SEISMIC SIMULATION TEST PROGRAM

ON A

ESFAS AUXILIARY RELAY CABINET

FOR

ACCO, ELECTRO MECH DIVISION
ONE RESEARCH DRIVE
STRATFORD, CONNECTICUT 06497

REVISIONS

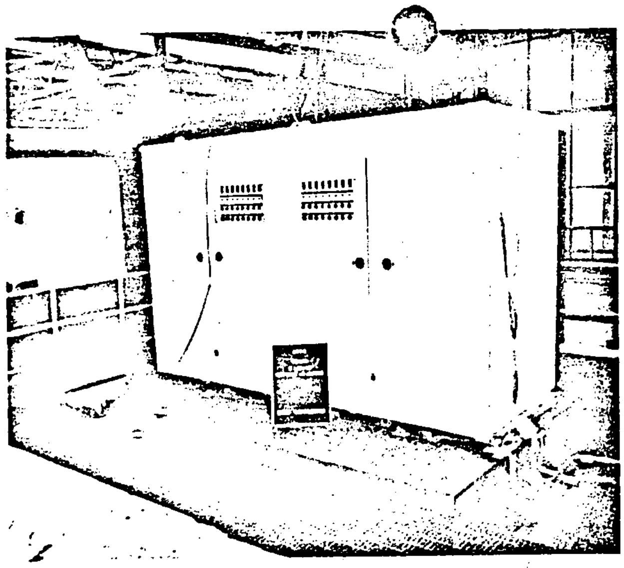
REVISION. A

REPORT NO. 42913-1

DATE: November 13, 1975

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP

REV. NO.	DATE	PAGES AFFECTED	BY	APP'L.	DESCRIPTION OF CHANGES
A	11-13-75	1	HJ		Stated that test complied with IEEE 323-1971 and IEEE 344-1975.
"	"	3, 7	HJ		Stated that surface mounting fixture was rigid and did not cause any dynamic coupling.
"	"	7	HJ		Stated the field torque requirement for the tie-down bolts.
"	"	8	GK		Add structurally and electrically to Paragraph 6.3.1
"	"	10	HJ		Stated the response time of the electrical monitoring channels
"	"	14	HJ		Change Reference 7.5 from IEEE 323-1974 to IEEE 323-1971. Delete 2.3.7 from Reference 7.7
"	"	118, 120, 132	HJ		Delete the word "reference" from Paragraphs 3.5.1, 3.5.2, and 4.2.



SEISMIC SIMULATION Test Report

REPORT NO. 42913-1, Rev. A

WYLE JOB NO. 42913

CUSTOMER P. O. NO. 8301

PAGE 1 OF 133 PAGE REPORT

DATE July 15, 1975

SPECIFICATION (S) See References in Section 7.0

1.0 CUSTOMER ACCO, Electro Mech Division

ADDRESS One Research Drive, Stratford, Connecticut 06497

2.0 TEST SPECIMEN ESFAS Auxiliary Relay Cabinet

3.0 MANUFACTURER ACCO, Electro Mech Division

4.0 SUMMARY

The ESFAS Auxiliary Relay Cabinet, hereinafter called the specimen, was subjected to a Seismic Simulation Test Program and a Temperature and Humidity Test as required by the ACCO, Electro Mech Division Purchase Order Number 8301, Wyle Laboratories' Seismic Test Plan 541/3385-2/ES, Revision A, and Environmental Test Procedures 541/3385-2E/ES for a ESFAS Auxiliary Relay Cabinet.

It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of structure or electrical function, the prescribed simulated seismic environment and the temperature and humidity test for the Arkansas Power and Light Nuclear Plant, Auxiliary Building, at the 386' floor elevation level.

Analytical justification to qualify the specimen for Forked River Unit 1 (Jersey), Waterford Unit 3 (Louisiana), and San Onofre Units 2 and 3 (Southern California Edison) is also included.

The test program complied with IEEE 323-1971 and IEEE 344-1975.

Ala. Professional Engineering License No. 7112

STATE OF ALABAMA
COUNTY OF MADISON } ss.

William W. Holbrook, being duly sworn, deposes and says: The information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

SEAL [signature]

SUBSCRIBED and sworn to before me this 23 day of July, 1975

[signature]

Notary Public in and for the County of Madison, State of Alabama.

My Commission expires June 13, 1979

TEST BY Siesmic Projects

PROJ. ENGINEER [signature] H. Jordan

WYLE Q. A. [signature] S. Bremer

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP
HUNTSVILLE, ALABAMA

4.0 SUMMARY (Continued)

Table I contains test run description.

Figures 1 through 6 show the Required Response Spectra.

Photograph 1 shows the ESFAS Auxiliary Relay Cabinet installed on the Multi-Axis Seismic Simulator in the side-to-side/vertical orientation.

Photograph 2 shows the specimen installed on the Multi-Axis Seismic Simulator in the front-to-back/vertical orientation.

Photographs 3 through 19, taken prior to test, show the accelerometer and strain gage locations. The horizontal accelerometers were oriented in the side-to-side direction during the side-to-side/vertical testing and were re-oriented in the front-to-back direction during the front-to-back/vertical testing.

Photograph 20 shows the specimen in the temperature and humidity chamber.

Photographs 21 through 24 show the thermocouple locations during the Temperature and Humidity Test.

Appendix I contains the analytical justification to qualify the ESFAS Auxiliary Relay Cabinet for Forked River Unit 1 (Jersey), Waterford Unit 3 (Louisiana), and San Onofre Units 2 and 3 (Southern California Edison).

Appendix II contains the transmissibility plots of the specimen response accelerometers from the resonant search tests.

Appendix III contains Test Response Spectra plots of the control and specimen response accelerometers from the full-level multi-frequency test in each orientation.

Appendix IV contains the environmental test data sheets and results.

Appendix V contains instrumentation log sheets and instrumentation equipment sheets.

Appendix VI contains Wyle Seismic Test Plan 541/3385-2/ES, Revision A, dated March 31, 1975, and the Wyle Environmental Test Plan 541/3385-2E/ES.

5.0 TEST REQUIREMENTS

5.1 Specimen Mounting and Orientation

The mounting hole pattern in the base of the specimen shall be transferred to the surface mounting fixture. The surface mounting fixture shall be rigid and cause no dynamic coupling over the frequency range of 1 to 40 Hz. These holes shall then be drilled in the fixture and the specimen shall be attached using twelve commercially-available 7/8" bolts. The bolts shall be torqued to 32 foot-pounds or greater. The surface mounting fixture shall be welded to the test table during the Seismic Simulation Test Program. The tests shall be conducted with the specimen in its actual gravitational orientation. The mounting shall simulate as closely as practical the actual in-service mounting. A

5.2 Resonant Search

A low-level (approximately 0.2 g horizontally and vertically) biaxial sine sweep shall be performed in both the front-to-back/vertical orientation and the side-to-side/vertical orientation. The sweep rate shall be 1 octave per minute over the frequency range of 1 to 40 Hz.

5.3 Analysis

At the completion of the low-level resonance search, the sine sweep test results (transmissibility plots) shall be evaluated by a Wyle Laboratories' analyst to determine:

> If the specimen can be qualified to the Forked River Unit 1, Waterford Unit 3, and San Onofre Units 2 and 3 Required Response Spectra (Figures 2, 3, and 4) by testing to the Arkansas Required Response Spectra (Figures 1 and 2) with a minimum Zero Period Amplitude of 1 g horizontally and 0.85 g vertically without stressing the specimen.

An analytical justification shall be provided to show, if possible, that the specimen has been qualified to the requirements specified for Forked River Unit 1 (Jersey), Waterford Unit 3 (Louisiana), and San Onofre Units 2 and 3 (Southern California Edison). The evaluation shall be performed for the vertical and horizontal axes.

If an analytical justification cannot be made, sine beat tests shall be performed only at those equipment natural frequencies where the TRS cannot envelope the RRS. The sine beat tests shall consist of five beats; each beat shall consist of ten cycles with a minimum of two seconds interval between each beat. The Zero Period Amplitude of the Southern California Edison RRS shall be used unless otherwise specified by ACCO. The tests shall be performed once for the in-phase and once for the out-of-phase conditions in each test axis.

An analysis of "welding versus bolting" shall be performed to show, if possible, that the specimen can withstand the simulated seismic environment either bolted or welded during the actual installation.

5.0 TEST REQUIREMENTS (Continued)

5.4 Multi-Frequency Tests

The specimen will be subjected to 30-second duration simultaneous horizontal and vertical inputs of random waveform motion consisting of frequencies spaced one-third octave apart over the range of 1 Hz to 50 Hz. The amplitude of each one-third octave frequency will be independently adjusted in each axis until the Test Response Spectra (TRS) envelope the Required Response Spectra (RRS) of the Arkansas Power and Light Company (Figures 1 and 2), at and above the lowest equipment natural frequency. The resulting TRS will be analyzed by a spectrum analyzer at a damping of one percent (1%) and plotted at one-third octave frequency intervals over the frequency range of interest. A minimum of five one-half-level tests, in each orientation, shall be performed prior to performing the full-level test.

5.5 Specimen Response

Eighteen specimen-mounted uni-directional piezo-electric accelerometers shall be located throughout the specimen under test. The placement of the accelerometers shall be at the discretion of the Customer Technical Representative. FM tape and oscillograph recorders shall provide a record of each accelerometer response during the test program. Transmissibility plots of the specimen accelerometers for the resonant search tests in each orientation shall be provided. Test Response Spectra (TRS) plots of the specimen accelerometers from the full-level test in each orientation at a damping of 1% shall be provided. The maximum deflection at the top of the specimen shall be determined from a full-level multi-frequency test in each orientation.

The specimen shall be instrumented with six uniaxial strain gages located at the discretion of the Customer Technical Representative. The strain gage data shall be recorded on an oscillograph recorder and the data shall be evaluated to determine the maximum stress levels of the specimen during the multi-frequency tests.

5.6 Electrical Monitoring

Twenty-five (25) channels of electrical monitoring shall be recorded on an oscillograph recorder during the Seismic Simulation Test Program. The electrical monitoring channels shall be connected as described in Paragraph 3.5.1 of the Seismic Test Plan (Appendix VI). These channels may be used to ascertain electrical continuity, current/voltage levels, spurious operation, contact chatter, etc. before, during and after the Seismic Simulation Test Program.

The specimen shall be operated as described in Paragraph 3.5.2 of the Seismic Test Plan (Appendix VI) by the ACCO Technical Representative during the full-level multi-frequency test in each orientation.

5.0 TEST REQUIREMENTS (Continued)

5.7 Environmental Test

The ESFAS Auxiliary Relay Panel shall be exposed to a Temperature and Humidity Test as described in the following paragraphs.

5.7.1 Pre-Test Setup

1. The specimen shall be placed in Wyle's large temperature and humidity chamber at ambient temperature.

2. Four thermocouples shall be installed in the specimen. The thermocouples shall be located near Relays K213, K301, K613, and K724.

3. The specimen shall be connected to the functional test bench and appropriate power supplied as directed by the ACCO Representative. The test cables shall be led into the cabinet via the top entry ports. The area around the cables shall be sealed to simulate actual operating conditions, as closely as possible.

4. The solidstate relay contacts shall be simulated by wiring the contacts of a Potter and Brumfield MDR 7034 Relay (Switch 1) as described in Paragraph 1.1.4 of the Environmental Test Procedure presented in Appendix VI.

5. Circuit Breakers 59A, 59B, 69A, 69B, 79A, 79B, 89A, 89B, and all initiation circuit breakers (CB61-68 and CB71-78) shall be closed.

6. The functional test bench shall be checked for proper operation as directed by the Acco Technical Representative.

7. After securing the specimen doors, Switch 1 on the functional test bench shall be closed and the initiation circuit breakers shall be energized by pushing the lockout reset pushbuttons associated with the individual initiation circuits. The functional test bench shall be checked for proper indication.

5.7.2 Auxiliary Relay Cabinet Operational Test

The following procedure shall be performed from the functional test bench, during the environmental test, at the intervals specified in Paragraphs 5.7.3 and 5.7.4.

1. Switch 1 shall be opened and the indicator lamps on the functional test bench shall be checked for proper operation.

2. Switch 1 shall be closed. Relay K623, K624, K625, K723, K724, and K725 shall be checked to insure that they are energized by using the test bench indicator lights.

5.0 TEST REQUIREMENTS (Continued)

5.7 Environmental Test (Continued)

5.7.2 Auxiliary Relay Cabinet Operational Test (Continued)

3. All initiation circuits shall be re-energized by pushing the lockout reset pushbuttons associated with the individual initiation circuits. The functional test bench indicator lights shall be checked for proper indication.

5.7.3 Environmental Test - Phase 1

1. The initial temperature and humidity shall be recorded and then the temperature shall be increased to 90°F at 95% relative humidity at the maximum attainable rate of the test equipment.

2. Perform the steps outlined in Paragraph 5.7.2.

3. Upon completion of Step 2 above, continue heat up from 90°F to 122°F at the maximum attainable rate of the test equipment. The test chamber moisture content shall be maintained below 95% relative humidity. Stabilize and maintain conditions for four hours.

4. Perform the steps outlined in Paragraph 5.7.2.

5.7.4 Environmental Test - Phase 2

1. The temperature shall be decreased at the maximum attainable rate of the test equipment to a temperature of 40°F while maintaining the relative humidity at a maximum of 95% for the respective temperature. Stabilize at 40°F, 95% relative humidity maximum and maintain conditions for five hours.

2. Perform the steps outlined in Paragraph 5.7.2.

3. The conditions shall be returned to ambient while insuring that excessive condensation does not occur. When ambient conditions are reached, an operational test per reference 2.2.5 (ACCO System Operational Test Procedure), Sections 5.4.2 through 5.9.2, with the exception of Sections 5.4.2.7, 5.5 and 5.6, shall be performed.

4. All test equipment shall be turned off and all closed circuit breakers in the ESFAS Auxiliary Relay Cabinet shall be opened.

6.0 TEST PROCEDURES AND RESULTS

6.1 Specimen Mounting and Orientation Procedures

The mounting hole pattern in the base of the specimen was transferred to the surface mounting fixture. The surface mounting fixture was rigid and caused no dynamic coupling over the frequency range of 1 to 40 Hz. These holes were then drilled in the fixture and the specimen was attached using twelve 7/8"-9 bolts. The bolts have mechanical properties of: A

Tensile Strength (pounds)	83,100
Tensile Strength (psi minimum)	180,000
Yield Strength (psi minimum)	155,000

The bolts were torqued to 32 foot-pounds or greater for Sine Sweep Test No. 1. The bolts were re-torqued to greater than 100 foot-pounds for the remainder of the Seismic Simulation Test Program (see Paragraph 6.2.1). The bolts should be torqued to a minimum of 100 foot-pounds during field installation. The surface mounting fixture was welded to the test table with the specimen in the side-to-side/vertical orientation as shown in Photograph 1 for the initial sequence of tests. For the second axes of test, the fixture and specimen were rotated 90 degrees in the horizontal plane to the front-to-back/vertical orientation as shown in Photograph 2. The tests were conducted with the specimen in its actual gravitational orientation. The mounting simulated as closely as practical the actual in-service mounting.

6.2 Resonant Search Procedures

A low-level (approximately 0.2 g horizontally and vertically) biaxial sine sweep was performed in both the front-to-back/vertical orientation and the side-to-side/vertical orientation. The sweep rate was 1 octave per minute over the frequency range of 1 to 40 Hz.

In addition to the biaxial sine sweep tests, single axis sine sweep tests were performed to better define the resonant frequency areas.

6.2.1 Resonant Search Results

Test run descriptions are presented in Table I.

The transmissibility plots, which showed the predominant resonant frequencies to be 9.5 Hz in the front-to-back direction, 12 Hz in the side-to-side direction, and 27.5 Hz in the vertical direction, are presented in Appendix II.

A biaxial sine sweep (Test 1) was performed in the side-to-side/vertical orientation. After evaluating the results of Test 1, it was decided to re-torque the tie-down bolts to greater than 100 foot-pounds in case the specimen was decoupling from the surface mounting fixture. A biaxial sine sweep was repeated (Test 2) with the bolts torqued to greater than 100 foot-pounds. The results (transmissibility plots) of Test 2 showed no significant difference from the results of Test 1. After re-evaluating the results of Tests 1 and 2, it was decided to perform single axis sine sweeps in order to improve the control of the test table. The results of

6.0 TEST PROCEDURES AND RESULTS (Continued)

6.2.1 Resonant Search Results (Continued)

the single axis sine sweeps (Tests 3, 4, and 15) indicated that a better control of the test table was obtained with the single axis sine sweeps. A biaxial sine sweep (Test 14) was also performed in the front-to-back/ vertical orientation. The results of Test 14 showed an improvement over Tests 1 and 2; however, a single axis front-to-back sweep (Test 15) was also performed to verify the front-to-back resonances.

6.3 Analysis Procedures

At the completion of the low-level resonance search, the sine sweep test results (transmissibility plots) were evaluated by a Wyle Laboratories' analyst to determine:

> If the specimen could be qualified to the Forked River Unit 1, Waterford Unit 3, and San Onofre Units 2 and 3 Required Response Spectra (Figures 2, 3, and 4) by testing to the Arkansas Required Response Spectra (Figures 1 and 2) with a minimum Zero Period Amplitude of 1 g horizontally and 0.85 g vertically without stressing the specimen.

An analysis of "welding versus bolting" was performed to show that the specimen can withstand the simulated seismic environment either bolted or welded during the actual installation.

6.3.1 Analysis Results

The analytical justification to show that the specimen was structurally and electrically qualified, in either the bolted or equivalent welded condition, to the requirements specified for Forked River Unit 1 (Jersey), Waterford Unit 3 (Louisiana), and San Onofre Units 2 and 3 (Southern California Edison), without overstressing the specimen, is presented in Appendix I.

6.4 Multi-Frequency Test Procedures

The specimen was subjected to 30-second duration simultaneous horizontal and vertical inputs of random waveform motion consisting of frequencies spaced one-third octave apart over the range of 1 Hz to 50 Hz. The amplitude of each one-third octave frequency was independently adjusted in each axis until the Test Response Spectra (TRS) enveloped the Required Response Spectra (RRS) of the Arkansas Power and Light Company (Figures 1 and 2), at and above the lowest equipment natural frequency, with a minimum Zero Period Amplitude of 1 g horizontally and 0.85 g vertically. The resulting TRS were analyzed by a spectrum analyzer at a damping of one percent (1%) and plotted at one-third octave frequency intervals over the frequency range of interest. A minimum of five one-half-level or greater tests, in each orientation, were performed prior to performing the full-level test.

6.0 TEST PROCEDURES AND RESULTS (Continued)

6.4 Multi-Frequency Test Procedures (Continued)

The horizontal and vertical input signals were made phase incoherent by utilizing an MRAD two-channel synthesizer. Each channel utilizes 24 potentiometers for amplitude controlling at 1/3 octave intervals over a frequency range of 0.5 Hz to 100 Hz. Each amplitude controller works in conjunction with an individual phase inversion switch. By positioning of the phase inversion switches in the horizontal and vertical control channels, the incoherent phasing was obtained.

6.4.1 Multi-Frequency Test Results

It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of structure, the prescribed simulated seismic environment.

Test run descriptions are presented in Table I.

Test Response Spectra plots of the control accelerometers, at a damping of 1%, from the full-level multi-frequency test in each orientation are presented in Appendix III.

6.5 Specimen Response Procedures

Eighteen specimen-mounted uni-directional piezo-electric accelerometers were located throughout the specimen under test as shown in Photographs 3 through 19. The placement of the accelerometers was at the discretion of the Customer Technical Representative. FM tape and oscillograph recorders provided a record of each accelerometer response during the test program.

The maximum deflection at the top of the specimen was determined from the full-level multi-frequency test in each orientation by double integrating the acceleration to obtain displacement.

The specimen was instrumented with six uniaxial strain gages located,as shown in Photographs 15 through 19, at the discretion of the Customer Technical Representative. The strain gage data were recorded on an oscillograph recorder and the data were evaluated to determine the maximum stress levels of the specimen during the multi-frequency tests.

6.5.1 Specimen Response Results

The transmissibility plots of the specimen response accelerometers from the resonant search tests are presented in Appendix II.

Test Response Spectra plots of the specimen response accelerometers from the full-level multi-frequency test in each orientation are presented in Appendix III.

6.0 TEST PROCEDURES AND RESULTS (Continued)

6.5.1 Specimen Response Results (Continued)

The maximum deflection at the top of the specimen during the full-level multi-frequency tests was as follows:

Accelerometer Location	SS/V Axes (Run 13)	FB/V Axes (Run 23)
8	2.6"	2.7"
9	2.5"	2.6"

The maximum strain of the specimen during the multi-frequency tests was as follows:

Strain Gage No.	Strain μ in./in.	
	SS/V (Test 13)	FB/V (Test 23)
1	20	45
2	50	60
3	40	50
4	65	75
5	40	60
6	30	30

6.6 Electrical Monitoring Procedures

Twenty-five (25) channels of electrical monitoring were recorded on an oscillograph recorder with a response time of 0.5 milliseconds or greater during the Seismic Simulation Test Program. The electrical monitoring channels were connected as described in Paragraph 3.5.1 of the Seismic Test Plan (Appendix VI). These channels were used to ascertain electrical continuity, spurious operation, contact chatter, etc. before, during and after the Seismic Simulation Test Program.

The following test points were monitored during the Seismic Simulation Test Program:

K301	K413	K211	S78B	K516
K312	K304	K102	K725	K816
K404	K101	S62B	K623	S62A
K402	K201	S72B	K620	S77A
K310	K105	S68B	K704	K203

The specimen was operated as described in Paragraph 3.5.2 of the Seismic Test Plan (Appendix VI) by the ACCO Technical Representative during the full-level multi-frequency test in each orientation.

6.0 TEST PROCEDURES AND RESULTS (Continued)

6.6.1 Electrical Monitoring Results

It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of electrical function, the prescribed simulated seismic environment

The electrical monitoring channels did not reveal any discontinuity, spurious operation, or contact chatter before, during and after the Seismic Simulation Test Program.

The specimen did not actuate any components during a simulated seismic event unless the proper safety actuation signal was initiated from the simulated plant protection system signal or by a manual operator action. When actuation was required, the specimen actuated all components and they remained in the actuated state until manually reset. Additionally, relays K623, K624, K625, K723, K724, and K725 were able to be automatically energized and de-energized by the simulated plant protection system via the solidstate relay during a simulated seismic event so as to insure their capability to cycle the components they actuate.

6.7 Environmental Test Procedures

The ESFAS Auxiliary Relay Panel was exposed to a temperature and humidity test as described in the following paragraphs.

6.7.1 Pre-Test Setup Procedures

1. The specimen was placed in Wyle's large temperature and humidity chamber at ambient temperature as shown in Photograph 20.

2. Four thermocouples were installed in the specimen. The thermocouples were located near Relays K213, K301, K613, and K724 as shown in Photographs 21 through 24.

3. The specimen was connected to the functional test bench and appropriate power supplied as directed by the ACCO Representative. The test cables were led into the cabinet via the top entry ports. The area around the cables was sealed to simulate actual operating conditions as closely as possible.

4. The solidstate relay contacts were simulated by wiring the contacts of a Potter and Brumfield MDR 7034 Relay (Switch 1) as described in Paragraph 1.1.4 of the Environmental Test Procedure presented in Appendix VI.

5. Circuit Breakers 59A, 59B, 69A, 69B, 79A, 79B, 89A, 89B, and all initiation circuit breakers (CB61-68 and CB71-78) were closed.

6. The functional test bench was checked for proper operation as directed by the ACCO Technical Representative.

6.0 TEST PROCEDURES AND RESULTS (Continued)

6.7.1 Pre-Test Setup Procedures (Continued)

7. After securing the specimen doors, Switch 1 on the functional test bench was closed and the initiation circuit breakers were energized by pushing the lockout reset pushbuttons associated with the individual initiation circuits. The functional test bench was checked for proper indication.

6.7.2 Auxiliary Relay Cabinet Operational Test Procedures

The following procedure was performed from the functional test bench, during the environmental test, at the intervals specified in Paragraphs 6.7.3 and 6.7.4.

1. Switch 1 was opened and the indicator lamps on the functional test bench were checked for proper operation.

2. Switch 1 was closed. Relays K623, K624, K625, K723, K724, and K725 were checked to insure that they were energized by using the test bench indicator lights.

3. All initiation circuits were re-energized by pushing the lockout reset pushbuttons associated with the individual initiation circuit. The functional test bench indicator lights were checked for proper indication.

6.7.3 Environmental Test Procedures - Phase 1

1. The initial temperature and humidity of 72°F and 64% relative humidity were recorded and then the temperature was increased to 90°F at 95% relative humidity at the maximum attainable rate of the test equipment.

2. The steps outlined in Paragraph 6.7.2 were performed.

3. Upon completion of Step 2 above, the heat up was continued from 90°F to 122°F at the maximum attainable rate of the test equipment. The test chamber moisture content was maintained at 35% relative humidity. The conditions were stabilized and maintained for four hours.

4. The steps outlined in Paragraph 6.7.2 were performed.

6.0 TEST PROCEDURES AND RESULTS (Continued)

6.7.4 Environmental Test Procedures - Phase 2

1. The temperature was decreased at the maximum attainable rate of the test equipment to a temperature of 40°F while maintaining the relative humidity at a maximum of 95% for the respective temperature. The conditions were stabilized at 40°F, 93% relative humidity, and maintained for five hours.

2. The steps outlined in Paragraph 6.7.2 were performed.

3. The conditions were returned to ambient while insuring that excessive condensation did not occur. When ambient conditions were reached, an operational test per reference 2.2.5 (ACCO System Operational Test Procedure), Sections 5.4.2 through 5.9.2, with the exception of Sections 5.4.2.7, 5.5 and 5.6, was performed.

4. All test equipment was turned off and all closed circuit breakers, in the ESFAS Auxiliary Relay Cabinet, were opened.

6.7.5 Environmental Test Results

It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of structure or electrical function, the environmental test.

The Environmental Test Data Sheets are presented in Appendix IV.

7.0 REFERENCES

7.1 The ACCO, Electro Mech Division Purchase Order Number 8301.

7.2 Wyle Laboratories' Seismic Test Plan 541/3385-2/ES, Revision A, dated March 31, 1975.

7.3 Wyle Laboratories' Environmental Test Plan 541/3385-2E/ES, dated June 20, 1975.

7.4 IEEE Standard 344-1975 Specification entitled "Recommended Practices for Seismic Qualification of Class I Electrical Equipment for Nuclear Power Generating Stations".

7.5 IEEE Standard 323-1971 Specification entitled "IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations".

7.6 Combustion Engineering General Engineering Specification 00000-ICE-3002, Revision 03.

7.7 ACCO System Operational Test Procedure.

TABLE I

TEST RUN DESCRIPTION

RUN	AXIS	TYPE TEST	LEVEL
1	SS/V	Biaxial Sine Sweep	0.2 g
2	SS/V	Biaxial Sine Sweep	0.2 g
3	SS	Single Axis Sine Sweep	0.2 g
4	V	Single Axis Sine Sweep	0.2 g
5	SS/V	RMF	< ½
6	SS/V	RMF	< ½
7	SS/V	RMF	< ½
8	SS/V	RMF	½
9	SS/V	RMF	½
10	SS/V	RMF	½
11	SS/V	RMF	½
12	SS/V	RMF	½
13	SS/V	RMF	Full
14	FB/V	Biaxial Sine Sweep	0.2 g
15	FB	Single Axis Sine Sweep	0.2 g
16	V	Single Axis Sine Sweep	0.2 g
17	FB/V	RMF	< ½
18	FB/V	RMF	½
19	FB/V	RMF	½
20	FB/V	RMF	½
21	FB/V	RMF	½
22	FB/V	RMF	½
23	FB/V	RMF	Full

LEGEND:

FB - Front-to-Back
SS - Side-to-Side
V - Vertical
RMF - Random Multi-Frequency

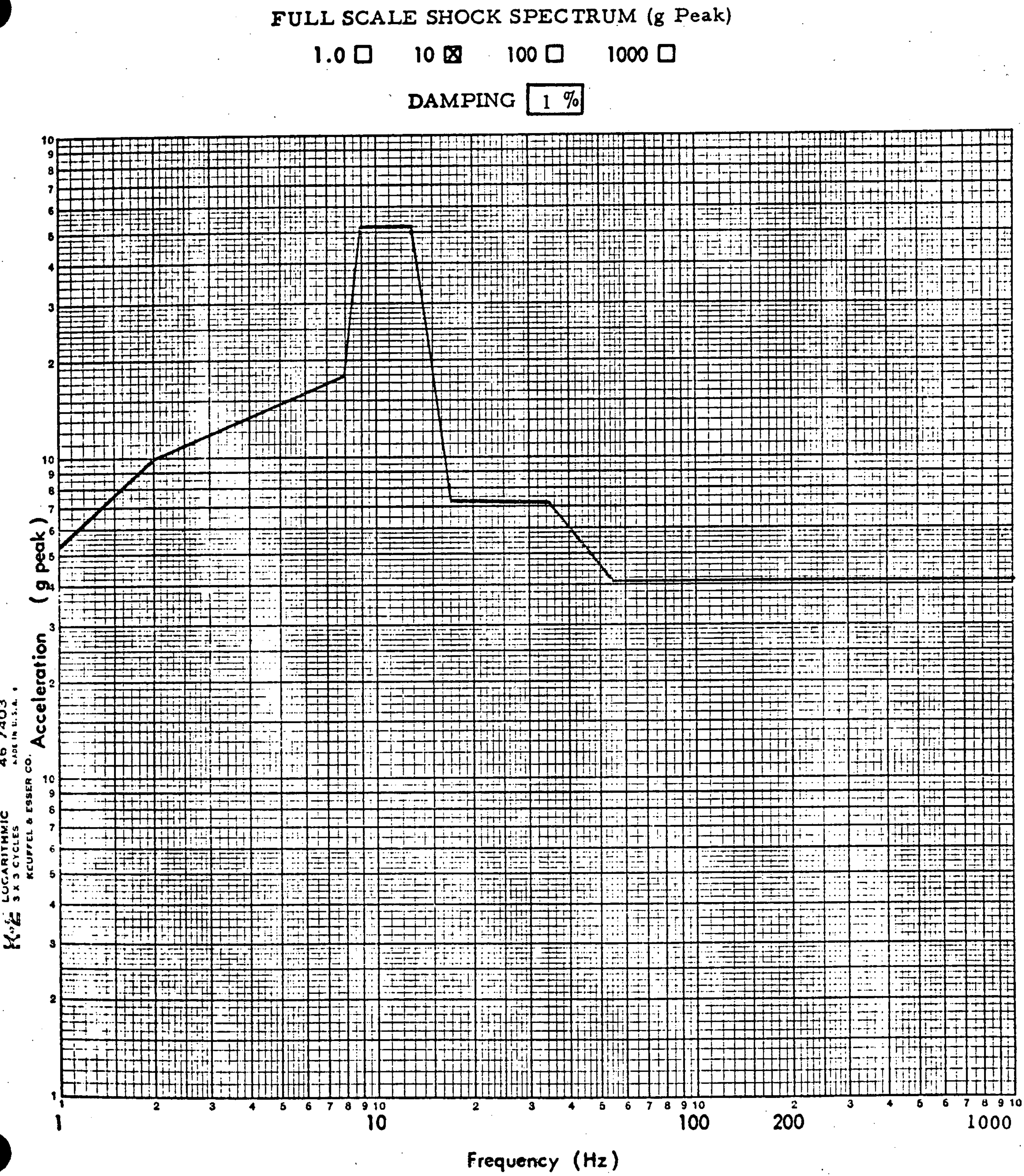


FIGURE 1

ARKANSAS POWER AND LIGHT, 386'
HORIZONTAL R R S

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☒ 100 ☐ 1000 ☐

DAMPING 1 %

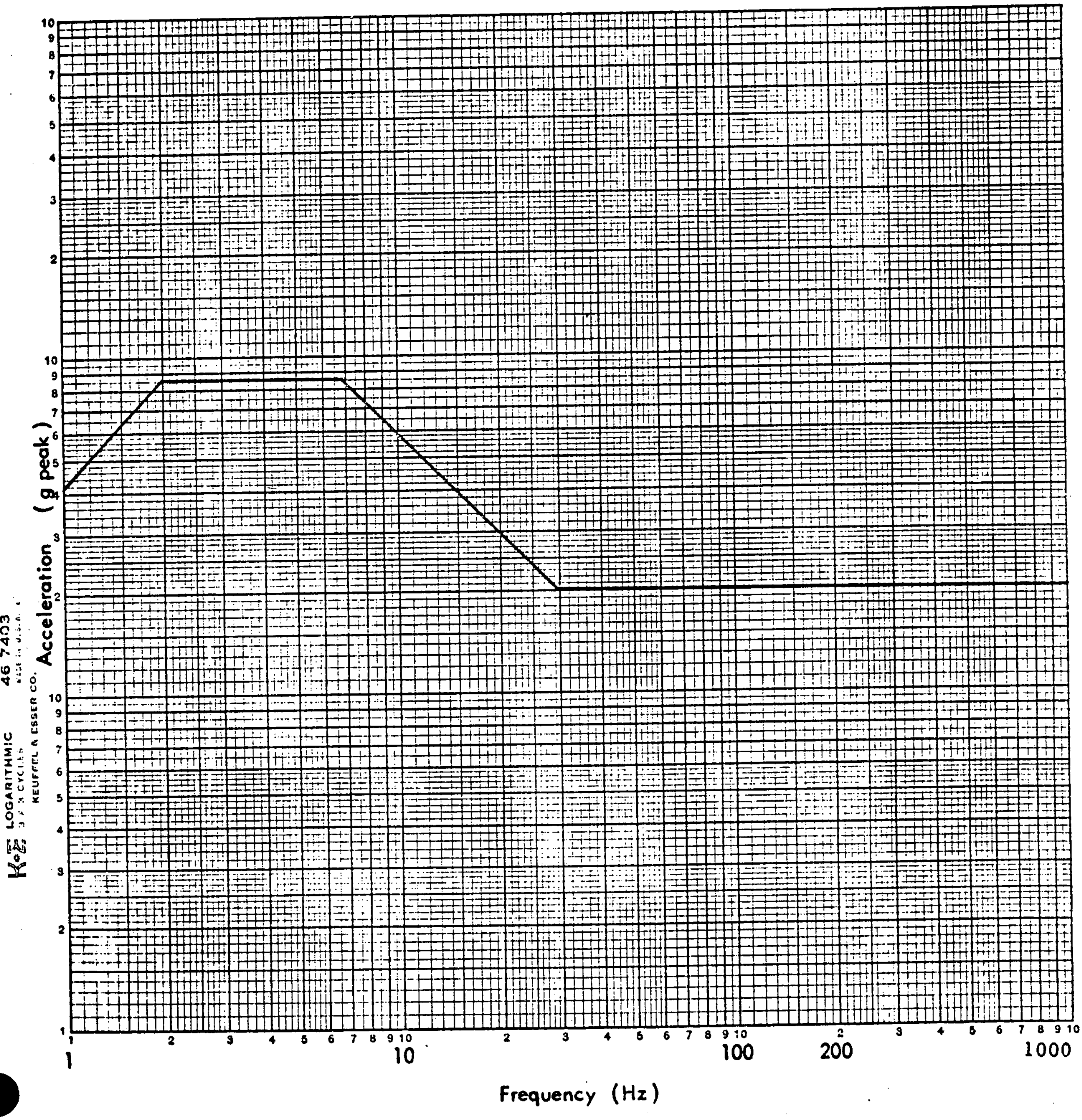


FIGURE 2

ARKANSAS POWER AND LIGHT, 386'
VERTICAL R R S

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☒ 100 ☐ 1000 ☐

DAMPING 1 %

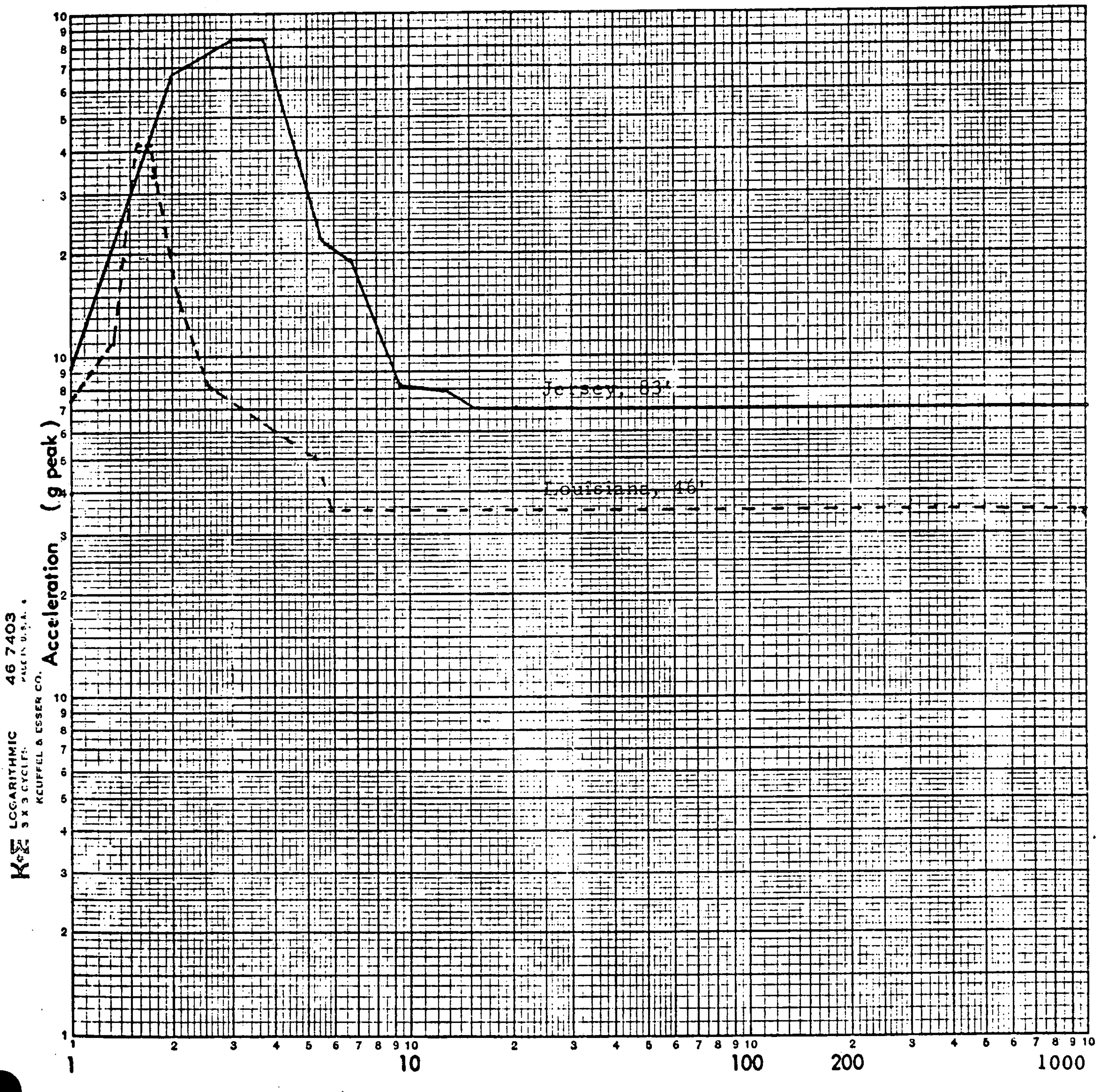


FIGURE 3

JERSEY AND LOUISIANA POWER AND LIGHT
HORIZONTAL R R S

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☒ 100 ☐ 1000 ☐

DAMPING 1 %

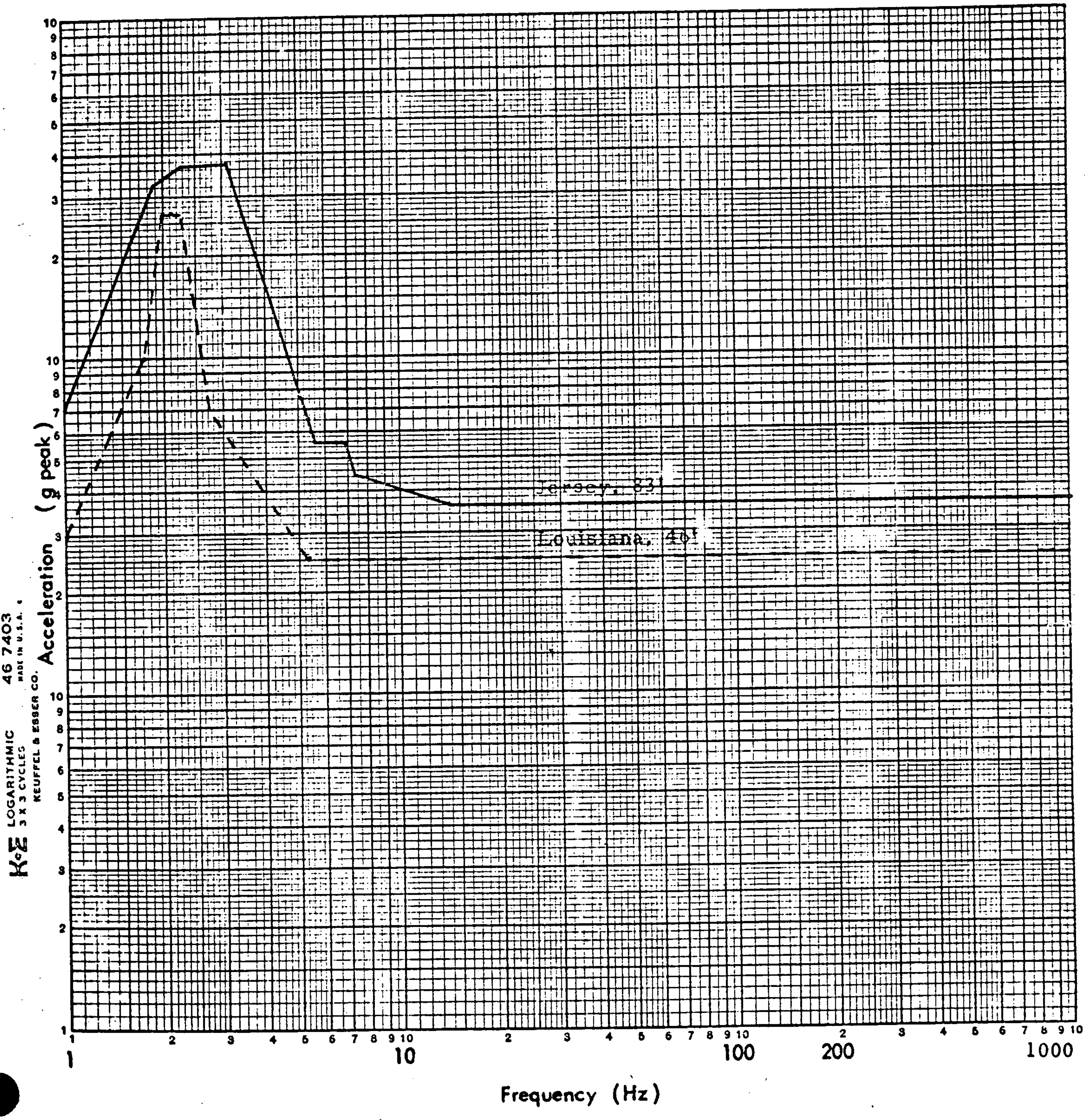


FIGURE 4

JERSEY AND LOUISIANA POWER AND LIGHT
VERTICAL R R S

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

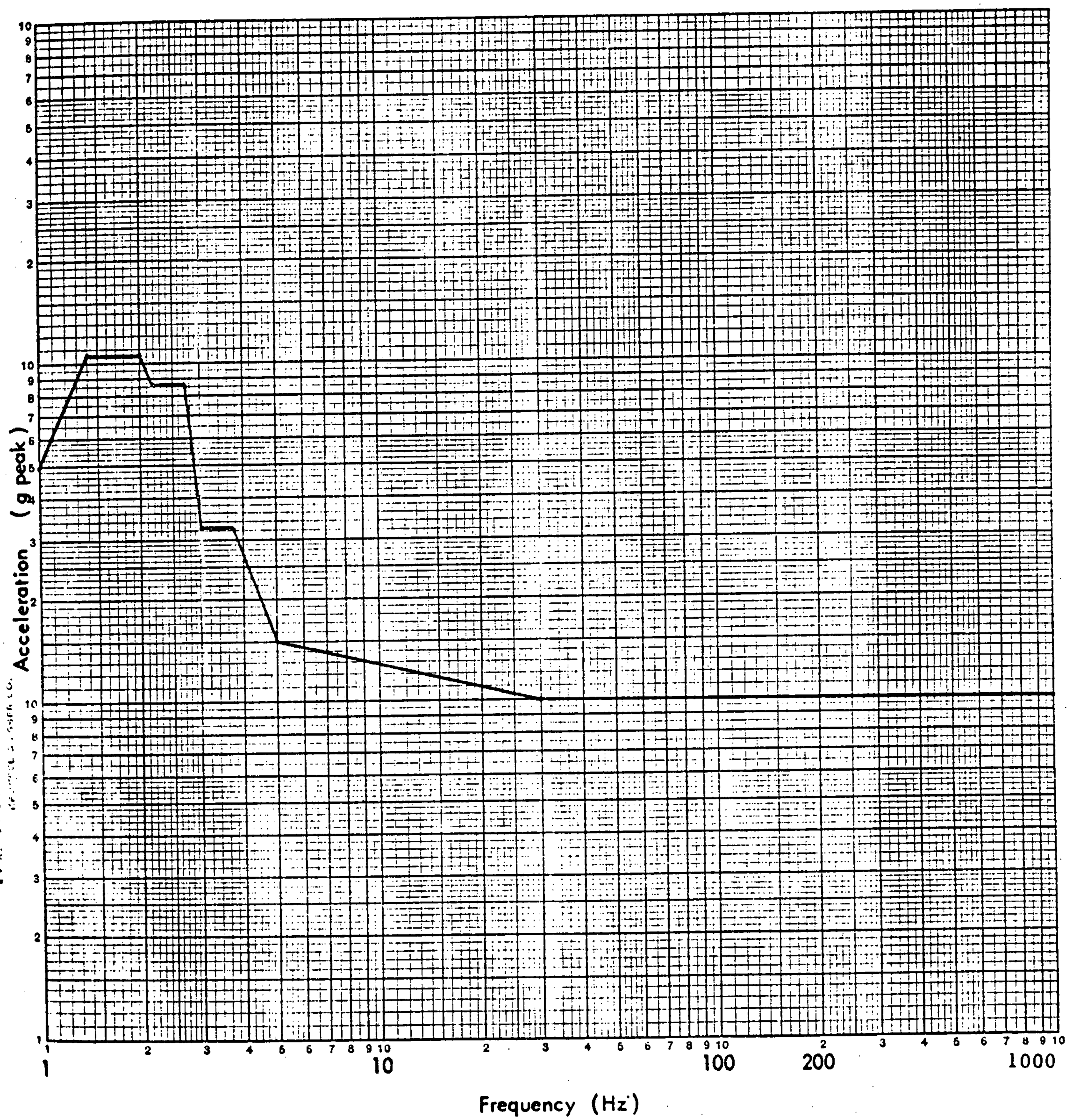


FIGURE 5

SOUTHERN CALIFORNIA EDISON, 30'
HORIZONTAL R R S

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING | 1 % |

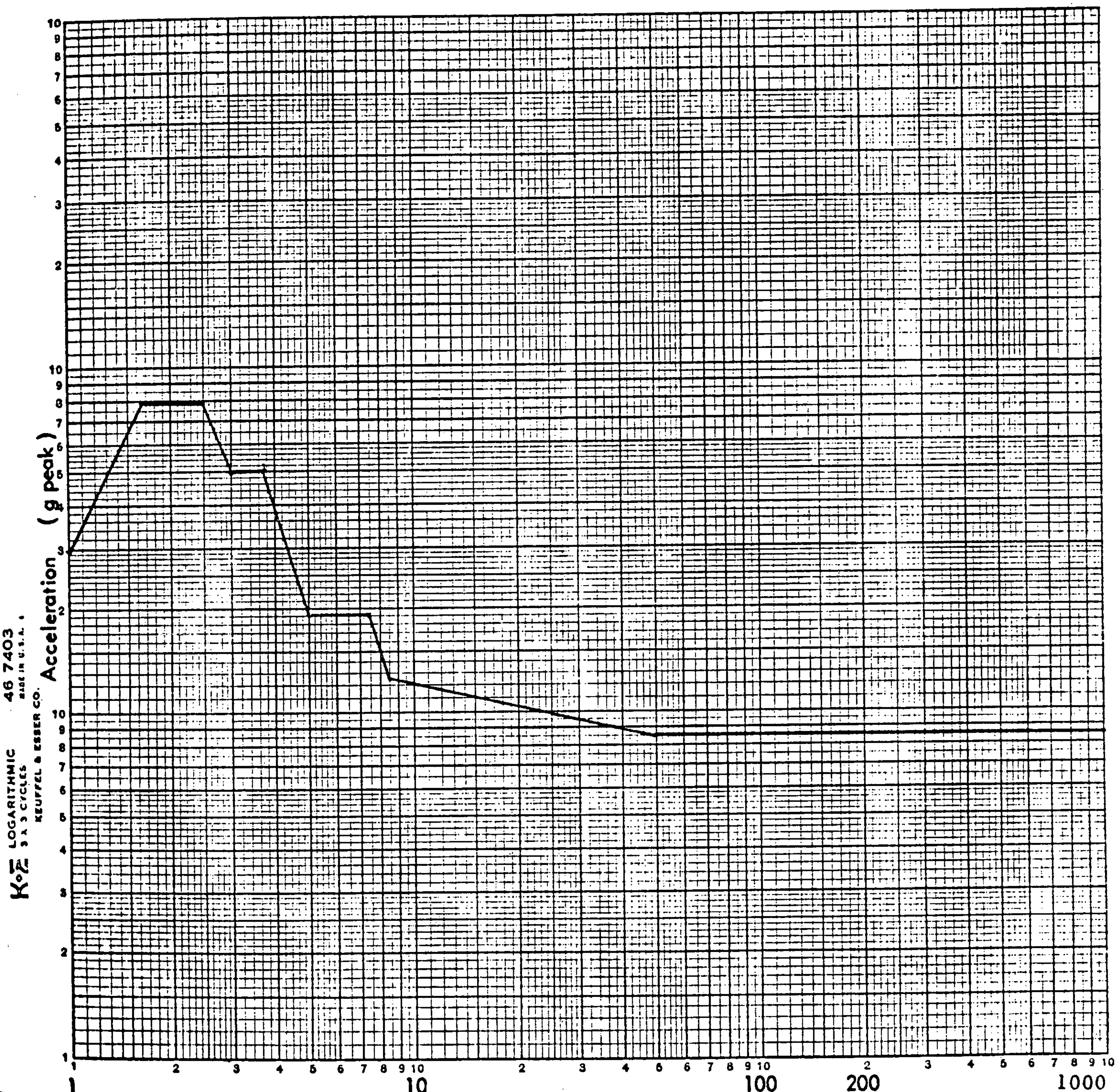
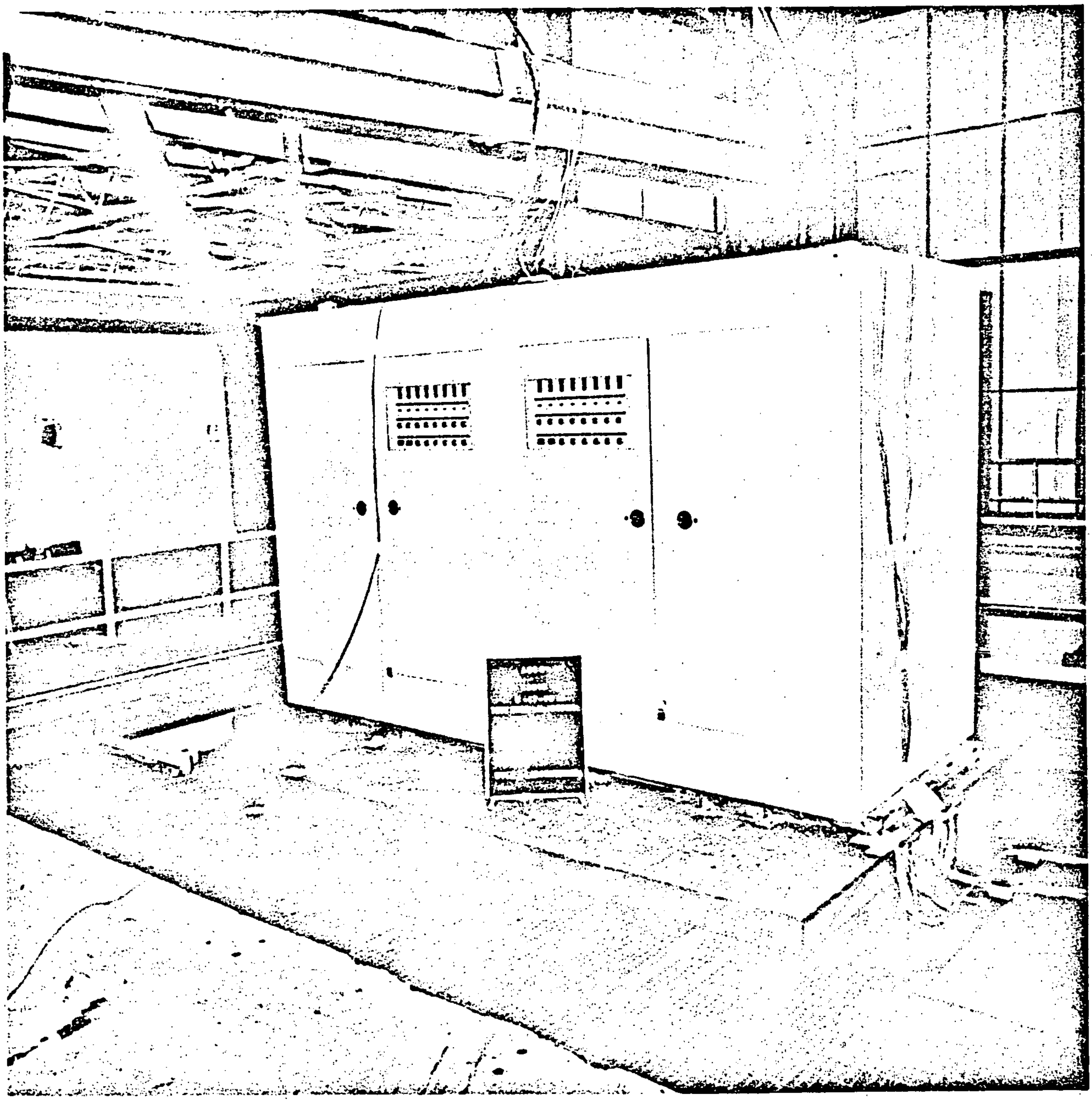


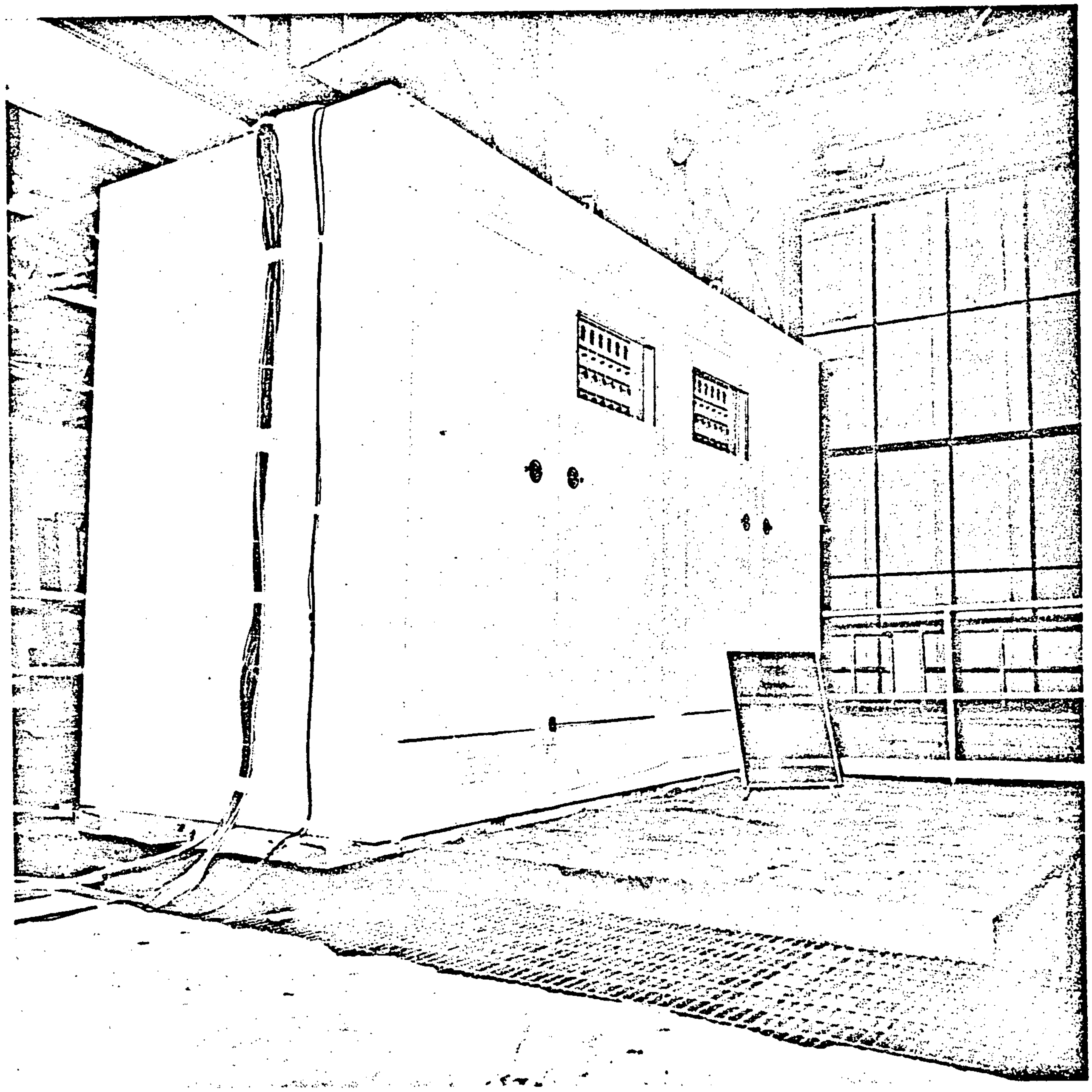
FIGURE 6

SOUTHERN CALIFORNIA EDISON, 30'
VERTICAL R R S



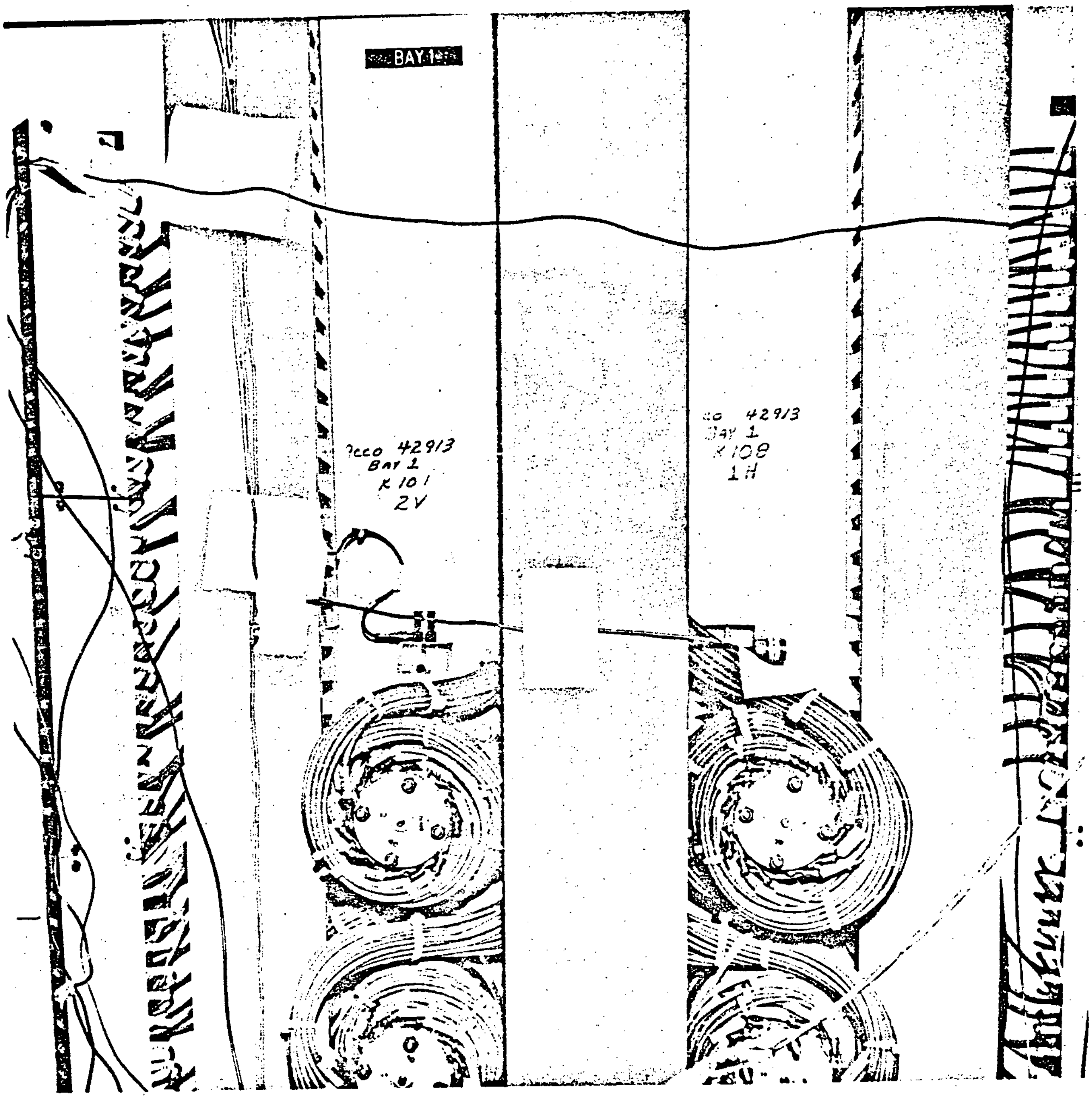
PHOTOGRAPH 1

GENERAL ARRANGEMENT OF THE ESFAS AUXILIARY RELAY CABINET
FOR
SIDE-TO-SIDE AND VERTICAL BIAXIAL TESTING
ON THE
SEISMIC SIMULATOR



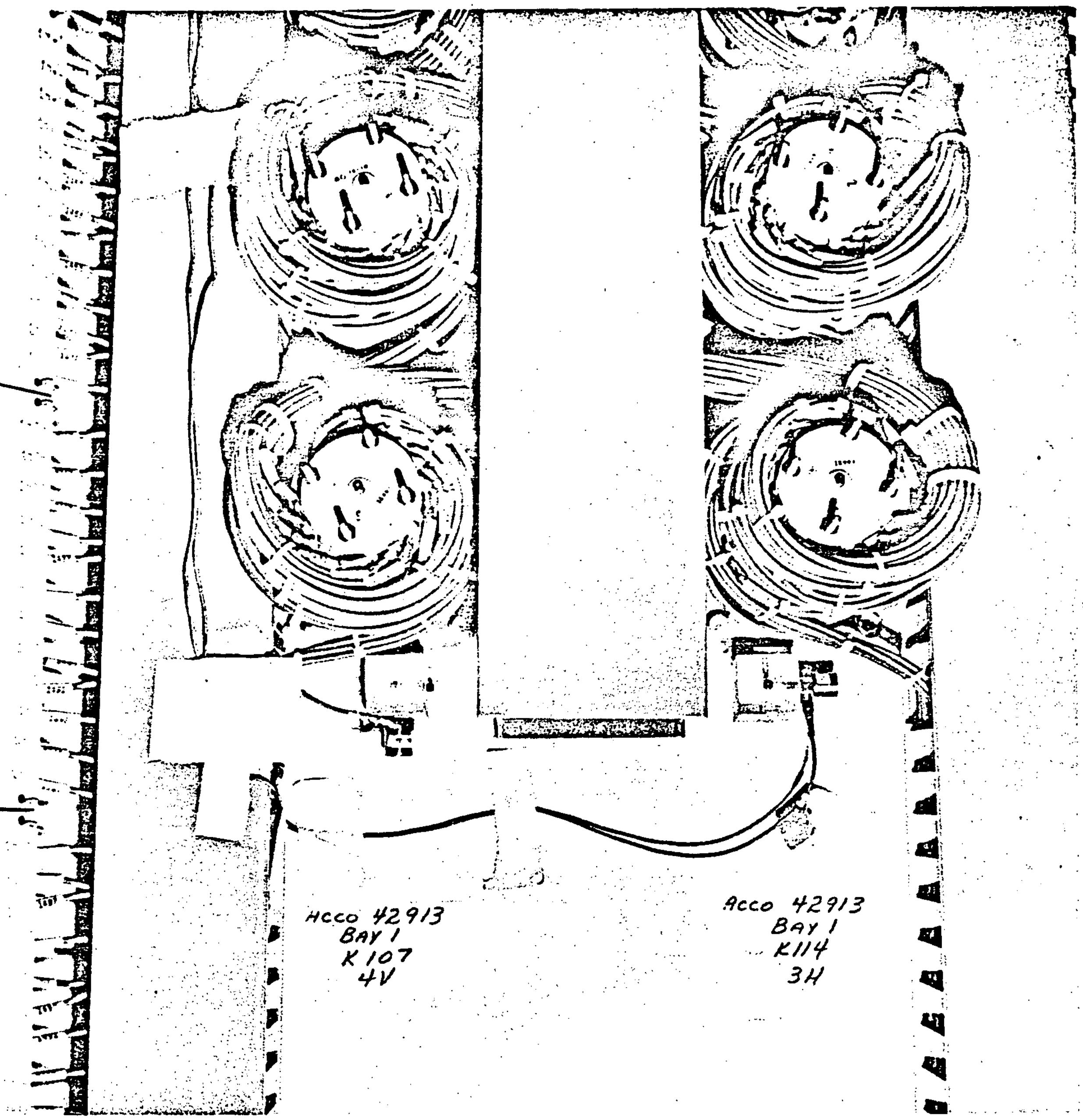
PHOTOGRAPH 2

GENERAL ARRANGEMENT OF THE SPECIMEN
FOR
FRONT-TO-BACK AND VERTICAL BIAXIAL TESTING
ON THE
SEISMIC SIMULATOR



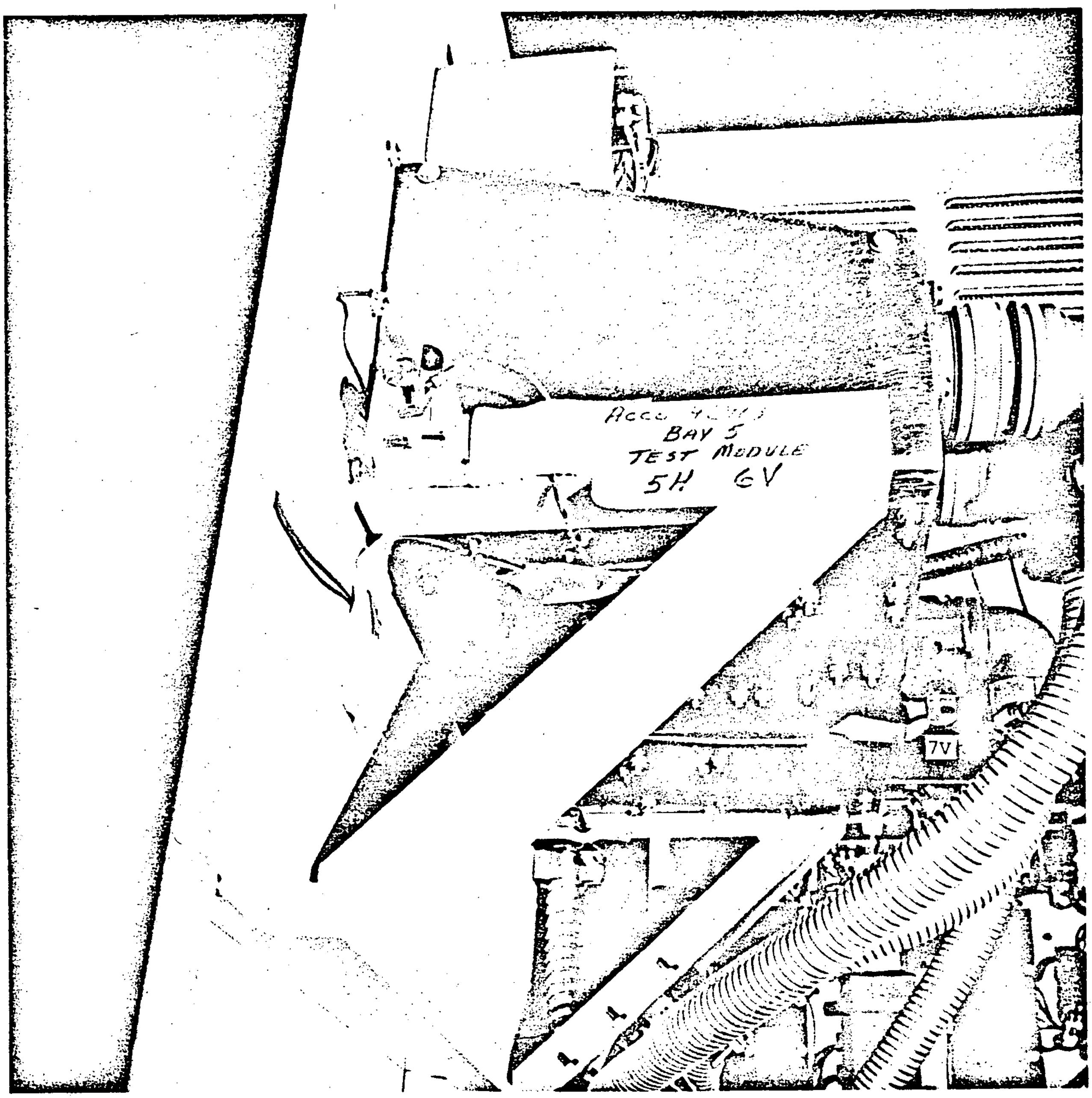
PHOTOGRAPH 3

LOCATION OF ACCELEROMETER 1H AND 2V



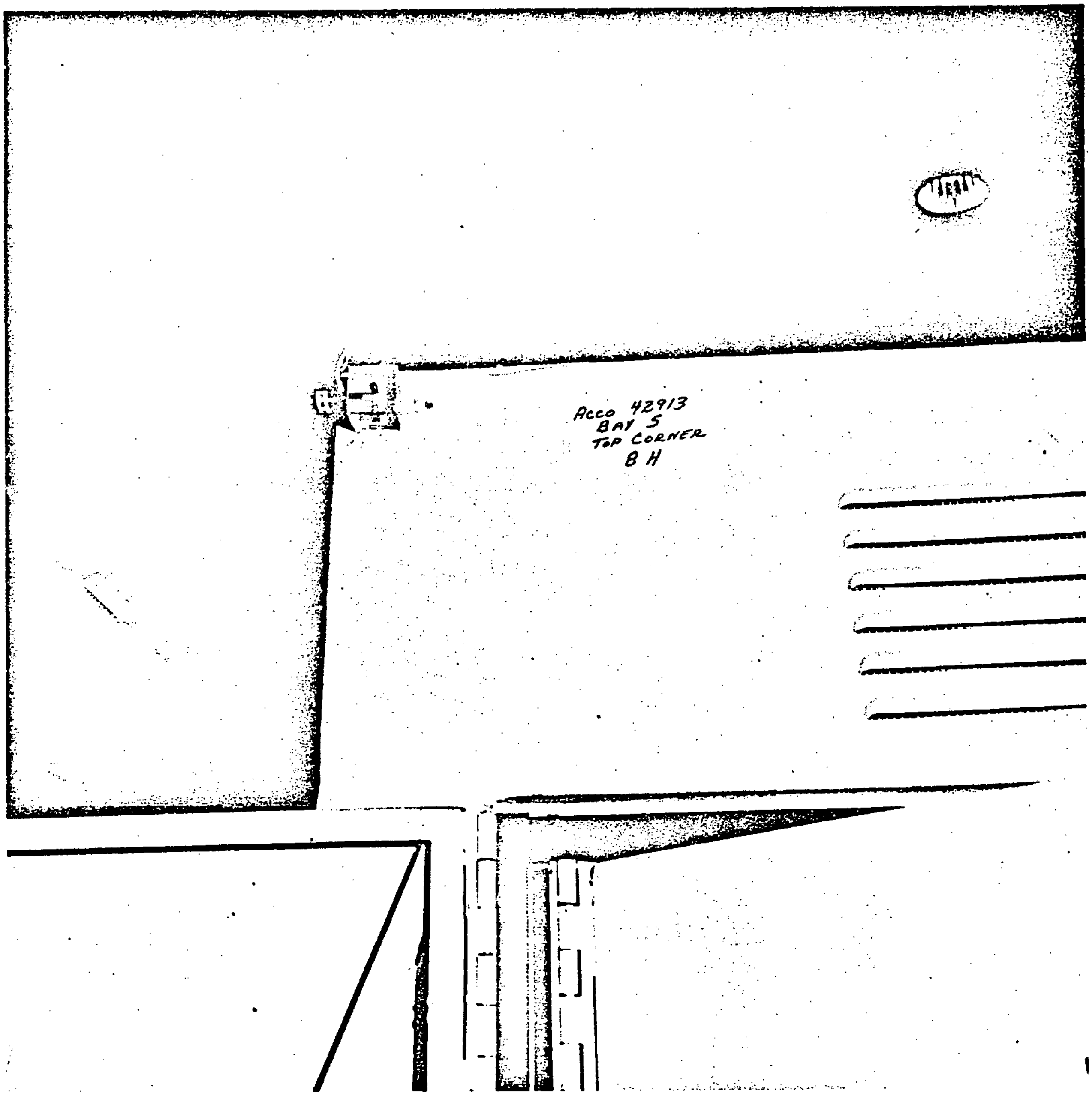
PHOTOGRAPH 4

LOCATION OF ACCELEROMETER 3H AND 4V



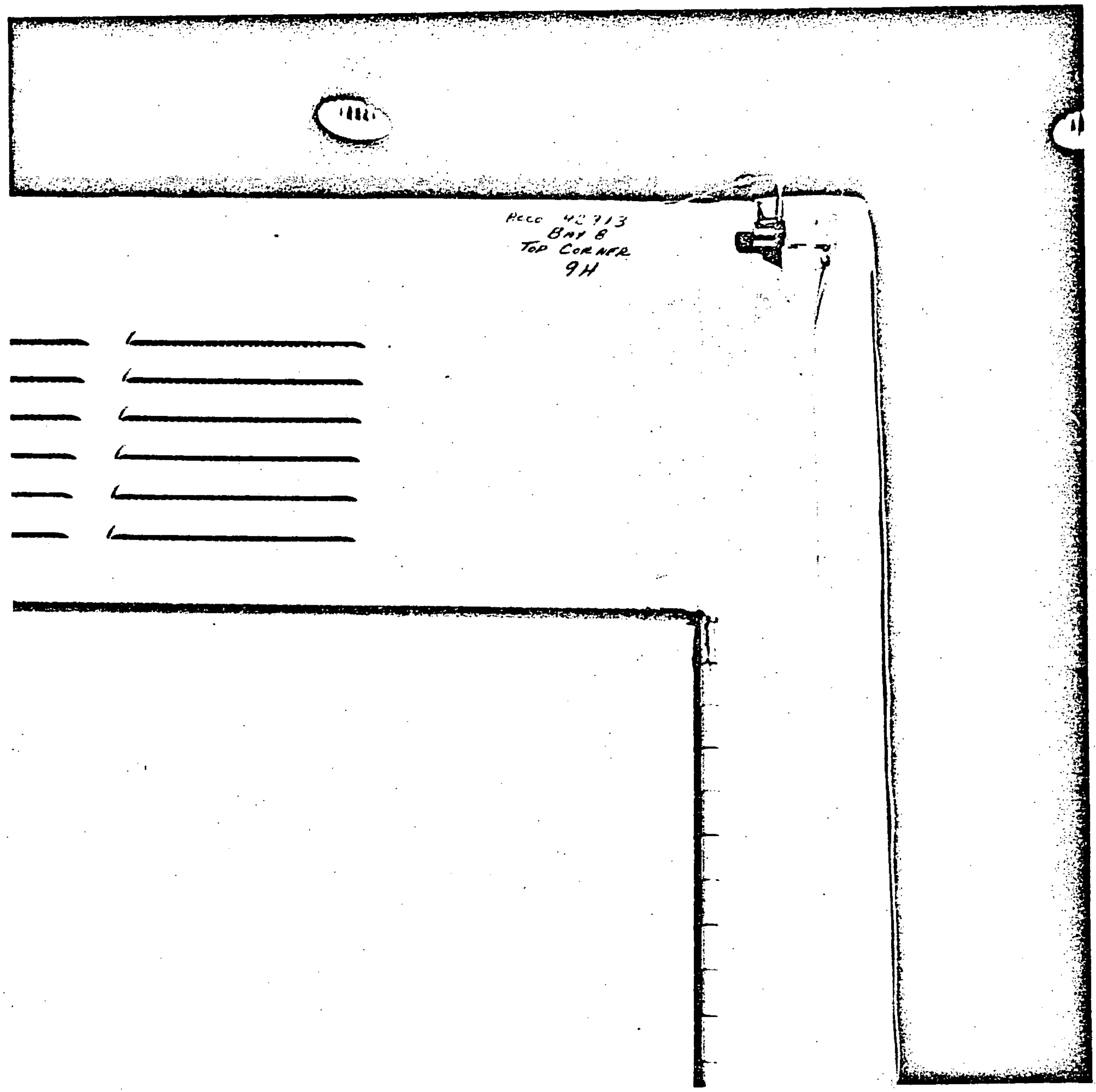
PHOTOGRAPH 5

LOCATION OF ACCELEROMETER 5H, 6V, AND 7V



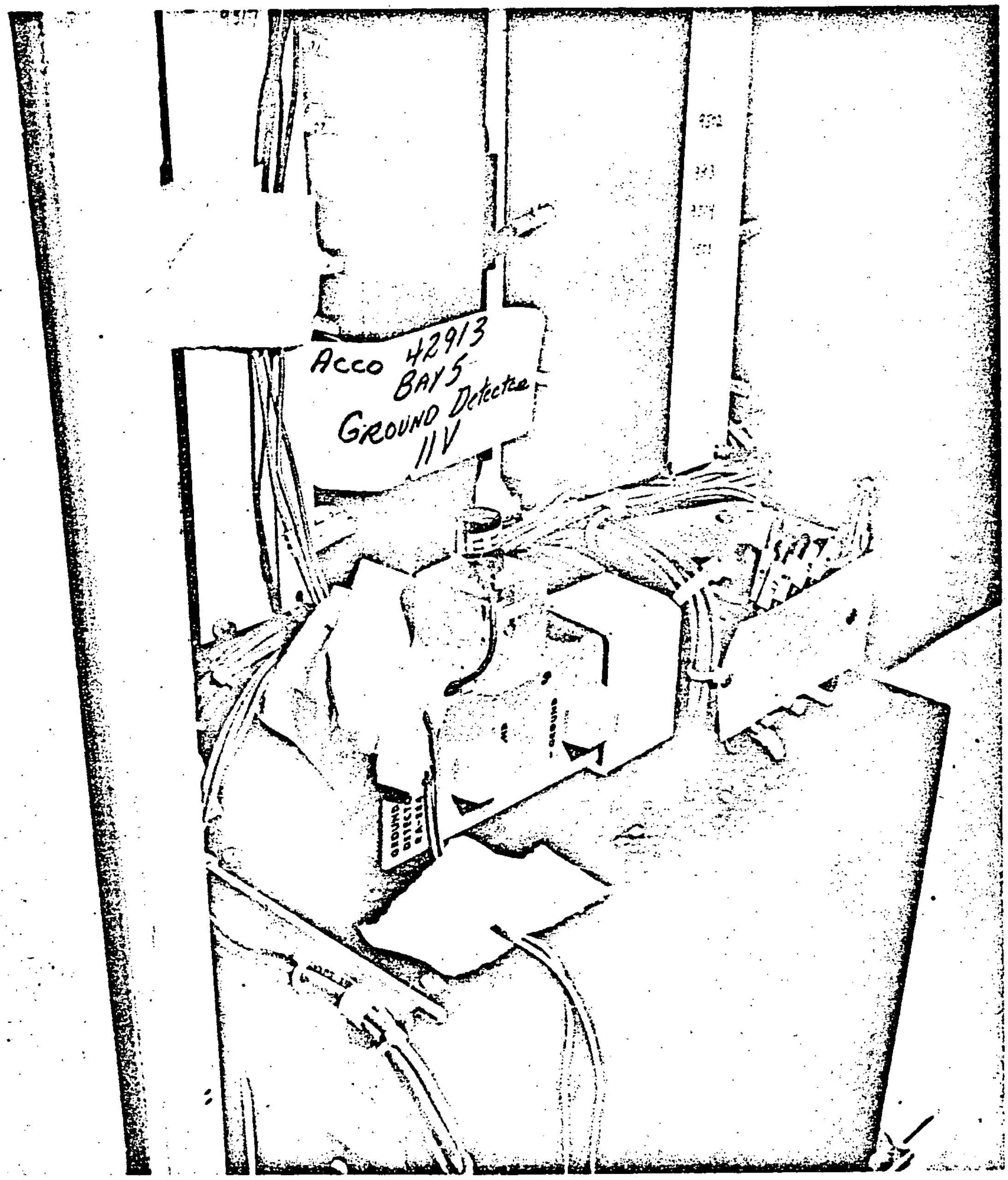
PHOTOGRAPH 6

LOCATION OF ACCELEROMETER 8H



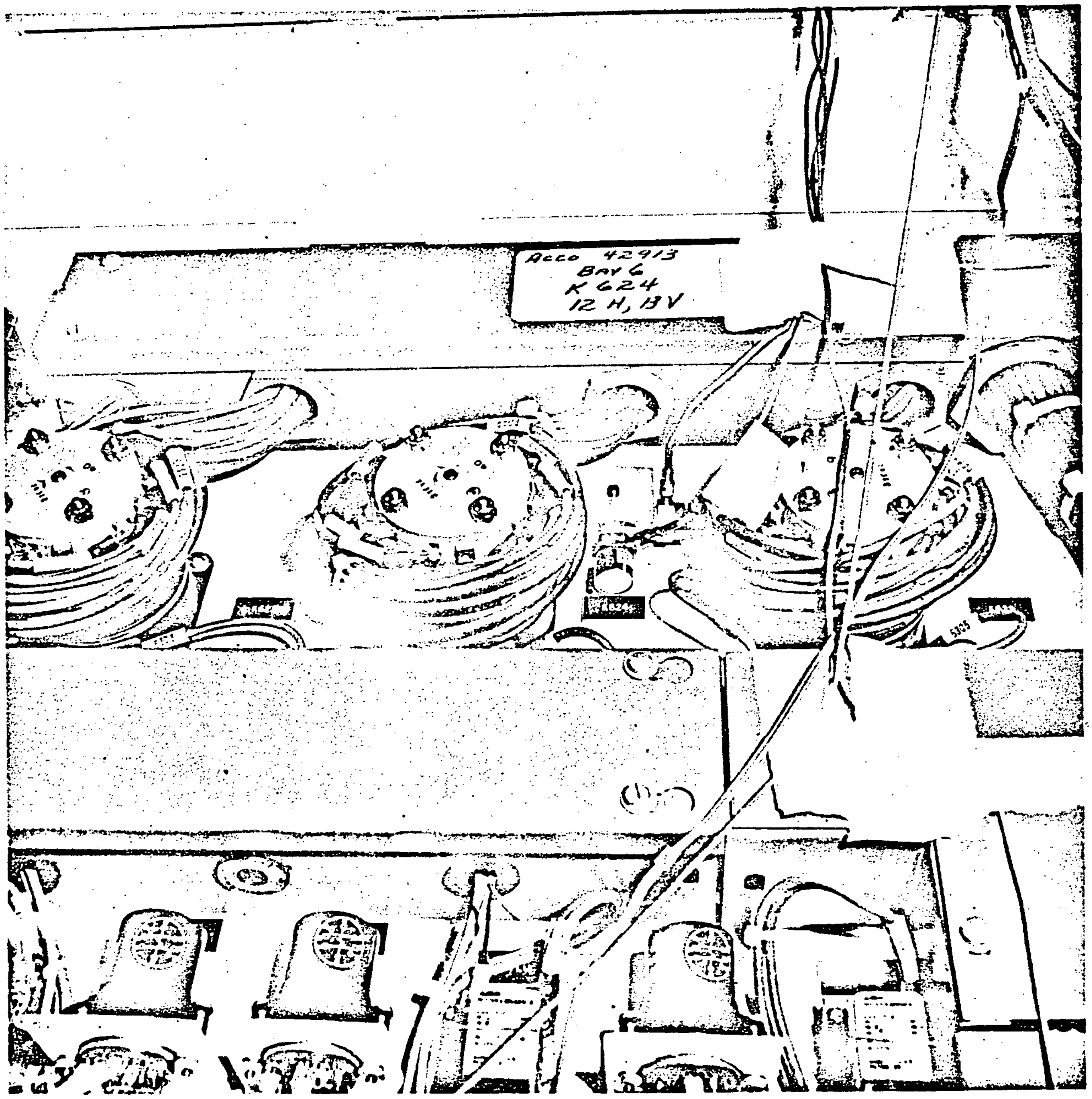
PHOTOGRAPH 7

LOCATION OF ACCELEROMETER 9H



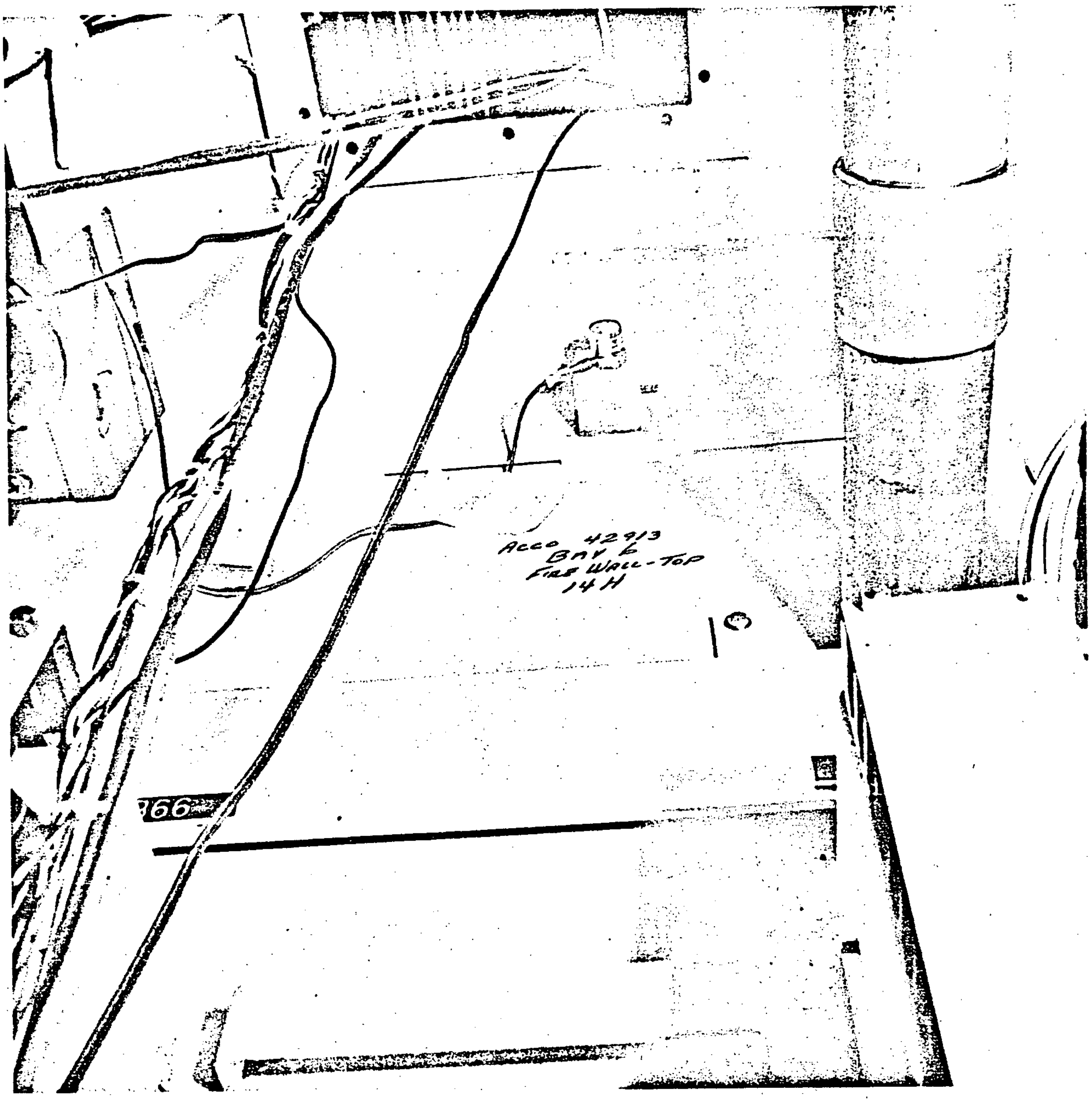
PHOTOGRAPH 8

LOCATION OF ACCELEROMETER 11V



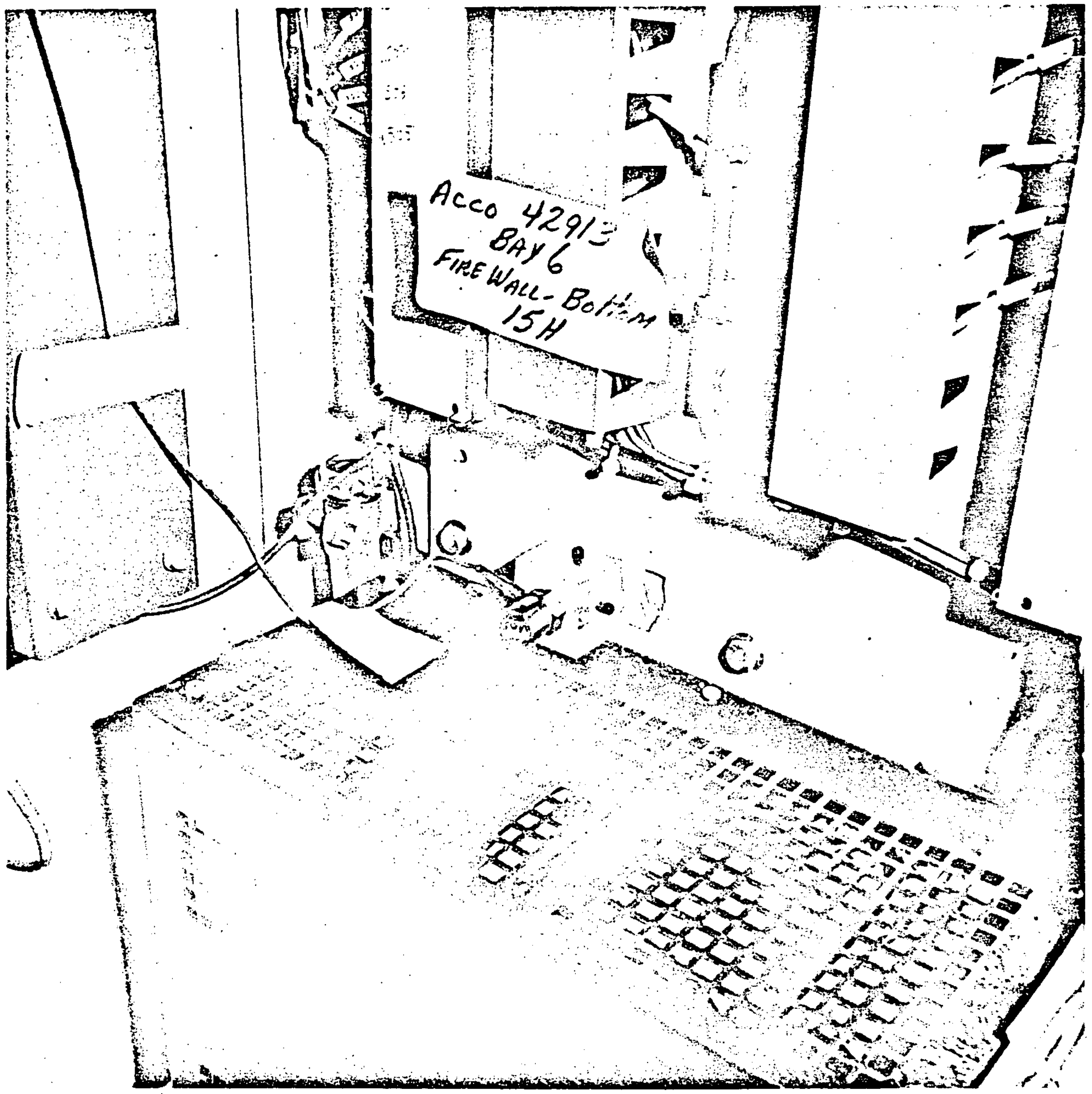
PHOTOGRAPH 9

LOCATION OF ACCELEROMETER 12H AND 13V



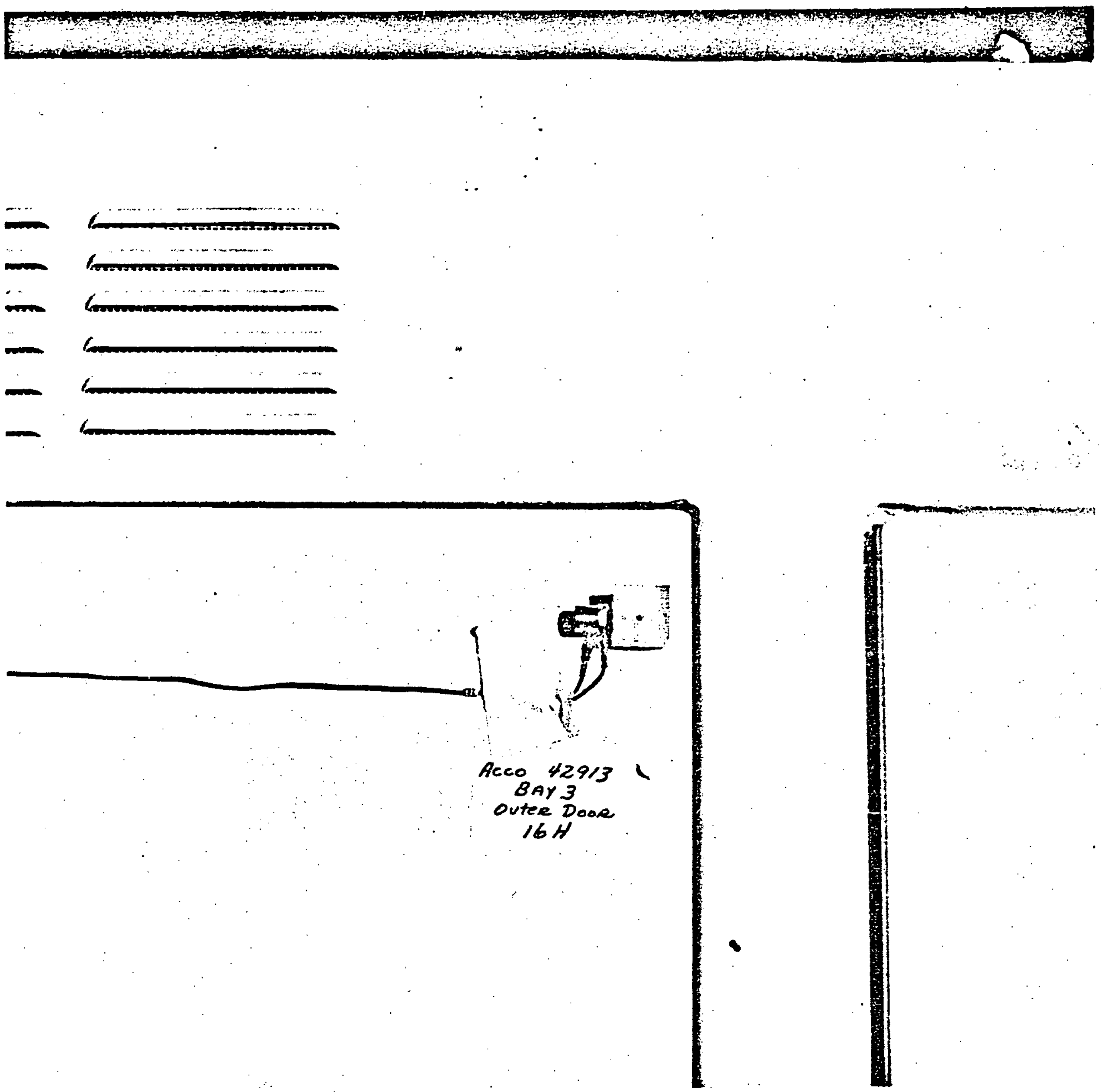
PHOTOGRAPH 10

LOCATION OF ACCELEROMETER 14H



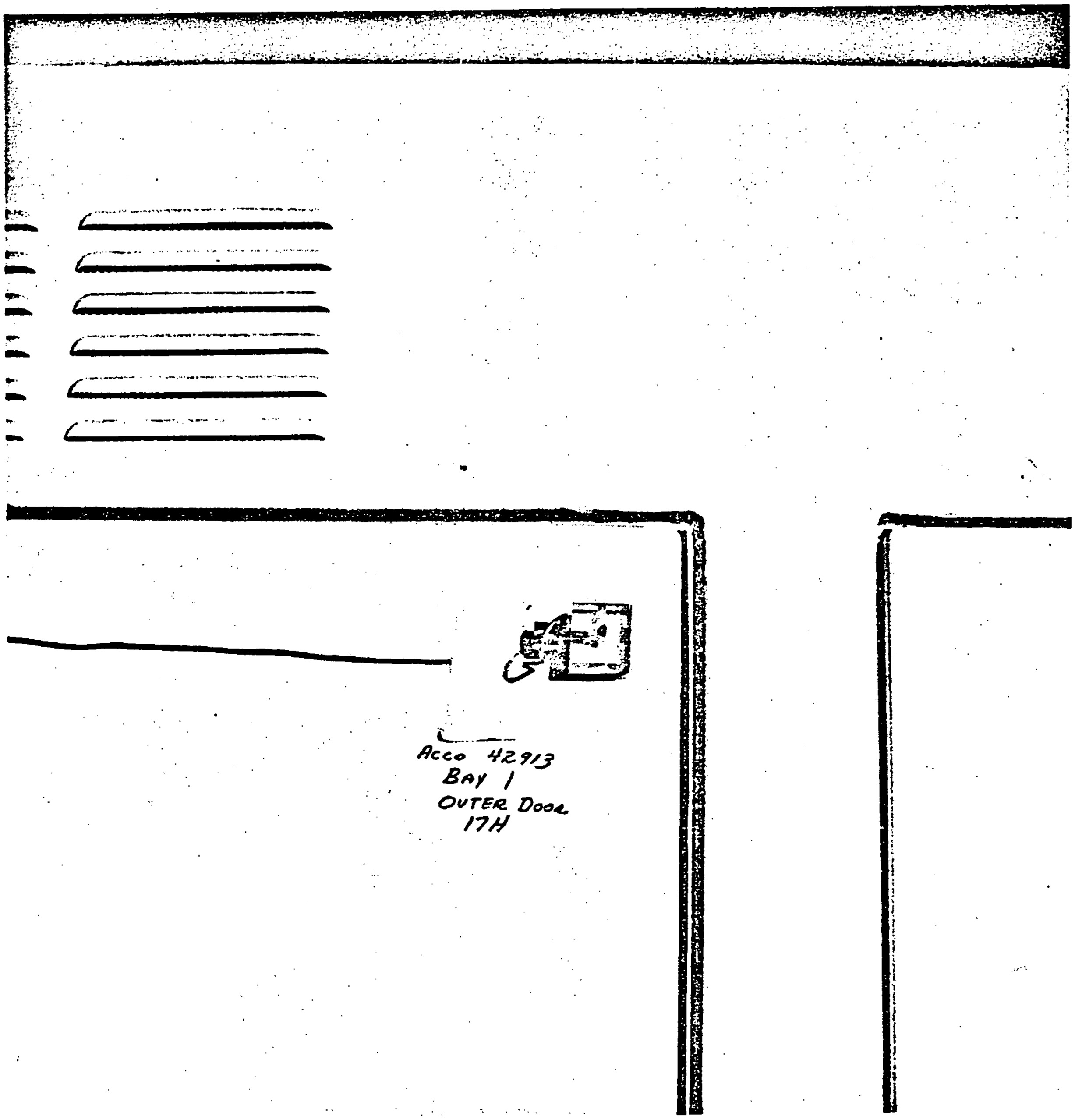
PHOTOGRAPH 11

LOCATION OF ACCELEROMETER 15H



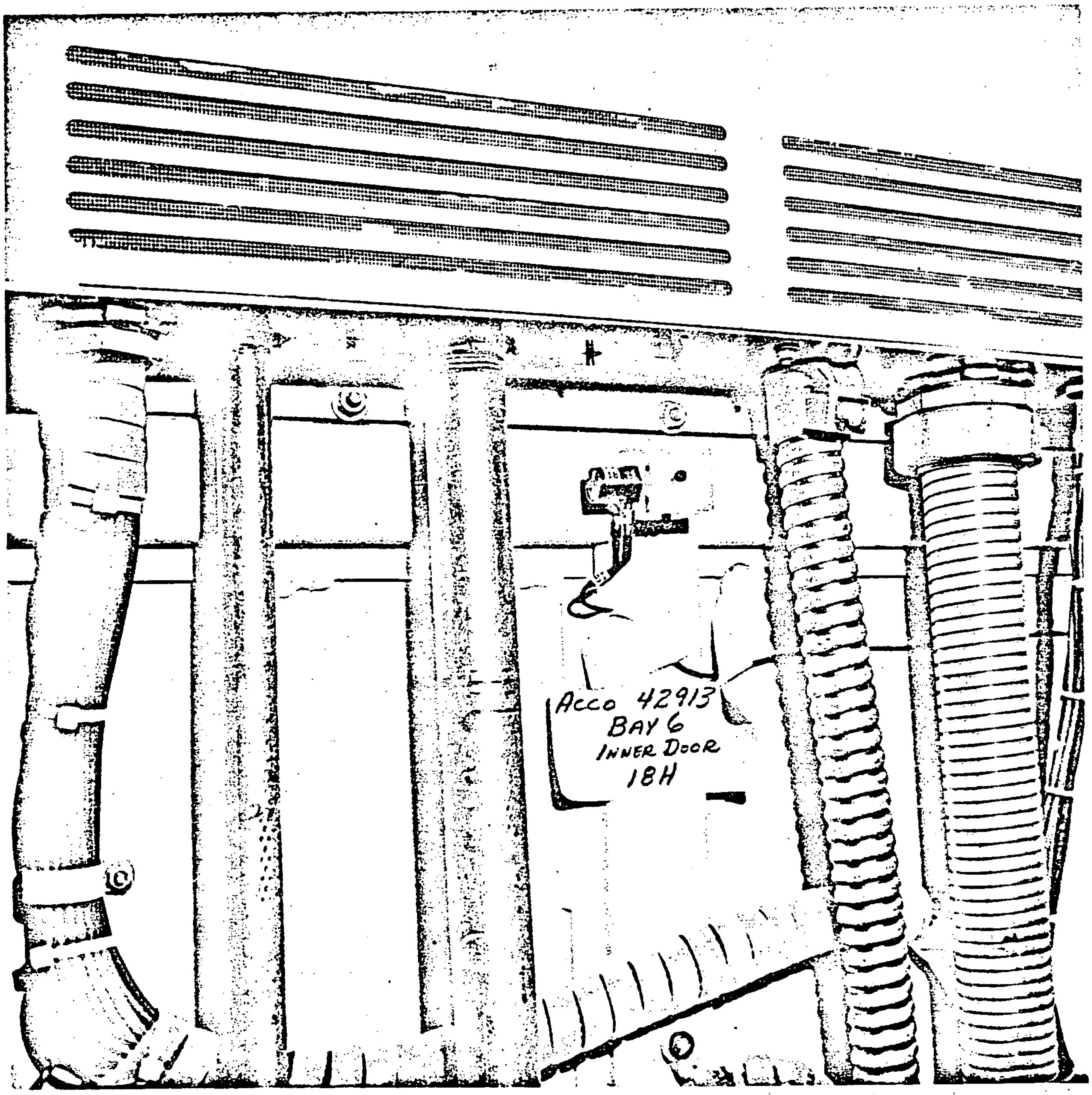
PHOTOGRAPH 12

LOCATION OF ACCELEROMETER 16H



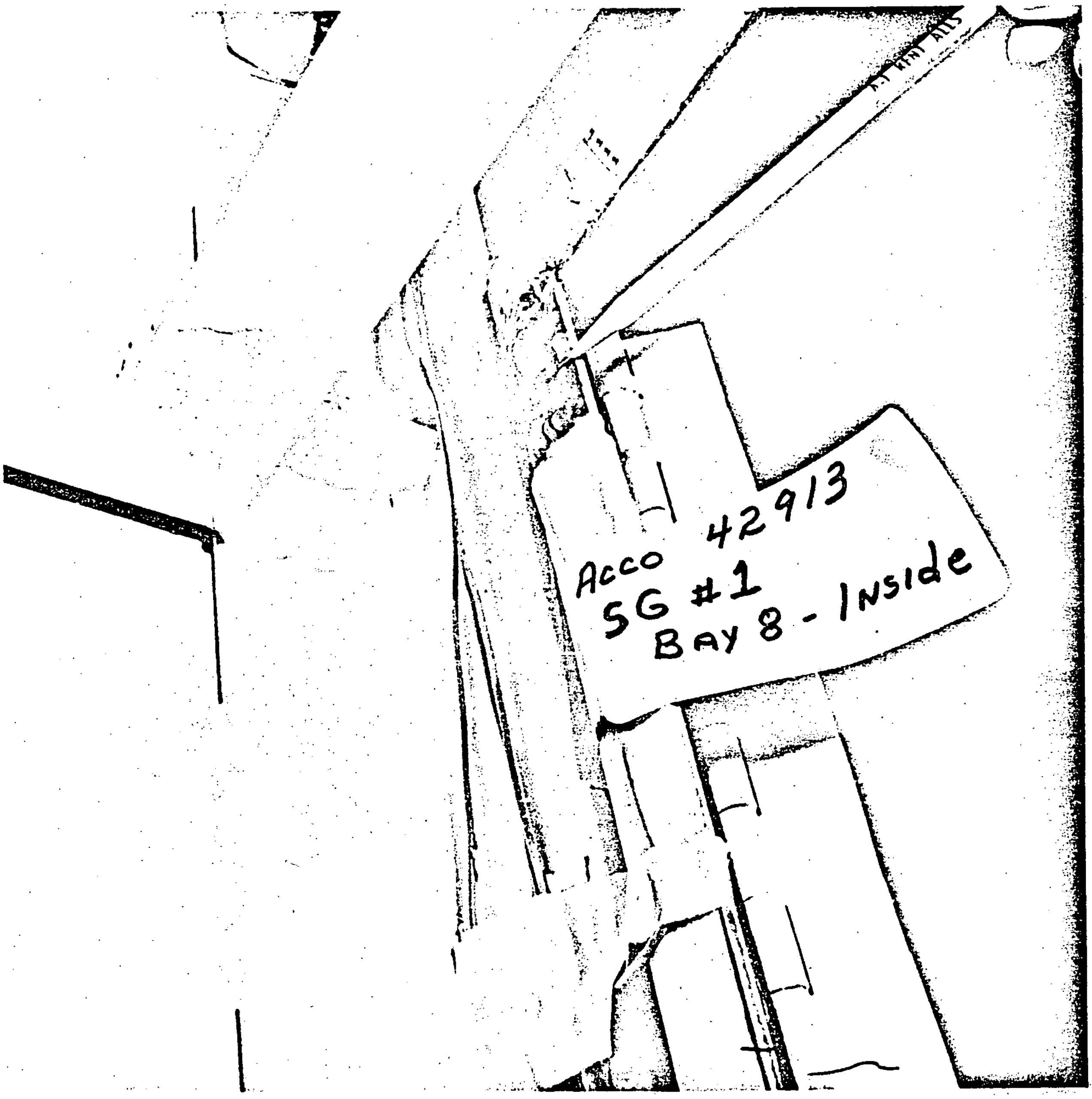
PHOTOGRAPH 13

LOCATION OF ACCELEROMETER 17H



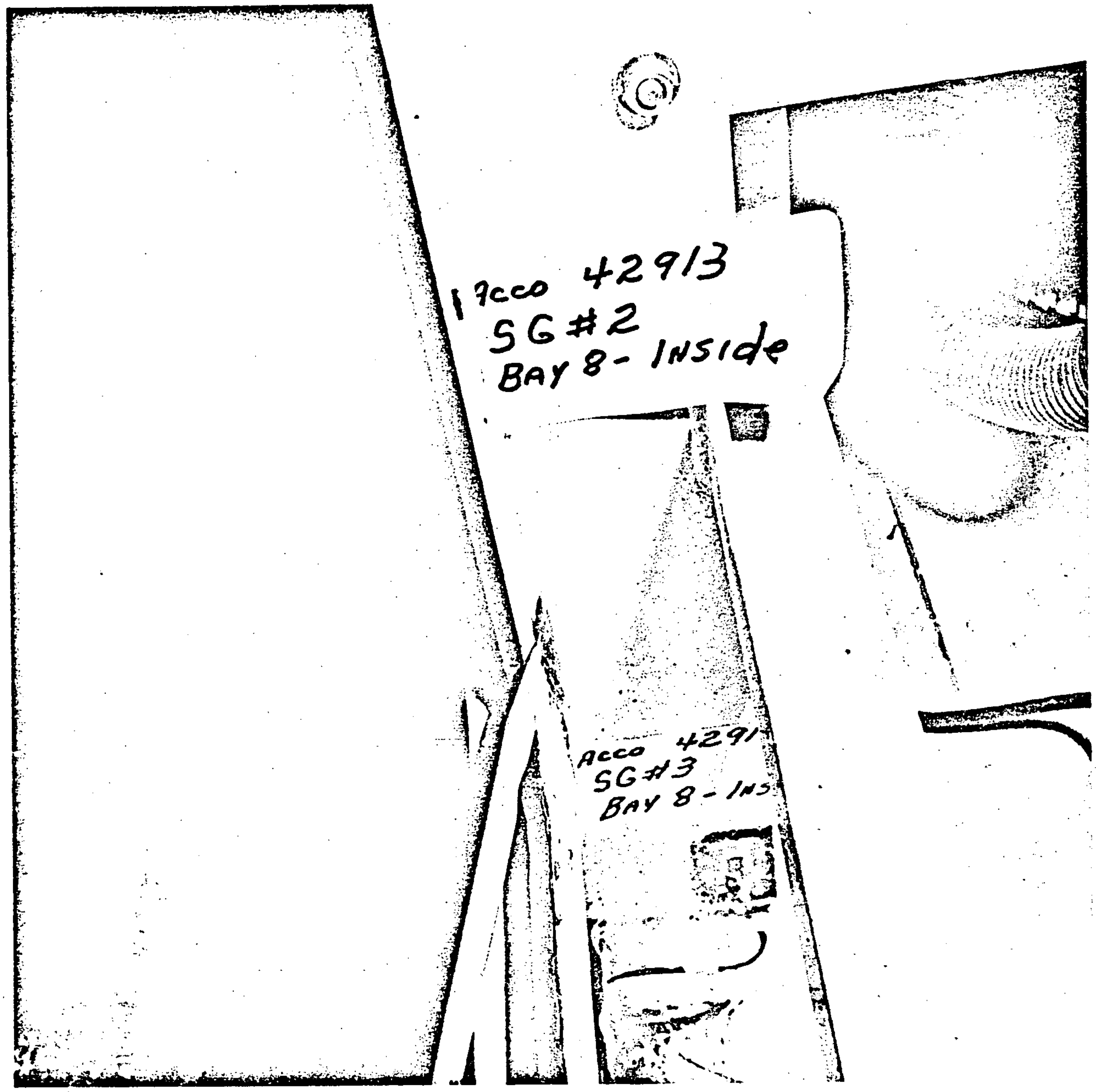
PHOTOGRAPH 14

LOCATION OF ACCELEROMETER 18H



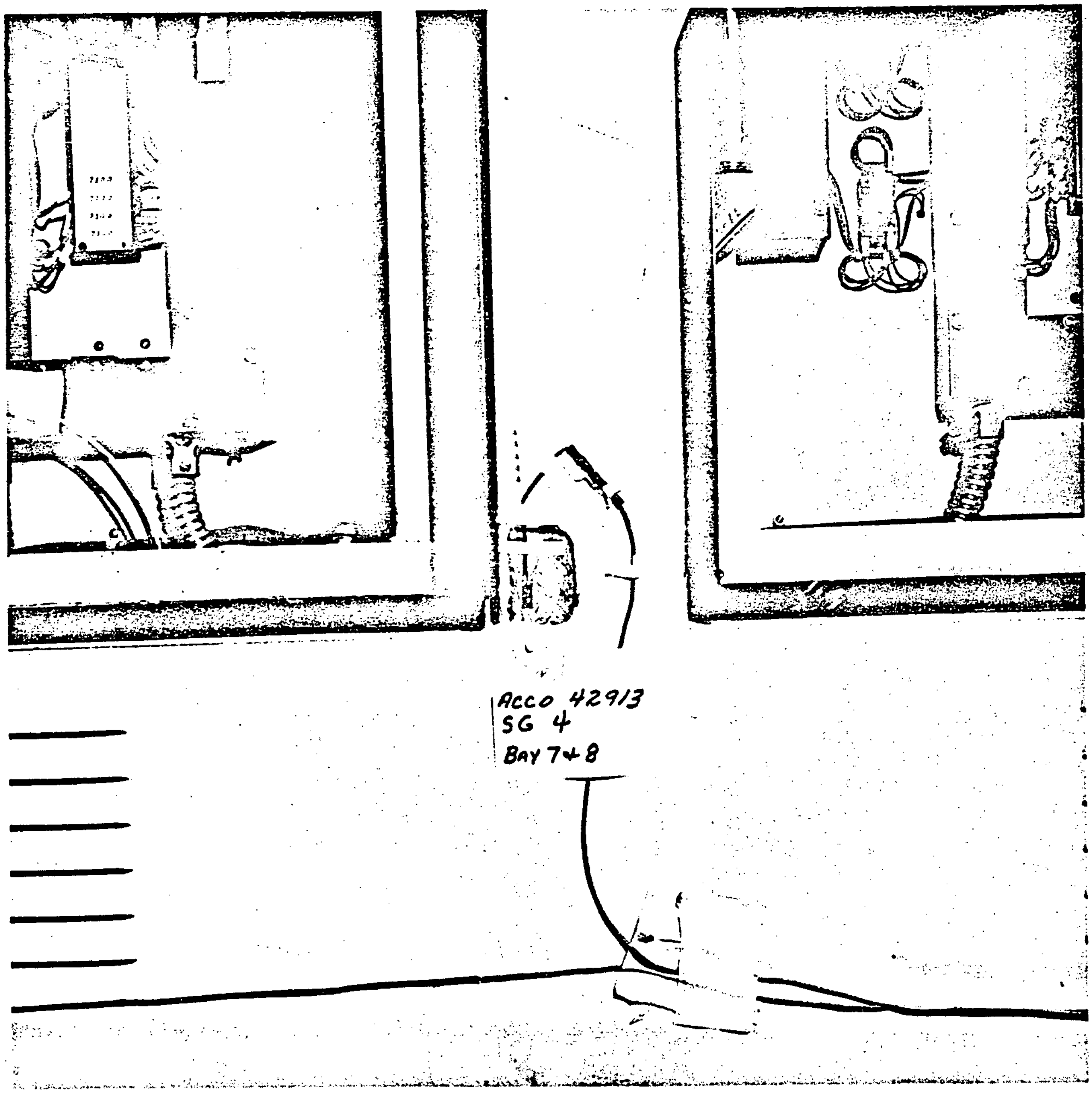
PHOTOGRAPH 15

LOCATION OF STRAIN GAGE 1



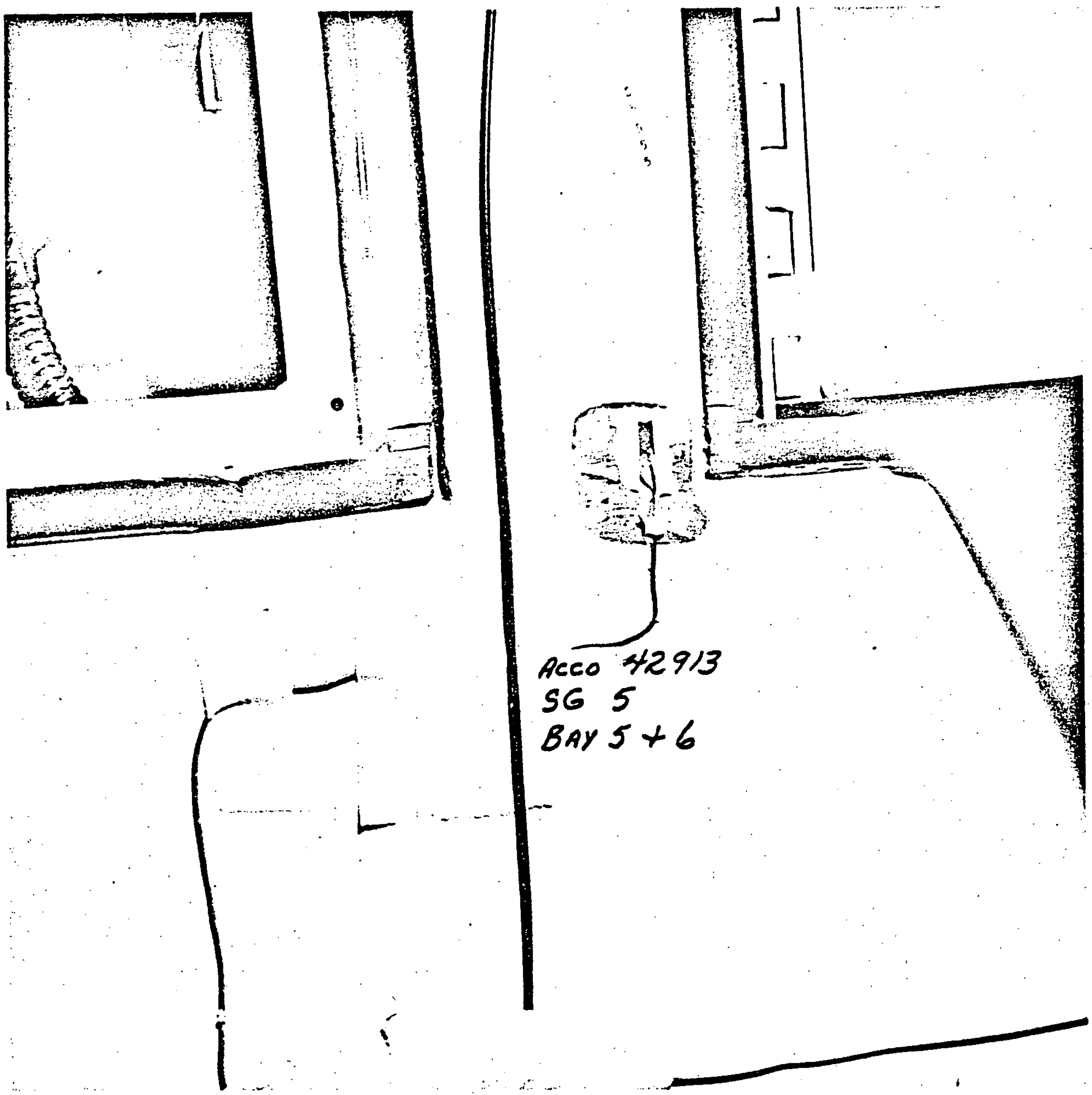
PHOTOGRAPH 16

LOCATION OF STRAIN GAGES 2 AND 3



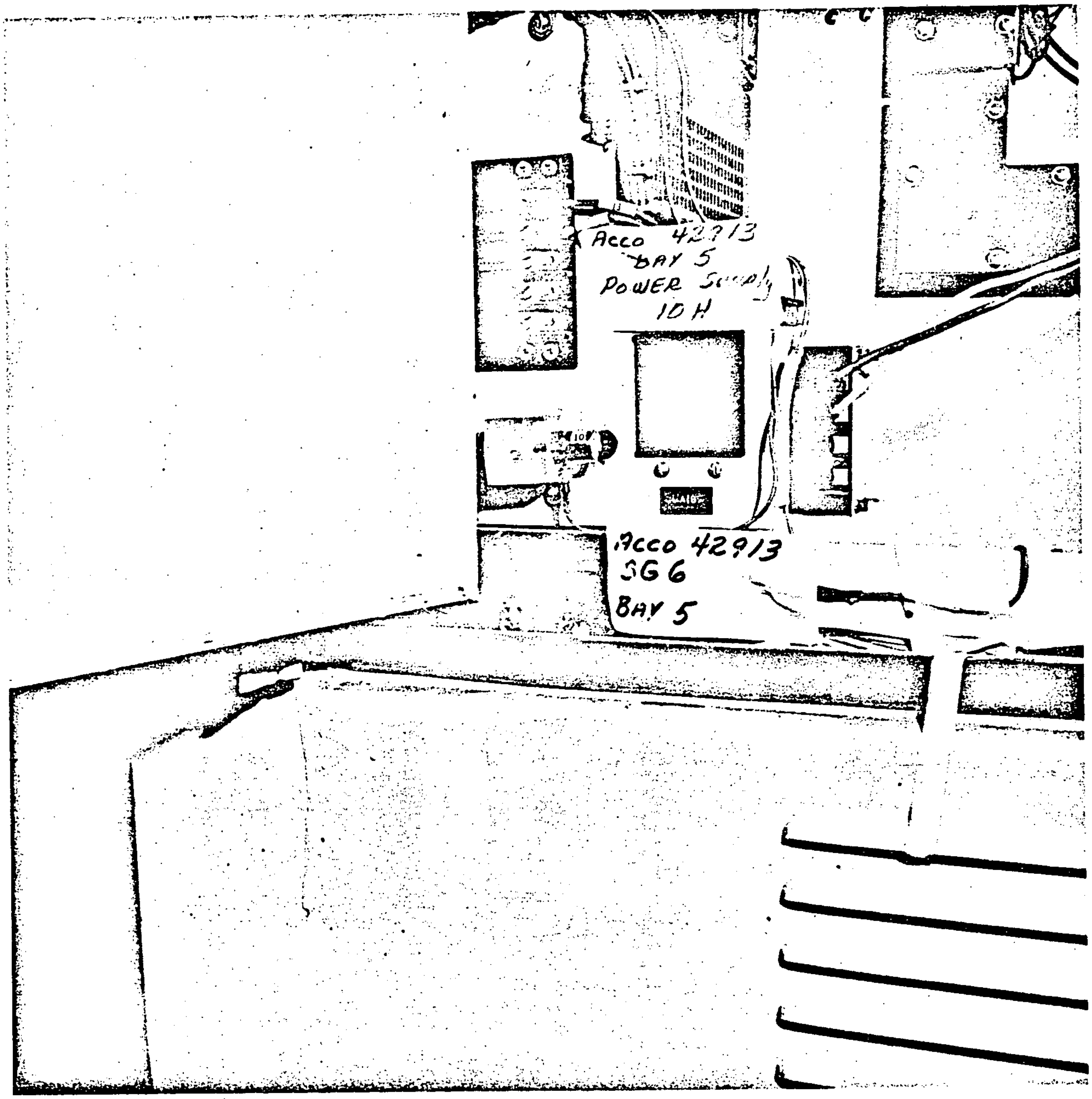
PHOTOGRAPH 17

LOCATION OF STRAIN GAGE 4



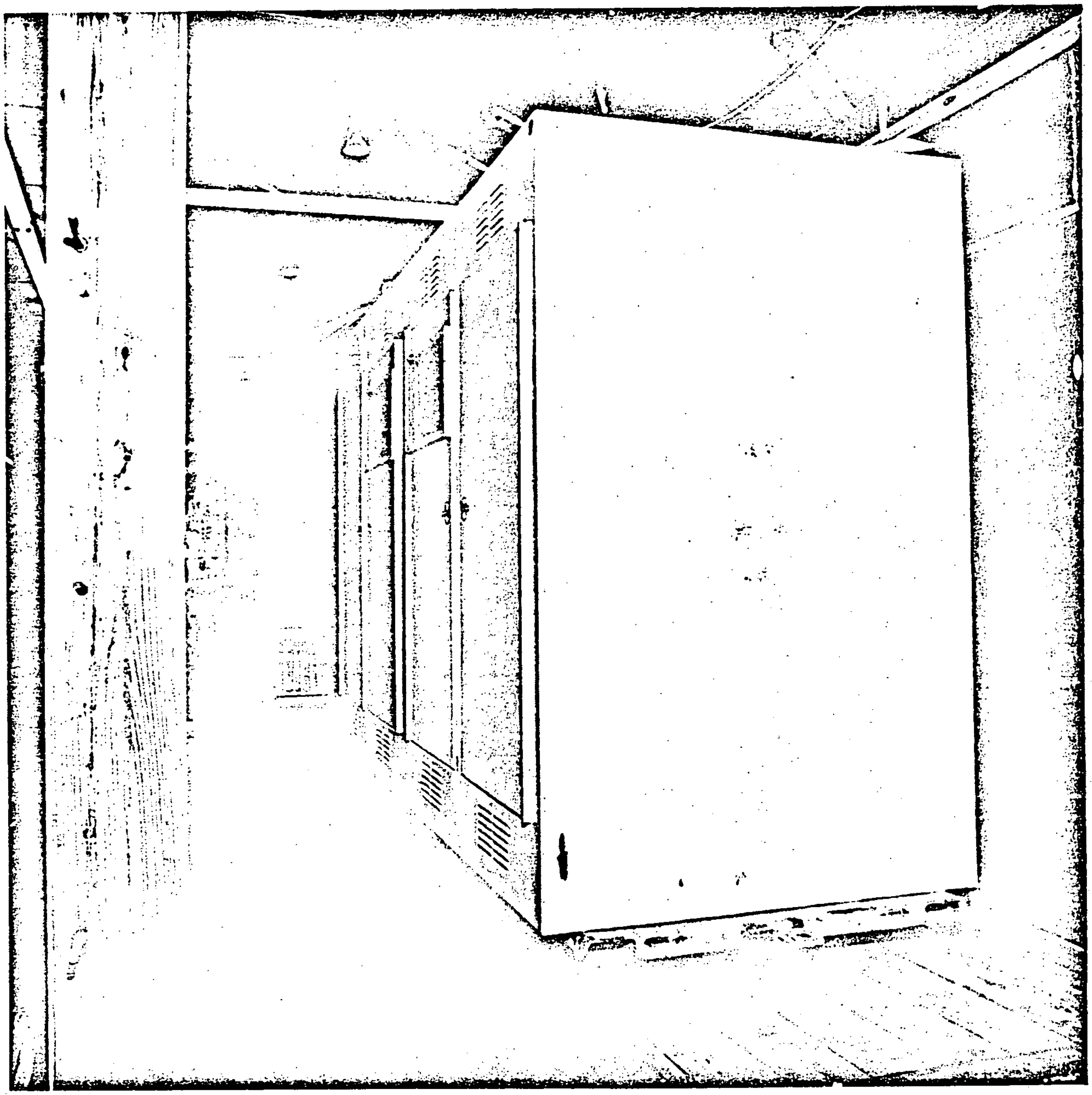
PHOTOGRAPH 18

LOCATION OF STRAIN GAGE 5



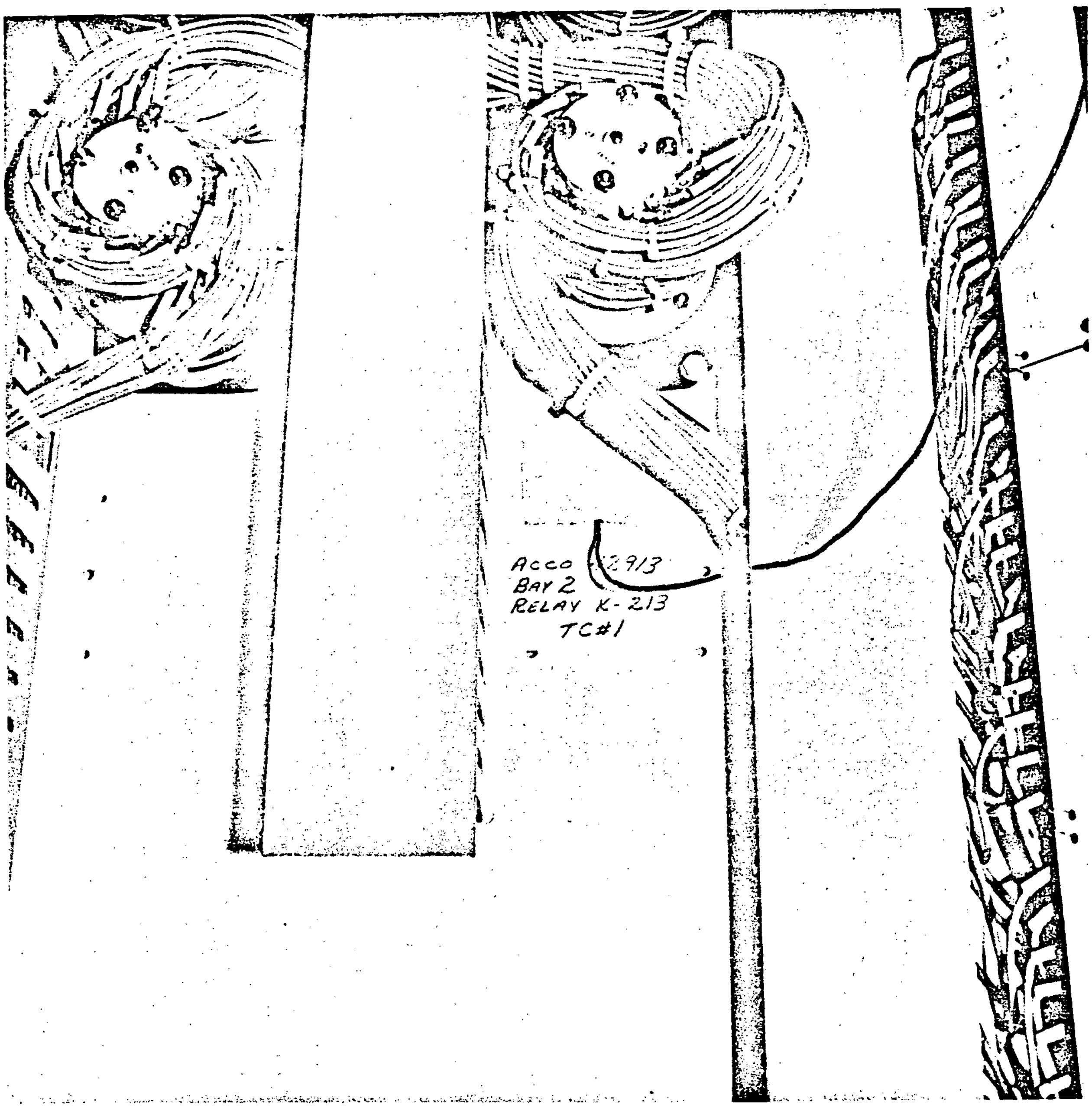
PHOTOGRAPH 19

LOCATION OF STRAIN GAGE 6
AND
ACCELEROMETER 10H



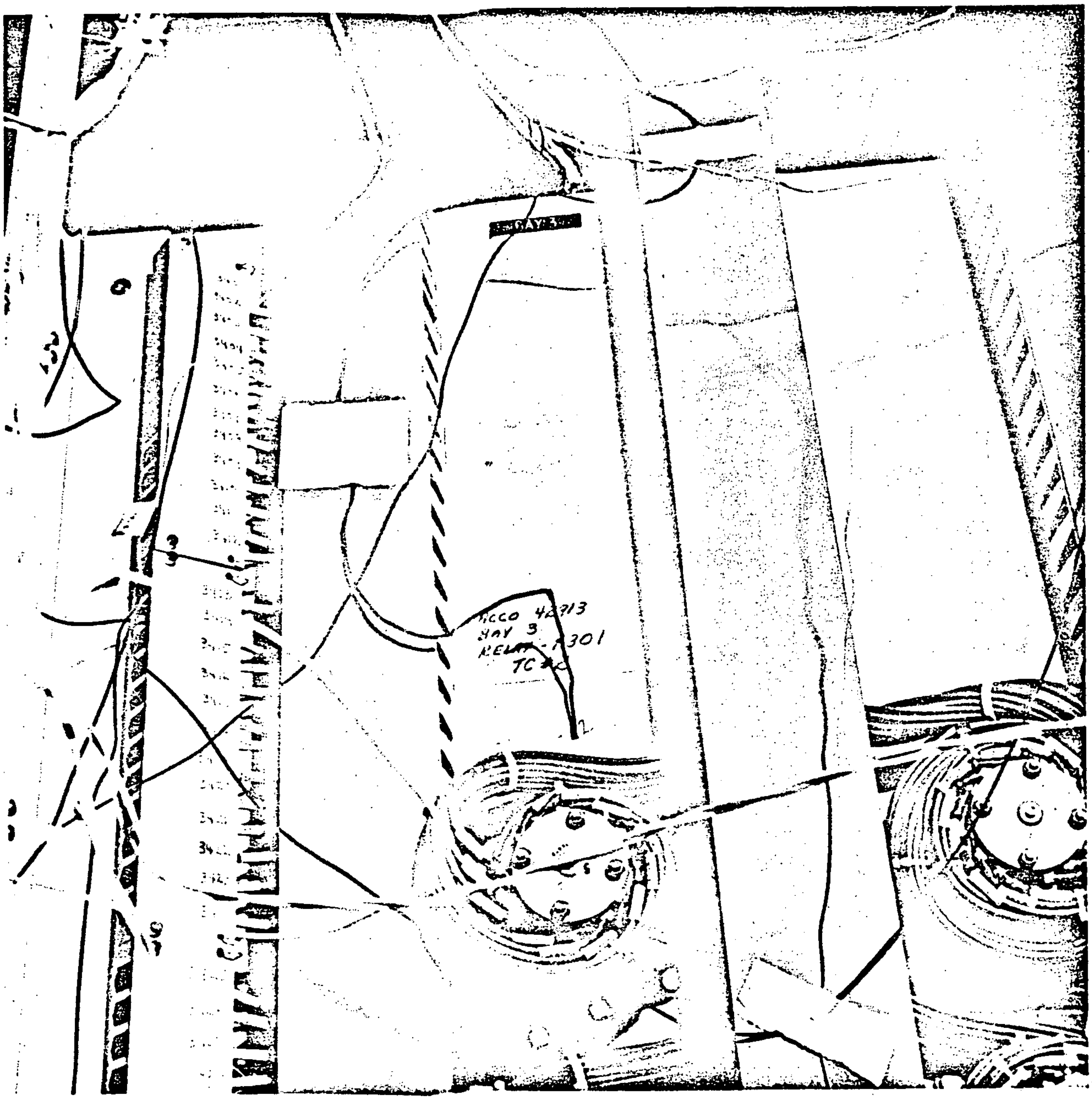
PHOTOGRAPH 20

GENERAL ARRANGEMENT OF SPECIMEN
IN
TEMPERATURE AND HUMIDITY CHAMBER



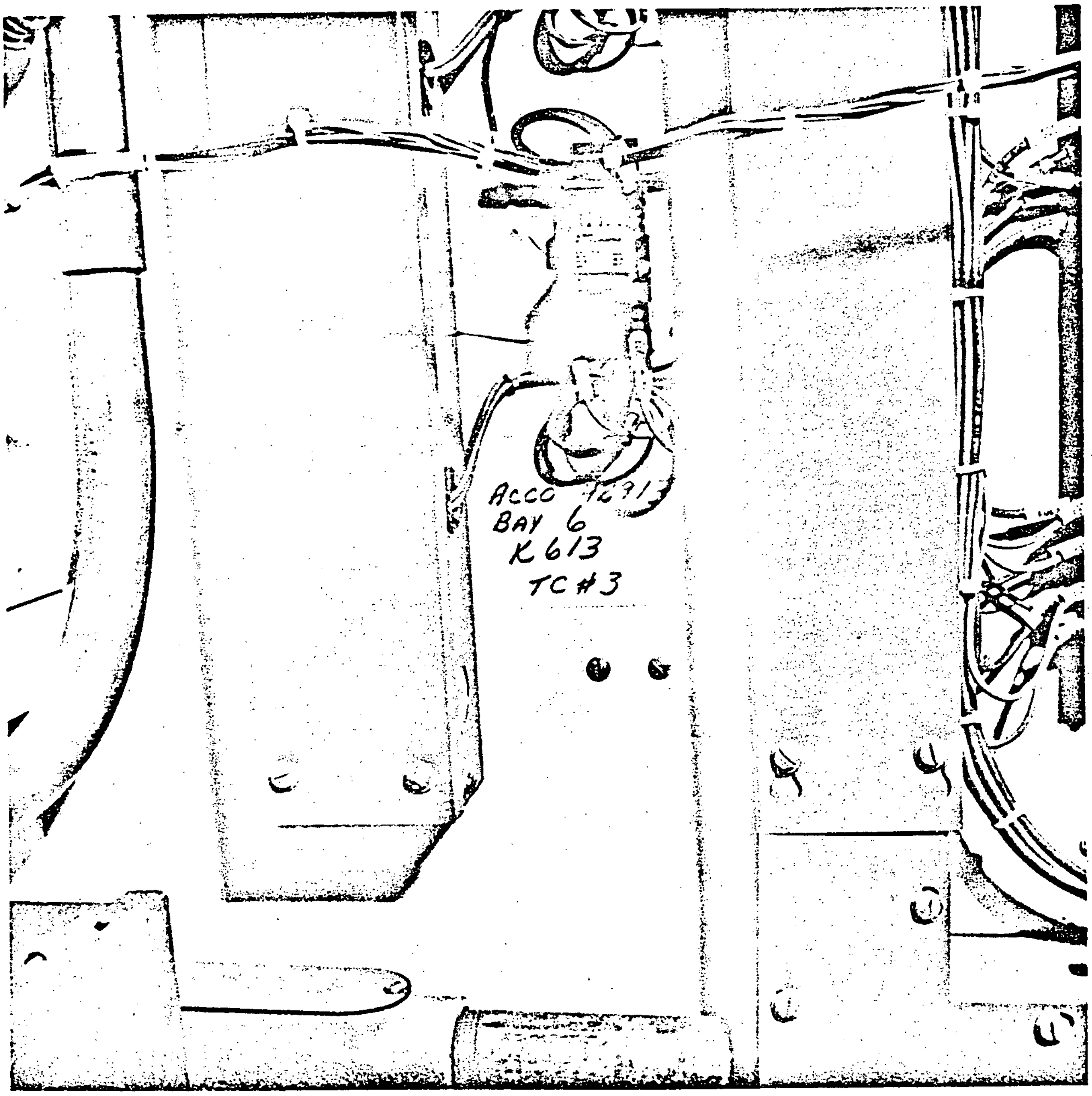
PHOTOGRAPH 21

LOCATION OF THERMOCOUPLE #1



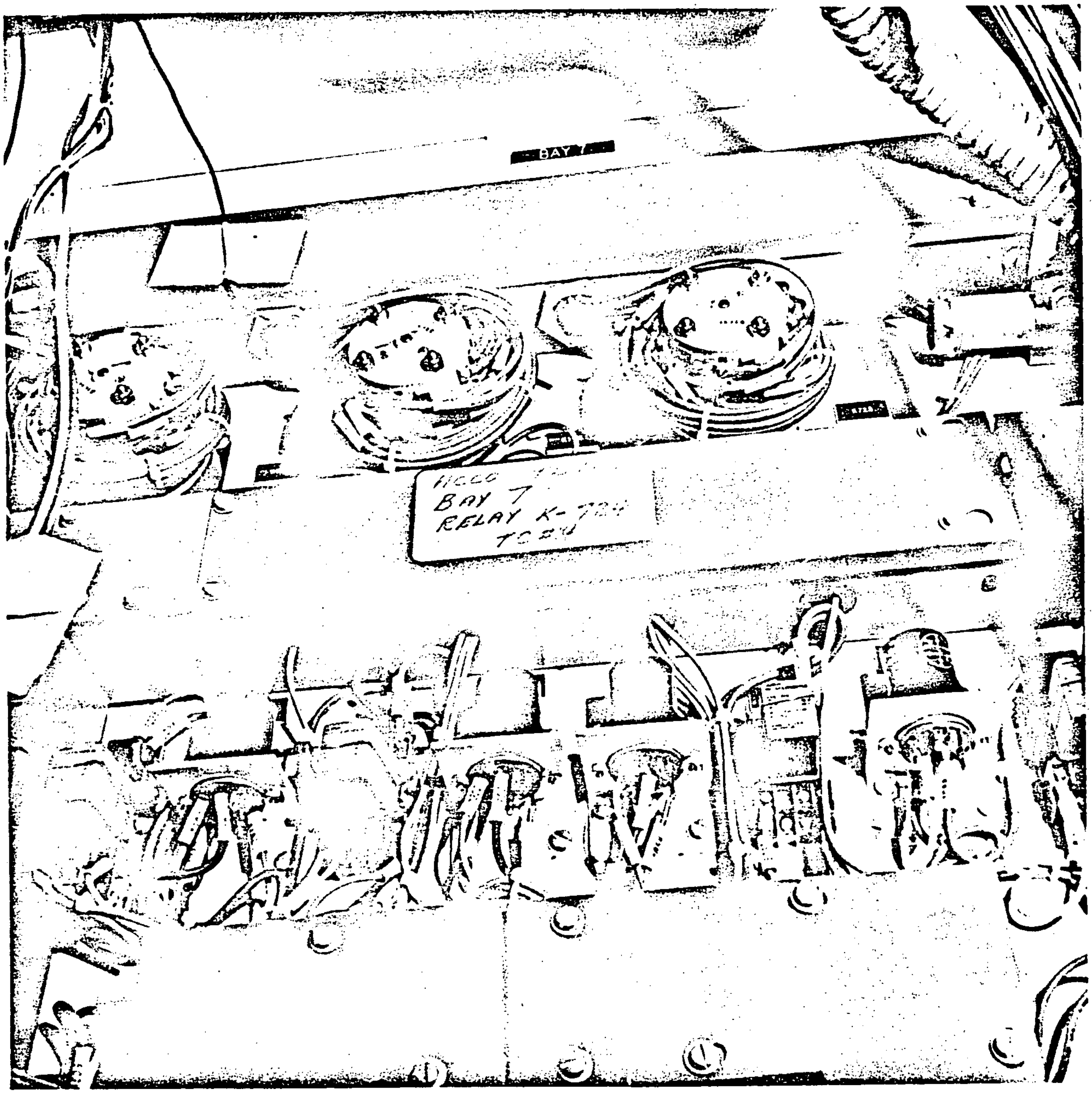
PHOTOGRAPH 22

LOCATION OF THERMOCOUPLE #2



PHOTOGRAPH 23

LOCATION OF THERMOCOUPLE #3



PHOTOGRAPH 24

LOCATION OF THERMOCOUPLE #4

APPENDIX I

ANALYTICAL JUSTIFICATION
TO
QUALIFY THE ESFAS AUXILIARY RELAY CABINET
FOR
SAN ONOFRE UNITS 2 AND 3, FORKED RIVER UNIT 1,
AND
WATERFORD UNIT 3

BY: G. C. Kao.
G. C. Kao, PH.D. P.E.

1.0 INTRODUCTION AND CONCLUSIONS

1.1 Introduction

The ESFAS Auxiliary Relay Cabinet was subjected to low-level sine sweeps and seismic tests according to the provisions as outlined in Wyle Laboratories' Test Procedure Number 541/3385-2/ES, Revision A, dated March 31, 1975. This test was for the requirements of Arkansas Power and Light Nuclear Plant, Auxiliary Building, at the 386' floor level.

The objectives of the justification analysis are as follow:

a) To demonstrate that the equipment tested with a minimum Zero Period Amplitude (ZPA) of 1 g horizontally and 0.85 g vertically also meets the requirements of:

- San Onofre Units 2 and 3
- Forked River Unit 1
- Waterford Unit 2.

In particular, the above locations have spectra below 5 Hz that are more severe than the test spectra to which the equipment was subjected and found acceptable.

b) To show that employing the test results of the equipment qualified under the "bolted" mounting condition also is satisfactory for the "welded" mounting condition. In addition, to determine the minimum lengths of weld and weld spacing required for the "welded" mounting condition.

c) The evaluation of the strain gage data to determine the stress levels of the equipment during testing.

The work performed herein consists of the evaluation of sine sweep data to determine resonant frequencies associated with each mode of vibration; the evaluation of seismic test data and the justifications used to qualify the same equipment for the other three plants. Details of the above are contained in Sections 2.0 and 3.0, respectively. The analysis of the "bolted" versus the "welded" condition is presented in Section 4.0. The evaluation of strain gage data is described in Section 5.0.

1.2 Conclusions

The conclusions drawn from the results of the test data and analysis are stated as follows:

- The test results as indicated by Test Run Numbers 13 and 23 and the analytical justification show that the test specimen has been qualified for the following nuclear power plant units:
  - Arkansas Power and Light Nuclear Plant, Auxiliary Building, at the 386' floor level
  - San Onofre Units 2 and 3
  - Forked River Unit 1
  - Waterford Unit 3
- The specimen, tested under the "bolted" mounting condition, can be justified for use under the "welded" mounting condition. The required lengths and locations of weld are shown in Figure D.
- The specimen has not been overstressed under the test environments and will be able to maintain its structural integrity under the specified Required Response Spectra (RRS).
- The levels of RRS for San Onofre, Forked River and Waterford Units can be reduced in the frequency range below 5 Hz. This is attributed to the fact that the lowest resonant frequency of the structure is 9.5 Hz and its response to the input table motions would be in a rigid body mode. Under these circumstances, the g levels that would be reached at low frequencies would be no greater than those called for at high frequencies (e.g. above 9.5 Hz). Since the present tests subjected the equivalent to higher g levels above 9.5 Hz than are required for any of the plants in question, it is clear that the equivalent will be satisfactory for any of these plants.

2.0 EVALUATION OF THE SINE SWEEP DATA

The specimen was subjected to low-level, single axis sine sweep tests. The input levels were approximately 0.2 g in the horizontal and vertical directions. The tests were performed in the frequency range of 1 Hz to 40 Hz at a sweep rate of 1 octave per minute. The input and output motions were monitored by a total of 18 accelerometers. The response data were reduced in terms of transmissibility functions at each measurement point. The measured resonant frequencies for Test Run Nos. 3, 4, and 15 are summarized as follows:

SUMMARY OF MEASURED RESONANT FREQUENCIES

ACCELEROMETER	MEASURED RESONANT FREQUENCIES, Hz										LOCATION*
	9.5	10.5	12	13	18	23	25	27.5	34	39	
1H	F/B+		S/S++			F/B			F/B		Internal Panel, Bay 1
3H	F/B		S/S			F/B					Internal Panel, Bay 1
5H	F/B		S/S		F/B			F/B			Component, Bay 5
8H	F/B		S/S								Frame, Bay 5
9H	F/B		S/S								Frame, Bay 8
10H	F/B		S/S							F/B	Component, Bay 5
12H	F/B		S/S						F/B		Internal Panel, Bay 6
14H	F/B		S/S								Top Firewall, Bay 6
15H	F/B		S/S								Bottom Firewall, Bay 6
16H	F/B	F/B	S/S	F/B						F/B	Outer Door, Bay 3
17H	F/B		S/S		F/B			F/B			Outer Door, Bay 1
18H	F/B		S/S			F/B					Inner Door, Bay 6
2V					X		X	X	X		Internal Panel, Bay 1
4V					X		X	X	X		Internal Panel, Bay 1
6V								X			Component, Bay 5
7V								X			Component, Bay 5
11V										X	Component, Bay 5
13V										X	Internal Panel, Bay 6

*The accelerometer locations are shown in Photographs 3 through 19

+Front-to-Back mode

++Side-to-Side mode

A discussion on these frequencies is given below:

a) 9.5 Hz - This is the lowest resonant frequency in the front-to-back (F/B) mode. This mode does not couple with either the S/S mode or the vertical mode.

b) 10.5 Hz - This is a local vibration mode of the door in Bay 3.

c) 12 Hz - This is the lowest resonant frequency in the side-to-side (S/S) mode. This mode does not couple with either the F/B mode or the vertical mode.

d) 13 Hz - This is a local vibration mode of the door in Bay 3.

e) 18 Hz - This is a local vibration mode of the doors in Bay 1 and Bay 5. No coupling with the S/S mode is observed. The coupling with the vertical motion in Bay 1 is insignificant.

f) 23 Hz - This is a localized panel mode in Bays 1, 5 and 6.

g) 25 Hz - This is a localized panel mode in Bay 1.

h) 27.5 Hz - This is the predominant resonant frequency in the vertical mode. This mode does couple with the F/B mode.

i) 34 Hz - This is a localized panel mode in Bays 1 and 6.

j) 39 Hz - This is a localized panel mode in Bays 3, 5 and 6.

The conclusions drawn from the results of the measured resonant frequencies are as follows:

- The lowest resonant frequency in the F/B mode is 9.5 Hz which is not coupled with either the S/S mode or the vertical mode.

- The lowest resonant frequency in the S/S mode is 12 Hz which is not coupled with either the F/B mode or the vertical mode.

- The lowest vertical resonant frequency is 18 Hz which is slightly coupled with the F/B mode. The predominant vertical frequency is 27.5 Hz which is also coupled with the F/B mode.

- There are no resonant frequencies below 9.5 Hz.

3.0 EVALUATION OF THE RANDOM MULTI-FREQUENCY DATA

The results of the full-level tests, namely Test Numbers 13 (side-to-side and vertical) and 23 (front-to-back and vertical), are shown in Figures A and B. Figure A shows the horizontal TRS, along with the RRS, for the four nuclear power plant units, as described in Section 1.0. The vertical RRS and TRS are shown in Figure B. The minimum ZPA's of the horizontal and vertical TRS were observed to be approximately 1.5 g and 1 g, respectively. Both the horizontal and vertical TRS envelope the Arkansas RRS. Therefore, based on the test results, the equipment has been qualified seismically for the Arkansas specifications.

The TRS do not meet the required levels of the RRS for frequencies below 5 Hz. To justify the use of the Arkansas seismic test result for qualifying the same equipment for the other three plants, it would be necessary to show that:

- The lowest resonant frequency of the equipment in a given mode of vibration is much higher than that of the exciting force; therefore, the equipment essentially would respond to the input motion in a rigid body mode.

- The TRS at the resonant frequencies of the equipment have met or exceed the amplitude of the RRS.

- The ZPA of the TRS is equal to or higher than the RRS.

For a single degree-of-freedom system with viscous damping, the absolute transmissibility between the mass and the base due to sinusoidal base motion can be represented by the amplitude and phase plots as shown in Figure C in which:

$$T = \frac{\text{Motion of the Mass}}{\text{Motion of the Base}}$$

$$\beta = \frac{\text{Exciting Frequency}}{\text{Resonant Frequency}}$$

It is shown that if β is smaller than unity, the mass will move in unison with the base (zero phase); the transmissibility reaches its maximum at the resonant frequency and decreases at higher exciting frequencies. Therefore, if the resonant frequency of a system is greater than the predominant frequency of an exciting force, the system will respond to a rigid body mode; the maximum response of the system will be equal to the maximum base motion (ZPA).

To apply the above concept to the present problem, it is necessary to compare the resonant frequencies in both the vertical and horizontal directions with respect to the predominant frequencies of exciting forces, and then to determine the amplitude of the transmissibility to check if the system is responding to a rigid body mode.

Since the modes of vibration in the S/S, F/B and vertical directions are not coupled for frequencies at 9.5 Hz, 12 Hz and 18 Hz, the Justification Analysis is treated separately for the three directions and is presented below:

3.1 Justification for the Vertical Test Results

Referring to Figure B, the dominant frequencies of input motions (RRS) may be assumed as follows:

San Onofre	:	2 Hz
Forked River	:	2.5 Hz
Waterford	:	2.2 Hz

The lowest resonant frequency in the vertical mode is 18 Hz. From Attachment A, the frequency ratio, β, and the transmissibility, T_R, can be estimated as follows (Figure C):

$$\beta_1 = \frac{2}{12} = 0.11 \; ; \; T_1 \simeq 1$$

$$\beta_2 = \frac{2.5}{12} = 0.14 \; ; \; T_2 \simeq 1$$

$$\beta_3 = \frac{2.2}{18} = 0.12 \; ; \; T_3 \simeq 1$$

All these T values indicate a rigid body motion in the vertical mode; the TRS envelope the RRS for frequencies above 5 Hz. Consequently, the equipment has been qualified for the other three plants.

3.2 Justification for the S/S Test Results

Referring to Figure A, the dominant frequencies of input motions (RRS) may be assumed as follows:

San Onofre	:	2 Hz
Forked River	:	3.5 Hz
Waterford	:	1.6 Hz

The lowest resonant frequency in the S/S mode is 12 Hz. The values of β's and T's can be estimated as follows (Figure C):

$$\beta_4 = \frac{2}{12} = 0.17 \; ; \; T_4 \simeq 1 \quad \text{(San Onofre)}$$

$$\beta_5 = \frac{3.5}{12} = 0.29 \; ; \; T_5 \simeq 1 \quad \text{(Forked River)}$$

$$\beta_6 = \frac{1.6}{12} = 0.13 \; ; \; T_6 \simeq 1 \quad \text{(Waterford)}$$

By the same rationale as given in Section 3.1, the equipment has been qualified in the S/S mode for the other three plants.

3.3 Justification for the F/B Test Results

The lowest resonant frequency in the F/B mode is 9.5 Hz. From Attachment A, the values of β's and T's can be estimated as follows (Figure C):

$$\beta_7 = \frac{2}{9.5} = 0.21 \; ; \; T_7 \simeq 1 \quad \text{(San Onofre)}$$

$$\beta_8 = \frac{3.5}{9.5} = 0.37 \; ; \; T_8 \simeq 1.2 \quad \text{(Forked River)}$$

$$\beta_9 = \frac{1.6}{9.5} = 0.17 \; ; \; T_9 \simeq 1 \quad \text{(Waterford)}$$

From the above data, the test results can be applied to qualify the equipment at San Onofre and Waterford Plants. As for the Forked River Plant, the response of the equipment would be amplified by, at most, 20% at 9.5 Hz due to input at 3.5 Hz. The TRS at 9.5 Hz show a response of 8.5 g; whereas, the corresponding RRS at 9.5 Hz are 0.8 g (Figure A). Thus, the equipment has been overtested by approximately eleven (11) times. In addition, the ZPA's of TRS and RRS are 1.5 g and 0.7 g (Forked River), respectively; this indicates that the peak input amplitude is about twice as great as the required (0.8 g). Consequently, the equipment has been qualified for the Forked River seismic environment.

4.0 EVALUATION OF STRAIN GAGE DATA

A total of six strain gage measurements were made during seismic testing. The measured stress levels are presented as follows:

Stress Measurement of Run No. 13 (SS/V)

Strain Gage No.	Strain in.	Stress Level* PSI
1	20	600
2	50	1500
3	40	1200
4	65	1950
5	40	1200
6	30	600

Stress Measurement of Run No. 23 (FB/V)

Strain Gage No.	Strain in.	Stress Level* PSI
1	45	1350
2	60	1800
3	50	1500
4	75	2250
5	60	1800
6	30	900

*Stress = Strain x 3 x 10^7 PSI

Since the measured stresses are significantly lower than the basic allowable stress of 22,000 PSI for A-36 steel by The American Institute of Steel Construction (AISC), the equipment has not been overstressed and will be able to maintain its structural integrity under the specified RRS.

5.0 EVALUATION OF "BOLTED" VERSUS "WELDED" MOUNTING CONDITIONS

The equipment has an overall dimension of 144" (length) x 56" (depth) x 90" (height) and was bolted to the test table by means of 12-7/8" diameter steel bolts to simulate the mounting condition at the Arkansas Plant. If the "welded" mounting condition were used instead of the "bolted" condition, the legnths of weld should be designed to resist the shears and over-turning moments as generated by the RRS. The resonant frequencies of the equipment under the "welded" condition should be equal or higher than that of the "bolted" condition. Consequently, the test results of the "bolted" condition will automatically qualify for the "welded" condition.

The calculations to determine the length of fillet weld required for the "welded" mounting condition are shown below:

Assuming a 3/8-inch fillet weld and an allowable shearing stress equal to 14,000 pounds*, the allowable shearing strength per linear inch of weld is:

$$S_a = 14,000\ (0.707 \times 0.375)$$
$$= 3712 \text{ lb/in.}$$

Total horizontal force, F, is assumed to be equal to the weight of the equipment multiplied by the peak g of the San Onofre RRS or approximately equal to:

$$F = 10.5\ g \times 13,000 \text{ lbs}$$
$$= 136,500 \text{ lbs.}$$

The required weld length to resist the total shear force is:

$$L_o = 136,500/3,712 = 36.77".$$

Assuming the center of gravity of the equipment is at the mid-height, then the over-turning moment of the equipment is:

$$M = F \times 45" = 156,000 \times 45$$
$$= 6,142,500 \text{ in.-lb}$$

The corresponding vertical forces acting along the tranverse and longitudinal directions are (see Figure D):

$$V_1 = \frac{M}{56"} = 109,688 \text{ lbs}$$

$$V_2 = \frac{M}{144"} = 42,656 \text{ lbs.}$$

*AISC specifies allowable shearing stress as 0.40 F_y for A-36 steel. The yield strength is 36,000 PSI; so $F_s = 0.4 \times 36,000 = 14,400$ PSI.

The required weld lengths to resist the vertical forces are computed as follows:

$$L_1 = \frac{109,688}{3712} = 29.55"$$

$$L_2 = \frac{42,656}{3712} = 11.49"$$

The total weld lengths required per side along the longitudinal and transverse directions are as follows:

Longitudinal Direction:

$$L_\ell = L_o/2 + L_1 = \frac{36.77}{2} + 29.55 = 47.94"$$

Transverse Direction:

$$L_t = L_o/2 + L_2 = \frac{36.77}{2} + 11.49 = 29.88".$$

Use: a) 6" Weld at 8 evenly-spaced places along each side in the longitudinal direction; total weld length is 48" per side.

b) 6" Weld at 5 evenly-spaced places along each side in the transverse direction; total weld length is 30" per side.

The required weld lengths are shown in Figure E. Note 6" is suggested length for skip-welding. The total length of the weld on each side is more important than the length of each individual weld.

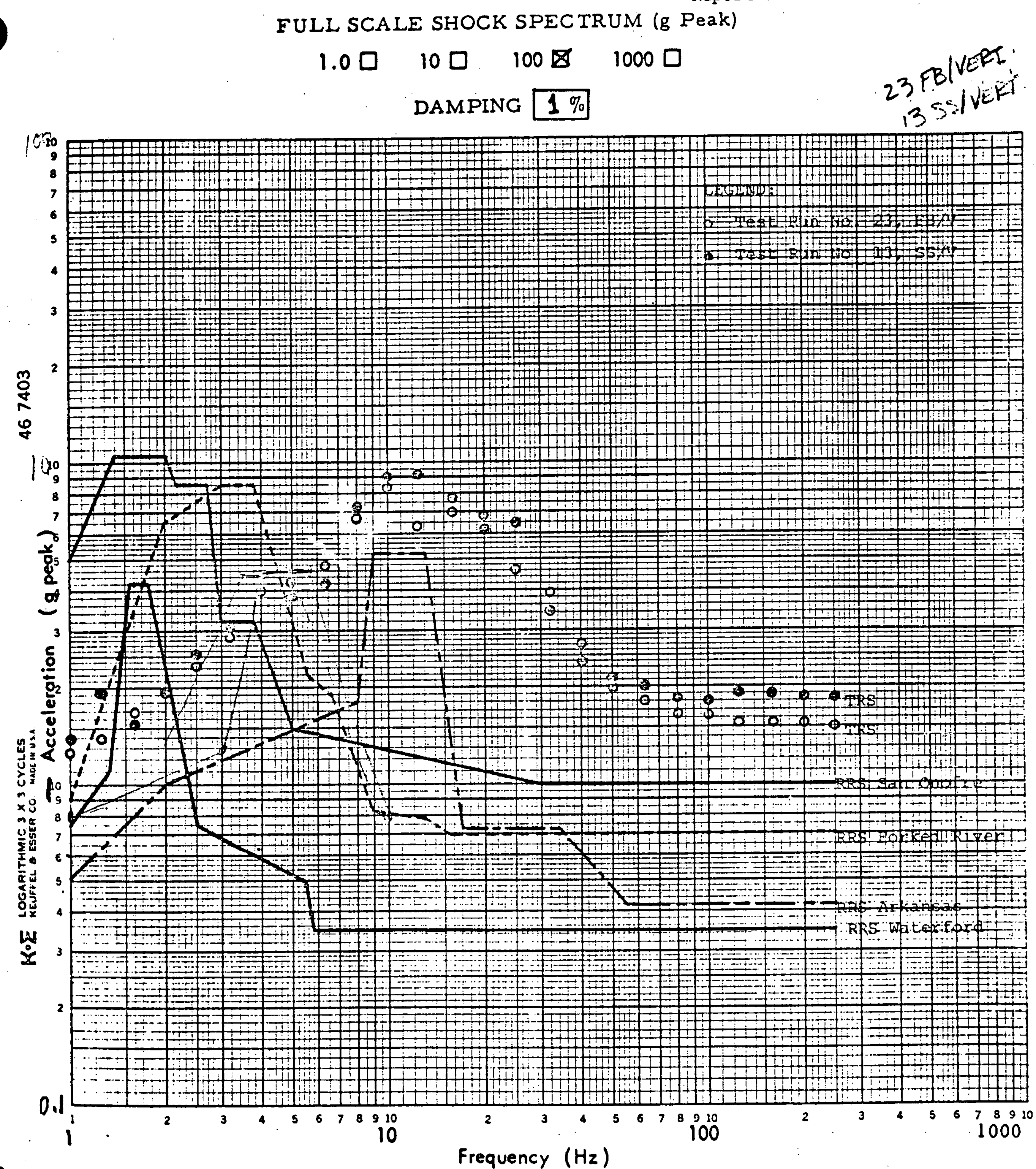


Figure A. Comparison of Horizontal RRS and TRS

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

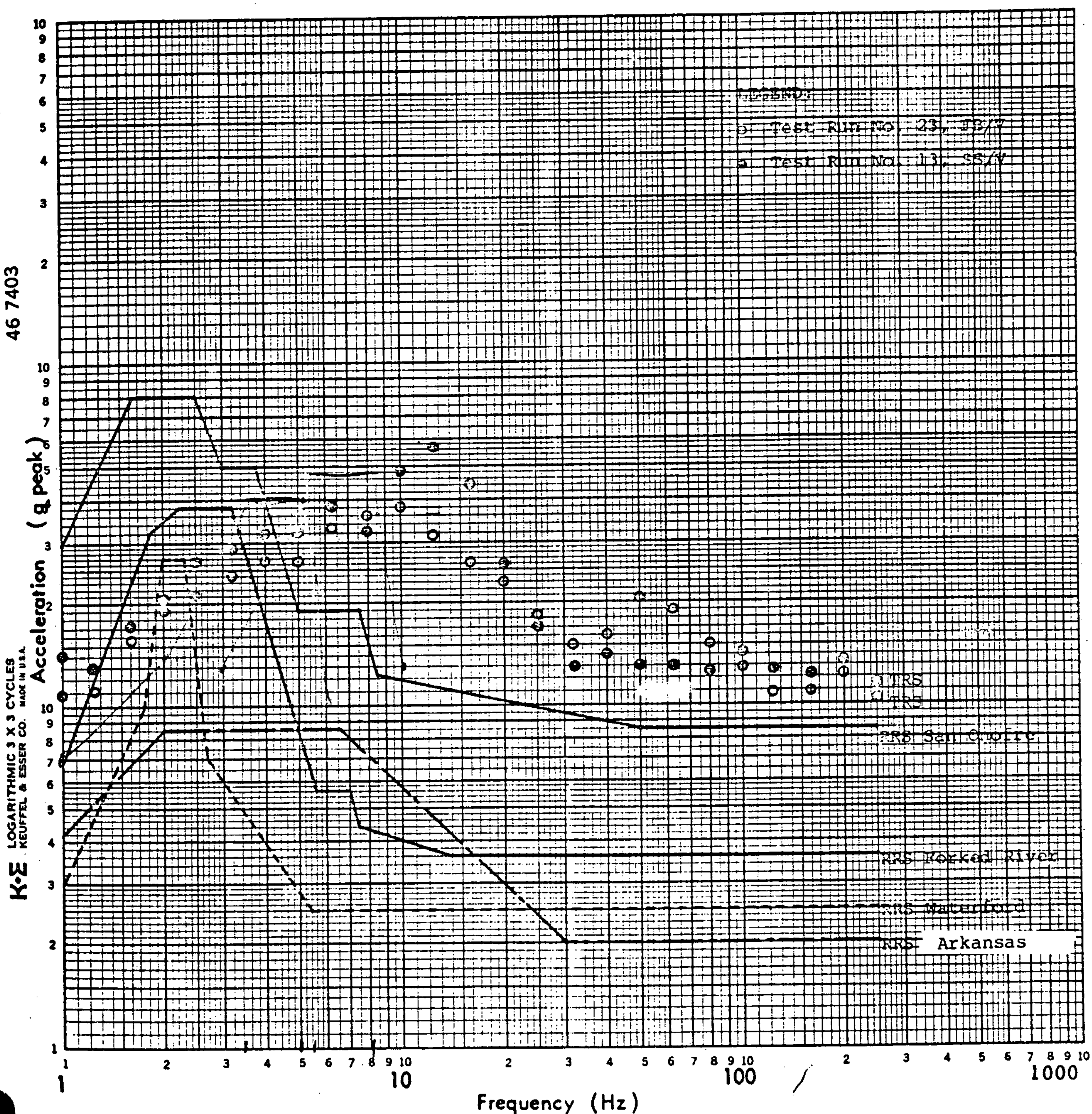
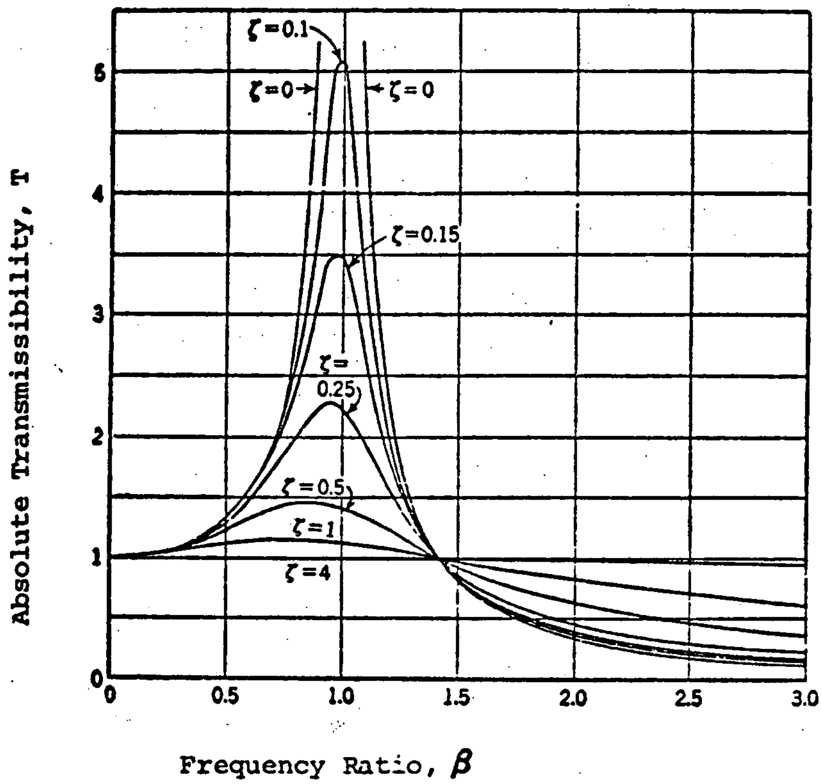


Figure B. Comparison of Vertical
RRS and TRS



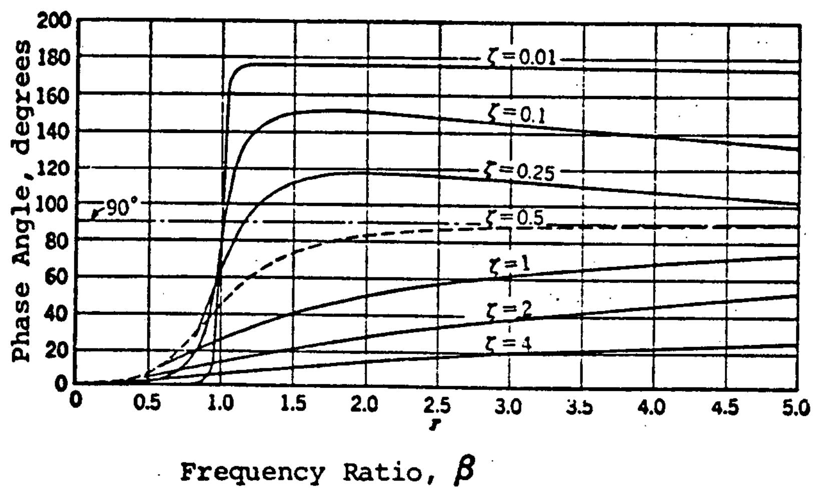
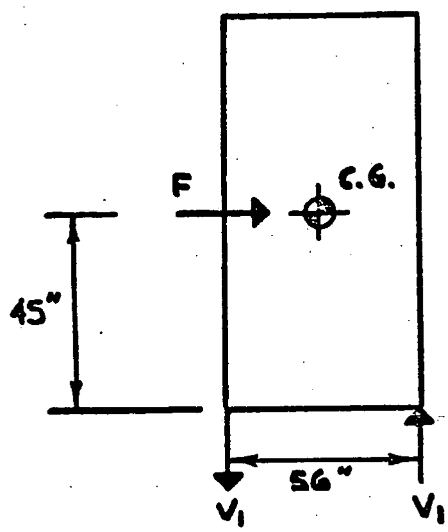
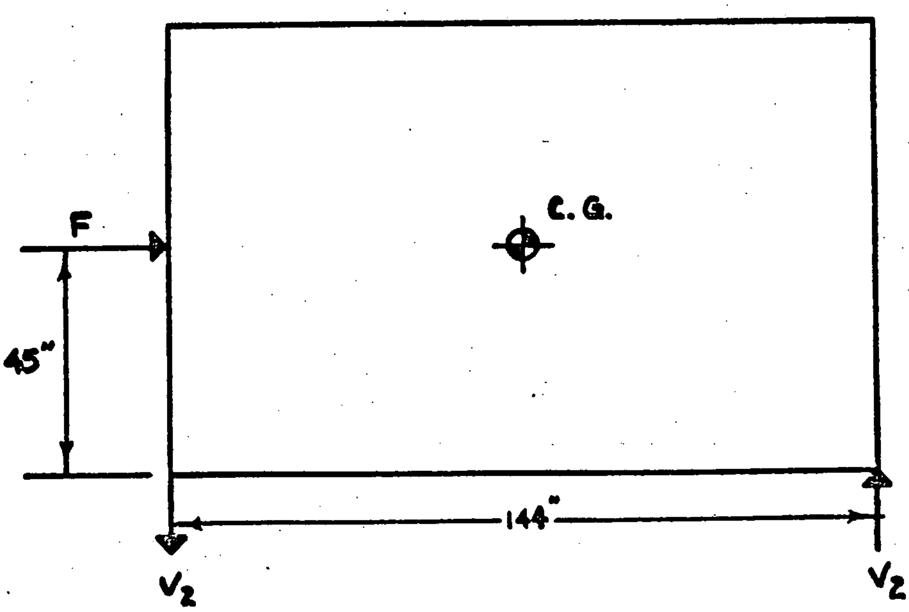


Figure C. Absolute transmissibility and phase angle (lag) for a vibration isolation system with directly coupled viscous damping.



(a) Force diagram showing vertical reaction forces due to moment about the longitudinal axis



(b) Force diagram showing vertical reaction forces due to moment about the transverse axis

Figure D. Force Diagrams of Vertical Reaction Forces

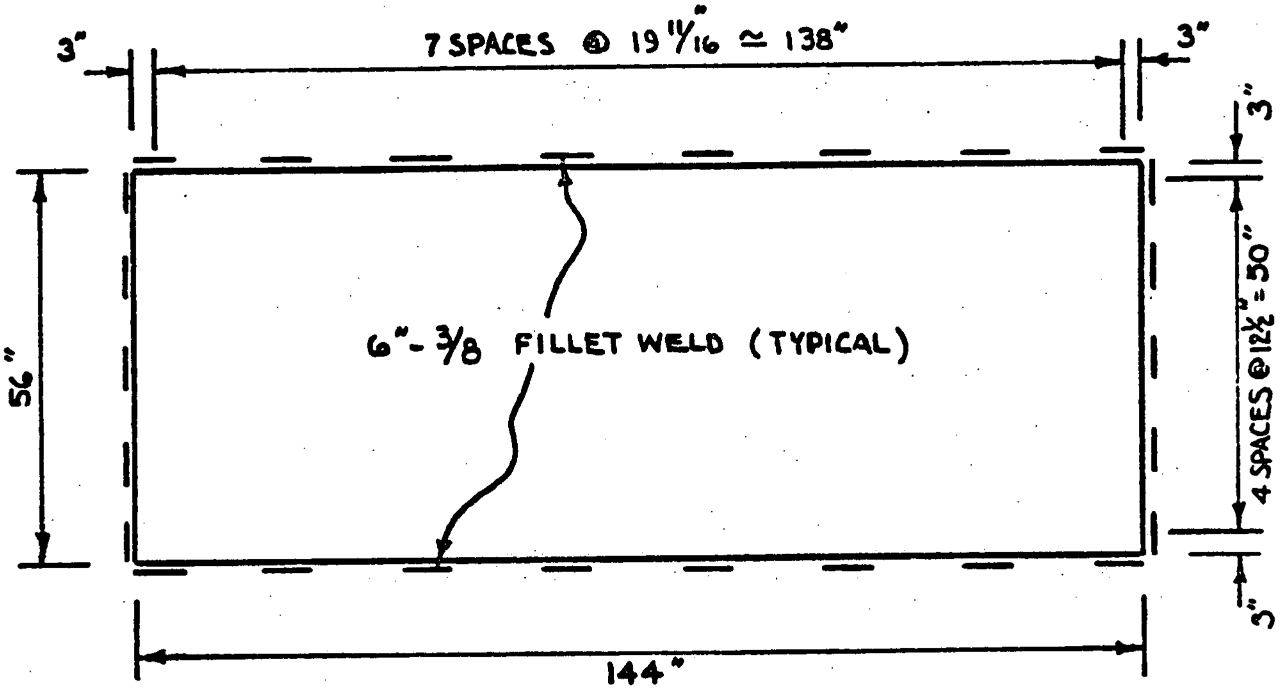


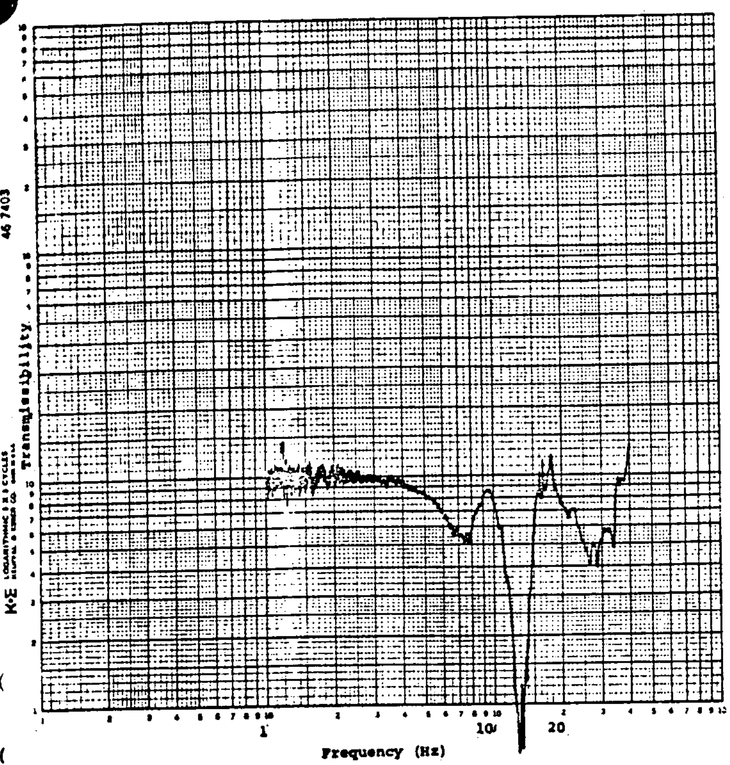
Figure E. Schematic of Weld Requirement at the Equipment Base

APPENDIX II

TRANSMISSIBILITY PLOTS

FULL SCALE TRANSMISSIBILITY

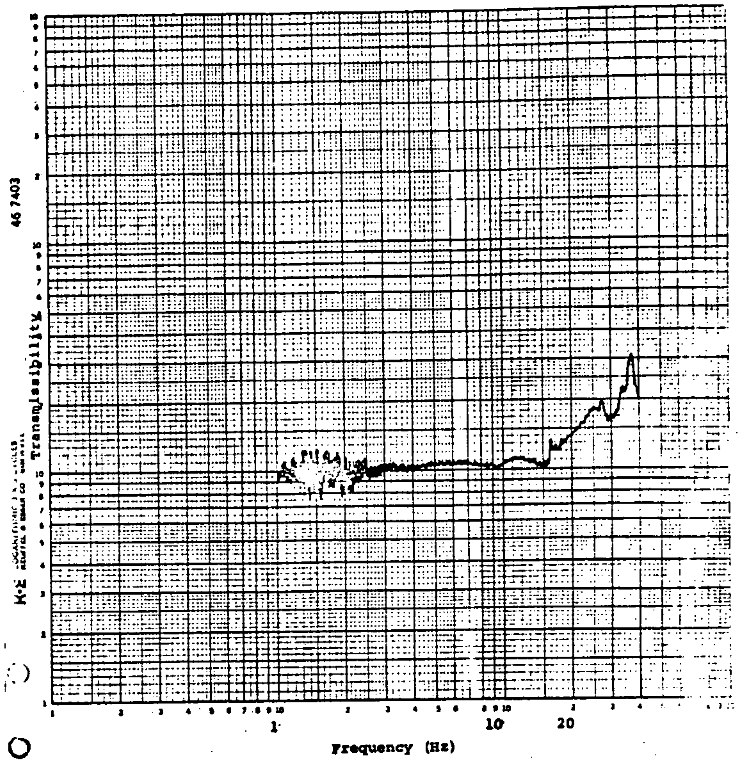
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO. 1SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

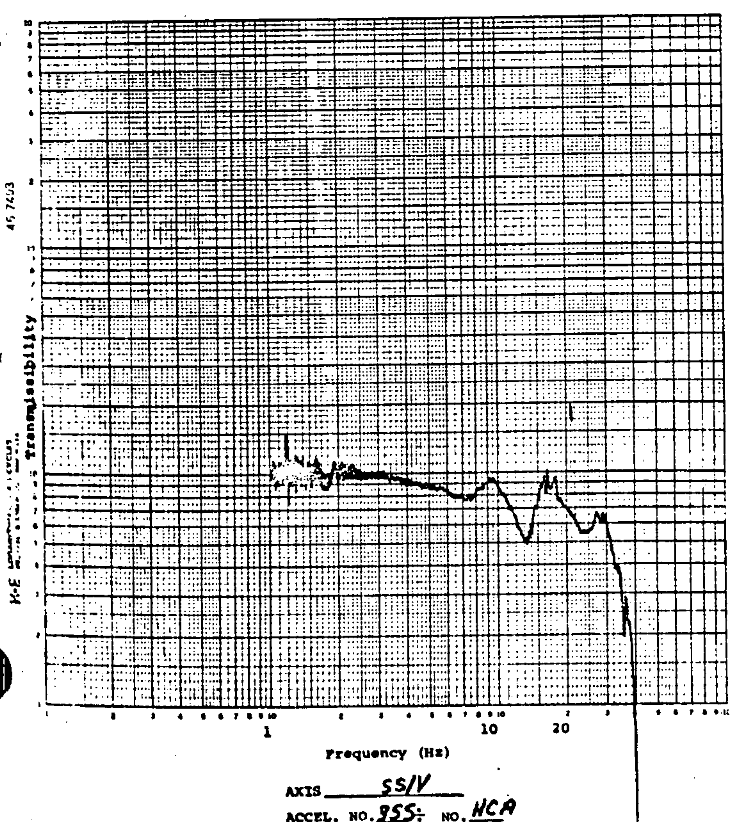
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO. 2V ÷ NO. VCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO. 3SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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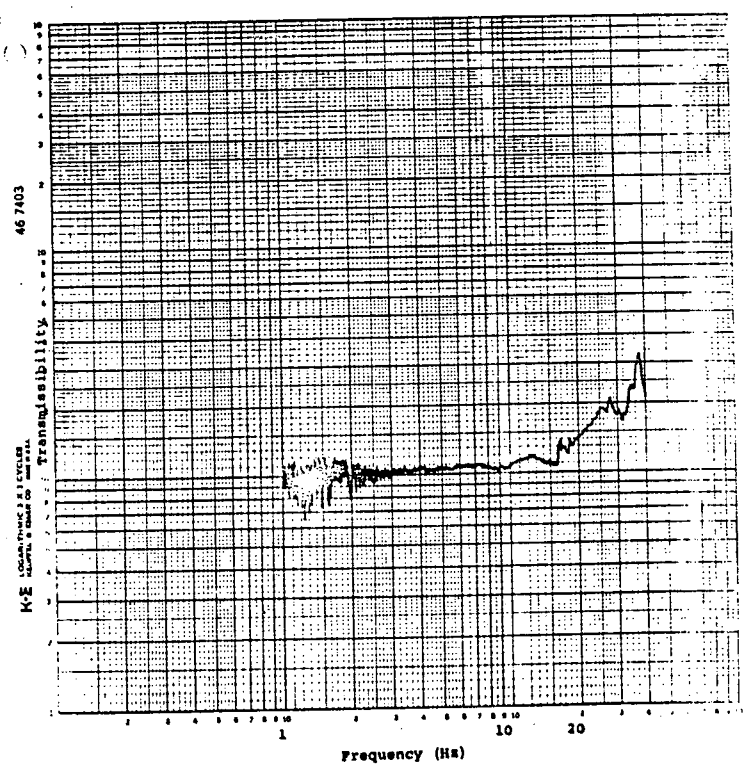
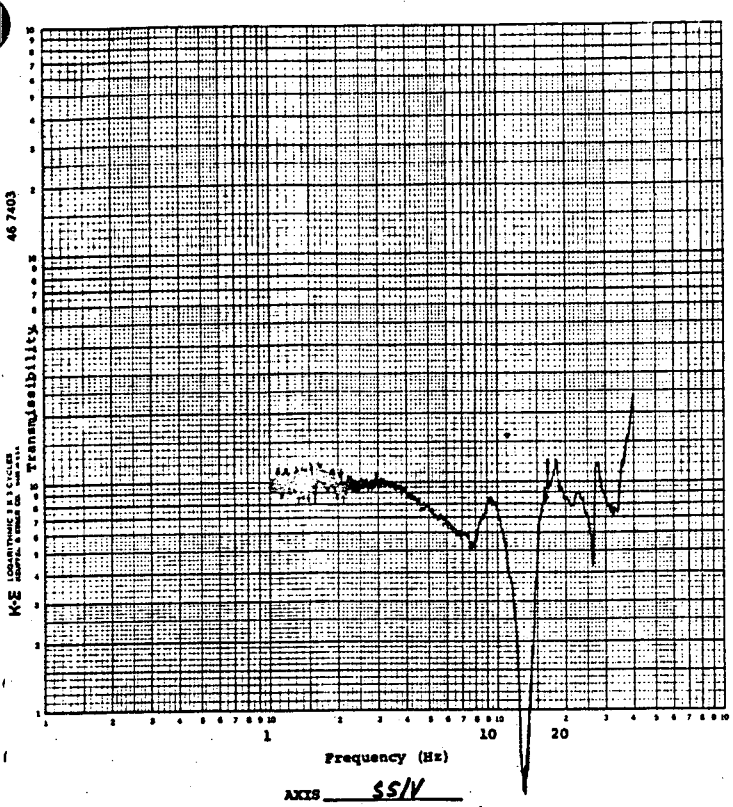


AXIS SS/V
ACCEL. NO. 4V ÷ NO. VCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO. 5SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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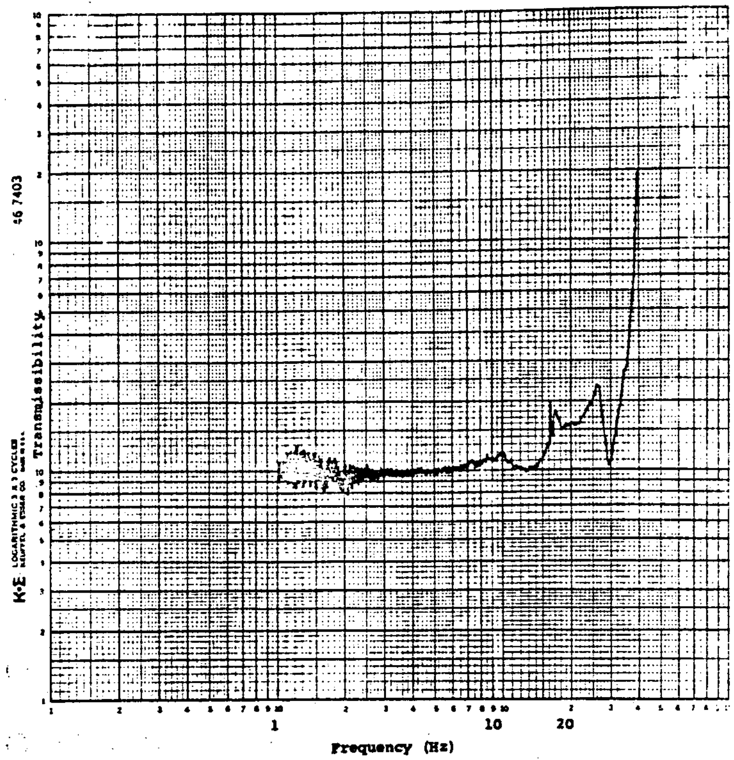

AXIS SS/V
ACCEL. NO. 6V ÷ NO. VCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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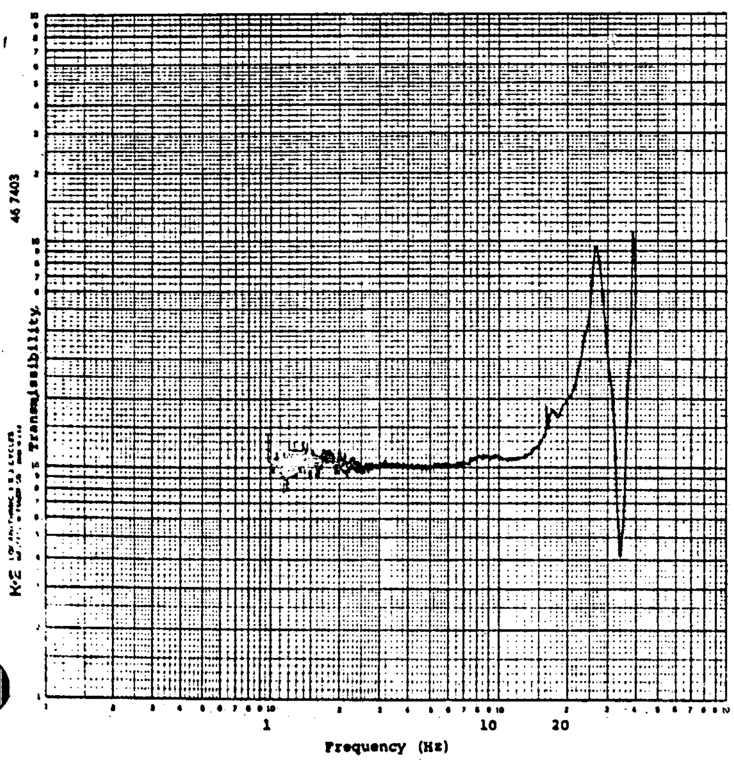
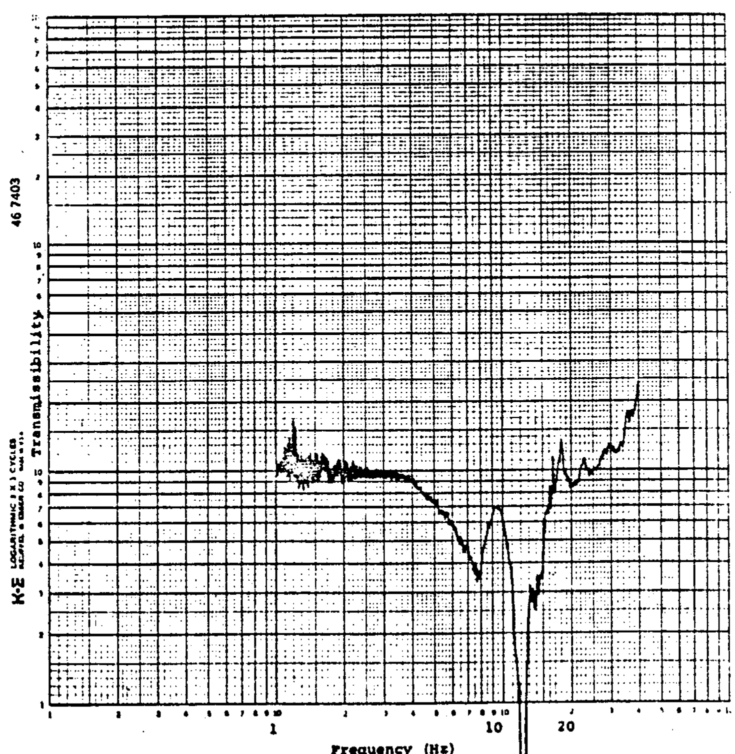


AXIS SS/V
ACCEL. NO. 7V ÷ NO. VCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO. 8SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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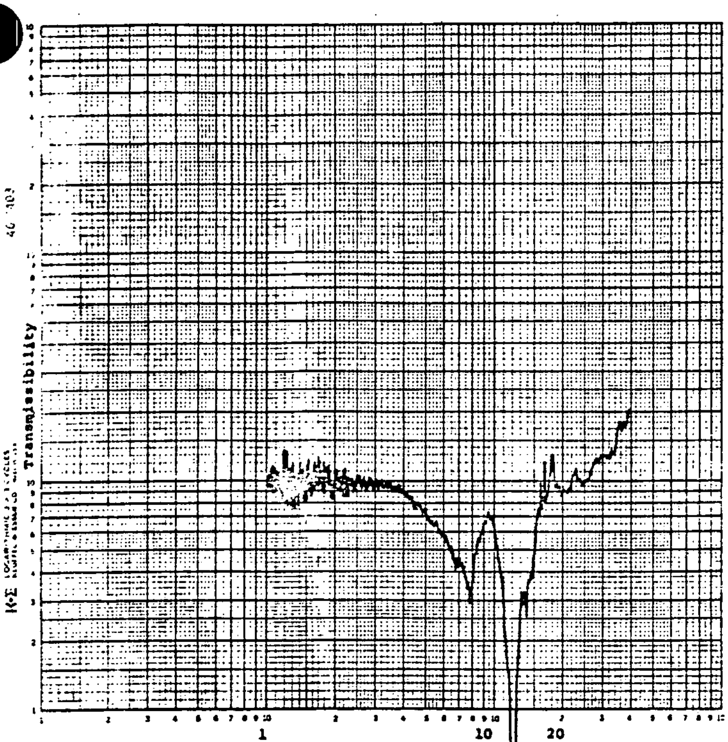

AXIS SS/V
ACCEL. NO. 9SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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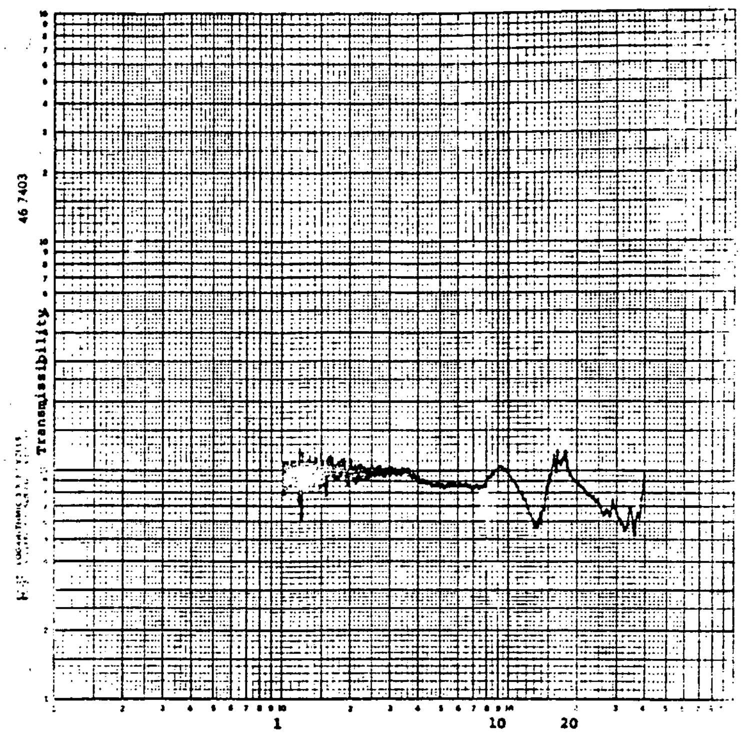
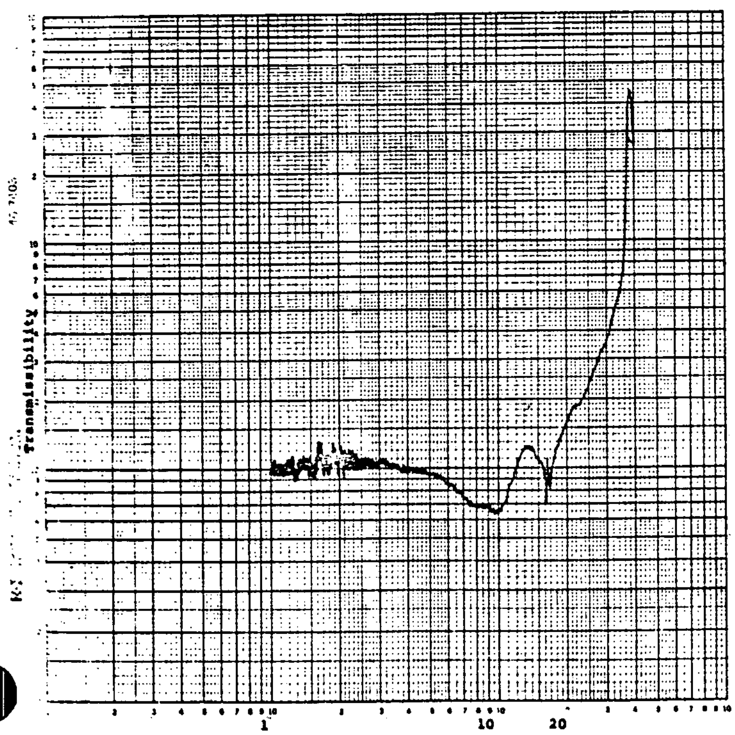


AXIS SS/V
ACCEL. NO. 10SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

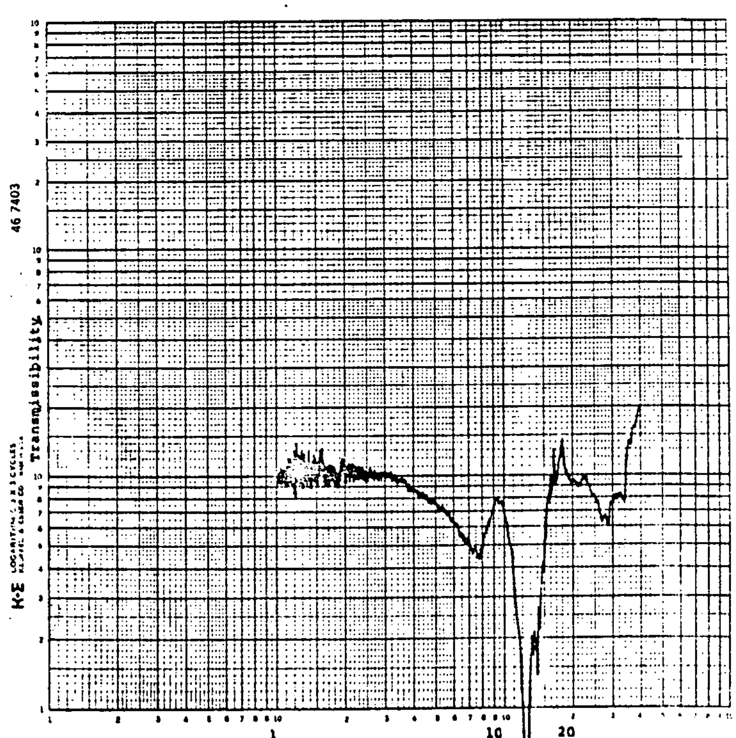
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO. 11V ÷ NO. VCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

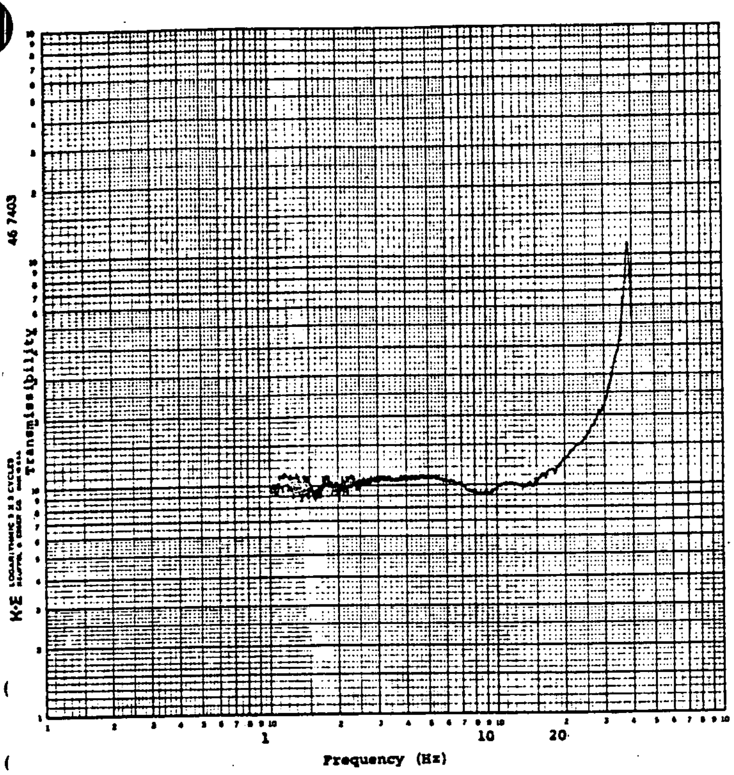
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO 12SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

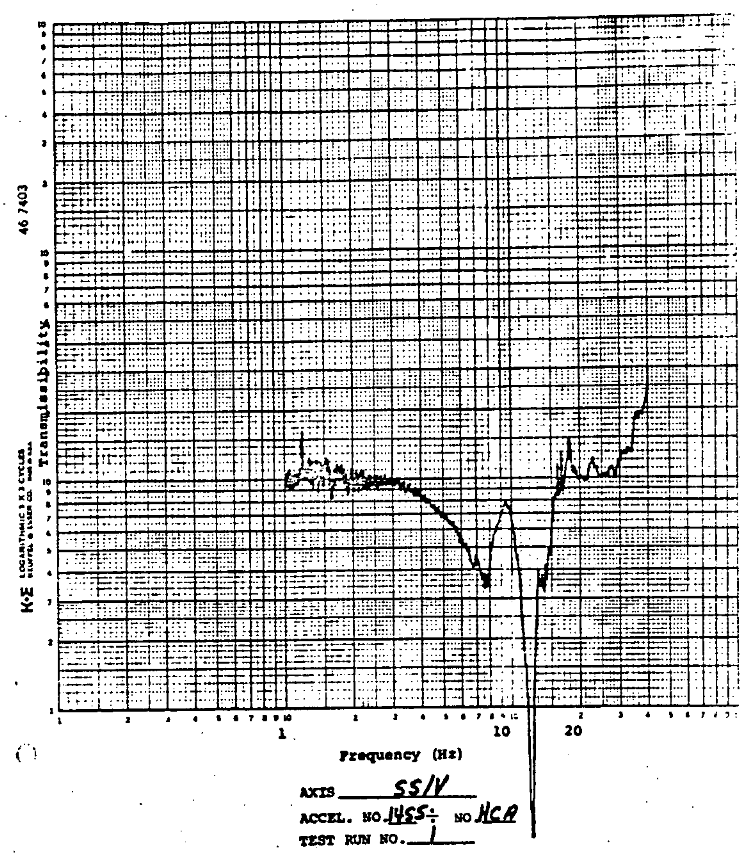
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO. 13V ÷ NO. VCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO. 14SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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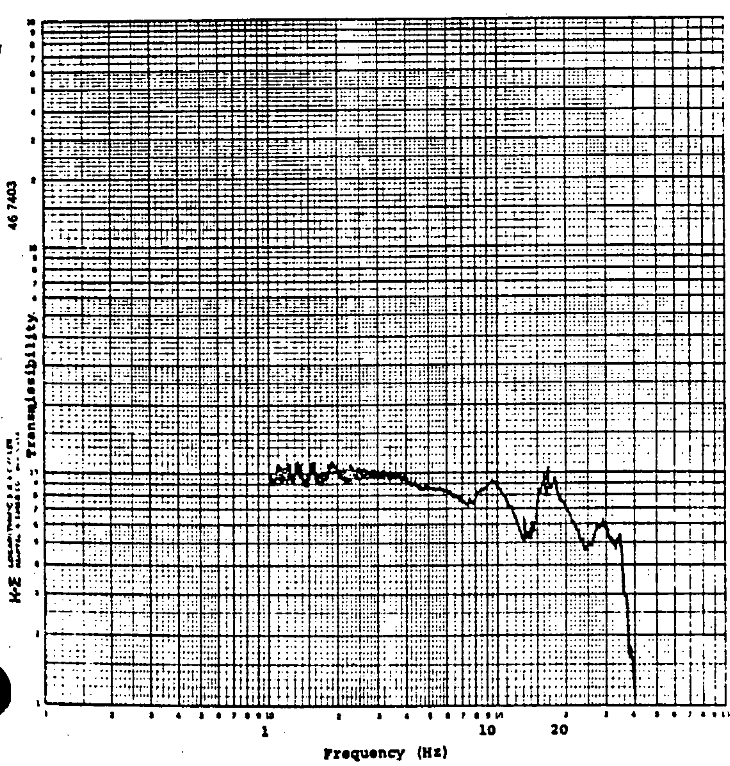

AXIS SS/V
ACCEL. NO. 15SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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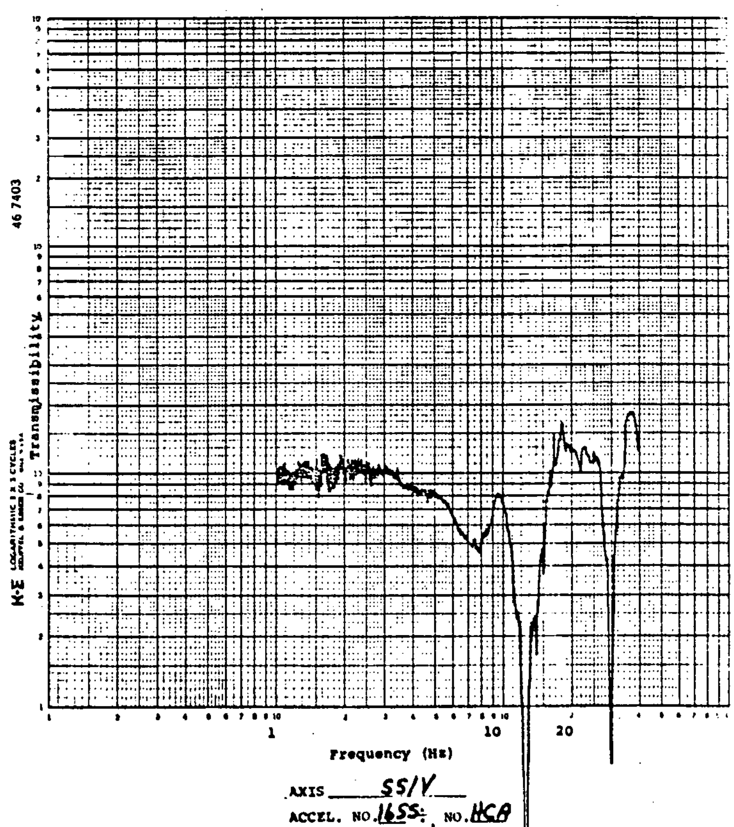

AXIS SS/V
ACCEL. NO. 16SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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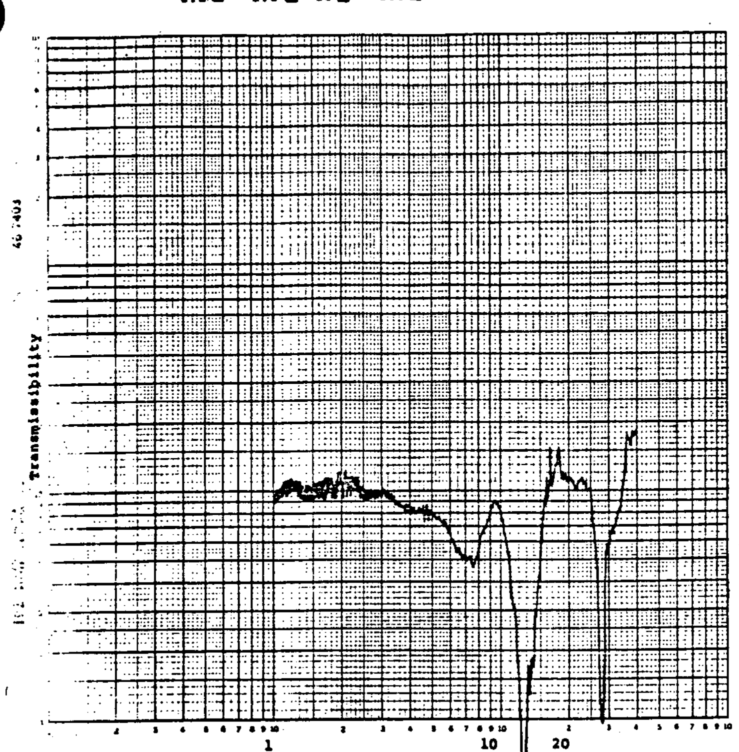

AXIS SS/V
ACCEL. NO 17SS ÷ NO HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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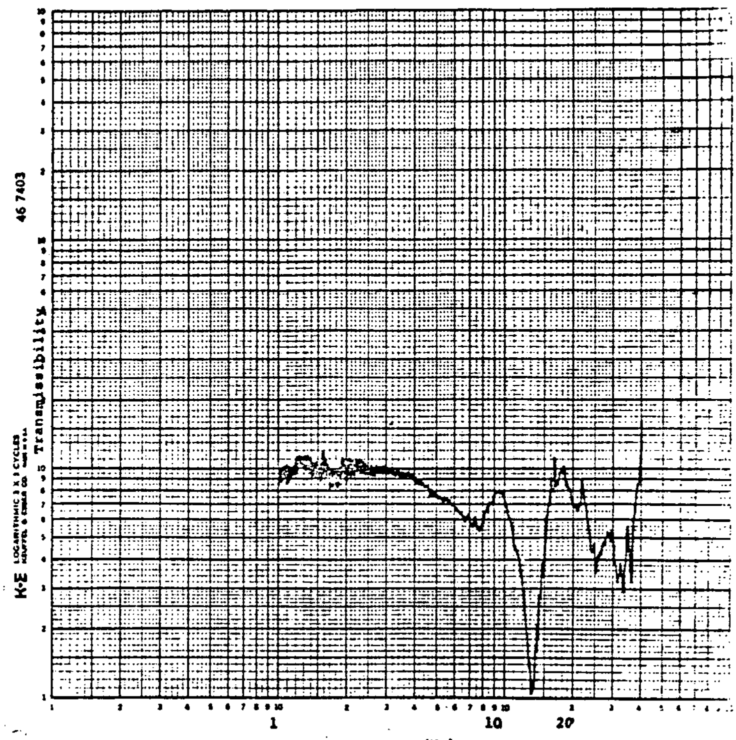

AXIS SS/V
ACCEL. NO. 18SS ÷ NO. HCA
TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

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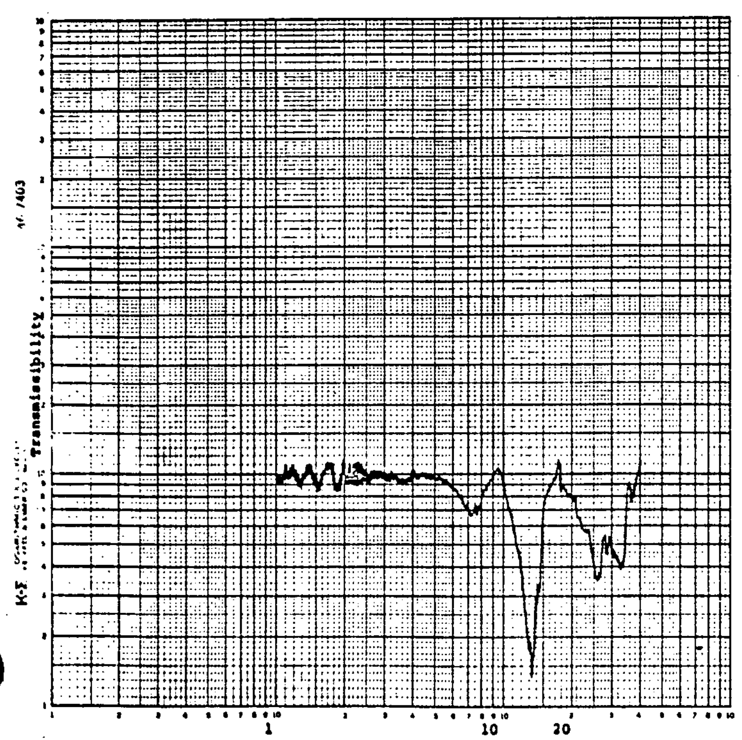
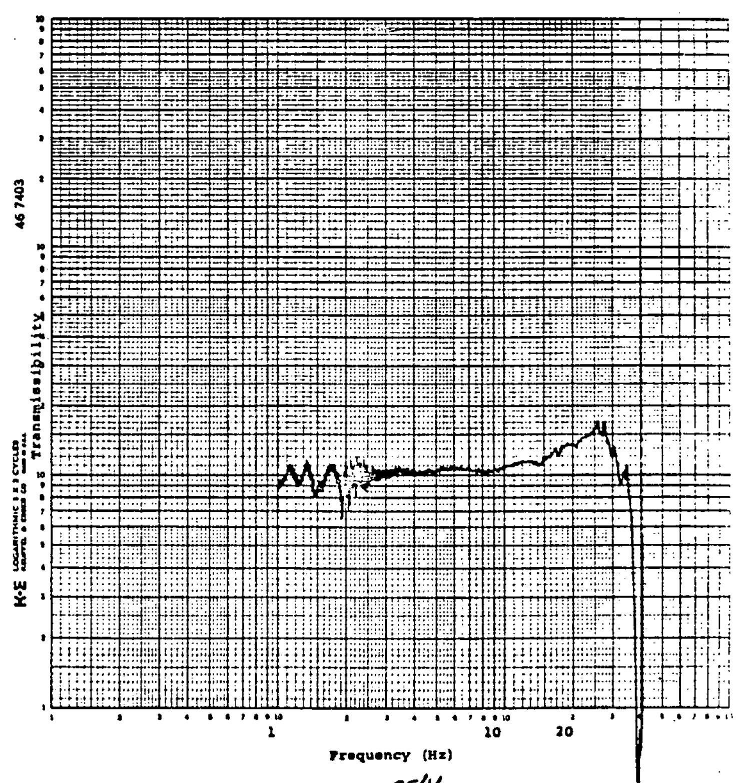


AXIS SS/V
ACCEL. NO 1SS ÷ NO. HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

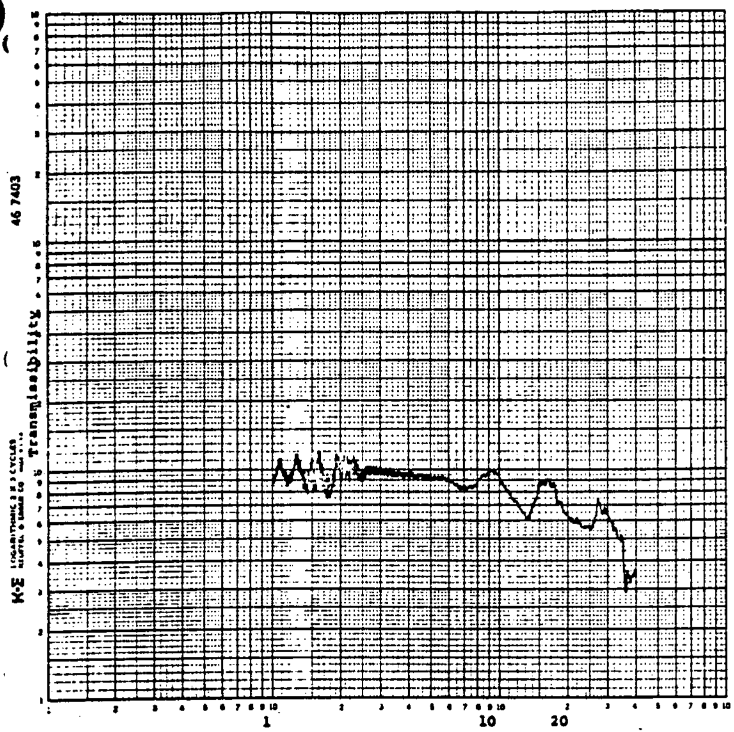
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO 2V ÷ NO. VCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

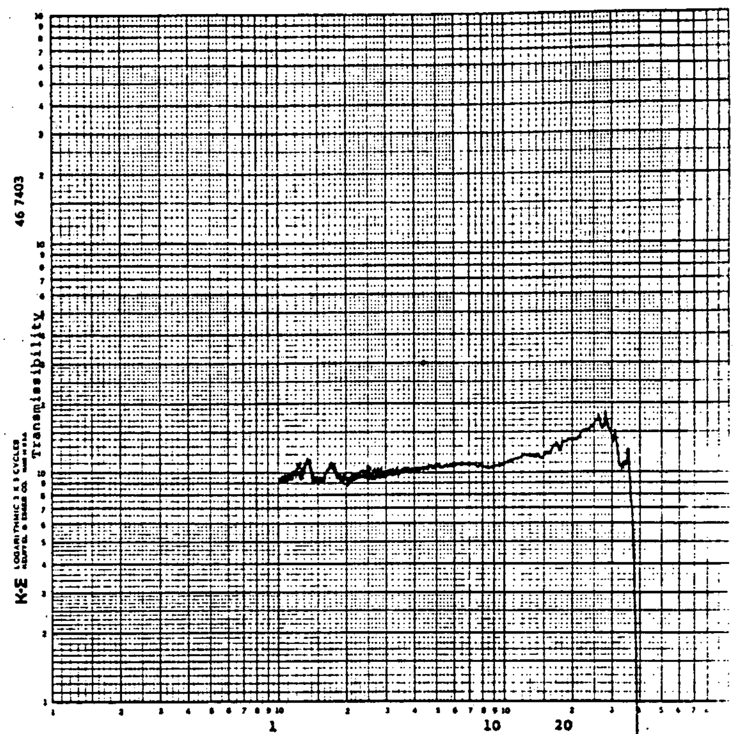


Frequency (Hz)

AXIS SS/V
ACCEL. NO 3SS ÷ NO HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

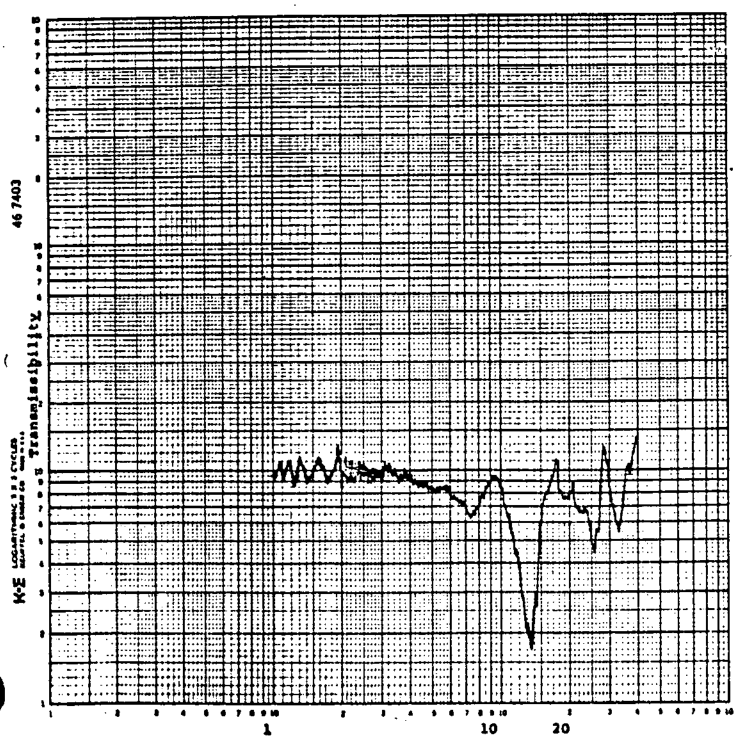


Frequency (Hz)

AXIS SS/V
ACCEL. NO. 4V ÷ NO. VCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



Frequency (Hz)

AXIS SS/V
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TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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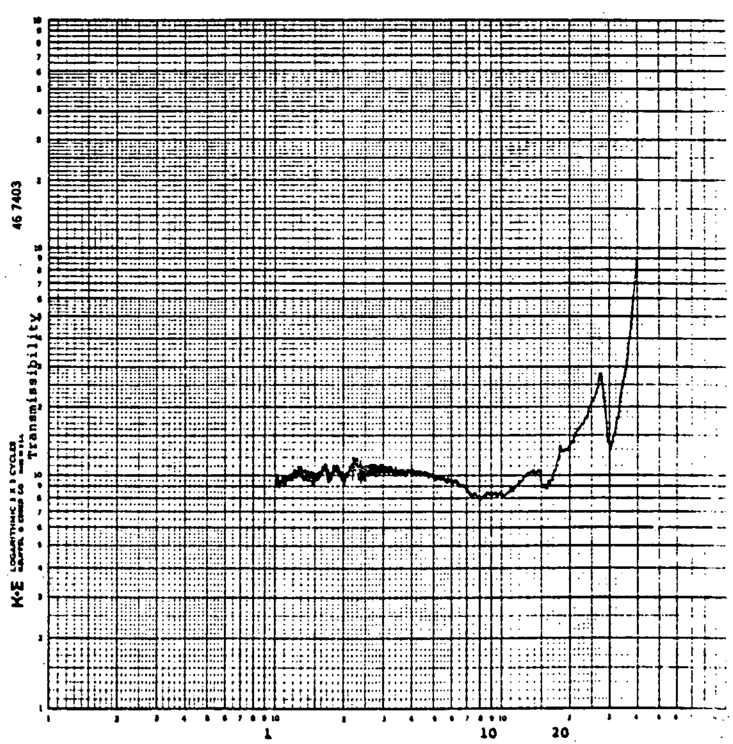

Frequency (Hz)

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FULL SCALE TRANSMISSIBILITY

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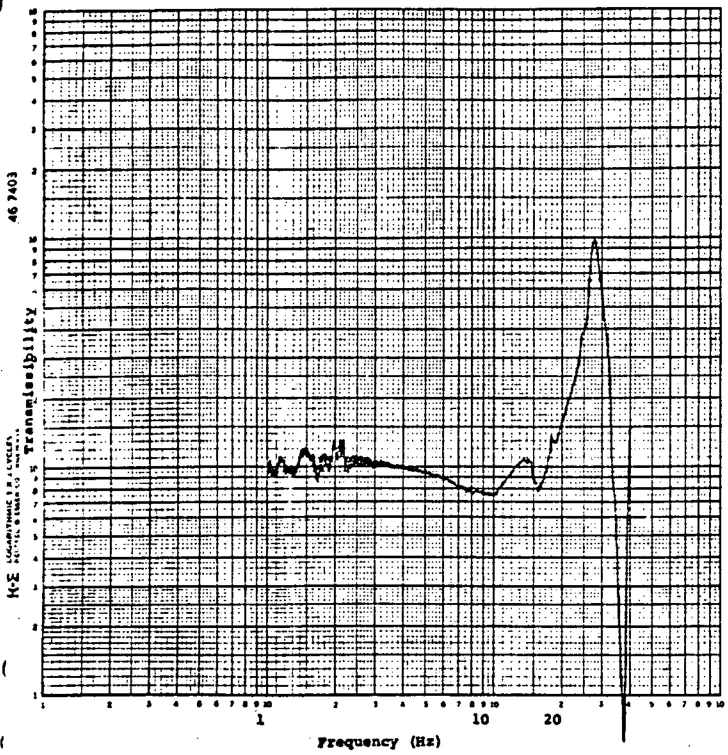

AXIS SS/V
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FULL SCALE TRANSMISSIBILITY

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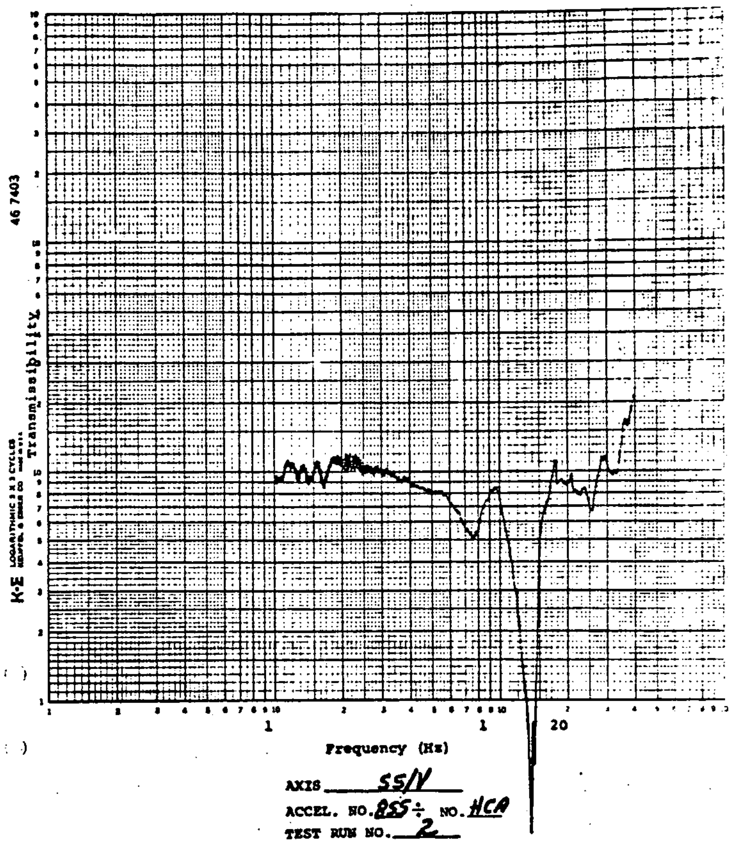

AXIS SS/V
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FULL SCALE TRANSMISSIBILITY

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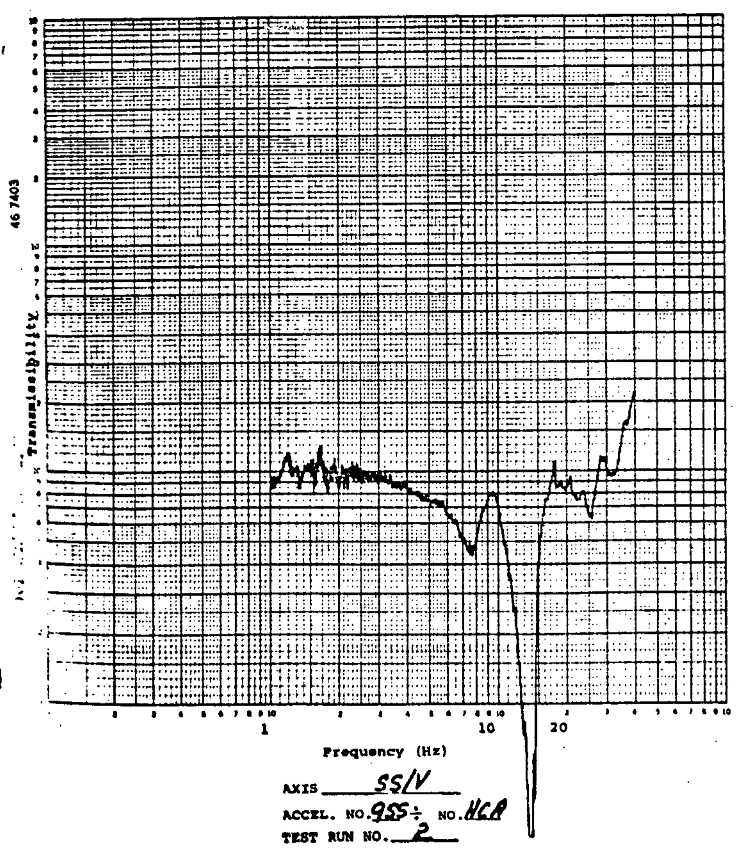

AXIS SS/V
ACCEL. NO. 9SS ÷ NO. HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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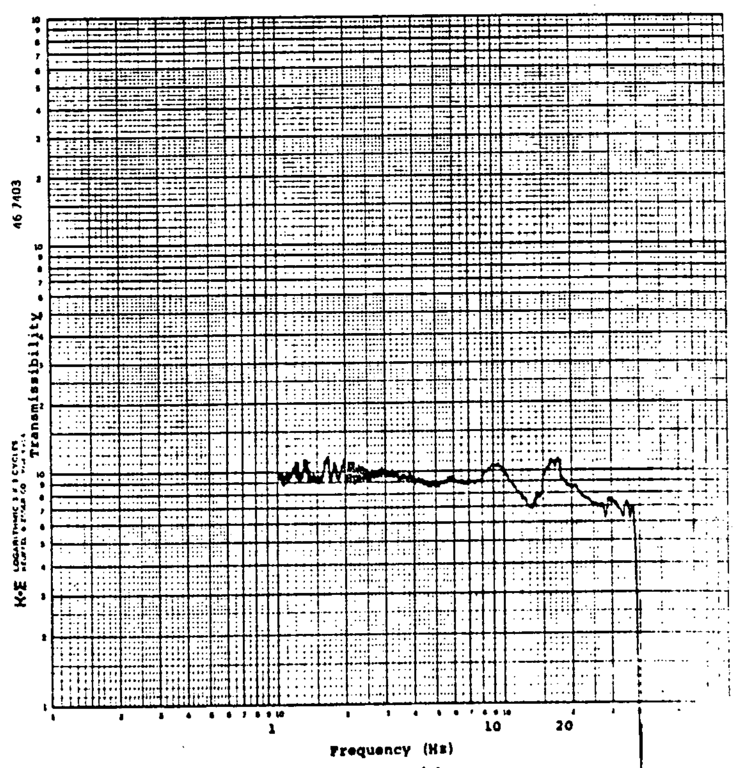

AXIS SS/V
ACCEL. NO. 10SS ÷ NO. HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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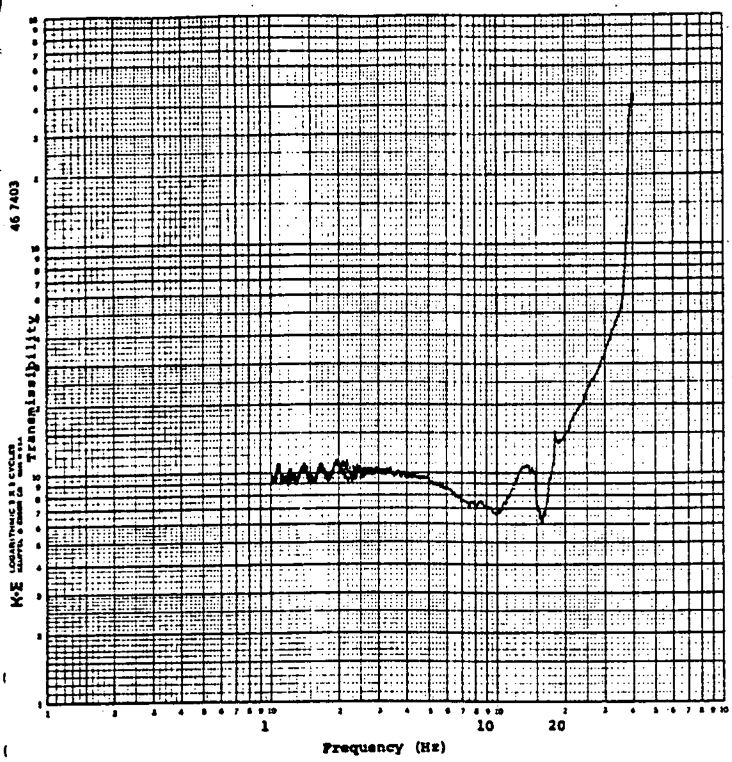
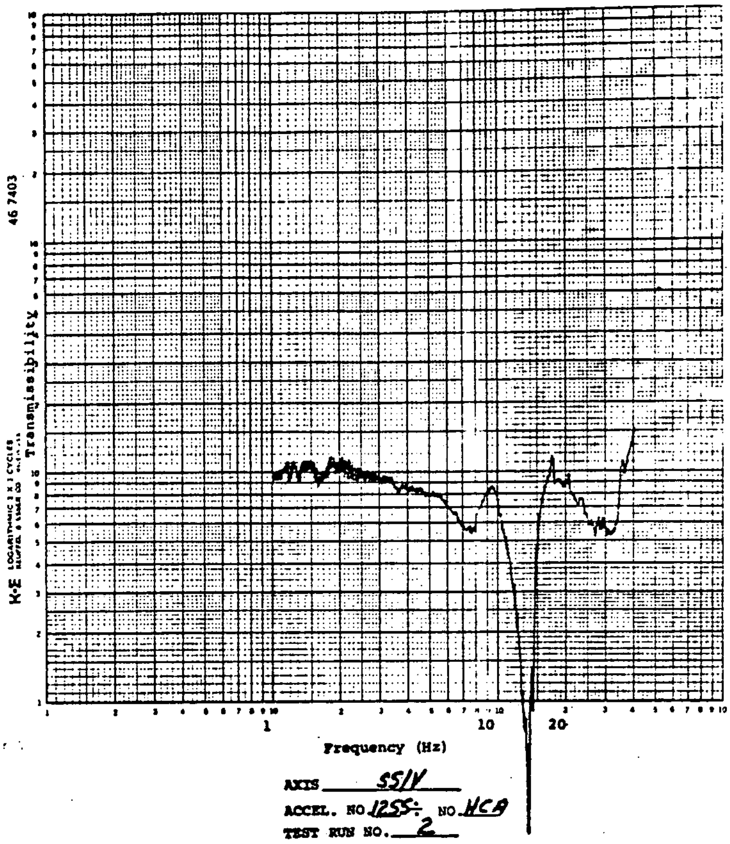


AXIS SS/V
ACCEL. NO 11V ÷ NO. VCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS/V
ACCEL. NO 12SS ÷ NO. HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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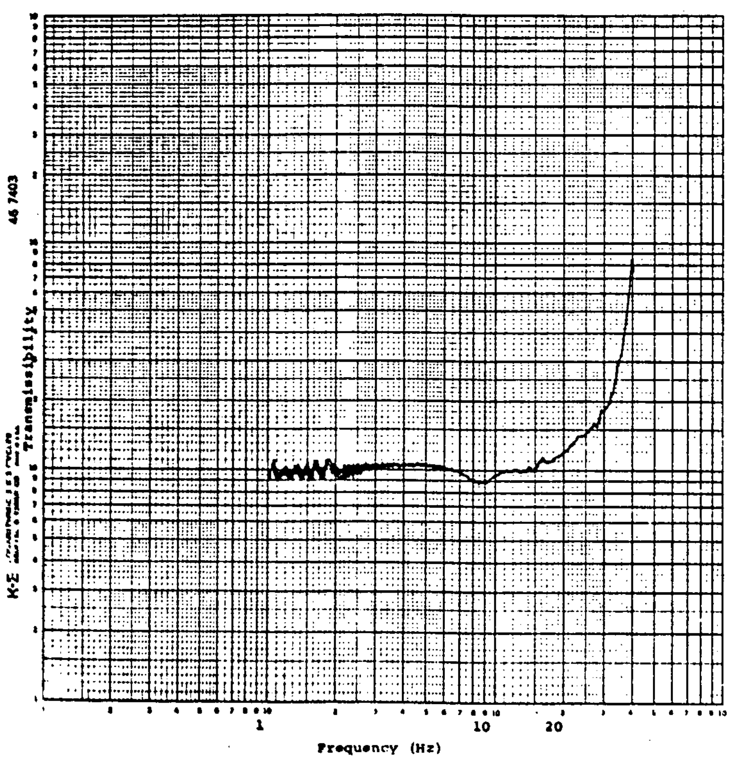

AXIS SS/V
ACCEL. NO 13V ÷ NO. VCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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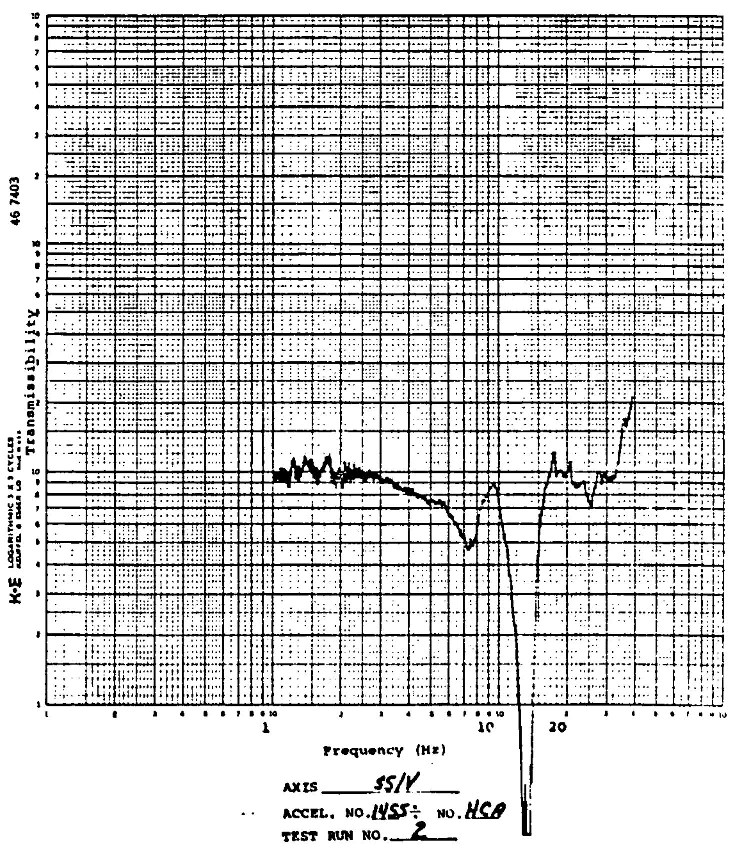

AXIS SS/V
ACCEL. NO. 14SS ÷ NO. HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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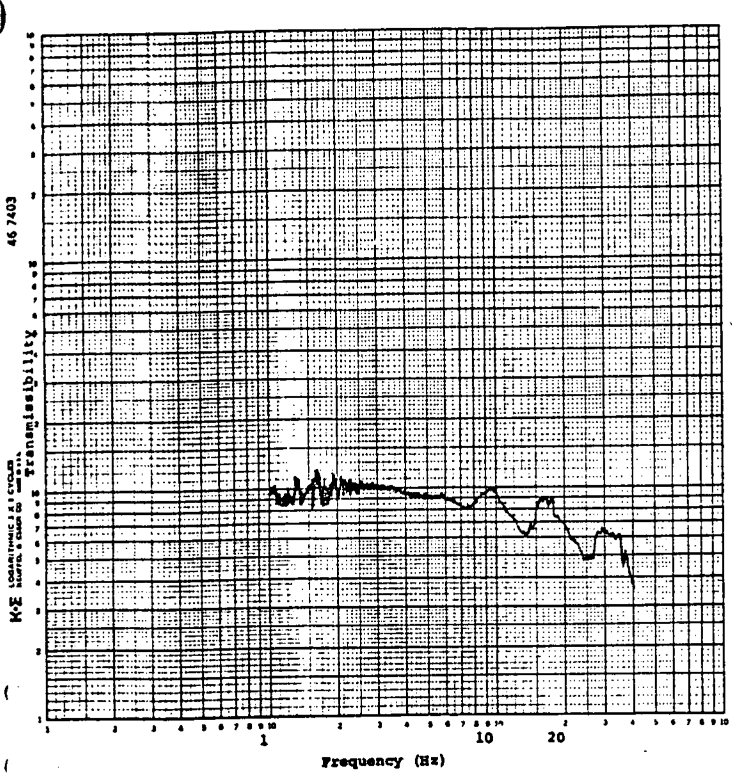

AXIS SS/V
ACCEL. NO. 1555 ÷ NO. HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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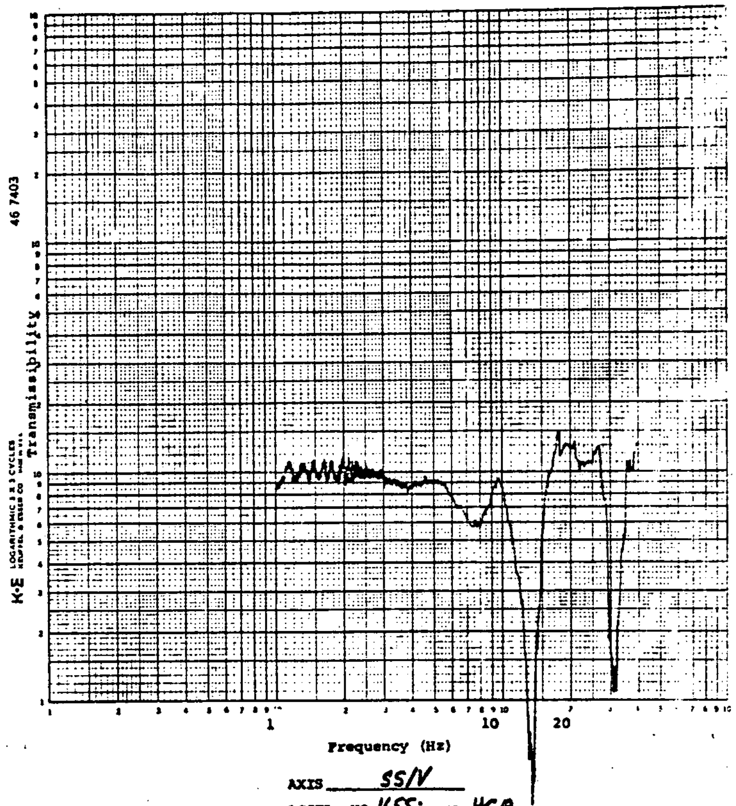

AXIS SS/V
ACCEL. NO 1655 ÷ NO. HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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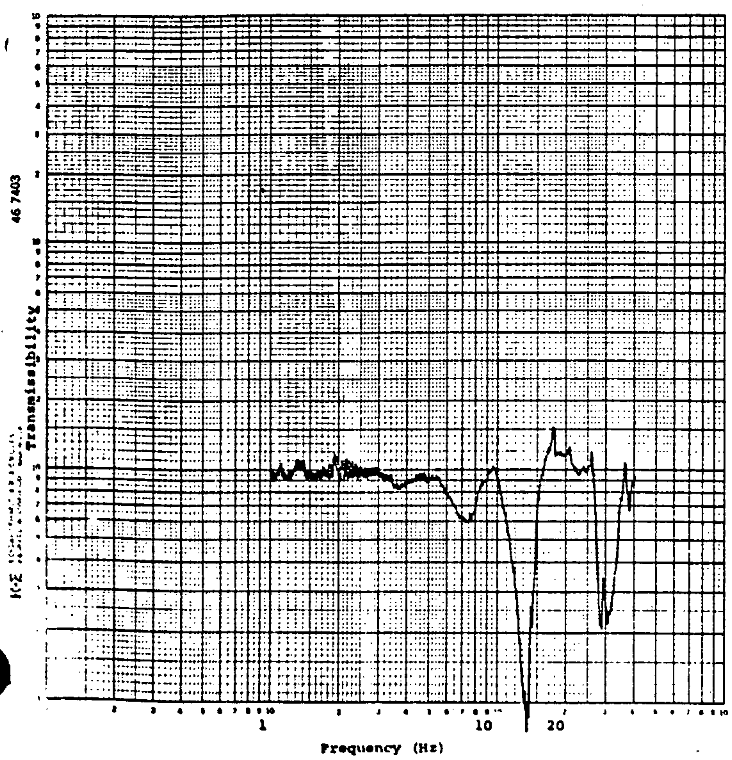

AXIS SS/V
ACCEL. NO 1755 ÷ NO HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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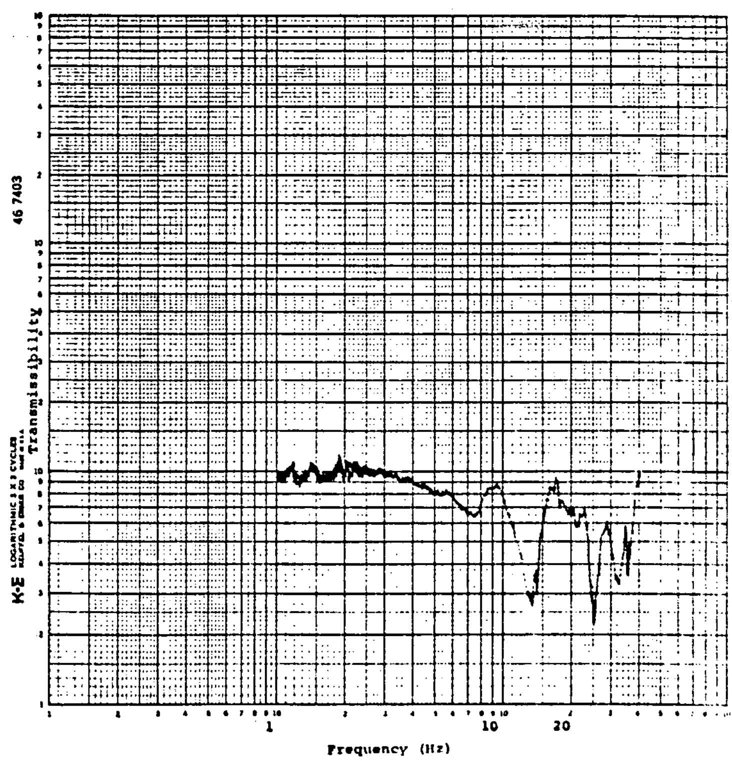

AXIS SS/V
ACCEL. NO. 1855 ÷ NO. HCA
TEST RUN NO. 2

FULL SCALE TRANSMISSIBILITY

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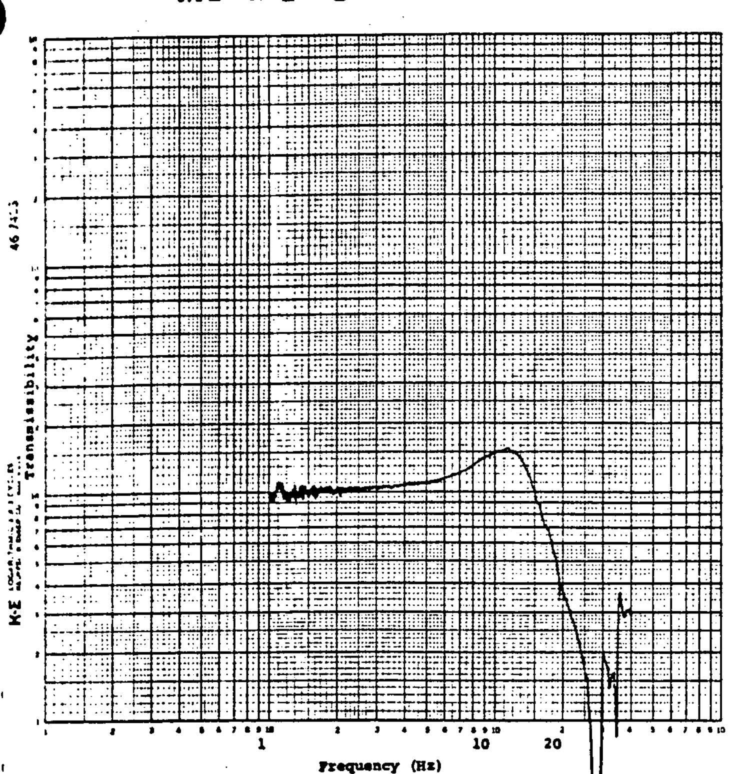
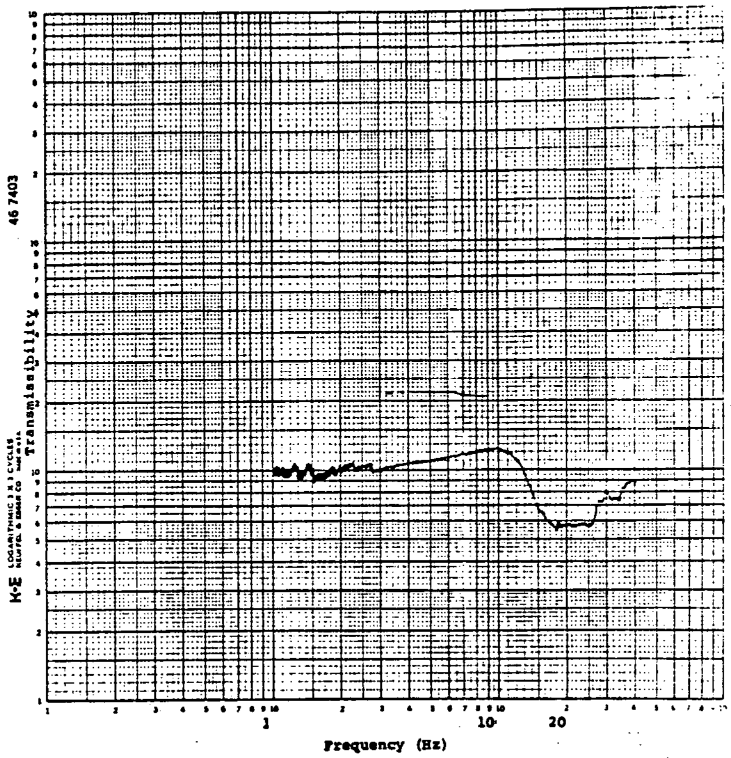


AXIS SS
ACCEL. NO. 1SS ÷ NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

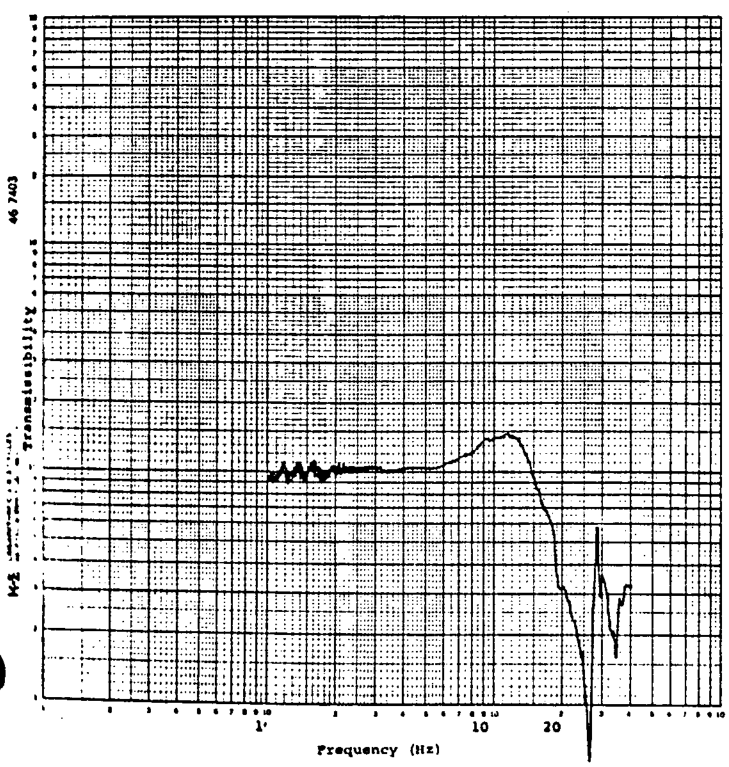
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS
ACCEL. NO. 3SS ÷ NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

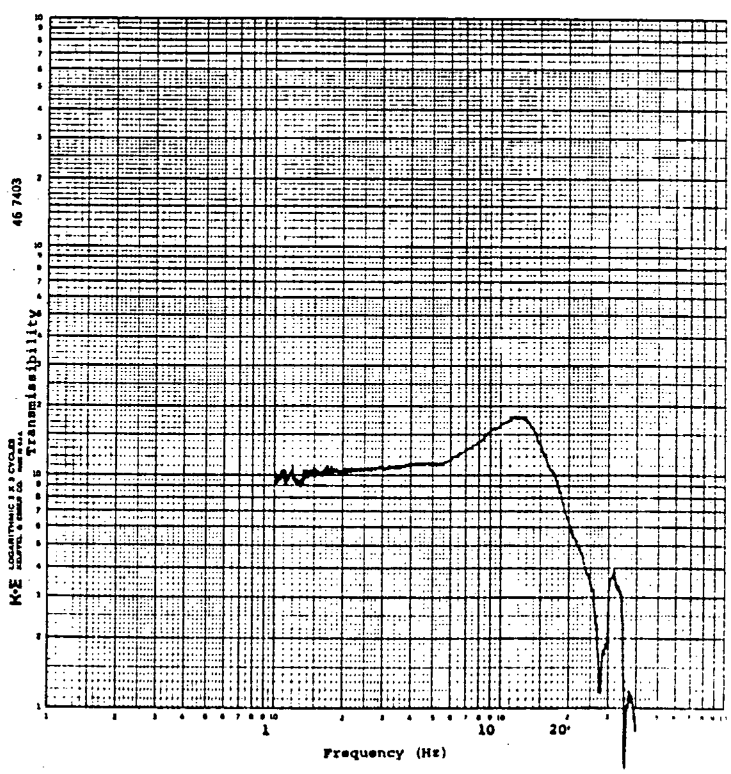
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS
ACCEL. NO 5SS ÷ NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS
ACCEL. NO. 8SS ÷ NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

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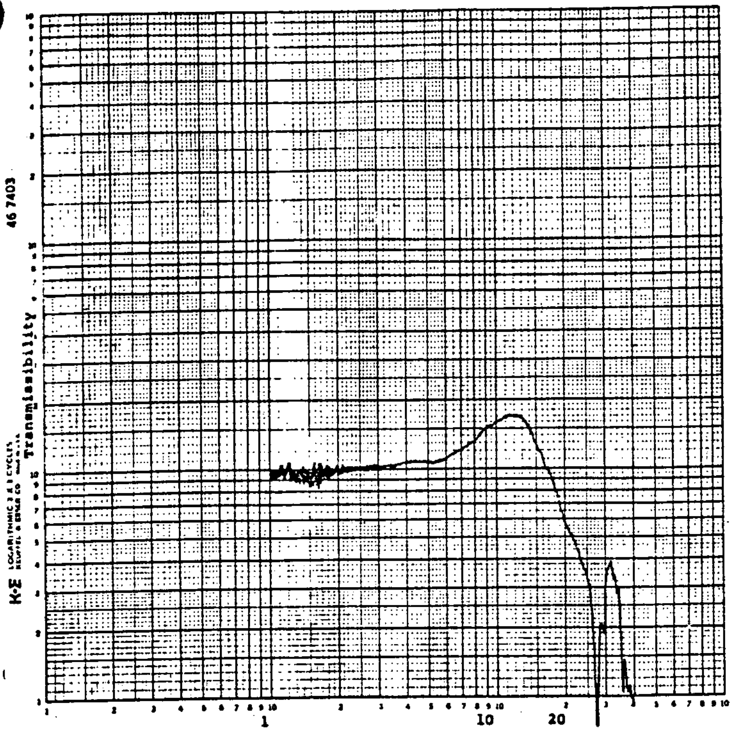
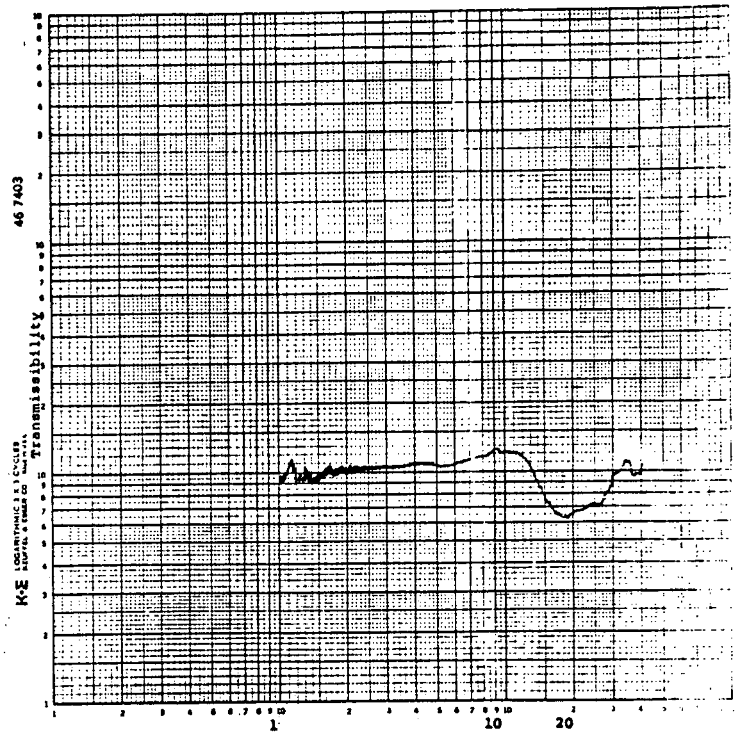


Frequency (Hz)

AXIS SS
ACCEL. NO. 9SS ÷ NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



Frequency (Hz)

AXIS SS
ACCEL. NO. 10SS ÷ NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

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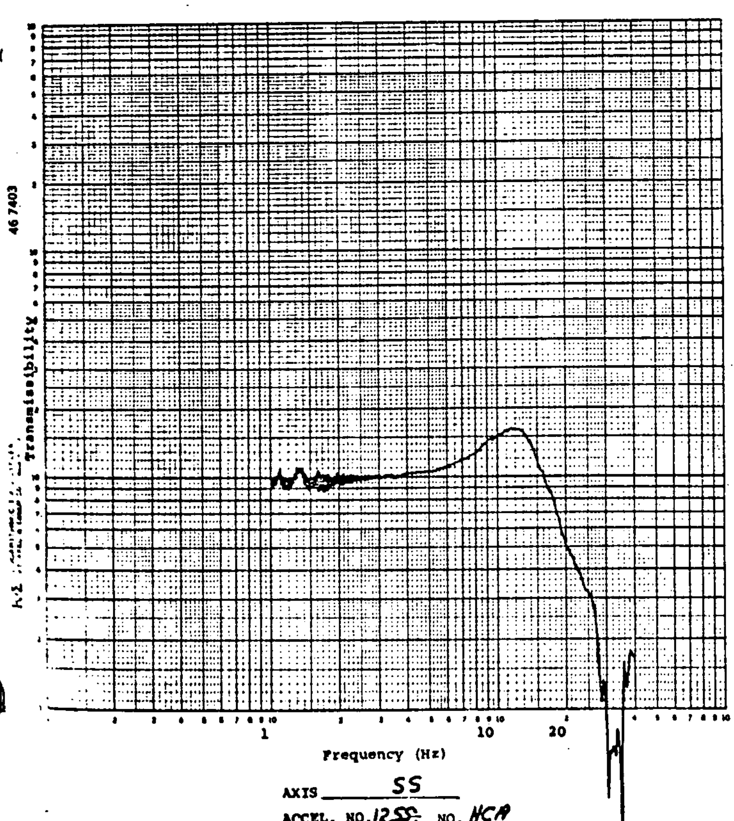
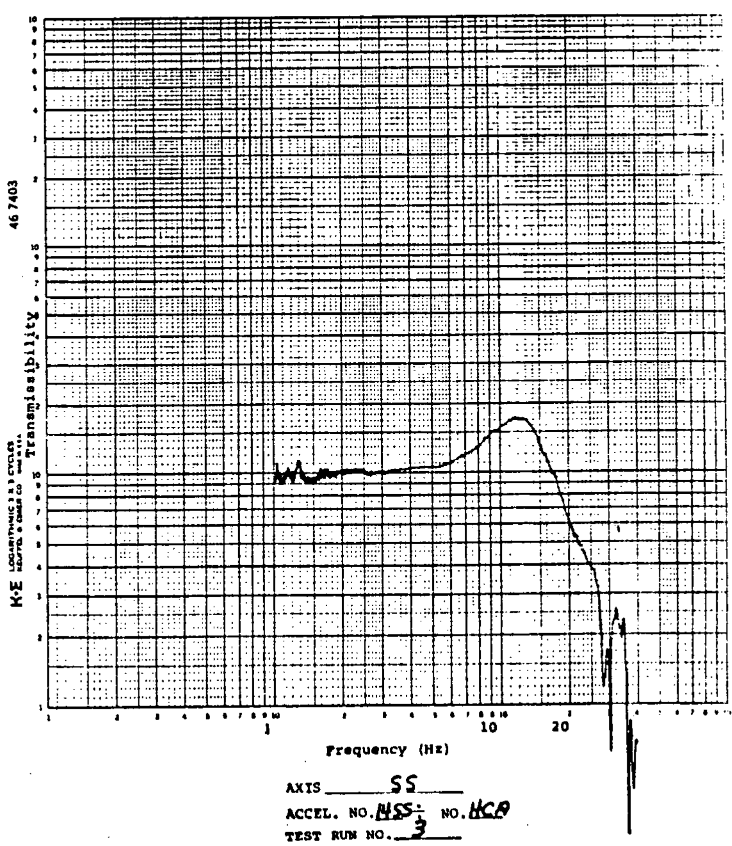


Frequency (Hz)

AXIS SS
ACCEL. NO. 12SS ÷ NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

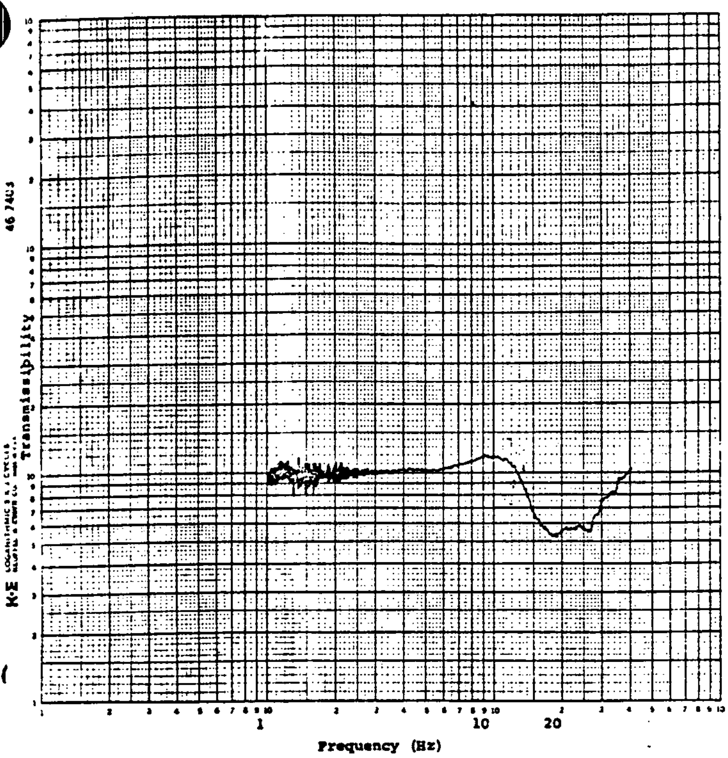


Frequency (Hz)

AXIS SS
ACCEL. NO. 11SS ÷ NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

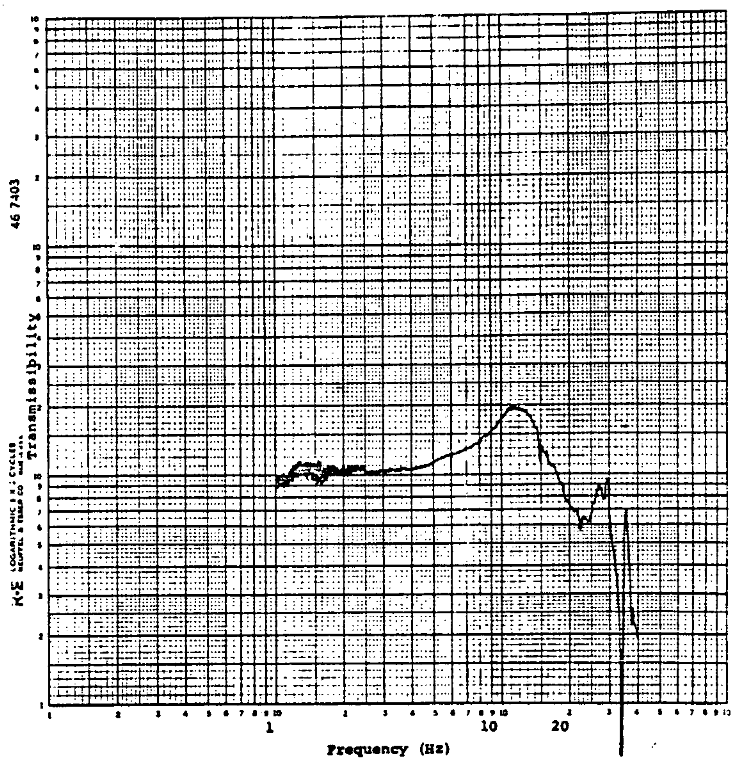
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS
ACCEL. NO. 15SS: NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

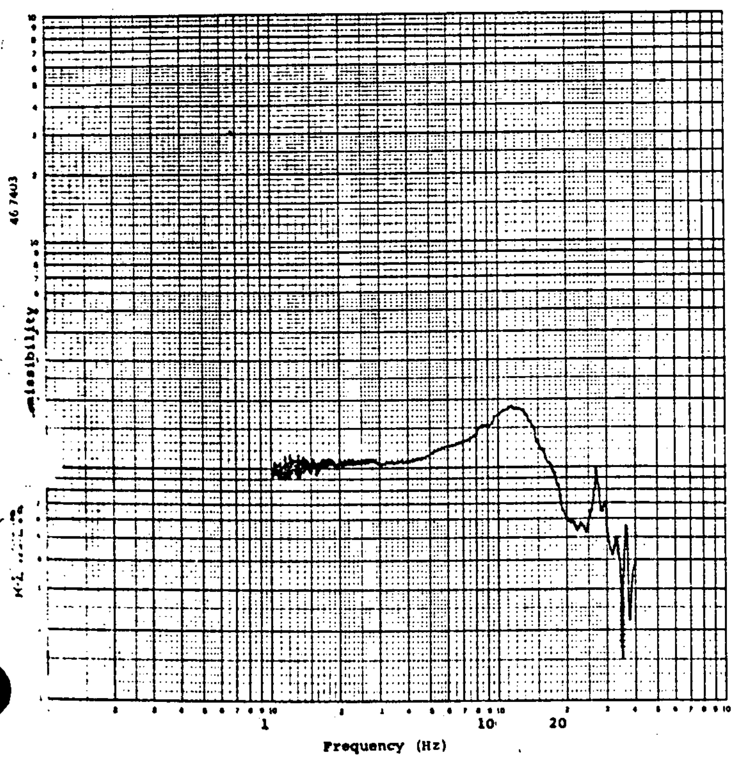
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS
ACCEL. NO. 16SS: NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

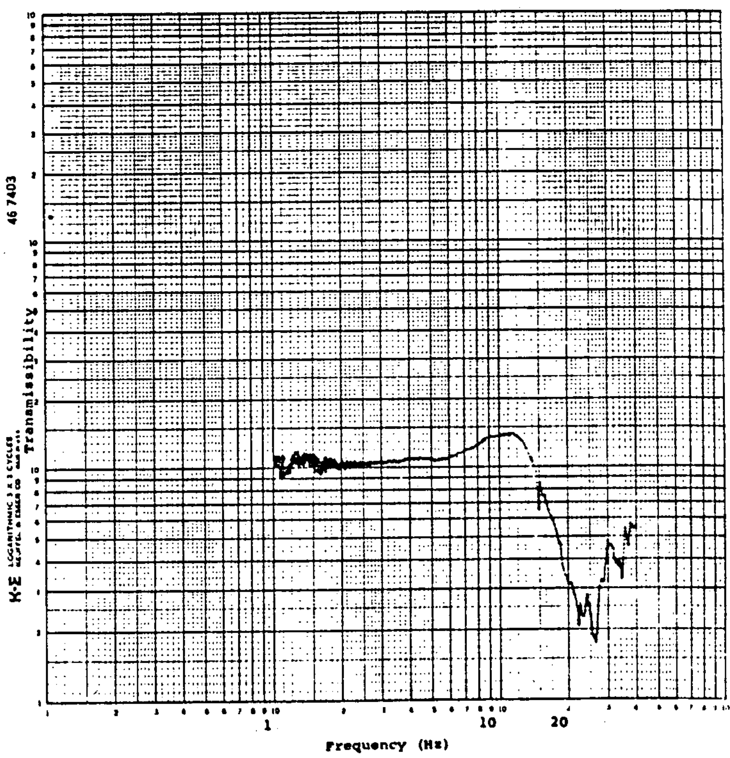
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS
ACCEL. NO 17SS: NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

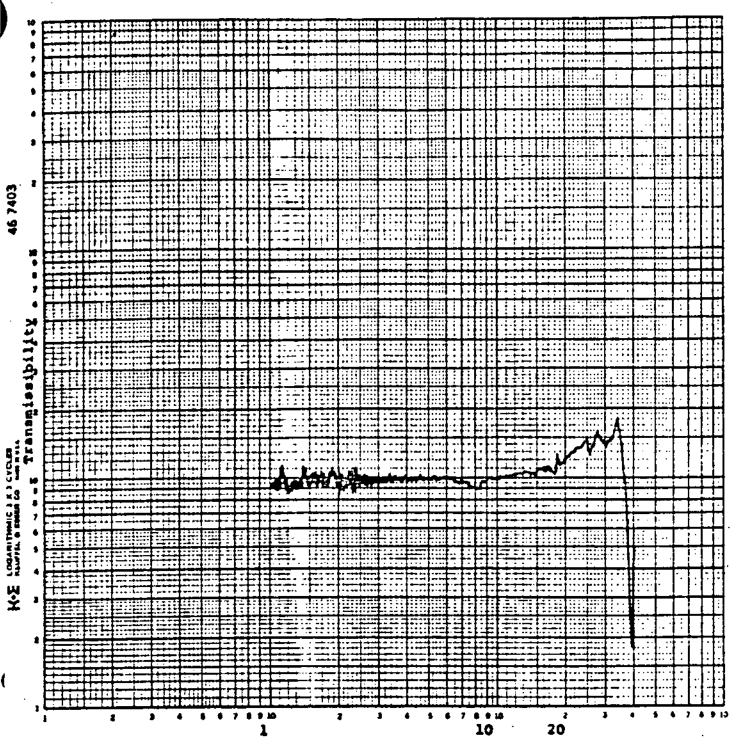
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS SS
ACCEL. NO. 18SS: NO. HCA
TEST RUN NO. 3

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



Frequency (Hz)

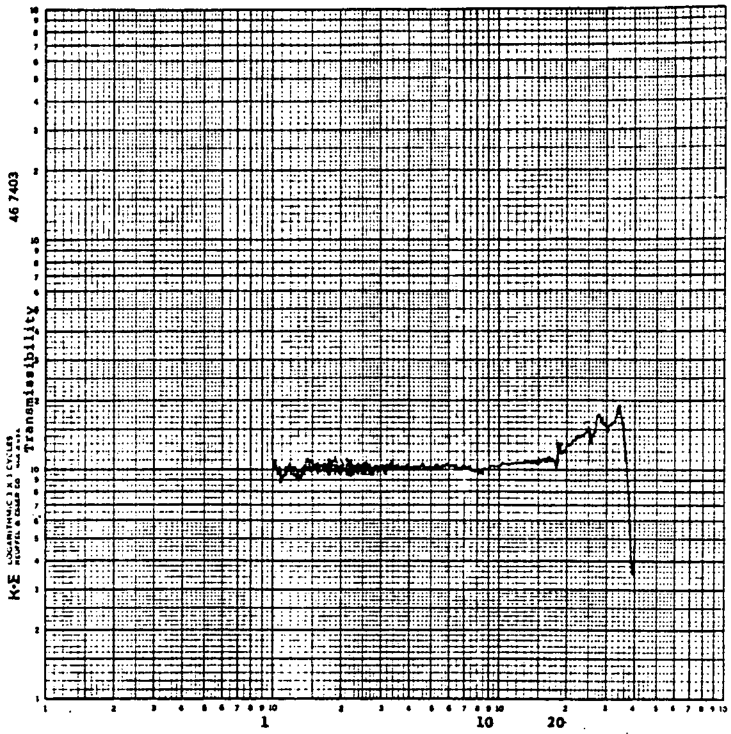
AXIS V

ACCEL. NO. 2V ÷ NO. V CA

TEST RUN NO. 4

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



Frequency (Hz)

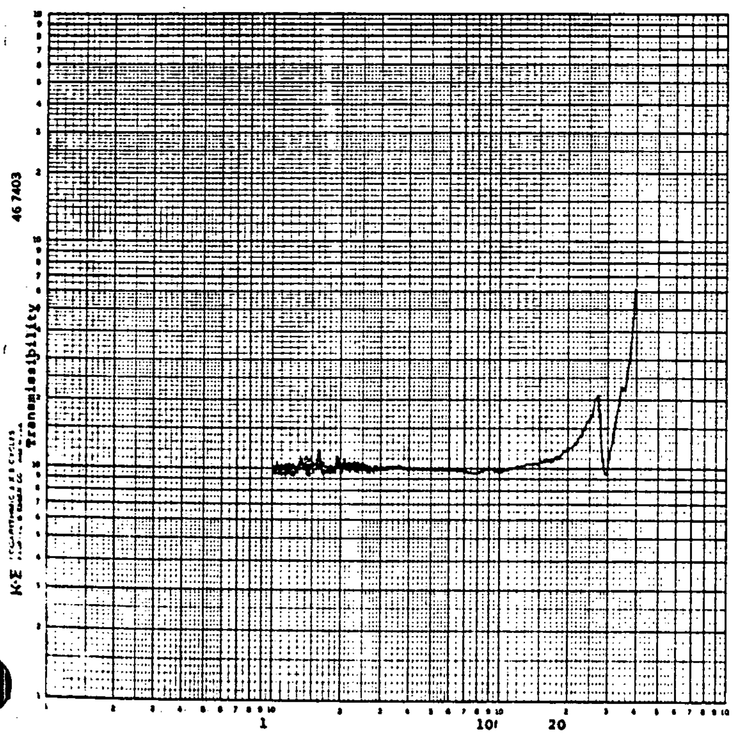
AXIS V

ACCEL. NO. 4V ÷ NO. V CA

TEST RUN NO. 4

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



Frequency (Hz)

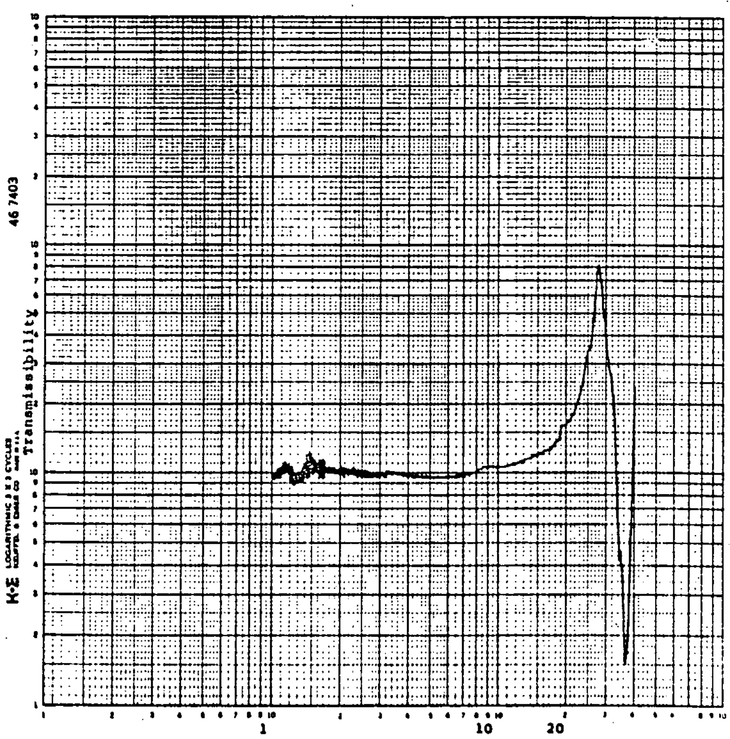
AXIS V

ACCEL. NO. 6V ÷ NO. VCA

TEST RUN NO. 4

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



Frequency (Hz)

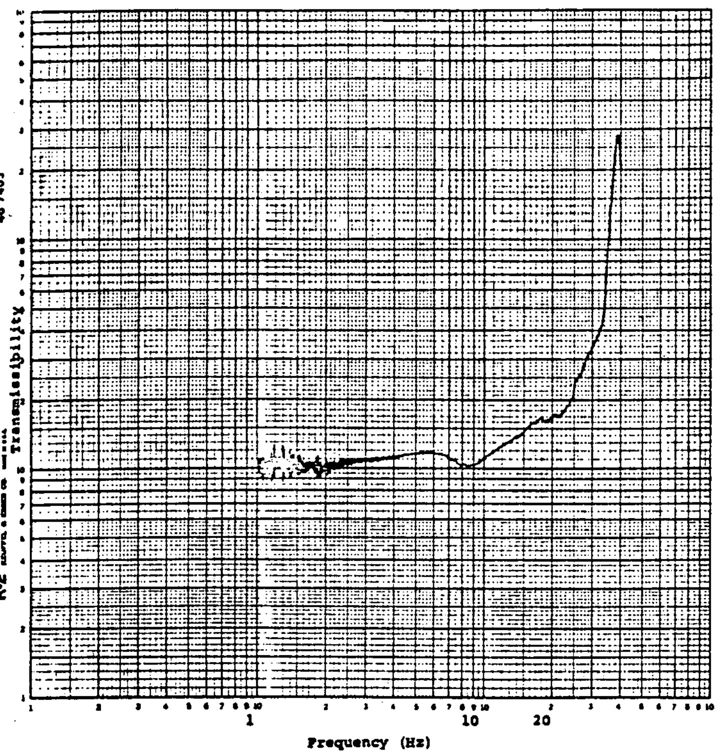
AXIS V

ACCEL. NO. 7V ÷ NO. VCA

TEST RUN NO. 4

FULL SCALE TRANSMISSIBILITY

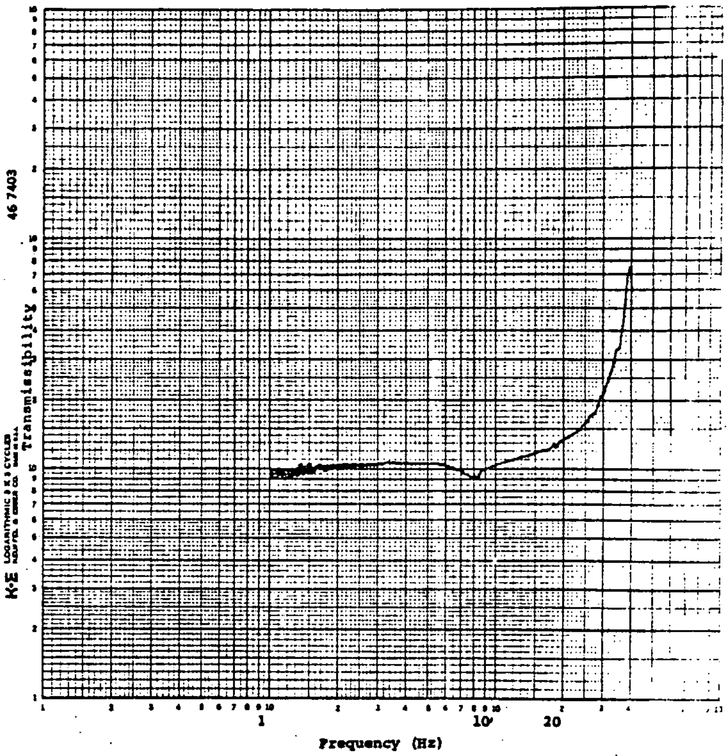
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS V
ACCEL. NO. 11V ÷ NO. VCA
TEST RUN NO. 4

FULL SCALE TRANSMISSIBILITY

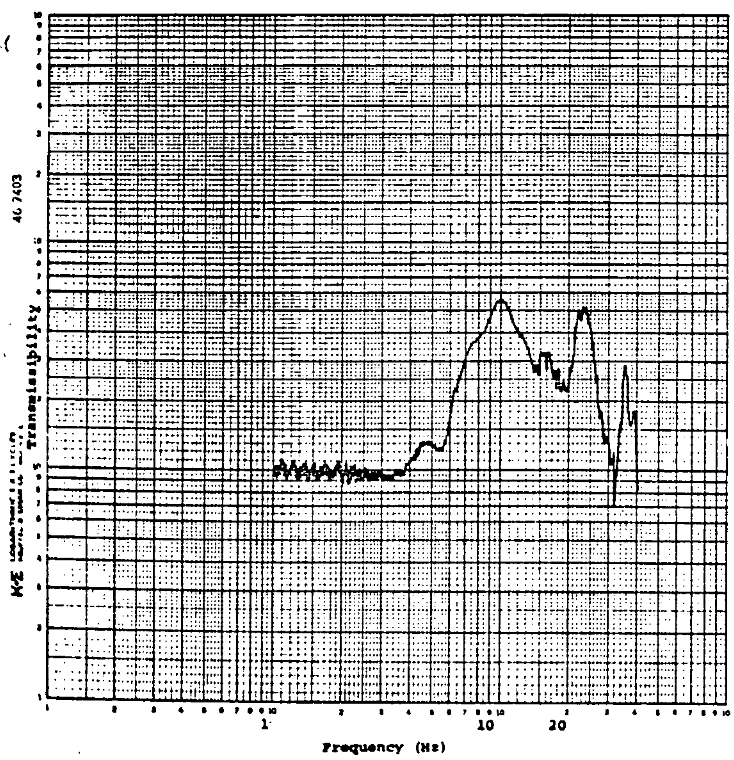
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS V
ACCEL. NO. 13V ÷ NO. VCA
TEST RUN NO. 4

FULL SCALE TRANSMISSIBILITY

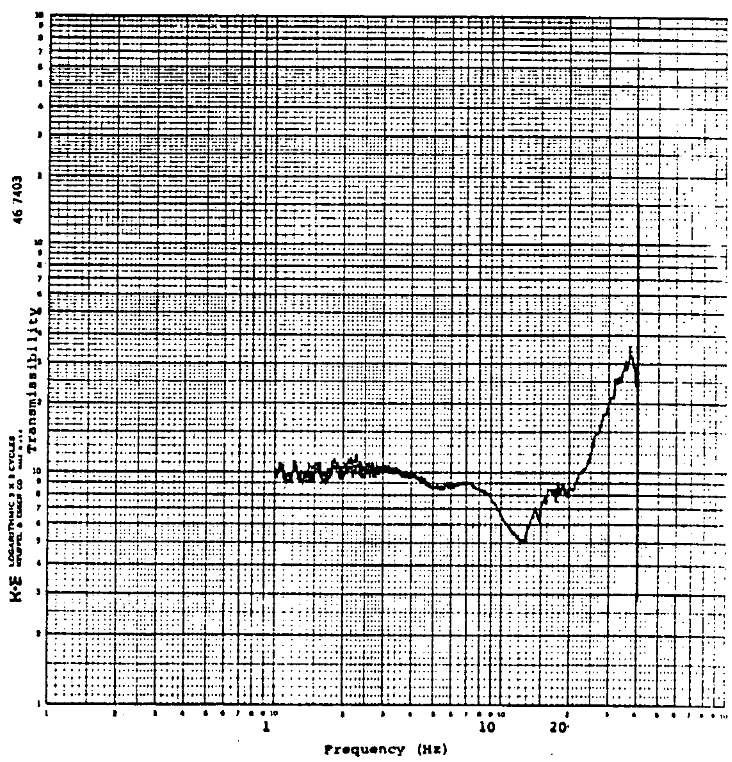
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 1FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

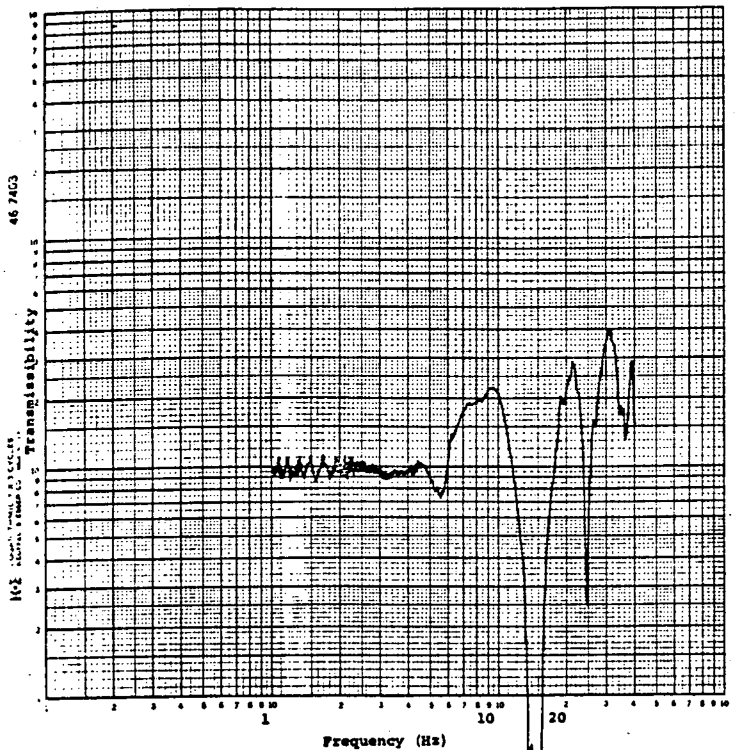
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB
ACCEL. NO. 2V ÷ NO. VS
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

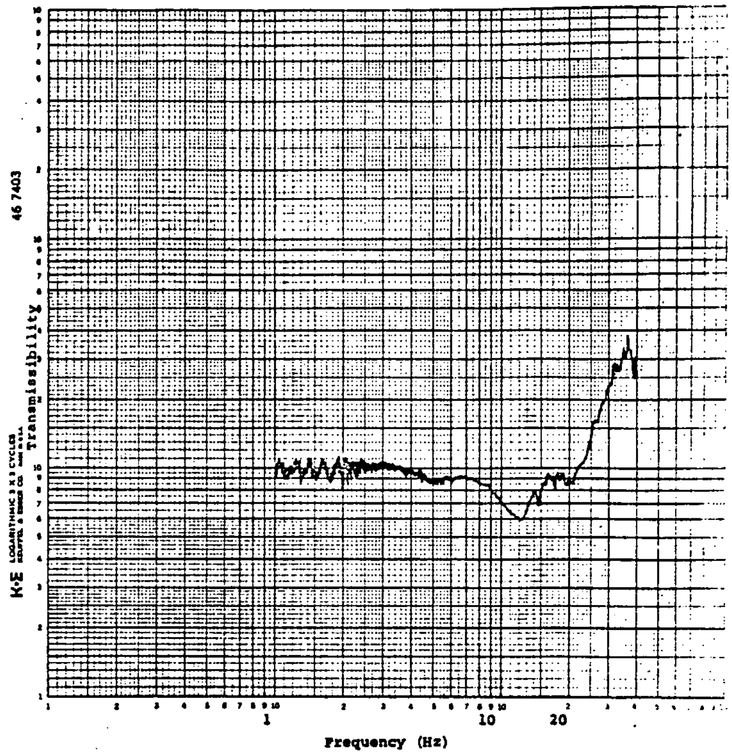
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 3FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

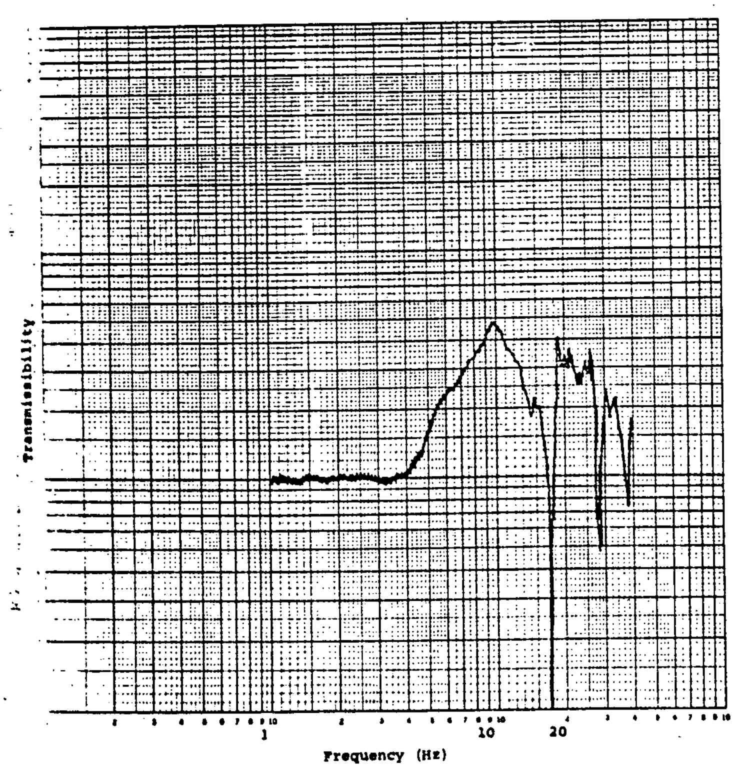
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 4V ÷ NO. YCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

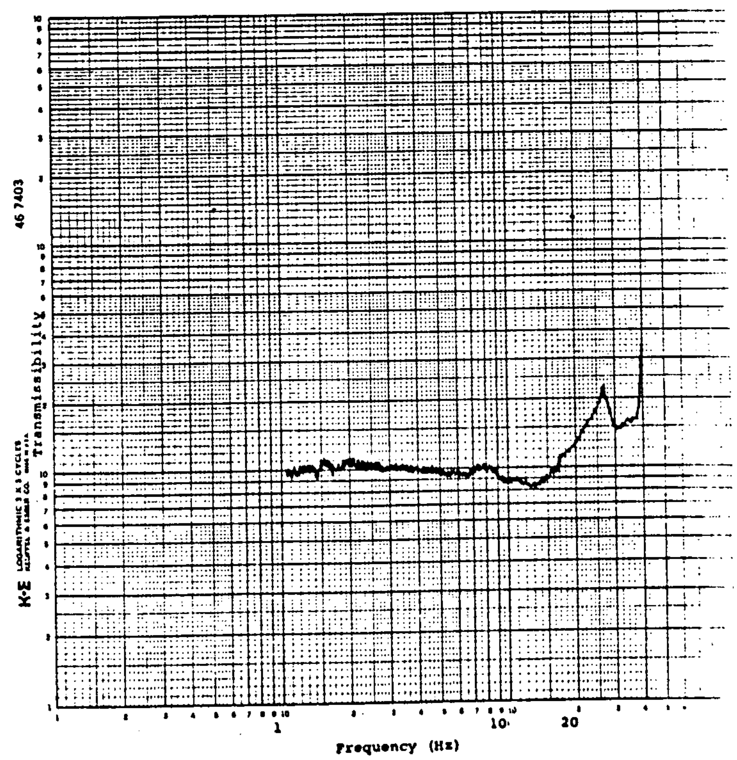
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 5FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

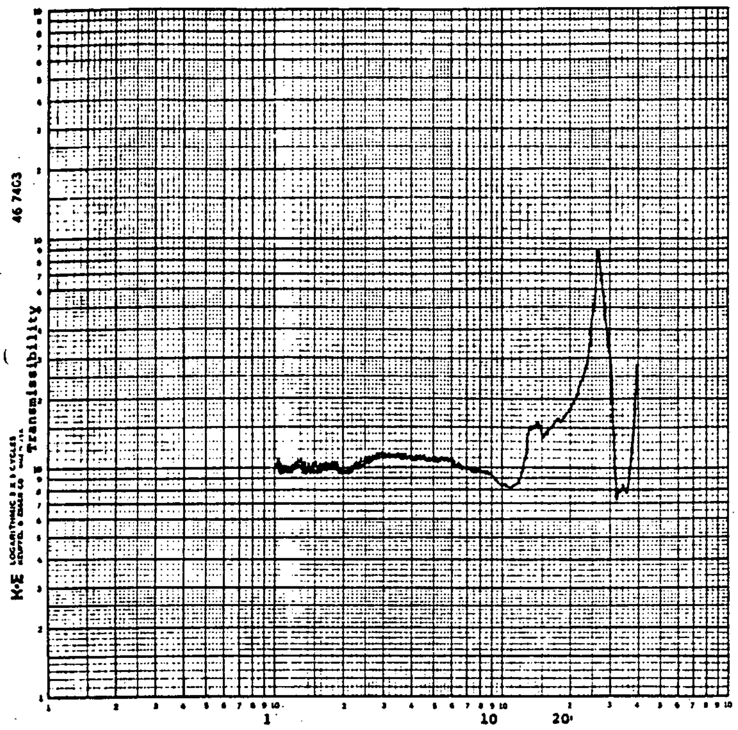
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 6V ÷ NO. YCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

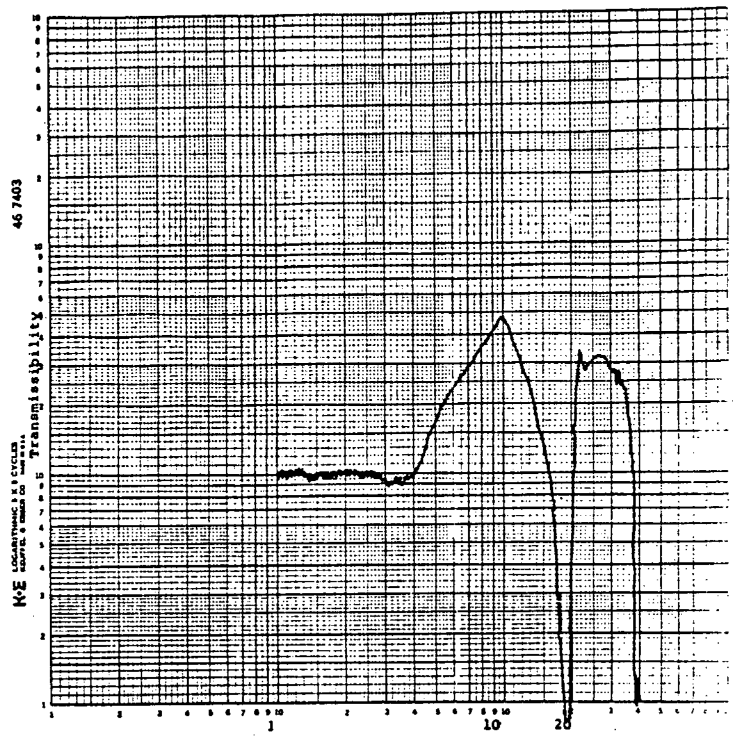


Frequency (Hz)

AXIS FB/V
ACCEL. NO. 7V ÷ NO. YCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

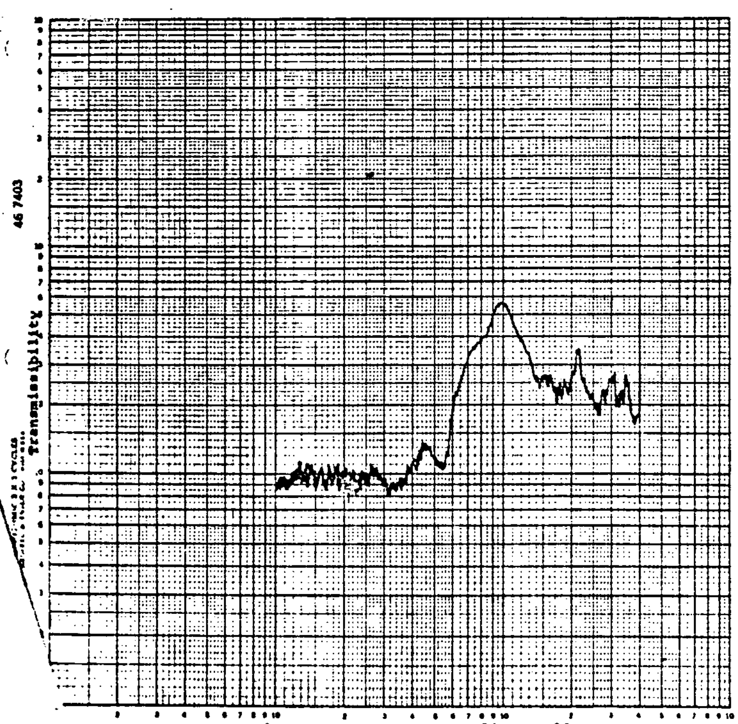


Frequency (Hz)

AXIS FB/V
ACCEL. NO. 8FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

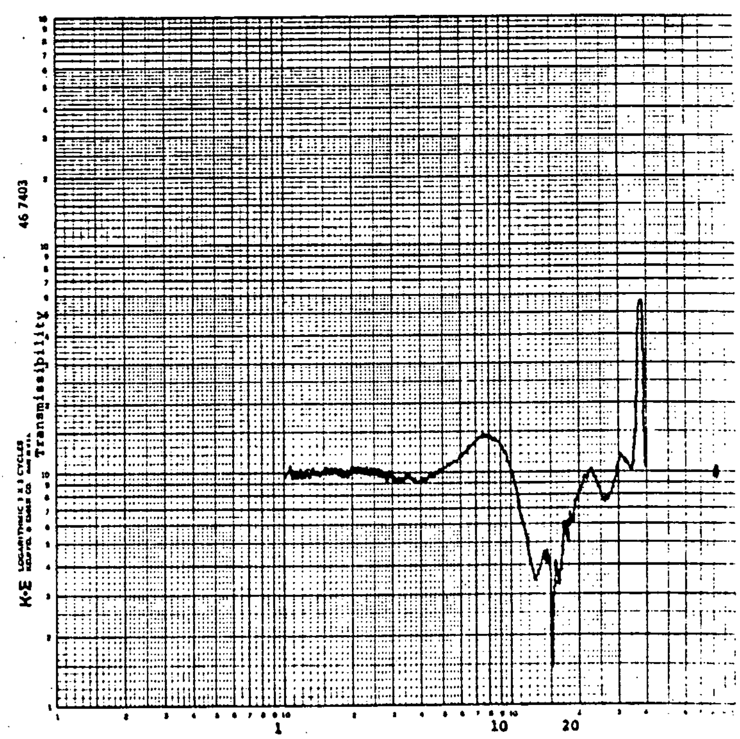


Frequency (Hz)

AXIS FB/V
ACCEL. NO. 9FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

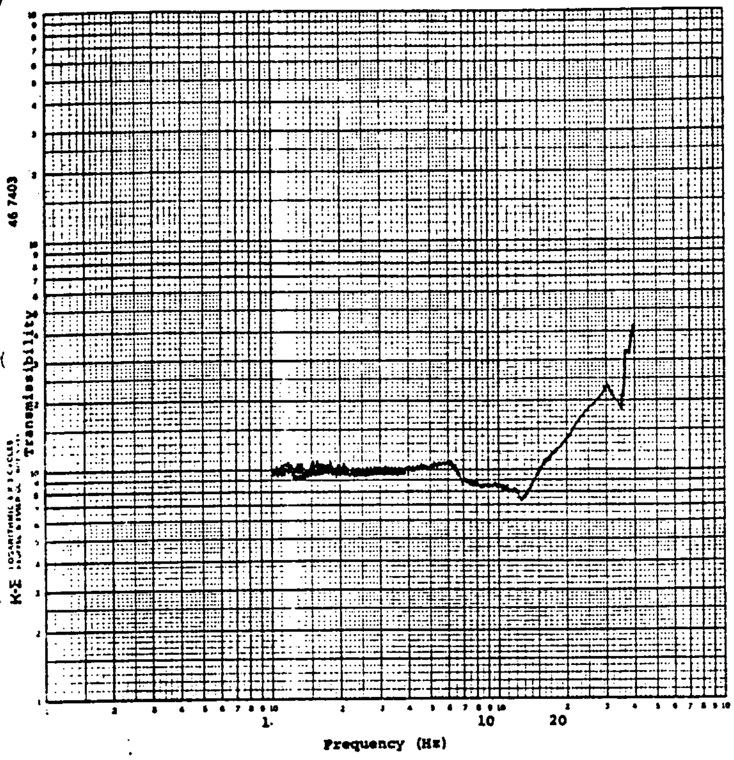


Frequency (Hz)

AXIS FB/V
ACCEL. NO. 10FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

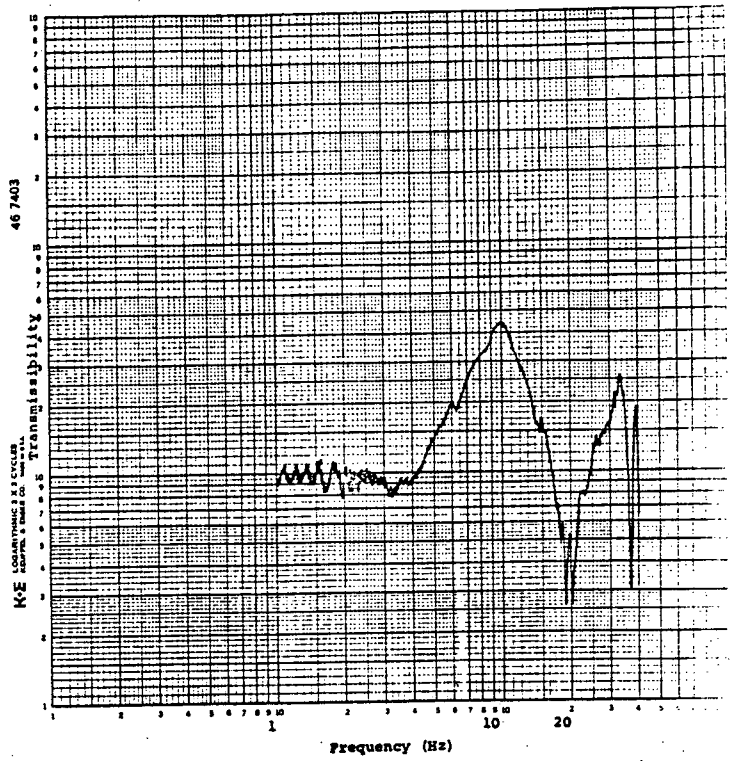
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 11V ÷ NO. VCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

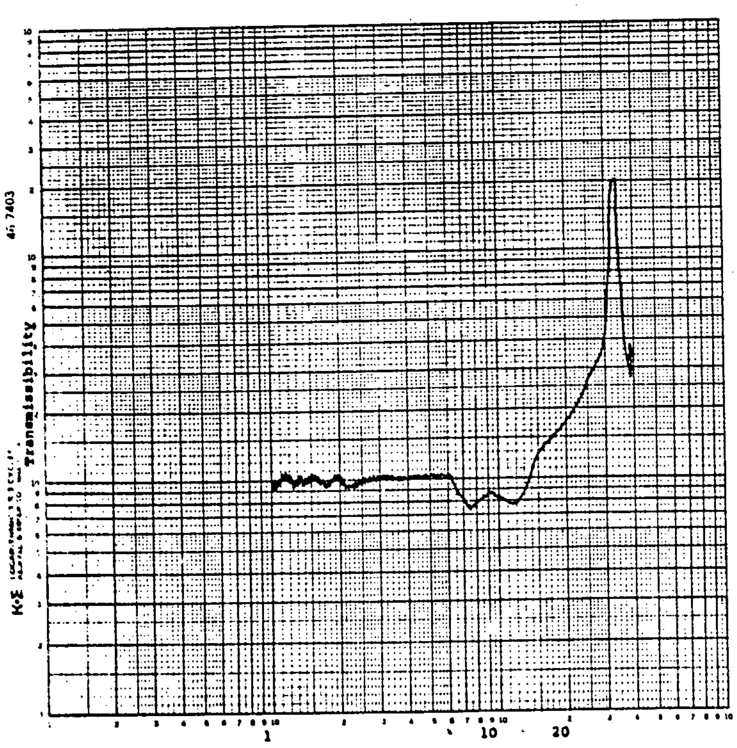
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 12FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

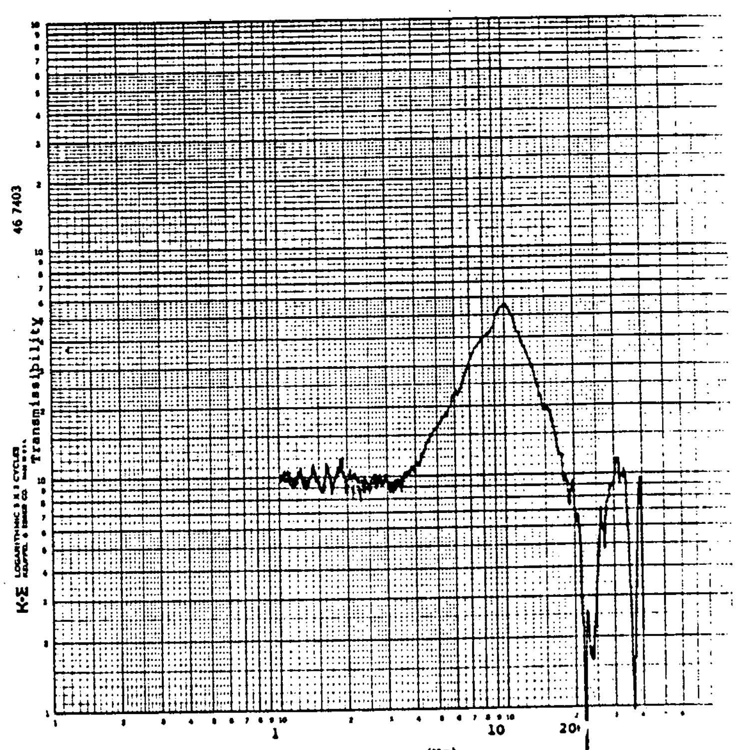
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO 13V ÷ NO. VCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

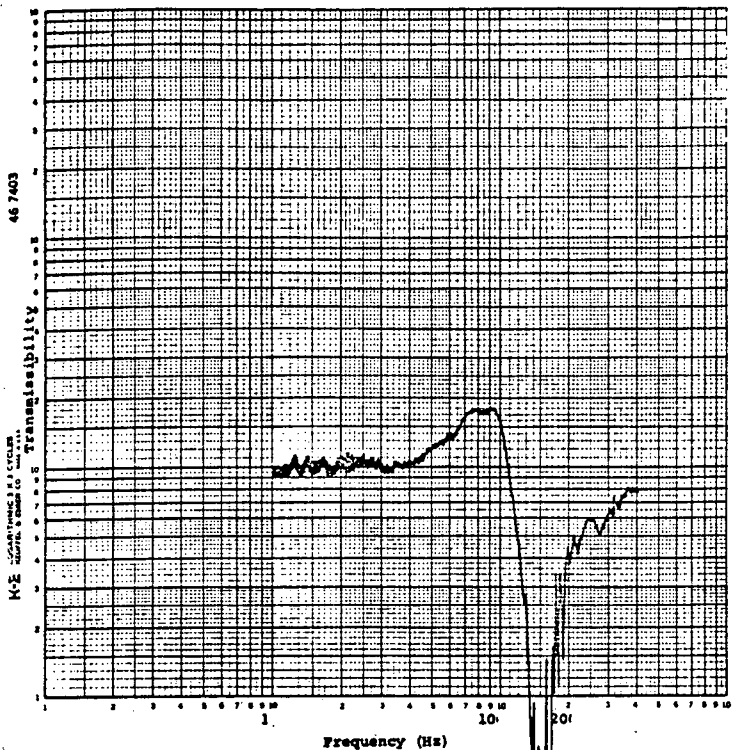
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO HFB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

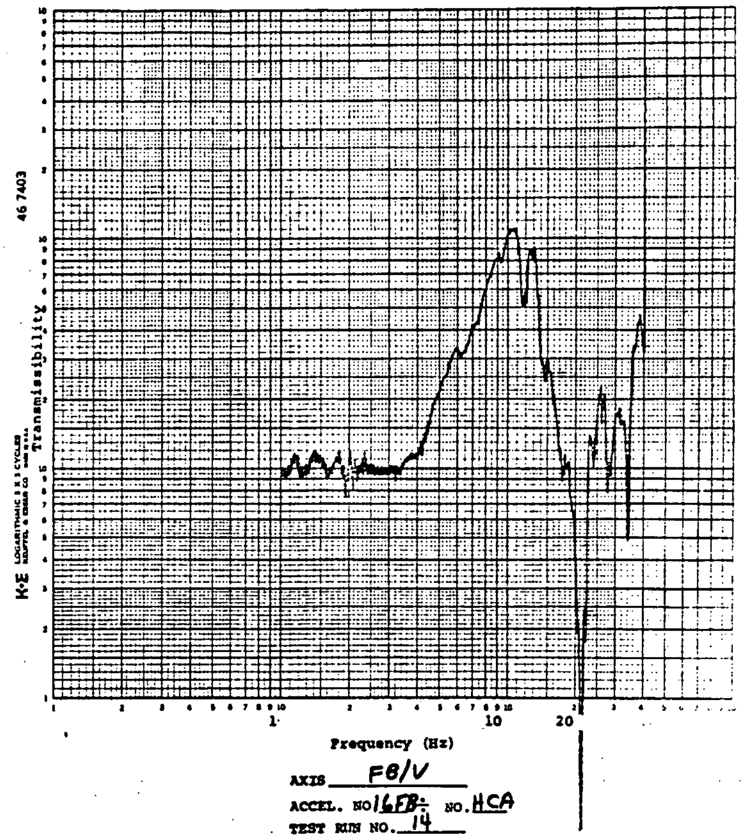
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 15FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

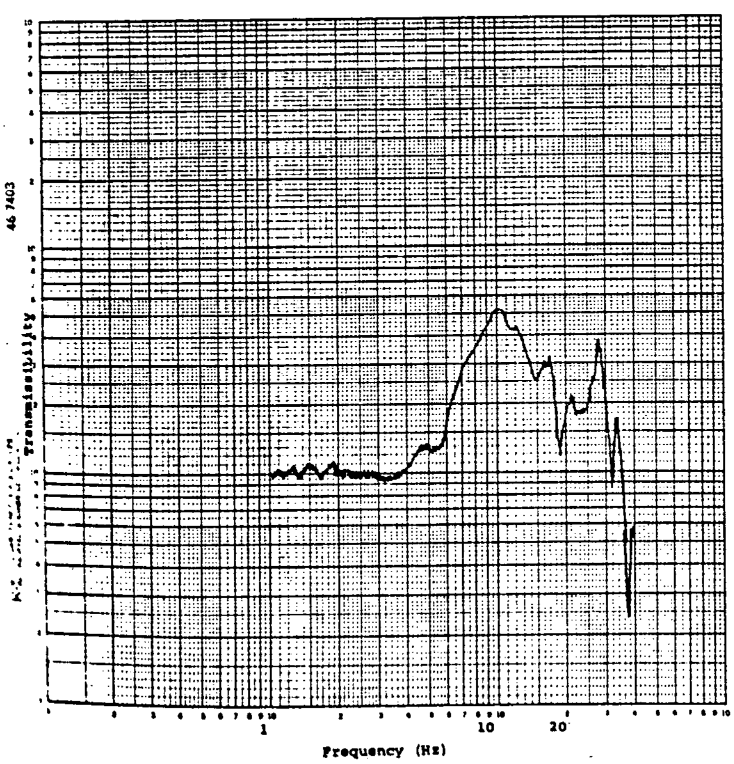
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 16FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

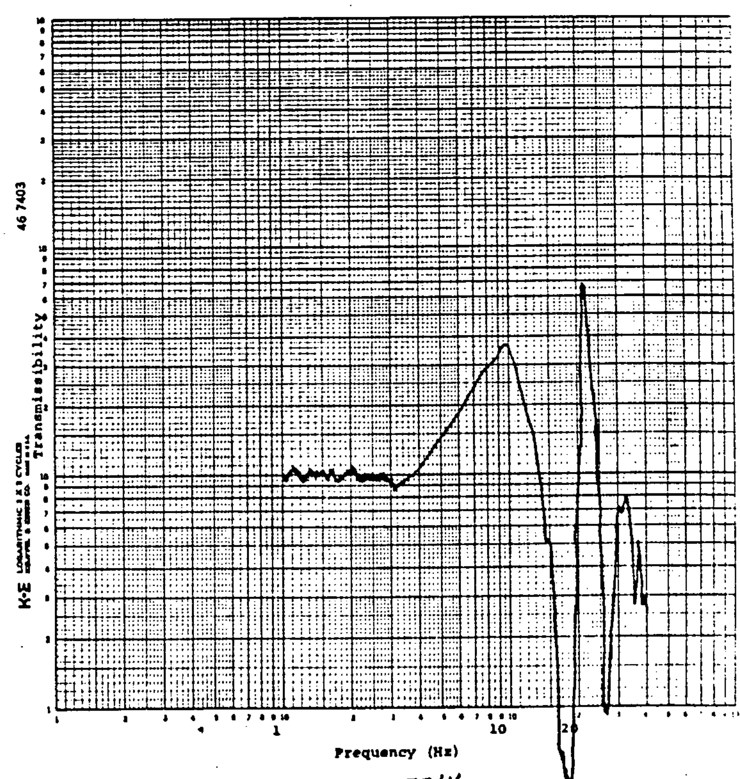
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 17FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

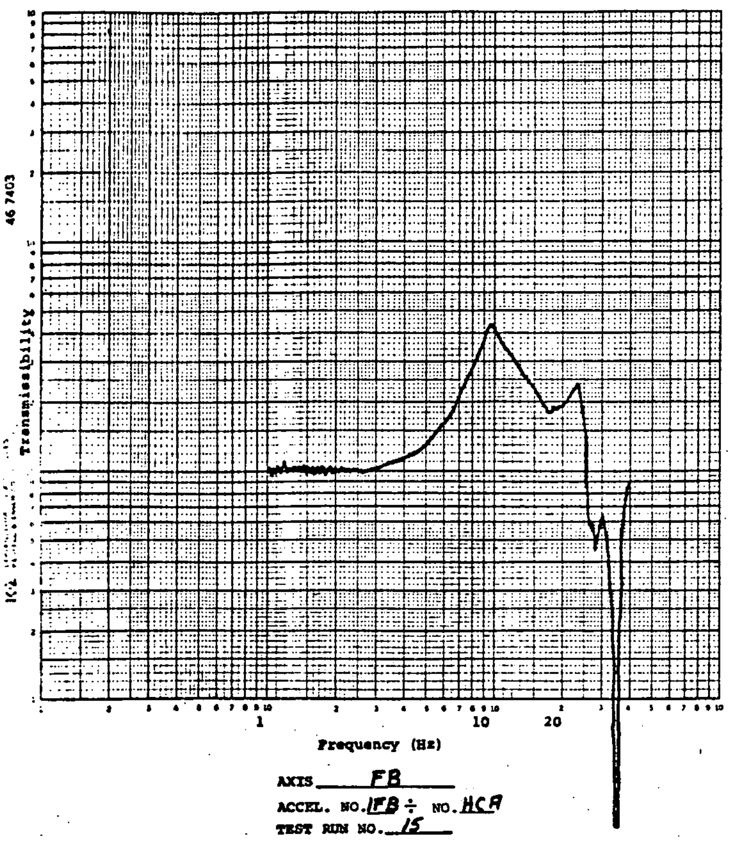
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB/V
ACCEL. NO. 18FB ÷ NO. HCA
TEST RUN NO. 14

FULL SCALE TRANSMISSIBILITY

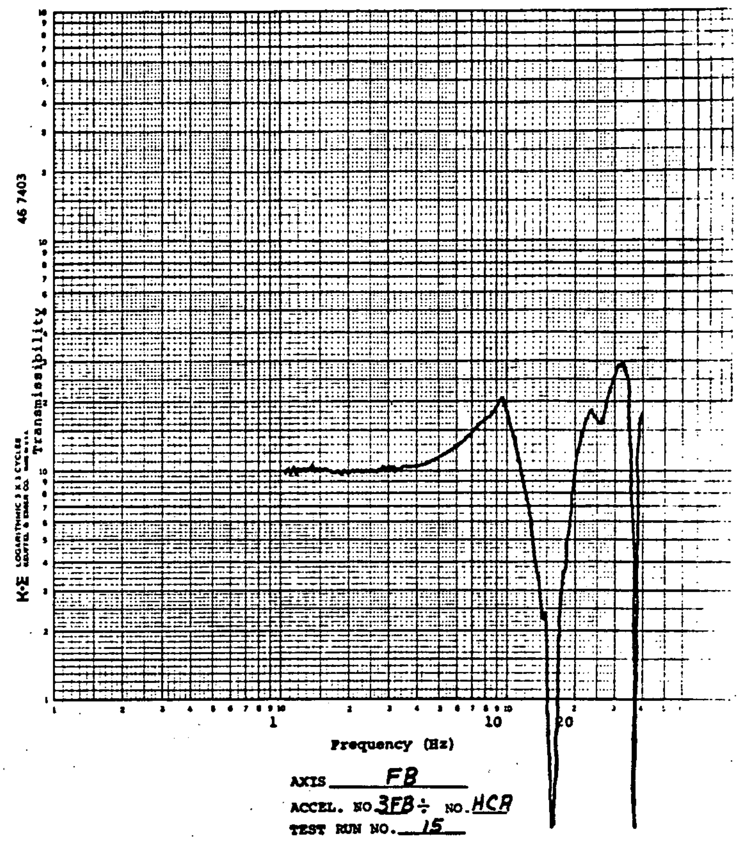
0.1☐ 1.0☐ 10☐ 100☒ 1000☐



AXIS FB
ACCEL. NO. 1FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

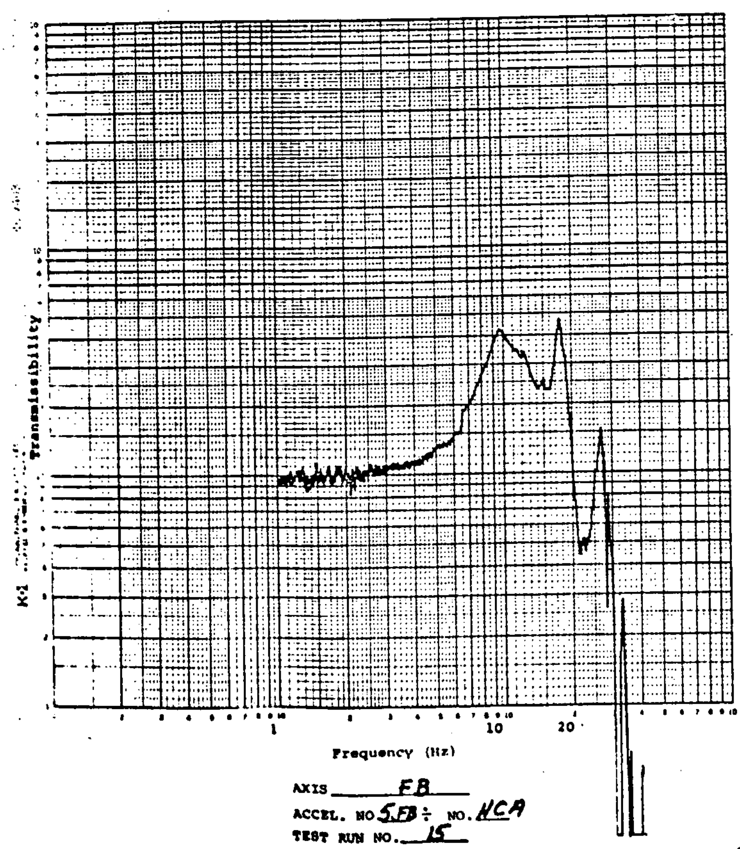
0.1☐ 1.0☐ 10☐ 100☒ 1000☐



AXIS FB
ACCEL. NO. 3FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

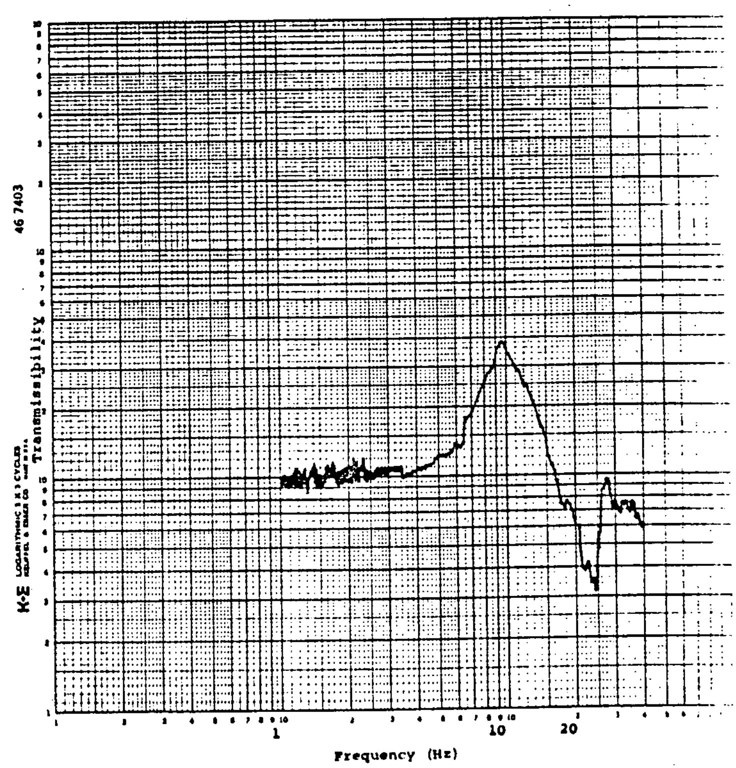
0.1☐ 1.0☐ 10☐ 100☒ 1000☐



AXIS FB
ACCEL. NO 5FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

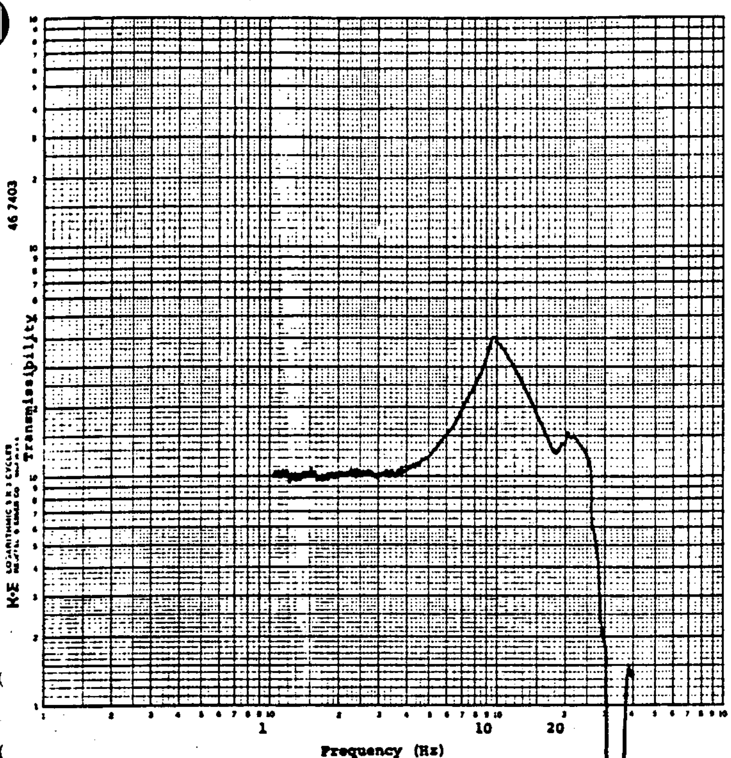
0.1☐ 1.0☐ 10☐ 100☒ 1000☐



AXIS FB
ACCEL. NO 8FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

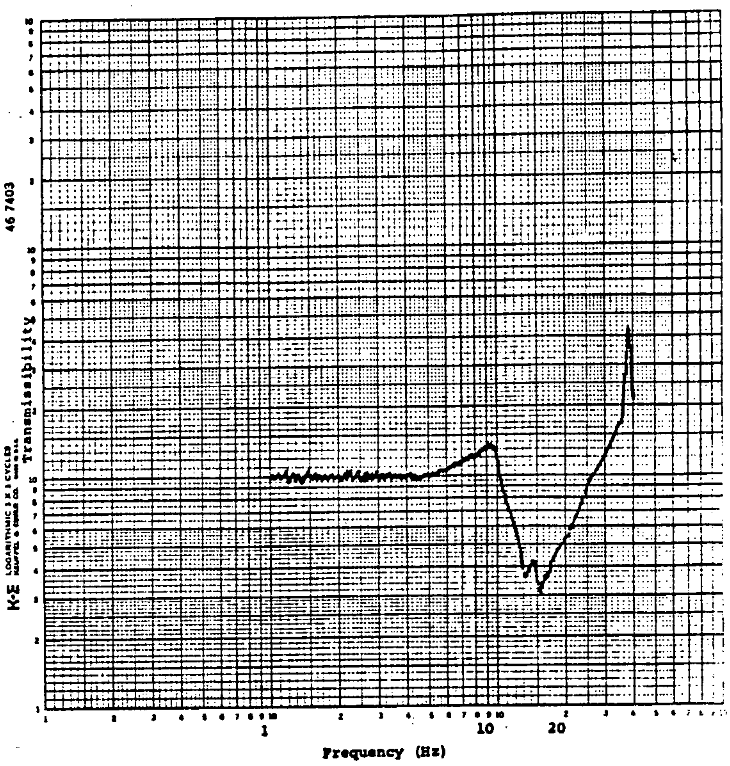
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB
ACCEL. NO. 9FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

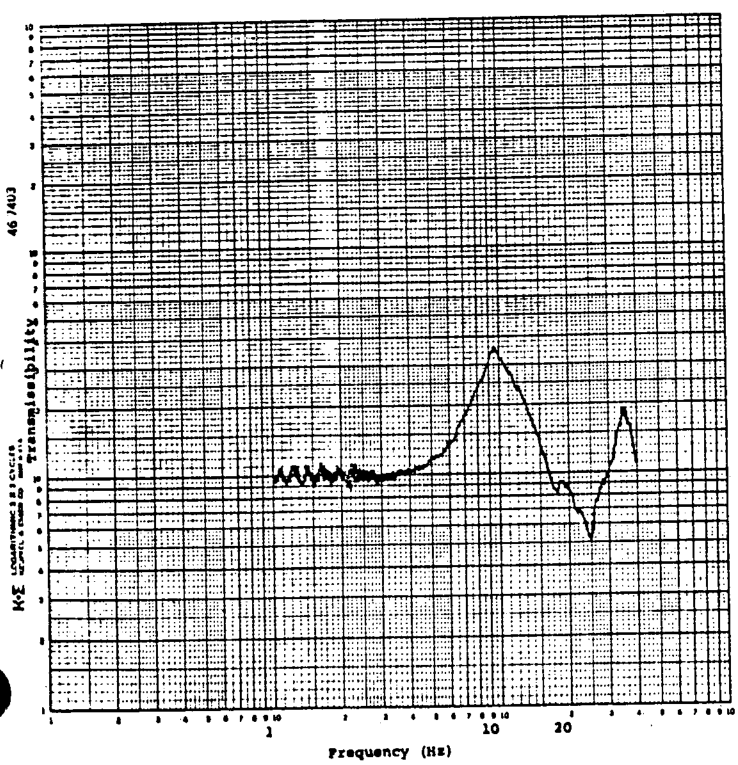
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB
ACCEL. NO. 10FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

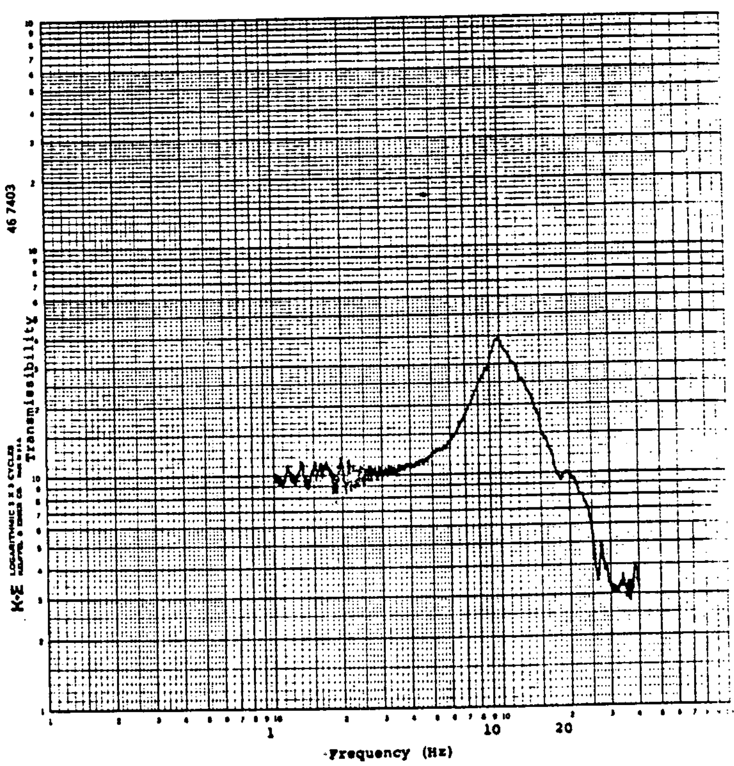
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB
ACCEL. NO. 12FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

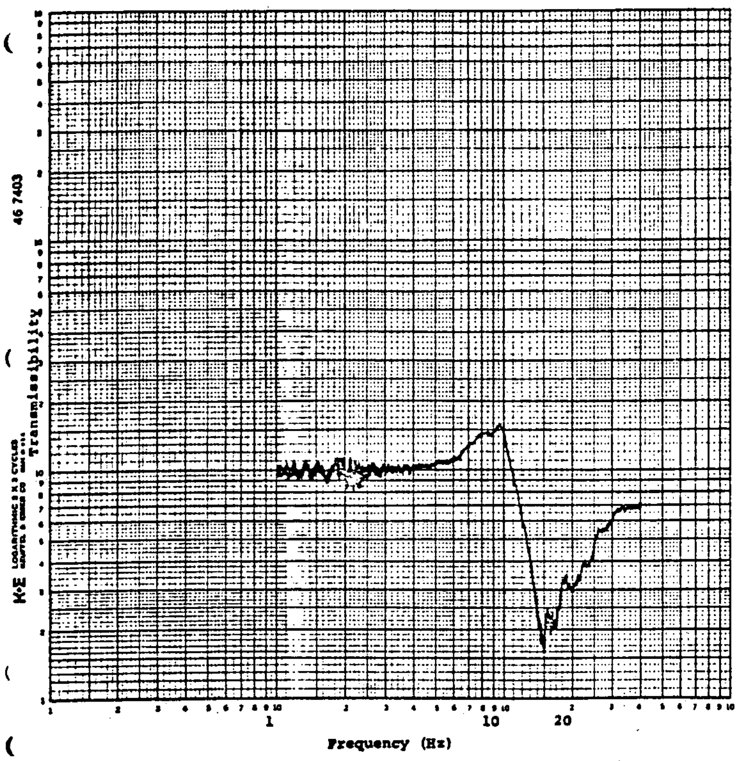
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB
ACCEL. NO. 14FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

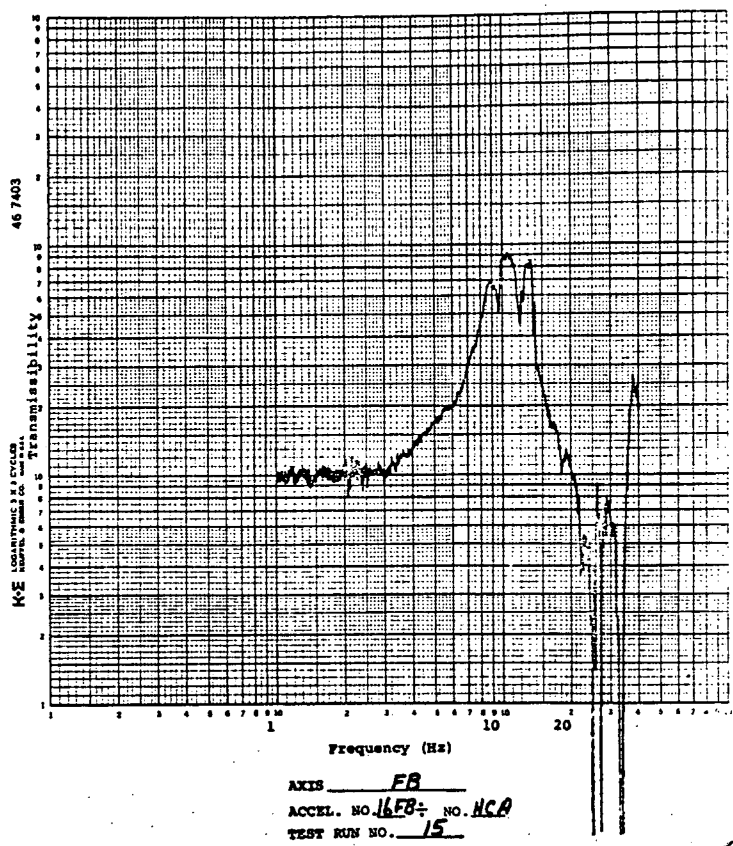
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB
ACCEL. NO. 15FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

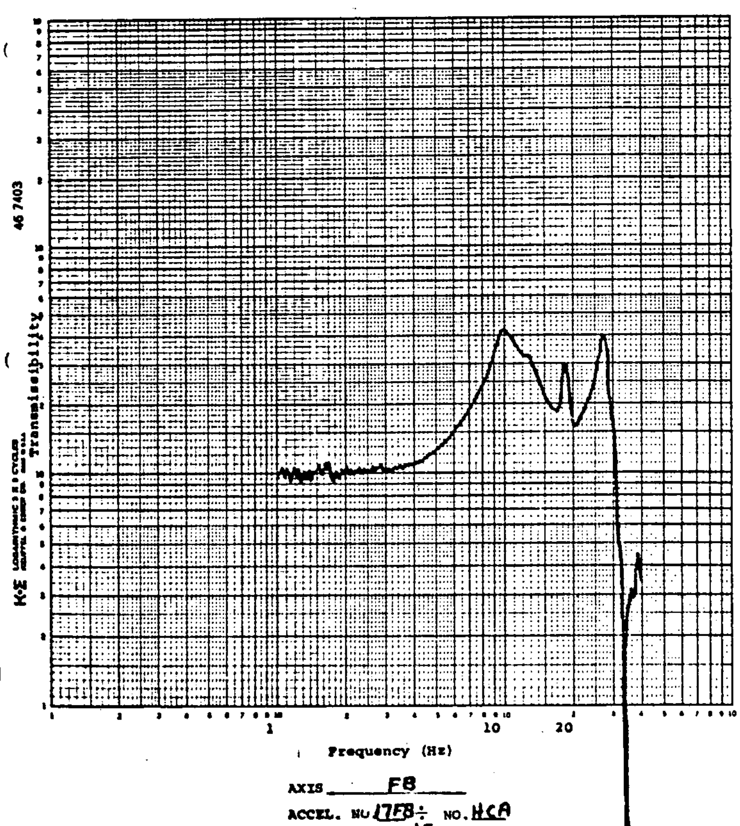
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB
ACCEL. NO. 16FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

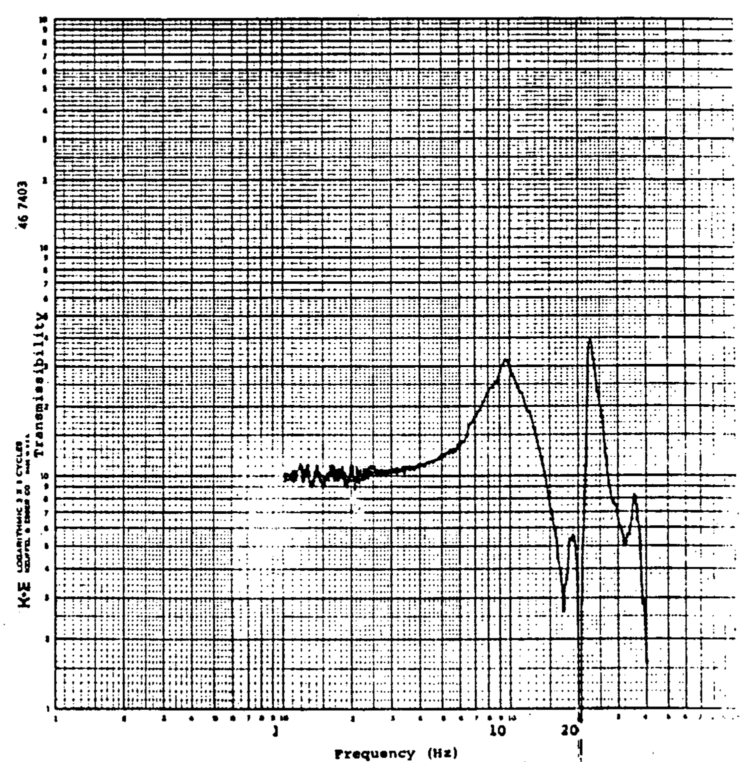
0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB
ACCEL. NO. 17FB ÷ NO. HCA
TEST RUN NO. 15

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS FB
ACCEL. NO 18FB ÷ NO. HCA
TEST RUN NO. 15

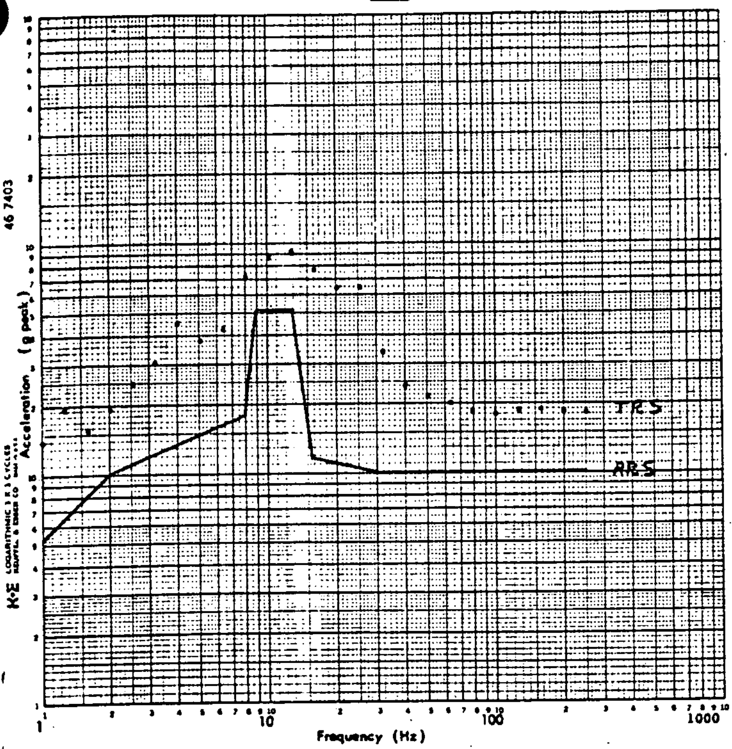
APPENDIX III

TEST RESPONSE SPECTRA PLOTS

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

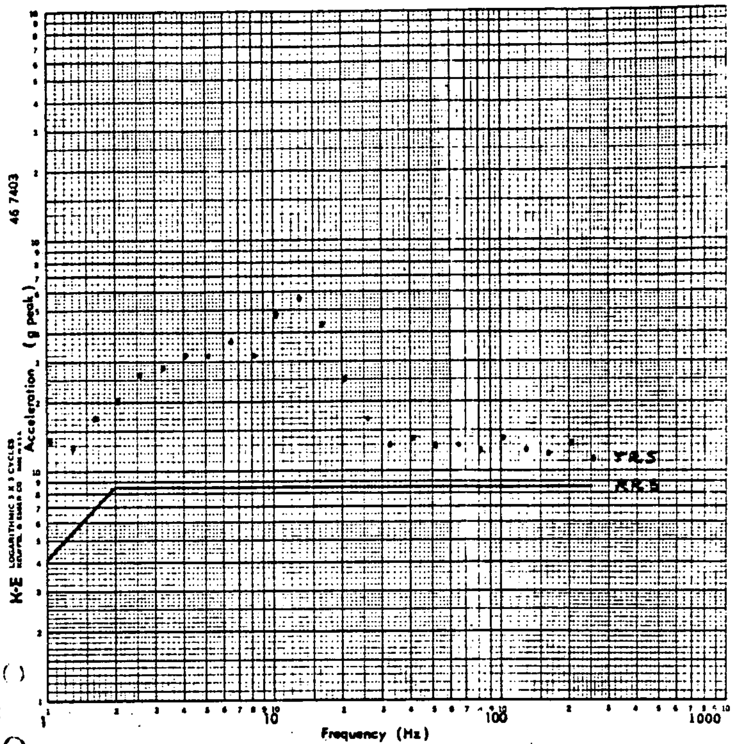


AXIS SS/V
LOCATION NO. HCA
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

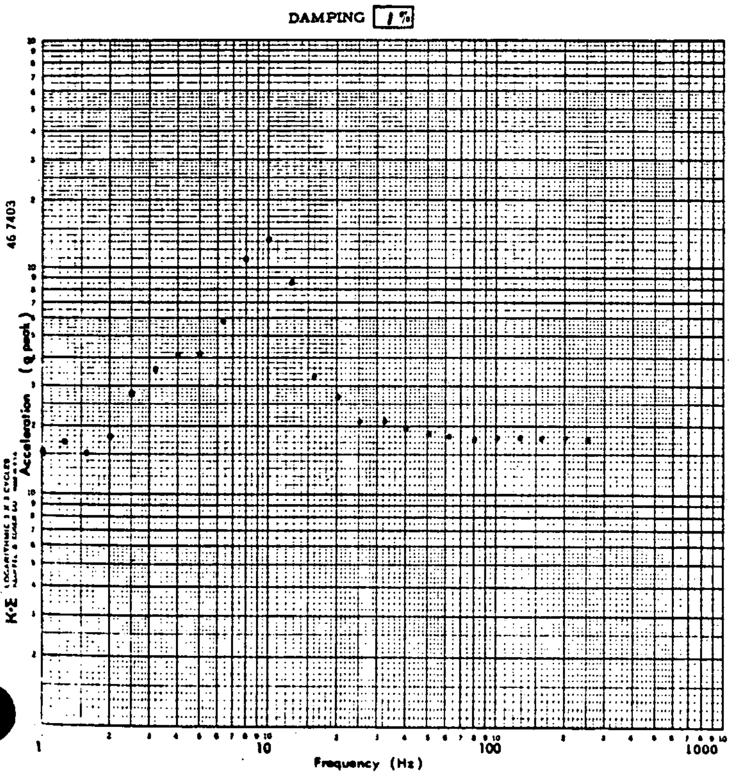


AXIS SS/V
LOCATION NO. VCA
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

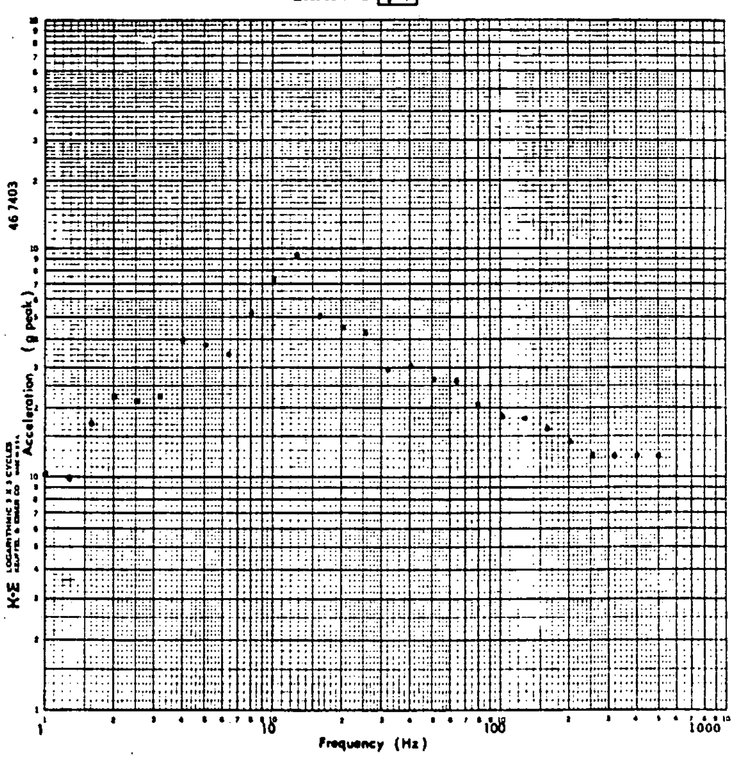


AXIS SS/V
LOCATION NO. 1SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

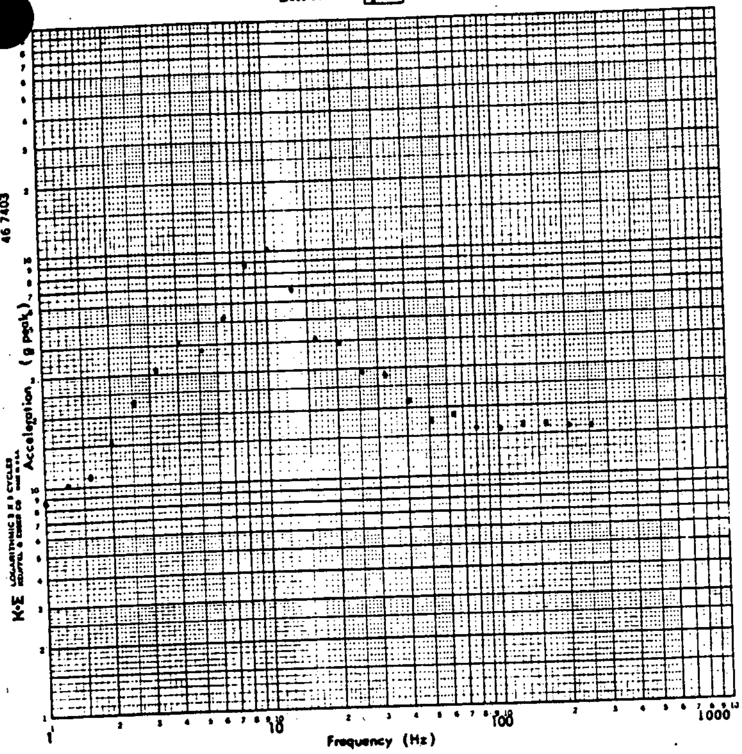


AXIS SS/V
LOCATION NO. 2V
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

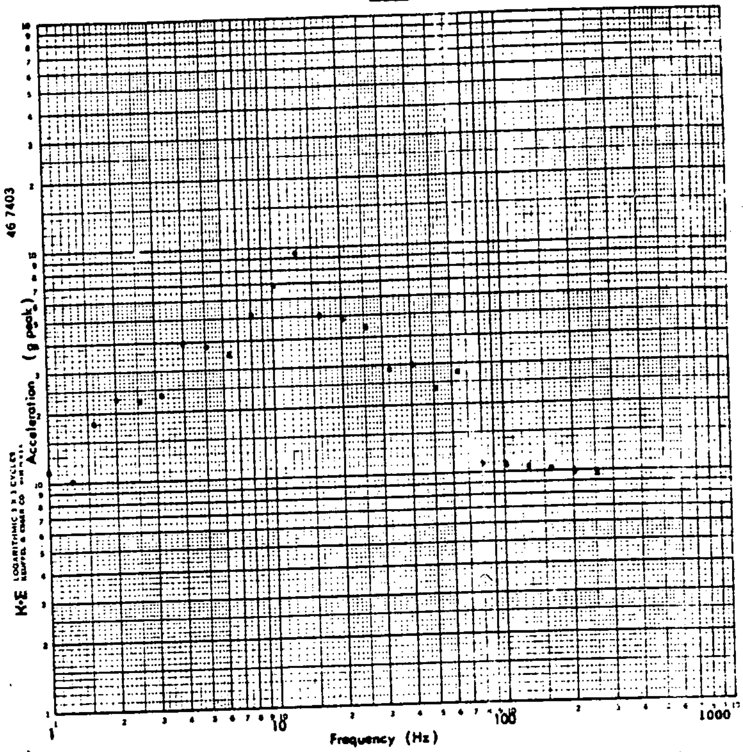


AXIS SS/V
LOCATION NO. 3SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

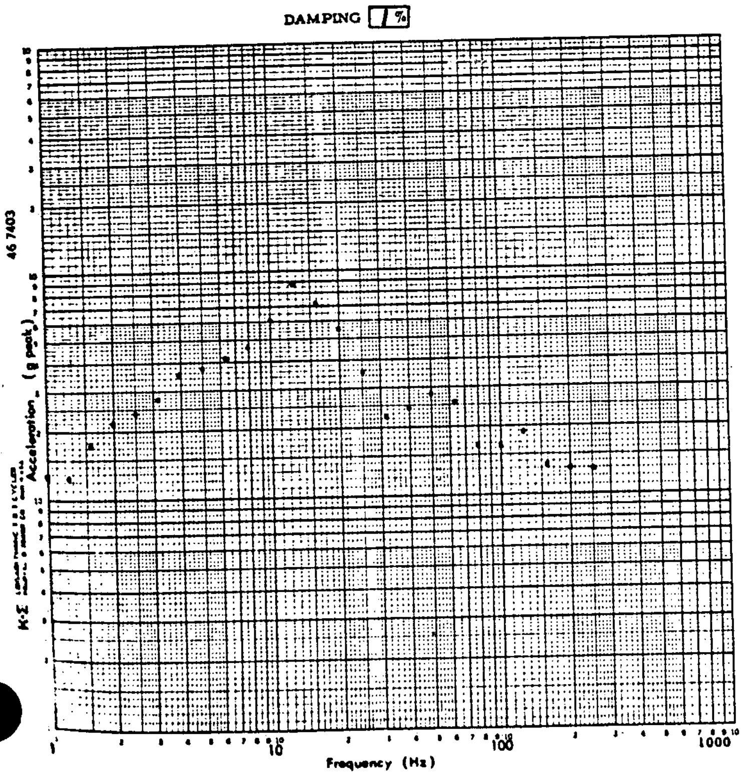


AXIS SS/V
LOCATION NO. 4V
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

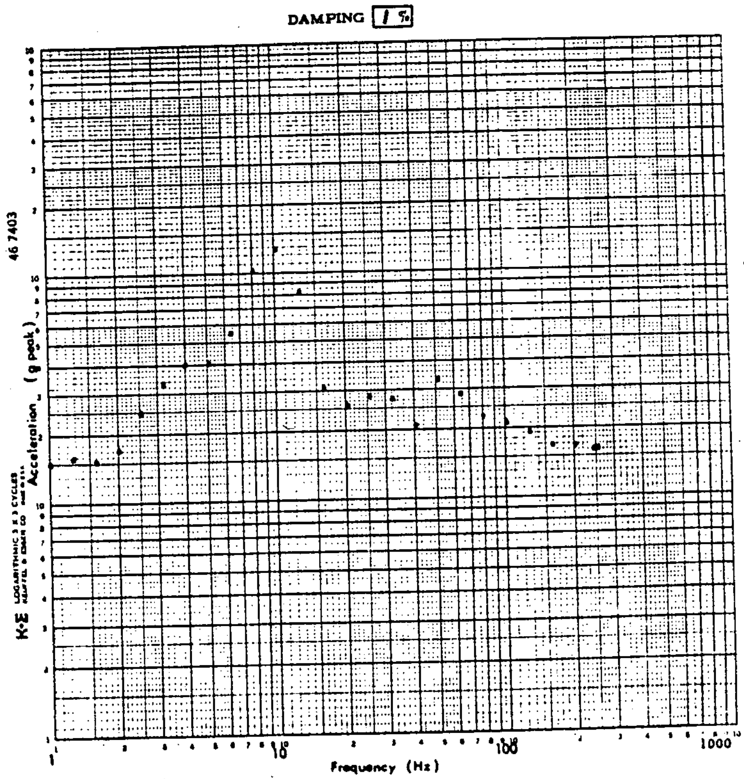


AXIS SS/V
LOCATION NO. 6V
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

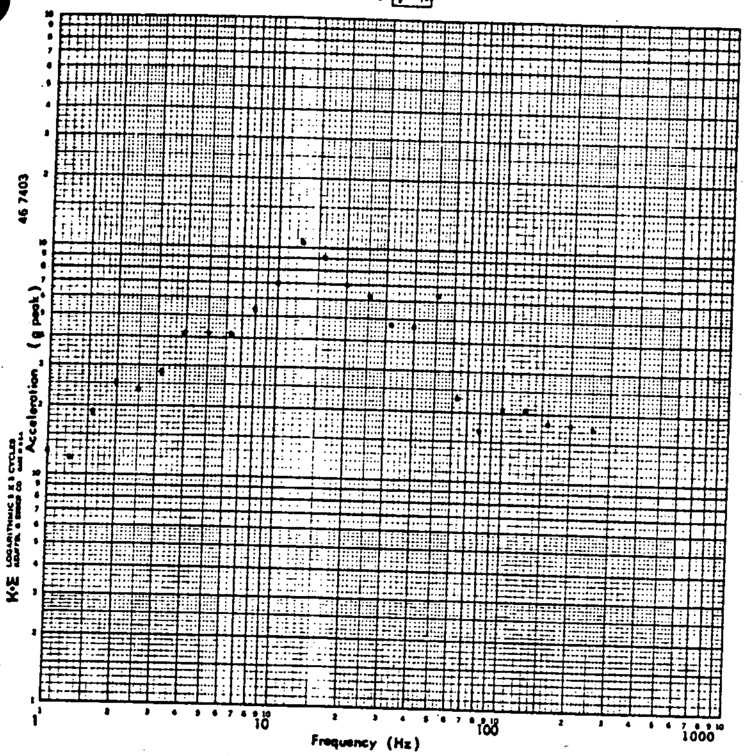


AXIS SS/V
LOCATION NO. 5SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

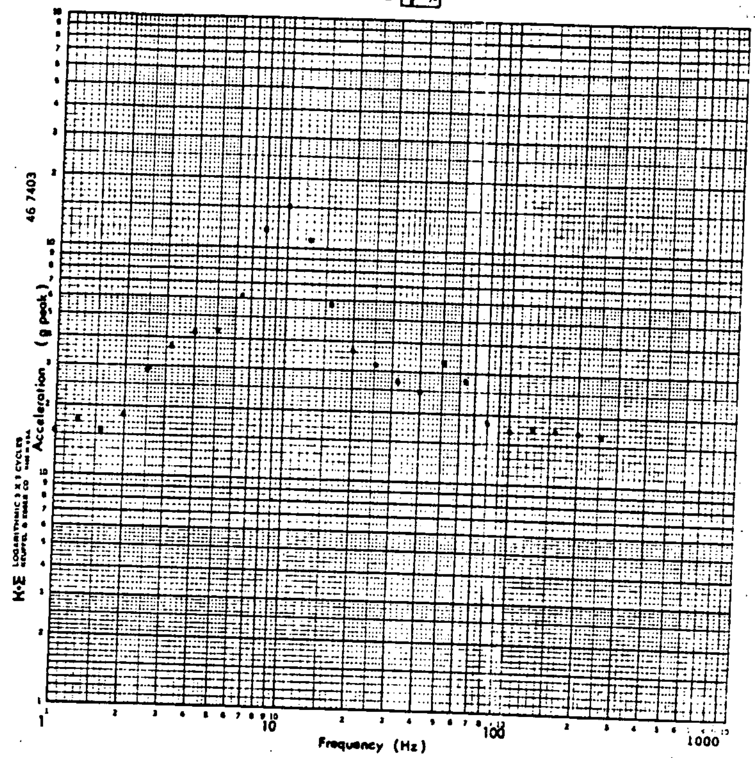


AXIS SS/V
LOCATION NO. 7V
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

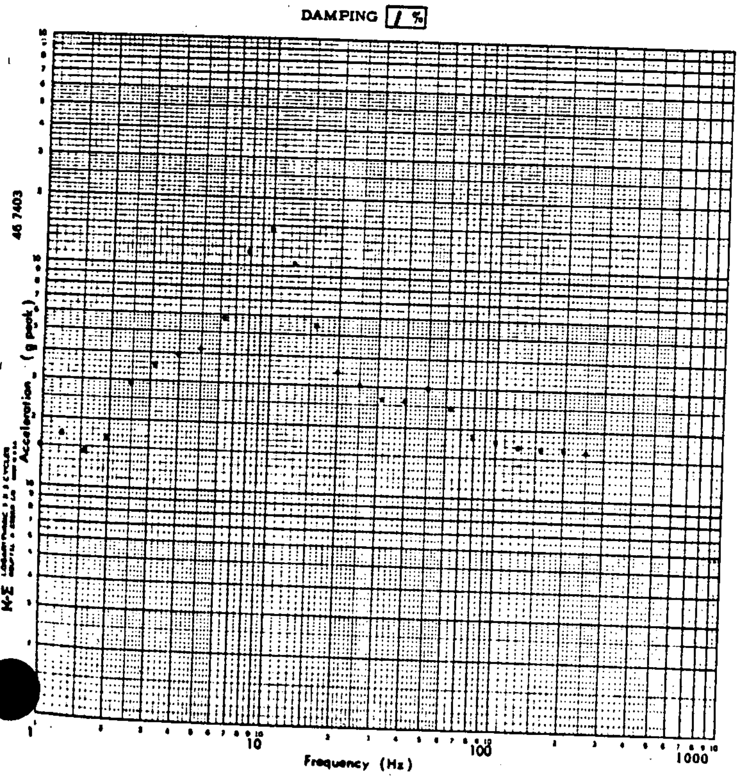


AXIS SS/V
LOCATION NO. 8SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

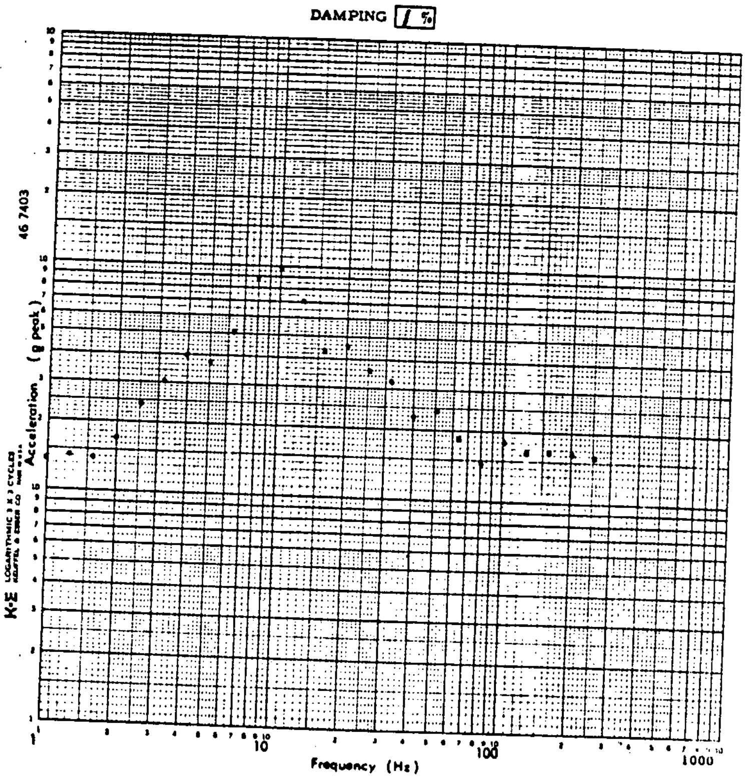


AXIS SS/V
LOCATION NO. 9SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

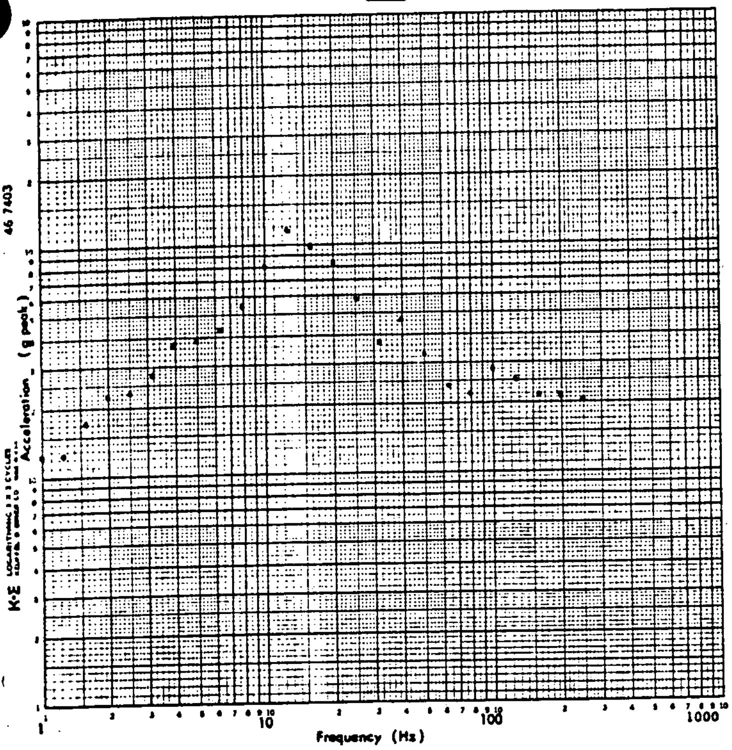


AXIS SS/V
LOCATION NO. 10SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

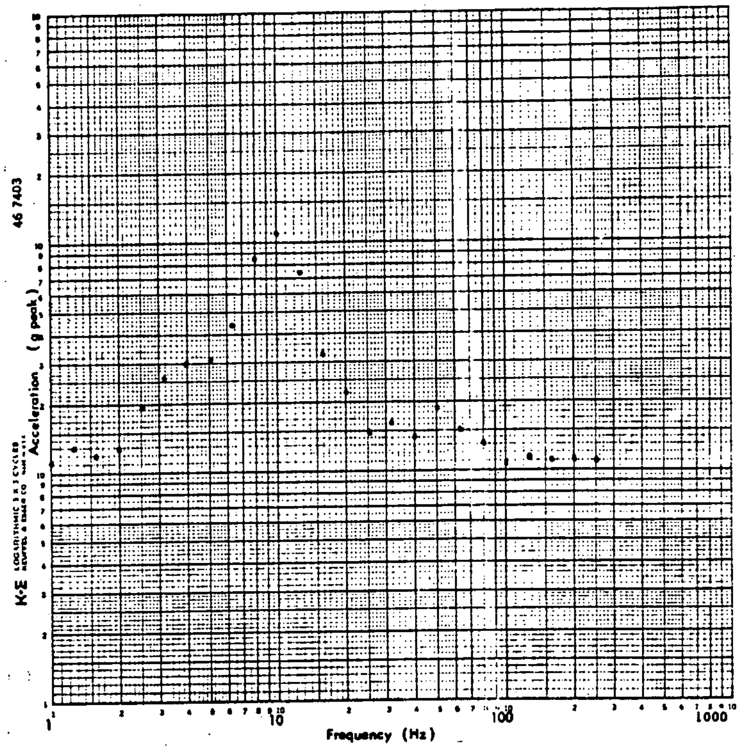


AXIS SS/V
LOCATION NO. 11V
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

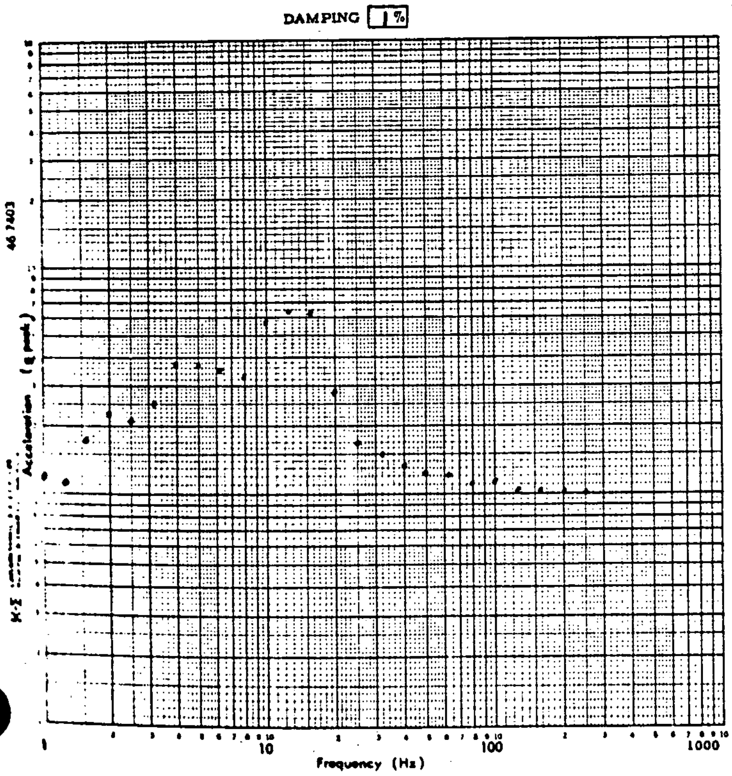


AXIS SS/V
LOCATION NO. 12SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

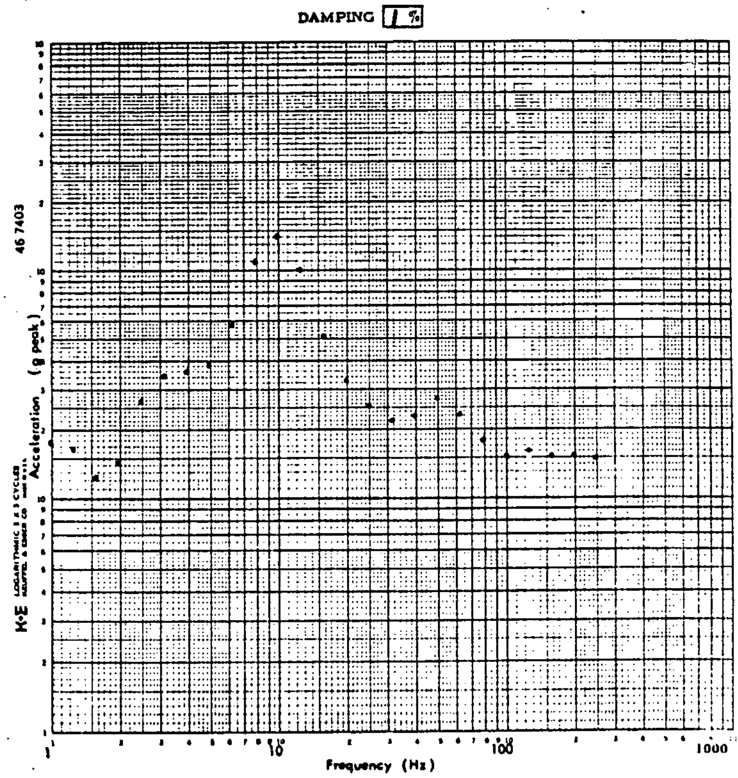


AXIS SS/V
LOCATION NO. 13V
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

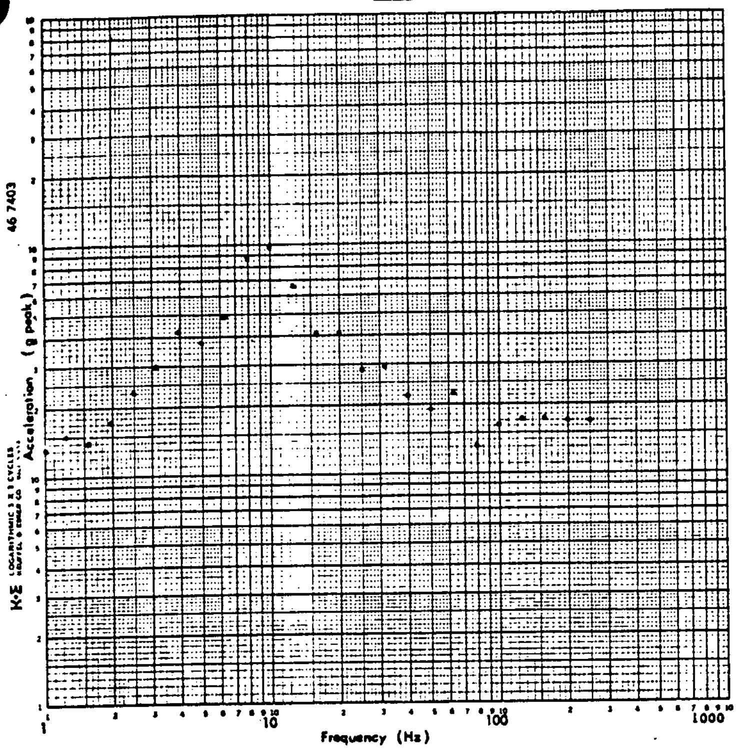


AXIS SS/V
LOCATION NO. 14SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

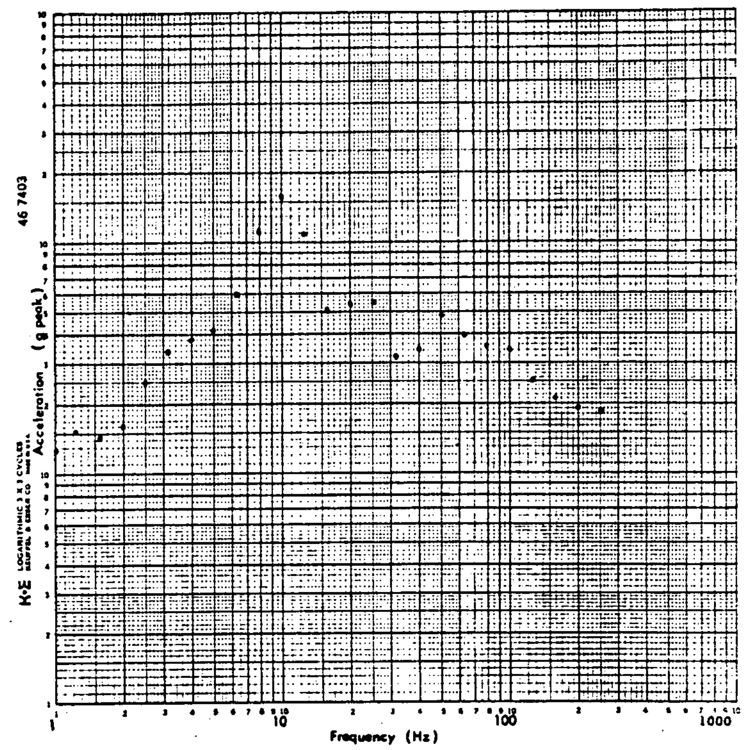


AXIS SS/V
LOCATION NO. 15SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

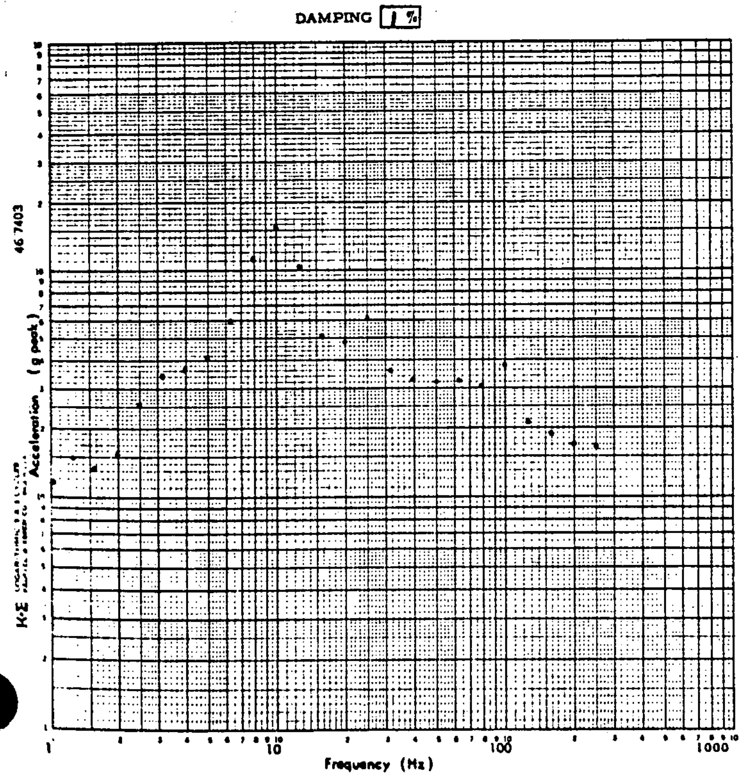


AXIS SS/V
LOCATION NO. 16SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

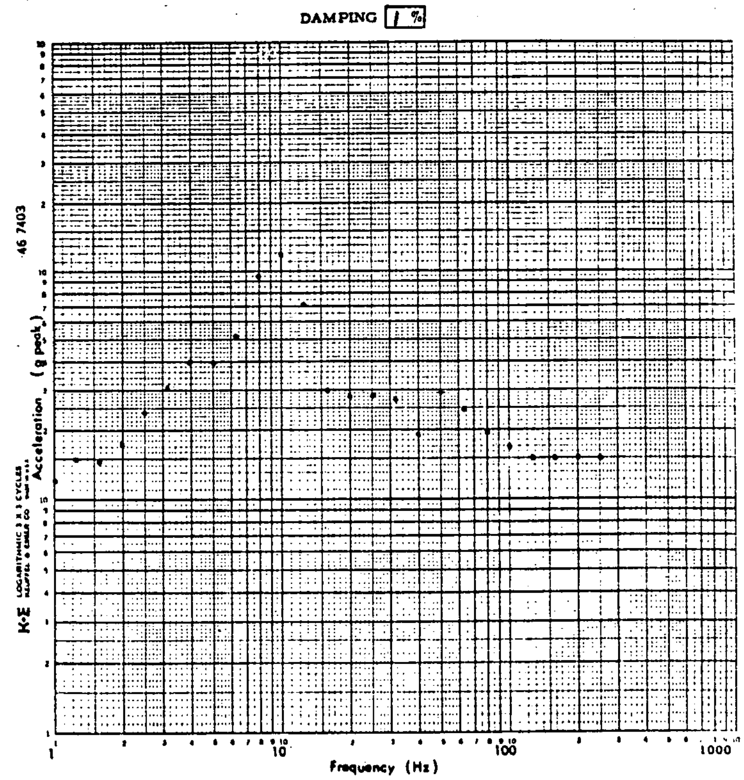


AXIS SS/V
LOCATION NO. 17SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

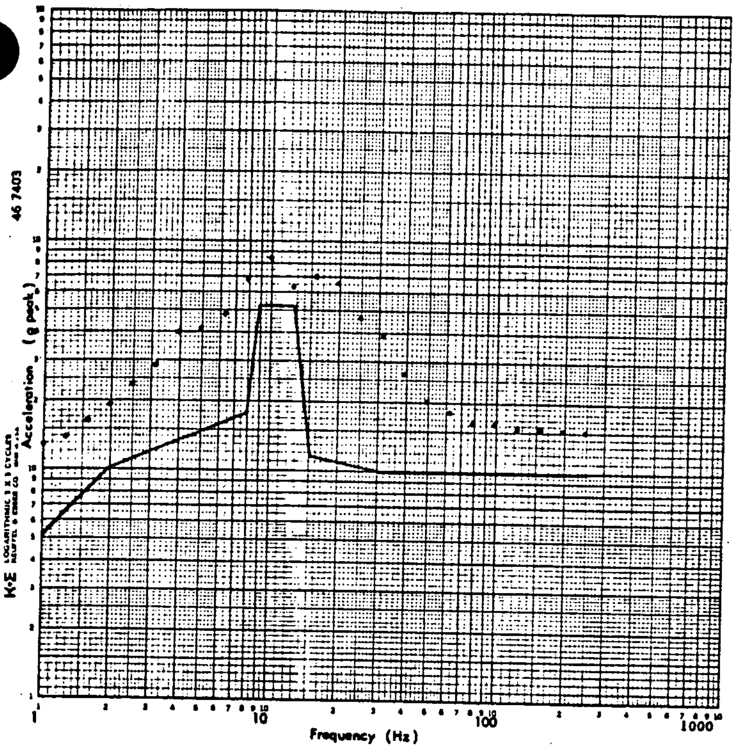


AXIS SS/V
LOCATION NO. 18SS
TEST RUN NO. 13

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1%]

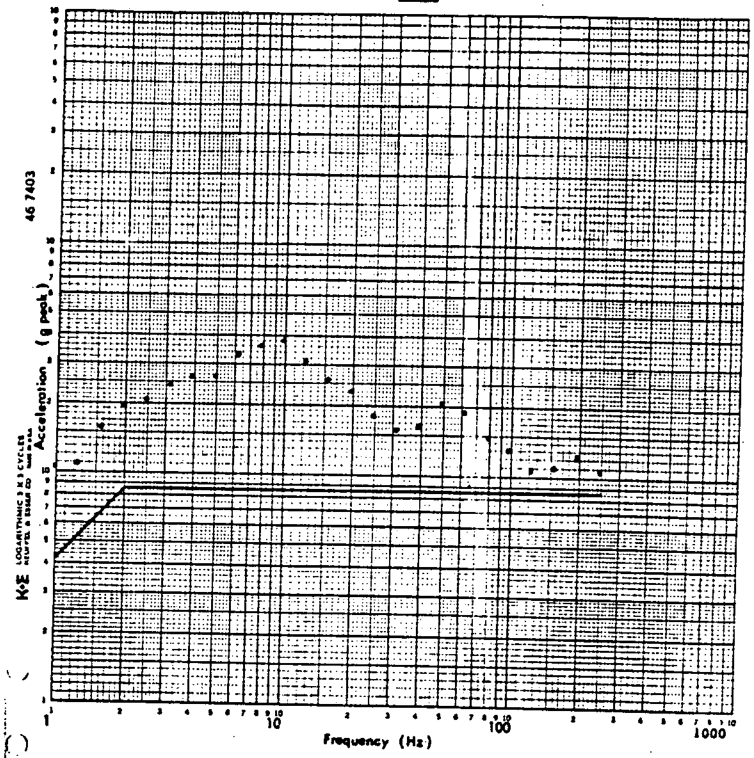


AXIS FB/V
LOCATION NO. HCA
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1%]

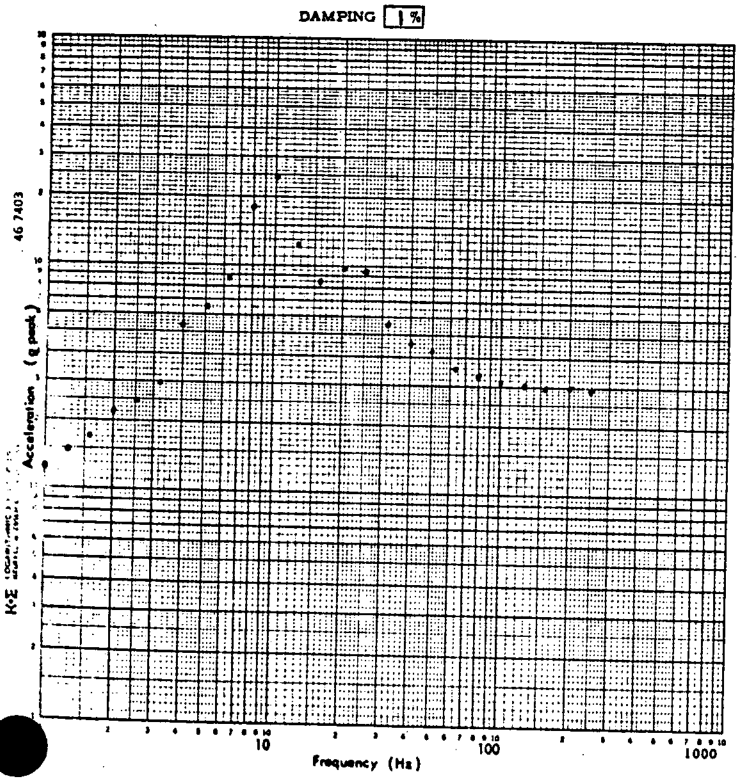


AXIS FB/V
LOCATION NO. VCA
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1%]

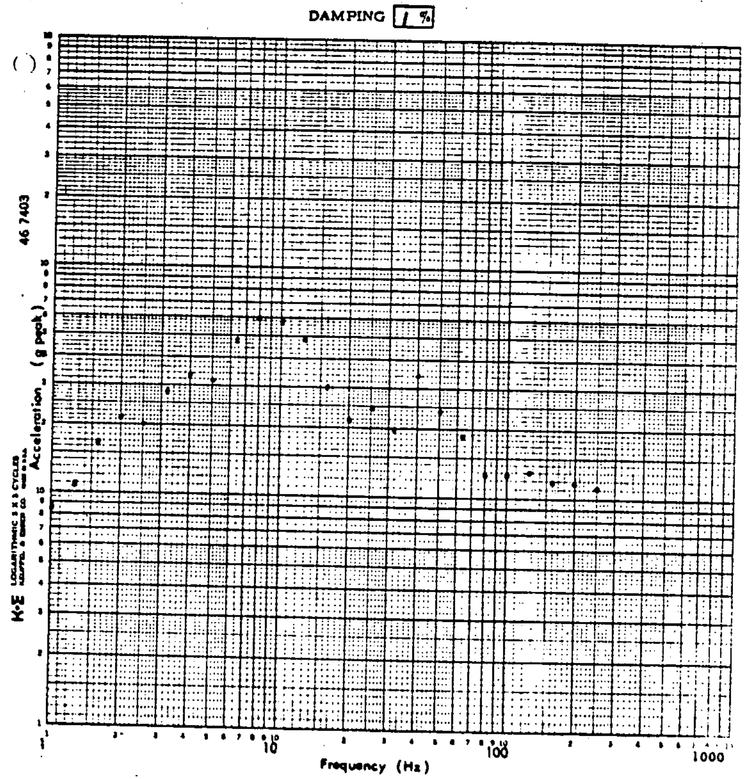


AXIS FB/V
LOCATION NO. 1FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1%]

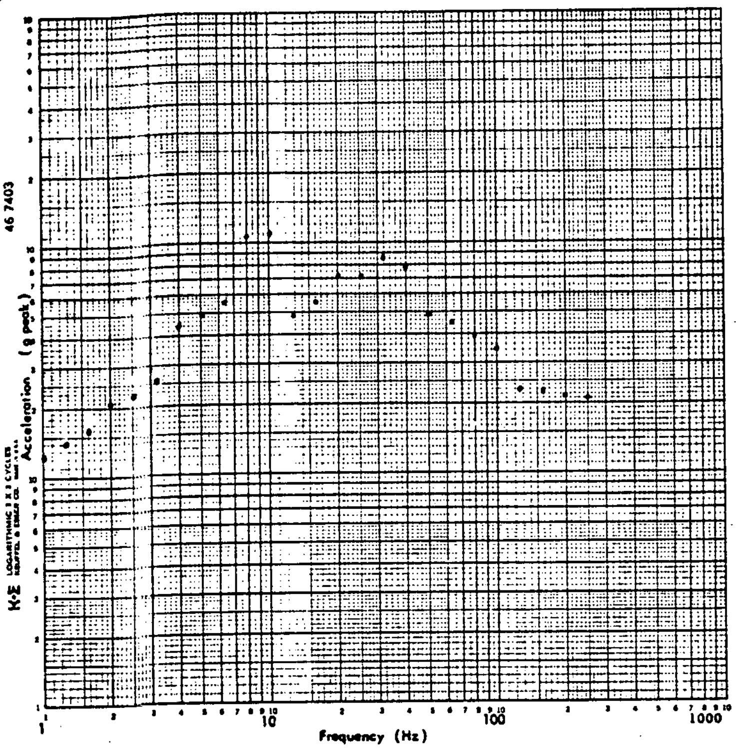


AXIS FB/V
LOCATION NO. 2V
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

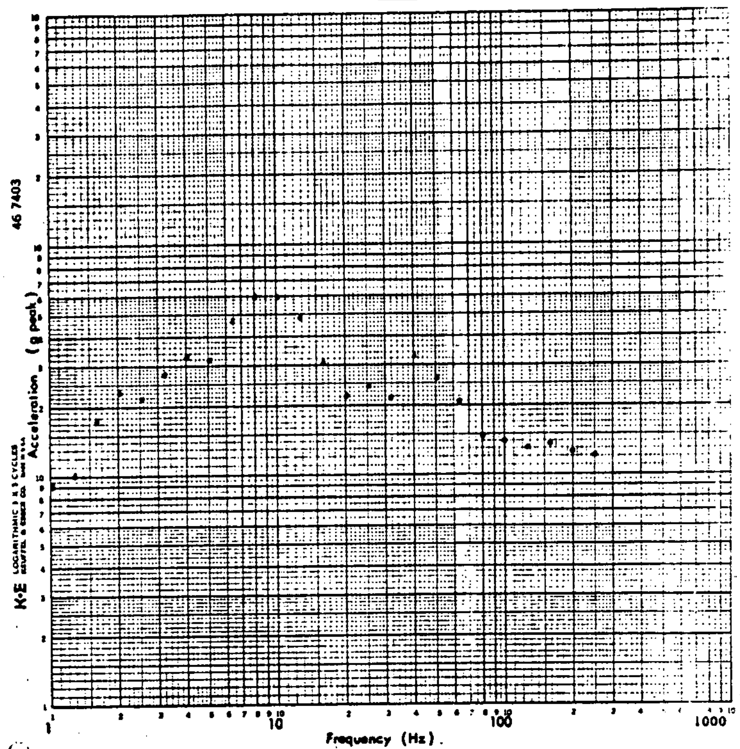


AXIS FB/V
LOCATION NO. 3FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

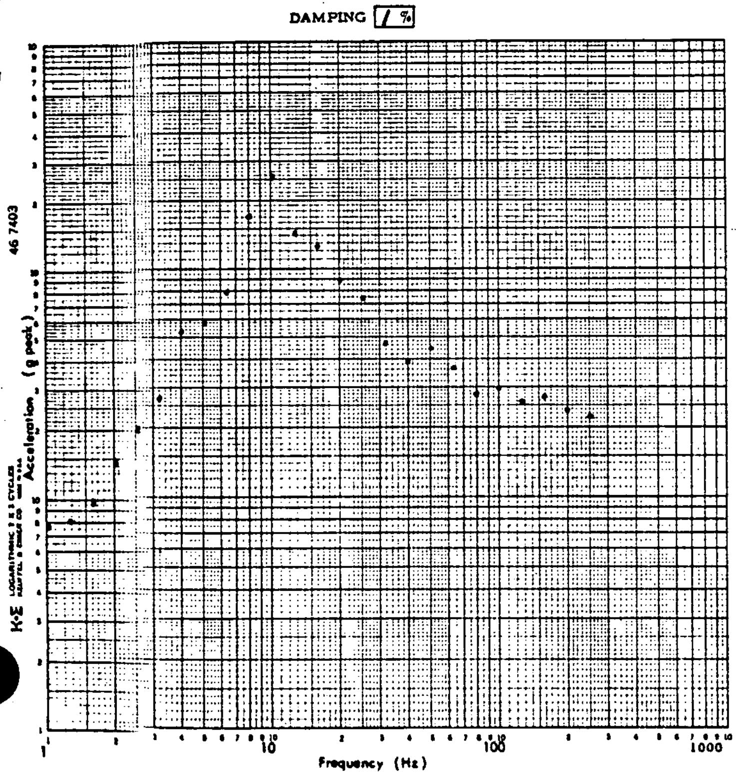


AXIS FB/V
LOCATION NO. 4V
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

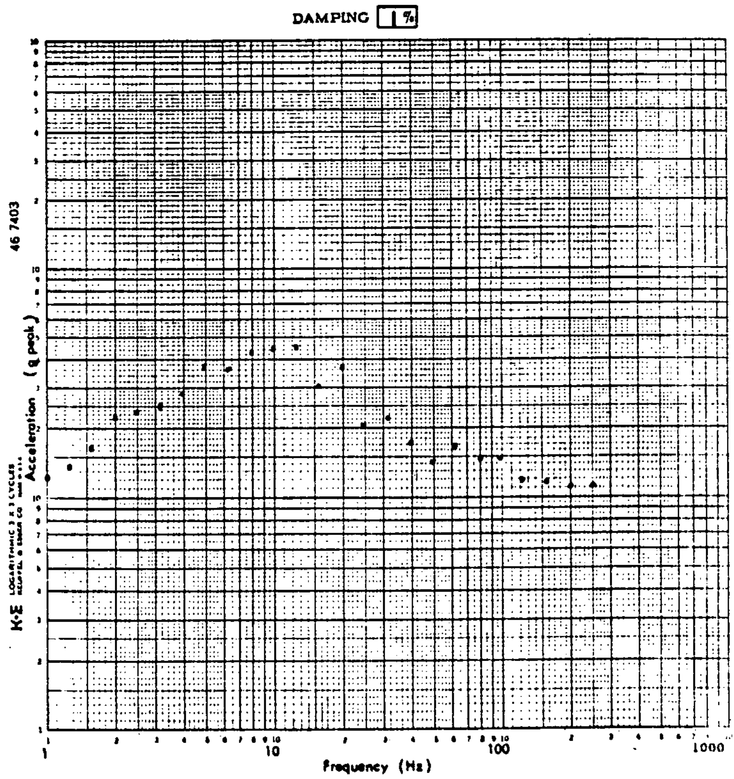


AXIS FB/V
LOCATION NO. 5FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

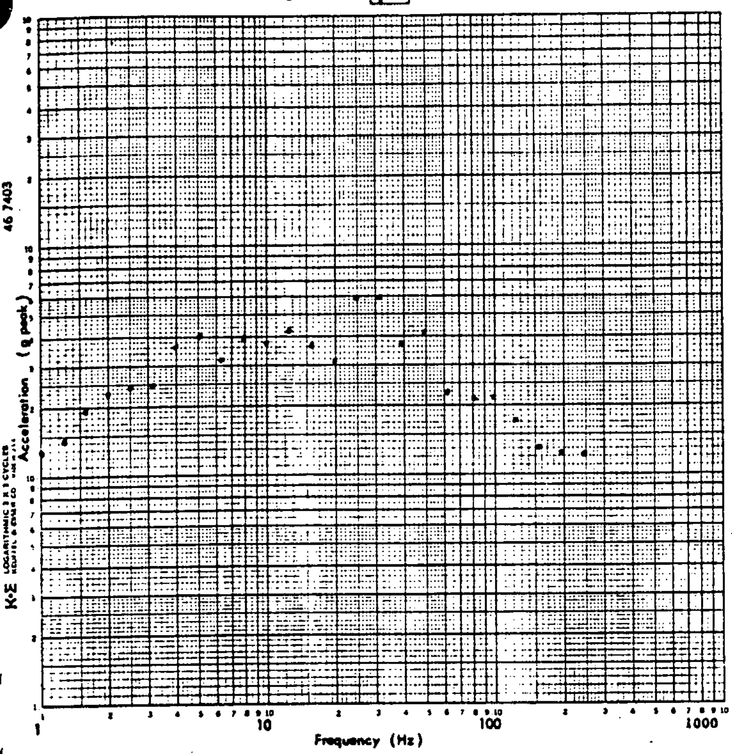


AXIS FB/V
LOCATION NO. 6V
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

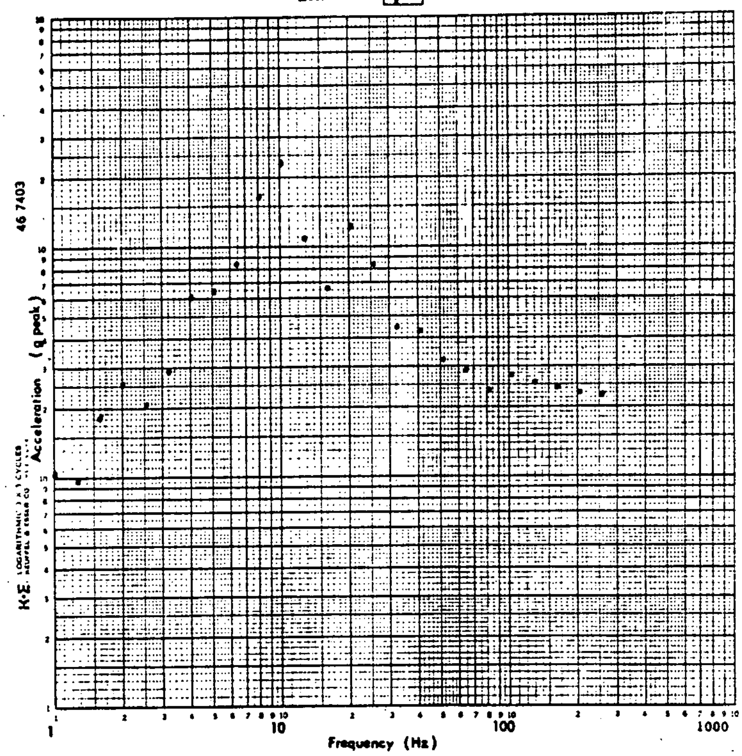


AXIS FB/V
LOCATION NO. 7V
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

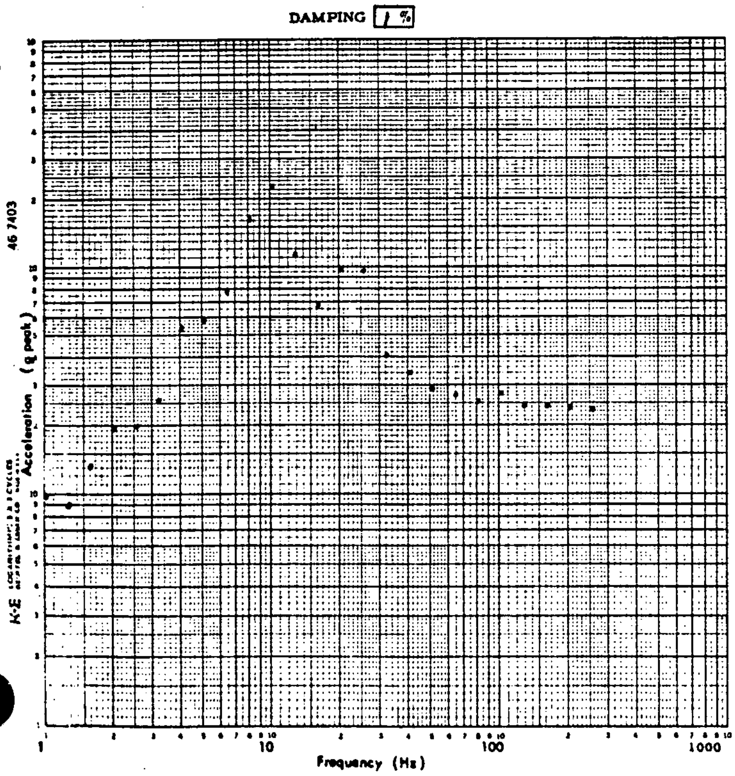


AXIS FB/V
LOCATION NO. 8FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

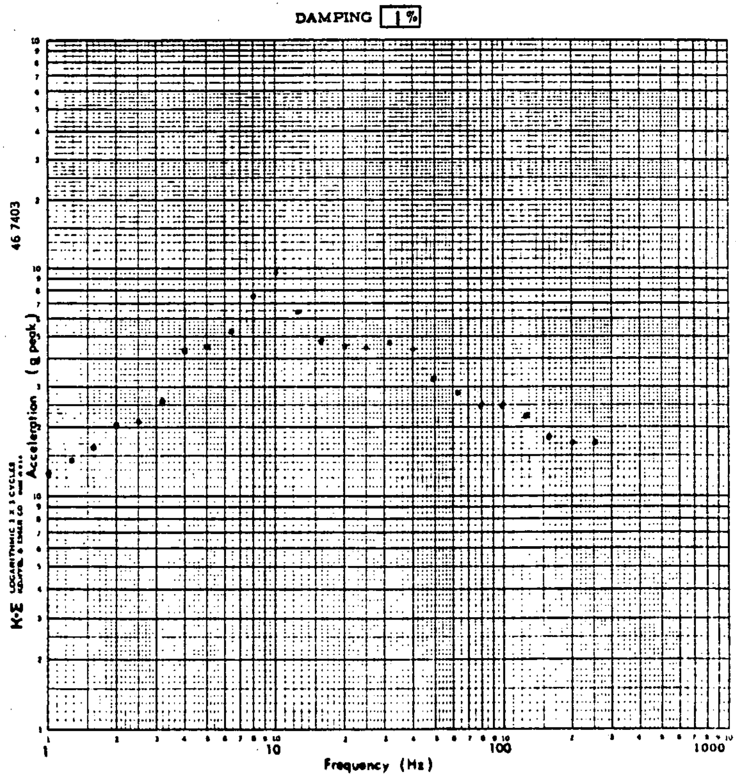


AXIS FB/V
LOCATION NO. 9FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

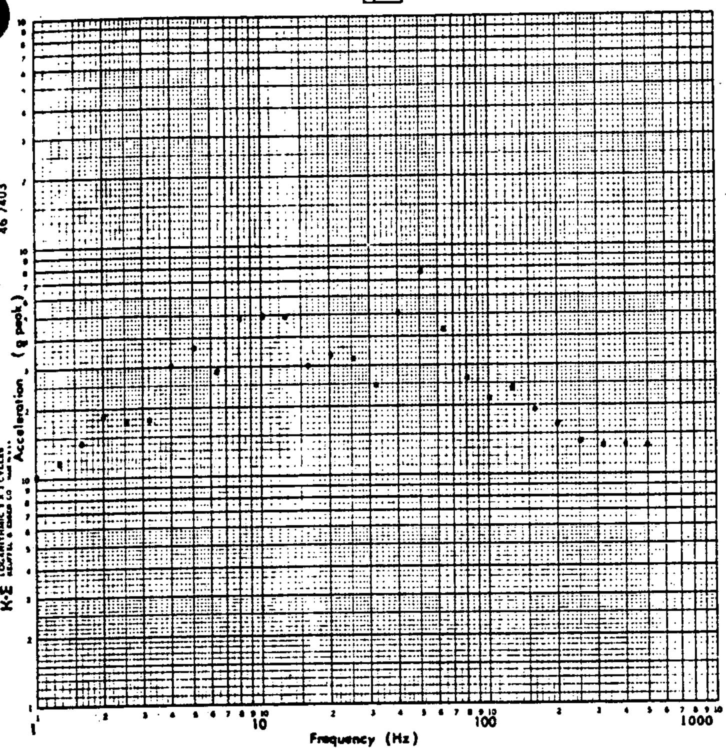


AXIS FB/V
LOCATION NO. 10FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

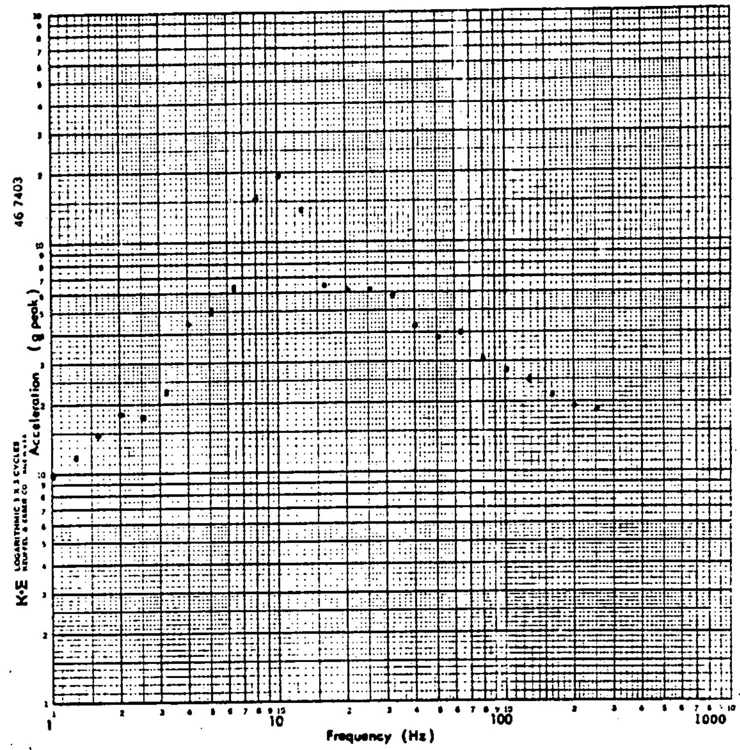


AXIS FB/V
LOCATION NO. 11 V
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

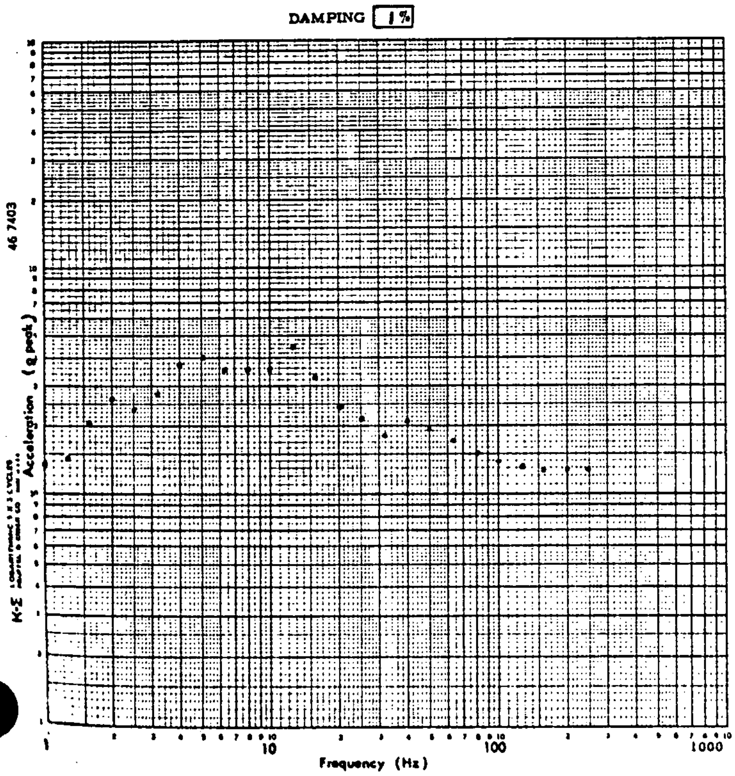


AXIS FB/V
LOCATION NO. 12 FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

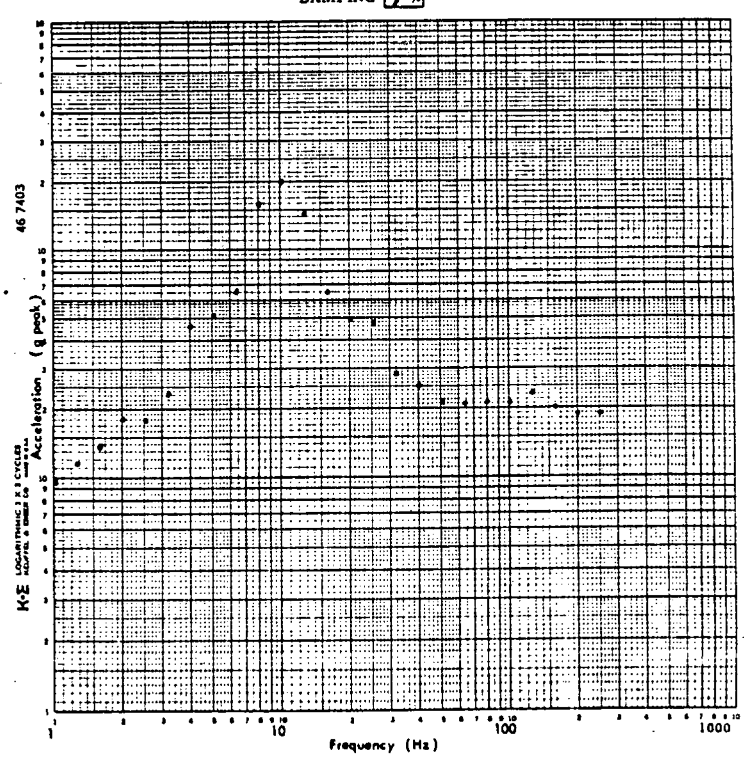


AXIS FB/V
LOCATION NO. 13 V
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

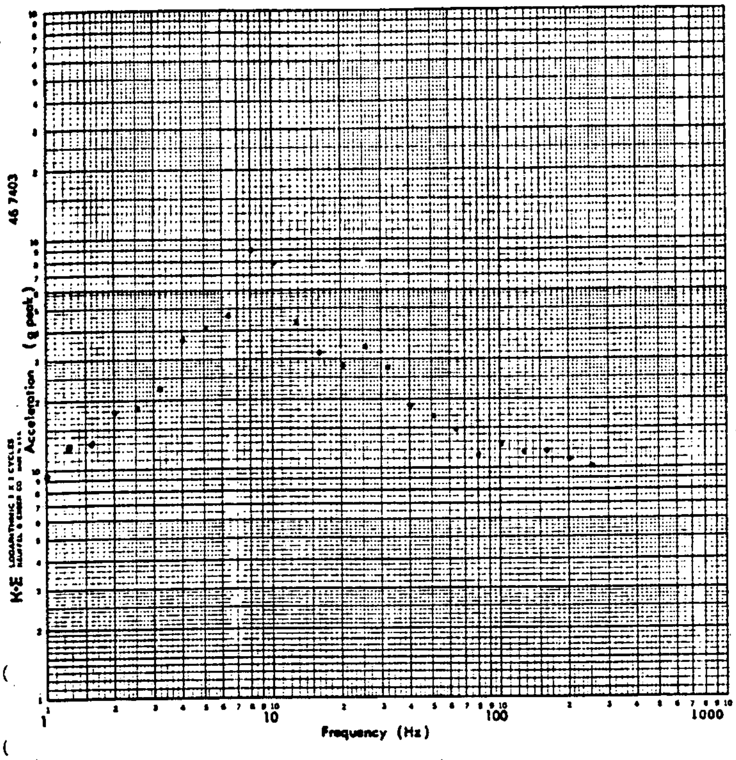


AXIS FB/V
LOCATION NO. 14 FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

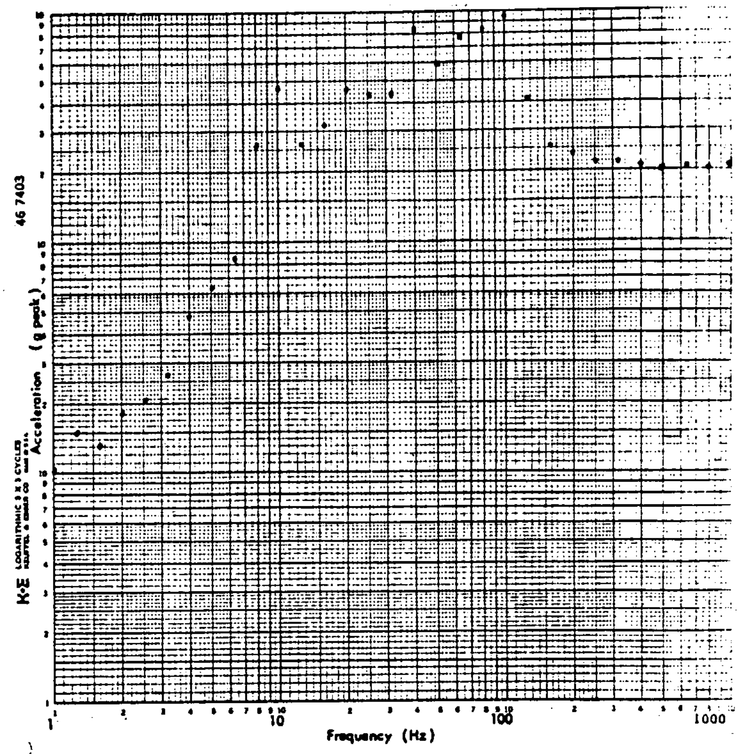


AXIS FB/V
LOCATION NO. 15FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

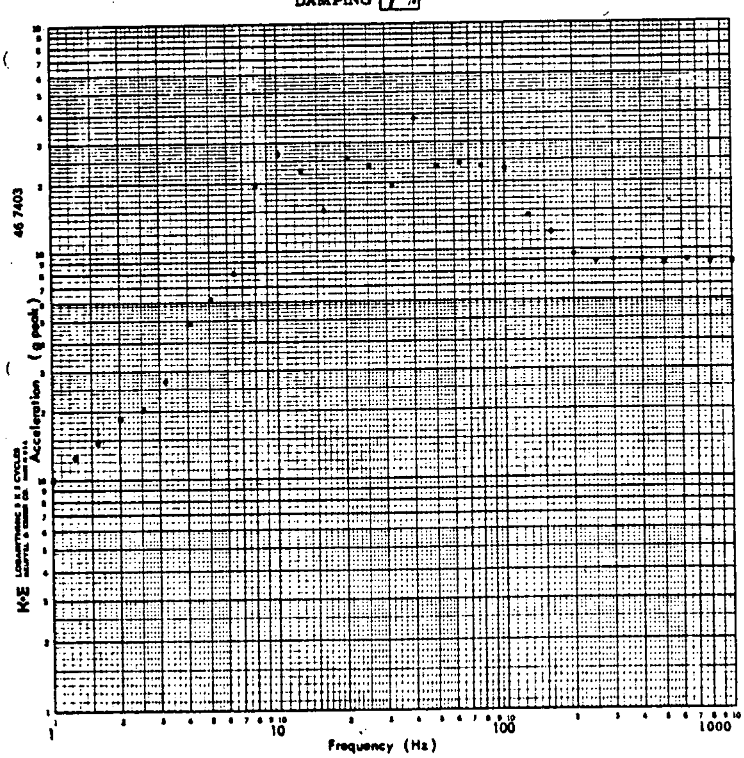


AXIS FB/V
LOCATION NO. 16FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

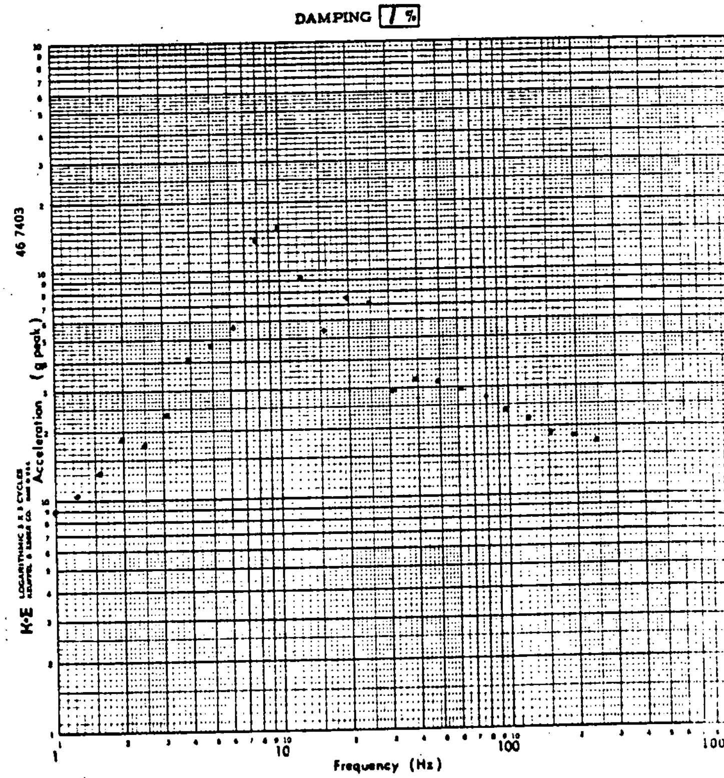


AXIS FB/V
LOCATION NO. 17 FB
TEST RUN NO. 23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]



AXIS FB/V
LOCATION NO. 18FB
TEST RUN NO. 23

APPENDIX IV

ENVIRONMENTAL TEST DATA SHEETS
AND
RESULTS

DATA SHEET

WYLE LABORATORIES

Customer ACCO
Specimen ESFAS Auxiliary Relay Cabinet
Part No.
Spec. Acco
Para. 5.0
S/N
GSI No

Amb. Temp. 75°F
Photo Yes
Test Med. Temp & Humidity
Specimen Temp. As Recorded

Job No. 42913
Report No. 42913-1
Start Date 6-20-75

Test Title Temperature And Humidity

Test Equipment

Instrument	Model No.	Wyle No.	Calibration Period	Date of Last Calibration
1. Chamber	01	98041	N/A	N/A
2. Temperature controller	64A-186	95287	90 Day	6-19-75
3. Humidity Controller	64A-186	95051	90 Day	6-19-75
4. Temperature Potentiometer	DS-520	95320	90 Day	5-12-75
5.				
6.				
7.				
8.				
9.				
10.				

The test specimen was placed in a humidity chamber and operating connections were made. Four (4) thermocouples were then affixed to the mounting panels of Relays K213, K306, K617 and K724. A pre-test functional was then performed by Acco personnel. The chamber ambient temperature and relative humidity were then increased to 90°F and 95 percent respectively in 30 minutes with the test specimen energized. This condition

Specimen Failed
Specimen Passed ✓
NOD Written

Tested By John Nodel Date: 6-20-75
Witness Date:
Sheet No. I of II
Approved Herschel Jordan

WH-614

DATA SHEET

WYLE LABORATORIES

Specimen ESFAS Auxiliary Relay Cabinet
Part No.
S/N

Job No. 42913
Report No. 42913-1
Date 6-20-75

Test Title Temperature And Humidity

Description of Test (Continued):

was maintained for four (4) hours. At the conclusion of this period a functional test was performed on the test specimen. The chamber ambient temperature was then increased to 122°F with a resulting decrease in chamber relative humidity of 35 percent. This condition was maintained for four (4) hours. At the conclusion of this period a functional test was performed. The chamber ambient temperature was then reduced to 40°F with a resulting increase of 93 percent relative humidity. This condition was maintained for Five (5) hours instead of the required 2 hours per the instructions of the Acco Representative. At the conclusion of this period a functional test was performed. The chamber ambient temperature was then increased to 70°F and maintained until specimen temperature stabilization was attained. a functional test was then performed by Acco personnel. Upon completion of the functional test the test specimen was visually inspected. There was no apparent damage or degradation noted resulting from the test performed. All functional test data was recorded and retained by Acco personnel. Detailed time, temperature and humidity data is presented on page 3 and 4.

WH-614B

DATA SHEET

WYLE LABORATORIES

Specimen ESFAS Auxiliary Relay Cabinet
Part No. ______
S/N ______

Job No. 42913
Report No. 42913-1
Date 6-20-75

Test Title Temperature And Humidity

Description of Test (Continued):

Time	Chamber Temp °F	Chamber % RH	Relay No. K213	Relay No. K301	Relay No. K613	Relay No. K724
0	72	64	72	72	72	72
.5	90	95	85	91	83	95
1.0	90	95	93	100	90	102
1.5	90	95	95	102	91	103
2.0	90	95	98	104	93	105
2.5	90	95	100	107	95	107
3.0	90	95	102	109	97	109
3.5	90	95	103	110	98	110
4.0	90	95	104	112	99	112
4.5	Increase to 122 122	35	106	115	102	116
5.0	122	35	108	117	106	120
6.5	122	35	110	120	109	123
7.0	122	35	114	124	114	128
7.5	122	35	117	128	118	132
8.0	122	35	118	129	119	133
8.5	122	35	121	131	121	135
9.0	122	35	123	132	123	136
9.5	Decrease to 40°F	Uncontrolled	123	133	124	138
10.5	40	93	93	120	95	114
11.0	40	93	84	110	84	103
11.5	40	93	78	102	76	93
12.0	40	93	72	93	62	81
12.5	40	93	69	88	57	77
13.0	40	93	67	81	55	71

WH-614B

DATA SHEET

WYLE LABORATORIES

Specimen ESFAS Auxiliary Relay Cabinet
Part No. ______
S/N ______

Job No. 42913
Report No. 42913-1
Date 6-20-75

Test Title Temperature And Humidity

Description of Test (Continued):

Time	Chamber Temp °F	Chamber %RH	Relay No K213	Relay No K301	Relay No K613	Relay No K724
13.5	40	93	65	78	54	69
14.0	40	93	63	76	53	67
14.5	40	93	59	65	54	65
16.0	40	93	58	56	53	62
15.5	40	93	67	54	51	61
16.0	70	55	73	79	70	81

WH-614B

APPENDIX V

INSTRUMENTATION LOG SHEETS
AND
INSTRUMENTATION EQUIPMENT SHEETS

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. 42913 — LOG PAGE NO. 1 OF 7

CUSTOMER ACCO — TEST ENGINEER [signature]

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)
16 June 75		Mounted specimen in the S-S & Vert. Axis. Specimen Torque 32' Lbs
		Set-up to Record 2 Control and 18 Response Accelerometers
		on Tape and Oscillograph. 6 Strain Gages on Oscillograph
		Set-up to Record 25 Electrical Monitor on Oscillograph
		Recorded Calibration Signal 1VPK @ 100 HZ on Tape 1 & 2
		Tape Start #1 0000' End 0100'
		#2 0000' 0100'
	1755	Run #1 Sine Sweep 1-40 HZ .2G Horiz & .2G Vert Input S-S & Vert. Axis
		Tape Start #1 0100' 0380'
		#2 0100 0372'
		Retorque specimen to > 100' Lbs

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. 42913

LOG PAGE NO. 2 OF 7

CUSTOMER ACCO

TEST ENGINEER [signature]

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)
17 JUNE 75	0900	RUN# 2, SINE SWEEP 1-40 HZ .2G Horiz & .2G Vert S-S & Vert AXIS
		Tape START #1 0380' END 0625'
		#2 0372' 0616'
	1125	RUN#3, SINE SWEEP 1-40HZ .2G HORIZ ONLY S-S AXIS
		TAPE #1 0625 END 0860'
		#2 0616' 0853'
	1215	RUN# 4, SINE SWEEP 1-40HZ .2G Vert ONLY Vert. AXIS
		TAPE START #1 0860' END 1110'
		#2 0853' 1105'
	1440	RUN#5, MULTI-Frequency Random Less Than OBE S-S & Vert. AXIS
		Tape START #1 1110' END 1160'
		#2 1105' 1160'

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. 42913

LOG PAGE NO. 3 OF 7

CUSTOMER ACCO

TEST ENGINEER [signature]

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)
17 JUNE 75	1450	RUN#6, MULTI-FREQUENCY RANDOM 50% HORIZ & 40% VERT S-S & VERT AXIS
		TAPE START #1 1160' END 1205'
		#2 1160' 1205
	1455	RUN#7, MULTI-FREQUENCY RANDOM S-S & VERT. AXIS
		TAPE START #1 1205' END 1250'
		#2 1206' 1250'
		OBE EXCEPT LOW @ 4HZ HORIZ.
	1507	RUN#8, MULTI-FREQUENCY RANDOM OBE
		TAPE START #1 1250' END 1295' S-S & VERT. AXIS
		#2 1250' 1295'
		DURING TEST THE SPECIMEN WAS CHANGED FROM ENERGIZED TO
		DEENERGIZED TO ENERGIZED
	1515	RUN# 9, MULTI-FREQUENCY RANDOM OBE S-S & VERT. AXIS
		TAPE START #1 1295' END 1335'
		#2 1295' 1335

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. 42913

CUSTOMER ACCO

LOG PAGE NO. 4 OF 7

TEST ENGINEER [signature]

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)
17 JUNE 75	1525	RUN#10, MULTI-FREQUENCY RANDOM OBE S-S & VERT. AXIS
		TAPE START #1 1335' END 1380'
		#2 1335' 1380'
	1535	RUN# 11, MULTI-FREQUENCY RANDOM OBE S-S & VERT. AXIS
		TAPE START #1 1380' END 1422'
		#2 1380' 1425'
	1537	RUN#12, MULTI-FREQUENCY RANDOM OBE S-S & VERT. AXIS
		TAPE START #1 1422' END 1460'
		#2 1425' 1460'
	1550	RUN# 13, MULTI-FREQUENCY RANDOM SSE S-S & VERT. AXIS
		TAPE START #1 1460' END 1500'
		#2 1460' 1500'
		STRAIN GAGE #4 READING 65 μIN

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. 42913

CUSTOMER ACCO

LOG PAGE NO. 5 OF 7

TEST ENGINEER [signature]

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)
18 JUNE 75		Rotated specimen 90° to the F-B & Vert. AXIS
	1235	RUN#14, SINE SWEEP 1-40 HZ .2G Horiz & .2G Vert. F-B & Vert. AXIS
		TAPE START #1 1500' END 1755'
		#2 1500' 1740'
	1245	RUN#15, SINE SWEEP 1-40 HZ .2G HORIZ ONLY F-B AXIS
		TAPE START #1 1755' END 1990'
		#2 1740' 1985'
	1255	RUN#16, SINE SWEEP 1-40 HZ .2G Vert ONLY Vert AXIS
		TAPE START #1 1990' END 2220
		#2 1985' 2215'
	1405	RUN#17, MULTI-FREQUENCY RANDOM 40% OF DBE F-B & Vert. AXIS
		TAPE START #1 2220' END 2265
		#2 2215' 2262

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. #2913

CUSTOMER ACCO

LOG PAGE NO. 6 OF 7

TEST ENGINEER [signature]

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)
18 JUNE 75	1615	RUN#18, MULTI-Frequency Random OBE F-B & Vert. Axis
		Tape START #1 2265' END 2305'
		#2 2262' 2305'
	1623	RUN#19, MULTI-Frequency Random OBE F-B & Vert. Axis
		Tape START #1 2305' END 2340'
		#2 2305 2340
	1637	RUN#20, MULTI-Frequency Random OBE F-B & Vert. Axis
		Tape START #1 2340' END 2376'
		#2 2340' 2377'
		During Test The specimen was Changed From energized To
		Deenergized To energized.
	1643	RUN# 21, MULTI- Frequency Random OBE F-B & Vert. Axis
		Tape START #1 2376' END 2410'
		#2 2377' 2411'

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. 42913

CUSTOMER ACCO

LOG PAGE NO. 7 OF 7

TEST ENGINEER [signature]

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)
18 JUNE 75	1647	RUN#22 MULTI-FREQUENCY RANDOM OBE F-B & Vert. AXIS
		TAPE START #1 2410' END 2450'
		#2 2411' 2446'
	1655	RUN#23, MULTI-FREQUENCY RANDOM SSE F-B & Vert. AXIS
		TAPE START #1 2450' END 2482' END OF TAPE
		#2 2446' 2472' END OF TAPE

INSTRUMENTATION EQUIPMENT SHEET

Date 16 JUNE 75 Job No. 42913 Test Area PIT#1

Technician K.W. Pointer Customer ACCO Type Test SEISMIC

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
1	Charge Amp.	DYNAMICS	7302	–	1652	500G	±2%	6-14-75	12-14-75
2	Charge Amp	DYNAMICS	7302	–	1628	500G	±2%	6-14-75	12-14-75
3	Charge Amp	DYNAMICS	7302	–	1621	500G	±2%	6-14-75	12-14-75
4	Charge Amp	DYNAMICS	7302	–	1635	500G	±2%	6-14-75	12-14-75
5	Charge Amp	DYNAMICS	7302	–	1661	500G	±2%	6-14-75	12-14-75
6	Charge Amp	DYNAMICS	7302	–	1516	500G	±2%	6-14-75	12-14-75
7	Charge Amp	DYNAMICS	7302	–	1678	500G	±2%	6-14-75	12-14-75
8	Charge Amp	DYNAMICS	7302	–	1580	500G	±2%	6-14-75	12-14-75
9	Charge Amp	DYNAMICS	7302	–	1532	500G	±2%	6-14-75	12-14-75
10	Charge Amp	DYNAMICS	7302	–	1631	500G	±2%	6-14-75	12-14-75
11	Charge Amp	DYNAMICS	7302	–	1620	500G	±2%	6-14-75	12-14-75
12	Charge Amp	DYNAMICS	7302	–	1559	500G	±2%	6-14-75	12-14-75
13	Charge Amp	DYNAMICS	7302	–	1578	500G	±2%	6-14-75	12-14-75
14	Charge Amp	DYNAMICS	7302	–	1670	500G	±2%	6-14-75	12-14-75
15	Charge Amp	DYNAMICS	7302	–	1501	500G	±2%	6-14-75	12-14-75
16	Charge Amp	DYNAMICS	7302	–	1629	500G	±2%	6-14-75	12-14-75
17	Charge Amp	DYNAMICS	7302	–	1667	500G	±2%	6-14-75	12-14-75
18	Charge Amp	DYNAMICS	7302	–	1650	500G	±2%	6-14-75	12-14-75

Instrument Test Engineer [signature]

Checked & Received By Herschel Jordan

[illegible]-1029

INSTRUMENTATION EQUIPMENT SHEET

Date 16 JUNE 75 Job No. 42913 Test Area PIT #1

Technician K. Pointer Customer ACCO Type Test SEISMIC

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
19	Charge Amp	DYNAMICS	7302	–	1600	500G	±2%	6-14-75	12-14-75
20	Charge Amp	DYNAMICS	7302	–	1653	500G	±2%	6-14-75	12-14-75
21	Charge Amp	DYNAMICS	7302	–	1641	500G	±2%	6-14-75	12-14-75
22	Charge Amp	DYNAMICS	7302	–	1544	500G	±2%	6-14-75	12-14-75
23	Charge Amp	DYNAMICS	7302	–	1569	500G	±2%	6-14-75	12-14-75
24	Charge Amp	DYNAMICS	7302	–	1617	500G	±2%	6-14-75	12-14-75
25	Charge Amp	DYNAMICS	7302	–	1560	500G	±2%	6-14-75	12-14-75
26	Charge Amp	DYNAMICS	7302	–	1624	500G	±2%	6-14-75	12-14-75
27	Charge Amp	DYNAMICS	7302	–	1508	500G	±2%	6-14-75	12-14-75
28	Charge Amp	DYNAMICS	7302	–	1519	500G	±2%	6-14-75	12-14-75
29	Accelerometer	ENDEVCO	2272	NA85	1430	1000G	±5%	5-27-75	8-27-75
30	Accelerometer	ENDEVCO	2272	NA94	1414	1000G	±5%	5-14-75	8-14-75
31	Accelerometer	ENDEVCO	2272	NA15	1425	1000G	±5%	5-27-75	8-27-75
32	Accelerometer	ENDEVCO	2272	NA50	1408	1000G	±5%	5-14-75	8-14-75
33	Accelerometer	ENDEVCO	2272	NA74	1426	1000G	±5%	5-14-75	8-14-75
34	Accelerometer	ENDEVCO	2272	CX03	95365	1000G	±5%	5-14-75	8-14-75
35	Accelerometer	ENDEVCO	2272	AY81	95229	1000G	±5%	5-14-75	8-14-75
36	Accelerometer	ENDEVCO	2272	NA28	1410	1000G	±5%	6-9-75	9-9-75

Instrument Test Engineer S. DeLucchi Checked & Received By Herschel Jordan

WH-1029

INSTRUMENTATION EQUIPMENT SHEET

Date 16 JUNE 75 Job No. 42913 Test Area PIT #1

Technician K. Pointer Customer ACCO Type Test Seismic

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
37	Accelerometer	ENDEVCO	2272	NA47	F-1440	1000G	± 5%	6-9-75	9-9-75
38	Accelerometer	ENDEVCO	2272	NA14	1407	1000G	± 5%	6-9-75	9-9-75
39	Accelerometer	ENDEVCO	2272	NA64	1422	1000G	± 5%	6-9-75	9-9-75
40	Accelerometer	ENDEVCO	2272	NA97	1409	1000G	± 5%	5-14-75	8-14-75
41	Accelerometer	ENDEVCO	2272	NA98	1424	1000G	± 5%	6-9-75	9-9-75
42	Accelerometer	ENDEVCO	2272	NA49	1441	1000G	± 5%	6-9-75	9-9-75
43	Accelerometer	ENDEVCO	2272	NA05	1421	1000G	± 5%	6-9-75	9-9-75
44	Accelerometer	ENDEVCO	2272	NA46	1412	1000G	± 5%	6-9-75	9-9-75
45	Accelerometer	ENDEVCO	2272	NA95	1404	1000G	± 5%	5-14-75	8-14-75
46	Accelerometer	ENDEVCO	2272	NA08	1436	1000G	± 5%	5-27-75	8-27-75
47	Accelerometer	ENDEVCO	2219	LA12	1456	1000G	± 5%	6-9-75	9-9-75
48	Accelerometer	ENDEVCO	2219	LA25	1457	1000G	± 5%	6-5-75	9-5-75
49	Accelerometer	ENDEVCO	2272	NA13	1419	1000G	± 5%	6-9-75	9-9-75
50	Accelerometer	ENDEVCO	2272	NA61	1411	1000G	± 5%	5-27-75	8-27-75
51	Galvo Amp	HONEYWELL	T66-500	–	96034	1:1	± 2%	2-11-75	8-11-75
52	Galvo Amp	HONEYWELL	T66-500	–	95397	1:1	± 2%	12-23-74	6-23-75
53	Galvo Amp	HONEYWELL	T66-500	–	95285	1:1	± 2%	3-14-75	9-14-75
54	Galvo Amp	HONEYWELL	T66-500	–	R-7	1:1	± 2%	6-12-75	12-12-75

Instrument Test Engineer J. DeLucchi Checked & Received By Herschel Jordan

WH-1029

INSTRUMENTATION EQUIPMENT SHEET

Date 16-June 75 Job No. 42913 Test Area Pit #1

Technician K. Pointer Customer Acco Type Test Seismic

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
55	Galvo Amp	Honeywell	T66-500	—	R-8	1:1	±2%	6-12-75	12-12-75
56	Oscilloscope	Textronics	561A	—	605F53	0.01 to 10 v/cm	±3%	4-23-75	7-23-75
57	Visicorder	Honeywell	1912	—	98638	D.C. to 2.5 K.Hz.	±2%	1-16-75	7-16-75
58	Visicorder	Honeywell	1508	-	95079	D.C. to 2.5 KHz.	±2%	3-25-75	9-25-75
59	Visicorder	Honeywell	1508	-	96059	D.C to 2.5 KHz.	±2%	4-17-75	10-17-75
60	Visicorder	Honeywell	1508	-	95423	D C to 2.5 KHz.	±2%	5-19-75	11-19-75
61	Visicorder	Honeywell	1508	-	96057	D-C to 2.5KHz.	±2%	6-9-75	12-9-75
62	Tape Recorder	Sangamo	3500	-	98753	D C to 215KHz.	±2%	6-2-75	12-2-75
63	Tape Recorder	Sangamo	3500	—	95378	D C to 215KHz.	±2%	5-2-75	11-2-75
64	Power Supply	Dressen	27144	—	95174	±15vdc.	±0.1%	4-27-75	7-27-75
65	Power Supply	Kepco	Sm11002	—	95100	0-160vdc.	±0.1%	4-22-75	10-22-75
66	DiGimark	Chadwick	423	—	97694	99KHz.	±1Cnt.	5-2-75	8-2-75
67	Servomonitor	Spectral Dynamics	Sd105C	—	95359	1000g	±4%	4-18-75	7-18-75
68	Servomonitor	Spectral Dynamics	Sd105C	—	95358	1000g	±4%	4-29-75	7-29-75
69	Tracking Filter	Spectral Dynamics	Sd1012	—	81609	40dB	±0.5dB	5-15-75	8-15-75
70	Carrier Generator	Spectral Dynamics	Sd1010	—	81432	40dB	±0.5dB	5-15-75	8-15-75
71	Log Converter	Spectral Dynamics	SD112	—	95132	80dB	±0.5dB	4-14-75	7-14-75
72	Log Freq. Converter	Spectral Dynamics	SD116	—	95123	5-20KHz	±2%	5-20-75	8-20-75

Instrument Test Engineer [signature] Checked & Received By Herschel Jordan

WH-1029

INSTRUMENTATION EQUIPMENT SHEET

Date 16 June 75 Job No. 42913 Test Area Pit #1

Technician K. Pointer Customer Acco Type Test Seismic

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
73	Spectrum Analyzer	MRAD	2825	–	95354	0.5 Hz. to 10 KHz.	±2%	12-26-74	6-26-75
74	X Y Plotter	H. P.	7044B	–	95297	0.5 MV - 10 V/in.	±2%	5-12-75	8-12-75
75	Spectrum Synthesizer	MRAD	1975	–	95363	0.5 Hz - 100 Hz	±4%	2-27-75	8-27-75

Instrument Test Engineer [signature] Checked & Received By Herschel Jordan

WH-1029

APPENDIX VI

SEISMIC AND ENVIRONMENTAL TEST PLANS

TEST PROCEDURE

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP
P. O. BOX 1008 • HUNTSVILLE, ALABAMA 35807
TWX (810) 726-2225 • TELEPHONE (205) 837-4411

TEST PROCEDURE NO. 541/3385-2/ES

DATE: March 31, 1975
Revision A

SEISMIC TEST PLAN

FOR AN

ESFAS AUXILIARY RELAY CABINET

FOR

ACCO
ELECTRO-MECH DIVISION
STRATFORD, CONNECTICUT

APPROVED BY: ____________
FOR: ____________

APPROVED BY: ____________
FOR: ____________

APPROVED BY: ____________
FOR: ____________

APPROVED BY PROJECT MANAGER: Larry E. Frazier

APPROVED BY QUALITY ENGINEER: ____________

PREPARED BY PROJECT ENGINEER: Herschel Jordan

REVISIONS

FORM 1054-1 Rev. 4/74

REV. NO.	DATE	PAGES AFFECTED	BY	APP'L.	DESCRIPTION OF CHANGES
A	6-16-75	3	HJ	LEF	Change can to will in Para. 2.2
"	"	3	HJ	LEF	Change IEEE-344 Draft 5 1974 to
					IEEE 344-1975.
"	"	4	HJ	LEF	Change can to will in last two para-
					graphs of NOTES
"	"	5	HJ	LEF	Change customer evaluated to Wyle
					evaluated in Paragraph 3.2
"	"	5	HJ	LEF	Add deflection at the top of the
					cabinet

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP

1.0 MOUNTING

1.1 Specimen Orientation

An Auxiliary Relay Cabinet, 144 inches long by 56 inches deep by 90 inches high, weighing approximately 13,000 pounds, hereinafter called the specimen, will be placed on a Wyle-fabricated fixture such that the base of the specimen will be flush with the top of the fixture. The specimen will be oriented such that its longitudinal axis will be colinear with the longitudinal axis of the test table. The specimen will be rotated 90 degrees in the horizontal plane for the second horizontal axis test.

1.2 Specimen Tie-Down

The mounting hole pattern in the base of the specimen will be transferred to the test fixture. These holes will be drilled in the fixture, and the specimen will be attached using twelve 7/8-inch bolts. The bolts will be torqued to 32 foot-pounds or greater providing the mounting area is accessible for the torque wrench. The mounting of the specimen will simulate, as closely as practicable, the actual in-service configuration. The test fixture will be welded to the test table during seismic simulation. A

The specimen will be shipped with lifting hooks such that Wyle might lift the unit from above, if they so desire.

2.0 EXCITATION

2.1 Simultaneous Biaxial Excitation

Each horizontal axis will be excited separately, but each one will be excited simultaneously with the vertical axis (longitudinal simultaneously with vertical, then lateral simultaneously with vertical). The horizontal and vertical input acceleration levels will be phase incoherent during the multi-frequency tests.

2.2 Resonant Search

A low-level (approximately 0.2 g horizontally and vertically) biaxial sine sweep will be performed from 1 Hz to 40 Hz to establish major resonances. The sweep rate will be one octave per minute.

At the completion of the low-level resonance search, the data will be evaluated by a Wyle Laboratories Analyst to determine: A

1) If testing of the specimen can be eliminated over the lower frequency range of the composite response spectrum (i.e. approximately 10 Hz and below)

2) If stressing will occur by testing to the remaining portion of the composite RRS with a ZPA of 1 g minimum.

If the evaluation shows that the specimen will not be stressed and a low frequency cutoff can be established, a random multi-frequency test will be performed such that the TRS will envelope the composite RRS above the cutoff frequency with a minimum of 1 g horizontally and 0.85 g vertically. However, the Arkansas RRS shall be completely (1 - 40 Hz) enveloped by this test (see Paragraph 2.3).

If a low cutoff point can be established, an analytical justification shall be provided to show that the equipment has been qualified for the frequencies involved which include the requirements specified for Forked River Unit 1 (Jersey), Waterford Unit 3 (Louisiana) and San Onofre Units 2 and 3(Southern California Edison). The above evaluation shall be performed for the vertical and horizontal axes.

If a justification cannot be made, sine beat tests will be performed only at those equipment natural frequencies where the TRS cannot envelope the RRS. The sine beat tests will consist of five beats, each beat will consist of ten cycles with a minimum of two seconds interval between each beat. The Zero Period Amplitude of the Southern California Edison RRS shall be used unless otherwise specified by ACCO. The tests will be performed once for the in-phase and once for the out-of-phase conditions in each test axis.

NOTES:

Reference: General Engineering Specification 00000-ICE-3002, Rev. 03.

All testing shall be in accordance with IEEE-344 1975 and 1971 version. A

Prior to equipment leaving Wyle Laboratories, it will be verified, if possible, that it has been qualified to the requirements specified for San Onofre Units 2 and 3, Forked River Unit, Waterford Unit, and Arkansas Nuclear One Unit 2.

A seismic analysis will be performed to determine the characteristics of weld mounting versus bolt mounting. This analysis will include the weld bead requirements. A

The data from the strain gages will be evaluated to determine whether or not overstressing of the Arkansas cabinet has occurred. The cost of this analysis effort is not included in the fixed price test quote and, if required, would be performed on a time and material basis. A

2.3 Multi-Frequency Tests

The specimen will be subjected to 30-second duration simultaneous horizontal and vertical inputs of random waveform motion consisting of frequencies spaced one-third octave apart over the range of 1 Hz to 50 Hz. The amplitude of each one-third octave frequency will be independently adjusted in each axis until the Test Response Spectra (TRS) envelope the Required Response Spectra (RRS) of the Arkansas Power and Light Company (Figures 1 and 2), at and above the lowest equipment natural frequency, within the limitations of the test machine. The resulting TRS will be analyzed by a spectrum analyzer at a damping of one percent (1%) and plotted at one-third octave frequency intervals over the frequency range of interest. The Zero Period Amplitude, as well as other areas, of the RRS will be exceeded in order to meet the peak responses of the curves.

2.4 Fifty Percent (50%) Level SSE or OBE Tests

A minimum of five one-half-level tests in each of the two test orientations will be performed prior to the full-level tests.

3.0 INSTRUMENTATION

3.1 Excitation Control

Control accelerometers will be mounted on the table at locations near the driving point for the horizontal and each vertical actuator. Additionally, two vertically-oriented accelerometers will be located on the test table for verification purposes.

3.2 Specimen Response

Eighteen (18) specimen-mounted piezo-electric accelerometers will be located on the specimen under test. Three of the accelerometers will be utilized to monitor the acceleration at the test module. The placement of the accelerometers will be at the discretion of the ACCO Technical Representative.

Oscillograph and FM tape recorders will provide a permanent record of each accelerometer response during the test program. The response accelerometers, in line with the excitation, will be analyzed over the frequency range of interest from a full-level multi-frequency test for each test series in each orientation at a damping value of one percent (1%). Transmissibility plots of accelerometers oriented in the line of excitation will be provided for the Resonant Search Test in each orientation.

The maximum deflection at the top of the Cabinet will be determined from a full-level multi-frequency test in each orientation. A

Six uni-axial strain gages will be located on the specimen under test. The placement of the strain gages will be at the discretion of the ACCO Technical Representative. The strain gages will be recorded on an oscillograph recorder, and the data will be evaluated by a Wyle Laboratories Analyst. A

3.3 Electrical Power

Electrical power of 120 VAC, single-phase, 60 Hz, and 125 VDC at 10 amperes or less will be provided to energize the specimen during the seismic simulation.

3.4 Electrical Monitoring

Twenty-five (25) channels of electrical monitoring will be recorded on an oscillograph recorder during the Seismic Simulation Test Program. These channels may be used to ascertain electrical continuity, current/voltage levels, spurious operation, contact chatter, etc. before, during and after the seismic excitation. A summary of the electrical monitoring results will be presented in the test report.

3.5 Seismic Operational Test Procedure

3.5.1 Initial Setup and Test

Refer to Section 5.0 of ACCO System Operational Test Procedure. Proceed* with the operational checkout of ESFAS Auxiliary Relay Cabinets from Section 5.0 to Section 5.9.2 with the exception of Sections 5.4.2.7, 5.5, and 5.6 to check for proper operation. Each solidstate relay must be simulated according to Figure 7. During the operational test, prior to the seismic test, a time response check of the initiation circuit will be performed.

*Note - During the initial setup in Section 5.4.1, also hook up the twenty-five electrical monitoring channels in accordance to the following table.

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP

Test Point	Connection Points	Type Test
K301 (SIAS)	3113-3114	Continuity
K312 (RAS)	3801-3802	Continuity
K404 (MSIS)	4313-4314	Continuity
K402 (EFAS I)	4137-4138	Continuity
K310 (EFAS II)	3625-3626	Continuity
K413 (CCAS)	4825-4826	Continuity
K304 (CSAS)	3313-3314	Continuity
K101 (SIAS)	1501-1502	Continuity
K201 (CIAS)	2113-2114	Continuity
K105 (MSIS)	1237-1238	Continuity
K211 (EFAS I)	2637-2638	Continuity
K102 (CCAS)	1413-1414	Continuity
S62B (CIAS)	1-2	Continuity
S72B (CIAS)	1-2	Continuity
S68B (CCAS)	6-5	Continuity
S78B (CASA)	6-5	Continuity
K725 (EFAS II)	TB76-17/18	Continuity
K623 (MSIS)	TB66-37/38	Continuity
K620 (CIAS)	4-12	Continuity
K704 (CIAS)	4-12	Continuity
K516 (SIAS)	3-5*	Continuity
K816 (CASA)	3-5*	Continuity
S62A (CIAS)	TB55-3/4	Continuity
S77A (CCAS)	TB85-17/18	Continuity
K203 (CIAS)	2216/2217	Continuity

*Solder connection required

Upon completion of Section 3.5.1, energize all circuits in the ESFAS Auxiliary Relays by pushing the lockout reset pushbuttons numbered S61A, S62A, S63A, S64A, S65A, S66A, S67A, S68A, S71A, S72A, S73A, S74A, S75A, S76A, S77A, and S78A.

3.5.2 During Simulated Seismic Test

Start the multi-frequency test as per Paragraph 2.3. Check for relay contact chatter and intermittent circuit operation which will be detected on the oscillograph recorders. Approximately 10 seconds after the seismic event starts, de-energize the relay simulating the solidstate relays (see Figure 1) by opening SW 1. After verifying all solidstate relays have de-energized by checking monitoring lights and oscillograph recorders, energize the relay simulating the solidstate relays by shutting SW 1 and checking to see that only the relays listed in the following table energize.

K623	K723
K624	K724
K625	K725

Check for relay contact chatter and intermittent circuit operation. After approximately 20 seconds from the beginning of the seismic event, de-energize the relay simulating the SSR's by opening SW 1 again. Check for relay contact chatter and intermittent circuit operation which will be detected (if any exist) on the oscillograph recorders.

After all seismic test runs have been completed, retest the Auxiliary Relay Cabinet using ACCO System Operational Test Procedure, Sections 5.4.2 through 5.9.2, with the exception of Sections 5.4.2.7, 5.5, and 5.6, to check for proper operation. Upon satisfactory completion of the operational test, open breakers CB59A and B, CB89A and B, and disconnect the test panel from the Auxiliary Relay Cabinet.

3.6 Acceptance Criteria

The Auxiliary Relay Cabinets must not actuate any components during a simulated seismic event unless the proper safety actuation signal is initiated from the simulated plant protective system signal or by manual operator action. If actuation is required, the Auxiliary Relay Cabinets will actuate all components and insure they remain in the actuated state until manually reset. Additionally, Relays K623, K624, K625, K723, K724, and K725 will be able to be automatically energized and de-energized by the simulated plant protection system via the solidstate relay during a simulated seismic event so as to insure their capability to cycle the components they actuate.

4.0 IN-PROCESS INSPECTION

The records will be checked for equality of performance after each test.

The specimen will be examined for possible damage following all violent tests such as at a severe structural resonance. A physical tightening of hardware, as directed by the ACCO Technical Representative, will be performed after such tests. Hardware tightening which will nullify qualification will not be performed.

All important vibration effects will be logged.

Photographs will be taken of any noticeable physical damage that may occur.

5.0 REPORT

Ten (10) copies of a certification-type report will be issued subsequent to completion of testing. This report will be signed by a Registered Professional Engineer and will include maximum g levels, transmissibility plots, response spectrum plots, natural frequencies, photographs of test setups, accelerometers, failures, etc. The test report will specify compliance to IEEE-323 and IEEE-344 1975.

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☒ 100 ☐ 1000 ☐

DAMPING 1 %

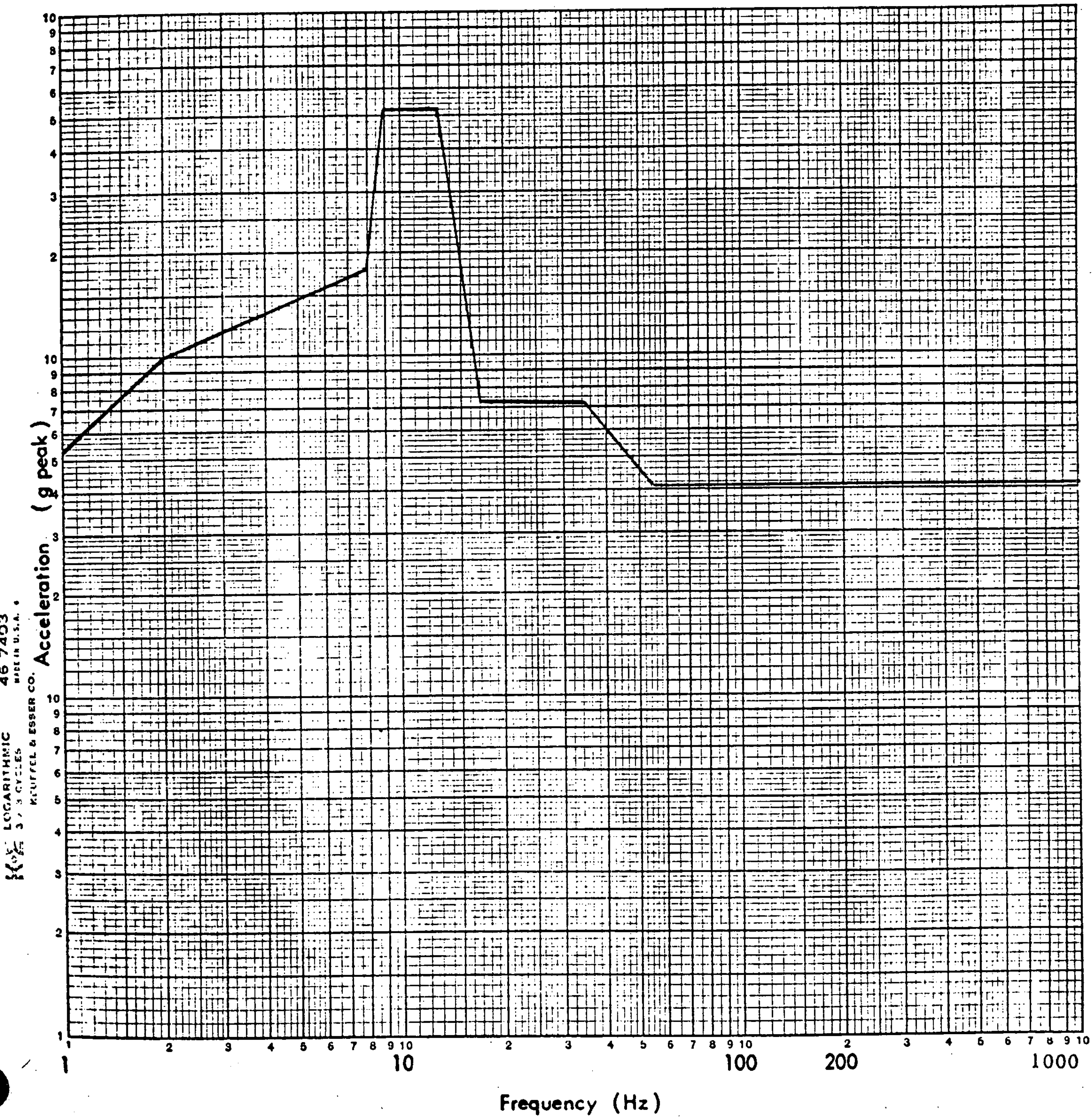


FIGURE 1

ARKANSAS POWER AND LIGHT, 386'
HORIZONTAL R R S

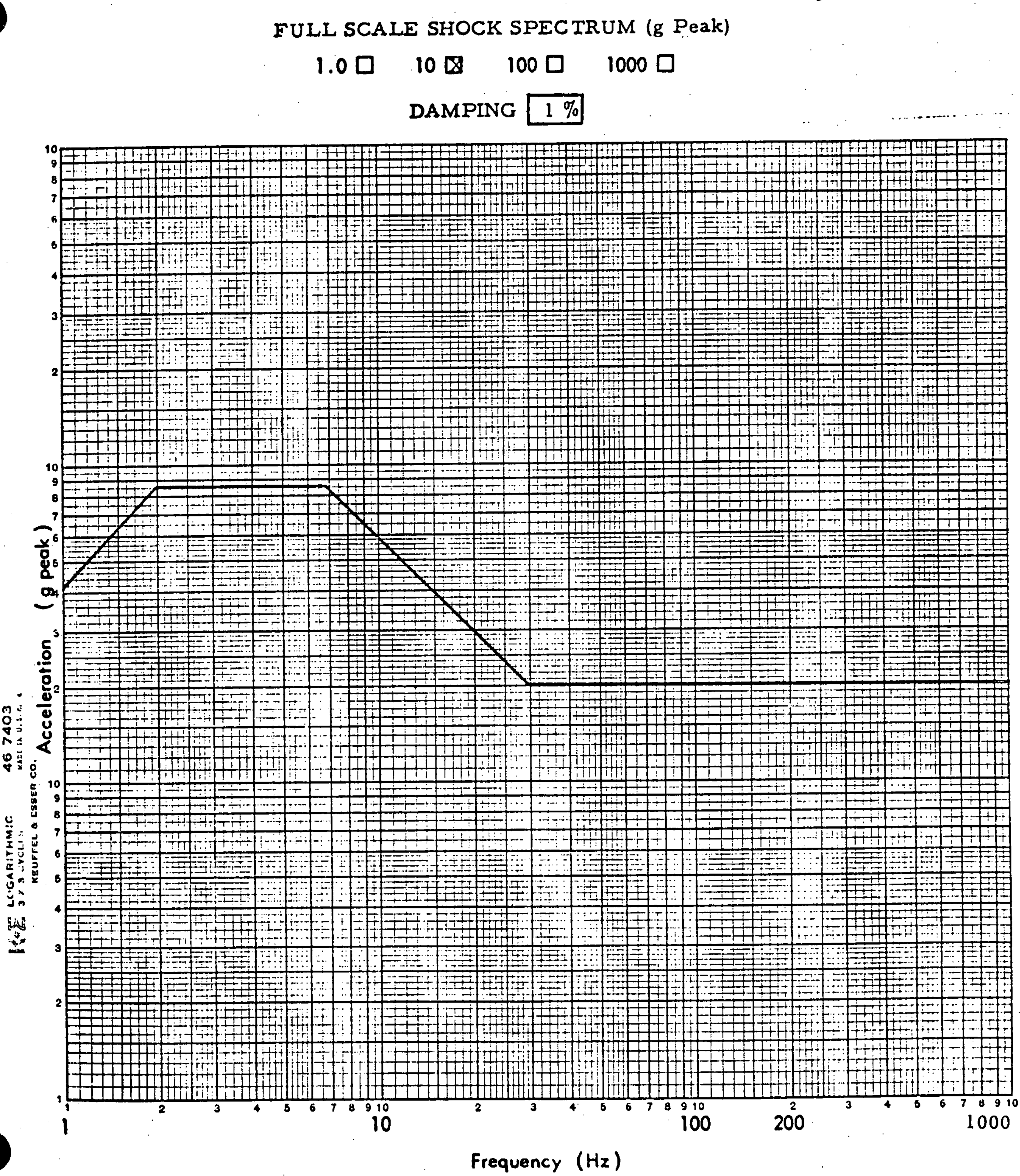


FIGURE 2

ARKANSAS POWER AND LIGHT, 386'
VERTICAL R R S

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☒ 100 ☐ 1000 ☐

DAMPING 1 %

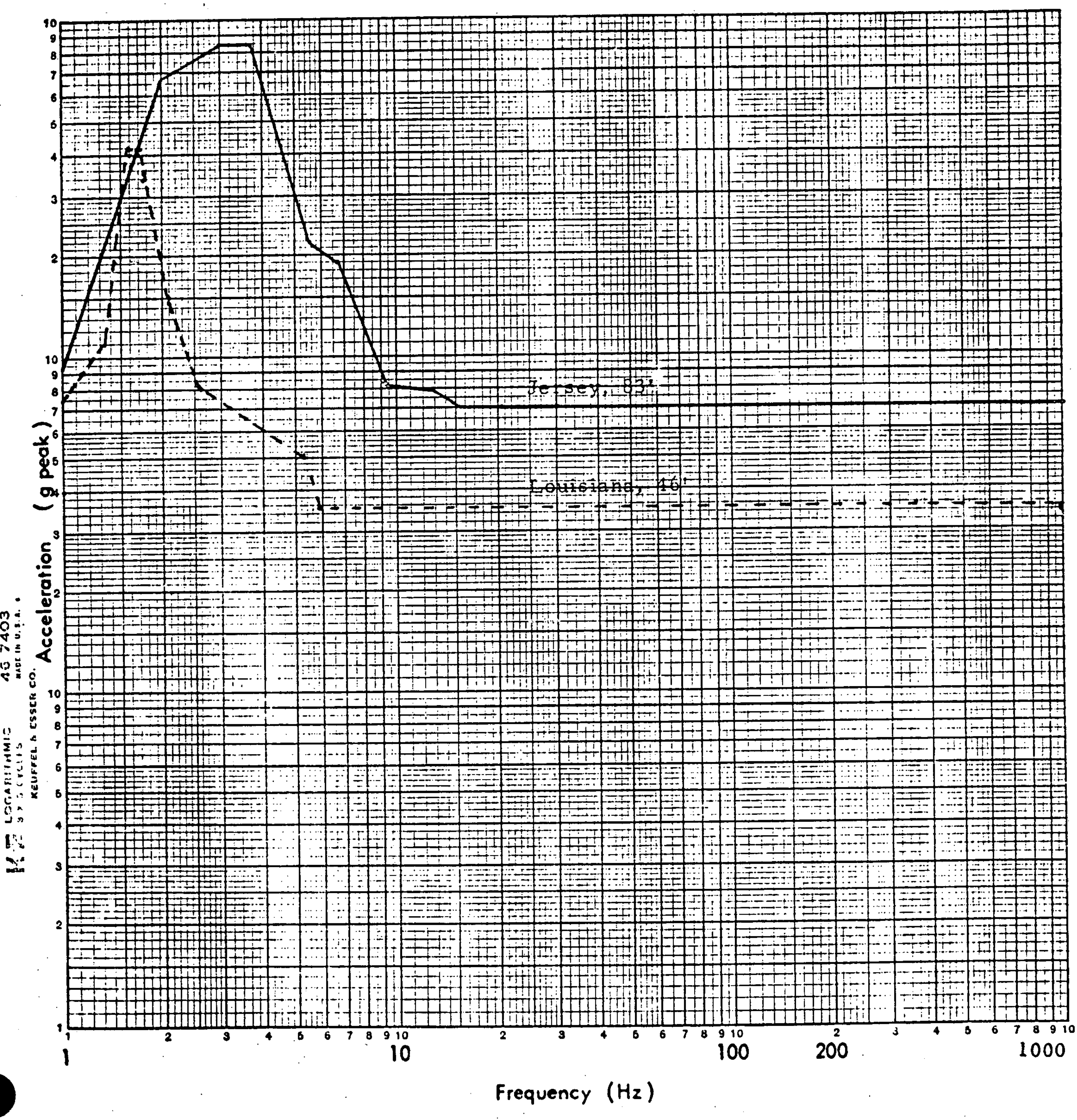


FIGURE 3

JERSEY AND LOUISIANA POWER AND LIGHT
HORIZONTAL R R S

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☒ 100 ☐ 1000 ☐

DAMPING 1 %

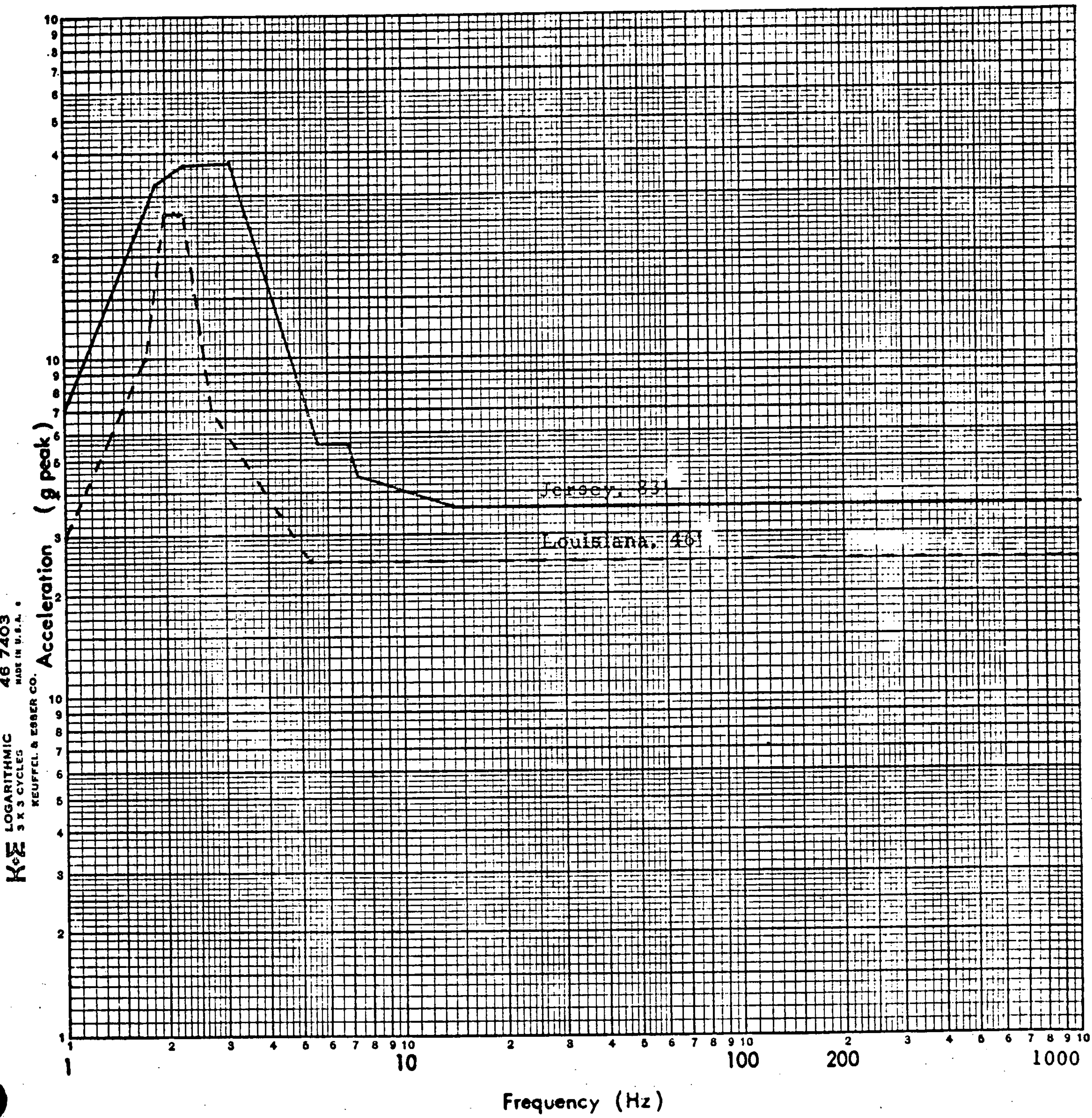


FIGURE 4

JERSEY AND LOUISIANA POWER AND LIGHT
VERTICAL R R S

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 1 %

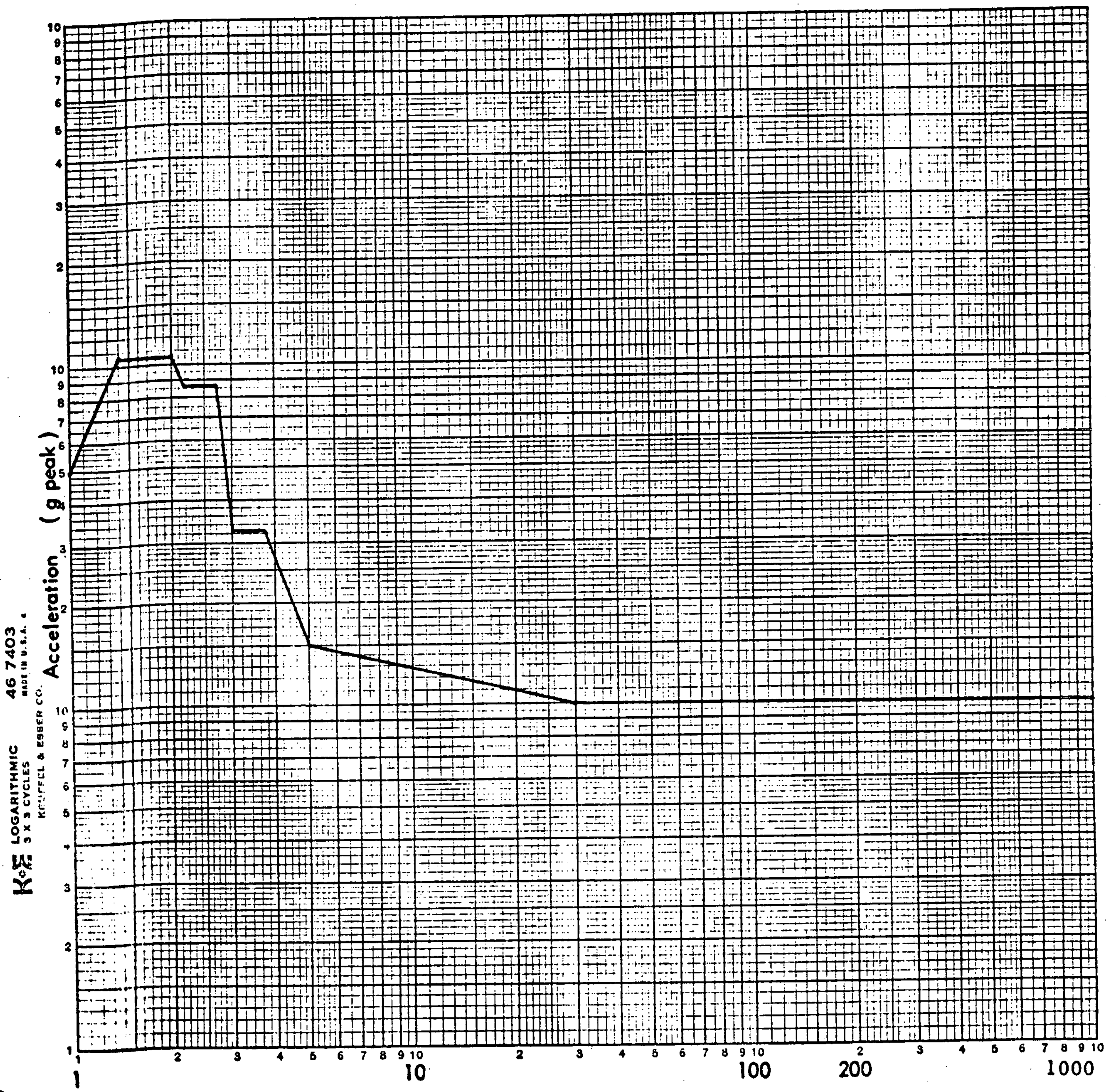


FIGURE 5

SOUTHERN CALIFORNIA EDISON, 30'
HORIZONTAL R R S

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING [1 %]

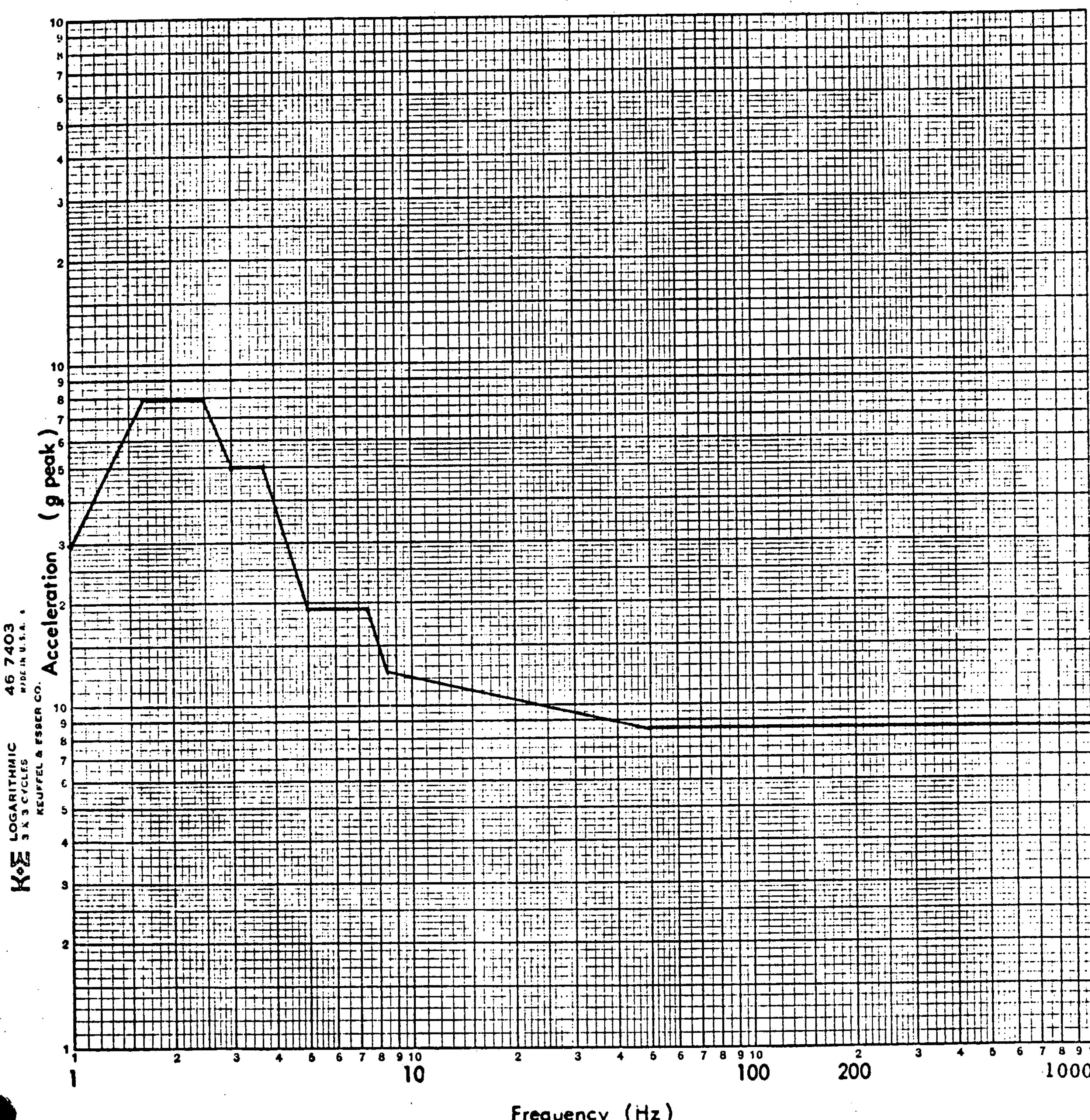
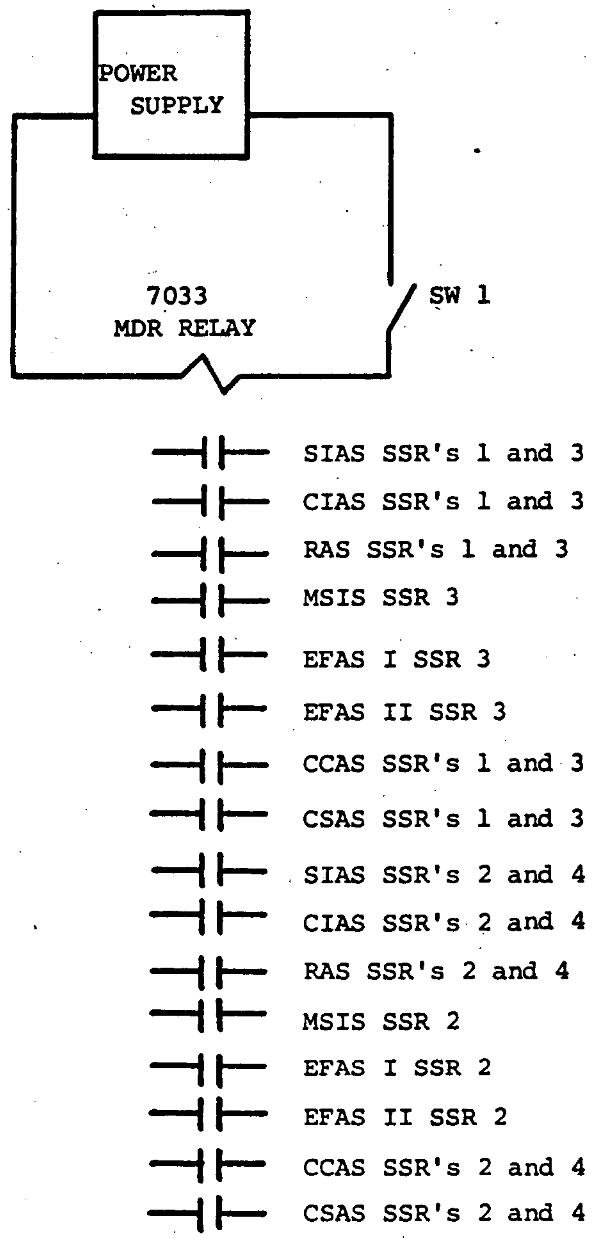


FIGURE 6

SOUTHERN CALIFORNIA EDISON, 30'
VERTICAL R R S



NOTE: 1) SSR's 1 and 4 for MSIS, EFAS I, and EFAS II must have a AWG 14 jumper installed.

FIGURE 7

TEST PROCEDURE

TEST PROCEDURE NO. 541/3385-2E/ES

DATE: June 20, 1975

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ENVIRONMENTAL TEST PLAN

FOR

ESFAS AUXILIARY RELAY CABINET
(GENERIC)

FOR

ACCO
ELECTRO MECH DIVISION
STRATFORD, CONNECTICUT

APPROVED BY: ____________
FOR: ____________

APPROVED BY: ____________
FOR: ____________

APPROVED BY: ____________
FOR: ____________

APPROVED BY
PROJECT MANAGER: ____________

APPROVED BY
QUALITY ENGINEER: ____________

PREPARED BY
PROJECT ENGINEER: Herschel Jordan

REVISIONS

FORM 1054-1 Rev. 4/74

REV. NO.	DATE	PAGES AFFECTED	BY	APP'L.	DESCRIPTION OF CHANGES

1.0 TEST PROCEDURE

1.1 Pretest Setup

1.1.1 Place the test unit into the test chamber.

1.1.2 Four thermocouples will be installed in the test unit as described below:

Monitoring Device Number	Bay Number	Location Next to Relay Number
1	2	K213
2	3	K301
3	6	K613
4	7	K724

1.1.3 The test unit will be connected to the functional test bench and appropriate power supplies as directed by the ACCO Representative.

Test cables will be led into the Cabinet via the top entry ports. The area around the cables will be sealed to simulate actual operating conditions, as closely as possible.

1.1.4 The solidstate relay contacts will be simulated by wiring into the Cabinet the contacts of a Potter and Brumfield MDR 7034 relay as shown below. Designate this relay SW1.

Wire Number	Cabinet Termination Plant
1A	TB55-25
1B	TB55-27
1D	TB75-25
1E	TB75-27
1G	TB55-28
1H	TB55-30
1K	TB75-28
1M	TB75-30
2A	TB55-31
2B	TB55-33
2D	TB75-31
2E	TB75-33
2G	TB55-34
2H	TB55-36
2K	TB75-34
2M	TB75-36

Wire Number	Cabinet Termination Plant
3A	TB55-37
3B	TB55-39
3D	TB75-37
3E	TB75-39
3G	TB55-40
3H	TB55-42
3K	TB75-40
3M	TB75-42
4A	TB55-43
4B	TB55-45
4D	TB75-43
4E	TB75-45
4G	TB55-46
4H	TB55-48
4K	TB75-46
4M	TB75-48

Connect a #14 AWG jumper wire across the following terminal points:

TB65 - 25 to 27	TB65 - 31 to 33
TB85 - 25 to 27	TB85 - 31 to 33
TB65 - 28 to 30	TB65 - 34 to 36
TB85 - 28 to 30	TB85 - 34 to 36
TB65 - 37 to 39	TB65 - 43 to 45
TB85 - 37 to 39	TB85 - 43 to 45
TB65 - 40 to 42	TB65 - 46 to 48
TB85 - 40 to 42	TB85 - 46 to 48

1.1.5 The following circuit breakers will be closed:

59A,B
69A,B
79A,B
89A,B

1.1.6 All initiation circuit breakers (CB61-68 and CB71-78) will be closed.

1.1.7 The functional test bench will be checked for proper operation as directed by the ACCO Representative.

1.1.8 All Cabinet doors will be secured.

1.1.9 On the functional test bench with switch SW1 closed, all initiation circuits will be energized by pushing the lockout reset pushbuttons associated with the individual initiation circuits. The functional test bench will be checked for proper indication.

The unit is now setup for remote operation during the environmental test.

2.0 AUXILIARY RELAY CABINET OPERATIONAL TEST

The following procedure will be performed from the functional test bench at the intervals specified in Paragraphs 3.0 and 4.0

2.1 Switch SW1 will be opened.

Check to insure that all test indicator lamps are off.

2.2 Switch SW1 will be closed.

Check to insure that the following relays are energized by using the test bench light indication:

K623	K723
K624	K724
K625	K725

2.3 Re-energize all initiation circuits by pushing the lockout reset pushbuttons associated with the individual initiation circuits. Check the functional test bench for proper indication.

3.0 ENVIRONMENTAL TEST - PHASE I

3.1 The initial temperature and humidity will be recorded.

3.2 The temperature will be increased to 90°F at 95% relative humidity at the maximum attainable rate of the test equipment.

3.3 Upon completion of Section 2.1, continue heat up from 90°F to 122°F at the maximum attainable rate of the test equipment. Maintain test chamber moisture content below 95% RH. Stabilize and maintain conditions for four hours. After stabilizing for four hours, the tests described in Sections 2.1 through 2.3 will be performed.

4.0 ENVIRONMENTAL TEST - PHASE II

4.1 Upon completion of Phase I, begin cooldown at the maximum attainable rate of the test equipment to a temperature of 40°F maintaining relative humidity at a maximum of 95% for the respective temperature. Stabilize at 40°F, 95% relative humidity maximum and maintain conditions for five (5) hours. After stabilization for five (5) hours, the tests described in Sections 1.2.1 through 1.2.3 will be performed.

4.2 Upon completion of Section 1.4.1, return conditions to ambient insuring that excessive condensation does not occur. When ambient conditions are reached, an operational test per ACCO System Operational Test Procedure, Sections 5.4.2 through 5.9.2, with the exception of Sections 5.4.2.7, 5.5, and 5.6.

4.3 All test equipment will be turned off. All circuit breakers closed in the ESFAS Auxiliary Relay Cabinet will be opened.

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