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DEVCOM ARMY RESEARCH LABORATORY

Case Loading Procedures for a Modified 3-Inch x 50 Caliber Gun System Used at Experimental Facility 14

by Allen Ducote

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14. ABSTRACT

This report fully describes the proper techniques in safely loading a cartridge case for firing a modified 3-inch x 50 Caliber Gun System and was written to support testing. This case loading process has consistently proven to be safe and successfully practical. All of the procedures illustrated in this report have been observed and approved by the US Army Combat Capabilities Development Command Army Research Laboratory Explosives Safety Officer.

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1. Introduction

The purpose of this report is to document the proper techniques for safely loading a cartridge case prior to electrically firing in a modified 3-inch x 50 Caliber Gun System. This procedure has been observed and certified through the US Army Combat Capabilities Development Command Army Research Laboratory Explosives Safety Officer (ESO).

2. Components for Case Assembly

Displayed in Fig. 1 are a 3-inch x .50-cal cartridge case and a piece of 1/8-inch-thick antistatic foam. The cartridge case is the key component to initiating the explosive train needed to fire this designated gun system. It is a steel case with characteristics revealing a tapered end that tightly fits behind a positioned launch package and a flanged end that allows extractors to expel the cartridge. Other components, mentioned later in the loading process, will be assembled into this case. The piece of foam is a static-free polyethylene material 3–4 inches wide by 24 inches long.

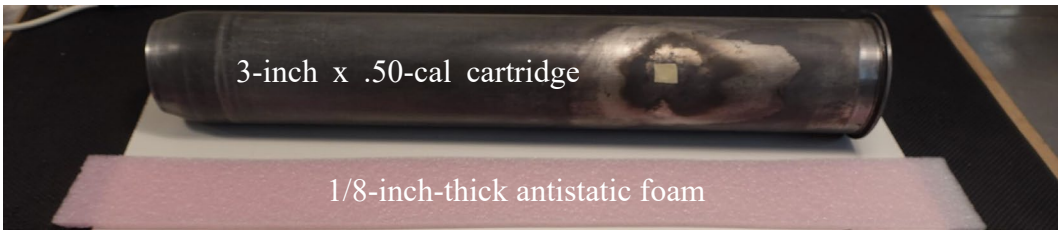

Fig. 1 A 3-inch x .50-cal case and a piece of 1/8-inch interior-diameter (ID) antistatic foam

The firing pin assembly, as shown in Fig. 2, consists of an electric primer, primer body, primer housing, firing pin assembly, Tygon tubing, and a Mylar washer. The tubing and washer act as insulators to prevent an internal short. Once these items are put together, they are attached to the piccolo spit tube, exhibited in Fig. 3.

Fig. 2 A firing pin/housing assembly with a 6-inch piece of 1/8-inch ID Tygon tubing and a Mylar washer

The Benite strand propellant, loaded into the piccolo spit tube, is a solid stick propellant that burns at a rapid rate. The holes in the spit tube allow for the hot gasses from the burning strands to evenly diffuse into the surrounding 40-mm Expro propellant, which completes the explosive train. Most spit tubes contain 9 to 11 strands of Benite depending on its diameter.

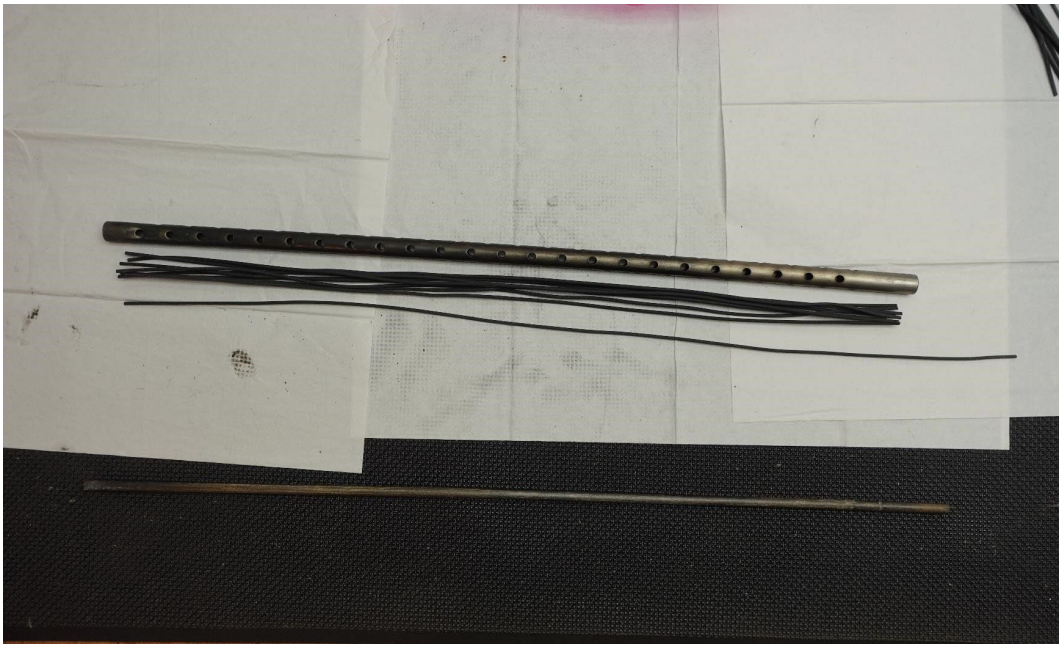

Fig. 3 Piccolo spit tube and nine pieces of 22-inch solid Benite strand propellant

Displayed in Fig. 4 is 40-mm Expro SGT York, a nonperforated propellant, selected for this type of gun barrel because previous data proves that stable powder curves were obtained consistently without causing too much wear on the barrel from heat or overpressurizing. Most of the tests performed with this 3-inch gun employed a powder weight of 2700 gr of Expro, which is equivalent to approximately 6.5 lb.

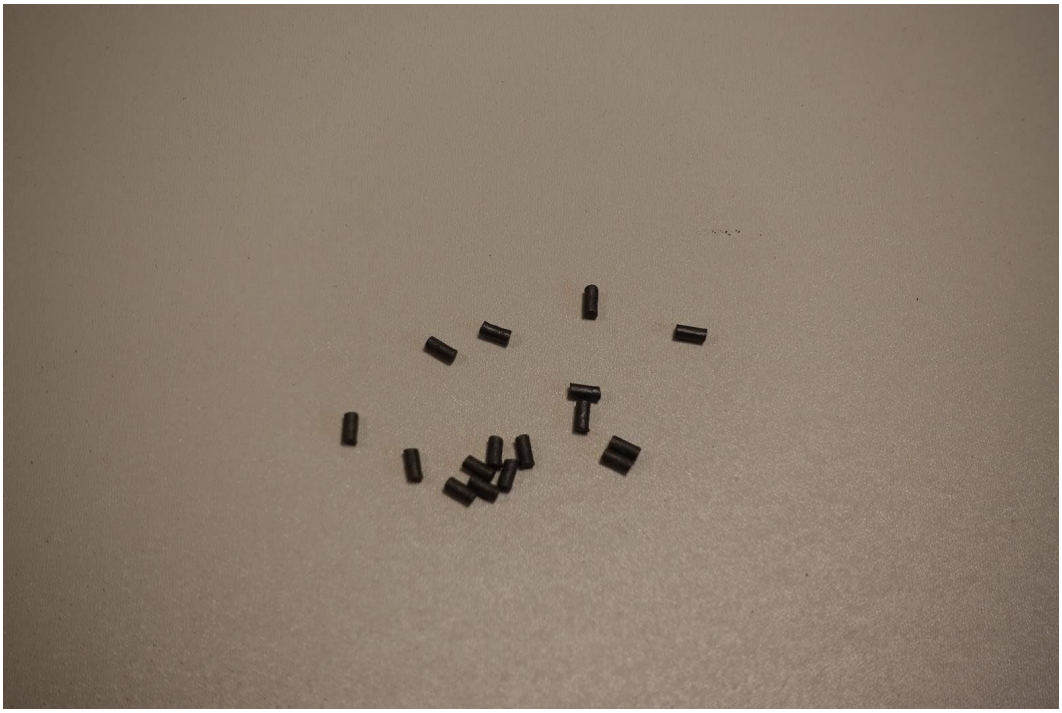

Fig. 4 Expro SGT York propellant, 40 mm

3. Preparation for Case Loading

All components must be thoroughly inspected and cleaned before beginning the assembly process. The approved and certified operator has selected a cartridge case and carefully inspected it to ensure that the case is free of any hairline fractures, stress areas, dents, or other defects. The operator has also performed a fit test with the case into the breech to confirm that it functions properly. Next, the operator verifies with the test director that the range has been cleared by a road guard, the gate has been shut, and warning lights turned on before proceeding to the loading room. The operator must be accompanied by a second person for the loading room operation. The operator will have the firing box keys and an approved ammo handling container. Before entering the loading room, all personnel must remove all personal electronic devices and store them outside in an approved area. Once entering the loading room, the operator will change into conductive shoes, perform a resistance test, and record a valid reading before the operation begins. The operator will don all appropriate personal protective equipment (i.e., lab coat, safety glasses, and hearing protection). The internal protection door must be closed after entering the loading/handling area. The operator will ensure the conductive mat working surface and measuring scale are bonded to ground and have power.

4. Case Loading Process

4.1 Step 1

Once the operator has located the ammo components to be loaded, they must practice “First Touch” before handling each time throughout this loading process. First Touch is the act of bonding yourself to the working surface to put yourself at the same electrical potential, eliminating the discharge of static electricity. Ensure the case and components of the firing pin/primer spit tube assembly are clean and free of debris. Wipe the surface of the case with isopropyl alcohol to remove all residue so the masking tape adheres. Place a piece of tape over the pressure port hole of the case to contain propellant, as shown in Fig. 5. Trim the tape with a sharp blade so the pressure port hole is barely covered.

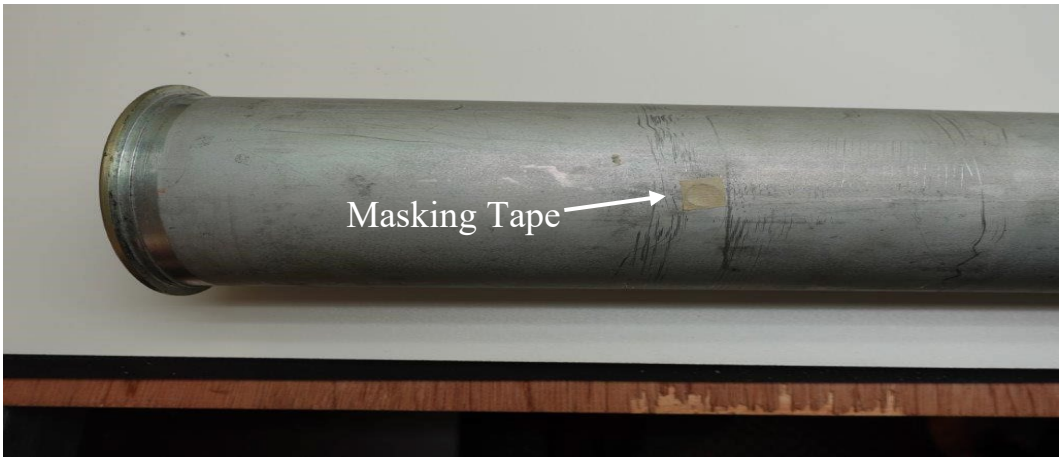

Fig. 5 Tape covering the pressure port hole

4.2 Step 2

Obtain a new electric primer (M52A3B1) from the ammo storage container and perform a resistance test with an approved blasting galvanometer to ensure the primer is good. The higher the value on the reading, the more resistance is detected. Furthermore, any reading above zero will indicate that the primer is good. The primer should not be used if the reading is negative or if there is no reading at all. In Fig. 6 the resistance reading is sufficient for the primer to function. This process will be repeated several more times throughout the loading procedures and finally at the gun before loading.

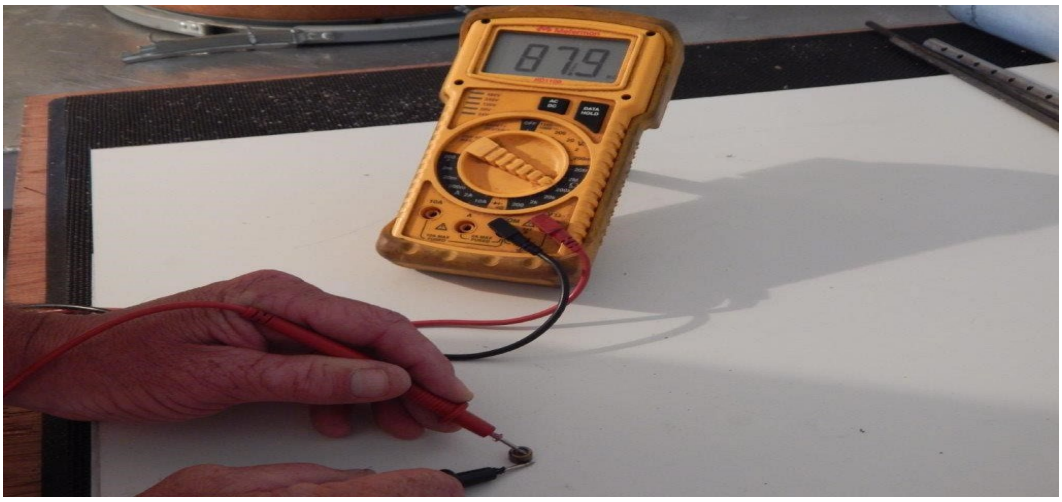

Fig. 6 Resistance check on the electric primer

4.3 Step 3

Ensure the primer body consists of electrical insulators such as a nonconductive Mylar washer and Tygon tubing by attaching both pieces over the long end of the primer body, as shown in Fig. 7. Close the gap between the tubing and the primer body by manually forcing the tubing toward the primer body until it is fully seated.

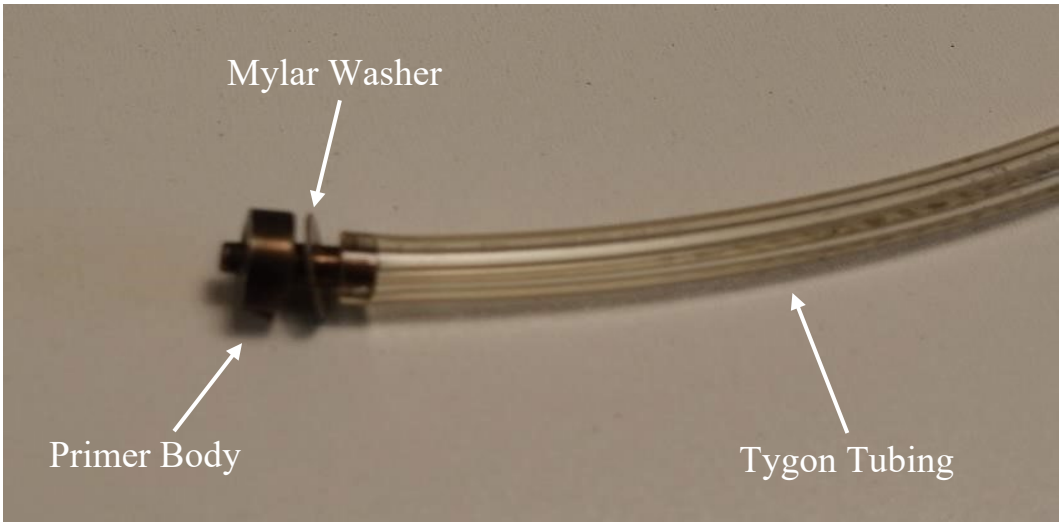

Fig. 7 Primer body assembly

4.4 Step 4

Carefully measure the length of each solid Benite propellant strand to fit inside of the piccolo spit tube and trim each piece by snapping it to break at the proper length. Leave one strand untrimmed, as seen in Fig. 8.

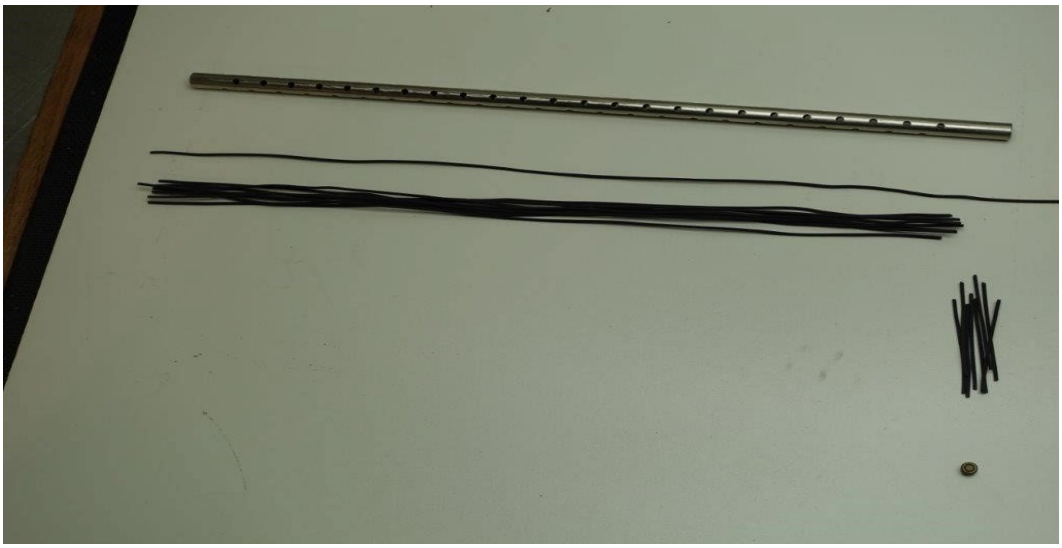

Fig. 8 Trimmed pieces of Benite propellant strands and one strand untrimmed

4.5 Step 5

Load all the Benite propellant into the piccolo spit tube while leaving the untrimmed strand long enough to extend through the top hole of the primer housing, as shown in Fig. 9.

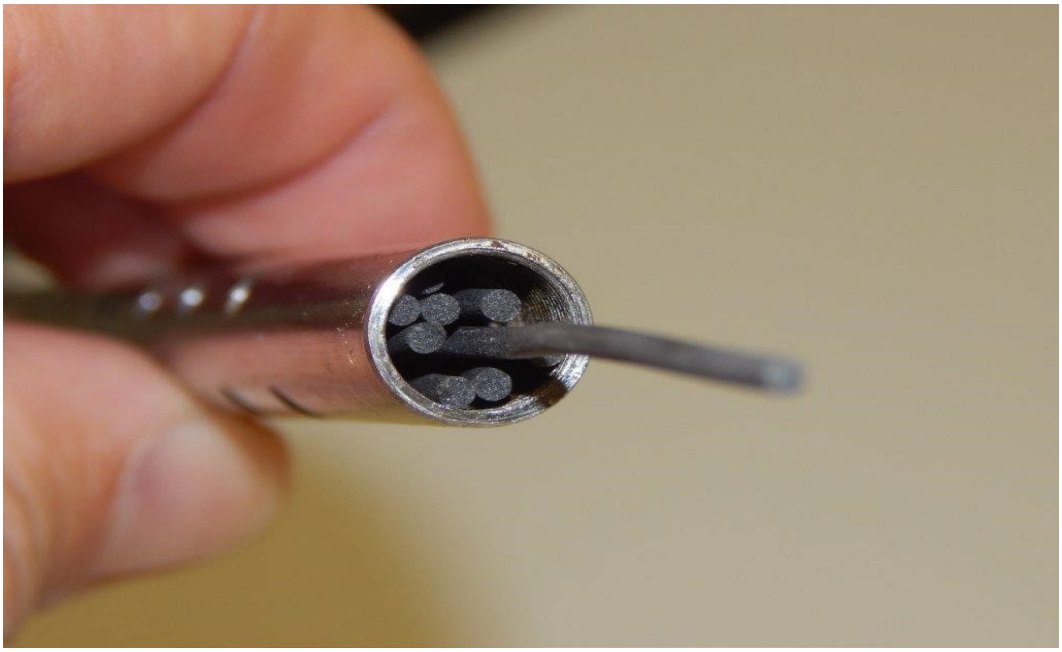

Fig. 9 Loaded spit tube

4.6 Step 6

Thread the primer housing onto the spit tube until comfortably tightened while leaving one Benite strand protruding, as shown in Fig. 10. Carefully break off the single excess strand of propellant, extending out of the primer housing, so that it is flush with the bottom of its cavity where the primer will seat, as shown in Fig. 11.

Fig. 10 Benite strand extended through primer housing

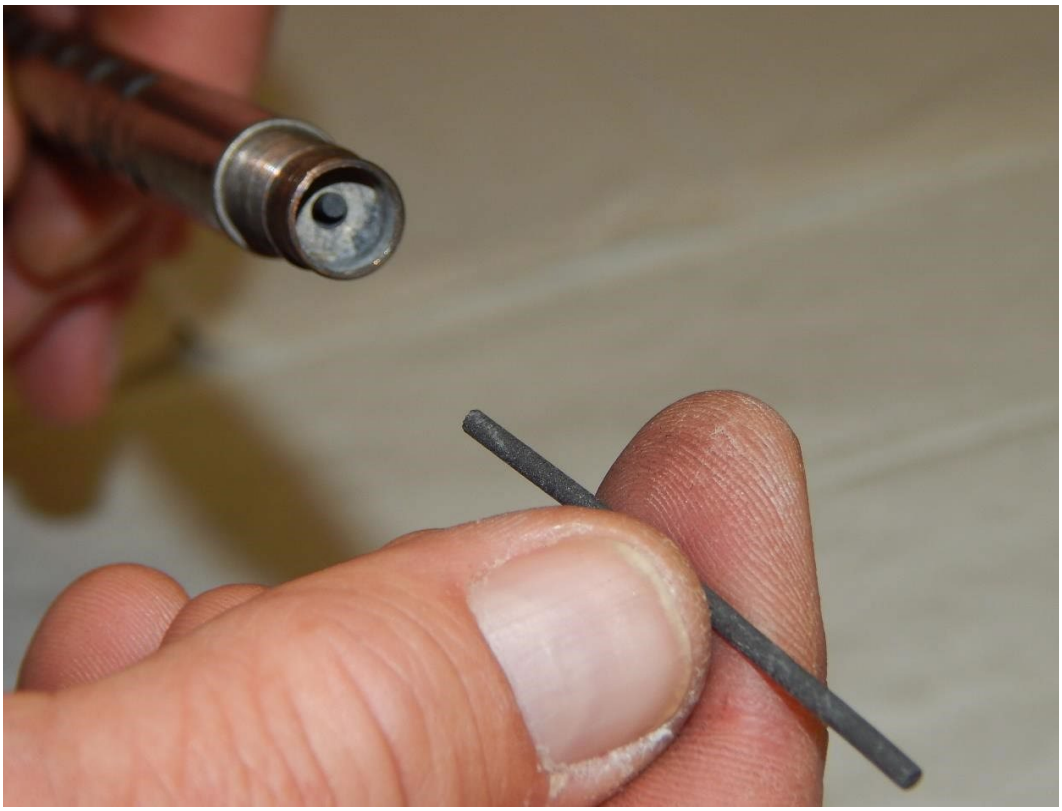

Fig. 11 Break the excess off until flush with the base of the housing cavity

4.7 Step 7

Screw the firing pin assembly onto the primer/spit tube assembly, making sure the primer body is pulled entirely forward and has no play within the housing, as shown in Fig. 12.

Fig. 12 Firing pin assembly threaded onto spit tube

4.8 Step 8

As shown in Fig. 13, shave the excess Tygon tubing flush with the top of the firing pin assembly with a sharp blade.

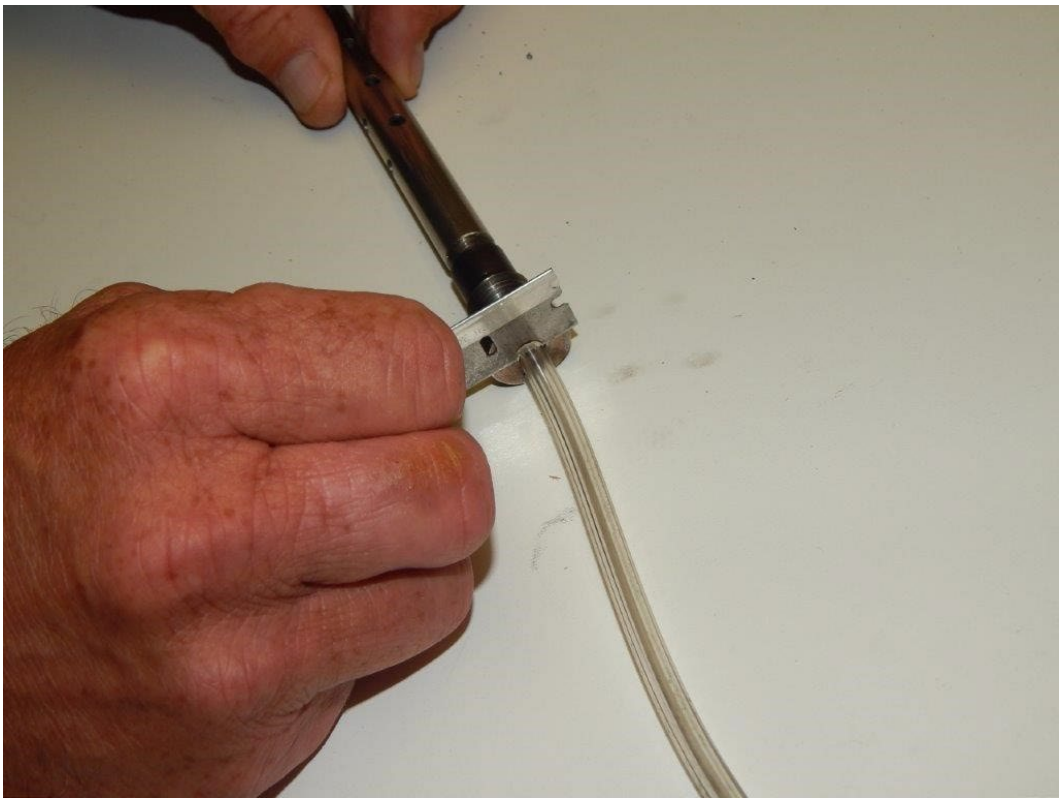

Fig. 13 Remove excess tubing

4.9 Step 9

Insert the fully assembled spit tube into the case and hand tighten with a designated spanner wrench, as shown in Fig. 14.

Fig. 14 Primer and spit tube assembly threaded into the case

4.10 Step 10

Once again, perform another resistance test with a blasting galvanometer, as shown in Fig. 15. If one of the insulators is missing from the assembly, a negative resistance reading will be noticed. This will require disassembling the primer and spit tube assembly to insert the missing component.

Fig. 15 Checking resistance of the primer through the case

4.11 Step 11

Place the case inside of a stabilized holder to load the propellant. Place a precut piece of 1/8-inch antistatic foam (approximately 3–4 inches wide x 24 inches long) inside of the case, covering the pressure port hole as shown in Fig. 16. This material is used to take up the ullage in the case, enabling the propellant to completely cover the spit tube, assuring the propellant will burn evenly.

Fig. 16 Case ready to be loaded with propellant

4.12 Step 12

Obtain propellant/powder (40-mm Expro propellant) from the ammo storage container for loading. Precisely measure the propellant/powder based on the calculation of the expected velocity for the test. Using a funnel, fill the case with propellant load, removing foam as needed to ensure that the spit tube is covered with propellant, as much as possible, to create an even burn. This procedure is shown in Fig. 17.

Fig. 17 Fill the case with propellant

4.13 Step 13

With a sharp blade, cut the antistatic foam, as shown in Fig. 18, so that the remainder of it can be tucked inside the case, over top of the spit tube to contain the propellant within the case to avoid spillage during transportation.

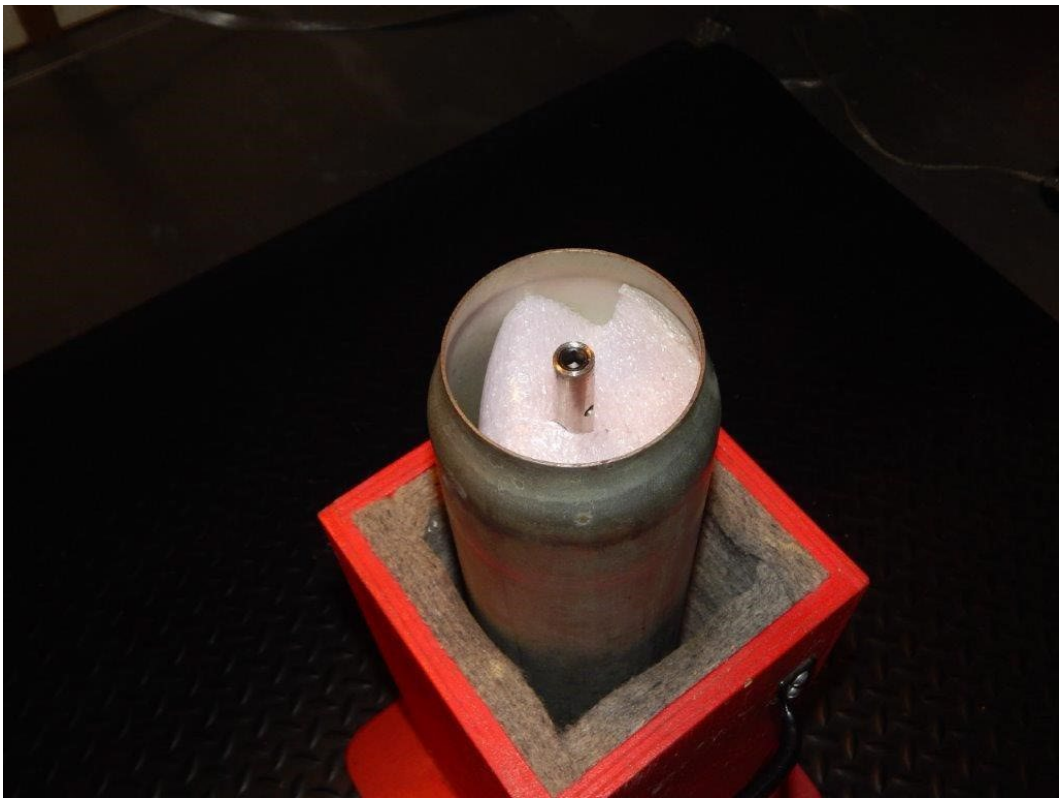

Fig. 18 Foam containing the propellant

4.14 Step 14

Wipe the surface of the case with isopropyl alcohol to remove all residue so the tape adheres. Cover the top of the case with masking tape and trim the outside with a sharp blade, as shown in Fig. 19. Only leave enough (approximately a quarter-inch down from the top of the case) to stick to the case and not get pinched in the forcing cone of the gun breech.

Fig. 19 Case covered with tape and trimmed

4.15 Step 15

Remove the fully loaded case and perform another resistance test with a blasting galvanometer, as shown in Fig. 20. Make sure to write the reading on top of the taped case for record keeping.

Fig. 20 Resistance check on the primer through the case

4.16 Step 16

Place the loaded case in the handler's approved container for transporting to the firing site, as shown in Fig. 21. Return any unused propellant or primer to its storage container(s).

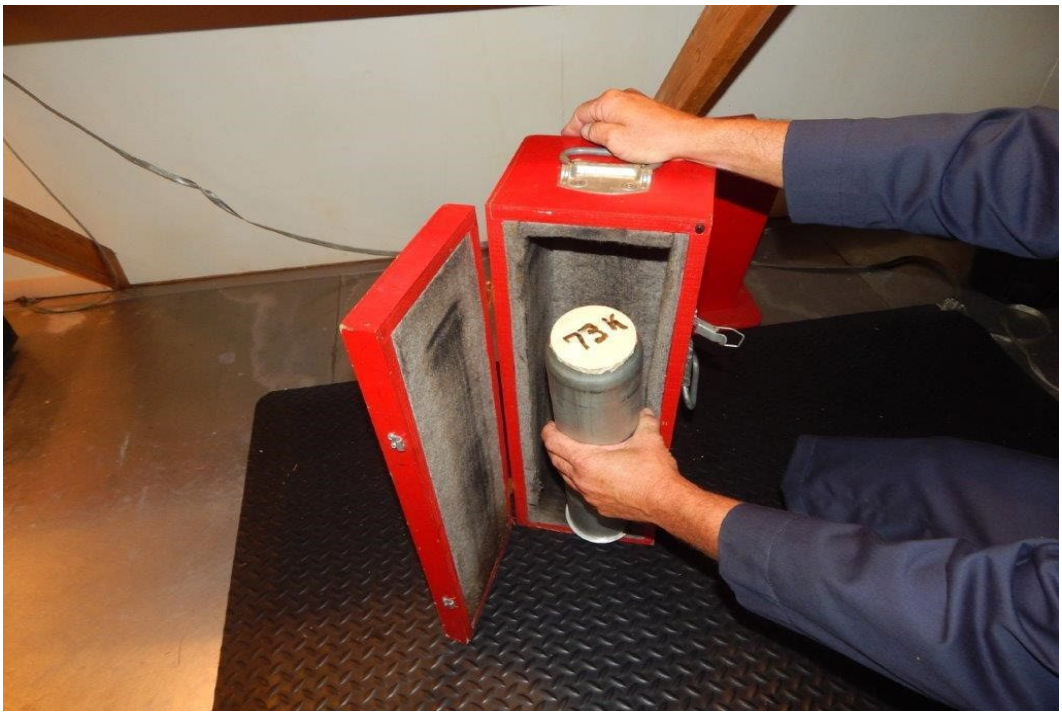

Fig. 21 Fully loaded case ready to transport

Before exiting the loading room, the operator must change out of their conductive shoes and back into their work boots. When exiting the loading room, the operator must lock the loading room and retain the keys. The operator can now safely return to the test site with the loaded case and wait for further instruction from the test director.

5. Conclusion

All the information illustrated in this report has specifically described the proper techniques in safely loading a cartridge case for firing a modified 3-inch x 50 Caliber Gun System. This case loading process has consistently proven to be safe and successfully practical. Any modifications to these procedures should be discussed with the ARL ESO.

List of Symbols, Abbreviations, and Acronyms

ARL	Army Research Laboratory
cal	caliber
ESO	Explosives Safety Officer
ID	interior-diameter

1 (PDF)	DEFENSE TECHNICAL INFORMATION CTR DTIC OCA
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