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TECHNICAL MEMORANDUM 1459

COMPARATIVE BLAST MEASUREMENTS OF VARIOUS HIGH EXPLOSIVE COMPOSITIONS IN A STANDARD WARHEAD CONFIGURATION (U)

HENRY L. HERMAN

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ACKNOWLEDGMENT

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(U) ABSTRACT

Presented in the report are the measured blast parameters of side-on peak overpressure and positive impulse (including positive impulse duration) plus the measured air shock wave time-of-arrival information generated by the free-air detonation of 57 uncased, centrally initiated, 7-lb. (approximate weight) constant volume high explosive charges (Figure 2) of these compositions:

Non-deaireated cast TNT from Lot KNK-11-639

Cast Composition B-3 from Lot HOL-11-92

Compression-molded Composition A-3 from Lot WAB-1-158

Compression-molded PBXN-1 from Lot HOL-SR-338-59

Cast Composition B from Lot HOL-7-1928

Compression molded PBX 9010 from Lot HOL-SR-490-61

Compression molded PBXN-3 from Lot HOL-SR-45-63

Compression molded 86/14 HMX/Butvar B72A

Cast 83/17 HMX/Laminac Styrene Binder

Cast 75/25 Cyclotol from Lot HOL-6-62

Compression molded PBX Type A from Lot OAC-596-55

Compression molded PBX Type B from Lot HOL-SR-46-57

The blast parameters were measured of distances of 10, 15 and 20 feet from transducer arrays redundant at 180° (Figure 3 and 4).

(U) INTRODUCTION

This is the second Technical Services Laboratory report (Reference 2) resulting from a continuing study by the Explosive Laboratory of Feltman Research Laboratory, concerned with the "Continuing Characterization of Existing Explosive Compositions" (Reference 1). A reference point for the study exists in the use of a centrally initiated constant volume barrel-shaped charge geometry as a standard test vehicle (Figure 2). The characterization of these compositions is evolved by comparison of the HE generated blast parameters of side-on peak overpressure and impulse (including positive impulse duration) as well as shock wave time-of-arrival information measured by use of a redundant gage array (Figure 1, 3 and 4).

(U) DISCUSSION OF RESULTS

At the writing of this report the following round was not available for characterization:

PBX 9010, one round

35mm film records were lost from the "North Array" on Composition A-3 Round 0284-2, from both arrays on Composition 86/14 HMX/Bulvar B72A, Round 147 and from Composition PBX-Type A, Round 058-1.

Extreme turbulence effects -- indicative of charge break-up -- were especially noted on the 35mm film records from the Composition A-3 Round 309-2. Irregular or abnormal impulse analogs, indicative of (in some instances) a fireball effect on the gages, were noted on the 35mm film records from: Composition 86/14 HMX/Bulvar B72A, Round 149, 150 and 151; 83/17 HMX/Laminac-Styrene binder, Round 0651-1; 75/25 Cyclotal, Round 057-4; Composition B-3, Round 0342-6; Composition PBX-9010, Round 057-2; Composition PBX-Type A, Round 009-3, 069-56.

Comparison of the results for TNT and Composition B of the present report with those of the first report (Reference 2) indicate a variation well within the overall accuracy of the measurement system.

(U) CONCLUSIONS

The results of this study to date indicate, that for the round geometry being used, at the 10-foot distance peak side-on overpressure is the most sensitive blast characterization criteria; at the 20-foot distance side-on positive impulse is the more sensitive criteria.

(U) RECOMMENDATIONS

The subject explosive characterization study be continued and expanded in scope.

(U) RESULTS

Measured parameter averages at the 10-, 15- and 20-foot distances for all compositions are presented in Table 1 and 2, (in Appendix A). Individual results are presented as Table 3 and 4.

(U) PROCEDURE (REFERENCE 2 and 3)

The program was conducted at Picatinny Arsenal during April-June 1964.

The rounds were positioned with their longitudinal axis in a vertical plane at a height of 10 feet above ground level (Figure 3). The transducer arrays, redundant at 180° (called "North Array" and "South Array" in Table 3 and 4) were placed in a horizontal plane perpendicular to the center of each round's longitudinal axis (Figure 3 and 4). Each individual array, consisting of two time-of-arrival gages (ARC-BD-20) which bracketed a side-on pressure-time gage (ARC-LC-33C) (Figure 4) was positioned at 10-, 15- and 20-foot distances from the longitudinal axis of the round. Shock wave time-of-arrival measurements were made using an ionization switch ("Chronograph Contactor" -- Dupont Model KC23 HRR) attached to each round. Closure of the switch (by detonation of the round) started the sweep of the Tektronix Model 545 oscilloscope (Figure 1). Time-of-arrival analogs were obtained (Figure 8) at the 9.5-foot distance and the 10.5-foot distance by hard wiring in parallel the series output of the two gages of the "South Array" to the Tektronix Oscilloscope.

The gages were hard wired using coaxial cable to two four-beam ETC (Model K470) oscilloscopes (for the side-on measurements) and to a dual-beam Tektronix Oscilloscope (for the time-of-arrival measurements). 35mm film records (Figure 7) were made of the information presented on the four-beam ETC oscilloscopes, using General Radio Model 651-5 streak cameras. Time-of-arrival records at the 10-foot distance were made using polaroid film (Figure 8). Figure 1 is a block diagram of the instrumentation.

The rounds were positioned for firing using a cardboard tube-cardboard cone arrangement. The firing train is shown in Figure 2. The M36 Electric Detonator was fired using 2,000 volts to insure operation. Figure 5 shows the individual detonator centering mechanism used with each charge.

The data was reduced using a Gerber analog to digital data reduction system accurate to 0.1% (Figure 6). Peak overpressure was computed from time-of-arrival information using the Rankine-Hugenoit relationship. Integration of the P-t analogs yielded positive impulse. Shock wave time-of-arrival information was obtained from the polaroid traces to the 10-foot distance and from the 35mm film records for the 15 and 20 foot distances. Positive impulse duration, was of course, also obtained from the 35mm film records.

Overall accuracy of the entire parameter measurement system is ± 5%.

REFERENCES

1. T. Costain, J. D. Hopper, Job Order Memorandum 4634-11-005 (470) TR 115-64, 25 February 1964.

2. H. L. Herman, Comparative Blast Evaluation of Various HE Compositions in a Standard Warhead Configuration, Picatinny Arsenal Technical Memorandum 1279, December 1963.

3. F. E. Baker, Research and Engineering Logbook No. 270-28, U. S. Army Munitions Command, Dover, New Jersey, June 1964.

APPENDICES

APPENDIX A

Tables

(C) TABLE 1

SUMMARY OF BLAST PARAMETER MEASUREMENTS

AVERAGED VALUES (U)

Compositions	Film Record Sample Size	Peak Overpressure, psi			Impulse, psi-seconds		Milli-
		10 ft.	15 ft.	20 ft.	10 ft.	15 ft.	20 ft.
TNT (Non-deaireated)	10	19.6	7.0	4.4	13.4	6.9	6.0
Composition B	10	35.4	12.7	6.8	19.9	12.3	10.0
Composition A-3	10	30.6	13.1	6.9	24.7	13.7	9.0
PBXN-1	10	30.8	13.2	8.2	21.5	12.6	8.1
Composition B-3	10	32.6	12.4	8.2	22.1	11.6	11.0
PBX-9010	8	32.6	16.3	8.2	19.6	15.0	12.2
83/17 HMX/Laminac Styrene Binder	10	31.9	13.5	9.5	24.8	13.3	8.5
75/25 Cyclotol	10	32.7	16.1	7.1	19.0	14.5	9.6
PBXN-3	10	25.8	11.5	9.1	25.0	15.5	8.9
86/14 HMX/Butvar 2A	8	30.4	13.7	7.1	18.0	12.1	9.9
PBX-Type A	8	33.3	12.9	6.6	19.7	12.2	7.4
PBX-Type B	10	31.5	12.2	7.8	18.2	12.1	9.6

(C) TABLE 2

AVERAGED VALUES

SHOCK WAVE TIME-OF-ARRIVAL AND IMPULSE DURATION

MEASUREMENTS IN MILLISECONDS (U)

Composition	Film Record Sample Size	10 ft.	ID10 ft.	15 ft.	ID 15 ft.	20 ft.	ID20 ft.
TNT (Non-deaireated)	11	3.46	2.44	6.96	2.66	10.64	3.19
Composition B	11	2.27	1.88	5.247	2.74	8.909	3.62
Composition A-3	11	2.485	2.36	5.475	2.9	9.265	3.21
PBXN-1	9	2.728	2.57	5.908	2.88	9.914	3.62
Composition B-3	11	2.742	2.67	5.852	2.74	9.558	3.44
PBX-9010	9	2.445	2.43	2.557	2.85	9.343	3.4
83/17 HMX Laminac Styrene	12	2.940	1.95	5.909	2.682	9.509	3.168
75/25 Cyclotol	9	2.543	1.8	5.649	2.66	9.235	3.2
PBXN-3	12	2.914	2.20	5.886	2.70	9.461	2.61
86/14 HMX/Butvar 2A	9	2.776	2.01	5.910	2.7	9.805	3.3
PBX-Type A	11	2.714	2.33	6.257	2.63	10.239	3.31
PBX-Type B	9	2.488	2.26	5.620	2.8	9.667	3.26

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(C) TABLE 3

INDIVIDUAL BLAST PARAMETER MEASUREMENTS

Sample No.	South Array 10 feet	South Array 15 feet	South Array 20 feet	North Array 10 feet	North Array 15 feet	North Array 20 feet
COMPOSITION B						
Peak Overpressure, psi						
0272-3	29.4	11.6	----	35.3	10.0	------
0731-6	33.5	14.7	7.4	32.7	13.0	7.0
0272-4	30.5	13.8	7.4	36.4	13.9	7.6
0731-2	32.5	13.6	6.2	35.5	13.6	7.5
0272-5	33.2	11.5	5.3	39.2	12.4	6.3
Impulse, psi-Milliseconds						
0272-3	14.9	11.9	----	18.5	10.0	-----
0731-6	19.7	13.6	9.6	----	10.5	9.8
0272-4	19.3	15.0	8.0	----	11.5	8.4
0731-2	28.4	16.1	13.8	18.8	11.3	10.0
0272-5	16.6	11.6	----	22.4	11.0	9.5
TNT						
Peak Overpressure, psi						
0301-2	23.3	9.3	1.6	21.9	5.0	5.0
0272-7	19.7	3.8	3.8	23.0	5.0	5.0
0292-3	16.2	4.8	3.8	17.4	5.4	5.4
0292-4	18.1	10.9	5.3	18.1	9.2	4.5
0292-12	20.7	9.2	4.9	17.7	7.8	4.5
Impulse, psi-Milliseconds						
0272-3	13.0	9.9	1.7	15.6	5.4	6.2
0231-6	14.1	3.7	---	----	5.3	5.6
0292-3	10.5	4.7	---	12.2	5.6	6.8
0292-4	15.8	10.7	8.1	13.0	8.8	5.6
0292-12	13.2	8.1	8.6	13.4	6.6	5.2
COMPOSITION A-3 (LOT WAB-1-158)						
Peak Overpressure, psi						
0284-2	34.5	12.2	12.4	----	----	---
309-1	26.7	11.1	6.6	25.9	9.9	6.6
284-3	31.8	10.5	7.4	41.0	10.5	7.0
311-11	36.1	13.6	6.7	33.2	13.1	7.1
309-2	24.5	11.3	6.7	21.9	13.9	6.4
Impulse, psi-Milliseconds						
0284-2	18.9	10.7	8.0	----	----	---
309-1	20.5	10.5	10.7	----	11.5	10.7
284-3	17.2	9.4	9.0	33.5	10.1	8.0
311-11	45.5	14.1	9.1	34.0	15.9	10.0
309-2	12.4	11.0	9.6	11.7	22.5	6.9
PBXN-1 (LOT HOL-SR-338-59)						
Peak Overpressure, psi						
241-1	19.7	11.8	6.4	29.1	17.5	7.2
016-1	39.7	11.6	6.6	32.0	12.2	5.7
256-1	31.9	11.3	12.4	----	----	5.3
256-2	30.5	12.7	5.5	27.8	15.6	5.3
016-2	32.2	12.8	7.5	34.3	11.7	6.5
Impulse, psi-Milliseconds						
241-1	12.7	13.6	9.8	19.8	15.4	8.6
016-1	41.5	9.8	10.9	23.0	11.2	2.0
256-1	18.2	12.1	7.8	----	----	---
256-2	24.6	11.8	10.9	16.4	15.4	6.9
016-2	21.7	11.8	10.1	21.7	11.4	7.6
PBXN-3 (LOT HOL-SR-490-61)						
Peak Overpressure, psi						
None (1)	28.3	8.5	6.2	28.5	12.6	---
None (2)	21.5	12.8	6.9	19.5	----	15.7
051-1	37.3	14.1	7.2	32.0	12.8	6.7
027-1	31.2	10.2	7.7	26.9	9.5	6.4
107-1	31.6	13.1	7.1	29.7	11.7	8.1
Impulse, psi-Milliseconds						
None (1)	25.4	13.3	11.0	44.0	20.65	---
None (2)	18.1	17.1	7.1	18.5	----	---
051-1	23.0	13.6	[illegible]	[illegible]	[illegible]	[illegible]

0292-12	13.2	8.1	8.6	13.4	6.6	5.2

COMPOSITION A-3 (LOT WAB-1-158)

Peak Overpressure, psi

0284-2	34.5	12.2	12.4	----	----	---
309-1	26.7	11.1	6.6	25.9	9.9	6.6
284-3	31.8	10.5	7.4	41.0	10.5	7.0
311-11	36.1	13.6	6.7	33.2	13.1	7.1
309-2	24.5	11.3	6.7	21.9	13.9	6.4

Impulse, psi-Milliseconds

0284-2	18.9	10.7	8.0	----	----	---
309-1	20.5	10.5	10.7	----	11.5	10.7
284-3	17.2	9.4	9.0	33.5	10.1	8.0
311-11	45.5	14.1	9.1	34.0	15.9	10.0
309-2	12.4	11.0	9.6	11.7	22.5	6.9

PBXN-1 (LOT HOL-SR-338-59)

Peak Overpressure, psi

241-1	19.7	11.8	6.4	29.1	17.5	7.2
016-1	39.7	11.6	6.6	32.0	12.2	5.7
256-1	31.9	11.3	12.4	----	----	5.3
256-2	30.5	12.7	5.5	27.8	15.6	5.3
016-2	32.2	12.8	7.5	34.3	11.7	6.5

Impulse, psi-Milliseconds

241-1	12.7	13.6	9.8	19.8	15.4	8.6
016-1	41.5	9.8	10.9	23.0	11.2	2.0
256-1	18.2	12.1	7.8	----	----	---
256-2	24.6	11.8	10.9	16.4	15.4	6.9
016-2	21.7	11.8	10.1	21.7	11.4	7.6

PBXN-3 (LOT HOL-SR-490-61)

Peak Overpressure,psi

None (1)	28.3	8.5	6.2	28.5	12.6	---
None (2)	21.5	12.8	6.9	19.5	----	15.7
051-1	37.3	14.1	7.2	32.0	12.8	6.7
027-1	31.2	10.2	7.7	26.9	9.5	6.4
107-1	31.6	13.1	7.1	29.7	11.7	8.1

Impulse, psi-Milliseconds

None (1)	25.4	13.3	11.0	44.0	20.65	---
None (2)	18.1	17.1	7.1	18.5	-----	---
051-1	23.0	13.4	9.7	14.7	11.8	6.5
027-1	25.4	9.1	10.6	13.2	7.7	6.3
107-1	21.1	11.6	----	16.5	10.9	9.0

86/14 HMX/BUTVAR 2A

Peak Overpressure, psi

147	Film record lost as electric 220 fuse blew when round fired					
148	32.6	13.4	7.5	31.0	12.9	7.6
149	29.1	14.3	6.6	29.1	13.4	7.7
150	32.7	12.3	7.0	25.2	12.3	7.0
151	34.5	16.3	6.7	28.9	14.3	7.1

Impulse, psi-Milliseconds

148	19.0	11.2	15.7	14.2	11.6	8.4
149	----	13.2	10.9	14.7	10.9	8.9
150	----	12.5	8.3	15.1	9.6	8.7
151	----	15.6	11.9	14.4	11.9	6.5

83/17 HMX/LAMINAC-STYRENE BINDER

Peak Overpressure, psi

None (1)	----	----	7.5	27.4	----	6.8
None (2)	33.7	----	10.7	32.3	13.3	8.8
None (3)	29.0	15.4	7.1	35.4	----	13.3
0651-3	29.9	11.6	6.1	33.8	11.9	8.7
0651-1	36.7	13.5	5.3	36.7	13.5	---

Impulse, psi-Milliseconds

None (1)	----	----	7.7	22.5	----	6.1
None (2)	24.0		14.4	29.1	14.7	7.4
None (3)	22.6	17.2	5.2	33.2	----	10.6
0651-3	15.5	10.9	12.2	17.9	10.2	10.3
0651-1	30.4	13.3	7.1	19.3	12.7	----

75/25 CYCLOTOL (HOL-6-62)

Peak Overpressure, psi

0571-4	31.0	14.9	8.4	34.4	12.4	7.1
0592-3	35.4	15.6	6.2	35.4	14.1	6.2
0592-4	34.0	14.9	6.9	39.3	14.5	6.9
0592-5	----	----	---	31.0	14.4	6.7
0592-6	24.9	----	---	30.4	13.1	7.6

Impulse, psi-Milliseconds

0571-4	----	14.0	11.8	19.6	11.9	8.5
0592-3	20.8	17.5	10.3	19.7	14.8	8.2
0592-4	22.7	13.9	9.3	21.7	13.7	7.8
0592-5	----	----	----	14.8	6.7	7.6
0592-6	13.6	----	----	16.7	12.0	10.7

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CONTINUED

(C) TABLE 3 (CONT'D)

Sample No.	South Array 10 feet	South Array 15 feet	South Array 20 feet	North Array 10 feet	North Array 15 feet	North Array 20 feet
PBX-TYPE A (LOT OAC-596-55)						
Peak Overpressure, psi						
058-1	Film destroyed - No Time Marks on Film					
069-2	34.9	12.4	4.8	33.3	17.8	------
069-3	33.3	12.6	6.9	32.3	12.3	7.0
064-2	31.9	10.6	7.8	30.0	9.7	6.5
069-5	34.8	12.9	6.0	34.8	14.8	6.6
Impulse psi-Milliseconds						
069-2	18.9	12.8	6.4	20.2	16.6	-----
069-3	20.4	11.2	---	17.1	11.0	7.2
064-2	17.9	10.6	9.1	15.8	8.8	7.4
069-5	26.2	12.0	----	20.3	14.4	6.5
PBX-TYPE B (LOT OAC-46-57)						
Peak Overpressure, psi						
059-1	33.0	9.7	12.9	----	----	11.7
064-1	35.0	12.7	5.8	----	----	7.5
070-1	25.0	12.7	5.5	27.1	12.7	6.5
070-4	27.9	9.4	5.7	32.2	13.7	7.4
070-5	35.6	13.0	7.4	35.6	12.6	7.0
Impulse, psi-Milliseconds						
059-1	24.5	----	17.5	----	----	13.5
064-1	23.7	13.2	9.8	----	----	9.0
070-1	12.9	11.8	7.6	14.4	12.3	5.9
070-4	17.3	10.0	9.0	15.6	12.2	8.1
070-5	19.3	12.5	7.4	20.1	12.3	7.3
COMPOSITION B-3 (LOT HOL-11-92)						
Peak Overpressure, psi						
0442-3	25.7	12.1	7.6	31.1	12.3	6.6
0442-2	32.9	----	---	34.1	11.5	6.9
0442-1	34.2	16.3	7.0	----	13.0	6.3
0342-3	27.8	9.2	7.9	38.1	11.8	7.5
0342-6	31.1	10.0	10.6	36.7	15.4	12.6
Impulse, psi-Milliseconds						
0442-3	16.4	10.4	9.7	16.1	12.2	6.3
0442-2	25.7	----	---	19.7	10.6	7.2
0442-1	25.9	14.2	10.0	----	12.0	6.9
0342-3	24.2	10.8	19.9	31.5	9.8	11.1
0342-6	16.5	10.7	11.5	----	13.6	14.4
COMPOSITION PBX-90/0 (LOT HOL-SR-490-61)						
Peak Overpressure, psi						
051-2	26.9	13.6	6.4	26.9	20.5	5.9
058-2	32.3	20.1	6.8	31.6	20.1	7.1
057-1	34.4	15.1	8.0	39.9	----	7.9
057-2	34.4	11.5	11.7	34.4	11.7	11.7
Impulse,psi-Milliseconds						
051-2	13.6	11.5	8.8	21.1	22.8	7.9
058-2	19.8	19.6	13.4	19.0	14.4	6.9
057-1	29.2	13.8	12.1	21.5	----	10.5
057-2	15.7	10.2	----	16.9	11.3	12.7

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(C) TABLE 4

SHOCK WAVE TIME OF ARRIVAL AND IMPULSE DURATION MEASUREMENTS, MILLISECONDS

Number	10 Ft.	Id 10 Ft.	15 Ft.	Id 15 Ft.	20 Ft.	Id 20 Ft.
COMPOSITION B						
0272-3	2.550	1.7	5.550	2.8	9.250	3.7
0731-6	2.640	2.2	5.690	2.55	9.240	3.55
0272-4	1.306	2.0	4.156	2.55	7.706	3.10
0731-2	2.591	2.0	5.591	2.9	9.441	4.15
0272-5	-----	1.5	-----	2.9	-----	3.6
TNT						
0292-12	3.57	2.85	7.02	2.45	10.77	2.95
0301-2	3.13	2.1	6.65	2.6	10.35	3.15
0292-4	3.44	2.55	7.14	2.75	10.94	3.75
0272-7	3.703	2.5	7.003	2.8	10.503	2.9
0292-3	-----	2.15	-----	2.9	------	3.2
COMPOSITION A-3						
0284-2	3.445	2.1	5.645	2.7	9.345	2.8
309-2	2.554	2.2	5.704	2.7	9.354	3.15
284-3	2.515	1.85	5.615	2.9	9.215	3.2
311-11	2.663	2.9	5.613	3.2	9.613	3.2
309-1	1.247	2.75	4.797	3.0	8.797	3.7
COMPOSITION B-3						
0442-2	3.010	2.70	6.060	2.50	9.720	3.00
0342-3	2.421	3.15	5.671	3.15	9.421	4.60
0442-1	3.130	3.40	6.330	2.5	10.080	3.15
0342-6	2.856	2.20	5.806	2.85	9.481	3.45
0442-3	2.290	1.90	5.390	2.7	9.090	3.00
PBXN-1						
0241-1	2.565	2.50	5.625	2.8	9.238	3.50
016-1	2.764	3.05	5.939	2.85	9.699	2.90
0256-2	2.870	3.10	6.130	2.85	9.955	4.05
016-2	2.715	2.20	5.940	2.80	9.765	3.40
0256-1	-----	2.00	----	3.10	-----	4.25
PBX 9010						
058-2	2.563	2.35	5.688	3.2	9.238	3.90
051-2	2.198	2.00	5.423	2.65	9.303	3.10
057-2	2.505	1.80	5.590	2.6	9.565	2.90
057-1	2.510	3.55	5.585	2.95	9.265	3.50
PBXN-3						
None	3.200	2.112	6.000	----	9.510	2.075
None	-----	2.273	-----	2.690	-----	2.735
107-1	2.595	2.75	5.600	2.60	9.160	2.70
027-1	2.705	1.95	6.085	2.55	9.870	3.05
051-1	2.59	1.90	6.455	2.75	9.205	3.30

0284-2	3.445	2.1	5.645	2.7	9.345	2.8
309-2	2.554	2.2	5.704	2.7	9.354	3.15
284-3	2.515	1.85	5.615	2.9	9.215	3.2
311-11	2.663	2.9	5.613	3.2	9.613	3.2
309-1	1.247	2.75	4.797	3.0	8.797	3.7
			COMPOSITION B-3			
0442-2	3.010	2.70	6.060	2.50	9.720	3.00
0342-3	2.421	3.15	5.671	3.15	9.421	4.60
0442-1	3.130	3.40	6.330	2.5	10.080	3.15
0342-6	2.856	2.20	5.806	2.85	9.481	3.45
0442-3	2.290	1.90	5.390	2.7	9.090	3.00
			PBXN-1			
0241-1	2.565	2.50	5.625	2.8	9.238	3.50
016-1	2.764	3.05	5.939	2.85	9.699	2.90
0256-2	2.870	3.10	6.130	2.85	9.955	4.05
016-2	2.715	2.20	5.940	2.80	9.765	3.40
0256-1	-----	2.00	----	3.10	-----	4.25
			PBX 9010			
058-2	2.563	2.35	5.688	3.2	9.238	3.90
051-2	2.198	2.00	5.423	2.65	9.303	3.10
057-2	2.505	1.80	5.590	2.6	9.565	2.90
057-1	2.510	3.55	5.585	2.95	9.265	3.50
			PBXN-3			
None	3.200	2.112	6.000	----	9.510	2.075
None	-----	2.273	-----	2.690	-----	2.735
107-1	2.595	2.75	5.600	2.60	9.160	2.70
027-1	2.705	1.95	6.085	2.55	9.870	3.05
051-1	2.59	1.90	6.455	2.75	9.205	3.30
			86/14 HMX/BUTVAR 2A			
148	2.713	2.25	5.963	2.60	9.563	3.40
149	3.165	2.00	6.204	2.70	9.879	3.40
147	2.540	2.10	6.000	3.00	9.805	3.30
151	2.575	7.7	5.475	3.60	8.975	3.10
			83/17 HMX/LAMINAC-STYRENE BINDER			
None	3.400	1.888	6.350	2.638	9.910	3.180
None	-----	1.733	-----	2.533	-----	3.370
None	-----	1.752	-----	2.778	-----	2.220
0651-1	2.703	3.00	5.578	2.00	9.128	2.70
0651-3	2.255	1.85	5.355	2.65	9.085	5.00
			75/25 CYCLOTOL			
0592-6	2.595	1.7	5.705	2.60	9.435	3.60
0571-4	2.548	2.2	5.513	2.80	9.068	2.70
0592-3	2.530	1.6	5.680	2.95	9.405	3.60
0592-5	2.499	1.88	5.699	2.30	9.049	2.90
			PBX-TYPE A			
069-5	2.600	2.70	5.680	2.7	9.405	2.50
058-1	2.485	2.65	-----	2.5	-----	2.90
069-3	3.170	2.15	6.380	2.55	10.080	5.40
069-2	2.675	2.20	6.285	2.75	11.135	2.80
064-2	2.640	1.95	6.690	2.65	10.335	2.95
			PBX-TYPE B			
064-1	2.473	2.40	5.623	2.8	9.423	3.85
070-5	2.580	2.35	5.550	2.85	9.290	2.60
059-1	2.213	2.50	5.398	2.9	9.018	3.50
070-1	2.685	1.80	5.910	2.85	9.945	3.10

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APPENDIX B

Figures

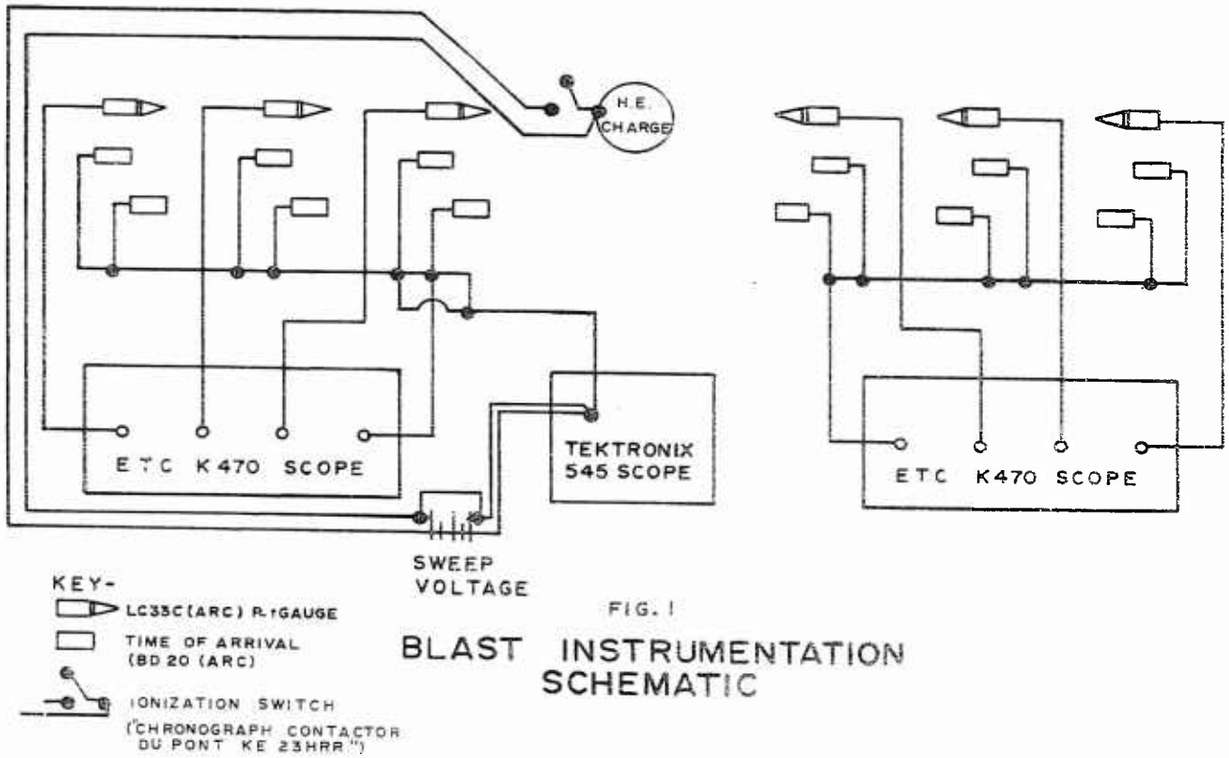

FIG. 1

BLAST INSTRUMENTATION SCHEMATIC

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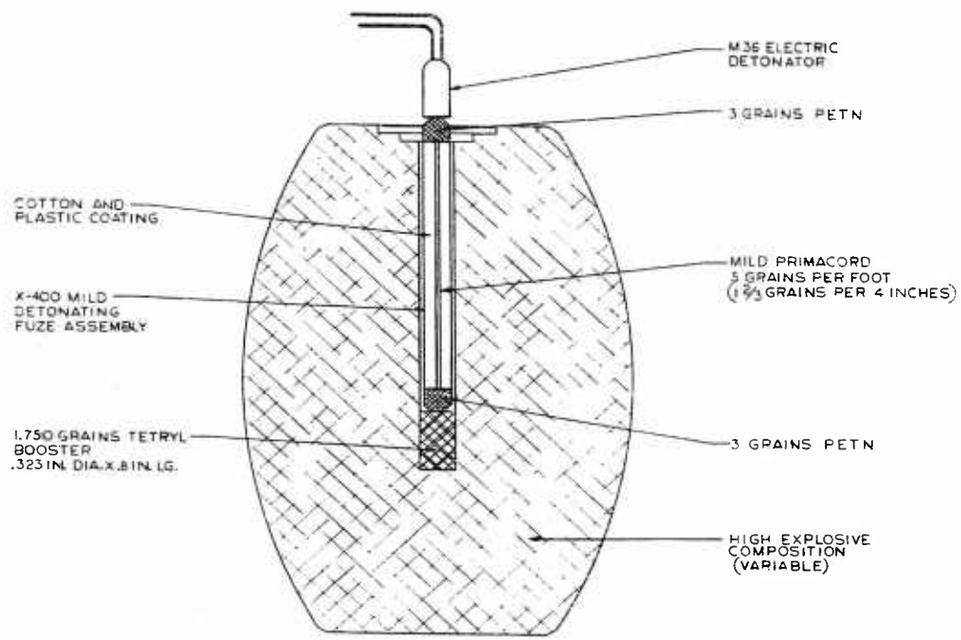

FIG. 2
INITIATION TRAIN

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REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL

SEE ENGINEERING RECORDS		PHYSICAL PROPERTIES	UNLESS OTHERWISE SPECIFIED
NEXT ASSY	USED ON	YP	DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES
APPLICATION		TS	
DO NOT	APPLY PART NO.	EL2	MATERIAL
DC	AS SPECIFIED	RA	
		BH	HEAT TREATMENT
		RH	FINAL PROTECTIVE FINISH

ORIGINAL DATE OF DRAWING 4 DEC 63

BLAST PARAMETER MEASUREMENT
CHARACTERIZATION OF EXISTING EXPLOSIVES IN PROTOTYPE WARHEAD GEOMETRY

SCALE | UNIT WT

PICATINNY ARSENAL
ORDNANCE CORPS
DEPT OF THE ARMY
DOVER, NEW JERSEY

DWG SIZE C | SK-64938
SHEET 1 OF 2

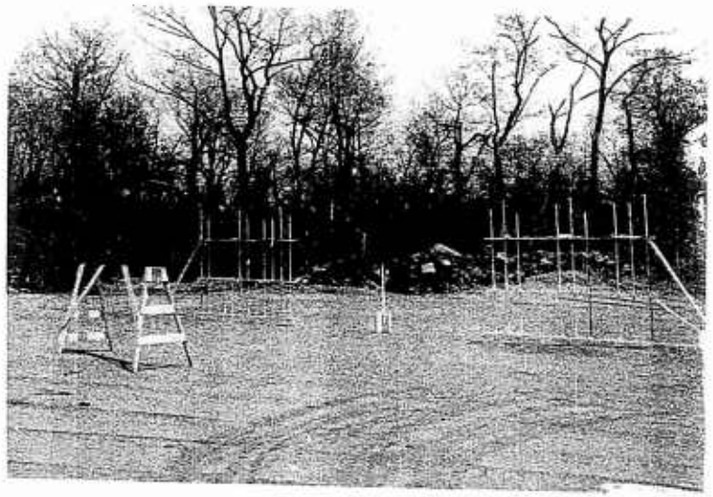


FIGURE 3

Blast Parameter Measurement Transducer Arrays, showing relative position of HE Charge.

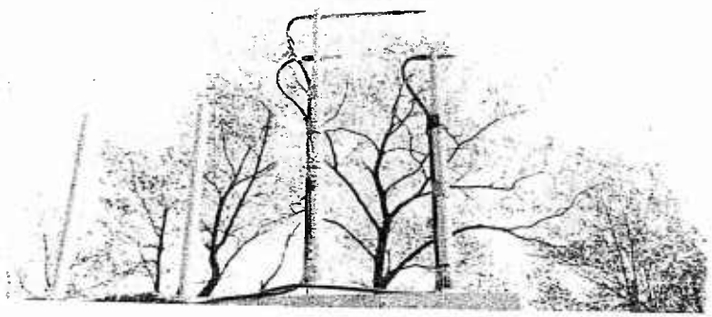


FIGURE 4

Detail of a Transducer Array Position showing side-on P-t Gage bracketed by two time-of arrival gages.

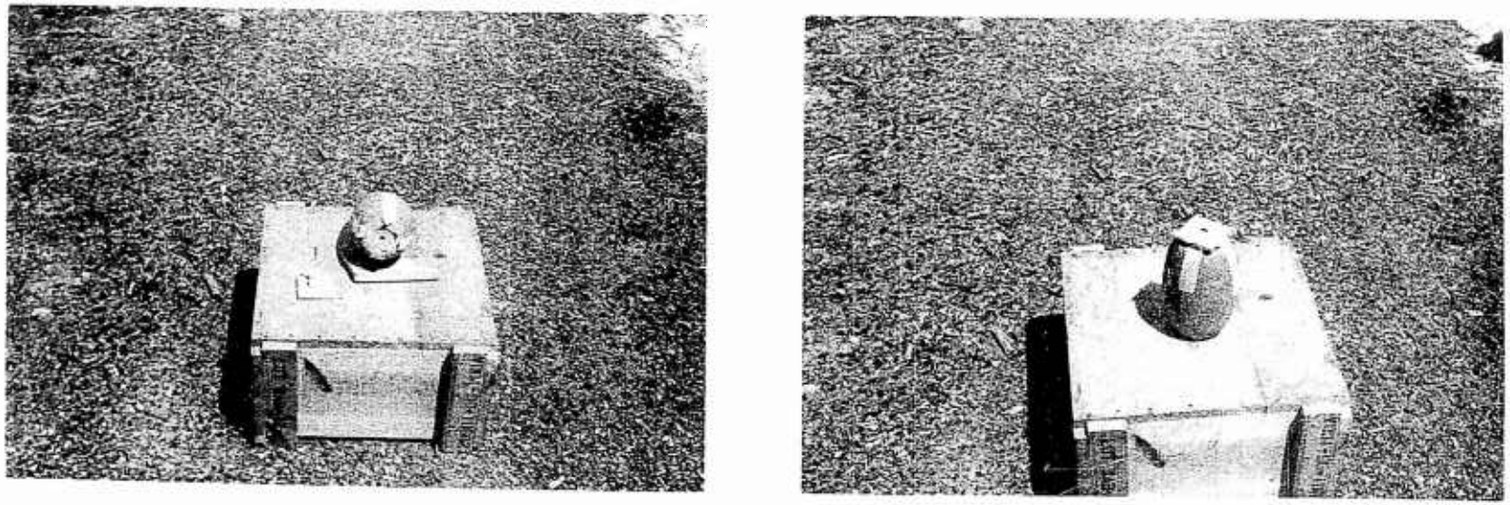
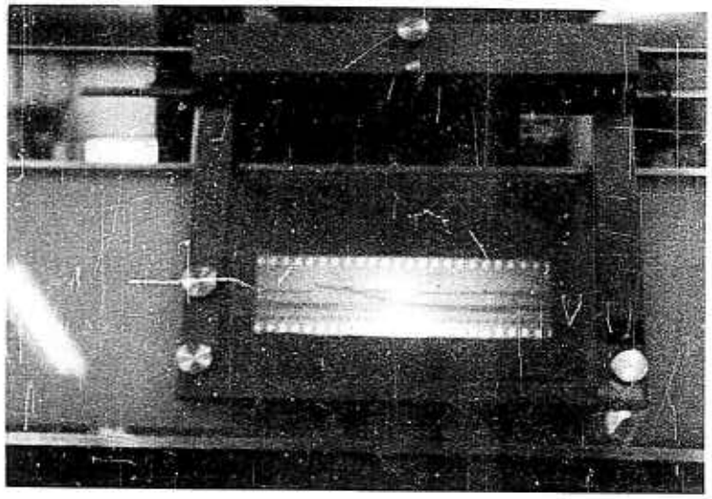


FIGURE 5

Views of a Typical Constant Volume HE Charge



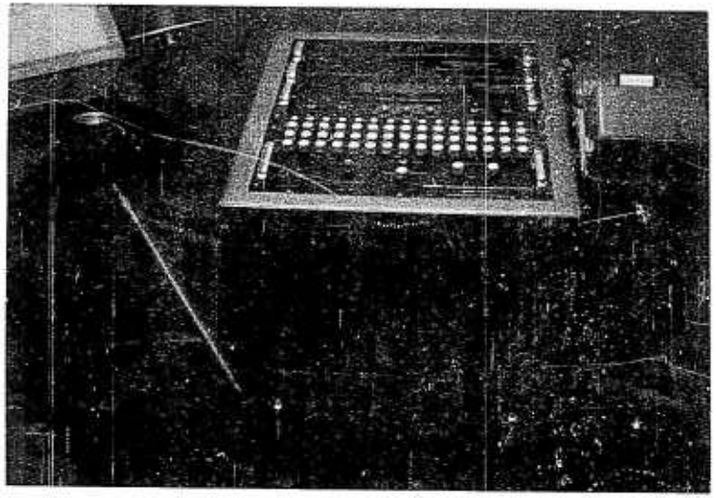


FIGURE 6

Gerber Analog to Digital Data Reduction System. Left, trace analog projection from 35mm film record; right - Gerber System programming Console and Digital Data Print-Out Device.

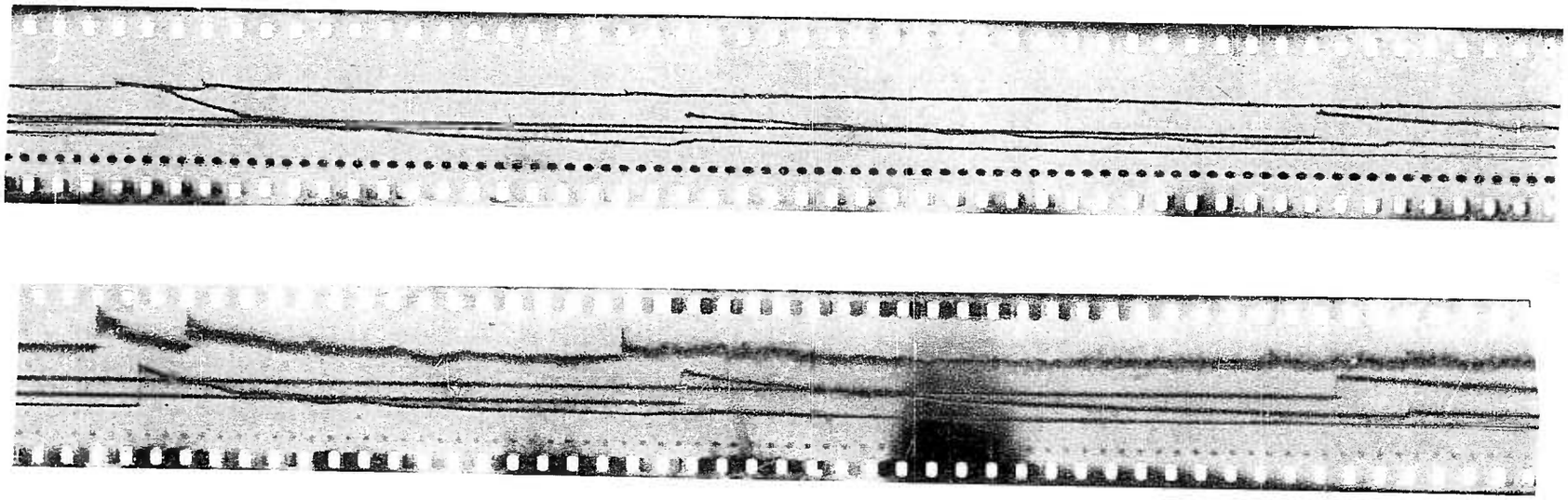
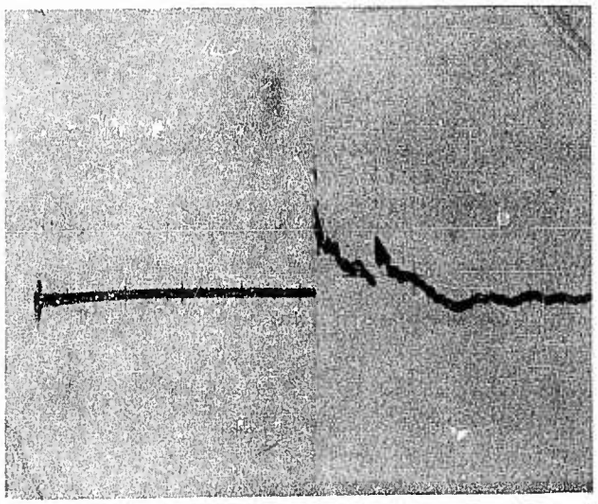


FIGURE 7

Typical 35mm Film Analog Records of Blast Parameters measured by the Redundant Principal Array. (Left to Right: Ten foot Distance, 15 foot Distance, 20 foot Distance). Top to Bottom: Time of Arrival Analog Distance, 20 foot P-t analog, 15 foot P-t analog, 10 foot P-t analog, Timing Generator Indications (10 KC).



(U) FIGURE 8

Air Shock Wave Time-of-Arrival Analogs. A sample Oscilloscope Trace is shown. Sweep generated by Ionization Switch Closure on HE Charge (Figure 1). Oscilloscope sweep rate is 0.5 milliseconds per centimeter. Time-of-Arrival gages are not calibrated as to Amplitude of Analog.

From Left to Right --

First Analog is the output of 9.5-foot distance time-of-arrival gage.

Second Analog output is generated by the output of the 10.5-foot distance time-of-arrival gage.

ABSTRACT DATA

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Picatinny Arsenal, Dover, New Jersey

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Henry L. Herman

Technical Memorandum 1459, July 1964, 20 pp, figures, tables. CONFIDENTIAL report from the Technical Services Laboratory, Ammunition Engineering Directorate.

Presented in the report are the measured blast parameters of side-on peak overpressure and positive impulse (including positive impulse duration) plus the measured air shock wave time-of-arrival information generated by the free-air detonation of 57 uncased, centrally initiated, 7-lb. (approximate weight) constant volume high explosive charges.

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I. Comparative Blast Measurements of Various High Explosive Compositions in a Standard Warhead Configuration.

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