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The Effect of an Underwater Explosion on a Subject Floating
on the Surface in a Submarine Escape Immersion Suit (S.E.I.S.).

by

A. H. Bebb

H. C. Wright

Report prepared for the
Underwater Blast Sub-Committee
of the
R.N.P.R.C.

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1. SUMMARY

The Submarine Escape Immersion Suit (S. E. I. S.) has been tested against underwater explosion shock waves in Horson Lake.

With a subject floating on the water surface, the fully inflated suit provides adequate protection against underwater explosion pulse pressures of the order of 600 lb/in². Even with a suit partly deflated the blow given to the subject's back resulting from this high pressure but small momentum did not produce a lasting effect, but the exact degree of contact between the subject's back and the water could not be stated specifically.

No damage was caused by the explosions to either of the suits listed under Conditions A and B of Table 2.

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1. INTRODUCTION

The object of this short trial was to ascertain the protective properties as well as to test the strength of the fabric against shock wave parameters of an underwater explosion.

It was arranged to test 2 suits, and to make observations on effects when one suit was fully inflated and when one was partly collapsed.

2. RANGE

The trial was carried out in Horsca Island Lake where the water is 20 ft. in depth.

The target distances were measured horizontally along a trot wire from a point vertically above the charge to the base of the subject's lungs. See Fig. 1.

3. CHARGES USED.

The weight of explosive used in each shot was $1\frac{1}{2}$ lb. T.N.T., and in all cases the charge was detonated 10 ft. below the free surface of the water. Bare charges were used throughout the trial in order to obviate all risks of injury from fragments of the metal casing normally used with $1\frac{1}{2}$ lb. demolition charges.

4. SUITS

Two suits were supplied by H.M.S. Dolphin in their sealed bags. Figs. 2-3-4 show a similar type of suit to that worn by one of us during these experiments, and the method of dressing.

5. UNDERGARMENTS

Only a thin shirt was worn between the S.E.I.S. and the skin of the subject. For condition A, this undergarment was worn dry and for condition B, wet. A sweater, as illustrated in Fig. 2.A., was not used in this trial.

6. POSITION OF SUBJECT

The subject floated on his back with his head towards the explosion as shown in Fig. 1.

7. RESULTS

The calculated shock wave parameters at various horizontal ranges are shown in Table 1. and the corresponding sensations experienced given in Table 2.

The results of these experiments show that the S.E.I.S. when fully inflated see Fig. 4.I., provides a high degree of protection from the effects of an underwater explosion. Even when the physical parameters are reasonably high there was no damage to the fabric.

When the suit was deflated, see Fig. 4.H., sufficiently to allow the water to press the suit and wet undergarment in contact with the subject's back, some discomfort was experienced, but this was at a comparatively short range where peak pressures are high.

TABLE 1

IMMERSION SUIT TRIAL (HORSEA LAKE).

1½ lb charge fired at a depth of 10 ft. in 20 ft. of water at various ranges from a subject floating on his back.

The surface of the suit in condition A and the subject's back in condition B is assumed to be $\frac{1}{2}$ ft. ($4\frac{1}{2}$ in) below water surface. The results herein are based upon (a) experimental determinations of shock wave parameters and time-constant C, and (b) that at time C, 43% and 80% respectively of the impulse and energy are received by the swimmer. The assumption is made that the pressure-time pulse is exponential from the shock wave onset time to time C.

Horizontal range from vertical above charge ft.	Peak pressure lb./in. ² .	Impulse lb. sec/in. ² .		Energy ft. lb./ft. ² .	
		Open water values	Open water values	Open water values	Open water values
15	753	0.057	0.166	71.4	102.1
20	591	0.040	0.137	41.6	66.0
25	481	0.029	0.116	25.4	45.4
30	402	0.023	0.101	16.8	32.9
35	344	0.018	0.089	11.5	24.8
40	300	0.014	0.080	8.3	19.3
50	237	0.010	0.066	4.6	12.7
60	195	0.0075	0.057	2.8	8.9
80	143	0.0045	0.045	1.3	5.1
100	112	0.0035	0.037	0.8	3.3

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TABLE 2

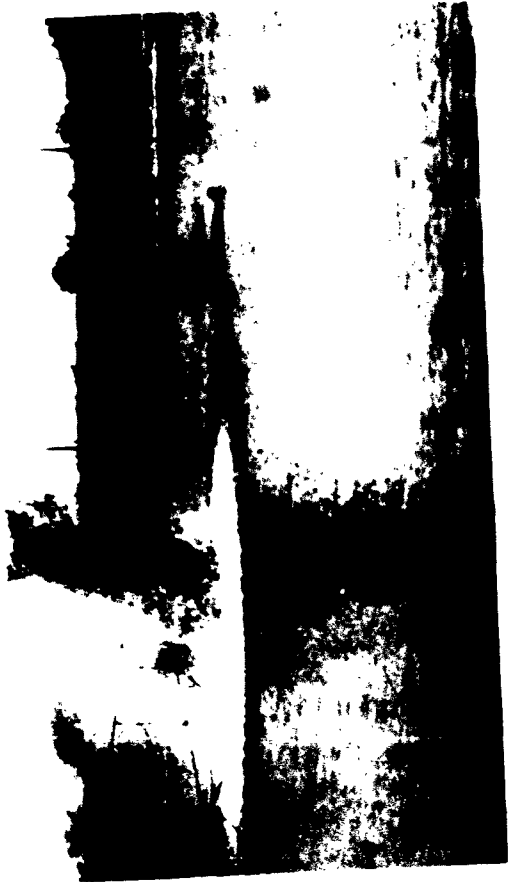
Shot No:	Horizontal distance in ft.	Condition A. S.E.I.S. fully inflated.	Condition B. S.E.I.S. deflated and undergarments worn wet.
1	100	-- Fairly loud noise on detonation	-- Fairly loud noise on detonation.
2	80	-- "	-- "
3	60	-- "	-- "
4	50	-- "	-- "
(5)	35	-- "	-- "
(6)	35	-- "	-- "
(7)	30	-- "	+ "
(8)	30	-- "	+ Body getting a little cold. Fairly loud noise on detonation.
(9)	25	-- "	++ Conditions much the same.
(10)	25	-- "	+ "
11	20	- Subject rocked by disturbance of water surface. No discomfort.	+++ Subject rocked by disturbance of water surface after receiving jar to spine. Stinging sensation on immersed hands and back of torso. Pain did not persist.
12	18	- Similar effects.	+++ Similar effects, jar more noticeable.

KEY: -- No sensation of pressure.
 Slight sensation of pressure.

+ Mild blow to back
 ++ Blow to back causing mild discomfort.
 +++ Violent blow to spine.
 No lasting effects.

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Fig. 1.





A



B

FIG. 2



C



F

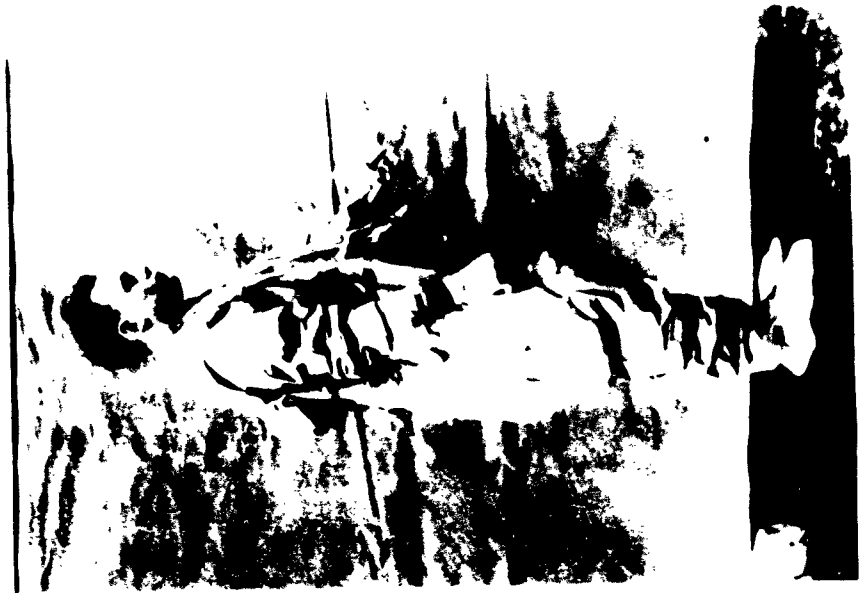


Fig. 3.

E



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*Information Centre
Knowledge Services*
[dstl] *Porton Down,
Salisbury
Wiltshire
SP4 0JG
22060-6218
Tel: 01980-613753
Fax: 01980-613970*

Defense Technical Information Center (DTIC)
8725 John J. Kingman Road, Suit 0944
Fort Belvoir, VA 22060-6218
U.S.A.

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