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IMPLEMENTATION OF DETONATION ELECTRIC EFFECTS

J. K. Boettner

DEVELOPMENT DIVISION

JANUARY - MARCH 1971

Normal Process Development
Endeavor No. 116

Mason & Hanger-Silas Mason Co., Inc.
Pantex Plant
P. O. BOX 647
AMARILLO, TEXAS 79105
806-335-1581

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Implementation of Detonation Electric Effects

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Using shock generated electrical signals to measure events in HE/laminate systems.

January, February, March 1971
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Section X

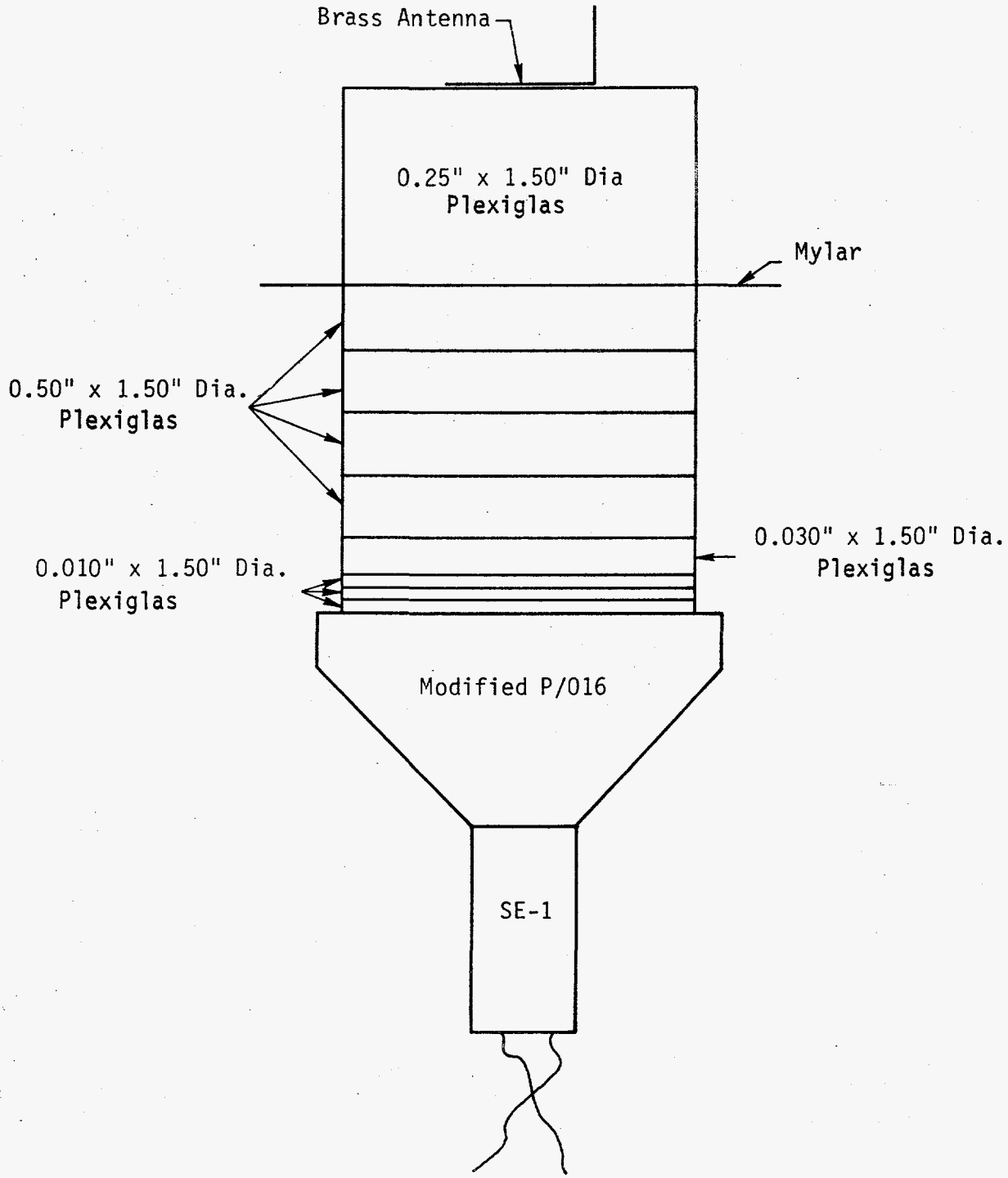
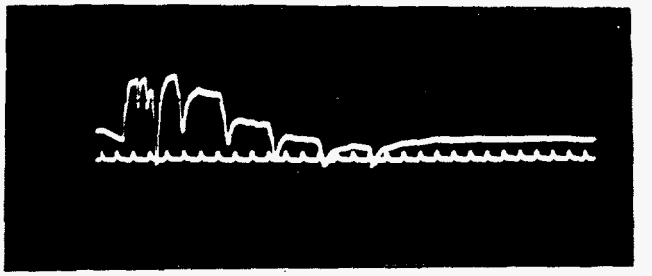
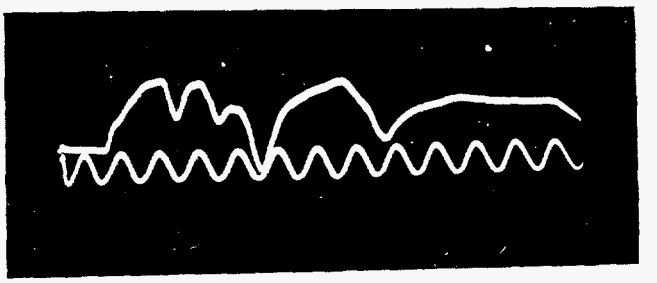


Fig. 1. Test Assembly

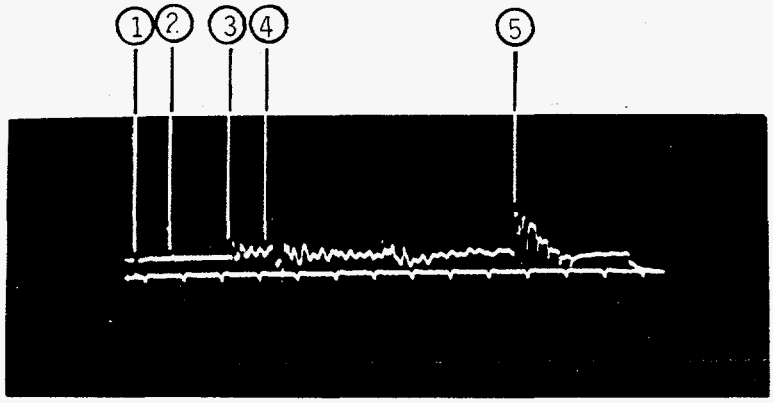


100 nanosecond Timemarks
Amplifier Gain 40 dB



50 nanosecond Timemarks
Amplifier Gain 40 dB

Fig. 2. Typical Detonation Electric Effect Signals Generated by a Stack of Plexiglas Discs monitoring the output of a Modified P/016



1 μsec Timemarks

Amplifier Gain 20 dB

Point	1	FID
Point	2	HEP trigger
Point	3	Initiation of current to detonator bridgewire
Point	4	Detonator bridgewire burst
Point	5	Modified P/016 to Plexiglas stack interface

Fig. 3. Tektronix 556 Oscilloscope Recording of the Total Event

Analysis of the Tektronix 556 records resulted in two observations of interest. First, the time of first vertical trace deflection corresponded approximately to the expected time of arrival of the current pulse at the detonator. This was confirmed by the raster oscilloscope recording, Fig. 4, of a detonator shaper pulse (coincident with EBW input). Secondly, the raster trace revealed a small signal about 2.35 μsec after the shaper pulse. This pulse was calculated to be the voltage spike of the detonator EBW burst which, after applying a 0.180 μsec correction time for the extra coaxial cable lengths, corresponds to the time of the second major pulse appearing on the Tektronix 556 trace. A block diagram of the instrumentation is shown in Fig. 5, and a time chart for the coaxial cable delays is shown in Fig. 6. Table I shows the corrected times for the interval of the fiducial marker pulse (FID) to the EBW burst as calculated for the raster and TEK 556 oscilloscope. Table II is a listing of the transit time from the SE-1 bridgewire burst to the modified P/016 output. Shot number 2171-1-16-4 indicates a very long transit time through the SE-1 and the P/016, but it is suspected that there was not good coupling between the detonator and the P/016.

Table I

	Raster Oscilloscope Time Intervals (μsec)		Tektronix 556 Oscilloscope Time Intervals (μsec)	
Shot Number	FID-Det Shaper	DET Shaper EBW Burst	FID-Det Shaper	DET Shaper EBW Burst
2171-2-16-4	2.15	1.10	2.13	1.09
2171-2-17-1	2.57	1.08	2.60	1.04
2171-2-17-4	2.33	1.10	2.37	1.05
2171-2-17-5	2.34	1.09	2.31	1.06

Table II. EBW Burst to PWL Output
(Tektronix 556 Oscilloscope)

Shot Number	Measured Time (μsec)	Theoretical Time (μsec)
2171-2-16-4	7.80	6.20
2171-2-17-1	6.37	6.20
2171-2-17-4	6.41	6.20
2171-2-17-5	6.32	6.20

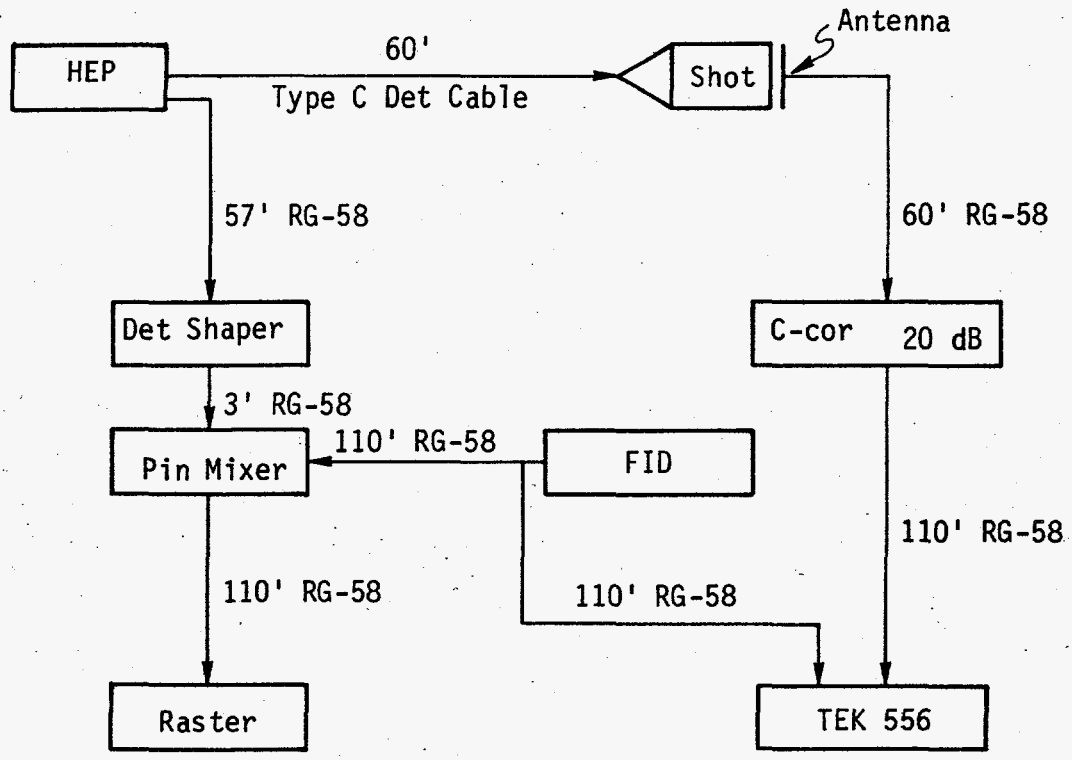


Fig. 5. Instrumentation Setup

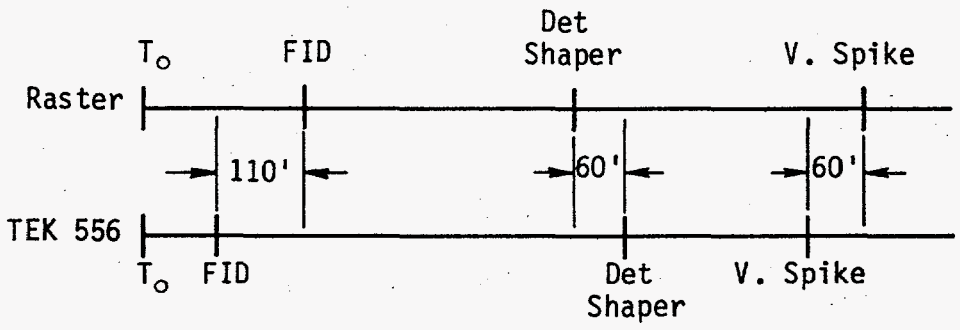


Fig. 6. Time Delay Relations Due to Unequal Cable Lengths

FUTURE WORK; COMMENTS; CONCLUSIONS

Although the primary goal of precisely recording shock wave transit time through PMMA segments was not attained, some useful information was gleaned for the possible application of the detonation electric effect to detonator timing. Table I shows that there is good agreement between the raster and Tektronix 556 detonation electric effect recordings, especially when one considers that there is a significant time-resolution difference between the two oscilloscopes. The resolution of the Tektronix 556 should improve with a faster sweep rate.

Future work will consist of firing HE shock generators into PMMA, brass, and aluminum laminates in order to record the characteristic signals of the materials as they are subjected to both plane and nonplanar shock waves.

Fig. 4 A Raster Oscilloscope Recording of 1-Fid, 2-Det. Shaper, and 3-EBW Voltage Spike
(Timemarks are 0.5 μsec)