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WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/699

Effects of High Temperature (+175°F) and Low Temperature (-65°F) Upon the Resistance of Boron (Type #1) to Perforation by Flak-Simulating Projectiles

BY

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DATE 4 October 1944

WATERTOWN ARSENAL
WATERTOWN, MASS.

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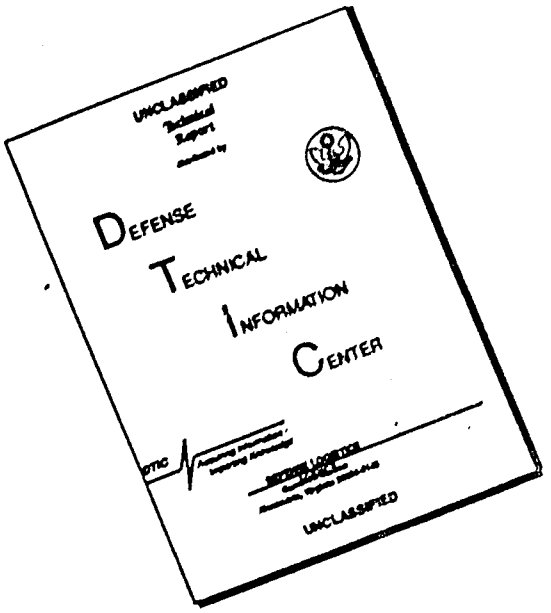

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MEMORANDUM REPORT NO. WAL 710/699

23rd Partial Report on Problem B-8.2

4 October 1944

Effects of High Temperature (+175°F) and Low Temperature (-65°F) Upon the Resistance of Doron (Type #1) to Perforation by Flak-Simulating Projectiles

1. In accordance with a request of the Office, Chief of Ordnance[1], tests have recently been conducted at this arsenal to determine the effects, if there are any, of high temperature (+175°F) and low temperature (-65°F) upon the resistance of Doron to perforation by flak-simulating projectiles.

2. Variations in temperature within the range investigated (+175°F to -65°F) apparently have no deleterious effects upon the resistance of Doron to perforation by cal. .45 steel-jacketed ball projectiles or by cal. .22 fragment-simulating projectiles, G-2[2]. However there is reason to believe that elevation of the temperature above 200°F may result in a lowering of resistance of this material.

3. Several pieces (24" x 24") of Doron which had been subjected to direct fragmentation tests at Aberdeen Proving Ground were received at this arsenal for weather cycling tests. Ten pieces were selected at random, areas (about 12" x 14") free from fragmentation impacts were marked out and cut off and these smaller sections were then subjected, at room temperature, to impact with cal. .45 steel-jacketed ball projectiles and with cal. .22 fragment-simulating projectiles, G-2.

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1. O.O. 400.112/13942(c) - Wtn 400.112/3134(c) dated 19 June 1944.

2. Watertown Arsenal Laboratory Memorandum Report No. WAL 762/253(c) "Development of a Projectile, to Be Used in Testing Body Armor, to Simulate Fragments of a 20 mm. H.E. Projectile", 7 January 1944.

4. Several samples were then selected randomly and subjected to the following weathering cycle:

(a) +175°F, high humidity - 24 hours.

(b) -65°F, dry air - 24 hours.

(c) +175°F, high humidity - 24 hours.

(d) -65°F, dry air - 24 hours.

(e) +175°F, high humidity - 24 hours.

then, at the end of phase (d) a number of samples were fired at -65°F and at the end of phase (e) other samples were fired at +175°F. In addition a few samples were allowed to return to room temperature after phases (d) and (e) and were then fired.

5. During a "hot run" preliminary to the formal weathering cycle several samples were accidentally subjected to temperatures above 200°F for a period of several hours. These samples showed considerable reduction in resistance to perforation by cal. .45 steel-jacketed ball projectiles when fired at +175°F after this run.

6. During these preliminary runs a single cabinet capable of maintaining temperatures within the range +220°F to -100°F was used. The use of a single cabinet necessitated a lag of two to four hours in adjusting from the low to the high temperature and vice versa. It was thus decided to use an oven for the hot phases and the "sub-zero" cabinet for the cold phases. The cabinet was also used to "hold" the samples at the desired temperature during firing.

7. In order to guarantee that the specimens would be fired at the desired temperature it was necessary to provide a special target frame. A frame was constructed which allowed the specimens to be dropped into position with a minimum of delay. The specimens were removed singly from the cabinet, dropped into position and impacted with the appropriate projectile within an elapsed time of fifteen seconds. After a single shot, the specimen was returned to the cabinet and remained therein until all the other samples had been fired. Specimens thus regained the desired temperature in time for each successive impact. Although thermocouples were not employed during these tests, earlier experiments provided assurance that the specimens were actually being impacted at the desired temperatures. The results of all firings are contained in Table I.

8. Examination of that table reveals no significant variation in resistance of samples as received and as subject to temperature variation within the prescribed range (+175°F to -65°F). It is thus considered that mere variation in temperature within such a range will produce no deleterious effects on the ability of the subject material to resist perforation by cal. .45 steel-jacketed ball projectiles and cal. .22 fragment simulating projectiles, G-2.

9. The sunlamp-fog weather test will be conducted and reported as soon as equipment for such a test becomes available.

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APPROVED:

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TABLE I

Summary of Results of Ballistic Tests Conducted at Watertown Arsenal on Samples of Doron (Type #1) Which Had Previously Been Subjected to Direct 20 MM. H.E. Fragmentation Tests at Aberdeen Proving Ground

Sample	Ballistic Limit Cal. .45	G-2
(Samples fired at room temperature, as-received):		
R474G	1011	1348
R474F	1010	1350
R474L	973	1344
R474C	909	1344
R474N	1035	1404
R474K	1039	1378
R474E	1041	1408
R580A	1060	1346
R575A	1015	1279
R582C	1014	1373
(Samples fired at -65°F at end of fourth phase of weathering cycle):		
R573A	1030	--
R582F	1021	--
R580C	1031	--
R583A	--	1363
R577B	--	1460
R579C	--	1344
R575D	--	1285
(Samples fired at room temperature at end of fourth phase of weathering cycle):		
R579C	1065	--
R572B	1117	--
R579D	1175	--

TABLE I (CONT'D)

Sample	Ballistic Limit Cal. .45	G-2
(Samples fired at +175°F at end of fifth phase of weathering cycle):		
R583A	1057	--
R574B	1096	--
R574D	1060	--
R576E	--	1270
R579D	--	1415
R574	--	1285
R574E	--	1257
R576B	--	1407
(Samples fired at room temperature at end of fifth phase of weathering cycle):		
R577D	1038	--
R577E	1072	--
R574	1046	--
(Samples fired at +175°F after a hot phase of the weathering cycle during which temperature of cabinet rose above 200°F for a period of several hours).		
R575E	680	--
R577D	869	--
R583D	836	--
R573A	680	--
R582F	676	--
R574E	805	--