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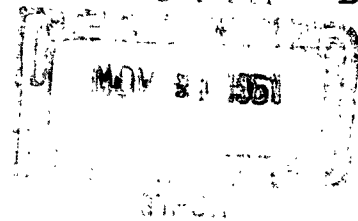
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REPORT R-1577

DEVELOPMENT OF
CARTRIDGE, 7.62MM BLANK: NATO, XM82

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ASTIA
OMS 5530.11.553M
DA Project 504-05-002



JUNE 1961

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FRANKFORD ARSENAL
RESEARCH AND DEVELOPMENT
GROUP
PHILADELPHIA 37, PA

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ABSTRACT

The subject of this study was the development of a blank cartridge for the 7.62mm family of United States weapons which would accurately simulate the performance of ball ammunition. Some of the conclusions arrived at, stated that (1) the short blank cartridge developed at Frankford Arsenal was unsatisfactory for use in the M60 machine gun and (2) that Belgian, Dutch and Canadian blank cartridges function the M14 rifle and M60 machine gun satisfactorily at ambient (70°F) temperature, provided blank firing attachments having correct orifice diameter are used.

It is recommended that foreign blank ammunition be used in United States 7.62mm weapons if the ammunition can be modified so as to be used with blank firing attachments compatible with the XM82 blank cartridge.

OBJECT

To develop a blank cartridge for the 7.62mm family of United States weapons (M14 rifle, M60 machine gun, and M73 machine gun) which, when used with appropriate blank firing attachments, would simulate performance of ball ammunition with respect to weapon functioning, noise, smoke and flash.

SUMMARY

Initial designs were based on the use of 7.62mm spent cases. To utilize spent cases a short cartridge similar to the caliber .30 blank cartridge was evaluated, but it produced stub round malfunctions when fired in the M60 machine gun. This development was suspended in October 1959 because there was no apparent solution to this condition.

Subsequently, a 7.62mm blank cartridge was developed which approximated the length and contour of United States 7.62mm ball ammunition. Propellant type, over all cartridge length, tagboard wad thickness, diameter of case mouth opening and wall thickness of the case neck were varied until a suitable combination was obtained. This was demonstrated by the ability of cartridges of this design to function 7.62mm weapons safely and reliably, even when cases were accidentally overloaded with propellant.

Several lots of cartridges, manufactured for the evaluation of each variable, were subjected to function and casualty tests in an M14 rifle and an M60 machine gun. The cyclic rate, noise level, and number of case casualties were recorded during these tests and, the best features of the cartridges tested during the design study, were incorporated into the final design - the XM82.

Ten thousand (10,000) XM82 cartridges were subjected to function and casualty tests in the M14 rifle and M60 machine gun, fitted with suitable blank firing attachments, at temperatures of 125°F, ambient, and -40°F at Aberdeen Proving Ground. Cyclic rate, noise level, smoke, flash, fouling, and barrel wear were recorded and were determined to be satisfactory.

The final 7.62mm Blank: NATO, XM82 cartridge design is shown on Drawing C-8597283, Appendix XII (FB53147) and employs approximately 18 grains of a smokeless propellant (currently SR-4759), a non-corrosive primer (currently No. 34), a 0.027 inch thick tagboard wad, a 0.025 inch mouth wall thickness, a controlled mouth opening and a cartridge length of 2.610 inch.

(The use of "NATO" in this cartridge designation merely defines the family of 7.62mm cartridges M59 through M64, M80 and XM82 which can be fired in 7.62mm weapons chambered similarly to the United States M14, M60, M73 or T65 and does not imply battlefield interchangeability in NATO weapons.)

INTRODUCTION

Office, Chief of Ordnance requested¹ that Frankford Arsenal, in cooperation with Ordnance Weapons Command, initiate development of a 7.62mm blank cartridge. Frankford Arsenal initiated development of Cartridge, 7.62mm Blank: NATO, XM82 under OTCM 37091². In conjunction with this OTCM, Technical Requirements Document 17-59³ (an in-house) planning document was issued.

To meet the required design criteria the following cartridge designs were considered:

1. Utilization of spent 7.62mm cases
 - a. With a combustible bullet insert
 - b. By securely attaching a metallic ogive to simulate the contour of a ball round
 - c. "As is", in a short cartridge similar in design to the caliber .30 blank cartridge
2. Using newly manufactured cases which simulate the length and contour of the ball round.

Because of the potential monetary savings to be realized in utilizing spent 7.62mm cases for this cartridge, an all out effort was made to produce a suitable cartridge using spent cases. The most

^{1,2,3} See List of References

feasible design for the utilization of 7.62mm spent cases was a short cartridge similar in design to the caliber .30 blank cartridge. Investigation of this type of cartridge showed that stub round malfunctions occurred when fired in the M60 machine gun. For this reason tests in the M14 rifle to check on feeding or functioning difficulties were never initiated.

On 16 October 1959 a meeting was held at Office, Chief of Ordnance to discuss the progress on the 7.62mm blank cartridge development^{4a}. The following agreements were reached at this meeting:

- a. The development of the short cartridge is to be temporarily abandoned.
- b. Frankford Arsenal is to develop a long blank cartridge.
- c. Frankford Arsenal is to secure samples of Canadian, Belgian and Dutch blank ammunition. Springfield Armory is to conduct tests on this ammunition to determine acceptability for use in United States 7.62mm weapons.

In November 1959, Frankford Arsenal undertook the development of a long cartridge necked down to simulate the length and contour of the 7.62mm ball cartridge. Based on experience, obtained while manufacturing the T116E2 grenade cartridge, a satisfactory blank cartridge was developed in 5 months time.

Throughout this project close cooperation was maintained between Springfield Armory and Frankford Arsenal. Springfield Armory was developing blank firing attachments for the 7.62mm weapons concurrently with Frankford Arsenal's development of the blank cartridge. Considerable testing of the blank cartridge was performed by Springfield Armory because of the accessibility of weapons and blank firing attachments and because they were appropriately equipped to measure gun functioning characteristics.

METHOD AND DISCUSSION

I. Investigation of the Use of 7.62mm Spent Cases

To facilitate handling and weapon feeding, it was believed, that the blank cartridge should simulate the length and contour of the 7.62 mm ball round. The need for weapon modifications and for various

weapon attachments (such as feedway blocks and magazine fillers) to assist in feeding the short blank cartridge would thereby be eliminated. Some type of case insert would therefore be required to lengthen the spent case.

The following devices for utilization of 7.62mm spent cases were considered:

- a. Assembly with a combustible bullet;
- b. Attachment of a metallic ogive to simulate the shape of a ball round;
- c. Crimping the resized case to form a short cartridge similar in design to the caliber .30 blank cartridge.

A combustible bullet which could be manufactured from wood, plastic or materials impregnated with plastic or propellants was considered. However, combustible bullets were not used. Combustible plastics and materials impregnated with plastics, such as mylar and impregnated fibre glass, have been tested for some time for use in ammunition. The results have shown that these materials shatter into minute fragments when the projectile is fired. Blank cartridges utilizing bullets made from some of the above materials would be expected to leave large residues of carbon and unburned materials in the barrel of the weapon. This could increase weapon wear and make the weapon difficult to clean. It is probable that this type of blank cartridge would also spray the area in front of the muzzle of the weapon with hot particles which would be dangerous to personnel in the area.

Therefore, the use of wood or propellant impregnated materials for a combustible bullet was considered impractical because of the uncertainty of complete combustion before emergence from the barrel.

The use of non-combustible bullet-shaped insert with a spent case creates the problem of fastening the insert securely to the case so that it remains attached after the cartridge is fired. This method of utilization of spent cases was abandoned because no practical method of securing the insert to the case was found either within the Ordnance Corps or by the Small Arms Industry. (At the time of writing this report such investigations are continuing in the Industry.)

It seemed then, that the short blank cartridge offered the best solution for the utilization of spent cases.

Twenty standard 7.62mm cases were cannellured as shown on Drawing FB53230, Appendix XII and ten standard 7.62mm cases were cannellured as shown on Drawing FB53231 Appendix XII. All thirty were primed with Frankford Arsenal No. 34 primers and charged with 12.0 grains of Western blank fire powder. The twenty cases were crimped with a roll crimp in accordance with Drawing FB53228,

Appendix XII and the remaining ten with a rosette crimp as shown on Drawing FB53229 Appendix XII. The rosette crimped cartridges were lacquered on the mouth with red lacquer to distinguish them from the 7.62mm M64 grenade cartridge.

The two lots of cartridges were subjected to function firing in an M60 machine gun which was fitted with a blank firing attachment (BFA) test fixture similar to that shown in Drawing FB53234 Appendix XII. The disc used in the BFA was 0.1 inch thick and had an orifice diameter of 0.055 inches. Details of the firing tests and the results of these tests are presented in Appendix Ia and b in two memoranda for record. These tests, performed at Frankford Arsenal, indicated that both roll and rosette crimped cartridges would feed and function the M60 machine gun satisfactorily; i.e. similarly to ball ammunition. But, cartridges having the roll crimp seemed superior. The cases of the roll crimped cartridges were slightly bulged after firing but produced no slivers and left the barrel of the weapon relatively clean. Compared to this, rosette crimped cartridges tended to shear in the region of the crimp when they were fired, depositing many small particles of brass in the barrel of the weapon.

Because the two lots of cartridges functioned the M60 machine guns satisfactorily, it was decided that further test firings were warranted. To arrive at an adequate level of performance, four lots of 250 cartridges each with a rosette crimp and four lots of 250 each with a roll crimp were manufactured having the following charges of Western Blank Powder, Army Lot 42375:

Table I

<u>Ammunition</u> <u>Lot</u>	<u>Type of Crimp</u>	<u>Propellant</u> <u>Charge</u> <u>(grains)</u>
FA X7.62-2645	Rosette	10
2646	Rosette	11
2647	Rosette	12
2648	Rosette	13
2649	Roll	10
2650	Roll	11
2651	Roll	12
2652	Roll	13

Because Frankford Arsenal had only a limited number of 7.62mm weapons (too few for testing blank cartridges) these lots of ammunition were sent to Springfield Armory for evaluation. Springfield Armory fired some in an M60 machine gun and some in an M73 machine gun. Modifications were made to the weapons to aid in feeding the cartridges and in functioning the weapons.

The feed plate of the M60 machine gun was modified by the addition of a filler block in order to guide and maintain the short blank cartridge in its proper position in the feedway.

The feed plate of the M73 machine gun was modified by the addition of a filler block and extension of the control lips 5/16 of an inch. Further, the recoil booster was modified to serve as a blank firing attachment.

Time-displacement curves were recorded for each ammunition lot. They were all fired in an M60 machine gun in which the orifice diameter of the blank firing attachment was systematically varied. This method was followed to determine the best orifice diameter for each powder charge in order to eliminate bulged fired cases. It would produce time-displacement curves similar to those obtained with ball ammunition. (The time-displacement curve is obtained by firing single shot in the M60 machine gun and measuring with an oscillograph drum camera the delay time of the operating rod and the buffer approach velocity of the bolt.)

The ammunition was also fired for function and casualty in an M60 machine gun. Similar tests on these 8 lots of ammunition were fired in an M73 machine gun. See Appendix II for results.

Springfield Armory, in firing rosette crimped cartridges in the M60 machine gun, noted instances "in which the crimped portion of the case mouth separated from the neck and was blown through the bore." Therefore, the rosette crimped cartridge was considered to be a potential hazard and unacceptable for blank ammunition. Cartridges having a roll crimp and containing 12.0 grains of Western blank fire powder seemed to produce the best weapon performance with respect to energy developed, in both the M60 and M73 machine guns.

Additional blank ammunition similar to lot FA X7.62-2651 (with a roll crimp and 12.0 grains Western blank fire powder) was requested by Springfield Armory for further testing and for use in conjunction with weapon modification and development of blank firing attachments. Frankford Arsenal sent 400 blank cartridges designated lot FA X7.62-2669 and 2000 additional blank cartridges of the same design designated lot FA X7.62-2673, to the Armory.

During automatic firing of this roll-crimped ammunition in the M60 machine gun, several stub round malfunctions occurred. Certain sections of this M60 machine gun were cut away to expose to view the behavior of the cartridges during the feeding operation. High speed motion pictures were made of the feeding operation of a 10-round series of cartridges from lot FA X7.62-2669. The pictures⁵ showed that the short blank cartridges dropped free of the feed tray when the mouth end of the cartridge was about 1/2 inch from the barrel chamber opening. Hence, this cartridge travels 1/2 inch unguided prior to entering the chamber. This undesirable condition is illustrated in Figure 1.

At a subsequent meeting held at Office, Chief of Ordnance on 16 October 1959 to discuss the status of the blank cartridge it was decided to discontinue the development of the short blank cartridge because there was no apparent solution to the condition of stub round malfunctions. The following action was indicated in the minutes^{4a, 4b} of this meeting:

a. Frankford Arsenal

- "1. Expedite acquisition and test of Canadian blank cartridge...
- "2. Obtain other foreign blank cartridges for comparative evaluation with a view toward possible qualifying one or all for use in United States weapons in the event off shore procurement for use in Europe becomes necessary.
- "3. Pursue development of a long blank cartridge..."

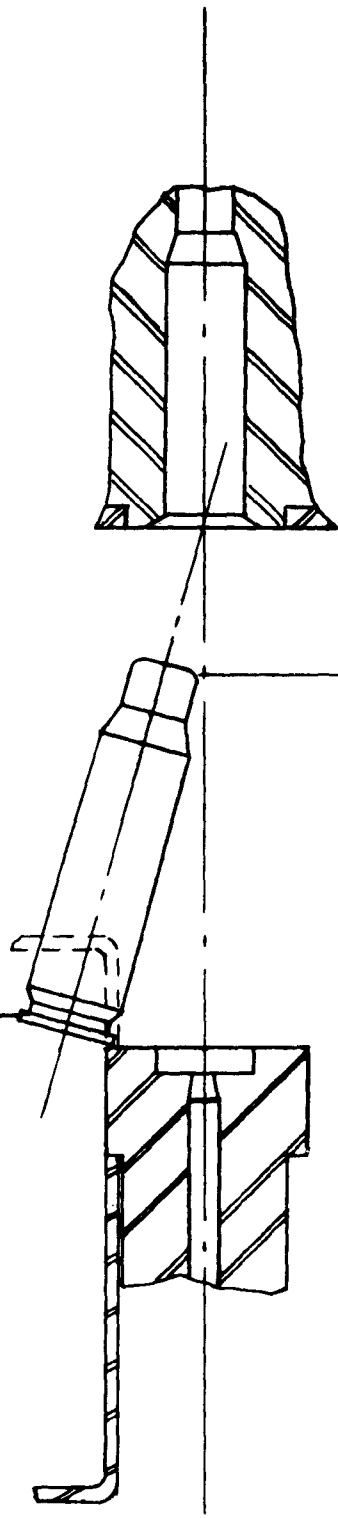
II. Investigation of Long Blank Cartridge

a. Evaluation of Foreign Blank Ammunition

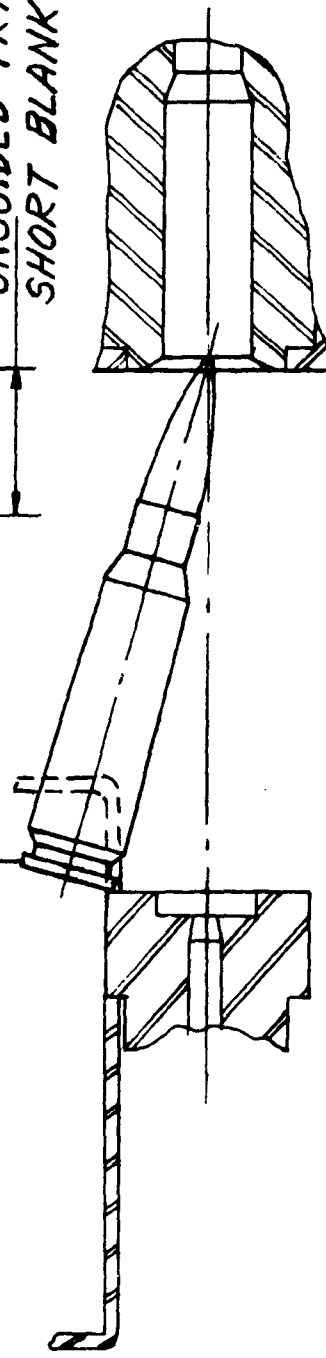
Samples of the following foreign ammunition were submitted to Springfield Armory for evaluation:

<u>Nomenclature</u>	<u>Manufacturer</u>	<u>Nationality</u>
Cartridge, 7.62mm, Blank, C24	Dominion Arsenal	Canadian
Munition Surete, 7.62mm	Fabrique Nationale D'Armes de Guerre	Belgian
Cartridge, Blank, Cal.7.62mm NATO	Nederlandsche Wapen-en Munitiefabriek	Dutch
Patrone, 7.62mm, X51, Manover	Dynamit-Actien- Gesellschaft	German

7.62 MM BLANK CTG



7.62 MM BALL CTG



UNGUIDED TRAVEL OF
SHORT BLANK CTG

Figure 1. Unguided Travel of Short Blank Cartridge

A description of each of these foreign blank ammunition types is given in Appendix III. Figures 2, 3 and 4 show the mouth closing operations for the Canadian, Belgian and Dutch ammunition, respectively. Figure 5 shows the closing operation of the United States 7.62mm XM82 blank cartridge for comparison purposes. It is noted that the Canadian cartridge requires seven closing operations, while the Belgian requires three and the United States XM82 and the Dutch only one; the latter, however, requires a chamfered case mouth. The Dutch NWM fabriek has recently eliminated the chamfer and gone to a three stage crimping operation similar to the Belgian design.

The German cartridge does not require any closing operations; however, it requires an assembly operation of base plug and plastic body as a final step. This German 7.62 Manöver- or Platz-Patrone, the French 9mm and Cal..306 Gevelot Cartouches à blanc and Norwegian Cal..306 Bakelittfabriken Lospatroner - which are all plastic blank cartridges - are shown in Figure 6. An X-ray photo of these cartridges showing details of the metal head is seen in Figure 7.

The test procedure submitted to Springfield Armory for evaluation of the foreign 7.62mm blank cartridges is described in Appendix IV. Photos of Belgian, Canadian, Dutch and United States XM82 blank cartridges before firing and after firing, both with and without blank-firing attachments on the weapon, are inclosed as Figures 8, 9, 10 and 11.

A report⁶ by Springfield Armory presented the results of initial testing of Belgian, Canadian, and Dutch ammunition in the M14 rifle and M60 machine gun at ambient temperature. The report indicated that for over all performance, including cleanliness rating, based on over all residue and carbon fouling conditions, they rated these foreign blank cartridges in the order: Dutch, Belgian and then Canadian.

However, results for the following criteria were similar:

1. Weapon functioning - acceptable
2. Bore erosion - slight
3. Flash characteristics - comparable to one another
4. Sound meter readings - approximately equal for all three but less than for standard ammunition.

The results to date were obtained in weapons utilizing a blank firing attachment having an orifice disc located at the muzzle of the barrel.

With all three blanks tested, particles and/or gases were emitted from the ejection port of the M14 rifle during functioning. This

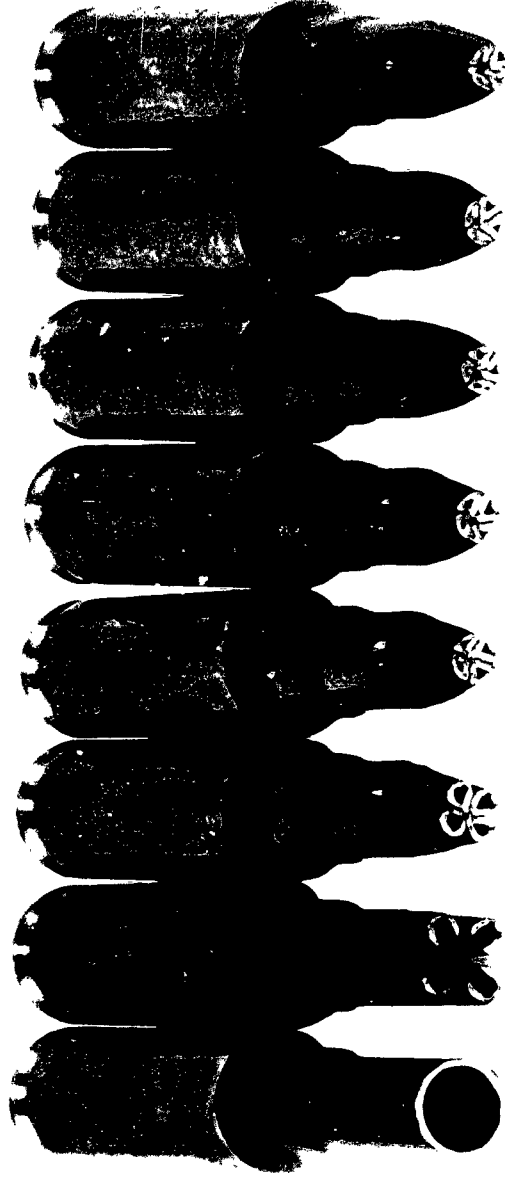


Figure 2. Closing Operations, Cartridge, 7.62mm, Blank, C24
Canadian

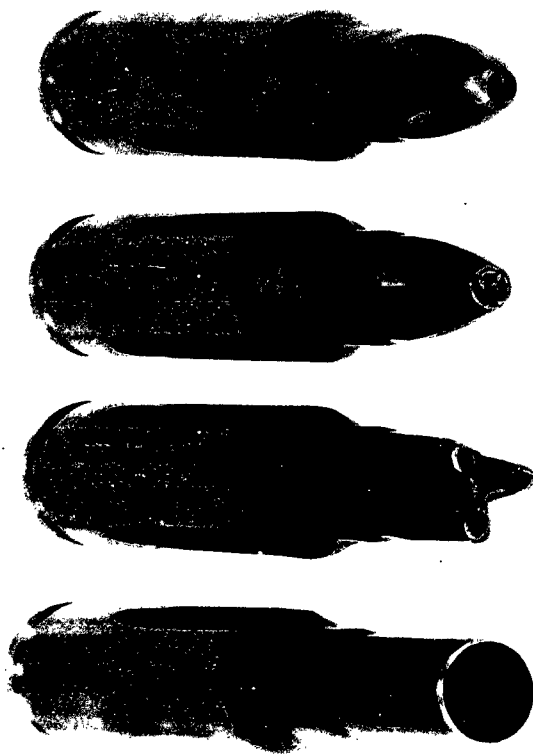


Figure 3. Closing Operations, Muniton Surete, 7.62mm
Belgian (F.N.)

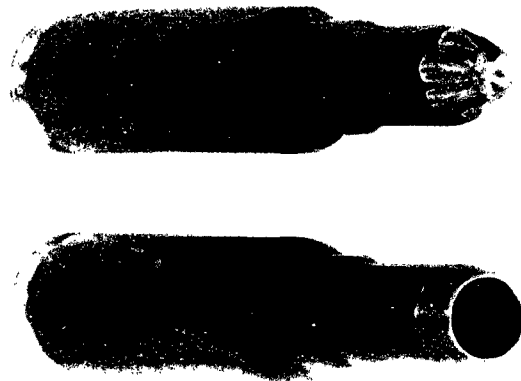


Figure 4. Closing Operation - Patrone, 7.62mm, 51 Manöver
Dutch (N.W.M.)

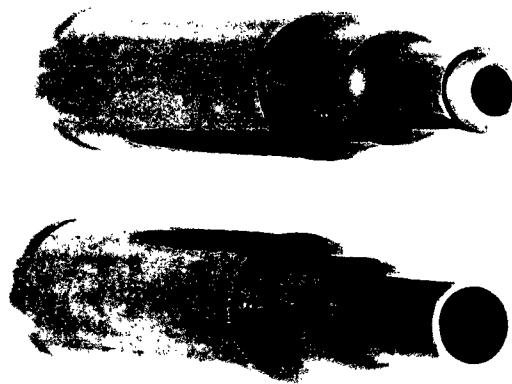


Figure 5. Closing Operation, Cartridge, 7.62mm, Blank, XM82
United States

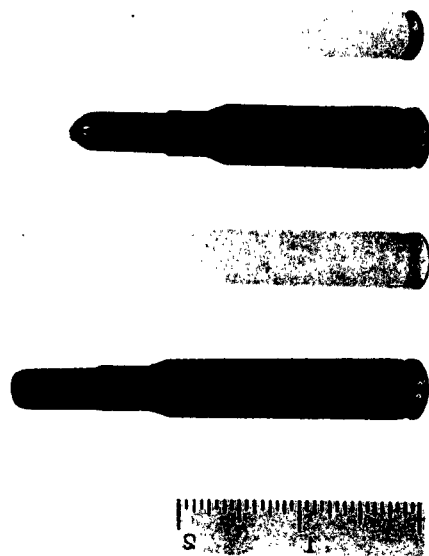


Figure 6. Photographs of Foreign Plastic Blank Ammunition

1. Norwegian Caliber .306 Bakelittfabriken Lospatroner
2. French Caliber .306 Gevelot Cartouche a Blanc
3. German 7.62mm D.A.G. Plaz-patrone
4. French 9mm Gevelot Cartouche a Blanc

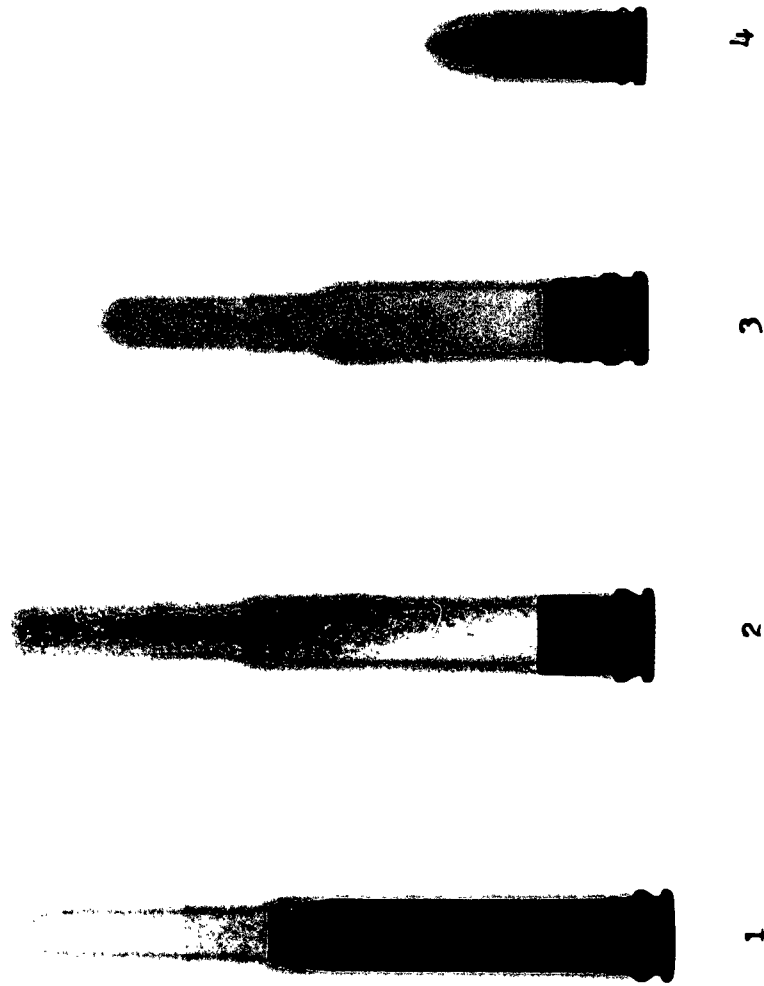


Figure 7. X-ray Photographs of Foreign Plastic Blank Ammunition

1. Norwegian Caliber .306 Bakelittfabriken Lospatroner
2. French Caliber .306 Gevellot Cartouche a Blanc
3. German 7.62mm D.A.G. Plaz-patrone
4. French 9mm Gevellot Cartouche a Blanc

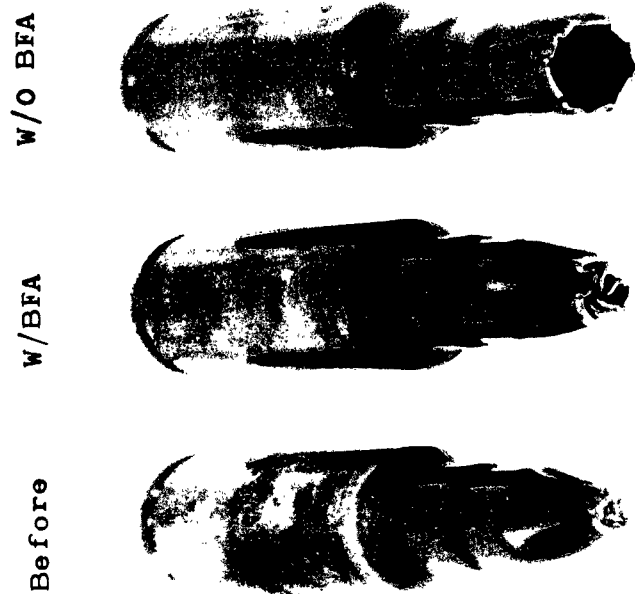


Figure 8. 7.62mm Blank Cartridges, Before and After Firing
Belgian



Figure 9. 7.62mm Blank Cartridges, Before and After Firing
Canadian



Figure 10. 7.62mm Blank Cartridge, Before and After Firing
Dutch

Before W/O BFA W/BFA

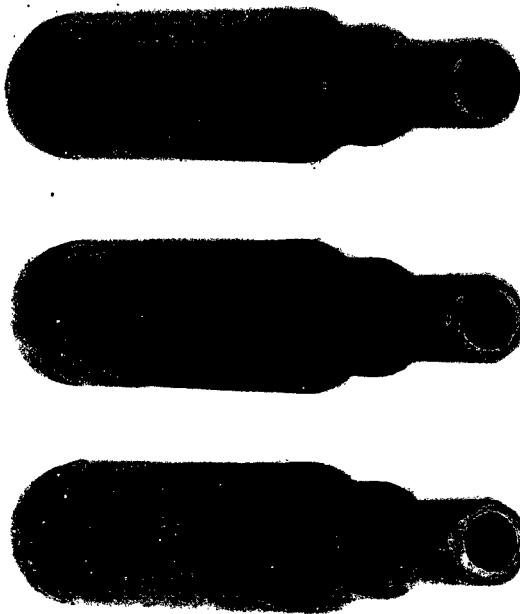


Figure 11. 7.62 Blank Cartridges, Before and After Firing
United States

condition is termed "blowback." To protect the shooter's face from blowback, a shield was required at the breech end of the M14 rifle when the foreign blanks were fired.

Additional testing of the foreign blank ammunition will have to be completed before the over all effectiveness of each type can be determined. These cartridges, as well as the German blanks, are scheduled to be tested at 125°F and -40°F in the M14 rifle and M60 machine gun and at high, low and ambient temperatures in the M73 machine gun. It is expected that the additional tests will be initiated after the designs of the blank firing attachments have been finalized.

The over all performance rating for each type foreign blank ammunition may be altered by the results obtained during future tests conducted at high and low temperatures with weapons utilizing blank firing attachments of military value. It is also to be noted that the foreign nations have continued development on their 7.62mm blank cartridges. An evaluation of their latest production cartridges might produce results different from those obtained with cartridges that are now being tested by Springfield Armory.

b. Development of Cartridge, 7.62mm, Blank, NATO, XM82

Experimental Designs

Five experimental designs were evaluated and are shown in Drawings FB 53235 through 53239, Appendix XII.

A caliber .30 two-draw cup was selected for use in the development of the blank case. This cup was chosen because it is readily available at Frankford Arsenal, since it is presently used in the manufacture of cases for caliber .30 match ammunition. Each lot of the experimental cartridges was manufactured by semi-automatic operation of machinery by a procedure similar to that outlined in Appendix V. The cartridges were loaded with propellant and crimped by hand. Each design included the Frankford Arsenal No. 34 primer, approximately 16 grains of SR 4756 propellant and a tagboard was 1/32 inch thick. Experimental cartridges of each of the five designs were fired for functioning in an M14 rifle which was fitted with a blank test firing attachment (Drawing FB 53233, Appendix XII).

Initially some cartridges of design 1 were tested in the M14 rifle with various charges of Western blank fire powder AL-42375. The necks of the cartridges expanded so much during firing that they became imbedded in the rifling of the weapon. Yet, all charges tested (up to 13.0 grains) failed to produce sufficient recoil to function the rifle. It was concluded that propellant of the type represented by Western blank AL 42375, burned too quickly under this condition of confinement to give satisfactory results when used in long blank cartridges.

After experimenting with various propellants, it was found that, of those tested, SR 4756 performed most satisfactorily when used in cartridges of the first experimental design. This propellant became a standard for testing the five experimental designs.

Cartridges manufactured in accordance with experimental design 1, having a bullet-profile neck and closed in a rosette crimp, split at the neck when they were fired.

Experimental design 2 attempted to correct this condition by incorporating a straight neck with a rosette crimped mouth. Again the cartridges split at the neck when they were fired.

Experimental design 3 utilized a bullet-profile neck which was partially closed at the mouth with a roll crimp. Cartridges manufactured according to this design expanded at the neck region when they were fired. Each of the fired cases had a bell shaped mouth.

Cartridges of experimental design 4, consisting of a fluted neck coned in at the mouth, split at the neck when they were fired.

Cartridges incorporating a straight neck with a tapered mouth as described in experimental design 5 functioned the M14 rifle satisfactorily in preliminary tests. Only a small percentage of case casualties were observed during these tests. This design was abandoned because the mouth of the cartridge was difficult to form.

Design Study

To eliminate the deficiencies of the five previously described experimental designs, a cartridge was designed as shown in Drawing FB 53132 using a case shown in Drawing FB 53231, Appendix XII. This basic design was used to evaluate the following variables:

- a. Type of propellant
- b. Overall length of cartridge
- c. Thickness of tagboard wad
- d. Wall thickness of neck of cartridge

Preliminary tests during the design study were conducted at Frankford Arsenal. Because of the interdependence of variables investigated, it was impossible to evaluate only one variable in each test performed. For the purposes of this report each test will be recorded under its main purpose. The results of individual firings are described in detail in Appendix VI.

During this study the cartridges were fired for function and casualty from an M14 rifle and M60 machine gun fitted with appropriate

test blank firing attachments, previously cited. Throughout the tests the orifice diameter was varied between 1/8 inch and 3/16 inch to obtain satisfactory weapon functioning.

All noise level readings recorded were made with the microphone of an audiometer placed 3 feet to the rear and 1 foot to the side of the breech of the weapon.

Discussion of Variables Studied

a. Type of Propellant

For each of the six propellants tested, lots of cartridges were assembled in which the propellant charge was varied in increments of 1 grain per lot. The cartridges were fired for function and casualty in an M14 rifle fitted with the test blank firing attachment. Functioning, cyclic rate and the incidence of case casualties were recorded.

The results of the investigation indicate that the following propellants, when used in combination with the FA 34 primer and design study cartridge, will function the M14 rifle satisfactorily when it is fitted with a blank firing attachment having the proper orifice diameter.

<u>Propellant</u>	<u>Charge Grs.</u>	<u>Orifice Diameter of Blank Firing Attachment</u>
		<u>Inches</u>
Hercules 2400	20.0	3/16
SR 4759	19.0	5/32 - 3/16
SR 4756	16.0	3/16
SR 4756	14.0	1/8
SR 4990-6	13.0	1/8
Hercules Unique	14.0	1/8

Of the propellants tested SR 4759 and SR 4756 seemed to be the most promising for use in the long blank cartridge. They produced less blowback in the rifle and fewer breech sparks.

T-profile propellant from Holland, supplied by NWM fabriek for these tests, produced lots of malodorous smoke. Although it did function the weapon, it was eliminated from further consideration due to its unpleasant side effects.

b. Over all Length of Cartridge

Originally it was believed that the blank cartridge should duplicate the length of the ball round (2.80 inches) as closely as practicable. This approach was delayed by a parallel development to permit use of spent cases. A cartridge length of 2.75 inches was later chosen. Many rejects were encountered during the second draw operation because the two-draw cup contained insufficient material to produce a 2.75 inch long cartridge. The cartridge length was reduced, therefore to 2.65 inches to reduce the number of rejected cases.

For a comparison test, cartridges 2.75 inches long and 2.625 inches long were assembled with No. 34 primers, 18.0 grains SR 4759 propellant and 0.031 inch wads. Each lot was fired for cyclic rate and function and casualty in an M14 rifle fitted with the test blank firing attachment. Cartridges 2.625 inches long were also fired for function and casualty in an M60 machine gun fitted with a test blank firing attachment. Cartridges of both lengths fed and functioned the M14 rifle and no difficulty was found in feeding and functioning an M60 machine gun with the 2.625 inch long cartridge. (see Appendix VI-2) Based on these tests a cartridge length of 2.625 inches was considered sufficient to prevent feeding malfunctions in both the M14 rifle and the M60 machine gun.

c. Thickness of Tagboard Wad

The wad in the blank cartridge performs two functions: (1) it prevents the propellant from falling out of the cartridge, and (2) it aids in the buildup of pressure in the cartridge. The type of wad material and the thickness of the wad affects the pressure buildup. For this cartridge, tagboard was chosen as the wad material. Chipboard, which performs similarly to tagboard, was chosen as the alternate.

Twenty (20) cartridges were assembled with No. 34 primer, 19.0 grains SR 4759 and tagboard wads of each of the following thicknesses: 0.015 inches, 2 wads each 0.015 inches and 0.042.

Ten (10) of these cartridges were fired in an M14 rifle and ten (10) in an M60 machine gun.

The above tests were repeated using cartridges assembled with 16.0 grains SR 4756 propellant. The results of these tests (shown in Appendix VI-3) indicate that, except as noted, there is no definite relationship between the thickness of the wad used in the cartridge and the following criteria:

Report of the ammunition
Cyclic rate of the weapon
Functioning of the weapon
Case casualties

Cartridges assembled with 19.0 grains SR 4759 propellant when fired in an M60 machine gun proved an exception to this general statement, producing higher cyclic rates as the thickness of the wad was increased.

A 0.031 inch thick wad was selected for the blank cartridge. The .015 inch thick wad was eliminated because it was too difficult to insert and seat, since no wad seat was designed into the cartridge. It was decided that a heavy, 0.042 inch thick wad was not required.

The incidence of stoppages during automatic firing with either propellant charge indicated that, with the 0.188 inch diameter blank firing orifice, the weapons were slightly underpowered. However, it has been found in other tests that by changing the orifice diameter of the blank firing attachment the cyclic rate of either weapon can be adjusted to an acceptable value. Another measure of satisfactory weapon operation is the cyclic rate, which is approximately 750 to 820 rpm in the M14 rifle, and 550 to 650 rpm in the M60 weapon when firing ball ammunition.

During these tests only cartridges loaded with 19.0 grains SR4759 caused a cyclic rate in the M60 machine gun comparable to the rate when ball ammunition is fired. In the M14 rifle both ammunition lots produced cyclic rates 20% lower than those obtained with ball ammunition.

The noise level of the report obtained with the blank ammunition - from 116 to 120 decibels - was somewhat lower than the approximately 126 decibels registered with ball cartridges.

d. Wall Thickness at Neck of Cartridge

To determine the effect of wall thickness at the neck of the cartridge, three lots of 40 cartridges each were manufactured and fired in an M14 rifle with the following results (see also Appendix VI-4):

<u>Cartridge Length</u>	<u>Neck Wall Thickness</u>	<u>B.F.A. Orifice</u>	<u>Case Casualties</u>
2.75 inch	0.021 inch (control)	0.188 in	10%
		0.156	35%
2.625 inch	0.021 inch	0.188	55%
		0.156	40%
2.625 inch	0.025 inch	0.188	0%
		0.156	0%

The cartridges were assembled with No. 34 primers, and 20 grains of SR 4759 propellant. The higher charge of SR 4759 propellant was used to test the wall of the cartridge under excessive stresses. Half of each lot had 0.016 inch thick wads, the other half 0.032 inch wads. No correlation could be determined between thickness of the tagboard wad and the number of case casualties.

The results indicated that a cartridge having a wall thickness approximately 0.025 inch can withstand the increased stresses imposed by ignition of a slightly heavy (20.0 grain) charge of propellant.

Eleven lots of blank ammunition were manufactured according to Drawing FB 53132, Appendix XII with the exceptions noted below, and shipped to Springfield Armory for more accurate evaluation.

Lot	Qty	Propel- lant	Chg (gr)	Pri- mer	Ctg. Lgth. (in.)	Wall Thickness (in.)	Wad Thickness (in.)
FAX7.62-2689	130	SR 4759	19.0	No.34	2.56	0.021	0.015
2690	30	"	19.0	No.34	2.56	"	0.042
2691	60	"	19.0	No.34	2.56	"	0.031
2692	30	"	19.0	No.34	2.63	"	0.042
2693	17	"	19.0	No.34	2.75	"	0.042
2694	20	"	19.0	No.34	2.75	"	0.042
2695	20	"	19.0	No.34	2.63	"	0.042
2696	30	SR 4756	16.0	No.34	2.56	"	0.015
2697	30	"	16.0	No.34	2.56	"	0.042
2698	40	"	15.0	No.34	2.44	"	0.042
2699	100	WC 820	12.0	No.34	2.63	"	0.031

Propellant WC 820 was selected for use in one lot of cartridges because, in very limited tests at Frankford Arsenal, only a small amount of blowback was encountered in the rifle when this propellant was used.

Due to the limitations of time, Springfield Armory tested only three lots of ammunition - Lots FA X7.62-2689, 2696, and 2699. Time-displacement curves were recorded for each of these three lots as they were fired in an M14 rifle fitted with a blank firing attachment.

In a meeting at Office, Chief of Ordnance on 18 January 1960, Springfield Armory reported that cartridges containing SR 4759 produced (1) slightly more blowback and (2) more power and more consistent bolt buffer approach velocities in the M14 rifle than cartridges containing SR 4756. Later they reported that the time-displacement curves made on cartridges containing WC 820 indicated that these cartridges produced erratic performance when fired in the M14 rifle. (In view of the preference indicated in their reports, SR 4759 propellant was subsequently selected to be used in the XM82 blank cartridge.)

Based on the results of the time-displacement curves, Springfield Armory requested additional ammunition similar to lot FAX7.62-2689 for use in function firing tests in the M14 rifle and M60 machine gun. The following two lots were manufactured and shipped to them:

<u>Lot</u>	<u>Qty</u>	<u>Propel- lant</u>	<u>Chg (gr)</u>	<u>Pri- mer</u>	<u>Ctg. Lgth (in.)</u>	<u>Wall Thickness (in.)</u>	<u>Wad Thickness (in.)</u>
FAX7.62-2714	131	SR 4759	19.0	No.34	2.56	.025	.042
2715	349	"	"	"	2.63	"	"

To eliminate the few neck splits which occurred when firing cartridges from lot FAX7.62-2689, the wall thickness at the necks of the cartridges was increased from .021 to .025 inches. An .042 inch thick wad was used in these cartridges in lieu of 0.015 inch thick wad because, as noted in section c, the thin wads were difficult to insert and seat manually in the cartridge, and 0.031 inch wads were unavailable.

Pressure-travel and time-displacement curves were obtained for cartridges from lots FAX7.62-2715 and FAX7.62-2689 when fired in an M14 rifle and for cartridges from lot 2715 when fired in an M60 machine gun. These cartridges were subjected to limited function tests in the M14 rifle, M60 machine gun and M73 machine gun. (See Appendix VII for preliminary results).

During function firing of lot 2715 several case casualties were observed. The frequency of occurrence in each weapon was as follows:

<u>Weapon</u>	<u>No. of Cartridges Fired</u>	<u>No. of Case Casualties</u>
M73	58	0
M14	80	1
M60	65	5

The M60 machine gun, which caused the highest incidence of split necks, has a chamfered surface in front of the rifling. When a cartridge similar in contour to those of lot 2715 is chambered in this weapon, the second shoulder of the cartridge is positioned at this chamfered surface. When the cartridge is fired the second shoulder tends to hit on this surface, increasing the chance of case splits. The possibility of neck splits is a potential safety hazard and should be minimized.

Modification of Design Study

Due to the large percentage of neck splits reported by Springfield Armory when cartridges from lot FAX7.62-2715 were fired in an M60 machine gun, two methods were attempted to minimize the number of split cases.

Method 1 - The second shoulder of the cartridge consisting of a 17° angle was modified. The following three lots of cartridges were manufactured following Drawing FB 53132, Appendix XII except as noted:

<u>Lot</u>	<u>Description of Second Shoulder</u>
1	17° angle (Control)
2	Double angle (17° followed by 45°)
3	1/4 inch radius

The cartridges were assembled with No. 34 primers, 19.0 grains SR 4759 and 0.031 inch thick wads and fired for function and casualty in an M60 machine gun fitted with the test blank firing attachment.

Method 2 - Two hundred cases made in accordance with Drawing FB 53131 were retapered moving the second shoulder of the case toward the head by 1/16 inch. Two lots of cartridges (one hundred each) were manufactured to Drawing FB 53147, Appendix XII (which superseded FB 53132) differing from each other by the contour of the second shoulder. These lots were designated as follows:

<u>Lot</u>	<u>Description of Second Shoulder</u>
A	17° angle
B	1/4 inch radius

Cartridges were fired for function and casualty in an M14 rifle and an M60 machine gun fitted with the appropriate test blank firing attachments. See Appendix VIII for detailed results of the five lots.

All lots, except as noted, functioned satisfactorily in the weapons in which they were tested. The incidence of case casualties may be summarized as follows:

<u>Lot</u>	<u>M14</u>		<u>M60</u>	
	<u>No. of Rds. Fired</u>	<u>No. of Split Necks</u>	<u>No. of Rds. Fired</u>	<u>Split Necks</u>
1	-	-	20	3
2	-	-	40	2
3	-	-	40	None
A	36	None*	36	None
B	60	None	40	None

*Four cartridges failed to eject and two misfired. This condition was attributed to cartridges whose first shoulder was deformed sufficiently to cause a snug fit in the chamber. This hindered chambering and ejection of the cartridge.

The cartridges of lot 3 utilizing a 1/4 inch radius at the second shoulder performed adequately in the M60 machine gun under limited testing. However, it was decided to move the second shoulder of the final cartridge design toward the head of the cartridge by 1/16 inch to give added assurance that this shoulder area would not hit against the chamfered surface of the M60 machine gun chamber. A 1/4 inch radius in place of 17° angle was selected for the contour of the second shoulder in order to give greater strength to this region of the cartridge.

Final Design - Heat Treatment and Size of Mouth Opening

Analysis of the results of the aforementioned tests permitted in each case the delineation of one critical parameter. With dimensions and propellant charge fixed, only heat-treatment remained as a variable. Three lots were prepared for evaluation:

Lot C - After initial tapering cases were immediately stress relieved, then retapered and stress relieved.

Lot D - After initial tapering cases, cases were left for two weeks before stress relieving; they were then immediately retapered and stress relieved.

Lot E - Cases were stress relieved immediately after initial tapering but were not relieved after retapering.

Cartridges from lots C, D and E were then sub-divided into groups whose mouth diameter was less than 0.127 inches, 0.127 to 0.138, 0.138 to 0.150 and greater than 0.150. In extensive function and casualty tests fired in the M14 rifle and the M60 machine gun, it was shown that the diameter of the case mouth should be between

0.130 and 0.160, that failure to stress relieve cases after retapering caused case splits, and that Springfield Armory's BFA for the M14 rifle was satisfactory.

The M14 rifle was fitted with a Springfield Armory blank firing attachment similar to that shown in Drawing SAD 42504. At the beginning of the tests the M60 machine gun was fitted with a Springfield Armory blank firing attachment (see Drawing SA 42801) which slipped over the flash hider. This attachment was replaced by the 5/32 inch orifice test blank attachment when at first a large amount of gas leakage occurred between the flash hider and the attachment causing slow cyclic rates and then the latch, fastening the BFA to the weapon broke.

In both the M14 rifle and M60 machine gun there was a tendency for the noise level readings and cyclic rate of the weapons to increase as the diameter of the aperture of the cartridge decreased. However, those cartridges having an aperture of less than 0.127 inches in diameter produced a high percentage of case casualties. Therefore, a minimum diameter of 0.140 inches was chosen to provide adequate assurance against the occurrence of case casualties caused by too small an aperture. The maximum diameter was chosen as 0.150 inch to assure that the cartridges would produce adequate cyclic rate of the weapon and sufficient noise.

The results of screen perforation tests showed that the paper screen was penetrated by small particles of unburned propellant when the screen was 9 feet in front of the muzzle of the M14 rifle and 12 feet in front of the muzzle of the M60 machine gun. There was no penetration when the screen was 15 feet in front of the muzzle of either weapon.

There seemed to be very little difference in the performance of the three lots of ammunition. However, good manufacturing procedure dictates that cases should be stress relieved immediately after tapering (as in lot C).

Temperature Conditioning Tests

Cartridges from Lot C (with apertures 0.138 to 0.150 inches) were chosen for this test. Twelve 20-rd magazines for the M14 rifle and one 50-rd belt for the M60 machine gun were conditioned at -40° for two hours and the same quantities at 125° F for two hours prior to the following function and casualty tests.

<u>Weapon</u>	<u>Attitude of Weapon</u>	<u>No. of Cartridge</u>	<u>Blank Firing Attachment</u>
M14	Vertically up	3 (20 rd) Magazines	None
"	" "	"	Spfd Armory's
"	Vertically down	"	Dwg SAD 42504
"	Horizontal	"	"
M60	Horizontal	50-rd belt	Test
			Dwg FB 53234

The cyclic rates of the M14 rifle and M60 machine gun as reported in Appendix IX, were lower when firing cartridges conditioned at -40° F. Cartridges conditioned at the high temperature developed a higher energy level. The ignition of the hot propellant produced higher pressure levels in the weapons giving greater power output. This increase in power output increased the cyclic rates of the weapons. Also, the report of both weapons was lower when firing cartridges conditioned at -40° F than those conditioned at +125°F.

The M14 rifle and the M60 machine gun functioned satisfactorily when firing cartridges conditioned at both the high and low temperatures in all attitudes except that the rifle was slightly underpowered when it was fired with the muzzle pointed vertically upwards using cartridges conditioned at -40° F. Two cartridges out of sixty failed to eject due to insufficient recoil.

During these tests no case casualties occurred. Examination of the fired cases ejected from the M14 rifle showed that almost all of them were subjected to back pressure, which is built-up by use of the blank firing attachment, exerting force on the primer before the bolt unlocks. After the bolt unlocks the gases trapped in the barrel of the rifle are dissipated through the ejection port.

Pre-production Lot

Because of the good results obtained in the preceding tests with Lot C (aperture 0.137 to 0.150 in.), 3000 cartridges of the same type (Lot FAX 7.62-2721) were manufactured for shipment to Springfield Armory for use in the development of blank firing attachments. Prior to shipment, three 20-round magazines were fired in an M14 rifle fitted with Springfield Armory's blank firing attachment, and one 100-rd burst was fired in an M60 machine gun fitted with the blank firing attachment.

The ammunition functioned the M14 rifle and M60 machine gun satisfactorily. No case casualties occurred in the M14 rifle; however,

one fired case (1.0% of the sample) ejected from the M60 machine gun had a split neck. Fifty percent (50%) of the cases ejected from the rifle had slight primer setbacks. There were no perforations in the paper screens placed 15 feet from the muzzle of the weapons.

Because of the one case casualty, a retest of double the number of cartridges was requested. The following table summarizes those results:

<u>Weapon</u>	<u>Functioning</u>	<u>Case Casualties</u>	<u>Primer Set-Backs</u>	<u>Perforation of Screen 14' in front of Muzzle</u>
M14 Rifle	Satisfactory Cyclic Rate 14% lower than in first test	None	100%	None
M60 M.G.	Satisfactory	One Split Neck	None	None

Since Lot FAX7.62-2721 performed satisfactorily in all tests at Frankford Arsenal, the 3000 rounds were shipped to Springfield Armory and the design of the 7.62mm blank cartridge was fixed according to the following drawings:

FB53147 - Cartridge, 7.62mm, Blank: NATO, XM82
 FC8691 - Case Cartridge, 7.62mm, Blank: NATO, FAT 142 E1
 FA30482 - Wad for Cartridge, 7.62mm, Blank: NATO, XM82
 See Appendix XII for drawings.

Eleven thousand (11,000) cartridges designated lot FAX7.62-2722 were manufactured in accordance with the above drawings using the procedure outlined in Appendix V. Because the machine modifications for the loading machine were not completed, these cartridges were hand loaded and hand crimped. Ten cases were withdrawn from the production line after each of the following processes:

Body Anneal - Lot 2722-1
 Neck Anneal - Lot 2722-2
 Final Case - Lot 2722-3

Diamond pyramid hardness values were taken every 1/4 inch along longitudinal cross sections of mounted case specimens. The finished cases were relatively uniform in hardness from the head to the mouth area.

The wall thickness of three cases chosen at random from the lot was measured at various locations along the profiles and found to be approximately equal to or slightly less than the maximum values shown on the drawing. These hardness values, wall thickness measurements, and the description sheet for propellant SR 4759, Lot 66 (the lot of propellant used in these cartridges), are shown in Appendix X.

A ballistic acceptance test was made on Lot FAX7.62-2722 similar to the retest fired with Lot FAX7.62-2721. In addition, 50 cartridges were fired in an M14 rifle for a screen perforation test. During this test, some unburned propellant penetrated a paper screen which was placed 15 feet in front of the muzzle of the weapon and four small holes, approximately 0.1 inch in diameter, were observed in the paper. No casualties occurred, and both weapons functioned satisfactorily.

Seventy-two hundred (7200) cartridges from Lot FAX7.62-2722 were shipped to Aberdeen Proving Ground for Engineering Development tests. An additional 2500 rounds (Lot FAX7.62-2741) were required for the completion of these tests. In the acceptance test at Frankford Arsenal the cartridges of lot 2741 functioned satisfactorily in both weapons. No case casualties occurred, and there was no perforation of the paper screen placed 15 feet from the muzzle of each weapon. However, the screen in front of the machine gun had four pieces of unburned propellant embedded in it.

Ammunition Engineering Test

Aberdeen Proving Ground began the Engineering Test of the XM82 blank cartridge on 25 April 1960. Approximately 2200 cartridges from Lot FAX7.62-2722 were tested in M14 rifles and M60 machine guns in accordance with the procedure set forth in a letter⁸ to Office, Chief of Ordnance from Frankford Arsenal. An extra 1000 rounds were fired in rapid sequence to check the endurance of the blank firing attachment supplied by Springfield Armory for the M60. The M73 tank machine gun was not included in these tests because the weapon was not ready for field use.

The remaining cartridges from this lot and cartridges from Lot FAX7.62-2741 were tested in accordance with Frankford Arsenal Purchase Description MI-2396 dated 13 May 1960⁹.

The preliminary results of the Engineering Tests on the XM82 blank cartridges are given in Appendix XI. The cyclic rates of both weapons were slower with ball ammunition than with blank ammunition. The report of the blank ammunition was uniform over the temperature range in both the rifle and the machine gun. The report of the blank ammunition fired in the machine gun was considerably lower than that

of ball ammunition. Only 0.8% case casualties occurred when firing 5660 blanks in the M14 rifle and 4029 rounds in the M60 machine gun. The casualties in the rifle consisted of three split necks and one pierced primer and in the machine gun four split necks. The weapons functioned as follows:

	<u>M14 w/Modified BFA</u>	<u>M60 w/BFA Tube Welded into Flash Suppressor</u>
No of Rounds Fired	3026	3634
Feeding Failures	2	0
Extraction Failures	1	2
Ejection Failures	1	8
Above Cited Failures Occuring at:		
125°	2	2
70°	1	5
-40°	1	3

No detached metal was detected in any of these firings.

The muzzle flash of both the rifle and machine gun was visible up to 200 yards when fired in daylight. Breech smoke emitting from the ejection port of the rifle was also visible at this distance.

A negligible amount of fouling was observed in both the rifle and machine gun. The barrels of both weapons were gauged before and after firing the blank ammunition. These measurements showed that no detectable wear had occurred.

A paper screen placed 15 feet in front of the gun muzzles showed no indication of penetration. However, after firing 4000 rounds (with an aggregate charge of 11 pounds of propellant), approximately one pound of unburned propellant was collected from paper placed on the ground in front of the weapons.

During these tests, the XM82 blank cartridge represented by Lots FAX7.62-2722 and 2741 satisfied all of the ballistic requirements listed in Frankford Arsenal Purchase Description MI-2396.

The blank firing attachments used in the Engineering Development tests were supplied by Springfield Armory. Figure 12 shows the attachment for M14 rifle. Figure 13 shows the attachment for the M60 machine gun and Figure 14 shows the attachment assembled on the M60 barrel.

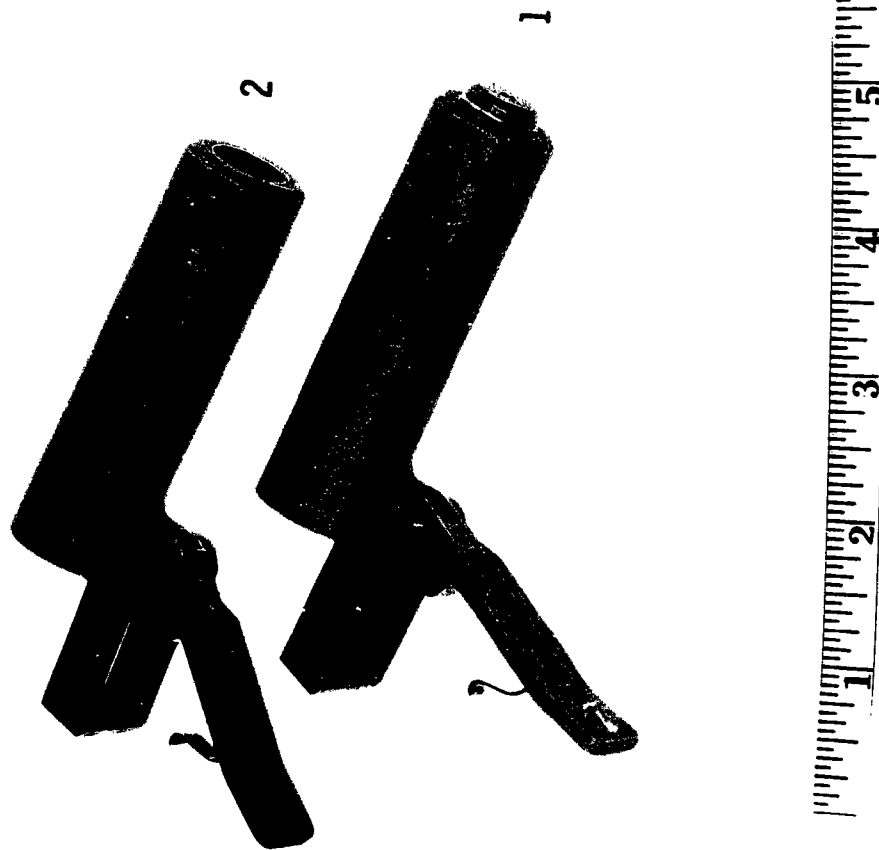


Figure 12.

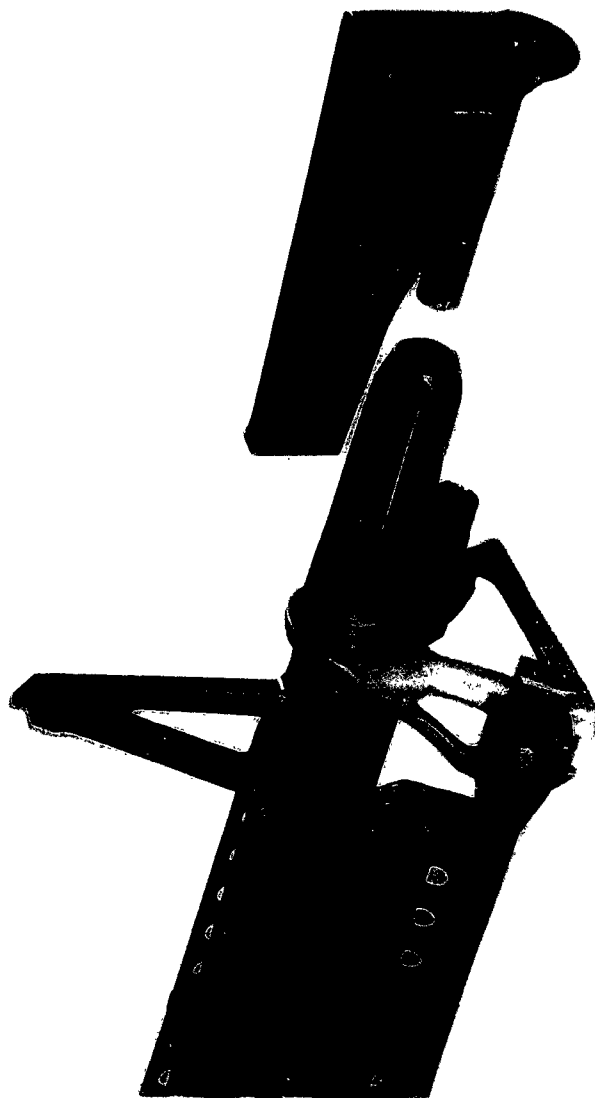
19-058-920/ORD-60

SPRINGFIELD ARMORY - ORDNANCE CORPS
RIFLE, 7.62-MM, M14

(BLANK FIRING ATTACHMENT, SA-C-42457)

1. Normal appearance of blank firing attachment.
2. Appearance of attachment after a caliber 7.62-mm projectile fired when attachment was assembled to weapon.

24 Aug 1960



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100

Figure 13.

SPRINGFIELD ARMORY - ORDNANCE CORPS
GUN, MACHINE, 7.62-MM, M60
Blank Firing Attachment and Parts

19 April 1960



Figure 14.

19-058-427/ORD-60

SPRINGFIELD ARMORY - ORDNANCE CORPS
GUN, MACHINE, 7.62-MM, M60
Blank Firing Attachment Assembled

19 April 1960

Neither the M14 attachment nor the M60 attachment proved to be entirely satisfactory. The M14 attachment aided in the accumulation of heat around the flash hider during repetitive firing. This heat weakened the flash hider prongs which tended to droop after firing five 20-round magazines. During prolonged repetitive firing of the M60 the tube of the blank firing attachment became welded to the flash hider. The attachment could not be removed from the weapon without becoming damaged.

Springfield Armory has redesigned these attachments in an attempt to improve their design. Tests with the improved attachments will be reported elsewhere.

The XM82 cartridge was found to be acceptable by the Office, Chief of Ordnance (Ref. TT ORD 7184, dated 13 June 1960).

CONCLUSIONS

1. The short blank cartridge developed by Frankford Arsenal is unsatisfactory for use in the M60 machine gun because it stubs during feeding in weapons of present design.

2. Belgian, Dutch, and Canadian Blank cartridges function the M14 rifle and M60 machine gun satisfactorily at ambient (70° F) temperature provided blank firing attachments having the correct orifice diameter are used, but develop excessive blowback in the M14 rifle.

3. Results of tests on limited production lots of the XM82 cartridge indicate that this cartridge performs satisfactorily at 125° F, 70° F and -40° F temperatures when fired in the M14 rifle and M60 machine gun fitted with appropriate blank firing attachments.

4. Belgian, Dutch, and Canadian blank cartridges have less energy output than the XM82 blank cartridge when tested with the BFA orifice appropriate for use with the XM82 cartridge.

RECOMMENDATIONS

1. Foreign blank ammunition be used in United States 7.62mm weapons only if the foreign manufacturers modify their ammunition so that it can be used with the blank firing attachments satisfactory for use with the XM82 blank cartridge.

2. Additional tests on the XM82 blank cartridge of regular production manufacture be made in the M14, M60 and M73 weapons using blank firing attachments which are manufactured according to the final design drawings.

3. Type classification of the 7.62mm NATO XM82 blank cartridge as Standard.

REFERENCES

1. Letter w/3 Incls from OCO, ORDTS to FA, 00/8UO-31056, 23 Oct 1958, Subject: Development of 7.62mm Blank Ammunition
2. OTCM 37091, Subject: Cartridge, 7.62mm, Blank: NATO, XM82 - Initiation of Development under D/A Project 504-05-002
3. Technical Requirements Document 17-59
- 4a. Frankford Arsenal Trip Report of 16 Oct 1959 OCO Meeting
- 4b. Minutes of Meeting - 20 381 Pentagon - 16 Oct 1959, Subject: 7.62mm Blank Cartridges and Firing Attachments
5. Trip Report dated 8 Oct 1959 on visit to Springfield Armory
6. Springfield Armory Report on Evaluation of Foreign Blank Ammunition
7. Trip Report dated 18 Jan 1960 on Meeting at OCO to Discuss The Status of the 7.62mm Blank Cartridge
8. Letter to OCO from Frankford Arsenal dated 29 Jan 1960, Subject: Engineering Development Tests for Cartridge, 7.62mm, Blank, XM82
9. Frankford Arsenal Purchase Description MI-2396, dated 13 May 1960

APPENDIX Ia

Mr. AFSchlack/jon/5287
23 June 1959

MEMORANDUM FOR RECORD

SUBJECT: 7.62mm Blank Cartridge with Roll Crimp

1. Twenty standard 7.62mm cases were cannellured per Dwg. FB53230.
2. These cases were primed with Frankford Arsenal's No. 34 primer (Dwg. B8594698).
3. Twelve grains of Western Blank powder were loaded into the cases.
4. Cases were crimped per Dwg. FB53228.
5. Two inert cartridges were fabricated. These cartridges contained no propellant and had dummy primers.
6. The following tests were fired using Gun, Machine, 7.62mm, M60-T161E2 LMG #2 at the Proof House on 17 June 1959. This gun was borrowed from Bridge Tool & Die Works.
 - a. Five (5) live cartridges, 7.62mm, ball, M59 and 1 inert blank cartridge were linked and fired automatically.
 - b. One (1) blank cartridge was linked and fired automatically.
 - c. Three (3) blank cartridges were linked and fired automatically.
 - d. Five (5) blank cartridges were linked and fired automatically.
 - e. Ten (10) blank cartridges were linked and fired automatically and 10 ball cartridges were linked and fired automatically. The two 10 round bursts were timed with a stop watch in order to obtain a rough estimate of the order of magnitude of the cyclic rate which might be obtained with blank ammunition of this type as compared to the M59 ball rounds.

SUBJECT: 7.62mm Blank Cartridge with Roll Crimp

f. During tests b, c, d and e, the blank firing attachment supplied by Bridge Tool & Die Works was attached to the gun. The orifice opening at the beginning of these tests was approximately 0.055 inch. The disc of blank firing attachment was approximately 0.100 inch thick.

7. The following results were obtained:

a. During test a. the inert blank cartridge fed into the chamber by action of the gun.

b. The results of tests b., c. and d. were similar:

- (1) All cartridges fed into the chamber, fired and ejected automatically.
- (2) The disc of the blank firing attachment was slightly bulged out at the completion of the tests.
- (3) The barrel of the gun was examined after each test and was found to be relatively clean.
- (4) Examination of the fired cases showed that the mouth, neck and shoulder of the cases were in good condition, however, the case bodies were expanded near the base to a diameter of approximately 0.480 inch.
- (5) The report of the gun was muffled when firing the blank cartridges.

c. Test e. -- The 10 ball rounds fired in approximately 1.8 seconds (equivalent to 333 rounds per minute) and the 10 blank rounds fired in approximately 1.6 seconds (equivalent to 375 rounds per minute).

/s/ Allen F. Schlack
ALLEN F. SCHLACK

cc: OCO, ORDTS, Mr. L. Thulin
1140, Mr. J. Regan
1411, File

APPENDIX Ib

Mr. AFSchlack/jon/5287
29 May 1959

MEMORANDUM FOR RECORD

SUBJECT: 7.62mm Blank Cartridge with Rosette Crimp

1. Ten standard 7.62mm cases were cannellured per Dwg. FB 53231.
2. These cases were primed with Frankford Arsenal's No. 34 primers (Dwg. B8594698).
3. 12.0 grains Western Blank Powder were loaded into above cases.
4. Cases were crimped per Dwg. FB53229.
5. Two inert cartridges were fabricated - these cartridges contained no propellant and had dummy primers.
6. The following tests were fired using Gun, Machine, 7.62mm, M60 - T161E2 LMG #2 at the Proof House on 26 May 1959. This gun was borrowed from Bridge Tool and Die Works.
 - a. 5 live cartridges, 7.62mm, ball, M59 and 1 inert modified 7.62mm grenade cartridge were linked and fired automatically.
 - b. One modified 7.62mm grenade cartridge was chambered and fired by bolt action.
 - c. Two modified 7.62mm grenade cartridges were linked and fired automatically.
 - d. Five modified 7.62mm grenade cartridges were linked and fired automatically.
 - e. During tests b, c and d the blank firing attachment supplied by Bridge Tool and Die Works was attached to the gun. The orifice opening at the beginning of these tests was approximately 0.050 inch.
7. The following results were obtained:

a. During test a. above the inert cartridge fed into the chamber by action of the gun.

b. The results of test b., c. and d. were similar:

- (1) All cartridges fed into the chamber, fired, and ejected automatically.
- (2) The disc of the blank firing attachment bulged out progressively more during each of the three test firings.
- (3) Large deposits of brass were found in the barrel and on the disc of the BFA.
- (4) Examination of the fired cases showed that the mouth of the cases had sheared, breaking into many small particles.
- (5) Report of gun was muffled.

ALLEN F. SCHLACK

APPENDIX II

FA Wakefield/odm/4268
No. WDB-L-3077
Date: 25 Sept 59
Date of Test 9 - 18 Sept 59

ENGINEER'S INTRADIVISION WORK REQUEST REPLY

TO: Chief, Weapons Development Branch
FROM: Chief, Testing Branch
J.O. 4109 ITEM Gun, Mach. M73 PROJ No. TS2-2015

OBJECT:

Function Test M73TMG with Blank cartridges submitted by Frankford Arsenal.

TEST MATERIEL:

1. Gun, Machine, Tank, M73, Cal. 7.62mm, Serial #26.
2. Plate, Feed. Modified by the addition of a contoured Filler-Block, the purpose of which was to maintain the short blank cartridge in its proper position during the traverse of the linked rounds into the feedway, across the feedplate and into the stripping slot. This filler-block also had a ramp cut designed to guide the cartridge down through the slot in the feed plate and into the barrel chamber.
3. A fully enclosed, non-vented type of booster which has been drilled and threaded for interchangeable gas exit orifices.
4. Two basic types of blank cartridges differentiated by the type of crimping employed to close the case mouth. The two basic lots are each divided into four (4) sub lots which vary only in the weight of powder charge. Lot types and characteristics are shown below:

<u>Type A - Roll Crimped</u>			
Lot FAX-2649	-	10.0	gr.
" "	2650	-	11.0 "
" "	2651	-	12.0 "
" "	2652	-	13.0 "

<u>Type B - Rosette Crimped</u>			
Lot FAX 2645	-	10.0	gr.
" "	2646	-	11.0 "
" "	2647	-	12.0 "
" "	2648	-	13.0 "

/s/ Donald R. Sears
APPROVAL
DONALD R. SEARS
Capt, Ord Corps

/s/ F. A. Wakefield
ENGINEER'S SIGNATURE
F. A. WAKEFIELD

INTRODUCTION:

1. Inasmuch as the work done in connection with this Test Program is actually a simultaneous development of a suitable NATO type blank cartridge and an adaptation of a weapon to the use of blank cartridges which are standardized in neither physical form nor powder charge, the procedures and sequences of testing were necessarily of an exploratory nature characterized by "cut and try". As is usually the case when pursuing such a course, many of the costs and motions are non-productive of anything either physical or informational which is significant to the furtherance of the objective. Most, if not all of this non-productive horsework will be omitted from this report as being irrelevant. All items considered to be in any respect significant however will be reported.

PROCEDURES AND RESULTS:

1. The test weapon, with modified feed plate installed, was attached to a rigid gun mount and the .125" orifice was screwed into the booster.

2. Attempts were made to fire cartridges from lots 2652 and 2648, representing the two basic types of mouth crimping. Inability of the weapon to feed the cartridges was demonstrated by a stubbing at 6 o'clock on the barrel at each attempt to fire. Reshaping the ramp portion of the filler-block failed to improve the misfeeding condition.

3. Time/Displacement curves were recorded with lot #2649 (10.0 gr. charge) through the expedient of manually loading single rounds directly into the chamber. An apparent need for reduction of overall power input plus the desirability of reshaping certain portions of the time/displacement curve resulted in enlarging the booster orifice (by steps) to .1875" and the addition of six (6) equally spaced radial bleeder holes, each .1875" diameter, located 1-3/4" to the rear of the front face of the booster.

4. Satisfactory feeding and automatic fire were realized at this point through a further modification to the feed plate which extended the control lips so that the cartridge was maintained on top of the plate and under control for an additional 5/16" of its forward travel. Two (2) twenty shot bursts produced a rate of 408 rounds/minute.

5. The net result of another protracted period of "cut and try" was the further modification of the booster by the addition of another row of twelve (12) equidistant radial bleeder holes located 3/4" forward of the original holes described in Para. 3., and the firing of cartridges from lot 2651 (12.0 gr.).

PROCEDURES AND RESULTS: (Cont'd)

6. With the above combination of modifications and ammunition, the weapon successfully pulled in three (3) twenty round belts (with additional rounds to make up the weight of 100 rounds) and recorded an average rate of 480 rd./min.

7. As a further confirmation of the adequacy of the power-input, the weapon was fired with a 100-round and a 20-round belt of lot 2650 (11.0 gr.) without malfunction, although the cadence of fire was noted to be slightly irregular.

CONCLUSIONS:

1. It is concluded that blank cartridges having the physical and ballistic characteristics of FAX-7.62-2651 may be successfully used in conjunction with the M73 Tank Machine Gun, provided that modifications as developed and proved during this test are incorporated in the weapon.

2. It is further concluded that the bleeder holes in addition to their function of tailoring the time/displacement curve, also serve as expulsion channels for the fouling which would otherwise be deposited in the booster chamber. Observation of the time/displacement curves recorded during the various phases of bleeder-hole incorporation leads to the belief that the original (most rearward) row of bleeders were, for all practical purposes, of no effect.

RECOMMENDATION:

1. It is tentatively recommended that:
 - a. A NATO type Blank cartridge duplicating the physical and ballistic characteristics of FAX 7.62-2651 be regarded as the basic standard, pending further confirmation, and
 - b. that a number of M73s be modified to the degree with which the final firing was done on this program, and
 - c. that tests be made to determine whether or not fouling accumulation in the booster area will present a problem, and
 - d. that testing be conducted in significant depth to establish the validity of test results and conclusions therefrom.

FA Wakefield/odm/4268
No. WDB-L-3070
Date: 29 Sept 59
Date of Test 8 - 22 Sept 59

ENGINEER'S
INTRADIVISION
WORK REQUEST REPLY

TO: Chief, Weapons Development Branch
FROM: Chief, Testing Branch
J.O. 4109 ITEM Gun, Mach., M60 (7.62) PROJ.No.TS2-2015

OBJECT:

Function test subject weapon with blank ammunition submitted by Frankford Arsenal.

TEST MATERIEL:

1. Gun, Machine, M60, Cal. 7.62 mm, Serial #59.
2. Plate, Feed, modified by the addition of a filler-block, the purpose of which is to guide and maintain the short blank cartridge into its proper position in the feedway.
3. A muzzle attachment which replaces the flash-suppressor and incorporates interchangeable muzzle exit orifices.
4. Two basic types of blank cartridges with each type sub-divided into four sub-lots as follows:

Type A - Roll Crimped

Lot FAX-2649 - 10.0 gr.
" " 2650 - 11.0 "
" " 2651 - 12.0 "
" " 2652 - 13.0 "

Type B - Rosette Crimped

Lot FAX-2645 - 10.0 gr.
" " 2646 - 11.0 "
" " 2647 - 12.0 "
" " 2648 - 13.0 "

INTRODUCTION:

1. It will be appreciated that due to the undeveloped status of either the blank firing attachments for the weapon, or the physical

/s/ Donald R. Sears
APPROVAL
DONALD R. SEARS
Capt, Ord Corps

/s/ F. A. Wakefield
ENGINEER'S SIGNATURE
F. A. WAKEFIELD

29 September 1959

INTRODUCTION: (Cont'd)

and/or ballistic characteristics of the ammunition, the testing procedures and sequences are of necessity of an exploratory nature featuring "cut and try". Pursuance of such programs invariably results in some false starts and short casts which produce nothing physical or factual of significance. Most, if not all of these fruitless pursuits and the results thereof will be omitted from this report as being irrelevant.

PROCEDURE & RESULTS:

1. All firing, unless otherwise specified, was done from the shoulder. Time/Displacement records were made with the weapon attached to a rigid base.
2. During the initial firings, it was noted that single rounds laid in the feedway slot could not be fed owing to stubbing. Upon further firing it was noted that even belted cartridges gave a high percentage of stubbing if the loops of the leading link contain a cartridge. This difficulty was greatly alleviated (though not entirely eliminated) if the double loops of the leading link are empty.
3. During the firing of the lots in which the Rosette crimp was used, a number of instances were noted in which the crimped portion of the case mouth separated from the neck as was blown through the bore.
4. Finally, after 165 rounds of trials with various combinations of crimp, charge and barrel exit orifice, a 46-round belt was fired without malfunction. This was accomplished with an .0935" orifice and ammunition from lot FAX-2652 (13.0 gr.) The rate of fire was 640 rounds/minute.
5. The above firings was followed by another phase of jockeying orifice diameters versus powder charge in an effort to eliminate bulging cases (indicating early unlocking) and to achieve a Time/Displacement curve with more normal configuration.
6. Time/Displacement records were made using FA lot 2651 and muzzle orifices of .062", .078" and .093". Velocities at unlock were 11.7, 11.4 and 10.6 ft./sec., and at the sear were 11.8, 10.6 and 9.4 ft./sec., respectively. The higher velocities in all cases being produced by the smallest orifice.

CONCLUSIONS:

1. On the basis of this very limited testing, it is concluded that the Rosette Type of case mouth crimp, as tested, is unacceptable, owing to the potential danger created by the separation of the crimped portion of the neck which then becomes a projectile.

2. Of the lots of roll-crimped ammunition tested, lot FAX 2651 having the 12.0 grain charge seems to represent a satisfactory balance between opulence and poverty, powerwise.

3. A study of the time/displacement curves leads to the conclusion that the .062" orifice provides the most normal velocities to the recoiling parts.

RECOMMENDATIONS:

1. It is tentatively recommended that

- (a) for the purpose of establishing a fixed factor in this simultaneous gun/ammunition development, that cartridges duplicating the physical and ballistic characteristics of FAX-2651 be regarded as the basic standard, and
- (b) that ammunition incorporating the Rosette type of mouth closure be given no further consideration unless the defects as noted above can be completely eliminated, and
- (c) that further testing be conducted on a group of weapons to confirm the tentatively recommended orifice diameter of .062", and
- (d) attention is respectfully drawn to the fact that the use of the long blank cartridge configuration, of which the Belgian NATO is representative, eliminates all but ballistic considerations in all weapons and feed mechanisms which will successfully feed bulletted NATO rounds.

APPENDIX III

<u>NATIONALITY</u>	<u>CASE</u>	<u>PROPELLANT</u>	<u>MOUTH CLOSURE</u>	<u>SEAL</u>
Canadian	Composition: Brass Length: 2-11/16" Weight: 244 grs	11.0 grs Hercules Unique	Wall Thk - .028 in Mouth Area Cut into cup Four Equal Seg- ments & Crimped until closed	Paper Seal at cup over propel- lant
Belgian	Composition: Brass Length: 2-9/16" Weight: 168 grs	12.0 grs Solid Extruded Rod 1/16" long x 1/32 dia irregular cut	Wall Thk - .015 in Mouth Folded in 3 Sections & Pinched Closed.	Lacquer Seal at Mouth
Dutch	Composition: Brass Length: 2-5/8" Weight: 215 grs	10.5 grs; T-profile	Mouth Wall Tapered from .022. Rosette Crimp to .009.	Alumi- num Lacquer Seal at Mouth
German:	Composition: Body-Plastic Similar to Bakelite Base-Brass Length: 2-3/4" Weight: Body: 34 Base: 96	10.3 grs T-profile	Bullet Tip Closed but Serrated to Weaken Body at This Point	Closed Mouth

APPENDIX IV

The following test procedure was submitted to Springfield Armory as a guide for evaluating these foreign cartridges:

1. Blank Ammunition to be tested
 - a. Belgian
 - b. Canadian
 - c. Dutch
 - d. German
2. Test Weapon to be used (using new barrels for each type of cartridge)
 - a. 7.62mm M60 machine gun
 - b. 7.62mm M73 machine gun
 - c. 7.62mm M14 rifle
3. Tests to be conducted for evaluation of each type of foreign blank cartridge
 - a. Five ten rounds M80 ball cartridges, single shot in each of the three weapons to determine muzzle velocity.
 - b. Using M80 ball cartridges, fire 3 ten round targets in the rifle and 3 twenty round burst targets in each machine gun to determine accuracy at 100 yards. Gauge and inspect barrels.
 - c. Assemble appropriate blank firing attachments to each weapon.
 - d. Determine the correct orifice size for the blank firing attachments by taking time-displacement curves by firing a 10 round series of blank cartridges single shot.
 - e. Fire 50 round belt of blank cartridges in an M60 machine gun under each of the following conditions:

Condition Temperature of
Weapon and Ammunition

-40
70
125
-40

Weapon Attitude

Vertically Upward
Vertically Upward
Vertically Upward
Horizontal

Condition Temperature of
Weapon and Ammunition

Weapon Attitude

70
125
-40
70
125

Horizontal
Horizontal
Vertically Downward
Vertically Downward
Vertically Downward

During the above tests the following data should be observed and recorded:

- (1) Feeding
(2) Noise (outdoors with audiometer placed 3 feet from gun)
(3) Cyclic rate
(4) Residue and fouling
(5) Smoke and flash
(6) Ejection
(7) Barrel wear due to erosion and peening

f. Fire four (4) additional 100 round belts of blank cartridges in an M60 machine gun conditioned at 70° F and held in the horizontal position to check for barrel wear and peening (optional depending upon the availability of ammunition).

g. Repeat step e using the M73 machine gun in lieu of the M60 machine gun.

h. Fire 3 magazines of blank cartridges in the M14 rifle under each of the conditions listed in step e and record the same information as in step e.

i. Remove blank firing attachments from all weapons.

j. Repeat step a.

k. Repeat step b.

APPENDIX V

SEQUENCE OF OPERATIONS FOR MANUFACTURE OF CTG 7.62mm, BLANK: NATO, XM82

Cup
1st Draw
Anneal, pickle, wash, rinse & dry
2nd Draw
Wash, Rinse & Dry
Trimming
Heading
Wash, Rinse & Dry
Head Turning
Venting
Body Anneal
1st Tapering
Wash, Rinse & Dry
Neck Anneal
2nd Tapering
Wash, Rinse & Dry
Final Trim
Stress Relief & Polish
Visual Inspection
Deburring Pocket & Mouth Sizing
Detect
Primer Insertion & Primer Seating
Primer Staking
Waterproofing
Powder Loading
Gauging
Wad Insertion
Lacquering
Crimping
Inspection

APPENDIX VI

Results of Preliminary Tests Conducted at Frankford Arsenal on the Design Study

Type of Propellant

Date of Test: 3 Dec 59
 Ctg: Dwg FB53132 - 2.75" long
 Weapon: M14 rifle No. 1353
 BFA: Test - Dwg FB53233

Orifice Diameter - 0.188"

<u>Propellant</u>	<u>Charge grs.</u>	<u>No. Rds Fired</u>	<u>Cyclic Rate</u>	<u>Function</u>
SR 4759	19.0	10	-	1FE - i.r.
	19.0	5	600	OK
	20.0	10	-	OK
	20.0	10	720	OK - 1 neck split
	21.0	1		Neck split
	22.0	1		Neck split
Hercules	14.0	13		2FF and 2FE - i.r.
Unique	15.0	1		Neck split
	16.0	1		Neck split
Hercules	19.0	10	-	2ff and 1FE - i.r.
2400	20.0	7	720	OK
	20.0	7	624	OK

Orifice Diameter - 0.157"

Hercules	14.0	10		1FF and 3FE - i.r.
Unique				

Orifice Diameter - 0.125"

T-Profile (Holland)	10.3	3		OK
Hercules	14.0	10	720	OK
Unique	14.0	12	696	OK

NOTE: i.r. = insufficient recoil

Date of Test: 10 Dec 59
 Ctg: Dwg FB53132 - 2.625" long
 Weapon: M14 rifle No. 1020
 BFA: Test - Dwg FB53233

Orifice Diameter - 0.188"

<u>Propellant</u>	<u>Charge grs.</u>	<u>No. Rds Fired</u>	<u>Cyclic Rate</u>	<u>Function</u>
SR 4756	14.0	4		1 stoppage - i.r.
	16.0	5	608	OK
	16.0	14	630	OK
	18.0	3		1-FE

Orifice Diameter - 0.157"

SR 4756	14.0	3		1-FF
---------	------	---	--	------

Orifice Diameter - 0.125"

SR 4756	14.0	14	630	OK
SR 4990-6	12.0	5		2-FF - i.r.
	13.0	5	617	OK
	14.0	5	624	OK

Overall Length of Cartridge

Date of Test: 7 Dec 1959
 Ctg: Dwg FB53132
 Propellant: SR 4759 Chg. 18.0 grs.

1. Weapon: M14 Rifle No. 1020
 BFA: Test - Dwg FB53233

Orifice Diameter - 0.188"

<u>Length of Ctg</u>	<u>No. Rds Fired</u>	<u>Cyclic Rate</u>	<u>Function</u>
2.625	10		3 stoppages - i.r.
2.25	1		FE - i.r.

Orifice Diameter - 0.157"

2.625	1		FF - i.r.
2.75	1		FE - i.r.

Orifice Diameter - 0.125"

2.625	6		1 stoppage - i.r.
2.625	20	671	OK
2.625	20	671	OK
2.75	20	634	OK

2. Weapon: M14 Rifle No. 1353
BFA: Test - Dwg FB53233

Orifice Diameter - 0.125"

2.625	20	621	OK
2.75	20	684	OK

3. Weapon: M60 machine gun No. 406
BFA: Test - Dwg FB53234

Orifice Diameter - 0.125"

2.625	14	506	OK - few breech sparks
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Thickness of Tagboard Wad

Date of Test: 30 Dec 1959
 Ctg: Dwg FB53132 - 2.625" long

1. Weapon: M14 Rifle No. 1312
 BFA: Test - Dwg FB53233
 Orifice diameter: 0.188"

19.0 grs SR 4759 Propellant

<u>Thickness of Wad</u>	<u>No. Rds Fired</u>	<u>Cyclic Rate</u>	<u>Noise Level</u>	<u>Function</u>
.015	10	641	116	OK
2-.015	10	591	116	OK
.042	10	637	117	OK
.042	10	-	-	2 stoppages - i.r.

16.0 grs SR 4756 Propellant

.015	20	605	120	2FF and 1FE - i.r.
2-.015	10	603	119	OK - 1 swollen case neck.
.042	10	635	118	Large muzzle flame.
				1FF - i.r.

2. Weapon: M60 machine gun No. 406
 BFA: Test - Dwg FB55234
 Orifice diameter: 0.188"

19.0 grs SR 4759 Propellant

.015	10	534	117	OK
2-.015	10	557	119	OK
.042	10	606	117	OK
.042	10	589	116	OK

16.0 grs SR 4756 Propellant

.015	10	480	122	OK
2-.015	10	576	119	OK
.042	10	461	119	OK

Wall Thickness at the Neck of the Cartridge

Date of Test: 18 Jan 60
 Ctg: Dwg FB53132
 Propellant: SR 4759 Chg: 20.0 grs
 Weapon: M14 Rifle No. 1020
 BFA: Test - Dwg FB53233

Orifice Diameter - 0.188"

<u>Length of Ctg</u>	<u>Wall Thickness</u>	<u>Thickness of Wad</u>	<u>No. Rds Fired</u>	<u>Function</u>
2.75	.021	.016	10	OK, 2 case neck splits
2.75	.021	.032	10	OK
2.625	.021	.016	10	OK, 7 case neck splits
2.625	.021	.032	10	OK, 4 case neck splits
2.625	.025	.016	10	OK
2.625	.025	.032	10	OK

Orifice Diameter - 0.157"

2.75	.021	.016	10	OK, 4 case neck splits
2.75	.021	.032	10	OK, 3 case neck splits
2.625	.021	.016	10	OK, 2 case neck splits
2.625	.021	.032	10	OK, 6 case neck splits
2.625	.025	.016	10	OK
2.625	.025	.032	10	OK

APPENDIX VII

TRIP REPORT (EXEMPT FROM REPORTS CONTROL - AR 305-15, PAR. 4a)		1. NUMBER T.O. 1400-133-60																									
2. TRIP (S)		3. TRAVELER (S)																									
A. PLACE(S) VISITED Springfield Armory Springfield, Mass.	B. DATES 12 February 1960	A. NAME(S) Allen F. Schlack	B. TITLE(S) Chemical Engineer																								
4. PURPOSE OF TRIP(S) To observe test firing of 7.62mm blank ammunition in the M14 rifle and M60 machine gun.		5. PERSONS CONTACTED (NAME AND TITLE) Mr. A. Lizza Mr. C. Packard Mr. S. Caloccia Mr. F. Chakow																									
6. REPORT (CONTINUE ON 8 X 10-1/2" WHITE BOND PAPER IF NECESSARY)																											
The writer was briefed on the preliminary results obtained with blank ammunition from lot FA X7.62-2715 (19.0 grs SR 4759, 2-5/8" length, .025" wall thickness and .042" wad). TD and PT curves were made on this ammunition when fired in an M14 rifle which was fitted with a blank firing attachment having a .140 orifice diameter. The results of these curves were compared with similar results obtained with ammunition from lot FA X7.62-2689 (19.0 grs SR 4759, 2-9/16" length, .021" wall thickness and .015" wad). Ammunition from lot 2715 produced more consistent results on both the TD and PT curves. Cartridges from lot 2715 tended to have a slightly higher port pressure after 4 ms than cartridges from lot 2689. This higher pressure level may cause a greater amount of blowback. Examination of the fired cases showed that those cartridges from lot 2689 split at the neck and those cartridges from lot 2715 were in good condition. The writer witnessed the following tests in an M14 rifle which was fitted with a BFA having a .140 orifice diameter using ammunition from lot 2715. <table border="1"> <thead> <tr> <th><u>Attitude of Weapon</u></th> <th><u>Firing Cycle</u></th> <th><u>Quantity</u></th> </tr> </thead> <tbody> <tr> <td>Horizontal</td> <td>Semi-Automatic</td> <td>20</td> </tr> <tr> <td>Horizontal</td> <td>Spasmatic</td> <td>20</td> </tr> <tr> <td>Horizontal</td> <td>Automatic</td> <td>20</td> </tr> <tr> <td>Vertical Up</td> <td>Semi-Automatic</td> <td>5</td> </tr> <tr> <td>Vertical Up</td> <td>Automatic</td> <td>5</td> </tr> <tr> <td>Vertical Down</td> <td>Semi-Automatic</td> <td>5</td> </tr> <tr> <td>Vertical Down</td> <td>Automatic</td> <td>5</td> </tr> </tbody> </table>				<u>Attitude of Weapon</u>	<u>Firing Cycle</u>	<u>Quantity</u>	Horizontal	Semi-Automatic	20	Horizontal	Spasmatic	20	Horizontal	Automatic	20	Vertical Up	Semi-Automatic	5	Vertical Up	Automatic	5	Vertical Down	Semi-Automatic	5	Vertical Down	Automatic	5
<u>Attitude of Weapon</u>	<u>Firing Cycle</u>	<u>Quantity</u>																									
Horizontal	Semi-Automatic	20																									
Horizontal	Spasmatic	20																									
Horizontal	Automatic	20																									
Vertical Up	Semi-Automatic	5																									
Vertical Up	Automatic	5																									
Vertical Down	Semi-Automatic	5																									
Vertical Down	Automatic	5																									

In all of the above tests the weapon functioned satisfactorily. Sufficient blowback was encountered to irritate the gunner. Also, an 18" flash at the muzzle was observed. Examination of the fired cases showed that one case split at the neck.

An M60 machine gun was fitted with a BFA having a .125" orifice diameter. Two 10 round strings of ammunition from lot 2715 were fired in this weapon. The weapon seemed to be slightly underpowered. A large muzzle flash was observed. Examination of the cases showed that two cases split at the neck.

To complete the evaluation of lot 2715 Springfield Armory has scheduled the following tests:

1. Repeat tests fired in M14 rifle using a cover shield over the ejection port. Check amount of fouling of rifle after tests.
2. Determine correct orifice diameter for M60 machine gun from TD curves.
3. Fire 150 rounds for function in M60 machine gun. Check amount of fouling of machine gun after tests.
4. Check feeding in M73 machine gun.

Springfield Armory expects to complete the evaluation of lot 2715 in two days. On 16 February 1960, Springfield Armory will report to this arsenal the results of this evaluation. At that time they will indicate which ammunition (either lot 2715 or 2689) is needed for further development of the blank firing attachment.

Allen F. Schlack
ALLEN F. SCHLACK
Chemical Engineer

Seymour Miller
SEYMOUR MILLER
Acting Chief, Small Arms Ammo Dev Br

Distribution:

0100-Senior Scientist
8800-Mr. H. Penn, Bldg 214
1000-Chief, PDLG
1100-Chief, Mission Mgmt Ofc
1140-Chief, Small Arms Ammo Br, MMO
1410-File
1411-File
1410-Weekly File

Capt Dorton	HZA	4/14/60
Col Tyler	WWS	24/4/60
1411		
Mr Dawett	CCF	2/24

APPENDIX VIII

Tests Conducted to Minimize the Number of Fired Cases Which Split at the Neck

Method 1

Date of Test: 25 Feb 1960
 Ctg: Dwg FB53132 - Modified Second Shoulder
 Propellant: SR 4759 Charge 19.0 grains
 Weapon: M60 machine gun No. 406
 BFA: Test - Dwg FB53234, 5/32 inch diameter orifice

<u>Lot</u>	<u>Description of 2nd Shoulder</u>	<u>No. Rds Fired</u>	<u>Function</u>
1	17° angle	20	OK, 3 case neck split
2	Double angle (17° followed by 45°)	20 20	OK, 1 case neck split OK, 1 case neck split
3	1/4 inch radius	20 20	OK, no case casualties OK, no case casualties

Method 2

Date of Test: 2 March 60
 Ctg: Dwg FB53147 - Modified Second Shoulder
 Cases: Retapered to obtained new location of Second Shoulder
 Propellant: SR 4759 Charge 19.0 grs

a. Weapon: M14 Rifle BFA: Test-Dwg FB53233, 5/32 inch
diameter orifice

A	17° angle	18	4FE - No case casualties
A	17° angle	18	2 misfires - due to deformed 1st shoulder the gun was not in battery- No case casualties
B	1/4 inch radius	3-20 rd magazines	OK - No case casualties

- b. Weapon: M60 machine gun BFA: Test-Dwg FB53234, 5/32
inch diameter orifice

<u>Lot</u>	<u>Description of 2nd Shoulder</u>	<u>No. Rds Fired</u>	<u>Function</u>
A	17° angle	18	OK - No case casualties
A	17° angle	18	OK - No case casualties
B	1/4 inch radius	20	OK - No case casualties
		20	OK - No case casualties

APPENDIX IX

Temperature Conditioning Tests

Results of Tests Conducted at High and Low
Temperatures on Cartridges from Lot C having
an Aperture Diameter between 0.137 and 0.150 inches

Date of Test: 23 March 60
Cartridge: Dwg FB53147 - Lot C
Cases: Retapered to obtain new location of Second Shoulder
Propellant: SR 4759 Charge: 19.0 grains

1. Weapon: M14 Rifle No. 1020
BFA: Springfield Armory attachment - 0.113" diameter orifice

Fired Outdoor

<u>Conditioned Temperature of Cartridges</u>	<u>Attitude of Rifle</u>	<u>No. Rds Fired</u>	<u>Results</u>
-40	Vertically up*	60	No case casualties; 1 low report
+125	Vertically up*	60	100% slight primer set- backs; 3 extra loud reports
-40	Vertically up	60	2FJ - insufficient recoil Weapon slowed up toward end of bursts
+125	Vertically up	60	Satisfactory function; 100% slight primer setbacks
-40	Vertically down	60	Satisfactory function; 100% slight primer setbacks
+125	Vertically down	60	1 stoppage - "chicken"; 100% slight primer set- backs

*No BFA was used with these firings.

Fired Indoor					
<u>Conditioned Temperature of Cartridges</u>	<u>Attitude of Rifle</u>	<u>No. Rds Fired</u>	<u>Cyclic Rate</u>	<u>Noise Level</u>	<u>Results</u>
-40	Horizontal	20	684	100	Satisfactory Function.
		20	684	100	100% slight primer
		20	701	102	setbacks
+125	Horizontal	20	726	106	Satisfactory Function.
		20	735	106	100% slight primer
		20	745	106	setbacks

2. Weapon: M60 machine gun No. 406
 BFA: Test, Dwg , 5/32" orifice diameter

Fired Indoor					
-40	Horizontal	50	533	107	Satisfactory Function.
+125	Horizontal	50	611	113	Satisfactory Function.

APPENDIX X

DIAMOND PYRAMID HARDNESS

Lot 2722-1, Body Anneal

Diamond pyramid hardness values obtained on longitudinal cross section of mounted specimens. (2-1/2 and 1 kg load).
Dist. from outside surface of base (in.)

Lot 2722-2, Neck Anneal

Diamond pyramid hardness values (2-1/2 kg load) obtained on longitudinal cross section of mounted specimens at locations indicated.
Dist. from outside surface of base (in.)

Lot 2722-3, Finished Case

Diamond pyramid hardness values (2-1/2 kg load) obtained on longitudinal cross section of mounted specimens.
Dist. from outside surface of base (in.)

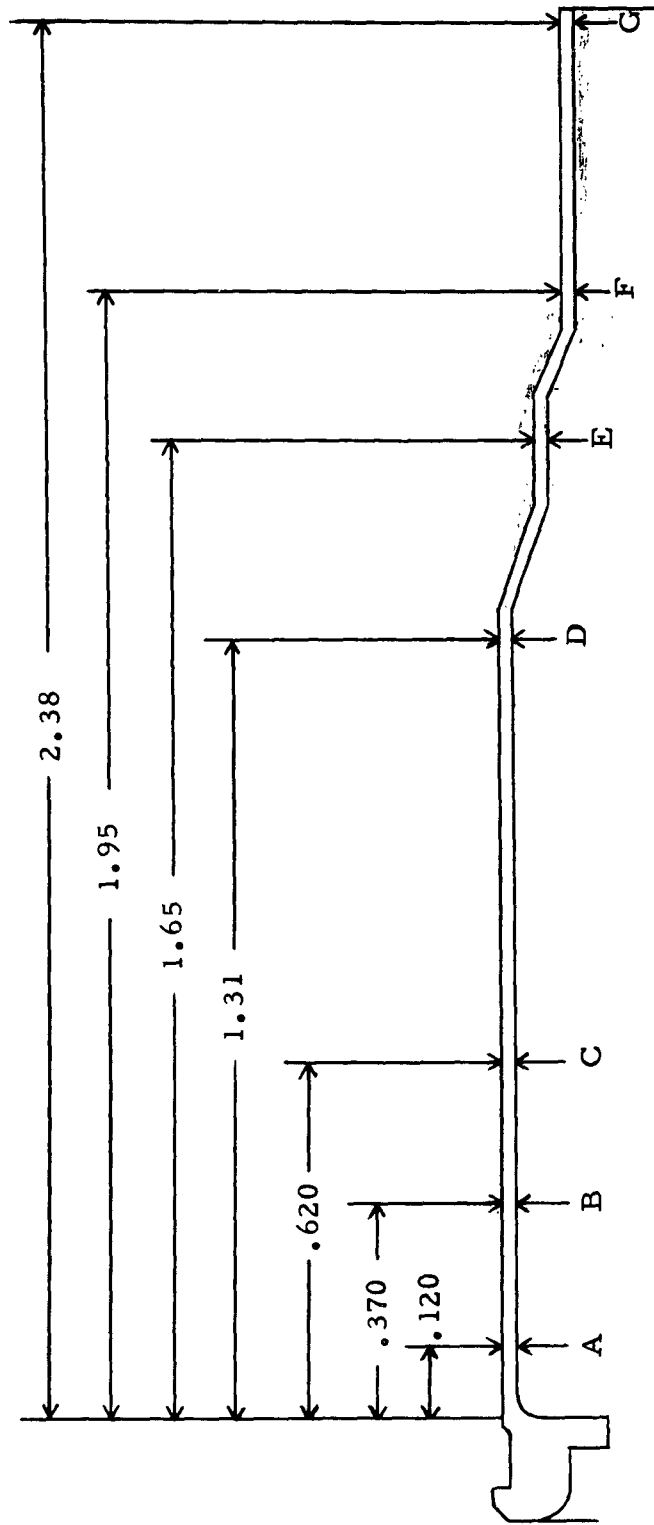


Table I. Wall Thickness Measurements: Lot FAX7.62-2722

POSITION	A	B	C	D	E	F	G
Case 1	.0415	.0290	.0210	.0145	.0185	.0240	.0210
Case 2	.0410	.0300	.0225	.0145	.0185	.0242	.0210
Case 3	.0405	.0305	.0220	.0142	.0185	.0242	.0210
Average	.0410	.0300	.0220	.0145	.0185	.0240	.0210
Values Shown on Drawing FC8691							
Maximum	-	-	-	-	-	.027	.027
Minimum	.032	.023	.020	.016	.018	.023	.023

E. I. DU PONT DE NEMOURS & CO., INC.
EXPLOSIVES DEPARTMENT, BLASTING SUPPLIES, N/C & POWDER SECTION
CARNEY'S POINT WORKS

5/26/60

SMOKELESS RIFLE POWDER DESCRIPTION SHEET

DESIGNATION: DU PONT SPORTING RIFLE POWDER - SR-4759 Lot 66

COMPOSITION: Nitrocellulose----(13.20% N)---100.0 Parts
 Composed of:
~~Ground Powder~~
~~Saved~~ ~~Alk~~-----}--See Make-Up
 H.G.-Pyro-100%-----}
 Diphenylamine-----added----- 0.7 Parts
 Graphite-----added----- None Parts
~~Wasa~~ Potassium Nitrate-----See Make-Up-----16.5 Parts
 Solvent: - Ether/Alcohol 65/35-----96.0 Parts

PROCESS: Granulation: Cut dry into bags, then immersed in water.
 Solvent Removal: Water dried: 2 days at 55°C, 8 days at 60°C
 Air Dried: 19 hrs. at 55°C
 Glazed: 1.0% graphite

ANALYSIS: Total Ether Extract----- 0.75%
 Total Volatiles----- 1.42%
 External Moisture----- 1.21%
 Residual Solvent----- 0.21%
 Diphenylamine----- 0.60%
~~Wasa~~ Potassium Nitrate----- 0.03%
 Ash----- 0.04%
 DNT & DBP-----
 Nitrocellulose----- 97.80%
 MVP at 134.5°C.----- 50'
 Explosion----- 5 + hrs.
 Gravimetric Density----- 672

DIMENSIONS: Die Finished Grain

Length:----- .0606" .0561"
 Diameter:----- .0700" .0498"
 Perforation:---- .0300" .0198"
 Mean Web:----- .0200" .0150"

ANALYSIS OF NITROCELLULOSE:

<u>Blend</u>	<u>Calculated Nitrogen</u>	<u>E-A Sol.</u>	<u>Ash</u>	<u>KI</u>	<u>MVP</u>
2018	13.21	35.6	.06	38'	30'
2019	13.20	38.2	.05	37'	30'

MAKE-UP DATA:

[illegible]

* % GP/% SA/% HG-P

PACKED: 10/20/59

WEIGHT: Covering 50 lbs. shipped to Frankford Arsenal on 4/11/60,
on FA order 60-F-6202, Du Pont Order CSNY-6076.

W. M. DONALDSON, MANAGER
CARNEY'S POINT WORKS

BY: Neil C. Miller
NEIL C. MILLER,
SENIOR SUPERVISOR

NCM:mgs

APPENDIX XI

Preliminary Results of Engineering Development Tests on Cartridge, 7.62mm, Blank: NATO, XM82 - Lots FAX7.62- 2722 and FAX7.62-2741

Weapon: M14 Rifle

BFA: Springfield Armory Attachment, Dwg SAD 42504

Conditioned Temperature of Ammuni- tion and Weapons °F	No. of Rounds Fired	Approxi- mate Noise Level db	Repre- sentative Cyclic Rate rpm	Case Casualties
-40	540	123	772	None
Ambient	2467	123	797	Two fired cases had split necks.
+125	1022	124	813	Two fired cases had split necks.
	<u>4029</u>			

Weapon: M60 Machine Gun

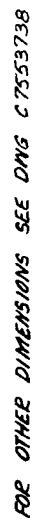
BFA: Springfield Armory Attachment, Dwg SAD 42801

-40	500	120	620	None
Ambient	4385	122	657	Two fired cases had split necks. One fired case had a pierced primer.
+125	775	122	685	One fired case had a split neck
	<u>5660</u>			
Total Rounds Fired	9689			

Representative Noise Level and Cyclic Rate Readings obtained with
M80 Ball Ammunition Fired at Ambient Temperatures

Weapon	Noise Level db	Cyclic Rate rpm
M14	-	740
M60	136	574



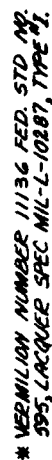
71

BEFORE CANNELURE
2.015 ± .015
1.784 ± .005
.092
.005
.287

.092

FOR OTHER DIMENSIONS SEE DWG C 7553738

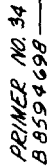
PITMAN-DUNN LAB GR. ORDNANCE CORPS DEPT OF THE ARMY US ARMY ORD ARSENAL FANNINGFORD		FB 53231	
CASE, CARTRIDGE, 7.62 MM BLANK. (ROSETTE CRIMP)		SCALE: 1/1	
DATE: 10/15/1940		BY: 10/15/1940	
DRAWN BY: 10/15/1940		CHECKED BY: 10/15/1940	
MATERIAL: CARTRIDGE BRASS ANNEALED, SPEC. MIL-B-50		FINISH: POLISHED	
TREATMENT: HEAT TREATMENT		MARKING: INDICATIVE MARK	
FB 53231		CTG. 7.62 MM	
BLANK		ROSETTE CRIMP	
APPROVED FOR APPLICATION		APPROVED FOR APPLICATION	
DATE: 10/15/1940		DATE: 10/15/1940	
BY: 10/15/1940		BY: 10/15/1940	
CHECKED BY: 10/15/1940		CHECKED BY: 10/15/1940	
MATERIAL: CARTRIDGE BRASS		MATERIAL: CARTRIDGE BRASS	
ANNEALED, SPEC. MIL-B-50		ANNEALED, SPEC. MIL-B-50	
TREATMENT: HEAT TREATMENT		TREATMENT: HEAT TREATMENT	
FINISH: POLISHED		FINISH: POLISHED	
MARKING: INDICATIVE MARK		MARKING: INDICATIVE MARK	



PRIMER TO BE SECURED IN
POCKET BY A CIRCULAR
CRIMP JOINT BETWEEN
BALLS OF PRIMER AND
POCKET WATERPROOFED
WITH A VISIBLE MATERIAL,
SPEC MIL -L-10287.

74

NOTE :-

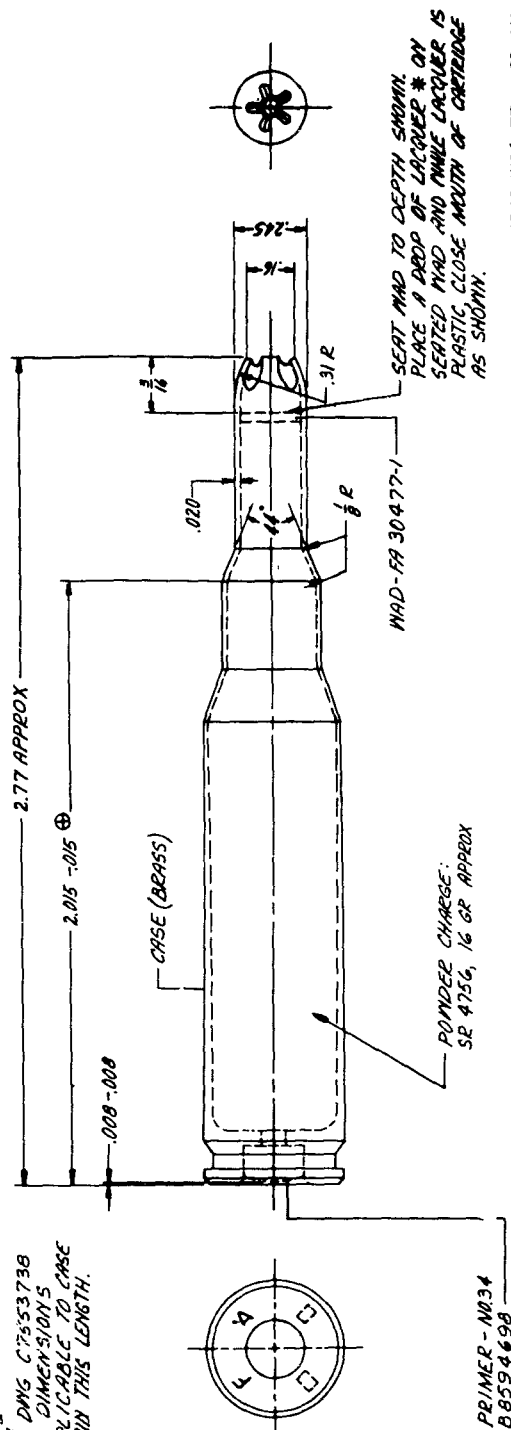


* VERMILION NUMBER 11136 FED. STD NO.
595, LACQUER SPEC MIL-1-10287,
TYPE #1

NOTE: JOINT BETWEEN WALLS OF PRIMER AND POCKET MATERIAL, WITH A VISIBLE MATERIAL, SPEC MIL-L-10287

CARTRIDGE,
7.62 MM BLANK
DESIGN STUDY #1

NOTE:
 SEE DWG C7553738
 FOR DIMENSIONS
 APPLICABLE TO CASE
 WITHIN THIS LENGTH.



* VERMILION NUMBER W36 FED. STD NO. 595, LACQUER SPEC MIL-L-10287, TYPE #1.

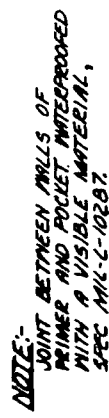
NOTE:-
 JOINT BETWEEN WALLS OF
 PRIMER AND CASE MATERIAL
 WITH A VISIBLE MATERIAL,
 SPEC MIL-L-10287

PITMAN-DUNN LAB & ORDNANCE CORPS		DEPT OF THE ARMY USARMY ORDNANCE CORPS PITMAN-DUNN LAB		B		FB53236	
CARTRIDGE, 7.62 MM BLANK DESIGN STUDY #2				SCALE: 1/4" = 1" WT. 2.0 GR APPROX			
ORIGINAL DATE OF DRAWING 10/10/50		REVISED DATE 10/10/50		SUBMITTED 10/10/50		APPROVED 10/10/50	
TOLERANCES ON DIMENSIONS FRACTIONS DECIMALS INCHES MILLIMETERS		TOLERANCES ON DIMENSIONS FRACTIONS DECIMALS INCHES MILLIMETERS		TOLERANCES ON DIMENSIONS FRACTIONS DECIMALS INCHES MILLIMETERS		TOLERANCES ON DIMENSIONS FRACTIONS DECIMALS INCHES MILLIMETERS	
MATERIAL		MATERIAL		MATERIAL		MATERIAL	
HEAT TREATMENT		HEAT TREATMENT		HEAT TREATMENT		HEAT TREATMENT	
FINAL PROTECTIVE FINISH		FINAL PROTECTIVE FINISH		FINAL PROTECTIVE FINISH		FINAL PROTECTIVE FINISH	
DO NOT APPLY PAINT NO. AS SHOWN		DO NOT APPLY PAINT NO. AS SHOWN		DO NOT APPLY PAINT NO. AS SHOWN		DO NOT APPLY PAINT NO. AS SHOWN	



NOTE:- JOINT BETWEEN WALLS OF PRIMER AND PCKET WATERPROOFED WITH A VISIBLE MATERIAL, SPEC MIL-L-10287.

77



* VERNILION NUMBER 11136 FED STD NO.595,
LACQUER, SPEC MIL-L-10287, TYPE I.

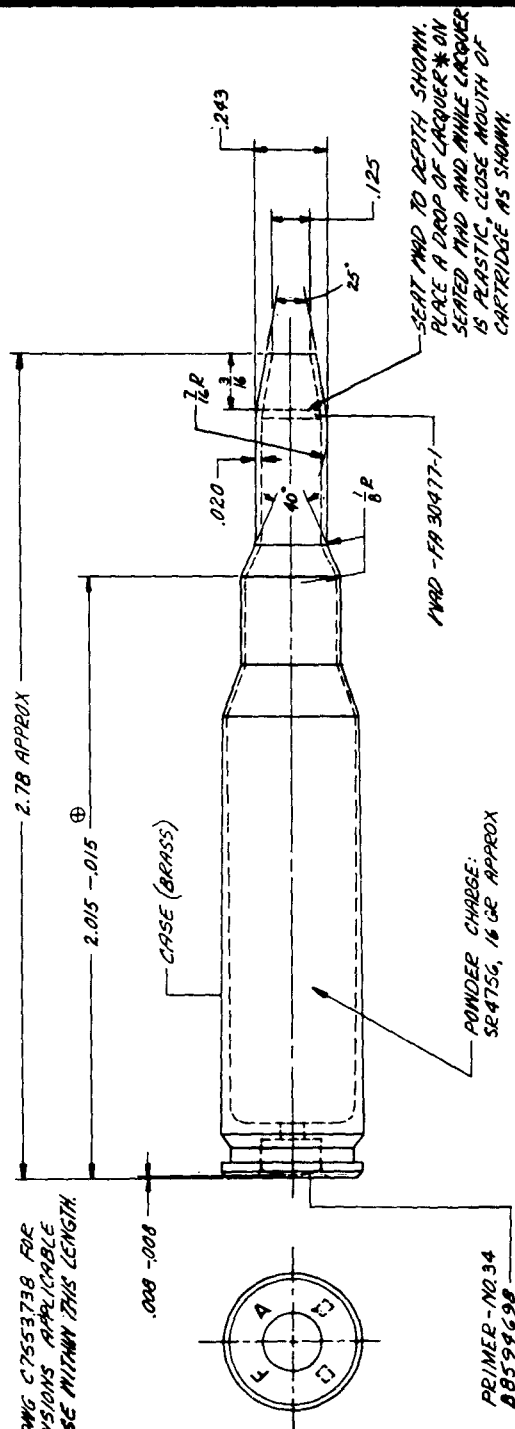
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CARTRIDGE,
7.62 MM BLANK.
DESIGN STUDY #

SCALE:- 1/4" = 1' 0"

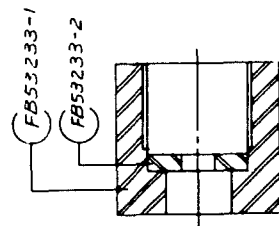
[illegible]

NOTE:-
 SEE DWG C7553738 FOR
 DIMENSIONS APPLICABLE
 TO CASE WITHIN THIS LENGTH.

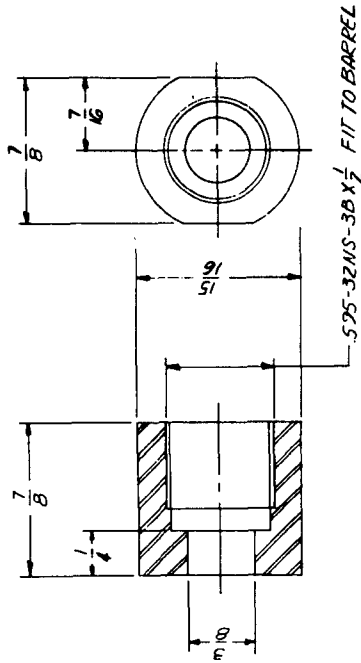


NOTE:-
 JOINT BETWEEN WALLS OF
 PRIMER AND POCKET WATERPROOFED
 WITH A VISIBLE MATERIAL,
 SPEC MIL-L-10287.

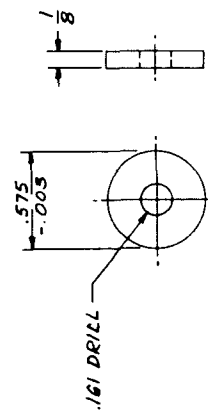
PITMAN-DUNN LAB GR ORDNANCE CORPS DEPT OF THE ARMY US ARMY ORD ASENAL FRANKFORD		B FB53239	
CARTRIDGE, 7.62 MM BLANK. DESIGN STUDY #5		SCALE: 3/4" = 1" AT 20 GR APPROX	
ORIGINAL DATE OF DRAWING AUG 18 1960 BY D. B. J. SUBMITTED FOR APPROVAL BY D. B. J. APPROVED BY D. B. J.		APPROVED FOR RELEASE DATE 10/10/01 BY D. B. J.	
TOLERANCES ON DIMENSIONS UNLESS OTHERWISE SPECIFIED FRACTIONS DECIMALS INCHES MILLIMETERS FRACTIONS DECIMALS MILLIMETERS		TREAT TREATMENT FINAL PROTECTIVE FINISH	
APPROVAL BY DATE APPLICATION APPLY PART NO. AS SHOWN		BY DATE AS SHOWN	



ASSEMBLY



FIRING ATTACHMENT (FB53233-1)
ONE-STEEL-FS1020
FINISH 63



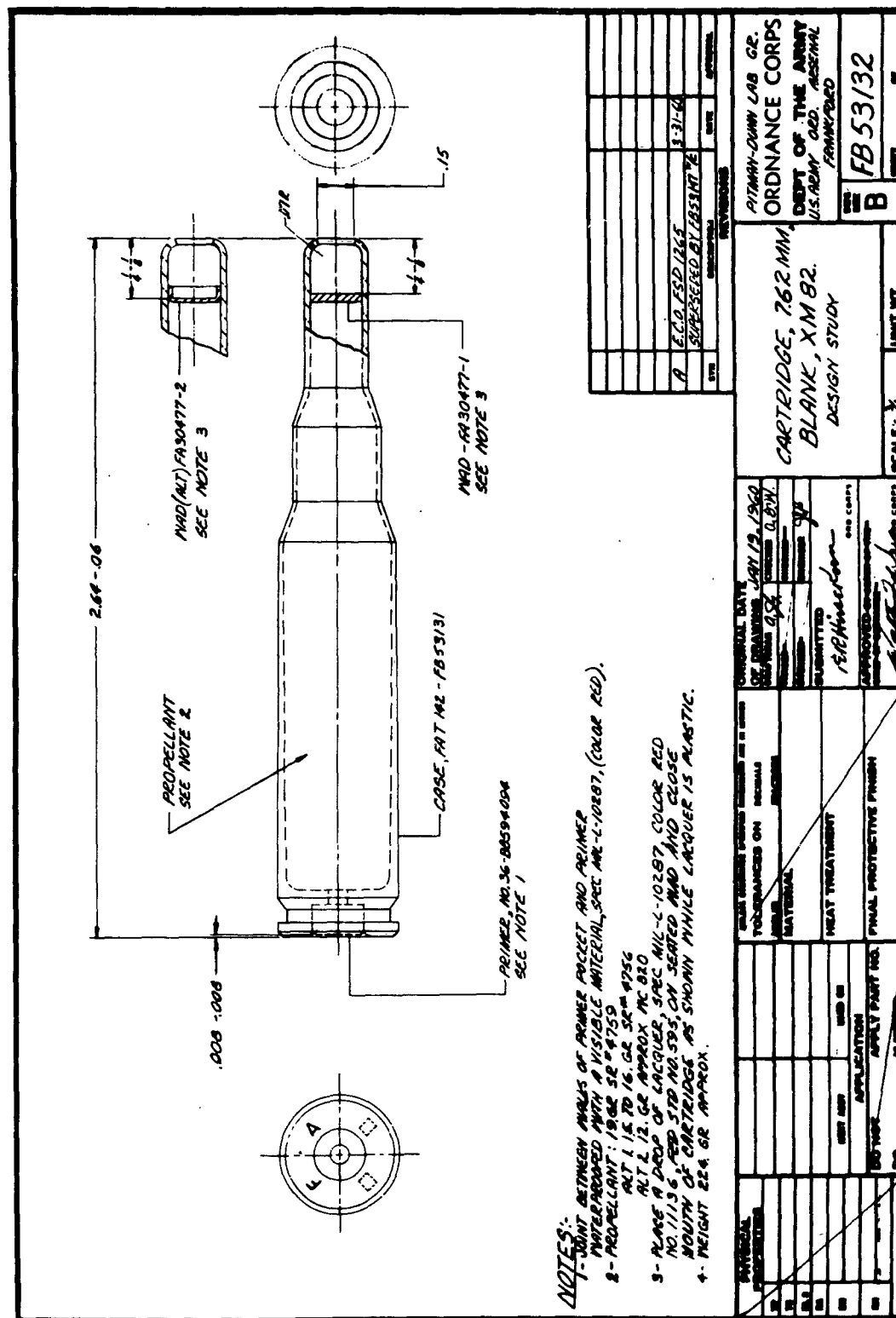
REDUCER (FB53233-2)
ONE-STEEL-FS1020
FINISH 63

REF: BARREL F77 90190 SH.1

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REVISIONS	AT ATTACHMENT, TEST FIRING, 7.62 MM BLANK, FOR M14 RIFLE FRANKFORD ARSENAL AUG. 2, 1960	
SUBMITTED	APPROVED	
ORDINANCE CORP. U.S.A.		ORDINANCE CORP. U.S.A.

SCALE: 1/2

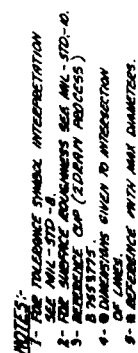


REV	DATE	BY	CHKD	APPD
1	3-31-60	A		
E.O. 12812				
SUPERSEDED BY 12812				
REVISED				

PITMAN-DUNN LAB GR.	
ORDNANCE CORPS	
DEPT OF THE ARMY	
U.S. ARMY ORDNANCE ASSEMBLY	
FRANKFORD	
FB 53132	

CARTRIDGE, 762 MM, BLANK, XM 82.	
DESIGN STUDY	
SCALE: 1/2	UNIT WT

ORIGINAL DATE	
1960 JAN 12 1960	
SUBMITTED	
APPROVED	
FINAL PROTECTIVE FINISH	

82

PHYSICAL PROPERTIES		APPLICATION		FA 30482			
YP	NEXT ASSY	USED ON	REVISIONS				
TS		FB 53147	SYN	DESCRIPTION	DATE	APPROVAL	
EL 2		CTG. 7.62 MM.	A ²	E.O. #FSD 1283	4-15-60	RAT	
RA		BLANK: NATO,					
BN		XMB2					
RN							
	DO NOT	APPLY PART NO.					
	DO	AS SPECIFIED					

A

A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON— DECIMALS FRACTIONS ANGLES	ORIGINAL DATE OF DRAWING <i>MARCH 31, 1960</i> DRAFTSMAN <i>Q.S.</i> CHECKER <i>Q.S.W.</i> TRACED <i>Q.S.W.</i> ENGINEER <i>Q.S.W.</i> SUBMITTED <i>R. D. Anderson</i> ORG CORPS	<i>WAD FOR</i> CTG, 7.62 MM, BLANK: NATO, XMB2	PITMAN-DUNN LAB GR ORDNANCE CORPS DEPT OF THE ARMY U.S. ARMY ORD. ARSENAL FRANKFORD
MATERIAL: - CHIPBOARD OR TAGBOARD HEAT TREATMENT FINAL PROTECTIVE FINISH	APPROVED <i>R. D. Anderson</i> ORG CORPS	SCALE: - <i>5/1</i>	DWS SIZE A FA30482

3. MARSH REVISED ASSEMBLY
TO MATCH WITH DETAILS. SEE
PAGE 10.

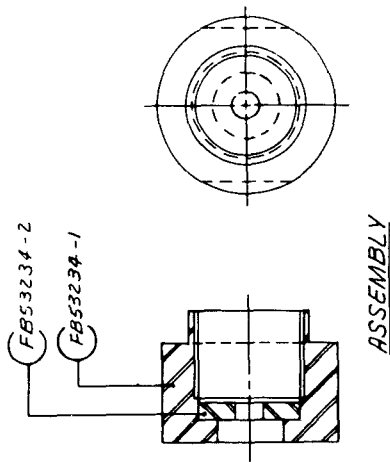


STANDARD GENERAL DATA

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ASSEMBLY,
BLANK FIRING
ATTACHMENT

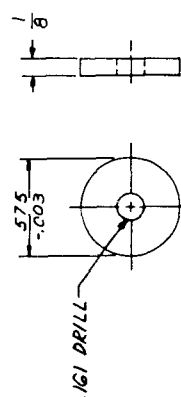
SAD42504

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[illegible]

SCALE - 2

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