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TECHNICAL REPORT SMCPB-ETT-35

# RECLAMATION AND RECYCLING OF L8A1 RED PHOSPHORUS GRENADE MIX

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Directorate of Engineering and Technology  
Pine Bluff Arsenal  
Pine Bluff Arkansas, 71602-9500

Prepared by:

Maggie Grassi  
Maggie Grassi  
Chemical Engineer

Prepared by:

Walton Boyce  
Walton Boyce  
Chemical Engineer

Concurred by:

Jon Davanport  
Jon Davanport  
Electrical Engineer

Concurred by:

Mike Collins  
Mike Collins  
ARDEC

Reviewed by:

Loy M. Aikman  
Loy M. Aikman  
Chief,  
Technical Support Division

Approved by:

Will C. Bradford  
for Will C. Bradford  
Director,  
Engineering and  
Technology

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Mix from unserviceable L8A1 red phosphorus grenades was recovered and recycled as feedstock for L8A3 red phosphorus grenades. Reuse of the mix avoided destruction of the L8A1 mix as a waste and reduced the amount of new raw materials needed for the manufacture of L8A3 rounds.

Both control L8A3 grenades (made from all new raw materials) and experimental L8A3 grenades (made from recovered L8A1 mix) were placed in storage at cold conditions (-51°C, -60°F), ambient conditions (21°C, 70°F), and hot conditions (65°C, 150°F). Control and experimental rounds were fired after approximately one week of storage and approximately ten weeks of storage.

The experimental L8A3 grenades generated smoke equivalent in quantity and quality to the control L8A3 grenades. Significant cost avoidance was realized through successful reclamation and reuse of the L8A1 mix in the L8A3 grenade manufacturing program.

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Technical Report SMCPB-ETT-35

RECLAMATION AND RECYCLING OF L8A1 RED PHOSPHORUS GRENADE MIX

Maggie Grassi  
Welton Boyce  
Loy Aikman  
Tony Davenport  
Michael Collins

September 1994

Technical Support Division  
Directorate of Engineering and Technology  
Pine Bluff Arsenal

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## SUMMARY

From both economical and environmental standpoints, reusing resources is preferable to destroying or landfilling those resources. The Army faces many opportunities to recover usable components from items classified as unserviceable.

The L8A1 Red Phosphorus Screening Smoke Launcher Grenade was placed in the unserviceable classification due to agglomeration of the mix after extended storage. This report documents the successful recovery and reuse of the L8A1 mix as feedstock for the L8A3 Red Phosphorus Screening Smoke Launcher Grenade.

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The authors wish to acknowledge with appreciation the expertise of the late Werner Beyth and of Dr. Aubrey Gosnell. Both gentlemen contributed greatly to the success of this project. Terry Brodnax of the Directorate for Materiel Management and Demilitarization developed the L8A1 downloading procedure and Gary Carter of the same directorate supervised downloading operations. Steven Still of the Directorate of Manufacturing Operations provided invaluable help during the full-scale studies. Mike McGhee, Curtis Robinson, John Mack, Lonnie Crabtree, Lynn Fowler, Erma LePhiew, Billy Woods, Charles Whitmore, and Robert White manufactured the L8A3 grenades using downloaded L8A1 mix. Michael Michael of the Directorate of Engineering and Technology helped in the production of experimental pellets. Jim Pennington of the Directorate of Engineering and Technology maintained the chambers for conditioned storage of the experimental and control grenades. Al Green, Loyd Kirkpatrick, Charles Holman, Homer Jackson, and Dan Smith of the Directorate of Manufacturing Operations spent many hours in support of the field firings of the test and control L8A3 grenades. Tuan Pham of the U.S. Army Chemical and Biological Defense Command provided support during the evaluation of the performance of the test grenades and the submittal of the engineering change proposal to the L8A3 technical data package.

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## INTRODUCTION

The United States Army manufactures munitions which use red phosphorus (RP) to provide obscuration smoke for field operations. The L8A1 RP Screening Smoke Launcher Grenade (NSN 1330-01-020-0504) used a red phosphorus/butyl rubber/talc formulation. Red phosphorus provided the screening smoke when the round was fired. Butyl rubber, as a binder, was used to form granules that would burn more slowly than powdered red phosphorus. Talc was a coating agent, used to prevent the red phosphorus/butyl rubber granules from agglomerating. The L8A1 also used black powder propellant, delay, and burster charges.

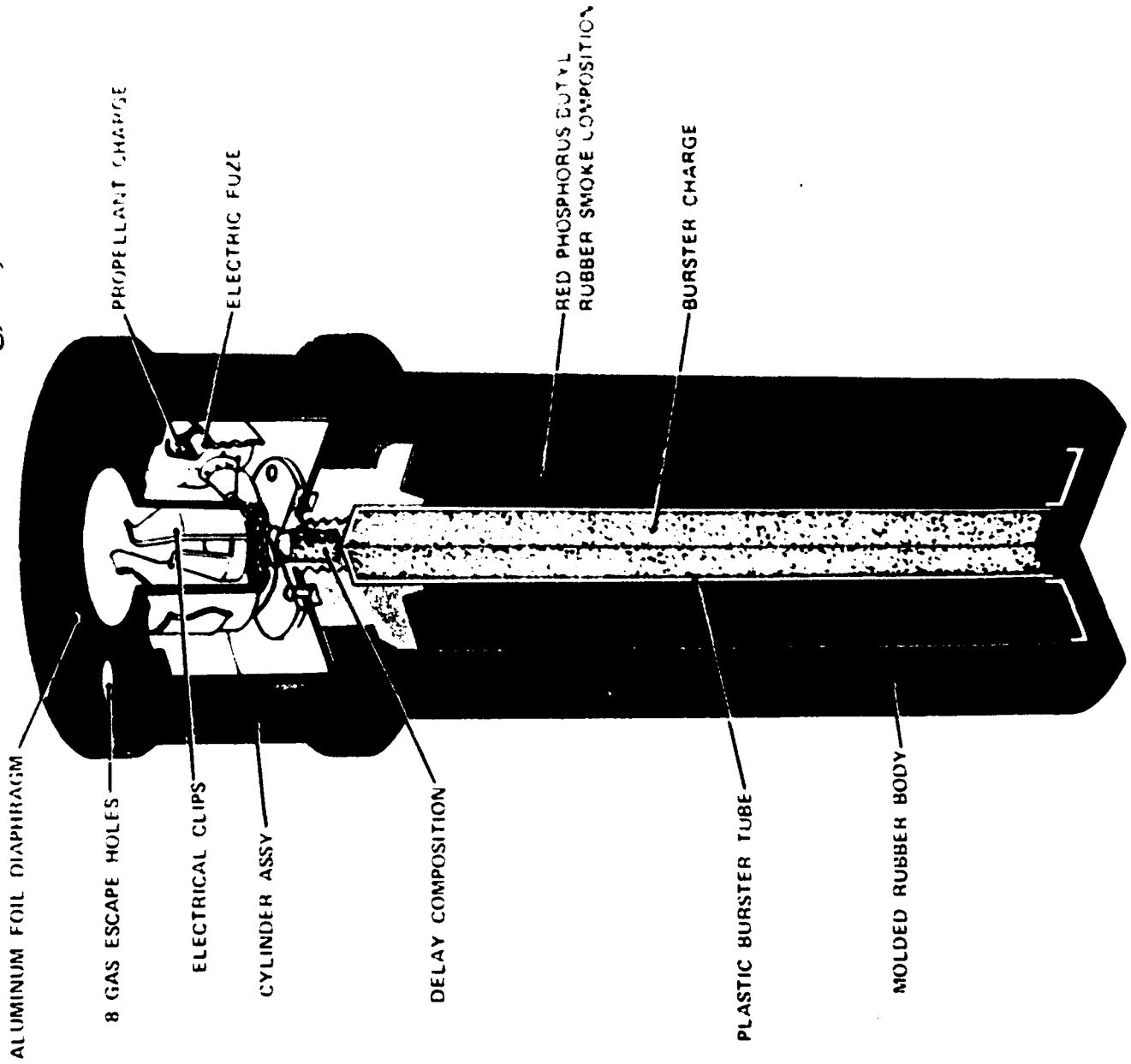
After extended storage, the coating properties of the talc failed, and the granules agglomerated. When agglomerated grenades were fired, the red phosphorus/butyl rubber was expelled in relatively large masses, rather than in a uniform dispersion of small granules. As a result, the smoke generated by the agglomerated grenades was patchy. The unserviceable L8A1s were placed in storage to await demilitarization.

The L8A3 RP Screening Smoke Launcher Grenade (NSN 1330-01-124-5031) (fig. 1) is the current version of the red phosphorus/butyl rubber munition. The L8A3 is similar to the L8A1, with the exceptions of the replacement of the talc with silica and the substitution of corrosion resistant components in the cylinder tray assembly. Agglomeration problems after extended storage have not been observed with the red phosphorus/butyl rubber/silica formulation.

Because the only formulation difference between the L8A1 and the L8A3 grenades was the coating agent, it was proposed that the red phosphorus/butyl rubber/talc mix in the unserviceable L8A1 grenades be recovered and recycled as feedstock for L8A3 grenades. Reuse of the L8A1 mix offered two benefits: (a) minimization of the raw materials costs for production of L8A3s, and (b) avoidance of disposal costs (both financial and environmental) of the recovered L8A1 mix.

Estimates that 500,000 L8A1 grenades world wide would require expensive demilitarization and liability to the government provided an impetus to develop valid reclamation procedures. Milestones were established (table 1). A program plan (app A) and revised program plan (app B) were prepared and staffed with the L8A3 Configuration Control Board (CCB). The program plan was revised to document additional details for the laboratory and pilot testing phases and

**FIGURE 1: Grenade, Launcher, Smoke: Screening, RP, UK L8A1 and L8A3**



**GRENADA, LAUNCHER, SMOKE: SCREENING, RP, UK L8A1 & L8A3**

**TABLE 1**  
**SIGNIFICANT MILESTONES**

<b>TASK</b>	<b>THIRD QUARTER 92</b>	<b>FOURTH QUARTER 92</b>	<b>FIRST QUARTER 93</b>	<b>SECOND QUARTER 93</b>	<b>THIRD QUARTER 93</b>	<b>FOURTH QUARTER 93</b>	<b>FIRST QUARTER 94</b>
<b>CONDUCT BENCH SCALE STUDIES BLDG. 33-730</b>							
<b>CONDUCT PILOT SCALE STUDIES BLDG. 34-630</b>							
<b>CONDUCT FULL SCALE STUDIES BLDG. 34-630</b>							
<b>ENGINEERING CHANGE PROPOSAL ACCEPTED</b>							
<b>FULL SCALE RECLAMATION AND PRODUCTION</b>							

to add a cyclic temperature test condition. (This test condition was later deleted.) These test plans provided the basis for work accomplished in fiscal year 1992, fiscal year 1993, and the first quarter of fiscal year 1994.

### L8A1 DOWNLOADING

A downloading procedure was needed to remove the mix from the unserviceable L8A1 grenades. Operating procedures were defined and equipment was installed in building 33-730 at Pine Bluff Arsenal (app C). The following steps were used to download the unserviceable L8A1 rounds:

1. The rubber boot was cut around the entire circumference at a point close to the cylinder assembly.
2. The rubber boot and the mix pellet were removed from the cylinder assembly, burster tube, and black powder charges.
3. The rubber boot was cut away from the mix pellet.

Operators were given safety gear to minimize the hazards of phosphine gas and black powder. They were to note any problems in removing the RP-butyl rubber pellets. The initial reclamation setup consisted of operators using a rotating vise and a mounted utility knife to slice through the circumference of the rubber boot. The operators would then carefully slide the burster tube/tray assembly away from the boot and the mix pellet. The boot was then cut away from the pellet. Downloaded RP-butyl rubber pellets were placed in 113.6 liter (30 gallon) drums lined with conductive plastic bags. An L8A1 RP-butyl rubber pellet weighs approximately 355 grams (0.78 pound) and consists of 95% RP, 5% butyl rubber, and trace amounts of talc. The burster tube/tray assemblies were stored to await incineration in a rotary deactivation furnace. The ash from this process is to be placed in a hazardous waste landfill. The rubber boots were placed in storage for possible future sale as a recyclable material.

An initial problem that was encountered in the reclamation process was the contamination of some L8A1 RP-butyl rubber pellets with black powder. Operators noted that some burster tubes were cracked, allowing the black powder to spill out of the tube and contaminate the RP-butyl rubber pellet to the extent that it could not be used as feedstock for L8A3 production. Operators were instructed to keep contaminated pellets separate from uncontaminated pellets. As of 23 Aug 94 approximately 227.7 kilograms (502 pounds) of contaminated pellets (0.2% of the total downloaded quantity) had

been accumulated. An ultra high speed fire suppression system was used to minimize fire hazard.

Full-scale downloading of mix from L8A1 grenades was achieved at building 33-730. Each batch was sampled and an analysis performed by the quality assurance laboratory to determine butyl rubber composition. This step was necessary before use of the downloaded mix as feedstock for L8A3 production because butyl rubber content is a critical factor in batch acceptance.

Once the quality of the reclaimed RP-butyl rubber mix was determined, a quality assurance ammunition specialist assigned a condition code to each batch.

### LABORATORY AND PILOT STUDIES

Laboratory scale studies were conducted in July and August 1992 to determine how to soften the recovered L8A1 mix so that it could be re-extruded into granules and coated with silica. Drawing number 13-19-147 of the L8A3 technical data package specifies methylene chloride as the solvent to gel the butyl rubber. Because extensive TECOM testing would have been necessary, no attempt was made in this study to evaluate various solvents as substitutes for methylene chloride, which is a suspected carcinogen. This phase of the project focused on obtaining data that would be critical to setting up full-scale production processes.

The laboratory and pilot study test facility occupied two cubicles in building 33-730. Cubicle D housed a laboratory hood, an oven, a balance, and a metal table for use in the laboratory scale phase of the project. A large industrial ventilation hood, a Baker-Perkins Model LX5 Sigma Blade Mixer, and a hand-operated modified meat grinder were installed in cubicle C for use during the pilot scale phase. The meat grinder was fitted with a modified die plate to allow extrusion of granules with diameters of 6.35 millimeters (0.25 inch) as required by the technical data package for the L8A3.

The objectives of the laboratory and pilot scale studies were to determine: (a) what ratio of methylene chloride to downloaded L8A1 mix would be needed to soften the mix to allow re-extrusion; (b) the softening and mixing times needed to reach the proper consistency for extrusion of good granules from the recovered L8A1 mix; and (c) whether new RP and new butyl rubber would be needed to obtain mix granules that would meet the requirements of the L8A3 specification, MIL-G-51478.



## Laboratory Studies

The first bench studies sought to determine the amount of methylene chloride needed for a given amount of recovered L8A1 mix. Measured amounts of mix and methylene chloride were placed in beakers and allowed to "soak". The mix was then stirred to break up large masses and to check the consistency. Ratios were tested ranging from 1.0 milliliter (0.001 quart) of methylene chloride for every 2.5 grams (0.006 pound) of mix to 15.0 milliliters (0.015 quart) for every 2.5 grams (0.006 pound) of mix. The consistency and appearance of the mix after soaking and stirring were recorded. At this point in the study, the optimum ratio appeared to be 1.0 milliliter (0.001 quart) of methylene chloride for every 2.5 grams (0.006 pound) of reclaimed mix. The L8A3 standard operating procedure (SOP) calls for a ratio of 1.0 milliliter (0.001 quart) of methylene chloride for every 4.8 grams (0.011 pound) of new RP-butyl rubber mix.

## Pilot Studies

Once the beaker studies were completed, an inert batch consisting of 1587.6 grams (3.5 pounds) of sodium bicarbonate and 83.9 grams (0.18 pound) of new butyl rubber gelled with 419 milliliters (0.44 quart) of methylene chloride was prepared in the pilot scale Baker-Perkins LX5 sigma blade mixer. This mixer was used to simulate the AMK Charles Ross sigma blade mixer/extruders used at the L8A3 production line. After mixing, inert granules were obtained using the modified, hand-operated meat grinder. By visual inspection, the inert granules were determined to be similar in length and consistency to actual L8A3 RP-butyl rubber granules.

After checking the equipment and the process with the inert ingredients, a batch was prepared using 1673.6 grams (3.7 pounds) of downloaded L8A1 mix and 669 milliliters (0.707 quart) of methylene chloride, following the ratio of 1.0 milliliter (0.001 quart) of methylene chloride for every 2.5 grams (0.006 pound) of mix. This batch was mixed and extruded, and the resulting granules were dried at 66°C (150°F). The dried granules were allowed to cool and then were coated with silica.

Three additional pilot scale batches were manufactured with downloaded L8A1 mix in an attempt to find the minimum amount of methylene chloride needed to soften the mix. The first of these used a ratio of 1.0 milliliter (0.001 quart) of methylene chloride for every 4.02 grams (0.009 pound) of mix. Unabsorbed liquid was noted in this batch, so a batch using a ratio of 1.0 milliliter

(0.001 quart) of methylene chloride for every 6.1 grams (0.01 pound) of mix was tested. Free liquid was also noted in this batch, and a third ratio of 1.0 milliliter (0.001 quart) of methylene chloride for every 9.1 grams (0.02 pound) of mix was attempted. However, this ratio resulted in a powdery mix, and methylene chloride was added to bring the ratio to 1.0 milliliter (0.001 quart) of methylene chloride for every 6.0 grams (0.01 pound) of mix.

The pilot studies confirmed that usable RP-butyl rubber granules could be obtained from the downloaded L8A1 pellets in a feasible manner. No new RP or new butyl rubber had to be added to the reclaimed mix.

It was recognized that some adjustments would have to be made to obtain meaningful data and some issues would have to be addressed to achieve production of L8A3 grenades made with reclaimed RP-butyl rubber mix:

1. The actual ratio of methylene chloride to reclaimed RP-butyl rubber mix would have to be adjusted during the full-scale studies using the L8A3 production equipment located at building 34-630.

2. Reclaimed RP-butyl rubber mix varies widely in consistency due to factors such as age, amount of talc, and, in some cases, contamination with the glue that is used to hold the rubber boot to the burster tube.

3. The potential for foreign matter contamination, such as black powder, cardboard, and sand, in the reclaimed RP-butyl rubber pellets will require strict quality control measures.

4. To verify that the L8A3 grenades manufactured using reclaimed RP-butyl rubber mix were equivalent to L8A3 grenades manufactured using new raw materials, "test" grenades (grenades manufactured using L8A1 mix as feedstock) would need to be fired at the L8A3 firing range at Pine Bluff Arsenal's bombing mat along with "control" grenades (L8A3 grenades, taken from inventory, which were manufactured using new raw materials).

## FULL-SCALE STUDIES

Once the laboratory and pilot studies were completed, work moved to the full-scale equipment at the L8A3 production line.

The objectives of this phase of the project were to: (a) verify the ratio of methylene chloride-to-mix needed for extrusion; (b) verify the production procedures necessary for use of the downloaded L8A1 mix as feedstock; (c) manufacture complete L8A3 grenades starting with downloaded mix; and (d) compare the performance of L8A3s manufactured using L8A1 mix with that of L8A3s manufactured using new RP and new butyl rubber.

In calendar year 1992, three "half-size batches" of L8A3 mix were manufactured using reclaimed L8A1 material. For each batch, approximately 45.4 kilograms (100 pounds) of reclaimed L8A1 mix and 9.5 liters (2.5 gallons) of methylene chloride were placed in a mix can. The reclaimed mix was allowed to soften during soak times which ranged from ten to sixty minutes. It was determined that 9.5 liters (2.5 gallons) of methylene chloride and a soak time of ten minutes were sufficient to soften 45.4 kilograms (100 pounds) of reclaimed mix. This is the same methylene chloride-to-mix ratio specified in the L8A3 SOP.

The granules extruded from these batches were pressed into pellets according to the L8A3 standard operating procedures. The pellets obtained from the reprocessed L8A1 mix were much looser and much more fragile than pellets made from all new materials. The granules did not "stick" together as well as granules manufactured from new raw materials. To compensate for the looseness of the pellets, the maximum allowable weight (360 grams, 0.79 pound) was used for each pellet. Also, consideration was given to the effect of the amount of silica used to coat the granules on the pressability of the granules. The first two half-sized batches were coated with the amount of silica normally used for a batch made from new raw materials (approximately 1% by weight). Once the pressability problem was encountered, the granules from these two batches were resifted to remove any excess silica. The minimum amount of silica allowed by the technical data package (0.5% by weight) was used in the third batch. A total of 102 complete test grenades were manufactured from these three batches.

Thirty-six of these grenades were compared with L8A3 control grenades during range firing at Pine Bluff Arsenal in September 1992. All munitions were fired according to specification MIL-G-51478. The test grenades were equivalent to the control grenades in granule dispersion and the amount and quality of smoke produced. Videotapes of these firings were recorded. The remaining

66 test grenades, along with 49 L8A3 control grenades, were placed in a conditioning chamber at 71°C (160°F). The purpose of the conditioning was to accelerate the effects of long-term storage on the grenades so that reagglomeration of the mix could be detected. Eight conditioned test grenades and three conditioned control grenades were fired at Pine Bluff Arsenal on 03 December 1992. No agglomeration was detectable and no differences were observed between the test and control grenades. These firings were also recorded on videotape.

In calendar year 1993, five more half-size batches were manufactured in an attempt to overcome the pellet fragility problem. The amount of silica used to coat the granules was varied during this phase of the project. The amounts of silica used for the half-size batches manufactured in 1993 ranged from 0.27% by weight to 0.81% by weight. Agglomeration of the mix, resulting in poor obscuring smoke, would not be avoided if too little silica were used; the use of too much silica would prevent the granules from being pressed into a pellet. A pellet weight of approximately 355 grams (0.78 pound) and an increased press load were used, and pellets were produced which could be handled without falling apart in the normal production process and which met the height and weight requirements of the technical data package. Fifty-two test grenades were made from batches with varying amounts of silica, and these grenades were placed in storage at 71°C (160°F) in July of 1993. On 07 September 1993, 36 of these conditioned test grenades and 12 unconditioned control grenades were fired to determine if the lesser amounts of silica had allowed agglomeration to occur (i.e., poor dispersion of the RP/butyl rubber granules when the item was fired). No agglomeration was observed. The remaining 16 test grenades were left in hot storage, and 12 were pulled and fired on 12 October 1993. Again, no agglomeration was detected. These test batches and firings confirmed that silica in the amount of 0.5% by weight yielded acceptable pellets and no evidence of agglomeration.

To verify scaleup of the production process, five full-size batches (90.7 kilograms, 200 pounds) were also manufactured in 1993. Two mix cans, each containing approximately 45.4 kilograms (100 pounds) of reclaimed mix and 9.5 liters (2.5 gallons) of methylene chloride were used for each full-size batch. The full-sized batches were more difficult to extrude than the half size batches. In fact, one batch would not successfully extrude and had to be discarded. Subsequent work in calendar year 1994 indicated that adequate mixing was not occurring. This inadequate mixing of the full-sized reclaimed mix batches was attributed to the energy needed to thoroughly process 90.7 kilograms (200 pound) of pellets, since (a) 90.7 kilogram (200 pound) batches can be made in the same equipment using powdered RP and new butyl rubber gel, and (b) 45.4 kilogram (100 pound) batches had been made in the same equipment

using downloaded L8A1 pellets. This problem was avoided by using half size batches during the 1994 production run. The use of half size batches did not slow the production rate because the batches extruded so quickly.

Approximately 368 test grenades were made from the nine acceptable batches manufactured in 1993. These test grenades, along with control grenades, were placed in chambers at cold (-51°C, -60°F), ambient (21°C, 70°F), and hot (65°C to 71°C, 150°F to 160°F) conditions.

A expert observer of L8A3 smoke trained PBA personnel in the measurement of "good smoke time" and "total burn time". "Good smoke time" is the amount of time, measured from the burst of the grenade, over which dense, obscuring smoke is generated. Specification MIL-G-51478 for the L8A3 grenade sets a minimum of 60 seconds for the good smoke time. For this project, the good smoke time was measured visually by observing the background trees. If the trees could not be seen through the smoke, the smoke being generated was considered "good"; when the trees could be seen through the smoke again, good smoke generation had ceased. "Total burn time" is the amount of time, measured from the burst of the grenade, over which any appreciable smoke is generated. Specification MIL-G-51478 sets a maximum total burn time of six minutes. Determination of good smoke time and total burn time is subjective and is impacted by the dispersal pattern of the granules, the viewing angle of the observer, the position of the sun relative to the observer and the smoke cloud, the wind speed, and the humidity of the surroundings.

Test and control grenades from each conditioning group were fired 10 days after manufacture and 10 weeks after manufacture. Tables 2 and 3 summarize the 1993 test firing data. Figures 2 through 13 compare the good smoke and total burn times of the control and test grenades conditioned at the cold, ambient, and hot temperatures. The raw data for these tests is presented (app D).

Figure 14 depicts a night firing of a salvo of four L8A3 grenades. In battle situations, L8A3 rounds are generally fired in multiples of four. Due to the size of the test firing range, only one round at a time could be fired during this project. Both control and experimental grenades were evaluated by these single firings; field use of four or more rounds would result in more effective screening.

The quality of the smoke generated by the test grenades was equivalent to the control grenade smoke. All of the test grenades met the minimum good smoke time and maximum total burn time, except the test grenades conditioned at -51°C (-60°F) for 10 days (fig. 6). Of the 33 non-dud test grenades fired from this group, 7 (23%)

TABLE 2  
SUMMARY OF TEST DATA

IMMEDIATE TEST GROUP  
(TESTED 10 DAYS AFTER ASSEMBLY)  
DURATION OF GOOD SMOKE OBSCURATION (MIN.)

	CONTROLS		TEST GRENADES
AMBIENT 70 DEGREES F	NO. OF SAMPLES AVERAGE STD. DEV.	16 1.29 0.19	36 1.37 0.30
HOT 150 DEGREES F	NO. OF SAMPLES AVERAGE STD. DEV.	16 1.61 0.31	36 1.60 0.29
COLD -60 DEGREES F	NO. OF SAMPLES AVERAGE STD. DEV.	16 1.01 0.43	36 1.37 0.62

**TABLE 3**  
**SUMMARY OF TEST DATA**

**LONG TERM STORAGE TEST GROUP**  
**(TESTED 10-11 WEEKS AFTER ASSEMBLY)**  
**DURATION OF GOOD SMOKE OBSCURATION (MIN.)**

	<b>CONTROLS</b>		<b>TEST GRENADES</b>	
<b>AMBIENT</b>	<b>NO. OF SAMPLES</b>	<b>17</b>	<b>NO. OF SAMPLES</b>	<b>36</b>
<b>70 DEGREES F</b>	<b>AVERAGE</b>	<b>1.79</b>	<b>AVERAGE</b>	<b>1.72</b>
	<b>STD. DEV.</b>	<b>0.37</b>	<b>STD. DEV.</b>	<b>0.28</b>
<b>HOT</b>	<b>NO. OF SAMPLES</b>	<b>16</b>	<b>NO. OF SAMPLES</b>	<b>54</b>
<b>150 DEGREES F</b>	<b>AVERAGE</b>	<b>2.05</b>	<b>AVERAGE</b>	<b>1.88</b>
<b>FIRED AT</b>	<b>STD. DEV.</b>	<b>0.40</b>	<b>STD. DEV.</b>	<b>0.36</b>
<b>125 DEGREES F</b>	<b>NO. OF SAMPLES</b>	<b>16</b>	<b>NO. OF SAMPLES</b>	<b>36</b>
	<b>AVERAGE</b>	<b>2.32</b>	<b>AVERAGE</b>	<b>2.15</b>
<b>COLD</b>	<b>STD. DEV.</b>	<b>0.89</b>	<b>STD. DEV.</b>	<b>0.33</b>
<b>-60 DEGREES F</b>				
<b>FIRED AT</b>				
<b>-50 DEGREES F</b>				

had good smoke times less than one minute; 9 (29%) had total burn times greater than six minutes. Of the 16 control grenades in the same conditioning group, 5 (31%) had good smoke times less than one minute, and 11 (69%) had total burn times greater than six minutes. Residual unburned mix was noted in some boots after firing.

Two test grenade duds were observed in the 10 day hot conditioning group and three test grenade duds were observed in the 10 day cold conditioning group. Duds included grenades that launched but did not burst and grenades that did not launch or burst. Duds were taken apart and problems were found such as loose contacts in the cylinder tray assembly or too much glue blocking the hole of the burster tube. These defects had nothing to do with the quality of the RP-butyl rubber pellets. Therefore, duds were counted as "no tests" because the purpose of the firings was to evaluate the performance of the RP-butyl rubber pellets in test grenades and control grenades.

#### **FISCAL YEAR 1994 L8A3 PRODUCTION USING DOWNLOADED L8A1 MIX AS FEEDSTOCK**

Full-scale L8A1 downloading operations provided the feedstock for the fiscal year 1994 L8A3 production run. Figure 15 represents downloading rates.

An engineering change proposal incorporating the use of recovered L8A1 mix was prepared and approved. Configuration Control Board approval was granted for the use of downloaded L8A1 mix as feedstock for the fiscal year 1994 L8A3 production run.

Delays in deploying the current methylene chloride solvent recovery system extended the original milestones of the project significantly in calendar year 1993 by delaying access to the L8A3 production line. The methylene chloride recovery system was made operational in December 1993, and production of L8A3 pellets manufactured using downloaded L8A1 mix as feedstock began in earnest. However, the L8A3 production process was hampered by metal parts components delivery problems; therefore complete assembly of the L8A3 munitions did not occur until June 1994. In the interim, batches were manufactured and the pellets were pressed and loaded into the rubber boot subassemblies. As of 23 Aug 94, nine lots (61,408 grenades) had been manufactured using reclaimed L8A1 mix.



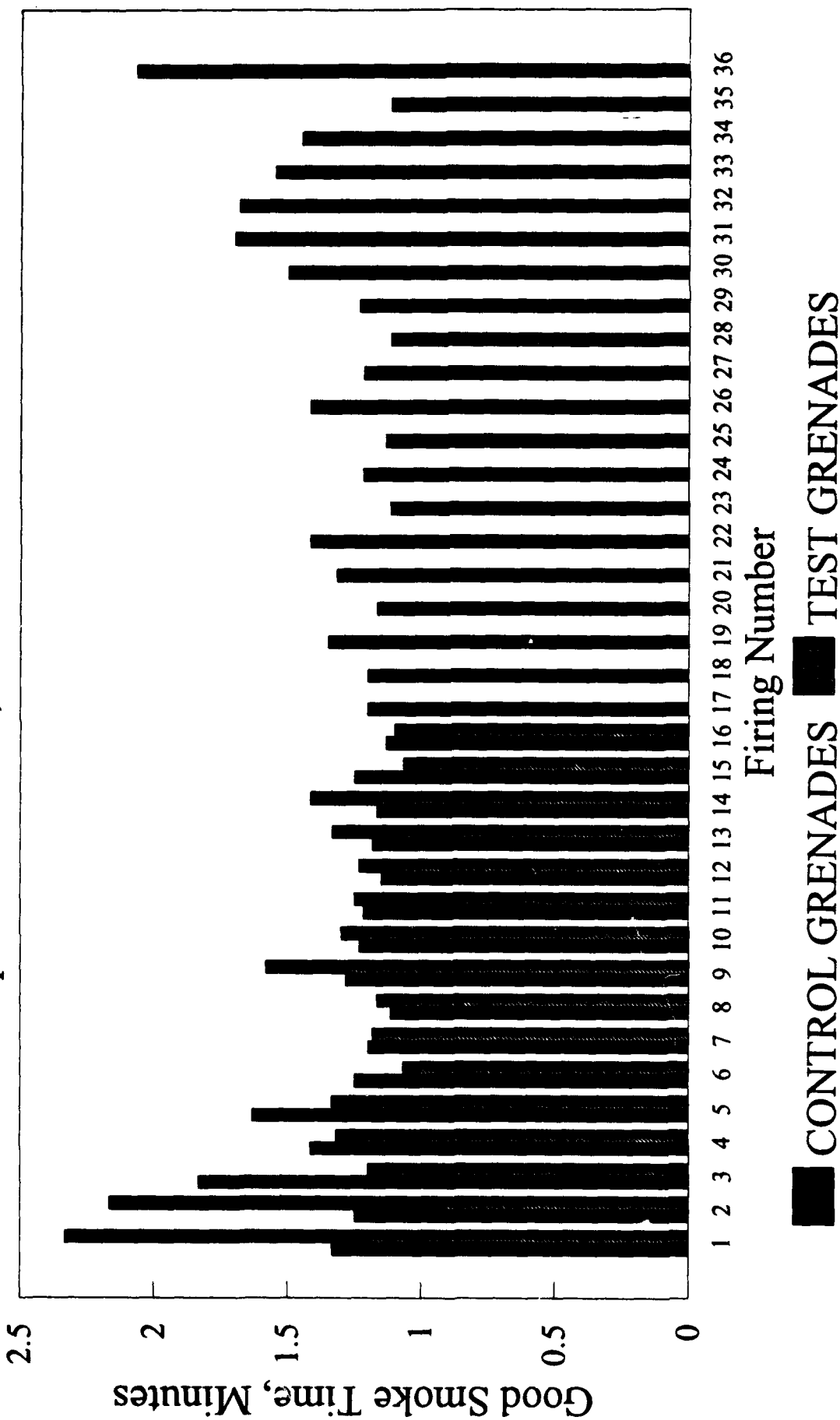
## CONCLUSIONS

1. The L8A3 test grenades manufactured using the recovered L8A1 mix were equivalent to the L8A3 control grenades manufactured using new raw materials, and met munition specification requirements.
2. The procedures for recovering and reusing RP/butyl mixture have been successfully implemented in the production of L8A3 grenades at Pine Bluff Arsenal.
3. Agglomeration has not been observed in the L8A3 grenades manufactured using recovered L8A1 mix.
4. Recovery and reuse of the L8A1 mix avoided unnecessary financial and environmental costs stemming from the destruction of the mix portion of the L8A1 grenades.
5. Recovery and reuse of the L8A1 mix avoided unnecessary material costs for the FY 94 L8A3 Production order.

## RECOMMENDATIONS

1. Evaluate reclamation of RP-butyl rubber mix as the primary disposal procedure for unserviceable L8A1 and L8A3 grenades beyond requirements for the current production run. This evaluation should include a determination of the shelf life of the downloaded mix.
2. If it is determined that the mix from unserviceable L8A1 and L8A3 grenades will not be reused within its shelf life, further studies should be conducted to determine the best disposal technique for whole L8A1s and L8A3s.
3. Develop reclamation projects for other munitions as feasible.

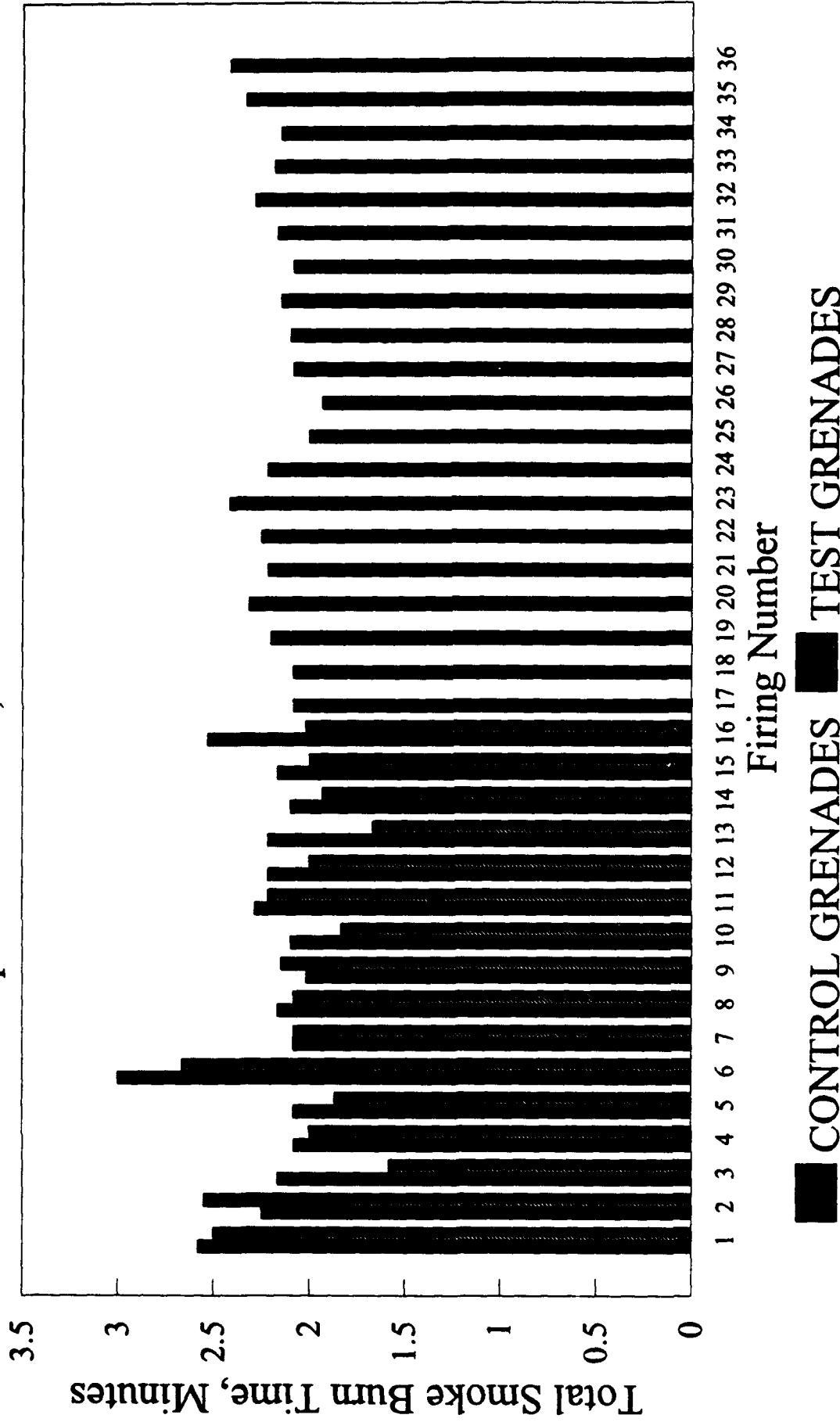
**FIGURE 2: L8A3 RP FUNCTIONING COMPARISON CHART**  
 September 27 - 30, 1993 Pine Bluff Arsenal



All Grenades were conditioned for ten days before firing at ambient (70 degrees F) temperature in storage. All test firings were done in accordance with MIL-G-51478 at PBA Bombing Mat. One minute of good smoke duration is required.

# FIGURE 3: L8A3 RP FUNCTIONING COMPARISON CHART

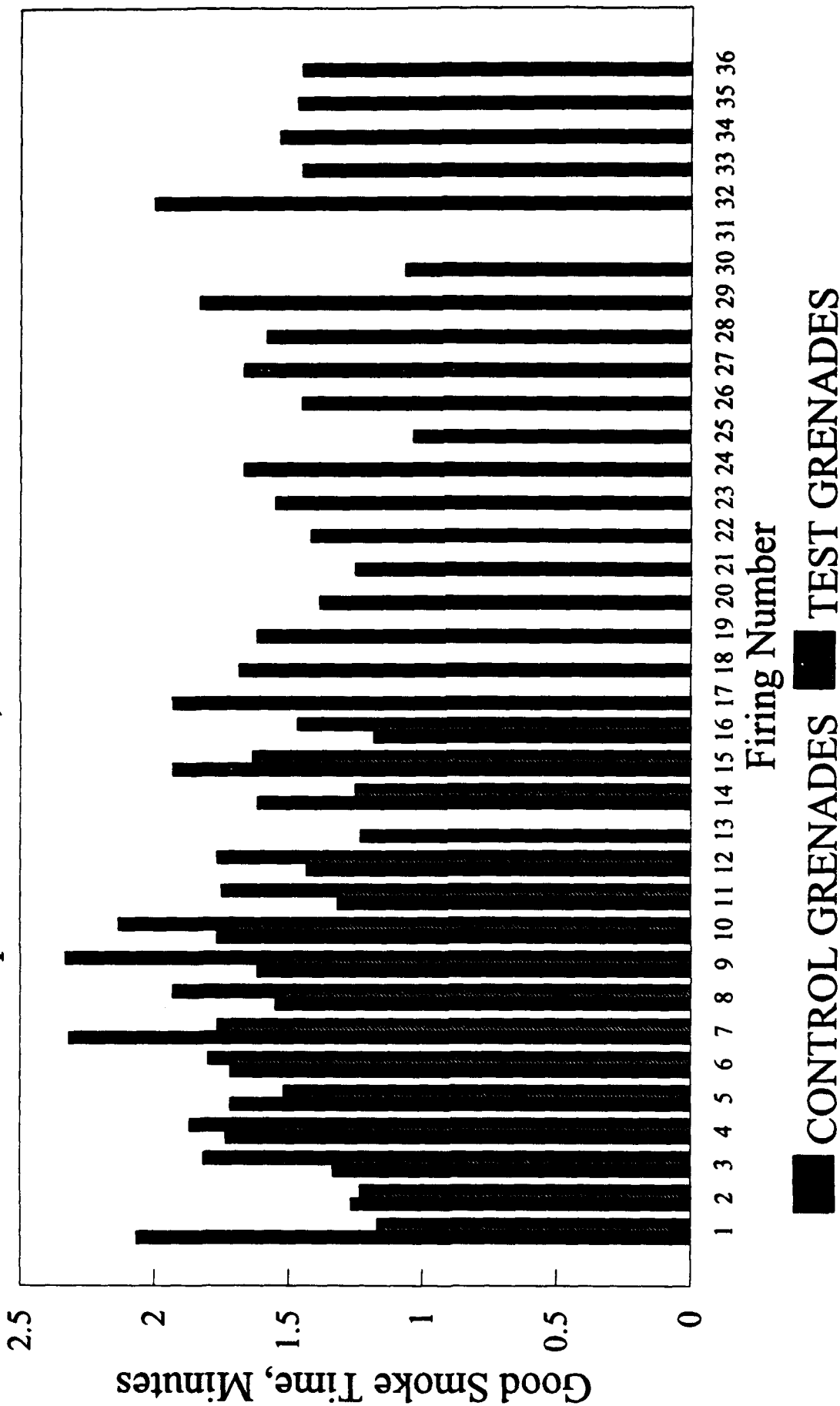
September 27 - 30, 1993 Pine Bluff Arsenal



■ CONTROL GRENADES ■ TEST GRENADES

All Grenades were conditioned for ten days before firing at ambient (70 degrees F) temperature in storage.  
All test firing were done in accordance with MIL-G-51478. RP granules are required to be burned out totally within six minutes.

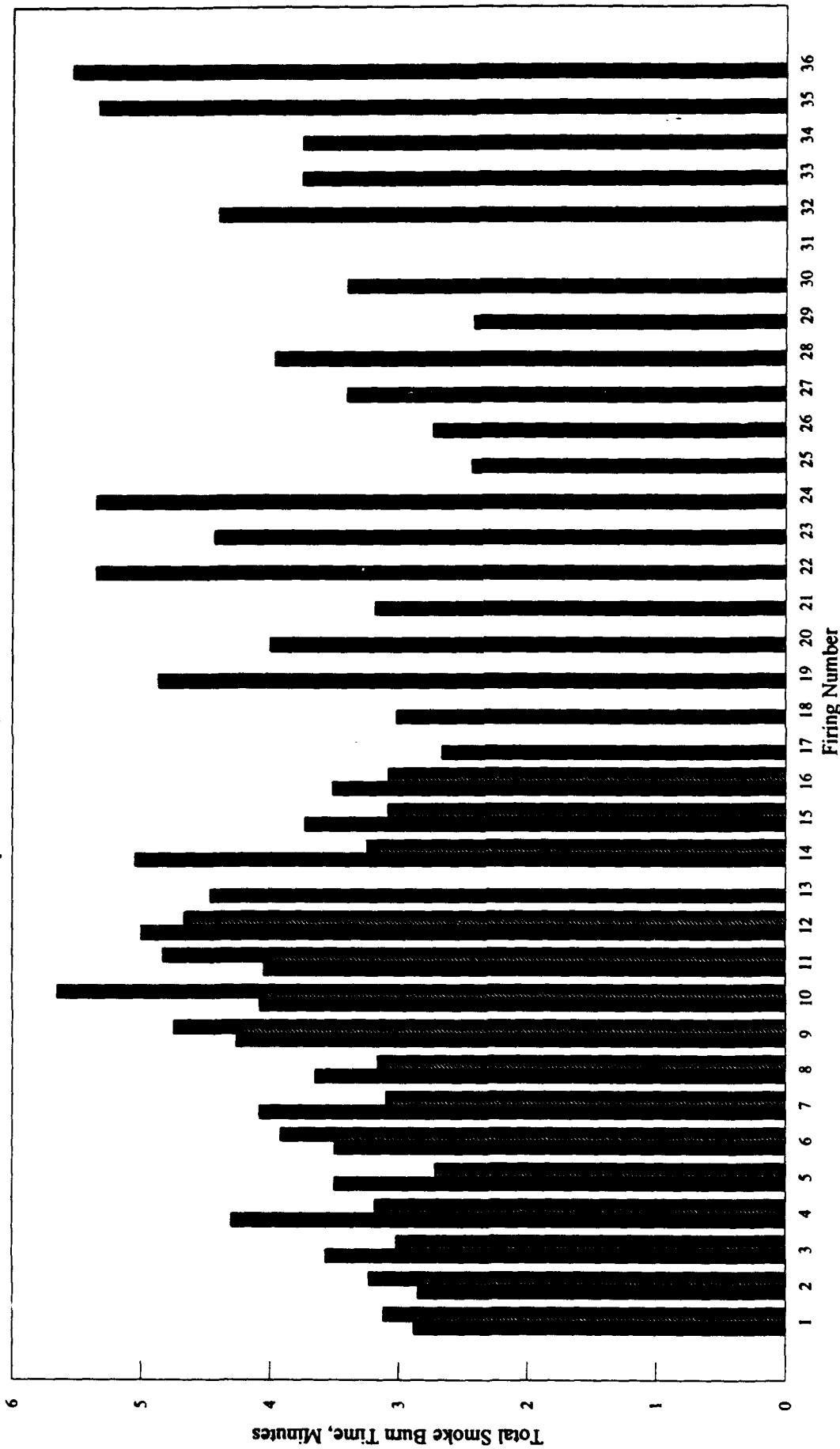
**FIGURE 4: L8A3 RP FUNCTIONING COMPARISON CHART**  
 September 27-30, 1993 Pine Bluff Arsenal



All Grenades were conditioned at 150 degrees F for ten days temperature in storage. Blank columns represent duds. Duds count as no tests.  
 All test firings were done in accordance with MIL-G-51478 at PBA Bombing Mat. One minute of good smoke duration is required.

# FIGURE 5: L8A3 RP FUNCTIONING COMPARISON CHART

September 27 - 30, 1993 Pine Bluff Arsenal

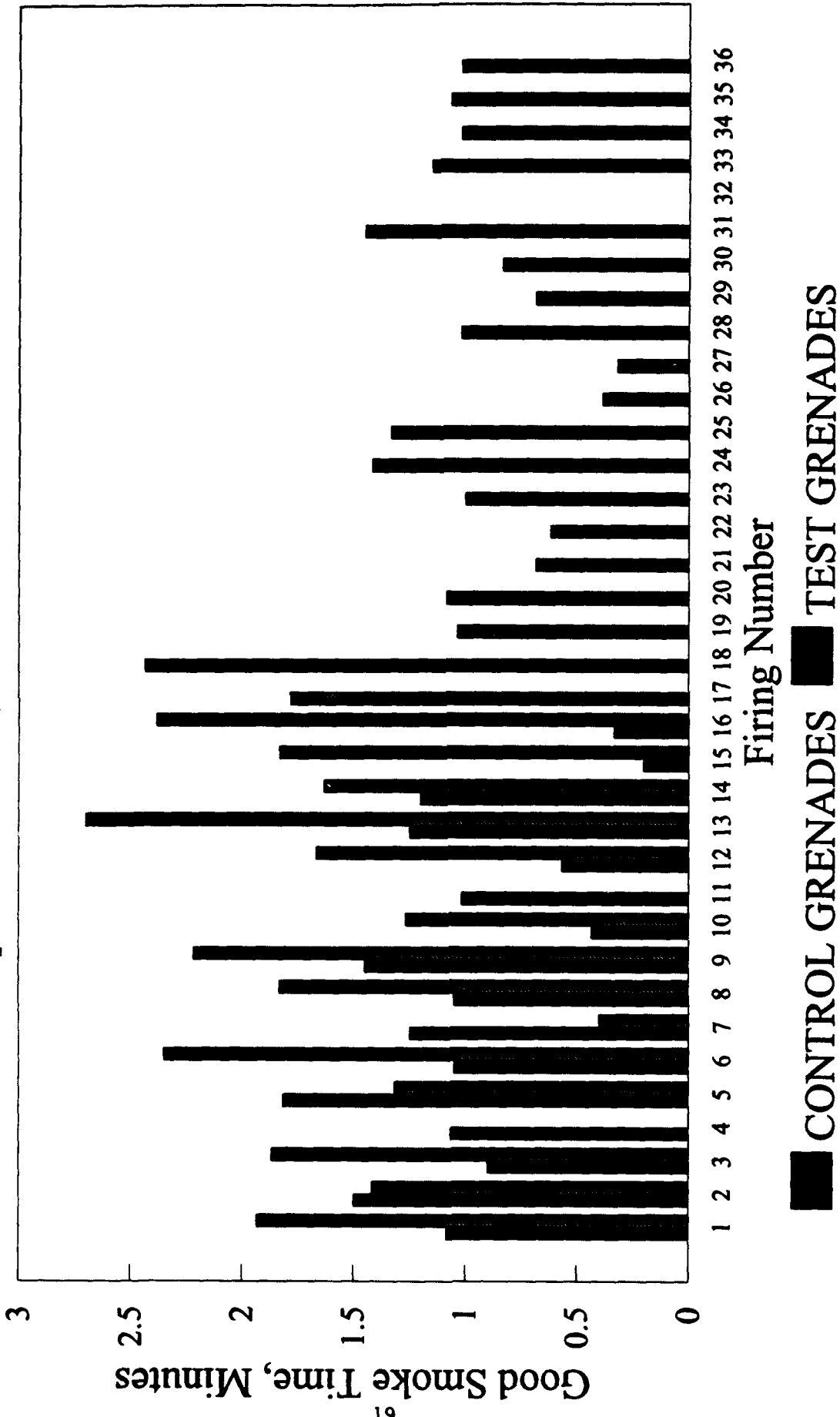


■ CONTROL GRENADES      ▨ TEST GRENADES

All grenades were conditioned at 150 degrees F temperature for ten days in storage. Blank columns represent duds. Duds count as no tests.  
All test firings were done in accordance with MIL-G-51478 at PBA Bombing Mat. RP granules are required to be burned out totally within six minutes.

# FIGURE 6: L8A3 RP FUNCTIONING COMPARISON CHART

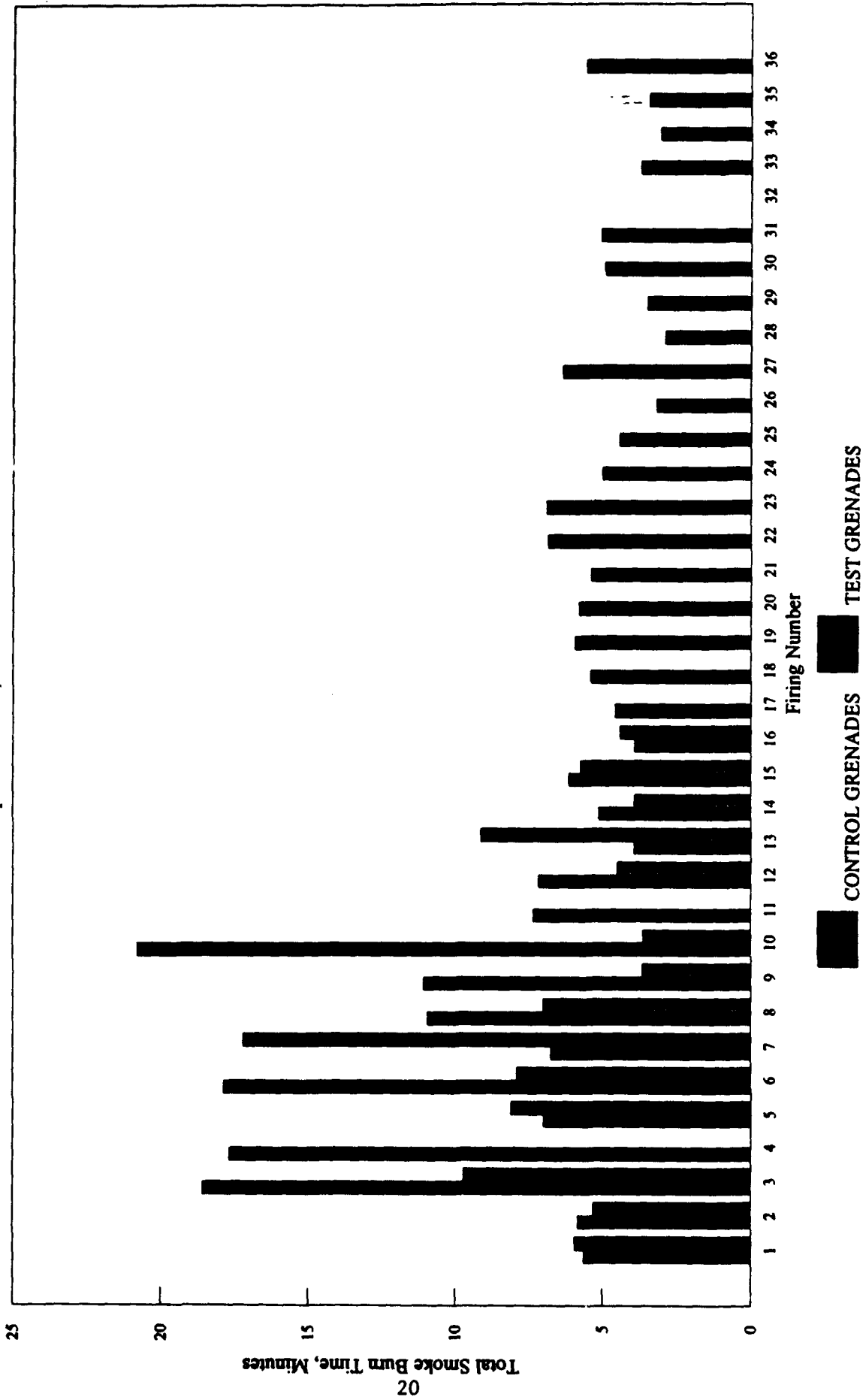
September 27-30, 1993 Pine Bluff Arsenal



All grenades were conditioned for ten days before firing at -60 degrees F in storage. Blank columns represent duds. Duds count as no tests. All test firings were done in accordance with MIL-G-51478 at PBA Bombing Mat. One minute of good smoke duration is required.

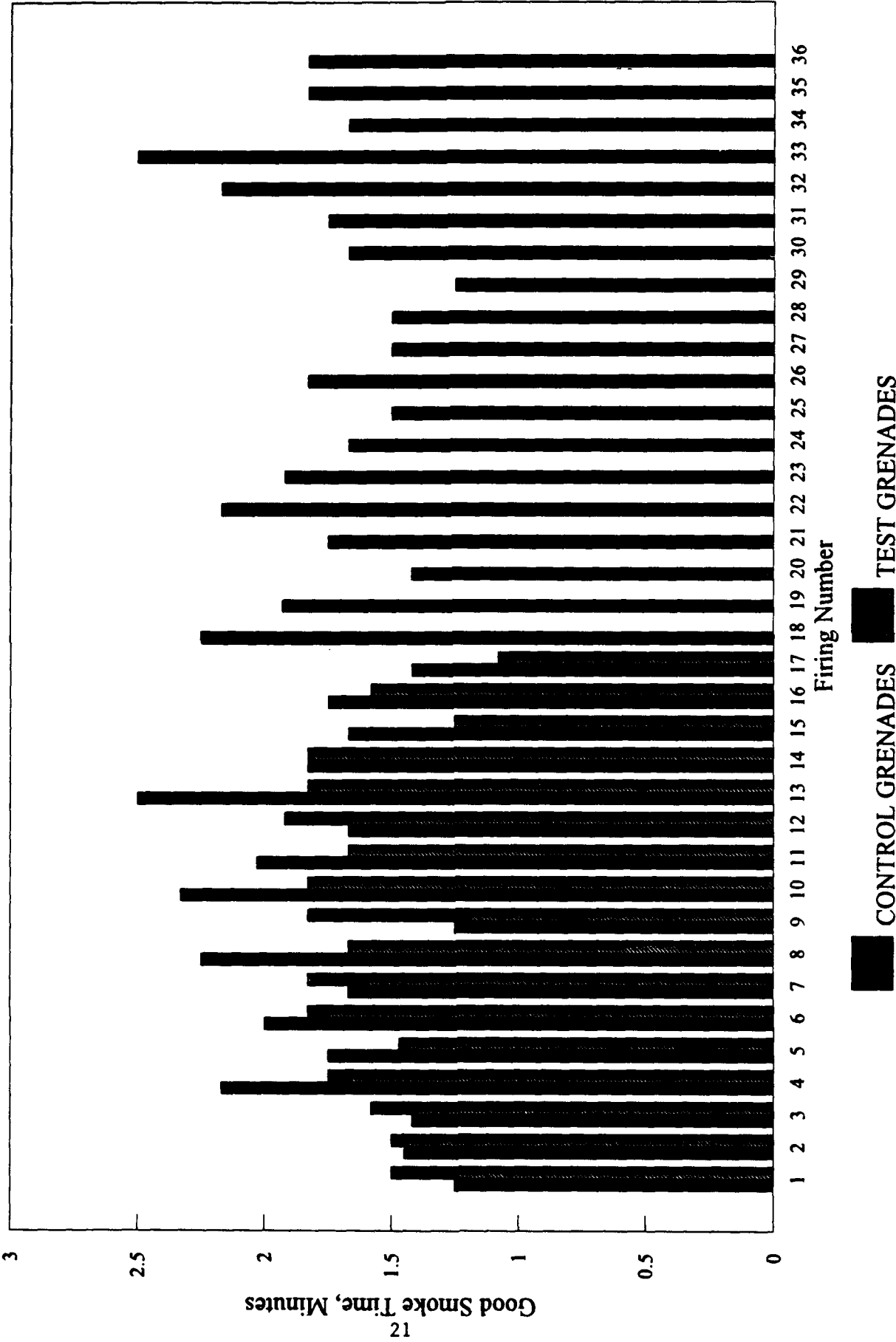
# FIGURE 7: L8A3 RP FUNCTIONING COMPARISON CHART

September 27-30, 1993 Pine Bluff Arsenal



All grenades were for ten days before firing at -60 degrees F temperature in storage. Blank columns represent duds. Duds count as no tests.  
All test firings were done in accordance with MIL-G-51478 at PBA Bombing Mat. RP granules are required to be burned out totally within six minutes.

**FIGURE 8: L8A3 RP FUNCTIONING COMPARISON CHART**  
 November 29 - December 13, 1993 Pine Bluff Arsenal

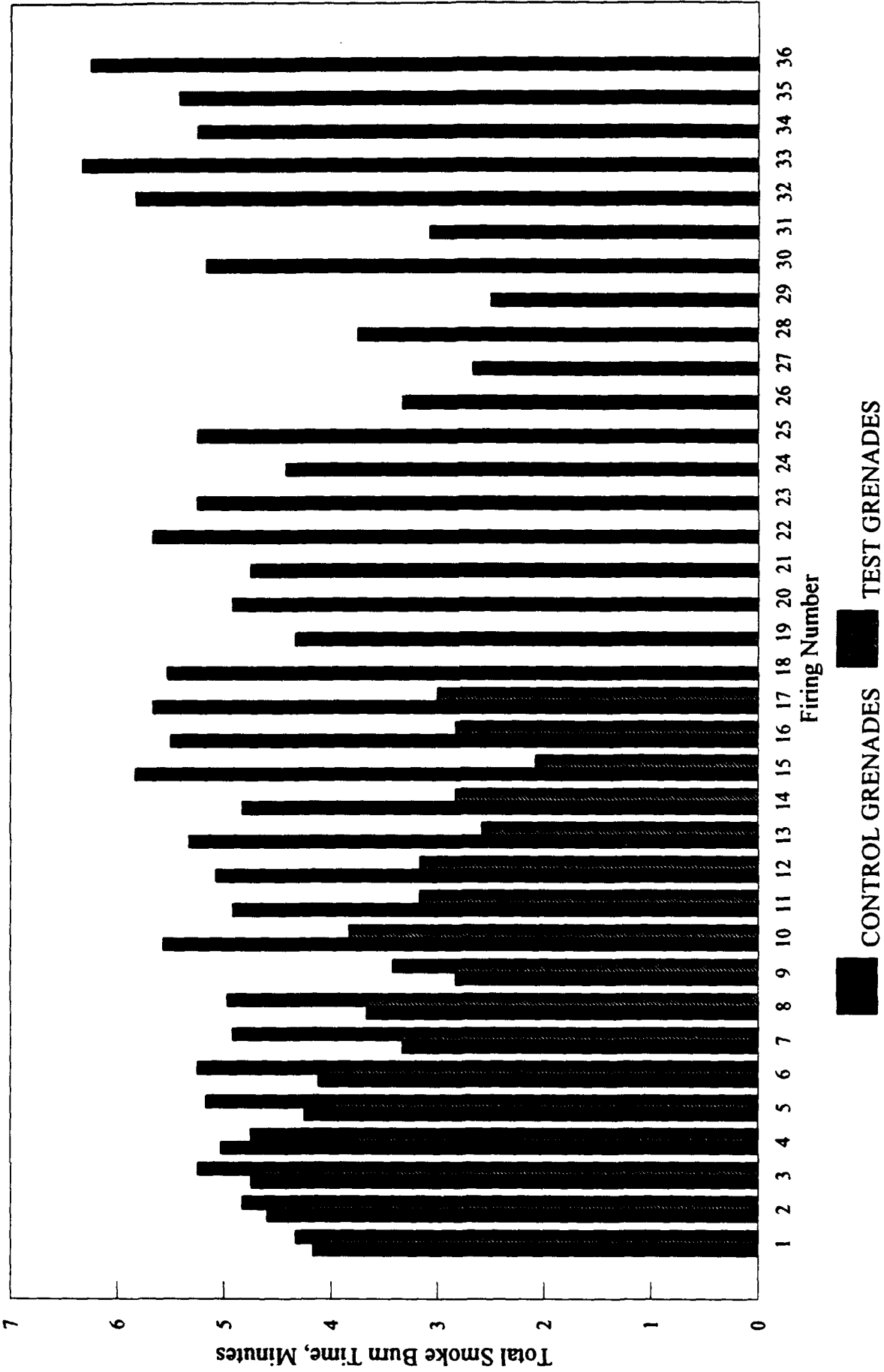


All Grenades were conditioned for ten weeks before firing at ambient (70 degrees F) temperature in storage.  
 All test firing were done in accordance to MIL-G-51478 at PBA Bombing Mat. One minute of good smoke duration is required.



# Figure 9: L8A3 RP FUNCTIONING COMPARISON CHART

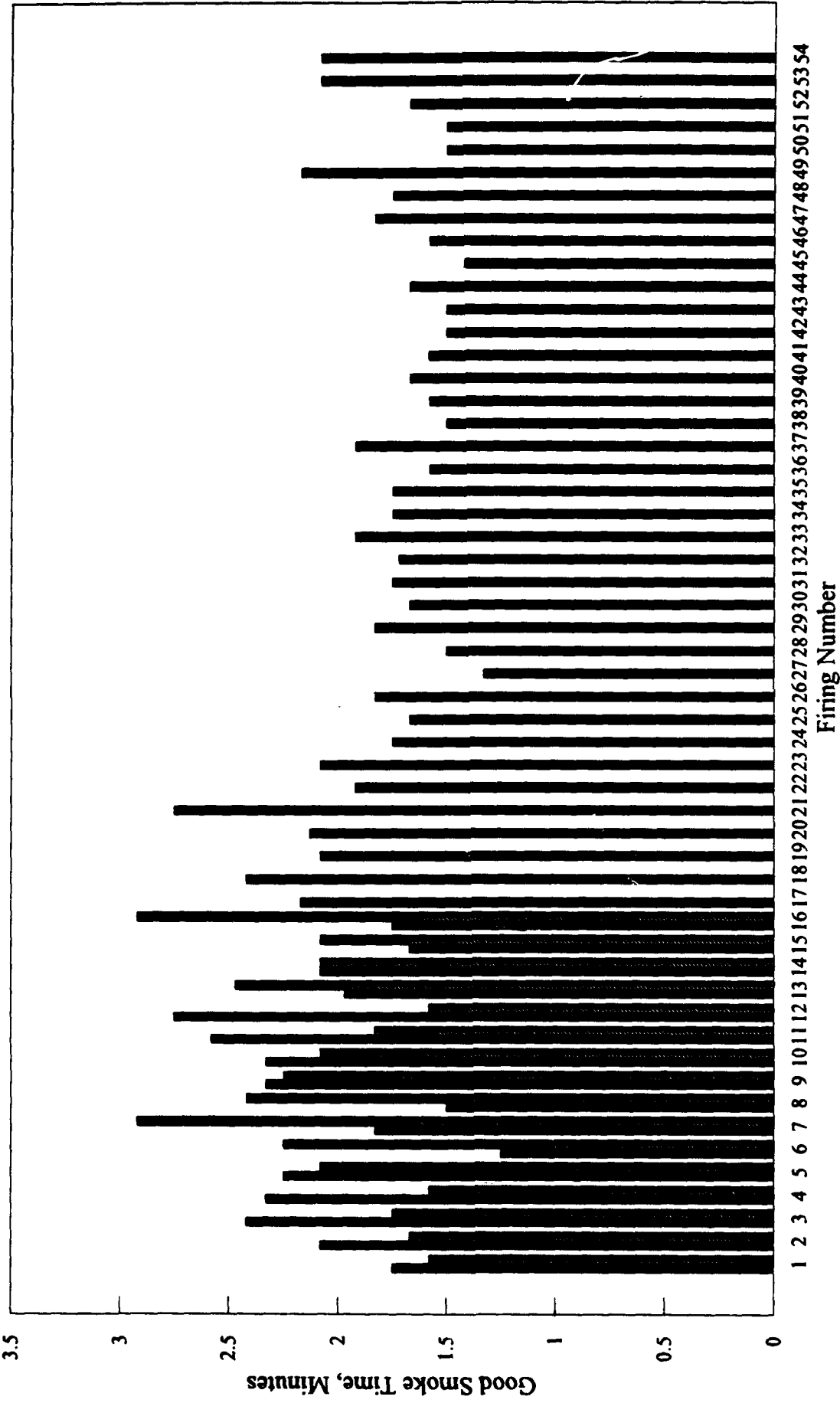
November 29 - December 13, 1993 Pine Bluff Arsenal



All Grenades were conditioned for ten weeks before firing at ambient (70 degrees F) temperature in storage.  
All test firings were done in accordance with MIL-G-51478. RP granules are required to be burned out totally within six minutes.

# FIGURE 10: L8A3 RP FUNCTIONING COMPARISON CHART

November 29 - December 13, 1993 Pine Bluff Arsenal

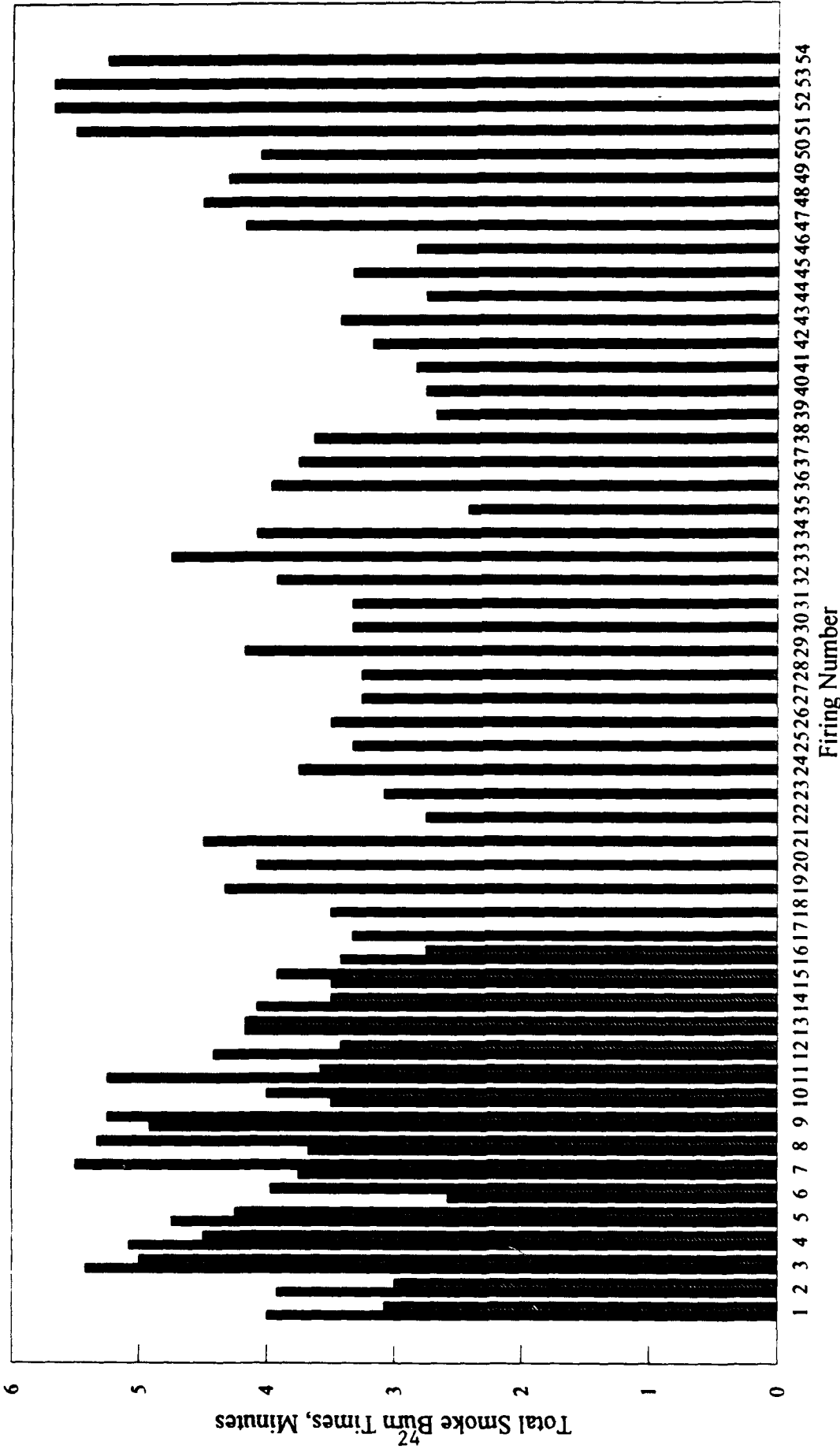


CONTROL GRENADES TEST GRENADES

All grenades were conditioned for ten weeks at 150 degrees F but were cooled to 125 degrees F before firing.  
All test firing were done in accordance with MIL-G-51478 at PBA Bombing Mat. One minute of good smoke duration is required.

# FIGURE 11: L8A3 RP FUNCTIONING COMPARISON CHART

November 29 - December 13, 1993 Pine Bluff Arsenal

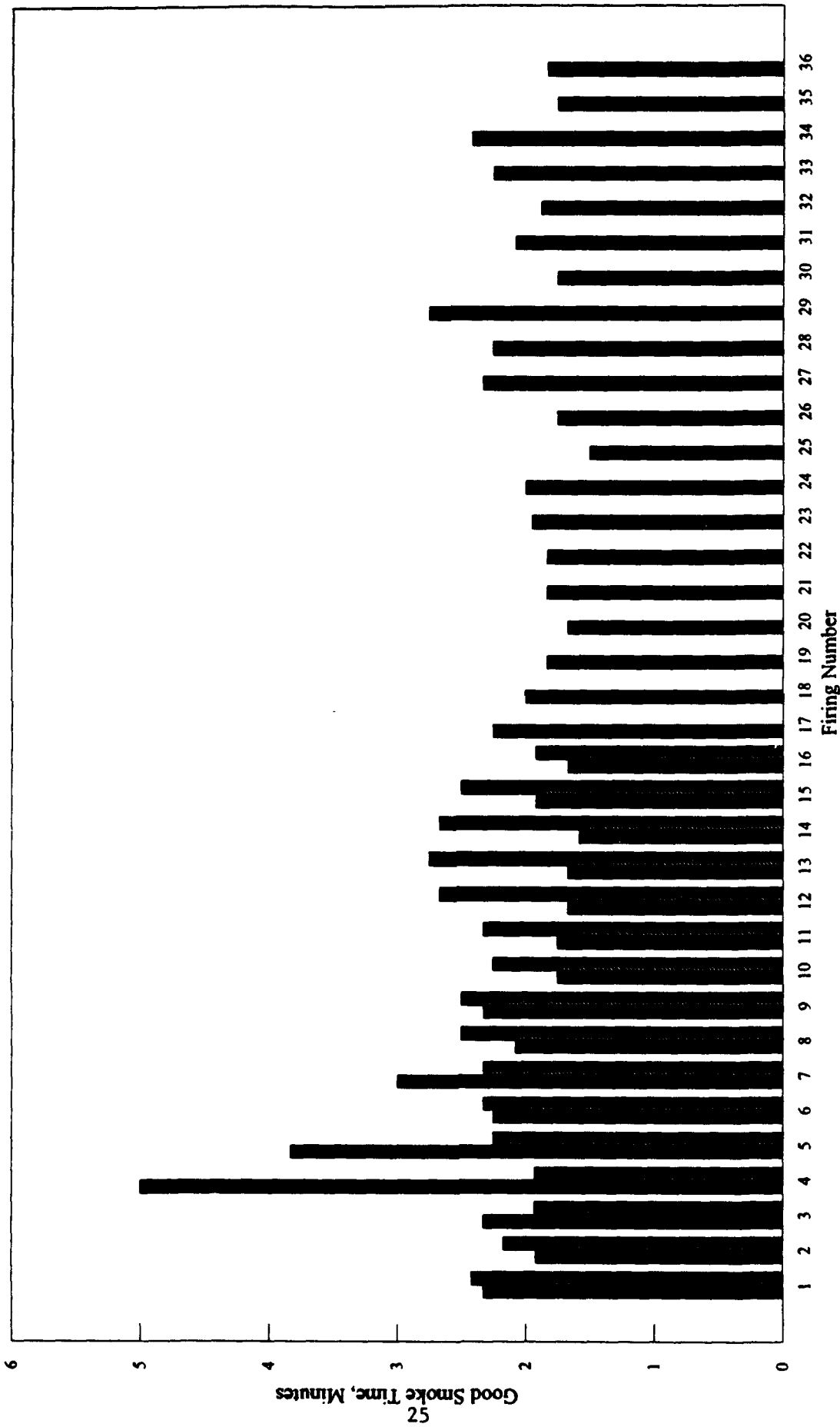


■ CONTROL GRENADES      ■ TEST GRENADES

All Grenades were conditioned for ten weeks at 150 degrees F but were cooled to 125 degrees F before firing.  
All test firings were done in accordance with MIL-G-51478. RP granules are required to be burned out totally within six minutes.

# FIGURE 12: L8A3 RP FUNCTIONING COMPARISON CHART

November 29 - December 13, 1993 Pine Bluff Arsenal

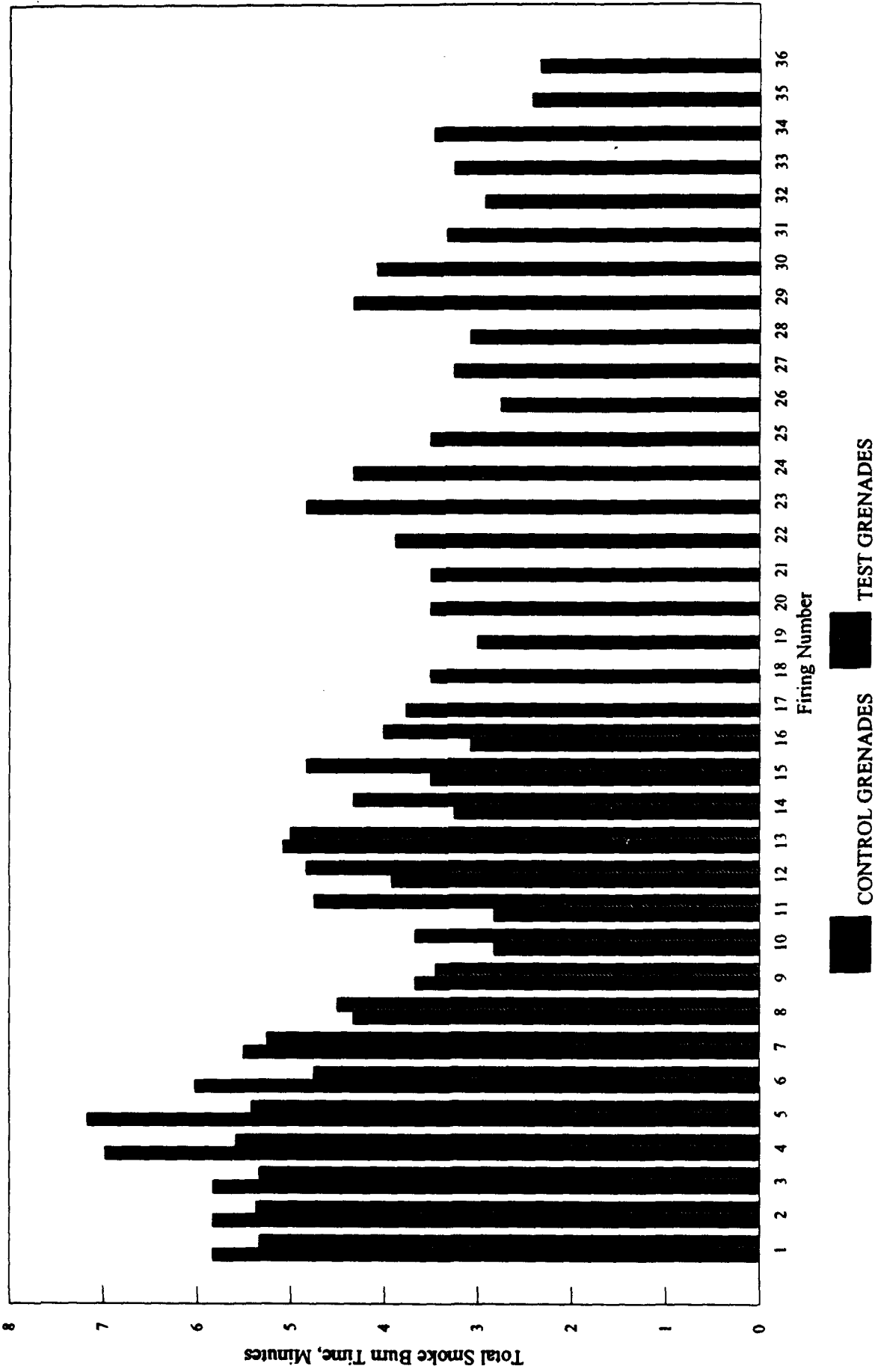


■ CONTROL GRENADES      ■ TEST GRENADES

All Grenades were conditioned for ten weeks at -60 degrees F temperature but were warmed at -50 degrees F temperature before firing. All test firings were done in accordance with MIL-G-51478. One minute of good smoke duration is required.

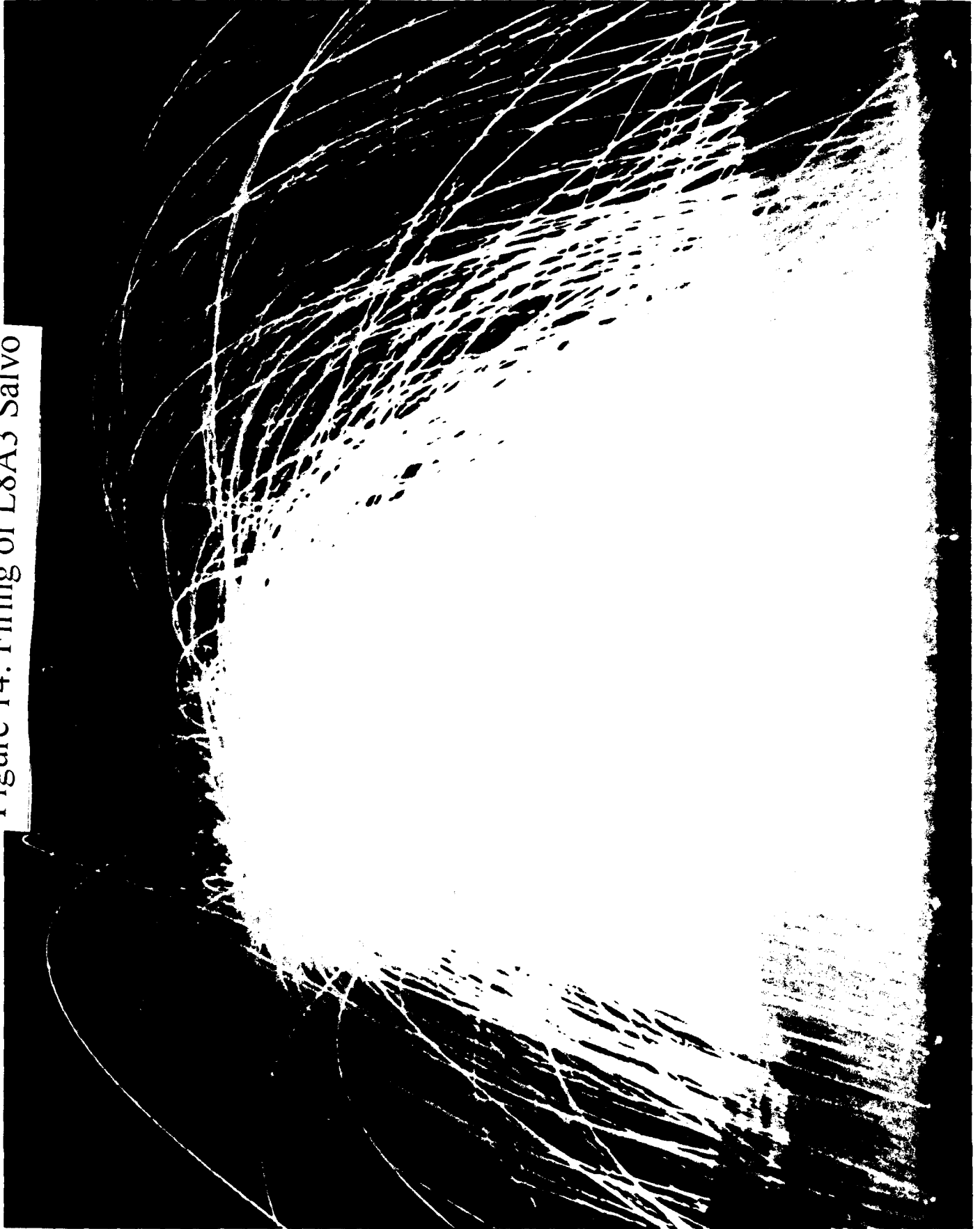
# FIGURE 13: L8A3 RP FUNCTIONING COMPARISON CHART

November 29 - December 13, 1993 Pine Bluff Arsenal



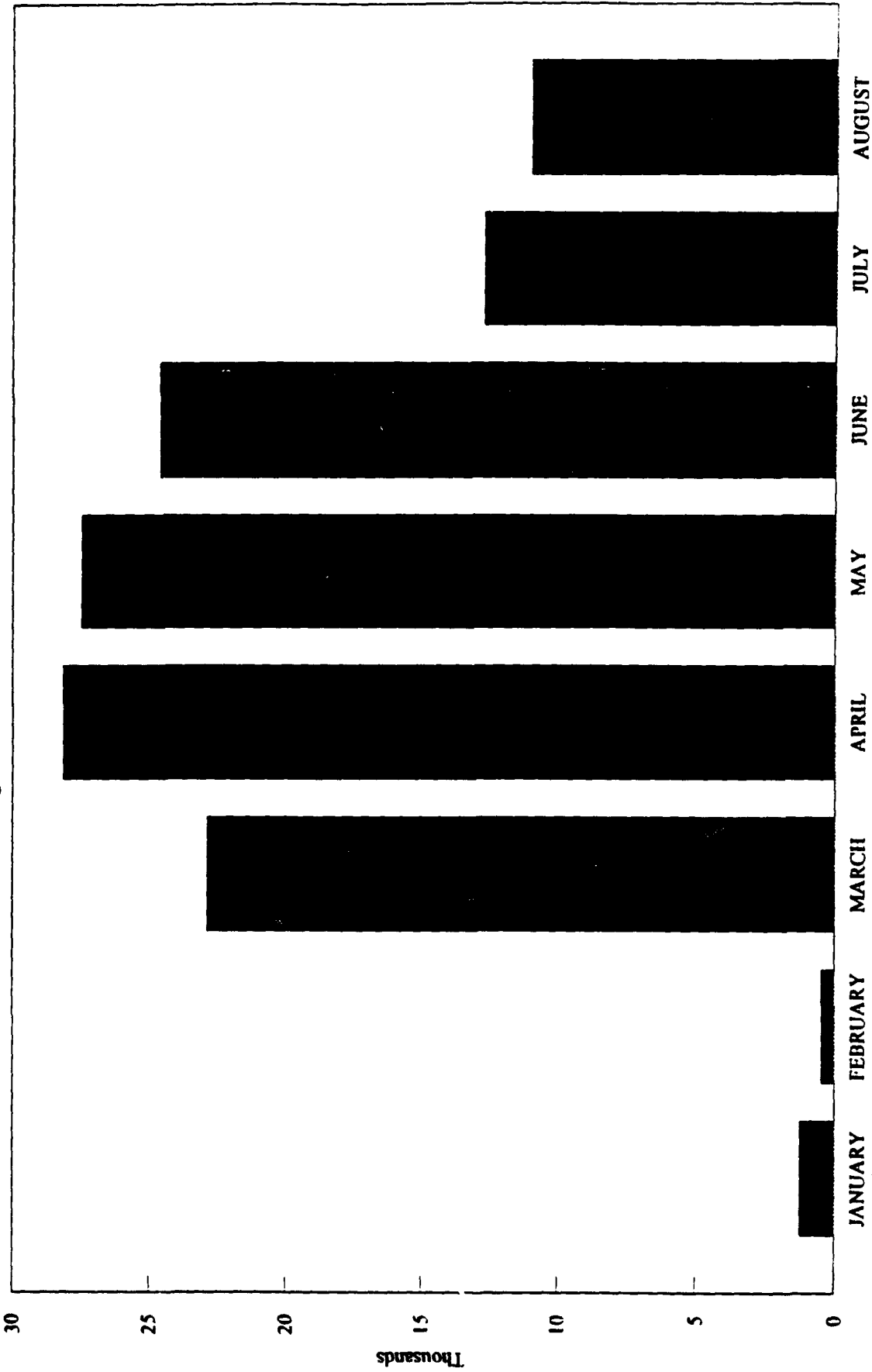
All Grenades were conditioned for ten weeks at -60 degrees F but were warmed to -50 degrees F temperature before firing.  
All test firings were done in accordance with MIL-G-51478. RP granules are required to be burned out totally within six minutes.

Figure 14: Firing of L8A3 Salvo



# FIGURE 15: L8A1 MONTHLY RECLAMATION

August 17, 1994 Pine Bluff Arsenal



Cut off date for information is August 17, 1994. A total of 128,432 out of 158,909 munitions funded for download have been completed. All download operations were conducted at bldg. 33-730. A monthly average of 16,054 downloaded items was obtained.

APPENDIX A  
PROGRAM PLAN, L8A1 RECLAIM STUDY



Directorate of Engineering and Technology  
Technical Support Division

PROGRAM PLAN, L8A1 RECLAIM STUDY

05 May 1992

1. Purpose: This program was established to determine the feasibility and parameters to reclaim the RP/butyl rubber contained in L8A1 smoke grenades which are in condition code H (demil). The reclaimed material will be processed and utilized as feed stock to produce L8A3 smoke grenades. This reclamation is a cost savings plus a considerable environmental bonus over conventional demilitarization (by burning).

2. Engineering Effort Details:

a. Laboratory Study: A limited number of L8A1 grenades will be downloaded for laboratory studies. These studies will determine (a) solvent requirements, (b) percent virgin RP/butyl rubber required, (c) ease of pelletization. This effort will be carried out under the locally approved Hazardous Work Permit program.

b. Pilot Plant Study: The most appropriate methodology as determined in 2a above will be utilized in PBA's pilot plant (Bldg 33-730) to prepare five pound batches. Grenades will be manufactured in accordance with procedures outlined in the Technical Data Package (TDP) for the L8A3. These grenades will be test fired to determine (in a limited manner) the smoke quality, amount of RP burned, pellet break-up, etc., prior to proceeding to the next step.

c.1. Full-Scale Experiments (FY 92): Based upon the result of the effort above, a half size batch (approximately 100 lbs) of RP/butyl rubber mix will be prepared in existing production line equipment, utilizing reclaimed RP, possibly with the addition of virgin RP, butyl rubber and silica, according to the formulation of the TDP, i.e., the same proportions of RP, butyl rubber and silica. Thirty-two full-up grenades will be assembled in accordance with the TDP of the L8A3. Quality assurance inspection procedures will be followed during the manufacture of these items. Eight of these items will be fired singularly. Pellet distribution and burning times will be recorded. Twenty-four full-up grenades will be fired in salvos of four. These will be compared with "standard" L8A3 grenades as to smoke quality and obscuration characteristics. Tests will be performed under wind conditions between 3 and 10 MPH only. Video cameras will be utilized to record the smoke cloud with

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Program Plan, L8A1 Reclaim Study

the tree line as the "target". The PBA "bombing mat" will be the test site.

c.2. FY 93 Effort: Based upon success of the results obtained in c.1. above, six 100 lb batches of mix will be prepared. This mix will be used to make approximately 400 complete grenades for the acceptance test plan. Standard Quality Assurance procedures will be followed as outlined in the L8A3 TDP.

Acceptance Test Plan: Twenty-four "standard" grenades out of Depot Stock for each condition of test will be handled in like manner as a control group. From the grenades prepared, sixteen grenades will be assigned from each of the six batches as follows:

<u>Control Group</u>	<u>Test Group</u>		
24	96	Hot Storage	12 wks @ 150 <sup>o</sup> F*.
24	96	Cold Storage	12 wks @ -50 <sup>o</sup> F**.
24	96	Ambient Stor	12 wks @ 70 + 10 <sup>o</sup> F.
24	96	Immed Test w/o storage	@ ambient cond.

\* The last 48 hours before firing at 125<sup>o</sup>F.

\*\*The last 48 hours before firing at -50<sup>o</sup>F.

c.3. Test Details FY 93 Effort: Identity of grenades will be maintained throughout the testing. Tests will be performed under wind conditions between 3 and 10 MPH only. Batch salvos will be fired in random order to determine variance due to variable wind conditions. Video cameras will be utilized to record the smoke cloud with the tree line as the "target". These videos will be compared with the "standard" L8A3 grenades as to smoke quality and obscuration characteristics. All of the above testing will be done at the PBA "bombing mat". Any dud item will be considered "no test" and will not result as a failure of this test program. The rationale for this decision is that this test is to determine suitability of the smoke composition, and not the use of the "standard" explosive train. Results of testing will be reported in a final report by PBA and furnished to the CCB for consideration in the "Deviation" approval process. Eight each of the "standard grenades" and eight each of the "reclaimed" grenades will be fired singularly: pellet size and burning time will be recorded. The balance of the grenades will be fired in salvos of four for smoke quality and obscuration time. The "reclaimed" L8A3 shall be as good as the "standard" grenades as to these stated characteristics.

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Program Plan, L8A1 Reclaim Study

3. Cost and Time Estimates: Cost and time estimates are to be found at Enclosure 1 and 2 respectively. It should be noted that these estimates do not include the follow-on "Production Phase". It is planned to update the estimates to include the "Production Phase" on or before 30 Oct 93.

4. Conclusion: The end result of this program will be the publication and approval of a deviation. This deviation will allow the use of a stated quantity (total inventory of condition code H, L8A1 smoke grenades) of reclaimed RP/butyl rubber as a feed stock to produce a stated quantity of L8A3 grenades to meet the stated requirements of the TDP.

Submitted by:

PBA

CONCURRENCES:

RAY JOHNSON, CRDEC

DREW FAHRENWALD, CRDEC

BILL SEMIATIN, PAD, CRDEC

MIKE COLLINS, ARDEC

## COST ESTIMATE, L8A1 RECLAIM STUDY

	<u>FY 92</u>	<u>FY 93</u>
Laboratory Study	45K	
Pilot Plant Study	56K	
Full-Scale Experiments	49K	270K
OGA	50K	30K
	<hr/>	<hr/>
	200K	300K

Enclosure 1 to Appendix A

PHASE SCHEDULE, L8A1 RECLAMATION PROGRAM

<u>Phase</u>	<u>3Q92</u>	<u>4Q92</u>	<u>1Q93</u>	<u>2Q93</u>	<u>3Q93</u>	<u>4Q93</u>	<u>1Q94</u>
Lab Study	x---x						
Pilot Plant Study	x-x	x-----x					
Full-Scale Experim FY 92	x--x						
FY 93					x-----x		
CCB Approv.							x

Enclosure 2 to Appendix A

**APPENDIX B**  
**REVISED PROGRAM PLAN, L8A1 RECLAIM STUDY**

Directorate of Engineering and Technology  
Technical Support Division

REVISED PROGRAM PLAN, L8A1 RECLAIM STUDY

20 Aug 1992

1. Purpose: This program was established to determine the feasibility and parameters to reclaim the RP/butyl rubber contained in L8A1 smoke grenades which are in condition code H (demil). The reclaimed material will be processed and utilized as feed stock to produce L8A3 smoke grenades. This reclamation is a cost savings plus a considerable environmental bonus over conventional demilitarization (by burning).

2. Engineering Effort Details:

a. Laboratory Study: A limited number of L8A1 grenades will be downloaded for laboratory studies. These studies will determine (1) solvent requirements, (2) percent virgin RP/butyl rubber required, (3) ease of pelletization. This effort will be carried out under the locally approved Hazardous Work Permit program. The laboratory scale procedure is as follows:

(1) Solvent Requirements

A small, known amount of downloaded RP/butyl rubber will be placed in a beaker with a known amount of solvent. The time and volume of solvent needed to make the downloaded material malleable will be noted.

(2) Percent Virgin RP/Butyl Rubber Required

If the recovered RP/butyl rubber cannot be made sufficiently malleable with addition of methylene chloride, the minimum weight percent of virgin mix that will need to be added to the reclaimed material will be determined.

(3) Ease of Pelletization

The objective of this step will be to determine the proper wetness required for good extrusion. The cohesiveness of the reprocessed mix will be noted. To be acceptable, the mix will be wet enough so that pellets may be formed but not excessively wet so that individual pellets stick together.

b. Pilot Plant Study: The most appropriate methodology as determined in 2a above will be utilized in PBA's pilot plant (Bldg 33-730) to prepare five pound batches. The first runs in the pilot equipment will be done with inert material such as sodium bicarbonate/butyl rubber/methylene chloride to simulate the RP/butyl

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REVISED PROGRAM PLAN, L8A1 RECLAIM STUDY**

rubber/methylene chloride mixture. After these test runs, the pilot scale procedure will be as follows:

(1) Solvent Requirements

Once an order-of-magnitude is determined for the amount of solvent needed, experiments will be done in a Jaygo high-speed mixer and/or a Jaygo sigma-blade mixer to confirm the amount of solvent needed, the necessary duration of mixing, and to check scale-up from the laboratory quantities. It will again be noted whether or not virgin mix will be needed to obtain an extrudable form of the downloaded mix, and if so, how much is required as a weight percent of downloaded mix.

(2) Percent Virgin RP/Butyl Rubber Required

Based on the solvent interaction with the downloaded material during mixing and pelletization, the minimum weight percent of virgin mix that will need to be added to the reclaimed material will be determined.

(3) Ease of Pelletization

Using a portable, hand-operated type of extruder, 5 pound batches of reprocessed reclaimed mix will be extruded for comparison with extruded L8A3 material. The objective of this step will be to confirm on a pilot scale the proper wetness required for good extrusion. The cohesiveness of the pellets will be noted. To be acceptable, the particles that make up the individual pellet will be cohesive so that the pellet does not crumble or fall apart; however, the extruded material should not be wet enough that individual pellets stick to one another.

After pilot processing, grenades will be manufactured in accordance with procedures outlined in the Technical Data Package (TDP) for the L8A3. These grenades will be test fired to determine (in a limited manner) the smoke quality, amount of RP burned, pellet break-up, etc., prior to proceeding to the next step.

c.1. Full-Scale Experiments (FY 92): Based upon the result of the effort above, a half size batch (approximately 100 lbs) of RP/butyl rubber mix will be prepared in existing production line equipment, utilizing reclaimed RP, possibly with the addition of virgin RP, butyl rubber and silica, according to the formulation of the TDP, i.e., the same proportions of RP, butyl rubber and silica. Thirty-two full-up grenades will be assembled in accordance with the TDP of the L8A3. Quality assurance inspection procedures will be followed during the manufacture of these items. All items



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 REVISED PROGRAM PLAN, L8A1 RECLAIM STUDY

will be fired singularly. Pellet distribution and burning times will be recorded. The test grenades will be compared with "standard" L8A3 grenades as to smoke quality and obscuration characteristics. Tests will be performed under wind conditions between 3 and 10 MPH only. Video cameras will be utilized to record the smoke cloud with the tree line as the "target". The PBA "bombing mat" will be the test site. All grenades will be fired over the RP test facility.

c.2. FY 93 Effort: Based upon success of the results obtained in c.1. above, six 100 lb batches of mix will be prepared. This mix will be used to make approximately 400 complete grenades for the acceptance test plan. Standard Quality Assurance procedures will be followed as outlined in the L8A3 TDP.

Acceptance Test Plan: Twenty-four "standard" grenades out of Depot Stock for each condition of test will be handled in like manner as a control group. From the grenades prepared, sixteen grenades will be assigned from each of the six batches as follows:

<u>Control Group</u>	<u>Test Group</u>		
24	96	Cyclic Storage	12 wks
24	96	Hot Storage	12 wks @ 150° F*.
24	96	Cold Storage	12 wks @ -50° F**
24	96	Ambient Stor	12 wks @ 70 + 10° F.
24	96	Immed Test w/o storage	@ ambient cond.

- \* The last 48 hours before firing at ambient
- \*\*The last 48 hours before firing at ambient.

c.3. Test Details FY 93 Effort: Identity of grenades will be maintained throughout the testing. Tests will be performed under wind conditions between 3 and 10 MPH only. Batches will be fired in random order to determine variance due to variable wind conditions. Video cameras will be utilized to record the smoke cloud with the tree line as the "target". These videos will be compared with the "standard" L8A3 grenades as to smoke quality and obscuration characteristics. All of the above testing will be done at the PBA "bombing mat". Any dud item will be considered "no test" and will not result as a failure of this test program. The rationale for this decision is that this test is to determine suitability of the smoke composition, and not the use of the "standard" explosive train. Results of testing will be reported in a final report by PBA and furnished to the CCB for consideration in the "Deviation"

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REVISED PROGRAM PLAN, L8A1 RECLAIM STUDY**

approval process. All items will be fired singularly: pellet size and burning time will be recorded. The "reclaimed" L8A3 shall be as good as the "standard" grenades as to these stated characteristics.

3. Cost and Time Estimates: Cost and time estimates are to be found at Enclosure 1 and 2 respectively. It should be noted that these estimates do not include the follow-on "Production Phase". It is planned to update the estimates to include the "Production Phase" on or before 30 Oct 93.

4. Conclusion: The end result of this program will be the publication and approval of a deviation. This deviation will allow the use of a stated quantity (total inventory of condition code H, L8A1 smoke grenades) of reclaimed RP/butyl rubber as a feed stock to produce a stated quantity of L8A3 grenades to meet the stated requirements of the TDP.

Submitted by:

LOY AIKMAN, PBA

CONCURRENCES:

RAY JOHNSON, CRDEC

BILL SEMIATIN, PAD, CRDEC

DREW FAHRENWALD, CRDEC

MIKE COLLINS, ARDEC

COST ESTIMATE, L8A1 RECLAIM STUDY

	<u>FY 92</u>	<u>FY 93</u>
Laboratory Study	45K	
Pilot Plant Study	56K	
Full-Scale Experiments	49K	300K
OGA	50K	
	-----	-----
	200K	300K

Enclosure 1 to Appendix B

PHASE SCHEDULE, L8A1 RECLAMATION PROGRAM

<u>Phase</u>	<u>3092</u>	<u>4092</u>	<u>1093</u>	<u>2093</u>	<u>3093</u>	
Lab Study	x---x					
Pilot Plant Study	x-x	x-----x				
Full-Scale Experim FY 92	x--x					
FY 93					x-----x	
CCB Approv.						x

Enclosure 2 to Appendix B

**APPENDIX C**  
**L8A1 DOWNLOADING OPERATING PROCEDURES**

This standard operating procedure was prepared by the Directorate of Materiel Management and Demilitarization.

1. PINE BLUFF ARSENAL

STANDING OPERATING PROCEDURE FOR

2. ITEM: a. L-8 Series 3. OPERATION: Demilitarization/RP Download  
Grenades  
b. DODAC 4. ESTIMATED DAILY PRODUCTION RATE 2304 ea.  
1330-G815 5. ORGANIZATION SYMBOL: SMCPB-MML  
c. Pkgd: 1.4G 6. SOP NO. PB-G815-J-006 DATE 11 Jan 94  
Fire Symbol 4 a. REV. NO. \_\_\_\_\_ DATE \_\_\_\_\_  
d. Demiled 1.1 b. CHANGE NO. \_\_\_\_\_ DATE \_\_\_\_\_  
Fire Symbol 1  
e. Chemical  
Hazard  
Symbol: 1 Set 3

3. OPERATION: Demilitarization/RP Download

4. ESTIMATED DAILY PRODUCTION RATE: 2304 each

5. ORGANIZATION SYMBOL: SMCPB-MML

6. SOP NO.: PB-G815-J-006 DATE: 11 Jan 94

Revision No.: \_\_\_\_\_ DATE: \_\_\_\_\_

Change No.: \_\_\_\_\_ DATE: \_\_\_\_\_

7. AUTHORITY PRON 6D106 DATE: 06 Dec 93

**SUPERVISOR'S STATEMENT**

SOP No. PB-G815-J-006 REV No. \_\_\_\_\_ CHANGE No. \_\_\_\_\_ DATE 11 Jan 1994

1. The Supervisor will sign this statement:
  - a. When first assigned as supervisor of this operation.
  - b. When an approved change is made to the SOP.
  - c. At least once per quarter during continuing operations.
  - d. After absence from the job in excess of 15 consecutive workdays.

2. I have personally reviewed each of the operational steps of the SOP and have no question in my mind that the operation can be performed safely and efficiently and in compliance with environmental restrictions noted in the SOP. I have verified to my satisfaction that operators have been trained and are capable of performing their part of the operation in a safe and efficient manner, and have instructed them to follow the SOP without deviation. Personnel that are assigned to this operation have been informed of the hazardous materials to which they may be exposed and to where the MSDS are kept.

SUPERVISOR'S PRINTED/TYPED NAME: \_\_\_\_\_

SUPERVISOR'S SIGNATURE

DATE

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OPERATOR'S STATEMENT

SOP No. PB-G815-J-006 REV No. \_\_\_\_\_ CHANGE No. \_\_\_\_\_ DATE 11 Jan 1994

1. The operator will sign this statement:
  - a. When first assigned the operation.
  - b. When an approved change is made to the SOP.
  - c. At least once per quarter during continuing operations.
  - d. After absence from the job in excess of 15 consecutive workdays.
  
2. I have read or have had read to me, and understand the general and specific safety requirements, environmental requirements, the personnel and explosive limits, and the work description and inspection requirements necessary to accomplish my operation. I have been thoroughly trained in, and am familiar with my part of the operation and I agree to abide by these instructions throughout my assignment to the operation. I have been informed of the hazardous materials to which I may be exposed and to where the MSDS are kept.
  
3. If I discover an industrial accident, I will notify the U.S. Army Health Clinic (Ext 3400), and when fire is involved the Fire Department (Ext 3500).
  
4. Following initial emergency notifications, I will report all injuries and accidents to my immediate supervisor.

<u>NAME/SIGNATURE</u>	<u>DATE</u>	<u>OPERATION NO.</u>
_____	_____	_____
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SOP NO. PB-G815-J-006 DATE 11 Jan 94

REV NO. \_\_\_\_\_ DATE \_\_\_\_\_

CHANGE NO. \_\_\_\_\_ DATE \_\_\_\_\_

INDEX OF OPERATIONS

<u>OPER NO.</u>	<u>BLDG. NO. OR SITE</u>	<u>BAY NO.</u>	<u>EXPLOSIVES</u>		<u>PAGE NO.</u>
			<u>ALLOWED IN BAY</u>	<u>DESCRIPTION OF OPERATION</u>	
<u>1</u>	<u>33-730</u>	<u>N/A</u>	<u>47.69LBS</u>	<u>RECEIPT AND UNPACKING</u>	<u>54</u>
<u>2</u>	<u>33-730</u>	<u>CUBICLE E</u>	<u>2.07LBS</u>	<u>CUTTING OPERATION/CUT RUBBER BODY AT METAL BASE</u>	<u>57</u>
<u>3</u>	<u>33-730</u>	<u>CUBICLE F</u>	<u>12 LBS</u>	<u>RUBBER SEPARATION FROM METAL BASE/RP REMOVAL</u>	<u>60</u>
<u>4</u>	<u>33-730</u>	<u>N/A</u>	<u>47.69LBS</u>	<u>PALLETIZATION</u>	<u>64</u>
<u>APP A</u>	<u>33-730</u>	_____	<u>N/A</u>	<u>LINE LAYOUT</u>	<u>66</u>
<u>APP B</u>	<u>33-730</u>	_____	<u>N/A</u>	<u>PRE-OPERATIONAL CHECKLIST</u>	<u>68</u>
<u>APP C</u>	<u>33-730</u>	_____	<u>N/A</u>	<u>SOP REVIEW SHEET</u>	<u>69</u>
<u>APP D</u>	<u>33-730</u>	_____	<u>N/A</u>	<u>HAZARD ANALYSIS</u>	<u>71</u>
_____	_____	_____	_____	_____	_____

**REMARKS:**

PURPOSE OF THIS SOP IS TO ESTABLISH A PROCEDURE FOR EXTRACTING RP FROM L-8 SERIES GRENADES.

**REFERENCES:**

- AMCR-385-100
- PBAR-385-7
- PB-0000-L001
- OSHA-1926.350, 351
- DA PAM 385-64
- AR 385-64
- AMCR 755-8

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### GENERAL SAFETY REQUIREMENTS

1. U.S. Army Health Clinic, Bldg 13-020, provides first aid and emergency medical treatment to all personnel involved in activities on post.
2. A preoperation checklist will be completed by supervisor prior to start of operations.
3. Standing Operating Procedures (SOP), applicable portion, shall be conspicuously posted in rooms or bays involved in the operation. Supervisory personnel shall maintain copies of a complete standing operating procedure and be responsible for the enforcement of its provisions.
4. There will be no deviation or change from the approved SOP without prior approval of the Installation Commander or his designated representative.
5. Employees will not tamper with any safety devices or protective equipment.
6. Any defect or unusual condition noted that is not covered by this SOP will be reported immediately to supervisor or QASAS personnel.
7. Appropriate fire symbol(s) and chemical hazard symbol(s) shall be displayed in such a manner as to be easily visible from all roads of approach.
8. Care will be taken to limit exposure of a minimum number of personnel, for a minimum time, to a minimum amount of hazardous material consistent with safe and efficient operations.
9. Personnel will be so located that operators will have an unobstructed path of travel to the nearest available exit.
10. Work locations will be maintained in a neat and orderly condition.
11. All handtools shall be maintained in a good state of repair.
12. Operators in proximity to steel banding operations will wear face shields and safety eyewear. Operators handling metal banding will also wear leather or leather-palmed gloves.

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13. Operators lifting material will use proper, safe hand holds, assume proper lifting position, avoid twisting when lifting or carrying, and avoid sharp objects.

14. Each MHE/Vehicle Operator will have in his possession a valid operators permit for the particular piece of equipment to be operated.

15. Materiel handling equipment used in handling of ammunition and explosives will comply with paragraphs 24-3 and 24-4 of AMCR-385-100.

16. Explosives-loaded ammunition, packaged ammunition or bulk explosives shall not be handled roughly, thrown about, tumbled, dropped, or walked over. Large ammunition items, packaged in DOT approved containers designed to permit dragging, rolling or towing, may be so moved when necessary during handling for storage and transportation.

17. QASAS, Safety Officer and any operational supervisor has the authority and responsibility to stop unsafe operations where imminent danger is involved.

18. Any ammunition determined to be dangerous to handle or store will be reported immediately to supervisory personnel. Operations will be suspended and if warranted, personnel will be evacuated pending further instructions. Doors of operating buildings should have panic hardware installed and must never be bolted or locked when operations are being conducted. Posted personnel and explosives limits must not be exceeded at any time. Transient personnel must comply with the same safety requirements as operating personnel. In bays where conductive footwear is required, transient personnel such as production controllers and other visitors to the operation are authorized to wear conductive booties or leg stats. No more than a 4-hour requirement of supplies should be kept in an operating building.

19. Forklift trucks will not be used in handling fuzed ammunition items unless the item is packed in an approved manner for safe shipment, complying with AMC and Department of Transportation regulations.

20. Tools used where there are exposed explosives will be made of spark resistant materials.

21. Equipment, conductive flooring, and the grounding system shall be tested for electrical resistance and continuity when initially installed and at intervals IAW 385-100 para 7-4 and 7-7. All exposed explosives or hazardous materials shall be removed prior to making the test. Test results will be recorded.

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22. Appropriate fire symbols and/or chemical hazard symbols shall be displayed on vehicles used in transporting ammunition intra-depot.

23. Leather or leather-palmed gloves will be worn when handling wooden boxes.

24. Steel toed safety shoes or boots will be worn by all personnel engaged in material handling operations.

25. Material Handling Equipment and other lifting devices will have the load rating and date of next inspection marked on them. The load rating will not be exceeded and the equipment will not be used without a current inspection date.

26. The degree of hazard associated with treated packing materials cannot be determined by visual examination. There are no quantifiable criteria to use in judging such items as "loose" or "excessive", therefore, the following information is disseminated to provide final guidance on protective measures for handling treated wood. This guidance should be followed under the direction of a resident Industrial Hygienist who has evaluated the actual exposure in question.

a. Prevent inhalation, ingestion, skin and eye contact.

b. Good housekeeping is essential to prevent re-entrainment of chemical treatment crystals or wood dust.

c. Prevention of skin and eye contact through the use of gloves, coveralls, and goggles. The type of gloves to be worn is dependent upon the characteristics of the wood being handled. Coveralls which are laundered on a routine basis (preferably daily) should be worn. The coveralls should not be taken home but should remain at the work site. When handling wood with visible crystals or when generating wood dust, chemical goggles should be worn.

d. When sawing and machining treated wood, if the airborne concentration exceeds, or is expected to exceed, the threshold limit value (TLV) of the treatment chemical, a NIOSH-approved respirator with dust prefilter must be worn.

e. No smoking, eating, or drinking should be permitted in the work the work areas. Separate break areas and washing facilities should be provided. Personnel should wash hands prior to eating, drinking, smoking or using toilet facilities. All exposed areas of the body should be washed at the end of each workday.

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27. Operations where dusts, vapors or gases are present should have an Industrial Hygienist evaluate the hazard to determine whether respirators are needed. If needed operators must be medically evaluated, trained, and fitted to use respiratory protective equipment. Identify the appropriate type of respirator in the list of equipment for that operation.

28. Whenever an electrical storm approaches the installation, personnel shall be evacuated from locations at which there is a hazard from explosives which could be ignited by lightning. Operations requiring attention at all times shall continue to be manned by the minimum number of personnel consistent with safety requirements. When the process has been brought to a condition in which it is considered safe to leave, the building will be completely evacuated.

29. All installed gages and equipment will be properly grounded.

30. The supervisor is responsible to report to the safety office all injuries and accidents occurring during his/her shift. In the event of a fire or explosion, activate all installed fire extinguishing equipment and alarm systems. The person discovering the fire/explosion will notify the Fire Department, and immediate supervisor.

31. Work tables will be equipped with side boards to prevent ammunition from rolling off. Metal table tops will be grounded.

32. Paint thinners, oily rags and other highly flammable materials will be kept in approved, closed receptacles.

33. All areas where acids, caustics, corrosive materials, or hazardous chemicals are stored, used or handled must be provided with emergency shower and eye wash station. For field type operations, an approved water supply with portable shower and eye wash fountain may be used with the approval of Safety Office.

34. Ladders and their usage must comply with OSHA standards, be inspected at least every four months, and be marked as to their next required inspection date.

35. All electrical panels will have access doors closed except during switching operations.

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36. All operations, work sites and equipment that have a noise level of 85 db or more must be posted with approved signs or decals warning of the hazard. All personnel must be provided with, and wear approved ear protection appropriate for the type of hazard they could be exposed to.

37. All operations, sites and equipment that are determined to require respiratory protection must be posted with approved signs or decals warning of the hazard. All personnel must be provided with, and wear, approved respiratory protection.

38. Designated smoking areas and procedures for control of match lighters must be approved by the Safety Office. Smoking areas must be established IAW PBAR-385-7 and have a minimum of :

- a. An approved container for disposal of used smoking material.
- b. A sign identifying the area.
- c. At least one approved fire extinguisher (water or multi-purpose).
- d. Enforced measures to insure that it is kept neat and orderly.

39. The following safety procedures will be followed during fueling operations:

- a. Fueling must be done at least 20 feet from inert buildings and loading docks; 100 feet from explosives locations or buildings for gasoline.
- b. Fueling shall only be done when equipment is not running.
- c. No smoking will be permitted within 50 feet of a fueling site.
- d. Portable fueling containers will not exceed five gallon capacity, provided with a flame arrestor screen and labeled as to its contents. A dry type chemical fire extinguisher (not less than 2 1/2 lbs.) must be at fueling site.
- e. All tanks, hoses and containers of five gallons or less shall be kept in metallic contact while flammable liquids are being transferred.
- f. Transfer of flammable liquids in excess of five gallons shall be done only when containers are electrically interconnected (bonded).
- g. Flammable storage tanks and systems shall be electrically bonded and grounded.

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40. Plumbed Emergency Eyewash and Showers (EE&S) will be flushed 5 minutes on a weekly basis. DA Form 2404 will be affixed to the EE&S to record this action.

41. Safety precautions for cutting and welding operations prescribed by OSHA 1926.350, 351 will be complied with. A water type fire extinguisher, 2 1/2 gallons or more, must be at work site (for control of grass fire) and fire blanket available if appropriate. DA Form 5383-R is required (issued by Safety Office or Fire Department).



**OPERATIONS FORMAT**

A. STANDING OPERATING PROCEDURE FOR: B. OPERATION NO. 1

Download L8A1 Grenades C. BAY N/A

D. SOP NO PB-G815-J-006 DATE 11 Jan 94

E. REV NO. \_\_\_\_\_ DATE \_\_\_\_\_

F. CHANGE NO. \_\_\_\_\_ DATE \_\_\_\_\_

G. OPERATION: Receipt and unpacking.

Hazard Pay: 0%, 4%, 8%

H. EXPLOSIVE LIMITS: UNITS: 1,152 ea EXPLOSIVE LBS: 47.69

I. PERSONNEL LIMITS: OPERATORS: N/A TRANSIENTS: N/A

Step No.	Description	Specific Instruction: Safety (S), Operational (O), Quality Check (QC)
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NOTE: Operators will wear the following clothing and safety gear: conductive sole shoes, flame resistant coveralls, and safety glasses. Personnel unpacking pallets must wear in addition, face shields and leather palmed gloves.

- |                                                                    |                                                                                                                                                                                             |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Transport L-8 grenades to work site.                            | 1a(O) Materiels will be transported to work site IAW PB-0000-L001.                                                                                                                          |
| 2. Post hazard symbols on building.                                | 2a(O) Display symbols so they are easily visible from access roads to building.                                                                                                             |
|                                                                    | 2b(O) (S) Post caution sign: "NO RADIO TRANSMISSION BEYOND THIS POINT" at entrances, 50 feet from building.                                                                                 |
| 3. Download transport vehicle and position pallet (Line Layout 1). | 3a(O) (S) Place pallet of grenades at end of conveyor. Remove strapping and place in wire basket.                                                                                           |
|                                                                    | 3b(O) Remove lead seals; open containers. Remove grenades and place in tray on conveyor with metal base down. Pass packing material to Line Layout 2 and empty containers to Line Layout 3. |

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REV \_\_\_\_\_ DATE \_\_\_\_\_

CHG NO. \_\_\_\_\_ DATE \_\_\_\_\_

OPERATION No. 1 Continued

Step J. No.	Description	Specific Instruction: Safety (S), Operational (O), Quality Check (QC)
4.	Containerize packing material (Line Layout 2).	4a(O) Separate packing material (styrofoam and plastic spacers). Place in separate plastic bags and transfer to incinerator complex for disposition.
5.	Palletize empty M2A1 containers (Line Layout 3).	5a(O) Transfer half of empty M2A1 containers to line layout 10 for packout.  5b(O) (QC) Verify each container is empty, label (EMPTY).  5c(O) (S) Palletize empty M2A1 containers and transfer to incinerator complex for disposition.
6.	Transfer grenades.	6a(O) Pass trays of grenades along conveyor to Line Layout 4.

K. SPECIAL REQUIREMENTS:

1. Good housekeeping will be maintained at all times.
2. When operations are affected by weather conditions, electrical storm, etc., site supervisors will cease operations and personnel will leave the building.
3. Conductive shoes will be tested daily, utilizing conductive shoe tester. A record of the shoe testing inspection will be accomplished by using a sign-in sheet to be posted near shoe tester.
4. Lot integrity will be maintained.

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CHG NO. \_\_\_\_\_ DATE \_\_\_\_\_

OPERATION No. 1 Continued

Step Specific Instruction: Safety (S),  
J. No. Description Operational (O), Quality Check (OC)  
L. EQUIPMENT, TOOLS AND SUPPLIES:

<u>ITEM</u>	<u>QTY REQ'D</u>	<u>SPEC/DWG NO.</u>	<u>NSN</u>
Coveralls, Flame Retardant	1pr/person	MIL-C-14610	8515-99-279-8722
Shoes, Safety, Conductive	1pr/person	ANSI STD Z41.1-1967	
Glasses, Safety or	1pr/person	GGG-G-521	4240-00-526-4527
Goggles Industrial	1pr/person	GGG-G-521	
Face Shield	As Req'd	GGG-G-521	4240-00-542-2048
Gloves, Leather	As Req'd	MIL-G-2366	
Chemical Symbol 1 Set 3	2 each		Locally Procured
Fire Symbol 1	2 each		Locally Procured
Fire Symbol 4	2 each		Locally Procured
Caution Sign "No Radio Transmission Beyond This Point"	2 each		Locally Procured
Shoe Tester (Model TM)	1 each		Locally Procured
Forklift, Gas	1 each		
Forklift, Electric	1 each		

NOTE: A substitute item may be used in place of any common tool or supplies, if approved by safety for use in the operation.

**OPERATIONS FORMAT**

A. STANDING OPERATING PROCEDURE FOR: Download L8A1 Grenades      B. OPERATION NO. 2  
 C. BAY Cubicle E

D. SOP NO PB-G815-J-006      DATE 11 Jan 94

E. REV NO. \_\_\_\_\_      DATE \_\_\_\_\_

F. CHANGE NO. \_\_\_\_\_      DATE \_\_\_\_\_

G. OPERATION: Cutting operation/cut rubber body at metal base.

Hazard Pay: 0%, 4%, (8%)

H. EXPLOSIVE LIMITS: UNITS: 50 ea.      EXPLOSIVE LBS: 2.07

I. PERSONNEL LIMITS: OPERATORS: 3      TRANSIENTS: 2

Step J. No.	Description	Specific Instruction: Safety (S), Operational (O), Quality Check (OC)
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NOTE: Operators will wear the following clothing and safety gear: conductive sole shoes, flame resistant coveralls, safety glasses and hearing protection. Personnel unpacking pallets must wear in addition, face shields and leather palmed gloves.

1. Cut rubber body at metal base (Line Layout 4).	1a(O)(S) Place grenade in slot on belt conveyor with metal base to the left. Grenade will be pulled through conveyor cutting rubber at base. Allow grenade to cycle completely through before repeating process. If conveyor is inoperative, use a box knife to make cut.
---------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

1b(O)(S) If grenade catches fire, or starts smoking as it is being pulled through conveyor, pull handle right side of conveyor which will drop round into container of water. After a 15 minute wait remove grenade from water drum. Separate rubber body from metal base and dump RP into contaminated RP container. Pack metal base IAW Operation No. 3 Step 6.

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REV \_\_\_\_\_ DATE \_\_\_\_\_

CHG NO. \_\_\_\_\_ DATE \_\_\_\_\_

OPERATION No. 2 Continued

Step No.	Description	Specific Instruction: Safety (S), Operational (O), Quality Check (OC)
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K. SPECIAL REQUIREMENTS:

1. Good house keeping will be maintained at all times.
2. When operations are affected by weather conditions, electrical storm, etc., site supervisors will cease operations and personnel will leave the building.
3. Conductive shoes will be tested daily, utilizing conductive shoe tester. A record of the shoe testing inspection will be accomplished by using a sign-in sheet to be posted near shoe tester.
4. Operators removing RP from grenades will wear pyro apron and plastic coated gloves.
5. Operators will wear a wire mesh glove on holding hand when cutting rubber body with a box knife.
6. Lot integrity will be maintained.

SOP PB-G815-J-006 DATE 11 Jan 94

REV \_\_\_\_\_ DATE \_\_\_\_\_

CHG NO. \_\_\_\_\_ DATE \_\_\_\_\_

OPERATION No. 2 Continued

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Step	Specific Instruction: Safety (S),
J. No. Description	Operational (O), Quality Check (OC)

---

L. EQUIPMENT, TOOLS & SUPPLIES:

<u>ITEM</u>	<u>QTY REQ'D</u>	<u>SPEC/DWG NO.</u>	<u>NSN</u>
Coveralls, Flame Retardant	1 pr/person	MIL-C-14610	8515-99-279-8722
Shoes, Safety, Conductive	1 pr/person	ANSI STD Z41.1-1967 MIL-S-3794E	
Glasses, Safety or	As Req'd	GGG-G-521	4240-00-526-4527
Goggles, Industrial	As Req'd	GGG-G-521	4240
Gloves, Leather	As Req'd	MIL-G-2366	8415
Face Shield	As Req'd	GGGG-G-521	4240-00-542-2048
Chemical Symbol 1 Set 3	2 ea.		7690-081-9588
Fire Symbol 1	2 ea.		Locally Procured
Fire Symbol 4	2 ea.		Locally Procured
Caution Sign - "NO RADIO TRANSMISSION BEYOND THIS POINT"	2 ea.		Locally Procured
Tester, Conductive Shoe	1 ea.		APE 1952
Plastic Coated Gloves	As Req'd		Locally Procured
Pyro Apron	As Req'd		Locally Procured
Hearing Protection	As Req'd		6515-00-137-6345
Caution Sign-"Hearing Protection"	As Req'd		Locally Fabricated
Wire Mesh Glove (large)	As Req'd		8415-01-X92-0462
Wire Mesh Glove (medium)	As Req'd		8415-01-x92-0463

NOTE: A substitute item may be used in place of any common tool or supplies, if approved by safety for use in the operation.

**OPERATIONS FORMAT**

A. STANDING OPERATING PROCEDURE FOR: Download L8A1 Grenades      B. OPERATION NO. 3  
 C. BAY Cubicle F

D. SOP NO PB-G815-J-006      DATE 11 Jan 94

E. REV NO. \_\_\_\_\_      DATE \_\_\_\_\_

F. CHANGE NO. \_\_\_\_\_      DATE \_\_\_\_\_

G. OPERATION: Rubber separation from metal base/RP removal.

Hazard Pay: 0%, 4%, (8%)

H. EXPLOSIVE LIMITS: UNITS: 291 ea.      EXPLOSIVE LBS: 12

I. PERSONNEL LIMITS: OPERATORS: 3      TRANSIENTS: 2

Step	Description	Specific Instruction: Safety (S), Operational (O), Quality Check (OC)
J.	No.	

NOTE: Weigh empty containers to establish a net weight when filled.

NOTE: Operators will wear the following clothing and safety gear: conductive sole shoes, flame resistant coveralls, safety glasses and hearing protection. Personnel unpacking pallets must wear in addition, face shields and leather palmed gloves.

- |                                                                            |                                                                                                                                                                                                     |
|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Separate rubber body from metal base assembly (Line Layout 5).          | 1a(O) Holding grenade with metal base pointed down, separate rubber body from metal base assembly.                                                                                                  |
|                                                                            | 1b(O) If during disassembly burster breaks and contaminates RP, pass rubber body containing contaminated RP to Line Layout 8.                                                                       |
|                                                                            | 1c(O) (S) Sweep up loose black powder with a fiber bristle brush and pass broken bursters and loose powder to Line Layout 9.                                                                        |
| 2. Pass grenades through tube conveyor for lengthwise cut (Line Layout 6). | 2a(O) (S) Feed grenade through tube conveyor for a lengthwise cut. If tube conveyor is inoperable, use a box knife to make a lengthwise cut in rubber. After cut pass rubber body to Line Layout 7. |

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OPERATION No. 3 Continued

Step J. No.	Description	Specific Instruction: Safety (S), Operational (O), Quality Check (QC)
		2b(O) (S) If grenade body starts smoking scoop up body with metal dust pan and place in water drum. After 15 minutes remove grenade body and dump RP into contaminated RP container (Line Layout 8).
3.	Remove RP from rubber body (Line Layout 7).	3a(O) (S) Dump RP into conductive bag inside grounded container.  3b(O) After container is filled and weighed (100 pounds is desired net weight), mark with the following information: (a) RP, (b) lot no., (c) net weight, (d) date filled.  3c(O) Transfer RP to Line Layout 12 for palletization.
4.	Containerize contaminated RP (Line Layout 8).	4a(O) (S) If RP is contaminated due to a broken burster during separation, dump RP into a conductive bag inside a grounded container.  4b(O) After container is filled and weighed, mark with the following information: (a) contaminated RP, (b) 1365-00-X00-0129, (c) net weight.  4c(O) Transfer contaminated RP to Line Layout 13 for palletization.
5.	Containerize broken bursters and loose black powder (Line Layout 9).	5a(O) (S) Broken bursters and loose black powder will be placed in a grounded container.



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CHG NO. \_\_\_\_\_ DATE \_\_\_\_\_

OPERATION No. 3 Continued

Step	Specific Instruction: Safety (S),	
J. No.	Description	Operational (O), Quality Check (OC)
		5b(O) Bursters/black powder containers will be marked with a line to approximate 10 lbs. When filled to line, or at the end of each day, weigh container and transfer contents to receptive container in cubicle A. Place an empty container in cubicle F at the beginning of each day.

**SAFETY NOTE:** Insure containers are bonded to each other prior to transferring bursters/black powder.

5c(O) Receptive container in cubicle A will have no more than 50 lbs. When 50 lbs. have accumulated, mark drum with the following information: (a) bursters/black powder L8 download, (b) 1376-00-X00-0101, (c) net weight. Transfer to storage igloo.

6. Pack metal base assemblies (Line Layout 10).

6a(O) Place rubber body over burster and and pack 8 each in M2A1 container with metal base down. Transfer to Line Layout 11 for palletization.

**K. SPECIAL REQUIREMENTS:**

1. Good housekeeping will be maintained at all times. Prior to cleaning cubicles E & F at the end of each day, move RP and contaminated RP to cubicle B, and bursters/black powder to cubicle A.
2. When operations are affected by weather conditions, electrical storm, etc., site supervisors will cease operations and personnel will leave the building.
3. Conductive shoes will be tested daily, utilizing conductive shoe tester. A record of the shoe testing inspection will be accomplished by using a sign-in sheet to be posted near shoe tester.

OPERATION No. 3 Continued

Step Specific Instruction: Safety (S),  
J. No. Description Operational (O), Quality Check (QC)

K. SPECIAL REQUIREMENTS (continued):

4. Operators removing RP from grenades will wear pyro apron and plastic coated gloves. Full face respirator with TC-21C-135 cartridge will be used in emergency conditions such as spills.

5. Operators will wear a wire mesh glove on holding hand when cutting rubber body with box knife.

6. Lot integrity will be maintained.

L. EQUIPMENT, TOOLS & SUPPLIES:

<u>ITEM</u>	<u>QTY REQ'D</u>	<u>SPEC/DWG NO.</u>	<u>NSN</u>
Coveralls, flame retardant	1 pr/person	MIL-C-14610	8515-99-279-8722
Shoes, safety, conductive	1 pr/person	ANSI STD Z41.1-1967 MIL-S-3794E	
Glasses, safety or	As Req'd	GGG-G-521	4240-00-526-4527
Goggles, industrial	As Req'd	GGG-G-521	4240
Gloves, leather	As Req'd	MIL-G-2366	8415
Face Shield	As Req'd	GGGG-G-521	4240-00-542-2048
Chemical Symbol 1 Set 3	2 ea.		7690-081-9588
Fire Symbol 1	2 ea.		Locally Procured
Fire Symbol 4	2 ea.		Locally Procured
Caution Sign - "NO RADIO TRANSMISSION BEYOND THIS POINT"	2 ea.		Locally Procured
Tester, Conductive Shoe	1 ea.		(Model TM)
Plastic Coated Gloves	As Req'd		Locally Procured
Pyro Apron	As Req'd		Locally Procured
Hearing Protection	As Req'd		6515-00-137-6345
Fiber Bristle Brush	1 ea.		8020-00-685-5392
Dust Pan	1 ea.		7290-00-224-8308
Forklift, Electric	1 ea.		
Scales	1 ea.		Locally Procured
Conductive Bags	As Req'd	MIL-P-82646/7	
Fullface Respirator w/ TC-21C-135 Cartridge			
Caution Sign-Hearing Protection	As Req'd		Locally Fabricated
Wire Mesh Glove (Large)	As Req'd		8415-01-X92-0462
Wire Mesh Glove (Medium)	As Req'd		8415-01-X92-0463

NOTE: A substitute item may be used in place of any common tool or supplies, if approved by safety for use in the operation.

**OPERATIONS FORMAT**

A. STANDING OPERATING PROCEDURE FOR: Download L8A1 Grenades      B. OPERATION NO. 4  
 C. BAY N/A

D. SOP NO PB-G815-J-006      DATE 11 Jan 94

E. REV NO. \_\_\_\_\_      DATE \_\_\_\_\_

F. CHANGE NO. \_\_\_\_\_      DATE \_\_\_\_\_

G. OPERATION: Palletization

Hazard Pay: 0%, **4%**, 8%

H. EXPLOSIVE LIMITS: UNITS: 1152      EXPLOSIVE LBS: 47.69

I. PERSONNEL LIMITS: OPERATORS: N/A      TRANSIENTS: N/A

Step J. No.	Description	Specific Instruction: Safety (S), Operational (O), Quality Check (OC)
----------------	-------------	--------------------------------------------------------------------------

NOTE: Operators will wear the following clothing and safety gear: conductive sole shoes, flame resistant coveralls, and safety glasses. Personnel unpacking pallets must wear in addition, face shields and leather palmed gloves.

- |                                                        |                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1. Palletize demiled grenades (Line Layout 11).</p> | <p>1a(O) Label containers with the following information: (a) 1330-00-X00-0118 (0119 for L8A3), (b) upper body assembly and flash tube F/L8 D/L, (c) lot number, PB-mixed-94 (or current FY), (d) Hazard Class 1.1D, (e) quantity.</p> <p>1b(O) (S) Palletize demiled grenades and transfer to cubicle B or to storage.</p> |
| <p>2. Palletize RP (Line Layout 12).</p>               | <p>2a(O) (S) Palletize drums of RP so markings are visible.</p> <p>2b(O) Transfer RP to cubicle B or to production division.</p>                                                                                                                                                                                            |
| <p>3. Palletize contaminated RP (Line Layout 13).</p>  | <p>3a(O) (S) Palletize drums of contaminated RP so markings are visible.</p>                                                                                                                                                                                                                                                |

SOP PB-G815-J-006 DATE 11 Jan 94

REV \_\_\_\_\_ DATE \_\_\_\_\_

CHG NO. \_\_\_\_\_ DATE \_\_\_\_\_

OPERATION No. 4 Continued

Step No.	Description	Specific Instruction: Safety (S), Operational (O), Quality Check (OC)
J.		3b(O) Transfer contaminated RP to cubicle B or to storage.

**K. SPECIAL REQUIREMENTS:**

1. Good housekeeping will be maintained at all times.

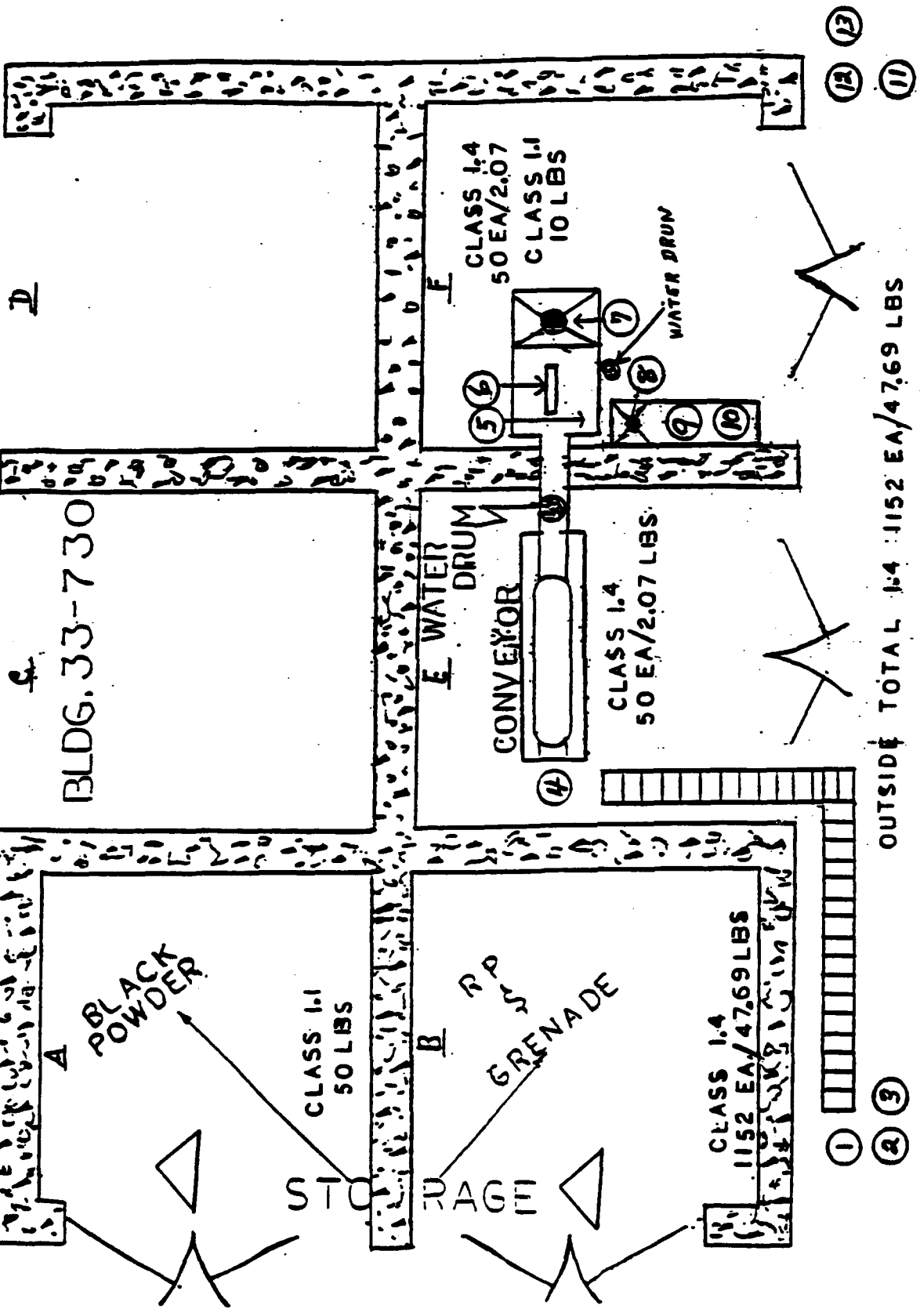
2. When operations are affected by weather conditions, electrical storm, etc., site supervisors will cease operations and personnel will leave the building.

3. Conductive shoes will be tested daily, utilizing conductive shoe tester. A record of the shoe testing inspection will be accomplished by using a sign-in sheet to be posted near shoe tester.

**L. EQUIPMENT, TOOLS & SUPPLIES:**

<u>ITEM</u>	<u>QTY REQ'D</u>	<u>SPEC/DWG NO.</u>	<u>NSN</u>
Coveralls, flame retardant	1 pr/person	MIL-C-14610	8515-99-279-8722
Shoes, safety, conductive	1 pr/person	ANSI STD Z41.1-1967 MIL-S-3794E	
Glasses, safety or	As Req'd	GGG-G-521	4240-00-526-4527
Goggles, industrial	As Req'd	GGG-G-521	4240
Gloves, leather	As Req'd	MIL-G-2366	8415
Face Shield	As Req'd	GGGG-G-521	4240-00-542-2048
Chemical Symbol 1 Set 3	2 ea.		7690-081-9588
Fire Symbol 1	2 ea.		Locally Procured
Fire Symbol 4	2 ea.		Locally Procured
Caution Sign - "NO RADIO TRANSMISSION BEYOND THIS POINT"	2 ea.		Locally Procured
Tester, Conductive Shoe	1 ea.		Model TM
Forklift, Electric	1 ea.		

NOTE: A substitute item may be used in place of any common tool or supplies, if approved by safety for use in the operation.



OUTSIDE TOTAL 1.4 1152 EA/47.69 LBS

APPENDIX A

LINE LAYOUT

SOP PB-G815-J-006 DATE 11 Jan 94

REV \_\_\_\_\_ DATE \_\_\_\_\_

CHG NO. \_\_\_\_\_ DATE \_\_\_\_\_

**APPENDIX A**  
**LINE LAYOUT**

**Operation 1:**

1. Cut strapping/open containers/remove grenades.
2. Containerize packing material.
3. Palletize empty M2A1 containers.

**Operation 2:**

4. Cutting operation/cut rubber body at metal base.

**Operation 3:**

5. Separate rubber body from metal base.
6. Feed-through tube conveyor/lengthwise cut.
7. Remove RP/containerize.
8. Remove contaminated RP/containerize.
9. Place broken bursters and loose black powder into metal container.
10. Repack grenades 8 each per M2A1 container.

**Operation 4:**

11. Palletize grenades.
12. Palletize RP.
13. Palletize contaminated RP.

SOP PB-G815-J-006 DATE 11 Jan 94

REV \_\_\_\_\_ DATE \_\_\_\_\_

CHG NO. \_\_\_\_\_ DATE \_\_\_\_\_

APPENDIX B

THIS CHECKLIST MUST BE COMPLETED  
PRIOR TO STARTING OPERATIONS

1. SOP at work stations.
2. SOP sign off sheet signed:
  - a. Operator
  - b. Supervisor
3. MHE checked out.
4. Fire extinguishers in place/checked.
5. Deluge system checked.
6. Safety showers checked.
7. Building hazard signs displayed.
8. Personnel protecting equipment worn/on hand.
9. Conductive sole shoes checked/log signed.
10. Visual inspection of static grounds.
11. Ensure emergency escape paths for operators is not blocked.

Checked By:

\_\_\_\_\_

Date \_\_\_\_\_

**APPENDIX C  
SOP REVIEW SHEET**

	YES	N/A
<b>1. SUMMARY SHEET</b>		
a. Hazard Analysis	<u>  X  </u>	<u>      </u>
b. SOP Validation	<u>  X  </u>	<u>      </u>
<b>2. COVER SHEET</b>		
Completed Items 1 thru 7	<u>  X  </u>	<u>      </u>
<b>3. STATEMENTS</b>		
a. Supervisors	<u>  X  </u>	<u>      </u>
b. Operators	<u>  X  </u>	<u>      </u>
<b>4. INDEX OF OPERATIONS</b>		
a. Listing by operation number	<u>  X  </u>	<u>      </u>
b. Description of operation	<u>  X  </u>	<u>      </u>
c. Applicable waiver of authorization	<u>      </u>	<u>  X  </u>
d. Reason for change or revision	<u>      </u>	<u>  X  </u>
e. References	<u>  X  </u>	<u>      </u>
<b>5. EXPLOSIVE LIMITS</b>		
a. Proper weight limits (bays & bldgs)	<u>  X  </u>	<u>      </u>
b. 4 hour supply of hazardous material	<u>  X  </u>	<u>      </u>
c. Personnel limits	<u>  X  </u>	<u>      </u>
<b>6. EQUIPMENT</b>		
a. Remote operation	<u>      </u>	<u>  X  </u>
b. Guards	<u>      </u>	<u>  X  </u>
c. Approved operator adjustments	<u>      </u>	<u>  X  </u>
d. Grounding and bonding	<u>  X  </u>	<u>      </u>
e. Approved APE	<u>  X  </u>	<u>      </u>
<b>7. FACILITY</b>		
a. Deluge system/sprinkler system	<u>  X  </u>	<u>      </u>
b. Conductive flooring	<u>  X  </u>	<u>      </u>
c. Approved electrical fixtures	<u>  X  </u>	<u>      </u>
d. Lightning protection	<u>  X  </u>	<u>      </u>
e. Ventilation (paintbooths)	<u>      </u>	<u>  X  </u>
<b>8. PROTECTIVE CLOTHING</b>		
a. Coveralls	<u>  X  </u>	<u>      </u>
b. Eye protection/face shield	<u>  X  </u>	<u>      </u>
c. Hearing protection	<u>  X  </u>	<u>      </u>
d. Respiratory protection	<u>  X  </u>	<u>      </u>
e. Conductive shoes	<u>  X  </u>	<u>      </u>
f. Special clothing	<u>  X  </u>	<u>      </u>



APPENDIX C  
SOP REVIEW SHEET  
(continued)

	YES	N/A
<b>9. TOOLS</b>		
a. Approved	<u>  X  </u>	<u>      </u>
b. Nonsparking	<u>  X  </u>	<u>      </u>
<b>10. PROCESS</b>		
a. Barricades	<u>      </u>	<u>  X  </u>
b. Grounding and bonding	<u>  X  </u>	<u>      </u>
c. Remote operations	<u>      </u>	<u>  X  </u>
d. Approved conveyor space	<u>  X  </u>	<u>      </u>
e. Proper sequence of operations	<u>  X  </u>	<u>      </u>
f. Exposure to concurrent operations	<u>      </u>	<u>  X  </u>
<b>11. MATERIAL HANDLING</b>		
a. MHE	<u>  X  </u>	<u>      </u>
b. Special requirements	<u>  X  </u>	<u>      </u>
<b>12. OTHER REQUIREMENTS</b>		
a. Training/certification	<u>  X  </u>	<u>      </u>
b. Medical clearance	<u>  X  </u>	<u>      </u>
c. Physical requirements	<u>  X  </u>	<u>      </u>
d. Industrial hygiene	<u>  X  </u>	<u>      </u>
e. Decontamination	<u>      </u>	<u>  X  </u>
f. Radiological hazards	<u>      </u>	<u>  X  </u>
g. Emergency procedures	<u>      </u>	<u>  X  </u>
h. PCP/Copper Naphthanate precautions	<u>      </u>	<u>  X  </u>
i. Fire fighting equipment	<u>  X  </u>	<u>      </u>
j. Weather restrictions	<u>  X  </u>	<u>      </u>
k. Hazardous chemicals	<u>      </u>	<u>  X  </u>
l. Electromagnetic radiation	<u>      </u>	<u>  X  </u>
m. Environmental	<u>      </u>	<u>  X  </u>
n. Procedures in event of electrical storm	<u>  X  </u>	<u>      </u>
o. General safety requirements	<u>  X  </u>	<u>      </u>
<b>13. DISPOSAL</b>		
a. Demolition ground restrictions	<u>      </u>	<u>  X  </u>
b. Misfire procedures	<u>      </u>	<u>  X  </u>
c. Burning ground IAW para 27-13, AMC-R 385-100	<u>      </u>	<u>  X  </u>
d. Burning operations observed continuously	<u>      </u>	<u>  X  </u>
<b>14. LAYOUT</b>		
a. Emergency exits	<u>  X  </u>	<u>      </u>
b. Diagram matches written description	<u>  X  </u>	<u>      </u>

DEMILITARIZATION/RP DOWNLOAD  
System L-8 SERIES GRENADES

Prepared by J. GAVIN/F. REYNA/B. MCARTHUR

Subsystem RECEIPT AND UNPACKING

Issue Date \_\_\_\_\_

Rev: \_\_\_\_\_

SHT 1 OF 6

SYSTEM EVENT(S)	HAZARD DESCRIPTION	EFFECT ON SYSTEM	RISK ASSESSMENT		RECOMMENDED ACTION	EFFECT
			SEV	PROB		
DOWNLOAD CARGO VEHICLE	MHE DROPPED CARGO DUE TO MECHANICAL MALFUNCTION, OR CARGO VEHICLE MOVEMENT	DAMAGE TO LOAD, MHE, OR CARGO VEHICLE  FRACTURED LIMBS OF PERSONNEL	III	C-4	CARGO AND MHE WILL BE INSPECTED PRIOR TO DOWNLOAD. CARGO VEHICLE WILL BE CHECKED.	IV D-5
UNPALLETIZATION	CUT ENERGIZED STRAPPING CONTACTS OPERATORS FACE OR BODY	CUTS TO SKIN  SERIOUS EYE INJURY	III	B-3	OPERATORS WILL WEAR SAFETY GLASSES, FACE SHIELD, LONG SLEEVE GARMENT, AND LEATHER PALMED GLOVES	IV D-5
	RADIO TRANSMISSION SIGNAL IGNITES GRENADE	DAMAGE TO BLDG AND EQUIPMENT  1ST, 2ND, AND 3RD DEGREE BURNS TO OPERATORS	III	C-4	CAUTION SIGNS WILL BE POSTED AT ENTRANCES 50 FEET FROM BLDG "NO RADIO TRANSMISSION BEYOND THIS POINT". OPERATORS WILL WEAR FLAME RETARDANT COVER-ALLS.	IV D-5
PALLETIZE EMPTY M2A1 CONTAINERS	STRAPPING BREAKS DURING BANDING OPERATION. ENERGIZED STRAPPING CONTACTS OPERATORS FACE OR BODY	CUTS TO SKIN  EYE INJURY	III	B-3	OPERATORS WILL WEAR SAFETY GLASSES, FACE SHIELD, LONG SLEEVE GARMENTS, AND LEATHER PALMED GLOVES	IV D-5

DEMILITARIZATION/RP DOWNLOAD

System L-8 SERIES GRENADES

CUTTING OPERATION/CUT

Subsystem RUBBER BODY AT METAL BASE

Prepared by J. GAVIN/E. REYNA/ B. MCARTHUR

Issue Date \_\_\_\_\_

Rev: \_\_\_\_\_

SHT 2 OF 6

SYSTEM EVENT (S)	HAZARD DESCRIPTION	EFFECT ON SYSTEM	RISK ASSESSMENT		RECOMMENDED ACTION	EFFECT
			SEV	PROB		
CUT RUBBER BODY AT METAL BASE	IGNITION OF ROUND DUE TO FRICTION FROM BLADE WITH POSSIBLE PROPAGATION OF FIRE	DAMAGE TO CONVEYOR OPERATOR BREATHERS FUMES FROM COMBUSTION	III	C-4	PROPER FEED RATE TO PREVENT PROPAGATION (1 EA PER CUTTING CYCLE). EMERGENCY HANDLE ON CONVEYOR TO DUMP GRENADE INTO DRUM OF WATER. WAIT 15 MIN. PRIOR TO REMOVING SMOKED ROUND. A DE-LUGE SYSTEM WILL BE IN PLACE.	IV D-5
	OPERATORS SUBJECT TO NOISE FROM CONVEYOR AIR MOTOR AND AIR COMPRESSOR	CHRONIC HEARING LOSS	II	B-2	OPERATORS WILL WEAR EAR PLUGS OR EAR MUFFS	IV D-5
CUT RUBBER BODY AT METAL BASE WITH BOX KNIFE (OPTIONAL)	KNIFE SLIPS STRIKING OPERATORS HOLDING HAND	SEVERE CUTS TO OPERATORS HAND	II	B-2	OPERATOR WILL WEAR A WIRE MESH GLOVE ON HOLDING HAND WHEN MAKING CUTS WITH A BOX KNIFE	IV D-5

**DEMILITARIZATION/RP DOWNLOAD**

System L-B SERIES GRENADES

Prepared by J. GAVIN/F. REYNA/B. MCARTHUR

RUBBER SEPARATION FROM

Subsystem METAL BASE/RP REMOVAL

Issue Date \_\_\_\_\_

Rev: \_\_\_\_\_ SHT 3 OF 6

SYSTEM EVENT(S)	HAZARD DESCRIPTION	EFFECT ON SYSTEM	RISK ASSESSMENT		RECOMMENDED ACTION	EFFECT
			SEV	PROB		
SEPARATE RUBBER BODY FROM METAL BASE ASSEMBLY	LOOSE BLACK POWDER IGNITES DURING CLEANUP FROM ELECTROSTATIC DISCHARGES	1ST AND 2ND DEGREE BURNS TO OPERATORS HANDS	II	C-3	USE FIBER BRISTLE BRUSH TO CLEAN UP BLACK POWDER. A DELUGE SYSTEM WILL BE IN PLACE.	IV D-5
PASS GRENADES THROUGH TUBE CONVEYOR FOR LENGTHWISE CUT	IGNITION OF RP DUE TO FRICTION FROM BLADE	DAMAGE TO CONVEYOR OPERATOR BREATHES FUMES FROM COMBUSTION	III	C-4	DUST PAN AVAILABLE TO SCOOP UP GRENADE AFTER EXITING TUBE CONVEYOR. DRUM OF WATER AVAILABLE TO PLACE SMOKED GRENADE. OPERATORS WILL WAIT 15 MINUTES PRIOR TO REMOVING GRENADE. A DELUGE SYSTEM WILL BE IN PLACE.	IV D-5
MAKING LENGTHWISE CUT IN GRENADE BODY WITH A BOX KNIFE (OPT.)	OPERATORS SUBJECT TO NOISE FROM CONVEYOR AIR MOTOR KNIFE SLIPS STRIKING OPERATORS HOLDING HAND	CHRONIC HEARING LOSS SEVERE CUTS TO OPERATORS HAND	II	B-2	OPERATORS WILL WEAR EAR PLUGS OR EAR MUFFS	IV D-5
			II	B-2	OPERATOR WILL WEAR A WIRE MESH GLOVE ON HOLDING HAND WHEN MAKING CUTS WITH A BOX KNIFE	IV D-5

DEMILITARIZATION/RP DOWNLOAD

Prepared by J. GAVIN/F. REYNA/B. MCARTHUR

System L-8 SERIES GRENADES

RUBBER SEPARATION FROM

Subsystem METAL BASE/RP REMOVAL

Issue Date \_\_\_\_\_

Rev: \_\_\_\_\_ SHT 4 OF 6

SYSTEM EVENT(S)	HAZARD DESCRIPTION	EFFECT ON SYSTEM	RISK ASSESSMENT		RECOMMENDED ACTION	EFFECT
			SEV	PROB		
REMOVE RP FROM RUBBER BODY	EXPOSED SKIN AND INHALATION HAZARD	IRRITATION OF EXPOSED SKIN SURFACES  IRRITATION TO RESPIRATORY TRACT	III	B-3	OPERATORS WILL WEAR LONG SLEEVE GARMENT, SAFETY GLASSES, PYRO APRONS, PLASTIC GLOVES SURVEY BY INDUSTRIAL HYGIENE (21 OCT 93) INDICATES NO RESPIRATORY PROTECTION REQUIRED	IV D-5
	FLASH FIRE FROM STATIC ELECTRICITY	1ST AND 2ND DEGREE BURNS TO OPERATORS HANDS	II	C-3	RP WILL BE DUMPED INTO A CONDUCTIVE BAG WHICH WILL BE IN A GROUNDED CONTAINER. A DELUGE SYSTEM WILL BE IN PLACE.	IV D-5
CONTAINERIZE CONTAMINATED RP	EXPOSED SKIN AND INHALATION HAZARD	IRRITATION OF EXPOSED SKIN SURFACES  IRRITATION TO RESPIRATORY TRACT	III	B-3	OPERATORS WILL WEAR LONG SLEEVE GARMENT, SAFETY GLASSES, PYRO APRONS, PLASTIC GLOVES SURVEY BY INDUSTRIAL HYGIENE (21 OCT 93) INDICATES NO RESPIRATORY PROTECTION REQUIRED	IV D-5
			II	C-3		IV D-5

DEMILITARIZATION/RP DOWNLOAD  
 System L-8 SERIES GRENADES  
 RUBBER SEPARATION FROM  
 Subsystem METAL BASE/RP REMOVAL

Prepared by J. GAVIN/F. REYNA/B. MCARTHUR

Issue Date \_\_\_\_\_

Rev: \_\_\_\_\_ SHT 5 OF 6

CONTAINERIZE CONTAMINATED RP (CONTINUED)	FLASH FIRE FROM STATIC ELECTRICITY	1ST AND 2ND DEGREE BURNS TO OPERATORS HANDS	II	C-3	RP WILL BE DUMPED INTO A CONDUCTIVE BAG WHICH WILL BE IN A GROUNDED CONTAINER. A DELUGE SYSTEM WILL BE IN PLACE	IVD-5
PLACING BROKEN BURSTERS AND LOOSE BLACK POWDER INTO CONTAINER	FLASH FIRE FROM STATIC ELECTRICITY	1ST, 2ND, & 3RD DEGREE BURNS TO OPERATORS HANDS MAJOR DAMAGE TO EQUIPMENT	II	C-3	BURSTERS AND LOOSE BLACK POWDER WILL BE PACKED IN A GROUNDED CONTAINER A DELUGE SYSTEM WILL BE IN PLACE.	IVD-5
TRANSFERRING BROKEN BURSTERS/LOOSE BLACK POWDER BETWEEN CONTAINERS	FLASH FIRE FROM STATIC ELECTRICITY	1ST, 2ND, AND 3RD DEGREE BURNS TO OPERATORS HANDS	III	C-4	OPERATORS WILL OBSERVE SAFETY NOTE AND INSURE CONTAINERS ARE BONDED TOGETHER PRIOR TO TRANSFERRING BURSTERS/BLACK POWDER. A DELUGE SYSTEM WILL BE IN PLACE	IVD-5

DEMILITARIZATION/RP DOWNLOAD  
 System L-8 SERIES GRENADES

Prepared by J. GAVIN, F. REYNA, B. MCARTHUR

Subsystem PALLETIZATION

Issue Date 10/11/11

Rev:          SHT 6 OF 6

SYSTEM EVENT(S)	HAZARD DESCRIPTION	EFFECT ON SYSTEM	RISK ASSESSMENT		RECOMMENDED ACTION	EFFECT
			SEV	PROB		
PALLETIZATION	STRAPPING BREAKS DURING BANDING OPERATION. ENERGIZER STRAP- PING CONTACTS OPERATOR'S FACE OR BODY	CUTS TO SKIN  EYE INJURY	III	B-3	OPERATORS WILL WEAR SAFETY GLASSES, FACE SHIELD, LONG SLEEVE GARMETS AND LEATHER PALMED GLOVES	IVD-5  IVD-5

**APPENDIX D**  
**PRESENTATION OF TEST RESULTS TO AMCCOM**



20 December 1993

TO: Tuan Pham

FROM: Loy Aikman

SUBJECT: L8A3 RP Grenade Test Program

1. The L8A3 test program to evaluate use of downloaded L8A1 RP/butyl rubber mixture as feed stock for L8A3 grenade production is complete.
2. All tests were successful. The test grenades meet the requirements of the L8A3 munition specifications, MIL-G-51478B (EA) and are equivalent to the L8A3 control grenades.
3. Tests followed the procedures defined in the test program plan dated 08 Jun 92, as modified by minutes of a program plan review meeting SCBRD-EN (RI) 05 Aug 93. The long-term-storage term was shortened to 10 weeks from 12 weeks to facilitate completion of tests and presentation of data prior to the Christmas holiday period, as agreed by Mr. Ray Johnson.
4. The revised test plan required testing as follows:

<u>Test</u>	<u>Test Qty</u>	<u>Control Qty</u>
Immediate Ambient Firing	32	16
Immediate Hot Firing	32	16
Immediate Cold Firing	32	16
12-Week Hot Storage & Firing	32	16
12-Week Cold Storage & Firing	32	16
12-Week Ambient Storage & Firing	32	16

It should be noted that the actual number of grenades tested often exceeded the test plan quantities. Some extra grenades were often conditioned at the storage temperatures and were fired, giving greater statistical reliability to the data.

5. A summary of immediate and long term storage test results are provided at Encl 1. Individual item test result for immediate tests are presented at Encl 2. Individual item test results for long term storage items are provided at Encl 3.

**SMCPB-ETT**

**SUBJECT: L8A3 RP Grenade Test Program**

6. During this program, manufacturing procedures were developed to download the L8A1 grenade, mix-extrude-dry the reclaimed RP/Butyl rubber mixture, press the mix into pellets and load the pellets into the L8A3 hardware.

7. Test firings of these grenades, and a significant number of grenades from previous tests to evaluate manufacturing procedures, were observed by several personnel from PBA, CBDCOM (RI) and Picatinny Arsenal. All observes agreed that the grenades made with reclaimed L8A1 fill material meet the munition specifications and are equivalent in obscuring capacity to the control grenade.

8. Approval of the ECP to permit use of downloaded L8A1 RP/Butyl rubber mix in the L8A3 grenade is recommended.

9. Any questions should be referred to Loy Aikman at DSN 966-2963 or Welton Boyce, DSN 966-2969.

  
LOY M. AIKMAN  
Chief, Tech Sup Div, DIR/ET

## LSA3 RP Grenade Test Program

Summary of Test Data  
 Representing Program Plan Dated 08 Jun 92 and Revised Aug 93

Immediate Test Group  
 (Tested 10 days after assembly.)

<u>Duration of Good Obscuration (min)</u>			
		<u>Controls</u>	<u>Test Items*</u>
Ambient 70°F	N	16	36
	Mean	1.29	1.37
	Std dev.	0.19	0.30
Hot 150°F	N	16	36
	Mean	1.61	1.60
	Std dev.	0.31	0.29
Cold -60°F	N	16	36
	Mean	1.01	1.37
	Std dev.	0.43	0.62

Long Term Storage Test Group  
 (Tested 10-11 weeks after conditioned storage)

<u>Duration of Good Obscuration (min)</u>			
		<u>Controls</u>	<u>Test Items*</u>
Ambient 70°F	N	17	36
	Mean	1.79	1.72
	Std dev.	0.37	0.28
Hot Stored @ 150°F Fired @ 125°F	N	16	54
	Mean	2.05	1.88
	Std dev.	0.40	0.36
Cold Stored @ -60°F Fired @ -50°F	N	16	36
	Mean	2.32	2.15
	Std dev.	0.89	0.33

\*Test grenades contained RP/Butyl rubber mixture from downloaded LSA1 RP grenades.

**LB93 GRENADE TEST PROGRAM  
IMMEDIATE TEST GROUP**

**GRENADES CONDITIONED 10 DAYS AT AMBIENT TEMP,**

<b>NUMBER</b>	<b>BATCH NUMBER</b>	<b>GOOD SMOKE (MIN.)</b>	<b>RP BURN TIME (MIN.)</b>	<b>REMARKS</b>
1	CONTROL	1.33	2.58	
2	CONTROL	1.25	2.25	
3	CONTROL	1.83	2.17	
4	CONTROL	1.42	2.08	
5	CONTROL	1.63	2.08	
6	CONTROL	1.25	3.00	
7	CONTROL	1.20	2.08	
8	CONTROL	1.12	2.17	
9	CONTROL	1.28	2.02	
10	CONTROL	1.23	2.10	
11	CONTROL	1.22	2.28	
12	CONTROL	1.15	2.22	
13	CONTROL	1.18	2.22	
14	CONTROL	1.17	2.10	
15	CONTROL	1.25	2.17	
16	CONTROL	1.13	2.53	
<b>AVERAGE:</b>		<b>1.29</b>	<b>AVERAGE:</b>	<b>2.25</b>
<b>STD. DEV.</b>		<b>0.19</b>	<b>STD. DEV.</b>	<b>0.25</b>

**GRENADES WERE OBSERVED FROM OBSERVATION TOWER.  
TESTING DATES: SEPTEMBER 27 - SEPTEMBER 30, 1993**

**L8A3 GRENADE TEST PROGRAM  
IMMEDIATE TEST GROUP**

**GRENADES GRENADES CONDITIONED 10 DAYS AT AMBIENT TEMPERATURE**

<b>NUMBER</b>	<b>BATCH NUMBER</b>	<b>GOOD SMOKE (MIN.)</b>	<b>RP BURN TIME (MIN.)</b>	<b>REMARKS</b>
1	3207-1	2.33	2.50	
2	3207-1	2.17	2.55	
3	3207-1	1.20	1.58	
4	3207-1	1.32	2.00	
5	3207-1	1.33	1.87	
6	3207-1	1.07	2.67	
7	3207-2	1.18	2.08	
8	3207-2	1.17	2.08	
9	3207-2	1.58	2.15	
10	3207-2	1.30	1.83	
11	3207-2	1.25	2.22	
12	3207-2	1.23	2.00	
13	3209-1	1.33	1.67	
14	3209-1	1.42	1.93	
15	3209-1	1.07	2.00	
16	3209-1	1.10	2.02	
17	3209-1	1.20	2.08	
18	3209-1	1.20	2.08	
19	3209-2	1.35	2.20	
20	3209-2	1.17	2.32	
21	3209-2	1.32	2.22	
22	3209-2	1.42	2.25	
23	3209-2	1.12	2.42	
24	3209-2	1.22	2.22	
25	3209-3	1.13	2.00	
26	3209-3	1.42	1.93	
27	3209-3	1.22	2.08	
28	3209-3	1.12	2.10	
29	3209-3	1.23	2.15	
30	3209-3	1.50	2.08	
31	3257-1	1.70	2.17	
32	3257-1	1.68	2.28	
33	3257-1	1.55	2.18	
34	3257-1	1.45	2.15	
35	3257-1	1.12	2.33	
36	3257-1	2.07	2.42	

<b>AVERAGE:</b>	<b>1.37</b>	<b>AVERAGE:</b>	<b>2.13</b>
<b>STD. DEV.</b>	<b>0.30</b>	<b>STD. DEV.</b>	<b>0.22</b>

**TESTING DATES: SEPTEMBER 27 - 30, 1993**

**LBA3 GRENADE TEST PROGRAM  
IMMEDIATE TEST GROUP**

**GRENADES CONDITIONED 10 DAYS AT HOT TEMPERATURE**

<b>NUMBER</b>	<b>BATCH NUMBER</b>	<b>GOOD SMOKE (MIN.)</b>	<b>RP BURN TIME (MIN.)</b>	<b>REMARKS</b>
1	CONTROL	2.07	2.88	
2	CONTROL	1.27	2.85	
3	CONTROL	1.33	3.57	
4	CONTROL	1.73	4.30	
5	CONTROL	1.72	3.50	
6	CONTROL	1.72	3.50	
7	CONTROL	2.32	4.08	
8	CONTROL	1.55	3.65	
9	CONTROL	1.62	4.27	
10	CONTROL	1.77	4.08	
11	CONTROL	1.32	4.05	
12	CONTROL	1.43	5.00	
13	CONTROL	1.23	4.47	
14	CONTROL	1.62	5.05	
15	CONTROL	1.93	3.73	
16	CONTROL	1.18	3.52	
<b>AVERAGE:</b>		<b>1.61</b>	<b>AVERAGE:</b>	<b>3.91</b>
<b>STD. DEV.</b>		<b>0.31</b>	<b>STD. DEV.</b>	<b>0.61</b>

**ALL OBSERVATIONS WERE MADE FROM THE TOWER.  
TESTING DATES: SEPTEMBER 27-30, 1993**

**LBA3 GRENADE TEST PROGRAM  
IMMEDIATE TEST GROUP**

**GRENADES CONDITIONED 10 DAYS AT HOT TEMPERATURE**

<b>NUMBER</b>	<b>BATCH NUMBER</b>	<b>GOOD SMOKE (MIN.)</b>	<b>RP BURN TIME (MIN.)</b>	<b>REMARKS</b>
1	3207-1	1.17	3.12	
2	3207-1	1.23	3.23	
3	3207-1	1.82	3.02	
4	3207-1	1.87	3.18	
5	3207-1	1.52	2.72	
6	3207-1	1.80	3.92	
7	3207-2	1.77	3.10	
8	3207-2	1.93	3.17	
9	3207-2	2.33	4.75	
10	3207-2	2.13	5.65	
11	3207-2	1.75	4.83	
12	3207-2	1.77	4.67	
13	3209-1			DUD; LAUNCH BUT NO BURST
14	3209-1	1.25	3.25	
15	3209-1	1.63	3.08	
16	3209-1	1.47	3.08	
17	3209-1	1.93	2.67	
18	3209-1	1.68	3.02	
19	3209-2	1.62	4.87	
20	3209-2	1.38	4.00	
21	3209-2	1.25	3.18	
22	3209-2	1.42	5.35	
23	3209-2	1.55	4.43	
24	3209-2	1.67	5.35	
25	3209-3	1.03	2.43	
26	3209-3	1.45	2.73	
27	3209-3	1.67	3.40	
28	3209-3	1.58	3.97	
29	3209-3	1.83	2.42	
30	3209-3	1.07	3.40	
31	3257-1			DUD; LAUNCH BUT NO BURST
32	3257-1	2.00	4.40	
33	3257-1	1.45	3.75	
34	3257-1	1.53	3.75	
35	3257-1	1.47	5.33	
36	3257-1	1.45	5.53	
<b>AVERAGE:</b>		<b>1.60</b>	<b>AVERAGE: 3.79</b>	
<b>STD. DEV.</b>		<b>0.29</b>	<b>STD. DEV. 0.95</b>	

**DUD ITEMS WERE COUNTED AS NO TEST.  
TESTING DATES: SEPTEMBER 27-30, 1993**

**L8A3 GRENADE TEST PROGRAM  
IMMEDIATE TEST GROUP**

**GRENADES CONDITIONED 10 DAYS AT COLD TEMPERATURE**

<b>NUMBER</b>	<b>BATCH NUMBER</b>	<b>GOOD SMOKE (MIN.)</b>	<b>RP BURN TIME (MIN.)</b>	<b>REMARKS</b>
1	CONTROL	1.08	5.63	
2	CONTROL	1.50	5.83	
3	CONTROL	0.90	18.55	
4	CONTROL	1.07	17.67	
5	CONTROL	1.82	7.00	
6	CONTROL	1.05	17.83	
7	CONTROL	1.25	6.73	
8	CONTROL	1.05	10.93	
9	CONTROL	1.45	11.07	
10	CONTROL	0.43	20.78	
11	CONTROL	1.02	7.35	
12	CONTROL	0.57	7.17	
13	CONTROL	1.25	3.93	
14	CONTROL	1.20	5.12	
15	CONTROL	0.20	6.13	
16	CONTROL	0.33	3.92	
<b>AVERAGE:</b>		<b>1.01</b>	<b>AVERAGE:</b>	<b>9.73</b>
<b>STD. DEV.</b>		<b>0.43</b>	<b>STD. DEV.</b>	<b>5.56</b>

**GRENADES WERE OBSERVED FROM THE TOWER.  
TESTING DATES: SEPTEMBER 27 - 30, 1993**



**LBA3 GRENADE TEST PROGRAM  
IMMEDIATE TEST GROUP**

**GRENADES CONDITIONED 10 DAYS AT COLD TEMPERATURE**

<b>NUMBER</b>	<b>BATCH NUMBER</b>	<b>GOOD SMOKE (MIN.)</b>	<b>RP BURN TIME (MIN.)</b>	<b>REMARKS</b>
1	3207-1	1.93	5.95	
2	3207-1	1.42	5.30	
3	3207-1	1.87	9.72	
4	3207-1			DUD: LAUNCH BUT NO BURST
5	3207-1	1.32	8.08	
6	3207-1	2.35	7.90	
7	3207-2	0.40	17.18	
8	3207-2	1.83	7.00	
9	3207-2	2.22	3.65	
10	3207-2	1.27	3.62	
11	3207-2			DUD: LAUNCH BUT NO BURST
12	3207-2	1.67	4.50	
13	3209-1	2.70	9.12	
14	3209-1	1.63	3.92	
15	3209-1	1.83	5.75	
16	3209-1	2.38	4.40	
17	3209-1	1.78	4.57	
18	3209-1	2.43	5.38	
19	3209-2	1.03	5.93	
20	3209-2	1.08	5.80	
21	3209-2	0.68	5.38	
22	3209-2	0.62	6.83	
23	3209-2	1.00	6.88	
24	3209-2	1.42	4.98	
25	3209-3	1.33	4.42	
26	3209-3	0.38	3.17	
27	3209-3	0.32	6.33	
28	3209-3	1.02	2.88	
29	3209-3	0.68	3.50	
30	3209-3	0.83	4.92	
31	3257-1	1.45	5.03	
32	3257-1			DUD: LAUNCH BUT NO BURST
33	3257-1	1.15	3.70	
34	3257-1	1.02	3.03	
35	3257-1	1.07	3.43	
36	3257-1	1.02	5.55	
<b>AVERAGE:</b>		<b>1.37</b>	<b>5.69</b>	
<b>STD. DEV.</b>		<b>0.62</b>	<b>2.64</b>	

**DUD ITEMS WERE COUNTED AS NO TEST.  
TESTING DATES: SEPTEMBER 27-30, 1993**

L8A3 GRENADE TEST PROGRAM  
LONG TERM STORAGE TEST GROUP

GRENADES CONDITIONED 10 WEEKS AT AMBIENT TEMPERATURE

NUMBER	BATCH NUMBER	GOOD SMOKE (MIN.)	RP BURN TIME (MIN.)	REMARKS
1	CONTROL	1.25	4.17	
2	CONTROL	1.45	4.60	
3	CONTROL	1.42	4.75	
4	CONTROL	2.17	5.03	
5	CONTROL	1.75	4.25	
6	CONTROL	2.00	4.12	
7	CONTROL	1.67	3.33	
8	CONTROL	2.25	3.67	
9	CONTROL	1.25	2.83	
10	CONTROL	2.33	5.57	
11	CONTROL	2.03	4.92	
12	CONTROL	1.67	5.08	
13	CONTROL	2.50	5.33	
14	CONTROL	1.83	4.83	
15	CONTROL	1.67	5.83	
16	CONTROL	1.75	5.50	
17	CONTROL	1.42	5.67	
AVERAGE:		1.79	4.68	
STD. DEV.		0.37	0.83	

OBSERVATIONS WERE MADE AT GROUND LEVEL.  
TESTING DATES: NOVEMBER 29 - DECEMBER 13, 1993

**L8A3 GRENADE TEST PROGRAM  
LONG TERM STORAGE TEST GROUP**

**GRENADES CONDITIONED TEN WEEKS AT AMBIENT TEMPERATURE**

<b>NUMBER</b>	<b>BATCH NUMBER</b>	<b>GOOD SMOKE (MIN.)</b>	<b>RP BURN TIME (MIN.)</b>	<b>REMARKS</b>
1	3207-1	1.50	4.33	
2	3207-1	1.50	4.83	
3	3207-1	1.58	5.25	
4	3207-1	1.75	4.75	
5	3207-1	1.47	5.17	
6	3207-1	1.83	5.25	
7	3207-2	1.83	4.92	
8	3207-2	1.67	4.97	
9	3207-2	1.83	3.42	
10	3207-2	1.83	3.83	
11	3207-2	1.67	3.17	
12	3209-1	1.92	3.17	
13	3209-1	1.83	2.58	
14	3209-1	1.83	2.83	
15	3209-1	1.25	2.08	
16	3209-1	1.58	2.83	
17	3209-1	1.08	3.00	
18	3209-1	2.25	5.53	
19	3209-1	1.93	4.33	
20	3209-2	1.42	4.92	
21	3209-2	1.75	4.75	
22	3209-2	2.17	5.67	
23	3209-2	1.92	5.25	
24	3209-2	1.67	4.42	
25	3209-2	1.50	5.25	
26	3209-3	1.83	3.33	
27	3209-3	1.50	2.67	
28	3209-3	1.50	3.75	
29	3209-3	1.25	2.50	
30	3209-3	1.67	5.17	
31	3209-3	1.75	3.08	
32	3257-1	2.17	5.83	
33	3257-1	2.50	6.33	
34	3257-1	1.67	5.25	
35	3257-1	1.83	5.42	
36	3257-1	1.83	6.25	
<b>AVERAGE:</b>		<b>1.72</b>	<b>AVERAGE:</b>	<b>4.34</b>
<b>STD. DEV.</b>		<b>0.28</b>	<b>STD. DEV.</b>	<b>1.17</b>

**TESTING DATES: NOVEMBER 29, 1993 - DECEMBER 13, 1993**

L8A3 GRENADE TEST PROGRAM  
LONG TERM STORAGE TEST GROUP

GRENADES CONDITIONED AT HOT TEMPERATURE

NUMBER	BATCH NUMBER	GOOD SMOKE (MIN.)	RP BURN TIME (MIN.)	REMARKS
1	CONTROL	1.75	4.00	
2	CONTROL	2.08	3.92	
3	CONTROL	2.42	5.42	
4	CONTROL	2.33	5.08	
5	CONTROL	2.25	4.75	
6	CONTROL	1.25	2.58	
7	CONTROL	1.83	3.75	
8	CONTROL	1.50	3.67	
9	CONTROL	2.33	4.92	
10	CONTROL	2.33	3.50	
11	CONTROL	2.58	5.25	
12	CONTROL	2.75	4.42	
13	CONTROL	1.97	4.17	
14	CONTROL	2.08	4.08	
15	CONTROL	1.67	3.50	
16	CONTROL	1.75	3.42	
	AVERAGE:	2.05	4.15	
	STD. DEV.	0.40	0.75	

TESTING DATES: NOVEMBER 29, 1993 - DECEMBER 13, 1993

L8A3 GRENADE TEST PROGRAM  
 LONG TERM STORAGE TEST GROUP

GRENADES CONDITIONED AT HOT TEMPERATURE

NUMBER	BATCH NUMBER	GOOD SMOKE (MIN.)	RP BURN TIME (MIN.)	REMARKS
1	3207-1	1.58	3.08	
2	3207-1	1.67	3.00	
3	3207-1	1.75	5.00	
4	3207-1	1.58	4.50	
5	3207-1	2.08	4.25	
6	3207-1	2.25	3.97	
7	3207-2	2.92	5.50	
8	3207-2	2.42	5.33	
9	3207-2	2.25	5.25	
10	3207-2	2.08	4.00	
11	3207-2	1.83	3.58	
12	3207-2	1.58	3.42	
13	3209-1	2.47	4.17	
14	3209-1	2.08	3.50	
15	3209-1	2.08	3.92	
16	3209-1	2.92	2.75	
17	3209-1	2.17	3.33	
18	3209-1	2.42	3.50	
19	3209-1	2.08	4.33	
20	3209-1	2.13	4.08	
21	3209-1	2.75	4.50	
22	3209-1	1.92	2.75	
23	3209-1	2.08	3.08	
24	3209-2	1.75	3.75	
25	3209-2	1.67	3.33	
26	3209-2	1.83	3.50	
27	3209-2	1.33	3.25	
28	3209-2	1.50	3.25	
29	3209-2	1.83	4.17	
30	3209-2	1.67	3.33	
31	3209-2	1.75	3.33	
32	3209-2	1.72	3.92	
33	3209-2	1.92	4.75	
34	3209-3	1.75	4.08	
35	3209-3	1.75	2.42	
36	3209-3	1.58	3.97	
37	3209-3	1.92	3.75	
38	3209-3	1.50	3.63	
39	3209-3	1.58	2.67	
40	3209-3	1.67	2.75	
41	3209-3	1.58	2.83	

**LSA3 GRENADE TEST PROGRAM  
LONG TERM STORAGE TEST GROUP**

**GRENADES CONDITIONED AT HOT TEMPERATURE**

42	3209-3	1.50	3.17
43	3209-3	1.50	3.42
44	3209-3	1.67	2.75
45	3257-1	1.42	3.33
46	3257-1	1.58	2.83
47	3257-1	1.83	4.17
48	3257-1	1.75	4.50
49	3257-1	2.17	4.30
50	3257-1	1.50	4.05
51	3257-1	1.50	5.50
52	3257-1	1.67	5.67
53	3257-1	2.08	5.67
54	3257-1	2.08	5.25

<b>AVERAGE:</b>	<b>1.88</b>	<b>3.85</b>
<b>STD. DEV.</b>	<b>0.36</b>	<b>0.84</b>

**TESTING DATES: NOVEMBER 29, 1993 - DECEMBER 13, 1993**

L8A3 GRENADE TEST PROGRAM  
LONG TERM STORAGE TEST GROUP

GRENADES CONDITIONED TEN WEEKS AT COLD TEMPERATURE

NUMBER	BATCH NUMBER	GOOD SMOKE (MIN.)	RP BURN TIME (MIN.)	REMARKS
1	CONTROL	2.33	5.83	
2	CONTROL	1.92	5.83	
3	CONTROL	2.33	5.83	
4	CONTROL	5.00	6.98	
5	CONTROL	3.83	7.17	
6	CONTROL	2.25	6.02	
7	CONTROL	3.00	5.50	
8	CONTROL	2.08	4.33	
9	CONTROL	2.33	3.67	
10	CONTROL	1.75	2.83	
11	CONTROL	1.75	2.83	
12	CONTROL	1.67	3.92	
13	CONTROL	1.67	5.08	
14	CONTROL	1.58	3.25	
15	CONTROL	1.92	3.50	
16	CONTROL	1.67	3.08	
AVERAGE:		2.32	4.73	
STD. DEV.		0.89	1.43	

TESTING DATES: NOVEMBER 29, 1993 - DECEMBER 13, 1993

**L8A3 GRENADE TEST PROGRAM  
LONG TERM STORAGE TEST GROUP**

**GRENADES CONDITIONED AT COLD TEMPERATURE**

<b>NUMBER</b>	<b>BATCH NUMBER</b>	<b>GOOD SMOKE (MIN.)</b>	<b>RP BURN TIME (MIN.)</b>	<b>REMARKS</b>
1	3207-1	2.42	5.33	
2	3207-1	2.17	5.37	
3	3207-1	1.93	5.33	
4	3207-1	1.93	5.58	
5	3207-1	2.25	5.42	
6	3207-1	2.33	4.75	
7	3207-2	2.33	5.25	
8	3207-2	2.50	4.50	
9	3207-2	2.50	3.45	
10	3207-2	2.25	3.67	
11	3207-2	2.33	4.75	
12	3207-2	2.67	4.83	
13	3209-1	2.75	5.00	
14	3209-1	2.67	4.33	
15	3209-1	2.50	4.83	
16	3209-1	1.92	4.01	
17	3209-1	2.25	3.77	
18	3209-1	2.00	3.50	
19	3209-1	1.83	3.00	
20	3209-2	1.67	3.50	
21	3209-2	1.83	3.50	
22	3209-2	1.83	3.88	
23	3209-2	1.95	4.83	
24	3209-2	2.00	4.33	
25	3209-2	1.50	3.50	
26	3209-3	1.75	2.75	
27	3209-3	2.33	3.25	
28	3209-3	2.25	3.08	
29	3209-3	2.75	4.33	
30	3209-3	1.75	4.08	
31	3257-1	2.08	3.33	
32	3257-1	1.88	2.92	
33	3257-1	2.25	3.25	
34	3257-1	2.42	3.47	
35	3257-1	1.75	2.42	
36	3257-1	1.83	2.33	

<b>AVERAGE:</b>	<b>2.15</b>	<b>AVERAGE:</b>	<b>4.04</b>
<b>STD. DEV.</b>	<b>0.33</b>	<b>STD. DEV.</b>	<b>0.90</b>

**TESTING DATES: NOVEMBER 29, 1993 - DECEMBER 13, 1993**



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 U.S. Army Chemical and Biological Defense Command  
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 Rock Island, IL 61299-7410

**Director**  
 U.S. Army TRADOC Systems Analysis Activity  
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 White Sands Missile Range, NM 88002

**Dr. Aubrey B. Gosnell** 1  
 2075 Elaine Circle  
 Arkadelphia, AR 71923

**Commander**  
 Pine Bluff Arsenal  
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