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NAVORD REPORT [illegible]

PRIMARY EXPLOSIVE EVALUATION, PROGRESS REPORT

22 SEPTEMBER 1953

U. S. NAVAL ORDNANCE LABORATORY

WHITE OAK, MARYLAND

SECURITY INFORMATION

NAVORD Report 2974

PRIMARY EXPLOSIVE EVALUATION, PROGRESS REPORT

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ABSTRACT: New explosive materials which have a good vacuum stability and which show sensitivities on the drop test machine in the range of primary explosives have been tested to determine their possibilities as primary explosives. Collodial lead styphnate and collodial lead azide, which are made by a process resulting in a small particle size, are similar in performance to regular azide or styphnate which has been ground in a ball mill for twenty-four hours. Of the new materials, methyl 5-nitrotetrazole, silver 5-nitrotetrazole, and potassium dinitrobenzofuroxan appear to have possibilities.

Explosives Research Department
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White Oak, Maryland

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This report gives the results of work done recently in the evaluation program for new primary explosives. It was done under Task Assignments NOL-B2c-18-1-54 and NOL-B2b-41-1-54. The experimental work on the firing time, dent, and stab sensitivity tests was done by Jacob Savitt, Warren Slie, and Theodore Bly respectively. These tests are preliminary in character and the results are presented for information only.

EDWARD L. WOODYARD
Captain, USN
Commander

James E. Ablard
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By direction

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PRIMARY EXPLOSIVE EVALUATION, PROGRESS REPORT

INTRODUCTION

1. A considerable number of new explosive substances have shown a sensitivity when tested on the impact machine which suggest that they might be considered as primary explosives. These materials have been subjected to the tests described in detail in reference (a).

SHORT DESCRIPTION OF TESTS

2. There are four of these tests. The first test to which a new material is subjected is a firing time test. This test is a measurement of the functioning time of a special electric detonator when subjected to an electrical pulse of considerably greater magnitude than that required to vaporize the bridge wire. The results obtained from this test appear to give a good indication of the length of column required for the explosive to build up to detonation. Five shots were attempted with each material. For a considerable number of the materials several failures were obtained. In general these materials were not tested further since failure to fire under these conditions indicates that the material is too insensitive to be considered as a primary explosive.

3. The dent test is a measure of the output of the explosive. Some previous work, reference (b), indicates that there is good correlation between the dent produced by a detonator and the ability of the detonator to initiate a tetryl booster. The explosive to be tested is loaded into a column 0".150 in diameter along the axis of a metal cylinder one inch long and one inch in diameter. This explosive is detonated in contact with a steel block. The depth of the dent produced is divided by the radius of the explosive column. This ratio is the value reported for the explosive.

4. The test of stab sensitivity was made with a modified detonator test set Mk 136. This test measures the sensitivity of the material when used in a percussion primer.

5. In the hot wire sensitivity test the explosive is press loaded into the charge holder of an initiator plug having a tungsten bridge wire

thirty mils long. The diameters of bridge wire used were about 0.27 mil and 0.1 mil respectively. Two groups of these initiators, one with each size of bridge wire, were loaded with the explosive being tested. These initiators were subjected to the discharge of a variable condenser which had been charged to a potential of twenty volts. The capacitance was varied so as to find the energy necessary to fire fifty percent of the initiators. All explosives were ground in a ball mill for twenty-four hours before loading except the collodial lead azide and collodial lead styphnate. These materials already have a small particle size and were therefore tested without being ground.

RESULTS

6. The results obtained are given in tabular form. Values are also given for several well known explosives for reference purposes. A typical value for the firing time is given when this was less than about fifty microseconds. For those materials which gave failures the number of fires in five trials is also given. In the stab sensitivity test the results given are obtained by multiplying the weight in grams of the ball used by the distance in inches through which the ball must be dropped to give fifty percent initiation.

CONCLUSIONS

7. The collodial lead azide gives results which are comparable to those of the ground polyvinyl alcohol lead azide and are better than those obtained with dextrinated lead azide which has been ground for only twenty-four hours in the ball mill used. The sensitivity of the dextrinated lead azide can be improved by further grinding. The results obtained with unground collodial lead styphnate are very similar to the values for regular lead styphnate which has been ground for twenty-four hours. Among the new materials silver 5-nitrotetrazole has a short build-up time, a fair output, and a good hot wire sensitivity. Potassium dinitrobenzofuroxan shows results somewhat similar to those of tetracene or lead styphnate. Silver azidodinitrophenolate had a low energy requirement in the stab sensitivity test but did not show up well in other tests. It should be kept in mind that these tests are only intended to be preliminary screening tests. Further extensive tests would be necessary before these materials could be recommended for replacement of those primary explosives now in use.

TABLE 1

Explosive	Firing Time No. of Fires (5 Attempts)	Time Microseconds	Dent	Stab Sensitivity (gram-in)
Copper-5-Nitro-tetrazole	3	long	none	failed
N-Nitro-N(3,3,3-Trinitro-propyl)Trinitroethyl carbamate	2	35		
2,2,2-Trinitroethyl-3,3,3-Trinitropropyl-nitramine	1			
Cupric-5-Nitramino-tetrazole	4	45	none	
Mercurous-5-Nitramino-tetrazole	5	30	dead pressed at 8,000 psi	
Silver Azidodinitro-phenolate	3	32	none	550
Mercurous 4,4,4-Trinitro-butyrate	0			
Lead 4,4,4-Trinitro-butyrate	0			
Potassium Cupric Styphnate Cupric-Hypophosphite	4	long	none	2000
Guanidine Nitroformate	0			
Silver Salt of Dinitro-triazole	4	long		
1-3-5 Tris(Trinitro-ethylnitraminoacetyl) Perhydro-5-Triazine	3	long		

TABLE 1 (CON'T)

Explosive	Firing Time No. of Fires (5 Attempts)	Time Microseconds	Dent	Stab Sensitivity (gram-in)
Lead Salt of Haleite*	3	long		
Mercuric Salt of Haleite*	4	long	none	1800
Silver Salt of Haleite*	3	long		

*Ethylenedinitramine also known as EDNA

TABLE 2

Explosive	Firing Time (Microsec.)	Dent d/r	Stab (gram-in)	Sensitivity Hot Wire Diam. 0."27 mils (ergs)	0.1 mils (ergs)
Methyl-5-Nitrotetrazole	15	0.05	1850		
Mercurous-5-Nitro-tetrazole	5	-	-	over 4000	
1,1,1,6,6,6-Hexanitro-3-hexyne	15	-	3100		
Collodial Lead Styphnate	30	none	1525	890	105
Collodial Lead Azide	4	0.20-0.35	1750	1270	290
Potassium Dinitrobenzo-furoxan	30	none	1200	860	135
Silver-5-Nitrotetrazole	6	0.08-0.28	-	1600	300
Lead Styphnate	20	0-0.15	2100	1140	125
Polyvinyl Alcohol Lead Azide	-	0.20-0.37	-	1325	290
Dextrinated Lead Azide	5	0.21-0.41	2100	2740	-
Mercury Fulminate	15	0.23-0.44	500	1140	285
Tetracene	13-47	none	915	900	310

REFERENCES

(a) NavOrd Report 2824 - Primary Explosives Evaluation Tests, L. D. Hampton, J. Savitt, W. M. Slie, R. H. Stresau.

(b) NavOrd Report 2815 - Direct Initiation of Boosters by Electric Detonators, R. H. Stresau, W. M. Slie, L. D. Hampton.

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