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SPECIFICATION

1 of 1

D1259

1. COMPONENT/PART NAME PER GENERIC CODE: Propulsion Parts & Materials, Solid Fuel Engines, Propellants	2. PROGRAM OR WEAPON SYSTEM: Multiple	3. DATE OF:	DAY	MO.	YR.
4. ORIGINATOR'S SPECIFICATION TITLE: Propellant Grain Processing for Rocket Motor, Mark 61 Mod 0	5. ORIGINATOR'S SPEC. NO.: OD30798	ISSUE	3	6	68
		REVISION			

6. SPECIFICATION IS: ☐ DRAFT ☐ PRELIMINARY ☒ FINAL

7. THIS SPECIFICATION COMPLEMENTS REPORT NO.

8. TYPE OF SPECIFICATION

- ☐ (A) GENERAL PRODUCT REQUIREMENTS FOR A FAMILY OF PARTS - PROCUREMENT DOCUMENT
- ☐ (B) INDIVIDUAL DETAIL PARTS DOCUMENT; STDS BOOK PAGES - FOR PROCUREMENT
- ☐ (C) DETAIL INSPECTION, PROCESS CONTROL, AND/OR TEST PROCEDURES FOR SPECIFIC PARTS
- ☒ (D) PROCESS (PAINTING, WELDING, FINISHING, HEAT TREATING ETC.) APPLICABLE TO MANY PARTS
- ☐ (E) SPEC. FOR PERFORMANCE, RELIABILITY, AND/OR ENVIRONMENT FOR ASSEMBLIES, EQUIPMENTS, SUBSYSTEMS AND SYSTEMS
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11. SIGNED	12. CONTRACTOR	SUBCONTRACTOR
R. S. Harper	NWC/CL	

22 25 25 1

NOTICES PAGE

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OD 30798

Code Ident
10001

JUN 3 1960

PROPELLANT GRAIN

PROCESSING

FOR

ROCKET MOTOR, MARK 61 MOD 0

Approved:

G. W. Leonard

By direction

RECORD OF REVISIONS		
Revision Letter	Date	Changes

This document consists of pages i to iii
and 1 to 21 inclusive

PUBLISHED BY DIRECTION OF
THE COMMANDER OF THE NAVAL ORDNANCE SYSTEMS COMMAND

CONTENTS

Section 1

1. INTRODUCTION.

1.1 The purpose of this document is to describe machining, processing, and inspection procedures for manufacturing an inhibited propellant grain from an unmachined billet. The procedures described herein are intended to provide a guide for activities engaged in the processing of inhibited propellant grains (MARK 81 MOD 0) for the MARK 61 MOD 0 Rocket Motor.

Section 2

2. PREPARATION FOR MACHINING.

2.1 Tools and Supplies:

Waterproof-ink marking pen, felt-tip
Tape, masking, 6 inch
Tape, masking, 1 inch
Knife, Beryllium
Rule, steel
Tray, grain
Box, 5-inch grain
Foil, Aluminum
Solvent, Acetone
Drum, waste disposal
Oven, vacuum
Mill, remotely operable
Lathe, remotely operable
Gage, dial, indicator
Micrometer, outside
Wipers, Kimwipes
Scale, balance

2.2 Preliminary instruction.

2.2.1 Unless otherwise specified herein, all operations involving the propellant should be conducted with the propellant at 75 ± 10 degrees Fahrenheit (°F).

2.3 GRAIN-BLANK MACHINING.

NOTE. All grains in a lot may be processed before proceeding to the next machine setup.

2.3.1 Billet cutting.

2.3.1.1 A minimum of 2 days is required between propellant extrusion and machining of the final outside diameter of grain blank to allow physical dimensions of propellant billet to stabilize.

2.3.1.2 Verify that Processing Request (PR) number and propellant type have been marked on box label and that billets have been labeled with extrusion and billet number.

2.3.1.3 Using a mill, by remote control, cut the billets into lengths of 0.25 ± 0.125 inch longer than final length.

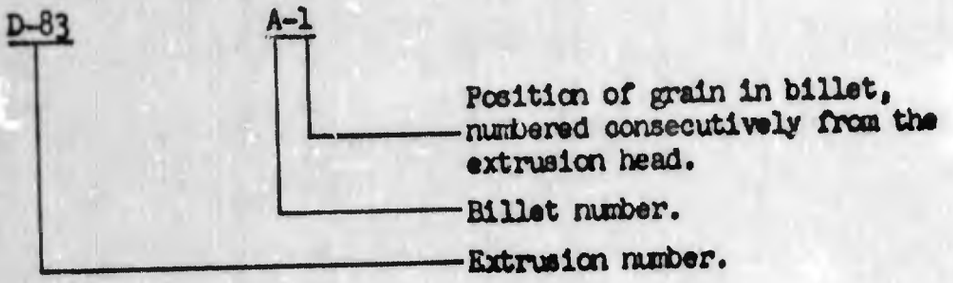
2.3.1.4 Discard billet end deformed by guillotine cutter.

2.3.1.5 Using a felt-tip, waterproof-ink marking pen, label the grain on the end as follows:

Example: Naval Weapons Center (NWC).

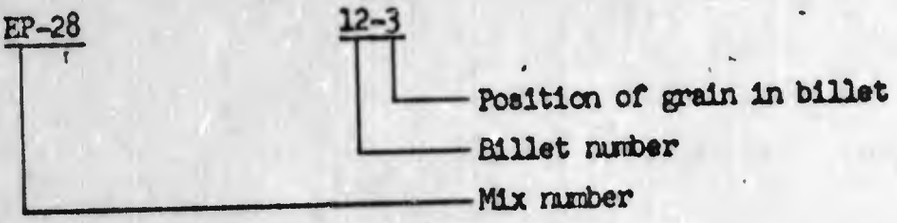
1. PR number. Example: PR 7350.

2. Extrusion-billet number. Example: D-83-A-1.



Naval Ordnance Station (NOS)

1. Mix number/billet number. Example: EP-28-12-3.



2.4 Package the grains in accordance with section 7, transport to machining facility, and store for a minimum of 3 hours at 75 ± 10°F.

2.5 Outside diameter machining (Drawing 2601927).

2.5.1 Clean the lathe with acetone and clean cloths.

2.5.2 Remove one grain from storage.

2.5.3 Assure that the PR, extrusion, and billet numbers are marked on the end of grain.

2.5.4 Place grain in lathe between pressure plates with 0.50-inch diameter guides and chuck to center.

2.5.5 Adjust to recommended speed for this operation: spindle, 145 revolutions per minute (rpm) and carriage longitudinal feed, 0.0156 inch per revolution (in/rev).

2.5.6 By remote control, machine to final outside diameter.

2.5.7 Remove the grain and pressure plates from the lathe.

2.6 Grain facing.

2.6.1 Place grain in chuck jaws, align to center, and tighten jaws firmly.

2.6.2 Install facing tool in tool holder.

2.6.3 Adjust lathe to recommended spindle speed of 145 rpm and the carriage cross-feed to 0.0156 in/rev.

2.6.4 By remote control, face one end of the grain.

2.6.5 Reverse the grain and face to length by repeating steps 2.6.1 through 2.6.4, transferring grain identification to opposite end of grain.

2.7 Counterboring.

NOTE. Machining of counterbore may be performed in section 5.

2.7.1 Place grain in chuck jaws, align to center, and tighten jaws firmly.

2.7.2 Install boring tool in tool holder.

2.7.3 Using dial indicator gage, adjust carriage stop for counterbore depth from end of grain.

2.7.4 Adjust lathe to recommended spindle speed of 93 rpm and carriage longitudinal feed to 0.0031 in/rev.

2.7.5 By remote control, counterbore end of grain.

2.8 Remove burrs, chips, and loose material from grain.

2.9 Package grains in accordance with section 7, transport to inspection site, and store at 75 ± 10°F.

Section 3

3. MACHINED PROPELLANT INSPECTION.

3.1 Assign a grain number to each grain. Using a felt-tip, waterproof-ink marking pen, label grain forward end (A end) with the assigned number.

3.2 Inspect grain for conformance to Drawing 2601927 and instructions contained in Processing Request (PR).

3.2.1 Record propellant type, extrusion, PR, grain, and billet numbers on Grain Inspection Data Sheets (Figures 1 and 2).

3.2.2 Measure length, outside diameter, and weight of grain and record on Grain Inspection Data Sheet (Figure 1).

3.3 Visual Inspection.

3.3.1 Inspect grain for any fissures or cracks.

3.3.2 Inspect grain to ensure that billet is a homogeneous mixture. A grain having one or more light (whitish) streaks is defective and should be rejected.

3.3.3 Inspect grain for evidence of poor workmanship.

3.3.4 Inspect grain for burrs, chips, and loose material in grain perforation.

3.4 Stamp accepted grains on one end with "1st inspection" stamp.

3.5 Submit a Grain Discrepancy Report (Figure 3) to Government representative for each grain out of tolerance or otherwise defective or questionable.

3.5.1 Label rejected grains as such and hold until notified of disposition by Government representative.

3.5.2 Scrap grains rejected by Government representative in accordance with regulations.

3.6 Package accepted grains in accordance with section 7 and transport to inhibiting site.

Grain Inspection Data Sheet

Sheet of

Propellant	Extrusion no.	Processing Request	Inspector	Date
Grain, Machined Inspected to		on	by	

Grain Identification		Grain, Machined														
Grain no.	Billet no.	Weight, GM	Length, inch		Igniter bore		Web variation, in.		OD, inch [1]							
									A-end		Center		B-end			
			Max	Min	Length, in	Dia., in	A-End	B-End	0°/90°	45°/135°	0°/90°	45°/135°	0°/90°	45°/135°		

[1] 0° plane defined as the grain outside diameter orientated with a starpoint.

Remarks

FIG. 1. Grain Inspection Data Sheet, Machined Propellant.

Grain Inspection Data Sheet

Sheet of

Propellant	Extrusion no.	Processing Request	Inhibitor	Inspector	Date

Grain, Inhibited Inspected to on by

Grain Identification		Grain, Inhibited											
Grain no.	Billet no.	Weight, GM	Length, Inch		End inhibitor thickness, in.		OD, inch [1]					
			Max	Min	A-End	B-End	A-end		Center		B-end	
							0°/90°	45°/135°	0°/90°	45°/135°	0°/90°	45°/135°

[1] 0° defined as the grain outside diameter orientated with a starpoint.

Remarks _____

FIG. 2. Grain Inspection Data Sheet, Inhibited Grain.

OD 30798

QUALITY ASSURANCE DISCREPANCY REPORT
ORDNANCE ITEMS - LIVE OR INERT X-RAY
FIND NOTS 8010 30 (2-67)

REPORT SYMBOL NOTS 8010-3 | NO.

A.

FROM	ITEM	ITEM	DATE	
INSPECTED AT (BUILDING)	PROJECT		P.O. NO.	
PART NO. (OR SERIAL NO.)	LOT NO.	MANUFACTURER		LIVE/INERT
DRAWING NO. (Inspection Criterion)	REVISION NO.	PART NAME		
X-RAY PLATE NO.	HANDLING PARTICIPATE: ☐ DAMAGED IN TRANSIT ☐ DROPPED ☐ OTHER			

FAILED PART DESCRIPTION

DETAILS OF DISCREPANCY (Include X reference). ATTACH ADDITIONAL SHEETS WHEN REQUIRED

USE 'AS IS'	REWORK	HOLD FOR OTHER USE	SCRAP	MATERIAL REVIEW BD	WORKMANSHIP POOR / GOOD	INSPECTOR'S OPINION DEVIATION / VARIATION
					QUALITY ASSURANCE SIGNATURE	

B.

					PROJECT ENGINEER SIGNATURE	
PART SUBSTITUTED					DATE	CODE

CORRECTIVE ACTION

RECOMMENDATIONS, ANALYSIS, CORRECTIVE ACTION TAKEN, SIGNIFICANCE, ETC.

FOR RELIABILITY USAGE

FIG. 3 Grain Discrepancy Report. NUMBER OF SHEETS ATTACHED 13

Section 4

4. INHIBITING.

4.1 Etching.

4.1.1 Cover ends of grains completely with 6-inch-wide masking tape.

WARNING

Use only clean rubber gloves to handle grains for remaining operations.

4.1.2 Clean grain surface with soap and cold tap water to remove grease and smudge. Rinse grains with cold tap water.

4.1.3 Wipe grains free of all drops of water with a clean wiper.

4.1.4 Grains should be etched with an 18 percent hydrochloric acid (HCl) solution (MS 36043). (The "as received" HCl is a 36 percent solution.)

4.1.5 Prepare etching solution by adding one volume HCl to one volume of water.

NOTE. Etching solutions should be replaced after there is a marked reduction in bubble evolution when immersing grains.

4.1.6 Immerse vertically the complete grain in etching solution. Ensure the grains are completely immersed but not more than 7 inches below the surface of the solution.

NOTE. Grains should not contact one another or container during etching process.

4.1.7 Etch grain for a period of 45 ± 5 minutes.

4.1.8 Assure that grain has been properly etched. Evidence that satisfactory etching of the propellant surface has been completed will be the marked reduction in bubble evolution from the propellant surface.

4.1.9 Rinse grains in cold tap water.

4.1.10 Wipe grains free of all drops of water with a clean wiper.

4.1.11 Remove masking tape from ends of grains.

4.1.12 Position grains vertically in vacuum oven and vacuum dry for one hour at 135°F.

4.2 End inhibitor.

4.2.1 Apply silicone tape, Dow Corning (DC) 269 glass cloth, to one end of end inhibitor casting fixture (3.75-inch OD by 1 inch thick aluminum casting fixture). Coat end inhibitor casting fixture on OD with "Teflon" to prevent bonding of fixture to end inhibitor material.

4.2.2 Position end inhibitor casting fixture on each end of grain, ensuring that the fixture completely covers grain perforation.

4.2.3 Apply two wraps of 1-inch-wide masking tape on each end of the grain, allowing approximately 0.5 inch to extend beyond ends of grain. Ensure that the tape is wrapped smoothly.

4.2.4 Prepare approximately 60 grams of flexible epoxy: 2 parts of "B" TC-459 resin to 1 part of part "A" TC-459 catalyst by weight. Mix thoroughly and pull vacuum until epoxy "breaks" (bubbles dissipate) (DWG 1092164).

4.2.5 Cast end inhibitor as follows:

(a) Using a suitable scale (balance), place grain on scale and balance.

(b) Increase scale reading by 30 grams.

(c) Pour flexible epoxy into boundaries until scale again balances.

4.2.6 Place grain in oven in a vertical position, inhibited end up, and cure inhibitor at 180 to 200°F for 1 hour and 15 minutes(minimum).

4.2.7 Reverse the grain and repeat steps 4.2.5 through 4.2.6.

4.3 Viton lacquer.

4.3.1 Remove masking tape from OD of grains, previously used while casting end inhibitors.

NOTE. Do not remove casting fixtures.

4.3.2 Place grains vertically in suitable fixture for completely immersing grain in Viton lacquer.

4.3.3 Prepare a solution of Viton lacquer that is 20 ± 2 percent Viton "A" (Copolymer WS 7682) and 80 ± 2 percent acetone(O-A-51) by weight.

4.3.4 Propellant grains should be limited to a maximum temperature of + 80°F for Viton lacquer application.

4.3.5 Completely immerse grain in Viton lacquer only long enough to allow complete coverage of grain, remove, and suspend from an appropriate fixture to air-dry for approximately 30 minutes (minimum).

4.3.6 Reverse grain and repeat 4.3.5 for three more coatings, reversing the grain, and allowing to dry after dipping.

4.3.7 After completion of final dip-coat, allow grain to air-dry for a minimum of 16 hours.

4.3.8 Remove inhibitor casting fixtures and glass cloth (DC 269), being careful not to damage end inhibitors.

4.3.9 Place grains vertically in clean, covered trays.

CAUTION

Take appropriate measures to eliminate any contact of Viton-coated surfaces with any foreign surface, material, or other grains, as Viton will adhere to other material.

4.3.10 Transport grains to tape-wrapping site in covered trays.

4.4 Tape wrapping.

4.4.1 Remove tape from cold storage and allow it to reach room temperature before application.

4.4.2 Place grain in tape-wrapping lathe between end blocks.

4.4.3 Adjust tape tension to approximately 16 ± 5 pounds per inch width.

4.4.4 Spiral wrap grain proceeding from counterbore end to aft end with 2-inch wide Minnesota Mining and Manufacturing Company (3M) tape (Y-9087), (Drawing 2601930).

4.4.5 Ensure that first spiral wrap is one continuous operation. Should a tape splice occur during application of first wrap, discard grain and submit a discrepancy report for each defective grain.

4.4.5.1 Should tape splices occur in succeeding wraps, remove applied tape with the exception of the first wrap and reapply tape.

4.4.6 Rough cut tape 0.5 inch beyond end inhibitor on each end of grain.

4.4.7 Remove grain from tape-wrapping lathe.

4.4.8 Place grains in suitable containers that will provide support and keep inhibitor from contacting oven floor. Place grains in oven and cure at 180 to 200°F for 24 hours.

4.4.9 Apply 1-inch width of 3M tape (Y-9087) longitudinally to the outside surface of the grain midway between star points (45 degrees) over entire grain length (four places). Apply three strips of tape at four locations. Apply additional strips as required to meet final grain dimensions.

4.4.10 Package grain in accordance with section 7 and transport to machining site.

Section 5

5. PROPELLANT GRAIN MACHINING.

5.1 Final facing.

5.1.1 Place grain in lathe chuck jaws, align to center, and tighten jaws firmly.

5.1.2 Install facing tool in tool holder.

5.1.3 Adjust lathe to recommended spindle speed of 145 rpm and carriage cross feed to 0.0156 in/rev.

5.1.4 By remote control, face aft end (B-end) of inhibitor to specified dimension. Aft end or "B"-end" is the end opposite the counterbore.

5.1.5 Reverse grain and face forward end inhibitor to achieve final grain length by repeating steps 5.1.3 through 5.1.4.

5.1.6 Package grain in accordance with section 7 and transport to inspection site.

Section 6

6. PROPELLANT GRAIN INSPECTION.

6.1 Record all inspection notes on Grain Inspection Data Sheet (Figure 2).

6.1.1 Inspect grain in accordance with drawing and instructions in PR.

6.1.2 Measure length, OD, and weight of grain and record on Grain Inspection Data Sheet.

6.2 Visually inspect inhibited grain as follows to ensure that good workmanship practices were followed. Verify that

(a) Inhibitor was applied to all surfaces intended to be inhibited and that no inhibitor was applied to surfaces intended to remain uninhibited.

(b) The inhibitor is free from foreign materials.

(c) The tape overlaps the end inhibitors and is trimmed flush with end inhibitors.

(d) The tape inhibitor is smoothly overlapped and is wrapped in the right direction.

6.3 Stamp accepted grains with "2nd Inspection" stamp.

6.4 Submit to the Government representative a grain discrepancy report for each grain out of tolerance or otherwise defective or questionable.

6.4.1 Label rejected grains as such and hold until notified of disposition by Government representative.

6.4.2 Scrap grains rejected by Government representative in accordance with regulations.

6.5 Package accepted grains in accordance with section 7 and transport to loading site.

Section 7

7. PACKAGING.

7.1 Transport all billets and grains in 5-inch grain boxes. Ensure that handles are securely attached and that lid can be securely fastened.

7.2 Viton lacquered grains shall be transported vertically in clean covered trays with care taken to eliminate any contact of the lacquered surface with foreign surfaces, materials, or other grains.

7.3 Line grain box with suitable material to keep propellant from abrading on grain box.

7.4 Billet and unmachined grains.

7.4.1 Place billets or grains in grain box and fasten lid.

7.5 Machined grains.

7.5.1 Wrap grain in aluminum foil.

7.5.2 Place grains in grain box and fasten lid.

7.6 Inhibited grains.

7.6.1 Wrap grain in aluminum foil.

7.6.2 Place grains in grain box and fasten lid. Label box end with appropriate information regarding contents. Remove any other labels.

Section 8

8. GENERAL SAFETY PRECAUTIONS.

8.1 The machining and handling of the grain covered by this document involve hazardous operations and, therefore, require suitable precautions. Use of this document shall not relieve the manufacturer of responsibility for the safety of his operation. See OP 5 for safety requirements and precautions. Such other warnings and precautions, pertinent to the operational effectiveness or safety during the machining and handling of the grain, are included in the detailed technical requirements of this publication.

8.2 All machining and handling operations should be conducted in a neat and orderly manner.

8.3 Safe equipment and methods should be utilized for transporting, handling, and machining of explosives.

8.4 When performing operations such as cutting, machining, and drying, remote control, barricaded handling equipment shall be used.

8.5 Personnel handling explosives should avoid using bare hands or improper equipment in order to prevent damage or deterioration from perspiration or other contaminating deposits.

8.6 To minimize the absorption of moisture from the atmosphere or other sources during machining and handling operations, the exposure of explosive materials shall be closely controlled.

8.7 All explosives should be stored in suitable storage magazines located in accordance with the American Table of Distances (ATD) or other applicable safety standards. While in process, these items shall be located in accordance with intraplant distances and stored in adequate ready or service magazines if outside of the inspection or machine room.

8.8 Proper care must be exercised at all times to protect personnel, equipment, and working areas from accidents, fires, or explosions.

8.9 Keep only minimum quantities of explosives and complete or partially loaded parts present at each stage of operation.

8.10 Keep explosives and explosive parts in approved covered receptacles. Ensure that covers are in place after material is taken out of or put into receptacles. Receptacles should be conductive to ground electrostatic charges.

8.11 Protect operations from electrostatic charges by effectively grounding all machinery, equipment, and fixtures. Employ suitable grounded conductive covering for floors, workbenches, and tables. Workers' clothing should be of a type to minimize the accumulation of static charges. Fabrics such as silk and nylon, which promote static generation, should be avoided. For safety, humidity of workrooms should be appropriately increased, as required, to lessen electrostatic effects without inducing excessive moisture absorption by any of the components.

8.12 Enforce the wearing of suitable safety footwear, gloves, goggles, respirators, and impregnated garments to protect personnel against burns, poisoning, and associated industrial hazards.

8.13 Allow no fires or exposed electrical or other sparking equipment. Allow little or no flammable material to be present in machining, handling, and storage spaces. Enforce proper "match" and "no smoking" rules.

8.14 Enforce good housekeeping and maintain effective policing, inspection, and supervisory methods throughout the work area and surroundings.

Section 9

9. OPERATIONAL SAFETY PRECAUTIONS.

9.1 Remote operation of the guillotine, lathe, and mill is mandatory. Operation will be directed from the control panel room. Explosive powders may explode upon application of friction, pressure, and heat; therefore, these safety rules must be followed before operating.

9.2 Clear the operation area of all personnel.

9.3 Clear operation area of waste explosives, if any.

9.4 Close personnel gate.

9.5 Store acetone drums away from the direct rays of the sun.

9.6 Put waste explosives in the waste disposal drum and cover with a layer of oil. Send the drum to the waste disposal magazine.

9.7 Clean operating area and equipment upon completion.

Section 10

10. APPLICABLE DOCUMENTS.

10.1 The drawings and publications listed herein are references and pertinent information applicable to these processing procedures. Activities should maintain a complete set of applicable documents.

STANDARDS

Military

MS 36043	Hydrochloric Acid HCl.

SPECIFICATIONS

Federal

O-A-51	Acetone, Technical

DRAWINGS

Bureau of Naval Weapons
(Code Ident 10001)

1092164	Encapsulating Compound.
2603593	Adhesive.
2601927	Propellant Grain, Machined.
2603593	Glass Tape.
2603593	Propellant Grain.

PUBLICATIONS

Naval Ordnance Systems Command
(Code Ident 10001)

OP 5	Ammunition Ashore.
	American Table of Distances.
WS 7682	Copolymer, Vinylidene Difluoride and Hexafluoropropylene.

Custodian:
NAVORD ORD9343

Preparing Activity:
NWC/China Lake, California