shall not be used for major defects (see 6.5). Failure criteria shall be as defined in 4.6.10 during quality conformance testing. All relevant failures occurring during the tests of 4.5.4 shall be used to verify conformance to the applicable acceptance and rejection criteria.

4.5.2.1.1 AQLs. The following AQLs are assigned to major and minor defects:

a.	Individuals:	Percent
	Major:	0.25
	Minor:	0.40
b.	Class basis:	Percent
	Major:	1.50
	Minor:	2.50
c.	Individual defects associated with the class basis:	Percent
	Major:	0.40

4.5.2.2 Machine inspection. Subject to contracting activity approval, inspection of critical, major and minor characteristics may be performed 100 percent by a qualified and periodically verified inspection probe in lieu of sampling the product utilizing the sampling procedures described in 4.5.2.

4.5.3 Classification of defects. The classification of defects shall be as delineated in Tables II through IV. MIL-STD-651 shall apply indexing and evaluating cartridge visual defects.

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TABLE II. Projectile assembly, 20mm SAPHEI. (Drawing 1575AS101).

Categories and defects	Method of Inspection
<u>CRITICAL:</u> None defined.	
<u>MAJOR:</u>	
101. Overall length max	Gage
102. Nose cap runout	Gage
<u>MINOR:</u>	
201. Workmanship (see 3.7)	Visual

TABLE III. Case, cartridge, primed. (see Drawing 1575AS100).

Categories and defects	Method of inspection
<u>CRITICAL:</u> None defined.	
<u>MAJOR:</u>	
101. Primer above flush	Gage ^{1/}
102. Depth of primer seating oversize	Gage
103. Cocked, loose, missing or inverted primer	Manual/ Visual
<u>MINOR:</u>	
201. Waterproof missing around primer	Visual
202. Primer crimp missing	Visual
203. Workmanship (see 3.7)	Visual

^{1/} Inspection verification of prior 100-percent inspections shall be performed in accordance with MIL-STD-105, AQL is 0.25, minimum sample size is 315 with zero defects allowed.

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TABLE IV. Cartridge assembly (see Drawing 1575AS100).

Categories and defects	Method of Inspection
<u>CRITICAL:</u>	
1. Split or perforated case	Visual $\frac{1}{1}$
2. Crack or split in projectile	Visual $\frac{1}{1}$
3. Crimp missing (case/projectile)	Visual $\frac{1}{1}$
<u>MAJOR:</u>	
101. Loose primer	Manual
102. Depth of primer seat	Gage $\frac{1}{1}$
103. Overall length, maximum	Gage $\frac{1}{1}$
104. Improper or incomplete crimp (case/projectile)	Visual
105. Profile and alignment, maximum	Gage $\frac{1}{2}$
106. Corrosion	Visual
107. Head configuration	Visual
108. Metal sliver on head face	Visual $\frac{3}{1}$
109. Inverted primer	Visual
110. Crack, split or dent in nose cap	Visual
<u>MINOR:</u>	
201. Marking incorrect, incomplete illegible or missing	Visual
202. Projectile protective coating damaged or incomplete	Visual
203. Waterproofing missing around primer	Visual

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TABLE IV. Cartridge assembly (see Drawing 1575AS100). (Continued).

Categories and defects	Method of inspection
204. Scratch, dent, buckle, bulge, wrinkle, or fold in case	Visual
205. Rotating band damage	Visual
206. Primer crimp missing	Visual
207. Foreign matter, except corrosion	Visual
208. Incorrect type cartridge	Visual
209. Gap between nose and projectile body	Gage
210. Lacquer on primer button	Visual

1/ Inspection verification of prior 100-percent inspections shall be performed in accordance with MIL-STD-105: AQL is 0.25; minimum sample size is 315 with zero defects allowed.

2/ A dead weight load of 60 pounds maximum may be used to insert the cartridge into the gage.

3/ A metal sliver bridging the primer insulation shall be cause for classifying the cartridge defective.

4.5.4 Acceptance tests. The tests listed in Table V shall be performed on each cartridge lot in accordance with the test methods prescribed in 4.6 (see 6.2.2). Unless otherwise indicated herein, tests shall be conducted with samples at 68 to 72°F. Sample size and acceptance criteria for each test shall be as specified. Only cartridges having met the visual and dimensional requirements, and having been selected in such a manner that the sample is representative of the entire lot, shall be used in the tests. The selected cartridges shall be thoroughly mixed before being divided into samples for the various tests. The combining of tests shall be permitted (see 6.6).

4.5.4.1 Firing defects and casualties. Firing defects and associated criteria shall be as specified in Table VI. For the defect definitions, see AMCR 715-505, Volume 8.

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TABLE V. Quality conformance inspection.

Test <u>1/</u>	Sample size of production lot	Requirement paragraph	Test paragraph	Combined		
				Accept	Reject	Retest sample size
Chamber pressure <u>2/3/</u>	20	3.2.1.1	4.6.1			40
Action time <u>3/4/</u>	20	3.2.1.2	4.6.2	0	1	None allowed
Velocity <u>3/5/</u>	20	3.2.1.3	4.6.3			40
Accuracy <u>6/</u>	20	3.2.1.4	4.6.4			80
Projectile extraction <u>2/</u>	10	3.2.1.5	4.6.5	1	2	10
Projectile torque <u>8/</u>	10	3.2.1.6	4.6.6	0	2	10
Projectile detonation <u>9/</u>	20	3.2.1.7	4.6.7			20
Projectile sensitivity	20	3.2.1.7.1	4.6.7.1	2	3	20
Electrical resistance verification	10	3.2.1.9	4.6.9	0	1	None allowed
Function/casualty <u>10/</u>	50	3.2.1.10	4.6.10			
Waterproofness	10	3.2.2.1	4.6.12.1		<u>11/</u>	40
Salt fog	50	3.2.2.2	4.6.12.2			50
Propellant contamination <u>12/</u>	10	3.3.2.1	4.6.11	0	1	None allowed

1/ The lot shall be rejected if during any firing test one or more of the following malfunctions or the casualties of Table VI occur:

- a. Premature detonation of the projectile.
- b. Projectile remaining in bore.

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TABLE V NOTES (Continued).

- c. Metal parts separation, except rotating band separation (see NOTE 4/ of Table VI).
- d. Accept or reject criteria for firing casualties are specified in Table VI.

An additional shot shall be fired except as otherwise specified and during the function and casualty test where the occurrence of a firing defect listed in Table IV prevents the obtainment of a reliable result for characteristics being tested.

- 2/ Pressure. If the sample fails to comply with the requirements, a second sample of 40 cartridges shall be tested. The lot shall be rejected if the second sample fails to comply with the applicable requirements.
- 3/ Ammunition shall be conditioned at 68 to 72°F.
- 4/ Action time. If any sample cartridge fails to meet requirements for action time, the lot shall be rejected.
- 5/ Velocity. If the sample fails to comply with either or both requirements, a second sample of 40 cartridges shall be tested for the failing parameters (average, standard deviation). The lot shall be rejected if the second sample fails to comply with the applicable requirement.
- 6/ Accuracy. If the accuracy of the sample cartridges exceeds the applicable requirement, a second sample of 40 cartridges shall be tested. The lot shall be rejected if the accuracy exceeds the applicable requirements.
- 7/ Projectile extraction:
 - a. Failure of two or more sample cartridges to comply with minimum requirements shall be cause for rejection of the lot. If one cartridge of the sample fails to comply with the minimum requirements, a second sample of 10 cartridges shall be tested. The lot shall be rejected if two or more cartridges of the combined samples fail to comply with the minimum requirement.

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TABLE V NOTES (Continued).

- b. Failure of four or more cartridges to comply with the maximum requirement shall be cause for rejection of the lot. If more than one, but less than four cartridges fail to comply with the maximum requirement, a second sample of 10 cartridges shall be tested. The lot shall be rejected if five or more cartridges of the combined samples fail to comply with the maximum requirement.

8/ Projectile torque. Failure of two or more of the sample cartridges to comply with the specified torque requirement shall be cause for rejection of the lot. If one cartridge of the sample fails to comply, 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 requirements.

9/ Projectile detonation. Failure of three or more sample cartridges to comply with the applicable requirement shall be cause for rejection of the lot. If two samples fail to comply, a second sample of 20 cartridges shall be tested. The lot shall be rejected if four or more cartridges of the combined samples fail to comply with the applicable requirements.

10/ Function and casualty. Except as provided in NOTE 1/ if malfunctions or casualties occur in excess of the Table IV applicable reject number, a second sample of 300 cartridges shall be selected. The lot shall be rejected if in the combined samples malfunctions or casualties occur in numbers equal to or greater than the applicable "Reject" number.

11/ Waterproofness. If the average velocity of the sample cartridges exposed to the waterproofness test fails to comply with the applicable requirement, a retest sample of 40 cartridges shall be tested. The lot shall be rejected if the retest average velocity differs by more than 100 fps from the average velocity of 40 additional unexposed sample cartridges fired to establish a new base for comparison. Misfires shall be handled in accordance with AMCR 715-505, Volume 8.

12/ Propellant contamination. The presence of foreign matter in the propellant of any of the test cartridges shall be cause for rejection of the lot.

4.5.4.2 Unlisted firing defects. The lot shall be suspended and referred to the contracting officer for disposition if a malfunction or casualty not covered by this specification occurs in any firing test.

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TABLE VI. Firing defects.

Component	Defects	Accept	Reject
Cartridge ^{1/}	Misfire	0	2
	Failure to extract	0	1
	Projectile remaining in bore	0	1
	Premature projectile function	0	1
Primer	Primer leak	6	17
	Primer perforation	1	4
	Loose primer	0	1
	Blown primer	0	1
Case: longitudinal split ^{2/}	I or S	7	22
	J	2	7
	K, L or M	0	1
Case: circumferential rupture ^{2/}	Partial		
	S, J or K	2	7
	L	1	5
	Complete	0	1
Projectile: rotating band separation	Detached metal ^{3/}	0	1
	Complete or partial separation	0	1
	Metal parts separation ^{4/}	0	1

^{1/} A cartridge shall be classed defective if it fires because of delayed ignition after the bolt has been unlocked and extraction has been initiated or completed. Misfired test cartridges, except those from the waterproofness test (Table I), shall be retested. If a cartridge fails to function in that test, examination shall be conducted for the following conditions:

- a. Excessive primer seating depth.
- b. Metal slivers across primer insulator.

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TABLE VI NOTES (Continued).

- 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, this condition shall be reported for information. The accept number shall be zero (0) and the reject number shall be 3 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 Note 3 of Table I). The lot shall be rejected if either condition e or f is observed. Misfires occurring in the waterproofness test shall be handled in accordance with AMCR 715-505, Volume 8.

2/ See Drawing C7258801 for classifying splits and ruptures in fired cartridge cases. Nomenclature is listed below. If a longitudinal split or circumferential rupture (partial) extends into two or more defined areas, only the most severe defect criterion of Table II for the areas involved, shall apply. If a rupture results in separation of the cartridge case into two or more portions, the defect shall be classified as a complete circumferential rupture.

Splits:

- I = Mouth or neck.
- J = In upper 3/4 body section.
- K = In lower 1/4 body section above extractor groove.
- L = In sidewall extending into extractor groove.
- M = In sidewall extending into primer pocket.
- S = In sidewall of shoulder.

Rupture:

- S = Neck and shoulder.
- J = In upper 3/4 body section.
- K = In lower 1/4 body section above extractor groove.
- L = In head and in extractor groove.

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TABLE VI NOTES (Continued).

- 3/ Metal sheared or missing from the fired cartridge case exterior, such as rim or neck shears, shall be classed as a defect. The lot shall not be penalized for shavings of metal from the interior wall of the case neck in the crimped area.
- 4/ For classification of defects, there must be evidence of separation or breakup of projectile parts as evidenced either by recovery of the band, or portion thereof, or by recovery of the parts or fragments or by holes in the fragmentation screens. The lot shall not be penalized for evidence of any individual fragment with a weight of less than 0.10 grams.

4.6 Test methods.

4.6.1 Chamber pressure. The sample cartridges shall be conditioned at 68 to 72°F for not less than 2 hours and fired from the single-shot test barrel. A copper crush type gage shall be used to measure the chamber pressure. The chamber pressure shall be measured through the case wall at 2.10 ±0.15 inches from the base of the case. The mean corrected pressure shall be utilized for verification of the requirements of 3.2.1.1.

$$P_{\text{corrected}} = P_{\text{chamber}} + P$$

P = X as shown in 4.3.3.

4.6.2 Action time. The sample cartridges shall be conditioned at 68 to 72°F and fired from the single-shot barrel. The time between firing pin-primer contact and the exit from the muzzle of the projectile shall be measured. The action time (t) shall comply with the requirements of 3.2.1.2.

4.6.3 Velocity. The sample cartridges shall be conditioned at 68 to 72°F and fired from the single-shot test barrel. The velocity shall be measured by two screens or coils located at 28 feet and 128 feet respectively from the gun muzzle. The corrected velocity shall comply with the requirements of 3.2.1.3.

$$V_{\text{corrected}} = V_{78 \text{ feet}} + V$$

V = X as shown in 4.3.3.

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4.6.4 Accuracy. The cartridges shall be divided into four groups of 10 cartridges each. Each group shall be single fired against a separate target at 500. The average mean radius shall be determined in accordance with the methods of AMCR 715-505, Volume 8, and shall meet the requirements of 3.2.1.4.

4.6.5 Projectile extraction. The sample cartridges shall be tested as specified in AMCR 715-505, Volume 8. The extraction force shall be within the limits specified in 3.2.1.5.

4.6.6 Projectile torque. Each cartridge of the test sample shall be marked with a light scratch extending axially across the rotating band onto the case neck, and torque as specified by 3.2.1.6 shall be applied slowly to the projectile. Movement of the projectile with respect to the cartridge case, detectable by misalignment in the scratch mark, shall be recorded.

4.6.7 Projectile detonation.

4.6.7.1 Projectile sensitivity. The sensitivity tests shall be conducted using a 0.063-inch 2024-T3 aluminum sheet to meet the requirement of 3.2.1.7.1. No impact shall be less than 3 calibers from an edge of the sheet or less than 3 calibers between holes. A valid function is described in AMCR 715-505.

4.6.7.2 Detonation delay. The detonation delay shall be measured by one of three methods: sequential X-ray heads, high-speed photography, or multiplate target array. The detonation plate shall be 0.080-inch thick 2024-T3 aluminum. The multiplate array spacing shall meet the requirements of 3.2.1.7.2. A no detonation will be designed by a 1 caliber hole in the plate. A detonation before the plate will be designated by a minimum of a 2 caliber hole in the plate. Premature detonation is considered to be the occurrence of any of the following:

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

4.6.7.3 Projectile fragmentation. The fragmentation test to meet the requirement of 3.2.1.7.3 shall utilize a 10-plate multiplate target using a 0.080-inch thick detonation plate of 2024-T3 aluminum. The nine witness sheets shall be placed $8 \pm .25$ inches apart. The witness sheets shall be 0.040-inch thick aluminum. A fragment penetration shall be .25 inch across or larger. The last sheet shall be 72 inches minimum from the detonation plate.

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4.6.8 Penetration. The penetration capability shall be determined in ballistic limit penetration tests against a nominal 0.375-inch thick armor plate as specified in MIL-A-12560 at an obliquity of 45 ± 2 degrees. The obliquity is considered to be the angle between a line perpendicular to the target surface and the projectile line of flight. The probable ballistic limit (PBL) is considered to be the average of five penetrations and five nonpenetrations within a velocity of 150 fps. A penetration is considered to be the perforation of the primary armor plate and a 0.020-inch thick aluminum witness sheet placed parallel to and 6 inches behind the armor plate. The plate shall have a grid of one foot squares with hardness measured in all squares. The thickness shall be measured for all squares on the plate periphery and interpolated for interior squares. The average hardness and thickness pertaining to the 10 impacts used for the PBL shall be determined. Impacts occurring under the following conditions shall be considered unsatisfactory and not utilized in computing the PBL:

- a. Projectile yaw greater than 3 degrees.
- b. Impacts within 2 inches of the plate edge or a prior impact point.

4.6.9 Electrical resistance.

4.6.9.1 Primed cartridge cases. The equipment and circuitry specified in Drawing 7259023 or equal shall be used to measure the resistance of the primer in each primed cartridge case.

CAUTION

The R x 1 scale of the Simpson Volt-Ohm-Ammeter shall be mechanically or electrically disabled prior to performing the test below. Failure to do so may result in firing of the primer.

4.6.9.2 Verification. A Simpson Volt-Ohm-Ammeter, Model 260, or approved equal, shall be used to measure the resistance of the primer in each primed cartridge case from the projectile extraction test sample. Only the R x 100 and R x 10,000 scales of the meter shall be used in order to limit the applied voltage and current, respectively, to 7.5 volts and 1.4 milliamperes, maximum.

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4.6.10 Function and casualty. The lot acceptance sample, specified for this characteristic in Table I, shall be test fired in the M61 Automatic Weapon for acceptance. In addition, this characteristic will be checked on all Mann barrel firings during the lot acceptance testing. The occurrence of one or more of the following casualties shall be cause for failure except as otherwise provided:

- a. Body breakup.
- b. Loss of nose or windshield.
- c. Complete rotating band separation (detachment of all the band having band seat knurling imprint).
- d. Partial rotating band separation (detachment of part of the band having band seat knurling imprint).
- e. The following criteria shall apply to thrown band fragments having no evidence of band seat knurling imprint:
 - (1) The sample shall fail if three or more assemblies throw band fragments with no evidence of band seat knurling imprint.
 - (2) The sample shall fail if any assembly throws a band fragment having a length greater than 0.50 inch (indicative of deep seat band lamination).
 - (3) The sample shall not be penalized for band particles thrown as a result of normal band fringing or slivering.

4.6.11 Propellant contamination. The propellant from each of the cartridges tested for projectile extraction shall be examined visually for contamination, as specified in AMCR 715-505, Volume 8.

4.6.12 Environmental tests.

4.6.12.1 Waterproofness. The sample cartridges shall be subjected to the waterproofness environment specified in MIL-STD-810, Method 512, Procedure I. The cartridges shall be fired at ambient condition and shall meet the requirements of 3.2.2.1

4.6.12.2 Salt fog. The cartridge shall be tested in accordance with the MIL-STD-810, Method 509.2 for a 48-hour period.

4.7 System safety. System safety testing shall be performed to meet the requirements of MIL-STD-882 to determine that all potential hazards are eliminated or controlled to a level acceptable throughout the entire life cycle of a system.

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4.8 Reliability. All relevant failures of all first article samples and production lots delivered under this specification by a contractor shall be used to determine conformance to the requirement of 3.6.

4.8.1 Failure criteria. A failure is the inability of the cartridge to meet any of the requirements specified herein. Failure categories are classified as relevant and nonrelevant as described in 4.7.1.1 and 4.7.1.2.

4.8.1.1 Relevant failure. A relevant failure is any failure except those classified and listed as nonrelevant failure.

4.8.1.2 Nonrelevant failure. Nonrelevant failures are defined as follows:

- a. Any failure caused by Government-furnished equipment.
- b. Any failure caused by test equipment.
- c. Any failure that results from operational or procedural error in testing.
- d. Secondary failures when they are confirmed to be induced failure of another part. However, at least one primary (relevant) failure must be charged when a secondary failure is claimed.

4.8.2 Projectile coating defect criteria. Projectiles indicating exposure of bare metal or underlying phosphate or organic pretreatment shall be considered unsatisfactory if any of the following conditions exist:

- a. Any area shall be not less than 0.090 square inch.
- b. More than one area shall be not less than 0.045 square inch.
- c. More than five areas of 0.021 square inch or less.

4.9 Packaging, packing, and marking inspection. MIL-STD-644 shall be used as a guide for the inspection of packaging, packing and marking as applicable to the drawing.

5. PACKAGING.

5.1 Preservation. The cartridge shall be preserved in accordance with the applicable requirements of the 49 CFR 100-199, AR-68/47, and AR-68/48.

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5.2 Packing. The cartridge packing shall conform to the applicable requirements for the shipment of hazardous items as defined in 49 CFR 100-199, and the applicable requirements of AR-68/47 and AR-68/48.

5.3 Marking. Marking for shipment and storage shall be in accordance with the instructions of the contract and shall comply with MIL-STD-129. In addition, exterior containers shall show the caution markings required by 49 CFR 100-199 indicating the appropriate classification of ammunition.

5.4 Documentation with shipment. When specified in the contract or purchase order (see 6.2.2), each shipment of ammunition shall contain data cards in accordance with MIL-STD-1167 and lot number assignments in accordance with such items as case, primer, ignition system, propellants, charge weights, projectile, and lot identification.

6. NOTES.

6.1 Intended use. The PGU-28/B cartridge is intended for use in 20mm M61 and M197 automatic weapons.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Place of inspection, if not at place of manufacture (see 4.1).
- c. Detailed packing and marking instructions (see 5.2 and 5.3).
- d. Provisions for the supply, maintenance and disposition of Government furnished test equipment for acceptance inspection purposes.

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below should be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DOD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD form 1423 is not used, the data specified below should be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
3.5	Safety Assessment Report	DI-SAFT-80102	---
4.3.1	Calibration System Description	DI-R-7064	---

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<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
4.4.1, 4.5.4	Test Plans and Procedures	DI-T-5204	---
4.4.1, 4.5.4	Test Reports	DI-T-2072	---
5.4	Ammunition Data Card	DI-MISC-80043	---

(Data item descriptions related to this specification, and identified in Section 6, will be approved and listed as such in DOD 5000.19L., Vol. II, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 First article. When a first article inspection is required, the items should be a first article sample. The first article should consist of 600 cartridges. The contracting officer should include specific instructions in acquisition documents regarding arrangement for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Process deviation. A process deviation is defined as a change in the approved method of manufacture, or an operational change which may alter the metallurgical or physical properties of the item.

6.5 AQLs. The optional use of AQL values for either individual defects or classes of defects, with individual major defect limitation, is intended to minimize inspection agency administrative burden which might result from an exclusive assignment of individual defect AQLs. The option also permits flexibility where continuous or sequential sampling inspection utilizing MIL-STD-1235 (Ord), Contractor Plan NB 502-1, or Contractors Sequential Ration Plan for acceptance is integrated into the manufacturing process.

6.6 Combining tests. Tests may be performed concurrently on the sample cartridge to minimize testing costs provided that the test results are not affected by this procedure.

6.7 Drawings. Drawings listed in Section 2 of this specification under the heading Department of the Army may also include drawings prepared by, and identified as, Edgewood Arsenal, Frankford Arsenal, Rock Island Arsenal, or Picatinny Arsenal drawings. Technical data originally prepared by these activities is now under the cognizance of the Department of the Army.

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6.8 Explosives safety precautions. Minimum explosives safety precautions for use by the contractor are detailed in DoD Instruction 4145.26M, DoD Contractors' Safety Manual for Ammunition, Explosives, and Related Dangerous Material.

6.9 Subject term (key word) listing.

Ammunition
Armor piercing ammunition
Bursting charges
Cartridge cases
Electric primers
Explosives
Incendiary ammunition
Nose fuzes
PGU-28/B
Projectiles
SAPHEI
Small arms ammunition
20 millimeter

Preparing activity:
Navy - (AS)
(Project: 1305-N⁰⁰⁸)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL*(See Instructions - Reverse Side)*1. DOCUMENT NUMBER
MIL-C-85717(AS)2. DOCUMENT TITLE CARTRIDGE, 20 MILLIMETER, SEMI-ARMOR PIERCING
HIGH EXPLOSIVE INCENDIARY, PGU-28/B

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS (Street, City, State, ZIP Code)

4. TYPE OF ORGANIZATION (Mark one)

VENDOR

USER

MANUFACTURER

OTHER (Specify): _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)