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TATB PBX DRILLING

Bill M. Washburn

DEVELOPMENT DIVISION

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*Process Development
Endeavor No. 216*



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ABSTRACT

The temperatures produced on drilling (without water) small holes in pressed TATB PBX samples were measured using thermocouples in 3/16-inch and 1/4-inch twist drills. Temperatures up to 273 C were obtained at 480 rpm and a feed rate of 0.001 in/rev for PBX 9502. Lower temperatures were measured at lower speeds and for RX-03-BB. A feed rate of 0.007 in/rev and speed of 160 rpm gave temperatures below 165 C in all cases.

DISCUSSION

Very limited information was available at Los Alamos, Lawrence Livermore Laboratory and Pantex as to expected temperature from drilling TATB PBX. Los Alamos has conducted TATB drilling experiments and those results are shown in Table I. Previous Pantex drilling experiments were conducted without thermocouples and these results are shown in Table II.

The current drilling experiments were designed to supplement the previous data with temperature measurements. The test matrix is shown as follows:

Sample Size: 25 x 25 x 76 mm

Composition: PBX 9502 (95/5%) RX-03-BB (92.5/7.5%) TATB/Kel-F

Speed (rpm)	Feed Rate (in/rev)			
	10%	50%	70%	
	0.001	0.005	0.007	0.010
100	X		X	X
160	X		O	X
200	X		X	X
480	X	⊗	X	X

O Production rpm and feed rate

⊗ Comparison with LASL results

Number of runs - 3 each condition

TEST PLAN - TATB DRILLING

Drill Sizes: 3/16-inch Twist, 1/4-inch Twist

Temperatures were measured for each of 3 tests during dry machining of matrix

Table I. LASL Drilling Experiments

(Temperatures from thermocouple in one flute on dry drilling)

	<u>Drill Size (in)</u>	<u>Drill Depth (mm)</u>	<u>Drill Speed (rpm)</u>	<u>Feed Rate (in/rev)</u>	<u>Temperature (C)</u>
TATB	1/16	38	480	0.005	116
	3/16	51	480	0.005	114
95/5 TATB/Kel-F (X-0290)	1/16	38	480	0.005	221
	3/16	51	480	0.005	210
90/10 TATB/Kel-F (RX-03-AB)	1/16	38	480	0.005	200
	3/16	51	480	0.005	159

Table II. Previous Pantex Drilling Experiments

(92.5/7.5% TATB/Kel-F, 95.5/4.5% TATB/Estane,
93.25/6.75% TATB/Viton)

<u>No. of Tests (ea)</u>	<u>Drill Size (in)</u>	<u>Drill Depth (mm)</u>	<u>Drill Speed (rpm)</u>	<u>Feed Rate (in/rev)</u>	<u>Water Flood</u>
2	1/4	51*	400	0.035	Yes
2	1/4	51*	400	0.035	No
2	1/4	38	300	0.060	Yes
2	1/4	38	300	0.060	No

**Material buildup in drill flutes and along drill caused drill to stall. Drill was driven through 51 x 51 x 51 mm samples without turning.*

conditions with 3/16- and 1/4-inch drills and both formulations.

The twist drills were a carbide type designed for plastic material. The thermocouples were iron-constantan. The iron was welded to the shank at the top of the flutes. The constantan lead was placed in one flute and covered with high temperature epoxy. These drills were calibrated in an oil bath.

The explosive sample size was 25 x 25 x 76 mm long. Fig. 1 shows a typical setup before and after drilling.

The drilling results are shown in Tables III and IV. The data are plotted on Figs. 2 and 3.

The 100 rpm data for the 1/4-inch drill were discounted and those for the 3/16-inch drill were reduced to only one feed rate (0.001 inch/rev) because of severe cracking of the test samples. The 160 rpm, 0.010 inch/rev tests were discontinued for the same reason.

A feed rate of 0.003 inch/rev was added to the 1/4-inch drill test series for additional information.

The maximum temperature experienced with the 3/16-inch drill in X-0290 at 480 rpm and 0.005 inch/rev was 248 C while LASL obtained 210 C under the same conditions. The Pantex thermocouple may have used more of the flute area than that of LASL.

Most of the samples broke at the high feed rate, and those which did not break produced hairline cracks. This was probably due to the sample size. In almost all cases the temperature dropped before drilling depth was reached. In all cases when temperature began dropping, cuttings began flowing up the single open flute, as viewed on the closed circuit TV monitor. In some cases the temperature would rise at a constant rate up to approximately 90 C then level off for a few milliseconds then rise at a fairly uniform rate to the peak temperature. The significance of this is not apparent at this time.

FUTURE WORK, COMMENTS, CONCLUSIONS

With the 3/16-inch drill maximum temperatures were experienced at the highest speed (480 rpm) and lowest feed rate (0.001 in/rev) tested. Lower temperatures were experienced with the 1/4-inch twist drill and the results were less dependent on feed rate. PBX 9502 gave slightly higher temperatures than RX-03-BB under all test conditions.

A speed of 160 rpm in combination with a feed rate of 0.007 in/rev gave maximum temperatures less than 165 C without severe breakage of the samples.



BEFORE



AFTER

Fig. 1. Typical Drilling Setup

Table III. PBX 9502 Drilling Results

Feed Rate (in/rev)	Speed (rpm)	Temperature (C)	
		Average	Maximum
(Drill Size 3/16-inch Twist, Depth 51 mm)			
0.001	100	172	173
	160	191	197
	200	211	214
	480	262	273
0.005	100	-	-
	160	-	-
	200	-	-
	480	247	248
0.007	100	-	-
	160	146	164
	200	146	164
	480	235	244
0.010	100	-	-
	160	138	149
	200	146	156
	201	201	205

(Drill Size 1/4-inch Twist, Depth 57 mm)

0.001	160	167	173
	200	162	165
	480	198	216
0.005	150	163	166
	200	182	183
	480	-	-
0.007	160	148	157
	200	159	163
	480	231	233
0.010	160	-	-
	200	161	169
	480	213	221

Table IV. RX-03-BB Drilling Results

Feed Rate (in/rev)	Speed (rpm)	Temperature (C)	
		Average	Maximum
(Drill Size 3/16-inch Twist, Depth 51 mm)			
0.001	100	150	151
	160	174	177
	200	174	175
	480	233	235
0.005	100	-	-
	160	-	-
	200	-	-
	480	217	218
0.007	100	-	-
	160	139	150
	200	158	161
	480	214	217
0.010	100	-	-
	160	123	135
	200	144	152

(Drill Size 1/4-inch Twist, Depth 57 mm)

0.001	160	156	161
	200	162	165
	480	191	194
0.005	160	161	167
	200	170	174
	480	-	-
0.007	160	135	157
	200	145	174
	480	202	205
0.010	160	-	-
	200	108	113
	480	203	210

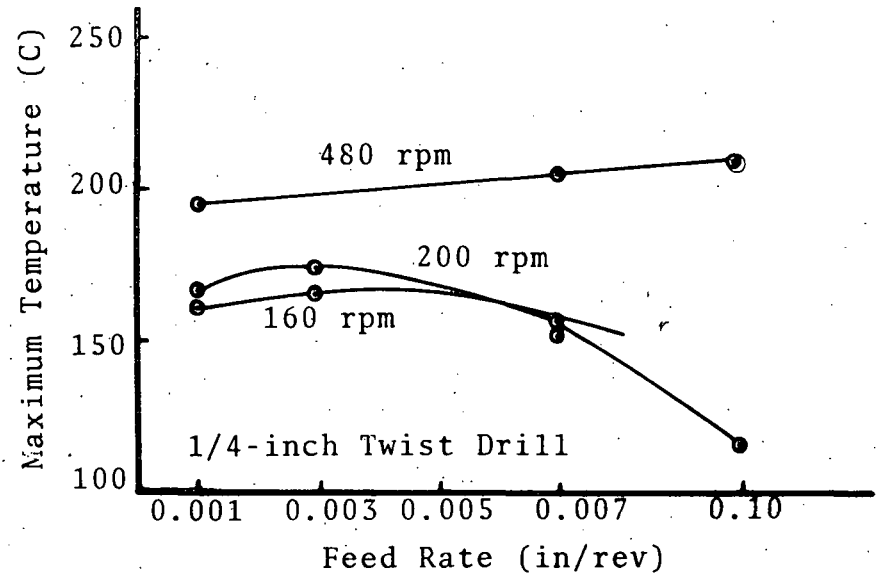
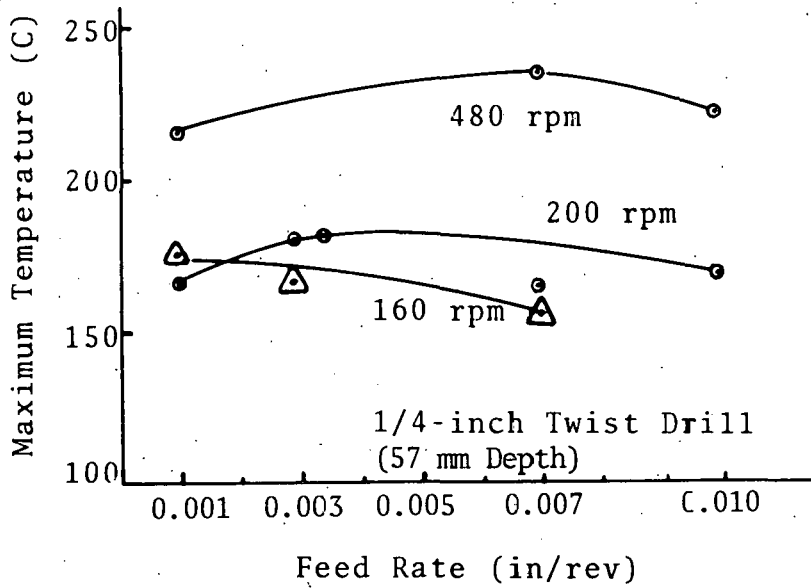
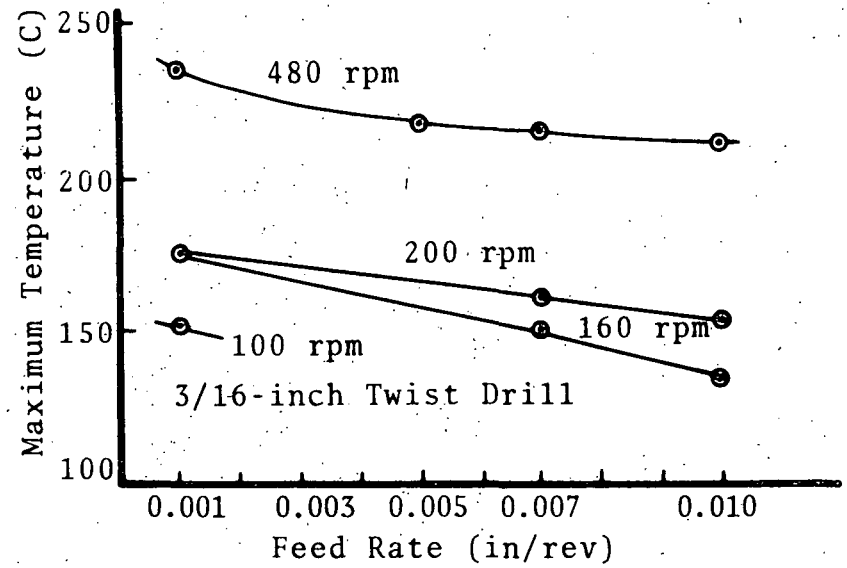
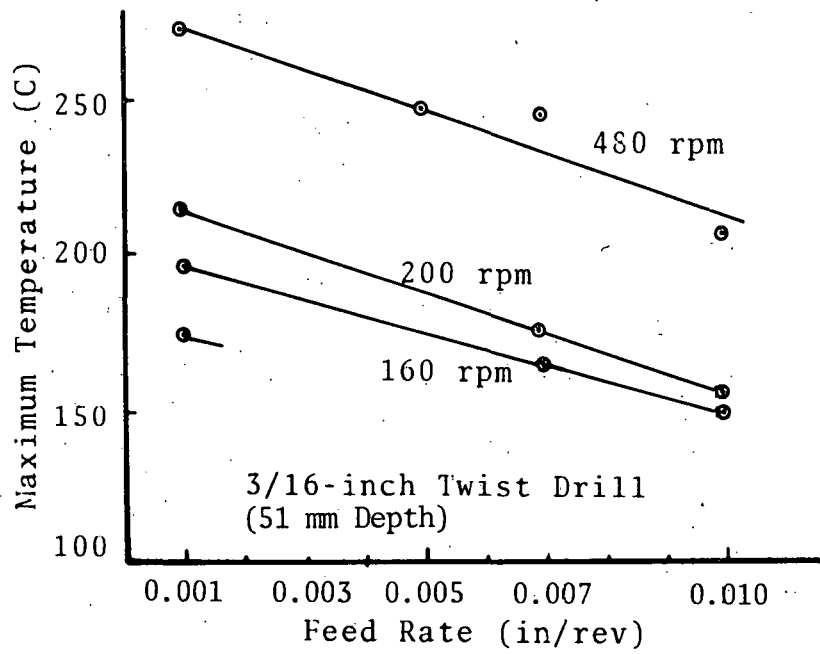


Fig. 2. PBX 9502 Dry Drilling Tests

Fig. 3. RX-03-BB Dry Drilling Tests

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