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Jack Rabbit Pretest 2021E PT5 Photonic Doppler Velocimetry Data

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The predictive accuracy of a high explosive model cannot be proven.

Except..... by experiment.

- Hart

ACKNOWLEDGEMENT

I want to thank all those who contributed to the success of the Jack Rabbit Pretest series. The encouragement, counsel, criticism, and support both technical and financial, all worked together in developing a successful series of tests and a very rich harvest of data.

One person deserves special mention. David E. Hare working in B Division at LLNL, who took a scientific interest in the test series. He ran well over 100 computer simulations examining high explosive models and predictions for different experiment designs. His work provided clear and compelling evidence of the usefulness and the need for these focused hydrodynamic tests. Dave's work was truly pivotal and his contribution cannot be overstated.

Secondly, none of the data you will see in this report would exist, were it not for the extraordinary skill and resourcefulness of the firing crew, technicians, and engineers working at the Contained Firing Facility (CFF) at Site 300, LLNL. After the countless meetings, presentations, design reviews, engineering design, parts fabrication, and experiment assembly, the process funneled down to a small group of experts who delivered the payoff of accurate data. They are to be commended for their work and accomplishments in executing the Jack Rabbit Pretest focused hydrodynamic experiments.

Mark M. Hart

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ABSTRACT

The Jack Rabbit Pretest (PT) 2021E PT5 was fired on March 17, 2008 at the Contained Firing Facility, Site 300, Lawrence Livermore National Laboratory. This experiment is part of an effort to determine the properties of LX-17 in a regime where corner-turning behavior and dead-zone formation are not well understood. Photonic Doppler Velocimetry (PDV) measured diagnostic plate velocities confirming the presence of a persistent LX-17 dead-zone formation and the resultant impulse gradient applied under the diagnostic plate.

EXECUTIVE SUMMARY

The Jack Rabbit Pretest 2021E PT5, 160 millimeter diameter experiment returned data on all eight PDV probes. The probes measured on the central axis and at 20, 30, 35, 45, 55, 65, 75 millimeters from the central axis. The experiment was shot at an ambient room temperature of 65 degrees Fahrenheit. The earliest PDV signal extinction was 40.0 microseconds at 45 millimeters. The latest PDV signal extinction time was 64.9 microseconds at 20 millimeters. The measured velocity ranged from meters per second to thousands of meters per second. First detonation wave induced jump-off was measured at 55 millimeters at 12.8 microseconds. The PDV data provided an unambiguous indication of dead-zone formation and an impulse gradient applied to the diagnostic plate. The central axis had a last measured velocity of 1877 meters per second. At 65 millimeters the last measured velocity was 2277 meters per second. The low-to-high velocity ratio was 0.82. Velocity data was integrated to compute diagnostic plate cross section profiles. Velocity data was differentiated to compute a peak pressure under the diagnostic plate at the central axis of 78 kilobars at 11.9 and 21.2 microseconds. Substantial motion (>1 m/s) of the diagnostic plate over the dead-zone is followed by detonation region motion within approximately 4.1 microseconds.

INTRODUCTION

The Photonic Doppler Velocimeter (PDV), also known as the Heterodyne Velocimeter, was fielded on each of the five Jack Rabbit Pretest Series. The PDV system is described in a Review of Scientific Instruments article.¹ Briefly, the PDV uses single mode fiber optic components to mix the Doppler-shifted light from a moving surface with undoppler-shifted light from the laser to generate a beat signal. The frequency of the beat signal is directly proportional to the velocity according to:

$$f_b = 2\left(\frac{v}{c}\right)f_0$$

where f_b is the beat frequency, v is the velocity of the moving surface, c is the speed of light and f_0 is the original frequency of the laser. The PDV system uses lasers with a wavelength of 1550 nanometers, so a velocity of 1000 meters per second yields a beat frequency of 1.29 GHz.



Figure 1. Example (2021E PT3) of shot stand with PDV probes sighted on diagnostic plate

¹ O.T. Strand, et.al, Compact System For High-Speed Velocimetry Using Heterodyne Techniques, Review Of Scientific Instruments 77, 083208 (2006)

There were eight channels of data recorded on each test where each channel corresponded to a probe mounted above the diagnostic plate. Each probe monitored the velocity time history of a discrete spatial location on the surface of the diagnostic plate. The probes used were a standard type commonly used by PDV. They were commercially available probes made by Oz Optics of Ottawa, Canada, and had a focal distance of 97 mm (part #LPF-04-1550-9/125-S-15-97-6.2AS-40-3A-3-5-SP). The probes were actually mounted a distance of 102 mm above the surface to enable the probe to follow the surface for a longer distance of travel. The distance from the center of the plate for each probe on each shot is shown in the table below:

Table 1. Probe location for all Jack Rabbit Pretest Experiments

Probe #	Distance from center (mm)				
	2021E PT3	2021E PT4	2021E PT5	2021E PT6	2021E PT7
1	00	00	00	00	00
2	10	10	20	20	20
3	20	20	30	30	30
4	25	25	35	35	35
5	30	30	45	45	45
6	35	35	55	55	55
7	40	40	65	65	65
8	50	50	75	75	75

The PDV data was recorded by high-bandwidth, high-sample rate digitizers that operated at a sample rate of 20 gigasamples per second. The beat waveforms were processed using two different methods. The early time data corresponding to velocities below approximately 20 meters per second were processed using a fringe counting method. This method uses the fact that the surface moves 775 nanometers for each beat cycle. For velocities above approximately 20 meters per second, a sliding Fourier transform method was used with a window length of 1024 points, which is 51 nanoseconds of sample time. The velocity profiles were then mapped onto a timebase with 100 nanoseconds per point using a linear

interpolation of the original points and are shown in Tabulated Diagnostic Plate Velocities, Table 3. The final velocity profiles were then integrated to obtain the diagnostic plate displacement versus time profiles shown in Figure 10, also with a timebase of 100 nanoseconds per point. The displacement versus time profile data is shown in Table 4.

The timebases given in the spreadsheets are referenced to the time of the CDU (fireset) current start. The timing corrections from the PDV digitizers to the measurement point on the diagnostic plate were determined by taking into account the various fiber and cable delays in the system. The timing loop used to make the timebase corrections is shown in Figure 2.

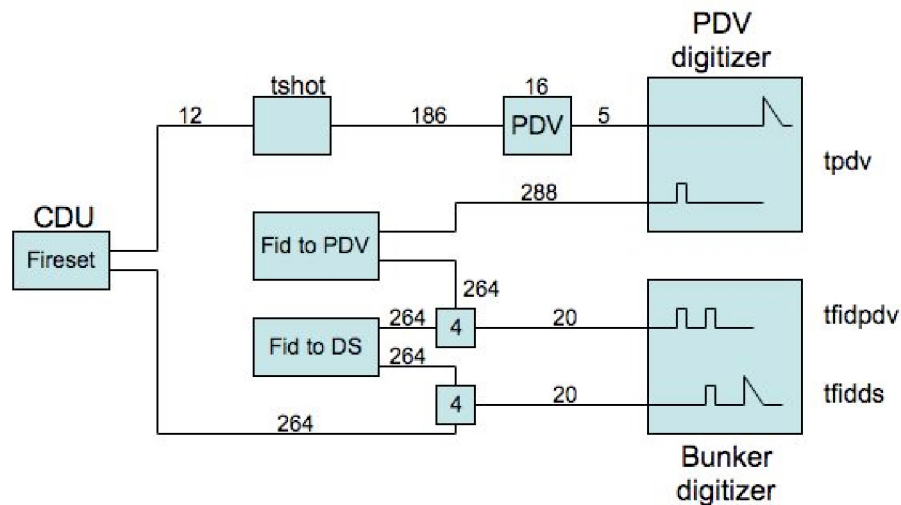


Figure 2. Jack Rabbit Pretest Experiment Timing Diagram

The times are given in nanoseconds. Moving around the loop starting at the fireset CDU yields the following equation:

$$12 + t_{\text{shot}} + 186 + 16 + 5 - t_{\text{pdv}} - 288 + 288 + t_{\text{fidpdv}} - 288 + 288 + t_{\text{fids}} - 20 - 4 - 264 = 0$$

$$12 + t_{\text{shot}} + 186 + 16 + 5 - t_{\text{pdv}} + t_{\text{fidpdv}} + t_{\text{fids}} - 20 - 4 - 264 = 0$$

$$t_{\text{shot}} = t_{\text{pdv}} - t_{\text{fidpdv}} - t_{\text{fids}} + 69$$

where t_{shot} is the time of interest at the diagnostic plate with respect to the CDU current start. The variable t_{pdv} is the time interval from the timing fid recorded by the PDV system to the event of interest in the velocity data. The variable t_{fidpdv} is the time interval from the PDV fid to the fireset fid, and t_{fidds} is the time interval from the fireset fid to the fireset CDU. Completing this loop shows that the total correction due to the various cable and fiber delays is 69 nanoseconds.

There are three velocity plots associated with each test:

- 1) short time axis giving details about the early-time motion on a semi-log plot, Figure 7,
- 2) intermediate time axis showing the early time motion of all the probes on a linear plot, Figure 8,
- 3) long time axis showing the entire data record on a linear plot, Figure 9.

In the velocity plots, the PDV channel numbers are identified by combining the number of the shot with the distance from the center. For example, the velocity profile for probe #3 on shot 2021E PT4 is v420, and the velocity profile for probe #6 on 2021E PT7 is v755. In one case, probe #5 of 2021E PT3 showed a break in the velocity time history at 13 μs , so the plots for 2021E PT3 show two velocity curves for that probe and they are labeled v3301 and v3302. Finally, the diagnostic plate displacement versus time data was extracted at 5 microsecond intervals and then transposed to obtain displacement versus radius profiles at 5 microsecond increments. The resulting displacement profiles are shown in Figure 10.

As a final look at the data, an attempt was made to infer what magnitude of pressure the center of the diagnostic plate experienced during the earliest part of each shot. The semi-log velocity versus time plot for each shot shows that the center probe recorded a fairly long and slow-rising velocity profile, rather than a shocked profile, Figure 7. Differentiating these velocity profiles yields the accelerations, which are related to the pressures. Deriving an expression for the

pressure is fairly straightforward. Start with

$$F = ma = \rho h A a$$

where F is the applied force on the aluminum diagnostic plate, m is the mass of the plate, ρ is the density of aluminum = 2.79 grams/cubic centimeter, h is the thickness of the plate = 6 millimeters, A is the area over which the force is applied, and a is the acceleration obtained by differentiating the velocity. The pressure P is the force per unit area:

$$P = \frac{F}{A} = \rho h a$$

Inserting the numerical values yields:

$$P[\text{kbar}] = (1.62 \times 10^{-7}) \times a[\text{m/s}^2]$$

The above expression applies only to a system in which the entire 6 millimeter plate accelerates as a solid body, and does not take into account shock compressions that would make the surface move in a manner different from the bulk motion. To compensate for that, the velocity time histories were smoothed with a 1.1 microsecond sliding average, which is approximately the sound speed transit time through the 6 millimeter thickness of the aluminum diagnostic plate, before differentiating to obtain the acceleration. In the dead-zone pressure plot of Figure 11, the thin red curve is the actual velocity profile, the thick red curve is the smoothed velocity profile, and the blue curve is the pressure obtained by differentiating the thick red curve.

2021E PT5

DESCRIPTION

2021E PT5 used a 76 millimeter thick cylindrical charge of LX-17, 160 millimeters in diameter, Figure 2. The charge was parted along a plane 20 millimeters from the top. The detonator flat cable, piezoelectric diagnostic pin, and embedded fiberoptic line were run through the parting line in the explosive charge. The main-charge diameter of this experiment was limited in the Jack Rabbit Pretest to ensure transparency for x-radiography imaging, while being large enough in diameter to permit transition from dead-zone to detonation wave contact on the aluminum diagnostic flyer plate. 2021E PT5 contained an 86 millimeter diameter, 10 millimeter thick, 303 stainless steel shadowplate. It was embedded on the central axis and within the cylindrical LX-17 main-charge. The shadowplate contained a PETN LX-16 pellet that fired downward, initiating an ultrafine TATB (UFTATB) hemispherical booster.

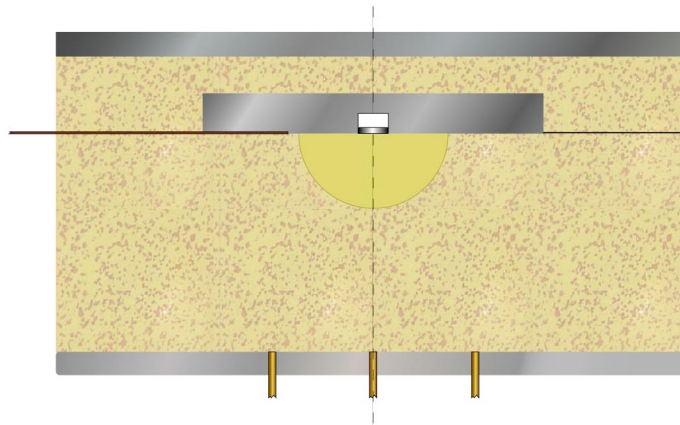


Figure 3. Graphic Cross Section of Jack Rabbit Pretest 2021E PT5

The charge was sandwiched between two 6 millimeter thick circular aluminum plates of the same diameter. The upper aluminum diagnostic flyer plate (diagnostic plate) monitored the progression of the detonation using x-ray imaging, framing camera imaging, and photonic Doppler velocimetry (PDV). Eight PDV probes were sighted down onto the diagnostic plate for measuring jump-off time and velocity as the diagnostic plate was accelerated in response to the detonation of the LX-17, Figure 1. The PDV laser beams were sighted within ± 0.25 millimeter of the nominal radial position. For purposes of positioning the probes in close quarters, the monitored positions were laid out along two orthogonal axes on the diagnostic plate surface, Figure 4. These PDV sighting locations were on lines clocked 45 degrees out from the location of the embedded piezoelectric timing pin, detonator cable, and fiberoptic diagnostic cable (not used in this test) to avoid their potential influence on the progression of the detonation wave. The PDV sighting positions on the aluminum plate were prepared by impressing a lightly textured steel ball on the aluminum surface for optimal laser beam reflection, Figure 6. The radial PDV positions were assigned to closely monitor anticipated regions of interest as shown in ARES simulations. The 2021E PT5, 160 millimeter experiment was monitored at radial distances of 0, 20, 30, 35, 45, 55, 65, and 75 millimeters.

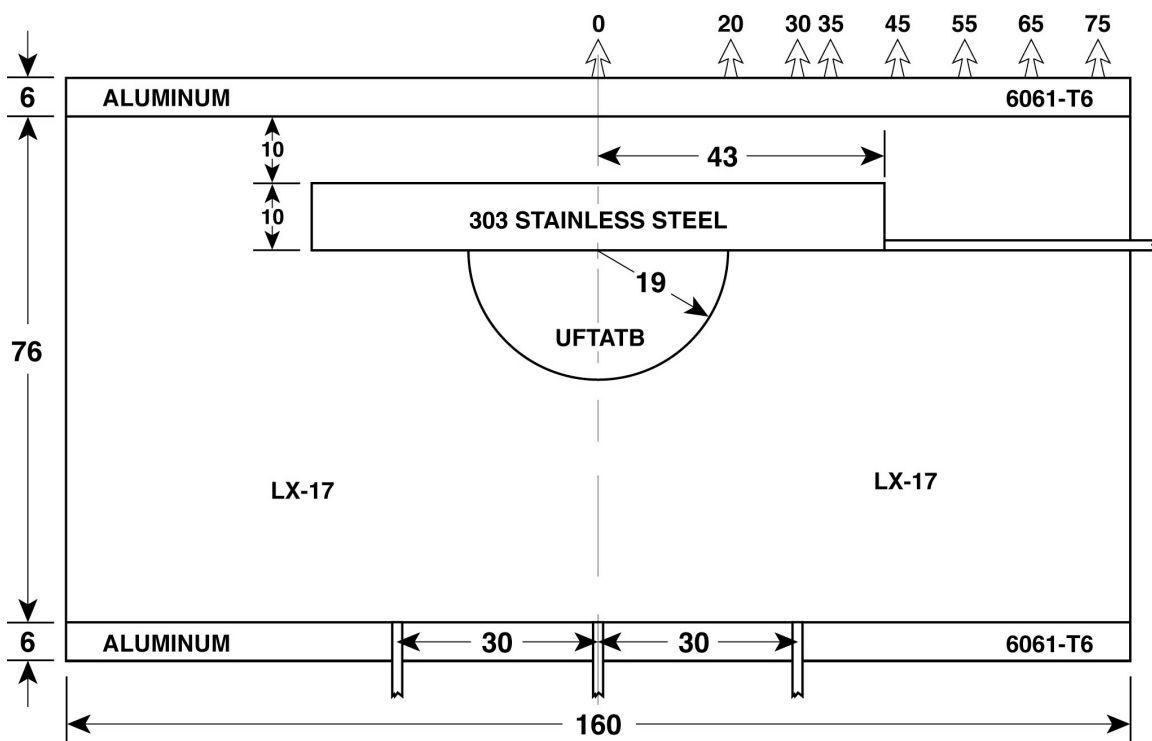


Figure 4. Schematic Cross Section of Jack Rabbit Pretest 2021E PT5, dimensions in millimeters

Booster: UFTATB, 25.8 g

Main charge: LX-17, 2764.2 g

Upper charge mass: 655.4 g

Lower charge mass: 2108.8 g

Upper charge density: 1.895 g/cc

Lower charge density: 1.896 g/cc

Main charge temperature: 18.3C (65F)

PDV measurement positions: 0, 20, 30, 35, 45, 55, 65, 75 mm

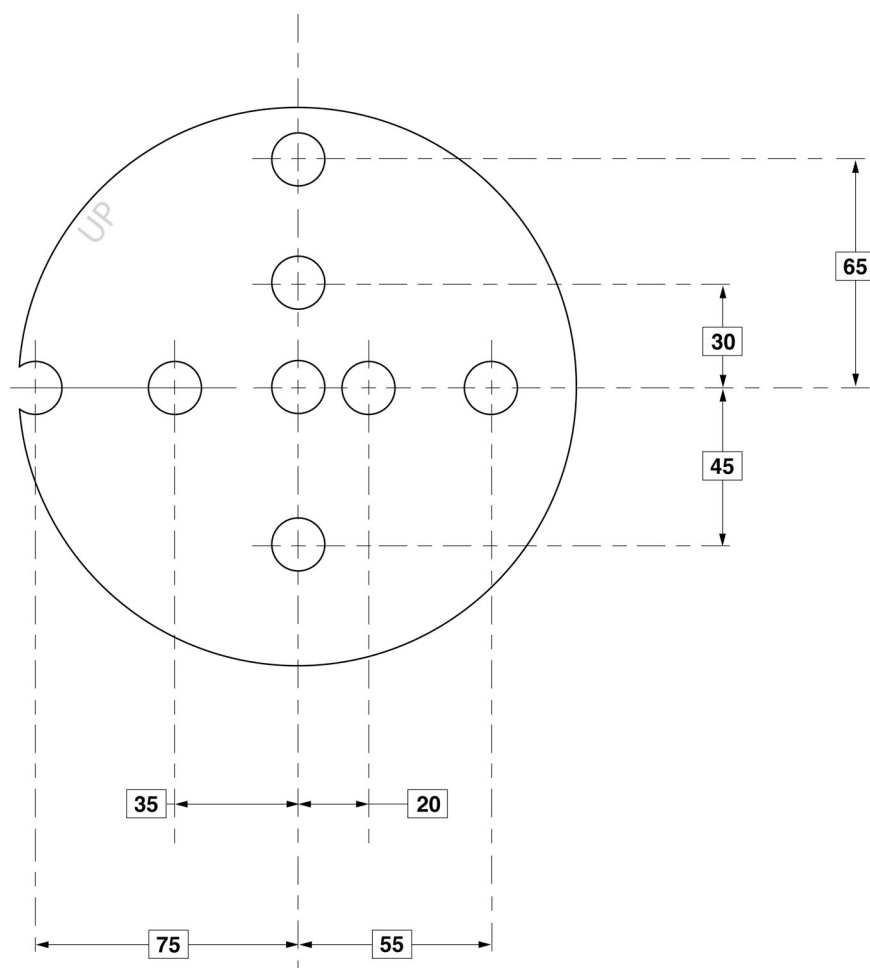


Figure 5. PDV Measurement Locations on 2021E PT5 Aluminum Diagnostic Plate, dimensions in millimeters

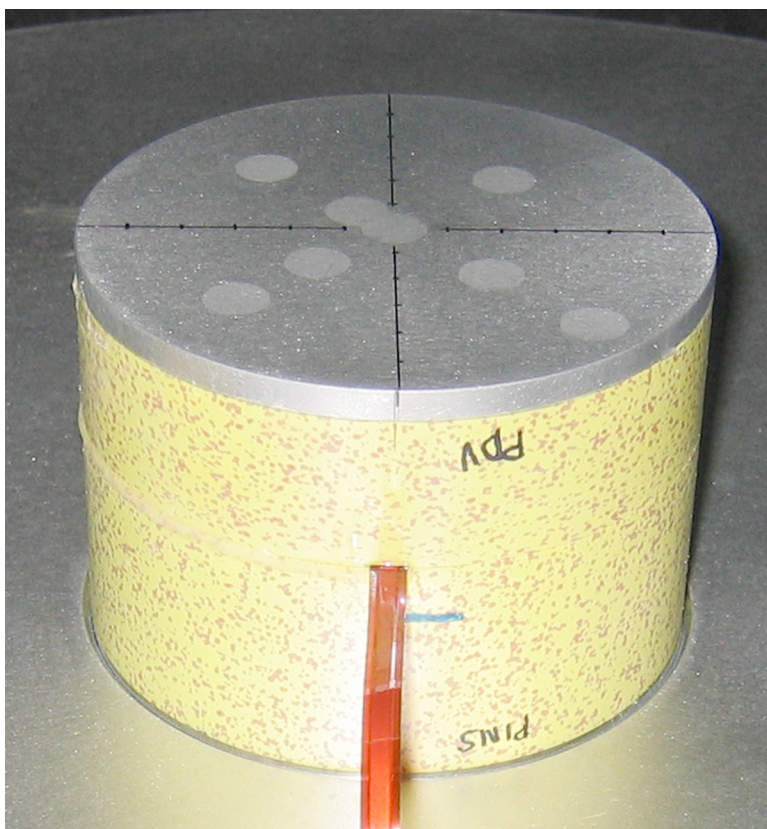


Figure 6. Example (2021E PT4) of a diagnostic plate showing circular spots prepared for optimal laser beam reflection

DIAGNOSTIC PLATE VELOCITY PLOTS

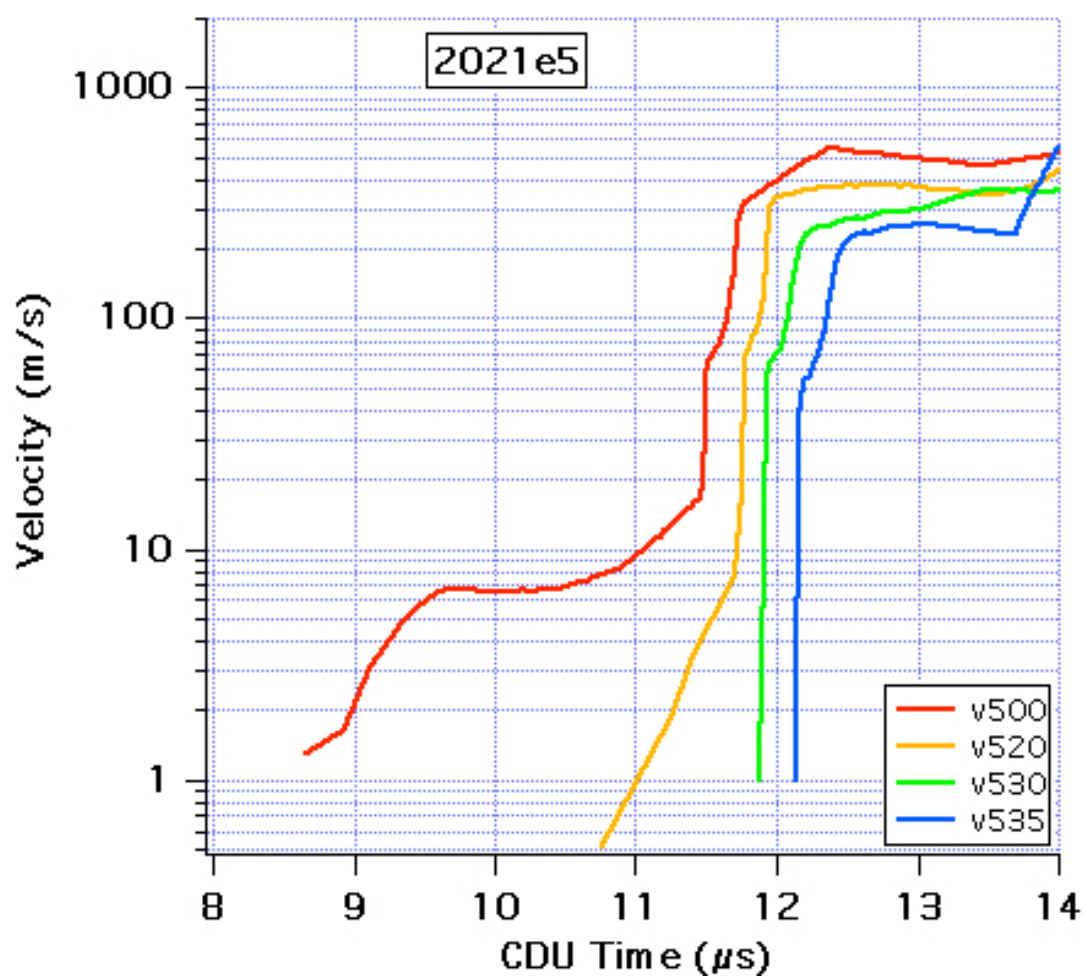


Figure 7. Short Time Axis Velocity Plot of Jack Rabbit Pretest 2021E PT5; time is referenced from detonator circuit current start

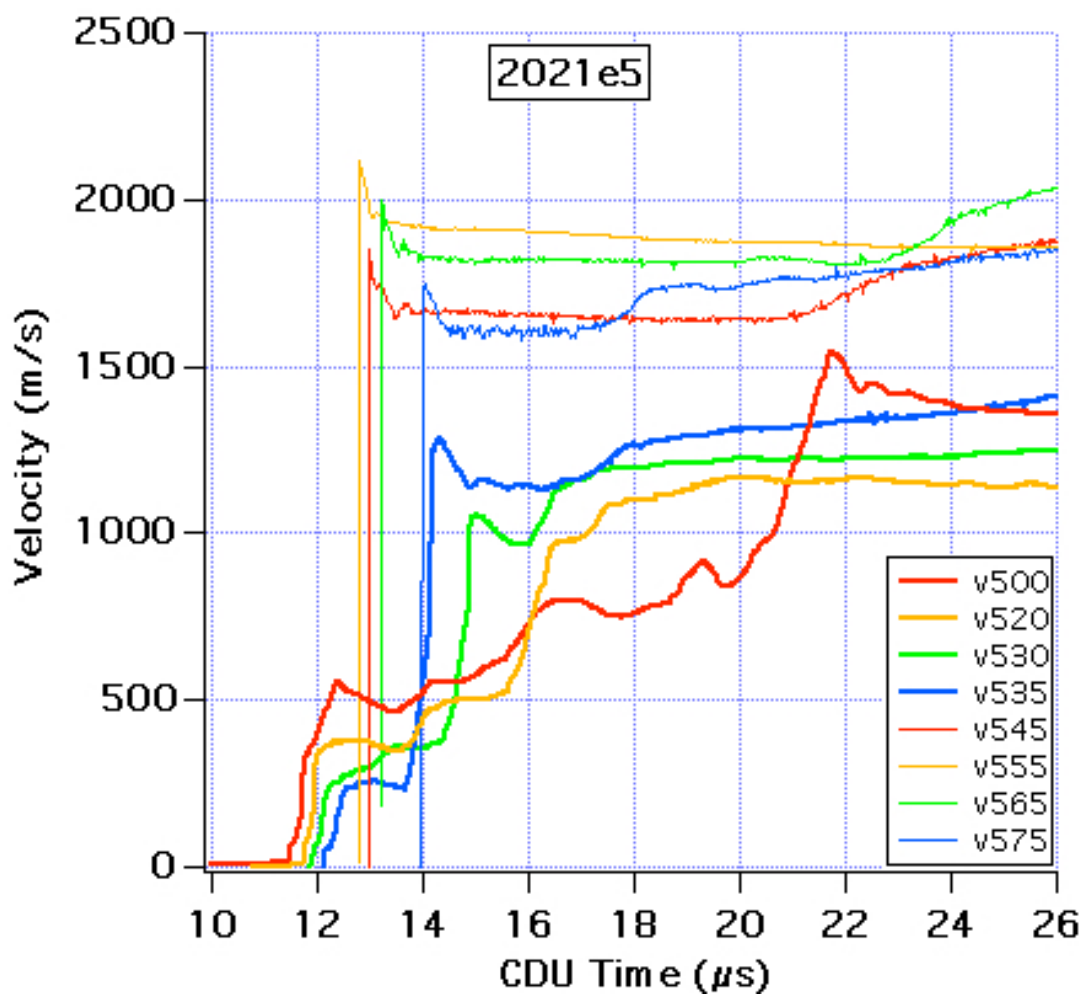


Figure 8. Intermediate Time Axis Velocity Plot of Jack Rabbit Pretest 2021E PT5; time is referenced from detonator circuit current start

Table 2. PDV measurement positions and signal extinction times for 2021E PT5 (μs)

00 mm	20 mm	30 mm	35 mm	45 mm	55 mm	65 mm	75 mm
				40.0			
					45.8		
			48.8				
						51.4	
		55.2					
							55.5
59.9							
	64.9						

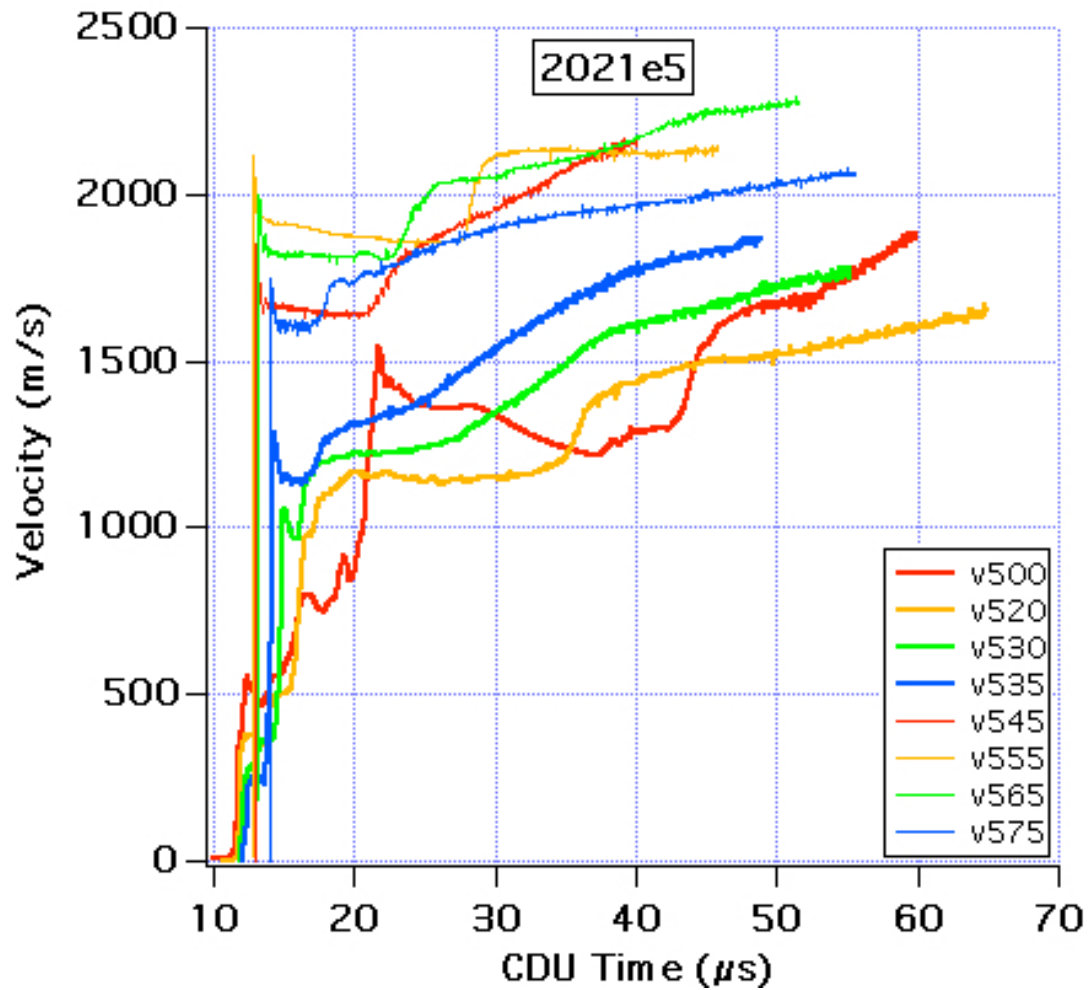


Figure 9. Long Time Axis Velocity Plot of Jack Rabbit Pretest 2021E PT5; time is referenced from detonator circuit current start

DIAGNOSTIC PLATE DISPLACEMENT PROFILES

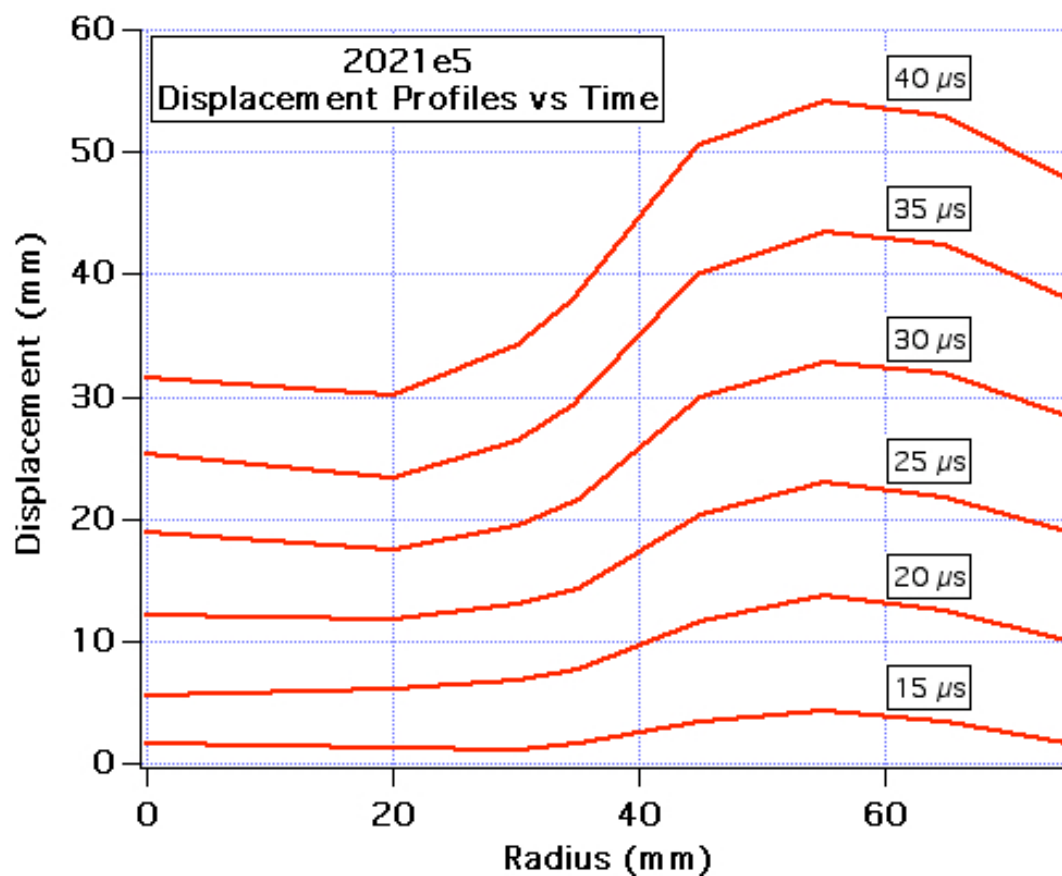


Figure 10. Diagnostic Plate Displacement Profiles of Jack Rabbit Pretest 2021E PT5; time is referenced from detonator circuit current start

CYLINDRICAL AXIS DEAD-ZONE PRESSURE PLOT

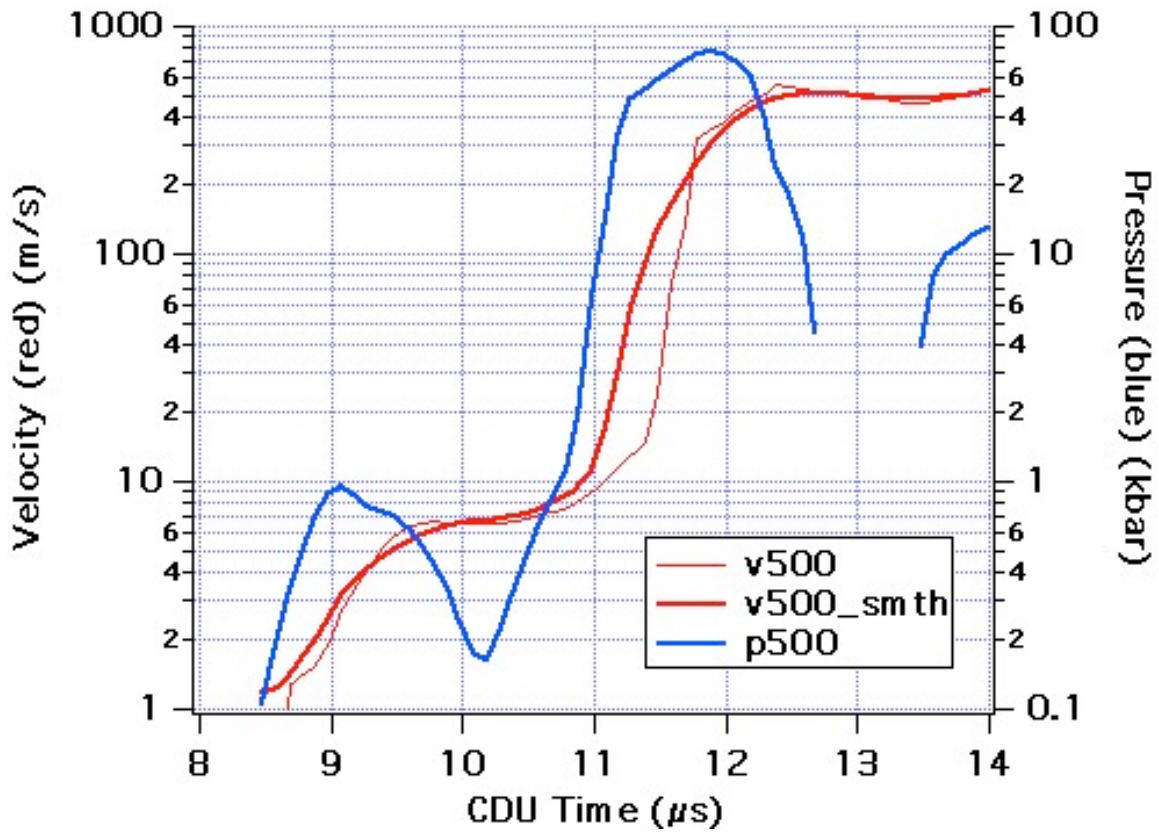


Figure 11. Dead-Zone Pressure Plot of Jack Rabbit Pretest 2021E PT5; time is referenced from detonator circuit current start

DIAGNOSTIC PLATE VELOCITY TABLE

Table 3. Tabulated Diagnostic Plate Velocities of Jack Rabbit Pretest 2021E PT5; time is referenced from detonator circuit current start

Jack Rabbit Pretest 2021E PT5 VELOCITY Data								
Columnar data: meters per second								
absolute timing accuracy relative to time zero = +/- 0.025 microseconds								
relative timing uncertainty between data channels = +/- 0.005 microseconds								
z velocity uncertainty = +/- 5 percent of velocity								
PDV measurement point position uncertainty = +/- 0.25 millimeters								
r →	0	20	30	35	45	55	65	75
t								
8	0	0	0	0	0	0	0	0
8.1	0	0	0	0	0	0	0	0
8.2	0	0	0	0	0	0	0	0
8.3	0	0	0	0	0	0	0	0
8.4	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0
8.6	0	0	0	0	0	0	0	0
8.7	1.3279	0	0	0	0	0	0	0
8.8	1.4631	0	0	0	0	0	0	0
8.9	1.5983	0	0	0	0	0	0	0
9	2.1076	0	0	0	0	0	0	0
9.1	2.8217	0	0	0	0	0	0	0
9.2	3.5247	0	0	0	0	0	0	0
9.3	4.2997	0	0	0	0	0	0	0
9.4	5.1261	0	0	0	0	0	0	0
9.5	5.9271	0	0	0	0	0	0	0
9.6	6.4728	0	0	0	0	0	0	0
9.7	6.6152	0	0	0	0	0	0	0
9.8	6.6276	0	0	0	0	0	0	0
9.9	6.462	0	0	0	0	0	0	0
10	6.5631	0	0	0	0	0	0	0
10.1	6.5755	0	0	0	0	0	0	0
10.2	6.6418	0	0	0	0	0	0	0
10.3	6.6018	0	0	0	0	0	0	0
10.4	6.7281	0	0	0	0	0	0	0
10.5	6.9486	0	0	0	0	0	0	0
10.6	7.1554	0	0	0	0	0	0	0
10.7	7.5463	0	0	0	0	0	0	0
10.8	7.8434	0.5907	0	0	0	0	0	0
10.9	8.4243	0.8644	0	0	0	0	0	0

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
11	9.2991	1.1382	0	0	0	0	0	0
11.1	10.314	1.412	0	0	0	0	0	0
11.2	11.796	1.6858	0	0	0	0	0	0
11.3	13.462	2.2707	0	0	0	0	0	0
11.4	15.299	3.2197	0	0	0	0	0	0
11.5	50.398	4.3764	0	0	0	0	0	0
11.6	78.685	5.7549	0	0	0	0	0	0
11.7	159.83	7.2813	0	0	0	0	0	0
11.8	328.01	72.346	0	0	0	0	0	0
11.9	357.88	121.41	7.8754	0	0	0	0	0
12	389.19	329.84	68.447	0	0	0	0	0
12.1	434.06	347.11	119.77	0	0	0	0	0
12.2	473.63	359.23	223.76	53.612	0	0	0	0
12.3	515.63	368.29	248.29	72.687	0	0	0	0
12.4	552.18	372.34	253.58	148.66	0	0	0	0
12.5	534.71	375.65	267.27	212.68	0	0	0	0
12.6	523.96	375.42	272.19	234.52	0	0	0	0
12.7	519.61	376.32	281.75	236.09	0	0	0	0
12.8	512.98	376.49	288.29	249.74	0	1185.6	0	0
12.9	501.82	376.17	291.48	251.53	0	2039.1	0	0
13	493.99	370.35	296.51	254.37	1828.8	1959.3	0	0
13.1	486.35	363.41	307.85	255.82	1747.6	1952	0	0
13.2	479.8	357.59	323.34	249.89	1743.6	1946.4	515.1	0
13.3	470.21	355.5	337.86	246.58	1702.2	1930.3	1937.8	0
13.4	464.29	347.9	347.91	240.88	1671.4	1929.7	1889.3	0
13.5	462.54	345.71	359.9	238.19	1649.4	1931.1	1851.1	0
13.6	471.33	345.15	361.22	232.39	1674.4	1923.6	1876	0
13.7	482.86	360.76	357.75	235.24	1686.7	1923.1	1851.7	0
13.8	493.86	374.02	354.64	317.29	1662.8	1922.3	1840.8	0
13.9	504.37	399.2	353.78	414.5	1661.9	1922.1	1824.1	0
14	519.27	438.48	356.68	542.07	1668.5	1917.7	1825.8	1726.4
14.1	539.81	460.96	359.77	659.96	1663.7	1914.9	1828.5	1717.4
14.2	551.95	472.22	366.23	1233.6	1663.5	1914.1	1825.3	1691.8
14.3	550.81	478.9	370.59	1276.6	1660.6	1913	1823.6	1651
14.4	549.77	488.45	380.29	1266.9	1670	1913.4	1821.4	1621.8
14.5	550.91	491.61	430.47	1238.9	1661.4	1911.2	1813.1	1614.7
14.6	552.75	495.58	480.33	1207.9	1665.9	1913.9	1824.8	1599.5
14.7	554.91	498.39	585.8	1183.1	1661.6	1912.9	1817.9	1614.6
14.8	556.9	501.48	706.68	1157.1	1664	1912.6	1815.8	1593.9
14.9	563.24	500.86	995.98	1138.7	1664.2	1910.3	1819.5	1619.6

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
15	572.32	499.96	1053.3	1144.2	1663.4	1913.4	1810.8	1609.9
15.1	583.78	500.51	1049.7	1160.1	1662.7	1911.4	1812.7	1599.5
15.2	595.65	503.38	1035.3	1160.3	1661.8	1910.8	1818	1608
15.3	604.62	507.05	1018.9	1152.8	1656.1	1912.1	1824.7	1613.9
15.4	610.99	511.5	1007	1146.6	1650.3	1910.5	1819.5	1620.5
15.5	617.57	516.85	988.62	1139.5	1651.3	1907.5	1818.7	1598.1
15.6	630.06	525.02	978.06	1134.7	1659.7	1909.8	1820.3	1606.3
15.7	655.05	563.63	967.02	1137.3	1652.9	1909.2	1824.5	1616.9
15.8	675.38	590.84	965.13	1143.7	1656.6	1907	1825.7	1604.5
15.9	696.99	626.14	966.82	1142	1656.4	1907.2	1819.7	1585.9
16	722.52	691.45	966.27	1142.4	1654.4	1904.5	1820.9	1610.3
16.1	748.34	752.38	987.32	1134.5	1654.2	1903.2	1823.1	1611.7
16.2	766.02	813.55	1017.9	1131.6	1657.1	1902.6	1824.4	1593.3
16.3	778.73	845.42	1044.1	1131.8	1653.9	1902.5	1817.9	1623.2
16.4	787.21	928.07	1072.6	1133	1653.4	1901.8	1819.4	1607
16.5	793.52	962.22	1118	1142.7	1650.3	1900.6	1821.8	1604.7
16.6	797.02	975.18	1130.4	1148.5	1653.3	1900.2	1822	1603.6
16.7	799.28	975.06	1139.1	1155.6	1654.6	1899.7	1820.6	1612.9
16.8	799.22	977.81	1149.1	1157.4	1650.5	1898.1	1820.2	1593.7
16.9	797.73	976.72	1157.5	1159.3	1651.5	1897.7	1820.4	1612.4
17	794.15	982.5	1157.6	1160.9	1649.4	1896.8	1818	1620.4
17.1	788.05	993.73	1161.7	1169.3	1645.9	1896.2	1816.8	1613.5
17.2	779.86	1007.4	1175.2	1176.7	1651.2	1894.4	1817.2	1617.1
17.3	771.3	1029.5	1186.6	1187.6	1647.4	1894.4	1820.1	1625.2
17.4	762.98	1057.6	1190.4	1199.7	1651.7	1893.6	1816.8	1629.4
17.5	755.26	1077.1	1190.6	1211.4	1640.4	1891.9	1818.2	1632.4
17.6	750.97	1083.8	1192.9	1225.2	1643.4	1890.8	1817.8	1634.9
17.7	749.16	1084.2	1195.2	1238.1	1647	1889.3	1818.8	1652.7
17.8	748.63	1090.6	1195.4	1251.1	1643.2	1889.1	1822.7	1656.4
17.9	751.12	1097.2	1193.9	1262.7	1632.8	1887.3	1816.9	1664.3
18	756.46	1097.9	1192	1264.5	1641.6	1886.5	1815.9	1691.5
18.1	763.69	1096.4	1191.3	1263.5	1643.4	1884.8	1817.3	1706.4
18.2	771.58	1095.7	1194.2	1262.3	1641.4	1883.1	1805.5	1719.1
18.3	778.48	1097.2	1198.4	1270.9	1641.6	1884	1815.2	1727.8
18.4	782.67	1101	1201.4	1275.1	1644.7	1883.4	1815.3	1734.2
18.5	784.93	1111.7	1203.7	1278.8	1640.7	1883.2	1815	1735.6
18.6	786.27	1110.8	1206.1	1278.4	1638.9	1881.1	1815.5	1735.5
18.7	794.6	1113.6	1208.9	1280.1	1638.7	1880.6	1815.1	1738.3
18.8	815.89	1118.1	1209	1283.4	1640.4	1879.7	1814.5	1738.5
18.9	838.6	1121.8	1209	1286.2	1642.2	1878.2	1814.7	1746.5

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
19	864.71	1127.7	1209.9	1287.7	1642.8	1880.2	1813.9	1746.7
19.1	879.19	1130	1209.4	1287.8	1642.1	1879.5	1814.3	1747.2
19.2	898.15	1138.9	1210.2	1289.8	1639	1877.6	1814.2	1744.5
19.3	912	1142.1	1210.2	1291.9	1642.3	1876.2	1814.6	1741.2
19.4	901.99	1148.2	1210.9	1293.7	1638.4	1875.4	1813.2	1733.3
19.5	885.27	1152.3	1212.5	1296.3	1640.2	1876.5	1814.5	1732
19.6	854.26	1155.1	1214.6	1300.2	1644	1875.8	1814.3	1731.7
19.7	839.71	1160.2	1216	1303.5	1643.8	1875.6	1812.2	1731.7
19.8	841.27	1163	1218.4	1307.2	1644.8	1879.6	1812.5	1733.5
19.9	849.29	1166.2	1221	1308.6	1642.3	1872.4	1814	1736.2
20	861.01	1167.7	1223.4	1309.5	1641.9	1872.2	1816.8	1742
20.1	882.45	1168.2	1223.5	1309.5	1642.5	1873.1	1816.1	1746.5
20.2	910.47	1167	1223.5	1310.3	1640.7	1873.4	1822.4	1748.4
20.3	939.85	1164.4	1222.8	1311.4	1633.5	1872.3	1824.3	1750.4
20.4	961.6	1163.4	1221	1310.6	1642.1	1872.6	1826.5	1755.9
20.5	975.43	1163.2	1219.5	1312.2	1638.8	1871.7	1825.3	1759.1
20.6	987.55	1158.4	1218.8	1311.7	1643	1871.3	1825.9	1760.1
20.7	1012.5	1153.4	1218.6	1313.1	1646.7	1870.7	1825	1762.8
20.8	1067	1152	1219.5	1313.5	1647.7	1871.6	1826.7	1763.8
20.9	1132.7	1152.3	1220.4	1314.5	1645.2	1870.9	1823.5	1766.7
21	1180.4	1156	1221.1	1316	1662.8	1870	1821.6	1767
21.1	1220.3	1152.9	1222.6	1319.9	1655.4	1871.4	1824.3	1767.1
21.2	1258.8	1153.1	1223	1321.3	1656.9	1872.4	1822.2	1765
21.3	1307.4	1153.3	1222.6	1320.5	1660.7	1872	1815	1762.4
21.4	1372.5	1153.7	1221.8	1321.9	1666.9	1870.8	1816.1	1760.4
21.5	1424	1154.1	1224	1323.2	1676.3	1870.9	1813.8	1762.7
21.6	1465.4	1155.5	1218.8	1325.3	1678.4	1869.2	1811.3	1767.1
21.7	1532.3	1154.2	1218.3	1328.1	1690.5	1867.9	1809	1766.1
21.8	1534.5	1155	1218.4	1330.5	1702.2	1874.3	1807.8	1767.9
21.9	1524.2	1159.5	1219.3	1333.1	1710.5	1866.4	1809	1767.7
22	1500.2	1160.1	1221.3	1335.8	1718.7	1864.4	1807.4	1778.5
22.1	1465.6	1161.9	1221.8	1337.9	1715.5	1863.3	1807	1777.3
22.2	1437.3	1162.1	1222.9	1335.9	1734.6	1863.6	1806.2	1780.4
22.3	1425.2	1162.4	1224	1339.3	1741.1	1863	1826.9	1781.2
22.4	1438.8	1162.8	1224.9	1338	1752.3	1863.3	1810	1783.4
22.5	1447.7	1161.8	1224.2	1347.1	1759.3	1862.4	1814.6	1785.6
22.6	1443.7	1160.7	1225	1334.8	1760.5	1860	1815	1787.7
22.7	1435.9	1158.9	1225.4	1347.7	1767.4	1860.4	1821.1	1788.9
22.8	1422.3	1156.9	1225.8	1345.5	1775.4	1858.7	1825.9	1791.4
22.9	1413.9	1154.7	1225.9	1338.8	1778.8	1858.3	1834.9	1788

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
23	1413.2	1152.5	1226.9	1343.5	1788.6	1857.1	1837.9	1791.3
23.1	1416.5	1151	1226	1342.2	1802.6	1857.3	1842	1792.6
23.2	1419.6	1149.8	1227.2	1346.2	1793.4	1858.4	1848.1	1794.1
23.3	1415.3	1149.4	1228	1347.1	1808.2	1859.9	1860.9	1795.1
23.4	1407.8	1148	1226.6	1348.3	1807.1	1858.9	1866.6	1795.9
23.5	1400.5	1146.9	1227.7	1349.5	1810.2	1859.9	1876.2	1797.2
23.6	1396.7	1146.5	1227.7	1351.4	1813.3	1859.8	1883.6	1799.9
23.7	1395.8	1146.1	1226.4	1354.2	1831.8	1859.6	1895.4	1804.9
23.8	1394.5	1145	1224.9	1355.9	1822.5	1859.1	1907.5	1806.7
23.9	1390.4	1144.6	1228.6	1356.3	1821.8	1858.3	1935.3	1811.6
24	1385.1	1145.5	1228.8	1357.6	1829.2	1857.9	1935.4	1815
24.1	1379.9	1145.6	1229.2	1361	1829	1858.1	1942.5	1818.3
24.2	1375	1147.3	1230.6	1365.2	1831.6	1858	1961.3	1826.9
24.3	1373.3	1151.3	1233.1	1366.3	1835.7	1859.7	1960.4	1819.7
24.4	1371.4	1147.6	1234.3	1367.7	1836.9	1849.9	1964.8	1823.5
24.5	1371.2	1144.1	1236.5	1370.3	1840.4	1858.3	1959.4	1828.4
24.6	1369.8	1141.1	1238.9	1372.9	1842.3	1858.3	1966	1824.8
24.7	1367.6	1138.2	1238.9	1375.9	1849.4	1858.4	1978.6	1830.3
24.8	1364.7	1134.8	1238.9	1371.7	1846.8	1856	1981.4	1831.3
24.9	1363.1	1132.8	1239.1	1379	1847.2	1858.8	1991.7	1832.5
25	1362.8	1132.4	1239.9	1378.5	1860.4	1857.3	1991.2	1826
25.1	1362.6	1134.3	1240.8	1383.9	1853.5	1858.9	1995.7	1836.8
25.2	1362.3	1137.6	1240.2	1384.5	1865	1857	2000.4	1833.7
25.3	1361.6	1141.8	1242.6	1387.4	1861.8	1858.5	2005	1831.9
25.4	1360.9	1145.9	1244.1	1365.7	1864.2	1859.9	2009.4	1840.3
25.5	1360.3	1148.4	1245.4	1392.2	1863.9	1860.8	2018.6	1841.5
25.6	1359.2	1146.5	1246.8	1394.6	1869.1	1859	2020.3	1839.6
25.7	1358.6	1145	1248	1399	1870.2	1860.9	2024.5	1845.2
25.8	1357.8	1140.7	1248.9	1404.2	1872.6	1859.6	2028.3	1845.8
25.9	1357.1	1137.5	1248.5	1406.1	1876.8	1860.5	2032.4	1844.8
26	1356.2	1134.3	1248.4	1409.1	1874.9	1857.8	2033.2	1850.1
26.1	1355.6	1132.3	1248.4	1411.4	1875.6	1856.1	2034.4	1851
26.2	1355	1131.3	1249.5	1414.9	1875.9	1855.6	2035.2	1852.7
26.3	1354.8	1130.7	1249.7	1416	1884.9	1856.4	2035.1	1855.1
26.4	1354.8	1132.2	1252.5	1418.9	1880.7	1857.1	2036.7	1854.3
26.5	1354.8	1133.5	1255.8	1419.8	1887.5	1857.2	2036.2	1855.9
26.6	1355.3	1134.4	1258.5	1429.4	1890.9	1858.2	2036.4	1856.5
26.7	1355.7	1136.5	1260	1431.8	1895.6	1857.7	2037.7	1857.2
26.8	1355.9	1139	1260.6	1432.4	1892.9	1859.5	2037.8	1859.6
26.9	1356.2	1140.6	1261.3	1435.7	1893.8	1858.6	2038.6	1862.2

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
27	1356.6	1141.1	1262.2	1439.6	1900.5	1860.1	2040.1	1862.7
27.1	1356.9	1141.8	1262.1	1443.7	1895.8	1861	2040.4	1863.7
27.2	1357.2	1144.2	1263.7	1449.5	1903.4	1860.5	2042.4	1865.9
27.3	1357.9	1143.8	1264.5	1447.1	1908	1860	2043.1	1867.9
27.4	1358.3	1144.3	1264.5	1451.3	1912.7	1863.4	2044.9	1873.6
27.5	1359	1142.5	1270.3	1457.5	1913.5	1868	2045.1	1868.8
27.6	1360	1142.9	1272.4	1459.5	1902.7	1870.7	2049.8	1873.1
27.7	1361.1	1142.1	1276.2	1462.3	1909.5	1874.5	2048.8	1866.6
27.8	1361.7	1141.1	1280.3	1465.8	1925.3	1884.7	2049.3	1876
27.9	1362.8	1140.1	1282.1	1470	1915.9	1897.7	2046.7	1878.4
28	1362.8	1141.3	1288.5	1470.9	1923.9	1914.6	2044.9	1877.7
28.1	1363.1	1138.7	1292.3	1468.5	1922.5	1934.3	2042.4	1879
28.2	1363.2	1139.6	1295.6	1476.3	1939.1	1959.5	2045.6	1880.9
28.3	1362.5	1141.7	1299.7	1479.3	1926.9	1977.2	2045.6	1878.3
28.4	1362.3	1140.2	1301	1479	1921.9	2003.7	2046	1887.8
28.5	1361.5	1143.5	1299.9	1489.8	1930.9	2020.9	2049.4	1885.5
28.6	1361.6	1144.1	1304	1491.8	1934.1	2041.1	2047.9	1887.3
28.7	1361.3	1145.3	1307.3	1494.2	1934.8	2048.5	2046.6	1886.5
28.8	1359.5	1147	1307.6	1493.8	1935.1	2048	2047.9	1884.3
28.9	1358.4	1147.9	1310	1503.6	1937.7	2063.2	2047	1888.6
29	1357.3	1150.2	1312.5	1505.2	1940.6	2075.4	2048.7	1892.2
29.1	1356.1	1149.6	1313.8	1506.2	1935.9	2084.7	2050.3	1887.1
29.2	1354.3	1149.5	1317.8	1507.8	1942	2086.3	2051	1887.2
29.3	1352	1151.3	1320.1	1512.2	1939.4	2091.5	2050.4	1896
29.4	1349.6	1151.3	1323.4	1518.8	1945.4	2092.2	2051	1887.2
29.5	1346.8	1151	1327.1	1518.5	1948	2101.7	2053.1	1888.1
29.6	1344	1150.2	1332.2	1521.1	1937.1	2104.2	2051.2	1891
29.7	1342.2	1149.9	1334.2	1520.5	1944	2109.5	2050.9	1901.7
29.8	1341	1149.6	1337.3	1525.9	1951	2113.8	2052	1899.2
29.9	1339	1148.9	1340	1530.4	1953.8	2115.6	2053.5	1900
30	1336.6	1148.4	1342	1530.2	1959.9	2117	2054.1	1899.6
30.1	1334.6	1147.9	1344.8	1533.8	1959.4	2120	2050.5	1901.6
30.2	1332.1	1147.3	1347.8	1535.4	1956.1	2120.8	2048.8	1901.1
30.3	1329.8	1147.2	1351	1541.6	1956.8	2118.2	2053.3	1903.5
30.4	1327.5	1146.9	1353.2	1544.2	1962.5	2121.4	2056.2	1903.6
30.5	1325.4	1146.9	1355	1548.7	1972.7	2122.1	2058.1	1905.7
30.6	1323.1	1146.8	1357.3	1550.9	1987.6	2116.3	2060.8	1905.2
30.7	1320.7	1147.1	1361.4	1553	1969.7	2120.5	2058.7	1909.8
30.8	1318.3	1146.7	1362.9	1556.7	1968.2	2120.8	2066.3	1908.6
30.9	1315.5	1147.4	1364.2	1562.8	1986.6	2122.4	2067.1	1909.9

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
31	1312.9	1150.2	1367.4	1562.3	1978.1	2122.5	2070.3	1910.5
31.1	1310.8	1150.3	1370.2	1564.5	1982.2	2125.4	2069.7	1912.5
31.2	1308.6	1151.2	1374.2	1565.1	1978.6	2123.7	2069.5	1913.2
31.3	1305.8	1152.9	1376.5	1569.1	1997.8	2129.9	2075	1913.7
31.4	1303.5	1153.7	1377.5	1572.7	1981.2	2127.5	2077.6	1914.9
31.5	1301.1	1155.4	1371.4	1581.1	1988.8	2124.1	2077.9	1917.1
31.6	1298.3	1154.4	1382.8	1578.3	1993.1	2131.5	2078.7	1911.2
31.7	1295.9	1155.1	1386.5	1577.8	1992	2127.8	2079	1912.3
31.8	1293.9	1155.5	1390	1581.9	2002	2128.8	2078.3	1920.8
31.9	1291.6	1157	1390	1581.3	1996.9	2128.9	2081.6	1919.8
32	1289	1156.6	1397.7	1588.2	2001.5	2129.5	2081.2	1919.8
32.1	1287.2	1157.8	1395.5	1587.9	2004.9	2130.9	2079.3	1920.3
32.2	1284.4	1157.6	1400.7	1591.9	1998.2	2133.4	2081.4	1921.9
32.3	1282.2	1158.5	1403.4	1594.9	2008.7	2133.8	2082.8	1921.5
32.4	1280.1	1158.6	1410.3	1600.1	2010.3	2132.3	2082.9	1926.5
32.5	1278.2	1158.9	1408.1	1605.5	2013.1	2132.2	2082.8	1926.4
32.6	1276.2	1159.5	1412.1	1616	2011.5	2132.8	2084	1920.6
32.7	1274.3	1160.2	1416.1	1609.8	2022.4	2132.2	2086.4	1924
32.8	1272.2	1162.1	1416.5	1610.3	2015.1	2133.1	2087.8	1936.9
32.9	1270.5	1163.8	1420.8	1609.4	2011.3	2133.5	2087.9	1925.9
33	1268.2	1165.4	1414.9	1616.6	2010	2134.5	2084.9	1928.6
33.1	1266.7	1167.4	1426.6	1618.5	2028.1	2134.3	2089.6	1928.6
33.2	1265	1169.4	1429	1620.9	2030	2134.4	2087.6	1930.6
33.3	1263.4	1171.4	1434.9	1623.5	2030	2134.7	2089.4	1929
33.4	1262.2	1173.5	1437.2	1629.8	2030.6	2135.2	2090.5	1929.6
33.5	1260.5	1176.2	1439.9	1628.7	2035	2134.5	2090.8	1927.8
33.6	1258.8	1176.9	1442.3	1631.3	2038.8	2133.5	2093.7	1929.2
33.7	1256.8	1180.5	1450.6	1638.1	2038.4	2134.7	2094.8	1931.3
33.8	1255.2	1183	1449.8	1640.6	2040.5	2130.9	2095	1934
33.9	1253.5	1180.5	1452.7	1642.5	2043.7	2132.8	2095.1	1934.2
34	1252.1	1182.6	1455.6	1643.3	2050.5	2134.1	2095.4	1934.7
34.1	1250.3	1183	1456.6	1639.9	2049.9	2137.1	2095.3	1936.9
34.2	1249	1187.7	1459.8	1645.9	2056.7	2137.7	2097.2	1932.9
34.3	1248.3	1189.6	1462.3	1647.4	2058	2136.2	2098.7	1935.6
34.4	1247.3	1190.8	1466.9	1656.2	2060.2	2134.5	2099.7	1938.7
34.5	1247.8	1192.1	1469.8	1653.4	2063.9	2136.7	2101.6	1938.3
34.6	1243.9	1195	1478.2	1654.2	2065.3	2132.9	2101	1937.4
34.7	1242.4	1199.4	1476	1659.7	2067.5	2133.8	2101.3	1938.3
34.8	1241	1201.4	1478.3	1661.6	2066.4	2138.1	2102.6	1947.9
34.9	1239.6	1204.2	1482.3	1664	2071.4	2138.1	2105.9	1939.9

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
35	1238.1	1207.3	1485.7	1667.3	2069.3	2135.1	2103.7	1937.9
35.1	1236.3	1213.2	1488.6	1668.1	2075.4	2137.1	2103.8	1940.3
35.2	1235.3	1221.7	1491.9	1672	2081.2	2136.5	2105.9	1942.4
35.3	1233.8	1229.7	1495.2	1672.1	2077.4	2138.5	2106	1942.9
35.4	1232.7	1238.2	1494.5	1679.6	2082.1	2134.7	2107.4	1942.5
35.5	1231.9	1247	1505.8	1677.6	2089.6	2134.3	2108.7	1943.6
35.6	1231.2	1258.7	1507.3	1689.1	2087.1	2134.7	2110.2	1942.7
35.7	1229.5	1273.5	1512.8	1684.1	2088.1	2132.7	2110.7	1944.8
35.8	1224.4	1274.1	1514.6	1687.5	2090.4	2131	2110.7	1946.3
35.9	1227.3	1282.9	1519.3	1687.7	2090.1	2130.6	2113	1944.7
36	1226.2	1303.1	1523.6	1690.6	2093.6	2132.2	2112.2	1947
36.1	1225.4	1302.6	1524.8	1693	2096.8	2132	2113.9	1942
36.2	1224	1315.1	1530.8	1694.4	2093.2	2130	2115	1947.7
36.3	1223.1	1333.8	1534.5	1694.6	2098.1	2130	2115.6	1946.8
36.4	1221.9	1347.1	1533.8	1696.6	2104.1	2129.2	2117.3	1949.2
36.5	1221.4	1350.3	1540.6	1699.6	2100.9	2129.6	2118	1950.2
36.6	1220.3	1355.3	1545	1699.7	2109.2	2129.6	2115.7	1950.7
36.7	1219.6	1361.3	1548	1703.9	2110.8	2127.6	2119.5	1936.2
36.8	1219.1	1367.4	1550.4	1698.4	2107.8	2129.6	2121.6	1950.3
36.9	1218.7	1371.1	1552.7	1707.1	2122.1	2129.4	2126.3	1953.4
37	1218.7	1372.2	1545.3	1713.9	2121.3	2129.8	2122.1	1952.2
37.1	1218.6	1377	1553.6	1716	2109.9	2131.7	2122.8	1951.4
37.2	1218.2	1379.1	1559.9	1713.7	2103.9	2128.3	2125.9	1952.9
37.3	1218.6	1388.1	1560.9	1716	2129	2117.8	2130.2	1953.8
37.4	1219.1	1389.2	1563.5	1721.3	2119	2128.3	2131.7	1954.4
37.5	1220.8	1387.9	1567.2	1720.3	2128.9	2129.1	2131.4	1955
37.6	1222.3	1393.3	1569.7	1724	2126.4	2128.8	2132.8	1955.5
37.7	1226	1397.6	1572.9	1719.2	2131.2	2130.3	2135.8	1955.1
37.8	1230.4	1399.1	1575.2	1730.1	2121.2	2129.4	2135.8	1955.5
37.9	1233.9	1398	1572.5	1729.6	2123.1	2129.1	2138.3	1960
38	1237.4	1398.2	1578.1	1734.6	2115.7	2127.8	2140.3	1960.6
38.1	1243.9	1400.1	1582.3	1734.1	2130.1	2127.6	2140.8	1956.9
38.2	1250.2	1402.2	1591.9	1725.4	2139.4	2127.4	2141.4	1957.2
38.3	1257.7	1408.2	1585.7	1737.1	2145.9	2122	2146.7	1958.9
38.4	1262.2	1403.9	1584.8	1738.4	2144.3	2120.7	2144.5	1967.3
38.5	1262.6	1406.5	1589	1743.8	2150.4	2125.5	2143.5	1952.8
38.6	1259	1389.9	1588.2	1745.7	2143	2126.7	2146	1961.7
38.7	1256	1414.1	1585.3	1748.9	2131.4	2126	2148.5	1962.2
38.8	1251.9	1418.9	1592.4	1740.6	2140.4	2123.4	2149.8	1963.7
38.9	1248.2	1424.2	1588.5	1750	2129.8	2124	2151.3	1962.2

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
39	1253.4	1426	1599.9	1755	2162.9	2125.9	2152	1961.3
39.1	1261.9	1428.9	1589.6	1753.6	2143.5	2121.7	2153.4	1964.8
39.2	1266	1428	1600	1758.6	2154.8	2120.7	2155.4	1961.6
39.3	1258.7	1429.7	1598.4	1758.6	2160.7	2122.6	2157	1962.2
39.4	1269	1429	1600.7	1761.6	2160	2126.1	2157.4	1961.6
39.5	1273.2	1428.9	1604.6	1764.6	2150.5	2124.2	2158.9	1967.4
39.6	1275.3	1430.3	1601.3	1763.8	2159.8	2126.7	2161.6	1967.3
39.7	1291.6	1430.5	1600.8	1769.2	2157.2	2129.5	2164	1970.5
39.8	1282.6	1432.3	1604.5	1765.4	2158.9	2127.6	2165.6	1968.1
39.9	1283.5	1432.8	1601.4	1768.3	2147.5	2123.8	2166.8	1972.2
40	1283.3	1432.8	1602	1773.9		2127.5	2171.4	1968.8
40.1	1285.2	1433.4	1586.9	1761.7		2123.3	2172	1968.7
40.2	1286.6	1436.7	1606.4	1784.7		2121.1	2173.8	1974.3
40.3	1286.9	1439.9	1608	1777.4		2122.1	2174.5	1971.8
40.4	1286.5	1442	1607.5	1764.8		2122.8	2175.6	1973.1
40.5	1286.2	1445.6	1611.1	1776.8		2126.5	2177.3	1973.2
40.6	1286.8	1449.4	1608.4	1774.3		2121.7	2179.6	1972.2
40.7	1288.7	1448.9	1611.3	1778.9		2123.7	2183	1973.3
40.8	1289.1	1450.8	1612.9	1781.6		2118.6	2185.2	1974.1
40.9	1289.1	1452.6	1613	1779.9		2121.3	2183.7	1969
41	1289.6	1454.4	1617.7	1782.8		2122.8	2184.3	1974.5
41.1	1291.2	1455.5	1618.9	1783		2107.7	2188.7	1975.6
41.2	1293.5	1456.8	1619.5	1778.7		2120.6	2190.5	1976.4
41.3	1294.6	1455.6	1615.5	1783.3		2118.6	2191.7	1975
41.4	1294.4	1456.3	1619.4	1783.8		2111.6	2194.9	1969.6
41.5	1294.9	1461.3	1621.8	1788.6		2121.7	2196.1	1975.8
41.6	1295.1	1458.3	1626.5	1789		2128.7	2196.7	1975.3
41.7	1295.3	1455.1	1627.3	1792		2121.7	2203.4	1976.9
41.8	1296.6	1457	1620.7	1794.1		2121.2	2202.6	1976.1
41.9	1295.9	1460	1621.6	1789.4		2121.9	2202.1	1978.4
42	1294.8	1462.7	1623.2	1798.2		2121.1	2207.8	1977.6
42.1	1295.2	1464.1	1624.5	1796		2122.3	2206.8	1983.7
42.2	1295.1	1464.9	1622.9	1796.8		2124.7	2213.3	1984.2
42.3	1295.2	1465.1	1627.7	1798.7		2124	2211.6	1980.3
42.4	1296.4	1466.2	1626.5	1801.3		2124	2212	1980.3
42.5	1299.4	1468	1630.3	1798.7		2123.8	2211.6	1982.8
42.6	1308.2	1469	1633	1801.7		2125.9	2213.3	1979.9
42.7	1307.7	1474	1632.5	1803.2		2125.3	2216.5	1981.7
42.8	1313.2	1475	1633.7	1803.5		2126.8	2217.3	1978.1
42.9	1320.4	1475.6	1634	1804.6		2127.1	2217.3	1982

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
43	1325.1	1476.9	1635.5	1803.4		2124.9	2216.3	1980
43.1	1331.7	1477.2	1639.4	1804.9		2126.9	2221.7	1982.7
43.2	1338.4	1477.5	1638.4	1801.6		2127.9	2219.1	1983.7
43.3	1346	1479.7	1633.5	1807.4		2129.6	2223.2	1985.7
43.4	1355.1	1481.7	1642.3	1807.7		2128.8	2224.3	1984.5
43.5	1367.8	1481.4	1642.1	1811.4		2129.8	2226	1981
43.6	1384	1483	1647.5	1813		2132.5	2225.9	1991.3
43.7	1397.6	1485.5	1645.8	1805.4		2134.3	2235.6	1989.4
43.8	1420.8	1483.7	1649.2	1812.3		2125.4	2229.8	1984.7
43.9	1438.1	1483.7	1649	1811.6		2132.1	2235.3	1991.8
44	1477.5	1485	1648.4	1811.9		2125.7	2223.9	1981.7
44.1	1476	1480.3	1634.6	1816		2137.2	2236.8	1991
44.2	1487.3	1486.3	1649	1815.1		2132.4	2237	1991.9
44.3	1495.4	1487.8	1647.6	1815.1		2135.5	2234	1996.4
44.4	1508.1	1489.2	1650.5	1816.9		2126.8	2234.5	1981.8
44.5	1520.8	1490.3	1653.2	1810.2		2133.2	2242.7	1994.2
44.6	1530.6	1492.5	1649.5	1814		2131.5	2243.2	1991.5
44.7	1538.4	1493.6	1658.6	1819.3		2130	2245.2	1994.2
44.8	1543.6	1494.7	1656.3	1824.8		2135.3	2242.8	1999.4
44.9	1546.2	1496.3	1648.1	1822		2121.8	2239.2	1995.3
45	1547.8	1499	1660.4	1826.9		2133.6	2248.6	1997.2
45.1	1550.4	1500.2	1657.1	1823.7		2131.1	2244.2	1994.8
45.2	1550.9	1500	1663.4	1830.4		2129.8	2247.9	2000.7
45.3	1558.9	1500.8	1661.8	1826.4		2140.5	2244.7	2005.1
45.4	1567.2	1504.4	1665	1825		2135.4	2244.4	1997.8
45.5	1571	1500.8	1664.6	1825.8		2126.8	2240.4	2003.7
45.6	1578.2	1499.7	1667	1826.4		2136.6	2247	2003.1
45.7	1590.2	1497.8	1661	1831.3		2143.7	2249.1	2003.8
45.8	1598.5	1500.2	1670.3	1837.3			2251.9	2001.6
45.9	1602.5	1501.4	1681.3	1831.4			2254.1	2004
46	1606.9	1500.4	1670.5	1828			2244.4	2005.6
46.1	1608.5	1502.5	1669.6	1828.2			2249.2	2008.1
46.2	1610.2	1502.8	1675.5	1832.7			2243.9	2011.2
46.3	1611.6	1505.3	1674.7	1819.5			2253	2005.2
46.4	1614.6	1501.5	1675.6	1832.7			2248.5	2005.3
46.5	1617.5	1502.3	1678	1836.1			2247.7	2009.9
46.6	1619.5	1499.3	1677.9	1838.9			2251.9	2005.8
46.7	1621.2	1501.1	1678.8	1832.5			2250.5	2008.3
46.8	1624.4	1501.7	1681	1832.7			2245.4	2000.7
46.9	1627.8	1500.6	1676.9	1838.6			2247.6	2011.4

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
47	1629.5	1501.1	1678.7	1839.5			2249.1	2011
47.1	1631.9	1499.9	1686.4	1838.4			2248.5	2011.7
47.2	1633.8	1505	1681.7	1843.5			2252.1	2010.7
47.3	1637.3	1498.8	1682.8	1835.9			2249.2	2012.6
47.4	1640.1	1499.7	1684.5	1849			2251.6	2018.1
47.5	1643.8	1502	1691.4	1849.3			2255	2019.7
47.6	1644.9	1500.5	1691.1	1861			2252.9	2016.8
47.7	1649.8	1504.1	1687.6	1851.1			2251.5	2018.3
47.8	1647.9	1505.5	1693.3	1856.1			2253	2015.4
47.9	1640.2	1497.9	1689.3	1862			2257.6	2018.3
48	1649.7	1503.1	1697.2	1857.5			2254.1	2014.5
48.1	1651.4	1506.9	1690.4	1853.4			2255.8	2018.7
48.2	1653.6	1507.9	1697.6	1860.3			2256.2	2018.1
48.3	1657.2	1507.7	1697	1857.3			2257.9	2019.2
48.4	1659.4	1508.3	1700.3	1862			2253.5	2027.6
48.5	1657.3	1507.8	1709.4	1850			2257.3	2015.1
48.6	1659.9	1508.4	1699.9	1860.8			2253.8	2023.7
48.7	1661.3	1507.8	1704.5	1865.9			2263.2	2021.2
48.8	1667.4	1511.5	1710.4				2258.2	2020.8
48.9	1668	1509	1700.6				2263.2	2022.5
49	1667.1	1510.8	1710.5				2263.1	2023.9
49.1	1644.8	1513.2	1716.6				2262.5	2021.1
49.2	1670.5	1514	1712.8				2260.2	2022.7
49.3	1665.7	1517.6	1712.7				2264	2029
49.4	1661.2	1517.5	1707.9				2269.6	2027.1
49.5	1666.8	1517.3	1713.4				2262.1	2026.4
49.6	1670.7	1519.2	1718.8				2266	2029.8
49.7	1668.8	1512.4	1717.5				2270.7	2032.4
49.8	1663.9	1511.4	1715.4				2264.6	2029.6
49.9	1673.9	1513.4	1717.4				2263.4	2037.8
50	1673.2	1523.7	1720.6				2265.9	2042.3
50.1	1676.6	1524.3	1720.3				2268.7	2034
50.2	1670.2	1520.5	1726.3				2269.7	2036.5
50.3	1674.4	1522	1718.1				2271.6	2036.3
50.4	1675.8	1521	1722.4				2270.2	2031.5
50.5	1666.3	1521.8	1725.2				2272	2035.8
50.6	1673.6	1519.4	1720.6				2275.6	2035.2
50.7	1671.8	1520.6	1729.5				2274.3	2028.1
50.8	1671.7	1519.1	1725.2				2268.6	2035.4
50.9	1676.3	1522.2	1724.9				2268.8	2036.4

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
51	1660	1523.6	1735.5				2277.7	2040.5
51.1	1674.4	1525.3	1727.2				2276.1	2039.8
51.2	1679.7	1521.3	1741.5				2277.7	2034.8
51.3	1680.9	1524.9	1732.3				2277.4	2038.1
51.4	1683.4	1525.9	1733.1					2040.8
51.5	1668.6	1526.2	1735.8					2045
51.6	1661.8	1526.4	1732.5					2040.4
51.7	1653.7	1528.8	1732.8					2041.9
51.8	1662.9	1527.7	1739					2044.3
51.9	1670.3	1528.2	1742.5					2045.7
52	1681.8	1530.2	1738.8					2041.8
52.1	1693.4	1530.8	1740.3					2045.7
52.2	1695.1	1529.7	1742.4					2043
52.3	1670.7	1531	1737.2					2052.3
52.4	1668.5	1529	1751.2					2053.1
52.5	1678.8	1534.7	1741.6					2048.7
52.6	1690.2	1534.6	1746.5					2046.7
52.7	1697.5	1537.8	1744					2051
52.8	1686.9	1539	1744.4					2049.8
52.9	1687.4	1539.1	1749.7					2047.6
53	1694.3	1536.8	1746.5					2051.8
53.1	1696.4	1540.1	1745.9					2049.4
53.2	1689.3	1541.3	1745.7					2053.3
53.3	1700.3	1540.8	1746.8					2054.4
53.4	1715.4	1548.5	1745.1					2047.9
53.5	1714.4	1543	1740.2					2046.3
53.6	1730.6	1546	1748.1					2054.6
53.7	1732.3	1545.9	1753.9					2056.2
53.8	1730.2	1556.1	1744					2056.9
53.9	1728.2	1548.8	1751.5					2055
54	1731.3	1548.5	1766.2					2058.2
54.1	1730.6	1548.3	1750.9					2063.7
54.2	1742	1550	1746.5					2065.7
54.3	1736.5	1551	1755.1					2056.4
54.4	1737.2	1551.9	1758.5					2063.8
54.5	1735.5	1551.8	1753.1					2061.5
54.6	1737.1	1554.3	1753.6					2058.7
54.7	1738.8	1553.2	1765					2060.3
54.8	1740.9	1557.1	1763.9					2064.3
54.9	1743.5	1555.6	1763.2					2058.8

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
55	1744.5	1556.3	1769.4					2059.6
55.1	1750.9	1559.9	1772.3					2060.7
55.2	1751.6	1565.6						2060.9
55.3	1756.5	1560						2065.6
55.4	1753	1558.8						2063.5
55.5	1761.7	1558.6						
55.6	1771.6	1562.9						
55.7	1751.7	1562.5						
55.8	1766.1	1561.7						
55.9	1760.7	1563.2						
56	1761.3	1566.1						
56.1	1767.9	1568.3						
56.2	1794.4	1566.2						
56.3	1770.6	1566.7						
56.4	1785.8	1574.1						
56.5	1783.6	1571.2						
56.6	1787.7	1572						
56.7	1800.4	1573.2						
56.8	1796.2	1571.8						
56.9	1802.4	1574.8						
57	1803.7	1579.6						
57.1	1806.3	1576.1						
57.2	1806.4	1572.9						
57.3	1804.2	1576.9						
57.4	1808.3	1579.1						
57.5	1814.8	1578.1						
57.6	1816.8	1577.1						
57.7	1820.7	1579.1						
57.8	1820.4	1576						
57.9	1821.4	1585.5						
58	1826.9	1592.3						
58.1	1826.2	1583.3						
58.2	1828.9	1582.9						
58.3	1838	1585.6						
58.4	1832.1	1582.2						
58.5	1847.6	1592.2						
58.6	1845.9	1592.1						
58.7	1844.7	1590.1						
58.8	1850.5	1588.6						
58.9	1852.4	1589.6						

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
59	1854.9	1593.3						
59.1	1847.8	1593.8						
59.2	1850.8	1602.7						
59.3	1861.1	1603.4						
59.4	1867.4	1595.4						
59.5	1865.5	1603.2						
59.6	1875.1	1596.7						
59.7	1875.8	1597.1						
59.8	1877.4	1594.2						
59.9		1595.8						
60		1597.8						
60.1		1598.3						
60.2		1601.4						
60.3		1604.2						
60.4		1606.3						
60.5		1602.8						
60.6		1609.2						
60.7		1605.3						
60.8		1603.4						
60.9		1607.8						
61		1606						
61.1		1604.4						
61.2		1604.7						
61.3		1611.8						
61.4		1614.2						
61.5		1611.3						
61.6		1614.7						
61.7		1613.3						
61.8		1615.4						
61.9		1614.7						
62		1630.5						
62.1		1616.7						
62.2		1619.9						
62.3		1628.3						
62.4		1621.9						
62.5		1619.5						
62.6		1623.6						
62.7		1624.4						
62.8		1623.8						
62.9		1627.3						

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
63		1626.1						
63.1		1622.9						
63.2		1626.8						
63.3		1621.3						
63.4		1620.2						
63.5		1623.2						
63.6		1631.9						
63.7		1638.7						
63.8		1654.1						
63.9		1632.5						
64		1633.3						
64.1		1636.6						
64.2		1637.5						
64.3		1639.1						
64.4		1637.1						
64.5		1638.1						
64.6		1644.1						
64.8		1665.1						

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

v = vertical velocity of diagnostic plate at position r = meters/second

t = time from detonator circuit current start = microseconds

DIAGNOSTIC PLATE DISPLACEMENT TABLE

Table 4. Tabulated Diagnostic Plate Displacement of Jack Rabbit Pretest 2021E PT5; time is referenced from detonator circuit current start

Jack Rabbit Pretest 2021E PT5 POSITION Data								
Columnar data: z = mm from top of diagnostic plate datum								
absolute timing accuracy relative to time zero = +/- 0.025 microseconds								
relative timing uncertainty between data channels = +/- 0.005 microseconds								
z position uncertainty = +/- 5 percent of measurement								
PDV measurement point position uncertainty = +/- 0.25 millimeters								
r →	0	20	30	35	45	55	65	75
t								
8	0	0	0	0	0	0	0	0
8.1	0	0	0	0	0	0	0	0
8.2	0	0	0	0	0	0	0	0
8.3	0	0	0	0	0	0	0	0
8.4	0	0	0	0	0	0	0	0
8.5	0	0	0	0	0	0	0	0
8.6	0	0	0	0	0	0	0	0
8.7	7E-05	0	0	0	0	0	0	0
8.8	0.0002	0	0	0	0	0	0	0
8.9	0.0004	0	0	0	0	0	0	0
9	0.0005	0	0	0	0	0	0	0
9.1	0.0008	0	0	0	0	0	0	0
9.2	0.0011	0	0	0	0	0	0	0
9.3	0.0015	0	0	0	0	0	0	0
9.4	0.002	0	0	0	0	0	0	0
9.5	0.0025	0	0	0	0	0	0	0
9.6	0.0031	0	0	0	0	0	0	0
9.7	0.0038	0	0	0	0	0	0	0
9.8	0.0045	0	0	0	0	0	0	0
9.9	0.0051	0	0	0	0	0	0	0
10	0.0058	0	0	0	0	0	0	0
10.1	0.0064	0	0	0	0	0	0	0
10.2	0.0071	0	0	0	0	0	0	0
10.3	0.0077	0	0	0	0	0	0	0
10.4	0.0084	0	0	0	0	0	0	0
10.5	0.0091	0	0	0	0	0	0	0
10.6	0.0098	0	0	0	0	0	0	0
10.7	0.0105	0	0	0	0	0	0	0
10.8	0.0113	3E-05	0	0	0	0	0	0
10.9	0.0121	0.0001	0	0	0	0	0	0

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
11	0.013	0.0002	0	0	0	0	0	0
11.1	0.014	0.0003	0	0	0	0	0	0
11.2	0.0151	0.0005	0	0	0	0	0	0
11.3	0.0164	0.0007	0	0	0	0	0	0
11.4	0.0178	0.001	0	0	0	0	0	0
11.5	0.0211	0.0013	0	0	0	0	0	0
11.6	0.0275	0.0018	0	0	0	0	0	0
11.7	0.0395	0.0025	0	0	0	0	0	0
11.8	0.0638	0.0065	0	0	0	0	0	0
11.9	0.0981	0.0162	0.0004	0	0	0	0	0
12	0.1355	0.0387	0.0042	0	0	0	0	0
12.1	0.1767	0.0726	0.0136	0	0	0	0	0
12.2	0.222	0.1079	0.0308	0.0027	0	0	0	0
12.3	0.2715	0.1443	0.0544	0.009	0	0	0	0
12.4	0.3249	0.1813	0.0795	0.0201	0	0	0	0
12.5	0.3792	0.2187	0.1055	0.0381	0	0	0	0
12.6	0.4322	0.2563	0.1325	0.0605	0	0	0	0
12.7	0.4844	0.2938	0.1602	0.084	0	0	0	0
12.8	0.536	0.3315	0.1887	0.1083	0	0.0593	0	0
12.9	0.5867	0.3691	0.2177	0.1334	0	0.2205	0	0
13	0.6365	0.4064	0.2471	0.1587	0.0914	0.4204	0	0
13.1	0.6855	0.4431	0.2773	0.1842	0.2703	0.616	0	0
13.2	0.7338	0.4792	0.3089	0.2095	0.4448	0.8109	0.0258	0
13.3	0.7813	0.5148	0.3419	0.2343	0.6171	1.0048	0.1484	0
13.4	0.8281	0.55	0.3762	0.2587	0.7858	1.1978	0.3398	0
13.5	0.8744	0.5847	0.4116	0.2826	0.9518	1.3908	0.5268	0
13.6	0.9211	0.6192	0.4477	0.3061	1.118	1.5835	0.7131	0
13.7	0.9688	0.6545	0.4836	0.3295	1.2861	1.7759	0.8995	0
13.8	1.0176	0.6913	0.5192	0.3572	1.4536	1.9681	1.0841	0
13.9	1.0676	0.7299	0.5547	0.3937	1.6198	2.1604	1.2674	0
14	1.1187	0.7718	0.5902	0.4416	1.7863	2.3524	1.4499	0.0863
14.1	1.1717	0.8168	0.626	0.5017	1.9529	2.544	1.6326	0.2585
14.2	1.2263	0.8634	0.6623	0.5963	2.1193	2.7354	1.8153	0.429
14.3	1.2814	0.911	0.6991	0.7219	2.2855	2.9268	1.9977	0.5961
14.4	1.3364	0.9594	0.7367	0.849	2.452	3.1181	2.18	0.7598
14.5	1.3915	1.0084	0.7772	0.9743	2.6186	3.3093	2.3617	0.9216
14.6	1.4467	1.0577	0.8228	1.0967	2.785	3.5006	2.5436	1.0823
14.7	1.502	1.1074	0.8761	1.2162	2.9513	3.6919	2.7257	1.243
14.8	1.5576	1.1574	0.9407	1.3332	3.1176	3.8832	2.9074	1.4034
14.9	1.6136	1.2075	1.0258	1.448	3.284	4.0744	3.0892	1.5641

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
15	1.6704	1.2576	1.1283	1.5622	3.4504	4.2655	3.2707	1.7256
15.1	1.7282	1.3076	1.2334	1.6774	3.6167	4.4568	3.4519	1.886
15.2	1.7872	1.3578	1.3377	1.7934	3.7829	4.6479	3.6334	2.0464
15.3	1.8472	1.4083	1.4404	1.9091	3.9488	4.839	3.8155	2.2075
15.4	1.908	1.4592	1.5417	2.024	4.1141	5.0302	3.9977	2.3692
15.5	1.9694	1.5107	1.6415	2.1383	4.2792	5.2211	4.1796	2.5302
15.6	2.0318	1.5628	1.7398	2.252	4.4448	5.4119	4.3616	2.6904
15.7	2.0961	1.6172	1.8371	2.3656	4.6104	5.6029	4.5438	2.8515
15.8	2.1626	1.6749	1.9337	2.4797	4.7759	5.7937	4.7263	3.0126
15.9	2.2312	1.7358	2.0303	2.594	4.9415	5.9844	4.9086	3.1721
16	2.3022	1.8016	2.1269	2.7082	5.1071	6.175	5.0906	3.3319
16.1	2.3757	1.8738	2.2246	2.822	5.2725	6.3654	5.2728	3.493
16.2	2.4514	1.9521	2.3249	2.9354	5.4381	6.5557	5.4552	3.6533
16.3	2.5287	2.0351	2.428	3.0485	5.6036	6.7459	5.6373	3.8141
16.4	2.607	2.1237	2.5338	3.1618	5.769	6.9361	5.8192	3.9756
16.5	2.686	2.2183	2.6433	3.2755	5.9341	7.1263	6.0013	4.1362
16.6	2.7655	2.3151	2.7558	3.3901	6.0993	7.3163	6.1834	4.2966
16.7	2.8453	2.4126	2.8692	3.5053	6.2647	7.5063	6.3656	4.4574
16.8	2.9253	2.5103	2.9836	3.6209	6.43	7.6962	6.5476	4.6178
16.9	3.0051	2.608	3.099	3.7368	6.5951	7.886	6.7296	4.7781
17	3.0847	2.706	3.2147	3.8528	6.7601	8.0757	6.9116	4.9397
17.1	3.1638	2.8048	3.3307	3.9693	6.9249	8.2654	7.0933	5.1014
17.2	3.2422	2.9048	3.4475	4.0866	7.0897	8.4549	7.275	5.2629
17.3	3.3198	3.0067	3.5656	4.2048	7.2547	8.6443	7.4569	5.4251
17.4	3.3965	3.111	3.6845	4.3242	7.4196	8.8337	7.6387	5.5878
17.5	3.4724	3.2178	3.8035	4.4447	7.5842	9.023	7.8205	5.7509
17.6	3.5477	3.3258	3.9227	4.5666	7.7484	9.2121	8.0023	5.9143
17.7	3.6227	3.4342	4.0421	4.6897	7.9129	9.4011	8.1841	6.0786
17.8	3.6976	3.543	4.1616	4.8142	8.0775	9.5901	8.3662	6.2441
17.9	3.7726	3.6523	4.2811	4.9399	8.2413	9.7789	8.5481	6.4101
18	3.848	3.7621	4.4004	5.0662	8.405	9.9676	8.7298	6.5779
18.1	3.924	3.8718	4.5196	5.1926	8.5692	10.156	8.9114	6.7478
18.2	4.0007	3.9814	4.6388	5.3189	8.7335	10.345	9.0926	6.9191
18.3	4.0783	4.0911	4.7585	5.4456	8.8976	10.533	9.2736	7.0914
18.4	4.1563	4.201	4.8785	5.5729	9.0619	10.721	9.4551	7.2645
18.5	4.2347	4.3116	4.9987	5.7006	9.2262	10.91	9.6366	7.438
18.6	4.3132	4.4227	5.1192	5.8284	9.3902	11.098	9.8182	7.6116
18.7	4.3923	4.534	5.24	5.9564	9.5541	11.286	9.9997	7.7853
18.8	4.4728	4.6455	5.3608	6.0845	9.718	11.474	10.181	7.9591
18.9	4.5555	4.7575	5.4817	6.213	9.8821	11.662	10.363	8.1333

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
19	4.6407	4.87	5.6027	6.3417	10.046	11.85	10.544	8.308
19.1	4.7279	4.9829	5.7237	6.4705	10.211	12.038	10.725	8.4827
19.2	4.8168	5.0963	5.8446	6.5994	10.375	12.226	10.907	8.6573
19.3	4.9073	5.2104	5.9656	6.7285	10.539	12.413	11.088	8.8316
19.4	4.998	5.3249	6.0867	6.8577	10.703	12.601	11.27	9.0053
19.5	5.0873	5.4399	6.2079	6.9872	10.867	12.788	11.451	9.1786
19.6	5.1743	5.5553	6.3292	7.1171	11.031	12.976	11.633	9.3517
19.7	5.259	5.6711	6.4508	7.2473	11.195	13.164	11.814	9.5249
19.8	5.3431	5.7872	6.5725	7.3778	11.36	13.351	11.995	9.6982
19.9	5.4276	5.9037	6.6945	7.5086	11.524	13.539	12.176	9.8717
20	5.5131	6.0204	6.8167	7.6395	11.688	13.726	12.358	10.046
20.1	5.6003	6.1372	6.939	7.7704	11.853	13.913	12.54	10.22
20.2	5.6899	6.2539	7.0614	7.9014	12.017	14.101	12.722	10.395
20.3	5.7824	6.3705	7.1837	8.0325	12.18	14.288	12.904	10.57
20.4	5.8775	6.4869	7.3059	8.1636	12.344	14.475	13.086	10.745
20.5	5.9744	6.6032	7.4279	8.2948	12.508	14.663	13.269	10.921
20.6	6.0725	6.7193	7.5498	8.4259	12.672	14.85	13.452	11.097
20.7	6.1725	6.8349	7.6717	8.5572	12.837	15.037	13.634	11.273
20.8	6.2765	6.9502	7.7936	8.6885	13.002	15.224	13.817	11.449
20.9	6.3865	7.0654	7.9156	8.8199	13.166	15.411	13.999	11.626
21	6.5021	7.1808	8.0377	8.9514	13.332	15.598	14.181	11.802
21.1	6.6222	7.2962	8.1598	9.0832	13.497	15.785	14.364	11.979
21.2	6.7461	7.4115	8.2821	9.2153	13.663	15.972	14.546	12.156
21.3	6.8744	7.5269	8.4044	9.3474	13.829	16.16	14.728	12.332
21.4	7.0084	7.6422	8.5266	9.4795	13.995	16.347	14.91	12.508
21.5	7.1483	7.7576	8.6489	9.6118	14.162	16.534	15.091	12.684
21.6	7.2927	7.8731	8.7711	9.7442	14.33	16.721	15.272	12.861
21.7	7.4426	7.9886	8.8929	9.8769	14.499	16.908	15.453	13.037
21.8	7.5959	8.104	9.0147	10.01	14.668	17.095	15.634	13.214
21.9	7.7489	8.2198	9.1366	10.143	14.839	17.282	15.815	13.391
22	7.9001	8.3357	9.2587	10.276	15.01	17.468	15.996	13.568
22.1	8.0484	8.4518	9.3808	10.41	15.182	17.655	16.176	13.746
22.2	8.1935	8.568	9.503	10.544	15.355	17.841	16.357	13.924
22.3	8.3367	8.6843	9.6254	10.678	15.528	18.027	16.539	14.102
22.4	8.4799	8.8005	9.7478	10.811	15.703	18.214	16.721	14.28
22.5	8.6242	8.9167	9.8703	10.946	15.879	18.4	16.902	14.459
22.6	8.7688	9.0329	9.9927	11.08	16.055	18.586	17.083	14.637
22.7	8.9127	9.1488	10.115	11.214	16.231	18.772	17.265	14.816
22.8	9.0556	9.2646	10.238	11.349	16.408	18.958	17.448	14.995
22.9	9.1975	9.3802	10.36	11.483	16.586	19.144	17.631	15.174

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
23	9.3388	9.4956	10.483	11.617	16.764	19.33	17.814	15.353
23.1	9.4803	9.6107	10.606	11.751	16.944	19.515	17.998	15.532
23.2	9.6221	9.7258	10.728	11.886	17.124	19.701	18.183	15.712
23.3	9.7638	9.8407	10.851	12.02	17.304	19.887	18.368	15.891
23.4	9.905	9.9556	10.974	12.155	17.484	20.073	18.555	16.071
23.5	10.045	10.07	11.097	12.29	17.665	20.259	18.742	16.25
23.6	10.185	10.185	11.219	12.425	17.847	20.445	18.93	16.43
23.7	10.325	10.3	11.342	12.56	18.029	20.631	19.119	16.61
23.8	10.464	10.414	11.465	12.696	18.211	20.817	19.309	16.791
23.9	10.604	10.529	11.587	12.831	18.394	21.003	19.501	16.972
24	10.742	10.643	11.71	12.967	18.576	21.189	19.694	17.153
24.1	10.881	10.758	11.833	13.103	18.759	21.374	19.888	17.335
24.2	11.018	10.872	11.956	13.239	18.942	21.56	20.084	17.517
24.3	11.156	10.987	12.079	13.376	19.126	21.746	20.28	17.7
24.4	11.293	11.102	12.203	13.513	19.309	21.931	20.476	17.882
24.5	11.43	11.217	12.326	13.649	19.493	22.117	20.672	18.064
24.6	11.567	11.331	12.45	13.787	19.677	22.303	20.868	18.247
24.7	11.704	11.445	12.574	13.924	19.862	22.489	21.066	18.43
24.8	11.841	11.559	12.698	14.061	20.047	22.674	21.264	18.613
24.9	11.977	11.672	12.822	14.199	20.231	22.86	21.462	18.796
25	12.113	11.785	12.946	14.337	20.417	23.046	21.661	18.979
25.1	12.25	11.899	13.07	14.475	20.602	23.232	21.861	19.162
25.2	12.386	12.012	13.194	14.613	20.788	23.417	22.061	19.346
25.3	12.522	12.126	13.318	14.752	20.975	23.603	22.261	19.529
25.4	12.658	12.241	13.442	14.89	21.161	23.789	22.462	19.712
25.5	12.794	12.355	13.567	15.028	21.347	23.975	22.663	19.897
25.6	12.93	12.47	13.691	15.167	21.534	24.161	22.865	20.081
25.7	13.066	12.585	13.816	15.307	21.721	24.347	23.067	20.265
25.8	13.202	12.699	13.941	15.447	21.908	24.533	23.27	20.449
25.9	13.338	12.813	14.066	15.587	22.096	24.719	23.473	20.634
26	13.473	12.926	14.191	15.728	22.283	24.905	23.676	20.819
26.1	13.609	13.04	14.315	15.869	22.471	25.091	23.879	21.004
26.2	13.745	13.153	14.44	16.01	22.658	25.276	24.083	21.189
26.3	13.88	13.266	14.565	16.152	22.846	25.462	24.286	21.374
26.4	14.016	13.379	14.69	16.294	23.035	25.648	24.49	21.56
26.5	14.151	13.492	14.816	16.436	23.223	25.833	24.694	21.745
26.6	14.286	13.606	14.941	16.578	23.412	26.019	24.897	21.931
26.7	14.422	13.719	15.067	16.721	23.601	26.205	25.101	22.117
26.8	14.558	13.833	15.193	16.864	23.791	26.391	25.305	22.302
26.9	14.693	13.947	15.319	17.008	23.98	26.577	25.509	22.489

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
27	14.829	14.061	15.446	17.151	24.17	26.763	25.713	22.675
27.1	14.965	14.175	15.572	17.296	24.359	26.949	25.917	22.861
27.2	15.1	14.29	15.698	17.44	24.549	27.135	26.121	23.048
27.3	15.236	14.404	15.825	17.585	24.74	27.321	26.325	23.234
27.4	15.372	14.519	15.951	17.73	24.931	27.507	26.529	23.421
27.5	15.508	14.633	16.078	17.875	25.122	27.694	26.734	23.608
27.6	15.644	14.747	16.205	18.021	25.313	27.88	26.939	23.796
27.7	15.78	14.861	16.332	18.167	25.504	28.068	27.144	23.983
27.8	15.916	14.976	16.46	18.314	25.695	28.256	27.348	24.17
27.9	16.052	15.09	16.588	18.461	25.888	28.445	27.553	24.357
28	16.188	15.204	16.717	18.608	26.08	28.635	27.758	24.545
28.1	16.325	15.318	16.846	18.755	26.272	28.828	27.962	24.733
28.2	16.461	15.432	16.975	18.902	26.465	29.023	28.167	24.921
28.3	16.597	15.546	17.105	19.05	26.658	29.219	28.371	25.109
28.4	16.733	15.66	17.235	19.198	26.851	29.418	28.576	25.297
28.5	16.87	15.774	17.365	19.346	27.043	29.62	28.781	25.486
28.6	17.006	15.888	17.495	19.495	27.237	29.823	28.985	25.675
28.7	17.142	16.003	17.626	19.644	27.43	30.027	29.19	25.863
28.8	17.278	16.117	17.757	19.794	27.624	30.232	29.395	26.052
28.9	17.414	16.232	17.887	19.944	27.817	30.438	29.6	26.24
29	17.55	16.347	18.019	20.094	28.011	30.645	29.804	26.43
29.1	17.685	16.462	18.15	20.245	28.205	30.853	30.009	26.618
29.2	17.821	16.577	18.281	20.395	28.399	31.061	30.214	26.807
29.3	17.956	16.692	18.413	20.546	28.593	31.27	30.419	26.996
29.4	18.091	16.807	18.546	20.698	28.787	31.479	30.625	27.186
29.5	18.226	16.922	18.678	20.85	28.982	31.689	30.83	27.374
29.6	18.361	17.037	18.811	21.002	29.176	31.899	31.035	27.563
29.7	18.495	17.152	18.944	21.154	29.37	32.11	31.24	27.753
29.8	18.629	17.267	19.078	21.306	29.565	32.321	31.445	27.943
29.9	18.763	17.382	19.212	21.459	29.76	32.533	31.65	28.133
30	18.897	17.497	19.346	21.612	29.956	32.744	31.856	28.323
30.1	19.03	17.612	19.48	21.765	30.152	32.956	32.061	28.513
30.2	19.164	17.727	19.615	21.919	30.347	33.168	32.266	28.703
30.3	19.297	17.841	19.75	22.073	30.543	33.38	32.471	28.893
30.4	19.43	17.956	19.885	22.227	30.739	33.592	32.677	29.084
30.5	19.562	18.071	20.02	22.381	30.936	33.804	32.882	29.274
30.6	19.695	18.185	20.156	22.536	31.134	34.016	33.088	29.465
30.7	19.827	18.3	20.292	22.692	31.332	34.228	33.294	29.655
30.8	19.959	18.415	20.428	22.847	31.529	34.44	33.5	29.846
30.9	20.091	18.53	20.565	23.003	31.726	34.652	33.707	30.037

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

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r →	0	20	30	35	45	55	65	75
t								
31	20.222	18.644	20.701	23.159	31.925	34.864	33.914	30.228
31.1	20.353	18.759	20.838	23.316	32.123	35.077	34.121	30.419
31.2	20.484	18.875	20.975	23.472	32.321	35.289	34.328	30.611
31.3	20.615	18.99	21.113	23.629	32.519	35.502	34.535	30.802
31.4	20.745	19.105	21.25	23.786	32.718	35.715	34.743	30.993
31.5	20.876	19.221	21.388	23.944	32.917	35.927	34.951	31.185
31.6	21.006	19.336	21.526	24.102	33.116	36.14	35.158	31.376
31.7	21.135	19.452	21.664	24.259	33.315	36.353	35.366	31.568
31.8	21.265	19.567	21.803	24.417	33.515	36.566	35.574	31.759
31.9	21.394	19.683	21.942	24.576	33.715	36.779	35.782	31.951
32	21.523	19.798	22.081	24.734	33.915	36.992	35.99	32.143
32.1	21.652	19.914	22.221	24.893	34.115	37.205	36.198	32.335
32.2	21.78	20.03	22.361	25.052	34.315	37.418	36.406	32.527
32.3	21.909	20.146	22.501	25.211	34.516	37.631	36.615	32.72
32.4	22.037	20.261	22.642	25.371	34.717	37.845	36.823	32.912
32.5	22.165	20.377	22.783	25.531	34.918	38.058	37.031	33.105
32.6	22.293	20.493	22.924	25.692	35.119	38.271	37.239	33.297
32.7	22.42	20.609	23.065	25.854	35.321	38.484	37.448	33.489
32.8	22.547	20.725	23.207	26.015	35.523	38.698	37.657	33.682
32.9	22.675	20.842	23.348	26.176	35.724	38.911	37.865	33.875
33	22.801	20.958	23.49	26.337	35.925	39.124	38.074	34.068
33.1	22.928	21.075	23.632	26.499	36.127	39.338	38.283	34.261
33.2	23.055	21.192	23.775	26.661	36.33	39.551	38.492	34.454
33.3	23.181	21.309	23.918	26.823	36.533	39.765	38.701	34.647
33.4	23.307	21.426	24.062	26.986	36.736	39.978	38.91	34.84
33.5	23.434	21.543	24.206	27.148	36.939	40.192	39.119	35.033
33.6	23.56	21.661	24.35	27.311	37.143	40.405	39.328	35.226
33.7	23.685	21.779	24.495	27.475	37.347	40.618	39.537	35.419
33.8	23.811	21.897	24.64	27.639	37.551	40.832	39.747	35.612
33.9	23.936	22.015	24.785	27.803	37.755	41.045	39.956	35.805
34	24.062	22.133	24.93	27.967	37.96	41.258	40.166	35.999
34.1	24.187	22.252	25.076	28.131	38.165	41.472	40.375	36.192
34.2	24.312	22.37	25.222	28.296	38.37	41.686	40.585	36.386
34.3	24.437	22.489	25.368	28.46	38.576	41.899	40.795	36.579
34.4	24.561	22.608	25.514	28.626	38.782	42.113	41.005	36.773
34.5	24.686	22.727	25.661	28.791	38.988	42.326	41.215	36.967
34.6	24.811	22.847	25.808	28.956	39.194	42.54	41.425	37.161
34.7	24.935	22.966	25.956	29.122	39.401	42.753	41.635	37.354
34.8	25.059	23.086	26.104	29.288	39.608	42.967	41.845	37.549
34.9	25.183	23.207	26.252	29.454	39.814	43.181	42.056	37.743

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r →	0	20	30	35	45	55	65	75
t								
35	25.307	23.327	26.4	29.621	40.021	43.394	42.266	37.937
35.1	25.431	23.448	26.549	29.788	40.229	43.608	42.476	38.131
35.2	25.554	23.57	26.698	29.955	40.437	43.822	42.687	38.325
35.3	25.678	23.693	26.847	30.122	40.644	44.035	42.898	38.519
35.4	25.801	23.816	26.997	30.29	40.852	44.249	43.108	38.714
35.5	25.924	23.94	27.147	30.457	41.061	44.462	43.319	38.908
35.6	26.048	24.065	27.297	30.626	41.27	44.676	43.53	39.102
35.7	26.171	24.192	27.448	30.794	41.479	44.889	43.741	39.297
35.8	26.293	24.319	27.6	30.963	41.688	45.102	43.952	39.491
35.9	26.416	24.447	27.752	31.132	41.897	45.315	44.163	39.686
36	26.539	24.577	27.904	31.301	42.106	45.529	44.374	39.88
36.1	26.661	24.707	28.056	31.47	42.315	45.742	44.586	40.075
36.2	26.784	24.838	28.209	31.639	42.525	45.955	44.797	40.269
36.3	26.906	24.97	28.362	31.809	42.734	46.168	45.009	40.464
36.4	27.028	25.104	28.516	31.978	42.944	46.381	45.22	40.659
36.5	27.15	25.239	28.669	32.148	43.155	46.594	45.432	40.854
36.6	27.272	25.374	28.824	32.318	43.365	46.807	45.644	41.049
36.7	27.394	25.51	28.978	32.488	43.576	47.02	45.856	41.243
36.8	27.516	25.647	29.133	32.658	43.787	47.232	46.068	41.437
36.9	27.638	25.784	29.288	32.829	43.999	47.445	46.28	41.633
37	27.76	25.921	29.443	33	44.211	47.658	46.492	41.828
37.1	27.882	26.058	29.598	33.171	44.422	47.871	46.705	42.023
37.2	28.004	26.196	29.754	33.343	44.633	48.084	46.917	42.218
37.3	28.126	26.334	29.91	33.514	44.845	48.297	47.13	42.414
37.4	28.248	26.473	30.066	33.686	45.057	48.509	47.343	42.609
37.5	28.37	26.612	30.223	33.858	45.269	48.722	47.556	42.804
37.6	28.492	26.751	30.379	34.03	45.482	48.935	47.769	43
37.7	28.614	26.891	30.537	34.202	45.695	49.148	47.983	43.195
37.8	28.737	27.031	30.694	34.375	45.908	49.361	48.196	43.391
37.9	28.86	27.17	30.851	34.548	46.12	49.574	48.41	43.587
38	28.984	27.31	31.009	34.721	46.332	49.787	48.624	43.783
38.1	29.108	27.45	31.167	34.895	46.544	49.999	48.838	43.979
38.2	29.233	27.59	31.326	35.068	46.758	50.212	49.052	44.174
38.3	29.358	27.731	31.485	35.241	46.972	50.425	49.267	44.37
38.4	29.484	27.871	31.643	35.414	47.186	50.637	49.481	44.567
38.5	29.61	28.012	31.802	35.589	47.401	50.849	49.696	44.763
38.6	29.736	28.152	31.961	35.763	47.616	51.062	49.91	44.958
38.7	29.862	28.292	32.119	35.938	47.83	51.274	50.125	45.154
38.8	29.987	28.434	32.278	36.112	48.043	51.487	50.34	45.351
38.9	30.112	28.576	32.437	36.287	48.257	51.699	50.555	45.547

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t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
39	30.237	28.718	32.597	36.462	48.471	51.912	50.77	45.743
39.1	30.363	28.861	32.756	36.637	48.687	52.124	50.985	45.94
39.2	30.49	29.004	32.916	36.813	48.902	52.336	51.201	46.136
39.3	30.616	29.147	33.075	36.989	49.117	52.548	51.416	46.332
39.4	30.742	29.29	33.235	37.165	49.333	52.761	51.632	46.528
39.5	30.869	29.433	33.396	37.341	49.549	52.973	51.848	46.725
39.6	30.997	29.576	33.556	37.518	49.764	53.186	52.064	46.921
39.7	31.125	29.719	33.716	37.694	49.98	53.399	52.28	47.118
39.8	31.254	29.862	33.876	37.871	50.196	53.611	52.497	47.315
39.9	31.382	30.005	34.037	38.048	50.411	53.824	52.713	47.512
40	31.51	30.148	34.197	38.225		54.037	52.93	47.709
40.1	31.639	30.292	34.356	38.402		54.249	53.147	47.906
40.2	31.767	30.435	34.516	38.579		54.461	53.365	48.103
40.3	31.896	30.579	34.677	38.757		54.673	53.582	48.301
40.4	32.025	30.723	34.837	38.934		54.886	53.8	48.498
40.5	32.153	30.867	34.998	39.111		55.098	54.017	48.695
40.6	32.282	31.012	35.159	39.289		55.311	54.235	48.892
40.7	32.411	31.157	35.32	39.466		55.523	54.453	49.09
40.8	32.54	31.302	35.482	39.644		55.735	54.672	49.287
40.9	32.669	31.447	35.643	39.823		55.947	54.89	49.484
41	32.798	31.593	35.804	40.001		56.159	55.108	49.681
41.1	32.927	31.738	35.966	40.179		56.371	55.327	49.879
41.2	33.056	31.884	36.128	40.357		56.582	55.546	50.077
41.3	33.185	32.029	36.29	40.535		56.794	55.765	50.274
41.4	33.315	32.175	36.452	40.713		57.006	55.984	50.471
41.5	33.444	32.321	36.614	40.892		57.217	56.204	50.669
41.6	33.574	32.467	36.776	41.071		57.43	56.424	50.866
41.7	33.703	32.612	36.939	41.25		57.642	56.644	51.064
41.8	33.833	32.758	37.101	41.429		57.854	56.864	51.261
41.9	33.962	32.904	37.263	41.609		58.067	57.084	51.459
42	34.092	33.05	37.426	41.788		58.279	57.305	51.657
42.1	34.221	33.196	37.588	41.968		58.491	57.525	51.855
42.2	34.351	33.343	37.75	42.147		58.703	57.746	52.053
42.3	34.481	33.489	37.913	42.327		58.916	57.968	52.252
42.4	34.61	33.636	38.076	42.507		59.128	58.189	52.45
42.5	34.74	33.783	38.238	42.687		59.34	58.41	52.648
42.6	34.87	33.929	38.402	42.867		59.553	58.631	52.846
42.7	35.001	34.077	38.565	43.047		59.765	58.853	53.044
42.8	35.132	34.224	38.728	43.228		59.978	59.074	53.242
42.9	35.264	34.371	38.892	43.408		60.191	59.296	53.44

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r →	0	20	30	35	45	55	65	75
t								
43	35.396	34.519	39.055	43.588		60.403	59.518	53.638
43.1	35.529	34.667	39.219	43.769		60.616	59.74	53.836
43.2	35.662	34.815	39.383	43.949		60.829	59.962	54.035
43.3	35.797	34.962	39.546	44.13		61.042	60.184	54.233
43.4	35.932	35.11	39.71	44.31		61.255	60.406	54.432
43.5	36.068	35.259	39.874	44.491		61.467	60.629	54.63
43.6	36.205	35.407	40.039	44.673		61.681	60.851	54.828
43.7	36.345	35.555	40.203	44.853		61.894	61.074	55.027
43.8	36.485	35.704	40.368	45.034		62.107	61.298	55.226
43.9	36.628	35.852	40.533	45.216		62.32	61.521	55.425
44	36.774	36.001	40.698	45.397		62.533	61.744	55.624
44.1	36.922	36.149	40.862	45.578		62.746	61.967	55.822
44.2	37.07	36.297	41.026	45.76		62.959	62.191	56.021
44.3	37.219	36.446	41.191	45.941		63.173	62.414	56.221
44.4	37.369	36.595	41.356	46.123		63.386	62.638	56.42
44.5	37.521	36.744	41.521	46.304		63.599	62.862	56.619
44.6	37.673	36.893	41.686	46.485		63.812	63.086	56.818
44.7	37.827	37.042	41.852	46.667		64.025	63.31	57.017
44.8	37.981	37.192	42.017	46.849		64.238	63.535	57.217
44.9	38.135	37.341	42.183	47.032		64.451	63.759	57.417
45	38.29	37.491	42.348	47.214		64.664	63.983	57.616
45.1	38.445	37.641	42.514	47.397		64.877	64.208	57.816
45.2	38.6	37.791	42.68	47.579		65.09	64.432	58.016
45.3	38.756	37.941	42.846	47.762		65.304	64.657	58.216
45.4	38.912	38.091	43.013	47.945		65.518	64.881	58.416
45.5	39.069	38.241	43.179	48.127		65.731	65.106	58.616
45.6	39.226	38.391	43.346	48.31		65.944	65.33	58.816
45.7	39.385	38.541	43.512	48.493		66.158	65.555	59.017
45.8	39.544	38.691	43.679	48.676			65.78	59.217
45.9	39.704	38.841	43.846	48.86			66.005	59.417
46	39.865	38.991	44.014	49.043			66.23	59.618
46.1	40.025	39.141	44.181	49.225			66.455	59.818
46.2	40.186	39.292	44.348	49.408			66.679	60.019
46.3	40.347	39.442	44.516	49.591			66.904	60.22
46.4	40.509	39.593	44.683	49.774			67.129	60.421
46.5	40.67	39.743	44.851	49.957			67.354	60.622
46.6	40.832	39.893	45.019	50.141			67.579	60.822
46.7	40.994	40.043	45.186	50.324			67.804	61.023
46.8	41.156	40.193	45.354	50.508			68.029	61.223
46.9	41.319	40.343	45.522	50.691			68.254	61.424

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
47	41.482	40.493	45.69	50.875			68.479	61.625
47.1	41.645	40.643	45.858	51.059			68.703	61.826
47.2	41.808	40.793	46.027	51.243			68.929	62.027
47.3	41.972	40.944	46.195	51.427			69.154	62.229
47.4	42.136	41.094	46.363	51.611			69.379	62.43
47.5	42.3	41.244	46.532	51.796			69.604	62.632
47.6	42.464	41.394	46.701	51.982			69.829	62.834
47.7	42.629	41.544	46.87	52.167			70.055	63.036
47.8	42.794	41.694	47.039	52.353			70.28	63.237
47.9	42.958	41.845	47.208	52.539			70.505	63.439
48	43.123	41.995	47.378	52.725			70.731	63.641
48.1	43.288	42.145	47.547	52.91			70.956	63.842
48.2	43.453	42.296	47.716	53.096			71.182	64.044
48.3	43.619	42.447	47.886	53.282			71.408	64.246
48.4	43.785	42.598	48.056	53.468			71.633	64.448
48.5	43.95	42.748	48.226	53.653			71.859	64.65
48.6	44.116	42.899	48.397	53.839			72.084	64.852
48.7	44.282	43.05	48.567	54.025			72.31	65.055
48.8	44.449	43.201	48.738				72.536	65.257
48.9	44.615	43.352	48.908				72.762	65.459
49	44.782	43.503	49.079				72.989	65.661
49.1	44.948	43.654	49.25				73.215	65.864
49.2	45.114	43.805	49.422				73.441	66.066
49.3	45.28	43.957	49.593				73.667	66.268
49.4	45.447	44.109	49.764				73.894	66.471
49.5	45.613	44.261	49.935				74.121	66.674
49.6	45.78	44.412	50.107				74.347	66.877
49.7	45.947	44.564	50.279				74.574	67.08
49.8	46.114	44.715	50.45				74.801	67.283
49.9	46.281	44.866	50.622				75.027	67.486
50	46.448	45.018	50.794				75.253	67.69
50.1	46.615	45.171	50.966				75.48	67.894
50.2	46.783	45.323	51.138				75.707	68.098
50.3	46.95	45.475	51.31				75.934	68.301
50.4	47.117	45.627	51.482				76.161	68.505
50.5	47.285	45.779	51.655				76.388	68.708
50.6	47.452	45.931	51.827				76.616	68.911
50.7	47.619	46.083	52				76.843	69.115
50.8	47.786	46.235	52.172				77.07	69.318
50.9	47.953	46.387	52.345				77.297	69.521

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
51	48.12	46.54	52.518				77.525	69.725
51.1	48.287	46.692	52.691				77.752	69.929
51.2	48.455	46.844	52.864				77.98	70.133
51.3	48.623	46.997	53.038				78.208	70.337
51.4	48.791	47.149	53.211					70.541
51.5	48.958	47.302	53.385					70.745
51.6	49.125	47.455	53.558					70.949
51.7	49.291	47.607	53.732					71.153
51.8	49.457	47.76	53.905					71.358
51.9	49.623	47.913	54.079					71.562
52	49.791	48.066	54.253					71.766
52.1	49.96	48.219	54.427					71.971
52.2	50.129	48.372	54.601					72.175
52.3	50.297	48.525	54.775					72.38
52.4	50.464	48.678	54.95					72.585
52.5	50.632	48.831	55.124					72.79
52.6	50.8	48.985	55.299					72.995
52.7	50.97	49.138	55.473					73.2
52.8	51.139	49.292	55.648					73.405
52.9	51.307	49.446	55.822					73.61
53	51.477	49.6	55.997					73.815
53.1	51.646	49.754	56.172					74.02
53.2	51.815	49.908	56.346					74.225
53.3	51.985	50.062	56.521					74.43
53.4	52.156	50.216	56.696					74.636
53.5	52.327	50.371	56.87					74.84
53.6	52.499	50.525	57.044					75.045
53.7	52.672	50.68	57.219					75.251
53.8	52.846	50.835	57.394					75.457
53.9	53.019	50.99	57.569					75.662
54	53.192	51.145	57.745					75.868
54.1	53.365	51.3	57.921					76.074
54.2	53.538	51.455	58.096					76.28
54.3	53.712	51.61	58.271					76.486
54.4	53.886	51.765	58.447					76.692
54.5	54.059	51.92	58.622					76.899
54.6	54.233	52.076	58.797					77.105
54.7	54.407	52.231	58.973					77.311
54.8	54.581	52.386	59.15					77.517
54.9	54.755	52.542	59.326					77.723

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
55	54.93	52.698	59.503					77.929
55.1	55.104	52.853	59.68					78.135
55.2	55.279	53.01						78.341
55.3	55.455	53.166						78.547
55.4	55.63	53.322						78.754
55.5	55.806	53.478						
55.6	55.983	53.634						
55.7	56.159	53.79						
55.8	56.335	53.946						
55.9	56.511	54.103						
56	56.687	54.259						
56.1	56.864	54.416						
56.2	57.042	54.573						
56.3	57.22	54.729						
56.4	57.398	54.886						
56.5	57.576	55.043						
56.6	57.755	55.201						
56.7	57.934	55.358						
56.8	58.114	55.515						
56.9	58.294	55.672						
57	58.474	55.83						
57.1	58.655	55.988						
57.2	58.835	56.145						
57.3	59.016	56.303						
57.4	59.197	56.461						
57.5	59.378	56.619						
57.6	59.559	56.776						
57.7	59.741	56.934						
57.8	59.923	57.092						
57.9	60.105	57.25						
58	60.288	57.409						
58.1	60.47	57.568						
58.2	60.653	57.726						
58.3	60.837	57.884						
58.4	61.02	58.043						
58.5	61.204	58.202						
58.6	61.389	58.361						
58.7	61.573	58.52						
58.8	61.758	58.679						
58.9	61.943	58.838						

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
59	62.128	58.997						
59.1	62.314	59.156						
59.2	62.499	59.316						
59.3	62.684	59.476						
59.4	62.871	59.636						
59.5	63.057	59.796						
59.6	63.244	59.956						
59.7	63.432	60.116						
59.8		60.275						
59.9		60.435						
60		60.595						
60.1		60.754						
60.2		60.914						
60.3		61.075						
60.4		61.235						
60.5		61.396						
60.6		61.556						
60.7		61.717						
60.8		61.877						
60.9		62.038						
61		62.199						
61.1		62.359						
61.2		62.52						
61.3		62.68						
61.4		62.842						
61.5		63.003						
61.6		63.164						
61.7		63.326						
61.8		63.487						
61.9		63.649						
62		63.811						
62.1		63.973						
62.2		64.135						
62.3		64.298						
62.4		64.46						
62.5		64.622						
62.6		64.784						
62.7		64.947						
62.8		65.109						
62.9		65.272						

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
63		65.434						
63.1		65.597						
63.2		65.759						
63.3		65.922						
63.4		66.084						
63.5		66.246						
63.6		66.409						
63.7		66.572						
63.8		66.737						
63.9		66.901						
64		67.064						
64.1		67.228						
64.2		67.392						
64.3		67.555						
64.4		67.719						
64.5		67.883						
64.6		68.047						
64.8		68.378						

r = radial distance of HPDV measurement, from center of diagnostic plate = millimeters

z = vertical distance from top surface datum of diagnostic plate = millimeters

t = time from detonator circuit current start = microseconds

CYLINDRICAL AXIS DEAD-ZONE PRESSURE TABLE

Table 5. Tabulated Dead-Zone Pressure of of Jack Rabbit Pretest 2021E PT5

First column: time in microseconds following detonator circuit current start

Second column: pressure in kilobars on cylindrical axis (POINT 00)

tpressure	PT5 Point 00	11.6	64.2834
8	0.0000	11.7	70.1094
8.1	0.0000	11.8	76.1003
8.2	0.0000	11.9	78.0738
8.3	0.0000	12	75.4336
8.4	0.0000	12.1	69.7903
8.5	0.1052	12.2	60.8356
8.6	0.1870	12.3	41.3513
8.7	0.3342	12.4	23.9061
8.8	0.4703	12.5	18.1753
8.9	0.6896	12.6	11.6770
9	0.8834	12.7	4.4575
9.1	0.9444	12.8	-2.7029
9.2	0.8723	12.9	-9.6277
9.3	0.7655	13	-11.5575
9.4	0.7381	13.1	-8.3340
9.5	0.7038	13.2	-5.3521
9.6	0.6288	13.3	-2.9398
9.7	0.5250	13.4	-0.0001
9.8	0.4254	13.5	3.8640
9.9	0.3322	13.6	7.6902
10	0.2397	13.7	9.9022
10.1	0.1745	13.8	10.9248
10.2	0.1642	13.9	12.0321
10.3	0.2128	14	12.9314
10.4	0.3180	14.1	12.9184
10.5	0.4583	14.2	11.8694
10.6	0.6225	14.3	10.7066
10.7	0.8381	14.4	10.1722
10.8	1.1026	14.5	9.9294
10.9	1.8657	14.6	9.1073
11	6.1978	14.7	8.0533
11.1	14.2648	14.8	8.1536
11.2	32.4922	14.9	9.2311
11.3	48.5639	15	10.4692
11.4	53.0394	15.1	12.8444
11.5	58.3310	15.2	15.9140

15.3	18.6492	20.2	26.5757
15.4	21.5155	20.3	36.4926
15.5	24.2881	20.4	44.6852
15.6	26.1624	20.5	50.0918
15.7	26.8636	20.6	53.6594
15.8	26.9147	20.7	56.3973
15.9	26.8859	20.8	60.2890
16	26.7138	20.9	65.0466
16.1	26.0032	21	69.3373
16.2	23.6366	21.1	75.3704
16.3	20.1948	21.2	78.6884
16.4	16.8570	21.3	73.7724
16.5	12.8249	21.4	62.9947
16.6	8.0221	21.5	50.2805
16.7	3.4526	21.6	38.8638
16.8	-0.2250	21.7	29.6447
16.9	-3.0985	21.8	22.9778
17	-5.2061	21.9	16.4588
17.1	-6.4989	22	8.4926
17.2	-7.2008	22.1	0.7332
17.3	-7.3252	22.2	-8.7714
17.4	-6.7736	22.3	-16.2732
17.5	-5.5975	22.4	-17.3364
17.6	-3.8575	22.5	-14.9655
17.7	-1.7295	22.6	-10.5070
17.8	0.3806	22.7	-5.7423
17.9	2.1657	22.8	-3.0892
18	3.7046	22.9	-3.6896
18.1	4.9032	23	-6.1203
18.2	7.4173	23.1	-7.2810
18.3	10.7643	23.2	-6.8061
18.4	14.2159	23.3	-5.6460
18.5	17.1379	23.4	-4.5672
18.6	18.7145	23.5	-4.5028
18.7	20.0410	23.6	-5.3436
18.8	19.6653	23.7	-6.3265
18.9	17.2593	23.8	-6.5929
19	13.4141	23.9	-6.0155
19.1	9.5264	24	-5.1037
19.2	7.8431	24.1	-4.4377
19.3	6.3500	24.2	-4.3877
19.4	4.5390	24.3	-4.5886
19.5	3.2585	24.4	-4.4263
19.6	3.2971	24.5	-3.7841
19.7	5.0151	24.6	-3.0168
19.8	6.5225	24.7	-2.3427
19.9	8.6242	24.8	-1.9283
20	12.1110	24.9	-1.8226
20.1	17.8513	25	-1.7502

25.1	-1.6959	30	-3.5892
25.2	-1.5990	30.1	-3.5481
25.3	-1.3273	30.2	-3.5253
25.4	-1.0985	30.3	-3.6025
25.5	-1.0370	30.4	-3.7432
25.6	-1.0959	30.5	-3.8495
25.7	-1.1455	30.6	-3.8602
25.8	-1.0883	30.7	-3.8655
25.9	-0.9748	30.8	-3.8992
26	-0.8381	30.9	-3.9020
26.1	-0.6742	31	-3.9295
26.2	-0.5002	31.1	-3.9870
26.3	-0.3320	31.2	-3.9862
26.4	-0.1879	31.3	-3.9393
26.5	-0.0201	31.4	-3.8942
26.6	0.1517	31.5	-3.8889
26.7	0.3243	31.6	-3.8814
26.8	0.4567	31.7	-3.8599
26.9	0.5456	31.8	-3.8473
27	0.6906	31.9	-3.7697
27.1	0.8050	32	-3.6816
27.2	0.8450	32.1	-3.6180
27.3	0.9180	32.2	-3.5433
27.4	0.9489	32.3	-3.4862
27.5	0.9479	32.4	-3.4704
27.6	0.9764	32.5	-3.4043
27.7	0.8967	32.6	-3.2568
27.8	0.7301	32.7	-3.1522
27.9	0.5981	32.8	-3.0655
28	0.4981	32.9	-2.9313
28.1	0.2635	33	-2.8767
28.2	-0.0222	33.1	-2.8953
28.3	-0.2818	33.2	-2.8604
28.4	-0.5839	33.3	-2.8061
28.5	-0.7870	33.4	-2.7687
28.6	-1.0881	33.5	-2.6846
28.7	-1.4973	33.6	-2.5977
28.8	-1.7485	33.7	-2.5735
28.9	-1.9757	33.8	-2.4282
29	-2.2959	33.9	-2.1782
29.1	-2.6522	34	-2.2104
29.2	-2.8728	34.1	-2.3878
29.3	-2.9751	34.2	-2.3918
29.4	-3.0824	34.3	-2.3228
29.5	-3.2325	34.4	-2.2808
29.6	-3.4317	34.5	-2.2848
29.7	-3.4973	34.6	-2.2623
29.8	-3.5179	34.7	-2.2448
29.9	-3.5821	34.8	-2.2271

34.9	-2.2676	39.8	3.3299
35	-2.4818	39.9	3.0077
35.1	-2.4652	40	2.3354
35.2	-2.4663	40.1	2.0632
35.3	-2.3102	40.2	1.5888
35.4	-2.0121	40.3	1.2126
35.5	-1.9518	40.4	1.0819
35.6	-1.8642	40.5	1.0486
35.7	-1.8340	40.6	1.1605
35.8	-1.8314	40.7	1.1897
35.9	-1.7780	40.8	1.1620
36	-1.7085	40.9	1.1643
36.1	-1.6392	41	1.2870
36.2	-1.5319	41.1	1.4197
36.3	-1.1935	41.2	1.3640
36.4	-1.0886	41.3	1.0887
36.5	-1.2208	41.4	0.9200
36.6	-1.1043	41.5	0.8701
36.7	-0.9271	41.6	0.6936
36.8	-0.7461	41.7	0.4191
36.9	-0.4358	41.8	0.2772
37	-0.0329	41.9	0.3724
37.1	0.3636	42	0.9735
37.2	1.1596	42.1	1.7476
37.3	1.8741	42.2	2.2286
37.4	2.3382	42.3	2.8456
37.5	3.0959	42.4	3.7589
37.6	4.0396	42.5	4.7236
37.7	5.1260	42.6	5.6990
37.8	6.0757	42.7	6.7709
37.9	6.4437	42.8	7.9745
38	6.1913	42.9	9.4078
38.1	5.5707	43	11.1996
38.2	4.6521	43.1	12.8415
38.3	3.3400	43.2	14.7176
38.4	2.6494	43.3	16.7700
38.5	3.1276	43.4	18.6879
38.6	3.4589	43.5	21.0072
38.7	2.7091	43.6	22.5054
38.8	1.9062	43.7	22.8837
38.9	1.6143	43.8	23.3738
39	1.6704	43.9	24.0593
39.1	2.4337	44	24.1786
39.2	3.2026	44.1	23.5415
39.3	3.9588	44.2	22.2786
39.4	4.7850	44.3	20.1661
39.5	5.0099	44.4	17.9050
39.6	4.3606	44.5	15.5859
39.7	3.4562	44.6	12.6256

44.7	10.8336	49.6	0.3583
44.8	10.6720	49.7	0.4222
44.9	10.1070	49.8	1.2198
45	8.9916	49.9	1.4962
45.1	8.5902	50	1.3504
45.2	8.7564	50.1	0.6172
45.3	8.7789	50.2	0.7000
45.4	8.8277	50.3	1.2710
45.5	8.8679	50.4	0.0790
45.6	8.8335	50.5	0.2303
45.7	8.8833	50.6	1.0700
45.8	8.6327	50.7	1.6852
45.9	7.9375	50.8	2.6755
46	7.3454	50.9	1.5738
46.1	6.8630	51	0.2285
46.2	5.9059	51.1	-0.8107
46.3	4.7979	51.2	-1.6731
46.4	4.1884	51.3	-1.3157
46.5	3.8195	51.4	0.6106
46.6	3.6795	51.5	1.7680
46.7	3.8183	51.6	1.4447
46.8	4.0357	51.7	0.7733
46.9	4.2884	51.8	-1.3523
47	4.2009	51.9	-2.3300
47.1	4.1366	52	-0.2284
47.2	4.2520	52.1	2.7615
47.3	3.8036	52.2	4.2058
47.4	3.1763	52.3	4.1140
47.5	3.2159	52.4	3.7060
47.6	3.4380	52.5	2.4833
47.7	3.4078	52.6	2.6666
47.8	3.4395	52.7	3.1041
47.9	3.0628	52.8	4.3819
48	2.5191	52.9	7.4166
48.1	2.4159	53	8.2029
48.2	2.5774	53.1	7.4989
48.3	2.6416	53.2	5.9243
48.4	2.9543	53.3	5.3213
48.5	2.7798	53.4	6.1575
48.6	2.3467	53.5	5.9677
48.7	1.9026	53.6	5.6434
48.8	0.6969	53.7	6.0369
48.9	0.2958	53.8	4.9314
49	1.3192	53.9	2.7012
49.1	1.5237	54	2.2778
49.2	0.7157	54.1	2.0135
49.3	0.7656	54.2	0.8082
49.4	0.8868	54.3	1.3128
49.5	0.7911	54.4	2.6302

54.5	2.9755	59.4	2.1339
54.6	2.9496	59.5	0.5786
54.7	3.0800	59.6	1.5274
54.8	2.1785	59.7	4.4277
54.9	3.0953	59.8	3.1300
55	5.7623	59.9	1.2677
55.1	5.3114	60	1.2962
55.2	4.1579	60.1	3.9565
55.3	3.9513	60.2	0.2589
55.4	3.3991		
55.5	2.6912		
55.6	3.9288		
55.7	4.0748		
55.8	3.3911		
55.9	4.9942		
56	5.2126		
56.1	3.9335		
56.2	3.9316		
56.3	4.2711		
56.4	5.4437		
56.5	6.6762		
56.6	6.2280		
56.7	4.5399		
56.8	4.4670		
56.9	5.0777		
57	4.1655		
57.1	2.8055		
57.2	2.3120		
57.3	3.6868		
57.4	4.0643		
57.5	3.3852		
57.6	2.8988		
57.7	3.5807		
57.8	4.1396		
57.9	4.0532		
58	3.7788		
58.1	3.3439		
58.2	4.7173		
58.3	5.0574		
58.4	5.3237		
58.5	4.7977		
58.6	3.0141		
58.7	4.2912		
58.8	5.0936		
58.9	4.6702		
59	4.3588		
59.1	5.0270		
59.2	5.1815		
59.3	3.1045		

APPENDIX A – COMPUTER READABLE FILE NAMES

To obtain computer readable files containing the data shown in this report, contact:

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DATA CONTENT	FILE NAME
PDV velocity data (m/s) for 2021E PT5	JackRabbitPretestVelocityPT5.xls
Position data (mm) for 2021E PT5	JackRabbitPretestPositionPT5.xls
Pressure data (kilobar) on center axis, Point 00 for all 2021E experiments	Pressure00VsTime_JR.txt
Diagnostic Plate Profile Vs Time PT5	ProfileVsTime_PT5_final.xls