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Characteristics of JAX Gun Propellant

Robert J. Lieb Joseph M. Heimerl

ARL-TR-465

June 1994





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13. ABSTRACT (Maximum 200 word	ds)		<u></u>
To increase the performance	of 120-mm kinetic energy ta	nk rounds, propellant mad	e by adding up to 30% ground RDX
-	- -		AX were met, its response to shaped
· · ·		•	that of JA2 alone. This unexpected
violent response of JAX prop	ellants has been documented	In the attempt to unders	tand the mechanism responsible for
this response, the deposition	of dry crystalline RDX on ex	posed JAX surfaces was di	iscovered. This crystalline formation
was detected during a routine	morphological examination	using a scanning electron	microscope, and the crystals were
•	• • •	•	g mechanism has been proposed to
•			ions were performed to substantiate
			ess occurs in all JAX propellant and
*	materials. Since JAX under	goes continuous morpholo	gical change with temperature and
time,			
			als, as well as questions concerning
presence of the deposited RD	• •		ard safety tests do not indicate the
presence of the deposited RD	A. All of these findings are	documented and the impir	cations are discussed.
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M. Leadore performed all mechanical properties testing of the propellants. C. Gillich used the scanning electron microscope to discover the white "powder" within the perforations of the JAX grains, and produced, cataloged, and performed initial analysis for the recent micrographs used in this study.

R. Pesce-Rodiriguez used her skill with the Fourier transform infrared (FTIR) microscope to determine that the "powder" seen on the JAX propellant surface was a nitramine. In addition, she performed the solubility experiments of RDX and HMX in DEGDN. We extend many thanks to her for allowing us to use her unpublished results. Thanks are also due to F. Robbins for allowing us to remark on his studies with PARAPLEX G59, and to W. J. Worrell and B. M. Riggleman of Hercules (Radford) for supplying information contained in Reference 21.

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1. INTRODUCTION

Methods have been and are being sought to increase the lethality of a kinetic energy (KE) tank round. One approach is to increase the rod's velocity by increasing the energy available to the round. This is most readily accomplished, at least in principle, by increasing the energy of the propellant.

The propellant of choice in several prior tank ammunition applications has been JA2. It is made from nitrocellulose (NC), nitroglycerine (NG), and diethylene glycol dinitrate (DEGDN) in relative amounts of roughly 60%, 15%, and 25%, respectively. JA2 has a nominal impetus of 1150 J/g, as computed from the BLAKE code. To increase the energy, cyclotrimethylenetrinitramine (RDX) has been added to JA2 during manufacture. The computed increase in the impetus, flame temperature, and the chemical energy, which is the impetus divided by $(\gamma - 1)$, is given in Table 1. The common, generic name for JA2 propellant with RDX added is JAX. A common name for a specific amount of RDX added to JA2, say B%, is 2RB. For example, 10% RDX added is given the designation 2R10. This is the nomenclature used in Table 1.

JAX has been made with nominal RDX additions ranging from 6.5 to 30% by weight. The RDX used in the earlier manufacture of JAX was fluid energy milled and had particles with a mean diameter of 7.5 μ m. The more recent manufacture used nominal 4- μ m recrystallized RDX from Dupont Corporation. The JAX referred to in this report is generally the earlier manufactured material. For the same propellant formulation, more stick propellant than granular propellant can be placed into a fixed volume gun chamber; thus, the JAX had been made in both granular and partially cut stick (PcS) geometries. The sticks were kerfed, or cut part way through at selected linear intervals along the stick, to relieve the internal pressure when the propellant began burning.

Performance increases were realized.² However, the response of JAX to the unplanned stimulus of a shaped charge jet was violent, approaching, or, in some cases, perhaps sustaining a detonative event. Because JA2 itself usually just burns in such tests, the violent response was not anticipated. In addition, other propellants, e.g., XM39 and M43, have been formulated with several times the RDX loading of the JAXs and in similar tests, they responded less violently to the shaped charge

Table 1. BLAKE Computations for JA2 and Selected JAXs

Formula	Impetus J/g	Flame Temp K	Impetus/(γ-1) J/g
JA2	1153	3448	5130
2R6.5	1168	3489	5194
2R10	1175	3509	5225
2R12	1179	3520	5240
2R16	1187	3541	5273
2R17.5	1189	3548	5283
2R20	1194	3560	5302
2R30	1209	3602	5367

attacks.⁴ Thus, the question is raised: what happens to the JA2 when the addition of even small amounts of RDX is observed to change the vulnerability response from burning to detonative?

In an effort to address this question, several test results are reviewed. First, the mechanical fracture response of JAX relative to JA2 is discussed. Second, the results of a number of vulnerability tests that demonstrate the different vulnerability responses of JA2 and JAX are reviewed. Third, JAX is characterized by the now standard propellant characterization techniques,⁵ the results were not anticipated and their interpretation consumes the latter half of this report.

2. THE FRACTURE RESPONSE OF JAX

2.1 Mechanical Response Testing.

Three lots of JAX propellant were produced in 1985 and had fracture response evaluations performed with methods that were in use during that period.^{6, 7, 8, 9} The mechanical parameters reported are the results of those tests. These results have been shown to agree with results gathered from improved procedures and equipment sue equently developed to expand the scope and quality of fracture response measurement. The section is based on an unpublished technology transfer report.¹⁰

Two methods of fracture evaluation were used to characterize the JAX materials. The first was the drop weight mechanical properties test (DWMPT)^{6,7} that provides high-rate, uniaxial, compressive loading to individual grains from which the propellant modulus, failure stress, failure strain, etc., are determined at various temperatures (-50° C to 60° C). These parameters are illustrated in Figure 1. This test characterized the uniaxial response of standard test grains and can indicate fracture response differences in materials. The second method was the gas gun impact test (GGIT)^{8,9} with surface area analysis performed using the damaged grains. In this latter test, a single grain is damaged by a single impact at a controlled velocity, orientation, and temperature. After several grains are damaged, the grain and any of its shards are collected and burned in a small closed bomb. The pressure-time data is reduced using burning rates established for undamaged grains. From this, a surface area vs fraction burned profile is generated that reveals the nature and degree of the fracture damage suffered during impact, as shown in Figure 2. The fracture susceptibility is quantified by summing the difference between the damaged-grain fracture profile and the profile predicted for the undamaged grain, which is represented by the shaded area in the plot. These two procedures provide mechanical and fracture response information that can be used to indicate propellant fracture susceptibility.

DWMPT and GGIT procedures were performed using JAX propellant under conditions similar to those used for previously tested JA2 propellant. DWMPT procedures were conducted at 20, -10, and -32° C at a strain rate of about 200 s⁻¹. Modulus, failure stress, and failure strain vs temperature results are shown in Figure 3. The JA2 results (solid diamonds) are connected by a smooth curve.

The JAX data in Figures 3a and 3c tend to lie on or above the JA2 line. Also, the JAX data tend to be ranked at a given temperature, the larger values corresponding to specimens with more RDX filler.

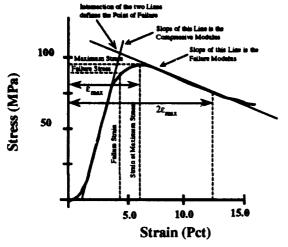


Figure 1. Mechanical Parameters Illustrated

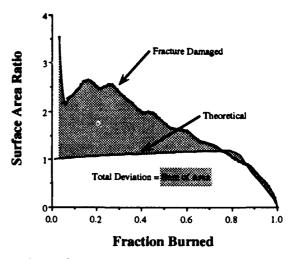
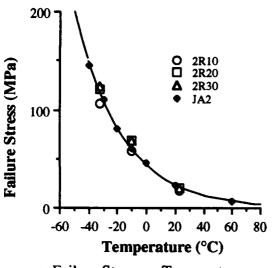
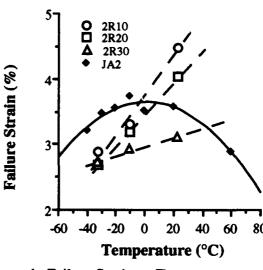


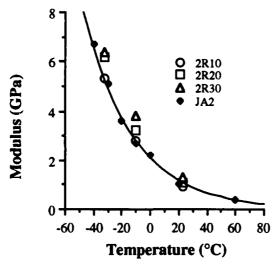
Figure 2. The Total Deviation Parameter



a. Failure Stress vs Temperature



b. Failure Strain vs Temperature



c. Modulus vs Temperature
Figure 3. Mechanical Response Results

The JA2 failure strain curve of Figure 3b decreases in both directions from 0° C. In the lower-temperature direction, the increased brittleness causes failure at lower strain; in the higher-temperature direction, the rapidly increasing softness causes plastic failure, also at lower strain. (Results from dynamic mechanical analysis 11 indicate that glass transition occurs at or slightly below -20° C. See Figure 4.)

Figure 3b shows that the JAX propellants do not soften as JA2 but maintain a brittle character over the temperature range tested. 2R10 and 2R20 exhibit similar slopes, while 2R30 has a much shallower one. Again, the magnitude of the strain at failure tends to be ranked with the level of RDX filler used in the JAX. Looked at another way, the addition of the RDX filler reduces (or

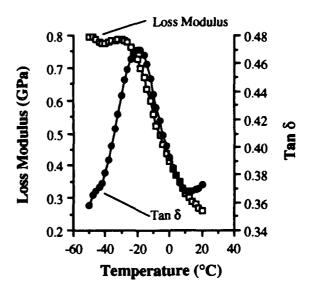


Figure 4. DMA Data for JA2 Which Indicate Glass Transition Temperature Region

possibly eliminates) the gross thermoplastic-flow characteristics of the JA2 propellant at higher temperatures and extends the brittle characteristics of the JAX into the higher temperature regimes.

The GGIT procedure was carried out at three velocity-temperature matrix points for the three JAX formulations. For JAX propellant at -20° C, grain fracture was observed to begin at about 110 m/s, so velocities of 90 and 120 m/s were chosen as two of the matrix points. At -30° C, the third matrix point was selected. The results of these tests and ones previously completed for JA2 are shown in Figure 5. The total deviation (defined earlier, see Figure 2) is an arbitrary scale that measures the

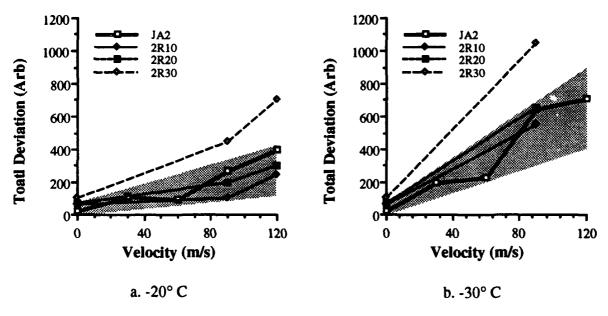


Figure 5. Total Deviation vs Impact Velocity for Gas Gun Impact Test

degree that the damaged grain surface-area profile deviates from the profile predicted for undamaged grains. Closed bomb results for undamaged grains, when subject to this analysis, produce total deviations that average about 45 with a range between 30 and about 100. Significant grain fracture is thought to have occurred when values near 200 result. The comparison of fracture damage and fracture susceptibility via the total deviation is made by noting differences in this parameter at similar impact conditions.

Figure 5 shows several things that are evident:

- 1) As the RDX content of the JAX increases, the fracture susceptibility increases.
- 2) The fracture susceptibilities of the 10% and 20% RDX compositions of JAX are similar to each other and comparable to JA2. (The shaded area indicates the range of JA2-like behavior.)
- 3) The 30% RDX composition has a significantly greater fracture susceptibility than JA2 at both -20 and -30° C.
- 4) These results are self-consistent and consistent with DWMPT results.

2.2 JAX Fracture Response Conclusions.

The mechanical properties and fracture response of JAX were measured under conditions that were thought to show the greatest differences between JA2 and JAX. Measurements showed that at RDX levels near or below 20%, JAX mechanical response was not significantly different from JA2, and may, in fact, have been slightly better (see Figure 5a). At RDX levels near 30%, the DWMPT mechanical response indicated the increase in brittleness would result in the creation of significant fracture-generated surface. This observation was confirmed in GGIT fracture susceptibility tests. JAX with 30% RDX had significantly greater fracture-induced surface area than did JA2, 2R10, or 2R20 under similar impact conditions.

These tests indicate that JAX propellant up to an RDX content of about 20% should not suffer worse fracture-related performance loss or vulnerability susceptibility than JA2, as long as the stress environments are equivalent. At RDX levels of 30% and greater, JAX can be expected to have significantly worse fracture-related performance and vulnerability responses than does JA2 under the conditions in these experiments. This does not say that a JAX propellant cannot be designed to give satisfactory performance under normal interior ballistic conditions. However, when conditions deviate from normal (such as localized ignition at low temperature, or shaped-charge jet interaction) and grain fracture occurs, a JAX propellant can be expected to have a more severe fracture response than JA2. Since JA2 has been shown to be a thermoplastic elastomer with time-temperature equivalence, ¹² failure strain results indicate that as the strain rate of the deformation increases, the divergence in mechanical response between JA2 and JAX should increase. That is, as the interaction rates increase, JAX should show an increasingly greater level of brittle response when compared to JA2 (see Figure 3b).

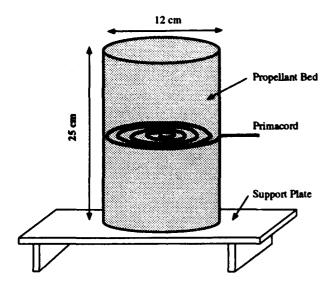


Figure 6. PrimaCord Shock Initiation
Test Setup

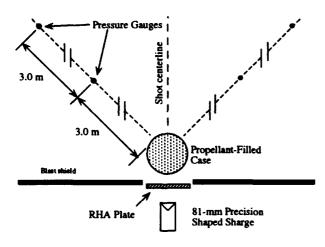


Figure 7. Schematic Diagram of the Air Blast Experiment

3. VULNERABILITY TESTS: DESCRIPTION AND RESULTS

Several vulnerability tests had been performed using these early JAXs as the test propellant. In this section, these tests and their results are outlined in rough chronological order: 1) the Primacord shock initiation test, 2) the air blast test, 3) the shock velocity test, 4) the impulse pendulum test, and 5) the staged compartment test.

3.1 The Primacord Shock Initiation Test.

This test has been designed to rank new propellant formulations by their relative response to explosive shock initiation. It is a simple "go" or "no-go" screening test designed to eliminate those propellants with a demonstrably poor vulnerability response.

Figure 6 shows a schematic of the Primacord shock initiation test setup. A 250-mm section of a 120-mm combustible case is filled halfway with granular propellant. A predetermined length of Primacord, with a mass of about typically 32 g, is coiled and placed on top of the propellant bed. A short length of cord extends through the wall of the case to accommodate the igniter. The case is filled to the top with propellant that is held in place by sealing the case with gun tape. The case is placed on a 305-mm by 610-mm section of 10-mm rolled homogeneous armor (RHA) plate supported by two plates of 51-mm RHA which, in turn, rest upon a large 51-mm section of

RHA (not shown). The Primacord is ignited and the propellant reacts. If the 10-mm support plate is destroyed, a detonative event is indicated and usually indentations can be found in the base plate.²

These tests indicated a violent response for 2R30 and mild responses for 2R10 and 2R20.² These results are consistent with the findings of the fracture response tests of JAX discussed in Section 2. The JAX formulation 2R30 was eliminated from further consideration.

3.2 The Air Blast Test.

A schematic of the test configuration for the air blast measurements is found in Figure 7. An 81-mm BRL precision shaped charge jet is conditioned by a 25-mm RHA plate at a distance of 2 cone

diameters (CD). (This standoff distance has been selected because the jet is thought to have well-defined characteristics [for example diameter, velocity, and length] at this distance.) The conditioned jet proceeds through and interacts with the propellant. The shock wave produced by the jet-propellant interaction is detected by in-ground pressure gages that are located along radii 45° on either side of the jet center line. The pressure gages are situated in lead shields sunk into ground. The entire test area had been graded and leveled. The data consists of time of arrival of the shock and the pressure measured at a given location. For comments on the difficulty of obtaining reliable data from this type of test, see Reference 13.

Table 2 shows data for an inert material, JA2 in both granular and PcS geometries, and a number of JAXs. The upper section of this table refers to the data taken at the 3.0-m locations while the lower section refer to those data taken at the 6.1-m locations. The left most column identifies the Range 10 shot number; the second and third columns identify the propellant used; the fourth and fifth columns tell the geometry (granular or partially cut stick) and the perforation (7 or 19). The sixth column shows the weight of each propellant in kilograms. The next columns display the results. Pressure values measured along the left (L) and right (R) legs, as well as the average (A) of both legs are show in columns 7, 8 and 9, respectively, in Table 2. The right most column shows the average arrival time of the shock.

Figures 8 and 9 graphically display the average air blast results for the different propellants. The JA2 responses are slightly greater than the inert material response. On the other hand, the JAXs give a more violent response.

Figures 10 and 11 show the air blast arrival times. The inert material exhibits the longest times (i.e., slowest shock wave, which in this case must be due only to the shaped charge jet itself). The arrival time for the JA2 propellants is slightly faster. The JAXs, however, all show significantly

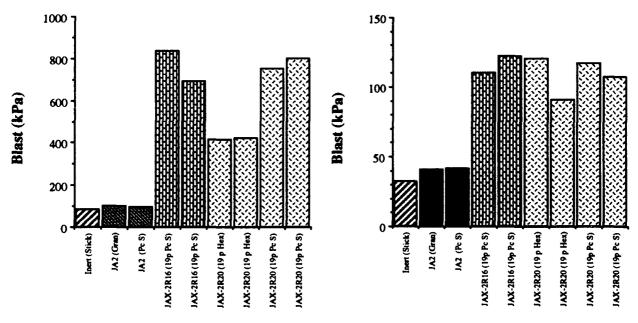


Figure 8. Air Blast Pressure at 3.0 m

Figure 9. Air Blast Pressure at 6.1 m

Table 2. 3.0 and 6.1-m Air Blast Data

Shot	Lot	Propellant	Number	Mass	3.0-1	3.0-m Blast Line (kPa)	(kPa)	3.0-m Arrival
Number	Number	Name (geometry)	Perfs	(kg)	Left	Right	Average	(msec)
S-NG711901	Orange EC	Inert (Stick)	<i>L</i>	3.5	82.7	No Data	82.7	5.4
S-NG711903	RAD00M0015102	JA2 (Gran)	7	4.1	124.0	87.5	99.2	4.7
S-NG716702	RAD792-32	JA2 (Pc S)	19	8.4	96.5	99.2	97.8	4.8
S-NG716203	HCL87A010-002	JAX-2R16 (19p Pc S)	19	4.9	654.6	1005.9	834	1.9
S-NG716703	HCL87A010-002	JAX-2R16 (19p Pc S)	19	5.3	792.4	592.5	692	1.9
S-NG711902	HCL86H003-009	JAX-2R20 (19 p Hex)	19	3.9	441.0	385.8	413	2.1
S-NG716901	HCL86H003-009	JAX-2R20 (19 p Hex)	19	3.9	430.6	413.4	422	2.2
S-NG716903	HCL86H003-009	JAX-2R20 (19p Pc S)	19	4.8	778.6	723.5	751	1.9
S-NG716302	HCL86H003-009	JAX-2R20 (19p Pc S)	19	5.0	792.4	806.1	799	1.8
Shot	10	Decree	Mambor	Mage	6.1-1	6.1-m Blast Line (kPa)	(kPa)	6.1-m Arrival
Number	Number	Name (geometry)	Perfs	(kg)	Left	Right	Average	(msec)
S-NG711901	Orange EC	Inert (Stick)	7	3.5	33.1	32.4	32.7	12.9
S-NG711903	RAD00M0015102	JA2 (Gran)	7	4.1	41.3	40.0	40.7	12.0
S-NG716702	RAD792-32	JA2 (Pc S)	19	4.8	48.2	34.5	41.3	11.0
S-NG716203	HCL87A010-002	JAX-2R16 (19p Pc S)	19	4.9	117.1	103.4	110.2	7.1
S-NG716703	HCL87A010-002	JAX-2R16 (19p Pc S)	19	5.3	158.5	86.1	122.3	6.9
S-NG711902	HCL86H003-009	JAX-2R20 (19 p Hex)	19	3.9	124.0	117.1	120.6	7.5
S-NG716901	HCL86H003-009	JAX-2R20 (19 p Hex)	19	3.9	89.6	92.3	6.06	7.7
S-NG716903	HCL86H003-009	JAX-2R20 (19p Pc S)	19	4.8	130.9	103.4	117.1	6.7
S-NG716302	HCL86H003-009	JAX-2R20 (19p Pc S)	19	5.0	103.4	111.6	107.5	6.7

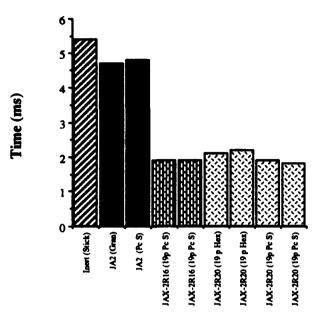


Figure 10. Air Blast Arrival Time at 3.0 m

faster arrival times, again indicative of a more violent reaction.

3.3 The Shock Velocity Test.

Figure 12 shows a schematic of the shock velocity test. 14. 15 An 81-mm BRL precision shaped charge is aimed at the center of the box of propellant. The shaped charge is fired, the jet is formed, and is conditioned by 51 mm of RHA. It then strikes the trigger plate and interacts with the propellant within the wooden box. Any residual jet is captured by the stack of RHA blocks. At a position 80 mm from the upper surface of the catcher blocks, the upper surface of the third RHA block was indexed to obtain a measure of the actual center-line of the jet. The 2R16 19-perforation stick JAX was broken at the kerfs to provide "grains" with an L/D about unity.

The wooden propellant box is made 250-mm square and 80-mm deep. In the vertical center plane of this box (i.e., 40 mm below the trigger),

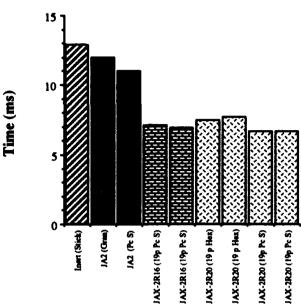


Figure 11. Air Blast Arrival Time at 6.1 m

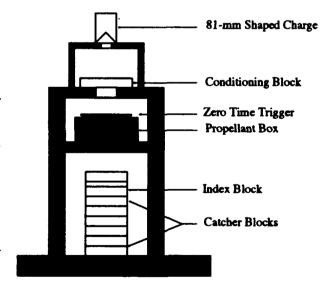


Figure 12. Schematic of the Shock Velocity Experiment

Table 3. Shock Velocity Coefficients

Shot Number	Propellant Name	Lot Number	A	В	С
16	INERT	WEP	-10.50	0.35	25.70
17	INERT	WEP	-6.19	0.21	16.40
36	2R16	HCL-87A-010-002	7.39	0.08	-10.60
41	JA2-19p	RADPE-792-11	-6.41	0.22	17.30
43	JA2-19p	RADPE-792-11	-7.61	0.26	19.60
44	JA2-19p	RADPE-792-11	-6.97	0.24	18.50

eight sacrificial microphones are positioned at progressively increasing radii from the center (see Figure 13). The microphones are located on radii 28 mm to 102 mm from the center of the box. The shock front from the propellant-jet interaction passes through the propellant bed and is sequentially detected by the microphones. Since the location of each microphone is known, the basic data consists of time of arrival of the shock front vs location. Differentiation provides velocity vs time information.

Table 3 identifies the lot numbers for several propellants, their shot numbers, and their coefficients in the empirical formula:

shock velocity (km/s) =
$$A + Bd^{+0.5} + Cd^{-0.25}$$
. (1)

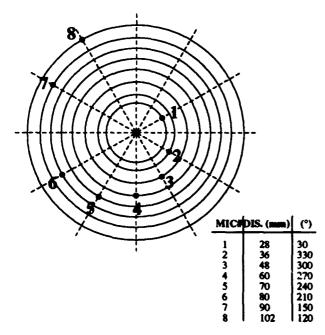


Figure 13. Schematic of Microphone Locations

Equation (1) has been used to compute the information in Table 4 for shots 16, 17, 36, 41, 43, and 44. The average of shots 16 and 17 (the inert shots) and the average of 41, 43, and 44 (the JA2 shots) are also shown in Table 4. The sigma column is the standard deviation of the three JA2 shots.

Figure 14 shows the shock velocity of the average inert, the average JA2 and the 2R16 plotted against distance from the center of the box. The inert material and JA2 propellant show a shock with monotonically decreasing velocity. By contrast, the 2R16 JAX exhibits an accelerating velocity with distance. These results clearly indicate that the response of the JAX is more violent and of a different nature than the response of the JA2.

Table 4. Shock Velocities (km/s) as a Function of Distance

				Sho	ots				
Distance (mm)	16	17	Average 16, 17	36	41	43	44	Average 41, 43, 44	Sigma
20	3.21	2.50	2.85	2.75	2.75	2.82	2.85	2.81	0.05
30	2.40	1.96	2.18	3.30	2.18	2.18	2.24	2.20	0.04
40	1.93	1.66	1.79	3.69	1.86	1.82	1.89	1.86	0.04
50	1.63	1.46	1.54	3.97	1.64	1.60	1.67	1.64	0.04
60	1.44	1.33	1.38	4.21	1.50	1.44	1.54	1.49	0.05
70	1.31	1.23	1.27	4.40	1.41	1.33	1.42	1.39	0.05
80	1.22	1.17	1.19	4.56	1.34	1.26	1.36	1.32	0.05
90	1.16	1.12	1.14	4.71	1.28	1.22	1.32	1.27	0.05
100	1.12	1.10	1.11	4.84	1.26	1.18	1.28	1.24	0.05

3.4 The Impulse Pendulum Test.

Figure 15 shows a schematic of the impulse pendulum test apparatus. ¹⁶ In this test, propellants are placed in a cardboard shipping container, nominally 150 mm in diameter and 520 mm long. The attack path is diagonally through the center of mass of the propellant and placed at a convenient angle (but constant) so that the jet will miss the pendulum bob. The attack is by unconditioned bare Viper placed 2 cone diameters away from the propellant charge. The shock wave, produced by the interaction of the Viper's jet and the candidate propellant, impinges upon the nearby pendulum bob of massive weight. The distance between the propellant tube and the pendulum face is 305 mm. The displacement and the period of the pendulum are measured directly and the total impulse delivered to the pendulum is calculated from the following formula:

Impulse =
$$2\pi$$
 [Mass x Displacement/Period]. (2)

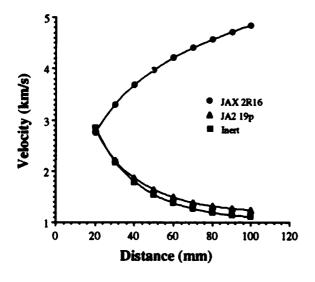


Figure 14. Shock Velocity Data for JA2 and JAX

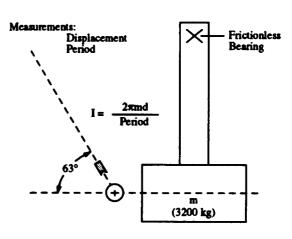


Figure 15. Schematic of the Impulse Pendulum Test

The contribution of the shaped charge itself is determined by shooting into a cardboard container filled with sand. This contribution is small and subtracted from the calculated impulse to obtain the impulse due to the jet-propellant interaction alone. Results are ranked in a relative fashion.

Table 5 identifies the propellant, the shot number, and the net impulse in N-s. The table is divided according to whether the weight of propellant tested was 2.3 kg or greater than 2.3 kg. Figure 16 shows the results for the 2.3-kg tests. Again, it is evident that 2R20, either in the granular or stick geometry, exhibits a greater response than the JA2. The results in Figure 17 are even more dramatic. Here JA2 at the 7.3-kg and 10-kg levels has about five times lower response than the 2R20 at the 7.3-kg level. This is further evidence that the JAX responds in fundamentally different fashion relative to JA2.

Table 5. Impulse Pendulum Data

opellant Name (type)	Mass (kg)	Lot Number	Shot Number	Impulse (N-s)
JA2 (7p)	2.3	RAD-84G-001-S176	88-10	612
JA2 (19p)	2.3	RAD-PE-792-11	88-11	657
JA2 (19 PcS)	2.3	RAD-PE-792-33	88-30	843
JAX 2R20 (7p PcS)	2.3	HCL-86C-006-004	88-27	1484
JAX 2R20 (19 p Hex)	2.3	HCL-86H-003-009	88-13	1618
JAX 2R20 (19p PcS)	2.3	HCL-86C-004-001	88-14	1896
JA2 (7p)	4.5	RAD-84G-001-S176	88-25	872
JA2 (19 PcS)	10.	RAD-PE-792-33	88-28	1201
JA2 (19p)	7.3	RAD-PE-753-10	88-26	1208
JAX 2R20 (7p PcS)	7.3	HCL-86C-006-004	88-29	5614

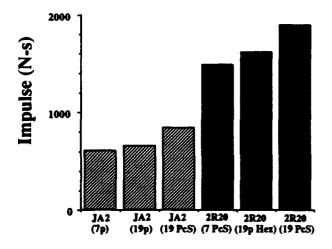


Figure 16. Impulse Pendulum Data for 2.3-kg Quantities of JA2 and JAX

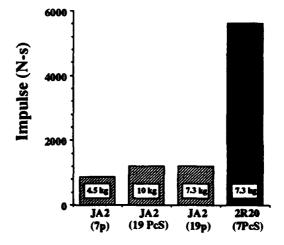


Figure 17. Impulse Pendulum Data for Various Amounts of JA2 and JAX

3.5 The Staged Compartment Test.

These tests characterize the relative response of candidate propellants in confined quarters that simulate the volume of the stowage compartment of an M1 tank. The apparatus used in this test is shown in Figure 18 and is capable of holding ten rounds of sleeved 105-mm ammunition. However, in these experiments, 2.3 kg of propellant are placed in a cardboard tube and blocked with wood. This tube is then located within a standard aluminum stowage sleeve that is placed in the test apparatus on the second tier from the bottom, in front of the hole cut into the angled face of the armor. Only the sleeved 2.3-kg propellant charge is in the compartment. The threat is an 81-mm BRL precision shaped charge located at standoff of 2 CDs (not shown). The jet passes through

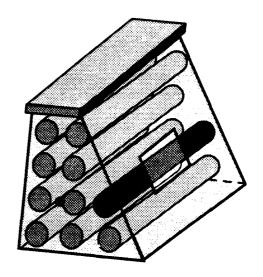


Figure 18. Schematic of the Ten-Round Staged Compartment Test (The target round is darkened.)

25 mm of RHA that is backed by 13 mm of Isodamp. The conditioning armor pack (not shown) is located against the slant wall of the compartment and the jet is aimed at the center of mass of the propellant. Two mounts for Kistler gages (calibrated to 13-MPa peak pressure) are located in both end walls of the compartment, in a plane parallel to the direction of the shaped charge jet attack. These gages provide (duplicate) pressure vs time data. The pressure-time curve is integrated (up to 10 ms) to provide specific impulse vs time information.

Table 6 identifies the propellants tested in the staged compartment apparatus. The testing of JA2 propellant took place on February 11, 1988, while the testing of 2R20 propellant took place on April 12, 1988. Figure 19 shows the computed impulse plotted against time for the four propellants listed in Table 6. It is obvious that the JA2 response is about five times lower than the JAX response.

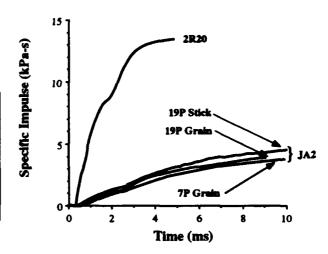
3.6 Summary of JAX Vulnerability Testing.

The mechanical properties tests, even at low temperatures, did not show an obvious correlation with the vulnerability tests that involved shaped charge jets interacting with the JAX propellant bed. This is not surprising since the role that mechanical properties play has been shown to be secondary to that of chemistry.¹⁷

All five tests discussed previously show that the response of JAX is fundamentally different from the response of JA2. Since JAX is manufactured by adding 30% RDX (or less) to JA2, the question arises: What is the specific mechanism that causes JA2 to go from a low response propellant, one that generally mimics the inert material response, to the violent response observed for the JAXs? The remainder of this report discusses how we began to address this question and what was found.

Table 6. Staged Compartment Propellants

Propellant	Lot#
2R20	HCL-88C-006-004
JA2 19P STICK	RAD-PE-792-33
JA2 19P GRAN	RAD-PE-792-11
JA2 7P GRAN	RAD-PE-001-S176



4. JAX MORPHOLOGY

Figure 19. Staged Compartment Test Results for 2.3-kg Quantities of JAX and JA2

4.1 SEM Background.

The physical arrangement of the processed material is very important to propellant performance. Defects such as voids, cracks, agglomerates, or foreign material can have a deleterious effect on the programmed burning of the charge by changing the mass generation rate of the propellant. This is done by supplying augmented surface area directly or through the resulting fracture, or by simply changing the intrinsic burning rate of the propellant. For this reason, scanning electron microscopy (SEM) has been adopted as a standard method of detecting these defects. Each propellant lot undergoing investigation is examined by SEM to ensure that the structure has its intended integrity. SEM micrographs are also used to assure that there are no processing problems, such as poor mixing of materials. Information may be uncovered during a routine SEM morphological screening examination that would alert researchers to potential performance problems and could eliminate or redirect subsequent testing.⁵

Therefore, undamaged specimens of each type of JAX propellant were cold fractured at dry ice temperatures. The low-temperature fracture reduces the possibility of introducing artifacts into the structure. Since cracks propagate through the material by a path of least resistance and defects usually supply a lower resistance pathway, the likelihood that a crack will encounter a defect (if it exists) as it propagates is enhanced. This process results in more defects being exposed at the fracture surface than would be represented in random sectioning of the specimen. Conversely, if no defects are seen on the newly exposed surface, it is likely that the defect population is small.

4.2 SEM's of JA2 Grains.

Figure 20 shows micrographs of the cold-fractured surface of typical JA2 propellant and is presented as a basis for comparison. JA2 is a thermoplastic elastomer that undergoes a transition from mostly plastic to brittle behavior at about -20° C at deformation rates on the order of 100 s⁻¹ (see Figure 4). The typical JA2 cold-fracture surface is smooth, indicating brittle fracture. Some nitrocellulose (NC) is observed because the high nitration level (13.1%) of the NC prevents all of the fiber from dissolving in the plasticizer. Other propellants that use lower levels of nitration (12.6%)

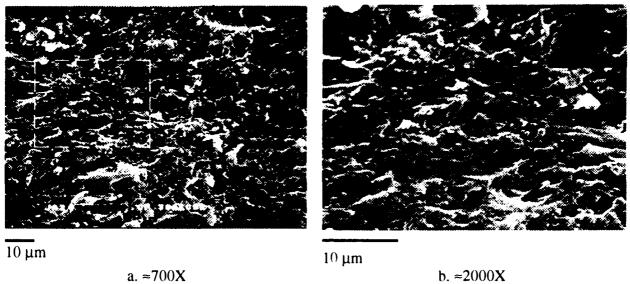


Figure 20. Micrographs of the Cold-Fractured Surface of JA2 Propellant

have the NC completely dissolved and do not show exposed fibers. The only other notable feature in typical JA2 propellant is the presence of very small (0.5- $2\,\mu m)$ particles distributed throughout the propellant. Their identity has not been established. They could be very fine carbon black, which is an added ingredient, or they could be small particles of MgO that are added during mixing to aid in the extrusion process. In any case, they seem to be found throughout the material.

4.3 SEM's of JAX Grains.

Figure 21 shows micrographs of 2R10, a JAX propellant. RDX particles that are less than $5\,\mu m$ in diameter are observed in these micrographs. The surface is not as smooth as the JA2 surface in Figure 20, but other JA2-like features are present, such as NC fibers and very small particles. The

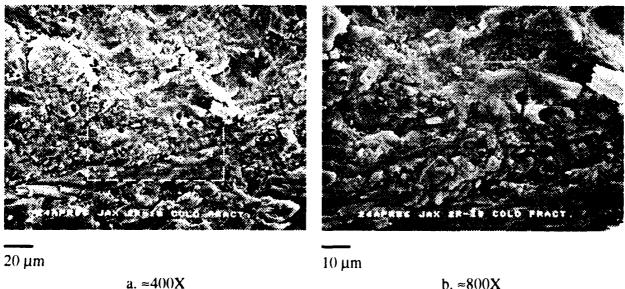


Figure 21. Micrographs of the Cold-Fractured Surface of 2R-10 JAX Propellant

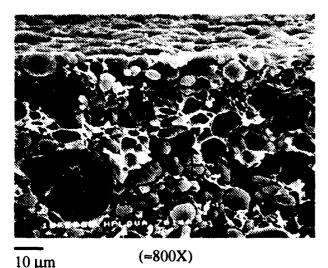


Figure 22. Nitramine Ba: Propellant with RDX in the 2 - 20 µm Particle Size Range

only unusual feature is that the particle size of the RDX is considerably smaller than expected. The distribution of particle sizes that was added to make JAX, and that typically appears in nitramine base propellants, has most of the particles within a range of 2 to 20 μm . Figure 22 shows an example of a nitramine base propellant. It has 76% RDX filler that falls within the 2-20 μm range. This range is representative of the RDX particles size distribution expected in the JAX specimen but was not observed.

Micrographs of JAX propellant with 20% RDX filler are found in Figure 23. As expected the number density of particles is greater, but the particle size is still about 5 μm . The fracture surface is rougher than the 2R10 surface (see

Figure 21). This was caused by the greater number of particles (i.e., defect locations) diffusing the path of the crack during the specimen preparation.

Micrographs of the 30% filled JAX propellant are presented in Figure 24. There are similar changes due to the increased concentration of RDX as were noted in Figure 23. There are more particles present and an even rougher surface. The major difference noted here is that the RDX size distribution seems to be more in line with what was expected.

The observations made for these three lots of JAX propellant are significant and consistent when considered in light of information that was gathered when a more recent production of JAX propellant was made. The JAX micrographs presented in Figures 22, 23, and 24 were taken when the propellant was first delivered in the Spring of 1986. A more recent production was manufactured

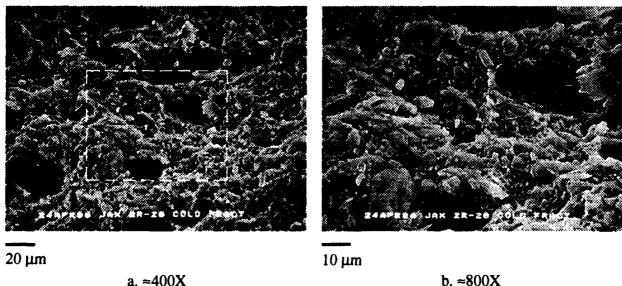


Figure 23. Micrographs of the Cold-Fractured Surface of 2R-20 JAX Propellant

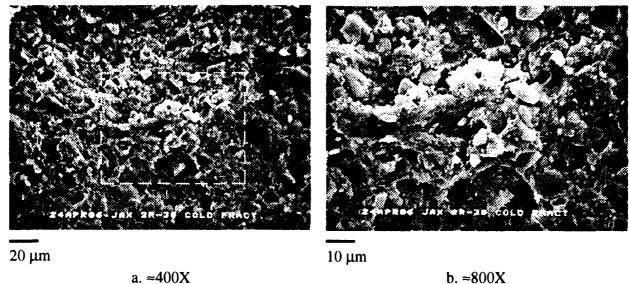


Figure 24. Micrographs of the Cold-Fractured Surface of 2R-30 JAX Propellant

at the Radford Army Ammunition Plant in February 1993.³ The objective in making the newer JAX had been to test the effects of using recrystallized RDX rather than fluid-energy-milled RDX in a JAX composition. This lot was received for routine morphological testing and was cold fractured to investigate the structure. Crystals were observed covering the surfaces of the perforation walls. These observations had not been made with any previous lot of JAX. However, the only surfaces that were investigated using the earlier propellant were cold-fracture surfaces. Micrographs of early lots were inspected for similar observations, but there were no portions of micrographs that showed perforation surfaces of sufficient magnification to confirm the presence of crystals growth. Figure 25 shows a comparison between a JA2 perforation surface and the corresponding surface of a 2R7.7 JAX grain. All perforations showed similar crystal structure. All areas of every perforation showed evidence of crystal growth.

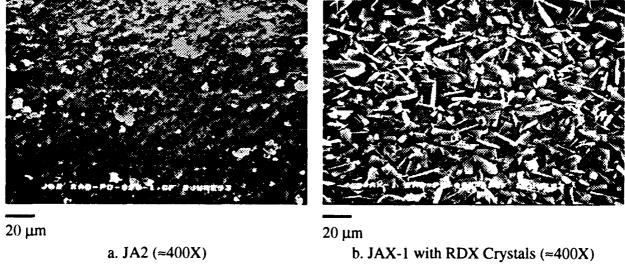


Figure 25. Micrographs of the Inner Perforation Surface of JA2 and JAX-1 Propellants

To understand the physical nature of the deposition process, the specimen used in Figure 25 was cold fractured along the radial direction of the grain. This provided an orthogonal view from the one presented in that figure, and provided an opportunity to observe the extent of the crystal growth.

Figure 26 shows the radial fracture surface. Attention is called to the whiter band of material that sits on the gray bulk of the propellant grain. It is clear that the crystals reside only on the extrusion surface. There is no extension of the crystals below a sharp line of demarcation, the extruded perforation surface.

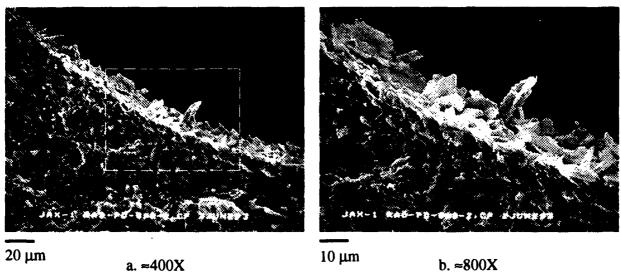


Figure 26. Micrographs of the Inner Perforation Surface of JAX-1 Shown in Figure 11b Cold-Fractured in the Radial Direction

The more recent lots of JAX were not the only ones to exhibit this crystallization phenomenon. The JAX propellant that was studied in 1986 (2R10, 2R20, 2R30, and 2R16) was still in storage in the magazine. It had been undisturbed for 7 years and was retrieved to see if this crystal growth could be seen in the perforations. When the ungraphited 2R16 JAX propellant was brought to the laboratory, a white "powder" was visible on its outside surfaces. Specimens of whole grains were prepared for SEM analysis and micrographs of the outside surface of the grain appear in Figure 27. Since the crystals must have appeared after extrusion, and since the crystals seem to appear upon annealing or long-term storage, the deposition mechanism is likely to be precipitation after transportation to the surface by means of solution.

4.4 Crystal Identification.

Positive identification of these crystals was needed and was obtained. The identification strategy consisted of 1) examining the surface of the perforations, where the crystals had been detected; and 2) examining the bulk material, away from external surfaces, as a control. The microreflectance-FTIR spectra of the JAX surfaces (see Figure 25b) were obtained using a Mattson Polaris FTIR spectrometer and a Spectra-Tech IR-Plan infrared microscope with a MCT detector. The software included Kramers-Kronig transformations to correct spectral distortions. For both spectra, 32 scans were collected with a resolution of 8 cm⁻¹. The scans are shown in Figure 28.

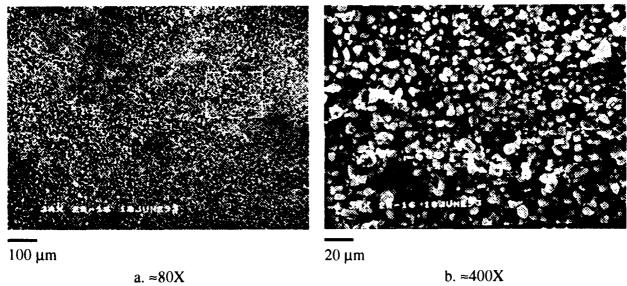


Figure 27. Micrographs of the Exterior Surface of 2R-16 JAX Propellant after 7-Year Storage

Attention is drawn to the ordinate of Figure 28 in the region between 1500 and 1700 cm⁻¹. From other spectra (not shown), an RDX spectral signature lies at about 1600 cm⁻¹ and an NC spectral signature lies at about 1660 cm⁻¹. In the upper scan labeled "Bulk Surface of JAX" (Figure 28), we see the NC spectral signature at 1660 cm⁻¹, but little or no indication of an RDX spectral signature at 1600 cm⁻¹. On the other hand, the lower scan, labeled "Perforation Surface of JAX" (Figure 28), we do find the RDX spectral signature at about 1600 cm⁻¹. The shape of the derived NC spectral signature at about 1660 cm⁻¹ is distorted. This results from a failure of the Kramers-Kronig transformation to perfectly compensate for the specular reflection of the crystals on the surface.

The crystals were positively identified as nitramines and we concluded that they were recrystal-lized RDX. With the information thus far it was hypothesized that some type of migration pro-

of RDX on the exterior surfaces of JAX propellants.

4.5 The Formation of Crystals on JAX Surfaces.

cess was occurring that resulted in the deposition

Processing records indicated that annealing of the propellant was performed for 6 hours at 43° C after extrusion and cutting to relieve residual grain stress. Annealing is routinely performed as a part of JA2 processing, and was included in the JAX processing.³ Thus, if heating were to accelerate the RDX deposition, all JAX materials should have RDX crystal growths on their external surfaces after manufacture.

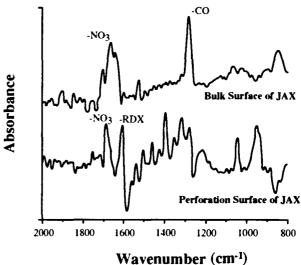


Figure 28. Microreflectance FTIR Spectra of JAX Surfaces

After annealing, the grains are tumbled to apply a graphite coating that aids in loading operations and increases packing density. We infer that the newer grains had the RDX removed from exposed outside surfaces during the tumbling process. This explains why crystals were found only within the perforations for the recently produced JAX. Grains stored for extended periods of time either were exposed to high temperatures (storage history is unknown) or the solution that transports the RDX to the surface had sufficient time to form these crystals after slowly evaporating.

As stated earlier, the annealing step in the processing of JAX suggests that heat might promote the RDX formation. We devised a simple test of this proposal. Specimens of JAX (2R16) were cut at 21° C (not cold-fractured) to expose fresh surface area that contained no crystals. One half of the grain was placed into an oven at 75° C for 65 hours. The other was placed within a laboratory hood at room temperature. After 23 hours the propellant specimens were removed from the annealing oven and inspected; crystals were observed on the surfaces. The control showed no sign of crystal formation. The samples were returned to the oven and the hood and after 65 hours they were again examined using the SEM. There was about the same number density of RDX crystals on the heated samples as there was after 23 hours, but the crystals were larger. The SEM results for heated and control samples after 65 hours are shown in Figure 29.

4.6 The Role of DEGDN.

Evidence from thermogravimetric analysis experiments shows large weight losses (13.5 to 19%) for JA2 upon exposure to elevated temperatures. Table 7 shows the weight loss observed for the propellants JA2, M30, and M43 upon exposure to 60° C for 1000 minutes and upon exposure to 100° C for 360 minutes.¹⁹

The candidates responsible for this relatively large weight loss observed for JA2 are the plasticizers DEGDN or NG. Table 8 shows the vapor pressure for these two neat materials²⁰ over

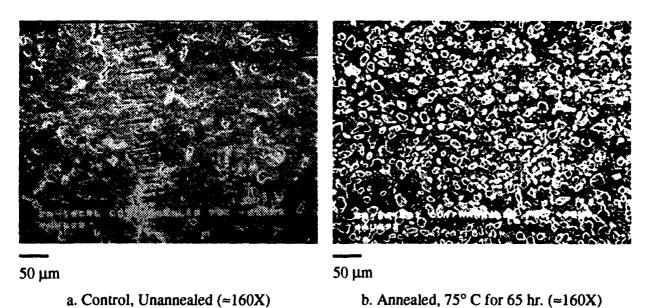


Figure 29. Micrographs of the Cut Surface of 2R-16 JAX Propellant

Table 7. Thermogravimetric Analysis for JA2, M30 and M43 at 60° C and 100° C

Table 8. Vapor Pressures of Neat DEGDN and NG

	(%Wt.	Loss)	
Propellant Specimen	T= 60° C t = 1000 min	T= 100° C t = 360 min	
JA2	13.5	19	
M30	7.5	12	
M43	1.5	3	

Temperature (° C)	Vapor Pressure (Pa)			
	DEGDN	NG		
20	0.48	0.20		
25	0.78	0.24		
40	no data	1.00		
45	no data	1.72		
60	17.3	8.00		

the temperature range 20° to 60° C. The neat vapor pressure of DEGDN is significantly greater than that of NG, a factor of 2 at 60° C, and the weight percentage of DEGDN is almost a factor of 2 greater than the weight percentage of NG in the formulation of JA2. These two ratios lead us to focus our attention on DEGDN as the principal solvent for the transport of RDX in the JAXs.

The next question concerns the solubility of RDX in DEGDN itself. Table 9 shows the available data for the solubility of RDX and HMX²⁰ at 25° C. The data are ranked according to the value of the absolute solubility of RDX. This value ranges from a low of 2.3 g/100 g solvent to a high of 41 g/100 g solvent. The absolute solubility of RDX in neat DEGDN has the lowest value.

Since DEGDN is about 25 wt% of JA2, and since 6 to 30 wt% of RDX is added to the JA2, the solution of dissolved RDX in the DEGDN and NG within the JAX propellant is very likely saturated.

4.7 The RDX Deposition Process.

The measurable solubility of RDX in DEGDN and high vapor pressures for DEGDN strongly supports the following deposition process.

When RDX is added to the JA2 propellant, it dissolves to form a saturated solution in the propellant plasticizers. This accounts for smaller than expected particle sizes observed in morphology investigations, especially at lower concentrations of RDX. The high vapor pressure of DEGDN causes rapid vaporization of the plasticizer at all exposed propellant surfaces. During annealing, this process is accelerated (and the solubility of RDX may be greater) causing rapid loss of plasticizer and transport of RDX from the interior to the exterior surfaces. As the plasticizer vaporizes, the dissolved RDX precipitates and is deposited on the surface. Once crystals are formed on the surface, the tendency to enlarge existing crystals would take precedence over the creation of new sites, as is usually the case when solids precipitate from saturated solutions. This was observed in the most recent annealing experiments (see Section 4.5). The effect of this process is to remove RDX from the bulk of the grain and deposit RDX crystals on the exterior surfaces.

Table 9. Solubility of RDX and HMX in DEGDN at 25° C

Solvent	RDX	НМХ	Ref	RDX/HMX
	(g/100g	Solvent)		
DEGDN	2.3	<0.2	a	>11
Acetonitrile	5.5	2.0	b	2.8
Cyclohexanone	7.7	1.0	b	7.7
Acetone	8.2	2.8	b	2.9
Butyrolactone	14	12	b	1.2
Hexamethyl phosphoramide	16	1.4	b	11
Dimethyl acetamide	33	С	b	
Dimethyl formamide	37	С	b	
Dimethyl sulfoxide	41	57	Ъ	0.7

a) Reference 18

5. SAFETY IMPLICATIONS

Some of the final processing steps in the manufacture of JAX are conducted at elevated temperatures.³ First, there is the "even-speed operation" conducted at 68° C that prepares the dough for carpet rolling. Second, the carpet rolls are conditioned at 66° C for a minimum of 30 hours. Finally after extrusion, trays of cut propellant are annealed for 6 hours at a temperature of 43° C. If our proposed mechanism for the precipitation of RDX on exposed propellant surfaces is correct, then it is likely that recrystallized RDX is formed in one or more of these processing steps. Thus, the recrystallized RDX constitutes a potential safety hazard even during its manufacture.

It is also noted²¹ that "Microscopic examination of 2R12 and 2R16 propellant carpet rolls in storage at Radford (since 1986) confirmed the presence of unbound (recrystallized) RDX on the propellant surface."

We have noted in section 4.5 that the recrystallized RDX is likely to be mechanically loosened from the exposed exterior surfaces of JAX propellant. This was confirmed when recrystallized RDX

b) CPIA/M3 "Solid Propellant Ingredients Manual" Nov 1989. RDX values from Unit 16, p15 of 21; HMX values from Unit 15, p16 of 22.

c) Shortly after the HMX dissolves, precipitation of solvate crystals occurs.

Table 10. Sensitivity Initiation Characteristics for JAX, JA2 and Neat RDX

Sample	Production Date	Total Volatiles	RDX Content Particle		Sample Thickness	Impact	Sliding Friction*	Electrostatic Dischsrge	Thermal Initiation
		(%)	Size (µ)	(%)	(mm)	(cm)	(MPa)	(J)	(°C)
2R12	Apr-86	0.05	47	12	2.46	80	390	≥9.5	198
2R16	Apr-86	<0.01	7.5	16	2.54	64	464	≥9.5	194
2R20	Feb-86	0.14	100	20	2.41	80	503	≥9.5	no data
JA2	Oct-86	0.30	0	0	2.46	80	617	≥9.5	195
neat RDX		dry	7.5	100	0.18-0.38	13-26	200-293	0.026-0.065	no data
neat RDX	(l	dry	47	100	0.38-0.45	51	170	0.065	no data
neat RDX		dry	100	100	0.28-0.36	26-64	170-345	0.13-0.26	no data
	* at 244 cm/								244 cm/s

was easily removed from 2R12 and 2R16 carpet rolls in experiments at Radford by scraping the propellant surfaces with a spatula.²¹

This RDX crystal growth and subsequent separation from the propellant introduce safety concerns during propellant moving and handling operations that are not well understood. These concerns arise during sample inspection, the finishing phases in the JAX manufacturing process, and propellant shipment and storage.

Recent safety testing of several JAXs, JA2, and neat RDX has been done.²¹ These results for threshold initiation levels are presented in Table 10. (In the table, threshold initiation level is defined as that level above which initiation can occur, and is established by 20 consecutive failures at the stated level. Initiation was determined by infrared detection of decomposition gases.) These data show little or no change in the initiation level among the JAXs as measured by electrostatic or thermal ignition. The differences in the JAX initiation values for impact and sliding friction were judged not significant. The report concludes that for all practical purposes the JAX initiation levels are comparable to the JA2 values. Table 10 also shows that dry, neat RDX is more easily initiated by impact, friction, and electrostatic discharge than either JA2 or the JAX propellants listed.

There are two implications that can be drawn from these data. First, the recrystallized RDX, when mechanically freed from the JAX, may either remain airborne and diffuse, or be convectively transported, thereby contaminating shipping or storage containers. The precise safety implications have not been quantified, but the data in Table 10 suggest a prudent caution since the loose RDX poses an increased safety hazard. Second, the fact that these safety tests showed no differences between JA2 and JAX (with or without surface RDX²¹) suggests that these tests cannot be used to predict or determine the level of recrystallized RDX present. To make this determination, a time-temperature study of the rate of formation of recrystallized RDX on the JAX propellant surfaces would have to be undertaken, perhaps as a function of the weight percentage of RDX. Once this relationship is determined, the temperature history of the JAX propellants would have to be recorded and evaluated to properly assess the current state of recrystallization. The increased hazard due to the evolution of loose RDX would also have to be determined.

Two considerations raise questions that may be significant, but are currently not resolvable. The first deals with the RDX deposition process at annealing and upper-extreme storage temperatures. The data in Table 8 show that the relationship between the vapor pressure and temperature is Arrhenius in nature. Thus, at elevated temperatures, the vapor pressures will continue to rapidly increase. However, the solubility of RDX in the propellant plasticizers is not known at higher temperatures. If the solubility is significantly larger and works in concert with the higher vapor pressure, the deposition rate will be markedly increased as the temperature rises. The second consideration concerns the deposition rate and is chemical in nature. Our interest has been focused on the role of DEGDN because of: 1) its higher vapor pressure (Table 8) and greater concentration relative to NG; and 2) the greater thermogravimetric weight loss experienced by JA2 relative to M30 (Table 7). Nevertheless, the role that NG plays in the RDX transport process is not clear. In addition, the mixture of DEGDN and NG that forms the JA2 plasticizer may have properties different from the properties of the neat components. Most of the information needed to address these concerns is not known. Two tacit assumptions were used throughout this analysis: 1) dramatic changes in the solubility of RDX with temperature were not considered; and 2) the vapor pressure of the plasticizer mixture would be an interpolation of the neat constituent values. If additional processes or chemical changes were introduced when the plasticizers were mixed, other explanations for these observations become possible. However, the mechanism, as presented, is qualitatively consistent with the information and physical data contained in this report.

In conclusion, the mechanism for the precipitation of RDX discussed in section 4.7 produces a dynamically changing structure on the surfaces of and within JAX propellants. Since JAXs can undergo morphological changes with time and temperature, and since the standard safety tests are not predictors of the changing state of a JAX propellant, the continued manufacture and use of JAXs as they are currently formulated and processed is not recommended.

6. OPTIONAL STRATEGIES TO RDX ADDITION

6.1 Solid Fills.

RDX is not the only energetic solid oxidizer that could be tried in the manufacture of a JAX-like propellant. Table 9 shows that the relative solubility of HMX in neat DEGDN is more than an order of magnitude lower than that of the RDX's solubility. While this is encouraging, this low value is no guarantee that HMX would not show a similar crystallization phenomenon. Recourse must be made to experimentation. Other solid oxidizers could also be tried.

6.2 Use of Less Volatile Plasticizer.

The DEGDN could either be replaced with a less volatile plasticizer or an inhibitor could be added to DEGDN to retard its migration. In this last regard, some experimentation with PARAPLEX G59, a viscous, high molecular weight hydrocarbon, has shown some success. 22 Approximately 10 wt% of G59 had been added to a recently manufactured nominal 2R20 JAX. The grains were exposed to testing as described in section 4.5, except that the heating at 75° C was continued for 120 hours. These grains were examined by SEM, as described in section 4.3, and analyzed by FTIR, as described in section 4.4. No crystalline RDX was observed on the exposed outer surfaces.

7. SUMMARY

The original goal of this investigation, to determine the mechanism(s) by which the vulnerability response of JAX was so much greater than that of JA2, was not reached. It may be that the raw crystalline RDX observed on the external JAX surfaces contributes to this increased violent response but it is not the only possible mechanism, and in no way has it been demonstrated. For example, the implication that RDX enters into solution in the DEGDN may also provide a mechanism for the increase violent response of the JAXs observed in the vulnerability tests.

During the course of routine investigations on JAX propellant, raw RDX crystals were found deposited on the external surfaces of all JAX grains examined. A mechanism for this deposition was hypothesized and tested, and found to be consistent with all data at hand. Safety implications of the deposition process were pointed out and some general approaches to mitigating or circumventing the RDX crystallization were suggested.

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APPENDIX A

JAX Propellant Description Sheets

Lot Numbers:

HCL86H003-008	HCL86C006-003	HCL87A010-006
HCL86H003-009	HCL86C006-004	HCL87C010-007
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HCL86H003-013		HCL87C010-009
HCL86H003-014	HCL86H008-001	HCL87C010-010
HCL86H003-015	HCL86H008-002	HCL87C010-011
	HCL86H008-003	HCL87C010-012
HCL86C004-001	HCL86H008-004	HCL87C010-013
HCL86C004-002	HCL86H008-005	HCL87C010-014
HCL86C004-003	HCL86H008-006	HCL87B010-015
HCL86C004-004	HCL86H008-007	
HCL86C004-005	HCL86H008-008	RAD-PD-090-1(JA2)
HCL86C004-006		RAD-PD-090-2
	HCL87A010-002	RAD-PD-090-3
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				A Alle	T						
	LOT NUMBER	Tan .	واطانته	12 Aug 1		STORCATION					Т
in i				104.19	THO M (II)		.715	(RICENS)			Ŧ
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NITTOC	llulose		N/A	A/K	55.09	MEAT PEST	120°C	CC 4	0'	СС	60'+
	ycarin		N/A	H/A	12.68	No Fume:	5	NF 1	hr	NF	1 Hr
DEGDN			N/A	N/A	20.99	FORM OF PE					
kard1t			N/A	N/A	0.61	HOE (ca)		- N/A		115	
	um Oxide		N/A	N/A	0.06	Abs. Der		:c) N/A	<u> </u>	11.6	0
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ar educarisadisa						PILICEN BE	RECEIPE	2	3851	o ender	Springer 1999
	LOT MARKET	The .	TANK THE 31	NSACT.		ST. SRCATION	94	RHEDER	 		-
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					PREF. BIA. (d)	N/A	.020	022		BATE	-
TANDARD	472-138	90	100 00%	100.00%	Web Ave.	N/A	.090	.085	!	_	
SAARKS	•	_		_	Inner	N/A	.106	.092	PAGE		/86
The 2R	10 was in sh				Middle	N/A	.099	.079	INST PA		/86_
	k .085") fii		inst the	AM829	Outer Too Division Visal Dov. is \$	N/A N/A	.0655	.086		8	/86
Pranda:	rd PE 472-13			••	/Bod. Borr. to S. of Work Arts.		<u> </u>	7.04	OWNE		
700cc 1	bomb @ 0.10	Em/cc	toading a	iensity.		N/A	1.11	1.15	PORTA		PORTS
					D-J	N/A	B1.95	27.95	<u> </u>		
MAARS :	Candelilla v the propella ed average (ex val	used as	ounts.	cant durin The physic	al dimension	and ma	his lo	resent t are	in a V	eight
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DALITUEL	OF CONTRACTOR'S		ATIVE . A	1	KI	CATATA	2/11/1/	. 😘	• • • • • • • • • • • • • • • • • • • •	:	
jn ' 11	. KIRKPATRIC	~ V	על האפ אנו	etuc	- _{R.} ' L.W.	SIMMONS. PR	OGRAM M	ANAGER			
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2R10	-19 P	erf. H	exagonal	Granula		DA 101 10111	HCTP	6н003-01	.5 -	
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itrocellulo			N/A	N/A	55.09	MAAT TEXT	# 120°			CC 60
itroclyceri			N/A	N/A	12.68	No Fund		NF 1		NF 1
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kardit II			N/A	N/A	0.61	HOE (ca		· N//		1156
ernesium Ox	ide		N/A	N/A	0.06	Abs. De		/cc N//		1.60
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געא			N/A	N/A	10.52	5lope (100=	le el c	=/Ein	0.353
Ash			N/A	N/A	0.10					
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tethylene Cl	Solut	oility.	N/A	N/A	34.28					
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مرسون بالمراجع المراجع	MUMUIII	That .			1	P. S. S. P. II.	- 12 m		****	
ist -01		-40		104.19		STORCATION	-	RINESHED	 	
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-01	.5	+145	123.47		DUMETTE DI	N/A	700	.654	-	٧. ٠
		1			PRIF. BLA. (d)	N/A_	020	.022-	1	9476
AMDARD 472	-138	90	100.00%	100.003	Web Ave.		.100	.089	ł	
MARKS.				_	Inner	N/A	.116	.094	I MARK	0/00
he 2R10 was					Middle	N/A	1.108	.083		8/86
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standard, PE	4/2-1 3	-		•	And Service &	N/A	, 14°3	4.84		9/11/8
700cc bomb (0 10		loedine.	denetre	10	N/A	1.05	11.12	PORTA	TON BOST
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PE OF PACIDNO CO	TAME	Fiber	Drum:	652D						
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	21-20	19 Peri	Stick			ħ		MCLS	COC	4-001	/		
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AND 31 B	DISED ARMY	Ammen	ITION PL	AMT. BAR	FARD. VA.	-	HEAT REAL						
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	llulose		/A	N/A	42.70	-	MEAT THE	120°0	,	CC 40		CC 6	
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DEGDN		$\overline{}$	/A	N/A	23.16		100A OF 10						
4.048			/A	N/A	0.64		HOE (ca)			· N/A		116	
Graphit	um Oxide		/A	N/A N/A	0.03		Abs. Den		(CC)	N/A		1.6	2
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	LOT SELECTE	THE T				IZ.	T WHIT BILL	RESID	7	11855		1	
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	PE-472-138		100 00%	area?	Web M	N/		.113	_	092 087	1455	2/24	
THE PARTY OF	hese are th	e clos	ed bomb m	results	Web M Web O	N/		.108 .077	_	104		2/0/	
for car	pet rolls c	ut to	strips of		Web A	N		.099		094	TAST FROM	31B	196
	lons 7.5"x.1 bomb with a			14	AND THE BE	N/	/A		T6	.67	774B		7/80
density	, DOMO ATEN W	U.1 gi	8/CC 1080	ring	W 74 44	N7		11.43	+	1.80	NEEDY	15 N 15	411
	•		•		0.7	N.		33.33	_	9.75	PCE WAL	363	
TIPL OF PACE	BHO CONTAINE !	lood Bo	v No. 32	7043. Ba							146		
	Candelilla :											n	
	the propella												
	analysis of	carpet	rolls.		-		•						
Signed	by		•	• • •	•					ment E		eT	
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THE REAL PROPERTY.	ADFORD AR	MY ARE	ION	ITION PL	INT. BADI	iord. V	A .	Ho	nevve 11	Eubcon!	TAC	: 93	2077_		
Chief Bride	to section and	- Jan 34	ĭ×	Act Cold Mil	प्रदेश ।	KLLLVI	H		A.C. 4955411.	\$1.50 E. N	, :			. 1	
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ROPL	MIT COAPOEM	34	***	भ राधाः	FRISHE		III	1	436	T A	94,777	440 1	HTOCAL	TUTS	
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Nitroc	llulose		T	/X	N/A	62.5			MAT PUT	120°C		CC 4	0.	CC	60. +
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DECON			I	/A	N/A	23.1	6		100A 91 F	0181111					
Akardin			N	7 X	K/A	0.64			HOE (ca)	/22		· N/A			166
Marnes	us Oxide		IN	/A	N/A	0.03			Abs. Der	18. (2/	CE	N/A		\Box .	.62
Graph1			N	/A	N/A	0.05			Talieni:						
MX	(Pround)		7	0	N/A	20.3	10		Slope e				z/Ein		A
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		+90		118.06	106.92			W		700 .021		23	-		يساح
EMBAN	PE-472-13	1 400		100.007	200	Web 1		M		-113		92			•
						Web M		NL		108		87	-	3/	86
-	These are	the cl	984	ed bomb s	results	Web O		11/		.077		04	MAD	6 37	16
IOL CE	rpet rolls	cut t	0 1	itripe di	?	Web A		N/		.099		94	TEST AN	10:6	2 42 4
Cinens:	lons 7.5"z	. 125"x	.08	35".		XI L	-	_		-1177	_		-		3/86
/00 CC	bomb with	a 0.1	81	i/cc loss	ing			X/			- I	67	PUED		
density	7•			•		9		W		3.93	13.		POLTA		
			_			94		N/		33.33			<u></u>		
THE WILL	EM CONTAIN	Mood	Bo	No. 32	7043 Ba	rrier B		عما	327041.	CATTO	N	. 32	7146	_	
	Cendelille	WEX 1		used as	a lubric	ent dur	ing	ex:	trusion (and me	y be	PTC:	sent i	ln	
1	the prope	llent 1	ما	trace so	ounts.	Propell	ant	CO	Mpositio	n resu	lts	ate .	fros		
	analysis	of Cati	pet	rolls.					•						•
Signed !	bv		• • •				•		:	Deve	lop	inse	Engine	er	
				HCL	86 COO	4-00	2		Ţ	AD.W.	K11	kpat	rick		
2	R-20	(9 p	rt.	الحدة الدارية المارية المارية	- and	. •			May .	1 ~		41	frat	<u>.</u>	•
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Water Biology Country 65 Pounds													
MA AL STORY OF ALMA TR	MUNITION DI	ANT DAD	FARA. VA	WHEN THE			1077						
Series of the se							2077						
		PITT	17:007:07	Turnes n ex	ومرومه	D RAID	Brend street						
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				13.08 13.11	-1	45+	30+						
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	MANUFAC	IURE AF	OLVENTER	S PROPELLA	1000		Same and March March						
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HARMANIA		666-80VI	16 12 132		West of the								
			16	Vijak i primata.	*		HY) BOAT						
Arbieni Ambieni Load Arbieni 110°F Incr	Porced Air	Dry	110 . 60										
	at tempera						4						
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					614	WILL THE W	ITECAL PUTS						
COMPRISED	TO CALL	1					ACNAL ACNAL						
Mitrocellulose Mitroclycerin	R/A N/A	N/A	62.70	MA 7 751		CC 4							
DEGDN	N/A	N/A	23.16	No Punes		NE 1	DX 14.5 1 11.5						
Akardit II	N/A	N/A	0.64	HOE (ca)		N/A	1166						
Harnesium Oxide	N/A	N/A	0.03	Abs. Der			1.62						
Graphite	N/A	N/W	0.05	Taliani:									
LDX (ground)	20	N/A	20.30	51ope (
Moisture	1 110	10/4			ssure d	id not	reach						
Ash	N/A	N/A	0.10	100									
	124	1	1										
THE PART OF THE PA				de l'alternation	11.894	3 184							
M water	n of Them		}	Proncation									
	0 102.99	104.97	U M CHO	W/A	1 6	RIGHT							
+9	V1.0/2.13_	106.86	-	N/A	700	678							
+1	45 121.83	106.92	101. BL 16		021	.023	9476						
FAMAM PF-472-138 49	0 100	THE OWN	Web J	M/A	113	.092							
These are the c	losed bomb	results	Web M	N/A	108_	087	1/86 1/86						
for carpet rolls cut	to strips o	t	Web O	N/A N/A	.077 .099	.104	NA PURE						
dimensions 7.5"x.125";	k.085".		12 E-72			1	3/86						
700 cc bomb with a 0.	l gm/cc los	ding		N/A		6.67	SUCESTION SOUL						
density.	•		0-0	N/A	2,29	2.32	I has maded						
THE OF SACRES ASSESSMENT OF					33.33								
THE OF PACIFIE CONTAINS MONTH	Hox No. 3	27043	rrier Bar	327041	Cartor	No. 32	/14D						
the propellent													
analysis of car	pet rolls.												

Signed by

2R-20. 19petstick

Development Engineer D.W. Kirkpetrick

	2R-20	7	Pert	Stick_			FEED BEST	60 Pc				
20 21 2					APT 049	CARA DA	SERVICE IN	158				
	PRINTER VI		4220	NITION PL	ANI, BAU	TURU, VA.	Moneyvel	Subcon	tract	9325	77	
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3 3 8 4 3 C	or the Parker and			MANUFACT	URE AF	OLVENTLES	2 920951	ANT	.			. & S
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TAR.	WIII			PROCE	SS-DRYH	lf : · · · ·	elija 🍇 🖓 🥱	A 65 1 1 1		. :	HVI	TROAT
	Amhien	Lo	ad Fo	reed Air	Dry							
110 E						110 : 3"						
110'F	110°F Ambieni			tempera							 	4
	77-17-4-11		Y								1	
More	MIT COMPOST	NGN		स्याः ।	FRISHE	PROPELL	M A	1	BUTT A	10 MI	SCAL RET	15
	CONTRIVER			THE CONT	111111		4			REAL		MINA
Nitroce				N/A	N/A	62.70		1 200		C_40'		+, 09
NIETO») DEGDN	ycerin			N/A	N/A N/A	13.12	No Pus				N NI	1 hz
Akardit	11			N/A	N/A	23.16		PROPELLAN		N/A		166
	um Oxide			N/A	N/A	0.03		ens.				.62
Graphit	e			N/A	N/A	0.05	Telier	1:				
RDX . (ground)			20	N/A	20.30		100mm				
Moistur			-+		1374			ssure di	d nee	Teac	<u>.p</u>	
Ash	<u> </u>			N/A	N/A	0.10	100	To He	- +			
				VA								
70000							Burgare	at taken	2	K		
No	101 WAS	<u> </u>	TLA!	- NAME		ļ	STIGRES TO		1	_		
			-40	102.99	104.97	LEON EL	20.4	15-0	115.			
			+90	118.06			N/A	395	139	_		
			+145	121.83	106 92	FEI. BA. M		.025	.02	22	DA.	76
	PP-472-1			I HO OOK	94.665		97/4	 	1.07	, 	ACTO	3/86
SEVANT 1	These are	the	clos	ed bomb t	resulta	Inner Outer	N/A N/A	.081	.07	, 	Man E	2786
for car	pet roll	B CU	t to	strips of	!	Ave.	N/A	.082	.07	7	151 Paris	53/86
	lons 7.5"			185". pa/cc lose	14	A LT	K/A	1.22	.04	7	- LB	3/80
density		n #	0.1 [M/CC 1080	rog	10	N/A	37.97	_		CH WAR	14316
	•			•			N/A	15.8	14.	65	W 141	
THE OF PACE		W U	and B	ox No. 32	7043. Be	rrier Bas					146	
						ent during						
1	the prope	lla	nt in	trace am		Propellant						
•	analysis	of (carpe	t rolls.			•		•			
												
Signed	by '			•••					lopud Liti		nginod: ick	•
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kenen	m 2R-20	7 Te	rf (Btick			1	-	BCTTP	2004-00	.5		1
PERM	W/A						╗	TAXAB CARRE	30 E	aunda			
A 10 Cm	MATARA AL	MY AM	411	ITIAR PL	ART. RAD	ARR. V		Honeyerli					
Sec Local	6 252 S 557 MO	78 To 2 also	200	All Carlotte	WAY BITTO	ZVILGI		HOROTOPILL	SUBCON	4/146	32077	· No	
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	S. Action			MANUFACT	BRE OF S	SLYENT	III	PROPELLA	MT	· · · · ×		or in the Real	
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Amblen	Ambien			TIA bear			-						
Ambien 110 F	110°F			Temper.		110 \$	7.7				-	-	
110°F	Ambien	Cool		tempera								-	4
PROPEL	MT COMPOST	-	·	TESTS OF	LENZHE	PROPE	III	17	174	WT 410	PHYDICAL	RETS.	
	TOWN TURE!			VECNI				,			MAULA	AC	NA
MITTOC				/A	N/A	42.7	_	HEAT TEST	€ 120°C	CC	401	CC 6	
Nitroel	ycerin			/ A	N/A	11.1		No Pupe		NF	l hr	NF I	hr
DECDN				/A	N/A N/A	423.4		7048 0/ /		N/		1	
Akardit Marnesi	um Oxide		_	/A	N/A	0.64		HOE (ca				116	
Graph1t				7 <u>A</u>	N/A	0.05	_	Taliani				 ```	-
KDX (ground)		7	0	N/A	20.3		5lope (2 31.	Om/min	•	
			┸						sure di	d not	reach		
Moietur	<u></u>		_	<u> </u>	N/A	+		100	mHe			 	
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			+		—					-		1	
· · · · · · · · · · · · · · · · · · ·	towns in a	13,44	ijij		Remail rooms		7	PULLED	RESID		#108		
		11	7 4	The state of the s									
6.0							\Box	PROACATION		Mapi			
		+9		102.99	104.97			N/A	15.0	15.0			
				121.83	106.92			N/A H/A	.025	.026			
-	PE-472-1	38 +9		100.00%	94.00%						3		
-	hese ere	the e		ed bomb t		Inner		N/A	.093	.086	7.00	3/8	
for car	pet roll	S CUE :	to 4	strips of	#2015	Outer		N/A	.087	.088	- June	3/86	
dimensi	lone 7.5"	x.125"	E.0	B5".		AVE TO		N/A	.090	.087		w#183,	/86
700 cc	bomb wit	h a 0.	l gi	m/cc load	ling		3	n/a	-6.90	2.57	SA F	0	
density	'•			•		٠		N/A	34.88		4 PIKE	TERN BI	MIS.
					· · · · · · · · · · · · · · · · · · ·	94		N/V	17.20	16.2			
THE OF PACE	BIRS CONTAIN	W Vood	-	- No 32	7043 Ray	refar B		No. 327041	Carto	No. 1	177146		

Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts. Propellant composition results are from analysis of carpet rolls.

Signed by

Development Engineer
D.W. Eirkpatrick
P.W. Muhostu

	2R-20	7	Port	St	1ck											
	M/A										30	BOUT	da			
EW 31 2	ADFORD AR	MT	Amms	HIT	ION DLA	MT. RAD	188	D. VA.	6	ALL THE	R			2077		
	san a								110	nevvell	Photoc	m		7077		
7. 10.4.01	Parties Compa	10	X X)		-Jai	RUS	977		4	umas ir u			RANCE			41.61
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	Ambien	ىل	oad F	279	ed Air			A (8)	_	-						
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2000	ANT COMPOST	_	6.4	7	2722	FINISHE	1	20071	-			440/7	7 ALS 8	HTBCAL		
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			+	N/A	RAULA	N/A	4		P _		1200			NULA .		00 ∓
Nitroel	llulose			N/A		N/A	-	42.70	-	No Puber			NF 1			I BE
DECDN	VERTIR			N/A	_	N/A	_	23.16	-	POLA OF PI			P	_0.1	-	
Akardin	77			N/A		N/A	_	0.64		HOE (ca)			· N/A		111	44
	um Oxide			N7A		N/A		0.03	_	Abs. Des		7cc				62
Craphie				N/A		N/A		0.05		Taliani						
RDX (ground)			20		N/A		20.30	_	Slope (HE	1.0	m'sin		
			$\Box 1$							# DTC	SSUTE	did	not	reach		
Hoistur				N/A	`	N/A				100	mm Re					
Ash				N/A		N/A		0.10								
							_						<u></u>		_	
				_			لم						L,	55.5		
a since way	/ / / -							Section 1	4	THI	III.	15	1135			
	101 101		na!	يك	Victory.		 - -		_			_				
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	PE-472-1	38	190		100 MT	-					1	丁		1		•
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fan	These are	Ene	s clo	884	pomp t	esults	0	uter		/A	.096	\Box .	093	WAN	3/	86
Admond	rpet roll lons 7.5":	. Cl	IE EO	35	rips or			Ve.	N	/A	.100	\Box .	097	THE RE		3/8€
	bomb wit					4),C		N	/A	-4.3	3	8.23	STUE.		
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-tenezt)	, •			•			E			A	18.8			-	1943	
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	2R-20	19	101	f Stick				TO M	C006-	111		
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E-18 0			AMM	INITION PLA	MT DAR	AN GEG	GAPTER BUILD				77	
							Moneywell					
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			_				13.0					
							Jews 13.11		45+	Π.	30+	
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\$771X	Winds:			MARUFACT	URE AF S	BLVENTLES	S PROPELLA	NT	10.50		1 . Sec. 1	3 × 2 5 3
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	WHI			PROCE	SS-DEYI	E type DV or	etik 🎉 eting jeri e					HOURS
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110'7	110°F			t temperat		1111.6.4.6					-	4
110°F				own for a								
ROPEL	MI CORPOR	në i		TESTS 84	BIZINE	200711		574	SAUTT AN	O MIT	CAL TRATE)
	CONSTRUCT		-	NE COM	AND THE					FORMU	<u>. T</u>	ACN4
Nitroce				N/A	N/A	42.68	MAI TET	1200		40'		C_60'+
Nitroel				N/A	N/A	13.48	No Fume			1_h		
DEGDN			$\neg \uparrow$	N/A	N/A	22,08	100A OF F					
Akardie	11			N/A	- M/A	0.77	HOE (ca		-	NA	-111	61
	um Oxide			N/A	32/4	0.03	Abs. De	ns. (g	22	-344	11.	62
Graphic	6			N/A	N/A	0.04	Taliani			- 117-11		
DDX (c	lass Il			20	R/A	20.92	Slope	100	18 21	Om/	o ale	260
Moistur	<u> </u>			-X/A	N/A	0.10						
Ash				N/A	N/A						_ _	
						-					{	
A CONTRACTOR OF THE PARTY OF TH								-1-2-61		6.550	سلج	
	,					All Marie	1244411111	REZE	2			****
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	*****		-40	113.33	(U) . 66	10-32-61	N/A	8.0	8.0	"" -		
			+90	123.05		SWELLE OI	N/A	.700	1.679	- 		+-
			+145			PRI. BA M	N/A	021	.022		BAT	_
TARAM	PE-472-1			THE COTE	MAL MATE		N/A	.113	.10		-	
MANAGES						Web M	N/A	.108	.090	7		/86
	These ar	e th	e cl	osed bomb	results	Web O	N/A	.077	.093		APLS :	786
				cut to st		Web A	N/A	.099	.09		T ROOM	3/86
				5"x.125"x.			M/A	•	4.9		100	
				a 0.1 gm/	ce	4	N/A	117.43	111.	(S B)	K BY TON	Petit.
	loading	dens	ity.	•	•	91	N/A		30.		X TAIN	•
		- 11-	-4 -	11- 223	0/3 5			1				
							No. 327041					
	the proce	lla-	. IS	trace and		ent suring	extrusion composition	and mai	I De a	resel	og in	
				t rolls.								
•		 -	y ·				-		•			

Development Engineer D.W. Kirkpetrick D.W. A. Spring

Signed by

PERCIT	W/A		- سارد المراد بروان					Ju pur		
MA 21 81					122, YA.	Honeywell	Subcor			
	mail an allen			~>	KITLIN	n fariyanê	74/24	والأخواص فيها		11 400 m 14
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Sec. 32.	and and the		AMUEACT	HOE OF C	ALVERTIE	S PROPELL	NT	18.00		1.1847.10
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Ambieni	Ambien	Load For	rced Air	ימנ						
Ambien					110 : 5"					-
110°F			temperat						- -	
	CALUARIT	-VVI 00							1	1
More	MIT COMPOSITION		TESTS OF	FRISHE	PROPELL	UT	-	-	MY SAL	es is
	COMPTENDED		PERM					761	404	ACTUAL
Nitroce	llulose		N/A	N/A	42.68	MAT TEST		C CC 4	0'	CC 60'
Mitroel			34/4	-144-	13.48	No Fund		NF 1	hr	NE
DECON			1	2/4	22.08	TOUR OF		<u></u>		
Akardie	um Oxide	 }-	*4	-4/4-	0.77	Abs. De		744	**	1161
Graphit			-N/A	-11/4	0.04	Talian		100	/4-	
	loss ()		20	N/4	20.92	Slope		Hg 21.0	ein	0.260
Hoistur	٠		N/A	N/A	0.10					
127		 }-	N/A	_ N/A						
								~-		
<i>)</i> 4.	FLEX	ET EON	i n		100	SPELLANT B	H. Kal	BIR	101	24 O 45 A
		1840 °F	STATE OF	Yings		· .				
in .						STORCARON	**	RHADIO		
		+90	177.73	103.86		N/A	12.75		 	
		#145				N/A	.700	.675	 	
TANDAN	PE-472-138		100.007			N/A	1.113		1	MATE
					Web M	N/A	.108			3/86
	These are t					N/A	.077	.093	MA	3/86
	for carpet				Web A	N/A	.099	.095	THE PER	3/86
	of dimension 700 ec bom				ALTE		1_	4.95	2722	
	loading der			~~	2	N/A	3.93		POLY	TON BORTS
	_		-		94	N/A		3 30.68		
MANARI (andelilla vine propelli analysis of	wax is a	trace and	lubrica	ent during		and m	y be pre	sent 1	ia .
Signed	by 21-20	19 put	stick H(:L860	C006-00		MA	Develope D.W. Ki	rkpatt	lck

D. W. Xelestral

	25-20 19	Perf	itick		لــــــــــــــــــــــــــــــــــــــ		Bu-07:	~~~			
POUN	W/A					AND STATE		Pounds			
THE R	ADFORD ARBY	AMMER	ITION PLA	MT. RADI	ORD. VA.	Honeywell	Subcon	Tact 01:	2077		
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								5+	30+		
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1 70 A	\$ 2 000 V)		ANUFACT	URE OF S	ALVENTLES	S PROPELLA	YT cassis				
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ROA	WIII.	installa g	PROCE	SS-DRYH	6 *** ** *	yakan dara			-	77	SJI
	Arhien Li	oad For	red Air	Dry							
Ambleni 110 F					110 : 5"				4—		
110°F			m for a						+-	-+-	
	CI CI	01 BO	TOY I	MDIIN					-	-+-	
									1	+	
MORL	MIT COMPOSTION	126	TESTS M	PRIZHE	790711	JT	\$1.A	MUTT AND PI	TBCAL S	UTS	
	CONTRIBUT		PRICE PROPERTY.	A PLAN				100		ACT	J4L
Nitroce	llulose		N/A	N/A	42.68	100AT 1957	120°C			3.33	_
Mitror			V/A	NA	13.68	No Pume		NF 1		177	
DECDN			37/4	- 17/4	22.08	FOLK OF P					
Akardie			NA	N/A_	0.77	HOE (ca				1161	
Graphit	um Oxide		¥/4	-1/4-	0.04	Talieni		EE	*	1.62	
RDX (c			20	N/A	20.92	5lope 0	100	B =1.0m	/min	0.26	5
Moistur	•		N/A	N/A	0.10						
Ash			N/A	N/A							
										<u> </u>	
	The Market	E SHOW	21.000	5 (1) (2) (1) (1)	30 10 10 10 10 10 10 10 10 10 10 10 10 10	DESTRUCTION	e e e e	उ ग्र≅ा	A P Y	. 30	
	LOT NUMBER				73		127.4	W 11=51			_
20						MONCATION	-	RNEND		1	<u> </u>
			113.33			N/A	1.6	11.6			
		+90	123.05		DIAMETE DI	N/A	.700	675		I	_
STATE AND	PE-472-138	+145 +90	124.88	100.28	Web I	N/A N/A	.113	022		MI	
	1.2-130	1.30			Web M	N/A	.108	102 -090	•	3/86	
SSMARKS	These are th	me clos	ed bomb	results	Web O	N/A	.077	.093		00/06	
	for carpet 1	rolls c	ut to st	rips	Web A	N/A	.099	.095	TEST TO	3/80	/26
	of dimension				A	N/A		4.95	OF LE		00
	700 cc bomb			cc	4 Feb 44	N/A	2.29	12.37	BUCE	TON BE	rts.
	loading dens	ity.	•		04	N/A	33.33	30.68	POLYA	LDGD	
-	BING CONTAINED BY	ood Boy	No. 327	043. Bar					1146		
-	andelilla ve	x 10 t	sed as a	lubrica	nt during	extrusion	and Bay	be pres	ent i	a	
•	he propeller	it in t	race amo	wats. I	ropellant	compositio	n resu	its are	LOB		

analysis of carpet rolls.

Signed by

Development Engineer D.W. Kirkpetrick

RAPPORD ARMY AMMUNITION PLANT, RAPPORD, VA. Honeywell Subcontract 932077 RESUMBLY AMMUNITION PLANT READY READY READY READY RAPPORT READY	PERM	ZX-20		- Phake			-	JU E	·		_
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Akardir	17		14/		N/A	_					
	um Oxide		1 N		N/A		HOE (ca	1/en)	- W		163
Graphit			14		N/A	0.05			CC N/		1.61
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Ash			\ <u>\</u>		N/A	17.78		3 O O Gazar.	A 21.0	2516	349
Moistur			₩	0.5	N/A 20.3	0.2	19 1				
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-	5-231	90		100 CFT	84.00%	Heb Ave	N/A			6 41	
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The c	losed bom	tear		d 2R-20	in the	Outer	N/A	.106	107		
•	orm fired				tandard.	X2 1. TE		1 4 1 7 3	+ ***	Lan son sale	786
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700ec	bomb, 0.3	gm/cc	10	en Tud des	nsity.	Lil	N/A	2.29	2.34	BUZEITE	
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Sitror)			I N		N/A	11.45			NF 1		CC NF
DECDN			N	/A	N/A	19.24	1004 0	PROPELLAN			
Akardit			N		N/A	0.73	HOE (c	al/em)	N		_116
Graphit	um Oxide		N/ N/		N/A N/A	0.05	Abs. I		/cc N	<u> </u>	
RDX			N		N/A	17.78		0 100	Hg El O	m'nin	.34
Ash			N/	Δ.	N/A	0.0					
Moistur			-	0.5	20.3	0.2					
Methyle	ne Cl Solu	bility	LN/	A	N/A	31.40			_+_		!
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307		76.01 4	9	90.97	101.69		STORES TO	1 100	Nee-D	508	
ar .		TAN	PP	90.97 92.47	101.69				Residence Services	008	
	ID! INJABII	-4 -4 -14	9 Q U V	90.97 92.47 96.81	101.69 103.43 104.25	100 to 10	N/A N/A N/A	8.0 .700 .054	8.0 -684 -048		
FAMOAD	ID! INJABII	-4 -4	9 Q U V	90.97 92.47	101.69	DARTH DI PER BA M Web Ave	N/A N/A N/A N/A	8.0 .700 .054 .073	8.0 684 .048		2476
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			•	IANUFACT	URE OF S	OLVENTLES	S PROPELL	ANT				
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A A A	Pullet :			22255	26 BAY!		_				_	_
AAA					SS-DRYII	15	<u>.</u>	·			Vi.	2
zhien zhien				rced Air		110 4 602						
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10 F	Ambien			n for s								
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Rome	urt compon	<u>~ [</u>				PROPELIA		574	-	PITECAL	TOTS	
	וופעזודעפוז		Γ	SECULIAR SEC	TO THE							S N
	llulose		_	/	N/A	50.64		6 150°C				_60
<u>ittorl</u> EGDN	vcerin		_	/4	N/A	19:45		PROPELANT		hr	110	1
kardit	11		_	/A	N/A	0.71	3) 30H			1/4	 .	163
	um Oxide			/A	N/A	0.05		ens. (g/		VA VA		163
raphit			_	/A	N/A	0.05						سلامي
DΧ			_	/A	N/A	17.78	Slope	100	e el	m'sin		349
sh			_	4	N/A	ي و	79				<u> </u>	
oistur	e Cl Sol		_	0.5	20.3 N/A	31.40					╀—	
	71 201	UBILITY	48	/A	NA	31.40					+-	
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		-4	_	90.97	101.69		PROPULTO		Design 1			T
				92.47	103.43	DANK DI	N/A N/A	2,68 .700	2.68			+
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40.00	S-231	90		100 007	BM 60%	Web Ave	N/A	.073	.074	7		-
PARS						Inner	N/A	.074		7:00		/86
The el	losed bom	h +	.,	d 28-20	in the	Middle	N/A	.073	.069	_		/86
	orm fired					Outer	N/A	1.0/2	1 .094	-	8	/86
	c bomeb, 0						W/A	1		B701		
		-		_	-	<u> </u>	N/A		3.92		4 242	
	040 (On!A44				102015	errier Bag	N/A	12.9	6 14.25	177144		_
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MANUFAC	TURE OF	OLVENTLES	S PROPELL	IKY	· · · · · · · · · · · · · · · · · · ·	., .,	••••
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				# 	ROL	AULA	ACTVAL
N/A	N/A			@ 120°C		_	CC 60'
N/A	N/A					<u>[</u>	NE 1 h
							11/1
		_					1163
N/A	N/A		Taliant	:			
N/A	N/A			100==	12 21.0	o'rin	.349
			29				
	T LA WY	الاستنا	PAUL MAIL B	HEN	2		
			PROACA NOW	T	Taras a		
	103.43	ものずま	N/A	15.0			
45 96.81	104.25			395	391		
	+						M 76
<u> </u>							8/86
		Outer	N/A		.080	Lerus	8/86
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cc Towarua	density.	₩.	N/A	37.97			De Berli
		ent during	extrusion	and may	y be pres	sent 1	n
in trace a	mounts.						
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		กนุร	,				
	PROCEDURATE TESTS TEST	PROCESS-BRYN Forced Air Dry Lase temperature to St temperature down for sampling TESTS OF FRESHE PROCESS-BRYN LAST STATE PROCESS-BRYN LAST STATE PROCESS-BRYN LAST STATE LAST	PROCESS-BRYING Forced Air Dry Lase remperature to 110 2 5 1 at temperature down for sampling TESTS OF FINISHES PROPELLA REAL PROCESS-BRYING AND FOR SAMPLING TESTS OF FINISHES PROPELLA TO INTERPEDIATE TO	MANUFACTURE OF SOLVENTIESS PROPELLANT PROCESS-DRYING Forced Air Dry ease remperature to 110 2 5 F at temperature to 110 2 5 F a	Forced Air Dry Pass temperature to 110 2 5 F at temperature to 120 2 5 F	MANUFACTURE OF SOLVENTILESS PROPELIANT PROCESS-DRYING Forced Air Dry CASE temperature to 110 2 5°F at temperature N/A N/A SO. AA MAN TOP & 120°C CC 4 N/A N/A 11.45 No Fures NF 1 N/A N/A 0.71 HOF (cal/gm) N/A N/A N/A 0.71 HOF (cal/gm) N/A N/A N/A 0.05 Abs. Dens. (a/cc N/A) N/A N/A 0.05 Taliani: N/A N/A 0.09 0.5 20.3 0.2 VN/A N/A 0.09 0.5 20.3 0.2 VN/A N/A 31.40 PROPILIANT PRETCHASE (Bec N/A) AS 96.81 106.25 DENSITE BY N/A 19.5.0 TOP BAME N/A 0.0815 .080 TOP BAME N/A 0.0815 .080 TOP BAME N/A 37.97 38.36. Colored Coloring density. Colored Coloring density.	MANUFACTURE OF SOLVENTILESS PROPELLANT PROCESS-BRYING Forced Air Dry Same remperature to 110 2 5°F at temperature to 110 2 5°F ANA N/A N/A SO AA MAN MAY MAY BEAR N/A N/A N/A SO AA MAN MAY MAY DO AB MAN MAY MAY DO AB MAN MAY MAY DO AB MAN MAY DO AB MAN DENS. (R/CC M/A N/A N/A N/A O.05 Abs. Dens. (R/CC M/A N/A N/A N/A O.05 Taliani: N/A N/A N/A O.05 Taliani: N/A N/A N/A O.09 Taliani: N/A N/A O.09 Taliani: N/A N

THE PARTY	■ 2H-2U 7	Perf G	ranular_				Nex-purior	, ~		
PERMIT	N/A					TERM STATE	209	Pounds		
BH 31 8/		MY AMM	MITION PL	ANT. BAD	FORD, VA.	Honeywell		9	32077	
					KUILK					
			DE PORT			Miles C	en land	-	Rain	וז.הת עו
B9508	9; 95091;	95092				┥…,,,		m 1-0		
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			MANUFAC	TURE OF	olventles	s propella	NT .	٠,	. v	e ge
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No 4 t	Will .		2000	ESS-BRYII	16		150.		7	
Amblen		1004	orced Air						-PE	T BOAT
Anhien		Increa	SP TORDET	ature to	110:57				1	
110.1	110°F		t tempera							4
110 F	Ambien		own for s						工	
									4-	_
	لمسمل			2 Hawa 42	40000					
	MI COMPOST	<u> </u>			8 PROPELLA		744	VII 40 A		
	CONSTITUEN			100			10010	CC 4	NULA .	ACTUAL
NICTOR	llulose		N/A	N/A N/A	11.45		No Funes		hr	CC 60'+
DEGDN	YEREUR		N/A	N/A	19:24		101-1		NY I BY	
Akardie	11		N/A	N/A	0.71			N/		1163
Magnesi	um Oxide		N/A	N/A	0.05			C N		1.61
Graphic			N/A	N/A	0.05		-			
RDY			N/A	N/A	17.28		TOOMER		o/Fir	349
Ash Moistur			N/A 0.5	1 20.3	0.2	2				
	ne Cl Sol	ubiliry		N/A	31,40			1		
			278	سبل						
	101 101 101	KII I		NO.		Buchen	1.510			
nr.	W	-40		101.69		STORU TON	-	ne b	 -	
		+0		1103.43	Sec of ILL	N/A	.539	.547		
		+14		104.25	DWATTE BI	N/A	.355	.354		
				1	101 BY RU	N/A	.023	.022		MR
FAREAD	15-231	90	100,000	100.00%	Web Ave	N/A N/A	.072	.072	.,,,,,	8/86
THE LAND					Inner Outer	N/A	.0725	.077	4	
The c	losed bom	b test i	sed 2R-20	in the					TEST AN	N/Kh
827 £	orm fired	against	t the 827	standard.	72 F. T.				ST UE	8/86
700 c	c bomb, 0	.1 gm/cc	loading	density.	4 7 0 4 9 10	N/A	1.52	13.10	T	154 \$4516 1919
			•			N/A	15.43		-CLAY	1949
1771 W PAC		• F1h	er Drum:	652 D						
					ent during	extrusion	and may	be pre	ent 1	8
			n Erace at			2) = F (3 (•
ł						•		•		

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B95089; 95091; 95092 MANUFACTURE OF SOLVENTIESS PROPELLANT MANUFACTURE OF SOLVENTIESS PROPELLA	
### 13.10 ### 13	
MANUFACTURE OF SOLVENTILESS PROPERTY AND	W PU
MANUFACTURE OF SOLVENTIESS PROPELLANT Achien Andrew Achien Andrew Achien Andrew Achien Load Forced Air Dry Achien Andrew Achien Load Forced Air Dry Achien Load F	
MANUFACTURE OF SOLVENTIESS PROPELLANT TRADE THE DAY Anhiem Antien Load Forced Air Dry Anhiem Investigation of the sampline TOTAL TOTA	
MANUFACTURE OF SOLVENTLESS PROPELLANT PROCESS-DRYING Achiem Index Load Forced Air Dry Achiem Index Load Forced Air	
PROCESS-DEVING PROC	
Achien Amhien Load Forced Air Dry Achiens 110°F Increase temperature to 110°2°F 110°F 110°F Hold at temperature 110°F Ambien Cool down for sampline **TESTS OF FRUSHED PROPELIARY** **COURTMENT PAIRTY PAIRTY PAIRTY** **COURTMENT PAIRTY PAIRTY** **COURTMENT PAIRT	
Achient Anhient Load Forced Air Dry Achient 110°F Increase temperature to 110°2 5°F 110°F 110°F Mode at temperature 110°F Ambient Cool down for sampline **TEXTS OF FRUSHES PROPELLANT **Construction** **Con	
Ablent 110°F	
110°F 110°F Mold at temperature	
TESTS OF FRUSHED PROPELLANT STABLET AND PROPELLANT STABLET	
Companies Comp	
Companies Comp	
Companies Comp	1071
Nitrocellulose	467
DEGDN	CC 60
Akardit 11	NF 1
Magnesium Oxide	1163
N/A N/A 17.78 Slope 100mmHg 1.0mm/pin	1.6
N/A N/A 0.09	
Marhylene Cl Solubility N/A N/A 31.40 Marhylene Cl Solubility N/A N/A 31.40	.349
Marthylene Cl Solubility N/A	
## 10	
10 10 10 10 10 10 10 10	
10 10 10 10 10 10 10 10	
#40 92 47 103 43 ### N/A 15.0 15.0 ### ### N/A .355 .354 ##2 #### ############################	
#1/45 96.81 10/4 25 DWARTH DI N/A .355 .354 #22 PANDAND S-231 90 WARTH DI N/A .023 .022 - PANDAND S-231 90 WARTH DI N/A .072 .072 The closed bomb test used 2R-20 in the 827 form fired against the 827 standard.	
######################################	32
The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. 700 cc bomb, 0.1 sm/cc loading density, at the 828 N/A 13.10	M TB
The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard. The closed bomb test used 2R-20 in the 827 standard.	- •
The closed bomb test used 2R-20 in the 827 form fired against the 827 standard. The property of the 827 standard of the 827 st	8/80
827 form fired against the 827 standard.	1910
700 cc bomb. 0.1 gm/cc loading density. Let Web 4-9 1 N/A 113.70 L	8/8
N/A 42.25 42.37 600 m	TO: SE
■ N/A 15.43 [16.34	
THE OF PACES CONTAINS Wood Box No. 327043, Barrier Bag No. 327041, Carton No. 327146	
Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.	B

55 PW SL

JHN-14-84 PKI 11:15

FAX NC. 7036397600

	PR	OPELL	ANT (S	CRIPT	ION SHE	ET		EXI	MPT-I		7-2:
COMPON	r fogos	R-16 19	Perf Stic	k		24 (01 Numas		74010-0	03		
PRIEA		Jeine C	PR 087-00	79		PAZZED AMOU	•	Pounds			
WO AT					DFORD, YA.	CONTRACT NUM	1944				
Page 22 1					TRUCKLUK	100000					7.000
			95081 - 95			HITTOOM		EI STAROL	سخيت	_	P Luci
							<u> </u>	۵۰۲۳ مرس	~ —		MAG.
						- Ave 13.		-454 <u>**</u>	3) +	#ML
								~		DOON	
104	10			icture o	ESOLVENIE	es propel	MIN	(5) (4) (4)			HEORIEI
210	215	Diff	erential i	lol line					20	<u></u>	130
145	155		speed Roll						-		
150	160		usion - Ca		11				+-		-
110	110		ling						24	0	-
						ne o de la constitución				-	
PROPEL	LANT COMPOSI	NON P	MESIS 0	PATINISHE	O PROPELLA	a fundament		HUTY AND P	MURA		CNAL
RITES	CONSTITUENT ELLULESE		Placent PORMULA N/A	TOLIE AND	47.65		13	cc 4			60'+
81788	LYCERIN		N/A	N/A	13.10			_	Hr	K!	1 Hr
DIETETLE	E BLYCAL D	BITTE	N/A	N/A	22.21 0.75			#=		 ==	
	EN BRIBE		N/A	N/A	0.08			_			-:-
			N/A	N/A	0.06	101 c	1/22-	-11/	A	-11	62—
	TOTAL	1	TIA	NA	100.00	A88 BEI	ISITY R/C	ريد ا		1.0	1
Moistw	<u> </u>		N/A	N/A	0.20						
				 -	_	No. of		1 29	<u> </u>	H	21
				 	_					-	
200	## × 38 € * * · C	LOSED BO	ME		WALL WAR PRO	PELLANTEDI	MENSION	See Inc	183 8	ن خيميد	Name of the
	LOT NUMB			1 SERVI	PARAMETER	SPECIFICATION	Ove	MINE CONTRACT	1	90	911001
1651	 	-40 +90	107.20	1103.83		N/A	8.0	8.0	SPRC.		N/A
		+14	5 107.67	104.03	PIEF. DIA (d)	N/A	.700	690	W/	_	
CSACHATE	5-231	+90	100.00	100.00%	Web Ave.	N/A	.099	.021		MIE	
EMARK!					Outer Middle	N/A N/A	.075 .108	.104	PACKED		
			as shot u	sing	Inner	N/A	115	.103	illi re	13/10)	"
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					D:d	N/A_	30.43	28.21			
	CKING CONTAIN	Carte	nn 327310;	Barrie	r Bag 32704	11; HOOG BO	M 36/3				
			used as a		ant during	extrusion	and ma	y be pro	esent	in (the
	er Develop			_							
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· ·	PRO	PELLI	ant des	CRIPT	ion she	ET		EXEM	PT - PA	IRA	1-20	l
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	HTROSETYCERIN 11 434 N/A N/A 11.45 NO FONES NF 1 H									NF	I Hr	
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RDX	ITE	111 Ex	N/A N/A	N/A	0.05	188	al/gm	N/A		116	3	4
	TOTAL				100.00	ALS DE	RSITT 8/cc	N/A		1.6	1	
Moisture Ash	-		N/A N/A	N/A 0.20		Form	f Prop.	Cv1		C.,		1
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		+14	92.47	103.43	DIAMETTE (D)	N/A N/A	.700	8.0 .690	N/A		N/A N/A	
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TIPE OF PAG	ENING) PHE	Cart	on 327310;	Barrie	r Bag 3270	41; Wood B	ox 32731	1]
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ARRCOM FORM 214 R 10 AUG 77

	PRO	PELLA	INT D	ESI	CRIPTI	ON SHE	ET		EXI	MPT -P	ARA	7-2a	
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I.	ADFORD A	BMA YM	MUNITIO	N PL	ANT, KAL	FORD, YA.	Honeywel	1 Subco	ntract	9320	77		
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BITROCE		N/A		<u> </u>	50.64	WEAT		CC 4			60'+		
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BEARDIT	ELTESL SI	BILBAIL	N/A		N/A N/A	19.24	-TALIANI		E1.8 8(/88 .34)				
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GRAPH			N/A		N/A	0.05	BOE CA	1/20	N	/A	116	3	
RDX			N/A		N/A	17.78							
	TOTAL					100.00	ARS DEN	\$117 2/00	N	<u> </u>	1.6	1	
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-		-40 +90	90	97	101.69	PARAMETER	PIGRCATION N/A	8.0	B.O	SPRC N/		N/A	
		+14	5 96	.81	104.25	DIAMETTE (D)	N/A	.700	-686	N/		1.93	
						PERF. DIA (d)	N/A ·	.023	.021	1	DATES	17:3	
MDARD	S-231	1+90	1100	.00	100.00%	Web Ave.	N/A	.099	.097	┨			
MARKS T	he close	d bomb	test u	sed	2R-20	Middle	N/A N/A	.074	.100	SAMPL			
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andard.	700cc	bomb wi	th 0.1	gm/	cc	U.S. DASS	. 20/4	7/4	2 7/		170	37	
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ARRCOM FORM 214 R 10 AUG 77

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	ywell Mu	leica	GER_	087- 029						Pou	nas		·	
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BITROCE	LLULOSE		Ī	N/A	N/A	50.64		MEAT	-		cc 40	•		60'+
#1720E				N/A	N/A	11.45		BO FUMES			NF 1	Hr		1 Hr
	E ETACOT D	MITRATE	4	N/A	N/A	19.24		FORM OF PE	OPELAN				Су	
ALARDIT MARNESIO			╬	N/A	N/A	0.71		-TALIANI			Elone at		.3	49
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រា		1-4	_	90.97	101.69	PARAMETER		HORICATION	Det	_	CENTINE	SPEC		ACTUA
			45	92.47	103.43	DUMETTE (D)	_	N/A	3.0		386	N/	_	N/A 11.57
		- * 	**	40.01	1119.23.	PERF. DIA. (d)	_	3/A	.025		026	N/	DATE	
ANDARD	S-231	1+9		100.00	100.00%	Web Ave.		V/A	.080		077 -			
DAARES .	The close	nd homb	•	et weed	2R-20	Outer Inner		N/A	.081		081 073	PACKED		
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	•					<u> </u>	l	8/A	20.2			PORWA		PACT 12
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ARREOM FORM 214 R 10 AUG 77

PROPERATION 2R-20 19 Perf Stick PAGENCATION RODEWORLD ARMY ANMUNITION PLANT, RADFORD, VA. RADFORD ARMY ANMUNITION PLANT, RADFORD, VA. RODEWORLD BLOOMS STANDARD STANDARD STANDARD STANDARD RESERVENCE STANDARD STANDAR	MACI MACI MACI MACI MACI
Honeywell Multics GFR DAZ- D29 ***RADFORD ARMY AMMUNITION PLANT, RADFORD, VA. Honeywell Subcontract 932077 ****B95089; 95091; 95092 ***********************************	MARIA MA MARIA MA MARIA MA MARIA MA MARIA MA MARIA MA MARIA MA MARIA MA MARIA MA MARIA MA MARIA MARIA MA MARIA MA MARIA MA MARIA MA MA MA MA MA MA MA MA MA MA MA MA MA
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CONSTRUCT TOUR TOUR TOUR TOUR TOUR TOUR TOUR TOU	VAL
MITROCELLULOSE N/A N/A 50.64 MAY - CC 40' CC	
SITE OCCUPANTS IN N/A N/A 11.45 BO FOMES NF 1 Hr NF	HI
R/A N/A John Comment of the comment	
BASHESIUM BIBE N/A N/A 0.05 Bioge at 1880 m	
GRAPHITE N/A N/A 0.05 SOE cal/sm N/A 116:	
RDX N/A N/A 17.78	
100.00 ASS SERSITY 2/cc N/A 1.6:	
Moisture N/A N/A 0.20	
Methylene Cl Solubility N/A N/A 31.40	
CLOSED BOME	
LOT NUMBER TRMP *1 RQ SLATIVE STATE	T
	ACTUA
1400 92.47 103.43 LENGTH ELL W/A 4.75 4.78 W/A	N//
+145 96.81 104.25 DIAMETER 80) W/A 700 690 W/A	N//
(AMDAID (C_99) IAM IMM MA WOWE WAN AWA W/A NGG NG7	
Outer N/A 075 104 PACKED 1/8	
The closed bomb test used 2R-20 Middle N/A 108 086 SAMPLED 1/8	
The closed bomb test used 2R-20 Middle N/A 108 086 SAMPLED 1/8 of the 827 form fired against the 827 Manual 700cc bomb with 0.1 sm/cc	
The closed bomb test used 2R-20 Middle N/A 108 086 SAMPLED 1/8 of the 827 form fired against the 827 Inner N/A 115 103 TEST PRINTING TEST PRIN	
The closed bomb test used 2R-20 Siddle N/A 108 086 SAMPLED 1/8 the 827 form fired against the 827 and ard. 700cc bomb with 0.1 gm/cc Web Diff N/A N/A 7.95 OFFEED 1/8 CONTRACT N/A N/A N/A 7.95 OFFEED 1/8 CONTRACT N/A N/A N/A 7.95 OFFEED 1/8 CONTRACT N/A	
The closed bomb test used 2R-20 Middle N/A 108 086 SAMPLED 1/8 Middle N/A 108 086 SAMPLED 1/8 And	
The closed bomb test used 2R-20 Colored N/A 108 086 Comput 1/8 of the 827 form fired against the 827 candard. 700cc bomb with 0.1 gm/cc or the sample of the	
The closed bomb test used 2R-20 The second bomb test used 2R-2	urs
The closed bomb test used 2R-20 The fired against the 827 Tandard. 700cc bomb with 0.1 gm/cc adding density. The closed bomb test used 2R-20 Tanner	urs

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COMPONION	PR-2U	10	Perf Stic	L		94 101 mms#	HC7.87	£010-00	08				
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Mark Mark 1													
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01000 0100	0/000					MARDON C		11.0		— ··· µ.	- Mets.		
95089; 9509	1; 95092				·····								
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TO THE PARTY OF THE	2.Newsold	No. Acres	MENHEAR	TAPE ME	RAIVE STAF	SS PROPELL	4 17	e de la company		17.5			
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PROPELLANT COMP	CUTION	100 Apr 1	TESTS OF	FINISHE	PROPELLA	NT MANAGEMENT	STAN	-	HTSICAL I	ESTS.			
CONSTITUE			PRICENT	POLITANCE				100	MULA	86	TUAL		
BITROCELLOLES			N/A	N/A	50.64	MAT		CC 4	0'	CC	60'+		
BITTOSLTCERIR	<u> </u>	一十	N/A	N/A	11.45	DO FONES	no Auditi	NF 1		NF	I Hr		
ETETLERE BLYCE	LEIBITRAT		N/A	N/A	19.24	PORM OF P				Cyl	,		
AEARDIT II		-	N/A	N/A	0.71	-TALIANI		21.8 8		.34	9		
ASECSION OTIO	£		N/A	N/A	0.05			stope at 188mm					
BRAPHITE		\Box	N/A	N/A	0.05	308	1/57		A	116	3		
RDY		\Box	W/A	N/A	17.78			┵		<u> </u>			
	TAL				100.00	ABS DEI	ISTT P/C	<u> </u>	<u> </u>	1.6	1		
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<u>sh</u>		+	N/A	N/A	0.09			+					
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7		40	7 90 97	101.69	PARAMETER	PEOFICATION	24	MAISH ED	PIC		ACTUAL		
		90	92.47	103.43	MINEM IN	N/A	2.70	2.71	11/		N/A		
		145	96.81	104.25	DIAMETER (D)	P/A	700	_690_	1 2		N/A		
			4		PERF. DIA. (d)	- N/A	.023	021 =	^٢ ٠٠٠٠	MIL			
AND480 5-231		<u> 190</u>	100.00	100 00%	Web Ave.	N/A N/A	075	.097 .104	PACKE	1/5	17		
The cl	osed bor	ab t	est used	2R-20	Right	N/A	108	086	SAMPU				
the 827 for					Inner	N/A	115	.103	ינו ה	HIM ED			
andard. 700	cc bomb	wit	h 0.1 gm/	cc		·		7.95	OFFE		17		
ding densit					Rep Ditt		N/A		PLKI		-78-7		
•					الناك	<u> </u>	3.86	3.93	- COLUM		46813		
					D:d	N/A	130,43	128.21	<u> </u>				
TPE OF PACES OF	TANKE C	erto	n 327310;	Barrie	Bag 3270	1; Wood B	ox 34/3/	L.J.					
			nsed as a		ant during	extrusion	and ma	y be pr	esent	10 1	the		
DHATURE OF DEVI	lopment	E98	ineer		<i>(</i>)	Blic							

SPERM FORM SIA P 18 AUG 77

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COMPONI	_					04 LD1 myma		2016			
PENEAU	2R-	20 1	9 Perf Sti	<u> </u>		PACES AND	BCL8	COIC	7-009		
None		leica.G	FR 087-029					Pound	is		
			MUNITION P		DEDED WA	CONTRACT NO					
							11 Subc				
		ID 14 MID 45	Market Street, September 1985.	PROS N	TROCELLULO	ISE MANAGE	A. 18. 18. 18.	1.4.		d Myster	Committee of
							MATERIAL DISTANCE				4941-61
B95089;	95091;	95092				يب سه 🗌	44 1		- BOLL		
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	DISTRUBIT		PEACENT	TOLTE AND	T MEASUR	D . W	TTS	_	POEML		ACTUAL
	IOCELLOLOSE N/A				50.64	WEAT		cc 40'		c 60'+	
BITEOSI			N/A	N/A	11.45	10 1986		_	<u>vf 1 1</u>	3.8	I Hr
	ELTEOL DI	BITRATE	R/A	N/A	19.24		PEOPELANT	_			y1 349
ARARBIT			N/A_	N/A	0.71	-TALIAN	<u></u>		1.8 8g /		247
MACHESIO			N/A	N/A	0.05						163
RDY	CRAPHITE N/A N/A					- 808	el/em	-+	N/A		103
. 	TOTAL		N/A	N/A	17.78	400 0	HSITY ./	_	N/A	• • •	.61
Moistur		<u></u>	N/A	N/A	0.20	-		-	N/A_		
Ash			N/A	R/A	0.09						
Methyle	ne Cl Sol	nb111t3		N/A	31-40						
								$\Box \Box$			
							· · · · · · · · · · · · · · · · · · ·				
			l								
1900 (100 100 100 100 100 100 100 100 100	800880000 : C1	LOSED BO		A With a standard	PRO	PELLANT B	IMEHSID	NS	inche	8	A
1	LOT NUMB	TE TEMP	· RQ	SPY INS	<u> </u>	·				of Maga	V. 00 %
76.57		-40		101.69	PARAMETER	PIONCATION	911	_	DHED.	SPIC .	ACTUAL
			92.47	103.43	UNE IN ILL	N/A	2.10		33	N/A	N/A
		+14	5 96.81	104.75	PERF. DA. (4)	N/A	700	_	90	P/A	
STANDARD	5-231	+90	100.00	190 002	Web Ave.	N/A	.023	- -0;	7	BA1	u
					Outor	N/A	075			ACKED 1	/87
			test used		Middle	N/A	108		36	AMPUD]	/87
in the 82	27 form f	ired ag	ainst the	827	Inner	N/A	115	1.10	737	EST PORTUGE	907
standard.	. 700cc	pomp At	th 0.1 ga/	cc	Web Diff	~ N/A	N/A	7.9	5 F	MITTED T	/6/
loading d	leasity.		_	•	,		3.00	_		CECEIPTION	Total Park
	•	_	•		L:D	N/A		_		OL AVEDE	· · · · ·
			907010	Reserve	D:d	N/A	30.63	178	71		
	XING CONTAIN	Cart	on 327310	PALLIE	- DER 32/0	71, 8000					
MARKE	4-1411-			- 1bd.a.							
			used as		mit enting	extrusion	and m	By De	e pres	sent in	the
P.	- Abertegi	. ID TYS	ice amount	•					•		
ستربس سيسي											
SIGNATURE O					110	Higund					
12 W	1 ch	les	than		11/10	HE CHE D	V				

APPENM FORM 214 P 10 AUG 77

Honeywell MADFOI		ca GFR	Perf St 1.				PALED AMOU	HCL87	C010-C	10		
Honeywell			DB7- 029				ACTO ANON					
RADFOI			116.7			- 1		34	ounds			
		v ammii	MITIRE D		05020	VA	Sulleact num			- 0000		
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		140 4D44		A STATE OF THE STA	KOCELI	TI 02			EI STAR			0341%
95089; 9509	1 . 050	02					MAI	_	163.3			a a
193069; 9309	1; 930	74						sl		MOLL -		
							Avo 13.	10	424		0+	
TENTAVISTI]				LOSON	
11.54	88303			CTURE OF	ZBFAE	HILES	S PROPELL	111-36-4	May 1.11.		0	DESE
210 215		Blendi	ne ential R	277422							<u> </u>	141
45 155			ed Roll									Ŀ
.50 160		Extrus	ion - Ca	rpet Rol	1							-
45 155			ion - Di	2						-+:	• •	 -
10 110		Anneal	ing							- 2	40	 -
		1.0	7070 8	FINISHE	0 0000	ELL AN	Publication and the	STA	ANITY AND	PHTRICAL	PLSTS	
PROPELLANT COM		- 1900		PINIO ITE		ECINI ASURID				DEMULA	~	KTUAL
11111111111111111111111111111111111111			Pracini SOSMULA N/A	N/A		.64	WEAT WEAT	·		40'	_	601
BITEOCLYCERIN			N/A	N/A		.45	BO FONES			1 Hr	NF	1 H
TRILLERE ELIC	L BIBITE	ATE	N/A	N/A		.24	FORM OF PI	OPELANT			Су	
AKARDIT II			N/A	N/A		<u>.71 </u>	.AVIIVE			8g/00 c stillo	.3	49
ASHESIUM OZIU BRAPHITE	<u> </u>		N/A N/A	N/A N/A		.05 .05	108	1/		R/A	111	<u>63</u>
BDX			W/A	W/A		.78	1	1/4		VA		
	STAL				100	.00	ABS DEI	SITT ./c	ناء	1/A	1.	61
pisture		- +	N/A	N/A		.20_	 		—		┼	
sh ethylene Cl	Calmbd	140	N/A	N/A N/A		.09 .40	 		_+-		+-	
ELITABLE CI	SULUBI				1		1				1	
	•										1_	
	50.00	(<u> </u>	<u> </u>	جيلح	DDAR	ELLANT DI	AL NEIO	18	eka et	1_	
	mwets 	I BMP "F	RQ	SESCE SELECTIVE	1 St. 1 1 1 1 1	TRUP	ELLANT DI	ומולחזא	43 10		DIV.	# X
		1-40		101.69	PARAME	TER	PEOPICATION	-	PONTEN	D 71	_	LACT
		+90	92.47	103.43	LING IN IL		N/A	1.60	1.61			N/
		+145	96.81	104.25	PIEI. DIA		N/A	.700	.690	<u> </u>	4	
NDARD 5-231		+90	100.00	100 00%	Web Av		N/A	.099	097	_	BATE	
		•			Outer		N/A	.075	1.104		9 1/	
the 827 for			st used		Middle Inner		N/A	_108 _115	.103	715	17	87
indard. 700	ce bon	b with	0.1 ga/	cc							17	<u>87</u>
ding densit			_		Heb Di			N/A 2.29	7.95 2.33	DIVI	PTON	44
•			•	•	L:D		N/A			- POLY	ALDED	
		<u> </u>	227210	Berrie	nu:a	27041	: Wood M	1 30 . 4 3 32 32 7 3	11			
TYPE OF PACKING CO				Barrie	D:d Bag 3	27041	N/A N/A ; Wood Bo	30.43 x 3273	28.2	1000		

ABRCOM FORM 214 B 10 AUG 77

INVILL	LAI	11 063	UNIFI	IUN SAL					سيد		
	9 Pe	rf Stick			DA 101 MIN		870 01	0-011	l		
KILLIA					PACETE WA	62					
Moneyorll Multica					CONTRACT IN		Pou	nds			
RADFORD ARMY	MM	DRITION P	LANT, RA	DFORB, VA.		rell Sub	conti	rect	93207	7	
ACEPTO LINE	-	SEES * ' ' ' ' '	(N)	TROCELLULD	SE MANN.	11. 14. 11.	vý. Ni	•	••		
					MINOOP	COMBNI			-	W11 (1368 %
195089; 95091; 95092					- A41	١	***	— 884 J.C			0.04
					-	۱۱ سیب			1		
					□~~ -≟	3.10	424		30		
ALCOUNT ILLIams Parties		N. 42 b = 40 = A							En	W OCK	
	i dita	MARSA	CIUAL O	ZOLAEMITE	SS PROP	LLAYI	e jare ee	·			IKONE
	end 1	ential R	-114						30		140
		eed Roll							1 -		•
50 160 Ex		ion - Ca		.1							-
45 155 Ex	Tus	ion - Di	t						IE		-
10 110 An	neal	ing							24	0	•
		•									
PROPELLANT COMPOSITION	Sec.			D PROPELLA		\$74	ABILITY	AND PHI	PCAL T	LSTS	التواجع المسرد
COMSTRUBLE	1	Pracini	TOLTEANC	T MEASURY	1	rs13	$\Box L$	FORM	VLA.		TUAL
RITEOCELLOLOSE	\perp	N/A	R/A	50.64	MEAT	•		cc 40	•		60'+
RICIATIONETIA		N/A	R/A	11.45	88 781	_	_	NF 1	Hr_		1 Hr
THYLENE GLYCOL DINITRATI	4	N/A	N/A	19.24		PROPELANT		1 4 4-		Cyl	
ACRESION OXIDE	+	N/A N/A	N/A N/A	0.71	*TALIA	<u> </u>		1.8 Bg			
SBAPUITE		N/A	N/A	0.05	100	cal/gm		N/A		110	3
ROX	1	N/A	N/A	17.78		CE1/18	一十				· ·
TOTAL				100.00	ABS	ENSITY . /	<u></u>	N/A		1.6	1
isture		N/A	N/A	0.20							
ih .	-	N/A	N/A	0.09							
thylene Cl Solubili	-43	N/A	N/A_	31.40							
							-+				
	\neg	•				····	_				
CLOSED	BOM	6	fyfiger (e.g.)	PRO	PELLANT	DIMENSIO	NS .	inch			
	MP *1		SFFFIAN						of Mo	₽ D. =	o X
	40		101.69	PARAMETER	PHOPICARO			240	29.65		ACTUAL
	90 145	92.47	103.43	DAMENT (D)	N/A N/A	4.75		28 86			L93
	142	70-51	104.75	PERF. BOA. (d)	N/A	1.023		21 -			
MDAED 5-731 +	90.	100.00	W0 00%	Web Ave	N/A	.099	_	97 -	. 177	,	
The closed bom		ar word	28-20	Outer Middle	N/A N/A	1.074			ACEED		
the 827 form fired				Inner	N/A	.107	_	00	AMPLE	1/1	37
ndard. 700cc bomb							_	<u> </u>	LST POOL	178	37
ding density.				Heb Diff	N/A	N/A_	43.	34	ONED		
				LiD	N/A		6.	.97	COLVAIN	10× 1	meets.
المدارية والمدار الأاليات المتارية والمتارية والمتارية والمتارة والمتارية والمتارية والمتارية والمتارية والمتار				D:d	N/A	130.43					
	rtop	327049 ;	Barrier	Bes 327202	, wood	sox 327	088				
Candelilla wax propellant in t				ent during	ext:rusio	n end m	ıy be	pre	sent	in (the

ABRCOM FORM 914 P 18 AUG 77

PENENT						b 1				. 11	
	2R-20	19 Pa	rf Stick			94 th semen		010-012			
						-	11				
240 41	well Mule					CONTRACT OUR		Pounds			
TT- I	LADFORD ARM	IA YMMI	INITION P	lant, Ra	DFORD, VA.	gone we		ontract	93207	77	
Y			* (23)		TRACFLABLE						
						ATTROOP S		E1 5148CH			13417
895089:	95091; 950	092				mar 13.		m1.0			24
		·		······································		- 11.	07		_)		
							10	434	<u>.] _20</u>	<u>+</u>	_~
TRACTE	70C 110									NOON	=
7150				CHED	20TAENLE	IS PABPELL	AVI	the representation of		14.1	IKO
210	215	Mendi	ential R	. 114					- 20		निया
145	155		eed Roll						 -		•
150	160		ion - Ca		.1				7-		-
145	155		ion - Di	_					1-		H
10	110	Anneal	ing						24	0	•
			•						\perp		
PROPELLA	MT COMPOSITION	Sec. 10			D PROPELLA		STAI	MA TTU	TECAL T	MSTS.	
α	CHETRUBIT	1	PINCINI	TOLISANO	Pidcin Measur	D . W.S.	15	101			CTVAL
BITEOCE			N/A_	N/A	50.64	MEAT	•	cc 40)'		60'
BITESELT			<u> </u>	N/A	11.45	so tants		NF 1	Hr		I H
AEARBIT	ELTCOL BINITI	IATE	N/A N/A	N/A	19.24	PORM OF PE	107BLANT	E1.8 8		Cy.	
ABBESIES			N/A	N/A	0.05	1021001		21000 2			•
SBAPE			N/A	N/A	0.05	388	1/gm	N/A		110	53
RDX			N/A	N/A	17.78						
	TOTAL				100.00	ADS DET	SITY e/c		$\left[\cdot \right]$	1.0	51
<u>oisture</u>	<u> </u>	 -	_N/A	N/A	0.20						
sh ethylen	ne Cl Solub	,,,,	N/A N/A	N/A N/A	31.40					-	
	NA SULLI		1//A		-1-31-411						
		1							· ·		
	CLOS			BLATIVE	same PRO	PELLANT DI	MENSION	S linci		DIV.	
	LOT NUMBER	15MP -9		1000	PARAMETER	PEOFICATION	T am		-9! M.y.	<u></u> 0	***
, ,		1+90		101.69		N/A_	2.70	2.71	N/		I N/
		+145	96.81	104.25	DIAMITTE (D)	N/A	.700	-686	_ 11/	A	1.93
			96.81		PIRE BIA. (d)			.686 .021		PV 157	
	S-231		96.81		PRI. BA. (d) Web Ave.	N/A N/A	.700 .023 .099	.021		DATE	
MDARD		+145	96.81	200 001	PIRE BIA. (d)	N/A N/A	.700 .023	.021	PACEED	9ATU	B7
MDARD (S-231 The closed to fire	+145 +90 comb te	96.81 100.00 st used	100 00% 2R-20	DIAMETER (D) PREF. DIA (d) Web Ave. Curer	N/A N/A N/A	.700 .023 .099	.021 .097 .090	PACKED	1/0 1/0	B7
the 82	he closed to 7 form fire 700cc box	+145 +90 comb te	100.00 st used	100 00% 2R-20 827	DAMENTO DO) PRES DA (d) Web Ave. Outer Middle Inner	N/A N/A N/A N/A N/A	.700 .023 .099 .074 .107	.021 .097 .090 .100	PACEED SAMPLE TEST POL	1/1 1/1 1/1 1/1	B7
the 823	he closed to 7 form fire	+145 +90 comb te	100.00 st used	90 60% 2R-20 827 cc	DAMNITH ID) PRI BA MI Web Ave. Outer Middle Inner Web Diff	N/A N/A N/A N/A N/A	.700 .023 .099 .074 .107 .116	.021 .097 .090 .100 .102	PACKED SAMPLE TEST PAR OFFEED	1/1 1/1 1/1 1/1	B7 B7 B7
the 82	he closed to 7 form fire 700cc box	+145 +90 comb te	100.00 st used	90 60% 2R-20 827 cc	DAMENTO DO) PRES DA (d) Web Ave. Outer Middle Inner	N/A N/A N/A N/A N/A	.700 .023 .099 .074 .107 .116 N/A 3.86	.021 .097 .090 .100 .102	PACEED SAMPLE TEST POL	1/1 0 1/1 1/1 1/1 1/1	B7 B7 B7

	1 110	6667		VIIII 11	011 01161) 1			TITI		
COMPOUN	2R-20	14 P	erf Stick			04 (Ø) m/m46	RCL	87 <u>C310-</u> 0	113		
PENEATI	>					-					
			R 087- 029			CONTRACT UNIT		Pounds			
1	LADFORD A	BRA YMN	IUNITION P	LANT, RAI	DFDRD, VA.	Moneyve		ontract	93207	77	
M 15					ROCELLULD				_		
				7,0		MATERIAL C		E STARCE	_		34876
B95089	95091;	95092				- AAE		m).o			meg.
											_ mag
							10 8	434		<u> </u>	wart
										NO SE	
1136	10			CTURE OF	ZBTAENLIF	SS PROPEL	LANT	Secretaria de la compansión de la compan		14 1	HK-M-
210		Blend							20		140
145	215 155		rential R						-		-
150	160		sion Ca		1						-
145	155		sion - Di						 -		_
110	110	Annes		<u> </u>					24	0	-
er o Ptiu	MI COMPOST	Co. 10000	O STEET .	FINISHE	O PROPELLA	NT-MARCHANIS.	STA	-	MTBCAL	ners.	
	CONSTRUCT		Pricini	TOLTE AND		. 70	71	100	MULA		CTUAL
BITEOE	LLULOSE		N/A	N/A	50.64	MAT		cc 4	0'	CC	60'+
BITEOG	TEERIR		N/A	N/A	11.45	as font:		NF 1	Hr		1 Hr
	E CLICAL BI	BITEATE	N/A	N/A	19.24		COPELANT			Cy.	
ARARBIT			N/A	N/A	0.71	. TALIANI		E1.8 8		.3	17
BARNESH			N/A	<u> </u>	0.05	1 885 6	-1/	510 90 1		11	<u> </u>
RDX	116		N/A N/A	N/A	17.78	- -c	al/FR		Δ		
•	TOTAL				100.00	ABS DE	HSITT ./	·c 11/	Α .	1.	61
Moistur	٠		N/A	N/A	0.20						
Ash			N/A	N/A	0.09						
Kethyle	ne Cl Sol	ubility	N/A	N/A_	37.40					 	
				 	-+:					 	
				}	_				• .	1	
**************************************	CI	OSED BOI	MB		PRO	PELLANT DI	MENSID	VS - Inc	hes		•
	LOT NUMB			ALL ATIVE	1				1	Div.	0 X
n si		1-40	90.97	101.69	PARAMETER	SPECIFICATION	Out	Parish(D)	9996		ACTUAL
		+40	92.47	103.43	ENSTH (L)	N/A	1 2,10	12.13	1 11/		1 N/A
		+145	96.81	104.25	PIEF. DA. (d)	N/A	.700	.686	 "		<u> 1.93 </u>
TANDAED	5-231	+90	100.00	100 007	Web Ave.	R/A	.099	.097	1	BAR	
					Outer	N/A	.074	.090	PACETTE		
	The close	d bomb t	est used	ZX-ZU	Middle Inner	N/A N/A	.107	.100	MAPLE		
			inst the				1.110	1:102	141 00	"17	87
	. /UUCC	DOME WIT	" A.T Pm		Web Diff	- N/A	N/A	5.34	Onne	•	
-eams	-4454LJ•			•	L:D	N/A	3.00	3.10	POLY	TION .	MIII.
				ا سیسی سیسی	D:d	N/A	30.43				
TIPE OF PA	DHO CONTAIN	Carto	327049 a	Barrie	BAS 32720	2; Wood B	ox 327	880			
			used as a		ent during	extrusion	and m	y be pr	esent	1n	the
MONATURE (o Develor	ment, En	gineer			1:0	11	· · · · · · · · · · · · · · · · · · ·			
10 11	sh l	tu				WE	HIEN	CESO			

APPENU FORM 214 P 18 AUG 77

20-21 19 Perf Stick			PELLA	NI DES	UNIT	ON SHE				AM	_لا	
PACED ACRES PACED ARMY AMMUNITION PLANT, RABFORD, VA. Converge to the pace of the pa	Composit		19 Pe	rf Stick			94 (Ø) mmaa	HCL87	010-01	4		
### ABFORD ARMY AMMONITION PLANT, RAFFORD, VA.		>			_		-					
### RAPPERS ARMY ANNUALTION PLANT, RAPPED, VA. Bioneywell Subcontract 932077 ACCOMP to two separated of the contract Subcontract Subc							CONTRACT NAME		rounds			
STOREST STOR		ladford a	emy amm	UKITION P	LANT, BAI	DFBED, VA.			ntract	93207	77	
	<u> </u>	ACD!	D & log Miles	100 TO	are all	POCELLULD	SE. WARM WE	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	4. 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	w ′ ;		. NA.
STATE STAT										24	477	الكراج
	895089	95(91;	95092				مدرائ	" • [-		<u></u>		~~
									AMM	4 30		An
MANUFACTURE OF SOLVERTIESS PROPELLANT DESCRIPTION DE								** -* _		4 		M.O
10 215 Differential Bolling	TEAU	TAP. W	tilis i de disc.	S-MAMMEA	7110E M	CALVESTA.	113886E 227	2 W 7 2 a 2	e Maria			2
10 715 Differential Politics 145 155 Evenspeed Rolling		 " 			DIONE OF	DOLICATOR	TO LABIET	NAT TO SE		1 20		1
10 10 Extrusion - Carpet Roll - -	10				11122							141
150 110 Annealing 240 -			Evens	seed Roll	ing					4-		<u> </u>
10 110 Annealing						<u>1</u>				 		-
PROPELLANT COMPOSITION					<u>e </u>					+=		
STATE STAT	.10	110	Annes	ing						-124	٧	<u> </u>
COMSTRUMENT COUNTY COUNT		<u> </u>		TICTE A	e enviewe	0 00005114	M7	CAN	AND D	TECAL I	ESTS	
SITE SELECTION			OH ****									CTUAL CO
### STYPESTEEN N/A N/A N/A 11.45 80 FEETS NF 1 Br NF 1 #### STYPESTEEN STYPESTEEN N/A N/A N/A 19.24 FORM OF PROPELANT C.y.1 ##### STYPESTEEN STYPESTEEN N/A N/A N/A 0.71 "TALIANI E1.8 N/B 3.349 #### STYPESTEEN N/A N/A N/A 0.05 806 cal/cm N/A 1163 #### BEAPHITE N/A N/A N/A 0.05 806 cal/cm N/A 1163 #### TOTAL N/A N/A 0.00 885 BESSITY C.C. W/A 1.61 #### STYPESTEEN N/A N/A N/A 0.20 0.09 ##### STYPESTEEN N/A N/A N/A 0.09 0.09 ##### STYPESTEEN N/A N/A N/A 0.00 0.666 N/A 0.00 ##### STYPESTEEN N/A N/A 0.00 0.666 N/A 0.00 ##### STYPESTEEN N/A 0.00 0.00 0.00 #### STYPESTEEN N/A 0.00 0.00 0.00 #### STYPESTEEN N/A 0.00 0.00 0.00 #### STYPESTEEN N/A 0.00 0.00 ### STYPESTEEN N/A								3				
### PROPELLANT DIMENSIONS												
STATEST N/A N/A N/A 0.71 TALIANI E1.8 81/mm 349			BITRATE I	بسرو مسجوب					- 		Cy.	1
### BEAPBITE N/A N/A 0.05 BBE cal/gr N/A 1163 ##################################							*TALIANI				.3	49
### ### ##############################				N/A							1	
TOTAL N/A		RITE						1/22_			111	20
N/A N/A 0.20	RDX_	TATAL		_B/A	 		ARS BEI	RITY - / -	-		1.	61
### PACENS CONTARM CATTON 327049; Barrier Bag 327202; Wood Box 327088	oistur		· · ·	W/A	N/A							
LOT NUMBER TEMP ** RQ SELECTIVE SPROPELLANT DIMENSIONS "FIRCHES] LOT NUMBER TEMP ** RQ SELECTIVE SPROPELLANT DIMENSIONS "FIRCHES] 1 - 40 90 97 101 69 PARABETES SPROPICATION DEL PROPELLANT DIMENSIONS SPEC ACT 490 92.47 103.43 UDGRO (U) N/A 1.60 1.61 N/A N/A 4145 96.81 104.25 DAMETTE DI N/A .023 .021 AMPDARD S-231 490 100.00 UDGRO (U) N/A .023 .021 DAMES AMPDARD S-231 490 100.00 UDGRO (U) N/A .074 .099 .097 MARKS The closed bomb test used 2R-20 N/A .074 .090 .097 Chitery N/A .107 .100 NAMPLED 1/87 Chitery N/A .107 .100 NAMPLED 1/87 Chitery N/A .107 .100 NAMPLED 1/87 Chitery N/A .116 .102 TEST PROMISSION Chitery N/A .107 .100 NAMPLED 1/87 Chitery N/A .107 .100 .100 .100 .100 .100 .100 .100 .100 .100 .100 .100 .100 .100 .100 .100 .100						0.09						
LOT NUMBER TEMP ** RO	ethyle	ne Cl Sol	ubility	N/A	N/A	31.40			4			
LOT NUMBER TEMP ** RO					 						 	
LOT NUMBER TEMP ** RO					 							
LOT NUMBER TEMP ** RO	** **********************************	ale ale : : C1	OSED BON	B	State of the state	PRO	PELLANT DI	MENSION	Sinci	163		
1-40 90 97 101 69 PARAMETER PROFICATION SHE PROFICE ACT 490 92.47 103.43 UPGTH ILL W/A 1.60 1.61 W/A N 4145 96.81 104.25 PARAMETER W/A .700 .686 W/A .99 100.00 We 607. Web Ave. N/A .099 .097 100.00 We 607. Web Ave. N/A .099 .097 100.00 We 607. Web Ave. N/A .074 .090 .090 100.00 We 607. Web Ave. N/A .107 .100 SAMPLED 1/87 100.00 Web 27 SAMPLED 1/87 100.00 Web 27 SAMPLED 1/87 100.00 Web 2.29 2.35 SAMPLED 1/87 100.00 W/A 30.43 32.15 100.00 W/A 30.43 32.15 100.00 W/A 30.43 32.15 100.00 Web 2.29 2.35 SAMPLED 2.29 2.35 100.00 W/A 30.43 32.15 100.00 W/A 30.43 32.15 100.00 W/A 30.43 32.15 100.00 W/A 30.43 32.15 100.00 Web 2.29 2.35 Web 2.29 2.35 100.00 W/A 30.43 32.15 100.00 W/A 30.43					I SESSE							
#145 96.81 104.25 PARTITE ON N/A .700 .686 N/A L9: PRIV. DEL 601 N/A .023 .021 DATES PRIV. DEL 601 N/A .099 .097			1-40	90.97	101.69	PARAMETER	PIONCARON	94	FINISHED	17K		ACT
PRF. BA. 60 N/A .023 .021 BATES				92.47	103.43	Men in						N/
MARKS The closed bomb test used 2R-20 the 827 form fired against the 827 Inner N/A .107 .100 sample 1/87 inderd. 700cc bomb with 0.1 gm/cc ading density. Web Diff N/A 1.16 .102 Test Position Solid Position Pos			+145	1-96-87	106.75	701. DA. 101				 "		
The closed bomb test used 2R-20 the 827 form fired against the 827 inner N/A .107 .100 inmfled 1/87 inner N/A .116 .102 infled N/A .116 .102 infled N/A .116 .102 infled N/A .116 infled N	MDARD	S-231	+90	100.00	100 00%	Web Ave.				j		
the 827 form fired against the 827 Inner N/A .116 .102 TEST NOUSHED AND ADDRESS OF THE PACCING CONTAINS CATTON 327049; Barrier Bag 327202; Wood Box 327088												
Heb Diff N/A 5.34 OFFIED L:D N/A 2.29 2.35 D:d N/A 30.43 32.15 PH OF PACCING CONTAINS CATTON 327049; Barrier Bag 327202; Wood Box 327088		ine close	d pomp to	inet the	827					1000	9 1 /	8/
The page of the pa	inderd.	. 700cc	bomb wit	h 0.1 gm/	/cc							87
D:d N/A 30.43 32.15 THE OF PACIFIC CONTARMS CARLOS 327049; Barrier Bag 327202; Wood Box 327088						Hep Ditt		7				C-184
PAGENIA CONTAINE CATTON 327049; Barrier Bag 327202; Wood Box 327088		•								i lotav	1910	BALLS .
										<u> </u>		
Candelilla wax is used as a lubricant during extrusion and may be present in the propellant in trace amounts.	C	andelille	vax 1s	used as	a lubric					esent	in	the

APREDM FORM 314 R 10 AUG 77

		JPEL	LAI	II DES	UNIT I	Ľ	11 3116	_				• • •	AL 224	. 11	
COMPOU		20 Car	pet	Roll					A LET SOUTHARD	RCL	3730	10-01	5		
PEHEAT					·			7	KEED PROM	55	Pour	nds			
MO AT	evell M	ltica	GFR	087-04				Ta	MISACI MUM						
	RADFORD /	LRMY	AMMU	HIIION P	LAKI, KA	Dt.	OKB, VA.	丄	Honeyvel	1 Sub					
35 A. 180			-	1865 × 19 12 12 12 12 12 12 12 12 12 12 12 12 12	Signal MI	TR	ocellul d	SE	STATE OF STATE	12: 4: 26	**	Strain of	14 311	38.65	
									MULTINOON CE			10 MIS	24	MALE O	M.C
B 950	88, 95059	9, 950	60								-	AN	<u>. </u>		_ 886
								႕	ave _13.	<u>, </u>	-7.5		1 30	+	WAIT
								_		- جند	1	~	4-	390×	
NATE OF	AVUELL	Addition 1	\$::	MANUFA	CTURE D	3	BLYENTL	E Z S	PROPELL	ANT	93 .7 90	www.j.j.j.	-	L TIL	IKONO
•	-	BI	endi	กด									20		
210	215			ential		_							-		
145	155			eed Roll		,							+-		-
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						_							I		
ROM	WI COMPOST	1011	. Agricon por	TESTS 0	f finishs	0 1	PROPELLA	IN	Sale Sections	81	ABUT	T AND P	ITSCAL S	RETTS	
	ONSTRUBIT			Piacini POPMULA	TOLTEAM		PEACEN MEASUR		Wil	3		101	AULA		TUAL
	LLULUSE			N/A	N/A		42.70		MEAT			cc 40		L	60'+
BITEOSI			}-	<u> </u>	N/A		13.1		BE FRMES			NF 1	Hr	NF	1 Hr
BARARE	E GLYCOL BI	BITEAT	4	N/A	N/A	_	23.10		*TALIANI			Z1.0 0	/00	├	
BASEESIE			+	N/A N/A	N/A		0.0	-	140.14			siese s		\vdash	*
BRAPI			_	N/A	N/A		0.0	5	300	1/20		11/		11	66
RDX				1/4	LY/A		20.30								
	TOTAL		-			_	100.00	<u> </u>	Form of	snr.	ce	<u> </u>		1.6	
loistur Ash	<u> </u>	-	+	N/A N/A	N/A		0.10	5	LOLM OI	Prop.		├─		Car	pet R
1311			+	_ N/ N	- P/A	_		_	*Did no	Teac	h 1	0 ==		1	
					<u> </u>							<u> </u>		<u> </u>	
alasta da la cara	8. 8. C	BEED	BON	6	ــــــــــــــــــــــــــــــــــــــ	1	DD:	n a l	LLANT DI	et utie	NE	··· 1106		<u> </u>	
4	LOT NUMB		IMP "F		I STATION	╁	- 781	J P L	LLANI UII	164917	н3_	THE	3.8	515	- 1
g I				1102.99		,	ABAMETER		PEGREATION	94	1,	MISH D	SPEC		ACTUA
		- 1+	90	118.06	106.86			I	N/A	N/A	工	4	N/		1/¥
			145	121.83	106.92		EF. DIA (d)	_	N/A	N/A N/A	_	N/A	_×/		N/A
ANDARD	PE-472-13	8	.90	100.00	100 007	۲		-	W/A	10/4	+	·/ Λ		BATE	5
						F					丰		PACKEE		
Close	d bomb wa	s sho	t us	ing carp	et roll	⊦		-		-	+		MAPL		
	nto strip against				90")	H		_			十		161 10		
700 c	c pomp na	ine o	27 B	em/cc 1	oading	L		<u> </u>		}	+		ONTE		
densi				6-,			<u>:p</u>		M/A	N/A	4	1	DIKE	1949	M4473
						D	: d	Ш	N/A	N/A		N/A	L		
	ZMG COMTAR	- 1	VPT	Pack Car											
MARKE C	andelilla	VAT	1= +	sed as	a lubric	an!	t d urine	2 5	ktrusion	and =	uy 1	be pre	tsent	in	the
	ropellant							, ~		E	y '				
•	-														
						_									
	Develo	pent	Eng	ineer	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			_	, 1		1	[]			
_, <i>y</i>	Develop	yest	w	-					4)	1	H	211		2	
w. K1	rkpatrick	<u></u> -							11/	\sim	//	72			

Application of the second	OPELLA				HEET						T PARA 7-28 AR 335-1
OMPOSITION: I	ROPELLANT JA	-2 19-PERF	HEX GRANULA	Ř			LOT NUMB	ER: RAC-P	D-090-1		
PECIFICATION:							PACKES A	MOUNT: 75.	5 pounds		
IANUFACTURES: F	RASFORS ARMY	NC:T:NUM	PLANT, RADE	ORS. VIRGIN	NIA 24141	-	CONTRACT	NUMBER:	DAAA09-91-2	-000:	
				112.0	POCELLUL	CER					
	ACCEPTED BLEN	NUMBERS		NIT	ROGEN CONTI	ENT		STARCH (5.5°C)		STABIL 134.5	
B 95539. BB 95	540. BB95541			H	IAX <u>13.17 N</u>		45.	MINS		30.	MINS
				H	IN 13.06		45-	MINS		30	MINS
					WG 11.13		45-	MINS		30-	MINS
									EXPLO	SION HRS	
			MANGE	ACERTS OF	507.VD00	200 1	ROPELLANT				
			# Chos		CESS - DR		HOLD CHICKLE	-			#6. ***
TEMPERAT		<u> </u>		PR	OCESS - DR	1110				TIM	
PROM	70								DA DA	15	HOURS
145	155		OLL AT EXTRU	2104							
160	170	EXTRUSIO	N DIE								
105	115	ANNEAL									
		<u></u>									
	eir of a			THET OF P	IMI SEED 1	PROPEL	Lant	, 59 s	, ·		
	PRCI	PELLANT CO	MPOSITION				s	TABILITY A	ND PHYSICAL	TESTS	
		Perce		rcent	Percent				Fa1		A
Const 1		Formu		erance	Measured 58.89		Tests		NCC 60		Actual CC 60'+
itrocellulose		59.5		2.00					<u> </u>		
itroglycerin		14.9		1.00	15.54	No fi	Thes		NF 60		NF 6C
Disthylene gly	col dinitrate			1.50	24.78	 			 _		
Akardit II		0.7		0.20	0.71	4					
tagnesium oxid	•	0.0		0.02	0.03		(cal/g)		1120 No		1115
Graphite		0.0	-	0.02	0.05	Abso	lute density	, g/cc	1.56 m	n .	1.56
Total		100.0	00		100.00						
Moisture conte	nt	0.9	ž	0.3	0.3	Form			hexagon	al	hexagonal
Ash content		3.3	М	vx	0.1	Numb	er of perfs		19		19
Methylene chic	ride solubles	40.	1	3.0	41.4				<u> </u>		
						1					
	cro	SED BOMB					PROPELLA	T DENGE	IGNS (INC	M\$ }	
			Relative	Relative	ar Edinary,				Merchanism 1	Unifo	emity by
Lot No	mber	Temp °F	Quickness	Force	-				_	SPEC	ACTUA
PD-090-1		+90	82.7	99.9		-	SPEC .	DIE	0.736	6.25 MA	
المستقال المستورين					LENGTH (0.75 NOM	0.024			
			Ļ	 	O.D. (1n		0.789 NOM	0.834	0.811	6.25 KA	ل
				1	PERF (10		0.527 NOM	0.026	0.026	ļ	Dat as
STD-71136		<u> </u>	100.00	100.00	WEB (avg		0.109 NOM		0.113		Dates
			<u> </u>		WEB (in		INFC		0.120	PACKED	
	ED IN A 700 CO	C BOMB AT	0.20 G/CC LC	ADING	WEB (mic		INFO		0.111	SAMPLED	
JEN:					WEB (OU	er)	INFO		0.108		NISHED 12-
					L/D		INFO		0.908	CFFERED	
					D/d		INFO		30.69	PORWARD	tion sheet ed
					WEB (d)		15 MAX	<u> </u>	4.04	<u> </u>	
							-C FIBER DR				
		REMA	RKS: THIS D	RUM CONTAIL	NED NET PRO	PELLAN	T WEIGHT OF	75.5 POUND	s		
			THIS	S LOT MEETS	SPECIFICA	TION R	QUIREMENTS				
						20.00.0	OVERNMENT QU	131 755 3001	IDANCE BEDDE		
SIGNATURE OF	CONTRACTOR'S	REPRESENTA	TIVE		SIGNATU	RE OF U	CASIMINEM A	WETTE WOO	NAME REFRE	PENINITAE	

				TION S	HEET.					IPT PARA T- AR 335-
CMPOSITION: F	ROPELLANT JAX	(-1 19-PER	F HEX GRANG	JLAR		LOT NUME	BER: RAE-	PE-095-2		
PECIFICATION.						PACKED	UMCUNT: 92.	5 pounds		
ANUFACTURED: R	ACFORD ARMY A	MMUNITION	PLANT. RA	OFCRS. VIRGI	NIA 34141	CONTRACT	NUMBER:	DAAA39-91-2-	2001	
				MIT	POCELLULO					
	CCEPTED BLENS	NUMBERS		NIT	ROGEN CONTEN		STARCH		STAB:	LITY Seci
8 95539. BB955	40, BB95541			- - ,	(AX 13.178	45	· MINS		30+	HINS
					IN 13.06	45	- HINS		30	HINS
					VG 13.13		- HINS			NINS
				_				EXPLO	SION HRS	,
			MAN	2200002		ISE PROPELIANT				
TEMPERATU	me ar	 	*U		OCESS - DRY			i i en legit		
FROM	70 TO	 			OCESS - DRT	ING		DA	TI.	HOURS
145	155	CARRET R	CLL AT EXT	MISTON					``	HOURS
160	170	EXTRUS:0							-+	
105	115	ANNEAL								
		 								
		l		7747 OF 4	THE PROPERTY OF	COPPLIABIT	a san a an in	L		an indicata socies i
		ELLANT CO						ND PHYSICAL	28873555	**************************************
		Perce		ercent	Percent			1		
Consti	tuent	Formu		lerance	Heasured	Tests		Formula		Actual
trocellulose		55.3	3	NON .	55.73	Heat test 6 120°	С	NCC 60		CC 60.+
itroglycerin		13.8	16	VOH.	14.25	No fumes		NF 60'		NF 60'
ethylene glyd	ol dinitrate	23.0	6 1	ION.	22.72					
рж		7.0	10 I	NOH.	6.42					
kardıt II		3.6	i5 I	NOM.	0.74	HOE (cal/g)		Info		1131
sauesinw oxig		0.0)5	NOM.	0.06	Absolute density	, g/cc	Info		1.59
raphite		0.0		NOM.	0.08					
Total		100.0			100.00	Form	···	hexagon	1	hexagonal
ash content		0.3		NOM	0.1	Number of perfs		19		19
ethylene chlo		40.4		NOM	42.2			 		
oisture conte		0.9		NOM	0.3					000000000000000000000000000000000000000
ya i walio ya s		EO BOILE	I			PROPERTY				tomics la
Lot Nu	mber	Temp °F	Relative Quickness				•		9:47	
AD-PD-090-2		+90	81.6	101.1		57 6 C	DEE	TIPLEMED.) (C.78)
					LENGTH (1)	n.) 0.75 MOM		0.746		4.4
					O.D. lin.	0.789 NOM	0.834	0.809 -	*****	0.6
					PERF (in.	0.027 NOM	0.026	0.026	*****	70.0
TD-71136			100.00	100.00	WEB (avg)	0.109 NOM		0.114		Dates
					WEB (inne	r) INFO		0.123		11-92
EMARKS: FIRE	D IN A 700 CC	BOMB AT	0.20 G/CC I	LOADING	WEB imidd			0.111		D 11-92
₽5M3					WEB (out			0.108		INISHED 12
					L/D	INFO		0.921		D 1-93
					D/d	INFO	<u> </u>	30.94	FORWAR	PTION SHEE DED
					WEB (diff			5.08	<u> </u>	
						OOT 21-C FIBER DR				
		REMA				ELLANT WEIGHT OF	92.5 POUNT			
				IS LOT NEETS		ION REQUIREMENTS	151 750 155	IDANCE DESCRI	***	Ter Termination
SIGNATURE OF	CONTRACTOR'S	REPRESENTA	TIVE		SIGNATURE	OF GOVERNMENT Q	UALITY ASS	TRANCE REPRE	VATE PROPERTY AND INC.	•

	OPELLA								PD			AR 335-1
CMPOSITION: PF									ER: RAC-F			
PECIFICATION:									MOUNT: 100			
ANUFACTURED: RA	ASFORS ARMY A	MMUNITION	FLANT	. RADE:				CONTRACT	NUMBER:	DAAA09-91-Z	-0001	
					NI	SPOCETTOTO	262					
AC	CEPTES BLENS	NUMBERS			NIT	ROGEN CONTE	NT		STARCH 5.5°C		STABIL 134 5	
9 95539. BB 955	40. BB 95541				,	MAX 13.176		45	MINS		<u> 37. </u>	INS
				_	1	MIN <u>13.06</u>		45	MINS		30 N	IINS
						AVG 13.13		45	- MINS		30- N	INS
										EXPLO	SION HRS	
			1	ands.	CTURE OF	COLVERT	202	PROPELLANT	<u> </u>			
TEMPERATUR	E. °F					ROCESS - DRY					TIME	
FROM	TC										ys I	HOURS
145	155	CARPET R	CL! AT	FXTRU	STON							ACCE.S
160	176	EXTRUSIO										
105	115	ANNEAL										<u> </u>
	•••									 -		τ .
		L			MAT OF I	THISHED S	2021	7.5.4.00				
	BBOB	ELLANT CO	APOSTT:				T		CA D 77 7 7 7 1	ND PHYSICAL	TC-TC	
	PROF						ـــــ		ABILITI A	ND PRISICAL	155:5	
Constit	uent	Perce Formu			rance	Percent Measured	1	Tests		Formula		Actual
trocellulose		51.7	7	NO	н.	54.48	Hea	test # 120°0	-	NCC 60		CC 60 -
itroglycerin		12.9	6	NO	н.	12.59	No	unes		NF 60'		NF 601
ethylene glyco	ol dimitrate	21.5	8	NO	и	20.07	†-			 		
o x		13.C	0	NOI	н.	12.10	+-					
kardit II		0.6	1	NO	и.	0.68	HOE	(cal/g)		Info		1144
gnesium oxide		6.0	4	NO	и.	0.05	Abs	olute density.	g/cc	Info		1.59
raphite		0.0	4	NO	и.	0.03	 		·			
Total		100.0	0			100.00	For	n		hexagon	al t	nexagona.
sh content		0.3		NO	н	6.1	Num	per of perfs		19		19
thylene chlor:	de solubles	40.4		NO	н	44.3	†					
pisture content		0.5		NO	H	0.2	1			†		
	Cros	ED BOIGS			<u>-</u>	1		PROPELLA	7 DIMES	TOME (INC	180)	
			Rela	tive	Relative				<u> 1</u> 1.2.00	4:	Unito	raity by
Lot Num	ber	Temp °F	Quice	iness	Force			t kan	State Telephone		Std Dev	riation,
AD-PD-090-3		-90	е	1.1	131.7			SPEC	DIE	CENEZINIT	SPEC	ACTUA
						LENGTH 1	ır.	0.75 NOM		0.760		1.90
			<u> </u>		L	O.D. 15.		0.789 NOM	0.834	0.810		0.70
			!			PERF in		0.027 NOM	C.026	0.527		
TD-71136			10	00.00	100.00			0.109 NOM		0.114		es
			<u> </u>	-	<u> </u>	WEB inne		INFO		0.114	PACKEL :	
EMARKS: FIRED DENSI		BOMB AT	0.26 G	cc ro	ADING	WEB imade		INFC		C.108	SAMPLES	
						WEB Out	er:	INFO		0.112		ISHED 11-
						L/C		INFC		C.938	OFFERED	
						D/d		INFO		30.16	FORWARDE	'ION SHEET C
						WEB idif		INFC		3.12	<u> </u>	
								1-C FIBER DRU				
		REMA	RKS:					NT WEIGHT OF	100 POUNDS	5 		
				THIS	LOT MEETS			equirements				
SIGNATURE OF CO	NTRACTOR'S R	EPRESENTA	TIVE			SIGNATUR	E OF	GOVERNMENT QU	ALITY ASSU	RANCE REPRES	SENTATIVE	
						P .						

Pf	ROPELLA	NT DE	ESCRI	PT:	ION S	HEET				RI		TROL SYSTE 1-1 ARA 1-15 AR
COMPOSITION:	PROPELLANT JA	(-2 19-PE	RF HEX JF	RANULA	(R			LOT NUM	BER: RAC-	PC-090-4		
SPECIFICATION:	DOE-P-640316	: CPCES F	RELEASE N	VC. 23	5-95. 7/	- 92		PACKED	AMCUNT: 13	: pounds		
MANUFACTURES: !	RACFORD ARMY	MMUNITION	FLANT.	RADEC	RE VIRG	NIA 24141		CONTRAC	T NUMBER.	DAAAC9-91-3	-000:	
	·				MI	TROCELLUL	988				-	
	ACCEPTED BLENS	NUMBERS			NI	TROGEN CONTI	ENT		5TARCH 65.5°C		STAB:	
96 95539. BB 95	5540. BB 95541				1	MAX 13 179		41	· MINS		30.	
					 	MIN 13.06		-	- MINS			MINS
					-	AVG 13.13			· MINS		30+	
		·			┼					EV81	SION HRS	H 1 11 2
			1/2	MITTER			200	PROPELLANT		ZAPO	-3104 485	
TEMPERATU	18E 05							SHOREMARK				<u>.</u>
FROM	TC					ROCESS - DR	1185				TIM	
145	155	CARPET R	A E	VTRUC	*=11					D/	YS	HOURS
160	170	EXTRUSIC		X1KUS								
105	170	ANNEAL	" DIE							\longrightarrow		
103	***	ANIVEAL								\longrightarrow	\longrightarrow	
	· · · · · · · · · · · · · · · · · · ·	L										
	2202				201 UF :	FINIANED 1	TOPE				···	<u>,, </u>
	PROP	ELLANT CO					<u> </u>	\$	TABILITY A	ND PHYSICAL	TESTS	
Const 1	tuent	Perce		Perc		Percent Heasured	l	Tests		Formui	.	Actual
itrocellulose		48.3	ie e	NOM	.	46.65	heat	test 0 120°	ε	NCC 60		CC 60 +
itroglycerin		12.3	1	NOM		13.54	No 1	unes		NF 60	- 	NF 60
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