

MIL-P-60547F (AR)  
 25 August 1986  
 SUPERSEDING  
 MIL-P-60547E (AR)  
 19 January 1981

## MILITARY SPECIFICATION

### PROJECTILE, 105MM, HE, M1 AND M760 METAL PARTS ASSEMBLY

This specification is approved for use within 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 contains requirements not covered by the drawings and provides quality assurance provisions for the fabrication and assembling of metal parts for Projectile, 105MM, HE, M1 and M760.

#### 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

##### FEDERAL

TT-C-490 - Cleaning method and pretreatment of ferrous surfaces for organic coatings.

##### MILITARY

MIL-A-48078 - Ammunition Standard Quality Assurance Provisions General Specification For

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Armament Research, Development and Engineering Center, Attn: AMSMC-QA, Dover, New Jersey 07801-5001 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

## MIL-P-60547F (AR)

## STANDARDS

## MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-1167 - Ammunition Data Card
- MIL-STD-1169 - Packaging, Packing and Marking for Shipment of Inert Ammunition Components

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.

## DRAWINGS

## US ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (ARDEC)

- 8593417 - Band Seating Testing Machine
- 8593429 - Band Seating Testing Machine, Indentor and Test Data
- 8837835 - Pallet for Projectiles and Projectile Metal Parts
- 10535876 - Projectile, 105MM, HE, M1, Metal Parts Assembly
- 12551742 - Projectile, 105MM, HE, M760, Metal Parts Assembly

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

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI-B46.1 - Surface Texture

(Application for copies should be addressed to the American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.)

## MIL-P-60547F (AR)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E-8	- Tension Testing of Metallic Materials
ASTM E-10	- Brinell Hardness of Metallic Materials
ASTM E-103	- Rapid Indentation Hardness testing of Metallic Materials
ASTM B-117	- Salt Spray (Fog) Testing
ASTM A-711	- Carbon and Alloy Steel Blooms, Billets and Slabs for Forging, Spec for
ASTM A-576	- Special Quality Hot-Rolled Carbon Steel Bars

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103).

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), 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 General. Materials, parts and assemblies shall comply with the requirements specified on the applicable drawings and referenced specification.

3.1.1 Steel quality. The item contractor shall establish procedures to provide a forge quality steel when procuring steel in accordance with ASTM A711 and A576, i.e., the steel shall be free of pipe, porosity and heavy segregation. The manufacturer will provide a certification to cite the ASTM specification under which the steel was manufactured and specific inspection techniques used to assure compliance with requirements of ASTM specification and the soundness condition stated above.

3.1.2 Heat treatment or stress relief. Heat treatment or stress relief applied to any component part shall be uniform throughout and shall be so conducted as to produce in each component the mechanical properties specified on the applicable drawing.

3.1.3 Hot forge - heat treat method. Prior to finish machining, projectile bodies manufactured from forgings shall be subjected to heat treatment to attain the required mechanical properties. The heat treatment shall consist of heating above the critical temperature, not to exceed 1600 degrees Fahrenheit (°F), followed by an oil quench. After quenching, the body

## MIL-P-60547F (AR)

forgings shall be tempered without delay at a temperature above 750°F, suitable to produce required mechanical properties. After removal from the tempering furnace, the body forgings shall be slowly cooled in air (forced air permitted) to a temperature of not more than 700°F, after which cooling may be accelerated by water spray.

3.1.4 Cold shaping and hot cup - cold draw methods. Cold working shall be so accomplished as to produce in the projectile body the mechanical properties specified. The projectile body shall be stress relieved at a temperature of 700°F, minimum, following the final forming operation during which time plastic flow takes place. The minimum soak time at or above minimum temperature shall be established which will produce mechanical properties specified on the applicable drawing. The temperature and time duration of a process anneal prior to final forming operation shall be established by the ability to meet the required mechanical properties when formed by an approved sequence of operations.

3.2 Mechanical properties components and assemblies.

3.2.1 Body mechanical properties. Body mechanical properties as specified on the applicable drawing shall apply throughout the component.

3.2.2 Rotating band. After application and subsequent removal, the rotating band shall have the following mechanical properties:

Tensile Strength - 30,000 lbs, per square inch (psi)  
minimum (min)

Elongation - 15 percent in one inch minimum

3.2.3 Banding.

3.2.3.1 Band seat. Prior to banding, the band seat shall be clean and free from oil, grease, dirt, rust or other foreign matter. Shot or sandblasting shall not be permitted for cleaning the band seat.

3.2.3.2 Band blank. The rotating band blank shall be in the form of a solid ring, annealed if necessary to comply with the applicable drawing requirements.

## MIL-P-60547F (AR)

3.2.3.3 Application. The rotating band shall be applied after final heat treatment of the body, by carefully pressing the band blank into the band seat so as to make contact with the sidewalls for a minimum of eight-tenths of the sidewall depth. The band shall be applied in such manner as not to distort the body wall. There shall be no visible gap between the rotating band and the sidewalls of the band seat (on the outside surface of the projectile) after the rotating band has been machined to final dimension.

3.2.3.4 Band seating. The diametrical clearance between the rotating band and band seat shall not exceed .006 inch when the destructive method of testing is used or .009 inches when the non-destructive method of testing is used.

### 3.3 Metal defects parts.

3.3.1 Body. The body, including the cavity, shall be free from cracks, splits, bursts, cold shuts; pipe porosity, inclusions, folds, seams and other metal defects.

3.3.2 Body cavity. The body cavity shall be free of scale, fins, burrs, draw marks, laminations, imbedded foreign matter, pits and sharp edges.

3.3.3 Visual standards. Visual standards for metal defects of paragraph 3.3.1 and 3.3.2 will be established for each contract after the first month's production, or whenever requested by the procuring activity.

3.4 Proving ground function test. The assembled projectile metal parts shall reveal no evidence of failure when tested at excess and service pressure. Metal parts failure shall be:

- a. Loss or breakup of metal components in bore or in flight.
- b. Shear of the rotating band as evidenced by complete lack of engraving.

3.5 Workmanship. All parts shall be finished and assembled in a thorough, workmanlike manner. The parts shall be free of burrs, chips, sharp edges, cracks, unblended radii, surface defects, dirt, grease, rust corrosion products and other foreign matter. The cleaning method used shall not be injurious to any part, nor shall the parts be contaminated by the cleaning agent. All required markings shall be neat and sharply defined.

3.5.1 Surface finish. The requirements for surface finish are as detailed on the applicable drawing.

## MIL-P-60547F (AR)

3.5.2 Threads. Threads shall be full and undamaged for the entire minimum length or depth as specified on the applicable drawing.

3.5.3 Painting. Painting shall comply with the requirements of the applicable drawing. All paint shall be dry to the touch prior to packing for shipment. Drying time prior to testing shall be in accordance with the applicable drawing.

3.5.4 Base cover weld. The weld shall be sound, and the welding operation shall be so controlled that there will be adequate fusion between projectile base and base cover.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, 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 supplies and services conform to prescribed requirements. Unless otherwise specified herein or in the contract, the provisions of MIL-A-48078 shall apply.

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 following types of inspection shall be conducted on this item:

- a. First Article Inspection
- b. Quality Conformance Inspection

## MIL-P-60547F (AR)

4.3 First article inspection.

4.3.1 Submission. The contractor shall submit a first article sample as designated by the contracting officer for evaluation in accordance with provisions of 4.3.2. The first article sample shall consist of the following items in sample quantities as indicated.

<u>Part Description</u>	<u>M1 Drawings</u>	<u>M760 Drawings</u>	<u>Quantity</u>
Cover, Base	10535879	10535879	5
Rotating Band Blanks	9594851	9594851	5
Body, Prior to nosing	10535878	12551740	5
Body	10535878	12551740	5
Body Assembly	10535877	12551741	5
Projectile, MPTS Assembly	10535876	12551742	55

4.3.2 Inspection to be performed. See MIL-A-48078 and Table I specified herein.

4.3.3 Rejection. See MIL-A-48078.

TABLE I. First article inspection.

MIL-P-60547F (AR)

**CLASSIFICATION OF DEFECTS & TESTS**

PARAGRAPH	TITLE	EXAMINATION OR TEST	NO. OF SAMPLE UNITS	SHEET 1 OF 2		DRAWING NUMBER See Below
				AQL OR 100%	REQUIREMENT PARAGRAPH	
	Projectile, 105MM, HE, M1 or M760 (as applicable) Components and Metal Parts					NEXT HIGHER ASSEMBLY
CATEGORY						PARAGRAPH REFERENCE /INSPECTION METHOD
	Cover, Base Dwg. 10535879 Examination for Defects		5	(a)	3.1	4.4.3.1
	Blank, Rotating Band Dwg. 8594851 Mechanical Properties		5	(a)	3.2.3.2	4.5.1
	Body, Prior to Nosing Dwg. 10535878 or 12551740 (as applicable) Examination for Defects		5	(a)	3.1	4.4.3.2
	Body Dwg. 10535878 or 12551740 (as applicable) Examination for Defects Hardness Mechanical Properties		5	(a) (a) (a)	3.1 3.1.1 3.2.1	4.4.3.3 4.5.3 4.5.2
NOTE:	(a) Refer to 4.3.3 for Rejection Criteria					

TABLE I. First article inspection.

## CLASSIFICATION OF DEFECTS &amp; TESTS

MIL-P-60547F (AR)

PARAGRAPH	TITLE	EXAMINATION OR TEST	NO. OF SAMPLE UNITS	SHEET 2 OF 2		DRAWING NUMBER See Below
				ADL OR 100%	REQUIREMENT PARAGRAPH	
CATEGORY						NEXT HIGHER ASSEMBLY
						PARAGRAPH REFERENCE / INSPECTION METHOD
	Projectile, 105MM, HE, M1 or M760 (as applicable) Components and Metal Parts					
	Body Assembly Dwg. 10535877 or 12551741 (as applicable)	5				
	Examination for Defects Band Seating		(a)	3.1	4.4.3.4	
	Mechanical Properties of Rotating Band Base Cover Weld Test		(a)	3.2.3.3	4.5.5	
			(a)	3.2.3.4		
			(a)	3.2.2	4.5.4	
			(a)	3.5.4	4.5.6	
	Projectile MPTS Assembly Dwg. 10535876 or 12551742 (as applicable)	5 (b)	(a)	3.1	4.4.3.5	
	Examination for Defects	5 (b)	(a)	3.1	4.5.7.1	
	Salt spray testing Protective coating thickness	5 (b)	(a)	3.1	4.5.7.2	
	Functional Test (PROVING GROUND) Dwg. 10535876 or 12551742 (as applicable)					
	Ballistic Testing					
	Excess Pressure	30	(a)	3.4	4.4.3.6	
	Service Pressure	20	(a)	3.4	4.5.8	
<b>NOTE:</b>	(a) Refer to 4.3.3 for Rejection Criteria					
	(b) These 5 samples can be used for all item tests.					

## MIL-P-60547F (AR)

4.4 Quality conformance inspection.

4.4.1 Inspection lot formation. Inspection lots shall comply with the lot formation provisions of MIL-A-48078.

4.4.1.1 Heat treatment lots. Heat treatment lots shall contain bodies from not more than one heat of steel, that has been heat treated in the same heat-treating equipment, at the same temperature, in one unchanged process. The heat treatment lot thus constituted shall be the basis for the selection of samples for the tests hereinafter prescribed.

4.4.1.2 Stress relieved lots. Stress relieved lots shall contain components from not more than one heat of steel shaped by the same process and procedure, utilizing the same shaping equipment (as applicable) and stress relieved in one unchanged process and procedure. The stress relieved lot thus constituted shall be the basis for the selection of samples for the tests hereinafter prescribed.

4.4.1.3 Miscellaneous lots. Small lots (such as components manufactured from abnormally small heats of steel, or bodies that have become separated from previously delivered lots, etc.) may at the discretion of the supplier be grouped into miscellaneous heat treatment of stress-relieved lots as the case may be. Such lots shall be identified by a miscellaneous lot code number and processed in accordance with either heat treat or stress-relieved lots as applicable. The miscellaneous lot thus constituted shall be the basis for the selection of samples for the tension test hereinafter prescribed.

4.4.1.4 Projectile metal parts assembly lots. When it has been determined that projectile metal parts of a heat treated, stress relieved lot has complied with the mechanical properties requirement of the applicable drawings, they may be regrouped for assembly into projectile metal parts assembly lots, to which will be assigned a projectile metal parts assembly lot number. Miscellaneous lots shall remain segregated and identified by a standard hybrid lot number. The projectile metal parts assembly lots shall consist of projectile metal parts assemblies produced by one supplier under one contract in one unchanged process, in accordance with the same drawing, same drawing revision, same specification, and same specification revision. The projectile metal parts assembly lot thus constituted shall be the basis for selection of samples for the tests hereinafter prescribed.

## MIL-P-60547F (AR)

4.4.2 Tool control dimensions. Dimensions marked tool control shall be gaged during First Article testing and after each four (4) hours of production on each machine in operation and prior to any tooling change. Where destruction of components is necessary to inspect these dimensions, measurements of the tool may be substituted provided the contractor has established correlation between the tool dimensions and the component dimensions prior to the start of production. The contractor shall be responsible for maintaining adequate surveillance to assure that drawing requirements are being met throughout the life of the tool. Corrective action will immediately be instituted by the contractor. All material produced prior to periodic inspection will be rejected and screened whenever a defective tool control dimension is found.

4.4.3 Examination. See MIL-A-48078.

a. Sampling plans. Unless otherwise specified in the Classification of Defects and Test tables, sampling plans and procedures for major and minor defects shall be in accordance with MIL-STD-105, Inspection Level II.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF DEFECTS & TESTS

MIL-P-60547F (AR)

PARAGRAPH	TITLE	EXAMINATION OR TEST	NO. OF SAMPLE UNITS	SHEET OF		DRAWING NUMBER
				1	1	
CATEGORY				AQL OR 100%	REQUIREMENT PARAGRAPH	PARAGRAPH REFERENCE / INSPECTION METHOD
4.4.3.1	Cover, Base					10535879 NEXT HIGHER ASSEMBLY 10535877 or 12551741 (as applicable)
<u>Critical</u>	None defined					
<u>Major</u> 101	Thickness, minimum (min.)			0.40%	3.1	Gage
<u>Minor</u> 201 202	Diameter, min Evidence of poor workmanship			0.65% 0.65%	3.1 3.5	Gage Visual
<b>NOTE:</b>						

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF DEFECTS & TESTS

MIL-P-60547F (AR)

PARAGRAPH	TITLE	SHEET 1 OF 1		NO. OF SAMPLE UNITS	EXAMINATION OR TEST	ADL OR 100%	REQUIREMENT PARAGRAPH	DRAWING NUMBER	PARAGRAPH REFERENCE / INSPECTION METHOD
4.4.3.2	Body, Prior to Nosing							10535878 OR 12551740 (as applicable)	
<u>CATEGORY</u>								NEXT HIGHER ASSEMBLY 10535877 or 12551741 (as applicable)	
<u>Critical</u>	None defined								
<u>Major</u> 101	Diameter of Charge Cavity at Forward Bourrelet Location					0.40%	3.1		Gage
102	Length from Base of Charge Cavity to inside Basic Diameter					0.40%	3.1		Gage
<u>Minor</u>	None defined								
<u>NOTE:</u>									

QUALITY CONFORMANCE INSPECTION

MIL-P-60547F (AR)

CLASSIFICATION OF DEFECTS & TESTS

PARAGRAPH	TITLE	EXAMINATION OR TEST	NO. OF SAMPLE UNITS	AQL OR 100%	SHEET OF		DRAWING NUMBER
					1	2	
CATEGORY						REQUIREMENT PARAGRAPH	PARAGRAPH REFERENCE / INSPECTION METHOD
4.4.3.3	Body						10535878 (as applicable) 12551740 NEXT HIGHEN ASSEMBLY 10535877 or 12551741 (as applicable)
<u>Critical</u> 1	Metal Defective			100%	3.3		Visual
<u>Major</u> 101	Length from edge of Band Seat to Rear Rib	(a)		0.40%	3.1		Gage
102	Length between Rear and Middle Ribs	(a)		0.40%	3.1		Gage
103	Length between Middle and Front Ribs	(a)		0.40%	3.1		Gage
104	Angle of Ribs in Profile	(a)		0.40%	3.1		Gage
105	Height of Ribs, min.	(a)		0.40%	3.1		Gage
106	Width of Band Seat	(a)		0.40%	3.1		Gage
107	Runout of Pitch Diameter of Thread with Bourrelets and Front Face			0.40%	3.1		Gage
108	Runout of Ogive with Bourrelets			0.40%	3.1		Gage
109	Runout of Body with Bourrelets			0.40%	3.1		Gage
110	Runout of Boattail with Bourrelets			0.40%	3.1		Gage
111	Diameter of Bourrelets, min.			0.40%	3.1		Gage
112	Diameter of bottom Band Seat			0.40%	3.1		Gage
113	Length to Band Seat			0.40%	3.1		Gage
114	Pitch Diameter, maximum (max.)			0.40%	3.1		Gage
115	Minor Diameter, max.			0.40%	3.1		Gage
116	Length of Threads, min.			0.40%	3.1		Gage
117	Variation in wall thickness			0.40%	3.1		Gage
118	Thickness through Base			0.40%	3.1		Gage
<u>NOTE:</u> (a)	See Paragraph 4.4.2						

QUALITY CONFORMANCE INSPECTION

MIL-P-60547F (AR)

CLASSIFICATION OF DEFECTS & TESTS

PARAGRAPH	TITLE	EXAMINATION OR TEST	NO. OF SAMPLE UNITS	SHEET 2 OF 2		DRAWING NUMBER 10535878 or 12551740 (as applicable) NEXT HIGHER ASSEMBLY 10535877 or 12551741 (as applicable)	PARAGRAPH REFERENCE /INSPECTION METHOD
				AQL OR 100%	REQUIREMENT PARAGRAPH		
4.4.3.3	Body						
<u>Major</u>							
119	Scoring missing or inadequate			0.40%	3.1		Visual
120	Radius or Chamfer missing from rear surface			0.40%	3.1		Visual
121	Band Seat contains foreign matter or evidence of shot or sand blasting			0.40%	3.1, 3.5		Visual
<u>Minor</u>							
201	Diameter of Body			0.65%	3.1		Gage
202	Diameter of Nose End			0.65%	3.1		Gage
203	Length to Basic Outside Diameter at Nose End			0.65%	3.1		Gage
204	Length to Basic Diameter near Juncture of Boattail and Body Diameter			0.65%	3.1		Gage
205	Length at rear-most Basic Diameter			0.65%	3.1		Gage
206	Length to rear of Bourrelet			0.65%	3.1		Gage
207	Total Length			0.65%	3.1		Gage
208	Depth from Front Face to Charge Cavity, Max.			0.65%	3.1		Gage
209	Diameter of Thread Lead in Angle			0.65%	3.1		Gage
210	Surface Finish improper			0.65%	3.1		Visual-ANSI-B46.1
211	Evidence of poor workmanship			0.65%	3.5		Visual
212	Radii or Chamfers missing or incorrect			0.65%	3.1		Visual
213	Staking Notches missing or incorrect (if applicable)			0.65%	3.1		Visual
<b>NOTES:</b>							

QUALITY CONFORMANCE INSPECTION

MIL-P-60547F (AR)

**CLASSIFICATION OF DEFECTS & TESTS**

PARAGRAPH	TITLE	EXAMINATION OR TEST	NO. OF SAMPLE UNITS	SHEET OF		PARAGRAPH REFERENCE / INSPECTION METHOD
				1	1	
CATEGORY	Body Assembly			AQL OR 100%	REQUIREMENT PARAGRAPH	
4.4.3.4	Body Assembly					DRAWING NUMBER 10535877 (as applicable) 12551741 NEXT HIGHER ASSEMBLY 10535876 or 12551742 (as applicable)
<u>Critical</u>	None defined					
<u>Major</u>	Length to rotating band	Length to rotating band		0.40%	3.1	Gage
101	Runout of rotating band with bourrelets	Runout of rotating band with bourrelets		0.40%	3.1	Gage
102	Outside diameter of rotating band	Outside diameter of rotating band		0.40%	3.1	Gage
103	Width of rotating band	Width of rotating band		0.40%	3.1	Gage
104	Length of outside diameter of rotating band	Length of outside diameter of rotating band		0.40%	3.1	Gage
105	Angle adjacent to outside diameter of rotating band	Angle adjacent to outside diameter of rotating band		0.40%	3.1	Gage
106	Width of relief groove, min.	Width of relief groove, min.		0.40%	3.1	Gage
107	Diameter of relief groove, max.	Diameter of relief groove, max.		0.40%	3.1	Gage
108	Undercut exceeds permissible maximum	Undercut exceeds permissible maximum		0.40%	3.1	Gage
109	Location of Base Cover	Location of Base Cover		0.40%	3.1	Gage
110	Gap between sidewall of Band Seat and Band exceeds specified limit	Gap between sidewall of Band Seat and Band exceeds specified limit		0.40%	3.1	Gage
111				0.40%	3.2.3.3	Gage
<u>Minor</u>	Angle from rear of Rotating Band Relief Groove	Angle from rear of Rotating Band Relief Groove		0.65%	3.1	Gage
201	Evidence of poor workmanship	Evidence of poor workmanship		0.65%	3.5	Visual
202	Marking missing, incorrect or illegible	Marking missing, incorrect or illegible		0.65%	3.1	Visual
203						
<b>NOTE:</b>						

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF DEFECTS & TESTS

MIL-P-60547F (AR)

PARAGRAPH	TITLE	EXAMINATION OR TEST	NO. OF SAMPLE UNITS	SHEET 1 OF 1		DRAWING NUMBER 10535876 or 12551742 (as applicable) NEXT HIGHEN ASSEMBLY
				AQL OR 100%	REQUIREMENT PARAGRAPH	
CATEGORY	PARAGRAPH REFERENCE / INSPECTION METHOD					
4.4.3.5	Projectile, 105MM, HE, M1 or M760 (as applicable) Metal Parts Assembly					
<u>Critical</u> 1	Blister, pool of paint or foreign matter in charge cavity			100%	3.1	Visual
<u>Major</u> 101	Weight		(a)	0.40%	3.1	Balance/Scale
102	Diameter of bourrelets, max.			0.40%	3.1	Gage
103	Band damaged			0.40%	3.1	Visual
104	Thread damaged			0.40%	3.1	Visual (See 6.7)
105	Corrosion preventive compound missing			0.40%	3.1	Visual
106	Protective coating missing, inadequate, or damaged exposing base metal			0.40%	3.1	Visual
107	Paint in threads, on rotating band or on forward surface			0.40%	3.1	Visual
<u>Minor</u> 201	Evidence of poor workmanship			0.65%	3.5	Visual
202	Paint not dry			0.65%	3.5.3	Visual-Tactile
<b>NOTE:</b> (a)	In the case of damaged threads, only those assemblies damaged to the extent that the minimum pitch diameter gage fails to enter to the minimum length shall be classed defective.					

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF DEFECTS & TESTS

MIL-P-60547F (AR)

PARAGRAPH	TITLE	SHEET 1 OF 1		NO. OF SAMPLE UNITS	EXAMINATION OR TEST	AGL OR 100%	REQUIREMENT PARAGRAPH	DRAWING NUMBER 10535876 or 12551742 (as applicable) NEXT HIGHER ASSEMBLY	PARAGRAPH REFERENCE / INSPECTION METHOD
4.4.3.6	Projectile, 105MM, HE, M1 or M760 (as applicable) Destructive Lot Acceptance								
<u>Critical</u> 1	<u>Government Proving Ground</u> Ballistic Test Components Break-up or become disassembled in bore or in flight			20		(a) (b)	3.4		4.5.8
<u>Major</u>	None defined								
<u>Minor</u>	None defined								
<p>NOTES: (a) Ten (10) samples shall be tested at excess pressure and ten (10) at service pressure. After three (3) consecutive lots have been tested and found to be acceptable, the service pressure phase of this test may be discontinued at the discretion of the procuring activity. However, this test phase may be reinstated at the direction of the contracting officer.</p> <p>(b) This test shall be stopped and the lot rejected upon encountering one (1) defective assembly.</p>									

## MIL-P-60547F (AR)

4.4.4 Testing. Unless otherwise specified herein all characteristics in this section are classed as major defects.

4.4.4.1 Steel quality. Records of test documentation shall be maintained and made available for Government review to provide evidence of compliance with the requirements of 3.1.1.

4.4.4.2 Mechanical properties.

4.4.4.2.1 Hardness.

4.4.4.2.1.1 Heat treatment lots. In order to determine uniformity of heat treatment, each body in the heat treatment lot (as defined by 4.4.1.1) after heat treatment, but prior to final machining of the bourrelet diameter, shall be subjected to a hardness test with a Brinell Hardness Tester or any other method approved by the procuring activity. Hardness impressions shall be made on the body bourrelet diameter and used as the basis for selecting the tension test samples of paragraph 4.4.4.2.2.1.

4.4.4.2.1.2 Stress relieved lots. Twenty-five cold shaped components from the first batch of each stress-relieved lot (as defined by 4.4.1.2) processed through the stress-relief furnace and five components from each one hour's production thereafter for the balance of the stress relieved lot shall be subjected to a Brinell hardness test or any method of hardness testing approved by the procuring activity to assess uniformity of the cold work and stress relief. Hardness readings are to be recorded for each component and used to meet the requirements of 4.4.4.2.2.3.

4.4.4.2.1.3 Miscellaneous lots (hardness). Miscellaneous heat treatment lots shall be subjected to a hardness test in accordance with 4.4.4.2.1.1. Miscellaneous stress relieved lots shall be subjected to a hardness test in accordance with 4.4.4.2.1.2.

4.4.4.2.2 Tensile, yield and elongation.

4.4.4.2.2.1 Heat treatment lots. Two components per heat treatment lot, one of the hardest and one of the softest, as determined by the hardness test shall be subjected to this test. Failure of any tension test specimen to comply with the yield strength or elongation requirements of the applicable drawing shall be cause for rejection of the lot represented by the failing specimen.

## MIL-P-60547F (AR)

4.4.4.2.2.2 Heat treatment lots (production control sample).

After three consecutive acceptable heat treatment lots have been manufactured the contractor has the option to utilize a production control sample. A production control sample is used to establish a hardness range in order to expeditiously obtain tension test samples for each heat treatment lot. The size of the production control sample shall be determined by the contractor. When a production control sample is used, the hardness range thus established shall be maintained throughout the heat treatment lot. Components which fall outside of the established hardness range for that heat treatment lot may be re-heat treated to fall within the established hardness range for that heat treatment lot or new mechanical properties may be determined from newly selected components which will more closely represent the true extremes of hardness in the heat treatment lot. Contracting officer approval is required prior to re-heat treatment of components.

4.4.4.2.2.3 Stress relieved lots. Two components, one of the hardest and one of the softest, as determined by the hardness test from the first twenty-five components shall be subjected to this test. Failure of any tension test specimen to comply with the mechanical property requirements of the applicable drawing shall be cause for rejection of the lot represented by the failing specimen. When it has been determined that the mechanical properties comply and furnace temperature and soak time have been established, the furnace temperature and soak time shall be maintained throughout each stress relief lot. The furnace temperature may have a range of 15.5°C (28°F) but not below the minimum temperature of 370°C (700°F). A minimum 30 minutes soak time shall be maintained. Furnace temperature and time will be recorded every hour to assess adequate control of stress relief equipment. The furnace temperature will be calibrated every eight hours.

4.4.4.2.2.4 Miscellaneous lot. Samples for tension test of miscellaneous heat treatment or stress relieved lots shall be selected in accordance with 4.4.4.2.2.2 or 4.4.4.2.2.3, as applicable. Failure of any tension test specimen to comply with the yield strength or elongation requirements of the applicable drawing shall be cause for rejection of the lot represented by the failing specimen. Tension tests shall be performed on each miscellaneous heat treatment or stress relieved lot before being grouped into a projectile lot. Provisions of 4.4.4.2.1.1 and 4.4.4.2.1.2 are also applicable.

## MIL-P-60547F (AR)

4.4.4.2.2.5 Disassembled rotating band. One body assembly prior to machining of rotating band, shall be selected from each four (4) hours' production from each banding machine and tested for tensile strength, yield strength and elongation in accordance with 4.5.4 and the applicable ASTM. The four hours production shall be rejected if the sample fails to comply with the specified requirements.

4.4.4.3 Rotating band seating.

4.4.4.3.1 Non-destructive method. A sample of five (5) body assemblies, prior to machining rotating band, shall be selected from each hour's production from each banding machine and tested as specified in 4.5.5.1. The hour's production represented by the sample shall be rejected if one or more body assemblies fail to conform to the specified requirement.

4.4.4.3.2 Destructive method. When non-destructive test equipment is not available, one body assembly, prior to machining of rotating band, shall be selected from each eight (8) hours' production, from each banding machine, and tested as specified in 4.5.5.2. The eight hours' production from the banding machine represented by a sample classed defective shall be rejected.

4.4.4.3.3 Sidewall contact. Rotating bands removed as specified under 4.4.4.2.2.5 or 4.4.4.3.2 shall be examined to determine compliance with 3.2.3.3. Failure to comply shall be cause for rejection of assemblies represented by the sample.

4.4.4.4 Base cover weld. A sample of five (5) body assemblies shall be selected from each hour's production, or fraction thereof, from each welding machine and tested as specified in 4.5.6. The hour's production from the welding machine represented by a sample classed defective shall be rejected.

4.4.4.5 Protective coating.

4.4.4.5.1 Protective coating - salt spray. The sample size and acceptance criteria shall be as specified in specification TT-C-490. If failure occurs, all items processed since last acceptance shall be rejected and corrective action taken.

4.4.4.5.1.1 Salt spray. After qualification in accordance with TT-C-490, two (2) salt spray samples shall be taken each week, one during the first 30 minutes of production and a second at any other time. Failure to comply with the requirements of the specification shall be cause for taking the corrective action prescribed in TT-C-490.

## MIL-P-60547F (AR)

4.4.4.5.2 Protective coating - thickness. Two samples shall be selected at random to represent each four hour period, or less, of continuous paint production. The samples shall be inspected using the equipment in accordance with 4.5.7.2. The sample body assembly shall be inspected for paint coating thickness at a minimum of four separate locations on each body assembly. Any body assembly failing to meet the applicable requirements shall be classed defective and every body assembly painted since the last acceptable sample shall be rejected.

4.4.5 Inspection equipment. The type of inspection equipment required to perform the examinations and tests required herein is listed in the "Paragraph Reference/Inspection Method" column in the Quality Conformance Inspection Classification of Defects, starting in paragraph 4.4.3.1. The contractor shall submit, for Government approval, inspection equipment designs in accordance with the terms of the contract. See Section 6 of MIL-A-48078 and Section 6 herein.

4.5 Methods of inspection.

4.5.1 Mechanical properties of rotating band blanks. The band blank shall be cut from front to rear and flattened, without hammering which may further cold work the material, and the largest obtainable flat type specimen shall be cut from the band, the length of which shall provide a one inch gage length, plus adequate material at each end to accommodate the grips of the tensile testing machine. This method should yield a specimen with a 0.500 inch gage width. In any event, the gage cross section shall be determined to the nearest 0.001 square inch and utilized to calculate the tensile and yield strengths, and elongation.

4.5.2 Mechanical properties of body. After all forming operations but prior to machining of band seat, the body shall be sectioned to yield adequate material from the sidewall of the projectile to machine two (2) largest obtainable round tensile specimens in accordance with ASTM Method E8. The length of each specimen shall coincide with the direction of the length of the body and the center of the length shall be coincident with the band seat location. Elongation shall be measured to the nearest 0.001 inch and converted to elongation to the nearest 0.1 percent.

4.5.3 Hardness. The hardness test shall be conducted in accordance with ASTM Method E 103 and the following:

a. The surface of the body in the area to be hardness tested shall be prepared by machining or grinding to a sufficient depth, .015 inches minimum, to remove scale and get below the decarburization zone.

## MIL-P-60547F (AR)

b. Periodic verification of the hardness tester during each operating shift shall be performed using Brinell test standards manufactured in accordance with ASTM Method E-10 in lieu of production samples.

c. All hardness test measurements shall be automatically displayed.

d. The Hardness Tester shall use a standard 10MM Brinell ball. The body shall be securely supported so that no rocking or shifting of the body will occur during the test. The tester shall apply a preload followed by application of the full load. The preload shall not exceed 10% of the major load of 300kg. The amount of penetration of the indenter (10MM ball) during that time period when the major load is applied including the dwell time at the end of the load application shall be automatically measured. The tester shall be provided with a means to compensate for any flexing of the test item that may occur during application of the major load. The hardness number will be displayed at the conclusion of the test.

4.5.4 Mechanical properties of disassembled rotating band. The rotating band, prior to machining, shall be cut from front to rear and removed from the body assembly and flattened without hammering which may further cold work the band material. The largest obtainable flat type specimen shall be cut from the band, the length of which shall provide a one inch gage length, plus adequate material at each end to accommodate the grips of the tensile testing machine. Machining shall remove the indentations caused by the scored ribs of the band seat. This method should yield a specimen with a 0.500 inch gage width. In any event, the gage cross section shall be determined to the nearest 0.001 square inch and utilized to calculate the tensile and yield strengths and elongation.

4.5.5 Rotating band seating.

4.5.5.1 Non-destructive test method. The body assembly shall be prepared for test and tested in accordance with Dwg. 8593417 or 8593429 as applicable.

4.5.5.2 Rotating band seating, destructive method. The body assembly shall be machined by setting up as for band machining and taking off just enough metal to "true-up" the circumferential surface of the band. The diameter of the band shall be measured on three (3) locations, 60 degrees apart, on the points along the cylindrical portion of their length near the front and rear edges. This comprises six (6) diametrical measurements per band.

## MIL-P-60547F (AR)

These points of measurement shall be marked on the bands and on the projectile body adjacent thereto in such a manner as to permit proper body and band orientation after removal. The bands shall be carefully removed so as to keep deformation to a minimum. After removal, the thickness of the band shall be measured at each of the marked points (a total of 12 measurements) and the diameter of the band seat corresponding to these points shall also be measured. Add to each of the diameters of the band seat the sum of the corresponding 2 thicknesses of the band; the results obtained shall then be subtracted from the previously determined diameters over the band. The resulting dimension represents the gap between the body band seat and the rotating band. The body shall be classed defective if this calculation exceeds the specified requirement.

4.5.6 Base cover weld. Visually inspect the base cover and select the area that appears to have the weakest weld; insert a 5/8" chisel in this area and apply force by use of a one pound steel hammer and an approximate one foot stroke. If the weld breaks loose after 2 strokes, the body assembly will be classed defective. If the weld is found to be secure, the burr made by the chisel may be knocked back into position and the sample returned to the lot.

4.5.7 Protective coating.

4.5.7.1 Salt spray testing. Salt spray testing shall be accomplished on production projectiles or sectioned projectiles that were acceptable at the time of painting and were sectioned subsequent to painting. If sectioned projectiles are used, sectioning shall be accomplished to allow testing of all major areas of the projectiles on an alternating basis. The salt spray test shall be performed utilizing the equipment and procedures specified by ASTM Method B-117. Test samples shall be dried in accordance with drawing 10535876 or 12551742 (as applicable).

4.5.7.2 Protective coating - thickness. Protective coating thickness testing shall be accomplished using commercially available equipment.

4.5.8 Proving ground.

4.5.8.1 Ballistic test. These tests shall be performed at a Government proving ground. The projectile metal parts assembly shall be inert loaded to a weight that falls within the weight zones specified on the applicable projectile loading drawing and the applicable weight zone marking applied to the projectile as

## MIL-P-60547F (AR)

shown on the applicable projectile loading drawing. For these tests, the weight of each round in the sample shall be adjusted to assure that the entire sample conforms to one weight zone. A dummy fuze, with weight compensation as required, shall be assembled to the inert loaded projectile and assembled to a cartridge which is standard for this round.

4.5.8.1.1 M1 Projectile. The M1 projectile shall be fired from an M137A1 cannon using a propelling charge which will produce an average piezo equivalent pressure of 35,800 pounds per square inch (psi), for service pressure and between 40,000 psi and 42,000 psi for excess pressure. The rounds shall be fired in an acceptable gun, based upon current gun tube condemnation criteria. The service pressure test rounds shall be uniformly temperature conditioned at  $70^{\circ}\text{F} \pm 2.5^{\circ}$  for a minimum of 24 hours prior to testing. The excess pressure test values can, at the option of the proving ground, be obtained by either the addition of propellant or by heating of the cartridge to obtain the pressures required.

4.5.8.1.2 M760 Projectile. The M760 projectile shall be fired from an M119 howitzer using the M200 propelling charge for service pressure and a PXR 200-1 charge (54,500 - 57,000 psi) for excess pressure. The rounds shall be fired in an acceptable gun, based upon current gun tube condemnation criteria. The service pressure and excess pressure test rounds (charges and projectiles) shall be uniformly temperature conditioned at  $70^{\circ}\text{F} \pm 2.5^{\circ}$  for a minimum of 24 hours prior to testing. The as fired fuze projectile weight shall be  $33 \pm 0.2$  pounds.

4.5.8.2 Range, deflection, velocity. The projectile will be fired for accuracy at a range selected by the proof director. Photographic equipment will be set up near the gun muzzle to record the flight of the projectile, and to determine compliance with 3.4. Velocity and chamber pressure will be recorded for each round fired. Range and deflections shall be recorded for information only. In the event of any abnormal flights, as observed by personnel, or instrumentation, an attempt shall be made to recover the metal parts for the purpose of determining the cause of the malfunction. The rounds tested at service pressure shall be fired alternately with rounds from a reference lot to facilitate comparison of range and accuracy.

## 5. PACKAGING

5.1 Palletizing, packing and marking. Palletizing, packing and marking shall be in accordance with drawing 8837835 and MIL-STD-1169.

5.2 Data cards. Data card information shall be as specified in MIL-STD-1167.

## MIL-P-60547F (AR)

## 6. NOTES

6.1 Intended use. The components covered by this specification are intended for use on the Cartridge 105MM, HE, M1 and M760.

6.2 Ordering data. See MIL-A-48078.

6.3 Submission of inspection equipment for design approvals. See MIL-A-48078. Submit designs as required to: Commander, US Army Armament Research, Development and Engineering Center ATTN: AMSMC-QAR-I (D), Dover, NJ 07801-5001.

6.4 Drawings. Drawings listed in section 2 of this specification under the heading US Army Armament Research, Development and Engineering Center (ARDEC) may also include drawings prepared by and identified as Edgewood Arsenal, Frankford Arsenal, Rock Island Arsenal, Picatinny Arsenal, US Army Research and Development Command (ARRADCOM) or US Army Armament Research and Development Center (ARDC) drawings. Technical data originally prepared by these activities is now under the cognizance of ARDEC.

6.5 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

6.6 Submission of test data and ammunition data cards. In addition to the normal distribution of records, when the projectile is procured by the US Army Armament Munitions and Chemical Command, one copy of all ballistic test data and ammunition data cards shall be forwarded to each of the following: Commander, ARDEC, ATTN: SMCAR-CCH-P and AMSMC-QAR-Q (D), Dover, NJ 07801-5001, and Commander, ARRCOM, ATTN: AMSMC-QAD, Rock Island, IL 61299-6000.

6.7 Visual examination qualification. When compliance with the applicable requirements is in doubt as a result of visual examination, the characteristics may be measured or gaged to determine acceptability.

6.8 Protective coating thickness. In checking the thickness of protective coating the "Dermatron" by Unit Process Assemblies Inc. 53-15 37th Ave., Woodside, NY 11377, has been proven to be satisfactory.

## MIL-P-60547F (AR)

6.9 Steel quality.

a. It is the responsibility of the manufacturer of the projectile metal parts to select a fully-killed carbon steel of a grade compatible with the abilities of the equipment and the methods of processing the metal within the operations of the shops of the forger and machiner to produce the projectile to the dimensions and mechanical properties and metal integrity specified as an end item requirement.

b. The supplier of the selected steel raw material is responsible only for furnishing a metal composition, grade, and type with dimensions, weight, soundness and freedom from metallurgical or mechanical defect limitations identifiable with the standard ANSI grade selected by the projectile manufacturer and complying with the specific ASTM designation and tests selected by the projectile manufacturer.

c. In the application of carbon steel, blooms, billets, slabs, and bars forging quality processing techniques adapted to use of the selected steel should be applied with the expectation that there will be variables in the metal cross-sectional dimensions in weight per unit length, in the hardenability variance from heat to heat in the mechanical condition of the surface, and in the straightness of the raw material. Economic advantages will be realized if the process and equipment within the shops of the forger and the machiner have been engineered in terms of equipment sequence of operations, tooling designs, handling devices, and processing techniques have capabilities of compensating for such variables.

6.10 Subject term (key word) listing.

Ammunition  
Ballistic testing (inert loaded) parts security, range,  
deflection and velocity  
Military Specifications  
Projectile; 105MM, M1 and M760  
Rotating Band Seating (band seating testing machine)

Custodian:  
Army - AR

Preparing activity:  
Army - AR

(Project 1315-A760)



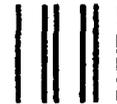
**INSTRUCTIONS:** In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

**NOTE:** This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE ARMY



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES

**OFFICIAL BUSINESS**  
PENALTY FOR PRIVATE USE \$300

**BUSINESS REPLY MAIL**  
FIRST CLASS PERMIT NO. 12062 WASHINGTON D. C.  
POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE ARMY

COMMANDER  
U S ARMY MUNITIONS & CHEMICAL COMMAND  
ATTN: AMSMC-QA  
DOVER, NJ 07801 5001



