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Jack Rabbit Pretest 2021E PT6 Photonic Doppler Velocimetry Data

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

Except..... by experiment.

- Hart

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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 PT6 experiment was fired on April 1, 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 PT6, 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 54.2 microseconds at 30 millimeters. The latest PDV signal extinction time was 64.5 microseconds at the central axis. 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 14.1 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 1860 meters per second. At 55 millimeters the last measured velocity was 2408 meters per second. The low-to-high velocity ratio was 0.77. 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 227 kilobars at 20.1 microseconds, indicating a late time chemical reaction in the LX-17 dead-zone. Substantial motion (>1 m/s) of the diagnostic plate over the dead-zone is followed by detonation region motion within approximately 1.7 microseconds.

INTRODUCTION

The Photonic Doppler Velocimeter (PDV), also known as the Heterodyne Velocimeter, was fielded on each of the five Jack Rabbit Pretest Series, Figure 1. 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 `tfidpdv` is the time interval from the PDV fid to the fireset fid, and `tfidds` 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 μ s, 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 PT6

DESCRIPTION

2021E PT6 used a 76 millimeter thick cylindrical charge of LX-17, 160 millimeters in diameter, Figure 3. The charge was parted along a plane 30 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 PT6 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 PT6

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 4. 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 5. 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 PT6, 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 PT6, dimensions in millimeters

Booster: UFTATB, 25.8 g

Main charge: LX-17, 2771.5 g

Upper charge mass: 1038.4 g

Lower charge mass: 1733.1 g

Upper charge density: 1.899 g/cc

Lower charge density: 1.900 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 PT6 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 PT6; time is referenced from detonator circuit current start

Figure 8. Intermediate Time Axis Velocity Plot of Jack Rabbit Pretest 2021E PT6; time is referenced from detonator circuit current start

Table 2. PDV measurement positions and signal extinction times for 2021E PT6 (μs) ; time is referenced from detonator circuit current start

00 mm	20 mm	30 mm	35 mm	45 mm	55 mm	65 mm	75 mm
		54.2					
			55.2				
					56.0		
							57.6
						58.3	
				58.5			
	61.6						
64.5

Figure 9. Long Time Axis Velocity Plot of Jack Rabbit Pretest 2021E PT6; time is referenced from detonator circuit current start

DIAGNOSTIC PLATE DISPLACEMENT PROFILES

Figure 10. Diagnostic Plate Displacement Profiles of Jack Rabbit Pretest 2021E PT6; 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 PT6; time is referenced from detonator circuit current start

DIAGNOSTIC PLATE VELOCITY TABLE

Table 3. Tabulated Diagnostic Plate Velocities of Jack Rabbit Pretest 2021E PT6; time is referenced from detonator circuit current start

Jack Rabbit Pretest 2021E PT6 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								
12	0	0	0	0	0	0	0	0
12.1	0	0	0	0	0	0	0	0
12.2	0	0	0	0	0	0	0	0
12.3	0.8939	0	0	0	0	0	0	0
12.4	1.0809	0	0	0	0	0	0	0
12.5	1.2678	0	0	0	0	0	0	0
12.6	1.4548	0	0	0	0	0	0	0
12.7	1.8326	0	0	0	0	0	0	0
12.8	2.2357	0	0	0	0	0	0	0
12.9	2.5406	0	0	0	0	0	0	0
13	2.8361	0	0	0	0	0	0	0
13.1	3.2237	0	0	0	0	0	0	0
13.2	3.4655	0	0	0	0	0	0	0
13.3	3.6763	0	0	0	0	0	0	0
13.4	3.7443	0	0	0	0	0	0	0
13.5	3.7654	0	0	0	0	0	0	0
13.6	3.8307	0	0	0	0	0	0	0
13.7	3.8443	0	0	0	0	0	0	0
13.8	3.7398	0	0	0	0	0	0	0
13.9	3.7127	0	0	0	0	0	0	0
14	3.7959	0	0	0	0	0	0	0
14.1	3.9093	0	0	0	0	542.9	0	0
14.2	4.0321	0	0	0	0	2257.7	0	0
14.3	4.2339	0	0	0	2226.7	2200.5	0	0
14.4	4.5117	0	0	0	2158.3	2161.7	0	0
14.5	4.6248	0	0	0	2085.5	2163.1	2225.2	0
14.6	9.9997	0	0	0	2070.5	2142.7	2159.7	0
14.7	80.302	0	0	0	2055.3	2147.1	2099.6	0
14.8	381.79	0	0	444.71	2052.8	2141.3	2097.5	0
14.9	410.27	0	0	1736.7	2051.4	2128.1	2098	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								
15	407.1	61.657	0	1646.8	2045.9	2129.5	2085.8	2034
15.1	398.35	87.953	0	1634.1	2041.5	2125.4	2079.9	1995.5
15.2	396.26	295.76	0	1648	2042	2120.8	2070.9	1955.4
15.3	393.79	327.16	0	1618	2037.6	2124.1	2065.7	1892.8
15.4	386.1	329.56	1336	1615	2033	2119.6	2059.8	1891.2
15.5	378.53	324.55	1366	1612.2	2031.3	2114.3	2057.9	1939
15.6	378.06	318.16	1379.1	1612.2	2027.7	2116.1	2066.3	1917
15.7	364.02	315.65	1372.2	1608.6	2030.4	2115.7	2065.6	1904.4
15.8	357.62	314.57	1360.4	1612.4	2032	2118.1	2062.8	1905.8
15.9	353.6	313.83	1317.2	1611.1	2029.5	2114.1	2056.4	1900.2
16	345.72	316.56	1297	1612.8	2023.1	2111.1	2057	1891.5
16.1	339.14	318.97	1276.1	1615.1	2028	2109.4	2054.7	1898.8
16.2	338.18	321.63	1270.1	1612.6	2025.6	2108.6	2053.9	1892.9
16.3	332.6	322.83	1264.3	1611.4	2030.8	2107.7	2054.1	1888.9
16.4	329	326.82	1265.3	1611.3	2021.7	2106.1	2047.4	1895.4
16.5	342.57	334.65	1257.2	1614.2	2027.3	2104.7	2050.9	1887.9
16.6	356	362.66	1257.9	1611.5	2019.5	2104.6	2046.2	1887.4
16.7	382.01	838.82	1257.4	1614.2	2022.6	2103.6	2046.9	1881.2
16.8	417.6	916.36	1259.7	1617	2021.5	2101.3	2047.6	1878.7
16.9	463.05	968.28	1271.7	1622.1	2022.5	2100.4	2049.3	1891.2
17	489.05	1006.9	1278.9	1616	2018.6	2100	2045.8	1895.6
17.1	502.76	1042.7	1298.5	1613.9	2018.6	2099.6	2045.4	1896.1
17.2	513.45	1064.5	1373.9	1618.8	2017.6	2098.1	2046.1	1895.4
17.3	521.48	1072.4	1398.7	1613.4	2016.3	2096.1	2042.1	1898.9
17.4	528.66	1072.3	1413.4	1626.8	2015	2097.6	2046.5	1903.1
17.5	538.96	1068.6	1415.5	1616.6	2014.9	2095.2	2043.5	1900.3
17.6	550.95	1063.4	1454.9	1618.6	2012.4	2096.2	2043	1901.5
17.7	563.34	1057.9	1464	1621.1	2008.7	2097	2045.7	1900.6
17.8	569.5	1064.2	1480.6	1622.2	2009.8	2094.2	2041.9	1889.5
17.9	573.35	1088.6	1484.7	1621.8	2011.1	2092.2	2047.9	1900.1
18	575.98	1133.7	1483.5	1621.4	2009.3	2092.5	2039.4	1899
18.1	577.56	1188.1	1486.9	1628	2009.2	2092.8	2041.5	1900.9
18.2	576.98	1239.7	1508.8	1634.7	2000.8	2088.7	2037.3	1901.7
18.3	574.06	1269	1513.9	1627.4	2005.5	2090.5	2037.5	1902.1
18.4	574.27	1281.6	1510.5	1629.6	2006.1	2090.6	2036.5	1902.8
18.5	576.6	1289.4	1520.2	1627.7	2004.2	2090.2	2037.4	1901.4
18.6	582.05	1291.8	1534.6	1627.8	2003.2	2091.3	2036.8	1898.7
18.7	590.75	1292.4	1542.9	1628.2	2003.6	2085.6	2032.7	1895.9
18.8	599.78	1291.6	1552.3	1617.1	1999.1	2086.4	2034.2	1897.1
18.9	602.1	1290.9	1555.2	1627.5	2000.9	2085	2034.3	1897.3

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								
19	602.44	1292	1550.1	1628.8	2000.8	2083.6	2033.7	1896.5
19.1	602.32	1296.1	1558.2	1628.1	1999.9	2084.6	2033.3	1897.6
19.2	602.36	1304.1	1564	1608.7	1999.3	2081.8	2032.7	1901.2
19.3	603.11	1313.3	1575.7	1623.8	1999.8	2079.1	2030.2	1896.9
19.4	605.21	1324.8	1586.4	1630.5	1998.9	2081.4	2029.2	1898.1
19.5	607.4	1340.5	1596.5	1628.8	1997.9	2081	2028.3	1899.3
19.6	660.89	1359.2	1603.9	1627.9	1996.1	2081	2033.5	1900.8
19.7	785.93	1379.5	1612.5	1631.9	1997.9	2079.9	2024.1	1899.7
19.8	1451.3	1399	1615.8	1632.5	1996.6	2080.5	2029.5	1898
19.9	1654.3	1413.4	1618.7	1635.1	1996.4	2079.3	2026.5	1895.9
20	1549.3	1424.6	1623	1638.2	1994.9	2078.1	2025.9	1902.8
20.1	1506.4	1433	1626.1	1640.6	1994.2	2077.5	2024.3	1897.6
20.2	1493.7	1442.1	1633.8	1642.8	1992	2076.2	2024.5	1898.2
20.3	1566.3	1448.8	1635.7	1647.3	1993.7	2075	2023.2	1897.9
20.4	1961.5	1455.9	1645.3	1646.4	1991.3	2074.8	2023.9	1897.8
20.5	1973.7	1464.2	1653.7	1655.9	1990.9	2074.5	2022.3	1898.4
20.6	2189.5	1470.2	1655.7	1656.4	1990.6	2074.4	2021.6	1897.3
20.7	2162.9	1476.2	1669.3	1665.3	1990.7	2073.5	2019.7	1897.6
20.8	2140	1482.1	1674.7	1664.3	1989.3	2073.5	2020.7	1899.9
20.9	2125.7	1484.6	1680.5	1670	1988	2073.6	2019.4	1896.9
21	2134.8	1488.8	1688.4	1675.4	1988.3	2072.4	2017.4	1894.1
21.1	2143.6	1492.3	1684	1681.5	1987.7	2071.7	2018.2	1897.5
21.2	2144.4	1496.5	1686.8	1687.7	1986.7	2070.9	2019.4	1897.1
21.3	2138.6	1500.8	1690.2	1694.7	1984.8	2070.4	2012.7	1899.4
21.4	2130.9	1504.4	1692.1	1700.8	1984	2069.9	2019.2	1898.5
21.5	2125.8	1507.1	1699.5	1712.8	1982.4	2069.4	2015.8	1899.1
21.6	2138.4	1510.5	1702.7	1724.6	1984	2067.9	2023.5	1898.7
21.7	2156.8	1514.6	1707.8	1740.3	1982.5	2070.5	2019.9	1899.3
21.8	2175.4	1518.6	1714.1	1748.8	2007.8	2070.7	2020.5	1898.6
21.9	2193.1	1522.7	1717.4	1757.5	1987	2069.9	2020.2	1899.5
22	2208.1	1527.7	1723.7	1772.4	1989.1	2069.9	2021.4	1900
22.1	2220.3	1533.5	1731.3	1784.6	1994.1	2069.9	2019.6	1900.1
22.2	2227.3	1539.3	1734.1	1798.9	1997.2	2069.1	2022.7	1901.1
22.3	2234.4	1546.4	1741.4	1814.5	2003.9	2064.2	2028.3	1901.6
22.4	2242.9	1552.4	1746.7	1832	2003.1	2066.2	2022.7	1901.9
22.5	2252.8	1557.2	1750.5	1847.7	2004.7	2068.3	2023.7	1902.5
22.6	2251.6	1568.8	1752.6	1855.3	2003.4	2064	2025.1	1903.9
22.7	2243.4	1581.1	1757.9	1873.4	2005.6	2067	2030	1908
22.8	2234.6	1590.8	1760.5	1877.9	2007.5	2066.9	2033	1908.9
22.9	2226	1602	1765.4	1887.9	2009.9	2063.4	2025.5	1911.9

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								
23	2217.7	1616.7	1766.8	1894.1	2009.5	2069.6	2027.4	1916.2
23.1	2210.1	1657.7	1769.8	1902.3	2009.1	2070.1	2043.3	1916.4
23.2	2203.2	1687.4	1771.1	1899.1	2007.1	2064.7	2028.9	1927.3
23.3	2199.1	1693.3	1780.5	1915.1	2005.9	2067.1	2031.5	1924.9
23.4	2200.1	1695.3	1782.5	1919	2004.1	2065.4	2045.9	1928.1
23.5	2206.5	1696.7	1785.9	1921.9	2003.2	2065.9	2041.7	1934.9
23.6	2216.5	1698.2	1789.2	1924.2	2003.3	2065.7	2051.7	1937.8
23.7	2227	1699.7	1795.9	1926.9	2001.8	2065.2	2042.3	1942.5
23.8	2235	1699.8	1801	1930.9	2005.2	2066	2056.3	1948.6
23.9	2242	1700	1804.7	1936.5	2003.1	2066.7	2021.9	1953.2
24	2246.9	1700.5	1807.2	1944.1	2003.7	2065.6	2049.7	1955
24.1	2249.7	1700.9	1813.1	1945.7	2003.6	2064.4	2052	1964.1
24.2	2250.2	1702.7	1820.8	1949.7	2001.5	2064	2055.3	1966.1
24.3	2248.8	1704.5	1811.4	1952.3	1999.8	2067.5	2050.1	1966.7
24.4	2245.8	1705.5	1826.9	1958.3	2001.7	2066.3	2044.7	1963.9
24.5	2241.1	1712.4	1827.2	1959.8	2002.4	2066.3	2056.7	1969.7
24.6	2235.9	1716.6	1834.1	1967.2	1998.5	2067.7	2051.6	1978
24.7	2231.9	1716.5	1836.1	1971.4	1998.5	2066.3	2043	1982.7
24.8	2228.2	1732.3	1839.5	1972.2	2000.2	2068.1	2050	1986.3
24.9	2224.5	1731.6	1845.7	1975.8	1998.1	2068.5	2049.5	1988.7
25	2221.8	1738.5	1852.6	1980.6	2000.3	2067.5	2047.4	1990.6
25.1	2220.5	1737.8	1851.2	1983.2	1998.1	2068.2	2041.8	1991.8
25.2	2220.1	1738.1	1851	1988.8	1997.7	2068	2047.6	1994.1
25.3	2220.2	1737.3	1851.8	1987.7	1997.3	2067.4	2049.1	1995.7
25.4	2221	1735.3	1856.7	1991.4	1998.7	2067.7	2047	1997.7
25.5	2222.8	1732.8	1852.8	1997.8	1998.3	2066.6	2048.1	1997.6
25.6	2225.2	1733.2	1853.4	1999.8	1998.9	2065.9	2046.9	1993.8
25.7	2223.2	1731.4	1858.4	2003.3	2002	2065.6	2050.8	2000.1
25.8	2222.7	1728.9	1867.8	2006.8	1997.6	2065.3	2050.9	2001.4
25.9	2221.5	1725.1	1864.8	2016.1	1997.1	2063.4	2049.5	1999.5
26	2220.3	1726.4	1878.3	2016.7	1997.4	2062.5	2049.2	2010
26.1	2218.3	1724.5	1886.8	2017.6	2000.1	2064.4	2050.3	1999.4
26.2	2216.5	1722.3	1893.3	2019.8	1996.7	2064.2	2051.7	2005.3
26.3	2214.5	1720.7	1897.7	2020.4	1997.5	2064.1	2050.5	2004.7
26.4	2211.7	1719.8	1899.5	2023.6	1995.5	2063.9	2051.1	2006.3
26.5	2209.7	1720.2	1891.9	2026.7	1995.7	2063.9	2050.6	2007
26.6	2207.8	1719	1894.3	2028	1997.6	2062.9	2050.8	2007.6
26.7	2206.1	1718.8	1898	2033.4	1996.6	2062.7	2050.7	2008.8
26.8	2204.1	1718.8	1897.4	2035.4	1994.9	2063.2	2050.5	2011.5
26.9	2202.8	1721	1900	2039.6	1995	2063.2	2049.7	2009.9

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								
27	2201.7	1722.2	1899.9	2042.9	1995.5	2062.9	2048.7	2011.2
27.1	2199.7	1724.5	1902.6	2042.3	1996	2063.2	2051.1	2013.8
27.2	2197.8	1727	1900.9	2047.7	1994.7	2062.5	2051.7	2011.3
27.3	2196.3	1729.3	1901.6	2048.5	1996.4	2062.6	2050.7	2011.6
27.4	2196.3	1731.1	1903.9	2052.6	1998	2062.3	2058.4	2011.3
27.5	2192.8	1732.5	1896	2051.6	1996.7	2063	2065.6	2014.2
27.6	2190	1733	1907.2	2053.4	1997.5	2063.9	2067.7	2011.9
27.7	2188.3	1732.9	1914.9	2058.8	1997.9	2061.6	2078.3	2012.7
27.8	2186.1	1735.6	1912.5	2059.7	1997.2	2061.6	2087.8	2018.2
27.9	2184.1	1733.6	1919.5	2058.9	1998.6	2061.6	2095.8	2018.7
28	2180.9	1734.1	1919.2	2061	1999.1	2060.6	2102.8	2021.1
28.1	2177.8	1734	1929.3	2062.9	1999.3	2060.9	2123.1	2020.8
28.2	2174.9	1733.5	1929.7	2064.4	2000.1	2060.5	2142.9	2021.1
28.3	2173	1733.2	1936.5	2067.2	2003.1	2060.2	2144.5	2022.3
28.4	2170	1733.5	1931.2	2069.6	2002.6	2066.9	2162.3	2023.4
28.5	2167	1730.2	1935.6	2069.5	2005.2	2060.8	2164.4	2023.9
28.6	2164.8	1733.7	1929.7	2073.1	2007.9	2062.4	2168.9	2026.4
28.7	2161.8	1731.7	1933	2075.1	2005.9	2061.9	2174.1	2027.9
28.8	2159.8	1734.2	1934.6	2076.1	2008.6	2062.9	2182.6	2027.8
28.9	2158.2	1731.6	1930.7	2077.4	2012.8	2063	2185	2025.9
29	2156.6	1733.2	1932.2	2076.2	2018.6	2062.3	2189.3	2025
29.1	2154.9	1729.5	1934.9	2078	2024.5	2064.3	2194.3	2032
29.2	2153.1	1736.3	1937.6	2080.3	2035.5	2066.1	2197.4	2032.3
29.3	2151.2	1732	1938.7	2084	2050.9	2067.8	2195.7	2039.4
29.4	2149.2	1733	1942.1	2076.5	2060.4	2071	2202.2	2037.7
29.5	2147.1	1732.3	1945.2	2084.5	2072.7	2076.9	2204.8	2035.5
29.6	2145.9	1730.9	1945.9	2087.4	2095.5	2084	2203.4	2037.7
29.7	2144.1	1731.6	1948	2081.7	2115.2	2091.8	2205.3	2039.6
29.8	2142.8	1729.3	1960.7	2086.8	2128.5	2106.4	2207.6	2036.5
29.9	2140.8	1727.2	1967.4	2086.9	2141.1	2124.5	2209	2040.7
30	2137.9	1735.8	1950.1	2088.4	2155.4	2138.9	2208.1	2041.1
30.1	2137.9	1736.1	1961.3	2092.5	2159.2	2155.3	2213.1	2040
30.2	2134.6	1731.3	1958.6	2093.7	2170.7	2178	2210.6	2043.3
30.3	2133.4	1735.6	1970.8	2084.7	2193.2	2196.4	2212.7	2042.7
30.4	2131.9	1737.7	1971.7	2097.3	2190.8	2215.5	2213.1	2037.6
30.5	2130.3	1732.4	1969.6	2097.8	2208.8	2217.7	2213	2046.3
30.6	2125.8	1735.8	1971.7	2100.2	2220.9	2229.9	2213.4	2045.2
30.7	2126	1733.1	1971.6	2099.7	2226.7	2238.7	2214.1	2047.5
30.8	2125.6	1735.6	1969	2094.7	2234.8	2250.4	2214.3	2048.6
30.9	2125.4	1735.4	1969	2102.4	2240.4	2258.5	2215.5	2048.7

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	2121	1736.6	1972.4	2104.3	2251.4	2268	2215.4	2050.3
31.1	2110.4	1735.9	1969.1	2097.6	2255.8	2276.3	2216.7	2051.4
31.2	2119.3	1737.1	1974	2108	2258.9	2281.9	2218.5	2051.4
31.3	2117.8	1735.6	1977.2	2107.6	2259.9	2290.1	2220	2052
31.4	2117.4	1736.6	1978	2112	2262.7	2293.5	2215.3	2054.6
31.5	2116.8	1735.3	1984.9	2114.2	2269.7	2300.1	2215.9	2063.9
31.6	2115.3	1735.8	1985.1	2114.7	2281.6	2301.5	2214.5	2055.3
31.7	2113.8	1736.6	1985.1	2115.9	2272.5	2305.9	2216.5	2054.4
31.8	2112.9	1737.3	1986.1	2117.5	2278.5	2306.7	2219.1	2057
31.9	2111.1	1737.6	1982.8	2119.6	2278.3	2308.3	2215.7	2054
32	2109.9	1738.9	1988.4	2118.8	2280.4	2308.2	2220.2	2057.4
32.1	2108.4	1739.4	1991.3	2120.7	2281.1	2307.5	2219.8	2058.4
32.2	2107.2	1739.9	1995.4	2127.5	2282.8	2306.5	2218.3	2059.7
32.3	2105.4	1738	1994.3	2125.9	2283.3	2306.7	2220.4	2056.9
32.4	2105	1742.6	2000.7	2127.6	2281.3	2307.4	2218.6	2057.9
32.5	2102.5	1744.7	2001.1	2129.8	2280.1	2308.1	2221.1	2055.1
32.6	2101.3	1745.7	1999.9	2127.6	2280.9	2313.9	2225.5	2057.9
32.7	2099.6	1745.3	2003.5	2130.8	2281.3	2312.7	2224.6	2057.9
32.8	2098	1746.6	2003.3	2132.3	2285	2311.5	2221.5	2061.4
32.9	2096.6	1749.7	1998.5	2132.6	2281.4	2312.6	2224.4	2061.2
33	2095.1	1749.9	2003.5	2135.7	2285.8	2310.9	2226.3	2060.6
33.1	2094.9	1750.3	2004.7	2138.8	2284.4	2310.4	2222.2	2062
33.2	2093.4	1750.5	2012.6	2139.7	2290.2	2311	2223.3	2063.2
33.3	2093.7	1751.3	2011.7	2133	2286.5	2311.8	2229.6	2061.8
33.4	2090.5	1749.8	2012.1	2137.9	2291	2312.3	2229.6	2066.3
33.5	2089.2	1752.4	2012	2145	2293	2312.7	2227.2	2063.4
33.6	2087	1751.9	2018.2	2146.3	2295.7	2313	2228.2	2067.4
33.7	2085.4	1751.7	2015.9	2147.5	2295	2314.9	2228.7	2059.7
33.8	2084	1750.4	2018	2148.7	2293.5	2315.3	2227.8	2064.7
33.9	2082.8	1757.4	2019.5	2148.2	2293.6	2316.1	2228.8	2069.3
34	2081.6	1754.2	2021.3	2150.5	2298.1	2316.6	2229.2	2065.7
34.1	2080.8	1754.4	2021.7	2152.4	2299.2	2318.5	2229.4	2066.5
34.2	2079.8	1756	2022.7	2151.8	2306	2319.2	2229.5	2067.4
34.3	2076	1759.1	2021.8	2154.4	2299.5	2319.6	2231	2068
34.4	2076.7	1759.9	2026.5	2156.5	2303.9	2320.8	2230.2	2067.1
34.5	2075.5	1760.9	2023.5	2157.5	2302.9	2321.4	2232.1	2066.3
34.6	2073.8	1761.9	2026.8	2158.6	2307.6	2321.9	2231.4	2070.5
34.7	2072.9	1763.5	2026.6	2159.7	2304.8	2322.4	2232.3	2072.1
34.8	2071.9	1765.4	2031.5	2160.6	2307.6	2322.4	2233.5	2070.9
34.9	2070.4	1767.4	2032.3	2161.1	2308.4	2323.2	2234.1	2068.1

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

r →	0	20	30	35	45	55	65	75
t								
35	2068.7	1767.1	2030.5	2161.4	2308.2	2324.1	2234.5	2071
35.1	2066.8	1769.2	2038.5	2162.8	2310.1	2325.4	2232.9	2074.4
35.2	2065.7	1768.5	2034.8	2163.2	2309.2	2326.3	2235.6	2075.3
35.3	2063.7	1757.9	2035.2	2165.2	2309.3	2327.3	2236.5	2074.3
35.4	2062.1	1770.5	2037	2168.3	2309.1	2327.9	2238	2080.7
35.5	2061	1778.1	2042.9	2169	2311.1	2327.9	2237.9	2075.5
35.6	2059.6	1763.4	2041.4	2169.5	2312.3	2328.7	2240.1	2076.1
35.7	2058	1773	2037.8	2170.9	2310.9	2329.6	2239.1	2077.1
35.8	2056.4	1774.4	2045.9	2171.2	2311.7	2330.6	2241.8	2078.5
35.9	2055.2	1777.8	2047.9	2173.3	2312.2	2331	2238.6	2079.3
36	2054.2	1777.9	2046.5	2170.6	2314.4	2332.3	2239.8	2079.8
36.1	2052.7	1779.6	2046.1	2177.5	2316.2	2332.4	2241.6	2078.4
36.2	2051.3	1778.4	2048.1	2176.1	2316.1	2332.8	2243.2	2082.6
36.3	2050.3	1776.9	2050.6	2177.5	2317.5	2332.8	2244.5	2088.5
36.4	2048.7	1782.5	2050.5	2181.7	2318	2333.4	2245.8	2084.6
36.5	2047.5	1781.3	2052.6	2178.1	2318.8	2333.5	2243.5	2087.6
36.6	2045.7	1789.5	2055.4	2180.3	2320.2	2334.8	2246	2084.8
36.7	2044.4	1786.9	2052.4	2182.8	2320.2	2335.3	2236.1	2086
36.8	2042.9	1786.8	2052.5	2183.8	2319.7	2336	2253.9	2083.9
36.9	2040.6	1790.8	2061.4	2183	2320.7	2336.2	2246.7	2085.8
37	2039	1791.4	2061	2184.8	2321.3	2337	2248.1	2085.8
37.1	2038	1792.9	2059.2	2179.8	2323.3	2337.6	2250.5	2088.4
37.2	2036.1	1794.5	2060.4	2187.8	2324.3	2337.6	2250.9	2088.5
37.3	2035.1	1795.9	2056.6	2187.6	2325.4	2338.5	2252	2098
37.4	2034.2	1795.8	2060.6	2189.1	2325.2	2338.9	2251.9	2081.5
37.5	2032	1796.6	2057.3	2188.8	2327.2	2338.8	2253.4	2090
37.6	2031.5	1799.7	2064.2	2190.7	2331.1	2339.4	2253.2	2092
37.7	2030.9	1800.8	2061.9	2189.6	2321.6	2339.9	2253.1	2093
37.8	2030.7	1803.5	2064	2191.2	2329.2	2340.3	2254.1	2093
37.9	2025.5	1804.7	2062.4	2192.7	2329.8	2340.4	2254.7	2094.2
38	2024.7	1806.1	2065.8	2194.4	2322.3	2340.9	2256.3	2094.6
38.1	2023.8	1806.4	2069.1	2195.4	2328.4	2341	2257.2	2096
38.2	2021.1	1807.9	2069.7	2196	2317	2341.4	2257.9	2093.4
38.3	2020	1808.1	2071.6	2196	2332.5	2341.8	2260.1	2095.4
38.4	2018.3	1809.1	2073.4	2196.5	2333.6	2341.7	2259.7	2101.7
38.5	2017.3	1809.9	2081	2187.5	2333.3	2342.3	2261.1	2101.3
38.6	2015.1	1811.3	2075.5	2199.9	2335.6	2342.8	2260.9	2099.9
38.7	2013.3	1813	2083.3	2201.1	2335.1	2343.7	2262.3	2099.8
38.8	2011.8	1814.6	2077.2	2202.3	2337.1	2344.2	2261.3	2099
38.9	2010.2	1815.6	2079.2	2202.2	2335.4	2344.8	2263.6	2099.8

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								
39	2008.7	1816.7	2079.6	2204.5	2336.1	2344.5	2266.3	2107.4
39.1	2007.3	1818.5	2083.4	2203.1	2336.7	2345.1	2265.4	2110.9
39.2	2005.5	1819.7	2082	2203.1	2333.4	2345.7	2265.8	2101.4
39.3	2004.4	1822.4	2081.1	2204.3	2336.8	2345.5	2266.4	2105.2
39.4	2002.5	1822.7	2085	2205.3	2338.3	2345.8	2267.6	2106.8
39.5	2001.3	1824.3	2081.6	2199.5	2339.1	2346	2268.5	2107.1
39.6	1998.9	1824.3	2084.7	2208.9	2339.8	2346.6	2270.9	2107.4
39.7	1997.8	1825.3	2085.2	2208.8	2340.5	2347	2271.2	2113
39.8	1995.2	1826.1	2086.4	2207	2341	2348	2269.2	2112
39.9	1993.9	1827.6	2090.9	2208.9	2342.1	2349.2	2271	2108.2
40	1992.2	1828.1	2084.9	2210.2	2342.6	2352	2270.7	2112.4
40.1	1991.5	1830.2	2090.8	2210.8	2342.8	2351.8	2273.1	2113.5
40.2	1989.9	1831.9	2096.1	2213.9	2342.7	2351.7	2270.4	2114.2
40.3	1988.3	1832.5	2092.6	2214.8	2342.8	2351.6	2276.6	2111.5
40.4	1986.5	1833.8	2092.1	2218.6	2343.7	2352.1	2275.5	2118.5
40.5	1984.8	1835.1	2095.7	2215.1	2343.5	2352.5	2276.1	2116.3
40.6	1983.2	1835.8	2096.9	2218	2344.7	2351.9	2274.9	2113
40.7	1981.4	1837.4	2093.2	2218	2345.3	2353.2	2277.9	2115.2
40.8	1979.7	1837.3	2098.8	2220.5	2347	2354.1	2278	2114.5
40.9	1978	1839.5	2101.1	2219.2	2348.1	2354.8	2279	2114.4
41	1976.3	1840.3	2103.7	2222.5	2347	2355.2	2277.3	2116.6
41.1	1974.9	1842	2101.3	2219.2	2348.5	2355.7	2288.7	2117.5
41.2	1973.3	1845	2102.2	2219.8	2345.6	2356.7	2281.1	2122.2
41.3	1971.1	1846.9	2107.5	2225.3	2346.4	2357.7	2280.4	2122.4
41.4	1968.7	1848.6	2106.4	2222.7	2348.3	2357.6	2281.4	2116.1
41.5	1968.1	1847.2	2108.6	2217.3	2350.1	2357.8	2278.6	2119.6
41.6	1966.4	1848.8	2108.1	2210.5	2349.1	2357.7	2283.3	2124.8
41.7	1964.5	1851.1	2110.4	2225	2349.1	2358.2	2281.9	2122.7
41.8	1962.5	1852.4	2110.2	2224.7	2347.4	2359.4	2283	2126.2
41.9	1961.5	1851.2	2113.1	2225.7	2350.2	2359.7	2283.5	2120.7
42	1960.2	1855.4	2108.5	2226.4	2348.4	2360.9	2283.6	2120
42.1	1957.9	1857.2	2116.1	2228.2	2335.1	2359.7	2283.5	2122.7
42.2	1955.3	1866.2	2118	2229.9	2351.2	2357.4	2283.8	2126
42.3	1950.6	1858.7	2113.6	2233.4	2352.3	2360	2285.7	2126.8
42.4	1932.9	1865	2120.9	2237.5	2351.3	2360.9	2287.2	2127.6
42.5	1938.4	1861.5	2117.9	2225.4	2351.1	2362.8	2284.5	2124.6
42.6	1938	1865.3	2118.9	2230.3	2351.7	2361	2286.8	2125.7
42.7	1946	1865.1	2124	2221.1	2341.2	2361.5	2290.5	2123.4
42.8	1927.2	1862.4	2123.8	2233.1	2365.6	2363	2288.1	2127.6
42.9	1930.8	1860.2	2133.3	2235.1	2352	2363.8	2287.7	2127.9

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								
43	1933.9	1874.3	2124.1	2235.2	2346.7	2363.4	2289.1	2127.4
43.1	1929.7	1869	2124.5	2241.4	2352.4	2366.2	2290.1	2127.8
43.2	1937.4	1870	2125.9	2236.5	2352	2364.4	2290.2	2128.2
43.3	1924.4	1862	2127.7	2240.2	2350.1	2364.5	2288.7	2132.3
43.4	1920.9	1874.3	2127.4	2241	2352.9	2365.8	2288.5	2128.6
43.5	1923.8	1872.9	2130.4	2245.8	2352.1	2365	2290.7	2128
43.6	1902.7	1874.7	2128.2	2243.2	2352	2370.6	2285.3	2132.3
43.7	1916.7	1875.6	2132.7	2244.7	2352.9	2366.4	2289.2	2130.6
43.8	1920.6	1878.3	2134.3	2254.3	2352.7	2366.8	2290.5	2134
43.9	1906	1875.1	2139.6	2243.6	2351.8	2366.7	2292.7	2133.2
44	1921.6	1879.3	2136.1	2247	2354.5	2367	2293.4	2139.2
44.1	1912	1886.3	2133.8	2247.7	2352.8	2369.8	2294.1	2134.6
44.2	1917.5	1883.1	2135.1	2244	2351.4	2368	2295	2121
44.3	1923.2	1882.3	2137	2249.4	2355.9	2367.4	2296.6	2133.1
44.4	1906.9	1886.3	2135.1	2250.8	2356.1	2367.7	2296.4	2134
44.5	1917.9	1883.1	2136.3	2250.5	2355.9	2368.5	2298.3	2134.6
44.6	1921	1888.8	2137	2249.8	2355	2367.8	2297	2133.7
44.7	1906.9	1889.4	2140.2	2249.1	2353.9	2367.3	2299.1	2127.8
44.8	1919.1	1893.1	2131.4	2254.5	2353.9	2368.3	2298	2136.6
44.9	1920.7	1890.4	2139.4	2252	2354.4	2369.1	2301.2	2139.2
45	1919.5	1891.8	2139.3	2248.3	2351.9	2369.1	2299	2137.2
45.1	1921.5	1893.8	2149.9	2254.5	2355.6	2370.1	2295.9	2141
45.2	1910.2	1894.6	2142	2255.9	2356.7	2368.1	2296.1	2140.3
45.3	1911.2	1895.7	2140.2	2257.7	2357.2	2369.6	2301	2138
45.4	1907.6	1905	2145.8	2259.5	2354.5	2372.9	2302.8	2140.4
45.5	1905	1896.6	2144.6	2256.6	2360.5	2369	2299.1	2138.4
45.6	1905.3	1903.3	2143.4	2256.8	2357.3	2369.7	2301.4	2142.1
45.7	1905.3	1903.2	2151	2258.6	2357.5	2370.9	2301.8	2144.2
45.8	1900.2	1889.3	2149.4	2255.8	2356.3	2371.2	2300.6	2142.4
45.9	1900.2	1908.5	2146.5	2258.5	2355.2	2371	2298.6	2144.6
46	1899.3	1906.1	2145.2	2258	2357.9	2371.1	2297.6	2138.2
46.1	1898.2	1903	2143	2258	2358	2370.5	2301.1	2146.8
46.2	1896.7	1908.7	2152.2	2259.8	2358.1	2373	2300.2	2145.2
46.3	1896.7	1909.3	2148.3	2259	2361.8	2370.8	2303.3	2147.4
46.4	1895.4	1909.6	2151.2	2256.3	2356.5	2367.5	2302.7	2143.9
46.5	1893	1912.2	2148.1	2260.1	2357.9	2371.1	2300.1	2144.8
46.6	1892.7	1911.6	2161.5	2261	2359.7	2372.7	2300	2142.2
46.7	1890.3	1918.9	2149	2260.8	2361.4	2372.5	2299.3	2132.7
46.8	1890.5	1914.7	2155.9	2262.4	2360.7	2371.9	2298.4	2153.2
46.9	1889.3	1915.2	2156.7	2262.1	2360	2371.8	2301.1	2152.1

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

r →	0	20	30	35	45	55	65	75
t								
47	1889.8	1916.9	2149.8	2262.6	2363.3	2371.2	2301.1	2155.5
47.1	1886.9	1914.9	2158.4	2260.4	2363.7	2369.6	2300.1	2155
47.2	1886.5	1922.2	2158	2259.3	2360.9	2370.9	2304.8	2155.8
47.3	1884.3	1918.6	2164.6	2260.7	2363.6	2371.4	2303.7	2160.3
47.4	1880.6	1920.3	2152.8	2268.2	2355.6	2366.5	2306.8	2153.8
47.5	1882.2	1921.8	2158.8	2260.4	2360.1	2370.6	2307.6	2155.6
47.6	1881	1922.9	2165.7	2262.3	2363.7	2373.7	2306.9	2156.5
47.7	1878.9	1924	2160.8	2261	2362.6	2371.8	2307.2	2157.5
47.8	1880.5	1920.4	2173.2	2262.9	2362.2	2371.7	2303.1	2156.2
47.9	1878.9	1925.5	2176.2	2261	2363.1	2373.7	2297.5	2158.5
48	1876	1930.3	2166.6	2263.2	2359.8	2373.4	2301.2	2159.7
48.1	1873.6	1926.1	2166	2265.4	2356	2373.9	2308.9	2158.5
48.2	1873.5	1930.6	2160.6	2284.9	2363.6	2371.3	2311.4	2164.3
48.3	1873.6	1927.5	2173.5	2266.2	2361.4	2372.9	2303.2	2162.5
48.4	1876	1927.2	2167.4	2261.9	2363.9	2374.5	2308.4	2156.2
48.5	1873.1	1933	2165.8	2264.2	2353	2383.6	2311.6	2160.1
48.6	1871.5	1929.5	2167.5	2266.1	2361.9	2375.3	2307.2	2165.4
48.7	1871.2	1932.4	2173.5	2263.8	2365.3	2373.9	2311.8	2159.4
48.8	1871.2	1932.4	2170.8	2267	2360	2374.8	2310.1	2166.7
48.9	1870.5	1934.4	2171.1	2267.3	2359	2374.6	2314.4	2162.9
49	1871.5	1933.2	2172.6	2269.5	2364.7	2373.2	2313	2167.4
49.1	1868.3	1932.4	2174.5	2266.9	2360.9	2374.8	2312.7	2162.5
49.2	1864	1935.7	2175.6	2268.1	2363.1	2373.8	2313.1	2177.7
49.3	1868.5	1936.1	2183	2267.5	2361.9	2378.4	2309.2	2168.7
49.4	1866.3	1939.4	2176.3	2268.2	2364.1	2375.1	2312.1	2158.9
49.5	1864.8	1939.1	2182.8	2267.5	2368	2376.6	2316.1	2167.4
49.6	1867.6	1936.3	2170.8	2268.5	2366.1	2380	2311.5	2169.4
49.7	1865	1940.7	2178.2	2267.9	2363.2	2377	2317.4	2172.4
49.8	1867	1939.2	2181.6	2273.3	2356.4	2378	2313.9	2165.6
49.9	1863.8	1942.6	2176.1	2271.5	2366.7	2377.4	2315.7	2175.4
50	1864.4	1944	2179.6	2268.1	2368.7	2377.7	2315	2165.6
50.1	1862.8	1941.8	2180.3	2272.7	2367	2379.5	2316.3	2170.4
50.2	1862.2	1942.7	2181	2268.7	2365.6	2378.1	2315	2175.4
50.3	1862.9	1944.5	2177.7	2268.2	2366.7	2378.4	2319	2172.5
50.4	1863.1	1948.7	2182.9	2271.5	2368.3	2380.9	2315.1	2169.8
50.5	1859.9	1947.9	2181	2269.7	2367.9	2379.9	2317.8	2173
50.6	1859.8	1948.6	2186.7	2272.6	2369.4	2380	2322.2	2170.6
50.7	1858.6	1949.8	2186.4	2272.3	2368.3	2387.2	2322.7	2173.1
50.8	1858.6	1949.7	2192.1	2274.9	2371	2383.4	2315.2	2175
50.9	1857.8	1946.5	2188.1	2272.5	2371.6	2381	2317.1	2172.2

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								
51	1857.7	1949.7	2188.9	2273.9	2371.8	2381.4	2317.9	2173.2
51.1	1857.4	1952	2189.1	2276.3	2369.9	2382.2	2317.6	2175.9
51.2	1855.6	1953.2	2189.1	2272.2	2364.1	2381.9	2322.9	2176.2
51.3	1855.5	1955.3	2186.7	2274.6	2368.1	2382.8	2322.4	2170.7
51.4	1854.5	1951.2	2190.3	2266.8	2372.2	2381.8	2321.3	2178.2
51.5	1852.9	1956	2188.2	2270.8	2372.5	2383.2	2322.6	2177
51.6	1854.7	1955.8	2189.8	2275.2	2372.9	2383.9	2324.5	2176.2
51.7	1852.5	1954.5	2197.9	2279.3	2381.4	2384.2	2323.1	2173.9
51.8	1851	1956.8	2196.6	2276.7	2373.7	2384.5	2323.2	2176.4
51.9	1850.9	1968	2191.3	2274.9	2369	2386.2	2323.7	2176
52	1850.7	1964.2	2188.4	2275.3	2371.6	2386.2	2322	2180.1
52.1	1851	1959.4	2192.4	2274.4	2374.4	2385.7	2324.7	2183.5
52.2	1849.5	1961.4	2195.9	2285.5	2372.3	2386.3	2326	2178.2
52.3	1848.8	1965.1	2201.6	2279.8	2369.8	2386.3	2317.6	2178.6
52.4	1848.4	1965.9	2194	2279.9	2375.4	2385.7	2332.2	2187.4
52.5	1847.6	1956.6	2191	2274.9	2377.1	2385.1	2326.1	2187.4
52.6	1847.1	1968.4	2193.3	2279.5	2374.2	2384.2	2330.2	2186.2
52.7	1848.1	1966.3	2198.3	2283.6	2377.7	2384.9	2333	2176.1
52.8	1847	1967	2197.9	2280	2378.2	2388.4	2330.3	2181.9
52.9	1845.1	1969.4	2202.3	2284.8	2378.8	2389	2322	2190.5
53	1847.2	1963.1	2198.3	2284.1	2380.2	2389.8	2324.8	2181.9
53.1	1843.4	1965.8	2192.3	2282.2	2374.5	2388.3	2327.4	2181.4
53.2	1845.3	1968.2	2200	2282.2	2378.1	2388.5	2328.8	2182.4
53.3	1844.5	1971.5	2199.9	2279.4	2379.8	2389.9	2325.5	2186.2
53.4	1844.8	1972.4	2201.7	2282.8	2379.3	2389.9	2331.5	2184
53.5	1844.4	1967.4	2197.8	2284.4	2387.1	2395.9	2321.2	2193.9
53.6	1840.5	1967.9	2196.3	2290	2381.5	2395.5	2325.5	2185.9
53.7	1842.2	1967.8	2214.6	2288.4	2378.7	2390.6	2329.6	2189.5
53.8	1843.7	1966.7	2201.2	2283.4	2382	2392.5	2330.1	2189.7
53.9	1843.8	1972	2197.3	2284.5	2371.5	2395.2	2335.9	2185.3
54	1843.7	1975.7	2199.6	2288.4	2380.9	2393.7	2328	2187
54.1	1843.8	1975.1	2201.7	2290.1	2387.9	2394.8	2330.1	2183.7
54.2	1845.3	1970.4		2286.3	2384.1	2395.6	2333.3	2188.6
54.3	1842.3	1972.5		2285.5	2383.3	2395.7	2329.7	2189.4
54.4	1843.2	1975.1		2282.6	2381.3	2396.8	2331.1	2181.6
54.5	1844	1975.7		2291.5	2382.9	2395.8	2335.5	2188.7
54.6	1844.2	1975.3		2278.6	2380.4	2394.3	2335	2184.4
54.7	1844.8	1974.8		2289.5	2379.2	2394.8	2332.2	2179.1
54.8	1843.4	1978		2293.9	2382.5	2398.3	2325.4	2183.5
54.9	1843.3	1975.6		2293.3	2387.5	2397.9	2328.2	2188.4

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								
55	1843.8	1982.4		2286.8	2389.9	2397.2	2330.9	2182
55.1	1843.4	1982.9		2287.5	2386.1	2397.7	2327.3	2193.4
55.2	1842.6	1976.7			2393	2398.4	2335.9	2193.9
55.3	1842.7	1978			2400.2	2398.7	2337.1	2188.9
55.4	1843.7	1980			2387.4	2397.8	2331.8	2190.4
55.5	1843.9	1979.4			2387.8	2397.7	2344.6	2195.3
55.6	1843.8	1983.3			2387	2396.7	2339	2194.8
55.7	1844.5	1979.4			2390.5	2399.5	2345.5	2187.9
55.8	1842.3	1976.8			2392.4	2399.7	2339.1	2189
55.9	1836.9	1979.3			2386	2408.4	2324.8	2191.4
56	1846.6	1984.5			2397.8		2341.9	2199.8
56.1	1843.5	1982.3			2392.7		2341.1	2190.5
56.2	1845.6	1978.6			2397.2		2342.8	2193.1
56.3	1845.7	1987.1			2391.1		2340.3	2192.1
56.4	1845.7	1986.1			2392.1		2339.8	2198.6
56.5	1845.7	1987.8			2385.2		2341.1	2191.5
56.6	1845.1	1986			2392.1		2337.3	2197.2
56.7	1847.9	1988.3			2397.7		2345	2202.3
56.8	1849.9	1988.3			2376		2339.1	2202
56.9	1848	1988.1			2390.4		2336	2193.9
57	1847.9	1985.8			2391.1		2336.5	2206.7
57.1	1849.3	1986.8			2391.4		2343.5	2198.4
57.2	1851.1	1981.6			2385.5		2342	2200.8
57.3	1849.2	1985.4			2395.4		2344.6	2190.8
57.4	1851.2	1987			2388.1		2336.9	2196.8
57.5	1849	1988.4			2393.3		2341.3	2195.7
57.6	1859.3	1994.8			2393.7		2340.3	
57.7	1855.3	1988.3			2396.4		2341.7	
57.8	1856.2	1991			2390.6		2343.7	
57.9	1851	1987.9			2391.3		2340.2	
58	1845.7	1995.8			2396.7		2341.5	
58.1	1849.1	1993.7			2386.1		2349.5	
58.2	1850.8	1992.7			2391.2		2341	
58.3	1845.5	2000			2377.6			
58.4	1855.9	1994.2			2397.2			
58.5	1857.5	1990.8						
58.6	1860	1979.6						
58.7	1854.7	1988.1						
58.8	1851.7	1994.9						
58.9	1847.2	1990.2						

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								
59	1848.2	1996.5						
59.1	1846.9	1992.4						
59.2	1841.4	1996.5						
59.3	1841	2000.6						
59.4	1837.8	2000.2						
59.5	1837.3	2001.7						
59.6	1826.5	1989						
59.7	1836.3	1993.8						
59.8	1842.5	1998.5						
59.9	1823.4	1990.9						
60	1833	1984						
60.1	1823.5	1994.8						
60.2	1843.6	1996.7						
60.3	1851.2	1987.3						
60.4	1847.8	1995						
60.5	1835.8	1996.9						
60.6	1845.6	1992.8						
60.7	1843.5	1986						
60.8	1837.2	1984.4						
60.9	1832.9	1990.5						
61	1830.1	1982.3						
61.1	1852	1994.5						
61.2	1830.2	1987.9						
61.3	1844.9	1986.1						
61.4	1835.1	1988.7						
61.5	1836.3	1979.2						
61.6	1835.5							
61.7	1836.3							
61.8	1850.6							
61.9	1854							
62	1847.2							
62.1	1830.5							
62.2	1860							
62.3	1862.3							
62.4	1844.4							
62.5	1852.9							
62.6	1838.5							
62.7	1836.9							
62.8	1855.7							
62.9	1845							

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	1845.4							
63.1	1830.4							
63.2	1845							
63.3	1844.8							
63.4	1839.6							
63.5	1833.4							
63.6	1825.5							
63.7	1833.5							
63.8	1842.2							
63.9	1842.2							
64	1850.3							
64.1	1850.1							
64.2	1841							
64.4	1859.7							

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 PT6; time is referenced from detonator circuit current start

Jack Rabbit Pretest 2021E PT6 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								
12	0	0	0	0	0	0	0	0
12.1	0	0	0	0	0	0	0	0
12.2	0	0	0	0	0	0	0	0
12.3	4E-05	0	0	0	0	0	0	0
12.4	0.0001	0	0	0	0	0	0	0
12.5	0.0003	0	0	0	0	0	0	0
12.6	0.0004	0	0	0	0	0	0	0
12.7	0.0006	0	0	0	0	0	0	0
12.8	0.0008	0	0	0	0	0	0	0
12.9	0.001	0	0	0	0	0	0	0
13	0.0013	0	0	0	0	0	0	0
13.1	0.0016	0	0	0	0	0	0	0
13.2	0.0019	0	0	0	0	0	0	0
13.3	0.0023	0	0	0	0	0	0	0
13.4	0.0026	0	0	0	0	0	0	0
13.5	0.003	0	0	0	0	0	0	0
13.6	0.0034	0	0	0	0	0	0	0
13.7	0.0038	0	0	0	0	0	0	0
13.8	0.0042	0	0	0	0	0	0	0
13.9	0.0045	0	0	0	0	0	0	0
14	0.0049	0	0	0	0	0	0	0
14.1	0.0053	0	0	0	0	0.0271	0	0
14.2	0.0057	0	0	0	0	0.1672	0	0
14.3	0.0061	0	0	0	0.1113	0.3901	0	0
14.4	0.0065	0	0	0	0.3306	0.6082	0	0
14.5	0.007	0	0	0	0.5428	0.8244	0.1113	0
14.6	0.0077	0	0	0	0.7506	1.0397	0.3305	0
14.7	0.0122	0	0	0	0.9569	1.2542	0.5435	0
14.8	0.0353	0	0	0.0222	1.1623	1.4686	0.7533	0
14.9	0.0749	0	0	0.1313	1.3675	1.6821	0.9631	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								
15	0.1158	0.0031	0	0.3005	1.5723	1.895	1.1723	0.1017
15.1	0.1561	0.0106	0	0.4645	1.7767	2.1077	1.3806	0.3032
15.2	0.1958	0.0297	0	0.6286	1.9809	2.32	1.5881	0.5007
15.3	0.2353	0.0609	0	0.7919	2.1849	2.5323	1.7949	0.6931
15.4	0.2743	0.0937	0.0668	0.9536	2.3884	2.7445	2.0012	0.8823
15.5	0.3125	0.1264	0.2019	1.1149	2.5916	2.9562	2.2071	1.0738
15.6	0.3504	0.1586	0.3392	1.2762	2.7946	3.1677	2.4133	1.2666
15.7	0.3875	0.1903	0.4767	1.4372	2.9975	3.3793	2.6199	1.4577
15.8	0.4236	0.2218	0.6134	1.5982	3.2006	3.591	2.8263	1.6482
15.9	0.4591	0.2532	0.7472	1.7594	3.4037	3.8026	3.0323	1.8385
16	0.4941	0.2847	0.8779	1.9206	3.6063	4.0138	3.238	2.0281
16.1	0.5283	0.3165	1.0066	2.082	3.8089	4.2249	3.4435	2.2176
16.2	0.5622	0.3485	1.1339	2.2434	4.0115	4.4358	3.649	2.4072
16.3	0.5957	0.3807	1.2606	2.4046	4.2144	4.6466	3.8544	2.5963
16.4	0.6288	0.4132	1.3871	2.5657	4.417	4.8573	4.0595	2.7855
16.5	0.6624	0.4463	1.5132	2.727	4.6194	5.0678	4.2644	2.9747
16.6	0.6973	0.4812	1.639	2.8883	4.8218	5.2783	4.4692	3.1634
16.7	0.7342	0.5412	1.7647	3.0496	5.0239	5.4887	4.6739	3.3519
16.8	0.7742	0.629	1.8906	3.2111	5.2261	5.6989	4.8786	3.5399
16.9	0.8182	0.7232	2.0172	3.3731	5.4283	5.909	5.0834	3.7284
17	0.8658	0.822	2.1447	3.535	5.6304	6.119	5.2882	3.9177
17.1	0.9154	0.9245	2.2736	3.6965	5.8322	6.329	5.4928	4.1073
17.2	0.9662	1.0298	2.4072	3.8581	6.034	6.5389	5.6973	4.2969
17.3	1.018	1.1367	2.5458	4.0197	6.2357	6.7486	5.9017	4.4866
17.4	1.0705	1.2439	2.6864	4.1818	6.4373	6.9583	6.1062	4.6767
17.5	1.1239	1.351	2.8279	4.3439	6.6388	7.1679	6.3107	4.8668
17.6	1.1784	1.4576	2.9714	4.5057	6.8402	7.3775	6.515	5.0569
17.7	1.2341	1.5636	3.1173	4.6677	7.0412	7.5872	6.7194	5.247
17.8	1.2907	1.6697	3.2646	4.8298	7.2421	7.7967	6.9238	5.4365
17.9	1.3479	1.7774	3.4128	4.992	7.4432	8.006	7.1283	5.626
18	1.4053	1.8885	3.5612	5.1542	7.6442	8.2153	7.3327	5.816
18.1	1.463	2.0046	3.7098	5.3167	7.8451	8.4245	7.5367	6.006
18.2	1.5207	2.126	3.8595	5.4798	8.0456	8.6336	7.7407	6.1961
18.3	1.5783	2.2514	4.0107	5.6429	8.2459	8.8426	7.9444	6.3863
18.4	1.6357	2.3789	4.1619	5.8058	8.4465	9.0516	8.1481	6.5765
18.5	1.6933	2.5075	4.3134	5.9686	8.647	9.2607	8.3518	6.7667
18.6	1.7512	2.6365	4.4662	6.1314	8.8474	9.4697	8.5555	6.9567
18.7	1.8098	2.7658	4.62	6.2942	9.0478	9.6786	8.759	7.1465
18.8	1.8694	2.895	4.7748	6.4564	9.2479	9.8872	8.9623	7.3361
18.9	1.9295	3.0241	4.9302	6.6187	9.4479	10.096	9.1658	7.5258

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	1.9897	3.1532	5.0854	6.7815	9.648	10.304	9.3692	7.7155
19.1	2.0499	3.2826	5.2408	6.9443	9.848	10.513	9.5725	7.9052
19.2	2.1101	3.4126	5.397	7.1062	10.048	10.721	9.7758	8.0952
19.3	2.1704	3.5435	5.5539	7.2678	10.248	10.929	9.9789	8.2851
19.4	2.2308	3.6754	5.712	7.4305	10.448	11.137	10.182	8.4748
19.5	2.2915	3.8087	5.8712	7.5935	10.648	11.345	10.385	8.6647
19.6	2.3549	3.9437	6.0312	7.7563	10.847	11.553	10.588	8.8547
19.7	2.4272	4.0806	6.192	7.9193	11.047	11.761	10.791	9.0447
19.8	2.5391	4.2195	6.3534	8.0825	11.247	11.969	10.993	9.2346
19.9	2.6944	4.3602	6.5152	8.2459	11.446	12.177	11.196	9.4243
20	2.8545	4.502	6.6772	8.4096	11.646	12.385	11.399	9.6143
20.1	3.0073	4.6449	6.8397	8.5735	11.845	12.593	11.601	9.8043
20.2	3.1573	4.7887	7.0027	8.7377	12.045	12.801	11.804	9.9941
20.3	3.3103	4.9332	7.1662	8.9022	12.244	13.008	12.006	10.184
20.4	3.4867	5.0785	7.3302	9.0669	12.443	13.216	12.209	10.374
20.5	3.6835	5.2245	7.4952	9.232	12.642	13.423	12.411	10.563
20.6	3.8916	5.3712	7.6606	9.3976	12.842	13.631	12.613	10.753
20.7	4.1093	5.5185	7.8269	9.5637	13.041	13.838	12.815	10.943
20.8	4.3244	5.6664	7.9941	9.7302	13.24	14.045	13.017	11.133
20.9	4.5377	5.8148	8.1618	9.8969	13.438	14.253	13.219	11.323
21	4.7507	5.9634	8.3303	10.064	13.637	14.46	13.421	11.512
21.1	4.9646	6.1125	8.4989	10.232	13.836	14.667	13.623	11.702
21.2	5.179	6.2619	8.6675	10.4	14.035	14.874	13.825	11.892
21.3	5.3932	6.4118	8.8363	10.57	14.233	15.081	14.026	12.081
21.4	5.6067	6.5621	9.0054	10.739	14.432	15.288	14.228	12.271
21.5	5.8195	6.7126	9.175	10.91	14.63	15.495	14.43	12.461
21.6	6.0327	6.8635	9.3451	11.082	14.828	15.702	14.632	12.651
21.7	6.2475	7.0148	9.5156	11.255	15.027	15.909	14.834	12.841
21.8	6.4641	7.1664	9.6867	11.43	15.226	16.116	15.036	13.031
21.9	6.6825	7.3185	9.8583	11.605	15.426	16.323	15.238	13.221
22	6.9026	7.471	10.03	11.781	15.625	16.53	15.44	13.411
22.1	7.124	7.6241	10.203	11.959	15.824	16.737	15.642	13.601
22.2	7.3464	7.7777	10.376	12.138	16.024	16.944	15.844	13.791
22.3	7.5695	7.932	10.55	12.319	16.224	17.151	16.047	13.981
22.4	7.7933	8.0869	10.725	12.501	16.424	17.357	16.249	14.171
22.5	8.0181	8.2424	10.899	12.685	16.624	17.564	16.451	14.361
22.6	8.2433	8.3987	11.075	12.871	16.825	17.771	16.654	14.552
22.7	8.4681	8.5562	11.25	13.057	17.025	17.977	16.857	14.742
22.8	8.692	8.7148	11.426	13.245	17.226	18.184	17.06	14.933
22.9	8.915	8.8745	11.602	13.433	17.427	18.39	17.263	15.124

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	9.1372	9.0354	11.779	13.622	17.628	18.597	17.465	15.316
23.1	9.3586	9.1991	11.956	13.812	17.829	18.804	17.669	15.507
23.2	9.5792	9.3664	12.133	14.002	18.029	19.011	17.873	15.699
23.3	9.7994	9.5354	12.31	14.193	18.23	19.217	18.076	15.892
23.4	10.019	9.7048	12.489	14.384	18.431	19.424	18.279	16.085
23.5	10.24	9.8744	12.667	14.576	18.631	19.631	18.484	16.278
23.6	10.461	10.044	12.846	14.769	18.831	19.837	18.688	16.471
23.7	10.683	10.214	13.025	14.961	19.032	20.044	18.893	16.665
23.8	10.906	10.384	13.205	15.154	19.232	20.25	19.098	16.86
23.9	11.13	10.554	13.385	15.347	19.432	20.457	19.302	17.055
24	11.354	10.724	13.566	15.541	19.633	20.664	19.506	17.25
24.1	11.579	10.894	13.747	15.736	19.833	20.87	19.711	17.446
24.2	11.804	11.064	13.928	15.931	20.033	21.076	19.916	17.643
24.3	12.029	11.235	14.11	16.126	20.233	21.283	20.121	17.84
24.4	12.254	11.405	14.292	16.321	20.433	21.49	20.326	18.036
24.5	12.478	11.576	14.475	16.517	20.634	21.696	20.531	18.233
24.6	12.702	11.748	14.658	16.714	20.834	21.903	20.737	18.43
24.7	12.925	11.919	14.841	16.911	21.033	22.11	20.941	18.628
24.8	13.148	12.092	15.025	17.108	21.233	22.316	21.146	18.827
24.9	13.371	12.265	15.209	17.305	21.433	22.523	21.351	19.025
25	13.593	12.438	15.394	17.503	21.633	22.73	21.556	19.224
25.1	13.816	12.612	15.579	17.701	21.833	22.937	21.76	19.423
25.2	14.038	12.786	15.764	17.9	22.033	23.144	21.965	19.623
25.3	14.26	12.96	15.95	18.099	22.233	23.35	22.169	19.822
25.4	14.482	13.133	16.135	18.298	22.432	23.557	22.374	20.022
25.5	14.704	13.307	16.32	18.497	22.632	23.764	22.579	20.222
25.6	14.926	13.48	16.506	18.697	22.832	23.971	22.784	20.421
25.7	15.149	13.653	16.691	18.897	23.032	24.177	22.989	20.621
25.8	15.371	13.826	16.878	19.098	23.232	24.384	23.194	20.821
25.9	15.593	13.999	17.064	19.299	23.432	24.59	23.399	21.021
26	15.815	14.172	17.251	19.5	23.632	24.796	23.604	21.222
26.1	16.037	14.344	17.44	19.702	23.832	25.003	23.809	21.422
26.2	16.259	14.516	17.629	19.904	24.031	25.209	24.014	21.622
26.3	16.48	14.689	17.818	20.106	24.231	25.416	24.219	21.823
26.4	16.702	14.861	18.008	20.308	24.431	25.622	24.424	22.023
26.5	16.923	15.033	18.198	20.511	24.63	25.828	24.629	22.224
26.6	17.144	15.205	18.387	20.713	24.83	26.035	24.834	22.425
26.7	17.364	15.376	18.577	20.916	25.03	26.241	25.039	22.626
26.8	17.585	15.548	18.766	21.12	25.229	26.447	25.244	22.827
26.9	17.805	15.72	18.956	21.324	25.429	26.654	25.449	23.028

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	18.026	15.893	19.146	21.528	25.628	26.86	25.654	23.229
27.1	18.246	16.065	19.336	21.732	25.828	27.066	25.859	23.43
27.2	18.465	16.237	19.527	21.936	26.027	27.273	26.064	23.631
27.3	18.685	16.41	19.717	22.141	26.227	27.479	26.269	23.832
27.4	18.905	16.583	19.907	22.346	26.427	27.685	26.475	24.033
27.5	19.124	16.756	20.097	22.552	26.626	27.891	26.681	24.235
27.6	19.343	16.93	20.287	22.757	26.826	28.098	26.888	24.436
27.7	19.562	17.103	20.478	22.962	27.026	28.304	27.095	24.637
27.8	19.781	17.276	20.67	23.168	27.226	28.51	27.303	24.839
27.9	20	17.45	20.861	23.374	27.425	28.716	27.513	25.041
28	20.218	17.623	21.053	23.58	27.625	28.922	27.722	25.243
28.1	20.436	17.797	21.246	23.786	27.825	29.128	27.934	25.445
28.2	20.653	17.97	21.439	23.993	28.025	29.334	28.147	25.647
28.3	20.871	18.143	21.632	24.199	28.225	29.541	28.361	25.849
28.4	21.088	18.317	21.825	24.406	28.426	29.747	28.577	26.051
28.5	21.305	18.49	22.019	24.613	28.626	29.953	28.793	26.254
28.6	21.521	18.663	22.212	24.82	28.827	30.159	29.01	26.456
28.7	21.738	18.836	22.405	25.028	29.027	30.366	29.227	26.659
28.8	21.954	19.01	22.598	25.235	29.228	30.572	29.445	26.862
28.9	22.17	19.183	22.792	25.443	29.429	30.778	29.663	27.064
29	22.385	19.356	22.985	25.651	29.631	30.984	29.882	27.267
29.1	22.601	19.529	23.178	25.858	29.833	31.191	30.101	27.47
29.2	22.816	19.703	23.372	26.066	30.036	31.397	30.321	27.673
29.3	23.032	19.876	23.566	26.274	30.24	31.604	30.54	27.877
29.4	23.247	20.049	23.76	26.483	30.446	31.811	30.76	28.08
29.5	23.461	20.223	23.954	26.691	30.652	32.018	30.981	28.284
29.6	23.676	20.396	24.149	26.899	30.861	32.226	31.201	28.488
29.7	23.891	20.569	24.343	27.108	31.071	32.435	31.421	28.692
29.8	24.105	20.742	24.539	27.316	31.284	32.645	31.642	28.895
29.9	24.319	20.915	24.735	27.525	31.497	32.857	31.863	29.099
30	24.533	21.088	24.931	27.733	31.712	33.07	32.084	29.303
30.1	24.747	21.261	25.126	27.943	31.928	33.284	32.305	29.507
30.2	24.96	21.435	25.322	28.152	32.144	33.501	32.526	29.712
30.3	25.174	21.608	25.519	28.361	32.362	33.72	32.747	29.916
30.4	25.387	21.782	25.716	28.57	32.582	33.94	32.968	30.12
30.5	25.6	21.955	25.913	28.78	32.801	34.162	33.19	30.324
30.6	25.813	22.129	26.11	28.99	33.023	34.384	33.411	30.529
30.7	26.026	22.302	26.307	29.199	33.245	34.608	33.632	30.733
30.8	26.238	22.476	26.504	29.409	33.468	34.832	33.854	30.938
30.9	26.451	22.649	26.701	29.619	33.692	35.058	34.075	31.143

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								
31	26.663	22.823	26.898	29.829	33.917	35.284	34.297	31.348
31.1	26.875	22.996	27.095	30.039	34.142	35.511	34.518	31.553
31.2	27.086	23.17	27.293	30.25	34.368	35.739	34.74	31.758
31.3	27.298	23.344	27.49	30.461	34.594	35.968	34.962	31.963
31.4	27.51	23.517	27.688	30.672	34.82	36.197	35.184	32.169
31.5	27.721	23.691	27.886	30.883	35.047	36.427	35.405	32.375
31.6	27.933	23.864	28.085	31.094	35.274	36.657	35.627	32.581
31.7	28.144	24.038	28.283	31.306	35.502	36.887	35.849	32.786
31.8	28.356	24.212	28.482	31.518	35.729	37.118	36.07	32.992
31.9	28.567	24.386	28.68	31.729	35.957	37.349	36.292	33.197
32	28.778	24.559	28.879	31.941	36.185	37.579	36.514	33.403
32.1	28.989	24.733	29.078	32.153	36.413	37.81	36.736	33.608
32.2	29.2	24.907	29.277	32.366	36.641	38.041	36.958	33.814
32.3	29.41	25.081	29.476	32.578	36.87	38.272	37.18	34.02
32.4	29.621	25.255	29.676	32.791	37.098	38.502	37.402	34.226
32.5	29.831	25.43	29.876	33.004	37.326	38.733	37.624	34.432
32.6	30.041	25.604	30.076	33.217	37.554	38.964	37.846	34.637
32.7	30.252	25.779	30.277	33.43	37.782	39.195	38.068	34.843
32.8	30.461	25.953	30.477	33.643	38.011	39.427	38.291	35.049
32.9	30.671	26.128	30.677	33.856	38.239	39.658	38.513	35.255
33	30.881	26.303	30.877	34.069	38.467	39.889	38.736	35.461
33.1	31.09	26.478	31.077	34.283	38.696	40.12	38.958	35.667
33.2	31.3	26.653	31.278	34.497	38.924	40.351	39.18	35.874
33.3	31.509	26.828	31.48	34.711	39.153	40.582	39.403	36.08
33.4	31.718	27.003	31.681	34.924	39.382	40.813	39.626	36.286
33.5	31.927	27.178	31.882	35.138	39.611	41.045	39.849	36.493
33.6	32.136	27.354	32.083	35.353	39.841	41.276	40.071	36.699
33.7	32.345	27.529	32.285	35.568	40.07	41.507	40.294	36.906
33.8	32.553	27.704	32.487	35.783	40.3	41.739	40.517	37.112
33.9	32.761	27.879	32.689	35.997	40.529	41.971	40.74	37.319
34	32.97	28.055	32.891	36.212	40.759	42.202	40.963	37.525
34.1	33.178	28.23	33.093	36.427	40.989	42.434	41.186	37.732
34.2	33.386	28.406	33.295	36.643	41.219	42.666	41.409	37.939
34.3	33.594	28.581	33.497	36.858	41.449	42.898	41.632	38.145
34.4	33.801	28.757	33.7	37.074	41.679	43.13	41.855	38.352
34.5	34.009	28.933	33.902	37.289	41.91	43.362	42.078	38.559
34.6	34.216	29.11	34.105	37.505	42.14	43.594	42.301	38.766
34.7	34.424	29.286	34.307	37.721	42.371	43.826	42.524	38.973
34.8	34.631	29.462	34.51	37.937	42.601	44.058	42.748	39.18
34.9	34.838	29.639	34.714	38.153	42.832	44.291	42.971	39.387

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

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t = time from detonator circuit current start = microseconds

r →	0	20	30	35	45	55	65	75
t								
35	35.045	29.816	34.917	38.369	43.063	44.523	43.194	39.594
35.1	35.252	29.993	35.12	38.585	43.294	44.756	43.418	39.801
35.2	35.458	30.169	35.324	38.802	43.525	44.988	43.641	40.009
35.3	35.665	30.346	35.527	39.018	43.756	45.221	43.865	40.216
35.4	35.871	30.522	35.731	39.235	43.987	45.454	44.089	40.424
35.5	36.077	30.7	35.935	39.452	44.218	45.686	44.312	40.632
35.6	36.283	30.877	36.139	39.669	44.449	45.919	44.536	40.839
35.7	36.489	31.053	36.343	39.886	44.68	46.152	44.76	41.047
35.8	36.695	31.231	36.547	40.103	44.911	46.385	44.984	41.255
35.9	36.9	31.408	36.752	40.32	45.142	46.618	45.208	41.463
36	37.106	31.586	36.957	40.537	45.374	46.851	45.432	41.671
36.1	37.311	31.764	37.161	40.755	45.605	47.085	45.656	41.878
36.2	37.516	31.942	37.366	40.972	45.837	47.318	45.88	42.087
36.3	37.722	32.12	37.571	41.19	46.069	47.551	46.105	42.295
36.4	37.927	32.298	37.776	41.408	46.3	47.784	46.329	42.504
36.5	38.131	32.476	37.981	41.626	46.532	48.018	46.554	42.712
36.6	38.336	32.654	38.187	41.844	46.764	48.251	46.778	42.921
36.7	38.54	32.833	38.392	42.062	46.996	48.485	47.002	43.129
36.8	38.745	33.012	38.597	42.28	47.228	48.718	47.227	43.338
36.9	38.949	33.191	38.803	42.499	47.46	48.952	47.452	43.546
37	39.153	33.37	39.009	42.717	47.692	49.186	47.677	43.755
37.1	39.357	33.549	39.215	42.935	47.924	49.419	47.902	43.964
37.2	39.561	33.729	39.421	43.154	48.157	49.653	48.127	44.173
37.3	39.764	33.908	39.627	43.372	48.389	49.887	48.352	44.382
37.4	39.968	34.088	39.833	43.591	48.622	50.121	48.577	44.591
37.5	40.171	34.267	40.039	43.81	48.854	50.355	48.802	44.799
37.6	40.374	34.447	40.245	44.029	49.087	50.589	49.028	45.009
37.7	40.577	34.627	40.451	44.248	49.32	50.823	49.253	45.218
37.8	40.78	34.807	40.657	44.467	49.553	51.057	49.478	45.427
37.9	40.983	34.988	40.864	44.686	49.786	51.291	49.704	45.637
38	41.186	35.168	41.07	44.906	50.018	51.525	49.929	45.846
38.1	41.388	35.349	41.277	45.125	50.251	51.759	50.155	46.055
38.2	41.59	35.53	41.484	45.345	50.483	51.993	50.381	46.265
38.3	41.792	35.71	41.691	45.564	50.715	52.227	50.607	46.474
38.4	41.994	35.891	41.898	45.784	50.949	52.461	50.833	46.684
38.5	42.196	36.072	42.106	46.003	51.182	52.695	51.059	46.894
38.6	42.398	36.253	42.314	46.223	51.415	52.93	51.285	47.104
38.7	42.599	36.434	42.522	46.443	51.649	53.164	51.511	47.314
38.8	42.8	36.616	42.73	46.663	51.883	53.398	51.737	47.524
38.9	43.001	36.797	42.937	46.883	52.116	53.633	51.963	47.734

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r →	0	20	30	35	45	55	65	75
t								
39	43.202	36.979	43.145	47.103	52.35	53.867	52.19	47.945
39.1	43.403	37.161	43.353	47.324	52.583	54.102	52.416	48.156
39.2	43.604	37.343	43.562	47.544	52.817	54.336	52.643	48.366
39.3	43.804	37.525	43.77	47.764	53.05	54.571	52.87	48.577
39.4	44.005	37.707	43.978	47.985	53.284	54.805	53.096	48.787
39.5	44.205	37.889	44.187	48.205	53.518	55.04	53.323	48.998
39.6	44.405	38.072	44.395	48.425	53.752	55.275	53.55	49.209
39.7	44.605	38.254	44.603	48.646	53.986	55.509	53.777	49.42
39.8	44.804	38.437	44.812	48.867	54.22	55.744	54.004	49.631
39.9	45.004	38.62	45.021	49.088	54.454	55.979	54.231	49.842
40	45.203	38.802	45.23	49.309	54.689	56.214	54.458	50.053
40.1	45.402	38.985	45.438	49.53	54.923	56.449	54.686	50.264
40.2	45.601	39.168	45.648	49.751	55.157	56.684	54.913	50.476
40.3	45.8	39.352	45.857	49.973	55.391	56.919	55.14	50.687
40.4	45.999	39.535	46.066	50.194	55.626	57.155	55.368	50.898
40.5	46.198	39.718	46.276	50.416	55.86	57.39	55.595	51.11
40.6	46.396	39.902	46.485	50.638	56.094	57.625	55.823	51.322
40.7	46.594	40.086	46.695	50.859	56.329	57.86	56.05	51.533
40.8	46.792	40.269	46.904	51.081	56.564	58.096	56.278	51.744
40.9	46.99	40.453	47.114	51.303	56.798	58.331	56.506	51.956
41	47.188	40.637	47.325	51.525	57.033	58.567	56.734	52.167
41.1	47.385	40.821	47.535	51.748	57.268	58.802	56.962	52.379
41.2	47.583	41.006	47.745	51.969	57.503	59.038	57.191	52.591
41.3	47.78	41.19	47.956	52.192	57.737	59.274	57.419	52.803
41.4	47.977	41.375	48.166	52.414	57.972	59.509	57.647	53.015
41.5	48.174	41.56	48.377	52.636	58.207	59.745	57.875	53.227
41.6	48.371	41.745	48.588	52.858	58.442	59.981	58.103	53.439
41.7	48.567	41.93	48.799	53.079	58.677	60.217	58.331	53.652
41.8	48.763	42.115	49.01	53.302	58.912	60.453	58.559	53.864
41.9	48.96	42.3	49.221	53.524	59.146	60.688	58.788	54.076
42	49.156	42.485	49.432	53.747	59.381	60.925	59.016	54.288
42.1	49.352	42.671	49.643	53.97	59.615	61.161	59.244	54.501
42.2	49.547	42.857	49.855	54.193	59.85	61.396	59.473	54.713
42.3	49.743	43.043	50.067	54.416	60.085	61.632	59.701	54.926
42.4	49.937	43.229	50.278	54.639	60.32	61.868	59.93	55.138
42.5	50.13	43.416	50.49	54.862	60.555	62.105	60.159	55.351
42.6	50.324	43.602	50.702	55.085	60.79	62.341	60.387	55.564
42.7	50.518	43.789	50.914	55.308	61.025	62.577	60.616	55.776
42.8	50.712	43.975	51.127	55.53	61.26	62.813	60.845	55.989
42.9	50.905	44.161	51.34	55.754	61.496	63.049	61.074	56.201

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r →	0	20	30	35	45	55	65	75
t								
43	51.098	44.348	51.552	55.977	61.731	63.286	61.303	56.414
43.1	51.291	44.535	51.765	56.201	61.966	63.522	61.532	56.627
43.2	51.485	44.722	51.977	56.425	62.201	63.759	61.761	56.84
43.3	51.678	44.909	52.19	56.649	62.437	63.995	61.989	57.053
43.4	51.87	45.095	52.403	56.873	62.672	64.232	62.218	57.266
43.5	52.062	45.283	52.616	57.097	62.907	64.468	62.447	57.479
43.6	52.254	45.47	52.829	57.322	63.142	64.705	62.676	57.692
43.7	52.445	45.658	53.042	57.546	63.377	64.942	62.905	57.905
43.8	52.636	45.845	53.255	57.771	63.613	65.179	63.134	58.118
43.9	52.828	46.033	53.469	57.996	63.848	65.415	63.363	58.331
44	53.019	46.221	53.682	58.221	64.083	65.652	63.592	58.545
44.1	53.211	46.409	53.896	58.445	64.319	65.889	63.822	58.759
44.2	53.402	46.597	54.109	58.67	64.554	66.126	64.051	58.971
44.3	53.594	46.786	54.323	58.895	64.789	66.362	64.281	59.184
44.4	53.786	46.974	54.537	59.12	65.025	66.599	64.51	59.397
44.5	53.977	47.163	54.75	59.345	65.26	66.836	64.74	59.611
44.6	54.169	47.351	54.964	59.57	65.496	67.073	64.97	59.824
44.7	54.36	47.54	55.178	59.795	65.731	67.31	65.2	60.037
44.8	54.552	47.729	55.391	60.02	65.967	67.546	65.43	60.251
44.9	54.744	47.918	55.605	60.245	66.202	67.783	65.659	60.464
45	54.936	48.108	55.819	60.47	66.437	68.02	65.889	60.678
45.1	55.128	48.297	56.033	60.695	66.673	68.257	66.119	60.892
45.2	55.319	48.486	56.248	60.921	66.908	68.494	66.349	61.106
45.3	55.51	48.676	56.462	61.146	67.144	68.731	66.579	61.32
45.4	55.701	48.866	56.676	61.372	67.38	68.968	66.809	61.534
45.5	55.892	49.056	56.891	61.598	67.615	69.205	67.039	61.748
45.6	56.083	49.246	57.105	61.824	67.851	69.442	67.269	61.962
45.7	56.273	49.436	57.32	62.05	68.087	69.679	67.499	62.176
45.8	56.463	49.626	57.535	62.275	68.323	69.916	67.729	62.391
45.9	56.653	49.816	57.75	62.501	68.558	70.153	67.959	62.605
46	56.843	50.006	57.964	62.727	68.794	70.39	68.189	62.819
46.1	57.033	50.197	58.179	62.953	69.03	70.627	68.419	63.033
46.2	57.223	50.388	58.393	63.178	69.266	70.865	68.649	63.248
46.3	57.413	50.578	58.608	63.404	69.502	71.102	68.879	63.463
46.4	57.602	50.769	58.823	63.63	69.737	71.339	69.11	63.677
46.5	57.792	50.96	59.038	63.856	69.973	71.576	69.34	63.892
46.6	57.981	51.152	59.254	64.082	70.209	71.813	69.57	64.106
46.7	58.17	51.343	59.469	64.308	70.445	72.05	69.8	64.32
46.8	58.359	51.535	59.685	64.534	70.681	72.287	70.03	64.534
46.9	58.548	51.726	59.9	64.761	70.917	72.524	70.259	64.749

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r →	0	20	30	35	45	55	65	75
t								
47	58.737	51.918	60.116	64.987	71.153	72.762	70.49	64.965
47.1	58.926	52.11	60.331	65.213	71.39	72.999	70.72	65.18
47.2	59.115	52.301	60.547	65.439	71.626	73.236	70.95	65.396
47.3	59.303	52.493	60.763	65.665	71.862	73.473	71.18	65.611
47.4	59.491	52.685	60.979	65.891	72.098	73.71	71.411	65.827
47.5	59.679	52.877	61.194	66.118	72.334	73.947	71.642	66.043
47.6	59.868	53.07	61.411	66.344	72.57	74.184	71.872	66.258
47.7	60.056	53.262	61.627	66.57	72.806	74.421	72.103	66.474
47.8	60.244	53.454	61.844	66.796	73.043	74.658	72.334	66.69
47.9	60.432	53.647	62.061	67.022	73.279	74.895	72.564	66.905
48	60.619	53.839	62.278	67.249	73.515	75.133	72.793	67.121
48.1	60.807	54.032	62.495	67.475	73.751	75.37	73.024	67.337
48.2	60.994	54.225	62.711	67.703	73.987	75.607	73.255	67.553
48.3	61.182	54.418	62.928	67.93	74.223	75.845	73.486	67.77
48.4	61.369	54.611	63.145	68.157	74.459	76.082	73.716	67.986
48.5	61.556	54.804	63.362	68.383	74.695	76.32	73.947	68.201
48.6	61.744	54.997	63.578	68.609	74.931	76.558	74.178	68.418
48.7	61.931	55.19	63.795	68.836	75.167	76.795	74.409	68.634
48.8	62.118	55.383	64.013	69.062	75.404	77.033	74.64	68.85
48.9	62.305	55.576	64.23	69.289	75.64	77.27	74.872	69.067
49	62.492	55.77	64.447	69.516	75.876	77.508	75.103	69.283
49.1	62.679	55.963	64.664	69.743	76.112	77.745	75.334	69.5
49.2	62.866	56.157	64.882	69.97	76.348	77.982	75.565	69.717
49.3	63.052	56.35	65.1	70.196	76.584	78.22	75.797	69.934
49.4	63.239	56.544	65.318	70.423	76.821	78.458	76.028	70.15
49.5	63.426	56.738	65.536	70.65	77.057	78.695	76.259	70.367
49.6	63.612	56.932	65.753	70.877	77.294	78.933	76.49	70.584
49.7	63.799	57.125	65.971	71.104	77.531	79.171	76.722	70.801
49.8	63.985	57.319	66.189	71.331	77.767	79.409	76.953	71.018
49.9	64.172	57.514	66.407	71.558	78.003	79.647	77.185	71.235
50	64.358	57.708	66.624	71.785	78.239	79.884	77.416	71.452
50.1	64.545	57.902	66.842	72.012	78.476	80.122	77.648	71.668
50.2	64.731	58.096	67.06	72.239	78.713	80.36	77.88	71.886
50.3	64.917	58.291	67.278	72.466	78.949	80.598	78.111	72.103
50.4	65.104	58.485	67.496	72.693	79.186	80.836	78.343	72.32
50.5	65.29	58.68	67.715	72.92	79.423	81.074	78.575	72.537
50.6	65.476	58.875	67.933	73.147	79.66	81.312	78.807	72.755
50.7	65.662	59.07	68.152	73.374	79.897	81.55	79.039	72.972
50.8	65.848	59.265	68.371	73.602	80.134	81.789	79.271	73.189
50.9	66.033	59.46	68.59	73.829	80.371	82.027	79.502	73.407

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	66.219	59.655	68.808	74.056	80.608	82.265	79.734	73.624
51.1	66.405	59.85	69.027	74.284	80.845	82.503	79.966	73.841
51.2	66.591	60.045	69.246	74.511	81.082	82.741	80.198	74.059
51.3	66.776	60.24	69.465	74.738	81.318	82.98	80.43	74.276
51.4	66.962	60.436	69.684	74.966	81.555	83.218	80.662	74.494
51.5	67.147	60.631	69.903	75.192	81.793	83.456	80.895	74.711
51.6	67.332	60.827	70.122	75.42	82.03	83.695	81.127	74.929
51.7	67.518	61.022	70.341	75.647	82.268	83.933	81.359	75.147
51.8	67.703	61.218	70.561	75.875	82.505	84.171	81.592	75.364
51.9	67.888	61.414	70.78	76.103	82.743	84.41	81.824	75.582
52	68.073	61.611	70.999	76.33	82.98	84.649	82.056	75.8
52.1	68.258	61.807	71.218	76.558	83.217	84.887	82.289	76.018
52.2	68.443	62.003	71.438	76.786	83.454	85.126	82.521	76.236
52.3	68.628	62.199	71.657	77.014	83.691	85.364	82.753	76.454
52.4	68.813	62.396	71.877	77.242	83.929	85.603	82.986	76.672
52.5	68.998	62.592	72.097	77.47	84.166	85.842	83.219	76.891
52.6	69.182	62.788	72.316	77.698	84.404	86.08	83.452	77.109
52.7	69.367	62.985	72.535	77.926	84.641	86.318	83.685	77.327
52.8	69.552	63.181	72.755	78.154	84.879	86.557	83.918	77.545
52.9	69.737	63.378	72.975	78.382	85.117	86.796	84.15	77.764
53	69.921	63.575	73.195	78.611	85.355	87.035	84.383	77.983
53.1	70.106	63.771	73.415	78.839	85.593	87.274	84.615	78.201
53.2	70.29	63.968	73.634	79.067	85.83	87.513	84.848	78.419
53.3	70.475	64.165	73.854	79.295	86.068	87.752	85.081	78.637
53.4	70.659	64.362	74.074	79.523	86.306	87.991	85.314	78.856
53.5	70.844	64.559	74.294	79.752	86.545	88.23	85.546	79.075
53.6	71.028	64.756	74.514	79.98	86.783	88.469	85.779	79.294
53.7	71.212	64.953	74.735	80.209	87.021	88.709	86.012	79.513
53.8	71.396	65.149	74.955	80.438	87.259	88.948	86.245	79.732
53.9	71.581	65.346	75.175	80.666	87.497	89.187	86.478	79.95
54	71.765	65.544	75.395	80.895	87.734	89.427	86.711	80.169
54.1	71.949	65.741	75.615	81.124	87.973	89.666	86.944	80.387
54.2	72.134	65.939		81.353	88.211	89.906	87.177	80.606
54.3	72.318	66.136		81.581	88.45	90.145	87.41	80.825
54.4	72.502	66.333		81.81	88.688	90.385	87.643	81.043
54.5	72.687	66.531		82.038	88.926	90.625	87.877	81.262
54.6	72.871	66.728		82.267	89.164	90.864	88.11	81.481
54.7	73.056	66.926		82.495	89.402	91.103	88.343	81.699
54.8	73.24	67.123		82.724	89.64	91.343	88.576	81.917
54.9	73.424	67.321		82.954	89.879	91.583	88.809	82.136

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	73.609	67.519		83.183	90.118	91.823	89.042	82.354
55.1	73.793	67.717		83.412	90.357	92.062	89.275	82.573
55.2	73.977	67.915			90.595	92.302	89.508	82.792
55.3	74.162	68.113			90.835	92.542	89.742	83.011
55.4	74.346	68.311			91.075	92.782	89.975	83.23
55.5	74.53	68.509			91.313	93.022	90.209	83.45
55.6	74.715	68.707			91.552	93.261	90.443	83.669
55.7	74.899	68.905			91.791	93.501	90.677	83.888
55.8	75.084	69.103			92.03	93.741	90.912	84.107
55.9	75.267	69.301			92.269	93.982	91.145	84.326
56	75.452	69.499			92.508		91.378	84.546
56.1	75.636	69.697			92.748		91.612	84.765
56.2	75.821	69.895			92.987		91.847	84.984
56.3	76.005	70.094			93.227		92.081	85.204
56.4	76.19	70.292			93.466		92.315	85.423
56.5	76.374	70.491			93.705		92.549	85.643
56.6	76.559	70.69			93.943		92.783	85.862
56.7	76.744	70.888			94.183		93.017	86.082
56.8	76.928	71.087			94.422		93.251	86.302
56.9	77.113	71.286			94.66		93.485	86.522
57	77.298	71.485			94.899		93.718	86.742
57.1	77.483	71.683			95.138		93.952	86.962
57.2	77.668	71.882			95.377		94.187	87.182
57.3	77.853	72.08			95.616		94.421	87.402
57.4	78.038	72.279			95.855		94.655	87.621
57.5	78.223	72.477			96.094		94.889	87.841
57.6	78.408	72.677			96.334		95.123	
57.7	78.594	72.876			96.573		95.357	
57.8	78.78	73.075			96.812		95.591	
57.9	78.965	73.274			97.052		95.826	
58	79.15	73.473			97.291		96.06	
58.1	79.335	73.672			97.53		96.294	
58.2	79.52	73.872			97.769		96.529	
58.3	79.705	74.071			98.007			
58.4	79.89	74.271			98.246			
58.5	80.075	74.47						
58.6	80.261	74.669						
58.7	80.447	74.867						
58.8	80.632	75.066						
58.9	80.817	75.266						

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	81.002	75.465						
59.1	81.187	75.664						
59.2	81.371	75.864						
59.3	81.555	76.064						
59.4	81.739	76.264						
59.5	81.923	76.464						
59.6	82.106	76.663						
59.7	82.289	76.862						
59.8	82.473	77.062						
59.9	82.656	77.262						
60	82.839	77.46						
60.1	83.022	77.659						
60.2	83.205	77.859						
60.3	83.39	78.058						
60.4	83.575	78.257						
60.5	83.759	78.457						
60.6	83.943	78.656						
60.7	84.128	78.855						
60.8	84.312	79.054						
60.9	84.495	79.252						
61	84.679	79.451						
61.1	84.863	79.65						
61.2	85.047	79.849						
61.3	85.231	80.048						
61.4	85.415	80.246						
61.5	85.598	80.445						
61.6	85.782							
61.7	85.965							
61.8	86.15							
61.9	86.335							
62	86.52							
62.1	86.704							
62.2	86.888							
62.3	87.074							
62.4	87.26							
62.5	87.445							
62.6	87.629							
62.7	87.813							
62.8	87.998							
62.9	88.183							

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	88.367							
63.1	88.551							
63.2	88.735							
63.3	88.919							
63.4	89.103							
63.5	89.287							
63.6	89.47							
63.7	89.653							
63.8	89.837							
63.9	90.021							
64	90.206							
64.1	90.391							
64.2	90.575							
64.4	90.945							

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 PT6

First column: time in microseconds following detonator circuit current start

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

tpressure	PT6 Point 00	11.7	0.0580
8	0.0000	11.8	0.1299
8.1	0.0000	11.9	0.1574
8.2	0.0000	12	0.1849
8.3	0.0000	12.1	0.2260
8.4	0.0000	12.2	0.2831
8.5	0.0000	12.3	0.3355
8.6	0.0000	12.4	0.3797
8.7	0.0000	12.5	0.4298
8.8	0.0000	12.6	0.4765
8.9	0.0000	12.7	0.5102
9	0.0000	12.8	0.4732
9.1	0.0000	12.9	0.4083
9.2	0.0000	13	0.3870
9.3	0.0000	13.1	0.3654
9.4	0.0000	13.2	0.3181
9.5	0.0000	13.3	0.2512
9.6	0.0000	13.4	0.2023
9.7	0.0000	13.5	0.1724
9.8	0.0000	13.6	0.1397
9.9	0.0000	13.7	0.1166
10	0.0000	13.8	0.1178
10.1	0.0000	13.9	0.1261
10.2	0.0000	14	0.4843
10.3	0.0000	14.1	5.9954
10.4	0.0000	14.2	33.2685
10.5	0.0000	14.3	57.6309
10.6	0.0000	14.4	59.6427
10.7	0.0000	14.5	58.7617
10.8	0.0000	14.6	57.9589
10.9	0.0000	14.7	57.6178
11	0.0000	14.8	56.8352
11.1	0.0000	14.9	55.7036
11.2	0.0000	15	55.0721
11.3	0.0000	15.1	53.6127
11.4	0.0000	15.2	46.6181
11.5	0.0000	15.3	18.5590
11.6	0.0000	15.4	-6.6785

15.5	-9.7483	20.4	87.2613
15.6	-9.4431	20.5	78.5502
15.7	-9.1249	20.6	90.6060
15.8	-9.4743	20.7	94.4917
15.9	-8.0239	20.8	89.3497
16	-4.9677	20.9	56.1294
16.1	-1.4988	21	26.9298
16.2	4.0671	21.1	10.0890
16.3	11.4960	21.2	-1.6693
16.4	17.6048	21.3	4.6655
16.5	21.4672	21.4	9.8943
16.6	24.3367	21.5	12.3443
16.7	26.3044	21.6	12.4403
16.8	27.8971	21.7	12.7482
16.9	29.8445	21.8	14.2608
17	30.7900	21.9	16.6004
17.1	30.6280	22	18.2193
17.2	29.1452	22.1	17.0714
17.3	25.4258	22.2	13.5851
17.4	19.9515	22.3	9.5707
17.5	14.9376	22.4	5.6549
17.6	12.0412	22.5	2.0823
17.7	9.9880	22.6	-1.0223
17.8	8.3857	22.7	-3.2892
17.9	7.4367	22.8	-4.5761
18	6.7247	22.9	-5.1990
18.1	6.1138	23	-5.3618
18.2	5.6227	23.1	-4.5371
18.3	5.0995	23.2	-2.5020
18.4	4.5561	23.3	-0.1368
18.5	4.0943	23.4	2.0209
18.6	3.7735	23.5	3.8340
18.7	3.7443	23.6	5.2549
18.8	4.2006	23.7	6.2822
18.9	4.7198	23.8	6.8000
19	8.4347	23.9	6.4894
19.1	20.6961	24	5.2367
19.2	75.3304	24.1	3.3598
19.3	138.7980	24.2	1.2945
19.4	147.9860	24.3	-0.6215
19.5	136.4620	24.4	-2.2195
19.6	132.2010	24.5	-3.4060
19.7	136.3590	24.6	-4.1131
19.8	168.5680	24.7	-4.3917
19.9	198.0510	24.8	-4.2605
20	216.8270	24.9	-3.7665
20.1	227.4390	25	-2.9028
20.2	210.9560	25.1	-2.1308
20.3	152.4670	25.2	-1.6217

25.3	-1.1670	30.2	-2.8237
25.4	-0.8124	30.3	-2.6433
25.5	-0.5829	30.4	-2.7674
25.6	-0.5594	30.5	-3.4259
25.7	-0.7027	30.6	-3.3402
25.8	-1.0210	30.7	-2.6296
25.9	-1.4363	30.8	-2.4275
26	-1.8921	30.9	-2.3064
26.1	-2.4932	31	-2.2104
26.2	-2.8316	31.1	-1.9501
26.3	-2.8890	31.2	-1.8211
26.4	-2.9539	31.3	-2.0403
26.5	-2.9875	31.4	-2.2143
26.6	-3.0169	31.5	-2.0570
26.7	-2.9918	31.6	-1.2344
26.8	-2.7967	31.7	-1.3342
26.9	-2.7030	31.8	-1.9706
27	-2.8532	31.9	-2.0443
27.1	-2.9047	32	-2.2301
27.2	-2.9019	32.1	-2.3001
27.3	-2.9267	32.2	-2.3186
27.4	-3.0683	32.3	-2.3604
27.5	-3.3362	32.4	-2.3825
27.6	-3.5608	32.5	-2.2849
27.7	-3.6505	32.6	-2.2102
27.8	-3.7599	32.7	-2.1125
27.9	-4.1098	32.8	-2.0972
28	-4.2375	32.9	-2.2470
28.1	-4.1348	33	-2.3015
28.2	-4.1802	33.1	-2.3166
28.3	-4.1615	33.2	-2.3186
28.4	-4.0838	33.3	-2.2640
28.5	-3.9462	33.4	-2.2203
28.6	-3.7475	33.5	-2.1494
28.7	-3.5822	33.6	-2.1527
28.8	-3.5014	33.7	-2.3812
28.9	-3.4402	33.8	-2.5068
29	-3.2504	33.9	-2.3362
29.1	-3.0905	34	-2.2403
29.2	-2.9286	34.1	-2.1722
29.3	-2.7836	34.2	-2.0300
29.4	-2.8805	34.3	-1.9803
29.5	-2.8532	34.4	-2.0257
29.6	-2.8529	34.5	-2.1304
29.7	-2.9362	34.6	-2.2057
29.8	-2.8629	34.7	-2.3042
29.9	-2.8276	34.8	-2.2167
30	-3.0045	34.9	-2.1908
30.1	-3.0666	35	-2.3351

35.1	-2.3325	40	-2.6277
35.2	-2.3775	40.1	-2.6302
35.3	-2.4387	40.2	-2.6113
35.4	-2.4304	40.3	-2.5961
35.5	-2.3966	40.4	-2.5884
35.6	-2.3297	40.5	-2.5865
35.7	-2.2775	40.6	-2.6172
35.8	-2.2393	40.7	-2.7232
35.9	-2.1762	40.8	-2.8310
36	-2.1993	40.9	-2.7947
36.1	-2.2506	41	-2.7001
36.2	-2.2321	41.1	-2.7368
36.3	-2.2661	41.2	-2.7713
36.4	-2.3488	41.3	-2.7312
36.5	-2.3792	41.4	-2.6614
36.6	-2.4103	41.5	-2.6669
36.7	-2.4150	41.6	-2.7647
36.8	-2.3742	41.7	-3.0773
36.9	-2.3998	41.8	-4.4700
37	-2.3899	41.9	-5.0566
37.1	-2.2518	42	-4.4685
37.2	-2.1184	42.1	-3.5883
37.3	-2.2934	42.2	-4.0856
37.4	-2.4335	42.3	-5.0411
37.5	-2.2904	42.4	-4.3289
37.6	-2.3680	42.5	-4.2409
37.7	-2.4398	42.6	-3.8014
37.8	-2.4262	42.7	-3.9369
37.9	-2.4917	42.8	-4.5627
38	-2.5136	42.9	-2.9064
38.1	-2.6116	43	-3.3567
38.2	-2.7624	43.1	-4.0397
38.3	-2.8927	43.2	-3.3364
38.4	-2.7407	43.3	-3.5005
38.5	-2.5343	43.4	-2.3131
38.6	-2.6298	43.5	-2.4160
38.7	-2.5758	43.6	-2.5708
38.8	-2.5063	43.7	-1.9111
38.9	-2.5311	43.8	-2.1119
39	-2.5891	43.9	-1.3497
39.1	-2.6302	44	-0.3781
39.2	-2.6050	44.1	0.3046
39.3	-2.6271	44.2	0.4162
39.4	-2.6347	44.3	-0.0708
39.5	-2.6045	44.4	0.9204
39.6	-2.5565	44.5	0.9435
39.7	-2.5537	44.6	-0.1440
39.8	-2.5908	44.7	-0.5595
39.9	-2.6120	44.8	-1.5756

44.9	-1.3767	49.8	-0.5285
45	-1.1651	49.9	-0.8652
45.1	-2.0686	50	-0.8469
45.2	-1.7466	50.1	-1.0524
45.3	-1.9672	50.2	-1.0984
45.4	-2.9624	50.3	-1.1677
45.5	-3.1551	50.4	-1.1591
45.6	-3.3013	50.5	-0.9723
45.7	-2.7224	50.6	-1.0779
45.8	-2.1825	50.7	-1.0206
45.9	-2.2813	50.8	-1.0807
46	-1.9850	50.9	-1.3119
46.1	-2.0024	51	-1.0872
46.2	-2.2089	51.1	-0.9407
46.3	-1.8727	51.2	-1.1307
46.4	-1.5306	51.3	-1.1460
46.5	-1.6856	51.4	-1.0922
46.6	-1.7867	51.5	-0.9915
46.7	-1.7974	51.6	-1.0327
46.8	-2.0980	51.7	-1.0410
46.9	-2.1551	51.8	-1.0037
47	-1.8670	51.9	-1.0337
47.1	-1.9137	52	-0.9674
47.2	-1.7256	52.1	-0.9435
47.3	-1.5540	52.2	-0.8630
47.4	-1.8562	52.3	-0.7987
47.5	-2.1800	52.4	-0.7024
47.6	-2.1940	52.5	-0.8723
47.7	-1.9875	52.6	-1.0330
47.8	-1.5755	52.7	-0.8175
47.9	-1.1801	52.8	-0.6712
48	-1.3441	52.9	-0.5942
48.1	-1.4793	53	-0.7530
48.2	-1.2904	53.1	-0.7542
48.3	-1.3247	53.2	-0.6575
48.4	-1.2842	53.3	-0.5975
48.5	-1.0925	53.4	-0.3818
48.6	-1.2560	53.5	-0.3953
48.7	-1.0384	53.6	-0.0607
48.8	-0.8692	53.7	0.0007
48.9	-1.3173	53.8	-0.2881
49	-1.1743	53.9	-0.1544
49.1	-0.8797	54	-0.0869
49.2	-0.7798	54.1	0.1935
49.3	-0.8381	54.2	0.2354
49.4	-1.0068	54.3	0.0355
49.5	-1.1316	54.4	-0.0118
49.6	-1.1564	54.5	-0.0198
49.7	-0.5914	54.6	-0.0720

54.7	-0.2565	59.6	-2.1331
54.8	-0.0981	59.7	0.3283
54.9	0.1308	59.8	0.9849
55	0.0464	59.9	0.1502
55.1	0.0330	60	0.3419
55.2	-0.0743	60.1	1.7720
55.3	-0.4328	60.2	1.0852
55.4	-0.1191	60.3	-0.7055
55.5	0.2000	60.4	-0.1736
55.6	0.1473	60.5	1.7396
55.7	0.3893	60.6	1.8655
55.8	0.4688	60.7	0.6472
55.9	0.4114	60.8	-0.8805
56	0.2900	60.9	-1.5785
56.1	0.4768	61	-0.3781
56.2	0.7483	61.1	-0.6180
56.3	0.7531	61.2	-0.1663
56.4	1.0554	61.3	1.9430
56.5	0.9116	61.4	2.3867
56.6	0.7823	61.5	1.1714
56.7	0.8837	61.6	0.7218
56.8	0.7406	61.7	2.8080
56.9	0.8158	61.8	2.1501
57	1.4270	61.9	1.1346
57.1	1.6783	62	1.1879
57.2	1.1869	62.1	-0.0809
57.3	0.6323	62.2	1.6382
57.4	-0.1142	62.3	1.0974
57.5	-0.1796	62.4	-1.4953
57.6	0.1297	62.5	-1.9745
57.7	-0.3907	62.6	-0.3492
57.8	-0.1667	62.7	-0.4472
57.9	0.6659	62.8	-2.7665
58	0.8796	62.9	-2.3560
58.1	0.1277	63	-2.7772
58.2	-0.7236	63.1	-2.2257
58.3	-0.9852	63.2	0.3580
58.4	-0.9097	63.3	-0.7848
58.5	-0.0941	63.4	-0.7928
58.6	-0.3868	63.5	1.1026
58.7	-1.2460	63.6	1.1795
58.8	-1.2064	63.7	1.7581
58.9	-1.6784	63.8	0.9991
59	-3.3710	63.9	0.7757
59.1	-3.6165	64	2.1747
59.2	-2.4333	64.1	2.3617
59.3	-2.6643	64.2	1.7430
59.4	-2.7306	64.3	1.3998
59.5	-2.8897		

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 PT6	JackRabbitPretestVelocityPT6.xls
Position data (mm) for 2021E PT6	JackRabbitPretestPositionPT6.xls
Pressure data (kilobar) on center axis, Point 00 for all 2021E experiments	Pressure00VsTime_JR.txt
Diagnostic Plate Profile Vs Time PT6	ProfileVsTime_PT6_final.xls