TECHNICAL REPORT 3082

FEASIBILITY STUDY
OF
UNCRIMPED CASE CARTRIDGE, 40 MM
(FOR M79 LAUNCHER)

JOHN S. WARE
DELBERT B. DECKER

COPY NO. 22 OF 47

NOVEMBER 1963

PICATINNY ARSENAL
DOVER, NEW JERSEY

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SECTION I

INTRODUCTION

A variability study was conducted on the 40mm Cartridge designed for the M79 Launcher. During this study it was found that cartridges assembled with straight mouthed (uncrimped) cases resulted in improved functional characteristics including standard deviation of velocity.

Concurrently there was a malfunction investigation to determine the cause of stuck cases in the Launcher, and 208,000 cases were declared unserviceable material because of this. The mouth of the cases either became deformed, or cracked upon firing and were difficult to eject. It has been determined that in the base plug crimping operation, excessive loads have been used, prestressing or overstressing the mouth area and causing some cases to crack or bulge at this point. Upon firing, the projectile is expelled and stretches the mouth of the case, further aggravating this condition. The consequent overstress in this area causes some cases to crack or distort and thus to stick. It is possible to salvage these cases by decrimping them, thus eliminating the secondary source of cracking.

The XM398 Projectile has a mating groove machined in the skirt to accommodate the precrimped cartridge case. The section thickness at this point is only 0.009 inches, and a number of skirts have been torn off in firing. By using the straight (uncrimped) case this groove would not be necessary and could be eliminated.

In addition to the above, the elimination of the mouth crimp would result in a price reduction in the cost of the case.

A new method of assembling the round must be instituted to take advantage of the above mentioned items by using a straight (uncrimped) case.

Purpose

The purpose of this project is to determine the feasibility of modifying the 40mm M118 cartridge case to provide a straight wall.

Procedure

The test procedure was set up in two parts, a) to evaluate the characteristics and variables involved and b) to correlate the modified design with the existing design.

Bullet pull tests were run using a special fixture set up in a testing machine. The case was held in the fixture while the projectile was pulled out by a rod clamped in the testing machine jaws.

This test determined the force necessary to remove the projectile from the case of a standard round. Further tests established the staking method and configuration necessary to duplicate this in the straight case.

Uncrimped cases are assembled to the projectile by staking. In the staking machine the staking punches are cam operated and the cam is actuated by a rack powered from a 6-inch air cylinder. In tests, the staking punch configuration and air pressure on the cylinder were varied, and the variation of standard deviation of bullet pull was tabulated for each condition. The most efficient staking pressure and punch configuration was established from these data.

Sealing tests were run concurrently with these and other tests to establish a sealant with increased pot life and sealing qualities equal to the current production sealant (Thiokol liquid polymer (LP-2) and curing agent (C5)). The following sealants were used:

a. Thiokol Polysulfide LP-2 with curing agent C5.

b. Silastic RTV.

c. Thiokol D196206-1 adhesive.

The sealant was applied by several methods as follows:

a. Sealant applied to case, projectile inserted with quarter turn.

b. Sealant applied to case, projectile inserted straight.

c. Sealant applied to projectile, projectile inserted with quarter turn.

d. Sealant applied to projectile, projectile inserted straight.

Air leak tests were run to determine the number of leakers in each category and some rounds were submerged in water overnight to determine the extent and effect of a leak.

The second phase of the procedure was a series of test firings to correlate the modified design with the existing design. Velocity and standard deviation of velocity were tabulated for the above mentioned conditions, using precrimped control rounds, straight (uncrimped) cases, and cases that had been decrimped by various methods. In these tests the usual sample size was 50 rounds.

Straight cases were supplied by Amron Corporation for this program to evaluate this proposed method of manufacture. However, because of the previously mentioned 208,000 cases (UMR), it was desired to know whether precrimped cases could be successfully decrimped and assembled in the same manner. If so, it would be possible to salvage these cases by this means. Samples of these cases were decrimped by the following methods:

a. Decrimping by sizing punch entering the mouth of the cartridge case.

b. Rolling out against a stop.

c. Rolling out by using a dial indicator as a control.

d. Rolling out by stopping against the roll.

These decrimped cases were then subjected to the same preparations and tests as the uncrimped cases.

SECTION II

SUMMARY

The variation of Bullet Pull (in pounds) with staking pressure is rather wide for horizontal staking. However the standard deviation of Bullet Pull values is optimum at a staking pressure of about 50 psi with a vertical stake configuration. With these conditions the Bullet Pull is approximately 110 pounds.

Adequate sealing is obtained by using Thiokol adhesive D-196206-1, applied to the projectile skirt, with the projectile twisted one quarter turn as it is inserted into the case.

Test firings substantiate the Bullet Pull data in that standard deviation of velocity is minimum for uncrimped cases staked vertically at 50 psi. These tests also show that for straight cases the standard deviation is substantially lower than for pre-crimped cases. These values of standard deviation are 2.74 for straight cases, and 3.37 for standard pre-crimped cases, which is an improvement of 0.63 or 19%.

Test firing data also shows that the standard deviation of velocity for uncrimped cases and decrimped cases is in the same order of magnitude. Therefore, unserviceable precrimped cases can be satisfactorily decrimped using a 1.5700-inch diameter sizing punch and assembled in the same manner as the uncrimped straight cases.

By using a straight walled case, assembled with the XM398 Projectile, the groove in the projectile skirt may be eliminated resulting in a thicker section at this point.

There would be a cost reduction of approximately $.0276 per case by the elimination of the mouth precrimp.

SECTION III

CONCLUSION

Straight (uncrimped) cases may be assembled into rounds successfully and the functional characteristics will be the same or better than for the precrimped rounds.

The standard deviation is improved by using straight cases.

These rounds are water-proof and will not come apart with usual handling.

It is possible to salvage the 208,000 unserviceable cases by decrimping and assembling them as straight cases.

SECTION IV

RECOMMENDATIONS

The Case,Cartridge 40mm, M118, used in the M79 Launcher should be modified as a straight (uncrimped) cases.

The 208,000 cases held as unserviceable should be decrimped and assembled as straight cases.

Staking fixtures (Dwg. SK78857) should be built and installed in suitable barricades on the production lines.

There should be further experimentation to develop a faster acting sealant although Thiokol D196206-1 adhesive gives adequate water proofing.

SECTION V

STUDY

The staking fixture was built according to Drawing (DWG.) No. SK-78857 and the sizing die, Dwg. No. SK-66737, was designed to decrimp precrimped cases.

To save time, an existing machine was modified into the geometric staking fixture, which was set up to stake four places around the case at the major diameter of the ball. This location of the staking impression is dimensioned 0.215 ±0.005 inches from the mouth of the case to the top of the 0.062-inch-long vertical stake. If the staking impressions were located otherwise than on the major diameter, the mouth of the case became distorted. Also staking pressures in excess of 85 psi (on the 6-inch diameter staking cylinder) will distort the wire-wrapped ball. At the optimum staking pressure (50 psi) the depth of the staking impression was measured at 0.023 ±0.004 inches and is governed mostly by the staking pressure.

As outlined in the procedure, bullet pull tests were conducted on samples assembled by staking at different pressures and different directions. The average bullet pull and standard deviation of bullet pull were calculated and tabulated in Table I.

TABLE I

BULLET PULL TEST

Staking Methods	Staking Pressure, psi	Average Pull, lbs	Standard Deviation, lbs
Horizontal	40	96	34.8
	50	156	43.7
Vertical	50	110	6.1
	70	190	36.0

From this table it may be seen that, for 50 psi staking pressure (vertical) the average bullet pull is optimum and the standard deviation is minimum.

Based on the bullet pull test results, test firings were made using straight cases, staked on assembly in the vertical direction and at various pressures. In these test firings 584 rounds were fired for velocity. The standard deviation was calculated and tabulated in Table II.

TABLE II

STANDARD DEVIATION (VELOCITY vs STAKING PRESSURE)

Quantity	Staking Pressure, psi	Sigma Velocity, Ft/Sec
49	40	3.61
387	50	2.74
50	60	2.75
98	70	2.77

From Table II it may be observed that standard deviation of velocity appears to be minimum at 50 psi staking pressure. It also appears to increase at a greater rate below this range. This is illustrated by Figure 1.

Although Standard Deviation does not increase greatly for values of staking pressure above 50 psi, it is desirable to maintain a staking pressure as low as possible consistent with good staking.

Therefore, optimum staking pressure has been established at 50 psi on the six-inch cylinder with the vertical stake.

A total of 982 rounds have been fired for velocity to compare sigma, the standard deviation of velocity, for the precrimped cases with that for the cases decrimped by four different methods. These decrimping methods were as outlined previously in the procedure. The results from these tests are tabulated in Table III.

TABLE III

VARIATION OF STANDARD DEVIATION OF VELOCITY WITH DECRIMPING METHOD AND STAKING PRESSURE

Type	Quantity		Sigma (Velocity fps)		
		Precrimped	Staking Pressure, psi		
			50	60	70
Precrimped*	546	3.37			
Precrimped	50	4.06			
Sized Out-Punch	101		3.00		
Sized Out-Punch	53		2.17		
Rolled-Out-Dial Ind. Stop	48		1.89		
Rolled Out-Positive Stop	26		2.11		
Rolled Out-Positive Stop	50		.	2.75	
Rolled Out-Stop Against Roll	10		3.22		
Rolled Out-Stop Against Roll	48				2.10
Rolled Out-Stop Against Roll	50				3.41
Total Number of Rounds	982	596	238	50	98
Average		3.43	2.50	2.75	2.77

It can be observed from Table III that standard deviation of velocity for decrimped cases is low. However, notwithstanding the fact that rolled out cases were generally lower than the sized out cases, there was a tendency to become bellmouthed in the rolling out process. For this reason it was decided to use the sizing punch in decrimping.

*This represents the control rounds fired in lots of 50 in conjunction with the other tests.

The sealant tests were conducted in conjunction with the other tests. The characteristic most desirable to improve was pot-life without the loss in effectiveness of other characteristics. The most satisfactory new sealant used was Thiokol D-196206-1 Adhesive. This had a pot-life of approximately 4-6 hours, as against 1/2 hour for the production sealant (Thiokol LP-2 with Curing Agent C5).

A sample of Thiokol Adhesive D-196206-1, was received for testing as a sealant. The greatest advantage of this sealant is a four hour pot-life, although the sealing ability is about the same as that for the Thiokol, Liquid Polymer (LP-2) and curing agent (C-5) used on current production. Observations from the test results indicate:

(1) Sealing ability increases with time.

(2) The percentage of leakers with the straight (uncrimped) cases using Thiokol D-196206-1 as a sealant was not excessive and will compare favorably with those using production sealant when production technique is developed.

TABLE IV
AIRLEAK TESTS

Date	Quantity	Number of Leakers				
		Precrimped (LP-2 Sealant)		Uncrimped (D-196206-1 Sealant)		
		Immediately	After 4 hrs	Immediately	After 4 hrs	After 3 days
1-22-63	284			1	1	1
2-11-63	159			17	17	17
2-28-63	50		2			
3-1-63	100			39	30	5
3-7-63	100	23	12			
Total Leakers		23	14	57	48	23
Total Tested		100	150	543	543	543
Percentage		23 %*	9.3 %*	10.5 %	8.9 %	4.2 %

* It has been found by production that rounds not passing the Airleak Test seal themselves within a 24-hour period. The number of rounds that do not is negligible.

APPENDIX

APPENDIX A

FIGURES

FIG 1
VARIATION OF STANDARD DEVIATION OF VELOCITY WITH STAKING PRESSURE
STANDARD DEVIATION (VELOCITY) σ
40
35
30
25
20
40
60
70
STAKING PRESSURE, PSI

FIGURE 1

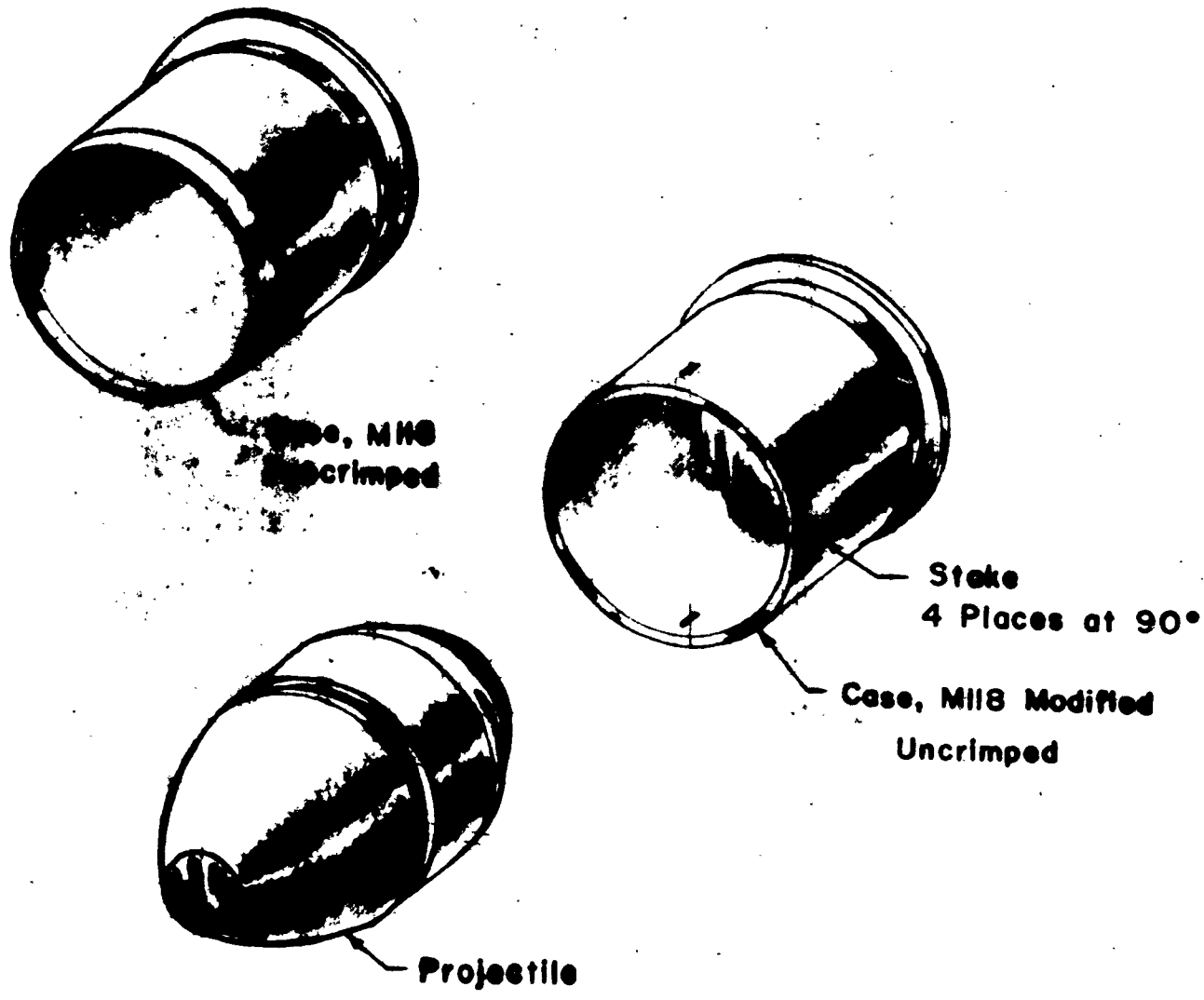

Figure 2. Cartridge, 40mm, Practice, M407E2
Staked Assembly

ABSTRACT DATA

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Because a problem existed with crimped cases becoming stuck in the launcher, tests were conducted to determine the feasibility of modifying unserviceable cases to eliminate the crimping.

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