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Jack Rabbit Pretest 2021E PT3 Photonic Doppler Velocimetry Data

Mark M. Hart, Oliver T. Strand, Stephen T. Bosson,
Randal A. Bonner and D. M. Hester

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

Except..... by experiment.

- Hart

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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.

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ABSTRACT

The Jack Rabbit Pretest (PT) 2021E PT3 was fired on March 12, 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 PT3, 120 millimeter diameter experiment returned data on all eight PDV probes. The probes measured on the central axis and at 10, 20, 25, 30, 35, 40, 50 millimeters from the central axis. The experiment was shot at an ambient room temperature of 65 degrees Fahrenheit. The earliest PDV signal extinction was 41.7 microseconds at 30 millimeters. The latest PDV signal extinction time was 65.0 microseconds at 10 millimeters. The measured velocity ranged from meters per second to thousands of meters per second. First detonation wave induced jump-off was measured at 40 millimeters at 10.9 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 1636 meters per second. At 40 millimeters the last measured velocity was 2056 meters per second. The low-to-high velocity ratio was 0.80. 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 64.6 kilobars at 15.7 microseconds. Substantial motion (>1 m/s) of the diagnostic plate over the dead-zone is followed by detonation region motion within approximately 2.2 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 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 PT3

DESCRIPTION

2021E PT3 used a 76 millimeter thick cylindrical charge of LX-17, 120 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 PT3 contained a 43 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 PT3

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 PT3, 120 millimeter experiment was monitored at radial distances of 0, 10, 20, 25, 30, 35, 40, and 50 millimeters.

Figure 4. Schematic cross section of the Jack Rabbit Pretest 2021E PT3, dimensions in millimeters

Booster: UFTATB, 25.8 g

Main charge: LX-17, 1577.1 g

Upper charge mass: 402.6 g

Lower charge mass: 1174.5 g

Upper charge density: 1.897 g/cc

Lower charge density: 1.896 g/cc

Main charge temperature: 18.3C (65F)

PDV measurement positions: 0, 10, 20, 25, 30, 35, 40, 50 mm

Figure 5. PDV measurement locations on 2021E PT3 aluminum diagnostic plate, dimensions in millimeter

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 PT3; time is referenced from detonator circuit current start

Figure 8. Intermediate Time Axis Velocity Plot of Jack Rabbit Pretest 2021E PT3; time is referenced from detonator circuit current start

Table 2. PDV measurement positions and signal extinction times for 2021E PT3 (μs); time is referenced from detonator circuit current start

00 mm	10 mm	20 mm	25 mm	30 mm	35 mm	40 mm	50 mm
				41.7			
			45.8				
						46.2	
							49.5
		53.6					
57.4							
					62.4		
	65.0

Figure 9. Long Time Axis Velocity Plot of Jack Rabbit Pretest 2021E PT3; time is referenced from detonator circuit current start

DIAGNOSTIC PLATE DISPLACEMENT PROFILES

Figure 10. Diagnostic Plate Displacement Profiles of Jack Rabbit Pretest 2021E PT3); time is referenced from detonator circuit current start

CYLINDRICAL AXIS DEAD-ZONE PRESSURE PLOT

Figure 11. Cylindrical Axis Dead-Zone Pressure Plot of Jack Rabbit Pretest 2021E PT3); time is referenced from detonator circuit current start

DIAGNOSTIC PLATE VELOCITY TABLE

Table 3. Tabulated Diagnostic Plate Velocities of Jack Rabbit Pretest 2021E PT3; time is referenced from detonator circuit current start

Jack Rabbit Pretest 2021E PT3 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	10	20	25	30	35	40	50
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	1.2776	0	0	0	0	0	0	0
8.8	1.8718	0	0	0	0	0	0	0
8.9	2.4659	0	0	0	0	0	0	0
9	3.1161	0	0	0	0	0	0	0
9.1	3.7788	0.7292	0	0	0	0	0	0
9.2	4.4236	0.8628	0	0	0	0	0	0
9.3	5.0371	0.9963	0	0	0	0	0	0
9.4	5.639	1.1298	0	0	0	0	0	0
9.5	6.0605	1.2723	0	0	0	0	0	0
9.6	6.2988	1.4744	0	0	0	0	0	0
9.7	6.3567	1.6765	0	0	0	0	0	0
9.8	6.4427	1.8656	0	0	0	0	0	0
9.9	6.6336	2.0411	0	0	0	0	0	0
10	6.8646	2.1496	0	0	0	0	0	0
10.1	6.9685	2.1882	0	0	0	0	0	0
10.2	7.0685	2.3425	0	0	0	0	0	0
10.3	7.287	2.5396	0	0	0	0	0	0
10.4	7.5296	2.6176	0	0	0	0	0	0
10.5	7.8577	2.9452	0	0	0	0	0	0
10.6	8.2498	3.47	0	0	0	0	0	0
10.7	8.7476	4.0409	0	0	0	0	0	0
10.8	9.3496	4.7884	0	0	0	0	0	0
10.9	10.119	5.5299	0	0	0	0	2100	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	10	20	25	30	35	40	50
t								
11	11.167	6.4358	0	0	47.979	1925.8	2014.6	0
11.1	12.399	7.4717	0	69.855	1948.1	1882.9	1958.8	0
11.2	14.068	8.5311	71.644	615.75	1874.9	1812.5	1948.5	0
11.3	60.753	9.8673	572.19	658.16	1824	1788.7	1917.8	1294.3
11.4	79.156	40.222	589.29	685.67	1795.2	1807.7	1916.1	1996.5
11.5	148.08	65.853	610.06	711.51	1774	1812.1	1904.9	1926.7
11.6	341.92	107.34	639.66	755.1	1747.5	1794.8	1898.9	1897.6
11.7	344.18	277.68	665.04	787.63	1735.3	1790.6	1897.8	1906.8
11.8	342.7	537.01	693.17	816.46	1714	1794.6	1890.5	1899.1
11.9	338.71	627.86	719.69	858.24	1704.7	1794.9	1890.8	1888.2
12	347.12	655.21	752.82	963.33	1700.9	1788.4	1886.8	1881.4
12.1	363.31	659.18	779.59	1284.9	1693.4	1784.1	1886.4	1887.2
12.2	386.34	655.05	804.22	1293.6	1689.8	1797.4	1885.8	1884.8
12.3	420.72	650.22	830.48	1299	1683.6	1791.1	1885.3	1882.6
12.4	464.51	648.39	863.31	1287.7	1673.7	1785.3	1882.7	1867
12.5	522.23	654.37	1129.7	1263	1669.4	1792.2	1880.7	1881.8
12.6	564.21	658.8	1130	1247.1	1667.3	1793.8	1878.3	1881.3
12.7	591.05	659.61	1127.1	1250.1	1676.2	1789.2	1877.2	1882.6
12.8	620.63	653.06	1103.6	1240.7	1685.1	1791.9	1875.2	1880.3
12.9	644.62	647.4	1082.3	1234.4	1694	1791.2	1875	1878.2
13	662.32	645.35	1063.8	1233.5	1708.1	1788.6	1872.4	1866.7
13.1	685.79	647.92	1059.9	1227.1	1696.5	1793.5	1870.9	1876.9
13.2	716.76	655.76	1063.7	1221.6	1715.1	1791.7	1869.8	1877.1
13.3	741.93	665.62	1070.3	1215.1	1727.6	1791.5	1868.1	1877.3
13.4	757.9	679.24	1063.9	1206.9	1730.7	1793.5	1866.5	1876.9
13.5	764.01	696.96	1070.4	1214.8	1733.4	1792.8	1864.7	1877.1
13.6	766.49	725.53	1070.2	1220.6	1734.8	1793.5	1864.5	1875.1
13.7	765.47	796.48	1077	1236.2	1735.9	1790.8	1861.1	1874.6
13.8	754.85	884.51	1096.2	1247.1	1741.6	1791.2	1861.6	1874.2
13.9	739.04	978.93	1126.1	1256.9	1735.9	1792.1	1858.7	1872.6
14	726.68	1000.2	1156.6	1254.7	1748.5	1791.9	1858.1	1872.1
14.1	727.68	1009.4	1172.6	1254.7	1757.5	1789.2	1856.6	1872.9
14.2	749.49	1015.3	1183.7	1257	1753.6	1788.6	1856.2	1870.7
14.3	795.49	1019.8	1192.8	1259.7	1768.7	1789.8	1855	1872.7
14.4	861.61	1023	1200.9	1264.8	1774.7	1788.9	1855.5	1871.2
14.5	942.44	1027.6	1207.1	1267.5	1787.1	1788.8	1855.8	1871.5
14.6	1006.4	1035.5	1205.6	1271.1	1784.4	1789.4	1851.3	1867.7
14.7	1039.2	1048.9	1209	1276.5	1777.1	1789.1	1851.5	1868.4
14.8	1054.6	1078.1	1214.1	1277.9	1773.3	1787.8	1848	1868.9
14.9	1062.4	1110	1209.6	1280.8	1769.1	1786.8	1848.3	1868.4

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	10	20	25	30	35	40	50
t								
15	1064.5	1138	1207.8	1285.9	1774.3	1787.5	1846.6	1868
15.1	1067.8	1159.3	1207.9	1295.1	1772.5	1786.9	1845.9	1866.8
15.2	1087.7	1171.2	1214.5	1301	1776.7	1786.8	1845	1867
15.3	1132.4	1175.6	1219.1	1298.1	1777.4	1785.9	1842.6	1865.6
15.4	1167.6	1202.5	1229.2	1296.5	1777.2	1785.4	1841.5	1864.2
15.5	1199.6	1254.5	1233.8	1295.3	1779.3	1786.7	1841.2	1861.1
15.6	1223.2	1284.5	1246.8	1294.5	1781.9	1786	1839.5	1865.6
15.7	1258.1	1308.8	1260.5	1297.6	1774.2	1787	1839.3	1862
15.8	1297.8	1327.8	1273.3	1301	1775.8	1785.1	1838.1	1862.1
15.9	1326.4	1339.1	1285.6	1304.2	1779.9	1784	1837.3	1855.6
16	1370.5	1345.6	1299.3	1315.5	1779.6	1786.8	1836	1861.2
16.1	1440.8	1349.7	1313.4	1325	1783.2	1786.9	1834.7	1860.7
16.2	1496.1	1352.2	1326.7	1333	1781.6	1784.1	1834.9	1858.8
16.3	1536.4	1353.5	1336.3	1339.6	1779.6	1783.7	1833	1858.2
16.4	1541.4	1355	1340.8	1346.6	1786.5	1783.8	1832.1	1856.8
16.5	1535.7	1358.6	1342.9	1353.5	1787.3	1783.8	1831.2	1857.3
16.6	1531.2	1364.7	1344.9	1361.6	1782.7	1784.2	1830.9	1857.2
16.7	1525.6	1369.5	1346.7	1369.5	1782.9	1783.2	1829.8	1856.7
16.8	1515.3	1369.6	1347.3	1375.7	1788.8	1782.9	1828.8	1858.6
16.9	1498.1	1367.2	1348.1	1382.7	1792.5	1782.7	1828.2	1855.6
17	1479	1363.2	1349	1387.4	1793.5	1782.6	1828	1855.2
17.1	1460.8	1358.5	1349.4	1395.1	1794.2	1782.8	1827.4	1854.4
17.2	1444.7	1354.5	1350.3	1396.5	1795.4	1782.8	1826.7	1853.7
17.3	1427.7	1349.6	1350.2	1399.5	1795.2	1782.7	1825.1	1854.2
17.4	1413.1	1343.2	1350.4	1402	1797.5	1782.4	1825.4	1852.8
17.5	1390	1339.5	1351.4	1405.1	1798.8	1781.5	1823.3	1852.5
17.6	1373.7	1340.6	1353.5	1408.4	1800.9	1780.9	1822.5	1852.2
17.7	1364.6	1343.1	1356.1	1412.2	1801.8	1780.3	1821.4	1852.1
17.8	1364.6	1344.6	1358.9	1414.9	1800.5	1780.1	1821.4	1852.4
17.9	1369.9	1345.4	1362.2	1415.9	1799.7	1780.5	1819.8	1853.5
18	1372.5	1344.7	1364.9	1417.9	1800.1	1780.4	1818.3	1850
18.1	1382	1342.7	1367.3	1419	1799.3	1779.8	1816.2	1849.8
18.2	1389.5	1340.6	1369.4	1423.8	1800.3	1778.7	1816.7	1846.9
18.3	1397.8	1338.2	1371.3	1427.3	1800.5	1779.8	1816.2	1848.3
18.4	1405.7	1335.4	1372.8	1431.2	1798.1	1780	1814.6	1847.6
18.5	1411.8	1333.9	1371.6	1436.4	1797.6	1781.7	1814.6	1847.2
18.6	1414.3	1333.7	1371.4	1442.3	1797.6	1777.3	1813.1	1845.6
18.7	1413	1338	1370.1	1447.4	1799.1	1779	1811.4	1844
18.8	1409.6	1341.9	1368.9	1451.9	1796.7	1777.8	1808.5	1843.3
18.9	1405.5	1347.1	1370.7	1456.4	1794.8	1777.8	1810.6	1843

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	10	20	25	30	35	40	50
t								
19	1407	1352.9	1374.2	1461.9	1794	1778.4	1811.7	1841.9
19.1	1409.8	1357.4	1378.2	1465.2	1792.8	1779.6	1810	1841.8
19.2	1413.2	1360.6	1381.8	1470.6	1792.7	1779.9	1809.9	1841.1
19.3	1413.8	1360.9	1384.8	1474.3	1791.3	1780	1808.6	1839.6
19.4	1409.8	1358.6	1388.1	1477.7	1788.9	1782.9	1809.7	1839.8
19.5	1402.6	1355.6	1388.8	1480.2	1792.9	1778.6	1812	1838.3
19.6	1394.6	1352.7	1391.3	1482.9	1788.1	1780.4	1808	1837.6
19.7	1389	1349	1392.8	1484.3	1787.4	1781.8	1809.2	1837.6
19.8	1387.4	1345.8	1394	1486.6	1786.2	1780.7	1801.4	1836.8
19.9	1387.3	1343.3	1395.3	1488.3	1785.3	1781.6	1805.9	1834.4
20	1390.8	1341.6	1397.4	1490.1	1783.3	1782.4	1805.8	1835.2
20.1	1395.5	1340.7	1400	1492.8	1783.6	1783.3	1806.5	1835.3
20.2	1396.4	1340.6	1402.3	1496.1	1784.2	1782.8	1803.9	1834.7
20.3	1394.8	1341.3	1405.5	1498.8	1780.5	1783.1	1800.5	1834.1
20.4	1395.2	1341.7	1408.1	1501.6	1777.6	1781.9	1797.2	1834
20.5	1396.3	1341.3	1410.1	1503.7	1779	1784.5	1799.1	1832.6
20.6	1396.9	1340.8	1411.9	1506.2	1778.1	1783.7	1798.1	1831.9
20.7	1398.6	1340.7	1413	1509.1	1777.8	1784.6	1799.6	1831.6
20.8	1401	1341.7	1414.3	1512.3	1778.1	1784	1800.8	1829.2
20.9	1404	1342.9	1416.1	1517.5	1776	1784.7	1801.8	1831.8
21	1406.4	1345.5	1417.2	1518.9	1776.8	1786.4	1806.5	1830.1
21.1	1408.4	1348.6	1418.5	1521.8	1774.7	1788.2	1813.8	1829.4
21.2	1409.6	1352.4	1420.2	1526	1774.4	1784.4	1809.7	1827.6
21.3	1411.6	1355.5	1423.6	1527.6	1775.2	1785.8	1804.5	1843.4
21.4	1413.7	1358.2	1422	1529.1	1772.5	1787.3	1815.2	1829.7
21.5	1415.1	1359.8	1424.4	1532.2	1773.5	1785.6	1821.8	1827.7
21.6	1415.2	1360.7	1426.8	1534	1773.1	1786.7	1814.8	1828.8
21.7	1413.6	1360.5	1428.5	1535.6	1772.3	1786	1821.3	1827.9
21.8	1410	1358.9	1431.5	1536.7	1773.1	1788.2	1820.1	1828.1
21.9	1406.1	1356.4	1433	1537.7	1773.1	1787.9	1824.2	1826.3
22	1401.5	1354.4	1434	1539.5	1772.9	1787.6	1826	1825.6
22.1	1398.3	1351.5	1435.2	1541.7	1774.7	1786.3	1824.1	1827.7
22.2	1395	1348.4	1436.2	1543.1	1773.1	1788.8	1827.1	1828.6
22.3	1391.8	1345.8	1437.3	1545.8	1773	1788.4	1827.4	1825.2
22.4	1389.3	1344.5	1438.2	1549.4	1770.4	1788.9	1827.2	1824.5
22.5	1387.4	1344.4	1438	1551.4	1769.8	1789	1827.3	1822.3
22.6	1385.9	1345.2	1440.1	1554.5	1770.2	1787.8	1826.3	1820.8
22.7	1383.6	1345.9	1442.1	1559	1781	1786.9	1825.5	1819.8
22.8	1382.3	1346.5	1443.4	1560.9	1778.5	1787.3	1822.4	1818.9
22.9	1380.8	1346.3	1444.6	1563.8	1783.9	1788	1829.8	1815.7

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	10	20	25	30	35	40	50
t								
23	1378.9	1346.1	1446.7	1565.8	1770	1787.5	1828.4	1816.6
23.1	1378.8	1345.5	1449.8	1567.1	1768.6	1788.2	1828.3	1814.1
23.2	1378.1	1344.8	1447.9	1568.8	1768.5	1788.5	1827.7	1816.7
23.3	1377.4	1345	1453.5	1565.2	1765.4	1788.3	1834.5	1820.1
23.4	1375.6	1346.1	1456.3	1571.1	1771.3	1791.3	1826.9	1815.3
23.5	1374.6	1347.5	1459.4	1572.6	1769.7	1781.8	1834.6	1813.1
23.6	1373.7	1349.5	1462.7	1574.6	1773.1	1784.6	1838.7	1815.3
23.7	1371.5	1351.6	1465.1	1576.2	1765	1794.8	1830.7	1812.2
23.8	1372	1353.2	1468.4	1577.6	1768.9	1794.4	1833.6	1812.1
23.9	1371.7	1354	1472.9	1578	1751.9	1794	1835.5	1812.1
24	1369.8	1354	1474.8	1581.5	1768.6	1795.9	1836.3	1810.8
24.1	1364.8	1353.9	1476.8	1581.5	1761.8	1796.6	1839.3	1811.8
24.2	1363	1353.8	1478.8	1587	1766.5	1797.4	1842.1	1811.3
24.3	1357.5	1352.9	1481.7	1594	1766	1797	1840.8	1810.3
24.4	1356.9	1351.6	1484.9	1593.4	1767.8	1799.7	1842.7	1809.6
24.5	1353	1349.2	1488.2	1597.1	1766.2	1803.9	1838.3	1803
24.6	1349.3	1348.6	1491.6	1601.1	1763.6	1801.1	1852.4	1809.5
24.7	1342.9	1348.8	1494.5	1604	1767.1	1806.8	1842.1	1809.8
24.8	1340.3	1350	1497.2	1606.5	1764.5	1806.9	1838	1806.4
24.9	1341	1351	1500	1610.6	1765.7	1809.8	1838.3	1805.9
25	1338.9	1352.4	1503.5	1610	1763.7	1811.7	1824.3	1805.2
25.1	1336.9	1354	1505.9	1612.3	1765.9	1814.5	1838.1	1804.3
25.2	1336.4	1355.6	1508.6	1623	1767.5	1819.2	1839.5	1803.2
25.3	1337.4	1357.2	1512.2	1619.1	1767.2	1817.8	1833.7	1801.9
25.4	1336	1359	1515.1	1623	1767.3	1825.3	1832.2	1800.9
25.5	1335.1	1361	1517.4	1626.4	1768.7	1832.5	1828.4	1799.3
25.6	1334.4	1363.3	1520.1	1628.6	1773.1	1837.8	1832.5	1798.4
25.7	1332.3	1365.6	1517.7	1630.7	1773	1843.9	1830.5	1797.1
25.8	1330.7	1368.4	1525.4	1632.3	1770.8	1845.1	1830.5	1796.5
25.9	1329.7	1368.8	1529.3	1636.4	1769.7	1851.1	1840.3	1797.4
26	1327.7	1373.7	1532.3	1641.3	1770.5	1861.3	1824.6	1794.9
26.1	1325.6	1378.4	1534.7	1644.7	1772.4	1870.5	1824.5	1793.9
26.2	1325.3	1379.5	1535	1645.2	1774	1865.6	1832.9	1792.8
26.3	1325.4	1382	1537.6	1647.4	1772.3	1881.2	1820.3	1793
26.4	1325.7	1384.7	1539.8	1652.1	1774.6	1888.1	1837	1791.1
26.5	1322.3	1386.2	1543	1653.3	1776.4	1888.8	1831.7	1791.5
26.6	1320.4	1388.1	1544.4	1656.4	1777	1897.1	1826.7	1790.8
26.7	1317.4	1388.1	1547.1	1657.7	1776.5	1900.3	1804	1789.5
26.8	1316	1388.1	1549	1659.2	1776.5	1904.3	1791.6	1789
26.9	1313.5	1388.5	1551.2	1664.1	1777.3	1909.9	1789.2	1788.1

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	10	20	25	30	35	40	50
t								
27	1311.1	1391.9	1552.7	1663.4	1778.6	1921.8	1779.5	1787
27.1	1309.8	1388.4	1554.2	1667.9	1778.5	1916.9	1772.2	1786.1
27.2	1308.9	1388.9	1561.7	1669.7	1780.2	1921	1762.5	1784.9
27.3	1307.5	1389.2	1558.3	1671.2	1779.4	1922.3	1752.7	1783.8
27.4	1307.7	1390	1559.2	1671.8	1777.6	1926.1	1741.1	1783.4
27.5	1308	1390.3	1560.8	1672	1784.4	1917.8	1729.3	1782.5
27.6	1308.5	1391.3	1562.8	1672.6	1780	1932.4	1712.6	1782.8
27.7	1309.2	1392.1	1564.4	1678.4	1773.2	1934.2	1709.5	1782.3
27.8	1309.4	1392.8	1564.8	1677.4	1777.1	1937.8	1692.7	1782.1
27.9	1309.7	1393	1567.1	1681.1	1769.7	1940.7	1691.4	1781.5
28	1309.4	1393.6	1570.5	1684	1765.4	1946.9	1682	1780.8
28.1	1308.7	1394.5	1571.2	1683.2	1769.6	1945.5	1677.8	1780.1
28.2	1308.8	1395.2	1573	1686.4	1769.1	1944.8	1679.8	1779.8
28.3	1308.2	1396.8	1575.4	1689.2	1770.2	1947.9	1688	1778.5
28.4	1308.2	1397.8	1576.4	1689.6	1770	1951.1	1699.7	1778.5
28.5	1309.4	1400.3	1577.8	1689.7	1761.1	1950.4	1723.5	1779.4
28.6	1309.5	1402.6	1578.6	1695.5	1755	1954.1	1719	1782.9
28.7	1309.4	1403.3	1580.5	1693.4	1766.7	1956.3	1726	1779.3
28.8	1309.2	1404.9	1583.7	1696.1	1755.7	1957.1	1747.5	1778.9
28.9	1308.6	1406.6	1585.2	1696.4	1754.1	1959.4	1751.5	1781.9
29	1307.9	1409.3	1581.5	1701.6	1752	1958.8	1785.9	1779.5
29.1	1307	1411.2	1584.2	1701.1	1740	1960.3	1796.7	1780.3
29.2	1305.7	1411.5	1588	1699.9	1751.2	1961.4	1793.3	1793.6
29.3	1304.6	1413	1593.1	1704.6	1743.4	1961.3	1830.3	1780
29.4	1303.4	1414.6	1589.1	1706.9	1745.6	1962.4	1842.8	1789.5
29.5	1302.6	1415.4	1587.5	1708.4	1743.1	1963.9	1880.2	1792
29.6	1302.6	1417.4	1591	1709.8	1735.1	1965.7	1915.9	1789.6
29.7	1303	1418.5	1595	1710.7	1726.6	1966.6	1946.8	1789.6
29.8	1303.6	1420.2	1594.3	1714.2	1728.4	1964.4	1977.7	1793.1
29.9	1305.3	1419.6	1595.4	1712.4	1728.7	1964.6	2002.3	1802.8
30	1306.7	1422.8	1596.7	1715.5	1725.9	1966.8	2017	1815.1
30.1	1308.1	1424.7	1596.4	1706.2	1718.6	1965.7	2043.2	1807.4
30.2	1309.2	1427	1599.5	1719.1	1716.1	1975.4	2042.1	1816.2
30.3	1310.3	1425.3	1599.7	1719.7	1711.8	1972.6	2056.5	1818.2
30.4	1312	1427.1	1602.9	1717.4	1702.8	1972.2	2060.3	1829.9
30.5	1311.5	1426	1601.5	1724	1707.6	1972.1	2074.7	1833.2
30.6	1312.4	1427.5	1601.1	1721.9	1702.2	1973.5	2076.9	1838.9
30.7	1313.2	1427.9	1603.9	1724.3	1721.4	1973.5	2065.8	1838.2
30.8	1315.1	1428.6	1606.1	1724	1714.3	1970.4	2055.7	1850.7
30.9	1315.7	1428.1	1607.7	1730.5	1709.6	1975.8	2054.5	1842.8

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	10	20	25	30	35	40	50
t								
31	1316	1429.1	1608.7	1727.9	1710.8	1974	2052.4	1864.2
31.1	1317.1	1427.6	1610	1727.6	1717.7	1974.4	2044.3	1868.2
31.2	1318.2	1423.3	1608.7	1726.2	1731.3	1973.2	2040.7	1873.3
31.3	1317.2	1426.9	1608.3	1730	1735.9	1984.2	2040.7	1875.4
31.4	1314.6	1427.4	1611.8	1730.8	1743.1	1978	2035.5	1882.5
31.5	1314.4	1427.7	1614	1734.6	1755.8	1976.9	2031.5	1891.3
31.6	1309.3	1426.9	1613.7	1734.6	1766.2	1978.5	2028.8	1893.5
31.7	1308.4	1426	1614.2	1735.4	1776.5	1979	2026.8	1899.3
31.8	1309.6	1426.5	1618.2	1737	1779.6	1979.9	2024.5	1906.7
31.9	1308.5	1427.3	1616.8	1738.9	1797.1	1979.5	2028.3	1905.4
32	1306.9	1429.6	1617.7	1740.7	1821.4	1979.6	2028.8	1912
32.1	1305.2	1429.8	1617.5	1741.2	1818	1979	2029.3	1911.6
32.2	1304	1430	1619.8	1741.9	1838.7	1980	2030.5	1918.8
32.3	1303.2	1427.7	1618.1	1740.1	1837	1982.8	2034.2	1922.9
32.4	1301.9	1431.5	1619.1	1746.3	1869.7	1982.4	2028.7	1922
32.5	1301.1	1431.9	1621	1747.9	1879.5	1983.8	2036.6	1929.1
32.6	1301.2	1436.3	1623.5	1747.2	1883	1985.1	2035.8	1931.8
32.7	1300	1432.3	1624	1748.4	1919.6	1985.5	2034.6	1937.6
32.8	1299.7	1432.4	1622.7	1749.8	1935.5	1986.2	2036.7	1939.9
32.9	1299.6	1434	1624.7	1748.4	1940.5	1987.5	2038.4	1938.6
33	1299.7	1436.7	1626.7	1751.2	1947.9	1988.5	2036.9	1937.8
33.1	1299.8	1434.6	1626.4	1749.9	1960.7	1989.3	2035.3	1944.8
33.2	1300.4	1434.2	1628.4	1751.7	1970.4	1990	2041.1	1951.2
33.3	1300.9	1434.5	1628.2	1753	1973.1	1990.7	2037.7	1948.6
33.4	1302.5	1435	1629.7	1750.7	1983.3	1990.2	2038.9	1949.7
33.5	1303.7	1436.1	1630.8	1752.4	1988.9	1992.5	2039.6	1953
33.6	1305.2	1437	1634.1	1753.6	1987	1993.7	2040.2	1954.2
33.7	1306.9	1436.4	1631	1755.4	1998.4	1993.5	2038	1955.6
33.8	1307.6	1438.9	1630.6	1757.2	1993.3	1994.5	2038.8	1954.4
33.9	1309.1	1440.2	1634.6	1757.8	1997.9	1995.5	2037.3	1956.7
34	1310.2	1438.3	1634.7	1760	1997	1994.5	2035.6	1956.9
34.1	1310.9	1439.7	1631.9	1763.9	2018.5	1994.3	2049.1	1955.3
34.2	1311.2	1439	1634.2	1769.4	2011.7	1995.1	2035.7	1950
34.3	1311.7	1424.4	1638.7	1772.8	2006	1997.1	2033.4	1962.5
34.4	1312.7	1439.2	1641	1772.1	2000.4	1998	2039.2	1957.4
34.5	1313.1	1439.8	1632.8	1769.6	2018.7	1997.2	2041.9	1959.1
34.6	1312.9	1439.9	1640.9	1769	2014.5	1997.8	2047.1	1960.4
34.7	1313.2	1440.4	1627.2	1772.3	2011.2	1998.2	2045.7	1962.3
34.8	1312.9	1444.9	1649.3	1769.9	2012.6	1999.3	2036.3	1962.8
34.9	1313.9	1442.7	1642.6	1767.9	2015.6	1999.9	2036.1	1962.1

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	10	20	25	30	35	40	50
t								
35	1313.6	1443.5	1645.1	1772	2010.5	2000.7	2036.2	1960.7
35.1	1313	1445.2	1644.2	1769.3	2008.3	2000.5	2030.7	1961.4
35.2	1313.6	1441.6	1645.1	1768.8	1999.1	1999	2034.6	1962.5
35.3	1314.5	1446.3	1639.2	1766.2	2010.7	2000.5	2034.9	1966.6
35.4	1326.7	1448.5	1648.3	1767.6	2004.9	2001.5	2034.3	1965.3
35.5	1445.8	1449.3	1646.6	1767.7	2006.1	1998.5	2027.1	1962.9
35.6	1549.1	1448	1645.9	1766.1	2001.1	2002.5	2033.7	1963.8
35.7	1550.7	1458.7	1647.3	1764.1	2001.5	2001.6	2030.6	1963.8
35.8	1505.4	1479.6	1655.7	1767.9	2004.4	2001	2032.9	1965.5
35.9	1475.1	1494.6	1648.8	1767	1998.6	2003.1	2048.5	1962.9
36	1459.2	1496.7	1646.1	1766.4	1998.1	2003.1	2051.7	1962.2
36.1	1450.5	1498.6	1651.2	1765	1999.9	2003.6	2028.4	1965.8
36.2	1446.6	1499.9	1650.8	1766.9	1997.6	2003.8	2030.5	1962.4
36.3	1447.9	1495.6	1649.3	1767.2	1991.2	2005	2030.1	1963.2
36.4	1456.8	1494.1	1651.2	1765.1	1995.6	2004.6	2029.2	1964.1
36.5	1457.3	1496.4	1652.8	1768	1992.8	2005.4	2030.2	1964.1
36.6	1462.5	1500.4	1652.7	1769.2	1994.2	2005.1	2031.6	1963.2
36.7	1470.8	1502.7	1656	1764.1	1999.8	2005.5	2044.1	1964.2
36.8	1475.4	1506	1660.4	1770.5	1988.7	2006.4	2044.9	1964.4
36.9	1480.8	1501.1	1658.4	1767.8	1988.6	2006.6	2046.5	1965.9
37	1487.1	1492.7	1657.3	1773	2000	2007.2	2047.3	1968.1
37.1	1487.9	1492.9	1661.5	1773.4	1990.8	2008.1	2037.7	1968.5
37.2	1492.1	1494.3	1659.4	1777.7	1990.2	2008.9	2052.1	1970.7
37.3	1497	1494.6	1663.7	1771.2	1997.6	2009.5	2028.9	1966.7
37.4	1504.4	1497.1	1667.3	1771.1	2004.4	2010.3	2031.6	1969.1
37.5	1506.4	1498.7	1669.9	1770.9	1997.6	2020.7	2024.7	1969.2
37.6	1521.7	1499.2	1667.8	1772.5	1989.6	2010.4	2036.6	1968
37.7	1547.2	1501.6	1670.1	1765.1	1988.3	2013.4	2045.3	1967.2
37.8	1574	1502.4	1674.1	1773.4	1985.7	2013.3	2054	1969.3
37.9	1580.8	1506.9	1677.8	1772.2	1989.3	2012.3	2057.9	1969.7
38	1574.8	1510.8	1674.5	1767.4	1983.8	2014	2055.7	1969.5
38.1	1571	1516	1674.5	1781.1	1998.2	2014.8	2056.1	1970.3
38.2	1564.3	1519.8	1678.2	1780.1	1990.7	2014.9	2056.2	1970.4
38.3	1576.5	1524	1678.2	1780.9	1986.3	2014.9	2057.6	1968.9
38.4	1579.4	1528.6	1683.2	1772.9	1987.1	2016.2	2057.7	1969.3
38.5	1585.8	1533.9	1681.5	1786	1996.4	2015.5	2058.2	1968.1
38.6	1596.7	1530.8	1682.1	1775.2	1983.7	2017.3	2061.6	1969.1
38.7	1586.6	1532.9	1680.2	1783.5	1987.4	2017.2	2060	1974
38.8	1592.4	1531.2	1682	1789.1	1988.9	2017.7	2062.8	1972.8
38.9	1593.4	1527.5	1684.8	1773.4	1982.2	2018.8	2064.2	1972.8

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	10	20	25	30	35	40	50
t								
39	1595.3	1531.4	1690.7	1786.1	1993.7	2018.9	2058.2	1973.2
39.1	1599.8	1528.8	1693.3	1783.2	1980.8	2020.1	2060.9	1975.5
39.2	1600.5	1532.9	1690.9	1789.9	1986.7	2020.2	2058.4	1975.1
39.3	1601.4	1533.3	1689.2	1787.7	1996.8	2020.9	2068.2	1975.6
39.4	1606.9	1535.5	1690.4	1786.9	1986.3	2020.7	2066.6	1975.8
39.5	1610.3	1537.1	1690.6	1789.7	1985.4	2020.8	2068.8	1976.2
39.6	1612.1	1537.9	1694.3	1789.1	1992.3	2021	2066.5	1975.7
39.7	1615.9	1539.1	1704.6	1791.4	1997.7	2022.7	2070.1	1976.2
39.8	1625	1539.5	1693.7	1780.3	1982.8	2022.9	2063.3	1976.8
39.9	1630.2	1541.9	1692.1	1795.6	1987.3	2020.5	2064.2	1976
40	1635.3	1543.6	1694	1797.4	1993.1	2026.9	2059.4	1977.5
40.1	1632.7	1546	1694.1	1794.8	1985.3	2020.4	2063.7	1977.3
40.2	1629.6	1544.1	1693.6	1786.8	1988.3	2027.5	2065.1	1979.9
40.3	1629.6	1549.2	1695.3	1797.8	1992.3	2022.4	2066.9	1977.7
40.4	1629.9	1549.6	1696.4	1800.6	1989.7	2024.3	2065.7	1979.9
40.5	1630.6	1557.8	1692.1	1798.8	1986.7	2021.3	2067.3	1978.4
40.6	1631.8	1559.8	1691.7	1800.2	1981.7	2026.5	2063.6	1978.3
40.7	1632.3	1558.9	1686.5	1801	1988.9	2025	2070.2	1979.8
40.8	1630.2	1562.1	1701.2	1788.2	1984.7	2026	2067.4	1980
40.9	1628.6	1562.7	1698.7	1791.6	1986.5	2025.7	2068.6	1984
41	1627.7	1562.2	1698.3	1786.5	1998	2028	2071.9	1983.2
41.1	1628.6	1544.3	1699.7	1794.5	1992.7	2025.9	2064.6	1981.4
41.2	1628.6	1563.1	1699.1	1785.9	1989.4	2028.1	2065	1978.8
41.3	1628	1563.7	1701.8	1789.8	1983.5	2027.9	2065.2	1986.2
41.4	1627.4	1565.1	1701	1793.9	1991.3	2027.7	2064.7	1988.7
41.5	1627.4	1561.3	1705.5	1782.7	1987.4	2028.4	2065.6	1987.9
41.6	1627.8	1566.8	1703	1799.8	1995.3	2027.7	2069.8	1988.2
41.7	1629.2	1568.6	1701	1775.9		2027.8	2063.1	1988.8
41.8	1631.1	1570.5	1703.6	1789.8		2027.7	2066.3	1990.2
41.9	1635.6	1571.1	1705.3	1807.6		2028.2	2068.9	1988.4
42	1635.3	1571.6	1706.9	1790.7		2026.3	2065.2	1988.3
42.1	1635.2	1574.5	1706.9	1817.7		2027.8	2067.1	1989.9
42.2	1634	1578.1	1706.5	1807.5		2026.3	2066.5	1990.6
42.3	1634.2	1576.8	1703.9	1814.7		2026.6	2071	1986.5
42.4	1637.1	1577.5	1704.8	1817.3		2028	2066.5	1991.3
42.5	1635.7	1579.4	1706.6	1815.2		2026.2	2065.6	1993.3
42.6	1635.2	1581.8	1707.8	1820.7		2029.1	2068	1993.5
42.7	1633.9	1584.7	1709.3	1815.4		2028.2	2066.2	1991.9
42.8	1632.8	1584.4	1710.8	1815.5		2027.3	2066.7	1991.8
42.9	1632.5	1585	1706.3	1817.7		2023.4	2066.4	1990.8

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	10	20	25	30	35	40	50
t								
43	1631.7	1585.8	1709.1	1820.6		2023.4	2067.5	1987.8
43.1	1631.7	1584.5	1710.9	1817.9		2022	2061.7	1993.9
43.2	1631.7	1586.3	1727.7	1821.4		2028.6	2063.8	1993.4
43.3	1630.7	1590.6	1717.6	1817.4		2028.1	2066.7	1994.9
43.4	1630.1	1589.4	1715	1821.7		2029.3	2066.9	1990.7
43.5	1628.8	1589.7	1716.9	1820.4		2029	2066.8	1991.5
43.6	1629.6	1589.3	1715.2	1817.7		2025.9	2062.2	1990.3
43.7	1628.7	1589.7	1709.9	1822.1		2020.8	2073	1992.7
43.8	1628.1	1592.3	1709.4	1828.8		2022.8	2071.3	1995.6
43.9	1629.1	1592.2	1713.2	1821.2		2023.5	2061.4	1992.2
44	1629.1	1594.3	1715.7	1819.5		2027.6	2062.9	1992.7
44.1	1627.4	1593.9	1716.3	1818.1		2027.5	2060.4	1994.5
44.2	1626.7	1596	1714.6	1821.8		2033.1	2062.7	1993.9
44.3	1625.8	1597.6	1727.3	1818.3		2026.4	2069.5	1996.4
44.4	1625.1	1600.9	1716.9	1821.7		2027.3	2066	1996.5
44.5	1624.4	1600.6	1717.3	1822.2		2027.6	2065.5	2006.9
44.6	1623.4	1601.6	1711.3	1823		2028.6	2065.2	1996.2
44.7	1622.2	1602.4	1717.9	1822		2028.9	2067.6	2000.6
44.8	1621.3	1604.1	1717.6	1819.9		2028	2063	2000
44.9	1619.7	1605.5	1720.7	1819.7		2030	2056.9	2003
45	1619.2	1606.6	1719.4	1820.5		2032.9	2065.7	2003.2
45.1	1617.8	1606.8	1720.8	1821.3		2028.8	2060.2	2004.3
45.2	1617.1	1609.8	1720.6	1821.3		2029.4	2066.6	2000.2
45.3	1614.8	1607.5	1722.8	1820.8		2029.6	2066	1997.6
45.4	1612.6	1610.6	1729.4	1822.4		2030.4	2065.9	2001.3
45.5	1609.4	1613.9	1724.1	1823.2		2029.8	2064.1	2006.3
45.6	1607.1	1613.7	1722.2	1824.2		2029.5	2066.5	2001.7
45.7	1608.1	1615.3	1721.9	1820		2030.1	2066.4	2002.7
45.8	1607.9	1614	1725			2030.4	2065.4	2003.7
45.9	1607	1613.3	1720.3			2030.7	2063.6	2002.5
46	1604.9	1614.4	1725.7			2032.3	2065.1	2004.9
46.1	1603.3	1615.4	1722.2			2030.7	2056	2004.5
46.2	1602.1	1616.9	1723.9			2030.2		2014.4
46.3	1600.9	1619.2	1718.8			2030.7		2003.3
46.4	1600	1620.8	1709.8			2031.8		2000.2
46.5	1598.1	1621.9	1722.2			2031.5		2003.7
46.6	1597	1622.3	1720.4			2032.5		2003.7
46.7	1594.9	1623.1	1725.4			2031.9		2003.9
46.8	1593.6	1623.7	1726.4			2030.8		2007.7
46.9	1593.6	1624.8	1725.8			2031.9		2006.7

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	10	20	25	30	35	40	50
t								
47	1592.7	1625.9	1727.6			2033.3		2006.3
47.1	1592	1626.8	1729.3			2028.9		2006.3
47.2	1590.6	1628.1	1723.3			2034.5		2005.3
47.3	1588.2	1628.3	1728.4			2029.2		2004
47.4	1588.1	1629.1	1729.5			2033		2002
47.5	1587	1630	1739.8			2032.3		2004
47.6	1584.7	1629.5	1730.2			2029.8		2012.8
47.7	1586.6	1624.6	1728.8			2031.6		2007.7
47.8	1584.2	1632	1728.6			2031.2		2015.3
47.9	1584.6	1636.7	1730.2			2030.1		2011.4
48	1583.4	1635.4	1731.6			2030.6		2013.3
48.1	1582.6	1635	1731.4			2031.2		2001.8
48.2	1582.6	1634.5	1728.8			2032.2		2007.8
48.3	1581.3	1635.8	1731			2033.4		2008.5
48.4	1581.5	1637.1	1727.3			2033.9		2009.9
48.5	1580.6	1633.8	1728.3			2031.8		2005.5
48.6	1580.5	1637.3	1730.2			2032.3		2011.1
48.7	1580	1635.4	1732.2			2032.1		2007.6
48.8	1579.3	1650.6	1730.7			2033		2018.6
48.9	1579.2	1633	1731.4			2031.1		2010.5
49	1579.2	1641.9	1730.3			2031.5		2007.5
49.1	1579.8	1640.9	1730.1			2030.7		2000.9
49.2	1579.1	1641.4	1731.5			2032.1		2007.6
49.3	1579.5	1640.5	1735.6			2033.4		2005.8
49.4	1579.8	1647.6	1726.7			2031.8		2009.9
49.5	1581.3	1643.3	1729.6			2031.5		
49.6	1580.8	1642.8	1730.5			2032.1		
49.7	1579.8	1644.7	1727.5			2032.4		
49.8	1581.2	1644	1734			2031.1		
49.9	1582.2	1650.3	1726.2			2039.2		
50	1582.7	1646	1736.8			2034.2		
50.1	1582.9	1645.8	1734.8			2031.7		
50.2	1583.2	1647.8	1733.4			2031.5		
50.3	1583.9	1649.3	1727.5			2033.5		
50.4	1584.7	1650.6	1733.8			2025.2		
50.5	1585.5	1651.9	1730.5			2031.9		
50.6	1585.4	1652.8	1733.4			2029.9		
50.7	1587.9	1650.3	1735.8			2032.9		
50.8	1588.7	1651	1729.3			2032.5		
50.9	1587.4	1651.9	1739.1			2032.8		

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	10	20	25	30	35	40	50
t								
51	1582.2	1654.6	1733.4			2032.4		
51.1	1590.7	1652.6	1733.9			2029.8		
51.2	1590.9	1658	1735.4			2029.5		
51.3	1590.3	1657.5	1736.3			2033.8		
51.4	1591.4	1656.1	1740.1			2031.9		
51.5	1595.2	1656.8	1740.1			2033.4		
51.6	1595.3	1664	1738.9			2031.1		
51.7	1595.4	1658.9	1739.3			2033.3		
51.8	1598.1	1658.7	1737.8			2032.3		
51.9	1597.8	1659.9	1723.5			2033.7		
52	1597.4	1661.1	1742.8			2033		
52.1	1597.4	1661.5	1737.7			2033.9		
52.2	1599.3	1662.7	1733.1			2035		
52.3	1599.1	1662.5	1736.6			2034.2		
52.4	1601	1664	1743.6			2032.9		
52.5	1602.3	1664.6	1738.7			2032.9		
52.6	1602.8	1661.2	1736.8			2034.1		
52.7	1604.3	1669	1741.1			2037.7		
52.8	1604.4	1659.7	1747			2035.7		
52.9	1605.5	1663.7	1740.2			2035.7		
53	1607.8	1663.2	1744			2038.9		
53.1	1607.8	1665	1740.7			2035.1		
53.2	1610.6	1666	1738.6			2035.6		
53.3	1609.9	1665.2	1732.5			2036.4		
53.4	1611.2	1665.2	1735.4			2036.5		
53.5	1612	1665.2	1743.8			2035.9		
53.6	1612.6	1665.2				2036.1		
53.7	1613	1665.3				2034.9		
53.8	1613.3	1668.5				2036		
53.9	1615.4	1670.6				2033.2		
54	1615.7	1669.9				2033.9		
54.1	1616.2	1671				2032.6		
54.2	1616.9	1670.2				2031.3		
54.3	1617.3	1671.3				2035.4		
54.4	1618.3	1671.3				2036.8		
54.5	1619.2	1672.2				2036.5		
54.6	1620.1	1672.4				2038		
54.7	1620.3	1668.4				2038.7		
54.8	1620.8	1672.6				2036.2		
54.9	1621.8	1672.6				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	10	20	25	30	35	40	50
t								
55	1620.6	1672.6				2038.8		
55.1	1619.9	1673.1				2035.1		
55.2	1622.3	1672.5				2037.5		
55.3	1624.3	1674.5				2041		
55.4	1624.5	1667.6				2039.2		
55.5	1625.5	1675.3				2040.9		
55.6	1627.1	1676.1				2039.3		
55.7	1626.6	1676.9				2039.2		
55.8	1628.3	1676.9				2040.5		
55.9	1631	1676.7				2035.1		
56	1630.3	1678				2041.1		
56.1	1629.6	1678.6				2040.4		
56.2	1625.6	1676.6				2039.4		
56.3	1630.1	1679.6				2039.3		
56.4	1635.5	1680.2				2039.4		
56.5	1634.6	1679.6				2037.2		
56.6	1631.4	1683.1				2039.1		
56.7	1635.8	1681.9				2039		
56.8	1631.8	1674.9				2040.2		
56.9	1632.2	1683.3				2036.5		
57	1634.9	1684.5				2039.5		
57.1	1636.5	1684.5				2039		
57.2	1633.2	1682.6				2040.4		
57.3	1635.8	1678.4				2040.2		
57.4		1682.4				2039.6		
57.5		1686.6				2040.1		
57.6		1684.3				2050		
57.7		1684.5				2042.1		
57.8		1684.7				2039.7		
57.9		1686				2040.8		
58		1685.9				2041.8		
58.1		1687.5				2039.2		
58.2		1688.9				2042.1		
58.3		1686				2043.1		
58.4		1683.1				2043.2		
58.5		1687.4				2041.5		
58.6		1688.8				2039.9		
58.7		1689.9				2040		
58.8		1690.7				2040		
58.9		1692.1				2042.5		

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	10	20	25	30	35	40	50
t								
59		1690.4				2041		
59.1		1688.7				2041.9		
59.2		1687.7				2042.1		
59.3		1692.1				2042.7		
59.4		1691.7				2040		
59.5		1691.3				2043		
59.6		1692.2				2041.9		
59.7		1693.6				2041		
59.8		1693.7				2041.8		
59.9		1694.5				2043.2		
60		1692.6				2041.8		
60.1		1691.7				2039.3		
60.2		1694.7				2040.7		
60.3		1696.1				2040.3		
60.4		1695.9				2040.2		
60.5		1694.9				2039.4		
60.6		1695.6				2048.1		
60.7		1698.4				2039		
60.8		1698.4				2034.1		
60.9		1695.5				2033		
61		1699.7				2042		
61.1		1700.9				2038.1		
61.2		1700				2037.9		
61.3		1699.8				2035.7		
61.4		1698.7				2039.7		
61.5		1701.1				2032.6		
61.6		1700.2				2031.9		
61.7		1701.7				2034.7		
61.8		1705.5				2044.9		
61.9		1694.5				2036.1		
62		1690.9				2029.2		
62.1		1704.8				2025.2		
62.2		1702.7				2027		
62.3		1703.2				2004.5		
62.4		1703						
62.5		1705.5						
62.6		1706.1						
62.7		1699.1						
62.8		1700.7						
62.9		1696.7						

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	10	20	25	30	35	40	50
t								
63		1694.9						
63.1		1698.7						
63.2		1697.2						
63.3		1703						
63.4		1705.3						
63.5		1702.2						
63.6		1701.2						
63.7		1700.3						
63.8		1705.8						
63.9		1707.3						
64		1702.7						
64.1		1711.3						
64.2		1711.9						
64.3		1714.2						
64.4		1710.8						
64.5		1709.2						
64.6		1712.8						
64.7		1716						
64.9		1715.7						

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 PT3; time is referenced from detonator circuit current start

Jack Rabbit Pretest 2021E PT3 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	10	20	25	30	35	40	50
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	0.0001	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	0.0007	0	0	0	0	0	0	0
9.1	0.0011	4E-05	0	0	0	0	0	0
9.2	0.0015	0.0001	0	0	0	0	0	0
9.3	0.0019	0.0002	0	0	0	0	0	0
9.4	0.0025	0.0003	0	0	0	0	0	0
9.5	0.0031	0.0004	0	0	0	0	0	0
9.6	0.0037	0.0006	0	0	0	0	0	0
9.7	0.0043	0.0007	0	0	0	0	0	0
9.8	0.005	0.0009	0	0	0	0	0	0
9.9	0.0056	0.0011	0	0	0	0	0	0
10	0.0063	0.0013	0	0	0	0	0	0
10.1	0.007	0.0015	0	0	0	0	0	0
10.2	0.0077	0.0018	0	0	0	0	0	0
10.3	0.0084	0.002	0	0	0	0	0	0
10.4	0.0091	0.0023	0	0	0	0	0	0
10.5	0.0099	0.0025	0	0	0	0	0	0
10.6	0.0107	0.0029	0	0	0	0	0	0
10.7	0.0116	0.0032	0	0	0	0	0	0
10.8	0.0125	0.0037	0	0	0	0	0	0
10.9	0.0134	0.0042	0	0	0	0	0.105	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	10	20	25	30	35	40	50
t								
11	0.0145	0.0048	0	0	0.0024	0.0963	0.3107	0
11.1	0.0157	0.0055	0	0.0035	0.1022	0.2867	0.5094	0
11.2	0.017	0.0063	0.0036	0.0378	0.2934	0.4715	0.7048	0
11.3	0.0207	0.0072	0.0358	0.1015	0.4783	0.6516	0.8981	0.0647
11.4	0.0277	0.0097	0.0938	0.1687	0.6593	0.8314	1.0898	0.2293
11.5	0.0391	0.015	0.1538	0.2385	0.8377	1.0124	1.2808	0.4254
11.6	0.0636	0.0237	0.2163	0.3118	1.0138	1.1927	1.471	0.6166
11.7	0.0979	0.0429	0.2815	0.389	1.1879	1.372	1.6609	0.8069
11.8	0.1323	0.0837	0.3494	0.4692	1.3604	1.5512	1.8503	0.9972
11.9	0.1663	0.1419	0.4201	0.5529	1.5313	1.7307	2.0393	1.1865
12	0.2006	0.2061	0.4937	0.644	1.7016	1.9099	2.2282	1.375
12.1	0.2361	0.2718	0.5703	0.7564	1.8713	2.0885	2.4169	1.5634
12.2	0.2736	0.3375	0.6495	0.8853	2.0405	2.2676	2.6055	1.752
12.3	0.314	0.4027	0.7313	1.015	2.2092	2.447	2.794	1.9404
12.4	0.3582	0.4677	0.816	1.1443	2.377	2.6258	2.9824	2.1279
12.5	0.4076	0.5328	0.9156	1.2718	2.5442	2.8047	3.1706	2.3153
12.6	0.4619	0.5985	1.0286	1.3973	2.711	2.984	3.3586	2.5035
12.7	0.5197	0.6644	1.1414	1.5222	2.8782	3.1632	3.5464	2.6917
12.8	0.5802	0.73	1.253	1.6467	3.0462	3.3422	3.734	2.8798
12.9	0.6435	0.7951	1.3623	1.7705	3.2152	3.5214	3.9215	3.0677
13	0.7088	0.8597	1.4696	1.8939	3.3853	3.7004	4.1088	3.255
13.1	0.7763	0.9244	1.5757	2.0169	3.5555	3.8795	4.296	3.4422
13.2	0.8464	0.9895	1.6819	2.1394	3.7261	4.0587	4.483	3.6299
13.3	0.9193	1.0556	1.7886	2.2612	3.8982	4.2379	4.6699	3.8176
13.4	0.9943	1.1228	1.8953	2.3823	4.0711	4.4171	4.8567	4.0053
13.5	1.0704	1.1917	2.0021	2.5034	4.2444	4.5965	5.0432	4.193
13.6	1.1469	1.2628	2.1091	2.6252	4.4178	4.7758	5.2297	4.3806
13.7	1.2235	1.3389	2.2164	2.748	4.5913	4.955	5.416	4.5681
13.8	1.2995	1.4229	2.3251	2.8722	4.7652	5.1341	5.6021	4.7555
13.9	1.3742	1.5161	2.4362	2.9974	4.939	5.3133	5.7881	4.9429
14	1.4475	1.6151	2.5504	3.1229	5.1133	5.4925	5.974	5.1301
14.1	1.5202	1.7155	2.6668	3.2484	5.2886	5.6715	6.1597	5.3173
14.2	1.5941	1.8168	2.7846	3.374	5.4641	5.8504	6.3453	5.5045
14.3	1.6714	1.9185	2.9035	3.4998	5.6402	6.0293	6.5309	5.6917
14.4	1.7542	2.0207	3.0231	3.6261	5.8174	6.2083	6.7164	5.8789
14.5	1.8444	2.1232	3.1435	3.7527	5.9955	6.3871	6.902	6.066
14.6	1.9419	2.2263	3.2642	3.8796	6.1741	6.566	7.0874	6.253
14.7	2.0441	2.3306	3.3849	4.007	6.3521	6.745	7.2725	6.4398
14.8	2.1488	2.4369	3.5061	4.1347	6.5297	6.9238	7.4575	6.6267
14.9	2.2547	2.5463	3.6272	4.2627	6.7068	7.1026	7.6423	6.8135

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	10	20	25	30	35	40	50
t								
15	2.361	2.6587	3.7481	4.391	6.884	7.2813	7.827	7.0003
15.1	2.4676	2.7736	3.8689	4.52	7.0613	7.46	8.0117	7.1871
15.2	2.5754	2.8901	3.99	4.6498	7.2388	7.6387	8.1962	7.3738
15.3	2.6864	3.0075	4.1117	4.7798	7.4165	7.8173	8.3806	7.5604
15.4	2.8014	3.1264	4.2341	4.9095	7.5942	7.9959	8.5648	7.7469
15.5	2.9198	3.2492	4.3573	5.0391	7.772	8.1745	8.7489	7.9332
15.6	3.0409	3.3762	4.4813	5.1686	7.9501	8.3531	8.9329	8.1195
15.7	3.165	3.5058	4.6067	5.2982	8.1279	8.5318	9.1169	8.3059
15.8	3.2928	3.6377	4.7334	5.4281	8.3054	8.7104	9.3008	8.4921
15.9	3.424	3.771	4.8613	5.5584	8.4832	8.8888	9.4845	8.678
16	3.5588	3.9052	4.9905	5.6894	8.6612	9.0674	9.6682	8.8638
16.1	3.6994	4.04	5.1212	5.8214	8.8393	9.2461	9.8517	9.0499
16.2	3.8462	4.1751	5.2532	5.9543	9.0175	9.4246	10.035	9.2359
16.3	3.9979	4.3104	5.3863	6.088	9.1956	9.603	10.219	9.4217
16.4	4.1518	4.4458	5.5202	6.2223	9.3739	9.7814	10.402	9.6075
16.5	4.3056	4.5815	5.6544	6.3573	9.5526	9.9598	10.585	9.7932
16.6	4.459	4.7177	5.7888	6.493	9.7311	10.138	10.768	9.9789
16.7	4.6118	4.8544	5.9233	6.6296	9.9094	10.317	10.951	10.165
16.8	4.7638	4.9913	6.058	6.7668	10.088	10.495	11.134	10.35
16.9	4.9145	5.1282	6.1928	6.9048	10.267	10.673	11.317	10.536
17	5.0634	5.2647	6.3277	7.0433	10.446	10.851	11.5	10.722
17.1	5.2104	5.4008	6.4626	7.1824	10.626	11.03	11.683	10.907
17.2	5.3556	5.5364	6.5976	7.322	10.805	11.208	11.865	11.092
17.3	5.4992	5.6716	6.7326	7.4618	10.985	11.386	12.048	11.278
17.4	5.6413	5.8063	6.8676	7.6018	11.164	11.564	12.23	11.463
17.5	5.7814	5.9404	7.0027	7.7422	11.344	11.743	12.413	11.649
17.6	5.9196	6.0744	7.138	7.8829	11.524	11.921	12.595	11.834
17.7	6.0565	6.2086	7.2734	8.0239	11.704	12.099	12.777	12.019
17.8	6.193	6.343	7.4092	8.1652	11.884	12.277	12.959	12.204
17.9	6.3297	6.4775	7.5453	8.3068	12.064	12.455	13.141	12.389
18	6.4668	6.612	7.6816	8.4485	12.244	12.633	13.323	12.575
18.1	6.6046	6.7464	7.8182	8.5903	12.424	12.811	13.505	12.76
18.2	6.7431	6.8805	7.9551	8.7325	12.604	12.989	13.687	12.944
18.3	6.8825	7.0145	8.0921	8.875	12.784	13.167	13.868	13.129
18.4	7.0227	7.1481	8.2293	9.018	12.964	13.345	14.05	13.314
18.5	7.1635	7.2816	8.3665	9.1613	13.144	13.523	14.231	13.499
18.6	7.3049	7.415	8.5037	9.3053	13.324	13.701	14.413	13.683
18.7	7.4462	7.5486	8.6407	9.4498	13.504	13.879	14.594	13.868
18.8	7.5874	7.6826	8.7777	9.5947	13.684	14.056	14.775	14.052
18.9	7.7281	7.817	8.9147	9.7401	13.863	14.234	14.956	14.237

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	10	20	25	30	35	40	50
t								
19	7.8687	7.952	9.0519	9.8861	14.043	14.412	15.137	14.421
19.1	8.0096	8.0875	9.1895	10.032	14.222	14.59	15.318	14.605
19.2	8.1507	8.2234	9.3275	10.179	14.401	14.768	15.499	14.789
19.3	8.2921	8.3595	9.4659	10.326	14.58	14.946	15.68	14.973
19.4	8.4333	8.4955	9.6045	10.474	14.759	15.124	15.861	15.157
19.5	8.5739	8.6312	9.7434	10.622	14.938	15.302	16.042	15.341
19.6	8.7137	8.7666	9.8824	10.77	15.117	15.48	16.223	15.525
19.7	8.8529	8.9017	10.022	10.918	15.296	15.658	16.404	15.709
19.8	8.9917	9.0364	10.161	11.067	15.475	15.836	16.584	15.892
19.9	9.1305	9.1709	10.3	11.216	15.654	16.014	16.765	16.076
20	9.2694	9.3051	10.44	11.365	15.832	16.193	16.945	16.259
20.1	9.4087	9.4393	10.58	11.514	16.01	16.371	17.126	16.443
20.2	9.5483	9.5733	10.72	11.663	16.189	16.549	17.307	16.626
20.3	9.6879	9.7074	10.86	11.813	16.367	16.728	17.487	16.81
20.4	9.8274	9.8416	11.001	11.963	16.545	16.906	17.667	16.993
20.5	9.9669	9.9757	11.142	12.113	16.723	17.084	17.846	17.177
20.6	10.107	10.11	11.283	12.264	16.901	17.263	18.026	17.36
20.7	10.246	10.244	11.424	12.415	17.078	17.441	18.206	17.543
20.8	10.386	10.378	11.566	12.566	17.256	17.619	18.386	17.726
20.9	10.527	10.512	11.707	12.717	17.434	17.798	18.566	17.909
21	10.667	10.647	11.849	12.869	17.611	17.976	18.747	18.092
21.1	10.808	10.781	11.991	13.021	17.789	18.155	18.928	18.275
21.2	10.949	10.916	12.133	13.173	17.966	18.334	19.109	18.458
21.3	11.09	11.052	12.275	13.326	18.144	18.512	19.29	18.642
21.4	11.231	11.187	12.417	13.479	18.321	18.691	19.471	18.825
21.5	11.373	11.323	12.559	13.632	18.499	18.87	19.652	19.008
21.6	11.514	11.459	12.702	13.785	18.676	19.048	19.834	19.191
21.7	11.655	11.595	12.845	13.939	18.853	19.227	20.016	19.374
21.8	11.797	11.731	12.988	14.092	19.031	19.405	20.198	19.557
21.9	11.937	11.867	13.131	14.246	19.208	19.584	20.38	19.739
22	12.078	12.003	13.274	14.4	19.385	19.763	20.563	19.922
22.1	12.218	12.138	13.418	14.554	19.563	19.942	20.745	20.105
22.2	12.358	12.273	13.561	14.708	19.74	20.121	20.928	20.287
22.3	12.497	12.408	13.705	14.863	19.917	20.299	21.111	20.47
22.4	12.636	12.542	13.849	15.017	20.094	20.478	21.293	20.653
22.5	12.775	12.677	13.993	15.172	20.271	20.657	21.476	20.835
22.6	12.913	12.811	14.136	15.328	20.448	20.836	21.659	21.017
22.7	13.052	12.946	14.281	15.483	20.626	21.015	21.841	21.199
22.8	13.19	13.08	14.425	15.639	20.804	21.193	22.024	21.381
22.9	13.328	13.215	14.569	15.796	20.982	21.372	22.206	21.563

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	10	20	25	30	35	40	50
t								
23	13.466	13.35	14.714	15.952	21.16	21.551	22.389	21.744
23.1	13.604	13.484	14.859	16.109	21.337	21.73	22.572	21.926
23.2	13.742	13.619	15.004	16.266	21.514	21.909	22.755	22.107
23.3	13.88	13.753	15.149	16.422	21.69	22.087	22.938	22.289
23.4	14.017	13.888	15.294	16.579	21.867	22.266	23.121	22.471
23.5	14.155	14.022	15.44	16.736	22.044	22.445	23.304	22.652
23.6	14.292	14.157	15.586	16.894	22.221	22.623	23.488	22.834
23.7	14.43	14.292	15.732	17.051	22.398	22.802	23.671	23.015
23.8	14.567	14.428	15.879	17.209	22.575	22.982	23.855	23.196
23.9	14.704	14.563	16.026	17.367	22.751	23.161	24.038	23.378
24	14.841	14.698	16.174	17.525	22.927	23.341	24.222	23.559
24.1	14.978	14.834	16.321	17.683	23.103	23.52	24.405	23.74
24.2	15.114	14.969	16.469	17.841	23.28	23.7	24.589	23.921
24.3	15.25	15.104	16.617	18	23.456	23.88	24.774	24.102
24.4	15.386	15.24	16.765	18.16	23.633	24.06	24.958	24.283
24.5	15.521	15.375	16.914	18.319	23.81	24.24	25.142	24.464
24.6	15.657	15.51	17.063	18.479	23.986	24.42	25.326	24.644
24.7	15.791	15.644	17.212	18.639	24.163	24.6	25.511	24.825
24.8	15.925	15.779	17.362	18.8	24.339	24.781	25.695	25.006
24.9	16.059	15.914	17.512	18.961	24.516	24.962	25.879	25.187
25	16.193	16.05	17.662	19.122	24.692	25.143	26.062	25.367
25.1	16.327	16.185	17.812	19.283	24.869	25.324	26.245	25.548
25.2	16.461	16.32	17.963	19.445	25.046	25.506	26.429	25.728
25.3	16.595	16.456	18.114	19.607	25.222	25.688	26.613	25.908
25.4	16.728	16.592	18.265	19.769	25.399	25.87	26.796	26.089
25.5	16.862	16.728	18.417	19.931	25.576	26.053	26.979	26.269
25.6	16.995	16.864	18.569	20.094	25.753	26.236	27.162	26.449
25.7	17.129	17.001	18.721	20.257	25.93	26.42	27.345	26.628
25.8	17.262	17.137	18.873	20.42	26.107	26.605	27.528	26.808
25.9	17.395	17.274	19.026	20.584	26.284	26.79	27.712	26.988
26	17.528	17.411	19.179	20.747	26.461	26.975	27.895	27.167
26.1	17.66	17.549	19.332	20.912	26.639	27.162	28.078	27.347
26.2	17.793	17.687	19.486	21.076	26.816	27.349	28.26	27.526
26.3	17.925	17.825	19.639	21.241	26.993	27.536	28.443	27.705
26.4	18.058	17.963	19.793	21.406	27.171	27.725	28.626	27.885
26.5	18.19	18.102	19.947	21.571	27.348	27.913	28.809	28.064
26.6	18.322	18.24	20.102	21.737	27.526	28.103	28.992	28.243
26.7	18.454	18.379	20.256	21.902	27.703	28.293	29.174	28.422
26.8	18.586	18.518	20.411	22.068	27.881	28.483	29.354	28.601
26.9	18.718	18.657	20.566	22.234	28.059	28.674	29.533	28.78

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r →	0	10	20	25	30	35	40	50
t								
27	18.849	18.796	20.721	22.401	28.237	28.865	29.711	28.958
27.1	18.98	18.935	20.877	22.567	28.414	29.057	29.889	29.137
27.2	19.111	19.074	21.032	22.734	28.592	29.249	30.065	29.316
27.3	19.242	19.213	21.188	22.901	28.77	29.441	30.241	29.494
27.4	19.372	19.352	21.344	23.068	28.948	29.634	30.416	29.672
27.5	19.503	19.491	21.5	23.236	29.126	29.826	30.589	29.851
27.6	19.634	19.63	21.656	23.403	29.305	30.018	30.761	30.029
27.7	19.765	19.769	21.813	23.57	29.482	30.212	30.933	30.207
27.8	19.896	19.908	21.969	23.738	29.66	30.405	31.103	30.385
27.9	20.027	20.047	22.126	23.906	29.837	30.599	31.272	30.564
28	20.158	20.187	22.283	24.074	30.014	30.793	31.441	30.742
28.1	20.289	20.326	22.44	24.243	30.191	30.988	31.609	30.92
28.2	20.419	20.466	22.597	24.411	30.368	31.183	31.776	31.098
28.3	20.55	20.605	22.754	24.58	30.544	31.377	31.945	31.276
28.4	20.681	20.745	22.912	24.749	30.721	31.572	32.114	31.453
28.5	20.812	20.885	23.07	24.918	30.898	31.767	32.285	31.631
28.6	20.943	21.025	23.228	25.087	31.074	31.962	32.457	31.809
28.7	21.074	21.165	23.385	25.256	31.25	32.158	32.63	31.988
28.8	21.205	21.306	23.544	25.426	31.426	32.354	32.803	32.165
28.9	21.336	21.446	23.702	25.596	31.602	32.55	32.978	32.344
29	21.467	21.587	23.86	25.765	31.777	32.745	33.155	32.522
29.1	21.597	21.728	24.019	25.936	31.951	32.941	33.334	32.7
29.2	21.728	21.869	24.177	26.106	32.126	33.137	33.514	32.878
29.3	21.858	22.011	24.336	26.276	32.301	33.334	33.695	33.057
29.4	21.989	22.152	24.496	26.446	32.475	33.53	33.879	33.235
29.5	22.119	22.293	24.654	26.617	32.65	33.726	34.065	33.415
29.6	22.249	22.435	24.813	26.788	32.824	33.923	34.255	33.594
29.7	22.38	22.577	24.973	26.959	32.997	34.119	34.448	33.773
29.8	22.51	22.719	25.132	27.13	33.169	34.316	34.644	33.952
29.9	22.64	22.861	25.292	27.302	33.342	34.512	34.843	34.131
30	22.771	23.003	25.451	27.473	33.515	34.709	35.044	34.312
30.1	22.902	23.145	25.611	27.644	33.687	34.905	35.247	34.494
30.2	23.033	23.288	25.771	27.815	33.859	35.102	35.451	34.675
30.3	23.164	23.43	25.931	27.987	34.03	35.3	35.656	34.856
30.4	23.295	23.573	26.091	28.159	34.201	35.497	35.862	35.039
30.5	23.426	23.716	26.251	28.331	34.372	35.694	36.069	35.222
30.6	23.557	23.858	26.411	28.504	34.542	35.892	36.276	35.406
30.7	23.688	24.001	26.571	28.676	34.713	36.089	36.483	35.589
30.8	23.82	24.144	26.732	28.848	34.885	36.286	36.69	35.774
30.9	23.951	24.287	26.892	29.021	35.056	36.483	36.895	35.959

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r →	0	10	20	25	30	35	40	50
t								
31	24.083	24.43	27.053	29.194	35.227	36.681	37.1	36.144
31.1	24.215	24.573	27.214	29.367	35.399	36.878	37.305	36.331
31.2	24.346	24.715	27.375	29.539	35.571	37.076	37.509	36.518
31.3	24.478	24.858	27.536	29.712	35.744	37.274	37.714	36.705
31.4	24.61	25	27.697	29.885	35.918	37.472	37.917	36.893
31.5	24.741	25.143	27.858	30.059	36.093	37.669	38.121	37.082
31.6	24.872	25.286	28.02	30.232	36.269	37.867	38.324	37.271
31.7	25.003	25.428	28.181	30.406	36.447	38.065	38.526	37.46
31.8	25.134	25.571	28.343	30.579	36.624	38.263	38.729	37.651
31.9	25.265	25.714	28.504	30.753	36.803	38.461	38.932	37.841
32	25.396	25.857	28.666	30.927	36.984	38.659	39.135	38.032
32.1	25.526	26	28.828	31.101	37.166	38.857	39.337	38.223
32.2	25.657	26.143	28.99	31.275	37.349	39.055	39.54	38.415
32.3	25.787	26.285	29.152	31.449	37.533	39.253	39.744	38.607
32.4	25.917	26.428	29.314	31.624	37.718	39.451	39.947	38.799
32.5	26.048	26.572	29.476	31.798	37.906	39.65	40.15	38.992
32.6	26.178	26.715	29.638	31.973	38.094	39.848	40.354	39.185
32.7	26.308	26.858	29.8	32.148	38.284	40.047	40.557	39.378
32.8	26.438	27.002	29.962	32.323	38.477	40.245	40.761	39.572
32.9	26.568	27.145	30.125	32.498	38.67	40.444	40.965	39.766
33	26.698	27.289	30.287	32.673	38.865	40.643	41.168	39.96
33.1	26.828	27.432	30.45	32.848	39.06	40.842	41.372	40.154
33.2	26.958	27.576	30.613	33.023	39.257	41.04	41.576	40.349
33.3	27.088	27.719	30.776	33.198	39.454	41.239	41.78	40.544
33.4	27.218	27.862	30.939	33.373	39.652	41.439	41.984	40.739
33.5	27.348	28.006	31.102	33.548	39.85	41.638	42.187	40.934
33.6	27.479	28.15	31.265	33.724	40.049	41.837	42.391	41.129
33.7	27.609	28.293	31.428	33.899	40.248	42.036	42.595	41.325
33.8	27.74	28.437	31.591	34.075	40.448	42.236	42.799	41.52
33.9	27.871	28.581	31.754	34.251	40.648	42.435	43.003	41.716
34	28.002	28.725	31.918	34.426	40.847	42.635	43.207	41.912
34.1	28.133	28.869	32.081	34.603	41.048	42.834	43.411	42.107
34.2	28.264	29.013	32.245	34.779	41.25	43.034	43.615	42.302
34.3	28.395	29.156	32.408	34.956	41.451	43.233	43.819	42.498
34.4	28.526	29.299	32.572	35.134	41.651	43.433	44.022	42.694
34.5	28.658	29.443	32.736	35.311	41.852	43.633	44.226	42.89
34.6	28.789	29.587	32.9	35.488	42.053	43.833	44.431	43.086
34.7	28.92	29.731	33.063	35.665	42.255	44.032	44.635	43.282
34.8	29.052	29.875	33.227	35.842	42.456	44.232	44.839	43.478
34.9	29.183	30.02	33.391	36.019	42.657	44.432	45.043	43.674

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r →	0	10	20	25	30	35	40	50
t								
35	29.314	30.164	33.556	36.196	42.859	44.632	45.247	43.871
35.1	29.446	30.309	33.72	36.373	43.06	44.832	45.45	44.067
35.2	29.577	30.453	33.885	36.55	43.26	45.032	45.653	44.263
35.3	29.708	30.597	34.049	36.726	43.46	45.232	45.857	44.459
35.4	29.84	30.742	34.213	36.903	43.661	45.432	46.06	44.656
35.5	29.979	30.887	34.378	37.08	43.862	45.632	46.263	44.852
35.6	30.129	31.032	34.543	37.257	44.062	45.832	46.466	45.049
35.7	30.284	31.177	34.707	37.433	44.262	46.033	46.67	45.245
35.8	30.437	31.324	34.872	37.61	44.463	46.233	46.873	45.442
35.9	30.586	31.473	35.038	37.786	44.663	46.433	47.077	45.638
36	30.732	31.622	35.202	37.963	44.863	46.633	47.282	45.834
36.1	30.878	31.772	35.367	38.14	45.062	46.834	47.486	46.031
36.2	31.023	31.922	35.532	38.316	45.262	47.034	47.689	46.227
36.3	31.167	32.072	35.697	38.493	45.462	47.234	47.892	46.423
36.4	31.313	32.221	35.862	38.67	45.661	47.435	48.095	46.62
36.5	31.458	32.371	36.028	38.846	45.861	47.635	48.298	46.816
36.6	31.604	32.521	36.193	39.023	46.06	47.836	48.501	47.012
36.7	31.751	32.671	36.358	39.2	46.26	48.036	48.705	47.209
36.8	31.898	32.821	36.524	39.377	46.459	48.237	48.909	47.405
36.9	32.046	32.972	36.69	39.553	46.658	48.438	49.114	47.602
37	32.194	33.121	36.856	39.73	46.857	48.638	49.318	47.798
37.1	32.343	33.271	37.022	39.908	47.057	48.839	49.523	47.995
37.2	32.492	33.42	37.188	40.085	47.256	49.04	49.727	48.192
37.3	32.642	33.569	37.354	40.263	47.455	49.241	49.931	48.389
37.4	32.792	33.719	37.521	40.44	47.655	49.442	50.134	48.586
37.5	32.942	33.869	37.687	40.617	47.855	49.643	50.337	48.783
37.6	33.094	34.019	37.854	40.794	48.055	49.845	50.54	48.98
37.7	33.247	34.169	38.021	40.971	48.254	50.046	50.744	49.176
37.8	33.403	34.319	38.188	41.148	48.452	50.247	50.949	49.373
37.9	33.561	34.469	38.356	41.325	48.651	50.449	51.155	49.57
38	33.719	34.62	38.524	41.502	48.85	50.65	51.36	49.767
38.1	33.876	34.772	38.691	41.68	49.049	50.852	51.566	49.964
38.2	34.033	34.923	38.859	41.858	49.248	51.053	51.772	50.161
38.3	34.19	35.076	39.027	42.036	49.447	51.254	51.977	50.358
38.4	34.348	35.228	39.195	42.213	49.646	51.456	52.183	50.555
38.5	34.506	35.381	39.363	42.391	49.845	51.658	52.389	50.752
38.6	34.665	35.535	39.531	42.569	50.044	51.859	52.595	50.949
38.7	34.824	35.688	39.699	42.747	50.243	52.061	52.801	51.146
38.8	34.983	35.841	39.867	42.926	50.441	52.263	53.007	51.343
38.9	35.142	35.994	40.036	43.104	50.64	52.465	53.213	51.541

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r →	0	10	20	25	30	35	40	50
t								
39	35.302	36.147	40.204	43.282	50.839	52.666	53.419	51.738
39.1	35.462	36.3	40.374	43.461	51.038	52.868	53.625	51.935
39.2	35.622	36.453	40.543	43.639	51.236	53.07	53.831	52.133
39.3	35.782	36.606	40.712	43.818	51.435	53.272	54.038	52.33
39.4	35.942	36.76	40.881	43.997	51.634	53.475	54.244	52.528
39.5	36.103	36.913	41.05	44.176	51.833	53.677	54.451	52.726
39.6	36.264	37.067	41.219	44.355	52.032	53.879	54.658	52.923
39.7	36.425	37.221	41.389	44.534	52.231	54.081	54.865	53.121
39.8	36.587	37.375	41.559	44.712	52.43	54.283	55.071	53.318
39.9	36.75	37.529	41.728	44.891	52.629	54.485	55.278	53.516
40	36.914	37.683	41.897	45.071	52.828	54.688	55.484	53.714
40.1	37.077	37.838	42.067	45.25	53.027	54.89	55.69	53.911
40.2	37.24	37.992	42.236	45.429	53.225	55.092	55.897	54.109
40.3	37.403	38.147	42.406	45.609	53.424	55.295	56.103	54.307
40.4	37.566	38.302	42.575	45.789	53.623	55.497	56.31	54.505
40.5	37.729	38.457	42.745	45.968	53.822	55.7	56.516	54.703
40.6	37.892	38.613	42.914	46.148	54.021	55.902	56.723	54.901
40.7	38.055	38.769	43.083	46.329	54.219	56.105	56.93	55.099
40.8	38.218	38.925	43.252	46.508	54.418	56.307	57.137	55.297
40.9	38.381	39.081	43.422	46.687	54.616	56.51	57.343	55.495
41	38.544	39.237	43.592	46.866	54.816	56.712	57.55	55.693
41.1	38.707	39.393	43.762	47.045	55.015	56.915	57.757	55.891
41.2	38.87	39.548	43.932	47.224	55.214	57.118	57.964	56.089
41.3	39.033	39.704	44.102	47.403	55.413	57.321	58.17	56.288
41.4	39.195	39.861	44.272	47.582	55.612	57.523	58.377	56.486
41.5	39.358	40.017	44.442	47.761	55.811	57.726	58.583	56.685
41.6	39.521	40.174	44.613	47.94	56.01	57.929	58.79	56.884
41.7	39.684	40.33	44.783	48.119		58.132	58.997	57.083
41.8	39.847	40.487	44.953	48.297		58.334	59.203	57.282
41.9	40.01	40.644	45.124	48.477		58.537	59.41	57.481
42	40.174	40.802	45.294	48.657		58.74	59.617	57.68
42.1	40.337	40.959	45.465	48.837		58.943	59.823	57.879
42.2	40.501	41.117	45.636	49.018		59.145	60.03	58.078
42.3	40.664	41.274	45.806	49.199		59.348	60.237	58.276
42.4	40.828	41.432	45.977	49.381		59.551	60.444	58.475
42.5	40.991	41.59	46.147	49.563		59.753	60.65	58.675
42.6	41.155	41.748	46.318	49.745		59.956	60.857	58.874
42.7	41.318	41.906	46.489	49.926		60.159	61.064	59.073
42.8	41.482	42.065	46.66	50.108		60.362	61.27	59.272
42.9	41.645	42.223	46.831	50.29		60.564	61.477	59.471

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r →	0	10	20	25	30	35	40	50
t								
43	41.808	42.382	47.001	50.471		60.767	61.684	59.67
43.1	41.971	42.54	47.172	50.653		60.969	61.89	59.869
43.2	42.134	42.699	47.344	50.835		61.172	62.096	60.069
43.3	42.298	42.858	47.517	51.017		61.374	62.303	60.268
43.4	42.461	43.017	47.688	51.199		61.577	62.51	60.468
43.5	42.624	43.176	47.86	51.381		61.78	62.716	60.667
43.6	42.786	43.334	48.031	51.563		61.983	62.923	60.866
43.7	42.949	43.493	48.203	51.745		62.185	63.129	61.065
43.8	43.112	43.653	48.374	51.928		62.387	63.337	61.264
43.9	43.275	43.812	48.545	52.11		62.59	63.543	61.464
44	43.438	43.971	48.716	52.292		62.792	63.75	61.663
44.1	43.601	44.13	48.888	52.474		62.995	63.956	61.862
44.2	43.764	44.29	49.059	52.656		63.198	64.162	62.062
44.3	43.926	44.45	49.231	52.838		63.401	64.368	62.261
44.4	44.089	44.61	49.404	53.02		63.604	64.575	62.461
44.5	44.251	44.77	49.575	53.202		63.806	64.782	62.661
44.6	44.414	44.93	49.747	53.385		64.009	64.988	62.861
44.7	44.576	45.09	49.918	53.567		64.212	65.195	63.061
44.8	44.738	45.25	50.09	53.749		64.415	65.402	63.261
44.9	44.9	45.411	50.262	53.931		64.618	65.608	63.461
45	45.062	45.571	50.434	54.113		64.821	65.814	63.662
45.1	45.224	45.732	50.606	54.295		65.024	66.02	63.862
45.2	45.386	45.893	50.778	54.477		65.227	66.226	64.062
45.3	45.547	46.054	50.95	54.659		65.43	66.433	64.262
45.4	45.709	46.215	51.123	54.841		65.633	66.64	64.462
45.5	45.87	46.376	51.296	55.024		65.836	66.846	64.662
45.6	46.031	46.537	51.468	55.206		66.039	67.053	64.863
45.7	46.191	46.699	51.64	55.388		66.242	67.259	65.063
45.8	46.352	46.86	51.812			66.445	67.466	65.263
45.9	46.513	47.022	51.985			66.648	67.672	65.464
46	46.673	47.183	52.157			66.851	67.879	65.664
46.1	46.834	47.344	52.329			67.054	68.085	65.864
46.2	46.994	47.506	52.502			67.257		66.065
46.3	47.154	47.668	52.674			67.46		66.266
46.4	47.314	47.83	52.845			67.664		66.466
46.5	47.474	47.992	53.017			67.867		66.667
46.6	47.634	48.154	53.189			68.07		66.867
46.7	47.794	48.316	53.361			68.273		67.067
46.8	47.953	48.479	53.534			68.476		67.268
46.9	48.112	48.641	53.706			68.679		67.469

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	10	20	25	30	35	40	50
t								
47	48.272	48.804	53.879			68.883		67.669
47.1	48.431	48.966	54.052			69.086		67.87
47.2	48.59	49.129	54.225			69.289		68.071
47.3	48.749	49.292	54.397			69.492		68.271
47.4	48.908	49.455	54.57			69.695		68.471
47.5	49.067	49.618	54.744			69.899		68.672
47.6	49.225	49.781	54.917			70.102		68.872
47.7	49.384	49.943	55.09			70.305		69.073
47.8	49.542	50.106	55.263			70.508		69.275
47.9	49.701	50.27	55.436			70.711		69.476
48	49.859	50.433	55.609			70.914		69.677
48.1	50.017	50.597	55.782			71.117		69.878
48.2	50.176	50.76	55.955			71.32		70.078
48.3	50.334	50.924	56.128			71.523		70.279
48.4	50.492	51.087	56.301			71.727		70.48
48.5	50.65	51.251	56.474			71.93		70.681
48.6	50.808	51.415	56.647			72.133		70.882
48.7	50.966	51.578	56.82			72.337		71.083
48.8	51.124	51.743	56.993			72.54		71.284
48.9	51.282	51.907	57.166			72.743		71.485
49	51.44	52.07	57.339			72.946		71.686
49.1	51.598	52.235	57.512			73.149		71.887
49.2	51.756	52.399	57.685			73.352		72.087
49.3	51.914	52.563	57.859			73.556		72.288
49.4	52.072	52.727	58.032			73.759		72.489
49.5	52.23	52.892	58.204			73.962		
49.6	52.388	53.056	58.377			74.165		
49.7	52.546	53.22	58.55			74.368		
49.8	52.704	53.385	58.723			74.572		
49.9	52.862	53.55	58.896			74.775		
50	53.02	53.714	59.07			74.979		
50.1	53.179	53.879	59.243			75.182		
50.2	53.337	54.044	59.417			75.385		
50.3	53.495	54.209	59.59			75.589		
50.4	53.654	54.374	59.763			75.791		
50.5	53.812	54.539	59.936			75.994		
50.6	53.971	54.704	60.109			76.197		
50.7	54.129	54.869	60.283			76.401		
50.8	54.288	55.034	60.456			76.604		
50.9	54.447	55.199	60.629			76.807		

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	10	20	25	30	35	40	50
t								
51	54.606	55.365	60.803			77.01		
51.1	54.764	55.53	60.976			77.213		
51.2	54.923	55.695	61.15			77.416		
51.3	55.082	55.861	61.323			77.62		
51.4	55.241	56.027	61.497			77.823		
51.5	55.401	56.193	61.671			78.026		
51.6	55.56	56.359	61.845			78.229		
51.7	55.72	56.525	62.019			78.433		
51.8	55.88	56.691	62.193			78.636		
51.9	56.039	56.857	62.366			78.839		
52	56.199	57.023	62.539			79.043		
52.1	56.359	57.189	62.713			79.246		
52.2	56.519	57.355	62.887			79.449		
52.3	56.679	57.521	63.06			79.653		
52.4	56.839	57.688	63.234			79.856		
52.5	56.999	57.854	63.408			80.059		
52.6	57.159	58.02	63.582			80.263		
52.7	57.319	58.187	63.756			80.466		
52.8	57.48	58.353	63.93			80.67		
52.9	57.64	58.519	64.105			80.874		
53	57.801	58.686	64.279			81.077		
53.1	57.962	58.852	64.453			81.281		
53.2	58.123	59.019	64.627			81.485		
53.3	58.284	59.185	64.801			81.688		
53.4	58.445	59.352	64.974			81.892		
53.5	58.606	59.518	65.148			82.095		
53.6	58.767	59.685				82.299		
53.7	58.928	59.851				82.503		
53.8	59.09	60.018				82.706		
53.9	59.251	60.185				82.91		
54	59.413	60.352				83.113		
54.1	59.574	60.519				83.316		
54.2	59.736	60.686				83.519		
54.3	59.898	60.853				83.723		
54.4	60.059	61.02				83.926		
54.5	60.221	61.187				84.13		
54.6	60.383	61.355				84.334		
54.7	60.545	61.522				84.538		
54.8	60.707	61.689				84.741		
54.9	60.87	61.856				84.945		

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

r →	0	10	20	25	30	35	40	50
t								
55	61.032	62.023				85.149		
55.1	61.194	62.191				85.352		
55.2	61.356	62.358				85.556		
55.3	61.518	62.525				85.76		
55.4	61.681	62.692				85.964		
55.5	61.843	62.859				86.168		
55.6	62.006	63.027				86.372		
55.7	62.168	63.195				86.576		
55.8	62.331	63.362				86.78		
55.9	62.494	63.53				86.984		
56	62.657	63.698				87.188		
56.1	62.82	63.866				87.392		
56.2	62.983	64.033				87.596		
56.3	63.146	64.201				87.8		
56.4	63.309	64.369				88.003		
56.5	63.472	64.537				88.207		
56.6	63.636	64.705				88.411		
56.7	63.799	64.874				88.615		
56.8	63.962	65.041				88.819		
56.9	64.126	65.209				89.023		
57	64.289	65.378				89.227		
57.1	64.453	65.546				89.431		
57.2	64.616	65.714				89.635		
57.3	64.78	65.883				89.839		
57.4		66.051				90.043		
57.5		66.219				90.247		
57.6		66.388				90.451		
57.7		66.556				90.656		
57.8		66.724				90.86		
57.9		66.893				91.064		
58		67.062				91.268		
58.1		67.23				91.472		
58.2		67.399				91.676		
58.3		67.568				91.88		
58.4		67.736				92.085		
58.5		67.905				92.289		
58.6		68.074				92.493		
58.7		68.243				92.697		
58.8		68.412				92.901		
58.9		68.581				93.105		

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	10	20	25	30	35	40	50
t								
59		68.75				93.309		
59.1		68.919				93.513		
59.2		69.088				93.718		
59.3		69.257				93.922		
59.4		69.426				94.126		
59.5		69.595				94.33		
59.6		69.764				94.534		
59.7		69.933				94.738		
59.8		70.103				94.943		
59.9		70.272				95.147		
60		70.442				95.351		
60.1		70.611				95.555		
60.2		70.78				95.759		
60.3		70.95				95.963		
60.4		71.119				96.167		
60.5		71.289				96.371		
60.6		71.458				96.576		
60.7		71.628				96.78		
60.8		71.798				96.984		
60.9		71.968				97.187		
61		72.137				97.391		
61.1		72.307				97.595		
61.2		72.477				97.798		
61.3		72.647				98.002		
61.4		72.817				98.206		
61.5		72.987				98.41		
61.6		73.157				98.613		
61.7		73.327				98.816		
61.8		73.498				99.02		
61.9		73.668				99.224		
62		73.837				99.427		
62.1		74.007				99.63		
62.2		74.177				99.833		
62.3		74.348				100.03		
62.4		74.518						
62.5		74.688						
62.6		74.859						
62.7		75.029						
62.8		75.199						
62.9		75.369						

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	10	20	25	30	35	40	50
t								
63		75.539						
63.1		75.708						
63.2		75.878						
63.3		76.048						
63.4		76.218						
63.5		76.389						
63.6		76.559						
63.7		76.729						
63.8		76.899						
63.9		77.07						
64		77.241						
64.1		77.411						
64.2		77.582						
64.3		77.754						
64.4		77.925						
64.5		78.096						
64.6		78.267						
64.7		78.438						
64.9		78.782						

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 PT3

First column: time in microseconds following detonator circuit current start

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

tpressure	PT3 Point 00	11.6	53.5651
8	0.0000	11.7	57.6239
8.1	0.0000	11.8	59.8512
8.2	0.0000	11.9	62.5549
8.3	0.0000	12	63.2160
8.4	0.0000	12.1	48.8632
8.5	0.0000	12.2	38.7985
8.6	0.0948	12.3	42.6620
8.7	0.1887	12.4	46.1274
8.8	0.3746	12.5	48.8581
8.9	0.5413	12.6	51.0197
9	0.6766	12.7	52.2128
9.1	0.8294	12.8	50.9327
9.2	0.8402	12.9	46.7115
9.3	0.7291	13	39.7874
9.4	0.6729	13.1	32.5940
9.5	0.6054	13.2	26.7093
9.6	0.5231	13.3	20.5698
9.7	0.4510	13.4	14.6076
9.8	0.3931	13.5	10.7838
9.9	0.3463	13.6	9.5021
10	0.3247	13.7	10.5721
10.1	0.3428	13.8	14.8070
10.2	0.4033	13.9	22.6770
10.3	0.4942	14	31.6906
10.4	0.6084	14.1	38.0748
10.5	0.7464	14.2	41.4474
10.6	0.9360	14.3	44.0256
10.7	4.5040	14.4	46.7099
10.8	9.3152	14.5	49.1823
10.9	15.9007	14.6	51.7304
11	35.1994	14.7	54.7691
11.1	49.3788	14.8	55.5628
11.2	49.3536	14.9	52.1097
11.3	48.8566	15	45.3128
11.4	49.0838	15.1	39.0686
11.5	50.8139	15.2	37.5816

15.3	39.1276	20.2	1.2287
15.4	42.8445	20.3	2.1379
15.5	50.6384	20.4	2.6401
15.6	59.4620	20.5	2.6955
15.7	64.6114	20.6	2.3212
15.8	63.0167	20.7	2.1634
15.9	57.0336	20.8	2.5315
16	51.3832	20.9	2.8693
16.1	46.5648	21	2.8533
16.2	41.0144	21.1	2.5973
16.3	33.4496	21.2	2.0362
16.4	25.7572	21.3	1.1799
16.5	17.6122	21.4	0.1492
16.6	6.5935	21.5	-0.8184
16.7	-5.0612	21.6	-1.6137
16.8	-14.3383	21.7	-2.3204
16.9	-20.3494	21.8	-2.9722
17	-23.1223	21.9	-3.6020
17.1	-24.2166	22	-4.1104
17.2	-24.1140	22.1	-4.4866
17.3	-22.4983	22.2	-4.6287
17.4	-19.8601	22.3	-4.4603
17.5	-16.2749	22.4	-4.1491
17.6	-12.2567	22.5	-3.6441
17.7	-8.5850	22.6	-3.1247
17.8	-4.9836	22.7	-2.7620
17.9	-1.6149	22.8	-2.4806
18	1.7914	22.9	-2.2775
18.1	4.7316	23	-2.0835
18.2	6.2403	23.1	-2.0758
18.3	6.3479	23.2	-1.9292
18.4	5.7247	23.3	-1.6423
18.5	5.4406	23.4	-1.6196
18.6	5.0089	23.5	-1.8728
18.7	4.0399	23.6	-2.2287
18.8	2.6090	23.7	-2.7048
18.9	0.5832	23.8	-3.0789
19	-1.5524	23.9	-3.2389
19.1	-3.1647	24	-3.5340
19.2	-3.7523	24.1	-4.1064
19.3	-3.5163	24.2	-4.5141
19.4	-2.7103	24.3	-4.5578
19.5	-1.9063	24.4	-4.7005
19.6	-1.8118	24.5	-4.7966
19.7	-2.3437	24.6	-4.4832
19.8	-2.7300	24.7	-3.9657
19.9	-2.3424	24.8	-3.4583
20	-1.3664	24.9	-3.1465
20.1	-0.0659	25	-2.9147

25.1	-2.6146	30	1.3121
25.2	-2.1792	30.1	1.5209
25.3	-1.7183	30.2	1.6908
25.4	-1.7739	30.3	1.7783
25.5	-1.9468	30.4	1.6709
25.6	-1.8368	30.5	1.5592
25.7	-1.6479	30.6	1.5120
25.8	-1.6147	30.7	1.3240
25.9	-1.8391	30.8	0.9035
26	-2.0914	30.9	0.4939
26.1	-2.3561	31	-0.0263
26.2	-2.4893	31.1	-0.5016
26.3	-2.4904	31.2	-0.5615
26.4	-2.6446	31.3	-0.7529
26.5	-2.6869	31.4	-1.1438
26.6	-2.5562	31.5	-1.4501
26.7	-2.5463	31.6	-1.7740
26.8	-2.6358	31.7	-2.0815
26.9	-2.6568	31.8	-2.2368
27	-2.3512	31.9	-2.1324
27.1	-1.8377	32	-1.9753
27.2	-1.3829	32.1	-1.6072
27.3	-1.0062	32.2	-1.2783
27.4	-0.7341	32.3	-1.3946
27.5	-0.4610	32.4	-1.3937
27.6	-0.2334	32.5	-1.1607
27.7	-0.1085	32.6	-0.8700
27.8	0.0118	32.7	-0.5681
27.9	0.1974	32.8	-0.2564
28	0.2533	32.9	0.0914
28.1	0.1701	33	0.4364
28.2	0.0590	33.1	0.7285
28.3	-0.0649	33.2	0.9831
28.4	-0.2026	33.3	1.2527
28.5	-0.3191	33.4	1.4760
28.6	-0.4070	33.5	1.6132
28.7	-0.5422	33.6	1.6658
28.8	-0.6716	33.7	1.6740
28.9	-0.7690	33.8	1.6989
29	-0.9312	33.9	1.6410
29.1	-1.0013	34	1.4505
29.2	-0.8887	34.1	1.2578
29.3	-0.6920	34.2	1.0288
29.4	-0.4140	34.3	0.9131
29.5	-0.1082	34.4	0.8074
29.6	0.1978	34.5	0.5423
29.7	0.5247	34.6	0.3960
29.8	0.8980	34.7	0.4369
29.9	1.1353	34.8	1.4824

34.9	11.3755	39.8	4.2772
35	27.6391	39.9	3.8883
35.1	34.9120	40	3.3501
35.2	31.4810	40.1	3.0564
35.3	25.9547	40.2	2.5180
35.4	22.5712	40.3	1.3147
35.5	20.7486	40.4	0.0568
35.6	19.8971	40.5	-0.6830
35.7	19.7329	40.6	-0.7338
35.8	20.3718	40.7	-0.3968
35.9	19.9504	40.8	-0.3091
36	10.3718	40.9	-0.3764
36.1	-4.9968	41	-0.4064
36.2	-11.3178	41.1	-0.3559
36.3	-7.1445	41.2	-0.1998
36.4	-0.7654	41.3	0.3502
36.5	3.0774	41.4	0.9156
36.6	5.2109	41.5	1.0674
36.7	6.8169	41.6	0.9476
36.8	7.8942	41.7	0.8010
36.9	7.8148	41.8	1.0855
37	8.4477	41.9	1.2668
37.1	11.0683	42	1.1755
37.2	13.9325	42.1	1.0499
37.3	15.4089	42.2	0.6956
37.4	14.6703	42.3	0.2955
37.5	13.0836	42.4	-0.2213
37.6	11.8645	42.5	-0.5708
37.7	11.8925	42.6	-0.5584
37.8	12.2527	42.7	-0.5255
37.9	12.0590	42.8	-0.5377
38	12.7363	42.9	-0.8870
38.1	11.5149	43	-1.0415
38.2	8.1375	43.1	-0.9224
38.3	4.7441	43.2	-0.9238
38.4	2.4535	43.3	-0.7188
38.5	2.8856	43.4	-0.4808
38.6	3.9857	43.5	-0.5173
38.7	4.8110	43.6	-0.6858
38.8	4.8767	43.7	-0.8039
38.9	4.5035	43.8	-0.8370
39	4.1850	43.9	-0.8362
39.1	3.2434	44	-0.8403
39.2	4.0983	44.1	-0.9387
39.3	5.5162	44.2	-1.0734
39.4	5.7892	44.3	-1.1625
39.5	5.7574	44.4	-1.3457
39.6	4.9300	44.5	-1.5875
39.7	4.3782	44.6	-1.6249

44.7	-1.6422	49.6	0.5233
44.8	-1.8459	49.7	0.6288
44.9	-2.1295	49.8	0.7498
45	-2.4461	49.9	0.7696
45.1	-2.4816	50	0.7160
45.2	-2.2213	50.1	0.8155
45.3	-2.1013	50.2	1.1607
45.4	-2.1608	50.3	1.1495
45.5	-2.2614	50.4	0.5112
45.6	-2.3350	50.5	0.6555
45.7	-2.3333	50.6	1.2501
45.8	-2.2657	50.7	1.1542
45.9	-2.1817	50.8	1.0408
46	-2.0673	50.9	1.2822
46.1	-1.8372	51	1.5001
46.2	-1.8694	51.1	1.4762
46.3	-2.0965	51.2	1.4730
46.4	-2.1482	51.3	1.4132
46.5	-2.0279	51.4	1.4110
46.6	-1.8912	51.5	1.8020
46.7	-1.9356	51.6	1.6886
46.8	-1.9754	51.7	1.1848
46.9	-1.9105	51.8	1.3490
47	-1.9091	51.9	1.5970
47.1	-1.6364	52	1.3989
47.2	-1.5022	52.1	1.2546
47.3	-1.4850	52.2	1.3530
47.4	-1.3929	52.3	1.2462
47.5	-1.4426	52.4	1.3226
47.6	-1.4064	52.5	1.5242
47.7	-1.3892	52.6	1.7274
47.8	-1.1955	52.7	1.7264
47.9	-1.0448	52.8	1.6668
48	-1.0225	52.9	1.7051
48.1	-0.8248	53	1.5807
48.2	-0.8966	53.1	1.5148
48.3	-0.9084	53.2	1.4097
48.4	-0.7445	53.3	1.4413
48.5	-0.6592	53.4	1.5422
48.6	-0.5395	53.5	1.3476
48.7	-0.4781	53.6	1.2470
48.8	-0.3182	53.7	1.1813
48.9	-0.1401	53.8	1.1340
49	0.0033	53.9	1.1984
49.1	-0.0207	54	1.1816
49.2	0.0290	54.1	1.1487
49.3	0.3044	54.2	1.1500
49.4	0.4788	54.3	1.2230
49.5	0.5273	54.4	1.0145

54.5	0.6395
54.6	0.7253
54.7	1.0266
54.8	1.0674
54.9	1.0477
55	1.1239
55.1	1.0665
55.2	1.0974
55.3	1.2947
55.4	1.2905
55.5	1.2546
55.6	1.0199
55.7	0.8490
55.8	1.2069
55.9	1.5157
56	1.2235
56.1	0.9968
56.2	0.9334
56.3	0.6438
56.4	0.5854
56.5	0.7805
56.6	0.7202
56.7	1.0742
56.8	1.1637
56.9	0.2976
57	-0.1686
57.1	0.1303
57.2	0.1446
57.3	0.2428
57.4	0.7767
57.5	0.4614
57.6	-0.5988
57.7	0.3701

APPENDIX A – COMPUTER READABLE FILE NAMES

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

Mark M. Hart
Lawrence Livermore National Laboratory
7000 East Avenue
P.O. Box 808
Livermore, California, 94550

Telephone: 925-423-4770

Email: hart6@llnl.gov

DATA CONTENT	FILE NAME
PDV velocity data (m/s) for 2021E PT3	JackRabbitPretestVelocityPT3.xls
Position data (mm) for 2021E PT3	JackRabbitPretestPositionPT3.xls
Pressure data (kilobar) on center axis, Point 00 for all 2021E experiments	Pressure00VsTime_JR.txt
Diagnostic Plate Profile Vs Time PT3	ProfileVsTime_PT3_final.xls