MiniSShot

ProtoSShot-M Short Stack Rocket Motor

Assembly & Propellant Loading Manual

Rev. 2008/08/08

Introduction

This document describes the procedures to assemble the *ProtoSShot-M Short Stack* rocket motor and to load the propellant charges. The *ProtoSShot-M Short Stack* is meant to be representative of the *ProtoSShot-M Mark II* motor in most respects except that it is single-phase operation and has a capacity of 3 grain segments. This compares to the to *ProtoSShot-M Mark II* motor which has dual-phase operation and holds 6 grain segments per chamber. The purpose of the *Short Stack* motor is to be a test bed for various design modifications that are being considered for incorporation into the *ProtoSShot-M Mark II* motor. Additionally the test firing of this motor will allow the opportunity for experience to be gained with the new propellant casting method and improved motor test equipment.

The *ProtoSShot-M Short Stack* motor is illustrated in Figure 1.

Instructions -- Check off the box on the left side upon completion of each step.

Parts listing

P/N	Qty.	Description
P1	1	Motor casing/thermal insulation assembly
P2	1	Nozzle assembly
P3	1	Bulkhead
P4	3	Propellant segment
P5	4	O-ring, -234, nitrile (Buna-N)
P6	48	#8-32x1/4 custom shoulder screw
P7	a/r	Silicone grease, Dow Corning 111 or equivalent
P8	a/r	Lacquer thinner or acetone
P9	a/r	Ignition Primer Slurry. Prepare by mixing 70% IPA with a blend of finely pulverized mixture of potassium nitrate and charcoal, to the mass ratio of 80/20. Slurry consistency should be that of thick paint.
P10	1	Primary Igniter (containing 5 grams CuO/Mg thermite)
P11	a/r	1” wide, 0.002” stainless steel foil tape
P12	a/r	3” wide, 0.002” stainless steel foil tape
P13	a/r	Intumescent paint
P14	a/r	Silicone sealant, GE type I or equivalent

Tools required

T1	Allen (hex) key, 9/64”
T2	Centre punch, tapered
T3	Wood craft sticks
T4	Small paint brush
T5	Medium paint brush
T6	Grain alignment tool (1” or larger metal Angle or Channel section, minimum length 18”)

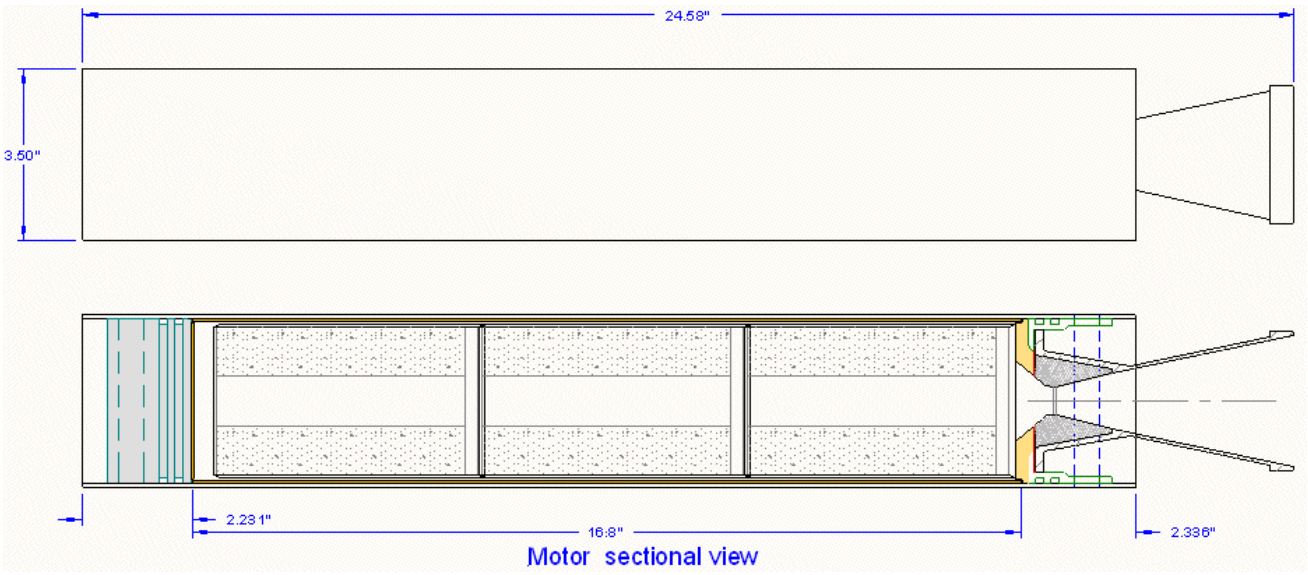

Figure 1 – Basic dimensions of the motor assembly

I. Priming of Propellant Segments

☐ 1. Prepare Ignition Primer slurry (P9) and using small brush (T4) paint onto both ends of all 3 propellant grain segments, as shown in Figure 2.
Optional: additionally paint core to within 1" of each.

☐ 2. Allow to dry fully prior to installation in motor.

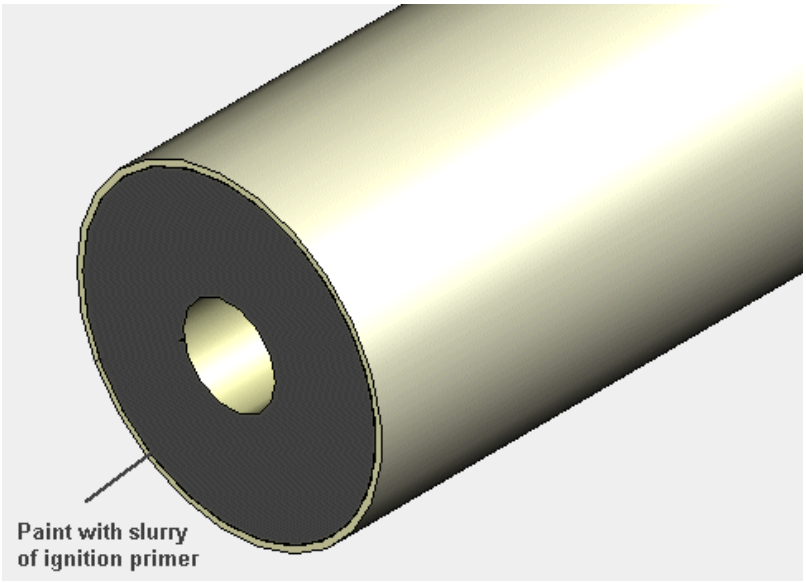

Figure 2 – Priming of propellant segments

II. Installation of Casing Insulation Joint Tape

- [ ] 1. Cut a piece of 1” stainless steel foil tape (P11) to a length of 16-3/4” (42.6 cm).
- [ ] 2. Carefully install piece of tape over insulation joint, leaving approximately 1/16” from each end (tape is intentionally shorter than insulation).
- [ ] 3. Press firmly to ensure positive adhesion.

III. Installation of Nozzle Assembly into Motor Casing

- [ ] 1. Fill o-ring grooves with silicone grease (P7) using a craft stick. Coat two o-rings (P5) with silicone grease.
- [ ] 2. Install both o-rings into grooves. Wipe off excess grease.
- [ ] 3. Lightly coat inside of Casing (aft end, non-insulated portion only) with silicone grease (P7).
- [ ] 4. Line up attachment holes in nozzle with attachment holes in casing and firmly push nozzle into casing. Push in far enough that holes are lined up as closely as possible.
- [ ] 5. Using centre punch (T2), align holes by inserting punch into hole and gently prying nozzle into aligned position. Do not use excessive force.
- [ ] 6. Install, but do not tighten, 24 screws (P6).
- [ ] 7. Tighten all screws, one by one, until firmly seated. Finish by torquing hand-tight. Do not over-tighten. Do not use power driver.

IV. Assembling Propellant Grain

Reference Figure 3

- [ ] 1. Using lacquer thinner (P8), clean outer surface and beveled ends of all 3 propellant segments.
- [ ] 2. Place propellant segments #3 and #2 onto Grain Alignment Tool (T6), per Figure 3.
- [ ] 3. Apply a light film of silicone (P14) sealant onto the beveled mating ends of two segments.
- [ ] 4. Butt the grain segments together making certain of full engagement. Use finger to smooth the silicone at joints and to remove any excess.
- [ ] 5. Cut a length of 3” stainless foil tape (P12) 10” in length, and carefully wrap around joint, centering tape over joint.
- [ ] 6. Using a suitable tool, press the tape firmly all around to ensure good adhesion.
- [ ] 7. Repeat steps 2-6 for mating segment #1, per Figure 3.
- [ ] 8. Using medium brush (T5) paint entire outer surface of Grain Assembly with 2 coats of intumescent paint (P13), allowing to dry between coats.

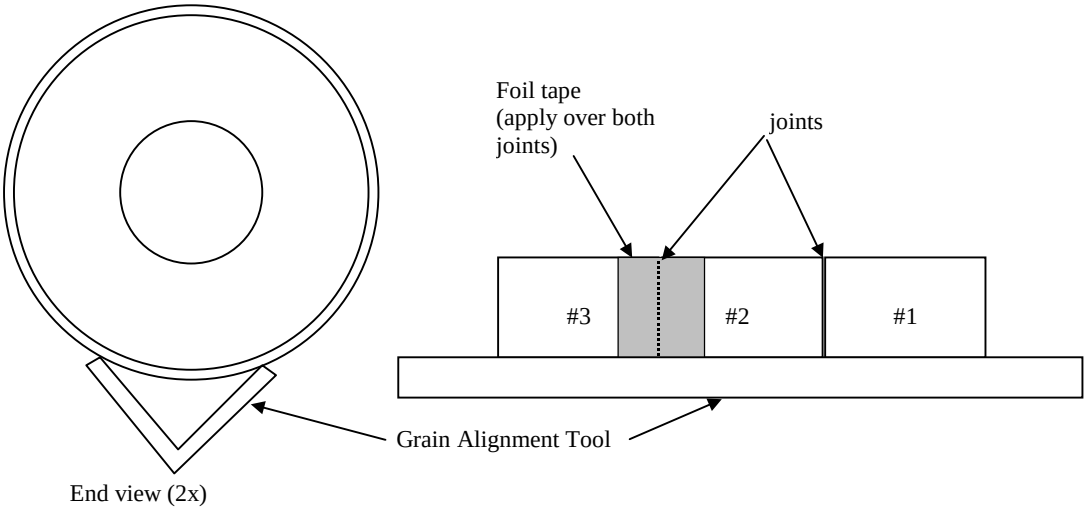

Figure 3 – Assembling propellant grain

V. Loading Propellant Grain into Casing

Note: propellant grain installed into casing deep recessed end first.

☐ 1. Insert Grain Assembly into Casing and slide fully in until seated against nozzle.

VI. Installation of Bulkhead into Casing Assembly

☐ 1. Fill the two o-ring grooves with silicone grease (P7) using a craft stick. Coat two o-rings (P5) with silicone grease.

☐ 2. Install both o-rings into grooves. Wipe off excess grease.

☐ 3. Lightly coat inside of Casing with silicone grease (P7).

☐ 4. Line up attachment holes in Bulkhead with attachment holes in Casing and firmly push Bulkhead into Casing. Push in far enough that holes are lined up as closely as possible.

☐ 5. Using centre punch (T2), align holes by inserting punch into hole and gently prying Bulkhead into aligned position. Do not use excessive force.

☐ 6. Install, but do not tighten, 24 screws (P6).

☐ 7. Tighten all screws, one by one, until firmly seated. Finish by torquing hand-tight. Do not over-tighten. Do not use power driver.

VII. Handling and storage preparation

☐ 1. Seal the nozzle to avoid moisture ingress.