INCH POUND

MIL-P-70504B (AR)
02 August 1993
SUPERSEDING
MIL-P-70504A (AR)
08 January 1987

MILITARY SPECIFICATION

PROJECTILE, 155MM: M864 BODY AND OGIVE ASSEMBLY FOR

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 covers the requirements, examinations and tests for Projectile, 155MM, M864 Body and Ogive Assembly (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents 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 (see 6.2).

SPECIFICATIONS

FEDERAL

TT-C-490	-	Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings

MILITARY

MIL-M-6867	-	Magnetic Inspection Units
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 ARDEC, ATTN: SMCAR-BAC-S, Picatinny Arsenal, New Jersey 07806-5000 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

STANDARDS

MIL-STD-410	- Nondestructive Testing Personnel Qualification and Certification
MIL-STD-1949	- Inspection Process, Magnetic Particle

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the DODSSP-Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

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

DRAWINGS

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

PRODUCT DRAWINGS

9381117	- Body and Ogive Assembly

PACKAGING DRAWINGS

8837839	- Pallet for Projectile, 155MM, HE & GB Hollow Base Type
12944446	- Packing and Marking for the 155MM Projectile Pallet

INSPECTION EQUIPMENT DRAWINGS

9280374	- Ultrasonic Inspection System for Body, Projectile, 155MM, M864
9280377	- Ogive Magnetic Particle Standard for 155MM, M864
9280378	- Circumferential Test Standard for Ultrasonic Inspection of Body, M864, 155MM Projectile
9280379	- Longitudinal Test Standard for Ultrasonic Inspection of Body, M864, 155MM Projectile

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

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM Method E-8	- Tension Testing of Metallic Materials
ASTM Method E-18	- Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM Method E-103	- Rapid Indentation Hardness Testing of Metallic Materials
ASTM Method B-117	- Salt Spray (Fog) Testing

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this document shall take precedence. Nothing in this document, 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 specifications.

3.2. Projectile forming, stress relief and heat treatment.

3.2.1 Forming. When a cold working operation is used in forming the projectile body, the maximum reduction in cross sectional area shall not exceed 22 percent. Process drawings showing the prior to cold work and after cold work process piece dimensions shall be submitted to the cognizant engineering agency, for approval prior to use. Once approved, the submitted process drawings shall not be changed without prior approval of the procuring activity. The hardness of the process piece prior to a cold working operation shall not exceed 241 Brinell (see 6.6).

3.2.2 Stress relief. Prior to the band welding operation, projectile bodies which have been cold worked shall be stress relieved at 1000 degrees F minimum temperature (body) for a minimum time of 1/2 hour. At the option of the contractor, the stress relief may be limited to the rotating band area of the body, provided the process and process controls are submitted to the technical agency for review and approval.

3.2.3 Heat treatment. Each component (bodies after application of the welded overlay band) shall be austenitized, quenched, and tempered uniformly to meet the mechanical properties specified on the applicable drawing. No work involving plastic flow is permitted after tempering unless followed by a stress relief. In accordance with accepted machining procedures, the component pre-heat treatment configuration shall minimize stress risers, sharp corners, and grooves with sharp roots (to minimize the possibility of quench cracking), and shall contain a sufficient material allowance to allow for removal of all decarburization, if any, during post-heat treatment machining operations. The contractor shall submit both the heat treatment and the forging billet heating process control documents to the technical agency for approval.

3.3 Rotating band.

3.3.1 Rotating band application. The rotating band shall be overlay welded using the gas metal arc welding process in accordance with the applicable drawings and specifications. Gas metal arc welding process, in this instance, is defined as the use of a consumable electrode with a non-electrode auxiliary wire. The width of the band shall be obtained by oscillating the welding head and the auxiliary wire feed system. The procedures for maintaining, controlling, and monitoring the process must be submitted to the technical agency for approval prior to the start of production. Documented records of the process control must be made available to the Government upon request (see 6.9).

3.3.1.1 Minimum melting of steel. Upon removal of the rotating band material, the steel band seat shall demonstrate visual evidence of minimum melting due to gilding metal adhesion during application of the rotating band. Visual comparison standards will be provided by the Government.

3.3.1.2 Subsurface defects. There shall be no evidence of either intergranular penetration of gilding metal or weld start-stop cratering when the body band seat is turned down to 5.875 plus or minus .010 inches diameter and tested as specified in 4.5.3.1.

3.3.2 Process control. Body material (steel) under the rotating band shall not extend above the finished bourrelet surface. A process requirement that will control this feature is depicted on drawing 9381123. The contractor may, at its option, use a control other than the one defined on the drawing. The manufacturing procedure and the inspection plan for controlling process shall be forwarded to the responsible technical agency for approval prior to its implementation into production.

3.3.3 Foreign matter on band seat. Prior to banding, the band seat shall be free from any contaminants that would be detrimental to the adhesion of the band to the band seat.

3.4 Metal defects.

3.4.1 Components or assemblies. All components or assemblies shall be free from all metal defects, in accordance with the defect standards (see 3.4.4), including cracks, splits, bursts, cold shuts, pipes, porosity, inclusions, folds, seams and other metal defects. In addition, the cavity of the components shall be free of scale, fins, burrs, draw marks, laminations, imbedded foreign matter, and pits (see 3.4.4).

3.4.2 Rotating band. The rotating band and band seat areas shall have no discontinuities, cracks, lack of bonding, or other metal defects in accordance with defect standards (see 3.4.4).

3.4.3 Body. The bodies shall be free of any discontinuities equal to or in excess of the ultrasonic inspection criteria within their respective zones. The inspection criteria are notches in standards which simulate rejectable defects. That is, all bodies shall have an ultrasonic echo signal that is less than the signal obtained from the standards.

3.4.4 Defect standards. Defect standards must be approved by the technical engineering agency. All visual standards for defects will be established for each contract after the first month's production, or whenever requested by the procuring contracting agency.

3.5. Proving ground function test. The body and ogive metal parts shall reveal no evidence of failure when tested. Metal parts failure shall be:

a. Loss or breakup of metal part component(s) in flight (except obturator).

b. Shear of the rotating band as evidenced by complete lack of engraving.

c. Base Assembly and cargo not ejecting (except excess pressure). Failure analysis must determine the cause to be the Body and Ogive Assembly.

3.6 Ogive. The ogive shall withstand, without leakage or rupture, an internal hydrostatic pressure of 12,000 pounds per square inch (psi) minimum for ten (10) seconds. Threads shall be dimensionally inspected after hydrostatic testing to insure compliance with drawing requirements.

3.7 First article . When specified in the contract or purchase order (see 6.2), a sample shall be subjected to first article inspection in accordance with the technical provisions herein (see 4.3).

3.8 Control dimensions.

3.8.1 Tool control dimensions. Dimensions marked tool control shall be gaged after each shift of production (not to exceed ten hours) for each machine in operation and prior to any tooling change. When 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, and instituting corrective action that assures drawing requirements are being met throughout the life of the tool.

3.8.2 Process control dimensions. The contractor shall prepare a process control plan for the dimensions marked process control. The plan shall be submitted to the technical agency for approval prior to use. Dimensions gaged for process control are to be assured to a Level III sampling plan (see 4.4.2a).

3.9 Protective finish. Details of the proposed procedure for zinc phosphate coating to be used by the contractor shall be submitted in writing to the Government Technical Agency, and written approval shall be received prior to initiation of production. The proposed procedure shall include materials, process and equipment to be used by the contractor, a detailed method of control including limits for time, temperature, concentration and all other information pertinent to the process. Approval of process, materials, or equipment implies no guarantee of acceptance of the results obtained in use.

3.10 Workmanship. The requirements for workmanship are as specified on the applicable drawings, referenced specifications and the following:

3.10.1 Burr and sharp edges. No component shall have a burr or sharp edge which might interfere with assembly or function of the item or which might be injurious to personnel handling the item.

3.10.2 Foreign matter. All parts and assemblies shall be free of chips, dirt, grease, oil, rust, or other foreign matter which may interfere with final inspection, and be completely free of the same prior to shipping.

3.10.3 Threads. Threads shall be full and undamaged for the entire minimum length or depth as required by the applicable drawings.

3.10.4 Painting. Painting shall be complete, void free, and undamaged.

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 (examinations and tests) and for the provisions of MIL-A-48078 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 ensure 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 inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

a. First Article Inspection (see 4.3)

b. Quality Conformance Inspection (see 4.4)

4.3 First article inspection.

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

PARTS DESCRIPTION	DRAWINGS	QUANTITY
Body and Ogive Assembly	9381117	25
Projectile Subassembly	9381118	5
Body	9381123	7
Body (prior to banding)	9381123	2
Ogive	9381121	7
Ogive Assembly	9381114	5
Fitting, Fuze	9381115	7

Twenty of the above body and ogive assemblies shall be forwarded to a designated load plant for loading, and shall then be forwarded to a Government Proving Ground for ballistic testing.

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

4.3.3 Rejection. See MIL-A-48078.

TABLE I. First article inspection

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
	Body and Ogive Assembly for Projectile 155MM, M864	1 OF 2	See Below
			NEXT HIGHER ASSEMBLY

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
	Ogive			
	(Dwg 9381121)			
	Examination for defects	5	3.1	4.4.2.3
	Yield strength & percent elongation	4 specimens	3.1	4.5.1.1/4.5.1.3
	Hydrostatic test	5	3.6	4.5.5
	Fuze fitting			
	(Dwg 9381115)			
	Examination for defects	5	3.1	4.4.2.4
	Yield strength & percent elongation	2 specimens	3.1	4.5.1.1/4.5.1.3
	Ogive assembly			
	(Dwg 9381114)			
	Examination for defects	5	3.1	4.4.2.5
	Body			
	(Dwg 9381123)			
	Examination for defects	5	3.1	4.4.2.2
	Yield strength & percent elongation	8 specimens	3.1	4.5.1.1/4.5.1.3
	Body (prior to banding)			
	(Dwg 9381123)			
	Examination for defects	2	3.1	4.4.2.1

NOTES:

TABLE I. First article inspection

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
	Body and Ogive Assembly for Projectile 155MM, M864	2 OF 2	See Below
			NEXT HIGHER ASSEMBLY

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
	Projectile subassembly			
	(Dwg 9381118)			
	Examination for defects	5	3.1	4.4.2.6
	Body and Ogive Assembly			
	(Dwg 9381117)			
	Examination for defects	25	3.1	4.4.2.7
	Salt spray test	2	3.1	4.5.7
	Ballistic tests		3.4	4.5.8
	a. Excess Pressure	10	3.5	4.5.8.1
	b. Zone Seven	5	3.5	4.5.8.2
	c. Service Pressure	5	3.5	4.5.8.3

NOTES:

4.4 Quality conformance inspection.

4.4.1 Inspection lot formation. Inspection lots shall comply with the lot formation provisions of MIL-A-48078. In addition, inspection lots of body and ogive assemblies shall contain ogives, bodies and fuze fittings from not more than one manufacturer.

4.4.1.1 Component heat treatment lot. A heat treatment lot of any component shall consist of components from only one mill heat of steel that have been heat treated in the same heat treatment equipment at the same temperature and for the same time cycles, in one unchanged process. The maximum lot size shall be 2000 components. If a mill heat exceeds 2000 components, the mill heat shall be divided into any convenient number of heat treatment lots that would preclude the need for forming miscellaneous heat treatment lots.

4.4.1.2 Miscellaneous lot. Components manufactured from small heats of steel, or bodies that have become separated from previously delivered lots may be grouped into a miscellaneous heat treatment lot. Such a lot shall be identified by a miscellaneous lot code number and processed in accordance with 4.4.1.1. The maximum lot size shall be 2000 components.

4.4.1.3 Use. The heat treatment lot constituted per 4.4.1.1. or 4.4.1.2. shall be the basis for selecting samples for mechanical properties tests. Components in each heat treatment lot shall be identified to that particular lot until satisfactory completion of mechanical properties tests.

4.4.1.4 Body and ogive assembly lot. Heat treatment lots that have been determined to have complied with the yield strength and percent elongation requirements of the applicable drawing may be regrouped for assembly into body and ogive assembly lots.

4.4.2 Examination and test.

a. Classification of characteristics. Quality conformance examination and tests are specified in the following Classification of Characteristics paragraphs. The contractor's quality program or detailed inspection system shall provide assurance of compliance of all characteristics with the applicable drawing and specification requirements utilizing, as a minimum, the conformance criteria specified. When cited herein, attributes sampling inspection shall be conducted in accordance with Table II below, using the inspection levels stated in the Classification of Characteristics paragraphs.

TABLE II. Attributes sampling inspection.

LOT SIZE	INSPECTION LEVELS					
	I	II	III	IV	V	VI
2 to 8	*	*	*	5	5	3
9 to 15	*	*	13	5	5	3
16 to 25	*	*	13	5	5	3
26 to 50	*	*	32	5	5	3
51 to 90	*	*	32	13	13	5
91 to 150	*	125	32	13	13	5
151 to 280	*	125	32	32	20	8
281 to 500	*	125	32	32	20	8
501 to 1200	*	125	80	50	20	13
1201 to 3200	1250	125	125	50	32	13
3201 to 10000	1250	125	125	50	32	13
10001 to 35000	1250	315	125	80	50	13
35001 to 150000	1250	315	125	80	50	13

Numbers under inspection levels indicate sample size; asterisks indicate one hundred percent inspection. If sample size exceeds lot size, perform one hundred percent inspection. Accept on zero and reject on one or more for all inspection levels.

b. Alternative quality conformance provisions. Unless otherwise specified herein or provided for in the contract, alternative quality conformance procedures, methods or equipment, such as statistical process control, tool control, other types of sampling procedures, etc. may be used by the contractor when they provide, as a minimum, the level of quality assurance required by the provisions herein. Prior to applying such alternative procedures, methods or equipment, the contractor shall describe them in a written proposal submitted to the Government for evaluation (see 6.13). When required, the contractor shall demonstrate that the effectiveness of each proposed alternative is equal to or better than the specified quality assurance provision(s) herein. In case

of dispute as to whether the contractor's proposed alternative(s) provides equivalent assurance, the provisions of this specification shall apply. All approved alternative provisions shall be specifically incorporated into the contractor's quality program or inspection system, as applicable.

c. Automatic gaging. Facilities equipped with Government furnished automatic gaging capable of performing 100 percent,0-1 inspection of any characteristic shall utilize this capability in accordance with the contract.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

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PARAGRAPH	TITLE		SHEET 1 OF 1	DRAWING NUMBER
4.4.2.1	Body (prior to banding)			9381123
				NEXT HIGHER ASSEMBLY
				9381118
CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Special				
a	Metal defective in band seat area (see 6.18)	100%,0-1	3.4.2	Visual
Major				
101	Diameter of rotating band seat	Level III	3.1	Gage
102	Distance between forward and aft bandseat tapers at basic height	Level III	3.1/ 3.8.2	4.5.2
103	Runout of rotating band seat to bourrelets	Level III	3.1/ 3.8.2	4.5.2
Minor				
201	Radii or chamfers missing	Level V	3.1	Visual
202	Surface finish of band seat	Level V	3.1	Visual
203	Evidence of poor workmanship	Level V	3.9	Visual

NOTES:

AMSMC Form 1570b-E, 1 Jul 89 Replaces AMSMC Form 1570, 1 Feb 85, which may not be used.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.2	Body	1 OF 5	9381123
			NEXT HIGHER ASSEMBLY: 9381118

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Special				
a	Metal defective (see 6.17)	100%,0-1	3.4.3	4.5.3.2.1
Major				
101	Yield strength and percent elongation	Note 4	3.2.3	4.5.1.1/4.5.1.3
102	Band chemical analysis	Note 4	3.1	4.5.4
103	Runout of body undercut with bourrelets	Level III	3.1	Gage
104	Base thread counterbore diameter oversize	Level III	3.1	Gage
105	Runout at first indicated position on the outside diameter from the forward face	Level III	3.1	Gage
106	Runout at second indicated position on the outside diameter from the forward face	Level III	3.1	Gage
107	Runout at third indicated position on the outside diameter from the forward face	Level III	3.1	Gage
108	Runout at fourth indicated position on the outside diameter from the forward face	Level III	3.1	Gage
109	Runout of rotating band flats with bourrelets	Level III	3.1	Gage

NOTES:
4. Sample size shall be as specified in applicable test method paragraph.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.2	Body	2 OF 5	9381123
			NEXT HIGHER ASSEMBLY: 9381118

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
110	Projected rumout of pitch diameter of base threads with bourrelets and rear face (2 places)	Level III	3.1	Gage
111	Runout of body cavity with bourrelets	Level III	3.1	Gage
112	Pitch diameter of body to ogive thread, max.	Level III	3.1	Gage
113	Minor diameter of body to ogive thread, max.	Level III	3.1	Gage
114	Outside diameter of undercut	Level III	3.1	Gage
115	Forward ogival diameter at basic location	Level III	3.1	Gage
116	Second ogival forward diameter at basic location	Level III	3.1	Gage
117	Third ogival forward diameter at basic location	Level III	3.1	Gage
118	Rear ogival diameter at basic location	Level III	3.1	Gage
119	Total length	Level III	3.1	Gage
120	Length from aft face to forwardmost bourrelet diameter of the aft bourrelet	Level III	3.1	Gage
121	Length from aft face to aftmost bourrelet diameter of the of the forward bourrelet	Level III	3.1	Gage
122	Location of forward cannelure	Level III	3.1	Gage
123	Location of rear cannelure	Level III	3.1	Gage
124	Straightness of rear face	Level III	3.1	Gage

NOTES:

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.2	Body	3 OF 5	9381123
			NEXT HIGHER ASSEMBLY: 9381118

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
125	Diameter of bourrelets, min. undersize (forward and rear)	Level III	3.1	Gage
126	Diameter of rotating band flats (3 places)	Level III	3.1	Gage
127	Diameter of cannelures (2 places)	Level III	3.1	Gage
128	Diameter of body cavity	Level III	3.1	Gage
129	Surface finish of body cavity	Level III	3.1	Comparison blocks
130	Width of keyway	Level III	3.1	Gage
131	Depth to bottom of keyway	Level III	3.1	Gage
132	Length of cavity	Level III	3.1	Gage
133	Length of keyway, min.	Level III	3.1	Gage
134	Min. wall thickness at keyway bottom	Level III	3.1	Gage
135	Min. wall thickness at forward cavity	Level III	3.1	Gage
136	Length of rotating band	Level III	3.1	Gage
137	Min pitch diameter of base threads (note 2) undersize	Level III	3.1	Gage
138	Mior diameter of base threads	Level III	3.1	Gage

NOTES:

2. "Variable" measurements shall be performed in accordance with the contractor's SPC plan (when approved). Functional gages shall be used for process control purposes (see defects 137, 148 and 150.

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.2	Body	4 OF 5	9381123
			NEXT HIGHER ASSEMBLY: 9381118

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
139	Runout of projected pitch diameter of ogive thread to bourrelets and forward face above max. (2 places) (note 3).	Level III	3.1	Gage
140	Location of basic diameter on rotating band	Level III	3.1	Gage
141	Location of basic diameter on internal taper	Level III	3.1	Gage
142	True position of base thread counterbore	Level III	3.1	Gage
143	True position of ogive thread pilot	Level III	3.1	Gage
144	Depth to base thread	Level III	3.1	Gage
145	Min base thread length	Level III	3.1	Gage
146	Band seat steel visible in cannelures	100%, 0-1	3.3.2	Visual
147	Diameter of bourrelets, max oversize (note 1)	Level III	3.1	Ring gage
148	Pitch diameter max. of base threads oversize (note 2)	100%, 0-1	3.1	Gage
149	Base thread counterbore dia. (undersize)	Level III	3.1	Plug gage
150	Pitch diameter of base threads	note 2	3.1	"Variables" gage

NOTES:

1. Not required when 100% gaging bourrelet diameter on body and ogive assembly (after paint)
2. "Variable" measurements shall be performed in accordance with the contractor's SPC plan (when approved). Functional gages shall be used for lot acceptance. "Variables" gage readings shall be used for process control purposes (see major defects 137, 148 and 150)
3. This inspection is not required when components are to be supplied as assemblies

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.2	Body	5 OF 5	9381123
			NEXT HIGHER ASSEMBLY: 9381118

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Minor				
201	Diameter of ogive thread counterbore	Level V	3.1	Gage
202	Depth of ogive thread counterbore	Level V	3.1	Gage
203	Radii or chamfers missing or incomplete	Level V	3.1	Visual
204	Presence and size of undercut forward of rotating band	Level V	3.1	Visual/Gage
205	Surface finish	Level V	3.1	Visual
206	Lot number missing or illegible	Level V	3.1	Visual
207	Protective finish inadequate or damaged	Level V	3.1	Visual
208	Evidence of poor workmanship	Level V	3.10	Visual

NOTES:

1. Not required when 100% gaging bourrelet diameter on body and ogive assembly (after paint).
2. "Variable" measurements shall be performed in accordance with the contractor's SPC plan (when approved). Functional gages shall be used for lot acceptance. "Variables" gage readings shall be used for process control purposes (see major defects 137, 148, and 150.
3. This inspection is not required when components are to be supplied as assemblies.
4. Sample size shall be as specified in applicable test method paragraph.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

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PARAGRAPH	TITLE		DRAWING NUMBER
4.4.2.3	Ogive	SHEET 1 OF 2	9381121
			NEXT HIGHER ASSEMBLY 9381118

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Special				
a	Metal Defective (see 6.18)	100%,0-1	3.4.1	4.5.3.2.2
Major				
101	Forward thread pitch diameter	Level III	3.1	Gage
102	Forward thread minor diameter	Level III	3.1	Gage
103	Diameter of body thread relief	Level III	3.1	Gage
104	Depth from front face to basic diameter	Level III	3.1	Gage
105	Length of cylindrical inside diameter	Level III	3.1	Gage
106	Width of body thread relief	Level III	3.1	Gage
107	Length from rear face to shoulder	Level III	3.1	Gage
108	Pitch diameter of body threads	Level III		
109	Major diameter of body threads	Level III	3.1	Gage
110	Location of basic outside diameter near front face	Level III	3.1	Gage
111	Location of basic outside diameter near shoulder	Level III	3.1	Gage
112	Runout at basic outside diameter near front face to datums (note 1)	Level III	3.1	Gage
113	Runout at basic outside diameter near shoulder to datums (note 1)	Level III	3.1	Gage
114	Wall thickness at forward indicated location (360 degrees)	Level III	3.1	Gage
115	Wall thickness at rear indicated location (360 degrees)	Level III	3.1	Gage
116	Inside diameter of body thread area	Level III	3.1	Gage

NOTES:

1. These inspections are not required when components are to be supplied as assemblies.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	OF	DRAWING NUMBER
4.4.2.3	Ogive	2	2	9381121

NEXT HIGHER ASSEMBLY: 9381118

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
117	Yield strength and percent elongation	4.5.1.3	3.1	4.5.1.1/4.5.1.3
118	Length from front face to shoulder	Level III	3.1	Gage
119	Hydrotest	see 4.5.5	3.6	4.5.5
120	Min effective thread length	Level III	3.1	Gage
Minor				
201	Protective finish inadequate or damaged	Level V	3.1	Visual
202	Surface finish improper	Level V	3.1	Visual
203	Evidence of poor workmanship	Level V	3.10	Visual
204	Tool marks in O-ring groove	Level V	3.1	Visual

NOTES:
1. These inspections are not required when components are to be supplied as assemblies.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.4	Fitting, Fuze	1 OF 2	9381115
			NEXT HIGHER ASSEMBLY 9381114

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Critical	None defined			
Special				
a	Metal defective	100%,0-1	3.4.1	Visual
Major				
101	Total length	Level III	3.1	Gage
102	Depth from front face to internal shoulder	Level III	3.1	Gage
103	Depth to end of fuze thread relief	Level III	3.1	Gage
104	Diameter of ogive thread relief	Level III	3.1	Gage
105	Diameter of fuze thread relief	Level III	3.1	Gage
106	Width of ogive thread shoulder	Level III	3.1	Gage
107	Width of ogive thread relief	Level III	3.1	Gage
108	Distance from ogive shoulder to end of ogive thread	Level III	3.1	Gage
109	Fuze thread pitch diameter	Level III	3.1	Gage
110	Fuze thread minor diameter	Level III	3.1	Gage
111	Ogive thread pitch diameter	Level III	3.1	Gage
112	Ogive thread major diameter	Level III	3.1	Gage
113	True position of smallest inside diameter	Level III	3.1	Gage
114	Outside diameter rear of threads	Level III	3.1	Gage
115	Smallest inside diameter	Level III	3.1	Gage
116	Distance between slots	Level III	3.1	Gage
117	Yield strength and percent elongation	4.5.1.3	3.1	4.5.1.1/4.5.1.3
118	True position of notches	Level III	3.1	Gage

NOTES:

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.4	Fitting, Fuze	2 OF 2	9381115
			NEXT HIGHER ASSEMBLY
			9381114

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
119	Projected runout of thread (2 places) (note 1)	Level III	3.1	Gage
120	Location of basic diameter on taper	Level III	3.1	Gage
121	True position of second smallest inside diameter	Level III	3.1	Gage
Minor				
201	Protective finish inadequate or damaged	Level V	3.1	Visual
202	Surface finish improper	Level V	3.1	Visual
203	Evidence of poor workmanship	Level V	3.10	Visual

NOTES:

1. Major 119 inspection not required when ogive assemblies or projectile subassemblies are being delivered.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.5	Ogive Assembly	1 OF 1	9381114
			NEXT HIGHER ASSEMBLY: 9381118

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Critical	None defined			
Major				
101	Projected runout of fuze threads (2 places) (see note 1)	Level III	3.1	Gage
102	Detorque test	Level III	3.1	Gage
103	Presence of stake(s)	Level III	3.1	Visual
104	Gap between ogive and fuze fitting	Level III	3.1	Gage
Minor				
201	Evidence of poor workmanship	Level V	3.10	Visual

NOTES:
1. Major 101 inspection not required when projectile sub-assemblies are being delivered.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

MIL-P-70504B (AR)

PARAGRAPH	TITLE		DRAWING NUMBER
4.4.2.6	Projectile Sub-assembly	SHEET 1 OF 1	9381118
			NEXT HIGHER ASSEMBLY 9381117

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Special				
a	Base threads damaged (see 6.19)	100%,0-1	3.1	Visual
b	Metal defective stamp(s) missing (indicating failure to pass test) (see 6.20)	100%,0-1	3.1	Visual
c	Metal defective (see 6.21)	100%,0-1	3.4	Visual (probe light)
Major				
101	Air leak test	100%,0-1	3.1	4.5.6
102	Maximum length	Level III	3.1	Gage
103	Projected runout of threads with bourrelets and front face (2 places)	Level III	3.1	Gage
104	Runout of ogive at forward basic location	Level III	3.1	Gage
105	Runout of ogive at rear basic location	Level III	3.1	Gage
106	Gap between ogive and body	Level III	3.1	Gage
107	Weight improper	Level III	3.1	Approved Scale
108	Interior lubricant missing, incomplete, or on threads or seating surface	Level III	3.1	Visual
Minor				
201	Evidence of poor workmanship	Level V	3.10	Visual

NOTES:

AMSMC Form 1570b-E, 1 Jul 89 Replaces AMSMC Form 1570, 1 Feb 85, which may not be used.

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.7	Body and Ogive Assembly	1 OF 2	9381117
			NEXT HIGHER ASSEMBLY

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Critical	None defined			
Special				
a	Ballistic test	4.5.8.4	3.5	4.5.8
Major				
101	Diameter of bourrelets, max. oversize (note 1)	100%, 0-1	3.1	Ring gage
102	Lifting plug detorque	Level III	3.1	Gage
103	Fuze threads damaged	Level III	3.1	Visual
104	Salt spray test	Note 2	3.1	4.5.7
105	Protective coating incomplete or damaged	Level III	3.10.4	Visual
Minor				
201	Distance coating overlaps leading edge of rotating band	Level V	3.1	Gage
202	Paint on threads	Level V	3.1	Visual
203	Paint not dry	Level V	3.1	Visual/Tactile
204	Marking missing, incorrect or illegible	Level V	3.1	Visual

NOTES:
1. At the contractor's option, the maximum diameter may be gaged at Level III when 100% inspection (Major defect 147, paragraph 4.4.2.2) is performed prior to paint.
2. Sample size per inspection method paragraph.

CLASSIFICATION OF CHARACTERISTICS

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.7	Body and Ogive Assembly	2 OF 2	9381117
			NEXT HIGHER ASSEMBLY

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
205	Grommet missing or loose	Level V	3.1	Visual
206	VCI paper missing (note 3)	Level V	3.1	Visual
207	Protective cap missing (note 3)	Level V	3.1	Visual
208	Evidence of poor workmanship	Level V	3.10	Visual

NOTES:

1. At the contractor's option, the maximum diameter may be gaged at Level III when 100% inspection (Major Defect 147, paragraph 4.4.2.2) is performed prior to paint.
2. Sample size per inspection method paragraph.
3. Not required for intra-plant use

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

MIL-P-70504B (AR)

PARAGRAPH	TITLE	SHEET	DRAWING NUMBER
4.4.2.8	Pallet for Projectile, 155MM, HE & GB, Hollow Base Type	1 OF 1	8837839
			NEXT HIGHER ASSEMBLY

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Critical	None defined			
Major	None defined			
Minor				
201	Pallet damaged (unserviceable)	Level V	3.1	Visual
202	Improperly packed	Level V	3.1	Visual
203	Strapping missing, loose or broken	Level V	3.1	Visual/Manual
204	Marking missing, incorrect or illegible	Level V	3.1	Visual
205	Evidence of poor workmanship	Level V	3.10	Visual

NOTES:

AMSMC Form 1570b-E, 1 Jul 89 Replaces AMSMC Form 1570, 1 Feb 85, which may not be used.

QUALITY CONFORMANCE INSPECTION

CLASSIFICATION OF CHARACTERISTICS

MIL-P-70504B (AR)

PARAGRAPH	TITLE	SHEET	OF	DRAWING NUMBER
4.4.2.9	Packing and Marking for 155MM Projectile Pallet	1	1	12944446

NEXT HIGHER ASSEMBLY

CLASSIFICATION	EXAMINATION OR TEST	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION METHOD REFERENCE
Critical	None defined			
Major				
101	Improperly assembled or parts missing	Level III	3.1	Visual
102	Spacers loose or damaged	Level III	3.1	Visual
103	Rods not properly engaged in cover or base	Level III	3.1	Visual
104	Lifting plug of projectile missing or damaged	Level III	3.1	Visual
105	Improper torque on nut at top of rod	Level III	3.1	Visual
106	Cotter pin not properly engaged	Level III	3.1	Visual
Minor				
201	Any marking missing, incorrect, or illegible	Level V	3.1	Visual

NOTES:

AMSMC Form 1570b-E, 1 Jul 89 Replaces AMSMC Form 1570, 1 Feb 85, which may not be used.

4.4.3 Testing. Testing is described in the Quality Conformance Inspection Tables and herein.

4.4.3.1 Hardness prior to cold forming (special defect). When the contractor elects to cold form the body, he will assure compliance with paragraph 3.2.1. Bodies subjected to this test will be hardness tested at a midpoint along the length of outside diameter of the body. For a minimum of 20,000 bodies, each body will be tested. Based upon conformance with the requirement during this testing, the contractor may propose a hardness sampling procedure. As a minimum, the hardness sampling procedure shall include hardness testing of the first twenty consecutive bodies out of slow cool after each start-up and sampling for hardness on a specific hourly basis. The sampling procedure shall be submitted to the procuring activity together with supporting hardness data for approval.

4.4.4 Inspection equipment. For inspection equipment required to perform the examinations and tests prescribed herein, the contractor shall submit for approval inspection equipment designs in accordance with the terms of the contract. See Section 6 of MIL-A-48078 and 6.3 herein.

4.4.4.1 Automatic inspection equipment. All automatic test and inspection equipment, when utilized by the contractor, shall be subjected to periodic verification or calibration check during production. The procedures shall include as a minimum: frequency, method of verification, and the method of retrieval of items produced between verification/calibration. These procedures shall be included in the operation/calibration procedures as required by the above paragraph.

4.4.4.2 Certification of nondestructive test (NDT) personnel. All personnel operating or calibrating NDT equipment shall be qualified and certified in accordance with MIL-STD-410. As a minimum, operating personnel shall be level I and calibrating personnel shall be level III.

4.5 Methods of inspection.

4.5.1 Mechanical properties.

4.5.1.1 Hardness of ogive and body. In order to determine uniformity of heat treatment, each component (ogive and body) will be subjected to a Rapid Indentation Hardness Test (Brinell alternative) after heat treatment. The test shall be made in accordance with ASTM Method E-103. The surface of each component, in the area to be hardness tested, shall be prepared by machining (or grinding) a flat of sufficient depth, 0.015 inches minimum, to remove scale and get below the decarburization zone. Alternately, a controlled diameter may be machined (to a sufficient depth, 0.015 inches minimum, below the decarburization zone) in the area of the body to be hardness tested in lieu of a flat. The test surface shall be prepared in such a manner so that the mechanical properties of the underlying material are not changed, and shall be of sufficient size and flatness so as to minimize error due to improper registration of the tester with the component. Manual grinding is prohibited. Flats and impressions shall be completely removed by final machining. Periodic verification of the hardness tester shall be performed using Brinell test standards manufactured in accordance with ASTM Method E-103 in lieu of production samples. All hardness test measurements shall be automatically displayed and recorded at the conclusion of the test. The hardness tester shall use a standard 10mm Brinell carbide ball, the indentor penetration shall be continuously measured, by automatic means, for the period beginning with the application of the major load, and ending after the prescribed dwell time for each component tested. 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. Scoping of components is prohibited, and shall not be used for measuring the hardness of the component for production piece acceptance (see 6.16).

4.5.1.1.1 Body hardness test location. Readings shall be taken on the body 2 3/4 inches forward of the finished rear face of the body. This location must be appropriately increased to allow for the extra length of a rough turned body.

4.5.1.1.2 Ogive hardness test location. Readings shall be taken on the ogive outside sidewall 8 3/8 inches rear of the forward face of the ogive.

4.5.1.2 Hardness of fuze fitting. In order to determine the uniformity of heat treatment, each fuze fitting will be subjected to a Rockwell C Hardness Test after heat treatment. The test shall be made in accordance with ASTM-E-18. The surface of each fitting shall be prepared by machining or grinding a flat on the outside diameter of .015 inches minimum, to remove scale and get below the decarburization zone. Flats and impressions shall be completely removed by final machining. Readings shall be taken midway along the outside diameter or on the rear face.

4.5.1.3 Yield strength and percent elongation. The two hardest and two softest components from each standard heat treatment lot, or the four hardest and eight softest components from each miscellaneous heat treatment lot, as determined by the hardness test in 4.5.1.1 or 4.5.1.2 (as applicable), shall be subjected to this test. Samples for mechanical property testing shall be selected after heat treatment of the entire heat treatment lot. If the hardness test yields a population of components at the high and/or low limit, the samples for mechanical properties testing shall be selected at random from that population. "Scoping" of components is prohibited, and shall not be used for measuring the hardness of the components (see 6.16). Screening of the components using "limits" is acceptable, provided the material falling outside the limits is not re-introduced into the screened components by the use of other means of hardness measurement or verification. The criteria for performing the tests shall be prescribed in ASTM Method E-8. Failure of any test specimen to comply with the yield strength or elongation requirements of the applicable drawing shall be cause for rejection of the lot. At the option of the contractor the entire lot may be re-heat treated and retested; or a new component may be selected and tested from a segment of the heat treatment lot having a tighter hardness range than that originally sampled. If an acceptable hardness range can be established for this heat treatment lot, components falling within this range will be accepted. All other components will be rejected. Rejected components may be re-heat treated and retested. All tensile specimens will be the largest obtainable round type specimen as prescribed in ASTM Method E-8. Test information for the body, ogive, and fuze fitting samples shall include:

a. Material and specimen identification, referencing the mill heat of material and heat treat lot.

b. Yield strength and the method used to determine the yield strength per ASTM Method E-8.

c. Tensile strength.

d. Elongation per ASTM Method E-8.

e. Reduction of area.

f. Specimen type per ASTM Method E-8.

g. Speed and method used to determine speed of testing.

h. Type of holder or grips used.

i. Hardness per ASTM Method E-103.

j. Specimen test section dimensions.

k. Reasons for replacement specimens.

l. A copy of the load-deflection curve.

4.5.1.3.1 Body. For each body tested, two specimens shall be taken longitudinally from opposite sides of each body, midwall of the band seat area, and two specimens shall be taken longitudinally from opposite sides of the body one inch from the front end.

4.5.1.3.2 Ogive. For each ogive tested, two longitudinal test specimens shall be taken from opposite sides of the sidewall such that the center of the gage length shall be 7 1/2 inches from the front end.

4.5.1.3.3 Fuze fitting. For each fuze fitting tested, one longitudinal specimen shall be taken midwall of the length.

4.5.2 Rotating band seat location and runout. The contractor may use any control method that will assure the band seat meets the dimensional requirements of the applicable drawing. The inspection plan must include all the required criteria to assure the dimensional aspects of the drawing will be equal to the characteristics defined in 4.4.2.2. When the contractor establishes a control method, the manufacturing procedure, and inspection plan shall be forwarded to the Technical Agency for approval prior to use in accordance with 3.8.2. No change to these controls will be made once established without approval from the Technical Agency.

4.5.3 Inspection for metal defects after machining.

4.5.3.1 Inspection of band seat.

4.5.3.1.1 Welder qualification sampling. The first five banded bodies, after the welded overlay band has been applied, for each welding machine in operation, shall be subjected to the test outlined below. Reduced sampling of one in twenty banded bodies may be implemented after five consecutive banded bodies per each welding machine in operation have been found acceptable. These bodies shall have the band removed by machining and chemically etching without damaging the band seat metal (steel) (see 6.7).

These bodies will be subjected to the following tests:

a. Visual examination for compliance with 3.3.1.1 minimum melt requirements.

b. Visual examination for compliance with 3.4.2 metal defects, using the technique described in 4.5.3.1.3.

c. Turn down band seat to the diameter specified in 3.3.1.2 and again visually inspect in accordance with 4.5.3.1.3. Any defect indication per 3.3.1.2 at this depth is considered to be a reject.

Should any sample for any of the above tests fail to comply with minimum acceptance requirements, the quantity of bodies represented by that sample shall be rejected.

4.5.3.1.2 Post Qualification Sampling.

4.5.3.1.2.1 Etched bandseat examination. Reduced sampling of one in each shift (not to exceed ten hours) of production, or fraction thereof, per welding machine in operation may be implemented after five consecutive samples of one in twenty banded bodies per each welding machine in operation have been found acceptable (see 6.9). One body per welder will be randomly selected and inspected according to the following criteria:

a. Visual examination for compliance with 3.3.1.1, minimum melting. The body selected for this test need not be the test sample having the lower rotating band iron content when tested in accordance with 4.5.4.

b. Visual inspection for compliance with 3.4.2, metal defects, using the technique described in 4.5.3.1.3. If the sample fails to comply with 3.4.2, then the band seat will be turned down to the diameter specified in 3.3.1.2 and again visually inspected in accordance with 4.5.3.1.3.

c. Should any sample fail to comply with the minimum acceptance requirements, the quantity of bodies represented by that sample shall be rejected.

d. Two consecutive failures when tested for 4.5.3.1.2a, or two consecutive failures when tested for 4.5.3.1.2b, for any welding machine will mandate the return to the original welder qualification sampling of 4.5.3.1.1. However, reduced sampling of one in each shift of production or fraction thereof may be implemented after the first five banded bodies have been found acceptable.

4.5.3.1.2.2 Sub-surface defect examination. The body having the highest acceptable iron content rotating band, when tested per 4.5.4 during each shift of post qualification sampling, shall be tested for compliance with 3.3.1.2. This body will have its band seat turned down to the diameter specified in 3.3.1.2 and visually inspected per 4.5.3.1.3. Failure of the body to comply with the specified requirements will require rejection of all bodies having bands welded by the same welder during the same sampling period. Failure of any body will also require that the body exhibiting the highest iron content from each welder will be similarly tested. Failure of any body will result in rejection of the quantity from each discrete welder respresented by the sample.
Two consecutive failures on any welding machine will mandate the return to the original welder qualification sampling of 4.5.3.1.1. However, reduced sampling of one in each shift of production, or fraction thereof, may be implemented after the first five banded bodies have been found acceptable.

4.5.3.1.3 Magnetic particle inspection. Magnetic particle inspection shall be as specified in MIL-STD-1949 for the wet fluorescent method, using indirect magnetization by the continuous method. Inspect initially after inducing a circular magnetic field, and again after inducing a longitudinal magnetic field.

4.5.3.1.4. Retest. If the sample selected in 4.5.3.1.2.2 fails to comply with the requirements, then a minimum of 10% of the bodies from the failed welder may be randomly selected for retest. These parts will be tested in accordance with 4.5.3.1.2.2. Only one retest per welder is allowed. Failure of any part will mandate the rejection of the product represented by the sample.

4.5.3.2 Finished components.

4.5.3.2.1 Bodies. Prior to slotting and threading, each body shall be ultrasonically inspected in accordance with dwgs. 9280374, 9280378, and 9280379. Any body failing to meet the requirement of 3.4.3 shall be rejected. As a minimum, the adequacy of the inspection process shall be verified by using the approved ultrasonic standards at the start and finish of each production shift or change in operator as well as at each half-shift. Components which comply shall be identified with the letter "U", as specified in the applicable drawing. All channels shall properly indicate a rejection signal when encountering the standard notches. If the inspection process is determined to be inadequate, the condition shall be corrected and all items inspected since the last acceptable verification shall be reinspected.

A log book shall be maintained by the operator of each system which, as a minimum, documents the use of standards, number of items inspected, number of rejects by zone, changing of transducers, instrumentation, repairs, reasons for equipment breakage, if any, and changing of qualified operators or inspectors. This log book shall be made available when requested for Government review.

4.5.3.2.2 Ogives. Each component, after final machining, shall be inspected by the magnetic particle inspection technique. At the option of the contractor, this test may be performed prior to machining the threads, or notches, as applicable. The procedures for performing this test shall be as specified in MIL-STD-1949, for wet fluorescent method with indirect magnetization by the continuous method. The entire component, inside and outside, shall be inspected after inducing a circular magnetic field and again after inducing a longitudinal magnetic field. To establish inspection sensitivity magnetic particle standard drawing 9280377 shall be used. Any component which fails to comply with the requirements of 3.4 shall be rejected. Components which comply shall be identified with the letter "M" as specified on the applicable drawing.

4.5.3.2.2.1 Magnetic particle suspension. The solids content of the magnetic particle suspension shall be maintained at the level recommended by the suspensoid manufacturer. The suspension shall be checked at the start of each shift of production, and at intervals of not over one half-shift of continuous operation, utilizing the procedures and equipment prescribed by Sections 4 and 5 of MIL-STD-1949. When performing this test for solids content of the suspension, if it is determined that it does not comply, all components that have been tested and accepted per 4.5.3.2.2 since the last satisfactory test was performed shall be retested after the suspension has been brought to the proper level. The magnetic particle test shall be performed on equipment that complies with the requirements of specification MIL-M-6867.

4.5.3.2.3 Fuze fitting. After final machining, each fuze fitting shall be inspected visually to comply with the requirements of 3.4. Components which comply shall be identified with the letter "V" as specified on the applicable drawing.

4.5.4 Band chemical analysis. The first five banded bodies, after the welded overlay band has been applied, for each welding machine in operation, shall be subjected to this test. Reduced sampling of one in twenty banded bodies may be implemented after five consecutive banded bodies per each welding machine in operation have been tested and found acceptable. Reduced sampling of one in each half-shift of production, or fraction thereof, per welding machine in operation may be implemented after five consecutive samples of one in twenty banded bodies per each welding machine in operation have been tested and found acceptable. Sample chips shall be obtained from each band from the last .050 inches removed when machining to the finished diameter. All chips shall be collected and identified with the body from which the chips were machined. A minimum 5 gram sample from each complete specimen thus obtained from each band shall be analyzed by any method that has been approved by the technical agency. The sample may not be cleaned with a magnet. Failure to comply with the requirements of the drawing shall be cause for rejection of the production represented by the sample.

4.5.5 Hydrostatic test of ogive. Prior to the application of protective finish, the finish machined ogive shall be subjected to a hydrostatic test. The ogive shall by hydrostatically tested using equipment capable of performing the test accurately and consistently. In performing the test, the hydrostatic pressure will be applied gradually until the required minimum pressure is reached. The equipment shall be calibrated prior to the start of each shift of operation, and at intervals of not over one-half shift of continuous operation. The equipment shall also be calibrated prior to re-starting the operation after a layoff of three hours or more. If it has been found that the equipment is out of calibration in such a direction that the test pressure was actually lower than that specified in paragraph 3.6, the ogives tested since the last satisfactory calibration shall be retested after the calibration error has been corrected. The fixture should be such that it does not restrain the ogive, except that it may seal on the outside diameter at a location of up to 0.570 inches from the forward face of the ogive. The ogive threads shall be dimensionally inspected for deformation after completion of the test. Ogives with deformed threads shall be rejected but shall not be considered as a hydrostatic test failure.

4.5.5.1 Lot sampling plan. 100 percent, 0-1 hydrostatic testing of finish machined ogives shall be conducted until 1200 ogives consecutively pass the hydrostatic test. Subsequently, lots of no greater than 4000 ogives may be submitted for testing. A sample of 50 ogives per lot shall then be tested. Failure of any ogive to meet the requirement of paragraph 3.6 shall be cause for rejection of the lot represented by the sample. When a lot has been rejected while on sampling inspection, the frequency shall revert back to the 100 percent inspection until 1200 ogives consecutively pass the hydrostatic test, to qualify for reduced sampling testing.

4.5.5.1.1 Rejection. If, during a period of 100 percent ,0-1 inspection, a defect is found before finding 1200 consecutive conforming units and the number of units screened is equal to or greater than 2500, the contractor shall notify the Government quality assurance representative, and corrective action shall be taken to improve the production process. The Government quality assurance representative may, at its option, suspend acceptance immediately or at any time thereafter during the period of 100 percent ,0-1 inspection until the supplier corrects the cause(s) of the high rate of defectiveness. After effective corrective action has been taken, 100 percent ,0-1 inspection shall be reinitiated in accordance with 4.5.5.1.

4.5.6 Air leak test (as applicable). The ogive to body joint and ogive to fuze fitting joint shall be tested in accordance with the applicable drawing for 15 seconds minimum. No force shall be applied in the axial direction that would compress either of the joints. Failure to comply shall be cause to reject the projectile subassembly. Projectile subassemblies which comply shall be stamped with the letter "A" in 1/8 inch letters in the area indicated on the drawing. The test may be accomplished by one of the following procedures.

4.5.6.1 Submersion test (alternate 1). The projectile subassembly shall be submerged in water. The required air pressure shall be applied and held for the minimum specified time, after the water in the tank is permitted to settle after submersion. Observation for leakage shall be made for the entire time the subassembly is required to be pressurized. Air bubbles in the vicinity of either joint or rising to the surface of the water shall be cause for rejection of the subassembly. A wetting agent may be used.

4.5.6.2 Pressure drop test (alternate 2). Each projectile subassembly shall be mounted so as to seal the subassembly above and below each joint with a collar (5 cu. in. max. each) and then pressurizing this collar at 15 psi for 15 seconds while looking for a maximum pressure drop of 0.01 psi during the 15 second hold cycle. The pressure source shall be inactive during the hold cycle. A pressure drop at either joint in excess of 0.01 psi shall be cause for rejection of the subassembly.

4.5.7 Salt spray test. The salt spray test shall be performed on the body/ogive assembly utilizing the equipment, methods, and procedures specified in ASTM B-117 and in accordance with the applicable detailed specification for the protective finish, except that the curing cycles for the body and ogive assemblies shall be in accordance with the component drawing. Sampling shall be as specified in TT-C-490. When on reduced sampling (twice per week), one sample shall be taken during the first thirty (30) minutes of production, and a second sample shall be taken from the second half of production that week. Failure to comply will be cause for rejection of the production since the previous test.

4.5.8. Proving ground ballistic test. The test shall be conducted using cannon tubes having 25 percent minimum remaining life based upon current gun tube condemnation criteria. Smear photographs shall be taken 10 and 30 meters in front of the muzzle. Radar equipment shall be used to track the projectile in flight. Chamber pressures and velocities shall be recorded for each round fired. All photographs and recovered hardware shall be examined for any noncompliance with the applicable requirements of 3.5. Range, deflection, and velocity will be recorded for informational purposes. An attempt will be made to recover the projectiles fired for first article. During production acceptance test, projectiles shall be recovered only if a failure or suspected failure occurs. See 6.14.

4.5.8.1. Excess pressure. The body and ogive assemblies submitted for this test shall be further assembled into projectiles that will contain inert cargo; have a base burner assembly with an inert grain, without igniters; a dummy expulsion charge; and a dummy fuze. Each projectile will be fired with a PXR 6297A1 propelling charge that has been temperature conditioned to obtain 60-64 thousand PSI chamber pressure and with an M199 cannon tube. The completely assembled projectiles shall be temperature conditioned to 145+/-5 F.

4.5.8.2 Zone seven. The body and ogive assemblies submitted for this test shall be further assembled into projectiles that will contain inert cargo; have a base burner assembly with inert grain, without igniters; a live expulsion charge, and a live M577 fuze. Each projectile will be fired in a complete M185 or M199 cannon tube with an M2A2 propelling charge. The complete projectile and the propelling charge shall be conditioned to -50 +/- 5 F. The fuze will be set for airburst. Fuze function time will be recorded.

4.5.8.3 Service pressure. The body and ogive assemblies submitted for this test will be assembled into projectiles as in 4.5.8.2. Each projectile will be fired in a M199 cannon tube with a M203 series propelling charge. The propelling charges and projectiles shall be conditioned to 70 +/- 5 ^{0} F. The fuze will be set for airburst. Fuze function time will be recorded.

4.5.8.4 Sampling procedure. Normal sampling will be conducted until five consecutive lots have been accepted. Reduced sampling shall then be instituted. Any failure, while on reduced sampling, mandates return to normal sampling. Sample sizes for normal and reduced sampling shall be as follows:

	Normal	Reduced
a. Excess pressure	5	2
b. Zone seven	3	3
c. Service pressure	2	-

5. PACKAGING

5.1 Packing. This section (Section 5) is not applicable if LAP operations are to be performed at the same facility.

5.2 Packaging, packing, and marking.

5.2.1 Packing and marking. The body and ogive assemblies shall be palletized and marked in accordance with Drawing 12944446.

5.2.2 Alternative packing. Only with the specific approval of the contracting officer, the projectiles shall be palletized and marked in accordance with drawing 8837839.

6. NOTES

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

6.1 Intended use. The body and ogive assemblies covered by this specification are intended for the Projectile, 155MM: M864.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of the specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1).

c. Requirements for submission of First Article Sample.

6.3 Submission of inspection equipment for design approvals. Gage designs as required shall be submitted to: Commander, ARDEC, ATTN: SMCAR-QAR-I, Picatinny Arsenal, NJ 07806-5000. This address shall be specified on the Contract Data Requirements List, DD Form 1423 in the contract.

6.4 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract, per the Contract Data Requirements List, DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.8.2, 3.9, 4.4.3.1, 4.5.2	DI-T-5372	Procedure Report	None

6.5 Submission of ballistic test data and data cards. In addition to the normal distribution, one copy of all ballistic data and ammunition data cards shall be forwarded to Commander, ARDEC,, ATTN: SMCAR-QAR-Q (D), Picatinny Arsenal, NJ 07806-5000.

6.6 Cold forming. The contractor is cautioned that if cold forming is utilized in processing of the projectile body, those bodies which do not completely clean up in the machining operation prior to the cold forming have a greater propensity to develop circumferential tears during the forming operation,particularly if areas of non-cleanup are heavily scaled.

6.7 Suggested etching procedures for removing gilding metal overlay.

a. Recommended. Immerse body in commercial copper stripper which is cyanide and chromate free and prepared in accordance with manufacturer's directions. In a fresh solution, an overlay layer 0.010 to 0.015 inch thick will dissolve in 10 to 14 hours. Renew solution as necessary.

b. Solution - 500 grams Chromic oxide (Cr_2O_3) (commercial flakes), 50 ml. sulphuric acid (H_2SO_4) (technical grade), 950 ml. water (H_2O) (distilled).

This solution may be used by passing current through the solution (50 amperes dc) with the immersed shell as the anode and the container as the cathode. An overlay layer 0.010 to 0.015 inch thick will require approximately two to three hours to dissolve in a fresh solution. The solution can also be used without an external current source by immersing the shell for approximately 8 to 12 hours. An active solution would clean all pits.

6.8 Alternate alloys. The specified alloys, 1340 and 4140, which are compatible with the welded overlay rotating band, have been successfully used as body material. Experience to date has indicated that 1340 steel requires closer control over the welding process and thermal treatment to prevent cracks after banding. However, this does not preclude the need for similar close control over the welding process and thermal treatment with 4140 steel to be compatible with the production process.

6.9 Band welding. It is recommended that the welding operation of the overlay welded band be guided by Frankford Arsenal "Process Recommendations for Banding 155MM, M483 Projectile" dated 19 April 1973. Requests for copies should be submitted to: Commander, ARDEC, ATTN: SMCAR-CCH-P, Dover, NJ 07806-5000.

6.10 Steel blooms, billets, slabs and bars.

6.10.1 Steel grade. It is the responsibility of the manufacturer of the body/ogive to select a steel of a grade(s) compatible with the abilities of the equipment and the methods of processing the metal within the operations of the shops of the forger and machinist to produce the metal parts to the dimensions, mechanical properties and metal integrity specified as an end item requirement.

6.10.2 Raw material. The supplier of the selected steel raw material is responsible for furnishing a metal composition, grade, and type with dimensions, weight, soundness and freedom from metallurgical or mechanical defect limitations identifiable with the standard AISI grade (selected by the body/ogive manufacturer) and complying with the specific ASTM designation and tests selected by the body/ogive manufacturer.

6.10.3 Forging quality processing techniques. 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 machinist have been engineered in terms of equipment sequence of operations, tooling designs, handling devices, and processing techniques having the capabilities of compensating for such variables.

6.11 Pre-production sample/hardness range. To minimize the need for re-heat treating material it is recommended that the contractor process a pre-production sample to establish what should be an acceptable hardness range for each mill heat. This hardness range could then be used for screening components during processing of the heat treatment lot from that mill heat. When using a hardness range, acceptance will still be in accordance with para. 4.5.1.

6.12 Subject term (key word) listing.

Ammunition
Artillery
Munition, Conventional, Improved, Carrier Metal Parts

6.13 Submission of alternative quality conformance provisions. Unless otherwise specified in the contract, proposed alternative quality conformance provisions will be submitted by the contractor for evaluation by the technical activity responsible for the preparation of this specification.

6.14 Ballistic tests. At the option of the Government, ballistic acceptance tests of body and ogive assemblies may be conducted in conjunction with acceptance tests of the base assembly.

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

6.16 Scoping. "Scoping" shall be defined as the use of a low-magnification microscope (usually hand held) which has, fixed in the eyepiece, a scale for measuring the Brinell ball indentation. This specification does not allow this method to be used for hardness measurement of production components.

6.17 Metal Defective (Ultrasonic). Upon detection of an ultrasonic indication, a static evaluation shall be made to determine the source of the indication. If the source of the ultrasonic signal is determined to be a discontinuity, the part shall be classified as having a critical defect. If the source of the ultrasonic signal cannot be determined, and no discontinuities are evident in the area of the signal the part shall be considered to have a minor defect, but shall be permanently rejected.

6.18 Metal Defective (Magnetic Particle). Upon detection of a magnetic particle indication, a visual examination shall be made to determine if the indication is caused by a discontinuity in the surface. If the indication is caused by a surface discontinuity, the part shall be considered to have a critical defect. If the indication cannot be identified as a surface discontinuity, the part shall be considered to have a minor defect and shall be permanently rejected.

6.19 Base Threads Damaged. If the damage to the base threads is cosmetic in nature, the part shall be considered to have a minor defect, but shall be permanently rejected. Damage which results in loss of thread metal shall be considered a critical defect.

6.20 Metal Defective Stamp Missing. In the event that a metal defective stamp is discovered to be missing, the part shall be removed from the assembly and inspected per its appropriate paragraph for all defects. If that part exhibits any indication, that part shall be considered critically defective, since it evidences a critical breakdown in the inspection and/or material handling system. If the part shows no indication, that part may be classified as having a minor defect and may be made acceptable by application of the appropriate metal inspection stamp. Non-affected components may be returned to production.

6.21 Metal Defective (Visual). Components which exhibit defects in excess of the requirements or standards, as applicable, shall be considered permanently rejected with a minor defect. The component shall be re-tested for metal defective in accordance with the appropriate paragraph.

6.22 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Army - AR

Preparing activity:
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(Project 1320-AD05)