


Image Cover Sheet

CLASSIFICATION UNCLASSIFIED	SYSTEM NUMBER 126856 
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TITLE
AREA SHOOT WITH 25 PR BE/CHEMICAL SHELL MK X CHARGED HBV \ (1.5% \) PERSPEX

System Number:

Patron Number:

Requester:

Notes:

DSIS Use only:

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84357-297 113

EXPERIMENTAL STATION, SUFFIELD, ALTA.
SUFFIELD REPORT NO. 85
SERIAL NUMBER _____
31 AUGUST, 1943

Classification / Determination _____
 Prepared to / For _____
 By: C. La Force
 Sur l'Autorisation de _____
 Date: 27 Feb 48 Signature: D. Kuselev
 Appointment _____
 Fonction _____

AREA SHOOT WITH 25 PR BE/CHEMICAL SHELL MK X CHARGED HBV (1.5%) PERSPEX.
 (Field Experiment No. 142)

REFERENCE

Priority Program No. 5 Item IV - 4(e).

1. OBJECT

- (a) To check the ammunition expenditure of 10 rounds per 100 x 100 yards considered necessary to achieve anti-personnel effects with the 25 pr BE/Chem Shell charged HBV (Perspex 1.5%) under hot weather conditions. (See P.M. 14).
- (b) To determine whether this expenditure produces any vapour and/or contact hazard under such conditions.

2. MATERIALS

300 rounds 25 pr. BE/Chem Shell Mk X charged HBV (1.5% Perspex) headfilled 1 1/2 oz. G 40 + 1 1/2 oz R.P. Smoke Box; Fuzed T & P No. 221 Mk.1 Lot 65 Maker R.C.

Cartridges 25 pr. Mk.I Cordite NH .025 Lot KA 119.

4 - 25 pr Mk.II guns on carriage 25 pr. Mk.I.

3. The shell charging was prepared by adding 8 lbs 3 ozs of Perspex to 553 lbs 4 ozs HB over a period of 1 1/2 hours. Total stirring was 6 hours at 400 r.p.m. and 26°C. The viscosity of the charging was 4 poises at 10°C and 2 poises at temperature of functioning.

4. PROCEDURE

The layout consisted of a 300 yard square of small cards on a 10 yard grid surrounded by a 100 yard frame of small cards on a 20 yard grid. 30 slit trenches (6' x 2' x 4' deep) were spaced uniformly over the 300 yard square, each containing one small jump card and a similarly numbered dummy. Each dummy was dressed in a green Gorman Field Uniform which consisted of a tunic and trousers suitable for wear in European weather conditions. 10 dummies were placed above ground level 5 standing and 5 prone. 30 livens drums were placed near the centre of the target. A diagram of the layout is attached as Appendix I.

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5. Four guns were laid parallel at 50 yard intervals. The 252 programme rounds were fired at Sweep 1° and Search 150 yards, the fuzes being adjusted 0.1 for searching. Ranging was carried out off the layout. Shells fired at the same Q.E. were observed to fall frequently as far as 600 yards apart. It therefore became necessary to range with bursts of 5 rounds gunfire. Fuzes were adjusted to give bursts on the line of sight and 2 rounds of Troop Fire were fired onto the target to confirm the ranging. The A/S was then raised 30 minutes for the programme firing.
6. Firing was at Charge III, range 8350 yards. Temperature of charging throughout firing was 43°C.
7. Injector-operated bubblers sampling at 21" above ground were positioned at 50 yard intervals around 4 sides of the target area. The inlets of the bubblers were curved downward to reduce entrance of liquid. Samples were taken for the duration of the shoot, and from cease fire to 1 hour after cease fire.
8. Heights of bursts were taken from two points using windows!
9. Immediately after firing had ceased observers were rushed onto the area and changed into the uniforms worn by the dummies during the shoot. The complete change was made within 5 minutes. The men were then engaged in heavy physical exercise for seven hours fighting a prairie fire started by one of the unstable rounds falling to graze short of the target. This entailed their working in an atmosphere which at times was almost unbearably hot. At the end of 4 hours some of them removed their tunics but as new trousers were not available, they continued to wear the trousers of the German uniforms in all cases for the full seven hours.
10. Immediately after firing had ceased four additional men in battle dress carried 30 livens drums 50 yards off the area. Their only protection was Ointment A.G. No. 5 applied to their hands 15 minutes before going onto the area.

RESULTS

11. Firing.

The program firing confirmed the fact observed during ranging that the 100% zone was greater than 600 yards, and the fuze zone was equally erratic. There were many short bursts (1000^x each and more) and a high percentage of grazes (about 15%). Several shells were heard wildly unsteady at the O.P. The short bursts started a fire which did not damage the layout. The shell gave all the indication of being unstable so that it was impossible to range accurately, even under the very favourable observation conditions of a field trial.

12. Programme firing commenced at 1451 hours and ceased at 1512 hours. Artillery details are given in Appendix II.
13. The observed heights of burst recorded during this trial are given in Appendix III.

Contamination of the layout.

14. Contamination on the target area (300 x 300 yds, 10 yard grid) amounted to 50.3 Kgm while 46.5 Kgm was deposited on the frame (20 yard grid). Recovery based on 252 shells fired was 47% (96.8 Kgm).

15. The distribution of contamination in different drop mass groups is given in Table 1.

Drop Mass Range (mg)	0.1 to 0.5	0.5 to 1.25	1.25 to 2.5	2.5 to 5.0	5 to 10	10 to 20	> 20	Total
Target Area	3.7	8.6	4.9	3.2	1.7	1.3	0.8	24.2
Frame	4.7	7.5	4.8	2.3	1.5	1.0	0.7	22.5
Drop Diam. range (m.m.)	0.5 to 0.9	0.9 to 1.2	1.2 to 1.5	1.5 to 1.9	1.9 to 2.4	2.4 to 3.1	3.1	46.7

16. The distribution of the charging in zones of different degrees of contamination (gm/Sq.m.) is given in Table II.

CONTAMINATION (gm/sq.m.)	TARGET AREA		FRAME	
	Mean Contamination (gm/sq.m.)	Area (sq.m.)	Mean Contamination (gm/sq.m.)	Area (Sq.m.)
Trace to 1.0	0.35 (0.30)	64200(61700)	0.27(0.26)	84000(71200)
1.0 to 5.0	1.76 (1.86)	13400(7450)	1.81(1.66)	13000(8360)
5.0 to 10.0	5.63 (5.3)	445(250)	--	--
10.0 to 50.0	18.2(10.3)	90(80)	--	--

Figures in parentheses refer to drops larger than 1 mm in diameter.

17. The average contamination found on assessing the cards placed in the slit trenches was 0.06 gms/sq.m. The heaviest contamination noted was 0.6 gm/sq.m., while some cards were uncontaminated. It was noted on visual examination that on each jump card the contamination was not uniform but was concentrated towards the downwind edge.

Vapour Concentrations on the Target Area

18. This experiment was carried out on a hot day (94°F) with a fairly steady wind of 9 mi/hr. Full meteorological details are given in Appendix IV.
19. The target terrain consisted of dry soil covered with charred remnants of a cover of short prairie grass which had been burned off a few days before the experiment.
20. A detailed record of vapour sampling results is given in Appendix V. The highest concentration recorded along the edge of the target area during the shoot was 0.9 mg/cu.m. at 21 inches height. The concentrations recorded for the first hour after firing had ceased were very low, the highest being 0.063 mg/cu m. No samples were taken within the target area.

Effects ON Human Observers

21. Of the twenty men wearing uniforms taken from dummies which had been lying in slit trenches, 14 received burns. The burns on 13 of these men did not approach casualty severity. The 14th man was classified as a Class II casualty (See S.R. No. 70).
22. In the group of 10 men wearing uniforms which had been on dummies positioned above ground six developed burns. Three of these showed various minor burns not of casualty severity. There were two Class I casualties with extensive burns involving the shoulders, buttocks and legs. Both of these men had extensive vesication involving the natal cleft. The sixth man had three areas of intense erythema in his right armpit which did not go on to vesication. As these lesions did not impair his ability to use the limb, he was classified as a non-casualty (Class III).
23. None of the men who carried livens drums off the area showed any effects.

Discussion of Results

24. The drop-spectrum from the charging used in this trial was satisfactory. It is similar to the spectrum obtained from 5.5 BE/Chem. Shell charged HTV plus 0.1 percent Perspex (See S.R. No. 84)
25. The mean contamination recovered on the 300 x 300 yd. target area was 5.6 Kg (equivalent to the charging from 7 rounds) per 100 x 100 yds. square. This is less than the 10 rounds per 100 x 100 yds. specified by P.M. 14 as the minimum expenditure likely to cause casualties by the blistering effect of drops falling on the skin and clothing.
26. This contamination did not give rise to sufficient vapour concentration to cause any appreciable vapour hazard. The maximum CT encountered was less than 30 min.Mg/cu m. This is in accordance with P.M.14 predictions.
27. It is appreciated that the practice of exposing clothing on dummies to mustard droplet contamination and subsequently changing the clothing on to observers may give false results of the hazard of wearing such clothing, since a considerable fraction of the mustard may be lost by evaporation before the change is effected, particularly under hot weather conditions. In this field trial, the change was completed within 5 minutes of "cease fire", and the limitation of the technique should be borne in mind when assessing the results.

28. It will be noted that some of the observers wore their tunics for a period of 4 hours, but as a result of their having to fight prairie fires occasioned by the shoot none of them was able to change his trousers for 7 hours. On account of the limitations of the technique used (para 27) and the unusually severe conditions experienced during the wearing period, no conclusions can be drawn as to the effects to be expected if the clothing were contaminated while being worn by the men and changed after 4 hours. The type of clothing worn which was heavy for the temperature under which the trial was carried out must also be kept in mind when judging the results.
29. The mean contamination over the bottom of the trenches scattered uniformly over the target area was approximately 1/10 of that found on the surface. It varied from Zero to about 0.6 gm/sq.m. The results of visual examination suggested that the sides of a 4 foot trench exert a considerable shielding effect on the floor of the trench.
30. CONCLUSIONS
- Anti-personnel effects may be obtained with expenditure of 25 pr. BE/Chemical Shell charged HBV (Perspex 1 $\frac{1}{2}$ %) as low as 7 rounds per 100 x 100 yds. under hot weather conditions when the personnel wear the contaminated clothing for seven hours while engaged in strenuous physical exercise.
31. The vapour danger and contact hazard from expenditure of this order are negligible.
32. Slit trenches will give fair shelter from BE/Chem Shell in wind of about 10 mi/hr.
33. The drop-spectrum produced by 25 pr. BE/Chem Shell charged HBV (1 $\frac{1}{2}$ % Perspex) is satisfactory.

This report was written by Capt. A.W. Birnie, R.C.E. (P.R.S.)

H.M. Barrett
 (H.M. Barrett)
 Acting Chief Superintendent,
 Experimental Station.

HMB/EH

APPENDIX II

ARTILLERY DETAILS

Nature of shell	25 pr. BE/Chem Mk X
Charging	HBV (Perspex 1 $\frac{1}{2}$ %)
Headfilling	1 $\frac{1}{4}$ oz. G.40 + 1 $\frac{3}{4}$ oz. R.P. Smoke Box
Fuze	T & P No. 221 Mk I Lot 65 Maker R.G.
Cartridges	25 pr Mk I Cordite NH .025 Lot KA 119.

Guns: Four 25 pr Mk II guns on Carriage 25 pr Mk I

No. 1 Gun	Barrel No. L/4182 EFC 490 ¹⁴ / ₁₆	1st quarter.
No. 2 Gun	Barrel No. L/4173 EFC 6020 ¹⁵ / ₁₆	2nd quarter.
No. 3 Gun	Barrel No. L/5405 EFC 192 ⁵ / ₁₆	1st quarter.
No. 4 Gun	Barrel No. L/5404 EFC 199 ⁹ / ₁₆	1st quarter

Firing data:

Charge	III
Charge Temperature	94°F
Map Range	8350 yds
Ballistic Wind	31 f.s. at 315°
Bearing of line of fire	90°
A/S	5' elevation
Fuze	11.9
Correction of the moment	- 625 yds
False range	8625 yds.

APPENDIX III

Height and Location of Bursts Obtained with 'Windows'

The table shows the height of bursts of shell with their location (+) or (-) of the flag at the centre of the layout. The 'shell No.' in the table was used only to assist in the computation - it has no relation to the order of fire. or between 'windows' 1 and 2.

Individual bursts could not be identified in the windows because of the rapid rate of fire. It was necessary therefore to assume that all shell travelled down the centre of the layout. Only air bursts were observed because burst at graze could not be distinguished from impact of the empty casing. Observation of air burst, too, was unsatisfactory during the latter part of the trial when smoke from prairie fires masked all bursts up to 100-200 feet. Less than half of the shell were recorded (70 by one observer, 113 by the other) and these may show a slightly high average height because of the selective effect of the smoke cloud before all bursts were obscured.

Besides the 'window' data it was observed that many shell burst at graze short of the layout.

APPENDIX III (cont)

LOCATION AND HEIGHTS OF BURST

WINDOW No. 1

<u>Shell No.</u>	<u>Horizontal (yards)</u>	<u>Vertical (feet)</u>	<u>Shell No.</u>	<u>Horizontal (yards)</u>	<u>Vertical (feet)</u>
1	+489	936	36	- 71	312
2	+489	1290	37	- 71	381
3	+373	294	38	- 71	660
4	+322	615	39	- 99	0
5	+249	279	40	- 99	0
6	+249	516	41	- 99	33
7	+213	195	42	-99	102
8	+213	672	43	- 99	378
9	+142	267	44	- 99	513
10	+142	342	45	-99	651
11	+142	420	46	- 99	651
12	+142	570	47	- 99	855
13	+109	114	48	- 152	33
14	+ 76	333	49	- 152	435
15	+ 76	480	50	- 152	633
16	+ 76	555	51	- 152	834
17	+ 45	36	52	- 203	0
18	+ 45	36	53	- 203	681
19	+ 15	252	54	- 250	666
20	+ 15	324	55	- 273	471
21	0	321	56	- 295	156
22	0	609	57	- 295	279
23	0	681	58	- 295	342
24	- 15	36	59	- 339	273
25	- 15	816	60	- 339	393
26	- 44	36	61	- 339	396
27	- 44	246	62	- 361	450
28	- 44	669	63	- 361	450
29	- 44	315	64	- 361	807
30	- 44	387	65	- 381	267
31	- 44	387	66	- 400	264
32	- 44	456	67	- 421	546
33	- 44	738	68	- 421	546
34	- 44	807	69	- 421	546
35	- 71	312	70	- 421	840

WINDOW NO. 2

Appendix III (Cont.)

Shell No.	Horizontal (yards)	Vertical (feet)	Shell No.	Horizontal (yards)	Vertical (feet)	Shell No.	Horizontal (yards)	Vertical (feet)
1	+ 452	250	37	+ 80	1010	73	- 173	326
2	+ 381	248	38	+ 48	144	74	- 173	326
3	+ 348	640	39	+ 48	432	75	- 173	420
4	+ 315	148	40	+ 16	715	76	- 173	515
5	+ 315	445	41	+ 16	1095	77	- 173	515
6	+ 281	147	42	- 16	48	78	- 173	705
7	+ 281	735	43	- 16	48	79	- 203	326
8	+ 246	244	44	- 16	142	80	- 203	510
9	+ 246	244	45	- 16	238	81	- 203	700
10	+ 246	342	46	- 16	334	82	- 203	1070
11	+ 246	440	47	- 16	525	83	- 233	46
12	+ 246	535	48	- 48	141	84	- 233	46
13	+ 246	535	49	-48	141	85	- 233	138
14	+ 246	635	50	- 48	238	86	- 233	510
15	+ 246	1120	51	- 48	238	87	- 233	695
16	+ 212	49	52	- 48	425	88	- 233	785
17	+ 212	145	53	- 48	520	89	- 233	785
18	+ 179	145	54	- 48	710	90	- 264	138
19	+ 179	243	55	- 48	1180	91	- 264	416
20	+ 179	437	56	- 79	238	92	- 264	510
21	+ 146	48	57	- 79	332	93	- 264	785
22	+ 146	145	58	- 79	425	94	- 294	230
23	+ 146	243	59	- 79	425	95	- 294	415
24	+ 146	340	60	- 79	615	96	- 294	780
25	+ 146	630	61	- 79	615	97	- 324	415
26	+ 146	920	62	- 79	615	98	- 324	875
27	+ 113	48	63	- 111	47	99	- 352	229
28	+ 113	144	64	- 111	140	100	- 352	412
29	+ 113	241	65	- 111	425	101	- 352	505
30	+ 113	625	66	- 111	705	102	- 382	500
31	+ 113	725	67	- 111	985	103	- 382	685
32	+ 80	338	68	- 142	47	104	- 382	685
33	+ 80	435	69	- 142	420	105	- 411	500
34	+ 80	435	70	- 142	420	106	- 411	590
35	+ 80	530	71	- 142	795	107	- 411	680
36	+ 80	725	72	- 173	233	108	- 411	770
						109	- 498	316
						110	- 498	765
						111	- 498	765
						112	- 543	134
						113	- 543	940

APPENDIX IV

Meteorological Conditions

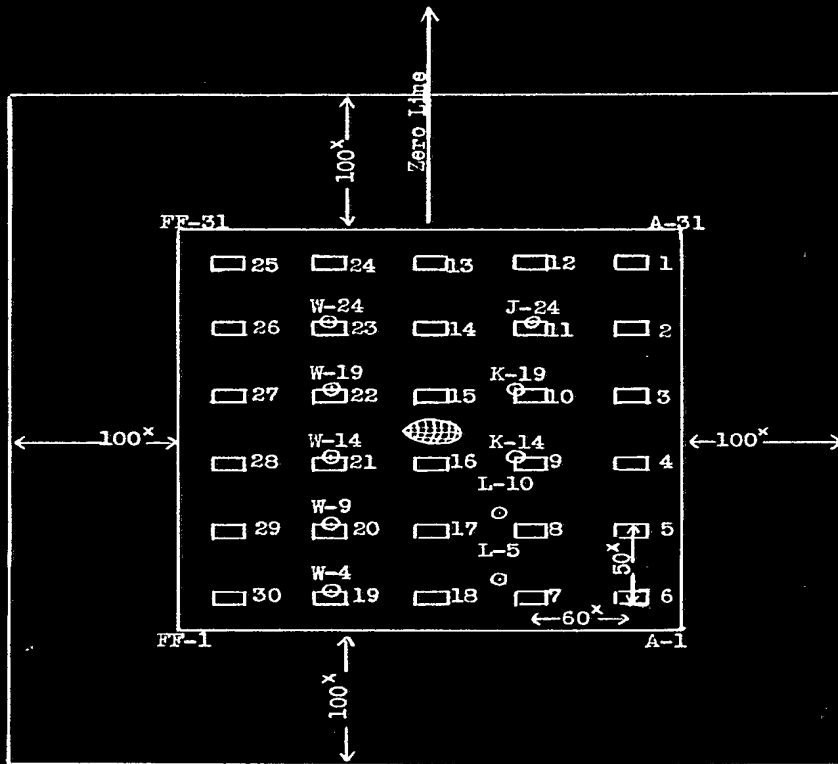
Date: 8 Jul 43.
Time: 1348 to 1611 hrs. M.D.T.
Air Temperature: 34°C (94.2°F)
Surface Temperature: 43°C (110°F)
Relative Humidity: 19% *per cent*
Wind Speed at 2 m.: 9.2 mi/hr.
Wind Direction: 260 to 315° (WSW to WNW)
Wind Ratio: R = 1.10
Gustiness: Gy = 0.65 Gz = 0.40
Temperature Gradient: (39 ft. - 4 ft.): -2.4°C (-4.3°F)
Remarks: Very bright sunshine throughout the period.
Site: Rolling prairie with dry grass 4 to 5 inches, 200 yards to the lee of a slough on up slope.

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APPENDIX V

Vapor Concentrations on Target Area

<u>Position No.</u>	<u>Sampling Height</u>	<u>Mgm. H per m³</u>	
		<u>During Shoot (Z - 30' to Z)</u>	<u>Z to Z + 1 hr.</u>
1	21"	.6	.01
2	21	lost	nil
3	21	.4	.01
4	21	.05	nil
5	21	.4	.02
6	21	.4	.02
7	21	.04	nil
8	21	.1	.01
9	21	.1	.04
10	21	.04	nil
11	21	.03	nil
12	21	.08	.03
13	21	.1	nil
14	21	.5	.06
15	21	.13	nil
16	21	.1	.04
17	21	.8	lost
18	21	.9	nil
19	21	.8	.04
20	21	.4	.03
21	21	.5	.04
22	21	lost	lost
23	21	nil	nil
24	21	.2	nil



- Centre - 31 Rows - Small Cards On 10X Grid
 Frame - 26 Rows - Small Cards On 20X Grid
- -1 - Trenches and Numbers
 ○ -W4 - Dummies and Nearest Card Number
 🥁 - Livens Drums

DIAGRAM OF LAYOUT

APPENDIX 1

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 23-8-43

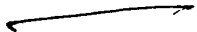
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