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Final Engineering Report
on
Production Engineering Project PE-559

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Methyl Centralite Coated M10 Propellant for the
25-mm Bushmaster Gun Projectiles

RAD 110.10

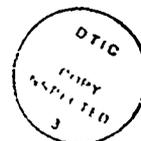
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<p>The purpose of this project was to develop a deterred single-base propellant which would meet the chemical, ballistic, flash, and noise requirements of the 25-mm Bushmaster gun system.</p> <p>➤ Early work concentrated on developing a single-perforated, methyl centralite deterred M10 for the HEI-T round. Effort culminated in the production of lot RAD-PE-559-6 which was accepted by FACC and used as a reference lot for future propellant procurement. (cont)</p>			

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20. Methyl centralite deterrred, seven-perforated, M10 was developed for the APDS round. Lots RAD-PE-559-15 and RAD-PE-559-16 were accepted by FACC. Field testing of lot RAD-PE-559-15 gave excessive noise and flash. As a result, potassium nitrate salt was added to the charges of lot RAD-PE-559-16. Field testing of this lot was acceptable. However, subsequent lots incorporating increased levels of potassium sulfate, added in the chemical formula to reduce the noise and flash, created excessive gun pressures. Production of subsequent lots was initiated to meet new requirements of FACC with respect to noise, flash, high gun pressures, increased projectile weights as well as adjusted ballistic requirements.

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INTRODUCTION

Production Engineering PE Project 559 "Methyl Centralite Coated M10 Propellant for the 25-mm Bushmaster Gun Projectiles" is the research and development project intended to provide deterred single-perforated (SP) and multi-perforated (MP) M10 propellants to the Bushmaster gun contractor, Ford Aeronutronics and Communications Corporation (FACC) of Newport Beach, California. This was directed by Rock Island and Frankford Arsenal through the Contracting Officer's Representative at Radford Army Ammunition Plant (RAAP) at Radford, Virginia. The development of inhibited propellants and gun range improvements at RAAP were concurrently performed with developments in gun, projectiles (APDS-T, HEI-T, and AP-T), primers, specifications, and other ammunition components at FACC.

The main sections of this report discuss the following seven phases of work:

1. RAAP gun test facilities
2. Evaluation of existing RAAP propellant at FACC
3. RAAP laboratory and closed bomb studies of potential SP and MP foreign and CONUS reference propellants
4. Propellant processing
5. Propellant coating
6. Chemical, physical, and internal ballistic tests
7. Gun testing and recommendations for a future project to improve propellants.

Work in most areas of this project was conducted on a best-effort basis with limited fundings. The work on pilot lots had been completed and production-sized lots had been produced before formal specifications were developed and unsatisfactory characteristics associated with propellant for the APDS-T projectile were reported by the customer. FACC performed all gun acceptance and evaluation tests for all pilot lots produced for this project including the final 1000-pound model lot (RAD-PE-559-11) and two production lots (RAD-PE-559-15 and 16) for the APDS-T projectile. Some gun tests at 21°C (70°F) were performed at RAAP with limited and outmoded ammunition components for lots RAD-PE-559-11, 12, 13, 14, 15, and 16 with the APDS-T projectile.

A new gun and components were provided to RAAP for all subsequent tests. Also, all subsequently produced or modified lots were tested at both RAAP and FACC using a partially standardized reference propellant (Lot RAD-PE-559-16 modified by addition of 0.5 g potassium nitrate salt).

ENGINEERING EFFORT

Work Scope and Specification

Propellants for the AP-T, HEI-T, and APDS-T rounds of ammunition of the Bushmaster weapons system were developed into the production stage as the result of this project. As directed, RAAP produced propellant to a series of evolutionary specifications, see appendix A. Coated propellants to be used in lieu of target lots P-2078 and P-1929 were produced. Also evaluated was whether a single propellant, such as CIL lot 5554, could be used for all projectiles. At a meeting on 1 December 1975 of FACC, Frankford Arsenal, Hercules Incorporated, and RAAP Contracting Officer's personnel, agreements upon tasks incidental to these accomplishments were made.

The tasks undertaken by RAAP at the beginning of this project were:

1. Receive and evaluate Oerlikon propellant lots P-2078 and P-1929 from Wimmis, Oerlikon, AP propellant (MUIDEN), and CIL lot 5554 from Canada.
2. Perform tests and evaluations at RAAP in screening ballistics parameters and developing "Americanized" propellants by means of closed bomb, chemical and physical tests, using specification MIL-P-3984 as a guide.
3. a. Based on the previously referenced work, RAAP was to manufacture, test, and deliver four 200 to 400-pound samples. Gun testing at RAAP was to be accomplished using FACC supplied: (1) single-shot test fixtures; (2) cartridge cases; (3) primer ignition systems; and (4) projectiles and gauges.
b. Samples of four existing lots at RAAP were to be shipped immediately to FACC for evaluation.
4. A 1000-pound pilot lot was to be produced based on the data from the preceding work.
5. Technical progress reports on a regular basis were required.
6. Ballistic parameters to be measured were:
 - a. Pressure versus time (from drilled cases) using Kistler transducers
 - b. Muzzle pressure versus time using Kistler transducers
 - c. Action time (primer strike to projectile exit)
 - d. Muzzle velocity measured at 20 to 40 feet from the gun muzzle

e. Barrel wear measurements were to be made on regular basis and reported in progress reports.

The importance of meeting flash requirements was discussed at that time but was not made a firm requirement. Also, the need to meet ballistic requirement at temperature extremes -54 to 71°C (-65 to 160°F) was discussed but no firm specification requirements were imposed on RAAP. No noise requirements were mentioned. However, it should be pointed out that the APCS-T specifications changed remarkably between 1978 and 1981 in the following respects:

<u>Item</u>	<u>Specification ADMS 567895</u>	<u>Specification AS12013523B</u>	<u>Effect</u>
Muzzle velocity correction factor, m/s/m (retardation)	12.5	0.19	-10 m/s at any pressure
Projectile weight, grams	132	Unspecified (possibly 135)	-6.6 m/s/g per gram
Test cartridge loading, grams	+0.1	+1	+10 m/s

RAAP Gun Test Facilities

Shortly after the project had been funded, it was determined that RAAP's Ballistic Range was inadequate for guns greater than 20 mm in size and that the following additional work scope was required:

Addition to deflection fence

Modification and addition to chain link security fence

Reinforced concrete foundation for gun mount

Reinforced concrete foundation for shed roofs

Reinforced concrete foundation for four velocity screens

Metal shielding for velocity screens

Shed roofs for gun mount

Shed roofs for four velocity screens

Adjustable mounts (metal) for four velocity screens

An electrical solenoid (firing mechanism)

Steel adapter plates for mounting 25-mm and 30-mm guns

Installation of electrical conduit, wiring, in connection with remote shell firing

Adaptations to utilize existing safety interlocks and firing circuits

Replacement of sand in tunnel

Application of steel plate on control house door

This extra effort required the authorization of a sum of money considerably greater than had been funded to the project, required more than a year for accomplishment, and resulted in RAAP's inability to accomplish gun testing for more than a year after the propellant was required by the customer (range completed 2 February 1977). Consequently, the Ballistic Range improvement effort and the propellant development effort became separate and parallel efforts. Also, the propellant development effort became dependent upon physical, chemical, and closed bomb testing performed at RAAP and gun testing performed at FACC. The old RAAP gun was used to test only lots RAD-PE-559-11 through 16 at 21°C (70°F) using the off-the-shelf threaded primers. The new RAAP gun system was used to test all subsequently produced lots.

FACC Evaluation of Existing RAAP Propellant for HEI-T and APDS-T Projectiles

Four samples of methyl centralite (MC) coated SP M10 propellant remaining at RAAP from 20-mm gun development support effort (Production Engineering Project PE-485) were shipped to FACC for immediate evolutionary gun propellant and the 25-mm Mann gun test data are presented in tables 1, 2, and 3, and in appendix B. The gun test results from the most satisfactory of these sublots (B1) for the APDS-T projectile are compared in figures 1 and 2 with gun test results from the first coated MP lots for the same projectile. MC had become the coating of choice because the 20-mm program had found other coating materials, e.g., ethyl centralite (EC) and dibutyl phthalate (DBP), to yield carbonaceous matter in rapid firing guns.

The ballistic evaluations by FACC of the blended and unblended samples from the four sublots (A1, A2, B1, and B2) of SP propellant from PE Project 485 led to a request for 200 and 800-pound samples from the A and B subplot dies, respectively. Each was to have a specific percentage of MC coating. These samples were coated from existing uncoated inventory at RAAP. Chemical, physical, and closed bomb tests for these lots are presented in table 4. To maintain die subplot identity, the lots were designated to be lot PEI-559-1, S/L A3 and S/L B3.

The desired coating levels were obtained and PEI 559-1, A3 sublot (4.56% MC), proved to be a satisfactory propellant for the HEI-T projectile and the only SP HEI-T lot (RAD-PE-559-6) subsequently produced was made to duplicate the PEI 559-1, S/L A3 lot.

The final version of the manufacturing and coating procedure used for propellant for the HEI-T projectile is contained in appendix C.

All necessary preproduction engineering work on deterred SP propellant for the HEI-T project was completed with the delivery and acceptance of pilot lot RAD-PE-559-1, S/L A3 and first production lot RAD-PE-559-6. The production lot is being used by FACC as the reference lot for future propellant procurement for a 25-mm gun system that is to be interchangeable among the forces of all NATO nations. The closed bomb traces in figure 3 show how the RAAP lots relate to each other, the original reference lot, and uncoated blank stock with regard to Dp/Dt versus pressure.

Based on acceptance gun tests at FACC, MC deterred MP M10 propellant developed for the APDS-T projectile was acceptable through the pilot lot (RAD-PE-559-11) phase and through two production lots (RAD-PE-559-15 and 16) before any unacceptable variables (pressure level) or attributes (flash and noise) were reported. These problems were later studied or resolved as directed by the Contracting Officer's Representative. Therefore, the production engineering effort described hereinafter which led to these lots will be only partially applicable to the propellant finally developed for this projectile. However, this report indicates the reasons why the propellant produced at the conclusion of this project required further tailoring during subsequent production efforts. It will also disclose some probable ways the propellant can be further improved. Although, as pointed out earlier, the final APDS-T propellant ballistic specifications differed remarkably from the earlier specifications and required a considerably improved coated propellant product over that originally required.

RAAP Laboratory and Closed Bomb Studies

Studies of potential single-perforated and multi-perforated foreign and CONUS reference propellants were performed concurrently with efforts previously described. Canadian and Swiss coated propellant lot samples provided by FACC, propellant samples coated at RAAP for previous PE Projects 271 and 485, and base grain propellant samples from PE Project 485 coated with other coating materials were subjected to chemical, physical, closed bomb, and heat of explosion (HOE) tests. The results are shown in table 5. Based on the fact that lot CIL 5554 was being used to replace either lot P-2078 or P-1929, any of the propellant samples, except the ones coated with ethylene dimethacrylate (EDM) (possibly inadequately) or lead 2-ethyl hexoate, may have qualified as replacement lots. Closed bomb Dp/Dt versus P traces for G54 coated RAD-PE-485A SP

propellant were those from lot P-2078, the original single-base MP Oerlikon lot, as shown in figure 4.

Although the G54 coatings on double- and triple-base formulas have proven satisfactory for 25-mm and 30-mm guns, the Contractor was directed to produce 7-perf single-base propellant coated with MC because: (1) G54 coatings "left residue in gun barrels," (2) "more loadability of propellant was needed to effect minimum momentum for the AP-T projectile," and (3) "dinitrotoluene (DNT) coatings were corrosive to gun barrels." The laboratory studies were therefore discontinued.

MC Coated 7-Perforation Single-Base Propellant for the APDS-T Projectile

A study using a projected L/D ratio of 1.0 (a 2 by 2 factorial study of MC coating levels and web sizes) was performed to determine the geometry and coating to be used for future lots. The lots were produced using dies available at RAAP which resulted in obtaining one lot of 7-perforated propellant with the same web (0.0187 in.) as the target lot (P-2078) and another with a smaller web (0.0157 in.), as intended.

A new coating procedure was developed. Pilot lots were being coated by RAAP's laboratories to determine by HOE and closed bomb testing the amount of coatings to be applied. A long-standing method (Old Method - see appendix D) of coating by steeping propellant and MC in water at 86°C (187°F) for 6 hours in a coating barrel required at least twice the amount of MC to obtain required HOE and closed bomb values than an alternate 1/2-hour coating cycle (New Method - see appendix E) developed and used at RAAP for another program. The results by both methods for sublots of lots RAD-PE-559-3 and 4 are contrasted in table 6.

These data clearly indicated that increased propellant loadability and any possibility of increased APDS-T projectile velocity required the use of the new coating method. The new coating method, with the exception that cycle time was increased from 1/2 to 2 hours commencing with lot RAD-PE-559-11, was used for all subsequent lots. Also, essentially the same MC coating (2.2%) as was predicted from this study for the RAD-PE-559-4 sublot to duplicate the original reference lot (P-2078), was used for all subsequently produced acceptable lots for the APDS-T projectile. The dies used for the RAD-PE-559-4 sublots were used for all subsequent APDS-T propellant production except for one other investigation (which was unsuccessful). These dies produced exactly the same propellant web as that of the original reference lot (P-2078).

The acceptance test data obtained for lots RAD-PE-559-3A, 3B, 4A, and 4B are presented in table 7. The FACC gun test data for lots RAD-PE-559-4A and 4B and blends of these lots are presented in table 8. These ballistics data are plotted against charge weight in figures 1 and 2 and are compared with the best of the SP MC coated lots (RAD-PE-485-B1) for the APDS-T projectile. The graphed data show that pressure levels

would be marginal with the lower projectile weights for SP MC coated propellant (RAD-PE-485-B1) or MP MC coated propellant using the 12.5 m/s/m extrapolation factor and 132-gram projectiles. Also, it was indicated from previous tests that blends of webs and coating levels did not sufficiently improve the velocity-pressure relationships (see figure 5 and 6) although specification conformance probabilities were greater using the old rather than the new velocity correction factor.

In all cases studied with both the SP and MP propellants used for the APDS-T projectile, the MC coating level was a very dominant factor in determining velocity-pressure-charge weight relationship. Therefore, it was indicated that the MC coating level for future lots be accurately ascertained. The next two series of lots RAD-PE-559-5A through 5E and 7 and 8 were essentially produced to establish this level. In the process it was learned that a different mode of post coating drying would be required and that longer coating cycle times (45 and 120 minutes) were beneficial.

APDS-T Coating Studies

In order to determine the proper MC coating level, approximately 2000 pounds of propellant were produced using the established die configuration and manufacturing procedure. Seven pilot lots, each with a specified coating level and identified as lots RAD-PE-559-5A, 5B, 5C, 5D, 5E, 7, and 8, were produced from this common propellant batch and tested at FACC. The FACC gun test results and the MC percentages (specified, used, and analyzed) to obtain these values are as follows:

Lot RAD- PE-559	Percentage MC			FACC gun test results ^a		
	Specified	Used	Analyzed	Velocity, m/s	Pressure, MPa	Charge wt., g
5A	2.70	2.55	2.53	1280	352	98
5B	3.20	3.00	3.03	1250	303	98
5C	3.70	3.49	3.51	1215	283	98
5D	1.50	1.56	1.39	1300	448	90 ^b
5E	2.00	2.07	1.89	1320	386	98
7	2.00 ^c	2.10	1.97	1322	386	98
8	2.35 ^c	2.08	2.10	1317	465	96 ^b

^a 132-gram projectiles were used in all cases.

^b Pressures were reportedly too high to test greater charge weights.

^c These two batches were to have the same coating level as lot RAD-PE-559-5E which had previously been produced and tested.

It will be observed from the preceding data that two of the pilot lots, RAD-PE-559-5D and 8, were found to yield unacceptably high pressures. This high pressure for lot RAD-PE-559-5D could logically be attributed to the low quickness (RQ) result. However, lot RAD-PE-559-8 was found to yield relatively high quickness and gun pressure results for no measurable reason unless these could be explained by coating time, the only observed difference which had inadvertently been somewhat longer for lot RAD-PE-559-7 than for lot RAD-PE-559-8. For all of the lots it was found to be impossible to remove alcohol acquired in the coating operation by forced air drying at 60°C (140°F).

Alcohol removal from subsequently produced lots was effected to less than one-half of a percent by drying coated stock for 48 hours in a water dry. The results from lots RAD-PE-559-5A through E and 7 and 8 are presented in table 9.

The MC coating levels for lots RAD-PE-559-5A, 5B, 5C, 5E, and 7 versus FACC measured gun pressures and velocities at 98-gram charge weights and with 132-gram projectiles are shown in figure 7. The RQ at +32.2°C (+90°F) versus gun variables for these lots is presented in figure 8. The data indicated that a more energetic propellant with a greater coating may be required.

Subsequent lots were produced having potassium sulfate decreased from 1.0 to 0.5%, alcohol eliminated by water drying, ether eliminated by the coating operation, and with relatively higher MC coating levels. The ether level reduction (>1%) during coating is greater than could be accomplished in 20 000 hours of water drying at 60°C.

On 17 August 1977, the gun test facilities at RAAP were available for testing. However, testing was further delayed because the projectiles had a 0.995-inch diameter while the gun had a 0.987-inch internal diameter. The projectile diameters had to be machined to be within tolerances of 132-gram SP propellant projectile weights.

Lot RAD-PE-559-7, which was to duplicate lot RAD-PE-559-5E, was reported to be a satisfactory lot by FACC. Four 1000-pound pilot lots were ordered for a 2 by 2 factorial length and MC coating level study. Propellant with a greater impetus level was desired. Hence, the decreased potassium sulfate level (0.5%), a longer coating time (120 minutes) to further remove ether and improve coating gradient, 28 to 48 hour water dry time to remove practically all of the coating acquired alcohol, and a nitrocellulose nitrogen content as close as possible to 13.20% were specified. The specifications for these lots are in appendix A-4 (COR letter, SARRA-EN dated 10 November 1977). The MC coatings specified, used, and obtained with specified L/D ratios and ballistic results follow:

Lot RAD- PE-559-	MC Coating, %			L/D Ratio	RAAP gun tests with 98-g charges and 132-g projectiles	
	Specified	Used	Analyzed		Pressure, MPa	Velocity, m/s
11	2.25	3.17	1.92	1.1	383	1321
12	2.75	3.90	2.37	1.1	349	1283
13	2.25	3.12	1.84	1.3	392	1327
14	2.75	4.05	2.26	1.3	3.56	1313
5E	2.00	2.07	1.89	1.1	386*	1326*
7	2.00	2.10	1.97	1.1	386*	1326*

*Reference lots with test made at FACC. A 2 m/s/m velocity correction was made in all cases.

Pilot mixes were coated and evaluated from each of the lots before the lots per se were coated. The pressure-velocity-charge weight data in figures 9 and 10 from preliminary and limited RAAP tests showed lot RAD-PE-559-11 to be the most acceptable lot. The FACC gun tests showed lot RAD-PE-559-11 to be acceptable and it was used as the model lot for succeeding production lots RAD-PE-559-15 and 16. These three lots are compared in figures 11 and 12 with the original Swiss reference lot P-2078.

The old specification (ADMS 567895) in effect for all of the development work, which required 1.25 m/s/m velocity-corrections and 132-gram projectile weights, was not too difficult to meet. The later specification AS12013532 which does not limit projectile weight (FACC apparently used 135 grams) and with changed velocity correction to 0.19 m/s/m is remarkably more difficult to meet (because propellant tailoring for a 30 m/s higher velocity at any pressure is required), and could require the development of a new propellant.

The velocity-pressure-charge weight relationships for model lot RAD-PE-559-11 and production lots RAD-PE-559-15 and 16 are shown in figures 11 and 12. The effect of the change in specified velocity correction factor from 1.25 to 0.19 m/s is shown in the velocity charge weight relationships in figure 11. The effects of the belated specification changes in correction factor and projectile weight on required propellant specifications and gun pressures were very significant.

Subsequent to the time that lot RAD-PE-559-11 was produced, no significant changes were made in the manufacturing or coating processes, except that improved coating equipment was installed after lot RAD-PE-559-23 was produced. Therefore, the process and coating changes and their effects were the same up to the time of production of lot RAD-PE-559-15 and 16. Engineering effort normally ceases with the

delivery of the first production lot. However, in this case it was continued through the second production lot which was accepted on 2 February 1979.

In August 1980, it was learned that flash and noise problems had been encountered in the field at Fort Carson, Colorado, and that 1/2 gram (1/2%) of potassium nitrate salt was being added to charges from lot RAD-PE-559-16. Another lot, RAD-PE-559-17, with potassium sulfate increased from 0.50 to 1.00%, was ordered and delivered in October 1980. At this time it was learned that an excessive gun pressure problem also existed. It was indicated that the increased salt may have been the assignable cause. Also, some questions of lack of uniformity of propellant arose. Because the PE program should have been concluded with lot RAD-PE-559-16, the production process and product quality at that time will be discussed before dealing with the subsequent problems. The chemical, physical, and closed bomb test results for the model and three subsequent production lots are shown in table 10.

State of the Art at Completion of PE Effort

The state of the art at the time that RAD-PE-559-17 was produced was such that a HOE range of 10 cal/g was observed among the four lots (one model and three production lots). This compares favorably with a 13 cal/g range for a series of solventless formula (N5) rocket propellant carpet roll lots. The reason for this excellent uniformity in energy content is that volatile solvents were virtually eliminated as variables. The coating mode and cycle reduces ether (by more than 1%) to an insignificant variable. The 48-hour post coating water dry cycle does the same for alcohol (reduces by more than 1%). Therefore, more energy is available after coating for projectile propulsion.

The amount of MC applied to propellant during the coating cycle is remarkably dependent upon time, as illustrated in table 10 and figure 13. The time involved in a coating cycle includes the 15-minute time on temperature at 24°C (75°F) when the MC slurry is added to the propellant with water and alcohol and extends through the time when the batch is immediately cooled to room temperature and washed with cold water.

Combined partial burner and chemical analyses have proven that MC applied to obtain coating percentages between 1.26 and 2.77 appear in propellant strata in fairly constant percentages of the total amount applied for a given geometry. The following table illustrates the percentage MC remaining after partial burns with blowout discs designed to cause approximately 1% per mil of disc thickness:

Partial burner disc thickness, mils	Grain weight percentages and MC coating percentages measured after partial burn tests for lots RAD-PE-559-							
	20		21		22		23	
	MC	Wt	MC	Wt	Mc	Wt	Mc	Wt
Unburned	100	100	100	100	100	100	100	100
7	84	97	83	96	80	94	99	96
25	29	61	32	61	22	62	26	66
40	20	55	20	52	0	51	20	60

Linear regression ($Y = MX + b$), slopes (M), intercept (b), and correlation coefficients (R^2) for percent MC remaining (X) related to remaining weight percentage (Y) are in the following table:

Lot RAD- PE-559-	Percent MC before partial burn	<u>M</u>	<u>b</u>	Web, in.	Perf in.	<u>R²</u>
20	1.97	0.5894	43.918	0.0184	0.0066	0.994
21	2.77	0.62	40.668	0.0181	0.0064	0.993
22	1.35	0.5058	51.205	0.0194	0.0058	0.997
23	2.39	0.4595	52.357	0.0195	0.0054	0.995

Therefore, different levels of MC appear to have the same distribution profile for a given perforation and web size. However, significant differences in total penetration and penetration quantity at a given depth result from very small differences in perforation and web sizes. A two-hour coating cycle was used for these lots.

As can be seen in table 10, dimensional and chemical analytical results for model lot RAD-PE-559-11 and production lots RAD-PE-559-15, 16, and 17 were nearly identical with the exception of increased potassium sulfate for lot RAD-PE-559-17. This is enhanced by the fact that HOE among lots varied not more than 10 cal/g which is the equivalent of a 0.5% total of any combination of alcohol, ether, and MC. Also, as can be seen from figure 14, lots RAD-PE-559-7, 11, 15, 16, 17 and Swiss lot P-2078 (original reference lot), closed bomb traces are congruent to the extent that these traces could have been from a single lot. Only lot RAD-PE-559-11 deviated in Dp/Dt on the upper side at pressures up to 83 MPa (12 000 psi) as though it had received less coating than the other lots. The data show this to be true. Lot RAD-PE-559-7 coincides with the final lot and reference lot traces and it was not as ballistically acceptable as lots RAD-PE-559-15 and 16. However, one must reach the conclusion that the reference lot (P-2078) and production lots RAD-PE-559-15, 16, and 17 yielded remarkably similar closed bomb test traces. All closed bomb tests were conducted in a 200 cm³ closed bomb at 32°C (90°F) using a loading density of 0.2 g/cm³.

Based on the preceding test data uniformity, it would be expected that there would be little difference in gun test data among these lots. The gun test data obtained at either FACC or RAAP for 98-gram charge weights from all lots known to have been acceptable to FACC were studied. These are presented in the following table:

<u>Lot RAD-PE-559-</u>	<u>98-gram charge</u>		<u>Tested at</u>	<u>Remarks</u>
	<u>Pressure, MPa</u>	<u>Velocity, m/s</u>		
5E	386	1320 ^a	FACC	All tests were made at 21°C. All lots contained 0.5% K ₂ SO ₄ . First two lots were coated for 30 and 45 minutes, respectively, while lot 11 had a 24-hour post coating water dry. All rounds corrected for +2 m/s/m to obtain muzzle velocity.
7	393	1326 ^a	FACC	
11	379	1318 ^a	RAAP	
15	384	1342 ^a	RAAP	
15	357 ^b	1332	FACC	
16	389	1348 ^a	RAAP	
16	389	1332	FACC	
P-2078 (Swiss reference)	382	1334 ^a	RAAP	
Average of averages	386	1331.5		
Std dev of averages	4.76	10.24		
Indicated upper 3 limit	400	1362		
Indicated lower 3 limit	372	1301		

^a Indicates it was known or reported that 132-gram projectiles were used.

^b Value excluded statistically.

From the preceding table it is obvious that both FACC and RAAP obtained relatively high pressures for all of the reference (or model) lots and the first two production lots. Also, the velocities at FACC were 10 to 15 m/s lower than those obtained at RAAP for the two comparable production lots. Therefore, 2 to 3 more grams of propellant (with 15 MPa or total of 401 MPa additional pressure) would be required by FACC to obtain specified velocity in cases designed to hold 98 grams (the capacity of reference lot P-2078) with propellant specified to have less loading density (0.92 g/cm³ minimum).

Only from lots RAD-PE-559-11, 12, 13, 14, 15, and 16 are comparable data available from the test gun originally supplied to RAAP and the tests made at FACC with other guns and ammunition.

SUBSEQUENT PRODUCTION ENGINEERING STUDIES

As requested, RAAP produced a 5000-pound lot (RAD-PE-559-17) with potassium sulfate changed from 0.5% to 1.0% even though indications were that 0.5 gram of potassium nitrate added to cartridges containing lot RAD-PE-559-16 was the assignable cause for higher gun pressures. The lot was produced, shipped, and gun tested only at FACC. The lot was found to yield high gun pressures at FACC although the only chemical, physical, or closed bomb difference between this lot and lot RAD-PE-559-15 (the reference lot) that could be found was the expected difference in potassium sulfate level (as previously pointed out in table 10 and figure 14).

Again as requested, a 500-pound batch from this lot was modified and shipped to FACC where the testing of the lot was witnessed by Hercules and Government representatives. The following results were obtained for this modified batch RAD-PE-559-17B or RAD-PE-559-17M on 4 and 5 October 1980.

<u>Work dir</u>	<u>Velocity,</u> <u>m/s</u>	<u>Average</u> <u>pressure,</u> <u>MPa</u>	<u>No.</u> <u>rounds</u>	<u>Propellant</u> <u>charge</u> <u>weight, gram</u>	<u>Test</u> <u>temp,</u> <u>°C</u>	<u>Piezo</u> <u>gauge</u>
ATP 1306	1342	418	10	99	21	PCB 1728
ATP 1307	1346	446	25	99	21	PCB 1761
ATP 1307	1346	401	21	99	21	PCB 1763
ATP 1307	1344	407	5	99	21	PCB 1764

Gauge number PCB 1761 was changed at the writer's request and pressures were lowered by 39 to 45 MPa on succeeding series of tests. This difference was considered to be significant in results associated with gauges. However, the gauge (PCB 1761) was tested by FACC personnel and found to be acceptable.

Additional Pilot Lots

Also ordered at the same time as lot RAD-PE-559-17 were two small pilot lots (RAD-PE-559-18 and 19) with larger webs (0.22 and 0.24 inch). The L/D and D/d rates were unspecified except in the specification drawing. The specification drawing requirements for these ratios were used rather than those desired but inadvertently never specified.

These lots (see attached description sheets in appendix F) with the larger webs were produced and coated. However, the lots became contaminated with DNT from hidden recesses of the barrel from a previous coating operation. This was discovered only during the analysis of the lots by a gas chromatographic method used to determine volatiles and moisture.

As would have been expected, the DNT coated the propellant first and limited the amount of MC that could be subsequently applied. The percentage of the two coatings obtained and the amount of MC desired follow:

Closed bomb ^a at +90°F		Web, inch		MC		Web difference, %		DNT %	
<u>%RQ</u>	<u>RF</u>	<u>Des^b</u>	<u>Obt^c</u>	<u>Des</u>	<u>Obt</u>	<u>Des</u>	<u>Obt</u>	<u>Des</u>	<u>Obt</u>
90.23	100.82	0.0212	0.0218	1.9	1.23	20	-19.75	0	2.09
80.83	100.42	0.0237	0.0247	1.9	1.19	20	-20.27	0	2.45

^a Results are for lot RAD-PE-559-18 and 19, respectively. Lot RAD-PE-559-17 was used as reference lot.

^b Des is desired

^c Obt is obtained

It will be noted that although the RQ was high and the total coating was high by at least 1%, the force was 100% or higher.

The closed bomb traces for these lots were different from any other lot produced in the Bushmaster series. The Dp/Dt versus P traces between pressures of 41 and 83 MPa (10 000 and 20 000 psi) were remarkably better in slopes and intercepts than those obtained from any of the other lots. These traces are shown in figures 15 and 16. The gun test results obtained from the product of this coating process (see appendix G) were also unique and favorable as would have been predicted from the closed bomb results.

As directed, several other lots and blends of lots (RAD-PE-559-24 through 30) were produced. These efforts are summarized in appendix G. It is remarkable that each test of each lot or blended batch produces an entirely different result. Perhaps this is, as observed earlier, entirely the result of gauge bias.

The following results have been reported for lot RAD-PE-559-16 at 21°C:

<u>salted</u>	<u>No. rounds</u>	<u>Pressures, MPa</u>	<u>Velocity, m/s</u>	<u>Charge wt, grams</u>
No	20	370 & 384	1334 & 1342	99.7
No	20	372 & 362	1336 & 1360	99.7
No	20	370	1348 & 1360	99.7
Yes	40	432	1350	99.7
Yes	20	424 & 422	1350	99.7
Yes	20	402	1325	99.5
Average	unsalted	373	1345	
Average	salted	420		

It appears that the addition of 0.5% of potassium nitrate did increase pressures by 47 MPa without affecting velocity, assuming no gauge or other component bias.

The APDS-T propellant and coating process developed up to the changes in projectile weight, velocity correction factor, and propellant formula change to increased potassium sulfate are contained in appendix H. All description sheets obtained for this project are shown in appendix F.

CONCLUSIONS

1. A completely acceptable, MC-coated SP propellant was developed for the 25-mm HEI-T Projectile. The acceptable reference lot is RAD-PE-559-6(HE) and the description sheet for this lot is attached in appendix F.
2. A study of coating materials for the APDS-T projectile using SP M10 propellant disclosed that Paraplex G54 and EC, in single or double coatings or with DBP, were as effective as MC coatings.
3. A unique production and coating process using alcohol, water, and KC was established for MP M10 propellant such that the Swiss reference lot performance was equaled or bettered. It would not have been possible to produce satisfactory propellant with the previous MC coating process.
4. The two-stage application of DNT and MC effected improved D_p/D_t versus P relationships.
5. The most acceptable APDS-T lots studied by closed bomb tests during this project were ranked in order of acceptability as follows:

<u>Lot</u>	<u>Remarks</u>
1. CAD 5554	MC coated Canadian w/organic lead salts
2. CIL 3331	MC coated Canadian w/organic lead salts
3. P-1929	Oerlikon camphor coated SP
4. RAD-PE-559-18	MC and DNT coated
5. RAD-PE-559-19	MC and DNT coated
6. HRS-7	German EC-DRP coated
7. RAD-PE-559-21	MC coated MP M10
8. RAD-PE-559-16	MC coated MP M10
9. RAD-PE-559-17	MC coated MP M10
10. RAD-PE-559-7	MC coated MP M10
11. RAD-PE-559-15	MC coated MP M10
12. RAD-PE-559-23	MC coated MP M10
13. P-2078	Camphor coat Oerlikon ref
14. RAD-PE-559-11	MC coated MP M10

RECOMMENDATIONS

1. Longer coating times, varied alcohol to water ratios, and different coating cycles should be evaluated to determine whether the 25-mm APDS-T propellant can be improved.
2. The DNT and NC coating process discovered during this project should be further evaluated to determine whether it can be used to produce improved coated MP M10 propellant.
3. Other coatings, particularly Paraplex G54, should be evaluated with SP M10 propellant to determine whether an improved APDS-T propellant can be produced.
4. The pressure gauge uniformity problem should be thoroughly studied. If, for example, gauges with low sensitivities do give high pressures such as those observed on 14 and 15 October 1980, then specification limits should be set on gauge sensitivities or correction to some standard conditions should be made for each gauge.
5. The study of M10 formula propellant with basic lead carbonate or other lead salts is highly recommended.

0300p

Table 1. Chemical and physical data for
sublots of single-base, single-perforated
propellant for 20-mm gun

<u>Item</u>	<u>PE Project 485 Sublot number</u>			
	<u>S/L A1</u>	<u>S/L A2</u>	<u>S/L B1</u>	<u>S/L B2</u>
Nitrocellulose, % (13.15%N)	94.25	92.48	94.82	92.82
Diphenylamine, %	0.55	0.57	0.52	0.51
Potassium sulfate, %	0.79	0.85	0.79	0.76
Methyl centralite, %	4.26	5.95	3.74	5.80
Graphite, %	0.11	0.15	0.13	0.11
Six-hour M&V, %	0.44	0.63	0.62	0.75
Bulk density, g/cm ³	0.9892	0.9805	0.9933	0.9985
Physical dimensions:				
Mean length, in.	0.067		0.067	
Mean outside diameter, in.	0.052		0.055	
Mean perforation, in.	0.0043		0.0042	
Mean web, in.	0.0235		0.0257	

Table 2. FACC gun tests of PE-485 sublots of MC-coated M10 single-perforated propellant from 20-mm program with 177-gram HEI-T projectile

<u>Round</u>	<u>Prop sublots</u>	<u>Chg wt, g</u>	<u>TA, Milli-second</u>	<u>Pm, MPa</u>	<u>Pc, MPa</u>	<u>Vm,* m/s</u>	<u>Remarks</u>
1	PE-485-A1	75	5.62	29.4	336.5	1030	485B sublots too fast for HE and were used w/AP. There are indications that a 10-gram heavier projectile is contemplated for future use.
2	PE-485-A2	75	6.21	33.2	231.7	941	
3	PE-485-B1	75	5.26	26.8	395.1	1038	
4	PE-485-B2	75	6.68	30.4	197.2	899	
5	A1	80	6.43	30.8	<u>318.6</u>	<u>1076</u>	
6	A2	85	6.27	37.9	233.8	1012	<u>Spec</u>
7	A1	90	5.04	30.7	431.7	<u>1172</u>	Shell cap = 90 g 1085 + 15 m/s w/390 MPa max press
8	A2	90	5.75	37.0	<u>277.2</u>	<u>1068</u>	
9	A1/A2	80/10	5.2	31.3	416.5	<u>1170</u>	
10	A1/A2	85/0	5.45	39.3	<u>357.2</u>	<u>1118</u>	
11	A1/A2	70/20	5.2	32.1	396.5	<u>1154</u>	
12	A1/A2	65/25	5.41	31.8	390.3	<u>1152</u>	
13	A1/A2	60/30	5.45	35.2	<u>365.5</u>	<u>1148</u>	
14	A1/A2	50/40	5.07	--	<u>382.0</u>	<u>1128</u>	

*Desired or greater velocities are underlined along with corresponding acceptable pressures. The velocities probably are corrected by twelve rather than two m/s/m.

Table 3. FACC gun tests of PE-485 sublots of MC-coated, M10 single-perforated propellant from 20-mm program with 121.5-gram AP-T projectile

<u>Round</u>	<u>Prop. sublots</u>	<u>Chg wt, g</u>	<u>TA, ms</u>	<u>Pm, MPa</u>	<u>Pc, MPa</u>	<u>Vm,* m/s</u>	<u>Remarks</u>
1	A1	75	5.25	27.7	278.6	1091	<u>Specs</u>
2	A2	75	6.03	27.0	181.4	971	1372 + 15 m/s 390.2 MPa, max
3	B1	75	5.37	27.7	291.7	1280	100 g case capacity. Data
4	B2	75	6.35	25.6	152.4	923	indicate that FACC test slug weighs 135 g
5	B1	80	--	28.5	209.0	1081	
6	B1	85	5.71	31.2	255.8	1177	
7	B1	90	5.49	33.7	297.2	1203	
8	B1	95	5.31	35.7	339.3	1293	
9	B1	97	5.07	37.0	359.3	1322	
10	B1	98	5.19	37.7	368.2	1328	
11	B1	100	4.91	37.0	402.0	<u>1361</u>	
12	B1/A1	75/25	4.47	--	404.8	1349	
13	B1/A2	75/25	4.57	--	369.6	1322	
14	B1/A2	85/15	4.56	--	393.1	1332	

*Desired or greater velocities are underlined along with corresponding acceptable pressures. The velocities probably are corrected by twelve rather than two m/s/m.

Table 4. Acceptance test results for 25-mm lots 559-1, A3 and B3

Constituent	Specification ^a	Lot PEI-559-1			
		(S/L A3)	(S/L B3)		
Nitrocellulose, % (13.12%N)	Remainder	92.14	92.51		
Diphenylamine, %	0.50 to 1.25	0.62	0.67		
Graphite, %	0.40, max	0.17	0.14		
Methyl centralite, %	In parenthesis	4.56	3.88 (3.90, nom)		
Potassium sulfate, %	0.10 to 1.0	0.81	0.89		
Total volatiles, %	2.35, max	1.70	1.91		
M&V, %	1.00 ± 0.25	1.14	1.18		
Residual solvents, %	1.10, max	0.65	0.73		
<u>HOE, cal/g</u>	N/A	846.1	862.7		
Expected charge from HOE for AP-T, g	(121.5) ^a	102	100		
Expected charge from HOE for HE, g	(177) ^a	92	90		
<u>Dimensions, inch</u>					
Length	---	0.071	0.070		
Diameter	---	0.0527	0.0556		
Perf diameter	---	0.0053	0.0056		
Web	---	0.0236	0.0251		
<u>Stability, methyl violet test</u>					
Heat test, 134.5°C, minutes	40, minimum	50	50		
No explosion, hours	5, minimum	5+	5+		
<u>Closed bomb test, 200 cm³ bomb^b</u>		<u>Loading density, g/cm³</u>			
Relative quickness, percent average	-57°F	92.51	88.55	84.10	83.92
	+90°F	117.29	106.31	109.45	99.67
	+165°F	135.32	123.42	128.68	113.59
Relative force, percent average	-57°F	100.29	99.02	99.79	99.26
	+90°F	101.80	100.81	101.44	99.67
	+165°F	102.65	102.85	102.48	101.92

^a Projectile weights and specification at start of program.

^b RAD-PE-271-1 tested at 90°F was used as the standard because it more closely approximated CAD 5554 (depleted) in RQ and RF.

Table 5. Summary of available test data for 25-mm Buellmaster Jots

Ingredient or Attribute	Lot or Sample Identity											
	CAD 5554	P1929	P2078	MS-7	PE-485 A1 & A2 (2:1)	RAJ 44378	RAJ-PE-271-3	EG(2C) ^a	EG(SC) ^b	G54 ^c	EM ^d	L-26 ^e
Nitrocellulose, X	97.71	98.40	97.94	98.44 ^f	98.56	98.61	98.24	98.56	98.56	98.56	50.56	98.56
Diphenylamine, X	0.87	1.07	1.03	0.85	0.59	0.68	0.87	0.59	0.59	0.59	0.59	0.59
K ₂ SO ₄ , X	0.62	---	1.03	---	0.85	0.71	---	0.85	0.85	0.85	0.85	0.85
PbCO ₃ , X	---	---	---	---	---	---	---	---	---	---	---	---
MgCO ₃ , X	---	0.53	---	0.71	---	---	0.89	---	---	---	---	---
TOTAL Coating, X	100.00	100.00 ^h	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	4.82 ^g	6.00 ^h	3.00 ^h	2.84 ^h	4.82 ^g	3.89 ^h	2.10 ^h	4.42 ^g	5.24 ^g	4.56 ^{g,j}	4.56 ^{g,j}	0.67 ^{g,j}
Graphite, X	0.16	0.20	0.10	0.47	0.12	0.14	0.33	---	---	---	---	---
Molature, X	1.23	0.89	1.15	0.79	1.19	1.20	1.07	0.22	0.21	0.19	0.22	---
Alcohol, X	0.00	0.38	0.47	0.86	0.00	0.01	0.00	0.11	0.11	0.25	0.09	---
Ether, X	0.37	---	0.24	0.02	0.57	0.74	0.65	0.74	0.67	0.69	0.62	---
TV, X	1.60	1.27	1.86	1.67	1.76	1.95	1.72	1.07	0.99	1.13	0.93	---
Residual Solvent, X	0.37	0.38	0.71	0.88	0.57	0.75	0.65	0.65	0.78	0.94	0.78	---
Configuration	SP	SP	MP	SP	SP	SP	SP	SP	SP	SP	SP	---
Web, in.	0.0244	0.019	0.019	0.021	0.0235	0.0271	0.023	0.0235	0.0235	0.0235	0.0235	0.0235
OD, in.	0.0553	0.044	0.097	0.053	0.052	0.0601	0.080	0.052	0.052	0.052	0.052	0.052
ID, in.	0.0066	0.006	0.007	0.011	0.0043	0.0063	0.009	0.0043	0.0043	0.0043	0.0043	0.0063
Length, in.	0.0822	0.063	0.148	0.079	0.067	0.0734	0.054	0.067	0.067	0.067	0.067	0.067
HOE, cal/g	984	991	987	1005	993	1003	984	1005	1005	1005	1005	1005
Basic Formula	853	808	879	867	871	887	854	879	861	865	898	978
Computed w/Coating	846	800	928	847	840	856	839	832	838	865	898	956
Measured	853	808	928	847	840	856	839	832	838	865	898	956
+90°V Cloud Bomb Average RF vs Lot CAD 5554 at Loading Densities of:												
0.1 g/cm ² , X	100	97.04	103.95	100.52	99.78	100.35	99.42	100.51	101.24	102.41	104.77	105.6
0.2 g/cm ² , X	100	97.66	104.40	100.40	100.96	100.63	99.82	101.19	101.57	102.41	104.20	105.4
+90°V Cloud Bomb Average RQ vs Lot CAD 5554 at Loading Densities of:												
0.1 g/cm ² , X	100	85.93	111.72	106.56	89.40	91.90	86.74	96.42	96.48	98.13	127.18	144.8
0.2 g/cm ² , X	100	92.6	115.31	111.20	96.25	97.26	99.27	103.97	102.12	108.47	120.6	140.3
Propellant Produced	Canada	Swiss	Swiss	German	RAAP	RAAP	RAAP	RAAP	RAAP	RAAP	RAAP	RAAP
By:	Interim Standard	Original Standard	Original Standard	2-Step Coating	2:1 Blend of A1 & A2 Coating Levels	Blend of Coating Levels	2-Step Coating	1-Step Ethyl Centralite Coating	1-Step Ethyl Centralite Coating	1-Step Polymer Coating	1-Step Polymer Coating	1-Step Lead Hexoate Coating
Remarks:												

^a EG(2C) - Ethyl Centralite (2-Stage Coating).
^b EG(SC) - Ethyl Centralite (Single Stage Coating).
^c G54 - Paraplex Polymer (Thermosetting).
^d EM - Ethylene Dimethacrylate Coating (Thermosetting).
^e L-26 - Lead 2-Ethyl Hexoate Coating. Promoted low pressure rates in coating such as if within propellant.
^f NC has been analyzed to be 13.73-13.27%N; whereas, all other samples were of 13.15%N level.
^g Methyl Centralite.
^h Camphor.
ⁱ Dibutyl phthalate.
^j Percent added per "as received" propellant weight.

Table 6. HOE, dimensional and closed bomb data;
a contrast between old and new coating methods

	<u>Grain measurement, inch</u>		
	Lot P-2078 WS f AP-T, 25-mm	Lot RAD-PE-559-4	Lot RAD-PE-559-3
Length	0.1585	0.1249	0.1131
OD	0.0944	0.0975	0.0871
Perforated	0.0068	0.0078	0.0082
Outer Web	0.0161	0.0192	0.0172
Inner Web	0.0209	0.0182	0.0143
Average Web	0.0185	0.0187	0.0157

Old method of coating, HOE, and closed bomb data*

	Lot P-2078 3% camphor	Lot RAD-PE-559-4		Lot RAD-PE-559-3	
		% methyl centralite 2.60	4.43	% methyl centralite 2.61	3.88
+90°F RQ, %	100	115.2	104.7	126.6	117.3
+90°F RF, %	100	99.4	96.9	99.9	98.8
HOE, cal/g	928.2	894.4	833.8	889.9	840.6
Estimated MC coating for 100% RQ, %		5.2		6.4	
Estimated RF for 100% RQ level coating, %		96		97	

New method of coating, HOE, and closed bomb data*

	Lot P-2078 3% camphor	Lot RAD-PE-559-4		Lot RAD-PE-559-3	
		% methyl centralite 3.91	5.72	% methyl centralite 2.46	3.88
+90°F RQ, %	100	94.08	87.72	105.29	93.02
+90°F RF, %	100	96.29	95.23	99.25	98.87
HOE, cal/g	928.2	843	816	896	854
Estimated MC coating for 100% RQ, %		2.2		3.1	
Estimated RF for 100% RQ level coating, %		97		99	

*Tests were made at +90°F, 0.2 g/cm³ loading densities in 200 cm³ closed bomb using lot P-2078 as standard.

Table 7. Comparison of RAD-PE-559 lots with reference lots

Ingredient or attribute	Swiss P-2078	RAD-PE-559-3A	RAD-PE-559-3B	Swiss P-1929	CAD 5554	RAD-PE-559-4A	RAD-PE-559-4B
Nitrocellulose, %	97.94	98.07	98.21	98.40	97.71	98.17	98.12
Diphenylamine, %	1.03	0.88	0.86	1.07	0.87	0.84	0.83
K ₂ SO ₄ , %	1.03	1.05	0.93	---	0.62	0.99	1.05
PbCO ₃ , %	---	---	---	---	0.80	---	---
Na ₂ C ₂ O ₄ , %	---	---	---	0.53	---	---	---
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Coating, %	3.00	3.91	5.72	6.00	4.82	2.46	3.88
Graphite, %	0.10	0.16	0.10	0.20	0.16	0.14	0.25
Moisture, %	1.15	1.48	0.49	0.89	1.23	0.62	0.29
Alcohol, %	0.47	0.56	0.37	0.38	0.00	0.50	0.50
Ether, %	0.24	0.40	0.43	---	0.37	0.42	0.39
Grav density, g/cm ³	1.021	0.941	0.914	0.995	0.962	0.981	0.975
HOE, cal/g	928	843	816	800	846	896	854
TV, %	1.86	2.44	1.29	1.27	1.60	1.54	1.18
Res sol, %	0.71	0.96	0.80	0.38	0.69	0.92	0.89
M&V, %	---	1.44	0.56	---	0.85	1.01	0.44
Dimensions:		<u>3A & 3B</u>				<u>4A & 4B</u>	
Length, in.	0.1585	0.1131		0.063	0.0822	0.1249	
Outside dia, in.	0.0944	0.0871		0.044	0.0553	0.0975	
Perf dia, in.	0.0068	0.0082		0.006	0.0066	0.0078	
Web, av, in.	0.0185	0.0157		0.019	0.0244	0.0187	
Web diff, %	-25.95	18.84		SP	SP	5.62	
L:OD ratio	1.68	1.30		1.43	1.49	1.28	
OD:d ratio	13.88	10.56		7.33	8.38	12.46	
+90°F closed bomb avg							
RF vs P-2078 at loading densities of:							
0.1 g/cm ³	100.00	---	---	93.40	96.2	---	---
0.15 g/cm ³	100.00	96.19	95.93	---	---	99.75	97.34
0.2 g/cm	100.00	96.29	95.23	93.54	95.79	99.25	98.87

Table 7. (cont)

Ingredient or attribute	Swiss P-2078	RAD-PE-559-3A	RAD-PE-559-3B	Swiss P-1529	CAD 5554	RAD-PE-559-4A	RAD-PE-559-4B
+90°F closed bomb avg	RQ vs P-2078 at loading densities of:						
0.1 g/cm ³	100.00	---	---	76.92	89.51	---	---
0.15 g/cm ³	100.00	93.33	85.57	---	---	106.64	88.38
0.2 g/cm ³	100.00	94.08	87.72	80.31	86.72	105.59	93.02
Dust, %	---	0.03	0.03	---	0.01	0.03	0.03
AP case cap, g	102.00	94.00	91.00	100.00	96.00	98.00	98.00
Stability heat test:							
S.P. 134.5°C, minutes		60 +	60 +		40	60 +	60 +
No explosion, hours		5+	5+		5+	5+	5+
Hygroscopicity, %		1.43	1.32		1.94	1.42	1.38

Table 8. FACC reported gun test data for the first
multi-perforated lots RAD-PE-559-4A and 4B

Lot RAD-PE-559-4A (2.46% MC)

<u>Test</u>	<u>Charge weight, g</u>	<u>Action time TA, ms</u>	<u>Chamber pressure, MPa</u>	<u>Muzzle velocity, m/s, with correction of</u>	
				<u>12 m/s/m</u>	<u>2 m/s/m</u>
1	85	5.37	289	1213	1223
2	92	4.94	342	1277	1287
3	95	4.50	415	1343	1353

Lot RAD-PE-559-4B (3.88% MC)

1	85	7.01	201	1100	1110
2	90	6.13	209	1148	1158
3	95	5.33	286	1232	1242

Blends of lots RAD-PE-559-4A and 4B

	<u>4A/4B (g/g)</u>				
1	85/10 = 95 g	4.55	408	1324	1324
2	85/15 = 100 g	4.28	445	1376	1386
3	80/20 = 100 g	3.90	416	1361	1372
4	75/25 = 100 g	3.92	420	1353	1363
5	70/30 = 100 g	3.82	417	1348	1358
6	60/40 = 100 g	3.83	420	1335	1345
7	50/50 = 100 g	4.02	389	1329	1339
Avg of 5	50/50 = 100 g	3.96	383	1327	1337

Table 9. Methyl centralite coating studies for
propellant for APDS-T projectile

	559-5A	559-5B	559-5C	559-5D	559-5E	559-7	559-8
Propellant Delivered, lb	109	110	110	106	107	474	488
NC Blend No.	BC-15058	BC-15058	BC-15058	BC-15058	BC-15058	C-15058	C-15058
Nitrogen %	13.19	13.19	13.19	13.19	13.19	13.12	13.12
<u>Solvents</u>							
Total %	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Alcohol %	35	35	35	35	35	35	35
Ether %	65	65	65	65	65	65	65
SR build up (hours)	64	64	64	64	64	64	64
SR time (hours)	24	24	24	24	24	24	24
WD time (days)	26	26	26	26	26	26	26
<u>Methyl centralite</u>							
Coating cycle (hours)	3/4	3/4	3/4	3/4*	3/4*	1-1/8*	3/4*
FAD after coating (hours)	104	104	104	96	96	96	96
Nitrocellulose, %	95.63	95.22	94.75	96.72	96.19	96.32	96.17
Diphenylamine, %	0.90	0.86	0.88	0.88	0.88	0.83	0.83
Graphite %	0.16	0.16	0.16	0.10	0.09	0.12	0.13
Methyl centralite %	2.53	3.03	3.51	1.39	1.89	1.97	2.08
Potassium sulfate %	0.94	0.89	0.86	0.91	0.95	0.88	0.92
Residual solvents %	1.38	1.15	1.04	1.17	1.11	1.29	1.20
Alcohol %	0.98	0.72	0.65	0.80	0.74	0.98	0.91
Ether %	0.40	0.43	0.39	0.37	0.37	0.31	0.29
Moisture (1 +.25) %	1.16	1.08	1.04	0.91	0.83	0.92	0.70
Total volatiles %	2.54	2.23	2.08	2.36	2.58	2.21	1.90
Hygroscopicity % ³	1.24	1.25	1.25	1.34	1.22	1.28	1.24
Bulk Density (g/cm ³)	0.9947	0.9994	0.9794	0.9844	1.0005	1.0005	1.008
Heat of explosion (cal/g)	872.1	861	847.2	901.2	889.7	883.2	886.3
<u>Die</u>							
<u>SP Spec</u>							
Length, in.	0.130	0.130	0.130	0.130	0.130	0.130	0.130
Diameter in.	0.147	0.147	0.147	0.147	0.147	0.147	0.147
Pin diameter, in.	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Av web (green), in.	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263
<u>Finished</u>							
Length, in.	0.0923	0.0923	0.0923	0.0923	0.0923	0.0923	0.0923
Diameter, in.	0.0947	0.0947	0.0947	0.0947	0.0947	0.0947	0.0947
Perf diameter, in.	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083
Av web, in.	0.0178	0.0178	0.0178	0.0178	0.0178	0.0178	0.0178
L/D	0.98	0.98	0.98	0.98	0.98	0.98	0.98
D/d	11.38	11.38	11.38	11.38	11.38	11.38	11.38
Length var (%)	2.70	2.70	2.70	2.70	2.70	2.70	2.70
Diameter var (%)	2.59	2.59	2.59	2.59	2.59	2.59	2.59
Web diff (%)	11.96	11.96	11.96	11.96	11.96	11.96	11.96
Outer web, in.	0.0189	0.0189	0.0189	0.0189	0.0189	0.0189	0.0189
Inner web, in.	0.0168	0.0168	0.0168	0.0168	0.0168	0.0168	0.0168
<u>Gun test at Ford Aeronautronics</u>							
Velocity 70°F (1350 ± 15 m/s)	1230	1250	1215	1300	1320	1320	1326
-65°						1306	
160°						1354	
<u>Pressure</u>							
Av chamber pressure							
70°F (402 MPa max)	352	303	283	448	386	385.6	464.8
(+0.72 S. D.)						393	
-65°F (496 MPa max)						371.9	
(+5 S. D.)							
160°F (496 MPa max)						428.1	
(+5 S. D.)							
Charge weight g	98	98	98	90	98	98	96
Action time (6.0 ms max)							
70°						-3.3	3.9
-65°						3.5	
160°						3.4	
RQ %	95.5	91.3	83.6	105.0	101.9	102.70	104.89
RF %	97.7	98.0	96.8	98.9	98.6	98.12	98.96
Std lot	P-2078	P-2078	P-2978	P-2078	P-2078	P-2078	P-2078

*Washed at coating temperature from 15 to 25 minutes, rather than dropping immediately to room temperature at the end of coating cycle and washing with cold water. These were the only batches thus treated.

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

Table 10 . Acceptance test results for lots RAD-PE-559-11,
15, 16 and 17

	<u>559-11</u>	<u>559-15</u>	<u>559-16</u>	<u>559-17</u>	<u>Avg</u>	<u>Std Dev</u>
Propellant Delivered, lb	971	4810	6999	5032	N/A	N/A
NC Blend	C-15104	C-15134	C-15228	C-15315		
Nitrogen %	13.16	13.16	13.16	13.15		
<u>Solvents</u>						
Total %	0.92	0.92	0.92	0.92		
Alcohol %	35	35	35	35		
Ether %	65	65	65	65		
SR build up (hours)	12	(70°) 32 (1/8 in. P.P.)	32	32		
SR time (hours)	34	(70°) 32 (1/4 in. P.P.)	32	32		
WD time (days)	12	(95°) 24 (1/4 in. P.P.)	24	24		
Methyl centralite coating cycle (hours)	2	2	2	2		
FAD after coating (hours)	24	48	48	48		
Nitrocellulose, %	96.71	96.34	96.28	95.88	96.30	0.339
Diphenylamine, %	0.89	0.86	0.86	0.83	0.86	0.024
Graphite %	0.17	0.20	0.19	0.14	0.175	0.0265
Methyl centralite %	1.92	2.24	2.41	2.15	2.18	0.204
Potassium sulfate %	0.48	0.56	0.45	1.14	N/A	N/A
Total volatiles %	2.48	2.01	1.93	1.68	2.03	0.35
Moisture (1 + .25)	1.18	1.23	1.00	1.24	1.16	0.111
Residual solvents	1.30	0.78	0.93	0.44	0.86	0.356
Alcohol %		0.30	0.41	0.24	0.32	0.086
Ether %		0.48	0.52	0.20	0.40	0.174
Hygroscopicity	1.38	1.38	0.99	1.33	1.27	0.188
Bulk Density (g/cm ³)	1.01	1.011	1.011	0.999	1.008	0.0059
Heat of explosion (cal/g)	897.4	900.5	889.9	892	895	4.87
Loadability, g	102	103.6	101		102.2	1.31
<u>Die</u>						
Length, in.	0.110	0.110	0.110	0.110	N/A	N/A
Diameter in.	0.147	0.147	0.147	0.147		
Pin diameter, in.	0.014	0.014	0.014	0.014		
Av web (green), in.	0.026	0.026	0.026	0.026		
<u>Finished</u>						
Length, in	0.1062	0.0996	0.0980	0.104	0.102	0.0038
Diameter, in.	0.0949	0.0941	0.0931	0.0935	0.0939	0.00078
Perf diameter, in.	0.0077	0.0068	0.0064	0.0064	0.0038	0.00061
Av web, in.	0.0180	0.0186	0.0187	0.0186	0.0195	0.00032
L/D	1.12	1.06	1.05	1.11	1.085	0.035
D/d	12.35	13.89	14.44	14.59	13.92	1.023
Length var (%)	1.97	1.65	2.07	1.83	1.88	0.182
Diameter var (%)	1.55	2.22	1.59	1.96	1.83	0.319
Web diff (%)	17.09	8.31	5.62	8.78	9.95	4.909
Outer web - in.	0.0196	0.0194	0.0192	0.0194	0.0194	0.00016
Inner web - in.	0.0165	0.0179	0.0181	0.0178	0.0176	0.00073
<u>Gun test at Ford Aeronutronics</u>						
Velocity 70°F (1100 ± 15 m/s)		1306	1348	1342		
-65°						
160°						
<u>Pressure</u>						
Av. chamber pressure						
70°F (402 MPa max)		357	373	418		
(+0.72 S. D.)						
-65°F (496 MPa max)						
(+5 S.D.)						
160°F (496 MPa max)						
(+5 S. D.)						
Charge weight		98.3	99.7	99		
Action time (6.0 ms max)						
70°						
-65°		3.4	3.3	3.22		
160°						
RQ %	97.89	101.95	100.76	100.33		
RF %	100.42	100.24	100.01	99.09		
Std lot	PE-559-7	PE-559-11	PE-559-15	PE-559-16		

Table 11. Effects measured on samples of Bushmaster propellant taken at stated time in minutes during an elevated temperature coating cycle

Sample number	Time on cycle, min	GCTV, %	H ₂ O, %	Ethyl alcohol, %	Ethyl ether, %	Residual solvent, %	Versus lot RAD-PE-559-7 % RQ1	% RQ2	% RF	HOE, cal/g	MC, %	DPA, %
P2579	30	1.82	0.70	0.20	0.92	1.12	119.69	116.68	102.05	939.0	1.25	0.84
P2580	60	2.03	1.04	0.21	0.78	0.99	113.55	111.58	102.19	931.7	1.44	0.92
P2581	95	2.60	1.68	0.24	0.68	0.92	108.08	106.78	101.05	919.4	1.60	0.83
P2582	120	2.75	1.86	0.27	0.62	0.89	103.03	102.47	100.31	912.4	1.75	0.83

Effect equation

HOE = -54.1607% MC + 1007.2721
 % MC = 0.00563 T (min) + 1.073
 % Ether = -0.003288 T (min) + 1.0007
 RQ2 = -28.0008% MC + 151.5888
 RQ1 = -32.7550% MC + 160.4656
 % H₂O = -4.0543% ether + 4.3607
 RQ1 = 1.1687915% RQ2 - 16.75199

Regression coefficient

-0.99
 -0.989
 -0.9997
 -0.9997
 -0.9795
 +0.9995

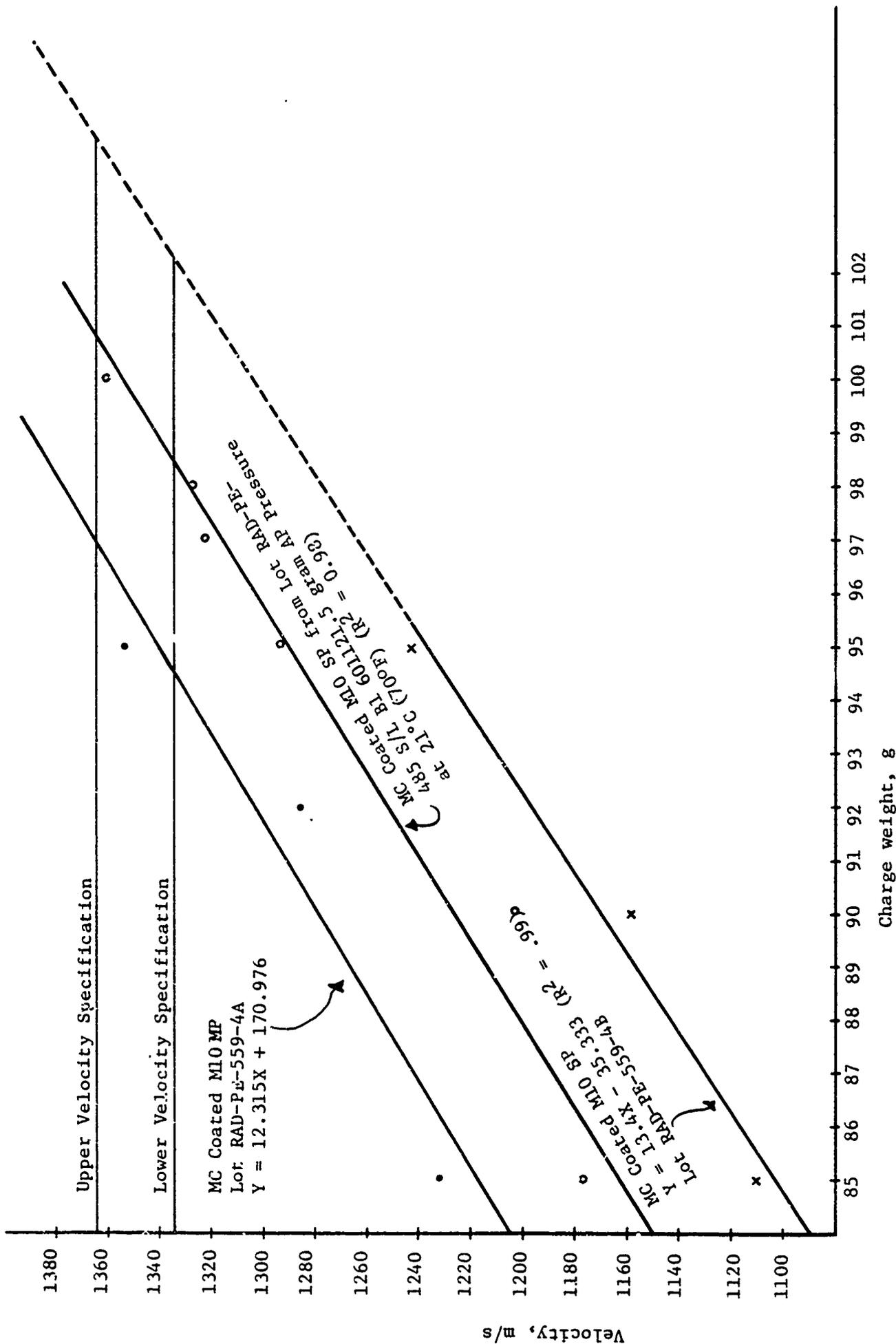


Figure 1. FACC gun test of first RAAP MC coated M10 SP and M10 MP pilot lots with 132 and 121.5 gram projectiles at 21°C (70°F) with 1.25 m/s/m, muzzle velocity correction factor.

Specification, $\bar{P} + 0.72$ S.D. at 21°C (70°F)
per spec ADMS - 567895 f/pressure

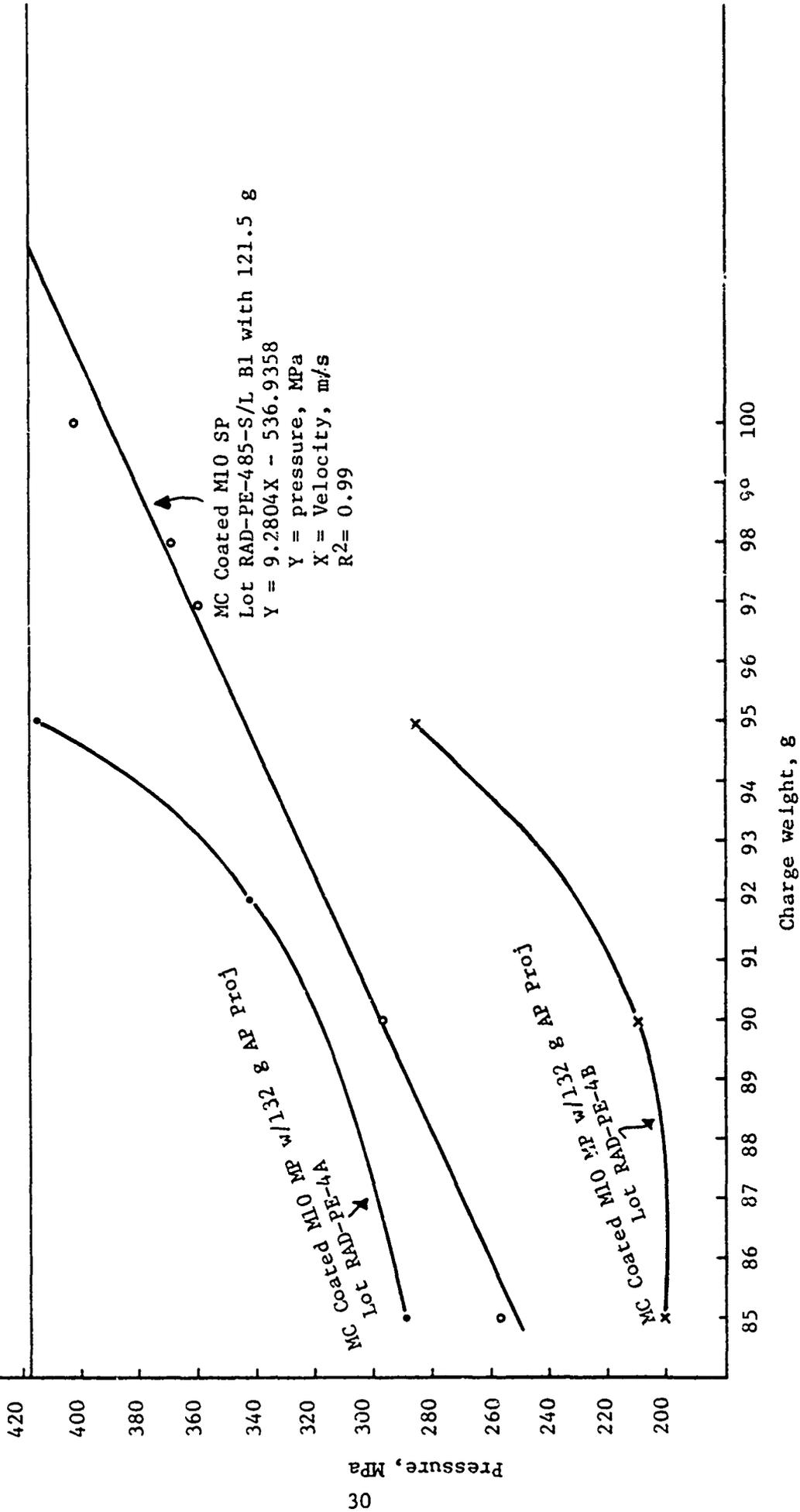


Figure 2. FACC gun tests of first RAAP MC coated M10 SP and M10 MP pilot lots with 132 and 121.5 gram APDS-T projectiles at 21°C (70°F)

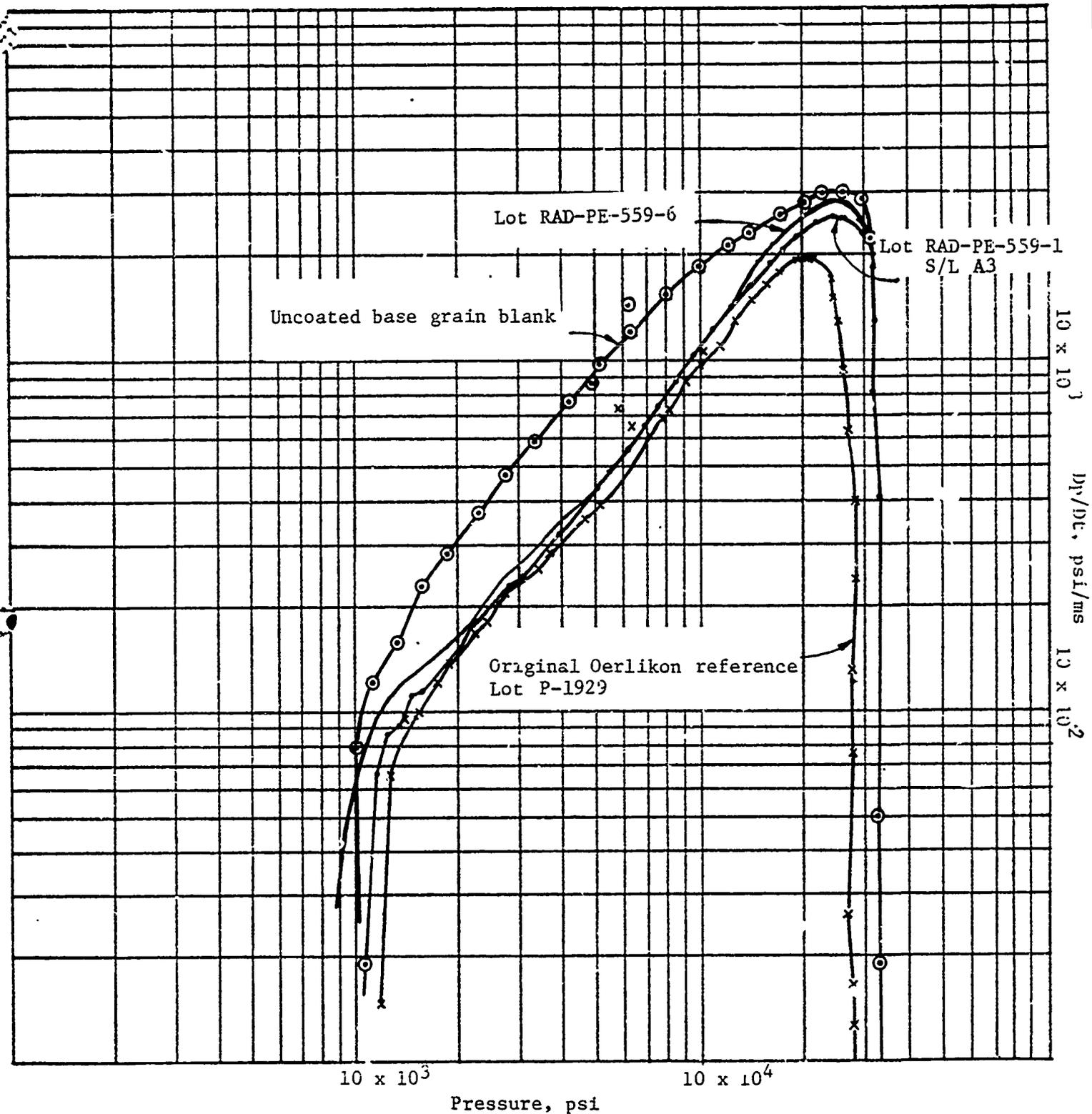


Figure 3. Closed bomb traces of HEI-T pilot and production lots compared with uncoated base grain blank and the original Oerlikon reference lot P-1929 (loading density 0.2 g/cm^3 , 200 cm closed bomb 90°F testing temp).

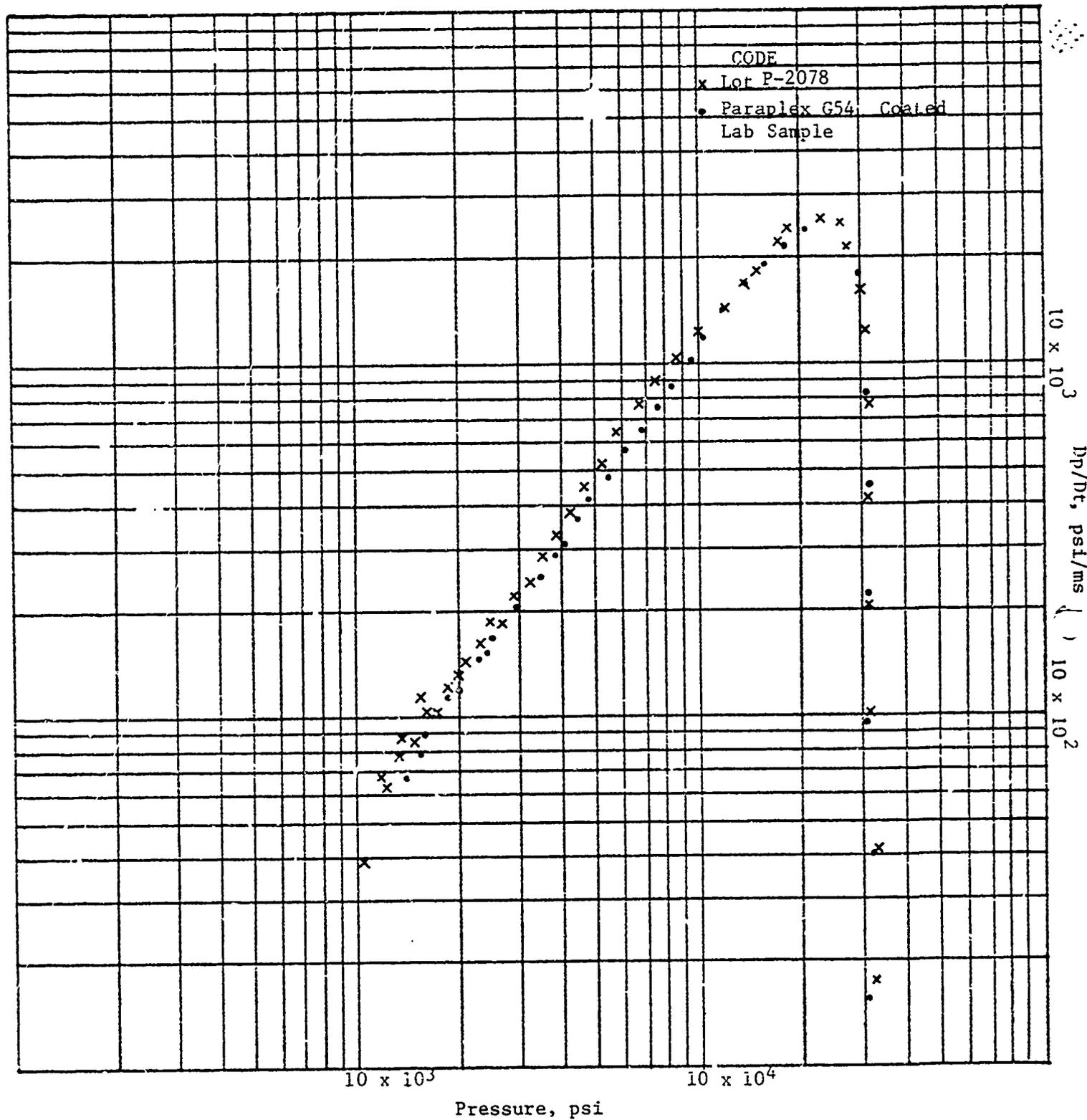


Figure 4. Closed bomb traces (200 cm^3 bomb, 0.2 g/cm^3 loading density and 90°F) showing close relationship between Paraplex G54 coated laboratory sample and original reference lot.

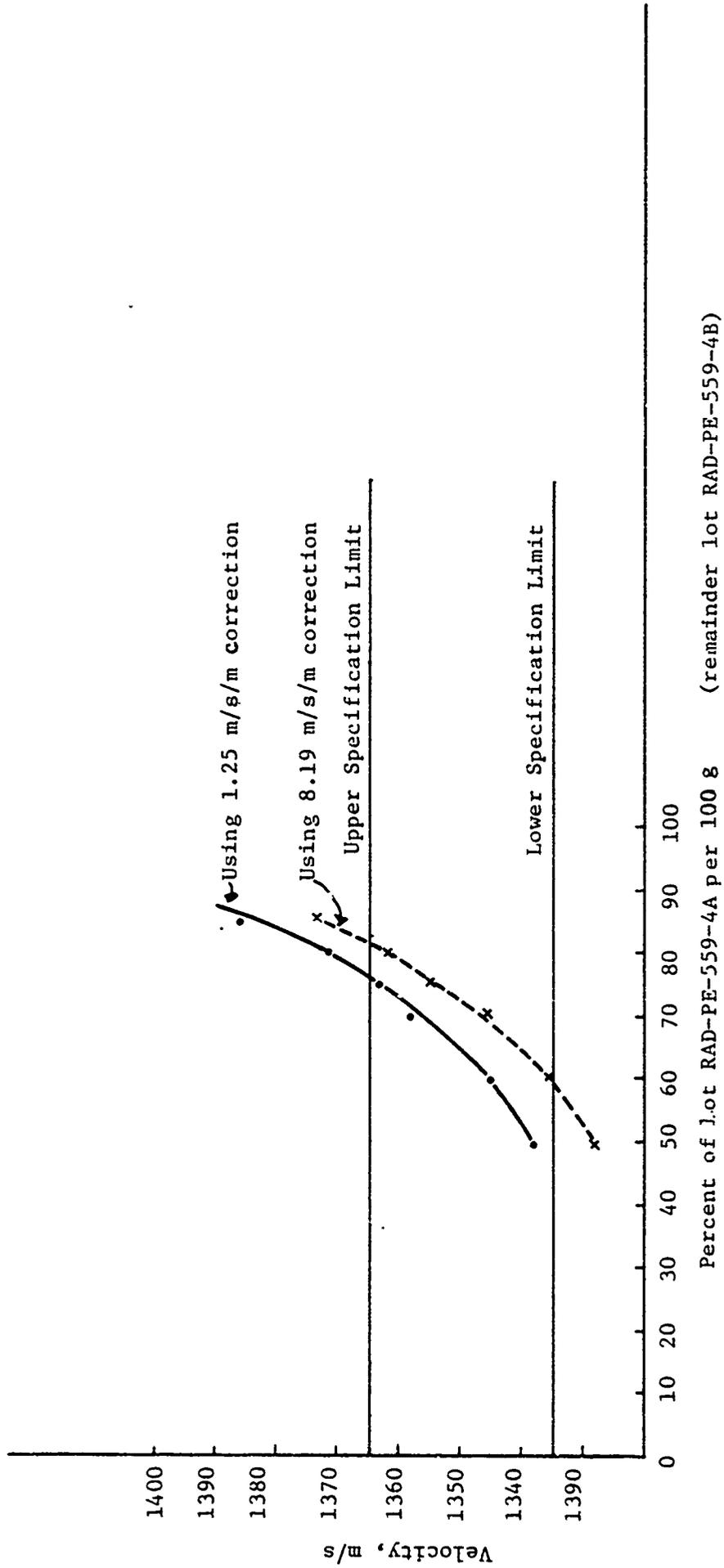


Figure 5. Effect on velocity of blending high and low quickness lots RAD-PE-559-4A and 4B at 100-gram charge weights.

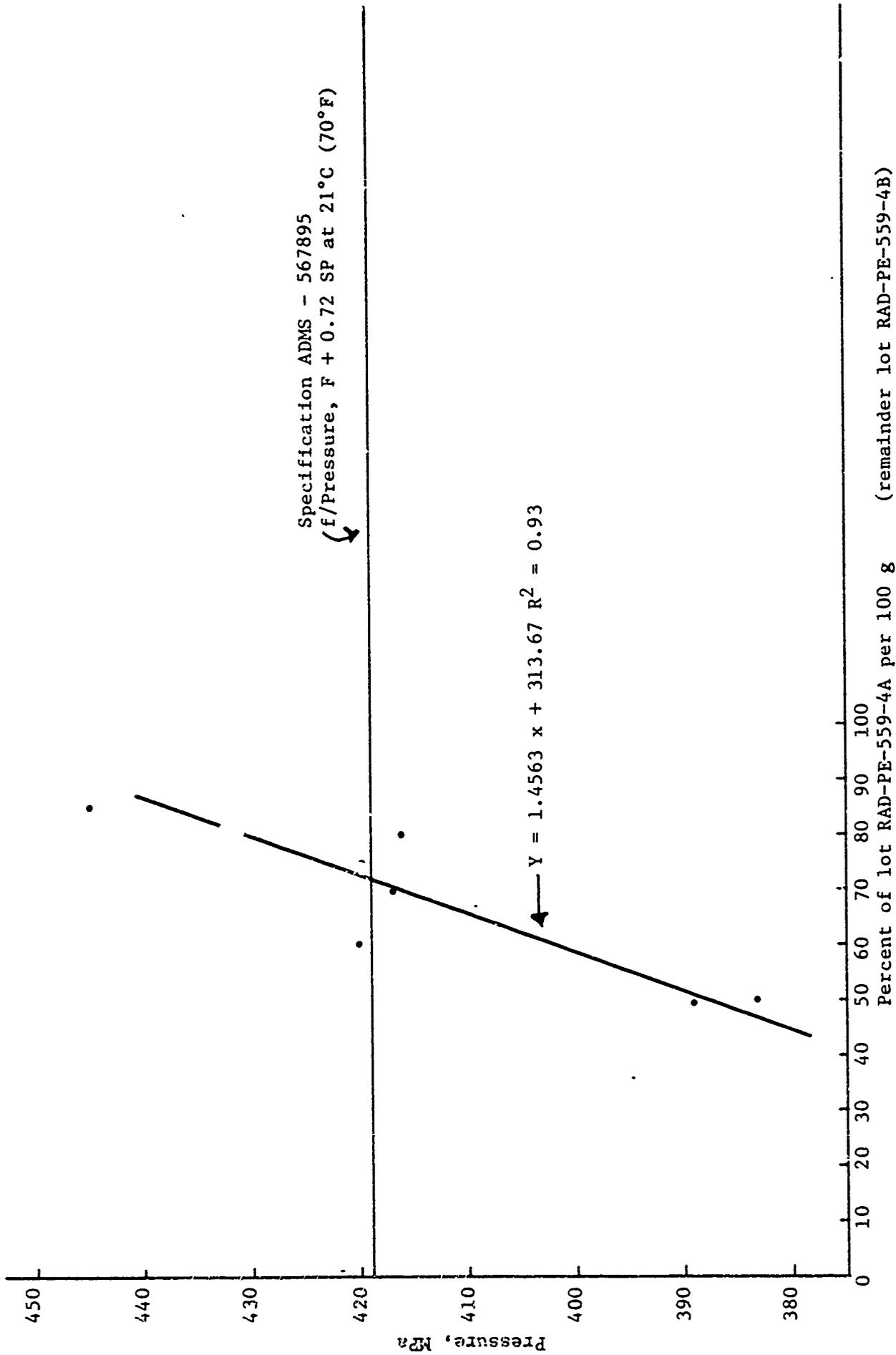


Figure 6. Effects on pressure of blending high and low quickness lots RAD-PE-559-4A and 4B at 100-gram charge weights.

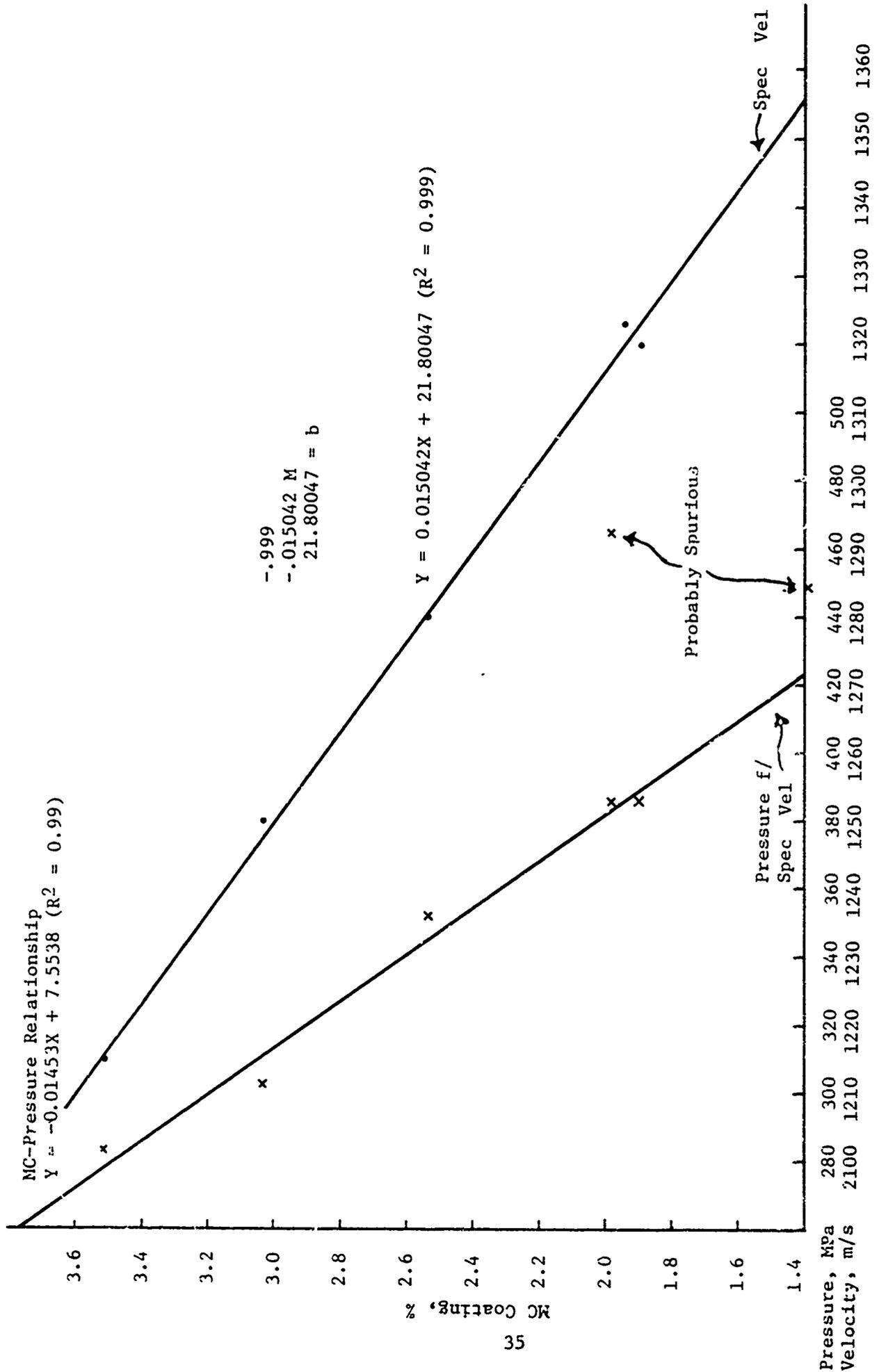


Figure 7. Methyl centralite and 21°C (70°F) velocity and pressure relationships for 132-gram APDS-T projectiles with 12 m/s/m velocity corrections for lots RAD-PE-559-5A, B, C, E, and 7.

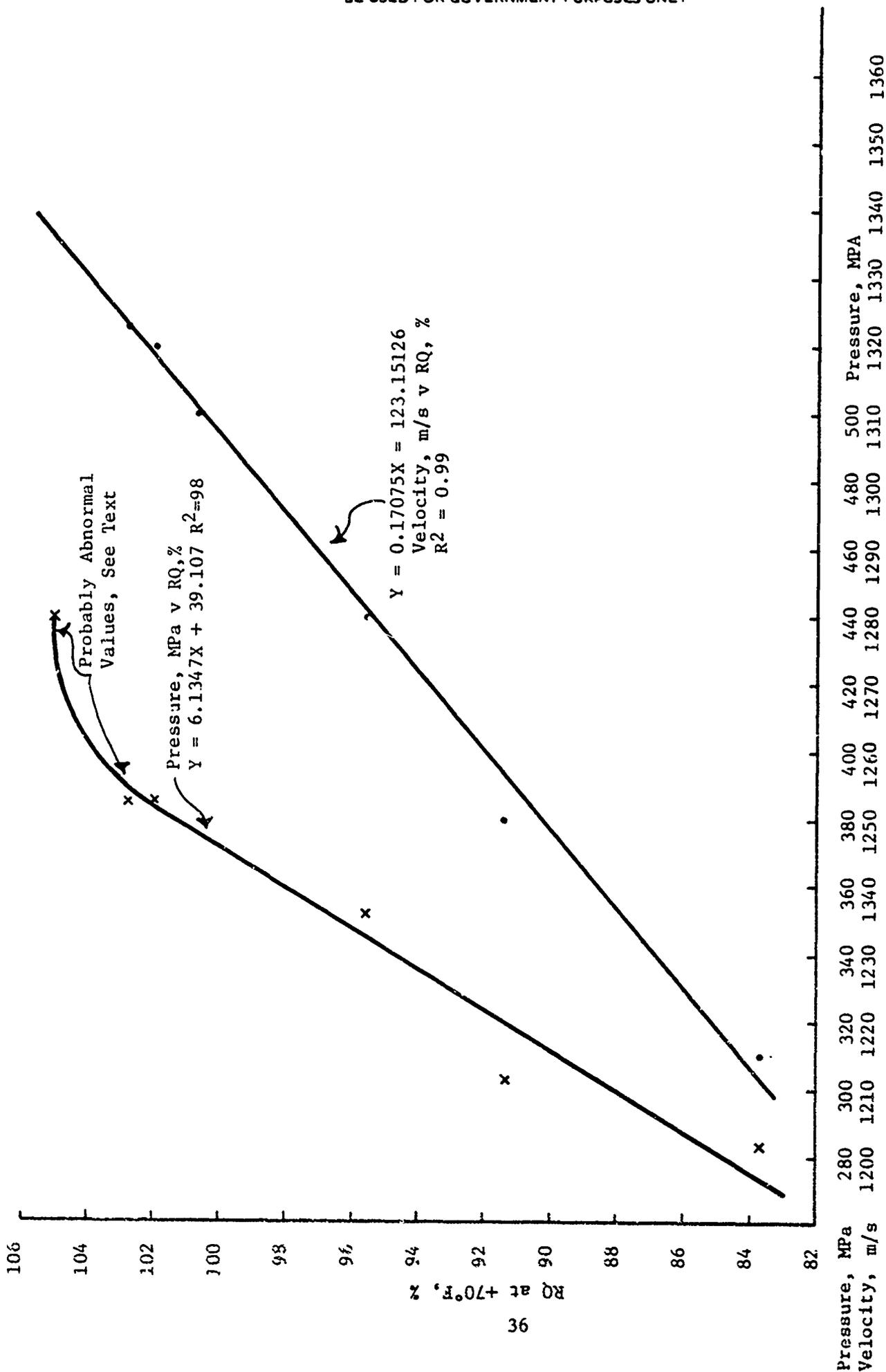


Figure 8. Relative quickness at 21°C (70°F) and velocity and pressure relationships for 132-gram APDS projectiles with 12 m/s/m velocity corrections for lots RAD-PE-559-5A, B, C, E, and 7.

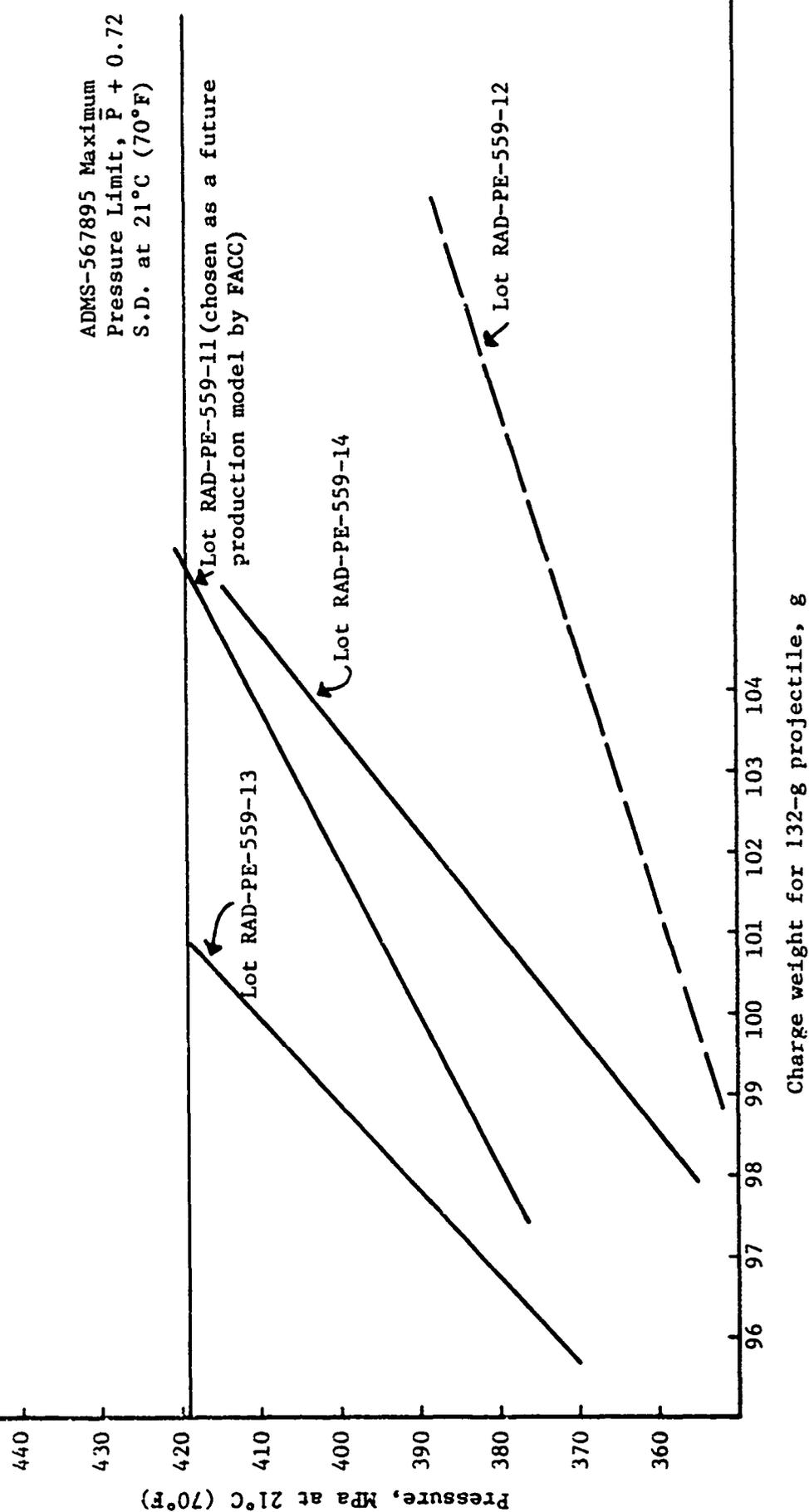


Figure 9. First tests made at RAAP on 25-mm pilot lots

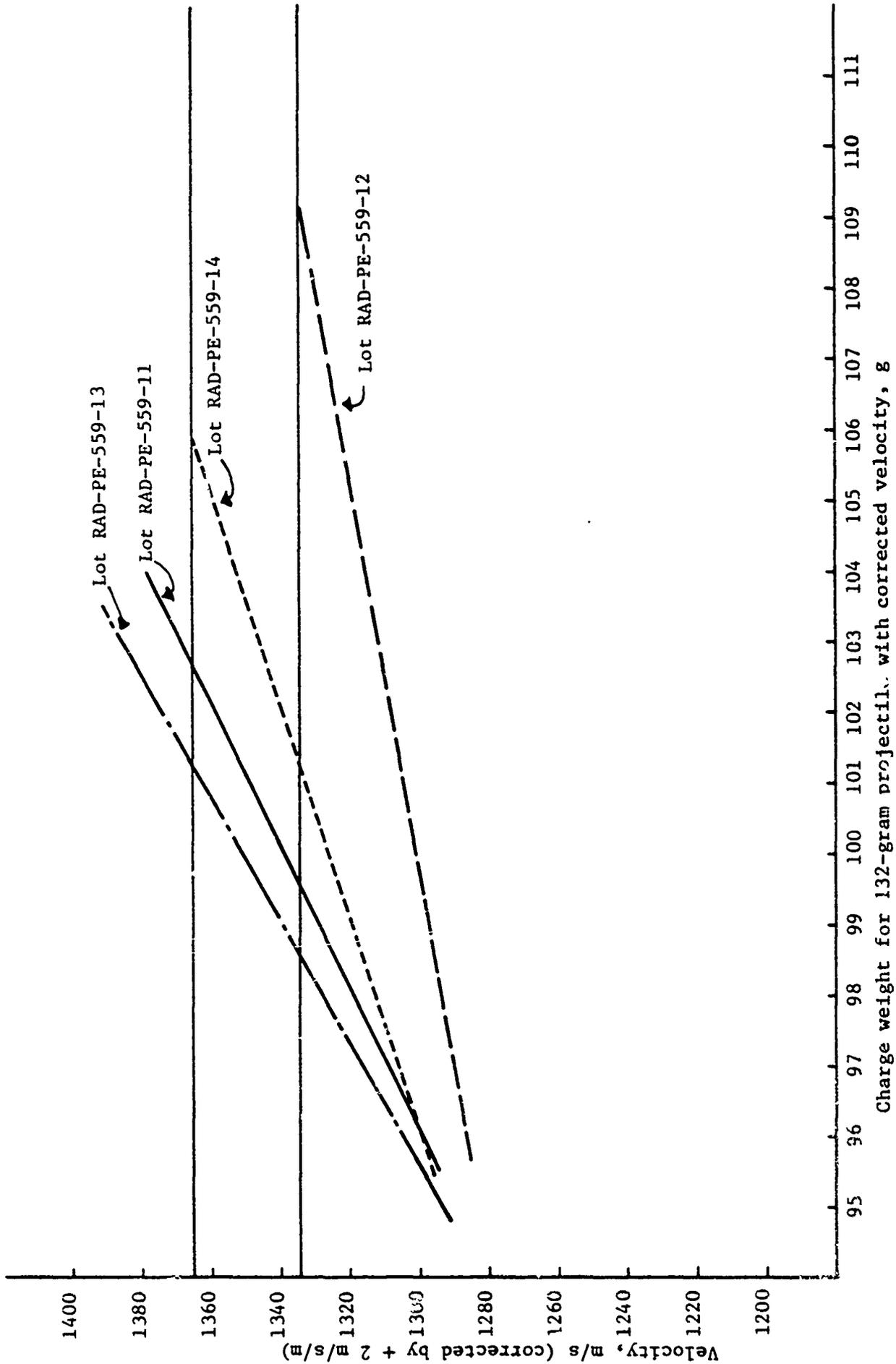
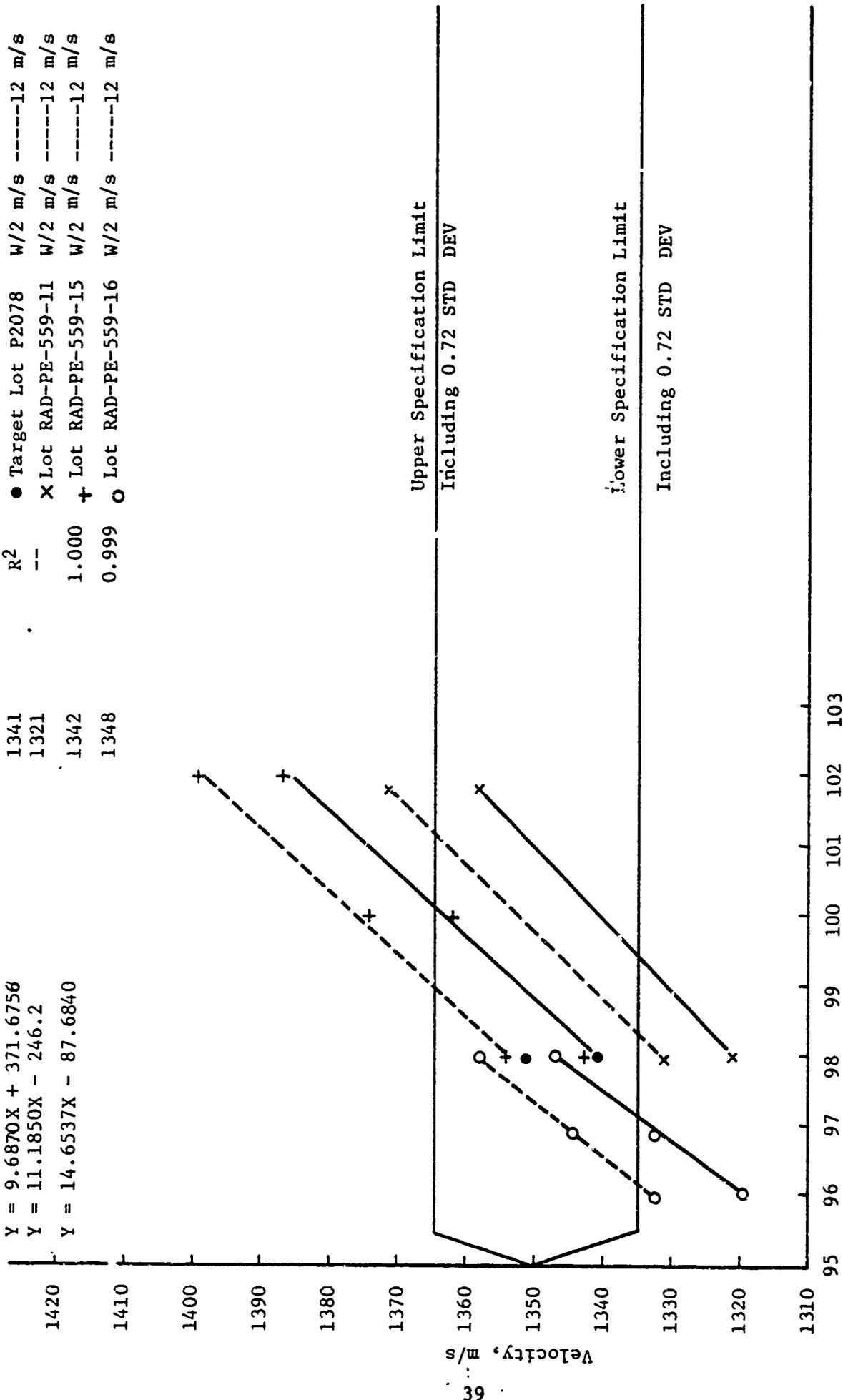


Figure 10. First tests made on 25-mm pilot lots at RAAP at 21°C (70°F)

RAAP Gun Tests of Development Lots RAD-PE-559-11, 15, & 16

Velocity, m/s	198-g chg	R ²	Target Lot	With Correction of
1341	1341	---	● Target Lot P2078	W/2 m/s -----12 m/s
1321	1321	---	× Lot RAD-PE-559-11	W/2 m/s -----12 m/s
1342	1342	1.000	+ Lot RAD-PE-559-15	W/2 m/s -----12 m/s
1348	1348	0.999	○ Lot RAD-PE-559-16	W/2 m/s -----12 m/s

$Y = 9.6870X + 371.6756$
 $Y = 11.1850X - 246.2$
 $Y = 14.6537X - 87.6840$



Charge weight for 132-gram projectile, g

Figure 11. Velocity - charge weight relationship for RAAP gun tests

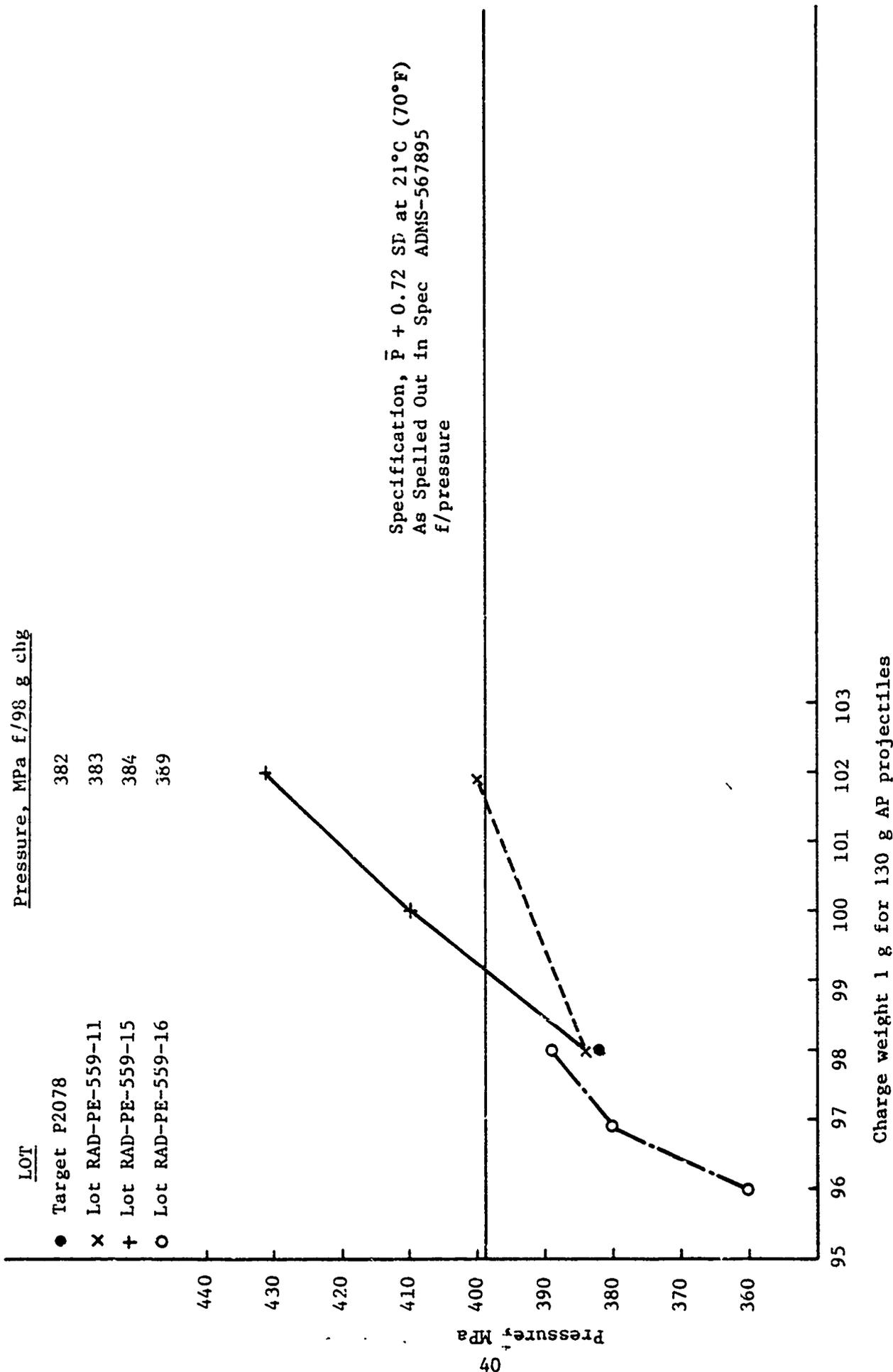


Figure 12. Pressure - charge weight relationship for RAAP gun tests

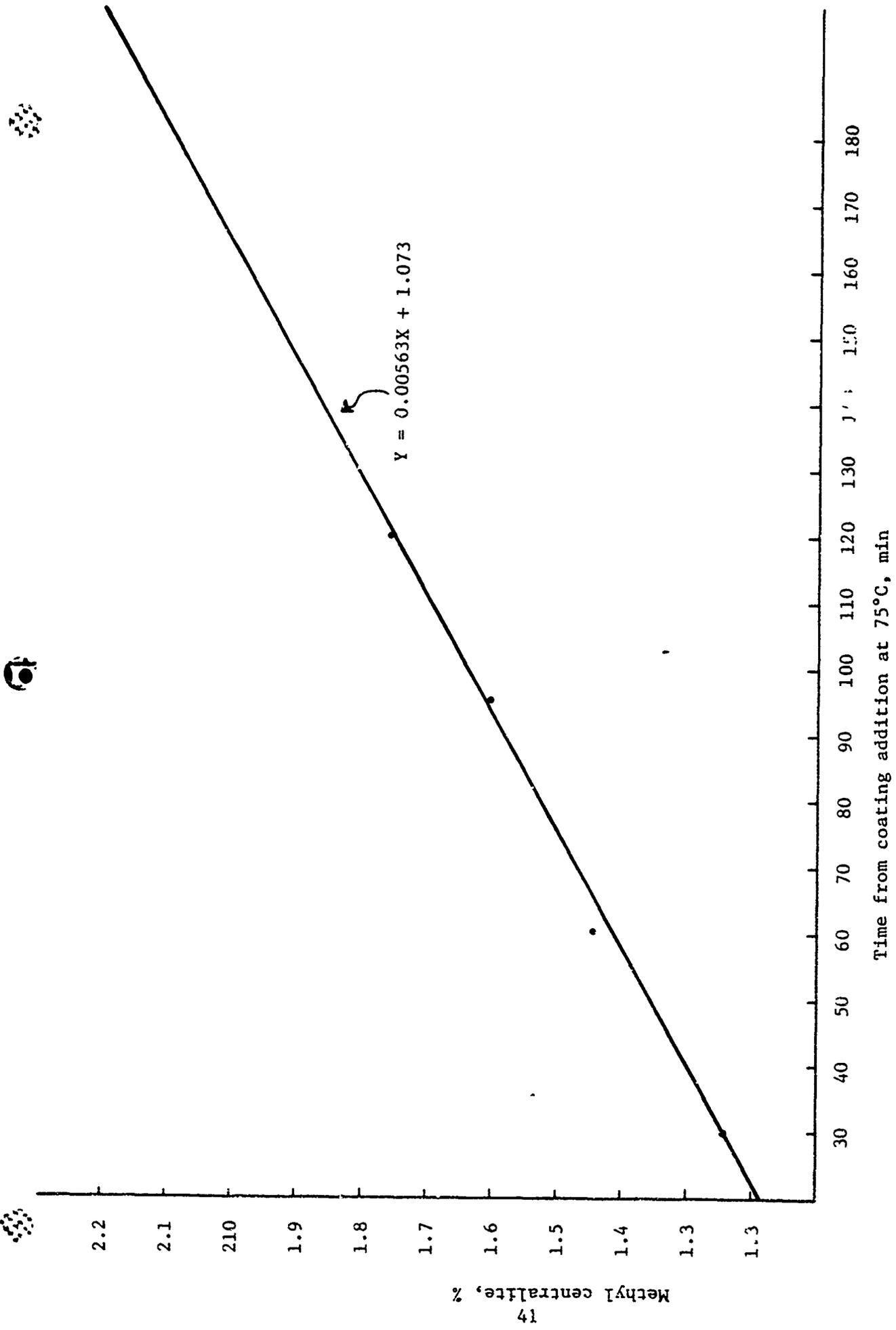


Figure 13. Relationship between coating cycle time and percent of methyl centralite applied

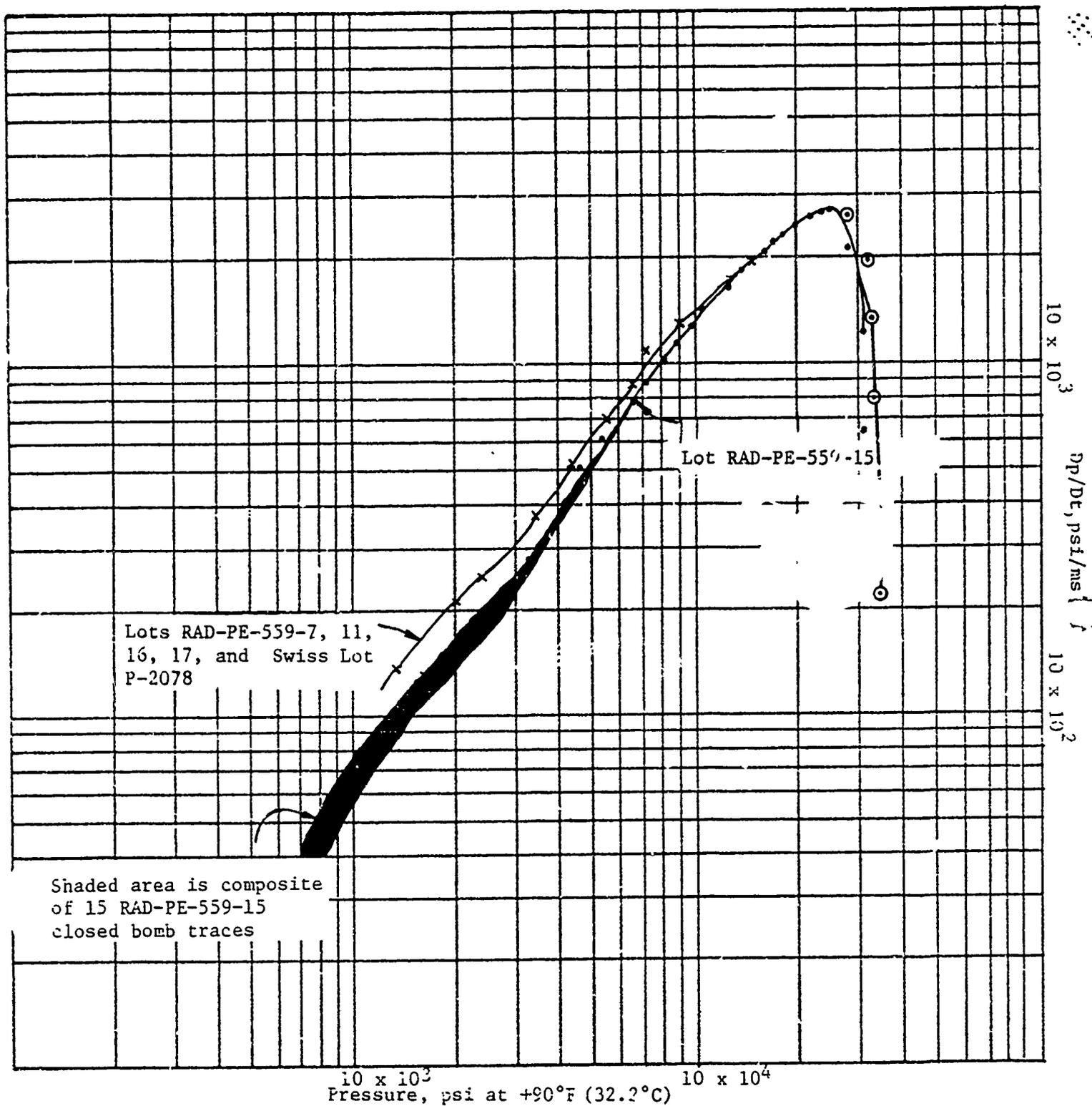


Figure 14. Closed bomb Dp/Dt versus P traces of Lots RAD-PE-559-15 compared with lots RAD-PE-559-11, 16, and 17 and Swiss lot P-2078.

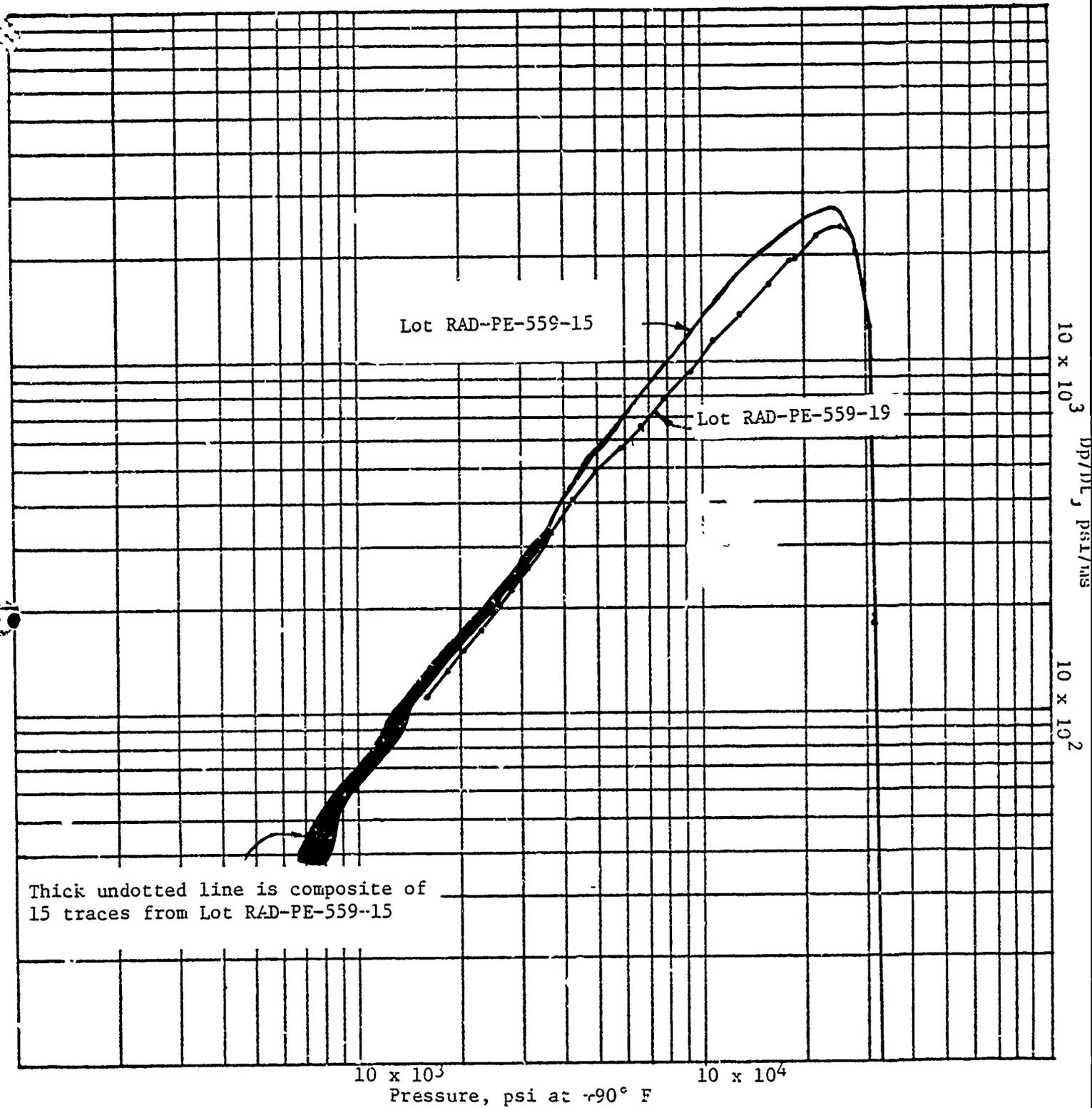


Figure 15. Comparison of Lot RAD-PE-559-15 with dual-coated (MC and DNT) lot RAD-PE-559-19.

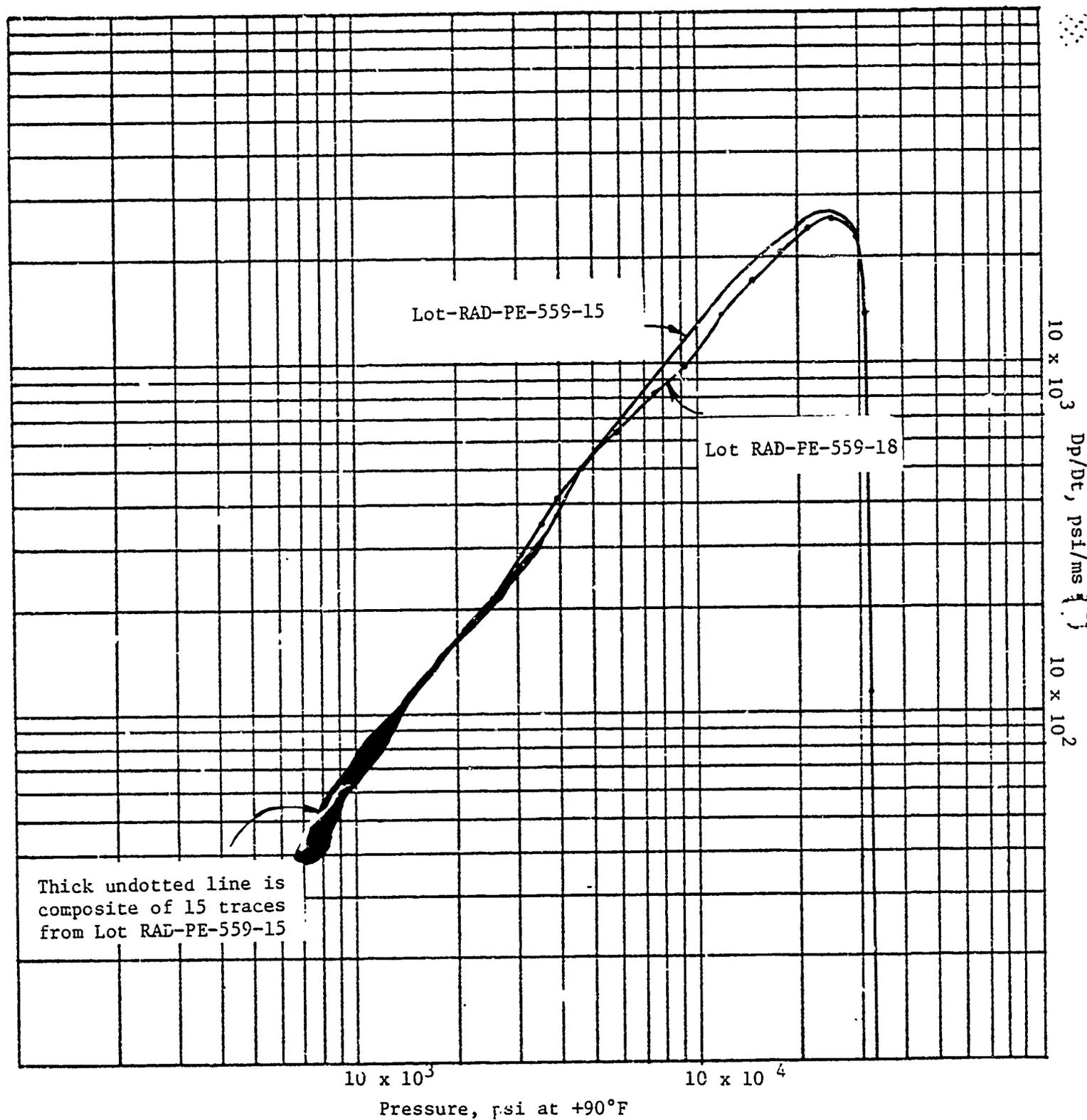


Figure 16. Comparison of lot RAD-PE-559-15 with dual-coated (MC and DNT) lot RAD-PE- 559-18

APPENDIX A
SPECIFICATIONS

- A-1. Propellant Requirements for Single-Base, Single Perforated,
Methyl Centralite Coated CR B 325, RSA-1
- A-2 Propellant Requirements for the AP-T and HEI-T
Rounds and Modifications of Scope of Work
- A-3 Special Request Order of Propellant Manufacture
- A-4 Product Specification for 25-mm APDS-T Propellant
- A-5 Product Specification for 25-mm Cartridge, APDS-T,
M791

APPENDIX A-1

Propellant Requirements for Single-Base, Single Perforated, Methyl
Centralite Coated CR B 325, RSA-1

Propellant Chemical and Physical Requirements (1)

Nitrocellulose, SPEC MIL-N-244 %	Remainder
Nitrogen in Nitrocellulose %	13.15 \pm 0.05
Diphenylamine, SPEC MIL-D-98 %	0.50 to 1.25
Graphite, SPEC MIL-G-135 (max) %	0.40
Methyl Centralite, SPEC MIL-M-19719 %	3 min
Potassium Sulfate, SPEC MIL-P-193 %	0.10 to 1.00
Total Volatiles (max) %	2.35
Moisture and Volatiles %	1.00 \pm 0.25
Residual Solvents (max) %	1.10
Hydroscopicity(max) %	1.80
Heat Test 134.5°C	
A. Discoloration-minutes to salmon pink	40
B. Explosion Hours	5
Dust and Foreign Matter (max) %	0.10
Bulk Density, g/cc	0.90 to 1.050
Dimensions - In.	
Mean Length (L)	0.073 to 0.085
Mean Diameter (D)	0.060 to 0.066
Mean Diameter of Perforations (d)	0.006 to 0.010
Mean WEB (W)	0.025 to 0.030

(1) Military Standard 286 Applies

APPENDIX A-2

Propellant Requirements for the AP-T and HEI-T
Rounds and Modifications of Scope of Work

1. Propellant Description

The propellant requirements for the AP-T and HEI-T rounds are as follows:

	<u>HEI-T</u>	<u>7 HP Single Base AP-T</u>
Projectile Weight (grams)	187	132
Available Chamber Volume (cm ³)	92.2	98
Projectile Travel (mm)	1867	1867
Nominal Bore Diameter (mm)	25	25
Shot Start Pressure (psi)	3,000	2,000
Action Time (M-Sec)	< 5	
<u>Interior Ballistics</u>		
Muzzle velocity (fps)	3600 ± 50 (min)	4400 ± 50
Muzzle Pressure (psi)	6000 (max)	5000 (max)
Peak Chamber Pressure ()	56.6 (ambient)	56.6 (ambient)
Barrel Travel Time (ms)	3.0	3.0

Propellant Characteristics

Max. Isochoric Flame Temperature	2800	2800
Mass Impetus ($\frac{\text{Ft Lb}}{\text{Lb}}$)	330,000	330,000

A common ignition system will be provided for both the rounds. Initially, the ignition system for both these rounds will be the M15 primer with approximately 1.3 grains Class 6 black powder booster. An improved ignition system is being developed and will be provided when available.

2. Quantities

Samples of propellants for both these rounds will be screened at the propellant plant and then shipped to Aeronutronic for evaluation in standard test gun using standard propellant for comparison.

A gun will be provided to the propellant manufacturer for development testing. Final ballistics evaluation of propellant will be done at Aeronutronic test facilities.

It is estimated that six samples of each of the two types of propellant will be required for preliminary evaluation. Size of these samples required is approximately 6-10 pounds each.

Aeronutronic will supply standard components with a prime booster system common to both the AP and HE-I rounds.

Larger quantities of the candidate propellant (1000 lb lots) will be required for propellant characterization. It is estimated that approximately 16,000 rounds will be evaluated at the Aeronutronic test facility.

The entire program calls for 750,000 rounds.

Time Frame

A copy of the ammunition schedule is attached. The propellant development program will start in January 1976 and will be completed in June 1976.

A total of 75,000 rounds are to be delivered in February 1977. These are broken down as follows:

TP Rounds	50,000
HEI-T - 12,500	25,000
TP-T - 12,500	
	<hr/>
	75,000 rounds

APPENDIX A-3
Special Request Order of Propellant Manufacture
DEPARTMENT OF THE ARMY
RADFORD AMMUNITION PLANT
RADFORD, VIRGINIA 24141

10 NOV 1977

SARRA-EN

Manager
Hercules Incorporated
Radford Army Ammunition Plant
Radford, Virginia 24141

Dear Sir:

Reference is made to a meeting held at this installation on 2 November 1977, concerning the 25mm Bushmaster Work Program (PE-559).

Within funds available under PE-559, Propellant for 25mm Bushmaster, authority is granted to produce the following propellant lots:

<u>Pounds</u>	<u>L/D</u>	<u>MC Coating, * percent</u>
a. 2000	1.1	(a) 1000 lbs, 2.30% (b) 1000 lbs, 1.70%
b. 2000	1.3	(c) 1000 lbs to be determined (d) 1000 lbs > at a later date

* Select final (a) and (b), and (c) and (d) from preliminary coating and firing (Mann Gun) and closed bomb (a) and (b) to be blendable.

The following process changes from lots PE-559-7 and PE-559-8 apply:

- a. K_2SO_4 reduced to 0.50 percent.
- b. Nitrogen content high side of spec. N_2 (13.20%).
- c. Water Dry adjustment.

Sincerely yours,

CHARLES E. FLYNN
Contracting Officer's
Representative

4-29-76

MODIFICATION OF SCOPE OF WORK

BUSHMASTER

PE-559

1. Change from methyl centralite which is not available in U.S.

Try other coatings. Suggest we try EDM, Paraplex, ethyl centralite.

Send 10 lb samples of promising candidates to Aeronutronic Ford for evaluation.
2. Coat 900+ lbs, Lot A3 (A1 & A2) at 4.75% MC.
3. Discuss need to reduce action time.

Reduce coating level.
4. Coat 200 lbs Lot B3 with 3.90%* MC.
5.
 - a. Try multiple perf grain (7) for AP.
Start with single-base
Make small lot with 7MP similar to Oerlikon dimensions, but with Lot B formula with methyl centralite.
 - b. No objection to double-base if it meets flame temperature requirements.
 - c. No objection to triple-base if nitroguanidine can be obtained in USA (or Canada).
6. Send components.
Send primed cases and projectiles - AP and TP.
Send mod. 'tion to crimper.
7. Send propellants specifications for AP and HEI-TP rounds.

* Analyzed

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
-	LIMITED RELEASE PER EO C33179		

PRELIMINARY ISSUE
SEP 15 1977

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*Now known as Ford Aerospace & Communications Corporation, Aeronutronic Division

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CONTRACT NO. DAAA09-75-C-2048		<p align="center">AERONUTRONIC FORD CORPORATION* AERONUTRONIC DIVISION NEWPORT BEACH, CALIFORNIA 92663</p> <p align="center">PROPELLANT, CARTRIDGE, 25MM, ARMOR PIERCING - TRACED</p>	
PREPARED BY			
CHECKED BY			
RESPONSIBLE ENGINEER		SIZE A	CODE IDENT NO. 09205
		52	ADMS567895 PAGE 1 OF 12

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1. SCOPE

1.1 This specification covers propellant for use in armor piercing-traced (AP-T) 25 millimeter (mm) cartridge (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Government documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-N-244

Nitrocellulose

STANDARDS

Military

MIL-STD-105

Sampling Procedures and Tables
for Inspection by Attributes

MIL-STD-286

Propellants, Solid, Sampling,
Examination and Testing

- MIL-STD-1168

Ammunition Lot Numbering

DRAWINGS

U.S. Army

C9256486

Container, Packing PA 54, Wood With
Metal Liner (Modified M24 Box for
Smokeless Powder)

F7549033

Container, Metal, Universal, M24 for
Propellant and Explosives, Assembly
and Details

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20-4-77	Packing and Marking of Box, Packing for Smokeless Powders
76-4-46	Box, Packing, Metal Liner (Copper), M24, for Smokeless Powders
76-4-56	Box, Packing, Metal-Wood, M17 for Smokeless Powders
8858577	Marking Diagram and Sealing of Container, Metal, Universal, M25 for Shipping of Propellant
8858848	Marking Diagram and Sealing of Metal Lined Wooden Packing Boxes for Shipment of Propellant

OTHER PUBLICATIONS

U.S. Army

AMCR 715-505, Vol. 8	Ammunition Ballistic Acceptance Test Methods
TECP 700-700, Vol. III	Manual of Test Methods for Small Arms Ammunition

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Chemical composition and physical properties. The finished propellant shall comply with the requirements specified herein. Applicable tests for chemical composition and physical properties of the propellant shall be performed in accordance with the procedures set forth in MIL-STD-286.

3.1.1 Composition. The propellant shall be of a conventional single or double base composition.

3.1.2 Nitrocellulose. Nitrocellulose recovered from the rework of propellants or new nitrocellulose with the nitrogen content not fully meeting the requirements of MIL-N-244 may be used in lieu of or in combination with complying nitrocellulose. Propellant so manufactured shall comply with all chemical, physical, and ballistic requirements.

3.1.3 Products of combustion. The products of combustion of the propellant shall not be corrosive to the gun barrel.

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3.1.4 Flame temperature. The propellant shall have an isochoric flame temperature of not greater than 3060 Kelvin (K). The Hirschfelder method of calculation shall be used.

3.1.5 Stability. The propellant shall be stable and compatible with materials it contacts. Stability tests shall be performed in accordance with MIL-STD-286.

3.1.6 Bulk density. The bulk density of this propellant shall be not less than 0.94 grams per cubic centimetre (g/cc).

3.2 Ballistics. The propellant, when loaded into the appropriate test cartridges (see 6.3), shall comply with the ballistic requirements as specified in the following subparagraphs.

3.2.1 Muzzle velocity (V_0). At plus 21.1 plus or minus 1.1 degrees Celsius, the average value of V_0 plus 0.72 standard deviation shall not fall above or below the following when using a 132 gram (g) Armor Piercing Practice (APP) projectile (see 6.3).

$$\bar{V}_0 + 0.72 S \leq 1356 \text{ metres per second (m/s)}$$

$$\bar{V}_0 - 0.72 S \leq 1326 \text{ m/s}$$

The standard deviation of the group shall not exceed 10 m/s. A correction factor of 1.25 m/s per metre for the APP projectile shall be applied to the recorded velocity at the measured range to obtain initial V_0 . A total of 20 shots each shall be fired during lot acceptance at minus 53.9 degrees C, plus 21.1 degrees C, and plus 71.1 degrees C.

3.2.2 Pressure.

3.2.2.1 Chamber. Simultaneously with the muzzle velocity measurements (see 3.2.1), the chamber pressure shall be measured with a Kistler Model 607B pressure transducer (or equal). Prior to pressure measurement, the sample cartridges shall be conditioned at minus 53.9 degrees C, plus 21.1 degrees C, and plus 71.1 degrees C. The maximum average pressure (\bar{P}_{max}) values obtained from 20 firings at each temperature shall satisfy the following:

$$+21.1 \text{ degrees C: } \bar{P} + 0.72 S \leq 4079 \text{ kg/cm}^2$$

$$\bar{P} + 5.14 S \leq 5062 \text{ kg/cm}^2$$

$$-53.9 \text{ degrees C: } \bar{P} + 5.14 S \leq 5062 \text{ kg/cm}^2$$

$$+71.1 \text{ degrees C: } \bar{P} + 5.14 S \leq 5062 \text{ kg/cm}^2$$

3.2.2.2 Muzzle. The muzzle pressure obtained with test cartridge shall not exceed 458 kilograms per centimetre squared (kg/cm^2) at plus 21.1 plus or minus 1.1 degrees C.

3.2.3 Action time. The maximum action time (from primer contact to bullet-barrel exit time) in milliseconds (ms) shall not exceed 6.0 ms at any cartridge temperature from minus 53.9 to plus 71.1 degrees C.

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3.2.4 Smoke and flash. The smoke and flash produced by test cartridges shall not exceed the smoke and flash produced by reference cartridges (see 6.2). This requirement applies to single shot firings and Bushmaster automatic gun firings through full rate.

3.2.5 Fouling. The test cartridges shall not produce fouling of the barrel, barrel bearings, muzzle attachments, ports or gas cylinders of the Bushmaster weapon to the extent that it will impair or prevent the normal functioning of the weapon.

3.2.6 Barrel erosion. The test cartridges shall not cause the average life per barrel to be less than with reference rounds. The barrel life shall be considered as having ended when the average velocity of an individual burst in the test drops 61 m/s or more with respect to that of the initial burst or when the bullets from 20 percent or more of the cartridges in any burst show keyholing which is defined as yaw exceeding 15 degrees at 25 metre range, whichever occurs first.

3.2.7 Air space. A minimum air space of zero linear inches shall be obtained when tested in accordance with the applicable procedure of MIL-STD-286.

3.2.8 Extreme temperature. The average muzzle velocity (see 3.2.1) and chamber pressure (see 3.2.2.1) of test cartridges subjected to specified temperature conditions (see table I) shall not vary from the average muzzle velocity and chamber pressure of similar test cartridges conditioned and fired at plus 21.1 plus or minus 1.1 degrees C by more than the amounts indicated in table I.

Table I. Characteristics variations at extreme temperatures

Condition	Variation in average velocity (m/s)	Variation in average chamber pressure (kg/cm ²)
Stored at +71.1° +1.1°C for 4 hours and fired at that temperature	+61, -30	+705, -141
Stored at -53.9° +2.8°C not less than 6 hours and fired at that temperature	+46, -76	+141, -705

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in

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the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the procuring activity. The procuring activity reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Quality assurance terms and definitions. Reference shall be made to MIL-STD-109 to define quality assurance terms used.

4.2 First-article sample. After inspection at source in accordance with the production lot acceptance tests for the first lot as cited in table II (acceptability shall be based on results of initial tests only, second tests are not permitted), a quantity of the first acceptable production lot (as prescribed by the procuring activity) shall be submitted to a procuring activity approved facility for first-article testing. The first production lot shall have been manufactured in the same manner, with the same materials, equipment, processes, and procedures as will be used in subsequent production lots and shall be packed in accordance with the contract or order. The first-article sample shall be inspected at a procuring activity approved facility for all the applicable requirements of the drawings and specifications.

4.2.1 First-article sample failure. Failure of the sample to comply with requirements of the drawings and specifications shall result in sample disapproval. Determination as to acceptability of any first-article sample shall be based upon result of initial tests only, and no second tests shall be permitted on that first-article sample. In the event of first-article failure, disposition of the first production lot shall be determined by the procuring activity.

4.3 Inspection provisions. In all chemical, physical, and ballistic testing, the use of the equipment specified and the methods of test prescribed in this specification and other documents referenced therein shall be mandatory.

4.3.1 Lot.

4.3.1.1 Submission of product. The product shall be submitted in accordance with MIL-STD-105.

4.3.1.2 Size of lot. The propellant lot size shall be as agreed upon between the supplier and the contracting officer, provided the formation of the lot is in accordance with MIL-STD-105.

4.3.1.3 Lot identification. Each lot of propellant shall be identified with a lot number in accordance with MIL-STD-1168.

4.3.2 Sampling. Random representative samples shall be taken by random selection of one container from each identifiable increment of the lot. A random sample of five containers shall be selected from these representative samples. From each container selected, a sample shall be taken such that aggregate quantity shall be sufficient for the required chemical, physical, ballistic, and ballistic uniformity tests. These samples shall be poured into

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Table II. Conditioning and testing by lots

Conditioning requirements by characteristics				Testing requirements by lots			
Characteristics	Conditioned and fired at temperatures (a)			First article sample tests (c)	Production lot acceptance tests		
	-53.9°C	+21.1°C	+71.1°C		First lot	Second to fifth lot	Sixth lot on
Chemical composition and physical properties				X (d)	X	X	X (b)
Muzzle velocity	X	X	X	X	X	X	X
Chamber pressure	X	X	X	X	X	X	X
Muzzle pressure		X		X	X	X	X
Action time	X	X		X	X	X	X
Smoke		X		X			
Flash		X		X			
Fouling		X		X			
Velocity uniformity		X		X	X	X	X
Barrel erosion		X		X			
Air space		X		X	X	X	X

NOTES: (a) Cartridge cases for pressure test to be drilled prior to being stored at specified temperature.
 (b) Except hygroscopicity.
 (c) First-article sample tests are performed by the procuring activity.
 (d) Squares marked "X" indicate conditioning/testing to be performed.

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clean containers, immediately closed with a hermetically tight seal and identified as "Representative Sample" with a label showing the container number from which the sample was taken, the lot number, propellant nomenclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. Prior to conducting lot acceptance tests, these samples shall be permitted to attain room temperature, then equal portions sufficient to make the required quantity of a composite sample shall be taken from each "Representative Sample" and blended. This composite sample shall be placed in two separate containers, immediately closed with a hermetically tight seal and identified respectively as "Chemical Sample" and "Ballistic Sample". These containers shall be further identified by the container numbers from which the composite sample was taken, the lot number, propellant nomenclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. The balance of the propellant remaining in each of the "Representative Samples" shall be used to perform the velocity uniformity test.

4.3.3 Tests. The following tests shall be performed in accordance with the provisions of 4.4.

4.3.3.1 Chemical composition and physical properties. The sample quantity of propellant to be tested for the chemical composition and physical properties requirements specified herein shall be as prescribed in MIL-STD-286. In the event of failure of the sample to comply with the requirements of 3.1, the procedure of note (a) of table III shall apply.

4.3.3.2 Ballistics. The ballistic tests shall be made in accordance with table II to determine compliance with the requirements of the cartridge (with 132g APP projectile) for which the propellant is intended. The "Ballistic Sample" shall be subjected to all of the tests prescribed in table III.

4.3.3.2.1 Velocity uniformity. Cartridges loaded with each of the "Representative Samples" shall be tested for velocity uniformity. These tests shall be conducted only at ambient conditions. Ten rounds from each of the "Representative Samples" shall be loaded at the same charge weight established for the "Ballistic Sample". The velocity shall be averaged for each 10-round test and the standard deviation determined. Criteria for "Ballistic Sample" charge establishment velocity, variation of "Representative Sample" velocity from that of "Ballistic Sample" and standard deviations for "Representative Sample" velocity.

- a. "Ballistic Sample" and "Representative Sample" muzzle velocity of 1341 m/s ($\bar{V}_0 + 0.72 S \leq 1356$ m/s, $\bar{V}_0 - 0.72 S \geq 1326$ m/s).
- b. "Representative Sample" and "Ballistic Sample" muzzle velocity standard deviation shall be less than or equal to 10 m/s.

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Table III. Ballistic sample tests

Test	Requirement paragraph
Muzzle velocity	3.2.1
Pressure	3.2.2
Action time	3.2.3
Smoke and flash	3.2.4
Fouling	3.2.5
Barrel erosion	3.2.6
Air space	3.2.7
Extreme temperature	3.2.8
Velocity uniformity	3.2.1

NOTES:

- (a) Failure of the propellant to comply with the requirements of 3.1 or 3.2 shall be cause for rejection of the lot subject to testing of a second sample for the characteristic(s) in which failure occurred. The second test shall be made using the original sample, provided sufficient propellant remains. If additional propellant should be required, it shall be taken from the same boxes of propellant from which the initial "Representative Samples" were obtained. Failure of the second sample to comply with the requirements of the characteristic(s) under test shall be cause for rejection of the lot. The above provisions for testing of a second sample shall apply to the second and subsequent production lots. Accept/reject decision for first production lot and first article sample shall be based upon results of initial test only, and no second tests shall be permitted.
- (b) Velocity and pressure may be fired either separately or simultaneously, as prescribed in the appropriate inspection equipment list.
- (c) Performed by the procuring activity only.

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Failure of the propellant to comply with the criteria of the uniformity test shall be cause for rejection of the lot subject to testing of a second sample. The second test shall be made using propellant from the original container in which sample failure occurred in the initial test. The second sample shall consist of 20 rounds. The criteria shall remain the same. Failure of the second sample to comply with the criteria of the uniformity test shall be cause for rejection of the lot.

4.3.3.3 Packing and marking inspection. Inspection of packing and marking to determine compliance with the requirements of 5.1 and 5.2 shall be as prescribed by the procuring activity (see 6.2).

4.3.4 Inspection equipment. All tests shall be made using equipment listed on the applicable inspection equipment list.

4.4 Test methods and procedure.

4.4.1 Chemical composition and physical properties. The applicable tests shall be performed in accordance with the procedures set forth in MIL-STD-286.

4.4.2 Ballistics. Ballistic tests listed in 4.3.3.2 shall be performed in accordance with AMCR 715-505 or TECP 700-700, as applicable, and methods developed specifically for the 25mm cartridge and the following.

4.4.2.1 Loading of test cartridges. The propellant sample selected in accordance with 4.3.2 shall be used to load test cartridges (see 6.3) with the charge weight established to obtain the specified average corrected velocity. When once established for a particular propellant lot, this charge weight may not be varied while the same lot is being tested. The test cartridges to be used for any velocity and pressure tests shall be loaded by a method capable of maintaining propellant charge weight uniformity ± 0.1 g.

4.4.2.2 Extreme temperature. The test cartridges shall be conditioned and fired as indicated in table II and 3.2.8. Characteristic(s) applicable to the cartridge under test shall be tested in accordance with 4.4.2.

5. PREPARATION FOR DELIVERY

5.1 Packing.

5.1.1 Level A (worldwide shipment and/or long term storage). Unless otherwise specified by the contracting officer (see 6.2), the propellant shall be packed in clean airtight containers conforming to Drawings 76-4-46, 76-4-56, F7549033, or C9256486.

ADMS 567895

5.1.1.1 Container integrity verification. Immediately prior to packing, containers listed in 5.1.1 shall be subjected to an internal pressure of 0.5 to 1.0 pounds per square inch (psi) by a method satisfactory to the procuring activity. A water manometer shall be assembled in the system. A drop of 0.7 inch or more on the manometer in 15 seconds shall be cause for rejection and the container removed from the lot.

5.1.2 Level B. Packing shall be as specified in 5.1.1.

5.1.3 Level C (CONUS shipment and/or short term storage). Unless otherwise specified by the procuring activity, the propellant shall be packed in standard commercial containers acceptable by common or other carrier for safe transportation to the point of delivery, at the lowest cost.

5.2 Marking.

5.2.1 Levels A and B. The containers shall be sealed and marked in accordance with Drawings 20-4-77, 8858577, or 8858848. Markings shall also include the date of manufacture of propellant (month and year).

5.2.2 Level C. Containers shall be marked on the top and side with the same markings as required for the top and side of the box shown on Drawing 8858848. Markings shall also include the date of manufacture of propellant (month and year).

5.2.3 Special marking. All packed containers (level A, B, or C) shall have a printed label affixed to the side with the following information:

NOTICE

AFTER FIVE YEARS FROM DATE OF MANUFACTURE, APPROVAL BY THE RESPONSIBLE ENGINEERING AGENCY IS REQUIRED PRIOR TO THE LOADING OF THIS PROPELLANT INTO SMALL ARMS AMMUNITION.

5.3 Palletization. All level A shipments shall be palletized in accordance with instructions furnished by the procuring activity. Palletization is not required for level B or C shipments.

6. NOTES

6.1 Intended use. Propellants procured under this specification are intended to be used in ammunition for the 25mm Bushmaster weapon.

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6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. Applicable technical data package.
- c. Provisions for the supply of the following, when applicable:
 - (1) Test equipment.
 - (2) Production cartridges.
 - (3) Production components.
 - (4) Reference cartridges.
 - (5) Reference propellant.
- d. Applicable packing container (see 5.1).
- e. Whether inspection of packing and marking is required and, if so, pertinent details (see 4.3.3.3).
- f. Provision for the submission of acceptance inspection reports containing propellant description sheets and ballistic acceptance test results for each lot of propellant presented to the procuring activity.

6.3 Definition of appropriate test cartridge. The appropriate test cartridge for all propellant acceptance tests shall be the same caliber, type, and model for which the propellant is intended and shall be assembled from components manufactured under production conditions as follows:

- a. Propellant under test.
- b. Primed cartridge case.
- c. Projectile as applicable.
- d. Case-to-projectile crimp to meet required bullet pull levels.

The test cartridge shall also be waterproofed and crimped as specified on the appropriate cartridge drawing.

APPENDIX A-3
Special Request Order of Propellant Manufacture
DEPARTMENT OF THE ARMY
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA 24141

10 NOV 1977

SARRA-EN

Manager
Hercules Incorporated
Radford Army Ammunition Plant
Radford, Virginia 24141

Dear Sir:

Reference is made to a meeting held at this installation on 2 November 1977, concerning the 25mm Bushmaster Work Program (PE-559).

Within funds available under PE-559, Propellant for 25mm Bushmaster, authority is granted to produce the following propellant lots:

<u>Pounds</u>	<u>L/D</u>	<u>MC Coating, * percent</u>
a. 2000	1.1	(a) 1000 lbs, 2.30% (b) 1000 lbs, 1.70%
b. 2000	1.3	(c) 1000 lbs to be determined (d) 1000 lbs > at a later date

* Select final (a) and (b), and (c) and (d) from preliminary coating and firing (Mam Gun) and closed bomb (a) and (b) to be blendable.

The following process changes from lots PE-559-7 and PE-559-8 apply:

- K_2SO_4 reduced to 0.50 percent.
- Nitrogen content high side of spec. N_2 (13.20%).
- Water Dry adjustment.

Sincerely yours,

CHARLES E. FLYNN
Contracting Officer's
Representative

APPENDIX A-4 -

AS 2013532A

Product Specification for 25-mm APDS-T Propellant

1. SCOPE

1.1 Scope. This specification covers propellant for use in 25mm cartridges, APDS-T, M791.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids, or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

MILITARY

- MIL-A-2550 - Ammunition, General Specification for
- MIL-N-244 - Nitrocellulose

STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-109 - Quality Assurance Terms and Definitions
- MIL-STD-286 - Propellants, Solid: Sampling, Examination and Testing
- MIL-STD-1168 - Lot Numbering of Ammunition

DRAWINGS (See 6.10)

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND

- 9256486 - Container, Packing PA 54, Wood with Metal Liner (Modified M24 Box for Smokeless Powder)
- 7549033 - Container, Metal, Universal, M25 for Propellant and Explosives, Assembly and Details
- 20-4-77 - Packing and Marking of Box, Packing, for Smokeless Powders

- 76 4-46 - Box, Packing, Metal Liner (Copper), M24, for Smokeless Powder
- 76 4-56 - Box, Packing, Metal Lined, M17 for Smokeless Powders
- 8858577 - Marking Diagram and Sealing of Container, Metal, Universal, M25 for Shipping of Propellant
- 8858848 - Marking Diagram and Sealing of Metal Lined Wooden Packing Cases for Shipment of Propellant
- 12013217 - Case, Cartridge, Primed
- 12013536 - Projectile Subassembly, Traced
- 12013533 - Cartridge, 25mm, APDS-T, M791
- 12013535 - Propellant, 25mm, APDS-T
- IEL-12013535 - Inspection Equipment List for Propellant, APDS-T

PUBLICATIONS

FIGHTING VEHICLE SYSTEMS

- AS12013566 - 25mm Ammunition Ballistic Test Methods

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. The propellant shall be in accordance with Drawing (Dwg.) 12013535 referenced specifications, publications, and other requirements specified herein.

3.2 Manufacturing process. The propellant shall be manufactured by a process approved by the contracting officer, and no deviations from that process shall be made without his prior approval (see 6.4).

3.3 First article inspection sample. This specification makes provision for a first article inspection sample. Unless otherwise specified by the contracting officer, a first article inspection sample is required (see 4.4 and 6.3).

3.4 Chemical composition and physical properties. The finished propellant shall comply with the requirements specified on Dwg. 12013535.

3.4.1 Nitrocellulose. Nitrocellulose recovered from the rework of propellants or new nitrocellulose with the nitrogen content not fully meeting the requirements of MIL-N-244 may be used in lieu of, or in combination with, complying nitrocellulose. Propellant so manufactured shall comply with all chemical, physical, and ballistic requirements.

3.5 Ballistics. The propellant, when loaded into sample chamber test cartridges in accordance with Dwg. 12013533, shall comply with the following requirements.

3.5.1 Muzzle velocity. The average projectile muzzle velocity of the sample cartridges conditioned at 18° to 24°C shall be 1350 ±15 meters per second (m/s). The sample standard deviation shall not exceed 10 m/s.

3.5.2 Pressure. The average chamber pressure of the sample cartridges, conditioned at 18° to 24°C, plus three standard deviations of chamber pressure, shall not exceed 454 megapascals (MPa). The average chamber pressure of the sample cartridges, when functioning at any individual temperature from -54° to 71°C, plus three standard deviations of chamber pressure, shall not exceed 496 MPa. (Pressure shall be measured with a piezoelectric type pressure transducer or equivalent.)

3.5.3 Action time. The action time of the sample cartridges shall not exceed 5.5 milliseconds (ms) at any cartridge temperature from -54° to 71°C.

3.6 Air space. The propellant charge weight required to achieve the ballistic requirements of 3.5 shall result in an air space in the Primed Cartridge Case (Dwg. 12013217) which shall permit the insertion of the Projectile (Dwg. 12013536) into the charged case without any vibration or tamping to cause compaction of the propellant charge.

4. QUALITY ASSURANCE PROVISIONS

4.1 Terms and definitions. Quality assurance terms and definitions shall be in accordance with MIL-STD-109.

4.2 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.3 Classification of inspections. The inspection requirements specified herein are classified as follows:

1. First article inspection (see 4.4).
2. Quality conformance inspection (see 4.5).

4.4 First article sample inspection.

4.4.1 First article sample. The first article sample shall be taken from the first production lot and the sample shall be submitted in accordance to contract requirements (see 6.3). The sample shall be manufactured using similar equipment, processes, and procedures as will be used in production. Identification shall be in accordance with MIL-STD-1168.

4.4.1.1 Examination and test. The tests listed in Table I shall be performed on the first article sample in accordance with the test methods prescribed in 4.6. Except as otherwise specified, tests shall be conducted with samples at $20^{\circ} \pm 10^{\circ}\text{C}$. Approval will be based upon examination and test of the sample as specified in Table I. Sample formation shall be as specified in 4.5.2.

4.4.1.2 First article sample rejection. Failure of the sample to comply with requirements of the drawings and specifications shall result in sample disapproval. Determination as to acceptability of any first article sample shall be based upon results of initial tests only and no second tests shall be permitted on that first article. The acceptance/rejection criteria for the first article sample shall be as specified in Table I. All first article units shall be inspected 100 percent for critical defects.

4.5 Quality conformance inspection.

4.5.1 Submission of product. The product shall be submitted in accordance with MIL-STD-105.

4.5.1.1 Lot. A lot shall consist of a uniform blend of propellant manufactured by one manufacturer, in one unchanged process, in accordance with the same drawings and drawing revisions, and the same specification and specification revision.

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TABLE I. First article inspection.

Examination or test <u>5/</u>	Sample size			Requirement paragraph	Test paragraph
	Temperature <u>1/</u>				
	-54°C	21°C	71°C		
Chemical and physical <u>2/</u> <u>3/</u>				3.4	4.6.1
Muzzle velocity <u>4/</u>	100	100	100	3.5.1	4.6.2
Pressure <u>4/</u>	100	100	100	3.5.2	4.6.2
Action time <u>4/</u>	100	100	100	3.5.3	4.6.2
Air space <u>3/</u>		20		3.6	4.6.3

NOTES:

1/ Tolerance on ammunition conditioning temperature $\pm 3^{\circ}\text{C}$ except when otherwise indicated.

2/ Sample size shall be as specified in MIL-STD-286.

3/ Test performed on "Composite Sample".

4/ Test performed on 20-round groups on each of the five "Representative Samples". Pressure, velocity, and action time tests may be performed on the same sample.

5/ If any individual group of samples fails to meet the applicable requirement, the first article shall be rejected.

4.5.1.2 Lot identification. Each packed ammunition lot shall be identified in accordance with applicable drawings and MIL-STD-1168, supplemented as directed by the procuring activity.

4.5.2 Sampling. Random representative samples shall be taken by random selection of one container from each identifiable increment of the lot. A random sample of five containers shall be selected from these representative samples. From each container selected, a sample shall be taken such that the aggregate quantity shall be sufficient for the required tests. These samples shall be poured into clean containers, immediately closed with a hermetically tight seal and identified as "Representative Sample" with a label showing the

container number from which the sample was taken, the lot number, propellant nomenclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. Prior to conducting lot acceptance tests, these samples shall be permitted to attain room temperature; then equal portions sufficient to make the required quantity of a composite sample shall be taken from each "Representative Sample" and blended. This composite sample shall be placed in containers, immediately closed with a hermetically tight seal, and identified respectively as "Composite Sample". These containers shall be further identified by the container numbers from which the composite sample was taken, the lot number, propellant nomenclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. Both the "Composite Sample" and the "Representative Sample" shall be used to perform the tests as specified in Tables I and II.

4.5.3 Test. The tests listed in Table II shall be performed on each propellant lot in accordance with the test methods prescribed in 4.6. Unless otherwise indicated tests shall be conducted with samples at $20^{\circ} \pm 10^{\circ}\text{C}$. Sample size and acceptance criteria for each test shall be as specified. Only propellant sampled in accordance with 4.5.2 shall be used in the tests. The combining of tests is permitted.

4.5.3.1 Unlisted firing defects. The lot shall be suspended and referred to the contracting officer for disposition if a malfunction or casualty not covered by this specification occurring in any firing test indicates that the product is unsuited for the purpose intended.

4.5.3.2 Packing and marking inspection. Inspection of packing and marking to determine compliance with the requirements of 5.1 shall be as prescribed by the procuring activity.

4.5.4 Inspection equipment. Inspection Equipment List No. IEL-12013535 identifies the applicable Inspection Equipment List required to perform examination and tests prescribed herein. The provisions of MIL-A-2550 shall apply.

4.6 Test methods and procedures.

4.6.1 Chemical composition and physical properties. The applicable tests shall be performed in accordance with the procedures set forth in MIL-STD-286.

4.6.2 Ballistics. Ballistic tests shall be performed in accordance with AS12013566 as applicable, and the following:

4.6.2.1 Loading of test cartridges. The propellant samples selected in accordance with 4.5.2 shall be used to load test cartridges with the charge weight established to obtain the required ballistics. The variation in established charge weight between each group of "Representative Samples" shall not exceed 2.0 grams. The test cartridges shall be loaded by a method capable of maintaining propellant charge weight uniformity of plus or minus 0.1 gram, for the selected charge weight.

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TABLE II. Quality conformance inspection.

Examination or test <u>5/</u>	Sample size			Requirement paragraph	Test paragraph
	Temperature <u>1/</u>				
	-54°C	21°C	71°C		
Chemical and physical <u>2/ 3/</u>				3.4	4.6.1
Muzzle velocity <u>4/</u>	100	100	100	3.5.1	4.6.2
Pressure <u>4/</u>	100	100	100	3.5.2	4.6.2
Action time <u>4/</u>	100	100	100	3.5.3	4.6.2
Air space <u>3/</u>		20		3.6	4.6.3

NOTES:

1/ Tolerance on ammunition conditioning temperature $\pm 3^{\circ}\text{C}$ except when otherwise indicated.

2/ Sample size shall be as specified in MIL-STD-286.

3/ Test performed on "Composite Sample".

4/ Test performed on 20-round groups on each of the five "Representative Samples". Pressure, velocity, and action time tests may be performed on the same sample.

5/ Failure of the propellant to comply with the requirements shall be cause for rejection of the lot subject to testing of a second sample for the characteristic(s) in which failure occurred. Failure of the second sample to comply with the requirements for the characteristic(s) under test shall be cause for rejection of the lot.

4.6.2.2 Velocity correction factor. A correction factor of 0.19 m/s per meter shall be applied to the recorded velocity at the measured range to obtain muzzle velocity.

AS12013532A

4.6.3 Air space. The propellant shall be poured into a primed cartridge case in accordance with MIL-STD-286, Method 508.1.2. Insert the projectile into the case mouth until it is completely seated without any vibration or rattling of the components.

5. PACKING

5.1 Packing - level A. (Worldwide shipment and/or long term storage.) Unless otherwise specified by the contracting officer, the propellant shall be packed in clean airtight containers conforming to Drawings 76-4-46, 76-4-56, 9256486, or 7549033.

5.1.1 Immediately prior to packing, containers listed in 5.1 shall be subjected to an internal pressure of 1/2 to 1 pound per square inch by a method satisfactory to the contracting officer's representative. A water manometer shall be assembled in the system. A drop of 0.7 inch or more on the manometer in 15 seconds shall be cause for rejection and the container removed from the lot.

5.2 Packing - level B. Packing shall be as specified in 5.1.

5.3 Packing - level C. (CONUS shipment and/or short term storage.) Unless otherwise specified by the contracting officer, the propellant shall be packed in standard commercial containers acceptable by common or other carrier for safe transportation to the point of delivery, at the lowest cost.

5.4 Marking.

5.4.1 Levels A and B. The containers shall be sealed and marked in accordance with Drawings 20-4-77, 8858577, or 8858848. Markings shall also include the date of manufacture of propellant (month and year).

5.4.2 Level C. Containers shall be marked on the top and side with the same markings as required for the top and side of the box shown on Drawing 8858848. Markings shall also include the date of manufacture of propellant (month and year).

5.4.3 Special marking. All packed containers (level A, B, or C) shall have a printed label affixed to the side with the following information:

NOTICE

AFTER FIVE YEARS FROM DATE OF MANUFACTURE, APPROVAL BY THE RESPONSIBLE ENGINEERING AGENCY IS REQUIRED PRIOR TO LOADING OF THIS PROPELLANT INTO SMALL ARMS AMMUNITION.

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6. NOTES

6.1 Intended use. Propellants procured under this specification are intended to be used in 25mm APDS-T ammunition.

6.2 Ordering data. Invitation for bids and contracts or orders should specify the following:

6.2.1 Title, number, and date of this specification.

6.2.2 Place of inspection, if not at place of manufacture.

6.2.3 First article sample requirements (see 3.3, 4.4, and 6.3).

6.2.4 Detailed packing and marking instructions (see Section 5).

6.2.5 Provisions for the supply, maintenance and disposition of Government furnished inspection equipment for acceptance inspection purposes.

6.2.6 Provisions for the submission and approval of the manufacturing process changes (see 3.2).

6.2.7 Provisions for the inclusion of MIL-STD-1167, Ammunition Data Cards, on DD Form 1423, Contract Data Requirements List.

6.3 First article inspection sample. The procurement agency may waive the requirement for a first article inspection sample if the contractor has recently demonstrated his ability to produce this item.

6.4 Process deviation. A process deviation is defined as a change in the approved basic method of manufacture, or an operational change which may alter the metallurgical or physical properties of the item.

6.5 AQL's. The optional use of AQL values for either individual defects or classes of defects, with individual major defect limitation, is intended to minimize inspection agency administrative burden which might result from an exclusive assignment of individual defects AQL's. The option also permits flexibility where sampling inspection for acceptance is integrated into the manufacturing process.

6.6 Computations. Standard deviation. Where computation of a sample standard deviation is specified for determination of lot acceptance, the method of computation will be:

$$S = \sqrt{\frac{\sum (x_i - \bar{x})^2}{(n - 1)}} \text{ or equivalent}$$

Where:

X_i = each individual value

\bar{X} = sample arithmetic mean

n = sample size

6.7 Combining tests. Tests may be performed concurrently on the sample cartridge provided that the test results are not affected by this procedure to minimize testing costs.

6.8 Submission of inspection equipment designs for approval. Submit equipment designs as required to Program Manager, Fighting Vehicle Systems, ATTN: DRCPM-FVS-PA, Warren, MI 48090. In request letter of submittal, state contractor contract number, specification number, item nomenclature, and classification of defect or test paragraph.

6.9 Submission of results of contractor-conducted examinations and tests. Unless otherwise specified by the contracting officer, the contractor should forward requested records of examinations or tests to Program Manager, Fighting Vehicle Systems, ATTN: DRCPM-FVS-PA, Warren, MI 48090.

6.10 Drawings. Drawings listed in Section 2 of this specification under the heading US Army Armament Research and Development Command (ARRADCOM) may also include drawings prepared by, and identified as, Edgewood Arsenal, Frankford Arsenal, Rock Island Arsenal, or Picatinny Arsenal drawings. Technical data originally prepared by these activities is now under the cognizance of ARRADCOM.

FURNISHED UNDER U.S. GOVT. CONTRACT DAAA09-75-C-2048 BY FORD AEROSPACE & COMMUNICATIONS CORP., AERONAUTRONIC DIVISION, NEWPORT BEACH, CALIF. 92663.

1. All surfaces must comply with drawing requirements and specification AS1201J532.

2. Specification Mil-STD-2088 applies.

PROPELLANT CHEMICAL AND PHYSICAL PROPERTIES (2)

PHYSICAL ATTRIBUTES AND VARIABLES

Configuration

Length (L) in.
 Diameter (D) in.
 Adaptors Top, Average, Inch (flange) (Coated)
 Length-to-Diameter Ratio
 Web Difference % of web std dev
 Performance-to-Diameter Ratio
 Uncoated
 Coated

6.9 to 1.3
 20 max
 11 ± 5
 15 ± 5
 506.1
 506.1
 502.1, without screens

Test Method (MIL-STD-2088F)

209.2
 T226.1
 T115.1
 T226.1

Formula

96.7 ± 1.0
 0.9 ± 0.4
 0.5 ± 0.3
 1.9 ± 0.5
 100.0

Ingredient

80-80-155
 MIL-D-98
 MIL-P-19
 MIL-M-19719

80-80-155
 MIL-D-98
 MIL-P-19
 MIL-M-19719

0.4 max
 2.9 max
 1.1 ± 0.4
 1.7 max
 0.10 max
 1.60 max

80-80-155
 MIL-D-98
 MIL-P-19
 MIL-M-19719

0.4 max
 2.9 max
 1.1 ± 0.4
 1.7 max
 0.10 max
 1.60 max

80-80-155
 MIL-D-98
 MIL-P-19
 MIL-M-19719

0.4 max
 2.9 max
 1.1 ± 0.4
 1.7 max
 0.10 max
 1.60 max

80-80-155
 MIL-D-98
 MIL-P-19
 MIL-M-19719

0.4 max
 2.9 max
 1.1 ± 0.4
 1.7 max
 0.10 max
 1.60 max

80-80-155
 MIL-D-98
 MIL-P-19
 MIL-M-19719

0.4 max
 2.9 max
 1.1 ± 0.4
 1.7 max
 0.10 max
 1.60 max

PROPERTY STATEMENTS

1. Relative hardness, 2 For information only and as requested

2. Relative force, 2 as requested

Method Violet Stabilizer

Test at 135°C

A. Color Change - Minutes to Silicon Pink

B. Expansion - hrs.

Explosive Hazard Classification

Sensate Compatibility Group

Self Hazard Classification

DOT Hazardous Precipitant Explosives (5.1)(D)

1
 2
 3
 4

AMSWE Form 403B, 29 Jul 69

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PROPERTY STATEMENTS

1. Relative hardness, 2 For information only and as requested

2. Relative force, 2 as requested

Method Violet Stabilizer

Test at 135°C

A. Color Change - Minutes to Silicon Pink

B. Expansion - hrs.

Explosive Hazard Classification

Sensate Compatibility Group

Self Hazard Classification

DOT Hazardous Precipitant Explosives (5.1)(D)

1
 2
 3
 4

AMSWE Form 403B, 29 Jul 69

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PROPERTY STATEMENTS

1. Relative hardness, 2 For information only and as requested

2. Relative force, 2 as requested

Method Violet Stabilizer

Test at 135°C

A. Color Change - Minutes to Silicon Pink

B. Expansion - hrs.

CONTRACT NO. 12013533 DATE 12/15/69 PREP 12/15/69 ENG 12/15/69 INGR 12/15/69 SUBMITTED		CONTRACT NO. 12013535 DATE 12/15/69 PREP 12/15/69 ENG 12/15/69 INGR 12/15/69 SUBMITTED	
TOLERANCES ARE IN INCHES ANGLES 3 PLACE DECIMALS 2 PLACE DECIMALS MATERIAL		US ARMY WEAPONS COMMAND ROCK ISLAND, ILLINOIS, 61201 PROPELLANT	
FINAL PROTECTIVE FINISH 12013533 USED ON HEAT ASSY APPLICATION		US ARMY WEAPONS COMMAND ROCK ISLAND, ILLINOIS, 61201 PROPELLANT	
APPROVED		APPROVED	

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APPENDIX A-5

Product Specification for 25-mm Cartridge, APDS-T, M791

AS12013532B

1. SCOPE

1.1 Scope. This specification covers propellant for use in 25mm cartridges, APDS-T, M791.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids, or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-A-2550 - Ammunition, General Specification for

MIL-N-244 - Nitrocellulose

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-109 - Quality Assurance Terms and Definitions

MIL-STD-286 - Propellants, Solid: Sampling, Examination and Testing

MIL-STD-1168 - Lot Numbering of Ammunition

DRAWINGS (See 6.10)

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND

9256486 - Container, Packing PA 54, Wood with Metal Liner (Modified M24 Box for Smokeless Powder)

7549033 - Container, Metal, Universal, M25 for Propellant and Explosives, Assembly and Details

20-4-77 - Packing and Marking of Box, Packing, for Smokeless Powders

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- 76-4-46 - Box, Packing, Metal Liner (Copper), M24, for
Smokeless Powder
- 76-4-56 - Box, Packing, Metal-Wood, M17 for Smokeless Powders
- 8858577 - Marking Diagram and Sealing of Container, Metal,
Universal, M25 for Shipping of Propellant
- 8858848 - Marking Diagram and Sealing of Metal Lined Wooden
Packing Boxes for Shipment of Propellant
- 12013217 - Case, Cartridge, Primed
- 12013536 - Projectile Subassembly, Traced
- 12013533 - Cartridge, 25mm, APDS-T, M791
- 12013535 - Propellant, 25mm, APDS-T
- IEL-12013535 - Inspection Equipment List for Propellant, APDS-T

PUBLICATIONS

FIGHTING VEHICLE SYSTEMS

- AS12013566 - 25mm Ammunition Ballistic Test Methods

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. The propellant shall be in accordance with Drawing (Dwg.) 12013535 referenced specifications, publications, and other requirements specified herein.

3.2 Manufacturing process. The propellant shall be manufactured by a process approved by the contracting officer, and no deviations from that process shall be made without his prior approval (see 6.4).

3.3 First article inspection sample. This specification makes provision for a first article inspection sample. Unless otherwise specified by the contracting officer, a first article inspection sample is required (see 6.4 and 6.3).

3.4 Chemical composition and physical properties. The finished propellant shall comply with the requirements specified on Dwg. 12013535.

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3.4.1 Nitrocellulose. Nitrocellulose recovered from the rework of propellants or new nitrocellulose with the nitrogen content not fully meeting the requirements of MIL-N-244 may be used in lieu of, or in combination with, complying nitrocellulose. Propellant so manufactured shall comply with all chemical, physical, and ballistic requirements.

3.5 Ballistics. The propellant, when loaded into sample APDS-T test cartridges in accordance with Dwg. 12013533, shall comply with the following requirements.

3.5.1 Muzzle velocity. The average projectile muzzle velocity of the sample cartridges conditioned at 18° to 24°C shall be 1350 ±15 meters per second (m/s). The sample standard deviation shall not exceed 10 m/s.

3.5.2 Pressure. The average chamber pressure of the sample cartridges, conditioned at 18° to 24°C, plus three standard deviations of chamber pressure, shall not exceed 454 megapascals (MPa). The average chamber pressure of the sample cartridges, when functioning at any individual temperature from -54° to 71°C, plus three standard deviations of chamber pressure, shall not exceed 496 MPa. (Pressure shall be measured with a piezoelectric type pressure transducer or equivalent.)

3.5.3 Action time. The action time of the sample cartridges shall not exceed 5.5 milliseconds (ms) at any cartridge temperature from -54° to 71°C.

3.6 Air space. The propellant charge weight required to achieve the ballistic requirements of 3.5 shall result in an air space in the Primed Cartridge Case (Dwg. 12013217) which shall permit the insertion of the Projectile (Dwg. 12013536) into the charged case without any vibration or tamping to cause compaction of the propellant charge.

4. QUALITY ASSURANCE PROVISIONS

4.1 Terms and definitions. Quality assurance terms and definitions shall be in accordance with MIL-STD-109.

4.2 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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4.3 Classification of inspections. The inspection requirements specified herein are classified as follows:

1. First article inspection (see 4.4).
2. Quality conformance inspection (see 4.5).

4.4 First article sample inspection.

4.4.1 First article sample. The first article sample shall be taken from the first production lot and the sample shall be submitted in accordance to contract requirements (see 6.3). The sample shall be manufactured using similar equipment, processes, and procedures as will be used in production. Identification shall be in accordance with MIL-STD-1168.

4.4.1.1 Examination and test. The tests listed in Table I shall be performed on the first article sample in accordance with the test methods prescribed in 4.6. Except as otherwise specified, tests shall be conducted with samples at $20^{\circ} \pm 10^{\circ}\text{C}$. Approval will be based upon examination and test of the sample as specified in Table I. Sample formation shall be as specified in 4.5.2.

4.4.1.2 First article sample rejection. Failure of the sample to comply with requirements of the drawings and specifications shall result in sample disapproval. Determination as to acceptability of any first article sample shall be based upon results of initial tests only and no second tests shall be permitted on that first article. The acceptance/rejection criteria for the first article sample shall be as specified in Table I. All first article units shall be inspected 100 percent for critical defects.

4.5 Quality conformance inspection.

4.5.1 Submission of product. The product shall be submitted in accordance with MIL-STD-105.

4.5.1.1 Lot. A lot shall consist of a uniform blend of propellant manufactured by one manufacturer, in one unchanged process, in accordance with the same drawings and drawing revisions, and the same specification and specification revision.

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TABLE I. First article inspection.

Examination or test <u>5/</u>	Sample size			Requirement paragraph	Test paragraph
	Temperature <u>1/</u>				
	-54°C	21°C	71°C		
Chemical and physical <u>2/ 3/</u>				3.4	4.6.1
Muzzle velocity <u>4/</u>	50	50	50	3.5.1	4.6.2
Pressure <u>4/</u>	50	50	50	3.5.2	4.6.2
Action time <u>4/</u>	50	50	50	3.5.3	4.6.2
Air space <u>3/</u>		20		3.6	4.6.3

NOTES:

1/ Tolerance on ammunition conditioning temperature $\pm 3^{\circ}\text{C}$ except when otherwise indicated.

2/ Sample size shall be as specified in MIL-STD-286.

3/ Test performed on "Composite Sample".

4/ Test performed on 10-round groups on each of the five "Representative Samples". Pressure, velocity, and action time tests may be performed on the same sample.

5/ If any individual group of samples fails to meet the applicable requirement, the first article shall be rejected.

4.5.1.2 Lot identification. Each packed ammunition lot shall be identified in accordance with applicable drawings and MIL-STD-1168, supplemented as directed by the procuring activity.

4.5.2 Sampling. Random representative samples shall be taken by random selection of one container from each identifiable increment of the lot. A random sample of five containers shall be selected from these representative samples. From each container selected, a sample shall be taken such that the aggregate quantity shall be sufficient for the required tests. These samples shall be poured into clean containers, immediately closed with a hermetically tight seal and identified as "Representative Sample" with a label showing the

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container number from which the sample was taken, the lot number, propellant nomenclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. Prior to conducting lot acceptance tests, these samples shall be permitted to attain room temperature; then equal portions sufficient to make the required quantity of a composite sample shall be taken from each "Representative Sample" and blended. This composite sample shall be placed in containers, immediately closed with a hermetically tight seal, and identified respectively as "Composite Sample". These containers shall be further identified by the container numbers from which the composite sample was taken, the lot number, propellant nomenclature, packing date, manufacturer, manufacturing plant, and total weight of the lot as packed. Both the "Composite Sample" and the "Representative Sample" shall be used to perform the tests as specified in Tables I and II.

4.5.2 Test. The tests listed in Table II shall be performed on each propellant lot in accordance with the test methods prescribed in 4.6. Unless otherwise indicated tests shall be conducted with samples at $20^{\circ} \pm 10^{\circ}\text{C}$. Sample size and acceptance criteria for each test shall be as specified. Only propellant sampled in accordance with 4.5.2 shall be used in the tests. The combining of tests is permitted.

4.5.3.1 Unlited firing defects. The lot shall be suspended and referred to the contracting officer for disposition if a malfunction or casualty not covered by this specification occurring in any firing test indicates that the product is unsuited for the purpose intended.

4.5.3.2 Packing and marking inspection. Inspection of packing and marking to determine compliance with the requirements of 5.1 shall be as prescribed by the procuring activity.

4.5.4 Inspection equipment. Inspection Equipment List No. IEL-1201353, identifies the applicable Inspection Equipment List required to perform examination and tests prescribed herein. The provisions of MIL-A-2550 shall apply.

4.6 Test methods and procedures.

4.6.1 Chemical composition and physical properties. The applicable tests shall be performed in accordance with the procedures set forth in MIL-STD-286.

4.6.2 Ballistics. Ballistic tests shall be performed in accordance with AS12013566 as applicable, and the following:

4.6.2.1 Loading of test cartridges. The propellant samples selected in accordance with 4.5.2 shall be used to load test cartridges with the charge weight established to obtain the required ballistics. The variation in established charge weight between each group of "Representative Samples" shall not exceed 2.0 grams. The test cartridges shall be loaded by a method capable of maintaining propellant charge weight uniformity of plus or minus 0.1 gram, for the selected charge weight.

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TABLE II. Quality conformance inspection.

Examination or test <u>5/</u>	Sample size			Requirement paragraph	Test paragraph
	Temperature <u>1/</u>				
	-54°C	21°C	1°C		
Chemical : physical <u>2/ 3/</u>				3.4	4.6.1
Muzzle velocity <u>4/</u>	50	50	50	3.5.1	4.6.2
Pressure <u>4/</u>	50	50	50	3.5.2	4.6.2
Action time <u>4/</u>	50	50	50	3.5.3	4.6.2
Air space <u>3/</u>		20		3.6	4.6.3

NOTES:

1/ Tolerance on ammunition conditioning temperature $\pm 3^{\circ}\text{C}$ except when otherwise indicated.

2/ Sample size shall be as specified in MIL-STD-286.

3/ Test performed on "Composite Sample".

4/ Test performed on 10-round groups on each of the five "Representative Samples". Pressure, velocity, and action time tests may be performed on the same sample.

5/ Failure of the propellant to comply with the requirements shall be cause for rejection of the lot subject to testing of a second sample for the characteristic(s) in which failure occurred. Failure of the second sample to comply with the requirements for the characteristic(s) under test shall be cause for rejection of the lot.

4.6.2.2 Velocity correction factor. A correction factor of 0.19 m/s per meter shall be applied to the recorded velocity at the measured range to obtain muzzle velocity.

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4.6.3 Air space. The propellant shall be poured into a primed cartridge case in accordance with MIL-STD-236, Method 508.1.2. Insert the projectile into the case mouth until it is completely seated without any vibration or tamping of the components.

5. PACKING

5.1 Packing - level A. (Worldwide shipment and/or long term storage.) Unless otherwise specified by the contracting officer, the propellant shall be packed in clean airtight containers conforming to Drawings 76-4-46, 76-4-56, 9256486, : 7549033.

5.1.1 Immediately prior to packing, containers listed in 5.1 shall be subjected to an internal pressure of 1/2 to 1 pound per square inch by a method satisfactory to the contracting officer's representative. A drop of 0.7 inch or more in 15 seconds shall be cause for rejection and the container removed from the lot.

5.2 Packing - level B. Packing shall be as specified in 5.1.

5.3 Packing - level C. (CONUS shipment and/or short term storage.) Unless otherwise specified by the contracting officer, the propellant shall be packed in standard commercial containers acceptable by common or other carrier for the transportation to the point of delivery, at the lowest cost.

5.4 Marking.

5.4.1 Levels A and B. The containers shall be sealed and marked in accordance with Drawings 20-4-77, 8858577, or 8858848. Markings shall also include the date of manufacture of propellant (month and year).

5.4.2 Level C. Containers shall be marked on the top and side with the same markings as required for the top and side of the box shown on Drawing 8858848. Markings shall also include the date of manufacture of propellant (month and year).

5.4.3 Special marking. All packed containers (level A, B, or C) shall have a printed label affixed to the side with the following information:

NOTICE

AFTER FIVE YEARS FROM DATE OF MANUFACTURE, APPROVAL BY THE RESPONSIBLE ENGINEERING AGENCY IS REQUIRED PRIOR TO THE LOADING OF THIS PROPELLANT INTO SMALL ARMS AMMUNITION.

AS120135329

6. NOTES

6.1 Intended use. Propellants procured under this specification are intended to be used in 25mm APDS-T ammunition.

6.2 Ordering data. Invitation for bids and contracts or orders should specify the following:

6.2.1 Title, number, and date of this specification.

6.2.2 Pl. of inspection, if not at place of manufacture.

6.2.3 First article sample requirements (see 3.3, 4.4, and 6.3).

6.2.4 Detailed packing and marking instructions (see Section 5).

6.2.5 Provisions for the supply, maintenance and disposition of Government furnished inspection equipment for acceptance inspection purposes.

6.2.6 Provisions for the submission and approval of the manufacturing process changes (see 3.2).

6.3 First article inspection sample. The procurement agency may waive the requirement for a first article inspection sample if the contractor has recently demonstrated his ability to produce this item.

6.4 Process deviation. A process deviation is defined as a change in the approved basic method of manufacture, or an operational change which may alter the chemical or physical properties of the item.

6.5 AQL's. The optional use of AQL values for either individual defects or classes of defects, with individual major defect limitation, is intended to minimize inspection agency administrative burden which might result from an exclusive assignment of individual defects AQL's. The option also permits flexibility where sampling inspection for acceptance is integrated into the manufacturing process.

6.6 Computations. Standard deviation. Where computation of a sample standard deviation is specified for determination of lot acceptance, the method of computation will be:

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{(n - 1)}} \text{ or equivalent}$$

AS120135323

Where:

X_i = each individual value

\bar{X} = sample arithmetic mean

n = sample size

6.7 Combining tests. Tests may be performed concurrently on the sample cartridge provided that the test results are not affected by this procedure to minimize testing costs.

6.8 Submission of inspection equipment designs for approval. Submit equipment designs as required to Program Manager, Fighting Vehicle Systems, ATTN: DRCPM-FVS-PA, Warren, MI 48090. In request letter of submittal, state contractor contract number, specification number, item nomenclature, and classification of defect or test paragraph.

6.9 Submission of results of contractor-conducted examinations and tests. Unless otherwise specified by the contracting officer, the contractor should forward requested records of examinations or tests to Program Manager, Fighting Vehicle Systems, ATTN: DRCPM-FVS-PA, Warren, MI 48090.

6.10 Drawings. Drawings listed in Section 2 of the specification under the heading US Army Armament Research and Development Command (ARRADCOM) may also include drawings prepared by, and identified as, Edgewood Arsenal, Frankford Arsenal, Rock Island Arsenal, or Picatinny Arsenal drawings. Technical data originally prepared by these activities is now under the cognizance of ARRADCOM.

ENGINEERING ORDER

REASON Ford Auto space & Communications Corporation Approval of Design Ford Mustang Newport Beach California 92660		SUBJECT CHANGE NOTICE (GENERAL RELEASE WITH CHANGE HAS LIMITED)		ENGINEERING ORDER NO. 03592	
TO UPDATE REQUIREMENTS		APPROPRIATE 80 000 & SUBQ RAP-1		OPERATION DATE 1/10/78 1/10/78	
CLASS OF CHANGE II		ENGINEERING DEPT. ENGRG SERVICES		DATE CHANGED TO US 1/10/78	
ENGINEERING DOCUMENT NO. AS12013532		CHO LTA B		VELOCITY TO BE CHANGED X	
TITLE PRODUCT SPECIFICATION PROPELLANT, 25MM, APDS-T		NO. REQUIRED BEST FINAL		VELOCITY TO BE CHANGED X	
CUSTOMER		RECOMMENDED DISPOSITION		INCORP BY DATE CHECKED DATE	

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

REVISED TABLE I AND II WAS: QUANTITIES "100"
 WAS: NOTE 4/- - on 20-round - r r

REVISED 5.1.1 WAS: IMMEDIATELY . . . REPRESENTATIVE. A WATER MANOMETER SHALL BE ASSEMBLED INTO THE SYSTEM. A DROP . . . MORE ON THE MANOMETER . . . LOT.

DELETED 6.2.7 WAS: PROVISIONS FOR THE INCLUSION OF MIL-STD-1167, AMMUNITION DATA CARDS, . . .

REVISED 6.4 WAS: A PROCESS DEVIATION . . . MAY ALTER THE METALLURGICAL OR PHYSICAL PROPERTIES OF THE ITEM.

EXTRA COPIES TO	QTY

EOC 35924

APR 78

ENGINEERING ORDER

Ford Aerospace & Communications Corporation
Aeronautics Division
Ford Road
Newport Beach, California 92663

SUBJECT

CHANGE

ENGINEERING ORDER NO. C32220

PROGRAM ENGR DATE: 4/30/80

SON

INCREASE FLASH SUPPRESSANT

TEMPERATURE CONES AFFECTED

BAP-1

EFFECTIVITY

80,000 & SUBQ

ENGINEERING DEPT.

ORDNANCE

ISS OF CHANGE

I

CUSTOMER

15TH

NO. REQUIRED

INITIAL

RECOMMENDED DISPOSITION

ASBY

DATE DETAIL

4/30/80

VEILLUM TO BE CHANGED

DATE

INCORP BY

DATE

CHECKED

DATE

ENGINEERING DOCUMENT NO.

20135535

CHG LTR

C

NEXT ASSEMBLY

12013553

RECOMMENDED DISPOSITION

ASBY

VEILLUM TO BE CHANGED

DATE

INCORP BY

DATE

CHECKED

DATE

IN F/D: CHEMICALS "WAS" "18"
88 POTASSIUM SULPHATE WT% 0.5 ± 0.3 1.0 ± 0.3

EXTRA COPIES 3 017

NOTES: UNLESS OTHERWISE SPECIFIED
 1. All sources must comply with drawing requirements and specification AS1201332.
 2. Specification MIL-STD-2048 applies.

FURNISHED UNDER U.S. GOVT. CONTRACT
 DAA40975-C-2048 BY FORD AEROSPACE & COMMUNICATIONS CORP., AERONAUTRONIC DIVISION, NEWPORT BEACH, CALIF. 92663.

MF IONE LTR	REVISIONS DESCRIPTION	DATE	APPROVED
-	GENERAL RELEASE FOR EDC 48073	5/14/79	[Signature]
A	SEE EDC 50690	10/11/79	[Signature]
B	SEE EDC 51210	4/14/80	[Signature]

PROPELLANT CHEMICAL AND PHYSICAL REQUIREMENTS (2)

PHYSICAL ATTRIBUTES AND VARIATIONS
 Configuration
 Length (L) in.
 Diameter (D) in.
 Advisory: Web, Average, Inch
 Length-to-Diameter Ratio
 Web Difference % of web and day
 Diameter-to-Perforation Ratio
 Coated
 Bulk Density, gm/cc

Test Method
 MIL-STD-2898
 209.2
 T226.1
 T216.1
 T226.1
 100.0

INGREDIENTS
 Ingredient Specification
 Type I, Grade G
 Mil-N-264
 Mil-D-98
 Mil-P-193
 Peracetic Sulphate
 Methyl Cellulose (c)
 21-N-19719
 TOTAL

308.1
 2103.3
 2103.3
 2103.3
 501.1

0.4 max
 2.9 max
 1.1 ± 0.4
 1.2 max
 0.10 max
 1.60 max

APPROX AND RESIDUAL INGREDIENTS
 Graphite
 Total Volatiles
 Moisture
 Residual Solvents
 Dust and Foreign Matter
 Hydroscopicity
 Ginned Bomb Test at 490°

308.3, without screens
 304.3
 304.3

209.2
 T226.1
 T216.1
 T226.1
 100.0

For information only and as requested
 For information only and as requested
 Methly Violer Stability Test at 135.5°C
 A. Color Change - Minutes to Salmon Pink
 B. Gasoline - hrs.

NO OTHER USE OF THIS DOCUMENT IS PERMITTED. FOR FURTHER INFORMATION CONTACT COMMANDER, U. S. ARMY TANK-AUTOMOTIVE MATERIAL READINESS COMMAND, ATTN: INSTA-1P, WARREN, MICHIGAN 48090, U.S.A.

PROPRIETARY NOTE
 THIS DOCUMENT CONTAINS PROPRIETARY DATA LICENSED UNDER THE PATENT ACT OF 1952 TO THE U. S. GOVERNMENT BY FORD AEROSPACE & COMMUNICATIONS CORPORATION AND/OR MACHINE TOOL WORKS OVERL-22, WARREN, MICHIGAN 48090, U.S.A.

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DEPT OF THE ARMY
 US ARMY WEAPONS COMMAND
 ROCK ISLAND, ILLINOIS 61201

PART NO. 12013535

PROPELLANT, 25MM APDS-T

THE CODE IDENT NO DRAWING NO
 B 19204 12013535

SCALE NONE

SHEET 1 OF 1

CONTRACT NO
 DATE
 PREP
 CHE
 INGR
 SUBMITTED

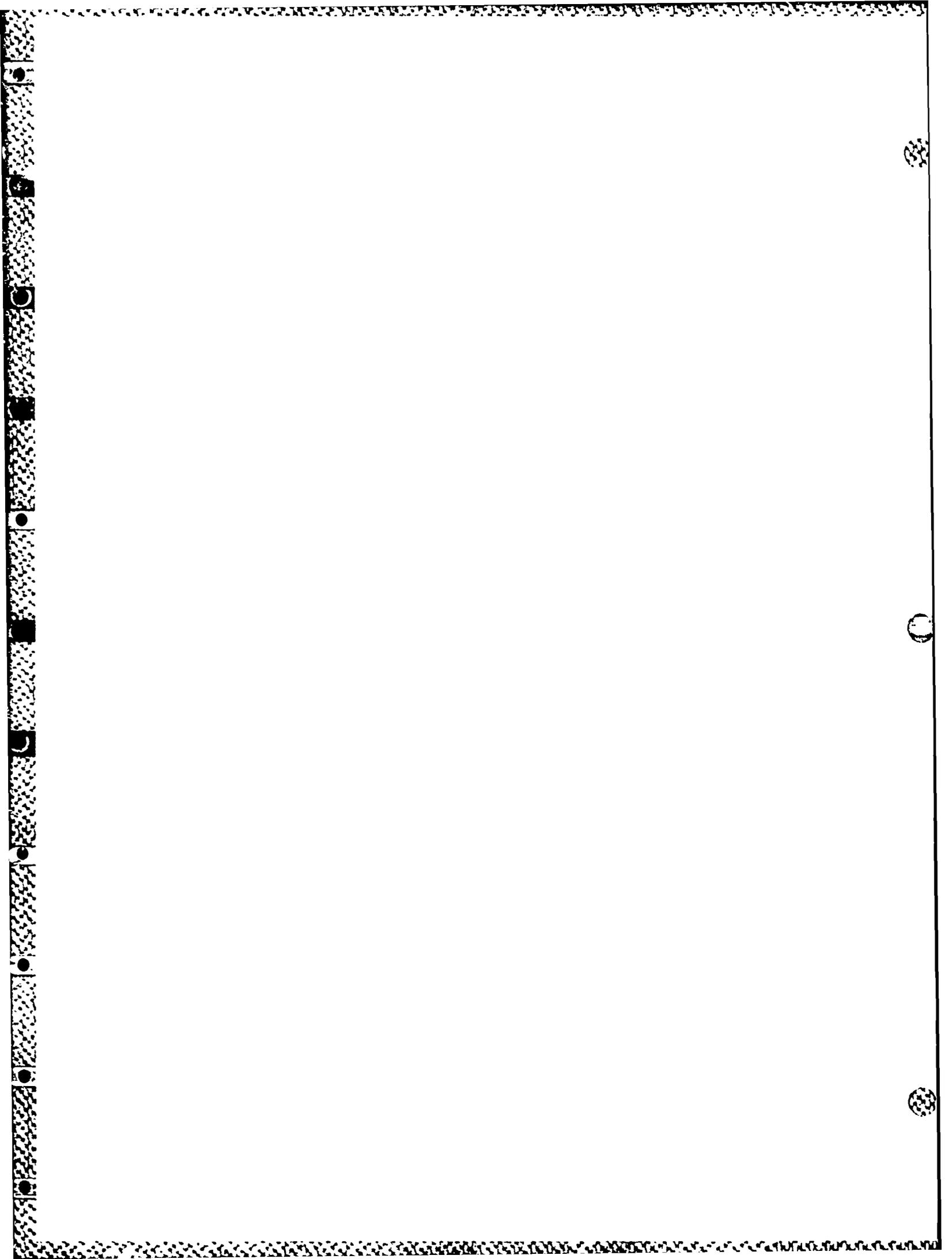
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE IN INCHES
 ANGLES 1
 2 PLACE DECIMALS
 3 PLACE DECIMALS
 NATIONAL

FINAL PROTECTIVE FINISH
 APPLICATION
 12013533
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 USED ON

APPROVED

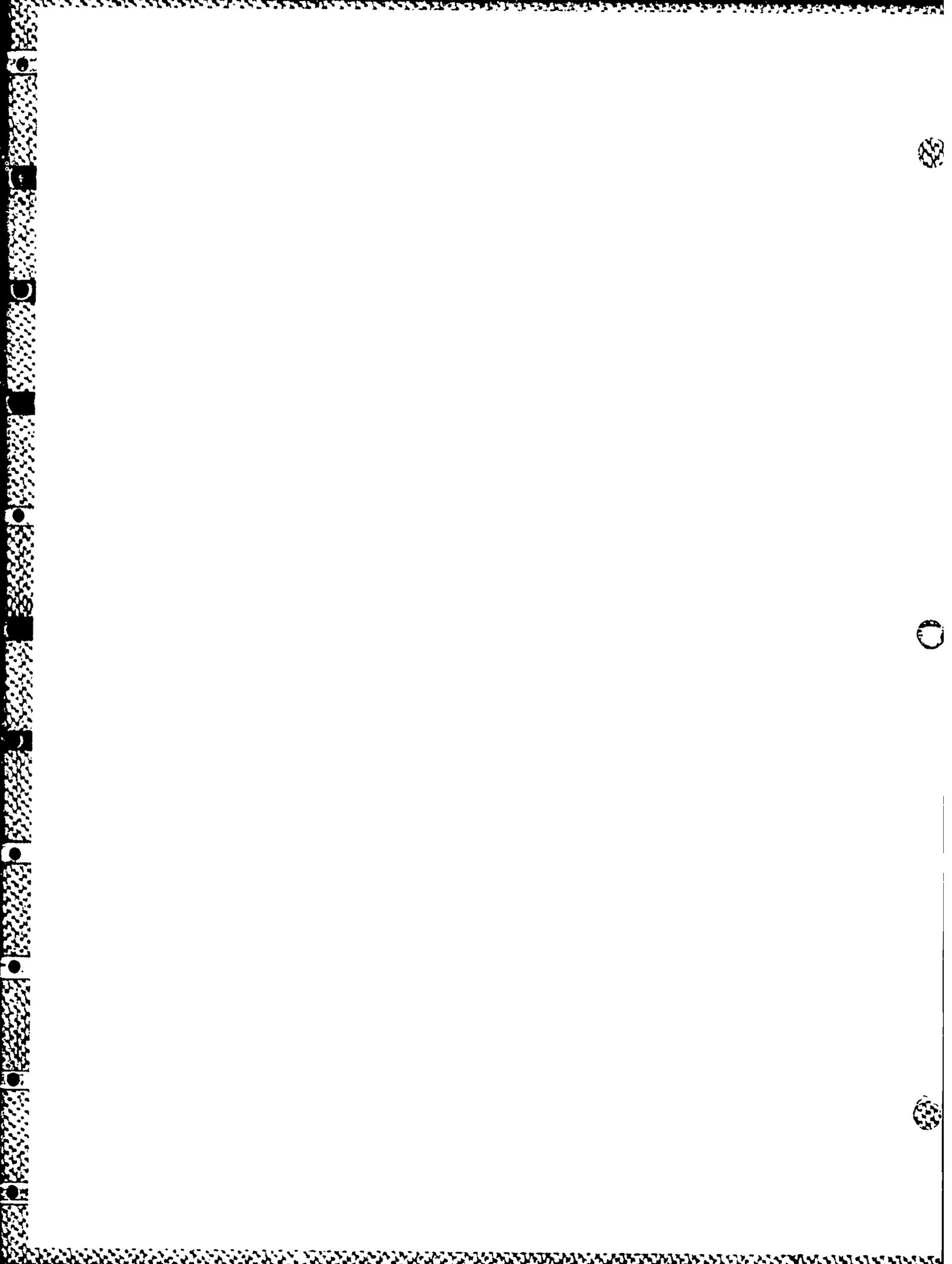
AP-1

APPROVED



APPENDIX B

DESCRIPTION OF 25-MM MANN GUN TEST



TECHNICAL DISCUSSION

HE Propellant Evaluation

The HE propellants were tested with Oerlikon components Lot 21-6-74. The Oerlikon test slug weight was 177 grams. The HE test slugs used with Olin propellants were 187 grams. Propellants A1, A2, B1 and B2 were initially tested at 75 grams charge weight. At this low charge weight, propellant B1 gave too high a pressure and seemed to be too fast for the HE rounds. B2 was too slow. Testing of A1 and A2 was continued at increasingly higher charge weights. At 35 grams charge weight, A1 gave the desired velocity of 3669 ft/sec. at a pressure of only 51.8 kpsi. Full case charge weight for the HE configuration is 92 grams. A1 was blended in various proportions with the slower propellant A2 at increased charge weights in order to reduce the air space. There was no problem meeting the velocity requirements within the pressure limitations.

Table I gives test data for propellants tested in HE configurations using Oerlikon test slugs, weight 177 grams. Further testing will be done with the 187 gram banded test slug for comparison with Olin propellant performance.

AP Propellant Evaluation

Propellants A1, A2, B1 and B2 were tested in AP components at 75 grams charge weight. At this charge weight, propellant B1 gave velocity of 4200 ft/sec. at pressure of 42.3 kpsi. Further testing of B1 propellant at increasingly higher charge weights was carried out until full case was achieved. At full case charge weight (100 grams), the pressure attained (58.3 kpsi) exceeded the maximum limit of 56.6 kpsi, but the velocity (4466 ft/sec.) was slightly below the desired velocity of 4500 ft/sec.

Propellant B1 was then blended with the slower propellants A1 and A2 in order to reduce the high pressure peak and to spread out the base of the P-T curve. None of these blends attained the desired velocity within the maximum pressure limit, but were not too far off. Table II gives ballistic data for propellants tested in AP components. The physical and chemical data for these propellants is given in Table III.

It is to be noted here that the weight of the Oerlikon AP test slugs with plastic sabot used in this evaluation (OE Lot 12-12-74) was only 121.5 grams, whereas the weight of our test slug is 135 grams.

D.R. B074

Page 2

CONCLUSIONS

Radford propellant A1, by itself, or when blended with propellant A2 appears to be satisfactory for the HE rounds. This will be confirmed by further testing using the 187 gram banded test slug. At full case charge weight of 100 grams, propellants B1, by itself, and/or when blended with A2 did not make velocity with the lighter (121.5 gram) projectile. Further development and testing of the AP-T propellant will have to be performed using the heavier (130 gram) projectile.

2-25-50
 2-25-50

April 1

WINDMILL PROPELLANT COLLECTION
 ON (CONFIDENTIAL)

Time	Altitude	Temp	Wind	Pressure	Remarks
10:00	80	11	0	1200	Increase chg. wt. to 80 g
10:10	85	11	0	1205	Increase chg. wt/ to 85 g
10:20	90	11	1	1210	Too fast for TP; cry with 10
10:30	95	11	0	1215	Too slow
10:40	100	11	1	1220	
10:50	105	11	1	1225	
11:00	110	11	0	1230	
11:10	115	11	0	1235	
11:20	120	11	0	1240	
11:30	125	11	0	1245	
11:40	130	11	0	1250	
11:50	135	11	0	1255	
12:00	140	11	0	1260	
12:10	145	11	0	1265	
12:20	150	11	0	1270	
12:30	155	11	0	1275	

... .. 20 grams for 25 configuration

... .. 20 grams

Best Available Copy

TABLE II
RADFORD PROPELLANT EVALUATION
(AP Configuration)

	<u>Propellant</u>	<u>Charge Weight (Grams)</u>	<u>t_A</u> <u>ms</u>	<u>P_m</u> <u>kpsi</u>	<u>P_c</u> <u>kpsi</u>	<u>V_m</u> <u>ft/sec.</u>
1.	A1	75	5.25	4.01	40.4	3580
2.	A2	75	6.03	3.91	26.3	3186
3.	B1	75	5.37	4.01	42.3	4200
4.	B2	75	6.35	3.71	22.1	3029
5.	B1	80	-	4.13	30.3	3547
6.	B1	85	5.71	4.53	37.1	3860
7.	B1	90	5.49	4.88	43.1	3947
8.	B1	95	5.31	5.17	49.2	4241
9.	B1	97	5.07	5.36	52.1	4338
10.	B1	98	5.19	5.47	53.4	4358
11.	B1	100	4.91	5.36	58.3	4466
12.	B1 - 75 A1 - 25	100	4.47	-	58.7	4426
13.	B1 - 75 A2 - 25	100	4.59	-	53.6	4338
14.	B1 - 85 A2 - 15	100	4.56	-	57.0	4370

Radford Propellant: Full Case Charge Weight = 100 grams for AP configuration

AP Components: OE Lot 12-12-74 Slug Weight = 121.5

TABLE III

CHEMICAL AND PHYSICAL DATA - RADFORD PROPELLANTS

	<u>A-1</u>	<u>A-2</u>	<u>B-1</u>	<u>B-2</u>
Nitrocellulose, % (13.15%N)	94.29	92.48	94.82	92.92
Diphenylamine, %	0.55	0.57	0.52	0.51
Potassium Sulfate, %	0.79	0.85	0.79	0.76
Methyl Centralite, %	4.26	5.95	3.74	5.80
Graphite %	0.11	0.15	0.13	0.11
Six-Hour HV, %	0.44	0.63	0.62	0.75
Density, g/cc	0.9892	0.9805	0.9933	0.9985
<u>Physical Dimensions</u>				
Mean Length, inches	0.067	0.067	0.067	0.067
Mean Outside Diameter, inches	0.052	0.052	0.055	0.055
Mean Perforation, inches	0.0043	0.0043	0.0042	0.0042
Mean Web, inches	0.0235	0.0235	0.0257	0.0257
<u>Theoretical Performance</u>				
Flame Temperature (K)	2810	2671	2725	2749
Impetus (ft./s)(lb)	329,000	219,000	324,000	325,000

APPENDIX C

PRODUCTION ENGINEERING INVESTIGATION
(PEI-559-4)

PEI 559-4

February 28, 1977

SPECIAL OPERATING INSTRUCTIONS

I. MATERIALS MANAGEMENT

A. Materials Control

Following is a list of materials required for the manufacture of 25mm propellant:

Nitrocellulose (13.15%N)	MIL-N-244 Type I, Grade C
Diphenylamine (DPA)	MIL-D-98
Potassium Sulfate	MIL-P-193
Graphite	MIL-G-155
Methyl Centralite*	MIL-M-19719

*Must be ground - 97 percent minimum to pass a 70 mesh screen.

II. PROPELLANT DEPARTMENT

Type Propellant: 25mm

Approximately 1000 pounds - 4 mixes will be required.

<u>Composition</u>	<u>Specification</u>	<u>Percent by Weight</u>	<u>Weight, pounds</u>
Nitrocellulose* (13.15 ± 0.05%N Cotton Linters)	MIL-N-244 Type I, Grade C	100.00	348.0
Diphenylamine (DPA)	MIL-D-98	1.00**	3.5
Potassium Sulfate	MIL-P-193	1.00**	<u>3.5</u>
			355.0

* Use blend with N closest to 13.20 percent.

** Based on nitrocellulose weight.

Nitrocellulose requirements are as follows:

	<u>Acceptable Limits</u>
Solubility	40 to 49 percent
Fineness	Final Blend: Control: 95 to 105ml Accept: 90 to 110ml
Freeness	Final Blend: 490 to 550ml

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<u>Solvents</u>	<u>Acceptable Limits</u>
92 pounds solvent per 100 pounds dry weight of ingredients	326 pounds of solvent per mix
65 parts ether per 100 parts solvents	212 pounds of ether per mix
35 parts alcohol per 100 parts solvents	114 pounds of alcohol per mix

A. Chemical Grind

Weigh ingredients as required in accordance with the following:

<u>Ingredient</u>	<u>Weight/Bag</u>	<u>Tolerance</u>
K ₂ SO ₄	3.5 lbs	± 0.3 oz
DPA	3.5 lbs	± 0.3 oz
Graphite*	2 lbs	± 0.3 oz
Methyl Centralite	As determined and requested by Technical Analytical Group	

*Graphite weight is based on 1000 pounds per batch.

B. Nitrocellulose Area

Supply a sufficient quantity of nitrocellulose (13.15% N linters) to produce approximately 1000 pounds dry weight of 25mm propellant.

C. Dehydration

1. Use General Operating Instructions and the following specific instructions:

Number of blocks	4
Dry weight of NC per block	87
Gallons of alcohol per block (min)	17
Nominal dwell time, minutes	1
Wet weight of individual block, lbs	104 ± 4

2. Weigh dehy blocks and record individual block weights on flow card. Identify each mix by NC blend number and type of propellant.

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D. Solvent Mix House

1. Use General Operating Procedures for preparing DPA with ether (mixed solvent). Mixture calculated weights of ingredients for preparation of one final mix charge and one solvent mix are as follows:

<u>Ingredient</u>	<u>One Final Mix, pounds</u>	<u>One Solvent Mix (4-1/2 Mixes)</u>
Ether	212.3	955.35 pounds
Diphenylamine	<u>3.5</u>	<u>15.78 pounds</u>
TOTAL	215.8	971.10 pounds

2. A laboratory analysis must be performed on each tank of solvent mix. The laboratory sample must meet the following requirements:

<u>Ingredient</u>	<u>Percent Ingredient</u>
Diphenylamine	1.02 to 2.22
Ether	97.38 to 99.38

E. Final Mixer (mixer temperature 50° maximum)

1. Build alcohol to 114 pounds and add the alcohol to the mixer. The alcohol add weight is determined by subtracting the dry nitrocellulose weight from the total wet weight of the dehydrated blocks and subtracting the difference from 114 pounds.
2. If there is no alcohol build, there must be a minimum of 10 pounds added to the mixer.
3. With the mixer in operation, gradually add 348 pounds of nitrocellulose (split blocks) to the mixer.
4. Mix for 4 to 5 minutes.
5.
 - a. Standard Method - Allow 216 \pm 1 pound of mixed solvents to start flowing into the mixer.
 - b. Alternate Method - Add 3.5 pounds (3 lbs 8 ozs \pm 0.3 ozs) of DPA to 10 pounds of ether in a solvent boot. Stir the mixture with a wooden paddle until the DPA is dissolved (approximately 1 minute). Add the slurry mix (DPA-ether) plus an additional 202 pounds of ether to the mixer.
6. Add one bag of K₂SO₄ (3.5 pounds) to the mix. Distribute the chemical evenly.

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7. Add 40 pounds of remix (strands, split press blocks, and heels) if available.
8. Close the lid and mix for 25 minutes.
9. Ten minutes, minimum prior to discharging the mixer, an additional solvent add (ether/alcohol in a 2:1 ratio) may be made, as required, to produce propellant which will extrude within the desired pressure range. Record all solvent adds and exact mixing time on the flow card.
10. Continue mixing until a minimum mixing time of 40 minutes (time after the start of solvent mix addition) has occurred.
11. When the desired mix consistency has been obtained, pull the mix into aluminum tubs.
12. Charge the required amount of propellant into the macerator.
13. Macerate for a minimum of five minutes.
14. Pull the macerated propellant and deliver to the preblocker.

Alternate Mixer

1. Produce 4 mixes using Beken-Mixer (double-wing) and current GOP.
2. Mix time will be 30 minutes or as specified by initiating engineer.

F. Preblocking, Macaroni, and Final Blocking

1. Preblocker - Sufficient dwell time to make blocks for macaroni press.
2. Macaroni - Use one 16-mesh screen.
3. Final Blocker - 30 seconds (minimum) high pressure dwell time.

G. Press and Cutting House

	<u>RAD-PE-559-6</u>
Type Press	Vertical
No. of Screens	2 (16 and 40 mesh)
No. of Dies/Press	49
Die Dimensions	
Agate, inch	0.080 inch
Pin, inch	0.010 inch
No. of Pins	1
Extrusion Pressure	2000-2800

PEI 559-4

February 28, 1977

G. Press and Cutting House (cont'd)

RAD-PE-559-5

Type Cutter	Small Arms
Green Length	0.071 ± 0.001 inch
Outer Web	0.086
Inner Web	0.086
Cutting Die	0.086
No. of Blades	56
Roll Size	1-1/2 plain
Gear Train	90 x 180 x 160 x 89

1. Dies (agates) must be QC inspected prior to use.
2. Adjustments may be necessary in the gear train and cutting dies to obtain correct dimensions.
3. Use water/alcohol mixture in dripolator on cutting machines.
4. Cutting machines must be kept in adjustment so as "tails" do not exceed 5 percent.
5. The lots must be properly identified and separated.

H. Solvent Recovery

Use General Operating Procedures.

1. Load the propellant into the Solvent Recovery tank at 35°C. Keep each lot separate.
2. Increase the temperature from 35°C to 55°C over a 12-hour period and hold at 55 ± 6°C for 34 hours (or until a solvent flow of 5 minutes or more is obtained).
- (SAMPLE) 3. Obtain a one-quart sample from each lot after cycle is completed. Label the samples for residual solvent analysis and physical measurements.
4. Transport to Water Dry.

I. Water Dry

1. Load propellant in Water Dry and cycle at 56°C - 62°C.
2. Water dry propellant for 10 days. Do not take off cycle.

PEI 559-4

February 28, 1977

I. Water Dry (cont'd)

- (SAMPLE)
3. Obtain a one-pound sample from each lot after 10 days of cycling. Label the samples for residual solvents and physical measurements.
 4. Instructions for additional cycling will be given by initiating engineers based on residual solvent analysis. An additional one-pound sample for residual solvents only may be required if cycle time is increased.

J. Coating House

Coating will be in accordance with the following table:

<u>Granulation Lot</u>	<u>Propellant* Wet Weight</u>	<u>Coating Level, %</u>	<u>Weight of Methyl Centralite/Ether Alcohol per Coating Blend</u>	<u>Weight of Ethyl Alcohol Pre-Wet/ Coating Blend</u>	<u>No. of Coating Blends</u>
559-6	223 lbs (wet) 200 lbs (dry)	4.56	11.0/17.0 lbs	9.0 lbs	5

Methyl centralite must be ground - 97 percent minimum to pass a 70 mesh screen.

*It will be necessary to determine the moisture content of the wet propellant from each granulation size. A representative sample (1 pint) will be taken from the bagged propellant and CCl₄ moisture determined in order to calculate proper dry propellant weight.

The first (pilot) blend will be sampled and tested for moisture, HOE and closed bomb before additional blends will be coated. Based upon these ballistic results, the remaining propellant will be coated according to instructions given by R-QCIC.

Coating Technique

1. Charge wet propellant (200 pounds dry weight) and prewetting alcohol into coating barrel.
2. Start barrel rotation.
3. Bring temperature to $75 \pm 1^{\circ}\text{C}$ ($167 \pm 2^{\circ}\text{C}$).
4. Rotate for 15 minutes at temperature and stop barrel.
5. In accordance with the table above or RQCIC, place coating slurry tank in coating barrel opening and start barrel.

PEI 559-4

February 28, 1977

6. Rotate barrel for 45 minutes starting from start of addition of methyl centralite.
7. Cool coating barrel to 40°C and cycle 10 minutes.
8. Wash propellant with cold water from coating barrel through trough and discharge into buggies.
9. Transport to air dry identified as lot RAD-PE-559-6.

K. Air Dry

1. Charge 2000 lb lot.
2. Maintain temperature of air at 54 ± 4°C (129 ± 7°F) for a sufficient time to obtain a moisture content range of 0.85% to 1.25%. Estimated time is 5 - 11 hours. A 20 minute M&V sample should be taken after five hours.
3. At the end of drying cycle, allow a minimum of one hour cool-down at 100 ± 5°F with blowers running.
4. Upon completion of drying, send propellant sublots to Blending and Glazing in drop plug buggies.

L. Blending and Glazing

1. Charge lot into a blender barrel and rotate for 10 minutes (ungraphited).
2. Obtain a one-pint sample from each lot, label, and send to Chemical Laboratory for 20 minute M&V analysis.
 - a. If M&V results are within range of 1.00 to 1.30 percent, no adjustment is necessary.
 - b. If M&V results are less than 1.00 percent, the water add can be calculated by the following equation:

$$\frac{\text{Pounds of Propellant} \times 1.15 - \text{M\&V Results}}{1.00} = \text{Pounds of water to add}$$

3. After the moisture content has been adjusted, glaze propellant batch with 0.2 percent graphite using a 3-hour glaze cycle (2 pounds/1000 pounds)

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February 28, 1977

4. Screen propellant.
5. Pull lot into fiber drums and identify as lot RAD-PE-559- 6.
- (SAMPLE) 6. Obtain a 10-pound sample from lot after screening has been completed. Label sample for gun, chemical, HOE, closed bomb, bulk density, hydroscopicity, and physical dimensions. Identify sample by proper designations.

M. Marking and Addressing

Marking and address is to be as follows:

One side: PROPELLANT EXPLOSIVE (SOLID) CLASS B
25mm GUN HE
LOT RAD-PE-559- 6
0.024" WEB SP GRAIN
150 LBS NET 161 LBS GROSS
4.2 CU FT PACKED *

*Insert as applicable.

TO: AERONUTRONIC FORD CORPORATION
AERONUTRONIC DIVISION
SAN JUAN CAPISTRANO TEST FAC.
SAN JUAN CAPISTRANO, CA. 92575

FROM: COMMANDER
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA 24141
CONTRACT: DAAA-09-71-C-0329

III. TECHNICAL DEPARTMENT

A. Quality Control

1. Monitor and inspect the propellant outlined under this PEI using Standard Inspection Procedure and Special Operating Instructions contained herein.
2. Ensure that the propellant is kept separated and properly identified at the cutting machine and in the powder buggies.

SAMPLING AND TESTING SUMMARY

<u>Item Sampled</u>	<u>Where Sample Taken</u>	<u>Frequency</u>	<u>Amount of Sample</u>	<u>Tests</u>	<u>Identification</u>
Solvent Content	Solvent Recovery	1 sample	1 pound or 1 pint	GC TV and 20' M&V	PEI No., Lot No., Solvent Recovery
Drying Time	Water Dry	Sample after water drying 10 days and at end of cycle.	1 pound or pint	GC TV and Moisture	PEI No., Lot No., Date, Hours dried, "Water Dried", 25mm
Moisture Level	Air Dry	1 sample after 5 hours*	1 pint, ea sample	20' M&V GC TV	PEI No., Lot No., Shift, Time, No. Hours Dried, 25mm
Qualify Coating	Coating	First Blend	1 pound	Moisture, HOE, RQ&RF	PEI No., Lot No., Date "Pre-Glaze" 25mm
Each Lot (Ungraphited)	Blender Barrel	1 sample	1 pint, ea sample	20' M&V, GV TV	
Finished Propellant	Final Screen House	1 sample lot	10 pounds	% Methyl Centralite % Graphite GC TV 5 Hour M&V Bulk Density Physical Dimensions Gun Test Closed Bomb HOE Hygroscopicity % DPA % K2SO4 RS	PEI No., Lot No., Date, Shift, Time, 25mm "Final Lot Acceptance Sample"

*Additional samples may be required, depending on initial results.

APPENDIX D

"OLD METHOD"

PROCEDURE FOR COATING PROPELLANT FOR 25-MM
HE PROJECTILE

PROCEDURE FOR COATING PROPELLANT FOR 25 mm HE PROJECTILE

Ingredients:

Base Grain: Single perforated M10 formula with: Web = 0.022" - 0.024";
D/d = 6 - 10; and L/D = 1.1 - 1.5

Coating: Methyl centralite, per specification MIL-M-19719, ground to
pass 70 mesh screen

Coating Vehicle: Water

Coating Equipment:

"Swætie" barrel, copper or stainless steel, with a hot water jacket. Barrel
is rotated at 18 revolutions per minute.

Procedure:

1. Charge wet (≈12 percent) propellant (100 - 1200 pounds, dry weight) to barrel while at ambient temperature.
2. Insert basket lined with 20-mesh screening into barrel opening and add to it ground methyl centralite in quantity necessary to effect the specified or desired coating level.
3. Commence barrel rotation and bring jacket temperature to 195 - 205°F (91 - 96°C).
4. Cycle at this temperature for 30 minutes.
5. Cover propellant with water so that propellant level is under water by at least six inches.
6. Steep (cycle) at 200 ± 5°F (91 - 96°C) for six hours.
7. Cool (15 minutes) and wash propellant into buggies containing filters or load washed propellant onto drying trays.
8. Dry for 6 - 8 hours in tank air dry or forced air dry at 140°F (60°C).
9. Blend, glaze, and pack.

APPENDIX E

"NEW METHOD"

PROCEDURE FOR COATING PROPELLANT FOR 25-MM APDS-T PROJECTILE

PROCEDURE FOR COATING PROPELLANT FOR 25-mm APDS-T PROJECTILE

Ingredients:

Base Grain: 7-Perforated M10 formula with: Web = 0.018' - 0.019";
D/d = 11 - 15; and L/D = 0.9 - 1.0

Coating: Methyl centralite, per specification MIL-M-19719

Coating Vehicle: Ethyl alcohol and water

Coating Equipment:

"Sweetie" barrel, copper or stainless steel, with a hot water jacket. Barrel is rotated at 18 revolutions per minute.

Procedure:

1. Charge water-dried propellant (100 - 1000 pounds, dry weight) that has been drained to ≤ 10 percent water into coating barrel.
2. Based on dry weight of propellant, bring water weight to 0.1 lb/lb, and add alcohol, 0.14 lb/lb. Bring rotating barrel jacket to $167 \pm 2^{\circ}\text{F}$ ($75 \pm 1^{\circ}\text{C}$).
3. Charge methyl centralite and alcohol coating slurry (quantity depends upon specified coating) to barrel contents over 5-minute period.
4. Rotate barrel and contents for 2 hours (± 5 minutes) at previously stated temperature.
5. Cool barrel to room temperature for 15 minutes.
6. Wash propellant from coating barrel with cold water through chutes into buggies with sieves in bottoms.
7. Water dry for 48 hours to remove excess alcohol.
8. Dry 5 to 8 hours in tank air dry at 140°F (60°C)
9. Blend, glaze and pack.

APPENDIX F

PROPELLANT DESCRIPTION SHEETS

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET

LOT NUMBER
 RAD-PEI-559-1 (S/L A-3)
 ACCEPTANCE DATE
 3 June 1976

MFG BY HERCULES INCORPORATED
 A1 RADFORD ARMY AMMUNITION PLANT
 CONTRACT NUMBER DAAA09-71C-0329
 WEIGHT OF LOT 807 lbs

PROOF FIRED BY _____ PROVING GROUND _____
 FIRING RECORD NUMBER _____
 PROJECTILE _____ WEIGHT _____
 PROJECTILE LOT NUMBER _____
 TEMPERATURE OF POWDER _____ OF _____
 STANDARD PROPELLANT LOT _____

PROPELLANT DESCRIPTION

TYPE _____ M _____
 AVERAGE WEB _____
 SPECIFICATION _____ DATED _____ WITH REVISION _____ DATED _____

CHARGE WEIGHTS

INC. MENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
25mm HE Propellant					
Accepted for PE Project 559.					

THIS PROPELLANT LOT IS ACCEPTED

 JAMES E. BLAND
 CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OF PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO _____

 CHIEF QUALITY ASSURANCE DIVISION

PROPELLANT DESCRIPTION SHEET

U.S. Army 360-PEI-559-1 (S/L A-3) of 1976 Composition No. _____ 25mm HE Propellant

Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 807 lbs.
 Contract No. DAAA09-71-C-0329 Date 6-30-71 Specification No. COK ltr SARRA-IE, dated 13 April 1976

ACCEPTED BLEND NUMBERS		NITROCELLULOSE		
<u>A-15177</u>		Nitrogen Content	KI Starch (65°C)	Stability (134.5°C)
		Maximum _____ %	_____ Min	_____ Min
		Minimum _____ %	_____ Min	_____ Min
		Average <u>13.12</u> %	<u>45+</u> Min	<u>30+</u> Min
				Explosion _____ Min

MANUFACTURE OF PROPELLANT
0.92 Pounds Solvent per Pound NC/Dry weight ingredients consisting of 65 Pounds Nitrocellulose and 25 Pounds ether per 100 Pounds Solvent
 Percentage Ratio to Water 0

PROCESS-SOLVENT RECOVERY AND DRYING				TIME	
TEMPERATURES °C				Days	Hours
From	To				
<u>35</u>	<u>35</u>	Temperature of SR Tank During Loading			
<u>35</u>	<u>55</u>	SR Tank Temperature Increase Period			<u>12</u>
<u>49</u>	<u>61</u>	Solvent Recovery Time			<u>34</u>
<u>56</u>	<u>62</u>	Water Dry Period		<u>10</u>	
<u>90</u>	<u>96</u>	Methyl Centralite Coating Cycle			<u>6 1/2</u>
<u>55</u>	<u>55</u>	Forced Air Drying After Coating			<u>7</u>

PROPELLANT COMPOSITION			TESTS OF FINISHED PROPELLANT		STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formic	Percent Measured	Formic	Formic	Formic	Actual
Nitrocellulose	Remainder	92.14	134.5°C	No CC 40'	50'	
Diphenylamine	0.5 to 1.25	0.62	No Explosion	5 hr, min	5 hr +	
Graphite	0.4 max	0.17	Form of Propellant			
Methyl Centralite	4.50 to 5.00	4.56	Heat of Explosion,			
Potassium Sulfate	0.30 to 1.00	0.81	cal/gm	N/A	846.1	
Total Volatiles	2.35 max	1.70				
Moisture and Volatiles	1.00 ± 0.25	1.14				
Residual Solvents	1.10 max	0.56				

CLOSED BOMB				PROPELLANT DIMENSIONS (inches)				Web Variation in % of Mean Dimensions	
Lot Number	Temp °C	Relative Humidity	Web Force	Specification	Die	Finished	Spec	Actual	
				Length (L)	0.070	0.0729	N/A	17.65	
				Diameter (D)	0.080	0.0527	N/A	2.83	
Standard		100.00%	100.00%	Web, Avg	0.035	0.0236			
Remarks									
									Packed 5/22/76
									Sampled 5/22/76
									Test Finished 6/3/76
									Offered 6/3/76
									Description Sheet Forwarded 6/3/76

Type of Packing Container Fiber Drums
 Remarks This lot meets all specification requirements.

Contractor's Representative R. A. Williams Government Quality Assurance Representative J. E. Bland

PROPELLANT DESCRIPTION SHEET CORRECTED

U.S. Army Lot No. RAD-PEI-559-1 of 19 76 Composition No. 25mm AP Propellant
(S/L B-3)

Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA Packed Amount 395 pounds *
Contract No. DAAA09-71-C-0329 Date 6-30-71 Specification No. COR 1tr SARRA-IE, dated
13 April 1976

ACCEPTED BLEND NUMBERS		NITROCELLULOSE		
<u>A-15177</u>		Nitrogen Content	K1 Starch (65 °C)	Stability (134 °C)
		Maximum _____ %	_____ Mins	_____ Mins
		Minimum _____ %	_____ Mins	_____ Mins
		Average <u>13.12</u> %	<u>45+</u> Mins	<u>30+</u> Mins
			Explosion _____ Mins	

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 65 Pounds Alcohol and 35 Pounds ether per 100 Pounds Solvent
Percentage Benzene to Whole 0

PROCESS-SOLVENT RECOVERY AND DRYING				TIME	
TEMPERATURES °C				Days	Hours
From	To				
<u>35</u>	<u>35</u>	Temperature of SR tank during loading			---
<u>35</u>	<u>55</u>	SR Tank temperature increase period			<u>12</u>
<u>49</u>	<u>61</u>	Solvent recovery time			<u>34</u>
<u>56</u>	<u>62</u>	Water dry period		<u>10</u>	---
<u>90</u>	<u>96</u>	Methyl centralite coating cycle			<u>6 1/2</u>
<u>55</u>	<u>55</u>	Forced air drying after coating			<u>7</u>

PROPELLANT COMPOSITION			TESTS OF FINISHED PROPELLANT		STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formed	Percent Tolerance	Percent Measured	Test	Formula	Actual
Nitrocellulose	Remainder		<u>92.51</u>	Heat Test <u>134.5°C</u>	<u>CC 40' min</u>	<u>50'</u>
Diphenylamine	<u>0.50 to 1.25</u>		<u>0.67</u>	No Explosion	<u>5 hr min</u>	<u>5 hr</u>
Graphite	<u>0.40 max</u>		<u>0.14</u>	Form of Propellant	<u>Monoperforated</u>	
Methyl Centralite	<u>3.9 nom</u>		<u>3.88</u>	Heat of Explosion,		
Potassium Sulfate	<u>0.10 to 1.00</u>		<u>0.89</u>	cal/gm	<u>N/A</u>	<u>862.7</u>
Total Volatiles	<u>2.35 max</u>		<u>1.91</u>			
Moisture & Volatiles	<u>1.00 + 0.25</u>		<u>0.18</u>			
Residual Solvents	<u>1.10 max</u>		<u>0.73</u>			

CLOSED BOMB				PROPELLANT DIMENSIONS (inches)				Mean Variation in % of Mean Dimensions	
Type	Lot Number	Temp °F	Reactive Quotient	Positive Force	Specification	Die	Finished	Mean Variation in % of Mean Dimensions	
								Spec	Actual
					Length (L)	<u>0.075</u>	<u>0.0709</u>	<u>N/A</u>	<u>4.98</u>
					Diameter (D)	<u>0.084</u>	<u>0.0558</u>	<u>N/A</u>	<u>3.64</u>
Standard			<u>100.00%</u>	<u>100.00%</u>	Part Dia (e)	<u>0.010</u>	<u>0.0056</u>	DATES	
Remarks					Web, avg	<u>0.037</u>	<u>0.0251</u>	Packed	<u>5/22/76</u>
								Sampled	<u>5/22/76</u>
					Web Difference/Std Dev in % of Web Average			Test Finished	<u>6/1/76</u>
					L D		<u>1.26</u>	Offered	<u>6/1/76</u>
					D d		<u>9.93</u>	Description Sheet Forwarded	<u>6/29/76</u>

Fiber Drums

Type of Packing Container _____
Remarks This lot meets all specification requirements.

*Description sheet is amended to reflect that 200 pounds were shipped to Aeronutronics Ford, and 195 pounds is retained in a RAAP magazine for future use.

Contractor's Signature <u>R. A. Williams</u>	Government Quality Assurance Representative <u>J. E. Bland</u>
---	---

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

*CORRECTED COPY

PROPELLANT ACCEPTANCE SHEET

WEAPON

LOT NUMBER

RAD-PEI-559-1 (S/L B-3)

MODEL

ACCEPTANCE DATE

3 June 1976

MFG BY **HERCULES INCORPORATED**
AT **RADFORD ARMY AMMUNITION PLANT**

PROF FIRED BY _____ PROVING GROUND _____

FIRING RECORD NUMBER _____

PROJECTILE _____ WEIGHT _____

PROJECTILE LOT NUMBER _____

TEMPERATURE OF POWDER _____ OF _____

STANDARD PROPELLANT LOT _____

CONTRACT NUMBER **DAAA09-71C-0329**

WEIGHT OF LOT **395 pounds**

PROPELLANT DESCRIPTION

TYPE _____ M _____

AVERAGE WEB _____

SPECIFICATION _____ DATED _____ WITH REVISION _____ DATED _____

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS./SQ. IN.
	<u>25mm AP Propellant</u>				
	Accepted for PE Project 559				

THIS PROPELLANT LOT IS ACCEPTED
*Corrected copy issued to correct
weight of lot.

James E. Bland
JAMES E. BLAND
CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED
BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT
WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO _____

CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET

LOT NUMBER

RAD-PE-559-3A

MODEL

ACCEPTANCE DATE

14 December 1976

MFG BY HERCULES INCORPORATED
AT RADFORD ARMY AMMUNITION PLANT

PROOF FIRED BY _____ PROVING GROUND _____

FIRING RECORD NUMBER _____

PROJECTILE _____ WEIGHT _____

PROJECTILE LOT NUMBER _____

TEMPERATURE OF POWDER _____ OF _____

STANDARD PROPELLANT LOT _____

CONTRACT NUMBER DAAA09-71C-0329

WEIGHT OF LOT 105 pounds

PROPELLANT DESCRIPTION

TYPE M

AVERAGE WEB _____

SPECIFICATION _____ DATED _____ WITH REVISION _____ DATED _____

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
Propellant, Single-Base, Multiple Perf., Methyl Centralite Coated for 25mm AP-T					
Accepted for PE Project 559.					

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND
CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO _____

CHIEF QUALITY ASSURANCE DIVISION

PROPELLANT DESCRIPTION SHEET

U S Army Lot No. RAD-PE-559-3A of 19 76 Composition No. Propellant, Single-Base, Multiple Perf.
Methyl Centralite Coated for 25mm AP-T
 Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 105
 Contract No. DAAA09-71-C-0329 Date 6-30-71 Specification No. COR letter SARRA-IE dated
15 July 1970

ACCEPTED BLEND NUMBERS		NITROCELLULOSE		
<u>C 15031</u>		Nitrogen Content	KI Storch (65°C)	Stability (134°C)
		Maximum _____ %	_____ Min	_____ Min
		Minimum _____ %	_____ Min	_____ Min
		Average <u>13.12</u> %	<u>45+</u> Min	<u>30</u> Min
				Explosion _____ Min

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Nitrocell and 65 Pounds Ether per 100 Pounds Solvent.
 Percentages Refer to Water 0

MANUFACTURE OF PROPELLANT			PROCESS-SOLVENT RECOVERY AND DRYING	
			Days	Hours
From	To			
35	55	Increase Temperature From Loading to Cycle Level		12
49	61	Solvent Recovery		34
56	62	Water Dry	16	
74	76	Coating Cycle		1/2
58	62	Post Coating Air Dry		16

PROPELLANT COMPOSITION				TESTS OF FINISHED PROPELLANT			STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Formula	Actual			
Nitrocellulose	Remainder		94.28	Heat Test S.P., 134.5°C	No cc	40'	60'+	
Nitrogen in NC	13.15	± 0.05	13.12	No Explosion	5 hr Min		5+	
Diphenylamine	0.50 to 1.25		0.80	Form of Propellant	Type I		Cylinder	
Graphite	0.40	Max	0.16	No Perforations			7	
Methyl Centralite	4.6	Nom	3.95					
Potassium Sulfate	0.10 to 1.00		0.97					
Total Volatiles	2.35	Max	2.55					
Moisture & Volatiles	1.00	± 0.25	1.64	Heat of Explosion				
Residual Solvents	1.10	Max	0.96	cal/gm			843	
Hygroscopicity	1.80	Max	1.43					
Dust & Foreign Matter	0.10	Max	0.03					
Bulk Density, gm/cc	0.940 to 1.050		0.941					

CLOSED BOMBS				PROPELLANT DIMENSIONS (inches)							
Lot Number	Temp °F	Reactive Cuckness	Relative Force	Specification		Die		Finished		Mean Variation in % of Mean Dimensions	
				Length (L)	Diameter (D)			Spec	Actual	Spec	Actual
(1) RAD-PE-559-3A	+90	93.33	96.19			0.118	0.1110	6.25	2.47		
(2) RAD-PE-559-3A	+90	94.08	96.29			0.132	0.0873	6.25	1.87		
Standard	P2078	+90	100.00%	100.00%	Part 219 (a) *	0.014	0.0082			DATES	
Remarks					Web*					Packed	11/19/76
					Avg	0.0185	Nom	0.0225	0.0157	Sampled	11/19/76
					Outer	0.018		0.0172		Test Finished	12/8/76
(1) Loading Density of	0.15 gm/cc			Inner		0.027		0.0143		Offered	12/9/76
(2) Loading Density of	0.2 gm/cc			Web Difference/3rd Dec in % of Web Average *	15 Max	-40.00		18.84		Description Sheet Forwarded	12/13/76
	200 cc (Nom) Closed Bomb			L ₀ *	1 Nom	0.89		1.30			
				D ₀ *	5 - 15	9.42		10.56			

Type of Packing Container: One fiber drum containing 100 pounds net and 5 pound sample.
 Remarks: * Dimensions are from the uncoated base stock propellant.

This lot was produced on a best effort basis.

Contractor's Representative: R. A. Williams
 Government Quality Assurance Representative: J. E. Bland

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET.	WEAPON	LOT NUMBER RAD-PE-559-3B
	MODEL	ACCEPTANCE DATE 14 Decmeber 1976

MFG BY AT CONTRACT NUMBER DAAA09-71C-0329	HERCULES INCORPORATED RADFORD ARMY AMMUNITION PLANT	PROOF FIRED BY	PROVING GROUND
WEIGHT OF LOT 105 pounds		FIRING RECORD NUMBER	
		PROJECTILE	WEIGHT
		PROJECTILE LOT NUMBER	
		TEMPERATURE OF POWDER	CF
		STANDARD PROPELLANT LOT	

PROPELLANT DESCRIPTION			
TYPE	M		
AVERAGE WEB SPECIFICATION	DATED	WITH REVISION	DATED

CHARGE WEIGHTS					
INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
	Propellant, Single-Base, Multiple Perf., Methyl Centralite Coated for 25mm AP-T				
	Accepted for PE Project 569.				

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND
 CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO _____

CHIEF QUALITY ASSURANCE DIVISION

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-3B of 19 76 Composition No. Propellant, Single-Base, Multiple Perf., Methyl Centralite coated for 25mm AP-T

Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 105
Contract No. DAAA09-71-C-0329 Date 6-30-71 Specification No. COR letter SARRA-IE dated 15 July 1976

ACCEPTED BLEND NUMBERS NITROCELLULOSE

C 15031	Nitrogen Content		KI Starch (85.5°C)	Stability (134.5°C)
	Maximum	_____ %	_____ Min.	_____ Min.
	Minimum	_____ %	_____ Min.	_____ Min.
Average	<u>13.12</u> %	<u>45+</u> Min.	<u>30</u> Min.	Explosion _____ Min.

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Alcohol and 65 Pounds Ether per 100 Pounds Solvent.
Percentage Ratio to White 0

PROCESS-SOLVENT RECOVERY AND DRYING

From	To		TIME	
			Days	Hours
35	55	Increase temperature from loading to cycle level		12
49	61	Solvent Recovery		34
56	62	Water Dry	16	
74	76	Coating Cycle		1/2
58	62	Post Coating Air Dry		16

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Formula	Actual	
Nitrocellulose	Remainder:		92.61	Heat Test S.P. 134.5°C	No cc 40'	60'+
Nitrogen in NC	13.15		13.12	No Explosion	5 hr Min	5+
Diphenylamine	0.50 to 1.25		0.79	Form of Propellant Type I		Cylinder
Graphite	0.40 Max		0.10			
Methyl Centralite	6.6 Nom		5.73	No. Perforations		7
Potassium Sulfate	0.10 to 1.00		0.87			
Total Volatiles	2.35 Max		1.36			
Moisture & Volatiles	1.00 ± 0.25		0.59	Heat of Explosion,		
Residual Solvents	1.10 Max		0.77	cal/gm		816
Hygroscopicity	1.80 Max		1.32			
Dust & Foreign Matter	0.10 Max		0.03			
Bulk Density, gm/cc	0.940 to 1.050		0.914			

CLOSED BOMB

PROPELLANT DIMENSIONS (inches)

Lot Number	Temp °F	Relative Humidity %	Relative Force	Specification	Dia	Finished	Mean Variation in % of Mean Dimensions	
							Specs	Actual*
Test (1) RAD-PE-559-3B +90		85.57	95.93					
(2) RAD-PE-559-3B +90		87.72	95.23	Length (L)	0.118	0.1111	6.25	2.47
				Diameter (D)	0.132	0.0875	6.25	1.87
Standard P2078	+90	100.00%	100.00%	Part Dia (d) *	0.014	0.0082		
Remarks				Web*				
				Avg	0.0185	Nom: 0.0225 0.0157	Packed	11/19/76
				Outer	0.018	0.0172	Sampled	11/19/76
(1) Loading Density of 0.15 gm/cc				Inner	0.027	0.0143	Test Finished	12/8/76
(2) Loading Density of 0.2 gm/cc				Web Difference/Spec Dia in % of Web Average *	15 max	-40.00 18.84	Ordered	12/9/76
200 cc (Nom) Closed Bomb				Ld *	1 Nom	0.89 1.50	Description Sheets Forwarded	
				Qd *	5 - 15	0.42 10.56		12/13/76

Type of Packing Container One fiber drum containing 100 pounds net and 5 pound sample.
Remarks * Dimensions are from the uncoated base stock propellant.

This lot was produced on a best effort basis.

Contractor's Representative

R. A. Williams

Government Quality Assurance Representative

J. E. Bland

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET

LOT NUMBER

RAD-PE-559-4A

MODEL

ACCEPTANCE DATE

14 December 1976

MFG BY **HERCULES INCORPORATED**
AT **RADFORD ARMY AMMUNITION PLANT**

PROOF FIRED BY _____ PROVING GROUND _____

CONTRACT NUMBER **DAAA09-71C-0329**

FIRING RECORD NUMBER _____

WEIGHT OF LOT **105 pounds**

PROJECTILE _____ WEIGHT _____

PROJECTILE LOT NUMBER _____

TEMPERATURE OF POWDER _____ CF _____

STANDARD PROPELLANT LOT _____

PROPELLANT DESCRIPTION

TYPE **M**

AVERAGE WEB _____

SPECIFICATION _____ DATED _____ WITH REVISION _____ DATED _____

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
Propellant, Single-Base, Multiple Perf., Methyl Centralite Coated for 25mm AP-T					
Accepted for PE Project 559.					

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND

CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO _____

CHIEF QUALITY ASSURANCE DIVISION

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-4A of 19 76 Composition No. Propellant, Single-Base, Multiple Perf, Methyl Centralite Coated for 25mm AF-T
 Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 105
 I. PROJECT No. DAAA09-71-C-0329 Date 6-30-71 Specification No. CCR Letter SARRA-JE dated 15 July 1976

ACCEPTED BLEND NUMBERS		NITROCELLULOSE			
<u>C15031</u>		Nitrogen Content	KI Strength (65.5°C)	Stability ((34.5°C)	
		Maximum _____ %	_____ Mine	_____ Mine	_____ Mine
		Minimum _____ %	_____ Mine	_____ Mine	_____ Mine
		Average <u>13.12</u> %	<u>45+</u> Mine	<u>30</u> Mine	_____ Mine
				Expiration _____	_____

MANUFACTURE OF PROPELLANT
0.92 Percent Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Alcohol and 65 Pounds Ether per 100 Pounds Solvent.
 Percentage Form to Which 0

PROCESS-SOLVENT RECOVERY AND DRYING			TIME	
From	To		Days	Hours
<u>35</u>	<u>55</u>	Increase Temperature from Loading to Cycle Level		<u>12</u>
<u>49</u>	<u>61</u>	Solvent Recovery		<u>34</u>
<u>56</u>	<u>62</u>	Water Dry	<u>15</u>	
<u>74</u>	<u>76</u>	Coating Cycle		<u>1/2</u>
<u>58</u>	<u>62</u>	Post Coating Air Dry		<u>16</u>

PROPELLANT COMPOSITION			TESTS OF FINISHED PROPELLANT		STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formula	Percent Clearance	Percent Measured	Form is	Actual	
Nitrocellulose	Remainder		<u>95.75</u>	Heat Test S.P. <u>134.5°C</u>	No CC <u>40</u> <u>60+</u>	
Nitrogen in Nitrocellulose	<u>13.15</u>	<u>-0.05</u>	<u>13.12</u>	No Explosion	5 hrs Mi- <u>5+</u>	
Diphenylamine	<u>0.50 to 1.25</u>		<u>0.79</u>	Form of Propellant Type	Cylinder	
Graphite	<u>0.40</u> Max		<u>0.14</u>	No Perforations	<u>7</u>	
Methyl Centralite	<u>3.0</u> Nom		<u>2.45</u>			
Potassium Sulfate	<u>0.10 to 1.00</u>		<u>1.01</u>			
Total Volatiles	<u>2.35</u> Max		<u>2.05</u>	Heat of Explos-		
Moisture & Volatiles	<u>1.00 ± 0.25</u>		<u>1.11</u>	sion, cal/gm	<u>896</u>	
Residual Solvents	<u>1.10</u> Max		<u>0.94</u>			
Hygroscopicity	<u>1.80</u> Max		<u>1.42</u>			
Dust & Foreign Matter	<u>0.10</u> Max		<u>0.03</u>			
Bulk Density, gm/cc	<u>0.940 to 1.050</u>		<u>0.981</u>			

CLOSED BOMB				PROPELLANT DIMENSIONS (inches)			
Lot Number	Temp °F	Weight Difference	Weight Error	Specification	Org	Finished	Mean Variation in % of Mean Dimensions
(1) <u>RAD-PE-559-4A</u>	<u>+90</u>	<u>106.64</u>	<u>99.75</u>				
(2) <u>RAD-PE-559-4A</u>	<u>+90</u>	<u>105.59</u>	<u>99.25</u>	Length (L)	<u>0.130</u>	<u>0.1250</u>	<u>6.25</u> <u>2.73</u>
				Diameter (D)	<u>0.147</u>	<u>0.0962</u>	<u>6.25</u> <u>2.01</u>
Standard	<u>P2078</u>	<u>+90</u>	<u>100.70%</u> <u>100.00%</u>	Part Dia (g)*	<u>0.014</u>	<u>0.0078</u>	
Remarks				Web*			DATES
				Avg	<u>0.0185</u> Nom	<u>0.02630</u> <u>0.0187</u>	Packed <u>11/19/76</u>
				Outer		<u>0.0215</u> <u>0.0192</u>	Sampled <u>11/19/76</u>
				Inner		<u>0.0310</u> <u>0.0182</u>	Test Finished <u>12/8/76</u>
(1) Loading Density of <u>0.15</u> gm/cc				Web Difference % of Web Average	<u>15</u> max	<u>-36.19</u> <u>5.62</u>	Offered <u>12/9/76</u>
(2) Loading Density of <u>0.2</u> gm/cc				L/D	<u>1</u> Nom	<u>0.88</u> <u>1.25</u>	Description Sheet Forwarded <u>12/13/76</u>
<u>200 cc (Nom) Closed Bomb</u>				g/s	<u>5 - 15</u>	<u>10.50</u> <u>12.46</u>	

Type of Picking Container One fiber drum containing 100 pounds net and 5 pound sample.
 Remarks *Dimensions are from the uncoated base stock propellant.

This lot produced on a best effort basis.

Contractor's Representative: R. A. Williams Government Quality Assurance Representative: J. E. Pland

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET

LOT NUMBER

RAD-PE-559-4B

MODEL

ACCEPTANCE DATE

14 December 1976

MFG BY **HERCULES INCORPORATED**
AT **RADFORD ARMY AMMUNITION PLANT**

PROOF FIRED BY _____ PROVING GROUND _____

CONTRACT NUMBER **DAAA09-71C-0329**

FIRING RECORD NUMBER _____

WEIGHT OF LOT **105 pounds**

PROJECTILE _____ WEIGHT _____

PROJECTILE LOT NUMBER _____

TEMPERATURE OF POWDER _____ OF _____

STANDARD PROPELLANT LOT _____

PROPELLANT DESCRIPTION

TYPE

M

AVERAGE WEB

SPECIFICATION

DATED

WITH REVISION

DATED

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
<p><u>Propellant, Single-Base, Multiple Perf., Methyl Centralize Coated for 25mm AP-T.</u></p> <p>Accepted for PE Project 559.</p>					

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND

CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE DIVISION

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-4B of 19 76 Composition No. Propellant, Single-Base, Multiple Perf.
Methyl Centralite Coated for 25mm AP-T

Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Pounds Amount 105

Contract No. DAAA09-71-C-0329 Date 6-30-71 Specification No. COR letter SARRA-IE dated
15 July 1976

ACCEPTED BLEND NUMBERS		NITROCELLULOSE		
C15031	Nitrogen Content	NI Starch (85.5°C)	Stability (134.5°C)	
	Maximum _____ %	_____ Min	_____ Min	_____ Min
	Minimum _____ %	_____ Min	_____ Min	_____ Min
	Average <u>13.12</u> %	<u>45+</u> Min	<u>30</u> Min	_____ Min
Explosion _____ Min.				

MANUFACTURE OF PROPELLANT
0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Alcohol and 65 Pounds Ether per 100 Pounds Solvent.
Percentage Rems to Whole 0

TEMPERATURES °C		PROCESS-SOLVENT RECOVERY AND DRYING	TIME	
From	To		Days	Hours
35	55	Increase temperature from loading to cycle level		12
49	61	Solvent Recovery		34
56	62	Water Dry	16	
74	76	Coating Cycle		1/2
58	62	Post Coating Air Dry		16

PROPELLANT COMPOSITION			TESTS OF FINISHED PROPELLANT		STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formula	Purge Tolerance	Percent Measured	Formula	Actual	
Nitrocellulose	Remainder		94.33	Heat Test S.P. 134°C	No CC 40'	60'+
Nitrogen in NC	12.15	± 0.05	13.12	No explosion	5 hrs Min	5+
Diphenylamine	0.50 to 1.25		0.78	Form of Propellant Type I		Cylinder
Graphite	0.40	Max	0.23	No Perforations		7
Methyl Centralite	5.0	Nom	3.88			
Potassium Sulfate	0.10 to 1.00		1.01			
Total Volatiles	2.35	Max	1.42			
Moisture & Volatiles	1.00	± 0.25	0.68	Heat of Explosion		
Residual Solvents	1.10	Max	0.89	cal/gm		854
Hvgroscopicity	1.80	Max	1.38			
Dust & Foreign Matter	0.10	Max	0.02			
Bulk Density, gm/cc	0.940 to 1.050		0.975			

CLOSED BOMB				PROPELLANT DIMENSIONS (inches)				Mean Variation in % of Mean Dimensions	
Lot Number	Temp °F	Relative Quiescence	Relative Force	Specification	Org	Finished	Specs	Actual*	
Test (1) RAD-PE-559-4B+90		88.38	97.34						
(1) RAD-PE-559-4B+90		93.02	98.87	Length (L)	0.130	0.1259	6.25	2.75	
				Diameter (D)	0.147	0.0971	6.25	2.01	
Standard	P2078	+90	100.00%	Part Dia (e)*	0.014	0.0078	JATES		
Remarks				Web*	0.0185	Nom			
				Avg	0.0263	0.0187	Packed	11/19/76	
				Outer	0.0215	0.0192	Sample	11/19/76	
				Inner	0.0310	0.0182	Test Finished	12/8/76	
(1) Loading Density of 0.15 gm/cc				Web Difference/Std Dev in % of Web Average	15 max	-36.19	5.62	Cleared	12/9/76
(1) Loading Density of 0.2 gm/cc				L D *	Nom	0.88	1.28	Classification Sheet Forwarded	
200 cc (Nom) CLOSED BOMB				e *	5 - 15	10.50	12.46		12/13/76

Type of Packing Container One fiber drum containing 100 pounds net and 5 pound sample.
Remarks * Dimensions are from the uncoated base stock propellant.

This lot was produced on a best effort basis.

Contractor's Representative R. A. Williams	Government Quality Assurance Representative J. E. Bland
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THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET	WEAPON	LOT NUMBER RAD-PE-559-5A
	MODEL	ACCEPTANCE DATE 25 May 1977

MFG BY AT CONTRACT NUMBER WEIGHT OF LOT	HERCULES INCORPORATED RADFORD ARMY AMMUNITION PLANT DAAA09-77-C-4007 109 pounds	PROF FIRED BY FIRING RECORD NUMBER PROJECTILE PROJECTILE LOT NUMBER TEMPERATURE OF POWDER STANDARD PROPELLANT LOT	PROVING GROUND WEIGHT OF
--	--	--	--

PROPELLANT DESCRIPTION

TYPE	M
AVERAGE WEB	
SPECIFICATION	DATED
	WITH REVISION
	DATED

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
<u>25mm MP Propellant for AP Projectile</u>					
Accepted for PE Project 559					

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND
 CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO _____

CHIEF QUALITY ASSURANCE DIVISION

PROPELLANT SHEET

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

U S Army Lot No. RAD-PE-559-5A Composition No. 25mm MP Propellant for AP Projectile

Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 109 lbs.
 Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. COR letter SARRA-IE dated 26 January 1977.

ACCEPTED BLEND NUMBERS		NITROCELLULOSE			
<u>BC-15,058</u>		Nitrogen Content	KI Starch (65.5°C)	Stability (134.5°C)	
Max:	_____ %	_____ %	_____ Mins	_____ Mins	_____ Mins
Min:	_____ %	_____ %	_____ Mins	_____ Mins	_____ Mins
Average	<u>13.19</u> %	<u>None</u> %	<u>30</u> Mins	<u>30</u> Mins	<u>30</u> Mins
				Explosion	_____ Mins

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Nitrocell and 65 Pounds Ether per 100 Pounds Solvent.
 Percentage Remn to Whole 25

TEMPERATURES °C			PROCESS-SOLVENT RECOVERY AND DRYING	TIME	
From	To	Days		Hours	
<u>17</u>	<u>24</u>	<u>Solvent Recovery</u>		<u>64</u>	
<u>32</u>	<u>38</u>	<u>Solvent Recovery</u>		<u>24</u>	
<u>56</u>	<u>62</u>	<u>Water Dry</u>	<u>26</u>		
<u>58</u>	<u>62</u>	<u>Air Dried After Coating</u>		<u>104</u>	

PROPELLANT COMPOSITION				TESTS OF FINISHED PROPELLANT			STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Test	Formula	Actual		
Nitrocellulose	Remainder		<u>95.63</u>	Heat Test <u>134.5°C</u>	<u>cc 40' Min.</u>	<u>60' +</u>		
Nitrogen in Nitrocell.	<u>13.15</u>	<u>+ 0.05</u>	<u>13.19</u>	No Explosion	<u>5 Hrs. Min.</u>	<u>5 Hrs.</u>		
Diphenylamine	<u>0.50</u> to <u>1.25</u>		<u>0.90</u>	Form of Propellant Type I		<u>Cyl</u>		
Graphite	<u>0.40</u> Max.		<u>0.16</u>	No Perforations		<u>7</u>		
Methyl Centralite	<u>2.70</u> Nom.		<u>2.53</u>					
Potassium Sulfate	<u>0.10</u> to <u>1.00</u>		<u>0.94</u>	Heat of Explosion	<u>N/A</u>	<u>872.1</u>		
Total Volatiles	<u>2.35</u> Max.		<u>2.54</u>					
Moisture and Volatiles	<u>1.00</u> + <u>0.25</u>		<u>1.16</u>					
Residual Solvent	<u>1.10</u> Max.		<u>1.38</u>					
Hygroscopicity	<u>1.80</u> Max		<u>1.24</u>					
Bulk Density	<u>0.940</u> to <u>1.050</u>		<u>0.9947*</u>					
Dust & Foreign Matter	<u>0.10</u> Max.		<u>0.01</u>					

CLOSED BOMB				PROPELLANT DIMENSIONS (inches)					
Test	Lot Number	Temp °F	Relative Density	Relative Density	Specification	Die	Finished	Mean Variation in % of Mean Dimension	
	<u>RAD-PE-559-5A+90</u>		<u>95.5</u>	<u>97.7</u>					
					Length (L)	<u>0.130</u>	<u>0.0923</u>	<u>6.25</u>	<u>2.70</u>
					Diameter (D)	<u>0.147</u>	<u>0.0947</u>	<u>6.25</u>	<u>2.59</u>
Standard	<u>P2078</u>	<u>+90</u>	<u>100.00%</u>	<u>100.00%</u>	Part Dia. (d)	<u>0.014</u>	<u>0.0082</u>	DATES	
Remarks					Web, Avz	<u>0.0185</u> Nom	<u>0.0263</u>	<u>0.0173</u>	Packed <u>5/12/77</u>
					Web, Inn		<u>0.0310</u>	<u>0.0168</u>	Sawed <u>5/12/77</u>
					Web, Out		<u>0.0215</u>	<u>0.0189</u>	Test Finished <u>5/20/77</u>
					Web Difference/3rd Dec. in % of Web Average	<u>15</u> Max.	<u>-36.19</u>	<u>11.96</u>	Offered <u>5/20/77</u>
					L D	<u>1</u> Nom	<u>0.68</u>	<u>0.98</u>	Description Sheets Forwarded
					D d	<u>5-15</u>	<u>10.50</u>	<u>11.38</u>	

Type of Packing Container One Fiber Drum @ 100 lbs. net.

Remarks *With tapping on container, 1.008 g/cc loading density obtained
**Uncoated base propellant dimensions.
For uncoated base stock, a heat of explosion of 963.8 cal/gm at 90+ °F R. Q. of 130.52 and +90°F R. Q. of 102.04 were obtained. Propellant sample produced on a best effort basis.

Contractor's Representative: _____ Government Quality Assurance Representative: JAMES E. BLAND

PROPELLANT TEST

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

U.S. Army Lot No. RAD-PE-559-5B Composition No. 25mm MP Propellant for AP Projectile
 Manufactured at RAUFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 110 lbs.
 Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. COR letter SARRA-IE dated 26 January 1977

ACCEPTED BLEND NUMBERS NITROCELLULOSE

B C-15,058	Nitrogen Content	KI Starch (65.5°C)	Stability (134.5°C)
	Maximum _____ %	_____ Mins	_____ Mins
	Minimum _____ %	_____ Mins	_____ Mins
	Average <u>13.19</u> %	<u>None</u> Mins	<u>30</u> Mins
			Explosion _____ Mins

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 25 Pounds Nitrocellulose and 65 Pounds Ether per 100 Pounds Solvent.

PROCESS-SOLVENT RECOVERY AND DRYING			TIME	
TEMPERATURES °C	From	To	Days	Hours
	17	24		64
	32	33		24
	56	62	26	
	58	62		104

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION			STABILITY AND PHYSICAL TESTS			
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Formula	Actual	
Nitrocellulose	Remainder		95.22	Heat Test 134.5°C	GE 40' Min 60'+	
Nitrogen in Nitrocell.	13.15	+ 0.05	13.19	No Explosion	5 Hrs. MIN 5 Hrs +	
Diphenylamine	0.50 to	1.25	0.86	Form of Propellant	Type I Cylinder	
Graphite	0.40	Max.	0.16	No. Perforations	7	
Methyl Centralite	3.2	Nom.	3.03			
Potassium Sulfate	0.10 to	1.00	0.89	Heat of Explosion		
Total Volatiles	2.35	Max.	2.23	cal/gm	N/A 361.0	
Moisture and Volatiles	1.00	+ 0.25	1.08			
Residual Solvents	1.10	Max.	1.15			
Hygroscopicity	1.80	Max.	1.25			
Bulk Density	0.940 to	1.050	0.9994*			
Dust & Foreign Matter	0.10	Max.	0.01			

CLOSED BOMB

PROPELLANT DIMENSIONS (inches)

Test	Lot Number	Temp °F	Reactive Quiescence	Reactive Force	Specification	Sig	Finished	Mean Variation in % of Mean Dimensions	
								Specd.	Actual
	RAD-PE-559-5B	+90	91.3	98.0	Length (L)	0.130	0.0923	6.25	2.70
					Diameter (D)	0.147	0.0947	5.25	2.59
Standard	P 2078	+90	100.00%	100.00%	Part Sig. (s)	0.014	0.0083	DATES	
Remarks					Web, Avg	0.0185	Nom 0.0263	0.0173	
					Web, Inn	0.0310	0.016		Packed 5/12/77
					Web, Out	0.0215	0.018		Repacked 5/12/77
					Web Difference/Sig Dev in % of Web Average	15, Max.	-36.19	11.96	Test Finished 5/20/77
					L.D.	1, Nom	0.68	0.98	Offered 5/20/77
					D.S.	5 - 15	10.50	11.38	Description Sheets Forwarded

Type of Packing Container One Fiber Drum @ 100 lbs. net.
 Remarks *With tapping on container, 1.022 g/cc. Loading Density obtained
** Uncoated base propellant dimensions. For uncoated base stock, a Heat of Explosion of 963.8 cal/gm, a +90°F R.Q. of 130.52 and +90°F R.F. of 102.04 were obtained.
Propellant sample produced on a best effort basis.

Contractor's Representative

Government Quality Assurance Representative

JAMES E. BLAND

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY
WEAPON

PROPELLANT ACCEPTANCE SHEET

LOT NUMBER

RAD-PE-559-5B

MODEL

ACCEPTANCE DATE

25 May 1977

MFG BY **HERCULES INCORPORATED**
AT **RADFORD ARMY AMMUNITION PLANT**
CONTRACT NUMBER **DAAA09-77-C-4007**
WEIGHT OF LOT **110 pounds**

PROOF FIRED BY **PROVING GROUND**
FIRING RECORD NUMBER _____
PROJECTILE _____ WEIGHT _____
PROJECTILE LOT NUMBER _____
TEMPERATURE OF POWDER _____ OF _____
STANDARD PROPELLANT LOT _____

PROPELLANT DESCRIPTION

TYPE

M

AVERAGE WEB

SPECIFICATION

DATED

WITH REVISION

DATED

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
<u>25mm MP Propellant for AP Projectile</u>					
Accepted for PE Project 559.					

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND

CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED
BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT
WL: 3E CONSIDERED.

LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY
-WEAPON

PROPELLANT ACCEPTANCE SHEET

LOT NUMBER RAD-PE-559-5C
ACCEPTANCE DATE 25 May 1977

MFG BY **HERCULES INCORPORATED**
 AT **RADFORD ARMY AMMUNITION PLANT**
 CONTRACT NUMBER **DAAA09-77-C-4007**
 WEIGHT OF LOT **110 pounds**

PROOF FIRED BY _____ PROVING GROUND _____
 FIRING RECORD NUMBER _____
 PROJECTILE _____ WEIGHT _____
 PROJECTILE LOT NUMBER _____
 TEMPERATURE OF POWDER _____ OF _____
 STANDARD PROPELLANT LOT _____

PROPELLANT DESCRIPTION

TYPE **M**
 AVERAGE WTS _____
 SPECIFICATION _____ DATED _____ WITH REVISION _____ DATED _____

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
	<u>25mm MP Propellant for AP Projectile</u>				
	Accepted for PE Project 559.				

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND
 CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO _____

CHIEF QUALITY ASSURANCE DIVISION

PROPELLTHE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY**HEET**U.S. Army Lot No. RAD-PE-559-5C Composition No. 25mm MP Propellant for AP ProjectileManufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 110 lbs.Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. COR letter SARRA-IE dated
26 January 1977.

ACCEPTED BLEND NUMBERS

NITROCELLULOSE

<u>B C-15,058</u>	Nitrogen Content	KI Starch (65.5°C)	Stability (134.5°C)
	Maximum _____ %	_____ Mins.	_____ Mins.
	Minimum <u>13.19</u> %	None Mins.	<u>30</u> Mins.
	Average _____ %	_____ Mins.	_____ Mins.
Explosion _____ Mins.			

MANUFACTURE OF PROPELLANT0.92 Pounds Solvent per Pound H.C. Dry Weight Ingredients Consisting of 35 Pounds Nitrocellulose and 65 Pounds Ether per 100 Pounds Solvent.
Percentage Rems to H.C. 25**PROCESS-SOLVENT RECOVERY AND DRYING**

TEMPERATURES °C			TIME	
From	To		Days	Hours
17	24	Solvent Recovery		64
32	38	Solvent Recovery		24
56	62	Water Dry	26	
58	62	Air Dried After Coating		104

PROPELLANT COMPOSITION**TESTS OF FINISHED PROPELLANT****STABILITY AND PHYSICAL TESTS**

Constituent	Percent Formula	Percent Tolerance	Percent Measured	Formula	Actual
Nitrocellulose	Remainder		94.75	Heat Test 134.5°C	CC 40' Min. 60'+
Nitrogen in Nitrocellulose	13.15	+0.05	13.19	No Explosion	5 Hr. Min. 5 Hrs.
Diphenylamine	0.50 to 1.25		0.88	Form of Propellant Type I	Cylinder
Graphic	0.40	Max.	0.16	No. Perforations	7
Methyl Centralite	3.70	Max.	3.51		
Potassium Sulfate	0.10 to 1.00		0.86	Heat of Explosion	
Total Volatiles	2.35	Max.	2.08	cal/gm	N/A 847.2
Moisture and Volatiles	1.00	+ 0.25	1.04		
Residual Solvents	1.10	Max.	1.04		
Hygroscopticity	1.80	Max.	1.25		
Bulk Density	0.940 to 1.050		0.9798*		
Dust & Foreign Matter	0.10	Max.	0.02		

CLOSED BOMBS**PROPELLANT DIMENSIONS (inches) ****

Test	Lot Number	Temp °F	Relative Thickness	Relative Force	Specification	Die	Finished	Mean Variation in % of Mean Dimensions	
								Spec.	Actual
	<u>RAD-PE-559-5C</u>	<u>+90</u>	<u>83.6</u>	<u>96.8</u>		<u>0.130</u>	<u>0.0923</u>	<u>6.25</u>	<u>2.70</u>
					Length (L)				
					Diameter (D)				
Standard	<u>P 2078</u>	<u>+90</u>	<u>100.00%</u>	<u>100.00%</u>	Part Die (d)	<u>0.014</u>	<u>0.0083</u>		
Remarks					Web,			DATES	
					Avg.	<u>0.0185 Nom</u>	<u>0.0263</u>	<u>0.0178</u>	Packed <u>5/12/77</u>
					Inner		<u>0.0319</u>	<u>0.0168</u>	Sampled <u>5/12/77</u>
					Outer		<u>0.0215</u>	<u>0.0189</u>	Test Finished <u>5/20/77</u>
					Web Difference/Std Dev. in % of Web Average	<u>15, Max.</u>	<u>-36.19</u>	<u>11.96</u>	Offered <u>5/20/77</u>
					σ	<u>1, Nom</u>	<u>0.68</u>	<u>0.98</u>	Description Sheet Forwarded
					σ _d	<u>5-15</u>	<u>10.50</u>	<u>11.38</u>	

Type of Packing Container One Fiber Drum @ 100 lbs. net.

*With tapping on container, 1.010 g/cc Loading Density obtained.

**Uncoated base propellant dimensions.

For uncoated base stock, a Heat of Explosion of 363.8 cal/gm A +90°C R.O. of 130.52 and +90°F R.F. of 102.04 were obtained. Propellant sample produced on a best effort basis.

Contractor's Representative

Government's Quality Assurance Representative

JAMES E. PLAND

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET	WEAPON	LOT NUMBER RAD-PE-559-5D
	MODEL	ACCEPTANCE DATE 6 July 1977

MFG BY HERCULES INCORPORATED
 AT RADFORD ARMY AMMUNITION PLANT
 CONTRACT NUMBER DAAA09-77-C-4007
 WEIGHT OF LOT 106 pounds

PROOF FIRED BY _____ PROVING GROUND
 FIRING RECORD NUMBER _____
 PROJECTILE _____ WEIGHT _____
 PROJECTILE LOT NUMBER _____
 TEMPERATURE OF POWDER _____ OF _____
 STANDARD PROPELLANT LOT _____

PROPELLANT DESCRIPTION			
TYPE	M		
AVERAGE WEB SPECIFICATION	DATED	WITH REVISION	DATED

CHARGE WEIGHTS					
INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
<u>25mm MP Propellant for AP Projectile</u>					
Accepted for	PE Project 559				

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND
 CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION					
THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE					
WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO _____

 CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-5D Composition No. 25mm NP Propellant

Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 106 lbs.

Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. _____

ACCEPTED BLEND NUMBERS NITROCELLULOSE

RC-15,058

Nitrogen Content	Kl Storch (65.5°C)	Stability (134.5°C)
Maximum _____ %	_____ Min.	_____ Min.
Minimum _____ %	_____ Min.	_____ Min.
Average <u>13.19</u> %	_____ Min.	<u>30</u> Min.
		Explosion _____ Min.

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Nitrocellulose and 65 Pounds Ether per 100 Pounds Solvent.

Percentage Remains to Waste 25

PROCESS-SOLVENT RECOVERY AND DRYING			TIME	
TEMPERATURES °C	From	To	Days	Hours
	17	24		64
	32	33		24
	56	62	26	
	58	62		96

TESTS OF FINISHED PROPELLANT STABILITY AND PHYSICAL TESTS

Constituent	Percent Formula	Percent Tolerance	Percent Measured	Form	Formula	Actual
Nitrocellulose	Remainder		96.72	Heat Test	134.5°C	CC 40 min., 60'+
Nitrogen in Nitrocellulose	13.15	+0.05	13.19	No Explosion		5 hrs. min., 5 hrs. +
Diphenylamine	0.50 to 1.25		0.88	Form of Propellant Type I		Cylinder
Graphite	0.40	Max.	0.10	No perforations		7
Methyl Centralite	1.50	Nom.	1.39			
Potassium sulfate	0.10 to 1.00		0.91	Heat of		
Total Volatiles	2.35	Max.	2.36	Explosion cal/g	N/A	901.2
Moisture & Volatiles	1.00	+0.25	0.91			
Residual Solvents	1.10	Max.	1.17			
Hygroscopicity	1.80	Max.	1.34			
Bulk Density	0.940 to 1.050		0.9844			
Dust & Foreign Matter	0.10	Max.	0.01			

CLOSED BOMB				PROPELLANT DIMENSIONS (inches) *					
Test	Lot Number	Temp °F	Positive Quickness	Negative Force	Specification	Dry	Finished	Mean Variation in % of Mean Dimensions	
	RAD-PE-559-5D	90	105.0	98.9	Length (L)	0.130	0.0923	6.25	2.70
					Diameter (D)	0.147	0.0947	6.25	2.59
Standard	P2078	90	100.00%	100.00%	Perf Dia (d)	0.014	0.0083		
Remarks					Web			DATES	
					Aug.	0.0185	0.0263	0.0178	Packed 6/17/77
					Inner		0.0310	0.0168	Sampled 6/17/77
					Outer		0.0215	0.0189	Test Finished 6/28/77
					Top Difference/Std Dev in % of Web Average	15 max.	-36.19	11.96	Offered 6/28/77
					L o	1 NOM.	0.68	0.98	Description Sheets Forwarded 7-1-77
					D d	5-15	10.50	11.38	

Type of Packing Container One Fiber Drum @ 100 lbs. net.

Remarks *Uncoated base propellant dimensions. For Uncoated base stock, a Heat of explosion of 963.8 cal/g, a +90° RO of 130.52 and a +90° RF of 102.04 were obtained. Propellant produced on a best efforts basis.

Contractor's Representative <p style="text-align: center;">R. A. Williams</p>	Government Official <p style="text-align: center;">J. E. Bl... ..</p>
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PROPELLANT ACCEPTANCE SHEET	WEAPON	LOT NUMBER RAD-PE-559-5E
	MODEL	ACCEPTANCE DATE 6 July 1977

MFG BY HERCULES INCORPORATED	PROOF FIRED BY PROVING GROUND
AT RADFORD ARMY AMMUNITION PLANT	FIRING RECORD NUMBER
CONTRACT NUMBER DAAA09-77-C-4007	PROJECTILE WEIGHT
WEIGHT OF LOT 107 pounds	PROJECTILE LOT NUMBER
	TEMPERATURE OF POWDER OF
	STANDARD PROPELLANT LOT

PROPELLANT DESCRIPTION

TYPE	M
AVERAGE WEB	
SPECIFICATION	DATED
	WITH REVISION
	DATED

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
<u>25mm MP Propellant for AP Projectile</u>					
Accepted for	PE Project	559			

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND

CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED
BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT
WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT DESCRIPTION SHEET

U S Army Lot No. RAD-PE-559-5E Composition No. 25mm NP Propellant
 Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 107 lbs.
 Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. _____

NITROCELLULOSE

ACCEPTED BLEND NUMBERS

EC-15,058

Nitrogen Content	KI Starch (65 °C)	Stability (134 °C)
Maximum _____ %	_____ Mins	_____ Mins
Minimum _____ %	_____ Mins	_____ Mins
Average <u>13.19</u> %	_____ Mins	<u>30</u> Mins
	Explosion _____ Mins	

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Alcohol and 65 Pounds Ether per 100 Pounds Solvent.
 Percentages Rems to Whole 25

PROCESS-SOLVENT RECOVERY AND DRYING

TEMPERATURES °C			TIME	
From	To		Days	Hours
17	24	Solvent Recovery		64
32	33	Solvent Recovery		24
56	62	Water Dry	26	
64	62	Air Dry After coating		96

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION

STABILITY AND PHYSICAL TESTS

Constituent	Percent Formula	Percent Tolerance	Percent Measured	Formula	Actual
Nitrocellulose	Remainder		96.19	Heat Test 134.5° C	cc 40 min. 60'+
Nitrogen in Nitrocell.	13.15	± 0.05	13.19	No Explosion	5 hrs. min. 5 hrs.
Diphenylamine	0.50 to 1.25		0.88	Form of Propellant Type I	cylinder
Graphite	0.40	Max.	0.09	No perforations	7
Methyl Centralite	2.00	Nom.	1.89		
Potassium Sulfate	0.10 to 1.00		0.95	Heat of	
Total Volatiles	2.35	Max.	2.58	Explosion Cal/g.	N/A 889.7
Moisture & Volatiles	1.00	+0.25	0.83		
Residual Solvents	1.10	Max	1.11		
Hveroscopocity	1.80	Max	1.22		
Bulk Density	0.940 to 1.050		1.0005		
Dust & Foreign Matter	0.10	Max	0.01		

CLOSED BOMB

PROPELLANT DIMENSIONS (inches) *

Test	Lot Number	Temp °F	Relative Quickness	Relative Force	Specification	Dig	Finished	Mean Variation in % of U.S. Dimensions	
								Spec.	Actual
	RAD-PE-559-5E	90	101.9	98.6	Length (L)	0.130	0.0923	6.25	2.70
					Diameter (D)	0.147	0.0947	6.25	2.59
Standard	P2078	90	100.00%	100.00%	Perf Dia (d)	0.014	0.0083		
Remarks					Web			DATES	
					Aug.	0.0185	0.0263	0.0173	6/17/77
					Inner		0.0310	0.0168	6/17/77
					Outer		0.0215	0.0189	6/28/77
					Web Difference/Std Dev in % of Web Average	15 Max.	-36.19	11.96	6/28/77
					L d	1 nom.	0.68	0.98	Description Sheets Forwarded
					D d	5.5	10.50	11.38	7-7-77

Type of Packing Container One Fiber Drum @ 100 lbs. net.
 Remarks *Uncoated base propellant dimensions. For uncoated base stock a heat of explosion of 963.8 cal/g, a +90°F RO of 150.52 and a +90°F RF of 102.04. Propellant produced on a best efforts basis.

Contractor's Representative

R. A. Williams

Government

Dr. J. Blunt

PROPELLANT ACCEPTANCE SHEET

WEAPON	LOT NUMBER
MODEL	RAD-PE-559-6(HE)
	ACCEPTANCE DATE
	27 July 1977

MFG BY AT CONTRACT NUMBER WEIGHT OF LOT	HERCULES INCORPORATED RADFORD ARMY AMMUNITION PLANT DAAA09-77-C-4007 1,285 pounds	PROOF FIRED BY FIRING RECORD NUMBER PROJECTILE WEIGHT PROJECTILE LOT NUMBER TEMPERATURE OF POWDER STANDARD PROPELLANT LOT	PROVING GROUND
--	--	--	----------------

PROPELLANT DESCRIPTION

TYPE	M
AVERAGE WEB SPECIFICATION	DATED
	WITH REVISION
	DATED

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
25mm Gun HE Projectile					
Accepted for PE Project 553					

THIS PROPELLANT LOT IS ACCEPTED
Corrected copy issued to correct
weight of lot.

JAMES E. BLAND
CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE DIVISION

PROPELLANT

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

HEET

U S Army Lot No. RAD-PE-559-6(HE) Composition No. 25mm Gun HE PROJECTILE

Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 1,285 lbs.*

Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. COR letter SARRA-EN dated 11 February 1977

ACCEPTED BLEND NUMBERS **NITROCELLULOSE**

C-15,058

Nitrogen Content	KI Starch (63.5°C)	Stability (134.5°C)	
		Maximum	Minimum
Maximum _____ %	_____ Mins	_____ Mins	_____ Mins
Minimum _____ %	_____ Mins	_____ Mins	_____ Mins
Average <u>13.12</u> %	<u>45+</u> Mins	<u>30+</u> Mins	_____ Mins
		Explosion _____ Mins	

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Nitrocell and 65 Pounds ether per 100 Pounds Solvent.
 Percentages Remain the Same 25

TEMPERATURES °C			PROCESS-SOLVENT RECOVERY AND DRYING	TIME	
From	To			Date	Hours
17	24	Solvent Recovery		64	
32	38	Solvent Recovery		24	
56	62	Water Dry	26		
58	62	Air Dried After Coating		7-3/4	

TESTS OF FINISHED PROPELLANT * STABILITY AND PHYSICAL TESTS

Constituent	Percent Formula	Percent Tolerance	Percent Measured	Test	Actual
Nitrocellulose	Remainder		92.58	Heat Test <u>134.5°f</u> ICC	<u>60'</u>
Nitrogen in Nitrocell.	13.15	+ 0.05	13.12	No Explosion	<u>5 hrs+</u>
Diphenylamine	0.50 to 1.25		0.68	Form of Propellant Type	<u>Cylinder</u>
Graphite	0.40	Max.	0.08	No. Perforations	<u>1</u>
Methyl Centralite	4.56	Nom.	4.59		
Potassium Sulfate	0.10 to 1.00		0.81	Heat of	
Total Volatiles	2.35	Max.	1.23	Explosion, cal/gm	<u>N/A</u> 828
Moisture & Volatiles	1.00	+ 0.25	1.23		
Residual Solvents	1.10	Max.	0.19		
Hygroscopicity	1.80	Max.	1.43		
Bulk Density	0.940 to 1.050		0.9974		
Dust & Foreign Matter	0.10	Max.	0.03		

CLOSED SOHB

PROPELLANT DIMENSIONS (inches)**

Test	Lot Number	Temp °F	Relative Humidity	Relative Force	Specification			Mean Variation in % of Mean Dimensions	
					Length (L)	Die	Finished	Spec	Actual
Test	<u>RAD-PE-559-6(HE)</u>	<u>+90</u>	<u>103.86</u>	<u>99.86</u>	<u>0.067, Nom</u>	<u>0.071</u>	<u>0.0675</u>	<u>6.25</u>	<u>1.61</u>
					<u>0.052, Nom</u>	<u>0.080</u>	<u>0.0529</u>	<u>6.25</u>	<u>2.52</u>
Stand	<u>RAD-PE-559-A3</u>	<u>+90</u>	<u>100.00%</u>	<u>100.00%</u>	<u>Part Dia Id</u>	<u>0.006, Nom</u>	<u>0.010</u>	<u>0.0091</u>	
Remarks					<u>Web, Avg</u>	<u>0.0226, Nom</u>	<u>0.035</u>	<u>0.0219</u>	
									<u>Packed 7/16/77</u>
									<u>Sampled 7/16/77</u>
									<u>Test Finished 7/25/77</u>
					<u>Web Difference/Std Dev in % of Web Average</u>	<u>20, Max</u>	<u>9.74</u>		<u>Offered 7/25/77</u>
					<u>L D</u>	<u>1.39, Nom</u>	<u>0.89</u>	<u>1.23</u>	<u>Description Sheets Forwarded 7/28/77</u>
					<u>D e</u>	<u>8.24, Nom</u>	<u>8.0</u>	<u>15.83</u>	

Type of Packing Container Fiber Drums: one (1) @ 100 lbs. net; one (1) @ 135 lbs. net; seven (7)

Remarks @ 150 lbs. net.

*Made and reported per Proj. No. 11731646 from Frankford Arsenal.

**Uncoated propellant dimensions.

This propellant lot meets all requirements of the applicable specification.

Contractor's Representative

Government Quality Assurance Representative

JAMES E. BLAND

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY
PROPELLANT DESCRIPTION TEST

U.S. Army Lot No. RAD-PE-559-7(AP) Composition No. 25mm 7 PERF Propellant for AP Projectile
 Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 474 lbs.
 Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. COR letter SARRA-EN dated 11 February 1977

ACCEPTED BLEND NUMBERS		NITROCELLULOSE		
C-15,058	Nitrogen Content	KI Starch (65.5°C)	Stability (134.5°C)	
	Maximum _____ %	_____ Min.	_____ Min.	_____ Min.
	Minimum _____ %	_____ Min.	_____ Min.	_____ Min.
	Average <u>13.12</u> %	<u>45+</u> Min.	<u>30+</u> Min.	_____ Min.
			Explosion _____	_____ Min.

0.92 MANUFACTURE OF PROPELLANT
 Pounds Solvent per Pound NC: Dry Weight Ingredients Consisting of 35 Pounds Alcohol and 65 Pounds Ether per 100 Pounds Solvent.
 Percentages Refer to Whole 25

PROCESS-SOLVENT RECOVERY AND DRYING			TIME	
From	To		Days	Hours
17	24	Solvent Recovery		64
32	33	Solvent Recovery		24
56	62	Water Dry	26	
58	62	Air Dry after Coating		96

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Test	Formula	Actual
Nitrocellulose	Remainder	-	96.32	Heat Test 134.5°C	cc 40' Min.	60'+
Nitrogen in Nitrocellulose	13.15	+ 0.05	13.12	No Explosion	5 Hr. Min.	5 Hrs. -
Diphenylamine	0.50 to 1.25		0.83	Form of Propellant	Type I	Cyl
Graphite	0.40	Max.	0.12	No. of Perforations		7
Methyl Centralite	2.00	Nom.	1.97			
Potassium Sulfate	0.10 to 1.00		0.88	Heat of Explosion		
Total Volatiles	2.35	Max.	2.21	cal/gm	N/A	883.2
Moisture & Volatiles	1.00	+ 0.25	0.92			
Residual Solvents	1.10	Max.	1.29			
Hygroscopicity	1.80	Max.	1.28			
Bulk Density	0.940 to 1.050		1.005			
Dust & Foreign Matter	0.10	Max.	0.04			

CLOSED BOMB					PROPELLANT DIMENSIONS (inches)**				
Test	Lot Number	Temp °F	Relative Quickness	Relative Force	Specification	Die	Finished	Mean Variation in % of Mean Dimensions	
								Spec.	Actual
TEST	RAD-PE-559-7(AP)	90	102.70	98.12	Length (L)	0.130	0.0923	6.25	12.70
					Diameter (D)	0.147	0.0947	5.25	12.59
Standard	P-2078	90	100.00%	100.00%	Perf. Dia. (d)	0.014	0.0083		
Remarks					Web			DATES	
					Avg.	0.0185	0.0263	0.0178	Packed 7/29/77
					Inner		0.0310	0.0168	Sampled 8/15/77
					Outer		0.0215	0.0189	Test Finished 3/18/77
					Max. Difference/Std. Dev. in % of Web Average	15 Max.	-36.19	11.96	Offered 8/18/77
					L.D.	1, Nom.	0.68	0.98	Description Sheets Forwarded
					Std.	5 - 15	10.50	11.28	

Type of Packing Container: Fiber Drums: 4 @ 100 lbs. net; 1 @ 74 lbs. net.
 Remarks: Uncoated base propellant dimensions. For uncoated base stock, a heat of explosion of 963.8 cal/g., a +90°F RO of 130.52 and a +90°F RF of 102.04 were obtained.
Propellant produced on a best effort basis.

Contractor's Representative: R. A. Williams
 Government Quantity Inspection Representative: J. E. Blane

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET	WEAPON	LOT NUMBER
	MODEL	ACCEPTANCE DATE

RAD-PE-559-8(AP)

22 August 1977

MFG BY AT CONTRACT NUMBER WEIGHT OF LOT	HERCULES INCORPORATED RADFORD ARMY AMMUNITION PLANT DAAA09-77-C-4007 488 lbs	PROOF FIRED BY FIRING RECORD NUMBER PROJECTILE PROJECTILE LOT NUMBER TEMPERATURE OF POWDER STANDARD PROPELLANT LOT	PROVING GROUND
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PROPELLANT DESCRIPTION

TYPE	M		
AVERAGE WT			
SPECIFICATION	DATED	WITH REVISION	DATED

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
25mm 7 PERF Propellant for AP Projectile					
Accepted for PE Project 559.					

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND
CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-8(AP) Composition No. 25mm 7 PERF Propellant for AP Projectile

Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 488 lbs.

Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. COR letter SARRA-EN dated 11 February 1977

ACCEPTED BLEND NUMBERS NITROCELLULOSE

C-15,058

Nitrogen Content	K ₁ Starch (65.5°C)	Stability (134.5°C)
Maximum _____ %	_____ Min.	_____ Min.
Minimum _____ %	_____ Min.	_____ Min.
Average <u>13.12</u> %	<u>45+</u> Min.	<u>30+</u> Min.
		Explosion _____ Min.

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC Dry Weight Ingredients Consisting of 35 Pounds Nitrocell and 65 Pounds Ether per 100 Pounds Solvent

Percentage Remo to White 25

PROCESS-SOLVENT RECOVERY AND DRYING

TEMPERATURES °C	From	To	Process	TIME	
				Days	Hours
17	24		Solvent Recovery		64
32	33		Solvent Recovery		24
56	62		Water Dry	26	
58	62		Air Dry after Coating		96

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Formula	Actual	
Nitrocellulose	Remainder		96.17	Heat Test 134.5°C	CC 40' Min.	60'+
Nitrogen in Nitrocellulose	13.15	± 0.05	13.12	No Explosion	5 Hrs. Min.	5Hrs +
Diphenylamine	0.50 to 1.25		0.83	Form of Propellant Type I		Cyl
Graphite	0.40	Max.	0.13	No. Perforations		7
Methyl Centralite	2.00	Nom.	2.08			
Potassium Sulfate	0.10 to 1.00		0.92	Heat of Explosion		
Total Volatiles	2.35	Max.	1.90	cal/gm	N/A	886.3
Moisture & Volatiles	1.00	± 0.25	0.70			
Residual Solvents	1.10	Max.	1.20			
Hygroscoivity	1.80	Max.	1.24			
Bulk Density	0.940 to 1.050		1.008			
Dust & Foreign Matter	0.10	Max.	0.03			

CLOSED BOMB

PROPELLANT DIMENSIONS (inches) *

Test	Lot Number	Temp °F	Relative Humidity	Relative Force	Specification	Dia	Finished	Mean Variation in % of Mean Dimensions	
								Spec.	Actual
	<u>RAD-PE-559-8(AP)</u>	<u>90</u>	<u>104.89</u>	<u>98.96</u>		<u>0.130</u>	<u>0.0923</u>	<u>6.25</u>	<u>2.70</u>
					Length (L)				
					Diameter (D)	<u>0.147</u>	<u>0.0947</u>	<u>6.25</u>	<u>2.59</u>
Standard	<u>P2078</u>	<u>90</u>	<u>100.00%</u>	<u>100.00%</u>	Net Dia (d)	<u>0.014</u>	<u>0.0083</u>		
Remarks					Web			DATES	
					Avg.	<u>0.0185</u>	<u>0.0253</u>	<u>0.0178</u>	Printed <u>7/29/77</u>
					Inner		<u>0.0310</u>	<u>0.0168</u>	Scanned <u>8/15/77</u>
					Outer		<u>0.0215</u>	<u>0.0182</u>	Test Finished <u>8/28/77</u>
					See Difference/Side Dev in % of JCB Average	<u>15, Max.</u>	<u>-36.19</u>	<u>11.96</u>	Checked <u>8/13/77</u>
					L D	<u>1, Nom.</u>	<u>0.68</u>	<u>0.98</u>	Description Sheet Forwarded
					D e	<u>5 - 15</u>	<u>110.50</u>	<u>11.38</u>	

Type of Packing Container Fiber Drums: 4 @ 100 lbs. net.; 1 @ 88 lbs. net.
 Remarks *Uncoated base propellant dimensions. For uncoated base stock, a Heat of Explosion of 963.8 cal/g., a +90°F RO of 130.52 and a +90°F RF of 102.04 were obtained. Propellant Produced on a best effort basis.

Contractor's Representative: R. A. Williams Government Quality Assurance Representative: J. E. Bland

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-11(A) Composition No. Propellant, Single-Base, Multiple Perf, Methyl Centralite-Coated for 25mm AP-T
 Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA Packed Amount 971 lbs
 Contract No. WAC9-77-C-4007 Date 4-1-77 Specification No. COR ltr SARRA-IE dtd 10 Nov 77

ACCEPTED BLEND NUMBERS NITROCELLULOSE

C 15104	Nitrogen Content	KI Storch (65.5°C)	Stability (134.5°C)
	Maximum _____ %	_____ Min.	_____ Min.
	Minimum _____ %	_____ Min.	_____ Min.
	Average <u>13.16</u> %	_____ Min.	<u>30</u> Min.
Explosion _____ Min.			

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Nitrocell and 65 Pounds Ether per 100 Pounds Solvent.
 Percentage Remain to Whole 16

TEMPERATURES °C		PROCESS-SOLVENT RECOVERY AND DRYING	TIME	
From	To		Days	Hrs
35	55	Increase Temperature from Loading to Cycle Level		12
49	61	Solvent Recovery		36
56	62	Water Dry	12	
74	76	Coating Cycle		2
56	62	Post Coating Water Dry		24

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION				STABILITY AND PHYSICAL TESTS		
Constituent	Specified Formula	Percent Tolerances	Percent Measured	Test	Formula	Actual
Nitrocellulose	Remainder		96.71	Heat Test SP, 134.50	C No CC 40: 60'	
Nitrogen in NC	13.15	±0.05	13.16	No Explosion	5 hrs min	5+
Diphenylamine	0.50 to	1.25	0.89	Form of Propellant		Cylindrical
Graphite	0.40	Max	0.17	No Perforations		7
Methyl Centralite	2.25	Nom	1.92			
Potassium Sulfate	0.50	Nom	0.48			
Total Volatiles	2.35	Max	2.51	Heat of Explo-		
Moisture & Volatiles	1.00	±0.25	1.18	sion, cal/gm	N/A	897.4
Residual Solvents	1.10	Max	1.30			
Hygroscopicity	1.80	Max	1.38	Propellant		
Dust & Foreign Matter	0.10	Max	0.02	Loadability, gms	N/A	102
Bulk Density, gm/cc	0.940 to	1.050	1.01			

CLOSED BOMB**				PROPELLANT DIMENSIONS (inches)			
Lot Number	Temp °F	Relative Humidity	Moisture Cycle	Specification	Die	Finishing	Mean Variation in % of Mean Dimensions
Typ RAD-PE-559-11 (AP)+90	97.89		100.42		0.110	0.1062	6.25 1.97
				Length (L)	0.147	0.0049	6.25 1.55
				Diameter (D)	0.014	0.0077	
Standard RAD-PE-559-7 (AP)+90	100.00%	100.00%		Perf Dia. (d)*			DATES
Remarks				Web*			Packed 12/14/77
				Avg	0.0185 Nom	0.0180	Sampled 12/14/77
				Outer		0.0215 0.0196	Test Finished 12/21/77
				Inner		0.031 0.0165	Offered 1/6/78
**Loading Density of 0.2 gm/cc				Max Difference/Std Dev. in % of Web Average	15 Max	-36.19 17.09	Description Sheet Forwarded 1/6/78
200 cc (Nom) Closed Bomb				L.S.	1.1 Nom	1.12	
				S.S.	5 - 15	12.35	

Type of Packing Container: Fiber Drums: 6 @ 150 lbs. net; 1 @ 61 lbs. net.
 Remarks: *Dimensions are from the uncoated base stock propellant.
Chemical test results corrected for TV, graphite, dust and foreign matter.
This lot produced on a best effort basis.

Contractor's Representative: R. A. Williams
 Government Quality Assurance Representative: J. J. Blend

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET	WEAPON	LOT NUMBER
	MODEL	ACCEPTANCE DATE

RAD-PE-559-12(AP)

10 January 1978

MFG BY HERCULES INCORPORATED
 AT RADFORD ARMY AMMUNITION PLANT
 CONTRACT NUMBER DAAA09-77-C-4007
 WEIGHT OF LOT 968 lbs

PROOF FIRED BY _____ PROVING GROUND _____
 FIRING RECORD NUMBER _____
 PROJECTILE _____ WEIGHT _____
 PROJECTILE LOT NUMBER _____
 TEMPERATURE OF POWDER _____ OF _____
 STANDARD PROPELLANT LOT _____

PROPELLANT DESCRIPTION

TYPE	M		
AVERAGE WEB			
SPECIFICATION	DATED	WITH REVISION	DATED

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
Propellant, S-B, Multi-Perf Methyl Centralite Coated for 25mm AP-T					
Accepted for PE Project 559					

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND

CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-12 (AP) Composition No. Propellant, S-B, Multi-Perf Methyl Centralite Coated for 25mm AP-T
 Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 968 lbs
 Contract No. DAAA09-77-C-4007 Date 3-1-77 Specification No. COR LTR, SARBA-IE dtd 10 Nov 77

ACCEPTED BLEND NUMBERS		NITROCELLULOSE			
C 15104		Minimum	Maximum	MI Starch (85.5°C)	Sinkity (134.5°C)
		Minimum	Maximum	MI Starch	Sinkity
		Average	13.16	MI Starch	30

MANUFACTURE OF PROPELLANT
0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Parts Nitrocellulose and 65 Parts Fiber per 100 Parts Solvent.
 Percentage Resin to White 16

PROCESS-SOLVENT RECOVERY AND DRYING			TIME	
From	To		Days	Hours
35	55	Increase Temperature from Loading to Cycle Level		12
49	61	Solvent Recovery		34
56	62	Water Dry	12	
74	76	Coating Cycle		2
56	62	Post Coating Water Dry		24

PROPELLANT COMPOSITION		TESTS OF FINISHED PROPELLANT			STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formula	Percent Clearance	Percent Measured	Formula	Actual	
Nitrocellulose	Remainder		96.26	Noop Test S.P. 134.5°C No CC 40' 50'		
Nitrogen in NC	13.15	±0.05	13.16	No Explosion	5-hrs Min	
Diphenylamine	0.50 to	1.25	0.89	Form of Propellant Type	Cylinder	
Graphite	0.40	Max	0.15	No Perforations	7	
Methyl Centralite	2.75	Nom	2.37			
Potassium Sulfate	0.50	Nom	0.18			
Total Volatiles	2.35	Max	2.44	Heat of Explos-		
Moisture & Volatiles	1.00	±0.25	1.27	sion, cal/gm	N/A	
Residual Solvents	1.10	Max	1.07		886.9	
Hygroscopicity	1.80	Max	1.36	Propellant		
Dust & Foreign Matter	0.10	Max	0.02	Loadability, gms N/A	103	
Bulk Density, gm/cc	0.940 to	1.050	1.00			

CLOSED BOMB**				PROPELLANT DIMENSIONS (inches)				
Lot Number	Temp °F	Resilive Strength	Resilive Force	Specification	Die	Finished	Mean Variation in % of Mean Dimensions	
							Spec	Actual
Test RAD-PE-559-12(AP) +90		95.69	99.43		0.110	0.1062	6.25	1.97
				Length (L)	0.147	0.0949	6.25	1.55
Storage RAD-PE-559-7(AP)		100.00%	100.00%	Perf Dia. (d) *	0.014	0.0077	DATES	
Remarks				Web*			Packed	12/14/77
				Avg	0.0185	Nom	0.026	0.0130
				Outer			0.0215	0.0196
				Inner			0.031	0.0165
				Max Difference/Std. Dev. in % of Web Average	± 15	Max	-36.19	17.09
**Loading Density of 0.2 gm/cc				L & E *	1.1	Nom	1.12	
200 cr (Nom) Closed Bomb				Gr	5 - 15		12.35	
							Test Finished	12/23/77
							Offered	1/6/78
							Description Sheets Forwarded	1/6/78

Type of Packing Container Fiber Drums: 6 @ 150 lbs. net; 1 @ 58 lbs. Net.
 Remarks *Dimensions are from the uncoated base stock propellant. Chemical test results corrected for TV, graphite, dust and foreign matter. This lot produced on a best effort basis.

Contractor's Representative R. A. Williams Government Quality Assurance Representative J. E. Blum

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET	WEAPON	LOT NUMBER
	MODEL	ACCEPTANCE DATE

LOT NUMBER	RAD-PE-559-13 (AP)
ACCEPTANCE DATE	10 January 1978

MFG BY HERCULES INCORPORATED
AT RADFORD ARMY AMMUNITION PLANT
CONTRACT NUMBER DAAA09-77-C-4007
WEIGHT OF LOT 988 lbs

PROOF FIRED BY _____ PROVING GROUND _____
FIRING RECORD NUMBER _____
PROJECTILE _____ WEIGHT _____
PROJECTILE LOT NUMBER _____
TEMPERATURE OF POWDER _____ OF _____
STANDARD PROPELLANT LOT _____

PROPELLANT DESCRIPTION

TYPE M

AVERAGE WEB SPECIFICATION _____ DATED _____ WITH REVISION _____ DATED _____

CHARGE WEIGHTS					
INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
<u>Propellant, Single-Base, MF Methyl Centralite Coated for 25mm AP-T</u>					
<u>Accepted for PE Project 559.</u>					

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND
CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION
THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO _____

CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-13 (AP) Composition No. Propellant, Single-Base, NP Methyl Centralite Coated for 25mm AP-T

Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 988 lbs

Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. COR ltr, SARRA-IE dtd 10 Nov 77

ACCEPTED BLEND NUMBERS		NITROCELLULOSE			
C 15104	Nitrogen Content	K1 Storch (65.5°C)	Stability (134.5°C)		
	Maximum _____ %	_____ Mins	_____ Mins	_____ Mins	
	Minimum _____ %	_____ Mins	_____ Mins	_____ Mins	
	Average <u>13.16</u> %	_____ Mins	<u>30</u> Mins	_____ Mins	
		Explosion _____ Mins			

MANUFACTURE OF PROPELLANT

0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Alcohol and 65 Pounds Ether per 100 Pounds Solvent.

Percentage Rems to Waste _____

PROCESS-SOLVENT RECOVERY AND DRYING			TIME	
TEMPERATURES °C	From	To	Days	Hours
35	55	Increase Temperature from Loading to Cycle Level		12
49	61	Solvent Recovery		34
56	62	Water Dry	12	
74	76	Coating Cycle		2
56	62	Post Coating Water Dry		24

TESTS OF FINISHED PROPELLANT				STABILITY AND PHYSICAL TESTS	
PROPELLANT COMPOSITION	Percent Formic	Percent Sterilize	Percent Measured	Formula	Actual
Nitrocellulose	Remainder		96.75	Heat Test S.P., 134.5°C No CC 40' 60'	
Nitrogen in NC	13.15	±0.05	13.16	No Explosion	5 hrs min: 5±
Diphenylamine	0.50 to	1.25	0.86	Form of Propellant Type I	Cylinder
Graphite	0.40	Max	0.16	No. Perforations	7
Methyl Centralite	2.25	Nom	1.24		
Potassium Sulfate	0.50	Nom	0.55		
Total Volatiles	2.35	Max	2.18	Heat of Explo-	
Moisture & Volatiles	1.00	±0.25	0.96	sion, cal/gm	N/A 900.0
Residual Solvents	1.10	Max	1.08		
Hygroscopicity	1.80	Max	1.39	Propellant	
Dust & Foreign Matter	0.10	Max	0.02	Loadability, gms	N/A 102
Bulk Density, gm/cc	0.940 to	1.050	1.00		

CLOSED BOMB **				PROPELLANT DIMENSIONS (inches)			
Lot Number	Temp °F	Relative Humidity	Relative Force	Specification	Die	Finished	Mean Variation in % of Mean Dimensions
Test RAD-PE-559-13 (AP)+90	102.46	101.27					Spec. Actual
				Length (L)	0.130	0.1239	6.25 2.45
				Diameter (D)	0.147	0.0960	6.25 1.85
Standard RAD-PE-559-7 (AP)+90	100.00%	100.00%		Part Dia. (d) *	0.014	0.0077	
Remarks				Web*			DATES
				Ave	0.0185 nom	0.026 0.0187	Packed 12/14/77
				Outer		0.0215 0.0203	Sampled 12/14/77
				Inner		0.031 0.0170	Test Finished 12/21/77
				Web Difference/Std. Dev. in % * of Web Average	15 max	-36.19 17.32	Offered 1/6/78
**Loading Density of 0.2 gm/cc				L.D	1.3 nom	1.28	Description Sheets Forwarded 1/6/78
200 cc (nom) Closed Bomb				g d	5 - 15	12.6	

Type of Packing Container: Fiber Drums: 6 @ 150 lbs, net; 1 @ 78 lbs, net.

Remarks: *Dimensions are from the uncoated base stock propellant. Chemical test results corrected for TV, graphite, dust and foreign matter. This lot produced on a best effort basis.

Contractor's Representative: R. A. Williams

Government Quality Assurance Representative: J. E. Bland

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY
WEAPON

PROPELLANT ACCEPTANCE SHEET

LOT NUMBER RAD-PE-559-14(AP)
ACCEPTANCE DATE 10 January 1978

MODEL

MFG BY HERCULES INCORPORATED
AT RADFORD ARMY AMMUNITION PLANT
CONTRACT NUMBER DAAA09-77-C-4007
WEIGHT OF LOT 931 lbs

PROOF FIRED BY	PROVING GROUND
FIRING RECORD NUMBER	
PROJECTILE	WEIGHT
PROJECTILE LOT NUMBER	
TEMPERATURE OF POWDER	OF
STANDARD PROPELLANT LOT	

PROPELLANT DESCRIPTION

TYPE	M		
AVERAGE WEB			
SPECIFICATION	DATED	WITH REVISION	DATED

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
Propellant, Single-Base MP Methyl Centralite Coated for 25mm AP-T					
Accepted for EE Project 559.					

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND
CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECT WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-14 (AP) Composition No. Propellant, Single-Base NP Methyl Centralite Coated for 25mm AP-T
 Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 931 lbs
 Contract No. DAA09-77-C-007 Date 4-1-77 Specification No. COR 1tr, SARRA-IE dtd 10 Nov 77

ACCEPTED BLEND NUMBERS		NITROCELLULOSE		
C 15104		Nitrogen Content	KI *taren (65.5°C)	Stability (134.5°C)
		Maximum _____ %	_____ Mins	_____ Mins
		Minimum _____ %	_____ Mins	_____ Mins
		Average <u>13.16</u> %	_____ Mins	<u>30</u> Mins
			Explosion _____	_____ Mins

MANUFACTURE OF PROPELLANT
0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Alcohol and 65 Pounds Ether per 100 Pounds Solvent.
 Percentage Ratio to Whole 16

PROCESS-SOLVENT RECOVERY AND DRYING			TIME	
TEMPERATURES °C	From	To	Days	Hours
	35	55	Increase Temperature from Loading to Cycle Level	12
	49	61	Solvent Recovery	36
	56	62	Water Dry	12
	74	75	Drying Cycle	2
	56	62	Post Coating Water Dry	24

PROPELLANT COMPOSITION			TESTS OF FINISHED PROPELLANT		STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Formula	Result	
Nitrocellulose	Remainder		96.40	Heat Test S.P. 134.5°C No. CC 40'	60'	
Nitrogen in NC	13.15	±0.05	13.16	No Explosion	5 hrs min	5+
Diphenylamine	0.50 to	1.25	0.87	Form of Proaction	Type I	Cylinder
Graphite	0.40	Max	0.20	No Perforations		7
Methyl Centralite	2.75	Nom	2.26			
Potassium Sulfate	0.50	Nom	0.47			
Total Volatiles	2.35	Max	1.77	Heat of Empla		
Moisture & Volatiles	1.00	+0.25	0.75	stn, cal/gm	N/A	804.2
Residual Solvents	1.10	Max	0.92			
Hygroscopicity	1.80	Max	1.30	Propellant		
Dust & Foreign Matter	0.10	Max	0.04	Loadability, gms	N/A	101
Bulk Density, gm/cc	0.940 to	1.050	0.98			

CLOSED BOMB**				PROPELLANT DIMENSIONS (inches)				Mean Variation in % of Mean Dimensions	
Lot Number	Temp °C	Relative Quiescence	Relative Force	Specification	Die	Finished	Spec	Actual ±	
Typ. RAD-PE-559-14 (AP)	+90	103.52	101.21	Length (L)	0.130	0.1239	6.25	2.45	
				Diameter (D)	0.147	0.0960	6.25	1.85	
Standard RAD-PE-559-7 (AP)	+90	100.00%	100.00%	Max Die (d ₁)	0.014	0.007			DATES
Remarks				Web*					Packed 12/14/77
				Avg	0.0185 nom	0.026	0.0187		Sampled 12/14/77
				Outer		0.0215	0.0203		Test Finished 12/21/77
				Inner		0.031	0.0170		Offered 1/6/78
** Loading Density of 0.12 gm/cc				Web Difference/Std. Dev. in % of Web Average	15 Max	36.19	17.32		Description Sheets Forwarded 1/6/78
2001 cc (nom) Closed Bomb				L.D	1.3 nom		1.28		
				Q.S	5 - 15		2.6		

Type of Packing Container Fiber Drums: 6 @ 150 lbs. net; 1 @ 21 lbs. net.
 Remarks *Dimensions are from the uncoated base stock propellant.
Chemical test results corrected for TV, graphite, dust and foreign matter.
This lot produced on a best effort basis.

Contractor's Representative: R. A. Williams
 Government Quality Assurance Representative: J. E. Wint

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET	WEAPON	LOT NUMBER RAD-PE-559-15 (AP)
	MODEL	ACCEPTANCE DATE 17 April 1978
MFG BY AT CONTRACT NUMBER WEIGHT OF LOT	HERCULES INCORPORATED RADFORD ARMY AMMUNITION PLANT DAAA09-77-C-4007 4,810 lbs	PROOF FIRED BY FIRING RECORD NUMBER PROJECTILE WEIGHT PROJECTILE LOT NUMBER TEMPERATURE OF POWDER OF STANDARD PROPELLANT LOT

PROPELLANT DESCRIPTION

TYPE	M		
AVERAGE WEB SPECIFICATION	DATED	WITH REVISION	DATED

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT.	TOTAL INCREMENT WT.	PROJECTILE WEIGHT	VELOCITY FT/SEC	PRESSURE LBS/SQ IN.
	Propellant Single-Base, Multi-Perf Methyl Centralite Coated f/25mm AP-T				
	Accepted for PE Project 559.				

THIS PROPELLANT LOT IS ACCEPTED

JAMES E. BLAND
CHIEF QUALITY ASSURANCE DIVISION

LOADING AUTHORIZATION

THE PROPELLANT LOT DESCRIBED ABOVE MAY BE USED IN LOADING ANY OF THE AMMUNITION ITEMS LISTED BELOW EXCEPT WHERE QUANTITIES ARE SPECIFICALLY ALLOTTED FOR A PARTICULAR PURPOSE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	TYPE	MODEL	PROJECTILE WT	DRAWING	DATE OF LAST REV

THIS LOADING AUTHORIZATION EXPIRES AFTER _____ AT WHICH TIME REBLENDING OR REASSESSMENT WILL BE CONSIDERED.

LOADING AUTHORIZATION ISSUED TO

CHIEF QUALITY ASSURANCE DIVISION

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET

REPORTS CONTROL SYMBOL
EXEMPT - PARA 7-2a
AR 335-15

TO	FROM	ACCEPTANCE DATE
		5 February, 1979

DESCRIPTION OF PROPELLANT

MODEL	<input type="checkbox"/> TYPE I (MP) <input type="checkbox"/> TYPE II (SP)	AVG WEB	LOT NUMBER
SPECIFICATION, REV, DATE and AMENDMENTS		LOT QUANTITY	
MFG BY	AT	CONTRACT NUMBER	
HERCULES INCORPORATED	RADFORD ARMY AMMUNITION PLANT	DAAA09-77-C-4007	
RAD-PE-559-16 (AP)		6,999 lbs	

PROVING GROUND DATA

PROOF FIRED BY	PROVING GROUND	FIRING RECORD NUMBER
PROJECTILE	WEIGHT	PROJECTILE LOT NUMBER
TEMPERATURE OF POWDER	°F	STANDARD PROPELLANT LOT

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT	TOTAL INCREMENT WT	PROJECTILE WT	VELOCITY FT/SEC	PRESSURE LB/SG IN
ACCEPTED FOR PE PROJECT 559					
Propellant, Single-Base, Multi-Perf Methyl Centralite Coated f/25mm AP-T,					

THIS LOT OF PROPELLANT IS ACCEPTED

JAMES E. BLAND

SIGNATURE AND TITLE

5 February 1979

DATE

LOADING AUTHORIZATION - The propellant lot described above may be used in loading any of the ammunition items listed below except where quantities are specifically allotted for a particular purpose.

WEAPON AND MODEL

COMPLETE ROUND OR PROPELLING CHARGE

WEAPON AND MODEL	MODEL	TYPE	PROJECT WT	DRAWING	DATE OF LAST REV

This loading authorization expires after _____ at which time reblending or reassessment will be considered.

LOADING AUTHORIZATION ISSUED TO

TYPED NAME AND TITLE OF APPROVING OFFICIAL	SIGNATURE	DATE

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RA-D-PE-559-15(AP) Composition No. Propellant, Single-Base, Multi-Perf
Methyl Centralite Coated f/25mm AP-T
 Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 4,810 lbs
 Contract No. DAAA09-77-C-4007 Date 4-1-77 Specification No. COR ltr SARRA-IE dated 16 February 1978

ACCEPTED BLEND NUMBERS		NITROCELLULOSE			
C-15134	Nitrogen Content	Maximum	Minimum	Average	Explosion
	%	%	%	%	Min
					Min
	K1 Starch (65°C)	Minimum	Maximum	Average	Min
					Min
					Min

MANUFACTURE OF PROPELLANT
 0.92 Pounds Solvent per Pound ~~XXX~~ Dry Weight Ingredients Consisting of 35 Pounds Alcohol and 65 Pounds Ether per 100 Pounds Solvent
 Percentage Resin to White 16

TEMPERATURES °C			PROCESS-SOLVENT RECOVERY AND DRYING		TIME	
From	To		Days	Hours		
21	21	Maintain Inert Gas Flow of 1/8-inch Positive Pressure			32	
21	21	Maintain Inert Gas Flow of 1/4-inch Positive Pressure			32	
21	35	Increase Temperature, Maintain 1/4-inch Positive Pressure			24	
56	62	Water Dry			10	
74	76	Coating Cycle			2	
56	62	Post Coating Water Dry			48	

PROPELLANT COMPOSITION			TESTS OF FINISHED PROPELLANT			STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formula	Percent Tolerance	Percent Measure	Formula	Actual		
Nitrocellulose	96.7	± 1.0	96.34	Heat Test S.P. 134.5PC No CC 60'	60'		
Diphenylamine	0.9	± 0.4	0.85	No Explosion	5 hr min	5 hr	
Potassium Sulfate	0.5	± 0.3	0.56	Form of Propellant	Type I	Cylinder	
Methyl Centralite	1.9	± 0.5	2.24	No. Perforations	7	7	
Total	100.0		100.00				
Graphite	0.4	Max	0.20	Heat of Explosion	N/A		
Total Volatiles	2.9	Max	2.01	Cal/gm		900.5	
Residual Solvents	1.7	Max	0.78	Bulk Density, gm/cc	0.940 to 1.050	1.011	
Moisture	1.1	- 0.4	1.23				
Hygroscopticity	1.8	Max	1.38	Loadability, gms	N/A	103.6	
Dust & Foreign Matter	0.1	Max	0.2				

CLOSED BOMB				PROPELLANT DIMENSIONS (inches)			
Lot Number	Temp °C	Relative Quickness	Relative Force	Specification	Die	Finished	Mean Variation in % of Mean Dimensions
Test RAD-PE-559-15(AP)	400	101.95	100.24				
				Length (L)	0.110	0.0996	6.25 1.65
				Diameter (D)	0.147	0.0941	6.25 1.22
Standard RAD-PE-559-11 (AP)	400	100.00%	100.00%	Part Dia. (d)	0.014	0.0068	
Remarks				Web			DATE
				Outer	0.0125	0.0104	Packed 3/30/78
				Inner	0.031	0.0179	Sampled 3/30/78
				Average	0.0185 Nom	0.0186	Test Finished 4/10/78
*Loading Density of 0.2 gm/cc in 200 cc (Nom) Closed Bomb				Web Difference/3rd Dev. in % of Web Average	15 Max	36 to 8.31	Offered 4/17/78
				LD	1.1 Nom	1.06	Description Sheets Forwarded 4/18/78
				0.4	5 to 15	113.89	

Type of Packing Container Fiber Drums: 32 @ 150 lbs Net
 Remarks Chemical test results corrected for TV, graphite, dust and foreign matter.

Contractor's Representative: _____ Government Quality Assurance Representation

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT DESCRIPTION SHEET

U.S. Army Lot No. RAD-PE-559-16(AP) Composition No. Propellant, Single-Base, Multi-Perf. Methyl Centralite Coated f/25mm AP-T
 Manufactured at RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Packed Amount 6,999 lbs.
 Contract No. DAAA9-77-C-4007 Date 4-1-77 Specification No. COR letter SARRA-IE, dated 10/3/78 and 12/22/78

ACCEPTED BLEND NUMBERS	NITROCELLULOSE			
	C-15,223	Nitrogen Content	KI Starch (65.5°C)	Stability (134.5°C)
		Maximum _____ %	_____ Mins	_____ Mins
		Minimum _____ %	_____ Mins	_____ Mins
Average <u>13.16</u> %		_____ Mins	<u>30</u> Mins	

MANUFACTURE OF PROPELLANT
0.92 Pounds Solvent per Pound NC/Dry Weight Ingredients Consisting of 35 Pounds Nitrocellulose and 65 Pounds ether per 100 Pounds Solvent.
 Percentage Range to Which 16

TEMPERATURES °C	PROCESS-SOLVENT RECOVERY AND DRYING		TIME	
	From	To	Days	Hours
	21		Maintain Inert Gas Flow of 1/8-Inch Positive Pressure	32
	21		Maintain Inert Gas Flow of 1/4-Inch Positive Pressure	32
	21	35	Increase Temperature, Maintain 1/4-Inch Positive Pressure	24
	56	62	Water Dry	10
	74	76	Coating Cycle	2
	56	62	Post Coating Water Dry	48

PROPELLANT COMPOSITION			TESTS OF FINISHED PROPELLANT		STABILITY AND PHYSICAL TESTS	
Constituent	Percent Formula	Percent Tolerance	Percent Measured	Formula	Actual	
Nitrocellulose	96.7	±1.0	96.28	Heat of Exp. S.P. 134.5°C	No CC 60"	60'+
Diphenylamine	0.9	±0.4	0.86	NO EXPLOSION	5 hr Min	5 hr
Potassium Sulfate	0.5	±0.3	0.45	Form of Propellant	Type I	Cylinder
Methyl Centralite	1.9	±0.5	2.41	No. Perforations	7	7
TOTAL	100.00		100.00	Heat of Explosion		
Graphite	0.4	Max	0.19	cal/gm	N/A	889.9
Total Volatiles	2.9	Max	1.93	Bulk Density,	0.940 to	
Residual Solvents	1.7	Max	0.93	gm/cc	1.050	1.011
Moisture	1.1	±0.4	1.00			
Heterospecificity	1.8	Max	0.99	Loadability, gm	N/A	101.0
Dust & Foreign Matter	0.1	Max	0.03			

CLOSED BOMB				PROPELLANT DIMENSIONS (inches)			
Lot Number	Temp °C	Positive Quickness	Positive Force	Specification	Die	Finished	Mean Variation in % of Nom Dimensions
Lot RAD-PE-559-16(AP)+90	+90	100.76	100.01	Length (L)	0.110	0.0980	Spec. 6.25 Actual 2.07
				Diameter (D)	0.147	0.0931	Spec. 6.25 Actual 1.59
Standard RAD-PE-559-15(AP)+90	+90	100.00%	100.00%	Web. Outer	0.0125	0.0192	DATES Packed 1/25/79 Samped 1/25/79 Test finished 2/2/79 Offered 2/2/79 Description Sheets Forwarded 2/6/79
				Inner	0.031	0.0181	
				Ave	0.0185	Nom 0.0187	
* Loading		2.2 gm/cc in		Web Difference/Std Dev in % of Web Average	15 Max	-36.19 5.62	
200 cc (Nom)		comb		L.O	1.1 Nom	1.05	
				2.3	5 to 15	14.44	

Type of Packing Container: FIBER DRUMS: 46 @ 150 lbs. net; 1 @ 89 lbs. net.

Remarks: Chemical test results corrected for TV, graphite, dust and foreign matter.

This lot meets all specification requirements.

Contractor's Representative: K. A. Williams
 Government Quality Assurance Representative: James E. Bland

PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYMBOL
EXEMPT-PARA 7-2a
335-15

COMPOSITION M10 E/25nm	DA LOT NUMBER RAD-PE-559-17 (AP)
SPECIFICATION COF letter SARPA-TE, dated 4/29/80	PACKED AMOUNT 5,032 lbs.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS C 15315	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
	MAX _____ %	_____ MIN	_____ MIN
	MIN _____ %	_____ MIN	_____ MIN
	AVG 13.15 %	45+ MIN	30 MIN
EXPLOSION HE			

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF 35 POUNDS ALCOHOL AND 65 POUNDS ether PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE 10

PROCESS-SOLVENT RECOVERY AND DRYING

TEMPERATURES °F	FROM	TO	PROCESS	TIME	
				DAYS	HOURS
		21	Maintain Inert Gas Flow of 1/8-Inch Positive Pressure		32
		21	Maintain Inert Gas Flow of 1/4-Inch Positive Pressure		32
	21	35	Increase Temperature, Maintain 1/4-Inch Positive Pressure		24
	56	62	Water Dry	10	
	74	76	Coating Cycle		2
	56	62	Post Coating Water Dry		48

PROPELLANT COMPOSITION

TESTS OF FINISHED PROPELLANT

STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	HEAT TEST	FORMULA	ACTUAL
Nitrocellulose	Remainder		95.88	S.P. 134.5°C	No CC 40'	60'
Diphenylamine	0.9	+0.4	0.83	NO EXPLOSION	5 hr Min	5 hr
Potassium Sulfate	1.0	±0.3	1.14	FORM OF PROPELLANT	Type I	Cylinder
Methyl Centralite	1.9	Nominal	2.15	No. Perforations	7	7
TOTAL	100.0		100.00	Heat of Explosion,		
Graphite	0.4	Max	0.14	cal/g	N/A	892.0
Total Volatiles	2.9	Max	1.68	Bulk Density,	0.940 to	
Residual Solvents	1.7	Max	0.44	g/cc	1.050	0.992
Moisture	1.1	±0.4	1.24			
Hygroscopicity	1.80	Max	1.33			
Dust & Foreign Matter	0.10	Max	0.035			

CLOSED BOMB

PROPELLANT DIMENSIONS

inches

LOT NUMBER	TEMP °F	RELATIVE CLUCKNESS	RELATIVE FORCE	SPECIFICATION	DIE	FINISHED	STD. DEV. in % of Mean Dimensions	ACTUAL
TEST RAD-PE-559-17 (AP)	+90	100.33	99.09	LENGTH (L)	0.1062 nom	0.110	0.104	6.25
				DIAMETER (D)	0.0949 nom	0.147	0.0935	6.25
				PERF. DIA. (d)		0.014	0.0064	
REMARKS Loading density of 0.2 g/cc in 200 cc (nom) closed bomb	STANDARD	559-16 (AP)	+90	100.00%	100.00%	Web, Outer	0.0125	0.0194
						Inner	0.031	0.0178
						Avg	0.019±0.002	0.0186
						Web Difference /Std. Dev. in % of Web Avg.	20 max	-36.19
						L:D	0.9 to 1.3	1.11
					D:d	5 to 15	14.59	
							DATES	
							PACKED	7/29/80
							SAMPLED	7/29/80
							TEST FINISHED	8/20/80
							OFFERED	8/27/80
							DESCRIPTION SHEETS FORWARDED	9-23-80

TYPE OF PACKING CONTAINER FIBER DRUMS 652D: 33 @ 150 lbs. net; 1 @ 55 lbs. net.

REMARKS
Chemical test results corrected for TV, graphite, dust, and foreign matter.
This lot meets all specification requirements.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE: R. A. Williams
SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE: James E. Bland

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT ACCEPTANCE SHEET

REPORTS CONTROL SYMBOL
EXEMPT - PARA 7-2a
AR 335-15

TO	FROM	ACCEPTANCE DATE 22 September 1980
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DESCRIPTION OF PROPELLANT

MODEL	<input type="checkbox"/> TYPE I (MP); <input type="checkbox"/> TYPE II (SP)	AVG WEB	LOT NUMBER RAD-PE-559-18(AP)
SPECIFICATION, REV, DATE and AMENDMENTS			LOT QUANTITY 48 lbs
MFG BY HERCULES INCORPORATED	A RADFORD ARMY AMMUNITION PLANT		CONTRACT NUMBER DAAA09-77-C-4007

PROVING GROUND DATA

PROOF FIRED BY	PROVING GROUND	FIRING RECORD NUMBER
PROJECTILE	WEIGHT	PROJECTILE LOT NUMBER
TEMPERATURE OF POWDER °F	STANDARD PROPELLANT LOT	

CHARGE WEIGHTS

INCREMENT NO.	INCREMENT WT	TOTAL INCREMENT WT	PROJECTILE WT	VELOCITY FT/SEC	PRESSURE LB. SQ IN
ACCEPTED FOR PROJECT 559					
M10 f/25 mm					

THIS LOT OF PROPELLANT IS ACCEPTED
JAMES E. BLAND 22 September 1980
SIGNATURE AND TITLE DATE

LOADING AUTHORIZATION - The propellant lot described above may be used in loading any of the ammunition items listed below except where quantities are specifically allotted for a particular purpose.

COMPLETE ROUND OR PROPELLING CHARGE

WEAPON AND MODEL	COMPLETE ROUND OR PROPELLING CHARGE				
	MODEL	TYPE	PROJECT WT	DRAWING	DATE OF LAST REV

This loading authorization expires after _____ at which time reblending or reassessment will be considered.

LOADING AUTHORIZATION ISSUED TO

TYPED NAME AND TITLE OF APPROVING OFFICIAL	SIGNATURE	DATE
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PROPELLANT

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

REPORTS CONTROL TABLE
EXEMPT-PARA 7-2a
AR 335-15

COMPOSITION M10 f/25mm	DA LOT NUMBER RAD-PE-559-18 (AP)
SPECIFICATION COR 1tr SAPRA-IE, dated 4/29/80	PACKED AMOUNT 48 lbs.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS C-15,315	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
	MAX _____ %	_____ MIN	_____ MIN
	MIN _____ %	_____ MIN	_____ MIN
	AVG 13.15 %	45+ MIN	_____ MIN
			EXPLOSION HP

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF	35 POUNDS ALCOHOL AND	55 POUNDS
ether PER 100 POUNDS SOLVENT	PERCENTAGE REMIX TO WHOLE	0

PROCESS-SOLVENT RECOVERY AND DRYING

TEMPERATURES °C			TIME	
FROM	TO		DAYS	HOURS
	21	Maintain inert gas flow of 1/8-inch positive pressure		32
	21	Maintain inert gas flow of 1/4-inch positive pressure		32
21	35	Increase temperature, maintain 1/4-inch positive pressure		24
56	62	Water Dry	10	
74	76	Coating Cycle		2
56	62	Post Coating Water Dry		48

PROPELLANT COMPOSITION

TESTS OF FINISHED PROPELLANT

STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED		FORMULA	ACTUAL
Nitrocellulose	Remainder		94.71*	HEAT TEST SP 134.5°C	No CC 60"	60'+
Diphenylamine	0.9	±0.4	0.93	NO EXPLOSION	5 hr Min	5 hr
Potassium Sulfate	1.0	±0.3	0.95	FORM OF PROPELLANT	Type I	Cylinder
Methyl Centralite	1.9	Nominal	1.23	No. Perforations	7	7
TOTAL	100.0		100.00	Heat of Explosion		
Graphite	0.4	Max	0.9	cal/g	N/A	902.0
Total Volatiles	2.9	Max	1.38	Bulk Density	0.940 to	
Residual Solvents	1.7	Max	0.44	g/cc	1.050	0.987
Moisture	1.1	±0.4	0.94			
Hygroscopicity	1.80	Max	1.32			
Dust & Foreign Matter	0.10	Max	*			
Dinitrotoluene			2.09*			

CLOSED BEAM

PROPELLANT DIMENSIONS (inches)

LOT NUMBER	TEMP °F	RELATIVE QUICPNESS	RELATIVE FORCE		SPECIFICATION	DIE	FINISHED	SPEC.	ACTUAL
TEST RAD-PE-559-18 (AP)	+90	90.23	100.82	LENGTH (L)		0.135	0.1247	6.25	2.53
				DIAMETER (D)		0.170	0.1056	6.25	4.72
				PERF. DIA. (d)		0.016	0.0072		
STANDARD RAD-PE-559-16 (AP)	+90	100.00%	100.00%	Web, Outer		0.025	0.0196		
REMARKS Loading density of 0.2 g/cc in 200 cc (nom) closed beam				Inner		0.036	0.0239		
				Avg	0.0212 Nom	0.0306	0.0218		
				Web Difference / Std Dev. in % of Web Avg	20 Max	-35.95	-19.74		
				L/D	1.1 Nom		1.18		
				D/d	5 to 15		14.62		
								PACKED 7/29/80	
								SAMPLED 7/29/80	
								TEST FINISHED 8/20/80	
								OFFERED 8/27/80	
								DESCRIPTION SHEETS FORWARDED 9-23-80	

TYPE OF PACKING CONTAINER FIBER DRUM 652D: 1 @ 46 lbs. net.

REMARKS Except for dinitrotoluene impurity, this propellant meets all design requirements and very satisfactory gun test results should be obtained. Chemical test results corrected for TV and graphite.

*This lot does not meet specification requirements because it contains dinitrotoluene either as a coating or within propellant, which would never have been detected if a gas chromatographic analytical method had not been required for methyl centralite test.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE R. A. Williams	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE James E. Bland
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PROPELLANT DESCRIPTION SHEET

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY.

REPORTS CONTROL SYMBOL
EXEMPT-PARA 7-2a
AR 335-15

COMPOSITION MLO E/25mm	DA LOT NUMBER RAD-PE-559-19 (AP)
SPECIFICATION COR letter SARRA-IE, dated 4/29/80	PACKED AMOUNT 59 lbs.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS C-15,315	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
	MAX _____ %	_____ MIN	_____ MIN
	MIN _____ %	_____ MIN	_____ MIN
	AVG <u>13.15</u> %	<u>45+</u> MIN	<u>30</u> MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF 35 POUNDS ALCOHOL AND 65 POUNDS other PER 100 POUNDS SOLVENT
PERCENTAGE REMIX TO WHOLE 0

PROCESS-SOLVENT RECOVERY AND DRYING			TIME	
TEMPERATURES (°C)	FROM	TO	DAYS	HOURS
		21	Maintain inert gas flow of 1/8-inch positive pressure	32
		21	Maintain inert gas flow of 1/4-inch positive pressure	32
	21	35	Increase temperature; maintain 1/4-inch positive pressure	24
	56	62	Water dry	10
	74	76	Coating Cycle	2
	56	62	Post coating water dry	48

PROPELLANT COMPOSITION

TESTS OF FINISHED PROPELLANT

STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	FORMULA	ACTUAL
Nitrocellulose	Remainder		94.43*	HEAT TEST S.P. 134.5°C	No CC 60'
Diphenylamine	0.9	±0.4	0.98	No Explosion	5 hr min
Potassium Sulfate	1.0	±0.3	0.95	FORM OF PROPELLANT	Type I
Methyl Centralite	1.9	Nominal	1.19	No. Perforations	7
TOTAL	100.00		100.00	Heat of Explosion,	
Graphite	0.4	Max	0.13	cal/g	N/A
Total Volatiles	2.9	Max	1.38	Bulk Density,	0.940 to
Residual Solvents	1.7	Max	0.28	g/cc	1.050
Moisture	1.1	±0.4	1.10		0.964
Hygroscopicity	1.80	Max	1.30		
Dust & Foreign Matter	1.10	Max	*		
Dinitrotoluene			2.45		

CLOSED BOMB

PROPELLANT DIMENSIONS (inches)

LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE	SPECIFICATION	DIE	FINISHED	STD. DEV. in % of Mean Dimensions	
							SPEC.	ACTUAL
TEST RAD-PE-559-19 (AP)	+90	80.83	1100.42	LENGTH (L)	0.150	0.1453	6.25	6.16
				DIAMETER (D)	0.190	0.1223	6.25	6.33
				PERF. DIA. (d)	0.018	0.0088		
RAD-PE STANDARD	559-16 (AP)	+90	100.00%	Web, Outer	0.0285	0.0222	DATES	
				Innr	0.0395	0.0272	PACKED 7/29/80	
				Avg	0.0237 Nom	0.034	0.0247	SAMPLED 7/29/80
REMARKS *Loading density of 0.2 g/cc in 200 cc (nom) closed bomb				Web Difference /Std. Dev. in % of Web Avg	20 Max	-32.35	-20.27	TEST FINISHED 8/20/80
				LD	1.1 Nom		1.19	OFFERED 8/27/80
				D-d	5 to 15		13.97	DESCRIPTION SHEETS FORWARDED 9-23-80

TYPE OF PACKING CONTAINER FIBER DRUM 652D: 1 @ 57 lbs. net.

REMARKS Except for dinitrotoluene impurity, this propellant meets all design requirements and very satisfactory gun test results should be obtained from it. Chemical test results corrected for TV and graphite. This lot does not meet all specification requirements because it contains dinitrotoluene either as coating or within propellant, which could never have been detected if a gas chromatographic analytical method had not been required for the methyl centralite test.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE

SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE

R. A. Williams

James E. Bland

PROPELLANT DESCRIPTION SHEET

COMPOSITION 25mm Bushmaster	DA LOT NUMBER RAD-PE-559-20 (AP)
SPECIFICATION COR letter SARRA-IE, dated 30 October 1980	PACKED AMOUNT 94 lbs.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS C-15333	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
	MAX _____ %	_____ MIN	_____ MIN
	MIN _____ %	_____ MIN	_____ MIN
	AVG 13.13 %	45+ MIN	30+ MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF 55 POUNDS ALCOHOL AND 55 POUNDS ether PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE 0

TEMPERATURES °C		PROCESS-SOLVENT RECOVERY AND DRYING	TIME	
FROM	TO		DAYS	HOURS
	21	Maintain Inert Gas Flow of 1/8-inch Positive Pressure		32
	21	Maintain Inert Gas Flow of 1/4-inch Positive Pressure		32
21	35	Increase Temperature, maintain 1/4-inch Positive Pressure		24
56	62	Water Dry	10	
74	76	Curing Cycle		2
56	62	Post Coating Water Dry		48

PROPELLANT COMPOSITION		TESTS OF FINISHED PROPELLANT			STABILITY AND PHYSICAL TESTS	
CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	HEAT TEST	FORMULA	ACTUAL
Nitrocellulose	95.95	Remainder	96.28	SP 134.5°C	No CC 40'	No CC 60'
Diphenylamine	0.90	±0.40	0.89	No Explosion	5 hr min	5 hr+
Potassium Sulfate	1.0	±0.3	0.86	FORM OF PROPELLANT	Type I	Cylinder
Methyl Centralite	2.15	Nominal	1.97	No. Perforations	7	7
TOTAL	100.00		100.00	Heat of Explosion,		
Graphite	0.40	Max	0.27	cal/g	900.5 nom	910.7
Total Volatiles	2.90	Max	1.38	Bulk Density,		
Residual Solvents	1.7	Max	0.32	g/cc	0.92 min	1.000
Moisture	1.10	±0.40	1.06	Loadability, g	> 97.5 Nom	93.6
Hygroscopicity	1.80	Max	0.93			
Dust & Foreign Matter	0.10	Max	0.06			

CLOSED BOMB				PROPELLANT DIMENSIONS (inches)					
LOT NUMBER	TEMP °F	RELATIVE HUMIDITY	RELATIVE FORCE	LENGTH (L)	DIE	FINISHED	STD. DEV. in % of Mean Dimensions		
TEST RAD-PE-559-20 (AP)	+90	103.16	100.32						
RAD-PE-559-20 (AP)	158	112.17	101.34						
STANDARD RAD-PE-559-15 (AP)	+90	100.00%	100.00%						
REMARKS: *Loading density of 0.2 g/cc in 200 cc (nom) closed bomb				LENGTH (L)	0.1062 nom	0.110	0.1047	6.25	2.42
				DIAMETER (D)	0.0949 nom	0.147	0.0911	6.25	2.28
				PERF. DIA. (d)	0.0064 nom	0.014	0.0066		
				Outer		0.0215	0.0177	PACKED	12/4/80
				Inner		0.031	0.0184	SAMPLED	12/4/80
				Avg	0.0186 nom	0.0263	0.0181	TEST FINISHED	1/16/81
Web Difference / Std. Dev. in % of Web Avg.	20, max	-36.19	-3.87	OFFERED	1/16/81				
LD	0.9-1.3		1.15	DESCRIPTION SHEETS FORWARDED					
G:d	5 to 15		13.75						

TYPE OF PACKING CONTAINER FIBER DRUM: 1 @ 89 lbs. net. and 5-10 sample

REMARKS
Chemical test results corrected for TV, graphite, dust and foreign matter
This lot meets all specifications with exception that loadability is somewhat lower than desired.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE R. A. Williams	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE J. E. Bland
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PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYMBOL
EXEMPT-PARA 7-2a
AR 335-15

THE INFORMATION CONTAINED HEREIN SHALL
BE USED FOR GOVERNMENT PURPOSES ONLY

COMPOSITION 25mm Bushmaster	DA LOT NUMBER RAD-PE-559-21 (AP)
SPECIFICATION COR 1tr SARRA-IE, dated 30 October 1980	PACKED AMOUNT 95 lbs.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS C-15333	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
	MAX _____ %	_____ MIN	_____ MIN
	MIN _____ %	_____ MIN	_____ MIN
	AVG 13.13 %	45+ MIN	30+ MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC, DRY WEIGHT INGREDIENTS CONSISTING OF 35 POUNDS ALCOHOL AND 65 POUNDS ether PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE 0

PROCESS-SOLVENT RECOVERY AND DRYING

TEMPERATURES °C			TIME	
FROM	TO		DAYS	HOURS
	21	Maintain Inert Gas Flow of 1/8-inch Positive Pressure		32
	21	Maintain Inert Gas Flow of 1/4-inch Positive Pressure		32
21	35	Increase Temperature; Maintain 1/4-inch Positive Pressure		24
56	62	Water Dry	10	
74	76	Coating Cycle		2
56	62	Post Coating Water Dry		48

PROPELLANT COMPOSITION TESTS OF FINISHED PROPELLANT STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	FORMULA	ACTUAL
Nitrocellulose	95.60	Remainder	95.49	HEAT TEST SP, 134.5°C No CC40'	60' No CC
Diphenylamine	0.90	±0.40	0.96	No Explosion	5 hr min 5 hr+
Potassium Sulfate	1.00	±0.3	0.78	FORM OF PROPELLANT	Type I Cylinder
Methyl Centralite	2.50	Nominal	2.77	No. Perforations	7 7
TOTAL	100.00		100.00	Heat of Explosion,	
Graphite	0.40	Max	0.32	cal/g	900.5 nom 884.5
Total Volatile	2.90	Max	1.41	Bulk Density,	
Residual Solvents	1.7	Max	0.36	g/cc	0.92 min 0.995
Moisture	1.10	±0.40	1.05	Loadability, g	> 97.5 nom 93.8
Hygroscopicity	1.80	Max	1.16		
Dust and Foreign Matter	0.10	Max	0.04		

CLOSED BOMB PROPELLANT DIMENSIONS (Inches)

LOT NUMBER	TEMP °F	RELATIVE DENSITY	RELATIVE FORCE	SPECIFICATION	DIE	FINISHED	SPEC.	ACTUAL
TEST RAD-PE-559-21 (AP)	+90	93.60%	99.27%	LENGTH (L)	0.1062 nom	0.110	0.1060	6.25 2.39
RAD-PE-559-21 (AP)+158		102.23%	99.98%	DIAMETER (D)	0.0949 nom	0.147	0.0905	6.25 2.09
STANDARD PE 559-15 (AP)	+90	100.00%	100.00%	PERF. DIA. (d)	0.0064 nom	0.014	0.0064	
REMARKS *Loading density of 0.2 g/cc in 200 cc (nom) closed bomb				Web				DATES
				Outer		0.0215	0.0185	PACKED 12/4/80
				Inner		0.031	0.0181	SAMPLED 12/4/80
				Average	0.0186 nom	0.0263	0.0183	TEST FINISHED 1/16/81
				Web Difference /Std. Dev. in % of Web Avg.	20 max	-36.19	+2.19	OFFERED 1/16/81
			L:d	0.9 - 1.3		1.17		DESCRIPTION SHEETS FORWARDED
			D:d	5 to 15		14.14		

TYPE OF PACKING CONTAINER FIBER DRUM: 1 @ 90 lbs. net. and 5 pound sample

REMARKS
Chemical test results corrected for TV, graphite, dust and foreign matter. This lot meets all specification requirements except that loadability is somewhat lower than desired.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE R. A. Williams	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE J. E. Bland
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PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYMBOL
EXEMPT-PARA 7-2a
AR 335-15

COMPOSITION 25mm Bushmaster	DA LOT NUMBER RAD-PE-559-22(AP)
SPECIFICATION COR 1tr SARRA-IE, dated 30 October 1950	PACKED AMOUNT 95 lbs.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

C-15333 ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
	MAX _____ %	_____ MIN	_____ MIN
	MIN _____ %	_____ MIN	_____ MIN
	AVG 13.13 %	45+ MIN	30+ MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF 55 PCUNDS ALCOHOL AND 65 POUNDS ether PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE 0

TEMPERATURES °C		PROCESS-SOLVENT RECOVERY AND DRYING	TIME	
FROM	TO		DAYS	HOURS
	21	Maintain Inert Gas Flow of 1/8-inch Positive Pressure		32
	21	Maintain Inert Gas Flow of 1/4-inch Positive Pressure		32
21	35	Increase Temperature, Maintain 1/4-inch Positive Pressure		24
56	62	Water Dry	10	
74	76	Coating Cycle		2
56	62	Post Coating Water Dry		48

PROPELLANT COMPOSITION

TESTS OF FINISHED PROPELLANT

STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	STABILITY AND PHYSICAL TESTS		
				FORMULA	ACTUAL	
Nitrocellulose	96.00	Remainder	96.78	HEAT TEST SP 134.5°C	No CC 40'	No CC 60'
Diphenylamine	0.90	± 0.40	0.97	No Explosion	5 hr min	5 hr+ NE
Potassium Sulfate	1.0	± 0.3	0.90	FORM OF PROPELLANT	Type I	Cylinder
Methyl Centralite	1.5	Nominal	1.35	No. Perforations	7	7
TOTAL	100.0		100.00	Heat of Explosion		
Graphite	0.40	Max	0.31	cal/g	900.5 nom	929.0
Total Volatiles	2.90	Max	1.27	Bulk Density		
Residual Solvents	1.7	Max	0.34	g/cc	0.92 min	0.991
Moisture	1.10	± 0.40	0.93	Loadability, g	97.5 nom	94.5
Hygroscopicity	1.80	Max	0.88			
Dust & Foreign Matter	0.10	Max	0.03			

CLOSED BOMB

PROPELLANT DIMENSIONS (inches)

LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE	PROPELLANT DIMENSIONS (inches)					STD. DEV. in % of Mean Dimensions			
				SPECIFICATION	DIE	FINISHED	SPEC.	ACTUAL				
TEST RAD-PE-559-22(AP)	+90	101.48%	100.99%	LENGTH (L)	0.1062 nom	0.110	0.1058	6.25	2.72			
RAD-PE-559-22(AP)	158	112.67%	101.44%	DIAMETER (D)	0.0949 nom	0.147	0.0895	6.25	1.15			
RAD-PE				PERF. DIA. (d)	0.0054 nom	0.012	0.0058					
STA. BARD	559-15(AP)	+90	100.00%	100.00%	Web			DATES				
REMARKS *Loading density of 0.2 g/cc in 200 cc (nom) closed bomb					Outer	0.0200	0.0173	PACKED 12/4/80				
					Inner	0.0355	0.0194	SAMPLED 12/4/80				
					Avg	0.0196 nom	0.0278	0.0183	TEST FINISHED 1/16/81			
					Web Difference /Std. Dev. in % of Web Avg.	20 max	-55.86	-11.81	OFFERED 1/16/81			
					LD	0.9 - 1.3		1.18	DESCRIPTION SHEETS FORWARDED			
D:d	17.6 nom		15.37									

TYPE OF PACKING CONTAINER FIBER DRUM 652D: 1 @ 90 lbs. net. and 5-pound sample

REMARKS

Chemical test results corrected for TV, graphite, dust and foreign matter. This lot meets all specification requirements except that loadability is somewhat lower than desired.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE

SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE

R. A. Williams

J. E. Bland

THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY
PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYMBOL
EXEMPT-PARA 7-2a
 AR 335-15

COMPOSITION 25mm Bushmaster	DA LOT NUMBER RAD-PE-559-23(AP)
SPECIFICATION COR ltr SARRA-IE, dated 30 October 1980	PACKED AMOUNT 96 lbs. net.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS C-15333	NITROGEN CONTENT MAX _____ % MIN _____ % AVG 13.13 %	KI STARCH (65.5°C) _____ 45+ _____ MIN	STABILITY (134.5°C) _____ 30+ _____ MIN
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MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF **35** POUNDS ALCOHOL AND **65** POUNDS ether PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE **0**

TEMPERATURES °C			PROCESS-SOLVENT RECOVERY AND DRYING		TIME	
FROM	TO		DAYS	HOURS		
	21	Maintain Inert Gas Flow of 1/8-inch Positive Pressure				32
	21	Maintain Inert Gas Flow of 1/4-inch Positive Pressure				32
21	35	Increase Temperature, Maintain 1/4-inch Positive Pressure				24
56	62	Water Dry	10			
74	76	Coating Cycle				2
56	62	Post Coating Water Dry				48

PROPELLANT COMPOSITION		TESTS OF FINISHED PROPELLANT			STABILITY AND PHYSICAL TESTS	
CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED		FORMULA	ACTUAL
Nitrocellulose	95.95	Remainder	95.84	HEAT TEST SP 134.5°C	No CC 40'	No CC 60'
Diphenylamine	0.90	= 0.40	0.91	No Explosion	5 hr min	5 hr+ NE
Potassium Sulfate	1.0	= 0.3	0.86	FORM OF PROPELLANT	Type I	Cylinder
Methyl Centralite	2.15	Nominal	2.39	No. Perforations	7	7
TOTAL	100.00		100.00	Heat of Explosion		
Graphite	0.40	Max	0.33	cal/g	900.5 nom	890.3
Total Volatiles	2.90	Max	1.49	Bulk Density,		
Residual Solvents	1.7	Max	0.42	g/cc	0.92 min	1.003
Moisture	1.10	= 0.40	1.07	Loadability, g	>97.5 nom	93.5
Hygroscopicity	1.80	Max	1.75			
Dust & Foreign Matter	0.10	Max	0.05			

CLOSED BOMB				PROPELLANT DIMENSIONS (inches)					
LOT NUMBER	TEMP °F	PERCENT QUICKNESS	RELATIVE FORCE						Std. Dev. in % of Mean Dimensions
TEST RAD-PE-559-23(AP)	+90	85.42%	98.93%						
RAD-PE-559-23(AP)	158	97.61%	99.60%	LENGTH (L)	0.1062 nom	0.110	0.1043	6.25	2.60
				DIAMETER (D)	0.0949 nom	0.147	0.0888	6.25	2.01
RAD-PE-				PERF. DIA. (d)	0.0054 nom	0.012	0.0054		
STANDARD	559-15(AP)	+90	100.00%	100.00%	Web				
REMARKS *Loading density of 0.2 g/cc in 200 cc (nom) closed bomb				Outer		0.0200	0.0177	PACKED	12/4/80
				Inner		0.0355	0.0195	SAMPLED	12/4/80
				Avg	0.0196 nom	0.0278	0.0186	TEST FINISHED	1/16/81
				Web Difference /Std. Dev. in % of Web Avg.	20 max	-55.86	-9.32	OFFERED	1/16/81
				Ld	0.9-1.3		1.17	DESCRIPTION SHEETS FORWARDED	
Dd	17.6 nom		16.38						

TYPE OF PACKING CONTAINER **FIBER DRUM 625D: 1 @ 90 lbs. net. and 6 pound sample**

REMARKS
 Chemical test results corrected for TV, graphite, dust and foreign matter. This lot meets all specification requirements except that loadability is somewhat lower than desire.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE R. A. Williams	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE J. E. Bland
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PROPELLANT DESCRIPTION SHEET

COMPOSITION 25mm Bushmaster	DA LGT NUMBER RAD-PE-559-20 (AP)
SPECIFICATION COR letter SARRA-IE, dated 30 October 1980	PACKED AMOUNT 94 lbs.
MFG AT RAUFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS C-15333	NITROGEN CONTENT	KI STARCH (62.5°C)	STABILITY (134.5°C)
	MAX. _____ %	_____ MIN	_____ MIN
	MIN. _____ %	_____ MIN	_____ MIN
	AVG. 13.13 %	45+ MIN	30+ MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF **35** POUNDS ALCOHOL AND **65** POUNDS ether PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE **0**

PROCESS-SOLVENT RECOVERY AND DRYING

TEMPERATURES °C	FROM	TO		TIME	
				DAYS	HOURS
		21	Maintain Inert Gas Flow of 1/8-inch Positive Pressure		32
		21	Maintain Inert Gas Flow of 1/4-inch Positive Pressure		32
	21	35	Increase Temperature, maintain 1/4-inch Positive Pressure		24
	56	62	Water Dry	10	
	74	76	Coating Cycle		2
	56	62	Post Coating Water Dry		48

PROPELLANT COMPOSITION

TESTS OF FINISHED PROPELLANT

STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	FORMULA	ACTUAL
Nitrocellulose	95.95	Remainder	96.28	HEAT TEST SP 134.5°C	No CC 40' No CC 60'
Diphenylamine	0.90	±0.40	0.89	No Explosion	5 hr min 5 hr+
Potassium Sulfate	1.0	±0.3	0.86	FORM OF PROPELLANT	Type I Cylinder
Methyl Centralite	2.15	Nominal	1.97	No. Perforations	7 7
TOTAL	100.00		100.00	Heat of Explosion,	
Graphite	0.40	Max	0.27	cal/g	900.5 nom 910.7
Total Volatiles	2.90	Max	1.38	Bulk Density,	
Residual Solvents	1.7	Max	0.32	g/cc	0.92 min 1.000
Moisture	1.10	±0.40	1.06	Loadability, g	> 97.5 Nom 93.6
Hygroscopicity	1.80	Max	0.93		
Dust & Foreign Matter	0.10	Max	0.06		

CLOSED BOMB

PROPELLANT DIMENSIONS

(Inches)

LOT NUMBER	TEMP °F	RELATIVE HUMIDITY	RELATIVE FORCE	SPECIFICATION	DIE	FINISHED	SPEC.	ACTUAL
TEST RAD-PE-559-20(AP)	+90	103.16	100.32	LENGTH (L)	0.1062 nom	0.110	0.1047	6.25 2.42
RAD-PE-559-20(AP)	158	112.17	101.34	DIAMETER (D)	0.0949 nom	0.147	0.0911	6.25 2.28
RAD-PE-559-15(AP)	+90	100.00%	100.00%	PERF. DIA. (d)	0.0064 nom	0.014	0.0066	
REMARKS				Web				DATES
				Outer		0.0215	0.0177	PACKED 12/4/80
				Inner		0.031	0.0184	SAMPLED 12/4/80
				Avg	0.0186 nom	0.0263	0.0181	TEST FINISHED 1/16/81
				Web Difference / Std. Dev. in % of Web Avg.	20, max	-36.19	-3.87	OFFERED 1/16/81
				L:d	0.9-1.3		1.15	DESCRIPTION SHEETS FORWARDED
				D:d	5 to 15		13.75	

TYPE OF PACKING CONTAINER FIBER DRUM: 1 @ 89 lbs. net. and 5-lb sample

REMARKS

Chemical test results corrected for TV, graphite, dust and foreign matter
This lot meets all specifications with exception that loadability is somewhat lower than desired.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE R. A. Williams	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE J. E. Bland
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PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYMBOL
EXEMPT-PARA 7-2a
AR 335-15

COMPOSITION 25mm Bushmaster	DA LOT NUMBER RAD-PE-559-21 (AP)
SPECIFICATION COR ltr SARRA-IE, dated 30 October 1980	PACKED AMOUNT 95 lbs.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS C-15333	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
	MAX _____ %	MIN _____	MIN _____
	MIN _____ %	MIN _____	MIN _____
	AVG 13.13 %	45+ MIN	30+ MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF 35 POUNDS ALCOHOL AND 65 POUNDS ether PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE 0

TEMPERATURES °C		PROCESS-SOLVENT RECOVERY AND DRYING	TIME	
FROM	TO		DAYS	HOURS
	21	Maintain Inert Gas Flow of 1/8-inch Positive Pressure		32
	21	Maintain Inert Gas Flow of 1/4-inch Positive Pressure		32
21	35	Increase Temperature; Maintain 1/4-inch Positive Pressure		24
56	62	Water Dry	10	
74	75	Coating Cycle		2
56	62	Post Coating Water Dry		48

PROPELLANT COMPOSITION TESTS OF FINISHED PROPELLANT STABILITY AND PHYSICAL TESTS

CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	FORMULA	ACTUAL
Nitrocellulose	95.60	Remainder	95.49	HEAT TEST SF, 134.5°C No CC40'	60' No CC
Diphenylamine	0.90	±0.40	0.96	No Explosion	5 hr min 5 hr+
Potassium Sulfate	1.00	±0.3	0.78	FORM OF PROPELLANT	Type I Cylinder
Methyl Centralite	2.50	Nominal	2.77	No. Perforations	7 7
TOTAL	100.00		100.00	Heat of Explosion,	
Graphite	0.40	Max	0.32	cal/g	900.5 nom 884.5
Total Volatile	2.90	Max	1.41	Bulk Density,	
Residual Solvents	1.7	Max	0.36	g/cc	0.92 min 0.995
Moisture	1.10	±0.40	1.05	Loadability, g	> 97.5 nom 93.8
Hygroscopicity	1.80	Max	1.16		
Dust and Foreign Matter	0.10	Max	0.04		

CLOSED BOMB PROPELLANT DIMENSIONS (inches)

LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE	SPECIFICATION	DIE	FINISHED	STD DEV. in % of Mean Dimensions	
				LENGTH (L)			SPEC.	ACTUAL
TEST RAD-PE-559-21(A.P)	+90	93.00%	99.27%					
RAD-PE-559-21(AP)+158		102.23%	99.98%	0.1062 nom	0.110	0.1060	6.25	2.39
				DIAMETER (D)	0.0949 nom	0.147	0.0905	6.25
				PERF. DIA. (d)	0.0064 nom	0.014	0.0064	
STANDARD RAD-PE-559-15(AP)	+90	100.00%	100.00%	Web			DATES	
REMARKS *Loading density of 0.2 g/cc in 200 cc (m) closed bomb				Outer		0.0215	0.0185	PACKED 12/4/80
				Inner		0.031	0.0181	SAMPLED 12/4/80
				Average	0.0186 nom	0.0263	0.0183	TEST FINISHED 1/16/81
				Web Difference /Std. Dev. in % of Web Avg.	20 max	-36.19	+2.19	OFFERED 1/16/81
				LD	0.9 - 1.3		1.17	DESCRIPTION SHEETS FORWARDED
			D _w	5 to 15		14.14		

TYPE OF PACKING CONTAINER FIBER DRUM: 1 @ 90 lbs. net. and 5 pound sample

REMARKS
Chemical test results corrected for TV, graphite, dust and foreign matter. This lot meets all specification requirements except that loadability is somewhat lower than desired.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE R. A. Williams	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE J. E. Blard
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PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYMBOL
EXEMPT-PARA 7-2a
AR 335-15

COMPOSITION 25mm Bushmaster	DA LOT NUMBER RAD-PE-559-22(AP)
SPECIFICATION COR 1tr SARRA-IE, dated 30 October 1950	PACKED AMOUNT 95 lbs.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS C-15333	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
	MAX _____ %	_____ MIN	_____ MIN
	MIN _____ %	_____ MIN	_____ MIN
	AVG 13.13 %	45+ MIN	30+ MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF **05** POUNDS ALCOHOL AND **05** POUNDS ether PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE **0**

TEMPERATURES °C		PROCESS-SOLVENT RECOVERY AND DRYING	TIME	
FROM	TO		DAYS	HOURS
	21	Maintain Inert Gas Flow of 1/8-inch Positive Pressure		32
	21	Maintain Inert Gas Flow of 1/4-inch Positive Pressure		32
21	35	Increase Temperature, Maintain 1/4-inch Positive Pressure		24
56	62	Water Dry	10	
74	76	Coating Cycle		2
56	62	Post Coating Water Dry		48

PROPELLANT COMPOSITION		TESTS OF FINISHED PROPELLANT			STABILITY AND PHYSICAL TESTS		
CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED		FORMULA	ACTUAL	
Nitrocellulose	96.00	Remainder	96.78	HEAT TEST SP 134.5°C	No CC 40'	No CC 60'	
Diphenylamine	0.90	± 0.40	0.97	No Explosion	5 hr min	5 hr+ NE	
Potassium Sulfate	1.0	± 0.3	0.90	FORM OF PROPELLANT	Type 2	Cylinder	
Methyl Centralite	1.5	Nominal	1.35	No. Perforations	7	7	
TOTAL	100.0		100.00	Heat of Explosion			
Graphite	0.40	Max	0.31	cal/g	900.5 nom	929.0	
Total Volatiles	2.90	Max	1.27	Bulk Density,			
Residual Solvents	1.7	Max	0.34	g/cc	0.92 min	0.99L	
Moisture	1.10	± 0.40	0.93	Loadability, g	97.5 nom	94.5	
Hygroscopicity	1.80	Max	0.88				
Dust & Foreign Matter	0.10	Max	0.03				

CLOSED BOMBS

PROPELLANT DIMENSIONS (inches)

LOT NUMBER	TEMP °F	SENSITIVE QUICKNESS	RELATIVE FORCE		SPECIFICATION	DIE	FINISHED	SPEC.	ACTUAL	
TEST RAD-PE-559-22(AP)	+90	101.48%	100.99%							
RAD-PE-559-22(AP)	158	112.67%	101.44%	LENGTH (L)	0.1062 nom	0.110	0.1058	6.25	2.72	
				DIAMETER (D)	0.0949 nom	0.147	0.0895	6.25	1.15	
				PERF. DIA. (d)	0.0054 nom	0.012	0.0058			
STANDARD	RAD-PE 559-15(AP)	+90	100.00%	100.00%	Web					
REMARKS *Loading density of 0.2 g/cc in 200 cc (nom) closed bomb	Outer					0.0200	0.0173	PACKED	12/4/80	
	Inner					0.0355	0.0194	SAMPLED	12/4/80	
	Avg					0.0196 nom	0.0278	TEST FINISHED	1/16/81	
	Web Difference /Std. Dev. in % of Web Avg.					20 max	-55.36	-11.81	OFFERED	1/16/81
	LD					0.9 - 1.3		1.16	DESCRIPTION SHEETS FORWARDED	
				D:d	17.6 nom		15.37			

TYPE OF PACKING CONTAINER FIBER DRUM 652D: 1 @ 90 lbs. net. and 5-pound sample

REMARKS
Chemical test results corrected for TV, graphite, dust and foreign matter. This lot meets all specification requirements except that loadability is somewhat lower than desired.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE R. A. Williams	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE J. E. Bland
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THE INFORMATION CONTAINED HEREIN SHALL BE USED FOR GOVERNMENT PURPOSES ONLY

PROPELLANT DESCRIPTION SHEET

PE-559
 REPORTS CONTROL SYMBOL
 EXEMPT-PARA 7-2a
 AR 335-15

COMPOSITION 25mm Bushmaster	DA LOT NUMBER RAD-PE-559-23(AP)
SPECIFICATION COR 1tr SARRA-IE, dated 30 October 1930	PACKED AMOUNT 96 lbs. net.
MFG AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
C-15333	MAX _____ %	_____ MIN	_____ MIN
	MIN _____ %	45+ MIN	30+ MIN
	AVG 13.13 %	_____ MIN	_____ MIN
			EXPLOSION HR

MANUFACTURE OF SOLVENT PROPELLANT

0.92 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF 35 POUNDS ALCOHOL AND 65 POUNDS ether PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE 0

TEMPERATURES °C		PROCESS-SOLVENT RECOVERY AND DRYING	TIME	
FROM	TO		DAYS	HOURS
	21	Maintain Inert Gas Flow of 1/8-inch Positive Pressure		32
	21	Maintain Inert Gas Flow of 1/4-inch Positive Pressure		32
21	35	Increase Temperature, Maintain 1/4-inch Positive Pressure		24
36	62	Water Dry	10	
74	76	Coating Cycle		2
56	62	Post Coating Water Dry		48

PROPELLANT COMPOSITION		TESTS OF FINISHED PROPELLANT			STABILITY AND PHYSICAL TESTS	
CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED		FORMULA	ACTUAL
Nitrocellulose	95.95	Remainder	95.34	HEAT TEST SP 134.5°C	No CC 40'	No CC 60'
Diphenylamine	0.90	± 0.40	0.91	No Explosion	5 hr min	5 hr+ NE
Potassium Sulfate	1.0	= 0.3	0.86	FORM OF PROPELLANT	Type I	Cylinder
Methyl Centralite	2.15	Nominal	2.39	No. Perforations	7	7
TOTAL	100.00		100.00	Heat of Explosion,		
Graphite	0.40	Max	0.33	cal/g	900.5 nom	890.3
Total Volatiles	2.90	Max	1.49	Bulk Density,		
Residual Solvents	1.7	Max	0.42	g/cc	0.92 min	1.003
Moisture	1.10	= 0.40	1.07	Loadability, g	>97.5 nom	93.5
Hygroscopicity	1.80	Max	1.45			
Dust & Foreign Matter	0.10	Max	0.05			

CLOSED BOMBS				PROPELLANT DIMENSIONS (Inches)				
LOT NUMBER	TEMP °F	INITIAL VELOCITY	INITIAL FORCE	SPECIFICATION	DIE	FINISHED	STD. DEV. in % of Mean Dimensions	
TEST RAD-PE-559-23(AP)	+90	85.42%	98.93%	LENGTH (L)	0.1062 nom	0.110	0.1043	
RAD-PE-559-23(AP)	158	97.61%	99.60%	DIAMETER (D)	0.0949 nom	0.147	0.0888	
RAD-PE-				PERF. DIA. (d)	0.0054 nom	0.012	0.0054	
STANDARD	559-15(AP)	+90	100.00%	Web				
REMARKS *Loading density of 0.2 g/cc in 200 cc (nom) closed bomb	Outer				0.0200	0.0177	PACKED 12/4/80	
	Inner				0.0355	0.0195	SAMPLED 12/4/80	
	Avg				0.0196 nom	0.0278	0.0186	
	Web Difference /Std. Dev. in % of Web Avg.				20 max	-55.86	-9.32	TEST FINISHED 1/16/81
	LD				0.9-1.3		1.17	DESCRIPTION SHEETS FORWARDED
				D:d	17.6 nom		16	

TYPE OF PACKING CONTAINER FIBER DRUM 625D: 1 @ 90 lbs. net. and 6 pound sampl

REMARKS
 Chemical test results corrected for TV, graphite, dust and foreign matter. This lot meets all specification requirements except that loadability is somewhat lower than desire.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE R. A. Williams	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE J. E. Bland
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APPENDIX G
GUN TEST RESULTS

PROPELLANT
BALLISTIC REQUIREMENTS 25mm APDS CARTRIDGES

-2048 contract
ADMS-567895 Spec

$$\begin{aligned}\bar{V}_o + .72S &\leq 1356 (21^\circ\text{C}), S \leq 10 \\ \bar{V}_o - .72S &\geq 1326 \\ \bar{P} + .72S &\leq 399 (21^\circ\text{C}) \\ \bar{P} + 5.14S &\geq 496 (-54 + 71^\circ\text{C})\end{aligned}$$

Avg = 1341 m/s

3m AP

-0010 contract
ASI2013532 Spec
12013535 drawing
A'91

$$\begin{aligned}V_o &= 1350 \pm 15 (21\text{ C}) - s \leq 10 \\ \bar{P} + 3S &\leq 454 (21^\circ\text{C}) \\ \bar{P} + 3S &\leq 496 (71^\circ\text{C})\end{aligned}$$

Avg = 1350 m/s

135 Gm AP

Oerlikon
WSW 62010D

$$\begin{aligned}\bar{V}_o + .72 S &\leq 1375 (21^\circ\text{C}), S \leq 10 \\ \bar{V}_o - .72 S &\geq 1345 \\ \bar{P}_C + 0.72 S &\leq 392 \text{ MPa} \\ \bar{P}_C + 5.14 S &\leq 490 \text{ MPa}\end{aligned}$$

Avg = 1360 m/s

3m AP

PROPELLANT
HISTORY/DIRECTION

1. Radford 559-15 selected in 1978 using 1340 M/s velocity criteria. Propellant has 0.5 percent K_2SO_4 flash suppressant. Specification ADMS-567895 was applicable.
2. Sept. 79 - Projectile velocity increased to obtain Bushmaster specification penetration 1340 \rightarrow 1350 m/s
3. Aug. through Oct. 79 - Muzzle blast and flash defined as a problem by the user. One-half gram KNO_3 added to solve problem. Increased pressure with RAD-559-16.
4. Jan. 80 - Specification AS12013532 ($\bar{P} + 3$ s.d. ≤ 496 at $71^\circ C$ and 1350 ± 15 m/s) and drawing 12013535 in effect. FACC recommended: (ref. letter OE-80-010, 18 Jan. 80) to user:

- a. Make and test propellant with salt before propellant drawing changed.
- b. Make and test four pilot lots of two webs (increased) and two coating levels to increase the propellant progressivity and reduce pressure.

Note: Recommendation 4A was not accepted,
Recommendation 4B was accepted for partial implementation,

5. June 80 - Drawing 12013535 changed per direction to incorporate 1.0 percent total K_2SO_4 (in propellant).
6. Aug. 80 - Lot RAD 559-17 with 1.0% K_2SO_4 (increase of 0.5%) was received and tested. Pressures were high and propellant returned to Radford for addition of more coating, blending and shipment back to FACC.
7. Oct. 80 - Lot RAD 559-17 (B) received and tested. Lot was improved but still pressures were too high at $+71^\circ C$.
8. Oct. 80 - Lot RAD 559-18 and -19 received and tested. It was determined by Radford after shipment that the lots were contaminated with DNT. The propellant also had not been configured as specified as recommended (Ref. 4B),

RAD-559 lot 19 was too slow, and lot 18 was better but the configuration and contamination were significant departures from the configuration in the 12013535 drawing.

9. Oct. 80 - Meeting at FACC. Radford was directed to proceed with another four pilot lots (two webs and two coatings of each web) in an attempt to return the configuration. Radford lot 559-15 was established as a reference powder for closed bomb purposes. Closed bomb results were to be used for comparisons since Radford was not able to perform ballistic firings.
10. Dec. 30 through Jan. 81 - Received and tested Radford 559 lot -20, -21, -22, and -23. Determined that due to last minute reblending performed at Radford before shipment, the loading density was effected and was too low (approximately 93 percent of nominal). Ballistic data were obtained by overloading and vibrating the case and charge. Radford lot -21 showed promise if the charge loadability could be increased.
11. Jan. 81 - Meeting at Radford for definition of redirection for the next lot RAD-559-24. RAD-21 was to be copied but with increased loadability. Salt level to be maintained at 1.0%.
12. Apr. 81 - RAD lot 559-24 received at FACC and tested. This lot was too slow and was also found to be contaminated with other propellant pieces. Blended samples of RAD-17 (too fast) and RAD-24 were tested at FACC, and a 25 percent RAD-24 and 75 percent RAD-17 extrapolated to a better solution.
13. Apr. 81 - Meeting at Radford to redirect future efforts. FACC presented the ballistic results of the RAD-24/17 blends. Radford was directed to repeat the blends using the full capacity blenders and ship the samples to FACC for ballistic tests. Radford was directed also to equip themselves, with help from FACC, to ballistically fire 25mm APDS-T ammunition by Jul. 1981. No changes to the specifications were requested by Radford personnel. Radford was also directed, when processing for the 20,000 lb. mid-July lot, to provide "high" and a "low" coated batches which would be blended to provide the proper coating.

14. June 81 - FACC received blended RAD lots 559-26, -27, -28, -29, and -30. FACC also received two samples from the 20,000 pound lot for mid-July delivery. These samples were to be one "high" and one "low" for blending purposes. The five blended samples were ballistically tested at FACC. Of those samples fired, three were fairly close together in performance but all were high in pressure at ambient temperature. The "low-high" samples from the 20,000 pound lot were even higher and had to be fired with 4 to 5 gram reduced charge weights.

15. July 81 - FACC compiled the data from (14) above and transmitted to interested government agencies prior to meeting at FACC on 7 July 1981.

FACC

RECOMMENDATIONS:

GOVERNMENT:

1. Provide funds to Radford to establish ballistic capability, evaluate Dutch propellant and establish 20,000-pound lot as deliverable.
2. Implement second source work directive on STS contract.

RADFORD:

1. Establish ballistic capability.
2. Evaluate Dutch lot MC 07-78 in closed bomb and Mann barrel.
3. Establish limits of propellant parameter for blending of two segments of 20,000-pound lot.

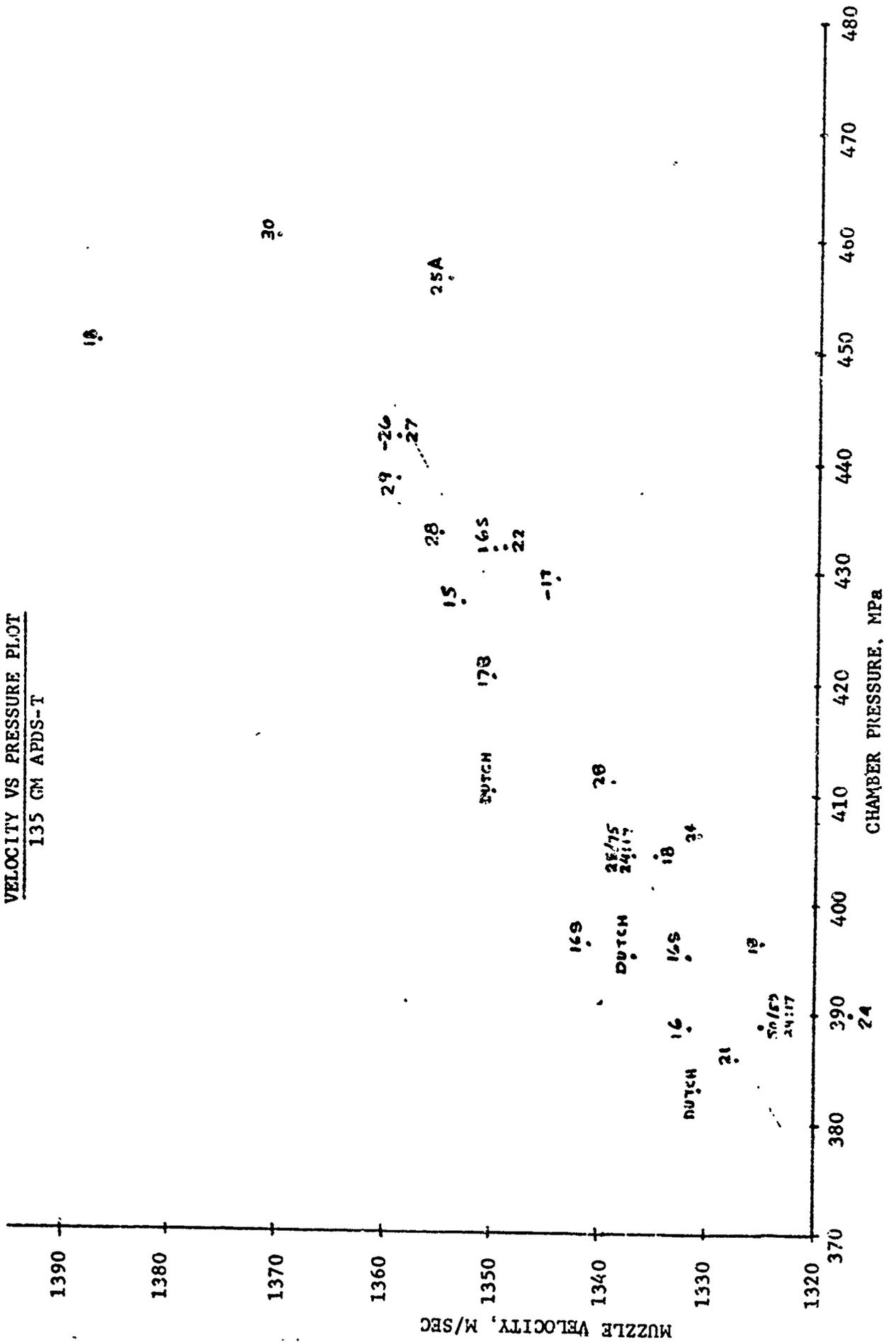
FACC:

1. Investigate RAD-18 and Dutch lot 07-78 further over temperature range against AS12013532 requirements.
2. Establish a more accurate relationship between chamber pressure and case mouth pressure. Ten percent may be too large.
 - o Include Oerlikon P_c location in evaluation (approximately 20mm difference between Oerlikon and CONUS pick-up locations).
3. Re-establish pressure differential for new Oerlikon pressure transducer location.

25mm APDS HOT-COLD PRESSURE DIFF. TRENIALS

<u>Mt.</u>	<u>Lot</u>	<u>MPa</u> <u>+71°C</u>	<u>MPa</u> <u>+21°C</u>	<u>ΔMPa</u>	<u>Test Location</u>
98.0	RAD-16 (S)	506	395	(111)	FACC
99.0	RAD-17B	505	420	(85)	FACC
99.0	RAD 24:17 25%/75%	482	404	(78)	FACC
98.0	RAD-28	495	411	(84)	FACC
98.5	Dutch MC-07-78	486	383	(103)	FACC
99.7	RAD-16 (S)	501	414	(87)	Oerlikon 5/14/81

25 MM AP PROPELLANT
VELOCITY VS PRESSURE PLOT
135 GM APDS-T



25mm FOREIGN PROPELLANT COMPARISONS

<u>WS P-2078</u>		<u>MC 06-78</u>
0.158"	Length	0.128"
0.094"	Diameter	0.100"
0.0068"	Inner Diameter	0.0067"
0.0185"	Web Thickness	0.019"
100%	RQ Radford	IBD
100%	RF Radford	TBD
97.94	NC, % (13.2%)	
1.03	DPA, %	
1.03	K ₂ SO ₄ , %	0.9
-	Ethyl Centralite, %	1.4
3.0%	Camphor, %	0.8%
0.1	Graphite, %	0.1
1.1	Moisture, %	1.2
0.5	Alcohol, %	
0.2	Ether, %	
1.02	Grav. Density, gm/cc	0.999
0.7	RS, %	0.8
1.9	TV, %	
928	HOE, Cal/gm.	906

DUTCH 25mm AP PROPELLANT

BALLISTIC RESULTS IN M791 DESIGN

<u>Lot No.</u>	<u>Charge g, °C</u>	<u>n</u>	<u>AVG P_C MPa</u>	<u>P_C sd</u>	<u>P_C + 3sd</u>	<u>V₀, m/s</u>	<u>V₀, sd</u>	<u>Temp. °C</u>	<u>Remarks</u>
ML 07-78	98.0	5	395	4.1	407	1337	3.3	+28	ATP-1525
ML 07-78	98.0	5	400	1.3	415	1349	1.5	+28	ATP-1525
ML 07-79	94.5	9	383	3.2	393	1331	1.2	+21	ATP-1532
ML 07-79	94.5	10	380	2.5	390	1397	3.7	+71	ATP-1532

RAD PE-559- Lot Ballistic Data
with 135 gram APDS-T Projectile

RAD Lot No.	Charge Wt., g	n	AVG P _C , MPa	P _C , sd	P _C + 3Csd	V _o , m/s	V _o , sd	Temp., °C.	Remarks
-15	99.0	5	427	4.8	441	1353	3.0	+21	ATP-1338, retest
-16	98.5	1.0	389	8.3	414	1332	3.5	+21	ATP-1347
-16S	98.5	1.0	396	6.4	415	1341	2.8	+21	ATP-1348
-16S	98.0	20	395	7.3	417	1322	5.9	+21	LAT PFC81A004-002
-16S	98.0	9	506	13.4	(546)	1400	7.2	+71	LAT PFC81A004-002
-16S	99.7	40	432	11.6	(467)	1350	5.4	+21	PFC80E004-001
-17	99.7	5	378	7.7	401	1348	-	21°	793002 H003 LAT
-17	99.0	5	429	10.0	(459)	1344	3.0	+21	ATP-1283 - Pressure high
-17B	99.0	1.4	420	9.0	447	1350	3.0	+21	ATP-1307 (0.3% more coating)
-17B	99.0	1.0	505	9.5	(533)	1399	3.2	+71	ATP-1307 (0.3% more coating)
-18	100.0	5	381	23.6	452	1342	9.9	+21	ATP-1310: Contaminated, and larger configuration
-19	100.0	3	323	-	-	1231	-	+21	ATP-1300: Flash, too slow
-20	92.0	5	406	5.3	422	1319	12.2	+21	ATP-1354: Low loadability, reblended.
-21	92.8	5	322	3.4	332	1264	2.8	+21	ATP-1354: Low loadability, reblended.
-21	97.0	5	386	5.1	401	1327	2.8	+21	ATP-1354: Low loadability, reblended.
-22	94.0	5	432	7.4	454	1349	3.3	+21	ATP-1354: Low loadability, reblended.
-23	93.0	5	289	10.3	320	1231	9.2	+21	ATP-1354: Low loadability, reblended.
-24	99.0	5	376	6.9	397	1305	2.4	+21	ATP-1443, Too slow and propellant contaminated
-24	100.0	5	390	8.0	414	1317	3.7	+21	ATP-1443, Too slow and

-24	100.0	5	390	8.0	414	1317	3.7	+21	ATP-1443, Too slow and propellant contaminated
-24	101.5	10	406	4.8	420	1331	2.5	+21	ATP-1443, Too slow and propellant contaminated
-24:17 ACC	99.0 99.0	20 5	404 482	6.9 2.4	425 489	1337 1385	3.8 3.1	+21 +71	ATP-1467, Blend: 25%/75% ATP-1467, Blend: 25%/75%
-24:17 FACC	99.0	2	389	-	403	1325	-	+21	ATP-1460, Blend: 50%/50%
-25A	95.0	5	(456)	3.4	(466)	1354	3.9	+21	ATP-1407B, 20,000 lbs preblend.
-25B	96.0	2	(526)	-	-	1399	-	+21	ATP-1507A, 20,000 lbs preblend.
-26	99.0	5	442	5.6	(459)	1359	5.6	+21	ATP-1496, 10%/90%, 24:17
-27	99.0	5	442	5.3	(458)	1360	4.5	+21	ATP-1496, 20%/80%, 24:17
-28	99.0	5	433	3.2	443	1355	4.2	+21	ATP-1496, 25%/75%, 24:17
-28	98.0	10	411	7.0	431	1339	5.8	+21	ATP-1497, 25%/75%, 24:17
-28	98.0	10	495	7.1	(516)	1392	5.4	+71	ATP-1497, 25%/75%, 24:17
-28	98.0	10	320	9.1	347	1260	6.6	-54	ATP-1497, 25%/75%, 24:17
-29	99.0	5	438	4.9	453	1359	1.7	+21	ATP-1496, 30%/70%, 24:17
-30	99.0	5	460	6.9	(481)	1370	4.0	+21	ATP-1496, ?
-18	99.0	5	396	11.2	430	1325	6.4	+21	ATP-1538, 1310 retest
-18	100.0	5	398	13.1	437	1335	9.5	+21	ATP-1538, 1310 retest
-18	100.0	5	450	6.7	470	1387	3.7	+71	ATP-1538, 1310 retest

Suffix S means 0.5 grams of powdered KNO₃ added to propellant.

APPENDIX H

PRODUCTION ENGINEERING INVESTIGATIONS
(PEI-559-17 through 19)



PEI 559-17 thru 19

June 6, 1980

SPECIAL OPERATING INSTRUCTIONS

I. MATERIALS MANAGEMENT

A. Materials Control

Following is a list of materials required for the manufacture of 25mm propellant:

Nitrocellulose (13.15ZN)	MIL-N-244 Type I, Grade C
Diphenylamine (DPA)	MIL-D-98
Potassium Sulfate	MIL-P-193
Graphite	MIL-G-155
Methyl Centralite*	MIL-M-19719

*Must be ground - 97 percent minimum to pass a 70 mesh screen.

II. PROPELLANT DEPARTMENT

Type Propellant: 25mm

Approximately 5,000 pounds - 16 miles will be required.

<u>Composition</u>	<u>Specification</u>	<u>Percent by Weight</u>	<u>Weight, pounds</u>
Nitrocellulose* (13.15 + 0.05% N Cotton Linters)	MIL-N-244 Type I, Grade C	100.00	348.0
Diphenylamine (DPA)	MIL-D-98	1.00**	3.5
Potassium Sulfate	MIL-P-193	1.00**	<u>3.5</u>
			355.0

*Use blend with N closest to 13.20 percent.

**Based on nitrocellulose weight.

Nitrocellulose requirements are as follows:

	<u>Acceptable Limits</u>
Solubility	40 to 49 percent
Fineness	Final Blend: 90 Control: 82 Accept: 77 to 95
Freeness	Final Blend: 416 to 550 ml

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Solvents

Acceptable Limits

92 pounds solvent per 100 pounds dry weight of ingredients	326 pounds of solvent per mix
65 parts ether per 100 parts solvents	212 pounds of ether per mix
35 parts alcohol per 100 parts solvents	114 pounds of alcohol per mix

A. Chemical Grind

Weigh ingredients as required in accordance with the following:

<u>Ingredient</u>	<u>Weight/Bag</u>	<u>Tolerance</u>
K ₂ SO ₄	3 lb 8 ozs.	+/- 0.3 oz
DPA	3 lbs 8 ozs.	+/- 0.3 oz
Graphite*	10 lbs 0.0 ozs.	+/- 0.3 oz
Methyl Centralite	As determined	

*Graphite weight is based on 5,000 pounds per batch.

B. Nitrocellulose Area

Supply a sufficient quantity of nitrocellulose (13.15 + 0.05% linters) to produce 16 mixes (348 pounds/mix).

C. Dehydration

1. Use General Operating Instructions and the following specific instructions:

Number of blocks/mix	4
Dry weight of NC per block	87
Gallons of alcohol per block (min)	17
Nominal dwell time, minutes	1
Wet weight of individual blocks, lbs	104 +/- 4

2. Weigh dehy blocks and record individual block weights on flow cards. Identify each mix by NC blend number and type of propellant.

D. Solvent Mix House

1. Use General Operating Procedures for preparing DPA with ether (mixed solvent). Mixture calculated weights of ingredients for preparation of one final mix charge and one solvent mix are as follows:

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<u>Ingredient</u>	<u>One Final Mix, pounds</u>	<u>16-1/2 Final Mixes, pounds</u>
Ether	212.3	3502.95
Diphenylamine	3.5	57.75
TOTAL	215.8	3560.70

2. A laboratory analysis must be performed on each tank of solvent mix. The laboratory sample must meet the following requirements:

<u>Ingredient</u>	<u>Percent Ingredient</u>
Diphenylamine	1.02 to 2.22
Ether	97.38 to 99.38

E. Final Mixer (mixer temperature 50° maximum)

1. Build alcohol to 114 pounds and add the alcohol to the mixer. The alcohol add weight is determined by subtracting the dry nitrocellulose weight from the total wet weight of the dehydrated blocks and subtracting the difference from 114 pounds.
2. If there is no alcohol build, there must be a minimum of 10 pounds added to the mixer.
3. With the mixer in operation, gradually add 348 pounds of nitrocellulose (split blocks) to the mixer.
4. Mix for 4 to 5 minutes.
5. a. Standard Method - Allow 216 +/- 1 pound of mixed solvents to start flowing into the mixer.
b. Alternate Method - Add 3.5 pounds (3 lbs 8 ozs +/- 0.3 ozs) of DPA to 10 pounds of ether in a solvent boot. Stir the mixture with a wooden paddle until the DPA is dissolved (approximately 1 minutes). Add the slurry mix (DPA-ether) plus an additional 202 pounds of ether to the mixer.
6. Add one bag of K_2SO_4 (3.5 pounds) to the mix. Distribute the chemical evenly.
7. Add 40 pounds of remix (strands, split press blocks, and heels) if available.
8. Close the lid and mix for 25 minutes.
9. Ten minutes, minimum prior to discharging the mixer, an additional solvent add (ether/alcohol in a 2:1 ratio) may be made, as required, to produce propellant which will extrude within the desired pressure range. Record all solvent adds and exact mixing time on the flow card.
10. Continue mixing until a minimum mixing time of 40 minutes (time after the start of solvent mix addition) has occurred.

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11. When the desired mix consistency has been obtained, pull the mix into tubs.
12. Charge the required amount of propellant into the macerator.
13. Macerate for a minimum of five minutes.
14. Pull the macerated propellant and deliver to the preblocker.

Alternate Mixer

1. Produce 16 mixes using Beken-Mixer (double-wing) and current GOP.
2. Mix time will be 30 minutes or as specified by initiating engineer.

F. Preblocking, Macaroni, and Final Blocking

1. Preblocker - Sufficient dwell time to make blocks for macaroni press.
2. Macaroni - Use one 16-mesh screen.
3. Final Blocker - 30 seconds (minimum) high pressure dwell time.

G. Press and Cutting House

	<u>Lots RAD-PE-559-17</u>	<u>-18</u>	<u>-19</u>
Type Press	Vertical Unmodified 12-inch press		
No. of Screens	2 (16 and 40 mesh) for all lots		
No. of Dies/Press	20 for all lots		
Agate, inch	0.147	0.170	0.190
Pin, inch	0.014	0.016	0.018
Pin Circle, inch	0.090	0.104	0.115
No. of Pins	7 for all lots		
Extrusion Pressure, psig	2,000 - 2,800 for all lots		
	<u>Lots RAD-PE-559-17</u>	<u>-18</u>	<u>-19</u>
No. Mixes	16	*	*
Type Cutter	Small Arms for all lots		
Green Length, inch (+/- 0.001)	0.110	0.135	0.150
Outer web, inch	0.150	0.190	0.213
Inner Web, inch	0.150	0.190	0.213
Cutting Die, inch	0.150	0.190	0.213
No. of Blades	28 for all lots		
Roll Size, inch	1-1/2 plain for all lots		
Gear Train D ₁ for D ₂ x 180 x 160 x 89	65	80	90

*Four blocks, two press loads, or approximately 200 pounds will be extruded for lot RAD-PE-559-18 and the same quantity will be extruded for lot RAD-PE-559-19. These two lots will be placed in sausage bags at cutting.

1. Adjustments may be necessary in the gear train and cutting dies to obtain correct dimensions. For lot RAD-PE-559-17 the correct average length is 0.108 +/- 0.005 inch for averages of 10. If first average of 10 is outside limits, a second set of ten measurements will be made and the average of 20 will be used for decisions (one gear tooth = 0.0014 inch).
2. Use water/alcohol mixture in dripolator on cutting machines.
3. Cutting machines must be kept in adjustment so as "tails" do not exceed 5 percent.
4. The lot must be properly identified.

E. Solvent Recovery

1. Prior to charging the Solvent Recovery Tank, the tank used must be checked to assure that all equipment, including U-gages, recorders, etc., are in proper working order.
2. Identify buggies and sausage bags with lot number, and propellant type.
3. Load at 21 +/- 3°C. Put identified sausage bag pilot lots RAD-PE-559-18 and -19 on top of SR tank load.
4. Maintain inert gas flow to 1/8-inch positive pressure for 32 hours.
5. Increase inert gas flow to 1/4-inch positive pressure and maintain for 32 hours.
6. Turn on heat exchanger and control at 35 +/- 3°C at 1/4 inch positive pressure for 24 hours.
7. Cover with water until ready for transport to water dry.
8. Identify buggies with propellant type, PEI No., SR Bldg. and Tank Nos.
9. Pull the lot and transport to water dry.

I. Water Dry

1. Load propellant lot in Water Dry and cycle at 56 - 62°C. Put the two lots, RAD-PE-559-18 and -19, in identified sausage bags on top of water dry tank and load.
2. Water dry propellant for 10 days.
3. Separate water from propellant and allow a 24-hour drainage period. Load 971 pounds into numbered stainless steel dump buggies. Take representative samples from first, third and fifth buggies for "sausage bag" TV. Be sure they are identified by buggy number. Quality Control will weigh 971 grams to within 0.1-gram and after a 10-hour air dry cycle and the average of the three TV results should be 900 +/- 10 grams after drying.

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Water Dry (Cont)

4. When sausage bag TV results are available, check buggy net weights, record changed weights, and transport buggies to coating house as necessary.
5. Also, take three 971-gram "sausage bag", air dry, TV samples from lots RAD-PE-18 and -19. QC will weigh these before and after drying for 10 hours in air dry tank.
6. Send a representative 2-pound sample from the "sausage bag" samples from lots RAD-PE-559-17, -18 and -19 to lab for complete analysis. Label "uncoated."

J Coating House

1. Check out coating barrel system by UOP to see that all valves are open or closed as required and to determine that temperature controls are functioning satisfactorily before coating operation commences.
2. Check out ventilating system and be sure butterfly valve is open.

Coating Technique*

1. Charge wet propellant (900 pounds, dry weight), build water weight to 90 pounds and add 128 pounds of alcohol.
2. Start barrel rotation.
3. Bring barrel temperature to 75 +/- 1°C (167 +/- 2°F).
4. Rotate for 15 minutes at temperature and stop barrel.
5. Add methyl centralite and ethyl alcohol slurry in three equal increments of 9 pounds 5.7 ounces of methyl centralite in 16 pounds of ethyl alcohol by means of tank lid using 1-inch orifice and minimum of 5-minute dispensing time.
6. Rotate barrel for two hours (+/- 5 minutes) starting from start of addition of last increment of methyl centralite.
7. Cool coating barrel to 40°C and cycle 10 minutes.
8. Wash propellant with cold water from coating barrel through trough and discharge into buggies.
9. Transport to water dry identified by appropriate lot number.

K. After Coating Water Dry

Water dry at 56 - 62°C for 48 hours.

*Using GOP 4-9-21.

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Air Dry

1. Charge 5000-pound lot.
2. Maintain temperature of air at 54 +/- 4°C (129 +/- 7°F) for a sufficient time to obtain a moisture content range of 0.85% to 1.25%. Estimated time is 10 hours. A 20 minute M&V and GCTV samples should be taken after 10 hours.
3. At the end of drying cycle, allow a minimum of one hour cool-down at 100 +/- 5°F with blowers running.
4. Upon completion of drying, send propellant sublots to Blending and Glazing in drop plug buggies.

M. Blending and Glazing

- 1.* Charge lot into a blender barrel and rotate for 10 minutes (ungraphited).
- 2.* Obtain a one-pint sample from the lot, label, and send to Chemical Laboratory for 20 minute M&V analysis.
 - a. If M&V results are within range of 1.00 to 1.30 percent, no adjustment is necessary.
 - b. If M&V results are less than 1.00 percent, the water add can be calculated by the following equation:

$$\frac{\text{Pounds of Propellant} \times 1.15 - \text{M\&V Results}}{1.00} = \text{Pounds of water to add}$$

3. After the moisture content has been adjusted, glaze propellant batch with 0.2 percent graphite using a 3-hour glaze cycle (10.0 pounds/5000 pounds).
4. Screen propellant. Use following screens:

Acceptance - 0.19 - .266 dia opening and .125 (L)
Fine - 0.086 dia opening
5. Pull lot into fiber drums and identify by lot RAD-PE-559-17 number.
6. Obtain a 25-pound sample from lot after screening has been completed. Label sample for gun, chemical, HOE, closed bomb, bulk density, hygroscopicity, and physical dimensions. Identify sample by proper lot number.
7. Glaze the two small lots with 0.2 percent graphite for 1 1/2 hours using a fiber drum and procedure, HXD-4-11-140. A 25-pound final lot sample will be taken from each of lots RAD-PE-559-18 and -19 after glazing. For tests as described in preceding paragraph six.

*Steps 1 and 2 are necessary only if GCTV from air dry sample is not acceptable.

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M. Marking and Addressing

Marking and address is to be as follows:

One side: PROPELLANT EXPLOSIVE (SOLID) CLASS B
25mm GUN
LOT RAD-PE-559- *
WEB MP GRAIN
LBS NET LBS GROSS
CU FT PACKED **

*Insert as applicable -17 for 5000-pound lot with 0.019" web, -18 for 50-100 pound lot with 0.021-inch web and -19 for 50-100 pound lot with 0.024 inch web.

TO: FORD AEROSPACE AND COMMUNICATIONS CORPORATION
33600 ORTEGA HIGHWAY
SAN JUAN CAPISTRANO, CA. 92675
MARK FOR: CONTRACT DAAK30-80-C-0010

FROM: COMMANDER
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA 24141
CONTRACT: DAAA09-77-C-4007

III. TECHNICAL DEPARTMENT

A. Quality Control

1. Monitor and inspect the propellant outlined under this PEI using Standard Inspection Procedure and Special Operating Instructions contained herein.
2. Ensure that the propellant is kept separated and properly identified at the cutting machine, in the powder buggies, at solvent recovery and at water dry.
3. It is requested that the following data be taken during pressing:
 - a. Granule length, diameter, web, web difference, percent tails, and perforation (20 grains)
 - b. Extrusion pressure (2/shift).
4. Composite samples of cut propellant will be observed for closed perforations twice per shift (25 grains/sample). If closed perforations are found, QC will notify Production and initiating engineer.
5. Perform 100 percent inspection of coating of propellant.
6. Deliver samples from water dry and Finishing area to Building 7105 as outlined in this PEI.

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B. Internal Ballistics Laboratory

1. Prepare and forward all propellant samples to the Powder Laboratory and Ballistics Range as outlined in this PEI.
2. Perform heat of explosion test on coated and uncoated samples from lots RAD-PE-559-17, -18 and -19.
3. Perform 5 shots closed bomb tests on uncoated samples from lots RAD-PE-559-17, -18 and -19. Use 200cc closed bomb, 0.2 gm/cc loading density and reference lot RAD-PE-559-11.
4. For final lot, perform 6-shot RQ and RF tests at +/- 90°F and 0.2 gm/cc loading density in 200cc closed bomb. Use lot RAD-PE-559-16 (AP) for reference lot.
5. Obtain engineering unit printouts for closed bomb tests.

C. Powder Laboratory

1. Perform chemical and physical analysis on lot samples as outlined in the following Sampling and Testing Instructions table.

Ballistics Area

Perform (70°) velocity, action time, chamber, and muzzle pressure tests in 25mm gun components on final lot. Samples will be fired at charge weights determined by RQ and HOE. Make single shot firings for velocity, action time, chamber, and muzzle pressure combined at charge weights determined by initiating engineer and Ballistic Range supervision. It is also desired that ignition delay time be ascertainable. Use the following test plans for tests:

<u>Test Number</u>	<u>Charge Weight</u>	<u>Lot RAD-PE-559-</u>	<u>Temp., °C</u>	<u>°F</u>
1	96.9	16	+21	+70
2	96.9	16	+21	+70
3	96	17	+21	+70
4	96	17	+21	+70
5	96	17	+21	+70
6	96.9	16	+21	+70
7	96.9	16	+21	+70
8	98	17	+21	+70
9	98	17	+21	+70
10	98	17	+21	+70
11	96.9	16	+21	+70
12	96.9	16	+21	+70
13-17	*	17	+21	+70
18	96.9	16	+21	+70
19	96.9	16	+21	+70
20-25	*	17	+21	+70
26	96.9	16	+21	+70
27	96.9	16	+21	+70
28-32	*	17	-54	-65

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<u>Test Number</u>	<u>Charge Weight</u>	<u>Lot RAD- PE-559-</u>	<u>Temp., °C</u>	<u>°F</u>
33-37	**	STD 12-12-74	-54	-65
38-42	*	17	+71	+160
43-47	**	STD 12-12-74	+71	+160

*Weight to be determined from .96 and .98 gram charge tests.

** Use existing loaded rounds and measure velocity, only.

SAMPLING AND TESTING SUMMARY

<u>Item Sampled</u>	<u>Where Sample Taken</u>	<u>Frequency</u>	<u>Amount of Sample</u>	<u>Test</u>	<u>Identification</u>
Before Coating	Air Dried (Sausage bag) samples from water dry	Composite of 3-bag samples of each lot	2 pounds/lot	Complete chem., physical dimensions, Bulk density, GCIV HOE, closed bomb and stability	PEI number, Lot number, "Before Coating"
Each Lot (Prohibited)	Blender Barrel	1 sample	1 pint, ea. sample	20' M&V, GCIV	PEI No., Lot No., Date, "Pre-Coating", 25mm
Finished Propellant	Final Screen House	1 sample lot	25 pounds	% Methyl Centralite % Graphite GCIV 6 Hour M&V Bulk Density Physical Dimensions Gun Test Closed Bomb HOE Hygroscopicity ZDPA XK ₂ SO ₄ RS	PEI No., Lot No., Date, Shift, Time, 25mm "Final Lot Acceptance Sample"

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