2cy

MHSMP-73-44C

EXPLOSIVES PERFORMANCE AND SENSITIVITY

P. E. Kramer

DEVELOPMENT DIVISION

JULY - SEPTEMBER 1973

For
Lawrence Livermore Laboratory
Livermore, California

Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant
P. O. BOX 647
AMARILLO, TEXAS 79177
806-335-1581

operated for the
ATOMIC ENERGY COMMISSION
under
U. S. GOVERNMENT Contract DA-11-173-AMC-487(A)

EXPLOSIVES PERFORMANCE AND SENSITIVITY

P. E. Kramer

DEVELOPMENT DIVISION

The purpose of this activity is to evaluate the performance and sensitivity of experimental explosives.

July - September 1973
SANL No. 260-003

EXPLOSIVES PERFORMANCE AND SENSITIVITY

ABSTRACT

Half-inch gap, wedge, and cylinder tests were conducted on RX-04-EL, a 94/6 weight percent HMX/Estane formulation.

A half-inch gap test was also performed on LX-10-0 Lot 710-4 which had been treated by thermal cycling under confinement after pressing.

There was also a continued investigation into the 1% difference in expansion velocities between LLL and Pantex cylinder shots.

DISCUSSION

As a continuation of the study of performance and sensitivity properties of HMX/Estane formulations, half-inch gap, wedge, and cylinder tests were conducted on RX-04-EL, which is 94/6 weight percent HMX/Estane.

The gap test, fired at ρ = 1.820 g/cc, yielded a G_{50} of 68 mils with a 95% confidence of ± 7 mils. This is consistent with results for RX-04-EE and RX-04-EF.

The 1-inch cylinder test yielded a detonation velocity of 8.739 ± 0.008 mm/µsec at 95% confidence; the expansion values are in Table I. Considering compositions and previous results for RX-04-EE, RX-04-EF, and RX-04-EG, both the detonation velocity and expansion for RX-04-EL seem to be slower than would be expected.

Table I. 1-Inch Cylinder Test Results for RX-04-EL

ρ = 1.822 g/cc

$R - R_o$ (mm)	T (µsec)	V (mm/µsec)
5	4.032	1.538
6	4.674	1.580
19	12.308	1.776

A 3-shot wedge test series was conducted on RX-04-EL at ρ = 1.820 g/cc and the results appear in Table II. In addition to its intrinsic value, this series was of great interest because the series fired on two other HMX/Estane formulations, RX-04-EE and RX-04-EF, yielded seemingly contradictory results (see report for April-June 1973). The Log-Log plots of distance to detonation and time to detonation vs transmitted pressure crossed at

about 90 kbar, but the plots of excess transit time vs transmitted pressure were parallel. For HE's which differ only in the percentage of components, it is normal for all three sets of plots to be parallel. The RX-04-EL data in Table II were plotted with the data for RX-04-EE and RX-04-EF. On all three plots, the RX-04-EE and RX-04-EL data were parallel. Furthermore, two of the three points for RX-04-EF fit quite well to the same pattern. The highest pressure point for RX-04-EF appears to be anomalous. This idea is supported by the feeling that the transmitted pressure value calculated for this shot, 95 kbar, is not consistent with the trend displayed by these formulations with other donors—91 kbar would be the expected value. In summary, of the wedge test series on these three formulations, the data appear to be self-consistent if the highest pressure point for RX-04-EF is disregarded. If this is done, then, in terms of transmitted pressure, RX-04-EF and RX-04-EL appear to be about equally sensitive, RX-04-EE may be slightly less sensitive; the difference is probably not significant.

There has been some investigation of the effects on LX-10-0 of subjecting it to thermal cycling under confinement after pressing. Desirable improvements in some properties have resulted. There was some speculation that this treatment might significantly reduce its shock sensitivity. A half-inch gap test was conducted on parts from Lot 710-4 which had been treated in this manner. At machining time, the density was 1.868 g/cc, a decrease of 0.003 g/cc in the nine months since treating the billets. The result was 99 ± 6 mils of brass. This does not represent a statistically significant departure from other LX-10-0 tests, but if there is a change, it is one of slightly increased sensitivity.

Table II. RX-04-EL Wedge Test Results

Transmitted Pressure (kbar)	Distance to Detonation (mm)	Time to Detonation (μsec)	Excess Transit Time (μsec)
44	7.1	1.69	0.88
55	5.0	1.11	0.54
89	2.3	0.45	0.19

Cylinder Tests

Examination of velocity differences between cylinder tests performed at Pantex and LLL (1% at 19 mm expansion) continued. Enough pieces of PBX 9404 for 4 shots were machined from a single billet. Four shots were assembled using Pantex cylinders. One was shipped to Frank Helm at LLL; it has not yet been fired. Two of the three remaining shots were fired at Pantex for a reproducibility check. As can be seen from Table III the agreement was quite good, especially for velocities. Agreement with a previous shot from the same lot was also quite good.

Table III. 1-Inch Cylinder Tests on PBX 9404 Lot 620-1

ρ = 1.842 g/cc
D_1 = 8.777 mm/μsec
D_2 = 8.780 mm/μsec

$R - R_o$ (mm)	T (μsec)		V (mm/μsec)	
	Shot 1	Shot 2	Shot 1	Shot 2
5	3.944	3.923	1.577	1.574
6	4.570	4.550	1.618	1.614
19	12.035	12.035	1.816	1.820

As stated in the report for January - March 1973, a Pantex study of writing rate measurements on the Model 101 camera indicated a probable error of + 0.2% for writing rates on cylinder tests; this would result in expansion velocity errors of + 0.2% also; other sources must be primarily responsible for the 1% discrepancies.

During this period a test of the linearity of the dynamic magnification of the Model 101 was conducted. Dynamic magnification was found to be uniformly 0.1% greater than static magnification; the linearity of the difference eliminates it as a source of error. However, during the tests it was discovered that the static magnification is non-linear; it is smallest in the film center, and appears to increase symmetrically toward the top and bottom. For a typical cylinder shot film, preliminary calculations indicate that the magnification at 19 mm expansion is about 0.3% greater than in the region where shot film magnification is measured. Again, this would be reflected directly in expansion velocity.

Combining these errors in writing rates and magnification thus tentatively accounts for a + 0.5% error in the Pantex 19 mm expansion velocity. More detailed study of the magnification is planned.

The cause of the remaining 0.5% discrepancy is yet to be discovered.