NORMANNA

Containment Data Report

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March 1995

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NORMANNA Instrumentation Summary

Instrumentation	Fielded	Data Return	Present in this Report
<u>Plug Emplacement</u> ^(a)	yes	yes	yes
<u>Radiation</u>	no	-	-
<u>Pressure</u>			
Stemming	no	-	-
Challenge	no	-	-
Cavity	no	-	-
Atmospheric	no	-	-
<u>Motion</u>			
Free field	yes	yes	yes
Surface	yes	yes	yes
Plug	no	-	-
Stemming	no	-	-
Surface casing	no	-	-
Emplacement pipe	no	-	-
Recording trailer	no	-	-
<u>Hydroyield</u>	no	-	-
<u>Collapse</u>	no	-	-
<u>Stress</u> ^(b)	yes	yes	yes
<u>Strain</u>	no	-	-
<u>Other Measurements</u>	no	-	-

(a) Plug pressure, penetration and conductivity probes.

(b) Mean stress: soil pressure transducers employed.

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1. Event Description

1.1 Containment summary

NORMANNA was detonated on July 12, 1984 at 07:00 PDT. All phenomena appeared normal with a chimney collapse to the ground surface about 7 minutes later. The mean radius of the resulting crater was 54.1 m and its maximum depth was 8.8 m.

No radiation arrivals were detected above ground and containment was satisfactory.

1.2 Site

The second in a series of three similar experiments, NORMANNA was located in hole U10cb in area 10 of the Nevada Test Site (NTS) as shown in figure 1.1. The first experiment of this series (JARLSBERG) was conducted about one year earlier. Figures 1.2 and 1.3⁽¹⁾ are geologic cross sections through hole U10cb. The diameter of the emplacement hole was 2.18 m and the depth-of-burial of 203 m placed the working point in alluvium about 100 m above the Paleozoic contact and nearly 300 m above the static water level.

1.3 Instrumentation

Stemming of the emplacement hole was designed to follow the plan of figure 1.4. No post-shot measurements were taken from the emplacement hole, however, quality assurance systems consisting of plug pressure, conductivity and penetration probes, and thermistors were fielded in three of the four rigid stemming plugs. These are indicated in the containment instrumentation plan (figure 1.5). All four rigid plugs were composed of two-part-epoxy (TPE) and the top three were capped with a layer of coal-tar as a gas sealant. Strain gages, bonded to the emplacement pipe, were used to monitor the load on the pipe during emplacement and stemming. A log of the stemming procedures was maintained by Holmes & Narver⁽²⁾.

Hole Ue10aa was instrumented for JARLSBERG with both stress and motion as shown in figure 1.6. The gage stations were emplaced on a fiber glass pipe and the 0.31 m diameter hole was grouted to about 36 m of the surface with the remainder of the hole being plugged with TPE. This system was activated for the NORMANNA event.

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A lightning strike, shortly after the satellite hole instrumentation was installed for JARLSBERG, destroyed several transducers and possibly damaged others. The satellite hole motion channels that were inoperative pre-shot or malfunctioning for unknown reasons were 41ut, 47at and all of stations 42 and 43. The only mean stress (soil pressure) channels yielding post-shot information were 51 and 54. Further details on the installation and operation of the instrumentation are given in reference 3.

The array of eight vertical motion stations were placed as shown in figure 1.7 at a depth of 0.61 m in the ground surface. Station locations were dictated by the desire to measure the effects on the surface ground motion of the crater and chimney produced by JARLSBERG. "Control" stations were also fielded 0.61 m in the ground surface that was left relatively unperturbed by that shot. Two of the data channels, namely 64gv and 65uv apparently malfunctioned from an undetermined cause. Further details of the instrumentation fielding and behavior are given in reference 4.

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FIGURE 1. MAP OF THE NEVADA TEST SITE
SHOWING THE LOCATION OF NORMANNA

Figure 1.1 Map of the Nevada Test Site indicating the location of hole U10cb.

Figure 1.2 Plan view of the region near Hole U10cb with an East-West geologic cross section through the hole.

Figure 1.4 As-built stemming plan for hole U10cb.

Figure 1.6 As-built instrumentation plan for the satellite hole (Ue10aa).

Figure 1.7 Plan view of the NORMANNA surface array.

2. Emplacement

2.1 Pipe strain

There were no load (strain) measurement of the emplacement pipe during emplacement recorded.

2.2 Plug level, temperature and pressure

Both the slurry level and the curing temperature of the stemming plugs was monitored by a string of thermistors and conductivity probes placed at 5 foot vertical intervals in the planned positions of each of the five plugs. The depths of these probes are listed in figure 1.5. Three thermistors were mounted in each of the long plugs while the two short plugs were instrumented with four thermistors each. Figures 2.1 through 2.7 show the plug quality assessment measurements taken during the stemming of NORMANNA.

All plugs were emplaced as planned.

Figure 2.1. Position and temperature history of the TPE emplacement for the first rigid plug. The position of the TPE level was derived from the conductivity probes (the elevations of which are indicated by solid circles) and its temperature was monitored by a thermistor placed near the center of the plug. The solid triangle indicates the elevation of the plug boundary as measured by a tag line.

Figure 2.2. Pressure of the liquid TPE of the first rigid plug monitored by a transducer placed near the bottom of the plug.

Figure 2.3. Position and temperature history of the TPE emplacement for the second rigid plug. The position of the TPE level was derived from the conductivity probes (the elevations of which are indicated by solid circles) and its temperature was monitored by a thermistor placed near the center of the plug. The solid triangle indicates the elevation of the plug boundary as measured by a tag line.

Figure 2.4. Pressure of the liquid TPE of the second rigid plug monitored by a transducer placed near the bottom of the plug.

Figure 2.5. Position and temperature history of the TPE emplacement for the third rigid plug. The position of the TPE level was derived from the conductivity probes (the elevations of which are indicated by solid circles) and its temperature was monitored by a thermistor placed near the center of the plug. The solid triangle indicates the elevation of the plug boundary as measured by a tag line.

Figure 2.6. Pressure of the liquid TPE of the third rigid plug monitored by a transducer placed near the bottom of the plug.

Figure 2.7. Temperature history of the TPE of the fourth rigid plug as monitored by a thermistor placed near the center of the plug. There were no conductivity probes installed for this plug nor was a liquid pressure measurement made.

3. Satellite hole (Free-Field) Measurements

3.1 Motion

Wave forms of the motion recorded and derived from stations in the satellite hole are presented in figures 3.1 through 3.21. Only the horizontal-transverse accelerometer at station 47 failed to produce data. Arrival times and peak values of the first motion are included in table 3.1. Characteristics of the associated transducers are given in tables 3.2 and 3.3.

Collapse-induced motion was of too low magnitude to be meaningfully reduced and is thus not shown.

3.2 Stress (soil pressure)

Mean dynamic stress in the grout of the satellite hole was monitored using soil pressure transducers in stations 51-56. The system at station 52 was inoperative pre-shot and was disconnected to preclude interference with the other stations. All recorded data channels (including those channels which are believed to be bad) are shown in figure 3.22. Channels 53,55, and 56 all experienced permanent off-sets at detonation time, obscuring meaningful data.

Figure 3.1 Explosion-induced vertical motion at a depth of 384 m in hole Ue10aa (station 41). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.2 Explosion-induced radial-horizontal motion at a depth of 384 m in hole Ue10aa (station 41). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.3 Explosion-induced transverse-horizontal motion at a depth of 384 m in hole Ue10aa (station 41). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.4 Explosion-induced vertical motion at a depth of 304 m in hole Ue10aa (station 44). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.5 Explosion-induced radial-horizontal motion at a depth of 304 m in hole Ue10aa (station 44). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.6 Explosion-induced transverse-horizontal motion at a depth of 304 m in hole Ue10aa (station 44). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.6 Explosion-induced vertical motion at a depth of 251m in hole Ue10aa (station 45). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.7 Explosion-induced radial-horizontal motion at a depth of 251 m in hole UE10aa (station 45). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.8 Explosion-induced transverse-horizontal motion at a depth of 251 m in hole Ue10aa (station 45). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.9 Explosion-induced vertical motion at a depth of 198m in hole Ue10aa (station 46). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.10 Explosion-induced radial-horizontal motion at a depth of 198 m in hole Ue10aa (station 46). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.12 Explosion-induced transverse-horizontal motion at a depth of 198 m in hole Ue10aa (station 46). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.13 Explosion-induced vertical motion at a depth of 173 m in hole Ue10aa (station 47). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.14 Explosion-induced radial-horizontal motion at a depth of 173 m in hole Ue10aa (station 47). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.15 Explosion-induced transverse-horizontal motion at a depth of 173 m in hole Ue10aa (station 47).

Figure 3.16 Explosion-induced vertical motion at a depth of 113 m in hole Ue10aa (station 48). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.17 Explosion-induced radial-horizontal motion at a depth of 113 m in hole Ue10aa (station 48). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.18 Explosion-induced transverse-horizontal motion at a depth of 113 m in hole Ue10aa (station 48). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.19 Explosion-induced vertical motion at a depth of 56m in hole Ue10aa (station 49). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.20 Explosion-induced radial-horizontal motion at a depth of 56 m in hole Ue10aa (station 49). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.21 Explosion-induced transverse-horizontal motion at a depth of 56 m in hole Ue10aa (station 49). Traces annotated with "A" are derived from the accelerometer data.

Figure 3.22 Pressure (mean stress) measured in the grout column of the satellite hole Ue10aa. Only stations 51 and 54 are believed to have recorded stress signals.

Table 3.1.
Summary of Satellite Hole Motion Data

<u>Gage</u>	<u>Slant Range (m)</u>	<u>TOA (ms)</u>	<u>Acceleration Peak (g's)</u>	<u>Velocity Peak (m/s)</u>	<u>Displacement</u>	
					<u>Peak (m)</u>	<u>Resid. (mm)</u>
41av	323.3	196	-0.083	-0.041	-0.0033	-5
41uv	323.3	-	-	-0.036	-0.0036	-1.8
41ar	323.3	196	0.102	0.023	0.0035	-10
41ur	323.3	-	-	0.065	0.0090	3
41at	323.3	196	0.073	0.011	0.0013	(a)
41ut	323.3	-	?? (b)			
44av	284.2	144	-0.287	-0.065	-0.0056	7
44uv	284.2	-	-	-0.046	-0.0039	1.2
44ar	284.2	144	0.298	0.144	0.0168	-6
44ur	284.2	-	-	0.106	0.0126	3.6
44at	284.2	146	0.083	0.060	0.0065	(a)
44ut	284.2	-	-	0.040	0.0044	2
45av	269.2	144	-0.190	-0.054	-0.0040	(a)
45uv	269.2	-	-	-0.057	-0.0046	-2
45ar	269.2	144	0.340	0.229	0.025	16
45ur	269.2	-	-	0.244	0.027	9
45at	269.2	145	0.135	0.067	0.0059	9
45ut	269.2	-	-	0.068	0.0070	1.5
46av	265.3	142	0.067	0.020	0.019	5
46uv	265.3	-	-	0.019	0.014	2
46ar	265.3	145	0.45	0.285	0.0314	-5
46ur	265.3	-	-	0.285	0.0308	8
46at	265.3	145	0.20	0.097	0.0133	6
46ut	265.3	-	-	0.095	0.0131	5
47av	267.1	146	0.090	0.035	0.0162	5
47uv	267.1	-	-	0.033	0.0164	2
47ar	267.1	146	0.400	0.292	0.0308	6
47ur	267.1	-	-	0.275	0.0287	11
47at	267.1	-	(c)	-	-	-
47ut	267.1	-	-	0.098	0.014	8.5
48av	280.8	162	0.150	0.072	0.0179	(a)
48uv	280.8	-	-	0.060	0.0147	7.7
48ar	280.8	163	0.30	0.280	0.0334	18
48ur	280.8	-	-	0.257	0.0302	10
48at	280.8	165	0.094	0.065	0.0141	-3
48ut	280.8	-	-	0.070	0.0141	6.5
49av	303.0	185	0.200	0.108	0.0151	13
49uv	303.0	-	-	0.112	0.0157	3
49ar	303.0	186	0.268	0.275	0.0455	-1
49ur	303.0	-	-	0.257	0.417	10
49at	303.0	186	0.120	0.082	0.0235	-5
49ut	303.0	-	-	0.168	0.0208	-8

(a) data can not be determined

(b) channel malfunctioned for unknown reason

(c) channel dead pre-shot

Table 3.2
Satellite Hole Accelerometer Characteristics^(a)

<u>Gauge</u>	<u>Natural Frequency (Hz)</u>	<u>Damping Ratio</u>	<u>System Range (g's)</u>
41av	182	0.70	1.6
41ar	138	0.65	1.6
41at	175	0.70	1.6
44av	180	0.70	2
44ar	122	0.75	2
44at	158	0.85	2
45av	170	0.65	2
45ar	117	0.65	2
45at	132	0.65	2
46av	174	0.70	2
46ar	170	0.65	2
46at	145	0.70	2
47at	175	0.60	2
47ar	175	0.75	2
47at	145	0.65	2
48av	184	0.65	2
48ar	169	0.70	2
48at	145	0.75	2
49av	170	0.65	2
49ar	120	0.65	2
49at	152	0.65	2

(a) All transducers are variable reluctance accelerometers.

Table 3.3
Satellite Hole Velocimeter Characteristics

<u>Gauge</u>	<u>Natural Frequency (Hz)</u>	<u>Time to .5 ampl. (sec)</u>	<u>Calibration Temperature °C</u>	<u>Operation Temperature °C</u>	<u>System Range (m/s)</u>
41uv	3.566	8.89	23.89	24.65	1.4
41ur	3.594	9.38	24.07	24.65	1.4
41ut	3.600	9.39	24.17	24.65	1.4
44uv	3.543	8.82	25.80	22.81	2.0
44ur	3.518	9.94	22.54	22.81	2.0
44ut	3.556	9.17	24.08	22.81	2.0
45uv	3.657	8.61	25.90	20.93	2.0
45ur	3.502	9.38	24.24	20.93	2.0
45ut	3.384	9.28	24.55	20.93	2.0
46uv	3.518	9.74	26.06	18.76	2.0
46ur	3.444	9.30	24.34	18.76	2.0
46ut	3.624	9.50	22.73	18.76	2.0
47uv	3.551	9.22	25.46	17.67	2.0
47ur	3.685	9.36	22.82	17.67	2.0
47ut	3.577	9.20	23.06	17.67	2.0
48uv	3.640	8.38	25.63	15.60	2.0
48ur	3.452	8.82	24.46	15.60	2.0
48ut	3.362	9.76	22.77	15.60	2.0
49uv	3.396	10.32	25.72	14.59	2.0
49ur	3.512	9.21	22.39	14.59	2.0
49ut	3.464	9.27	22.40	14.59	2.0

4. Surface Motion

The measured and derived histories of the surface motion obtained on the event NORMANNA are displayed in figures 4.1–4.8. Each of the standard variable reluctance accelerometers (denoted "av") was accompanied by an auxillary piezoresistive accelerometer (denoted "gv"). When both an "av" and a "gv" gage were present, appeared valid, and yielded significantly different wave forms, both are presented. The wave form traces denoted by "A" are derived from the "av" gages and the "gv" gage wave forms are denoted by "B". Arrival times and peaks of the first motions are included in table 4.1. Tables 4.2 and 4.3 give the operational characteristics of the motion transducers in the surface array.

Collapse reached the surface about 7 minutes after detonation and the collapse motion is shown in figures 4.9–4.16.

Figure 4.1 Explosion-induced vertical motion of the ground surface at a horizontal range of 53.8 m and azimuthal angle of 74.0° from SGZ (station 61). Traces annotated with "A" were derived from a variable reluctance accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.2 Explosion-induced vertical motion of the ground surface at a horizontal range of 251.1 m and azimuthal angle of 177.1° from SGZ (station 62). Traces annotated with "A" were derived from a variable reluctance accelerometer while those annotated with "B" were derived from a piezoresistive accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.3 Explosion-induced vertical motion of the ground surface at a horizontal range of 169.0 m and azimuthal angle of 110.2° from SGZ (station 63). Traces annotated with "A" were derived from a variable reluctance accelerometer while those annotated with "B" were derived from a piezoresistive accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.4 Explosion-induced vertical motion of the ground surface at a horizontal range of 15.7 m and azimuthal angle of 89.7° from SGZ (station 64). Traces annotated with "A" were derived from a variable reluctance accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.5 Explosion-induced vertical motion of the ground surface at a horizontal range of 179.2m and azimuthal angle of 141.0° from SGZ (station 65). Traces annotated with "A" were derived from a variable reluctance accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.6 Explosion-induced vertical motion of the ground surface at a horizontal range of 101.5 m and azimuthal angle of 89.6° from SGZ (station 66). Traces annotated with "A" were derived from a variable reluctance accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.7 Explosion-induced vertical motion of the ground surface at a horizontal range of 110.6 m and azimuthal angle of 66.1° from SGZ (station 67). Traces annotated with "A" were derived from a variable reluctance accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.8 Explosion-induced vertical motion of the ground surface at a horizontal range of 53.3 m and azimuthal angle of 109.6° from SGZ (station 68). Traces annotated with "A" were derived from a variable reluctance accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.9 Collapse-induced vertical motion of the ground surface at a horizontal range of 53.8 m and azimuthal angle of 74.0° from SGZ (station 61). Traces annotated with "A" were derived from a variable reluctance accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.10 Collapse-induced vertical motion of the ground surface at a horizontal range of 251.1 m and azimuthal angle of 177.1° from SGZ (station 62). In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.11 Collapse-induced vertical motion of the ground surface at a horizontal range of 169.0 m and azimuthal angle of 110.2° from SGZ (station 63). In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.12 Collapse-induced vertical motion of the ground surface at a horizontal range of 15.7 m and azimuthal angle of 89.7° from SGZ (station 64). Traces annotated with "A" were derived from a variable reluctance accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.13 Collapse-induced vertical motion of the ground surface at a horizontal range of 179.2m and azimuthal angle of 141.0° from SGZ (station 65). In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.14 Collapse-induced vertical motion of the ground surface at a horizontal range of 101.5 m and azimuthal angle of 89.6° from SGZ (station 66). In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.15 Collapse-induced vertical motion of the ground surface at a horizontal range of 110.6 m and azimuthal angle of 66.1° from SGZ (station 67). In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Figure 4.16 Collapse-induced vertical motion of the ground surface at a horizontal range of 53.3 m and azimuthal angle of 109.6° from SGZ (station 68). Traces annotated with "A" were derived from a variable reluctance accelerometer. In the upper map, surface stations are indicated by circles, drill holes by squares, and the approximate size of the collapse crater from JARLSBERG is shown as a shaded region. Filled symbols show the active elements of this figure.

Table 4.1
Summary of Surface Motion Data

<u>Gauge</u>	<u>Slant Range (m).</u>	<u>Azimuth Angle(†) (degrees)</u>	<u>Acceleration</u>		<u>Velocity</u>	<u>Displacement</u>	
			<u>TOA (ms).</u>	<u>Peak (g's).</u>	<u>Peak (m/s).</u>	<u>Peak (m).</u>	<u>Resid. (mm).</u>
61av	210.0	74.0	148	0.67, 9.1(a)	0.48	0.660	-140
61gv			147	(b)	(c)	(c)	(c)
61uv			-	-	1.10	0.165	-75
62av	322.9	177.1	218	0.66	0.255	0.0268	-5
62gv			222	(b)	(c)	(c)	(c)
62uv			-	-	0.233	0.0230	-3
63av	263.9	110.2	192	0.88, 2.1(a)	0.350	0.0377	-28
63gv			195	(b)	(c)	(c)	(c)
63uv			-	-	0.410	0.0420	-10
64av	203.6	89.7	132	2.30, 9.4(a)	1.21	0.192	18
64gv			101, 143	(b,d)	(c)	(c)	(c)
64uv			-	-	1.27	0.204	-55
65av	270.8	141.0	210	0.78	0.287	0.0315	8
65gv			209	(b)	(c)	(c)	(c)
65uv(d)			-	-	0.225	0.0240	-17
66av	227.0	180.3	170	2.25, 13.2(a)	0.820	0.107	-16
66gv			171	(b)	(c)	(c)	(c)
66uv			-	-	0.830	0.106	-16
67av	263.0	66.1	211	0.40	0.182	0.011	(c)
67gv			(b)	(c)	(c)	(c)	(c)
67uv			-	-	0.150	0.0080	-9
68av	209.9	109.6	148	1.75, 6.3(a)	1.12	0.172	-53
68gv			(b)	(c)	(c)	(c)	(c)
68uv			-	-	1.14	0.175	-52

(†) Horizontal propagation angle; East = 0.0

(a) slap-down peak

(b) peaks out of band

(c) data can not be determined

(d) possible malfunction: cause undetermined

Table 4.2
Ground Surface Accelerometer Characteristics

<u>Gage</u>	<u>Natural Frequency (Hz)</u>	<u>Damping Ratio</u>	<u>System Range (G's)</u>	<u>Type*</u>
61av	346	0.65	15	vr
61gv	243	NA	0.5	pr
62av	190	0.63	2	vr
62gv	243	NA	0.5	pr
63av	260	0.57	6	vr
63gv	250	NA	0.5	pr
64av	338	0.75	20	vr
64gv	254	NA	1	pr
65av	260	0.62	8	vr
65gv	245	NA	0.5	pr
66av	309	0.75	12	vr
66gv	250	NA	0.5	pr
67av	270	.65	12	vr
67gv	245	NA	0.5	pr
68av	329	0.65	15	vr
68gv	247	NA	0.5	pr

* vr = variable reluctance; pr = piezoresistive
NA = no data available

Table 4.3
Ground Surface Velocimeter Characteristics

<u>Gage</u>	<u>Natural Frequency (Hz)</u>	<u>Time to .5 ampl. (sec)</u>	<u>Calibration Temperature ° C</u>	<u>Operation Temperature ° C</u>	<u>System Range (m/s)</u>
61uv	3.473	9.62	24.46	26.26	2.4
62uv	3.519	8.61	24.60	24.60	1.0
63uv	3.558	9.00	24.89	24.89	1.6
64uv	3.645	7.94	25.26	26.26	10.0
65uv	3.450	9.71	25.00	25.45	1.6
66uv	3.606	8.05	24.78	26.86	2.0
67uv	3.754	6.70	24.58	25.86	1.6
68uv	3.742	7.75	24.14	27.35	2.4

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