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HE FRICTION SENSITIVITY

J. H. Van Velkinburgh

DEVELOPMENT DIVISION

JULY - SEPTEMBER 1973

Lawrence Livermore Laboratory
SANL 260-003

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NOTICE

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This is the study of the frictional sensitivity of explosives and the mechanism of frictional initiation as applied to large bare explosive samples in oblique impact (the Skid Test).

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ABSTRACT

An extensive series of instrumented skid tests was done on 11-inch diameter billets of RX-04-EL and RX-04-EK (94/6 and 96/4 HMX/Estane by weight respectively).

Friction machine tests were done on RX-04-EL. Results are presented and discussed.

Skid tests were done on RX-08-CH, an ECX, from a height of 10-feet at both 14° and 45°. No reactions were observed.

DISCUSSION

An extensive series of instrumented skid tests was done on 11-inch diameter hemispheres of RX-04-EL and RX-04-EK (mean densities were 1.821 and 1.834 g/cc respectively). Both were found to exhibit about the same sensitivity to oblique impact. Melting at the impact spot occurred at heights greater than or equal to 3.5 feet at 45° and 1.25 feet at 14° with the RX-04-EK exhibiting the greater melting. Examination of the skid surface after testing, the calculated coefficients of friction and the measured final rotational velocities confirmed the melting. While a visual examination of the skid surface after testing gave a qualitative estimate of the difference in melting between the RX-04-EL and -EK, a plot of the final rotational velocity versus drop height shows this difference (and the difference in shear strength or cohesive strength) more readily. Figs. 1 and 2 give such a plot. Included are the RX-04-EG (98/2 HMX/Estane) and RX-04-EE (95/5 HMX/Estane) results for comparison and to show the trend in decreasing final rotational velocity with increasing HMX content. Tables I and II give pertinent test parameters and results.

Fig. 3 graphically presents the reaction level-normal force data from the friction machine tests on RX-04-EL. The size of the explosive sample was a 1.000-inch diameter x 0.125-inch disc. The frictional sensitivity of RX-04-EL is slightly less than PBX 9404 and approximately that of LX-07.

Three each skid tests were done on an extrusion cast explosive, RX-08-CH, at 10'/45° and 10'/14°. No reactions were observed in any of the tests. No accelerometer records were obtained due to the inability to satisfactorily bond the accelerometers to the equatorial surface of the billet.

COMMENTS, CONCLUSIONS

Experimental work was halted for the last third of the period for installation of new equipment at the firing site. The installation should be completed the first part of next period.

Molding powder was formulated and pressing initiated on RX-04-EI and RX-04-EJ (98/2 and 99/1 HMX/Vistanex).

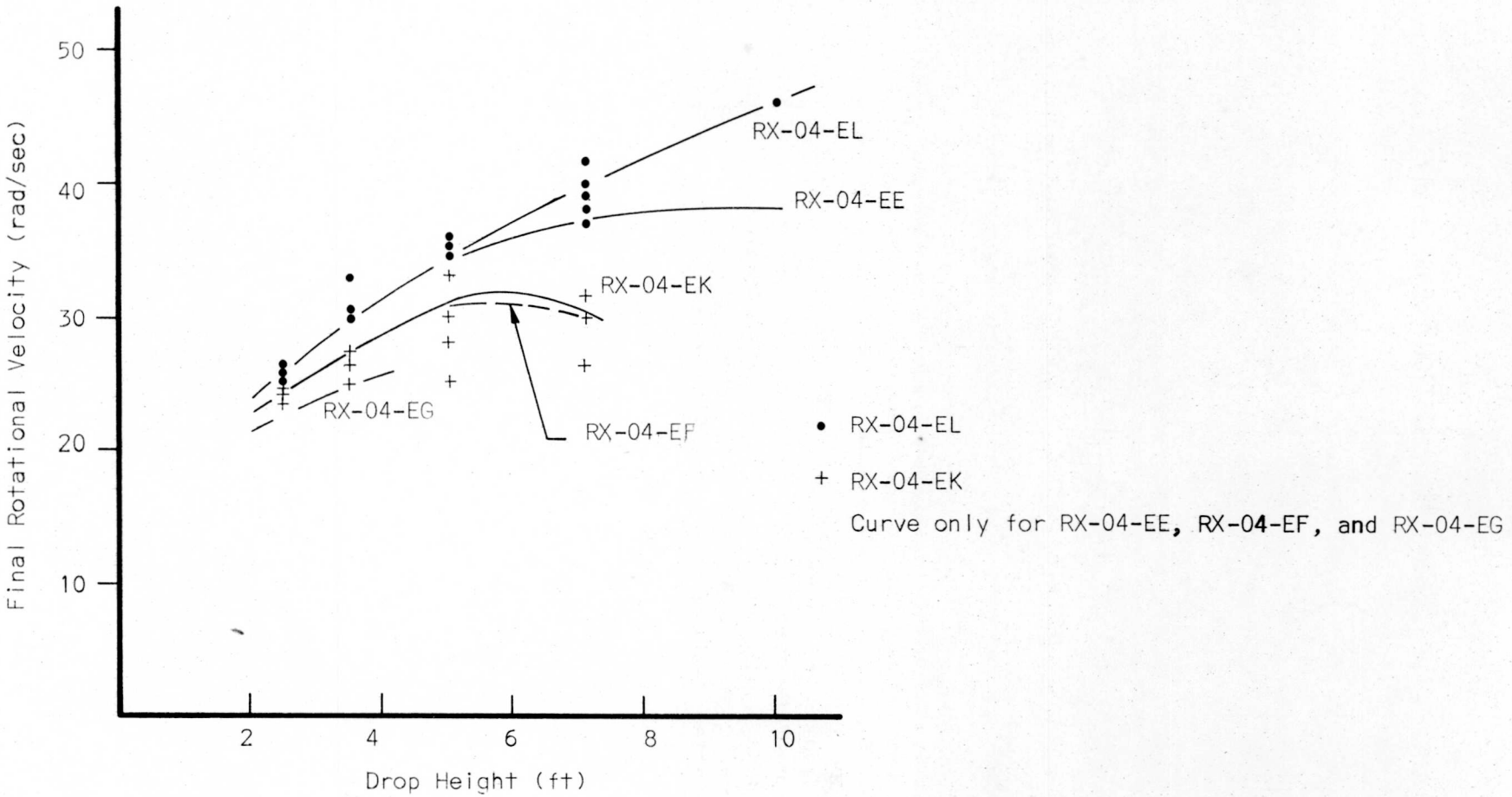

Fig. 1. Final Rotational Velocity Versus Drop Height for 45° Impact Angle

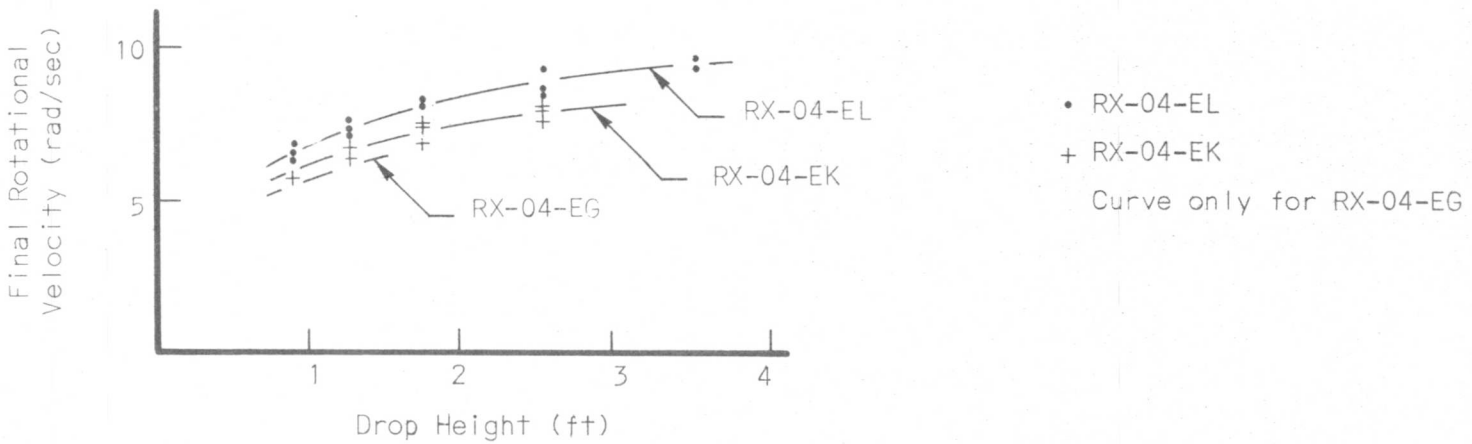

Fig. 2. Final Rotational Velocity Versus Drop Height for 14° Impact Angle

Table I. Test Parameters for Skid Tests Using RX-04-EL

45° Impact Angle

Skid No.	Drop Height (ft)	Billet Wt. (lbs)	Final Rotational Velocity (Rads/sec)		Coefficient of Restitution	
			Fastax	Accelerometer		
946	2.5	22.93	24.51	25.72	0.37	
947	2.5	22.92	24.96	24.95	0.39	
948	2.5	22.86	23.61	26.04	0.38	
949	3.5	22.92	28.80	Record Lost	0.39	
950	3.5	22.93	28.82	30.21	0.38	
951	3.5	22.88	33.24	29.56	0.40	
952	5.0	22.75	34.61	35.06	0.37	
953	5.0	22.90	33.74	34.46	0.38	
954	5.0	22.90	34.13	35.52	0.40	
955	7.1	22.59	39.03	41.48	0.40	
956	7.1	22.77	38.12	39.91	0.37	
957	7.1	22.77	36.80	41.55	0.37	
958	10.0	22.60	-	-	-	#6 Reaction
1006	10.0	22.09	46.19	Record Lost	0.33	

14° Impact Angle

972	0.88	22.45	6.25	6.25	0.30	
973	0.88	22.60	6.57	6.81	0.30	
974	0.88	22.42	5.24	6.17	0.30	
978	1.25	22.31	7.16	7.65	0.30	
979	1.25	22.44	8.23	7.09	0.30	
982	1.25	22.40	7.28	6.78	0.30	
984	1.75	22.19	7.23	8.15	0.30	
985	1.75	22.32	7.54	Record Lost	0.30	
986	1.75	22.41	7.53	7.94	0.30	
990	2.5	22.19	8.07	9.11	0.30	
992	2.5	22.10	8.41	8.22	0.30	
993	2.5	22.40	6.51	8.34	0.30	
996	3.5	22.06	8.25	9.11	0.30	
997	3.5	22.07	8.82	9.42	0.30	
998	3.5	22.07	-	-	-	#3 Reaction

Table II. Test Parameters for Skid Tests Using RX-04-EK

45° Impact Angle

Skid No.	Drop Height (ft)	Billet Wt. (lbs)	Final Rotational Velocity (Rads/sec)		Coefficient of Restitution	
			Fastax	Accelerometer		
959	2.5	22.92	26.14	24.85	0.39	
960	2.5	23.01	26.21	23.00	0.37	
961	2.5	23.05	24.58	23.07	0.38	
962	3.5	23.04	24.88	24.35	0.40	
963	3.5	23.06	29.67	26.83	0.39	
964	3.5	23.07	29.82	26.04	0.40	
965	5.0	23.01	28.14	25.05	0.38	
966	5.0	22.97	32.51	29.99	0.40	
967	5.0	22.83	35.07	32.84	0.39	
968	7.1	22.87	30.04	Record Lost	0.37	
969	7.1	22.67	31.91	Record Lost	0.36	
970	7.1	23.01	26.41	25.77	0.36	
971	10.0	22.58	-	-	-	#5 Reaction

14° Impact Angle

975	0.88	22.61	Too Small to Resolve	5.79	0.30	
976	0.88	23.07	Too Small to Resolve	5.62	0.30	
977	0.88	22.81	Too Small to Resolve	5.74	0.30	
980	1.25	22.90	5.93	6.47	0.30	
981	1.25	22.53	5.73	6.40	0.30	
983	1.25	22.77	6.52	Record Lost	0.30	
987	1.75	22.50	7.50	7.55	0.30	
988	1.75	22.77	7.14	7.46	0.30	
989	1.75	22.96	6.90	6.85	0.30	
991	2.5	22.53	7.35	7.80	0.30	
994	2.5	22.19	Film Lost	7.20	-	
995	2.5	22.35	6.62	7.23	0.30	
1002	3.5	22.27	-	-	-	#4 Reaction

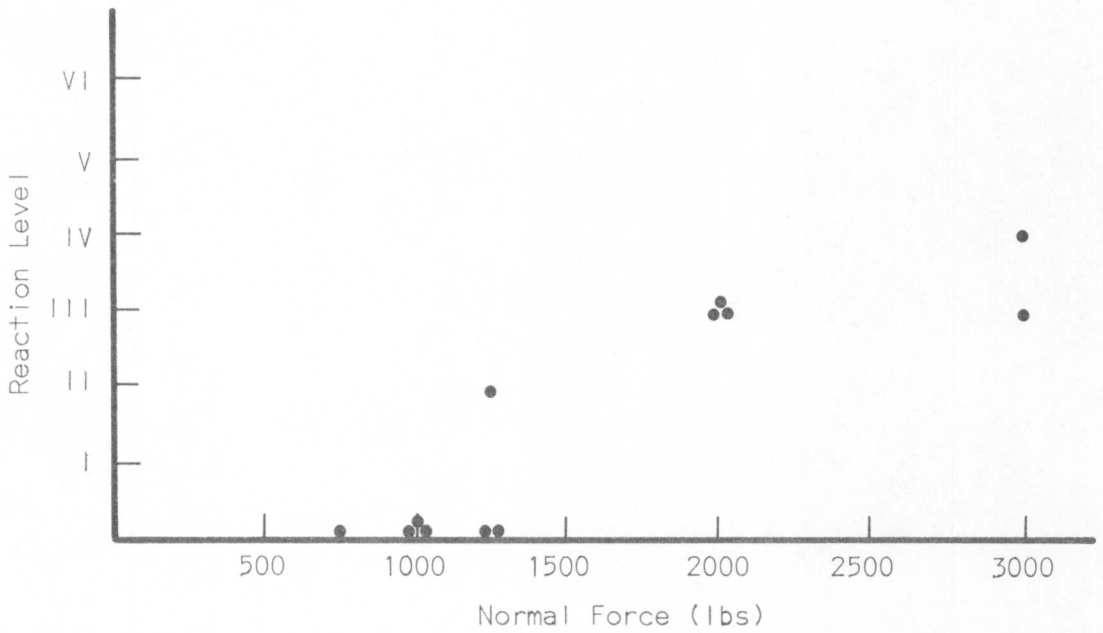

Fig. 3. Friction Test Results on RX-04-EL