

# NASA Technical Memorandum 78676

(NASA-TM-78676) CONCORDE NOISE-INDUCED  
BUILDING VIBRATIONS, JOHN F. KENNEDY  
INTERNATIONAL AIRPORT (NASA) 67 F HC A04/MF  
A01 CSCL 20A

N78-20919

Unclas

G3/71 11899

CONCORDE NOISE-INDUCED BUILDING VIBRATIONS  
JOHN F. KENNEDY INTERNATIONAL AIRPORT  
REPORT NUMBER 2

STAFF-LANGLEY RESEARCH CENTER

FEBRUARY 1978

**NASA**  
National Aeronautics and  
Space Administration  
**Langley Research Center**  
Hampton, Virginia 23665



**CONCORDE NOISE-INDUCED BUILDING VIBRATIONS**

**JOHN F. KENNEDY INTERNATIONAL AIRPORT**

**REPORT NUMBER 2**

**By Staff-Langley Research Center\***

**SUMMARY**

The NASA, in cooperation with the FAA, made measurements of noise-induced building vibrations in the vicinity of John F. Kennedy International Airport on January 18-19 and on February 3-5, 1978, as part of the Concorde monitoring program. The purpose of these studies was to expand the data base developed at Dulles International Airport during the early months of Concorde operations by obtaining aircraft noise and building vibration data on typical residential structures in the New York area. The outdoor/indoor noise levels and associated vibration levels resulting from aircraft and nonaircraft events were recorded at eight homesites and a school. In addition, limited subjective tests were conducted to examine the human detection/annoyance thresholds for building vibration and rattle caused by aircraft noise. A description of the test plan and procedures along with sample data were presented in reference 1. Presented herein are the majority of the window and wall vibration data recorded during Concorde and subsonic aircraft overflights. Analyses of the data are continuing and additional results, including building response to nonaircraft events, will be presented in follow-on reports.

---

*ANRD	IRD	OSD	STIPD
W. H. Mayes, D. G. Stephens, R. DeLoach, J. M. Cawthorn	H. K. Holmes, R. B. Lewis	B. G. Holliday, W. T. Miller	D. W. Ward

## INTRODUCTION

Measurements of aircraft noise-induced building vibrations are being conducted by the NASA as part of the DOT/FAA monitoring program to assess the environmental impact of Concorde operations at JFK (refs. 1 and 2). The purpose of this element of the monitoring program is to make a comparative assessment of the building response resulting from Concorde, subsonic aircraft, and nonaircraft events.

The approach being followed in the assessment of Concorde noise-induced building vibrations involves the following steps: (1) the measurement of the vibratory response of selected buildings; (2) the development of functional relationships ("signatures") between the vibration response of building elements and the outdoor and/or indoor noise levels associated with events of interest; and (3) the comparison of Concorde induced response with the response associated with other aircraft as well as common domestic events and/or criteria. This approach was followed by NASA in making measurements in the vicinity of Dulles International Airport during the early months of Concorde operations. Noise and vibration measurements were made at Sully Plantation, an historic site located near Dulles, and at three homes in Montgomery County, Maryland, where residents had complained of building vibration. The results of these studies were published in references 3 through 6. The JFK studies are directed at expanding the data base developed at Dulles by obtaining aircraft noise and vibration data on typical residential structures for both takeoff and approach operations and, secondly, to explore in some detail human response to building vibration and rattle. This latter issue requires that the physical measurements be augmented by subjective tests to determine the level of noise and/or vibration

required to produce perceptible vibration and rattle and to determine, if possible, the degree of annoyance associated with perceptible building response. The subjective tests are exploratory in nature since neither the way in which a person perceives vibration (for example, tactile, wholebody, visual) nor the dominant building stimulus elements (for example, floor, window, wall) have been studied in any detail for human response to building vibrations.

A description of the test plan and test procedures for acquiring both physical and subjective data, along with sample data recorded on a window at one test site, were presented in reference 1 to illustrate the data reduction/analysis procedures and to indicate preliminary findings in the JFK area. This report presents the majority of the window and wall response data recorded for Concorde and subsonic overflights during the January and February test periods. Follow-on monthly reports will present additional data from these tests as well as results from additional data analyses including building response to nonaircraft events.

## TEST SITES

The test sites for the January and February studies were located in the communities of Cedarhurst, Inwood, Rosedale, and Belle Harbor which are shown on the map, figure 1. The approximate locations of the houses relative to the main runways at JFK are shown in figure 2. Test sites 1, 3, and 6 were monitored on January 18, 1978, during landing operations on runway 31R, whereas test sites 9, 10, and 11 were monitored on January 19, 1978, for Concorde landings on runway 31R and subsonic departure operations on runway 04R. Additional measurements were obtained at test site 11 on February 3, 1978, and at test sites 2 and 11 on February 4, 1978, during landing operations on 31R.

Test sites 4 and 5 were monitored on February 5, 1978, for Concorde landing and takeoff operations on runway 31R and 31L and for subsonic operations. In addition, several aircraft events were recorded at each house including walking, jogging in place, dropping a book, closing doors and windows, etc.

The houses were selected from homeowners who had volunteered to participate in this phase of the assessment program. The houses represent a range of construction typical of the neighborhoods surrounding the airport. The room selection in a particular house was based on information provided by the homeowner concerning maximum noise and/or vibration exposure to aircraft flyovers. Accelerometers typically were located on a window, wall, and on the floor, and microphones were located both in the test room and outside the house. A plan-view sketch of the houses and instrument locations are provided in figure 3.

## DATA ACQUISITION AND PROCEDURES

### Instrumentation

Acoustic measurements of both interior and exterior sound pressure levels were recorded with special low-frequency response microphones used for the interior measurements. Vibration data were obtained from piezoelectric crystal accelerometers mounted on the window and from more sensitive, but heavier, servoaccelerometers mounted on the wall and the floor. (The mass of the servoaccelerometers precluded their use on the windows.) The floor measurements consisted of the vertical and horizontal acceleration imparted to a 50 kg (110 lb) cement block which was placed in the center of the room to simulate the loading of a person. All data were recorded on analog FM tape for subsequent analysis.

## Frequency Response and Calibration

Extensive pretest documentation of all items of the acquisition systems was performed to include frequency response, deviation linearities, gain accuracies, and dynamic range. Daily calibrations in the field consisted of pink noise (exhibiting flat 1/3-octave band spectrum level) insertion in all microphone channels, a fixed sine wave reference voltage insertion into the accelerometer channels as well as a 1 g static calibration of the servo-accelerometers, and a 250 Hz piston-phone acoustic calibration of the microphone systems during pretest and posttest periods. Frequency response of the acoustic channels was nominally  $\pm 1$  dB over the range 5 Hz to 10 kHz for the exterior measurement systems and 1.5 Hz to 10 kHz for the lower frequency interior measurement systems. The accelerometer channel frequency response extended from dc to approximately 1 kHz for the servoaccelerometers and from 3  $\mu$  to in excess of 3 kHz for the piezoelectric type. Amplitude response for both systems was nominally  $\pm 1/2$  dB over the applicable frequency range.

## Test Procedures

Aircraft control tower communications were monitored and aircraft spotters were located near each test house to identify aircraft as well as to control and coordinate data acquisition. Time code was recorded at each test house to provide a common time base for use in subsequent analysis of the data. Radio communications were used to obtain time synchronization between houses and for data acquisition control and calibrations at each test house.

Subjective tests were conducted utilizing members of the NASA Concorde monitoring team and residents of a particular test site. The members of the monitoring team participated at each house whereas the resident subjects

participated only at their own home. The subjective test sessions were approximately 1 hour in length and were scheduled to include one or more Concorde operations at each house although this was not always possible due to variations in Concorde schedules. The subject instructions, rating forms, and test procedures are described in reference 1.

## RESULTS

### Scope

Over one hundred and fifty residents of the JFK area who had complained of aircraft noise and resulting building vibrations were asked if they would permit vibration measurements to be made in their homes. Almost all of them declined, however, measurements were made at 9 of 15 sites where permission was granted. (Severe snowstorm activity which forced the closing of JFK airport prohibited the acquisition of data at 6 of the 15 available test sites.) Noise-induced vibration measurements were made on such structural elements as walls, windows, and floors of nine test sites, which consisted of eight residential structures and a high school. During the 4 days of testing, five of the nine test sites experienced overflights, with the remaining four sites experiencing noise from ground operations and fairly distant flight trajectories. Some of the direct overflight data have already been presented (ref. 1); this report presents the remainder of the data acquired at the test sites which experienced direct overflights. A total of 113 flyovers were recorded at these sites. Data are presented which illustrate the relationship between vibration level and sound pressure level at several test sites. Peak levels of noise and vibration are also presented.

### Analysis Procedure

Two channels of noise data (inside and outside) and four channels of vibration data (window, wall, vertical floor, and horizontal floor) were recorded on FM magnetic tape and later played back into a multichannel, true rms logarithmic digital voltmeter. The voltmeter sampled the data and performed the analog-to-digital conversion and averaging tasks necessary to convert these signals to overall levels suitable for digital processing. Overall (unweighted) noise and vibration levels were obtained in this way for each flyover. The voltmeter was interfaced to a digital computer which, with its associated peripherals, corrected the raw data for changes in gain settings and calibration levels and provided a printed time history for each flyover, listing the overall levels of noise and vibration for each of the six data channels at 1/2-second intervals. These data were then recorded on digital magnetic tape for subsequent analysis.

### Discussion of Results

Data are presented in the form of tabulated values of peak overall outside sound pressure level and peak acceleration level for the windows and walls of several test sites in Tables I-IV. Data are also presented in the form of vibration/noise "signatures," which illustrate how vibration levels vary with outdoor noise level for different structural elements. Included in the Appendix of this report are composite vibration/noise signatures for several aircraft types measured at each of the test sites for which aircraft flyovers were recorded. The small spread in the data which comprise the signatures in the Appendix suggests relatively little variation from flyover to flyover in the relationship between structural response and outside noise level for a given aircraft



type. Therefore, composite signatures are used instead of single-event signatures in the inter-aircraft response comparisons made in this report.

The composite response signatures of the Appendix are overlaid in figures 4 and 5 to facilitate inter-aircraft comparisons. (To avoid the confusion which would be caused by including all of the data points on the figures, only Concorde data points are included.) Figures 4 and 5 indicate that the vibration response signature for Concorde is not markedly different from the response signatures of any of the conventional aircraft tested. That is, the difference between the Concorde signature and the signature of any other aircraft is generally no greater than signature differences among conventional aircraft. This suggests that conventional aircraft are generally as efficient in exciting building response as the Concorde under similar flight conditions. Relatively high levels of building vibration which may be measured during Concorde overflights are, therefore, attributed more to relatively high OASPL levels than to unique Concorde-source characteristics.

Most of the overflights recorded near JFK were approaches. A small number of takeoffs were recorded at site 4. The composite response signatures for these takeoffs are included in figures 4 and 5. These figures show that the takeoff response signatures do not vary significantly from the approach signatures, which suggests that the source differences between takeoff and approach power conditions were not large enough to significantly affect the vibration response of the structure.

The range of wall acceleration magnitudes at site 2 was too small to reliably determine the wall vibration response signatures at that site. (Site 2 was a high school with massive masonry walls.) Wall response signatures for site 2 are, therefore, omitted from figure 5.

### Subjective Test Results

Subjective response tests of vibration, rattle, and noise included both Concorde and a variety of subsonic aircraft operations. The subjective tests were designed to obtain vibration and rattle detection thresholds<sup>\*</sup>; vibration, rattle, and noise annoyance thresholds; and an overall annoyance rating of each aircraft noise event. The data are currently being analyzed to correlate with the physical measures to establish detection and annoyance thresholds. Both vibration and rattle were detected in several houses for some operations of both the Concorde and subsonic aircraft.

### CONCLUDING REMARKS

Physical and subjective data were acquired at eight residential sites and a school near JFK International Airport during January and February 1978, for Concorde, subsonic aircraft, and nonaircraft events. This report presents the majority of the noise and structural vibration data acquired at these test sites during overflights of Concorde and subsonic aircraft. Results of the data analyzed to date suggest the following:

- o Both building vibration and rattle can be detected subjectively under certain conditions for operations of both the Concorde and subsonic aircraft.

- o The relationship between the vibration of directly exposed structural elements and aircraft noise is:

- linear, with vibration levels being directly proportional to OASPL levels measured near the structure

- consistent from flyover to flyover for a given aircraft type

---

<sup>\*</sup>Threshold is defined as a positive rating by 50 percent of the subjects.

- the same for Concorde and conventional jet transports

- the same for approach and takeoff operations

o Relatively high levels of structural vibration which may be measured during Concorde operations are due to higher OASPL levels than to unique Concorde-source characteristics.

Follow-on reports will contain additional data and the results of further data analyses.

## REFERENCES

1. Staff-Langley Research Center: Concorde Noise-Induced Building Vibrations John F. Kennedy International Airport, Report Number 1. NASA TM 78660, January 1978.
2. Department of Transportation, Federal Aviation Administration: Concorde Monitoring, John F. Kennedy International Airport, Route - Proving Flights, October 1977.
3. Staff-Langley Research Center: Concorde Noise-Induced Building Vibrations for Sully Plantation, Chantilly, Virginia, NASA TM X-73919, June 1976.
4. Staff-Langley Research Center: Concorde Noise-Induced Building Vibrations Sully Plantation - Report No. 2, Chantilly, Virginia, NASA TM X-73926, June 1976.
5. Staff-Langley Research Center: Concorde Noise-Induced Building Vibrations Montgomery County, Maryland - Report No. 3, NASA TM X-73947, August 1976.
6. Staff-Langley Research Center: Concorde Noise-Induced Building Vibrations, International Airport Dulles - Final Report, NASA TM 74083, September 1977.

TABLE I.- AVERAGE MAXIMUM LEVELS FOR APPROACHES AT SITE 2 (SCHOOL)

A/C Type	No. of Flights	Average Maximum Level			
		OASPL, dB		Acceleration, dB re 1µg	
		Outside	Inside	Window	Wall
707	3	99.5 ± 3.9	78.2 ± 1.6	94.1 ± 1.8	61.6 ± 1.6
727	1	91.8	76.2	87.7	58.2
DC-9	2	94.2 ± 3.7	77.2 ± 1.4	87.9 ± 1.1	58.6 ± 0.4
747	1	93.6	78.8	90.1	60.7
L1011	1	91.6	79.0	85.6	59.0
SST	1	99.0	80.0	95.4	66.5

TABLE II.- AVERAGE MAXIMUM LEVELS FOR APPROACHES AT SITE 3

A/C Type	No. of Flights	Average Maximum Level				
		CASPL, dB		Acceleration, dB re 1 $\mu$ G		
		Outside	Inside	Window	Wall	
707	5	94.0 $\pm$ 4.8	73.4 $\pm$ 2.2	95.5 $\pm$ 3.3	70.7 $\pm$ 3.1	
DC-8	3	95.6 $\pm$ 3.1	73.9 $\pm$ 2.2	96.9 $\pm$ 3.5	72.8 $\pm$ 3.5	
727	5	92.2 $\pm$ 2.5	72.0 $\pm$ 3.0	95.0 $\pm$ 3.4	70.2 $\pm$ 3.0	
747	4	95.2 $\pm$ 3.8	74.8 $\pm$ 3.0	97.6 $\pm$ 4.8	72.7 $\pm$ 4.6	
L1011	3	91.7 $\pm$ 1.8	74.6 $\pm$ 1.3	92.9 $\pm$ 1.3	68.9 $\pm$ 1.9	
SST	1	107.2	84.6	110.6	83.8	

TABLE II.-- AVERAGE MAXIMUM LEVELS AT SITE 4

A/C Type	Configuration	No. of Flights	Average Maximum Level			
			OASPL, dB		Acceleration, dB re 1µg	
			Outside	Inside	Window	Wall
707	Approach	4	104.4 ± 3.2	82.0 ± 2.7	101.4 ± 2.7	85.3 ± 2.7
707	Takeoff	1	85.7	69.95	82.38	69.86
727	Takeoff	1	95.0	75.5	89.4	76.7
DC-9	Approach	1	92.7	73.4	93.1	76.5
747	Takeoff	5	92.1 ± 6.8	81.4 ± 5.0	89.7 ± 9.6	76.2 ± 8.4
DC-10	Takeoff	2	92.8 ± 0.0	82.3 ± 0.4	82.6 ± 0.4	69.4 ± 1.0
SST	Approach	1	113.3	94.0	117.4	98.2

TABLE IV.- AVERAGE MAXIMUM LEVELS FOR APPROACHES AT SITE 11

A/C Type	No. of Flights	Average Maximum Level				
		OASPL, dB		Acceleration, dB re 1 $\mu$ g		Wall
		Outside	Inside	Window	Wall	
707	10	107.5 $\pm$ 1.4	84.4 $\pm$ 1.9	102.1 $\pm$ 2.2	81.5 $\pm$ 2.6	
DC-8	5	102.4 $\pm$ 3.0	83.4 $\pm$ 1.5	99.2 $\pm$ 2.8	79.2 $\pm$ 3.2	
727	8	100.3 $\pm$ 3.0	79.0 $\pm$ 2.0	102.1 $\pm$ 3.4	81.8 $\pm$ 2.6	
DC-9	3	95.1 $\pm$ 3.6	78.2 $\pm$ 4.3	95.7 $\pm$ 5.1	77.2 $\pm$ 3.9	
747	8	100.3 $\pm$ 1.9	85.0 $\pm$ 2.6	102.2 $\pm$ 0.9	81.8 $\pm$ 0.6	
DC-10	4	97.5 $\pm$ 3.5	83.4 $\pm$ 4.5	98.0 $\pm$ 2.6	78.9 $\pm$ 3.6	
L1011	2	97.5 $\pm$ 0.2	84.1 $\pm$ 4.4	99.0 $\pm$ 0.4	80.0 $\pm$ .7	
SST	1	114.2	92.5	117.6	94.5	



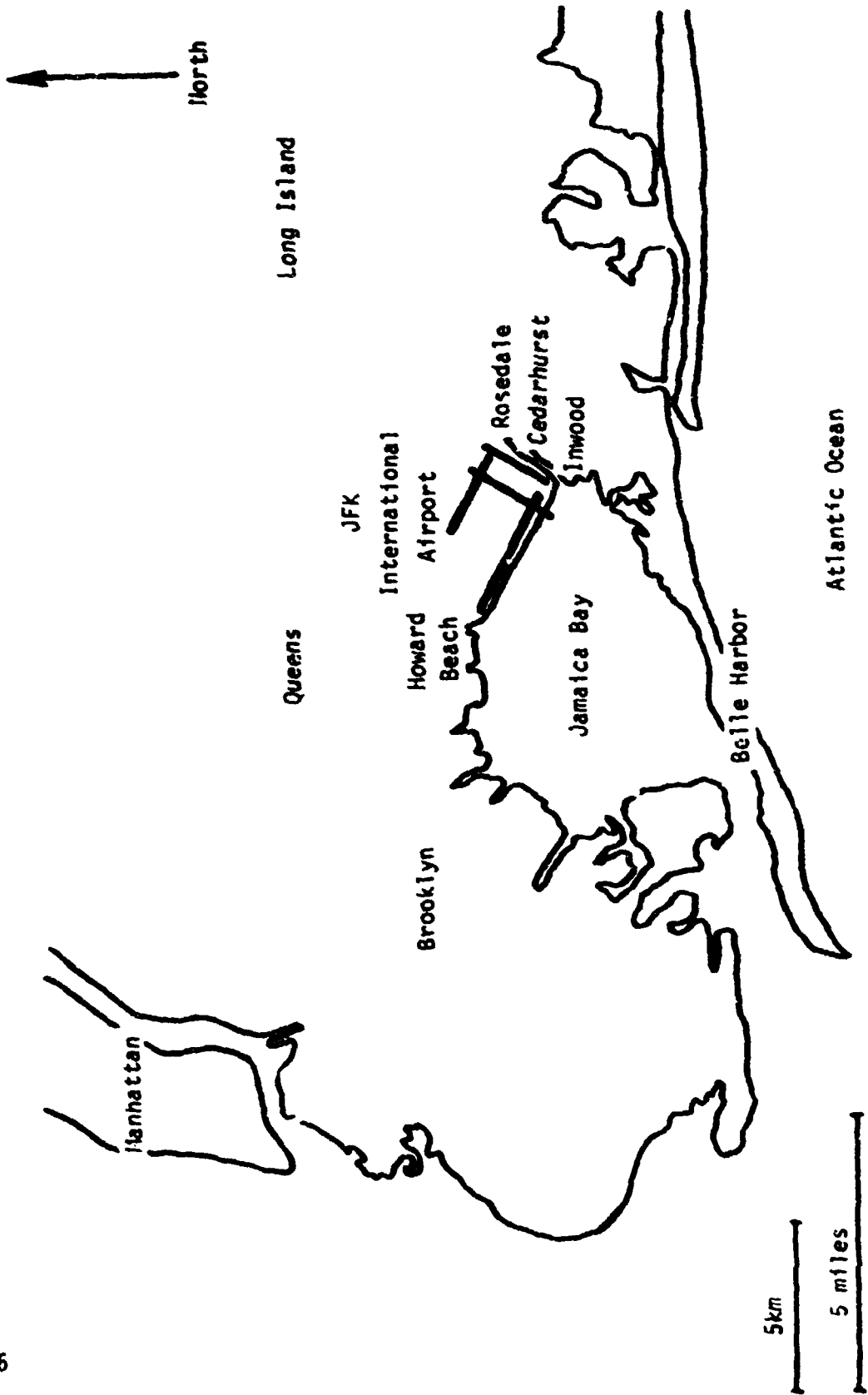


Figure 1. - JFK International Airport and surrounding area.

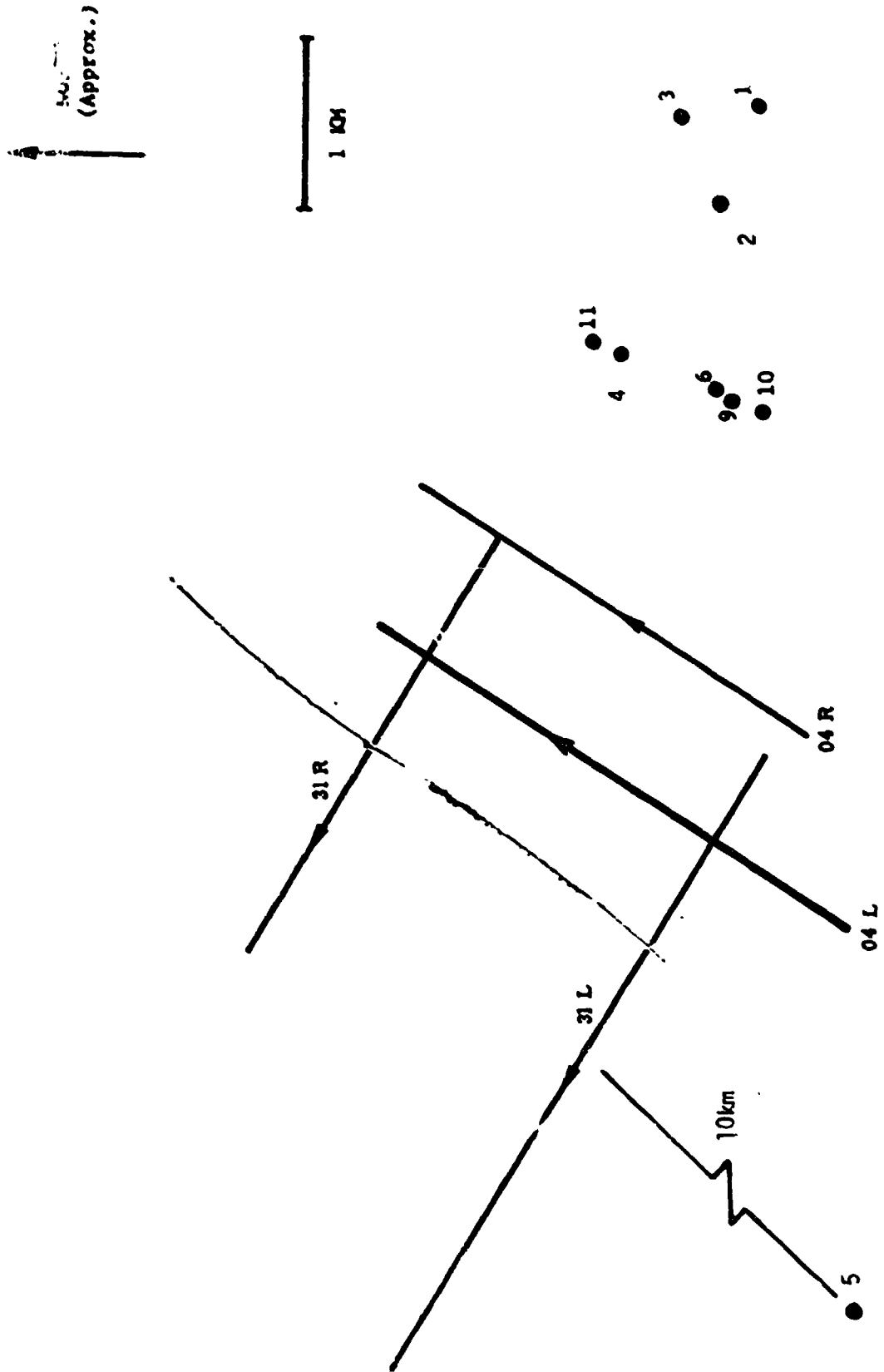


Figure 2. - Structural vibration test site locations.

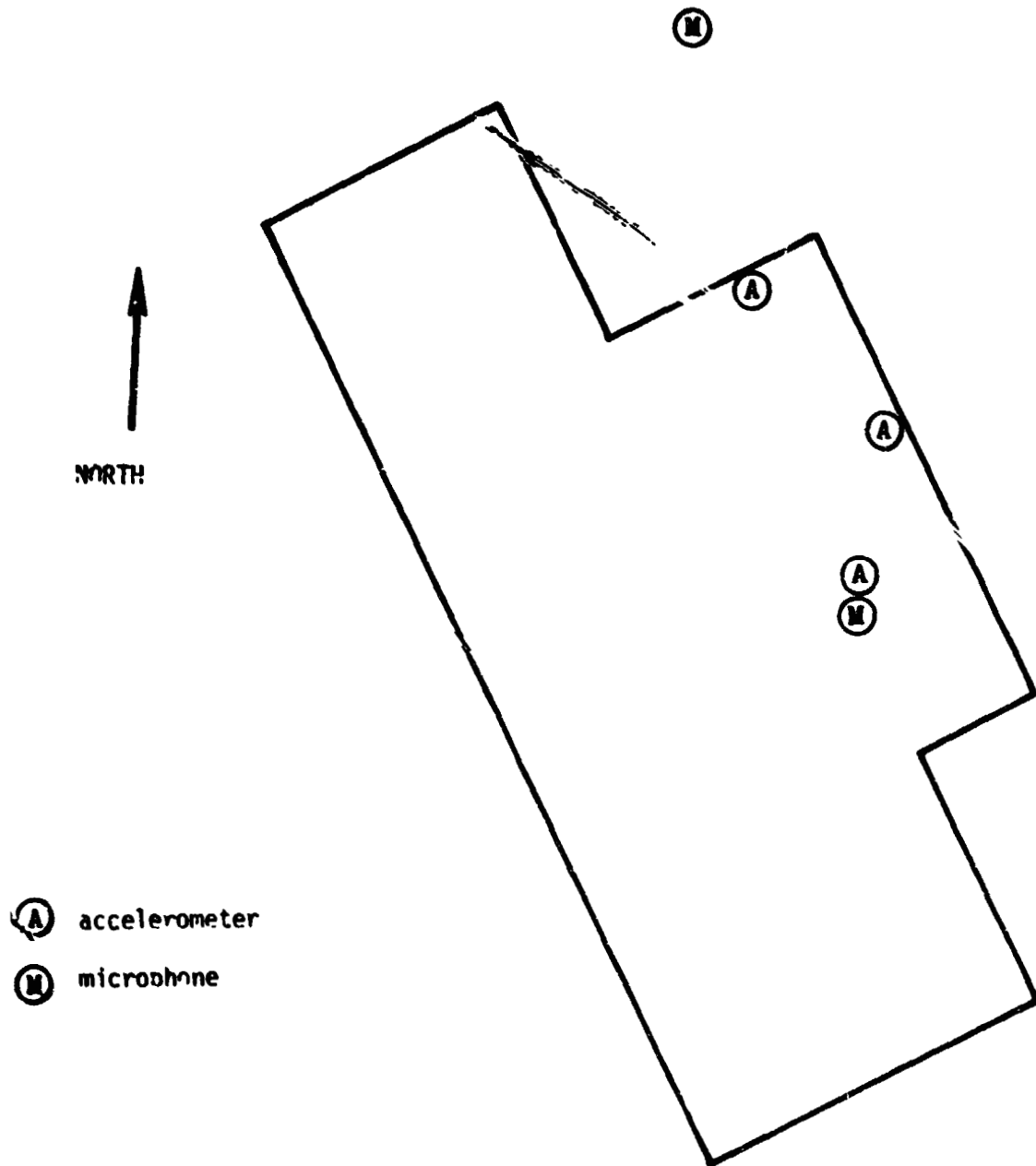


Figure 3(a). - Plan view sketch of test structure 1.

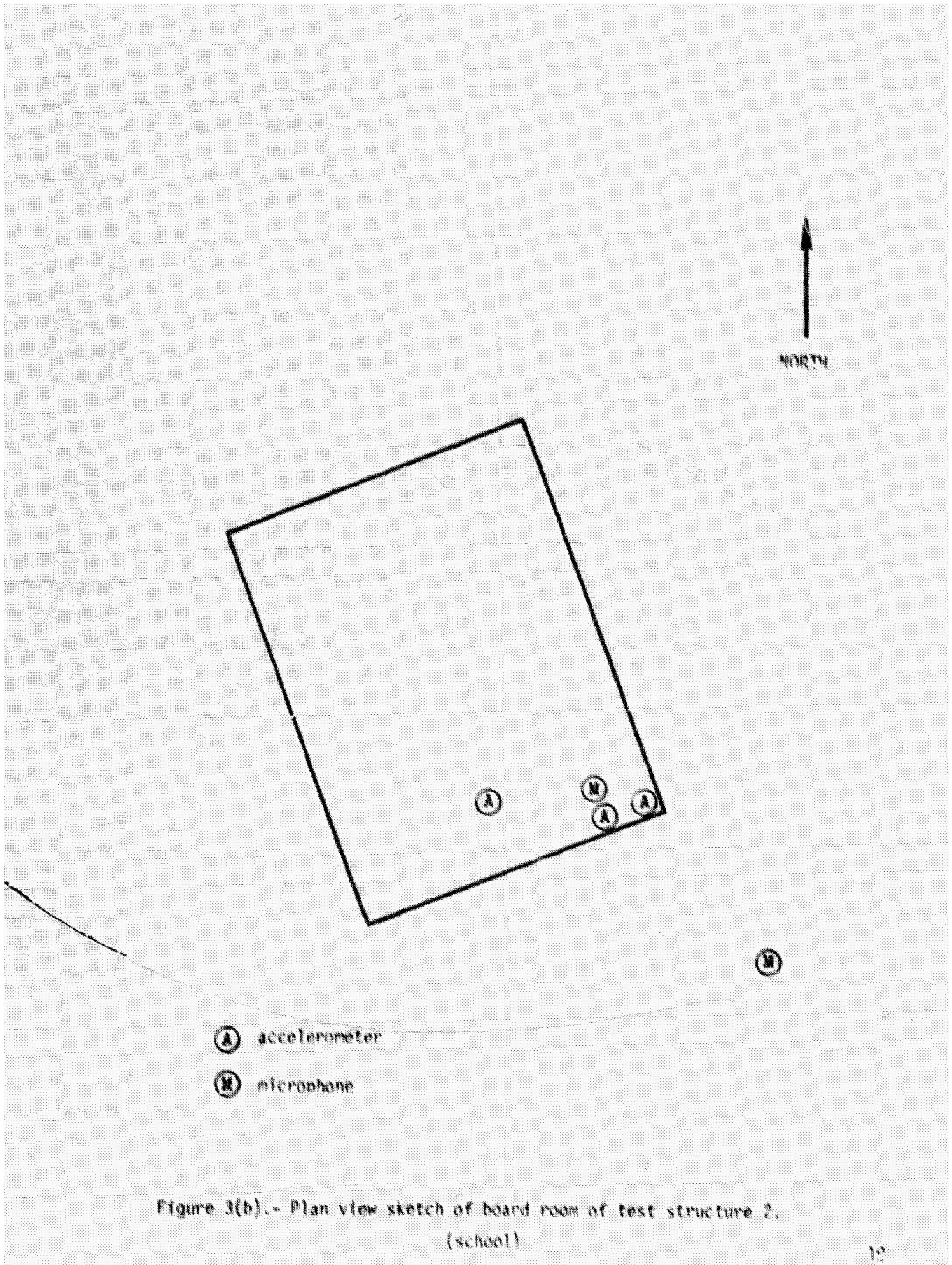


Figure 3(b).- Plan view sketch of board room of test structure 2.  
(school)

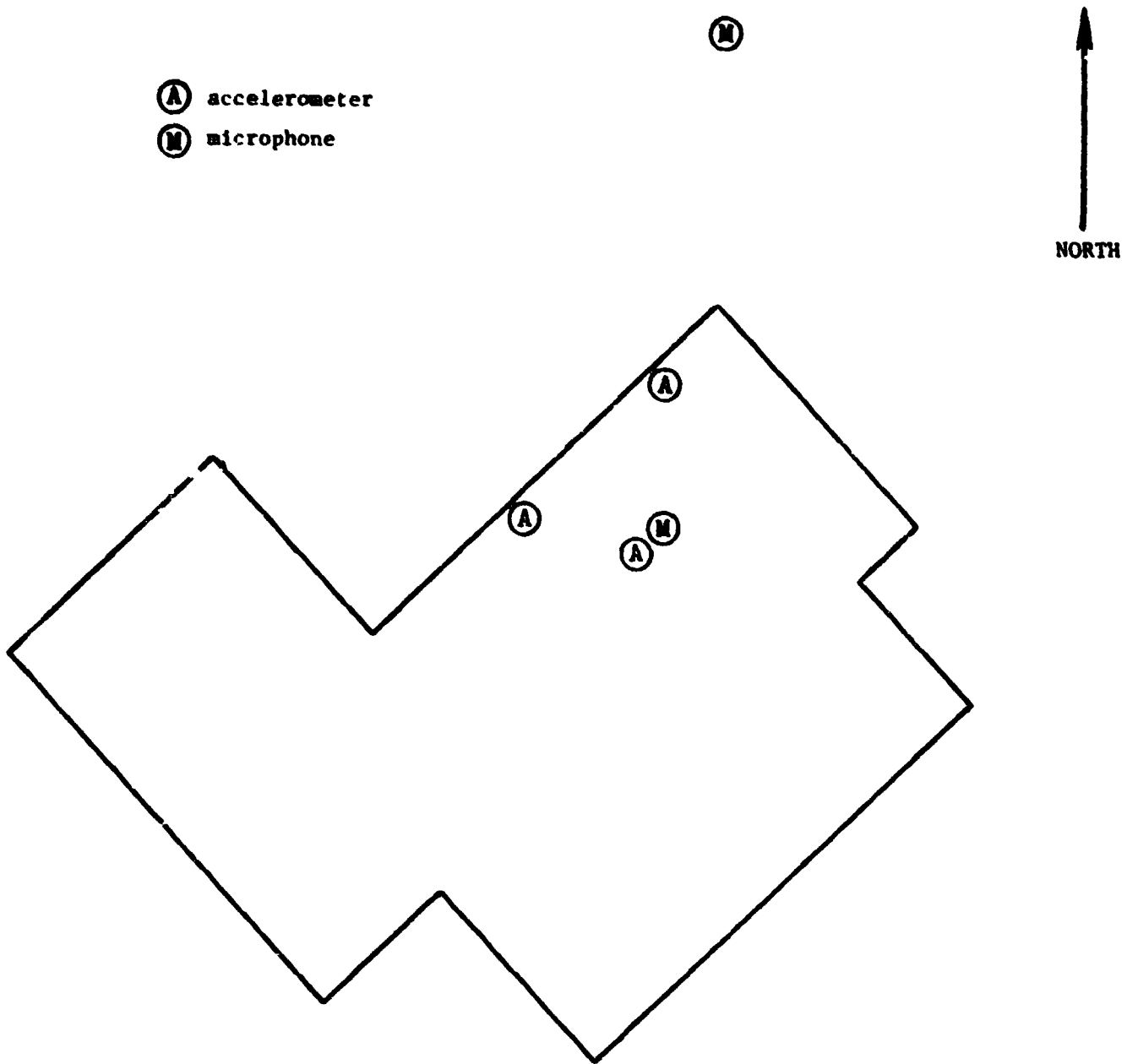


Figure 3(c). - Plan view sketch of test structure 3.

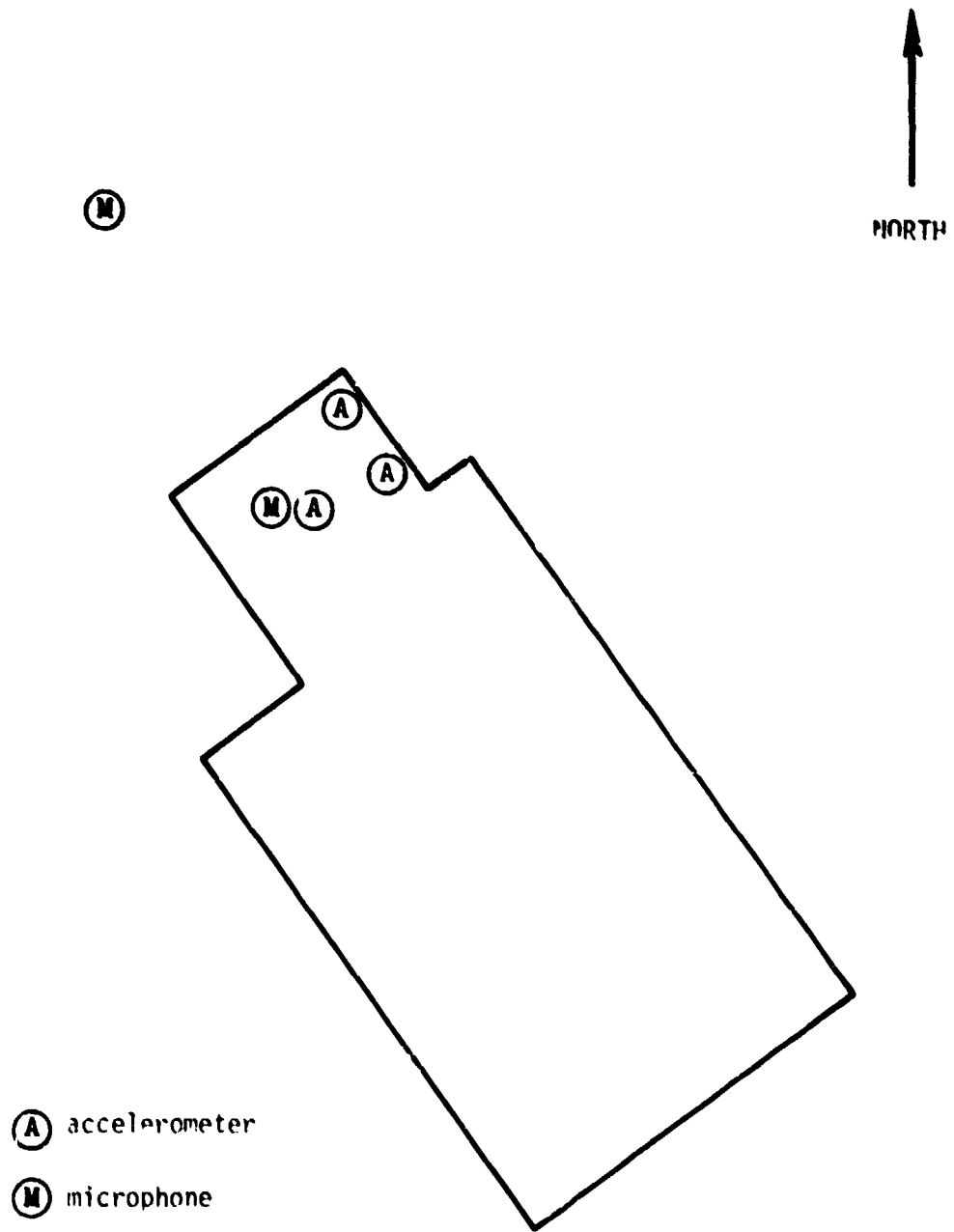


Figure 3(d). - Plan view sketch of test structure 4.

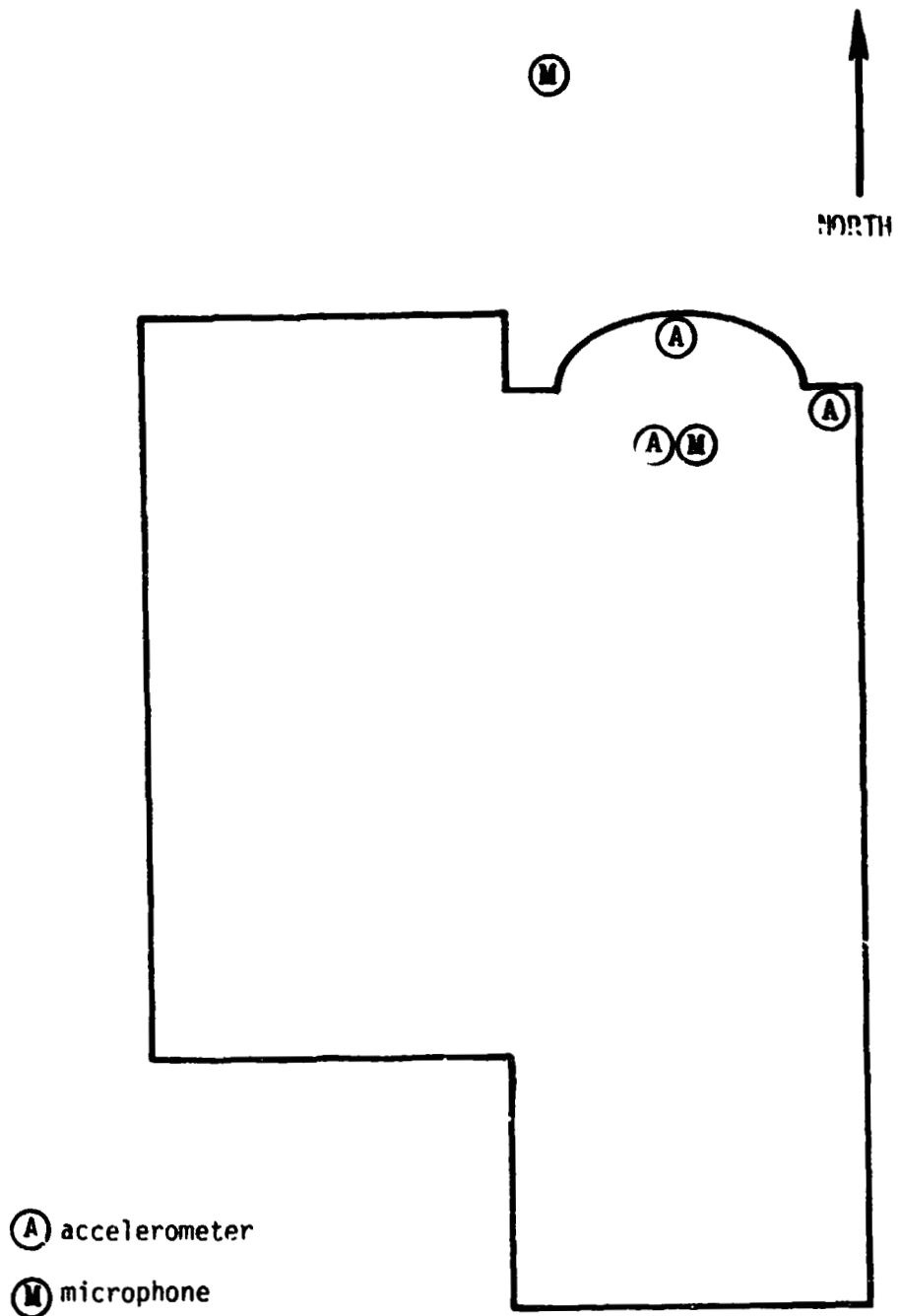


Figure 3(e). - Plan view sketch of test structure 5.

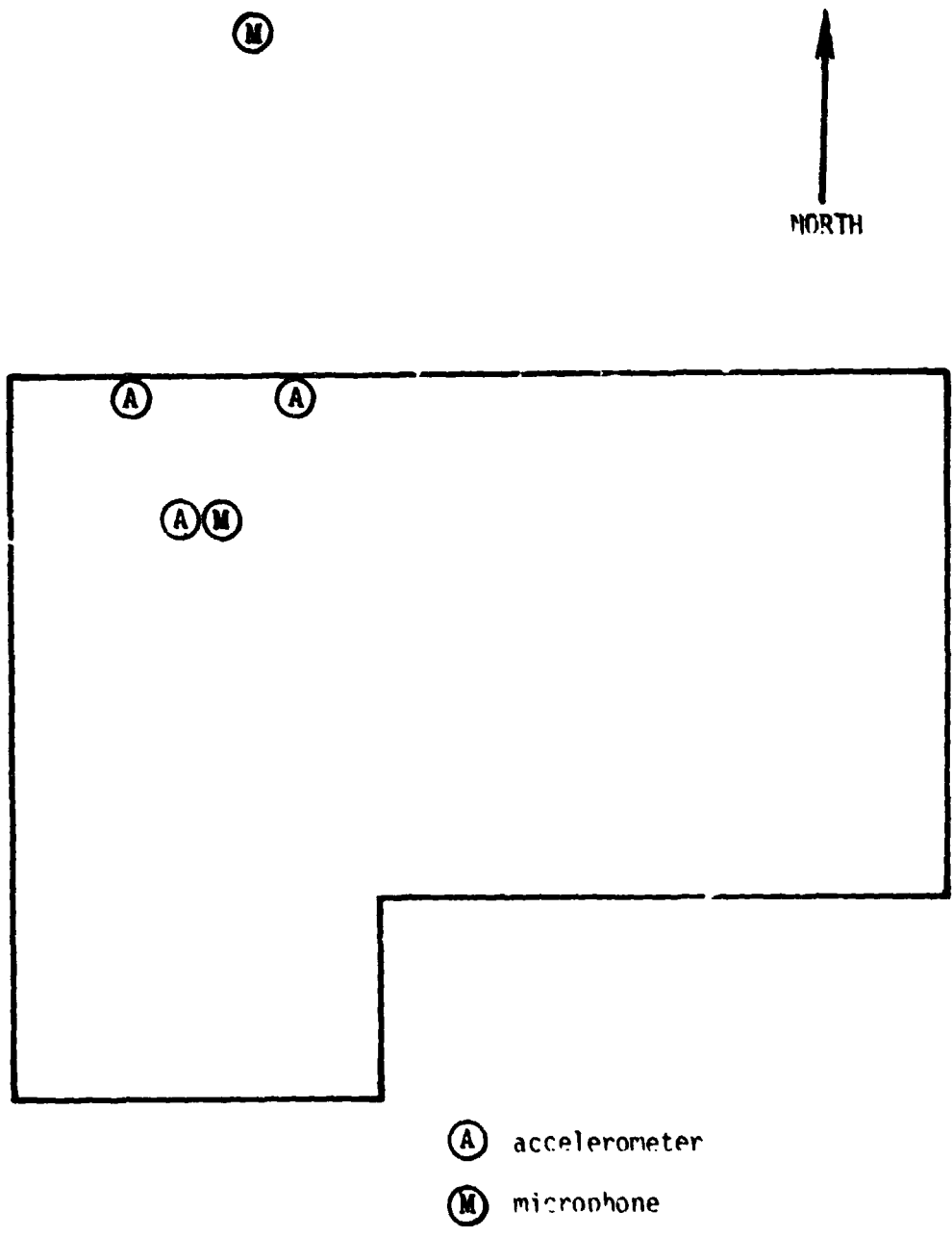


Figure 3(f). - Plan view sketch of test structure 6.



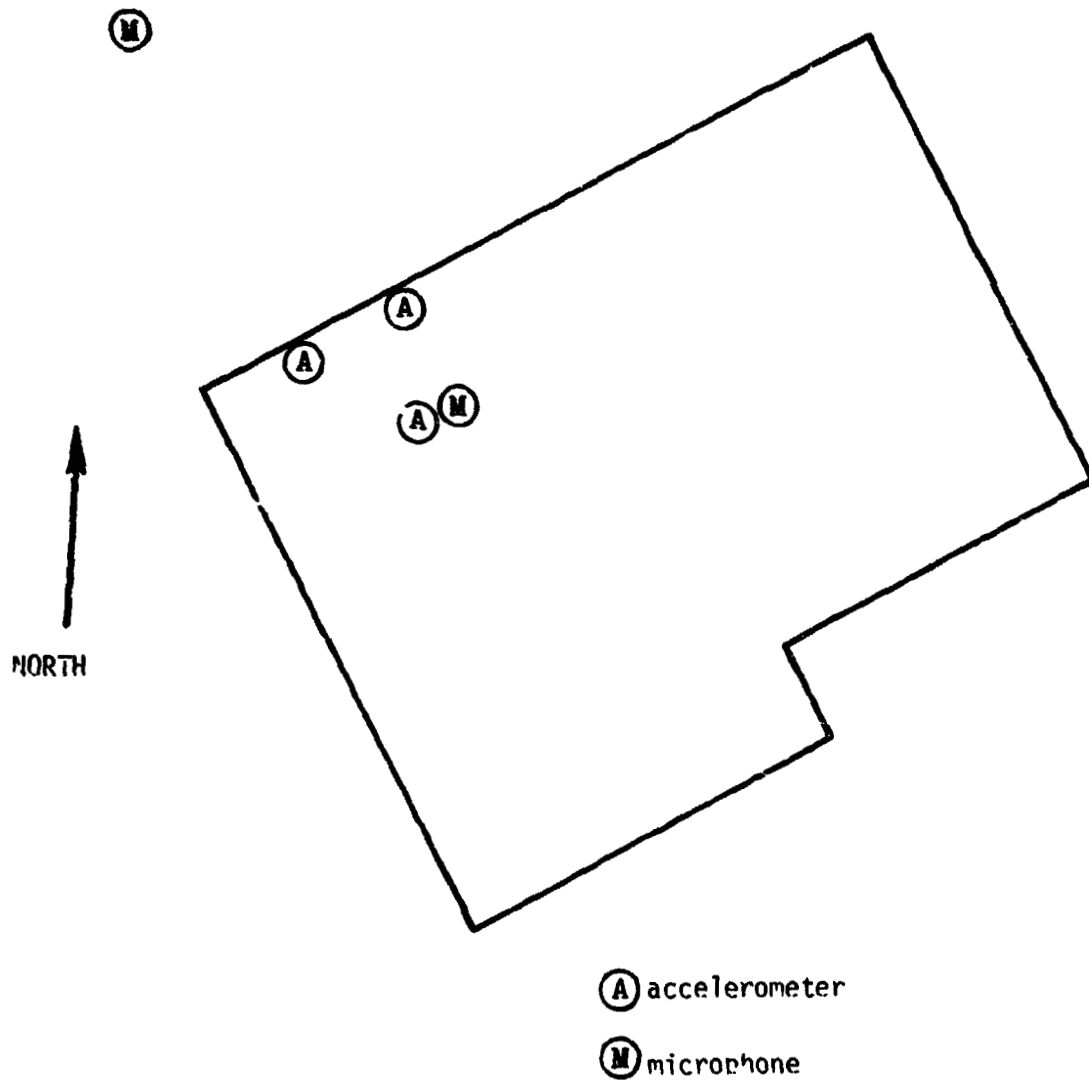


Figure 3(g). - Plan view sketch of test structure 9.

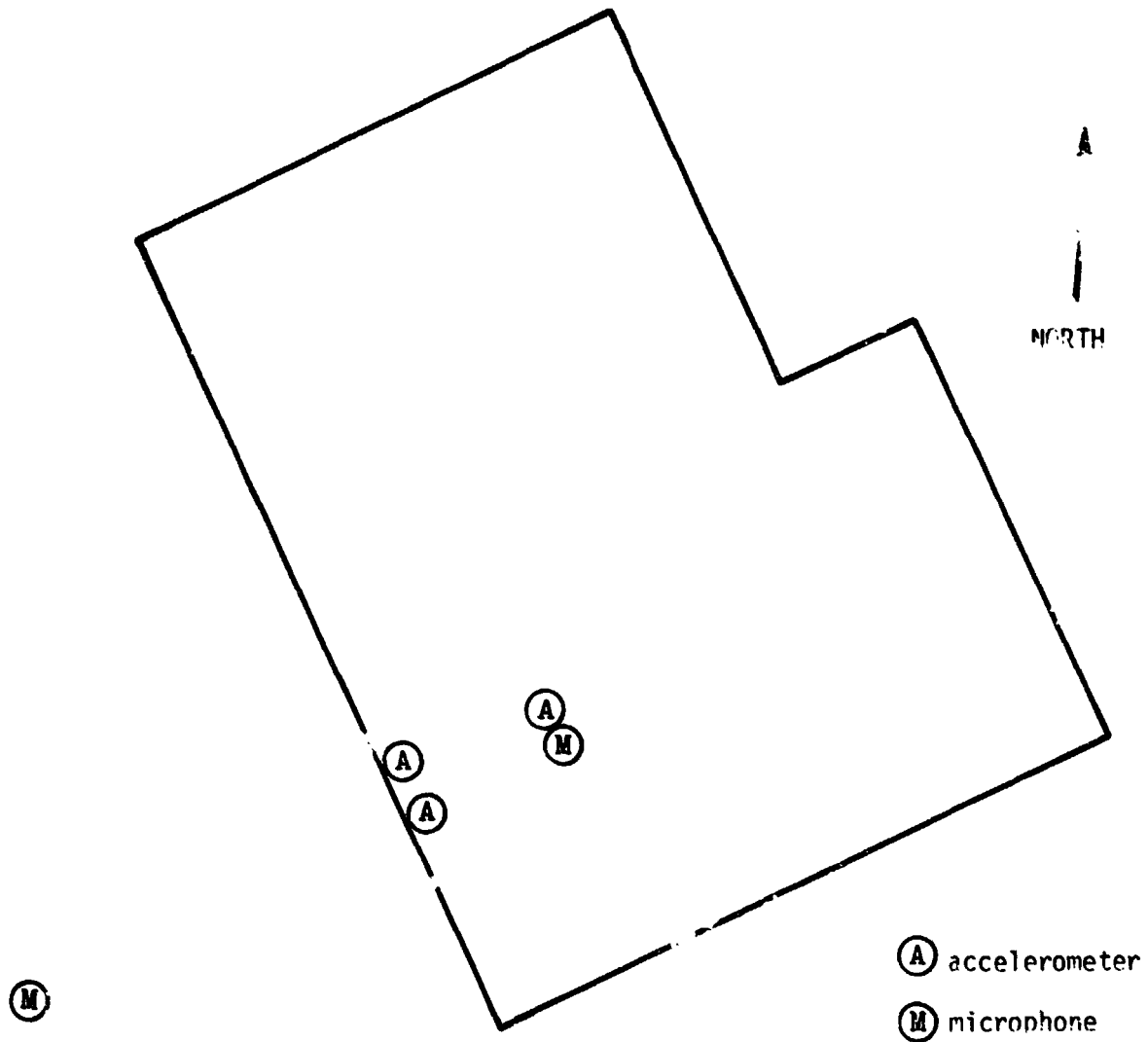


Figure 3(h). - Plan view sketch of test structure 10.

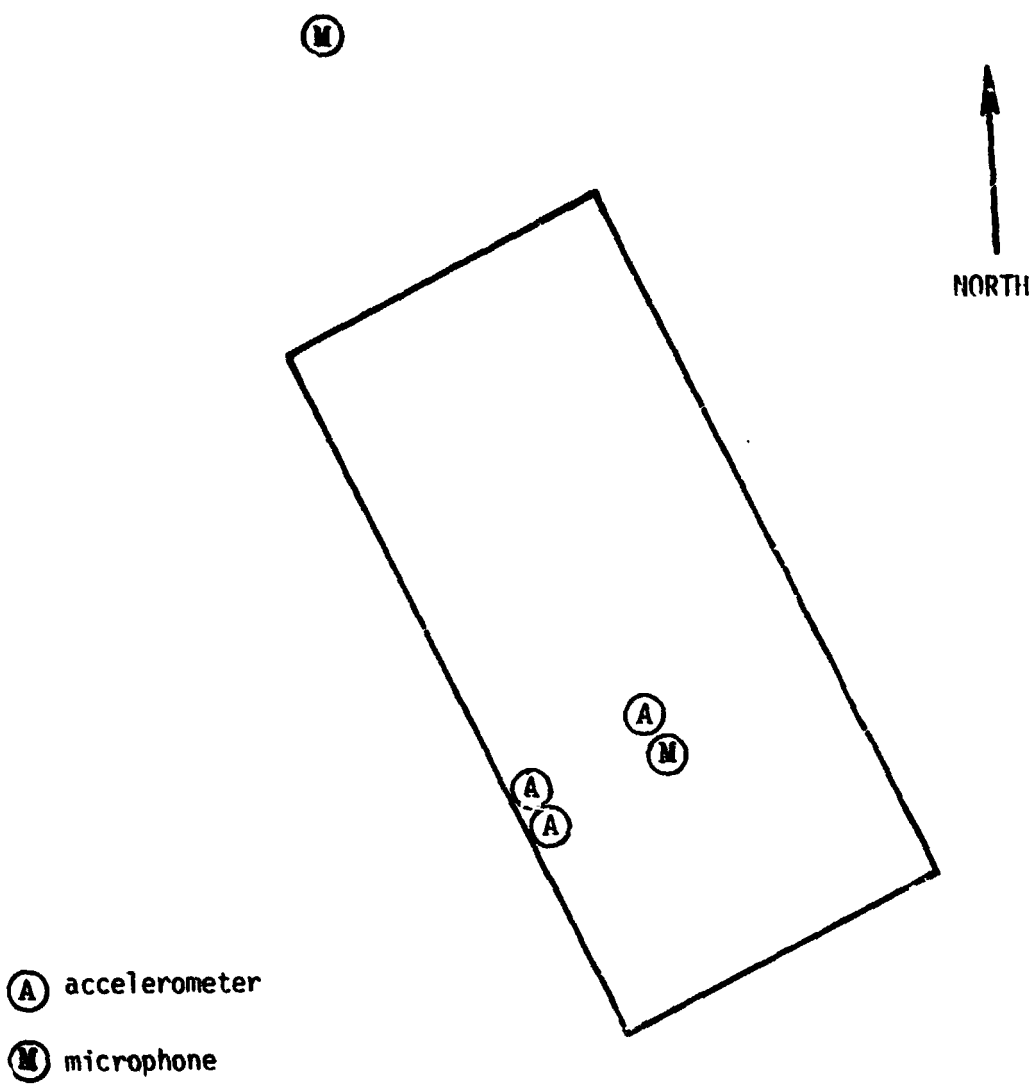


Figure 3(i). - Plan view sketch of test structure 11.

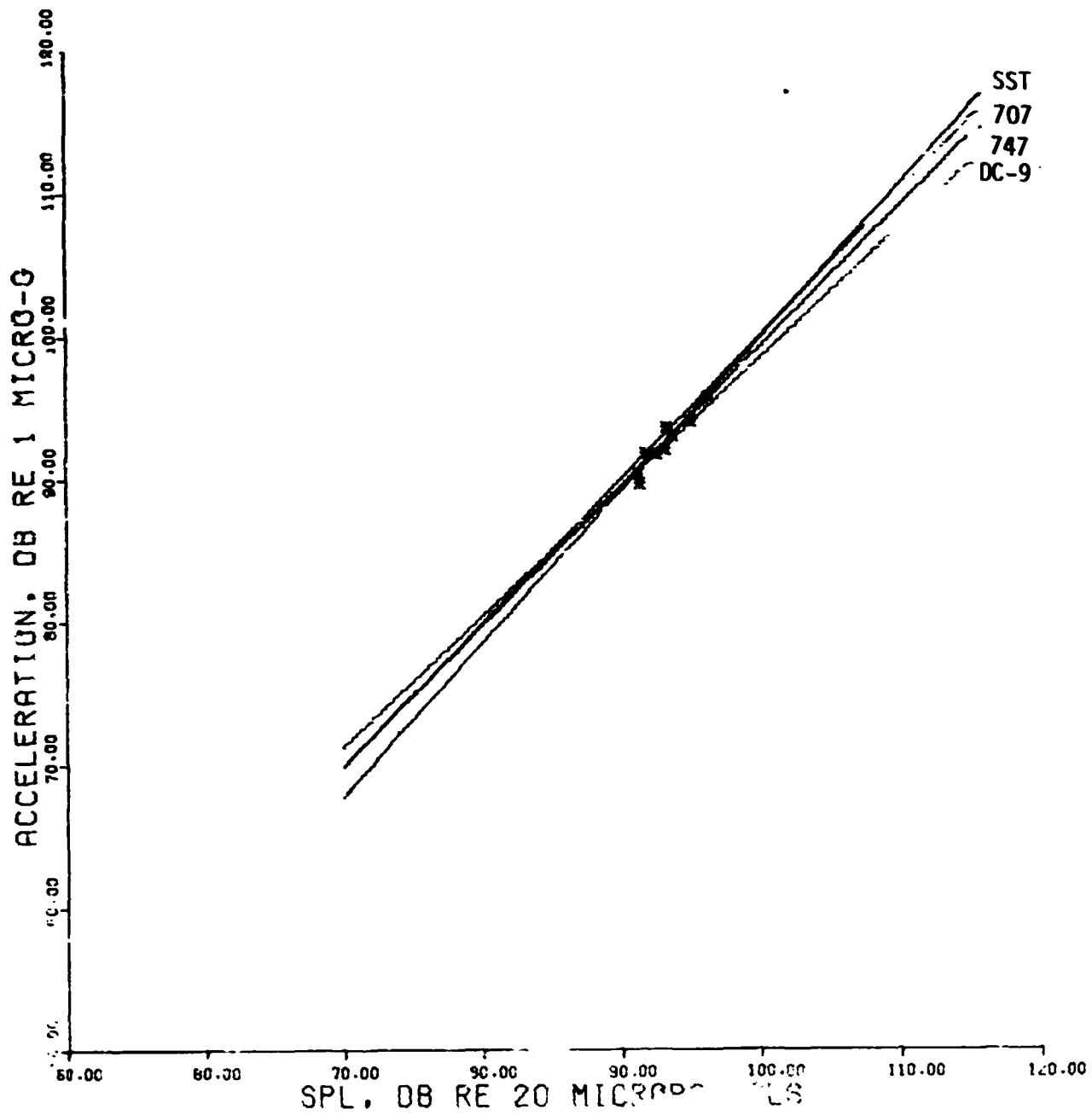


Figure 4(a).- Composite window vibration response curves for Concorde and subsonic aircraft approaches at site 2. Data points are for Concorde

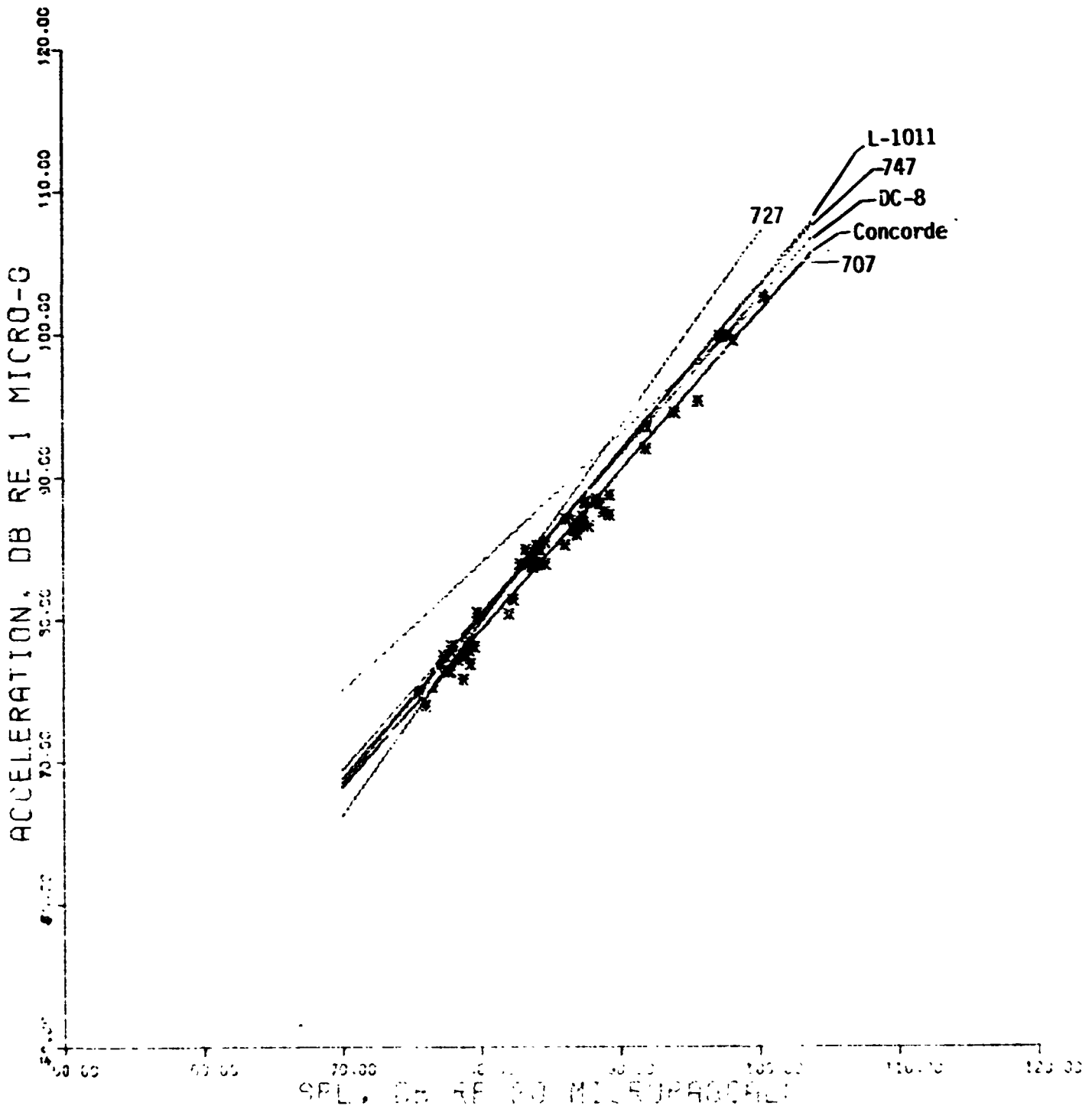


Figure 4(b).- Composite window vibration response signatures for Concorde and subsonic aircraft approaches at site 3. Data points are for Concorde.

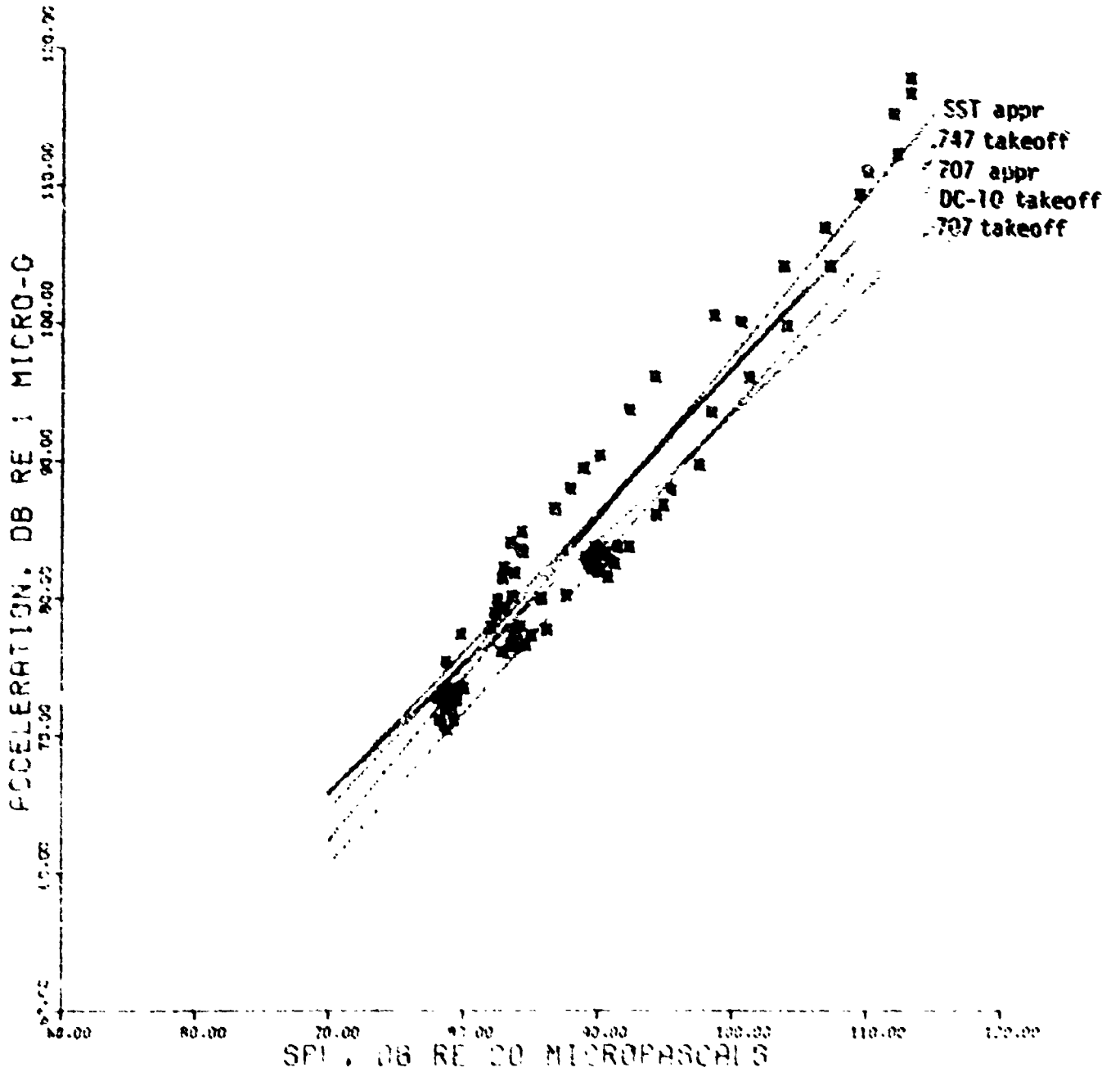


Figure 4(c).- Composite window vibration response signatures for Concorde and subsonic aircraft flyovers at site 4. Data points are for Concorde.

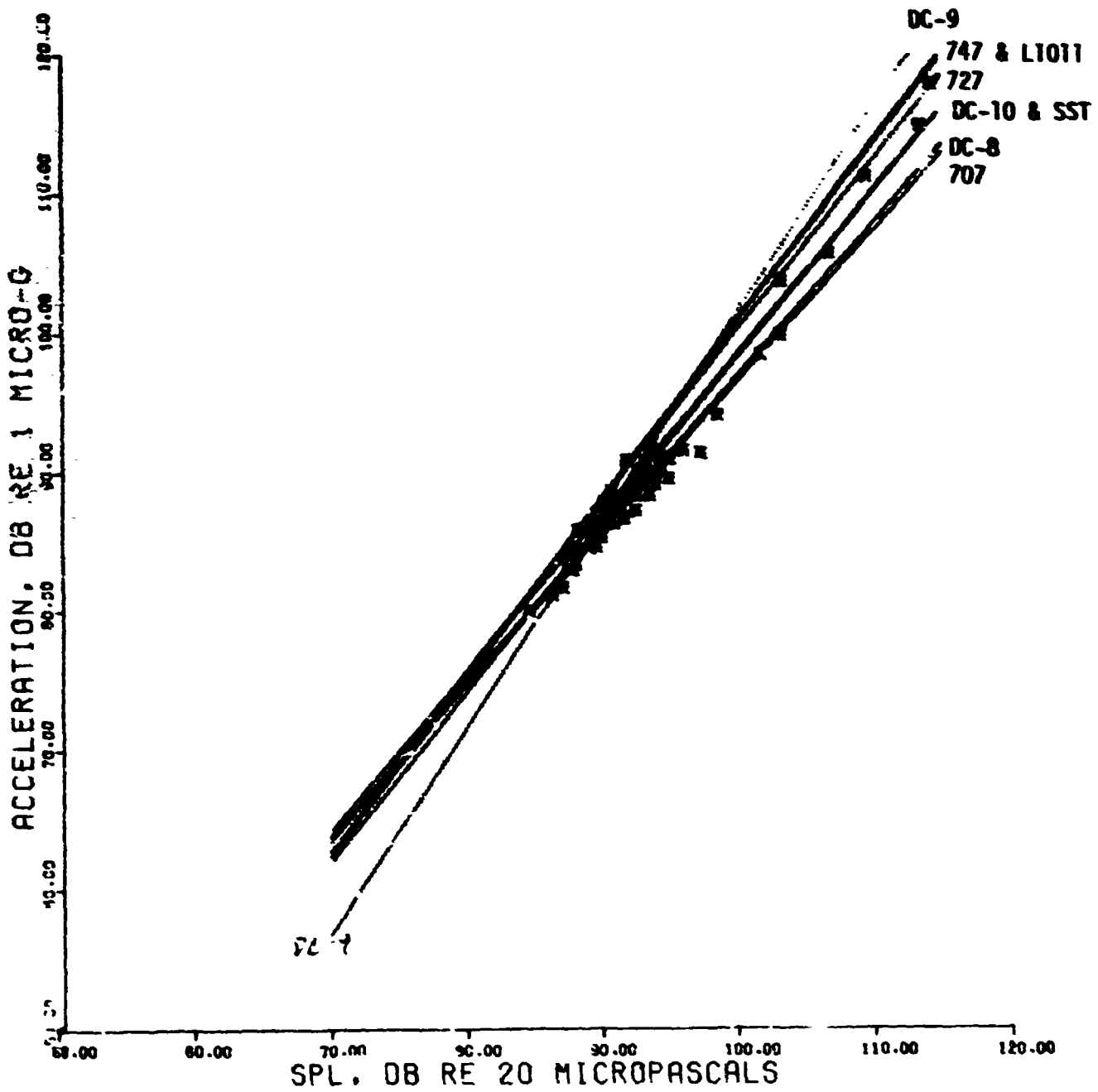


Figure 4(d).- Composite window vibration response signatures for Concorde and subsonic aircraft approaches at site 11. Data points are for Concorde.

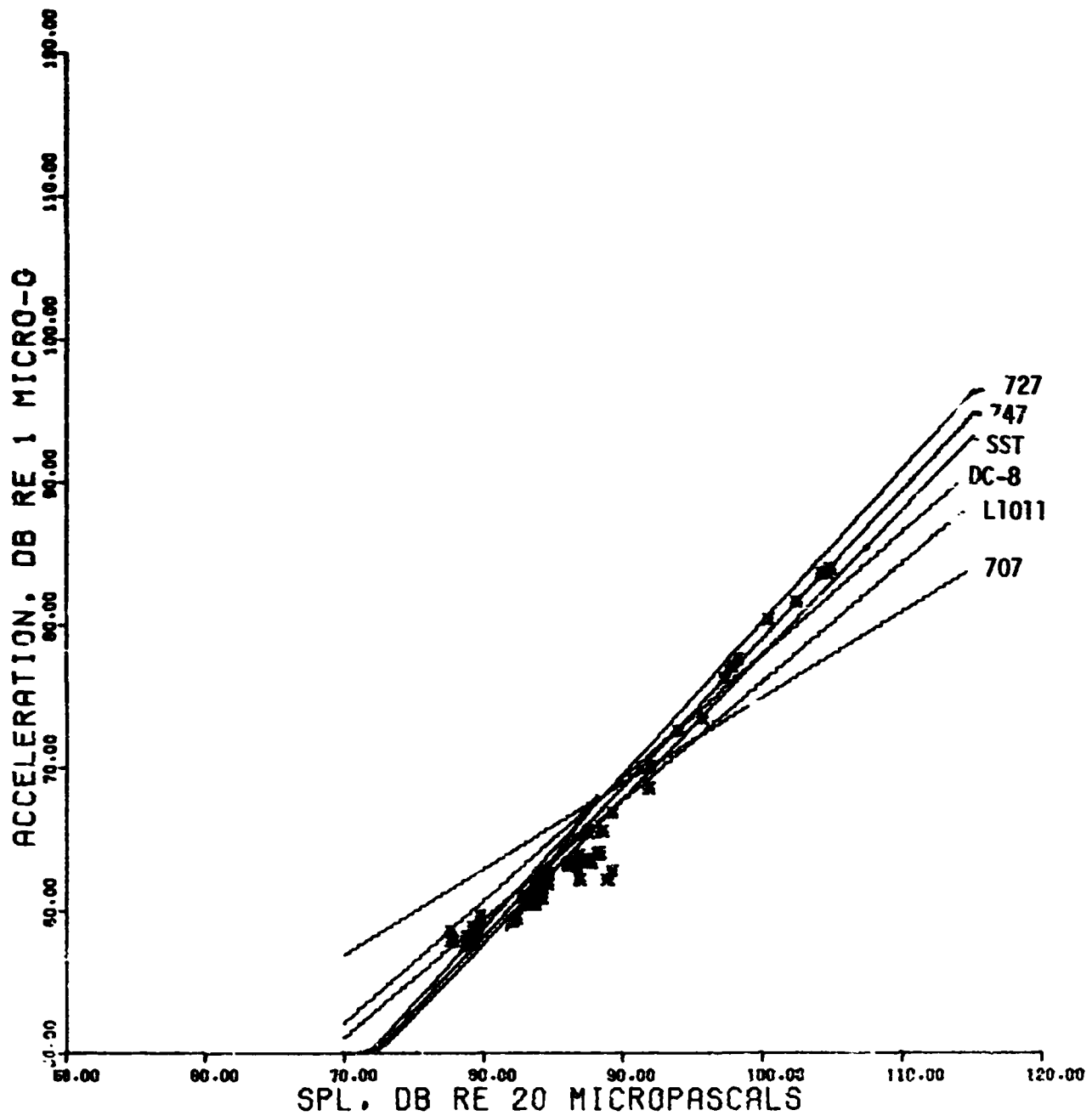


Figure 5(a).- Composite wall vibration response signatures for Concorde and subsonic aircraft approaches at site 3. Data points are for Concorde.



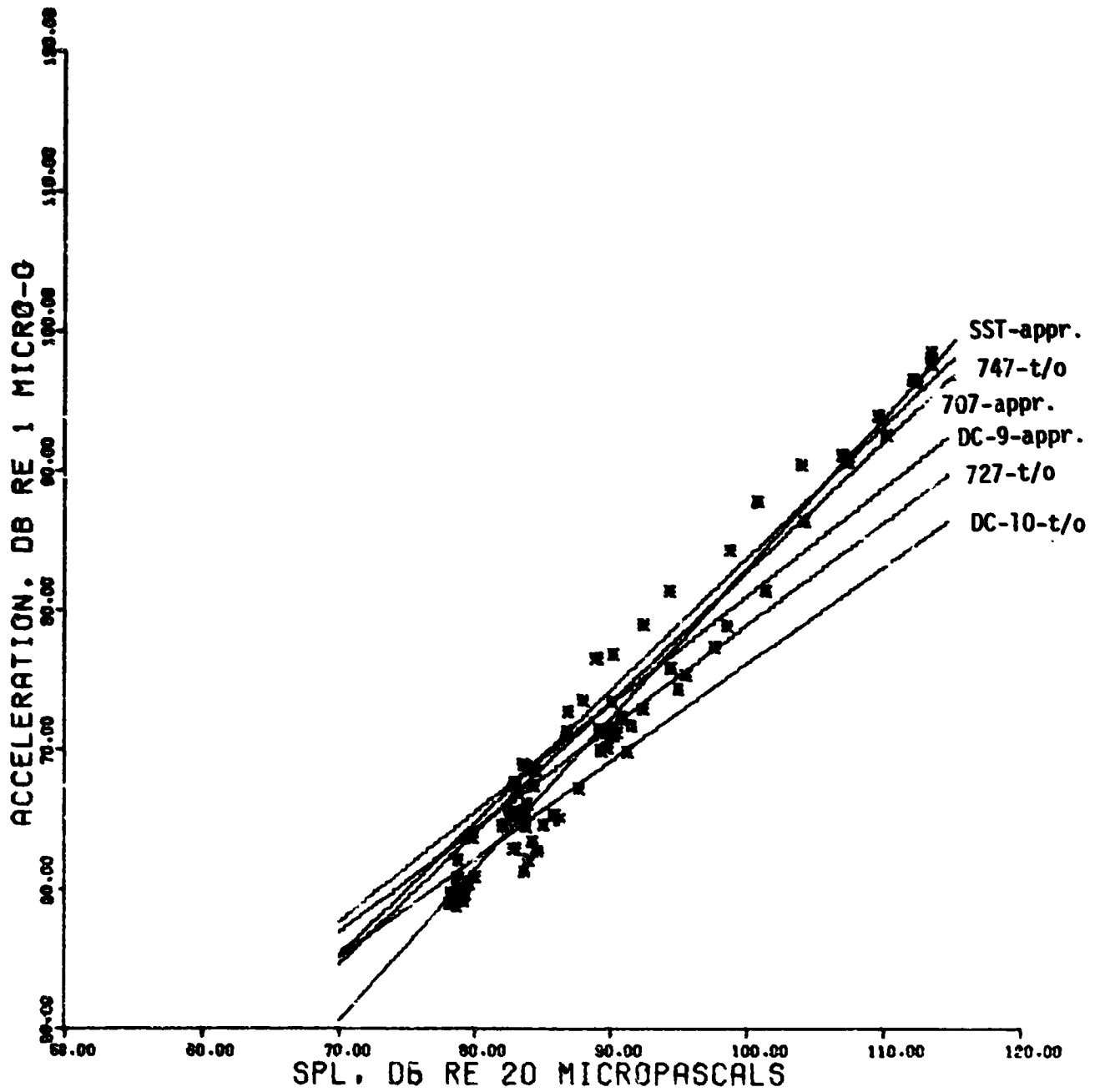


Figure 5(b).- Composite wall vibration response signatures for Concorde and subsonic aircraft flyovers at site 4. Data points are for Concorde.

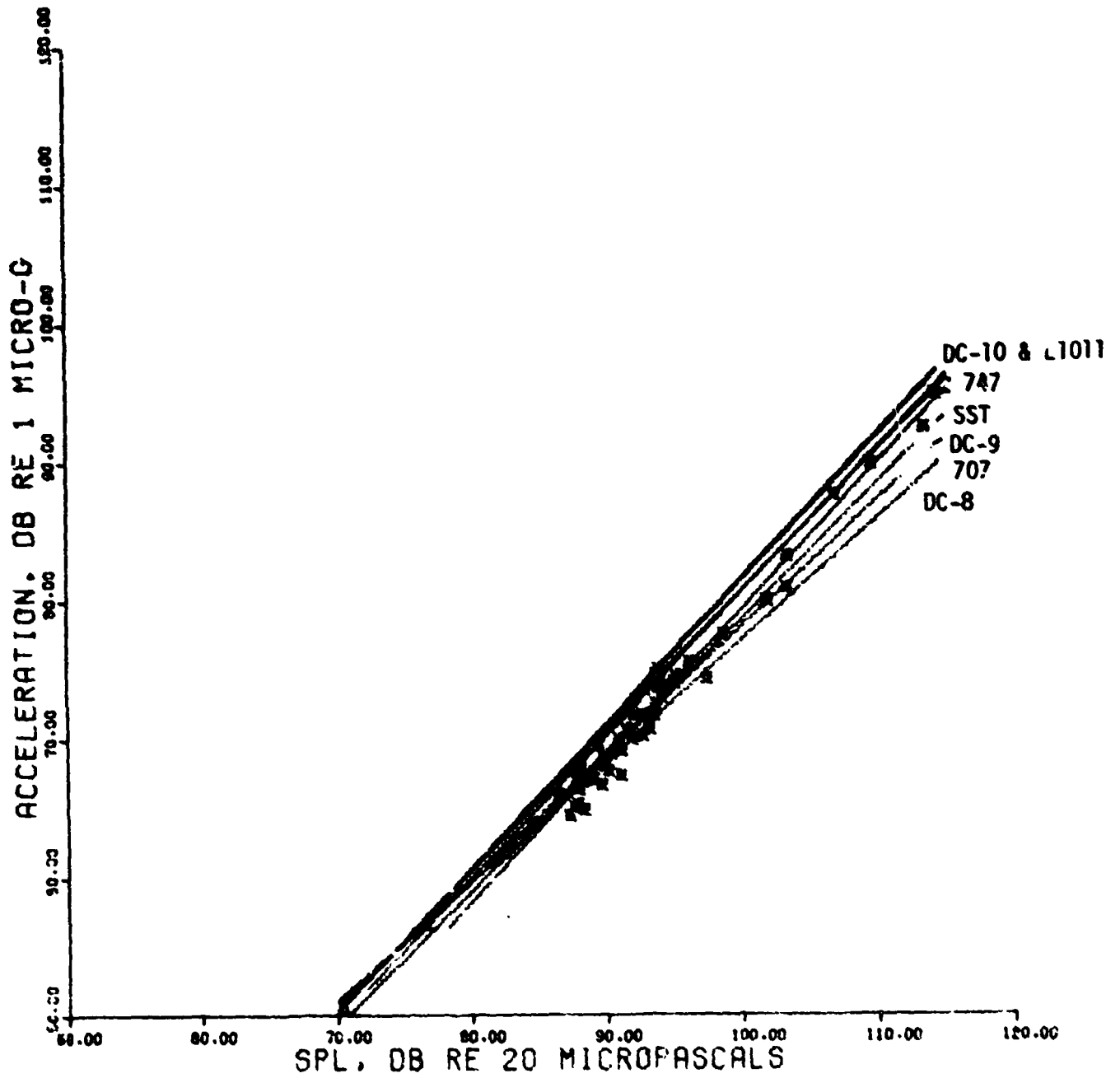


Figure 5(c).- Composite wall vibration response signatures for Concorde and subsonic aircraft approaches at site 11. Data points are for Concorde.

## APPENDIX

### STRUCTURAL RESPONSE SIGNATURES

This appendix contains figures which illustrate how structural vibration levels vary with sound pressure level for a given aircraft type at a given site. Most of the figures are composite "signatures," comprised of more than one flyover of a given aircraft type at a given site. These signatures describe direct overflights of aircraft at the test site; responses due to sideline noise or ground operations are not included here. Care was taken to include in each figure only those data points for which the outdoor microphone and the structural element under investigation were exposed to the same sound fields. Thus, effects due to differential loading of the microphones and the accelerometers (shadow effects, for example) were screened from the analysis.

The best straight line fitting the data in each figure was determined by linear regression techniques. These straight lines are overlaid in the main body of the text to facilitate inter-aircraft comparisons at a given site.

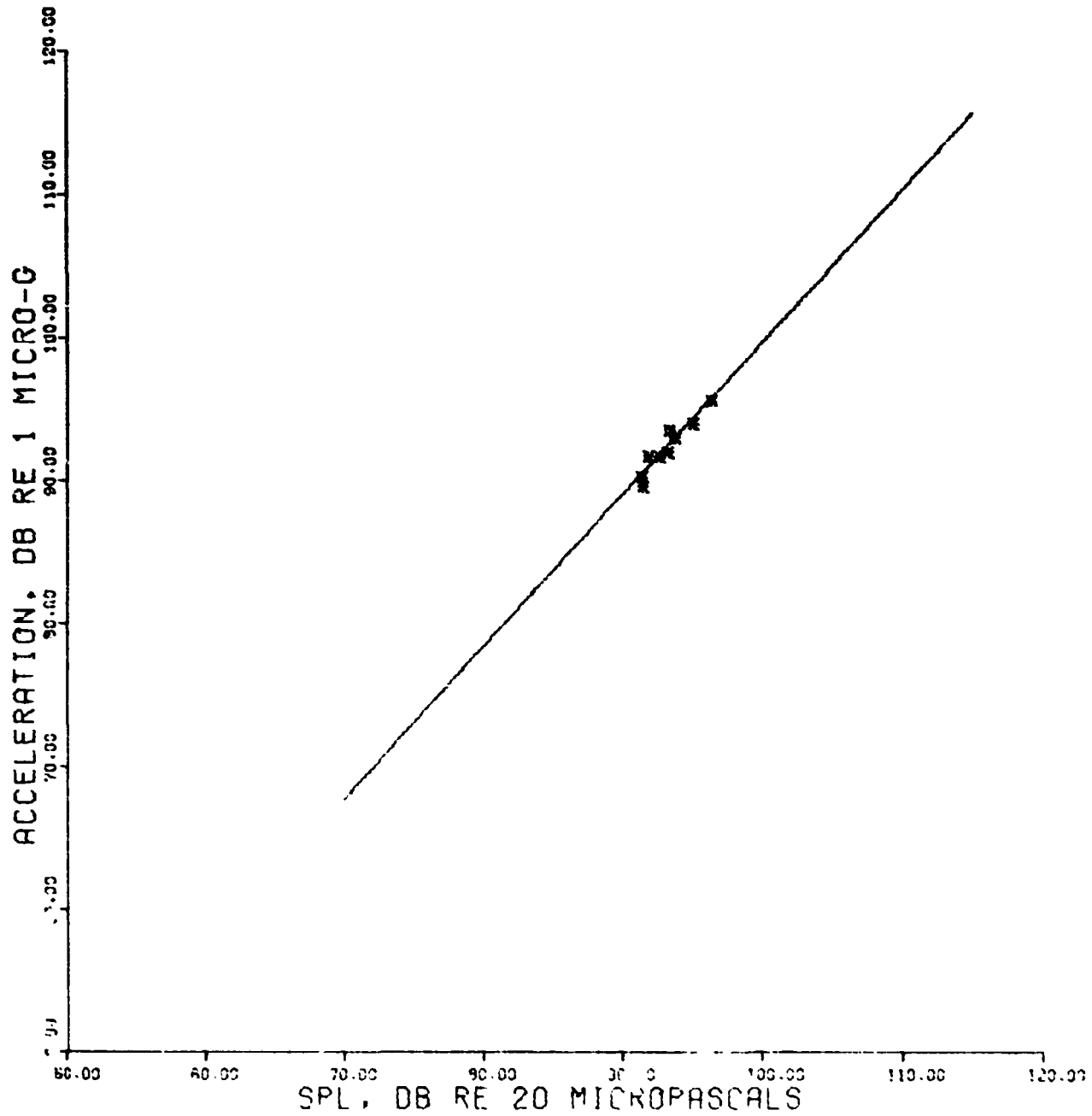


Figure A-1.- Composite window vibration response signature for SST approach at site 2 (1 flyover).

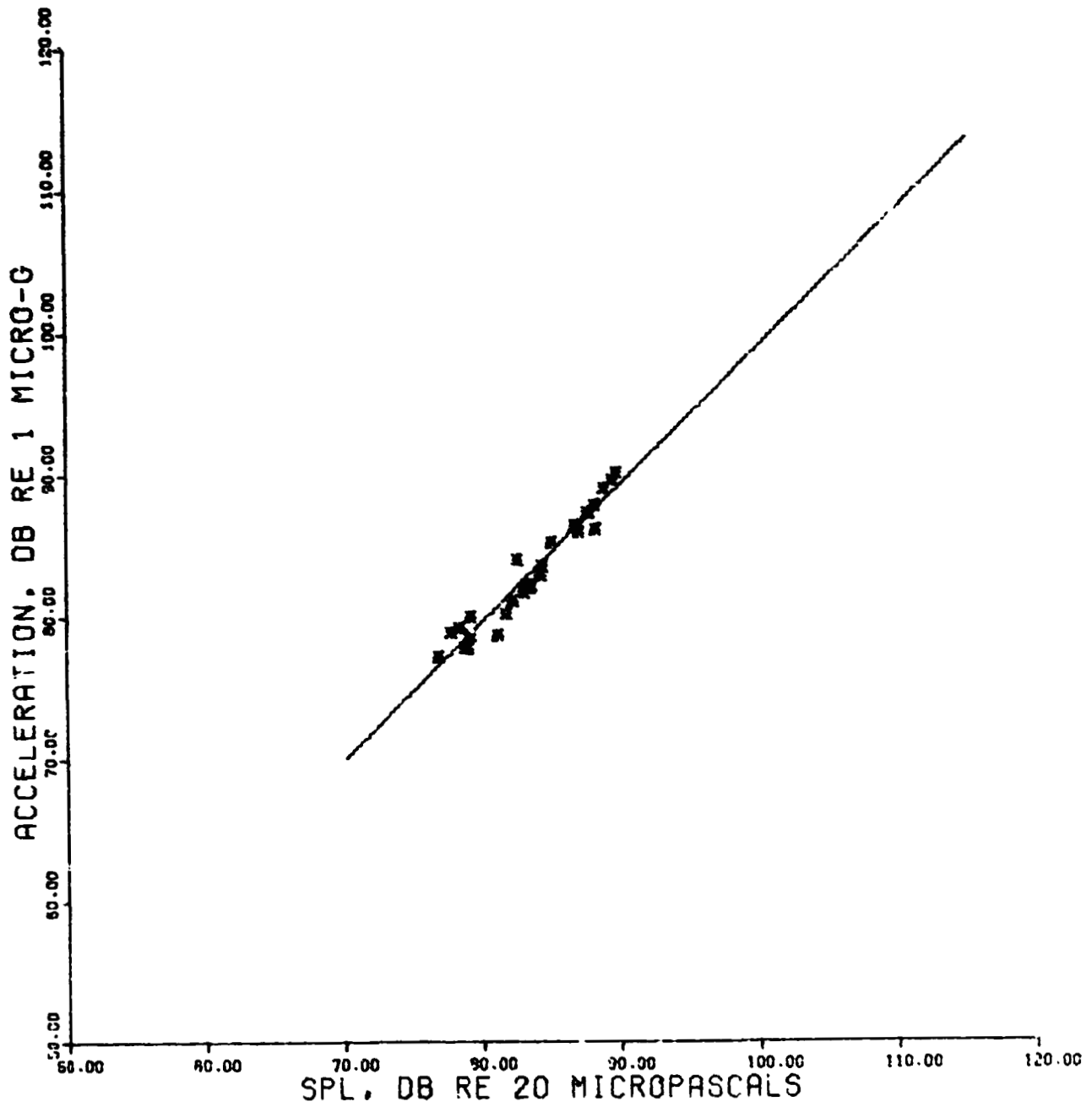


Figure A-2.- Composite window vibration response signature for B747 approach at site 2 (1 flyover).

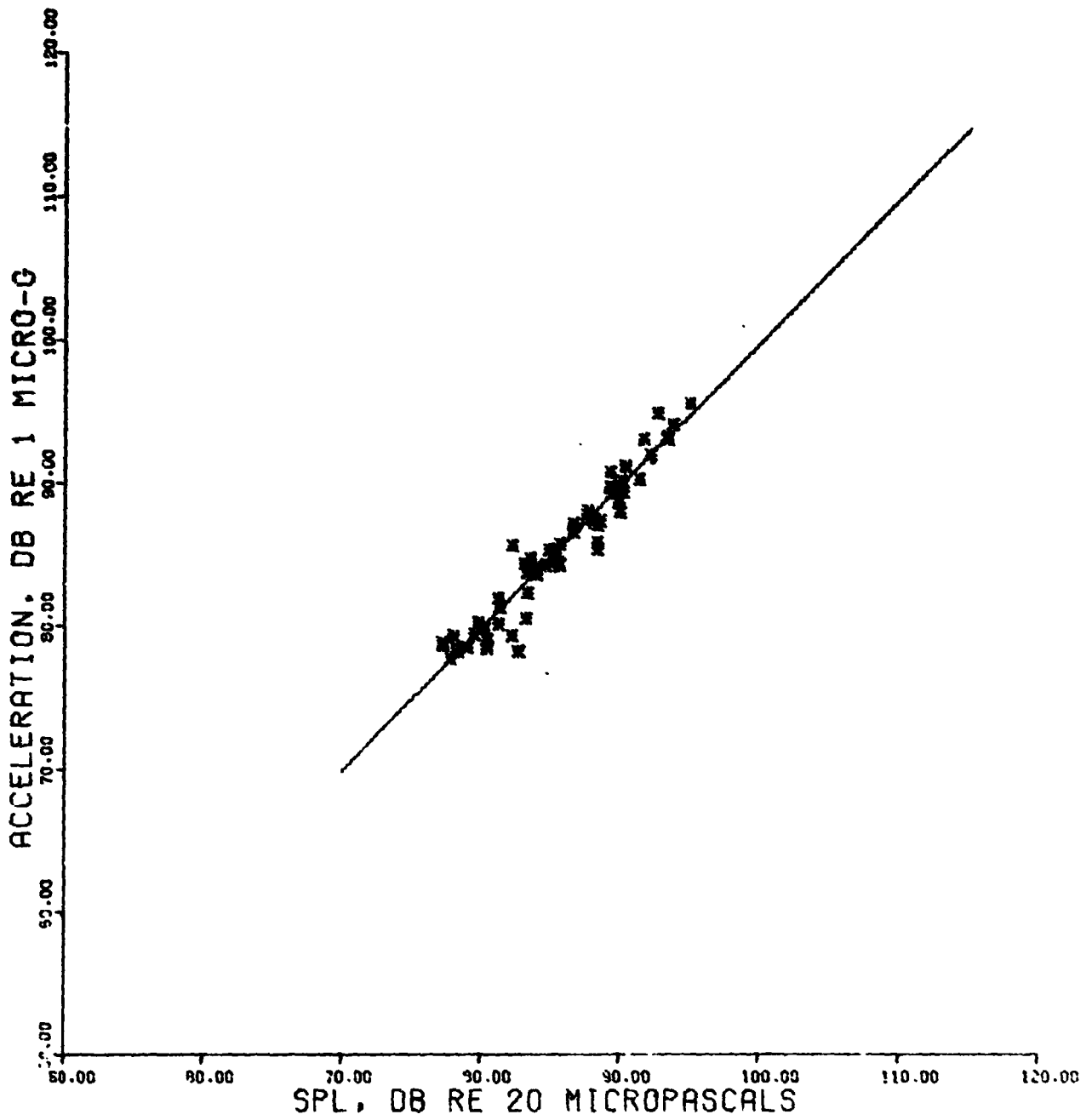


Figure A-3.- Composite window vibration response signature for B707 approach at site 2 (3 flyovers).

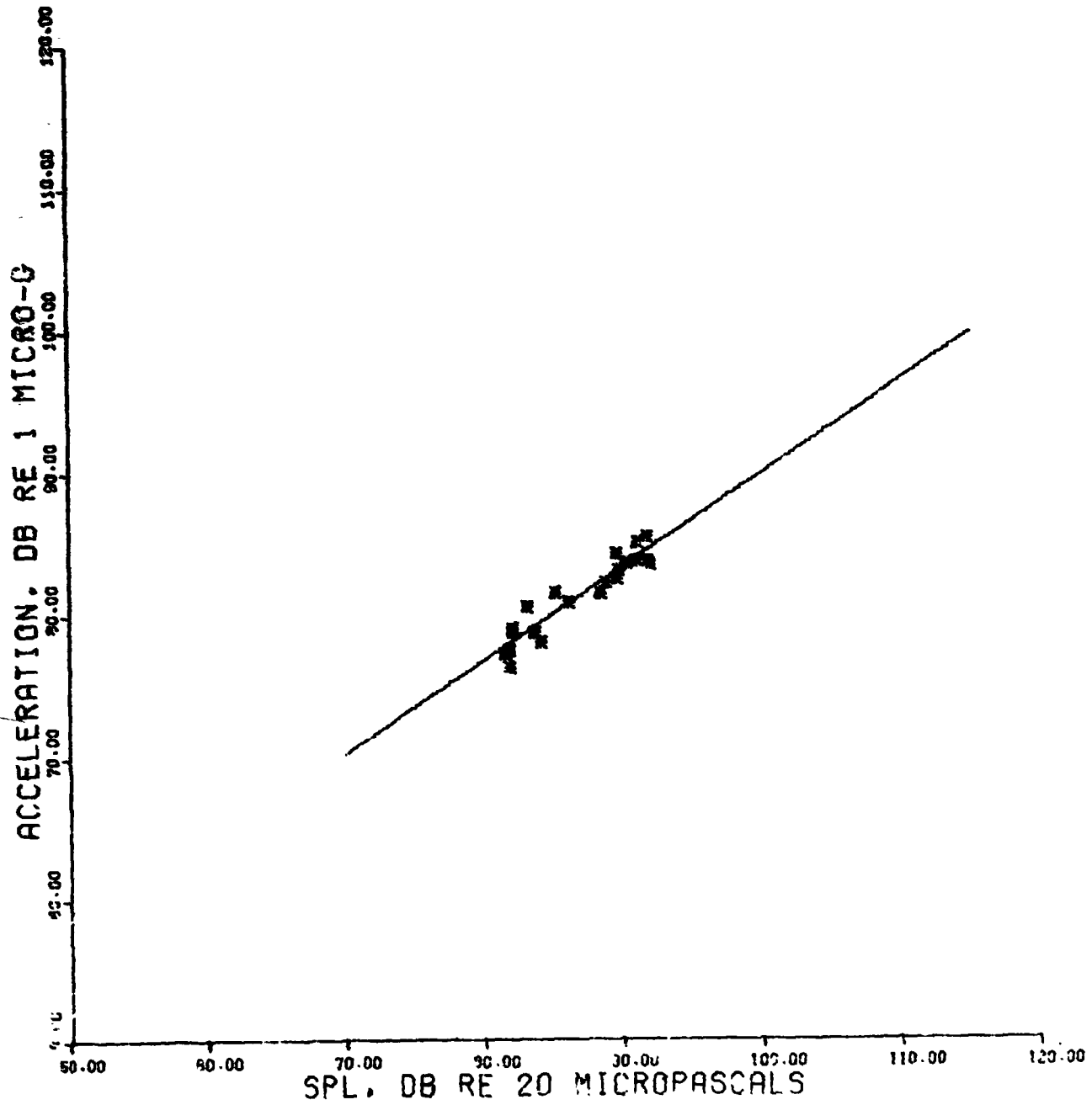


Figure A-4.- Composite window vibration response signature for DC-8 takeoff at site 2 (1 flyover).

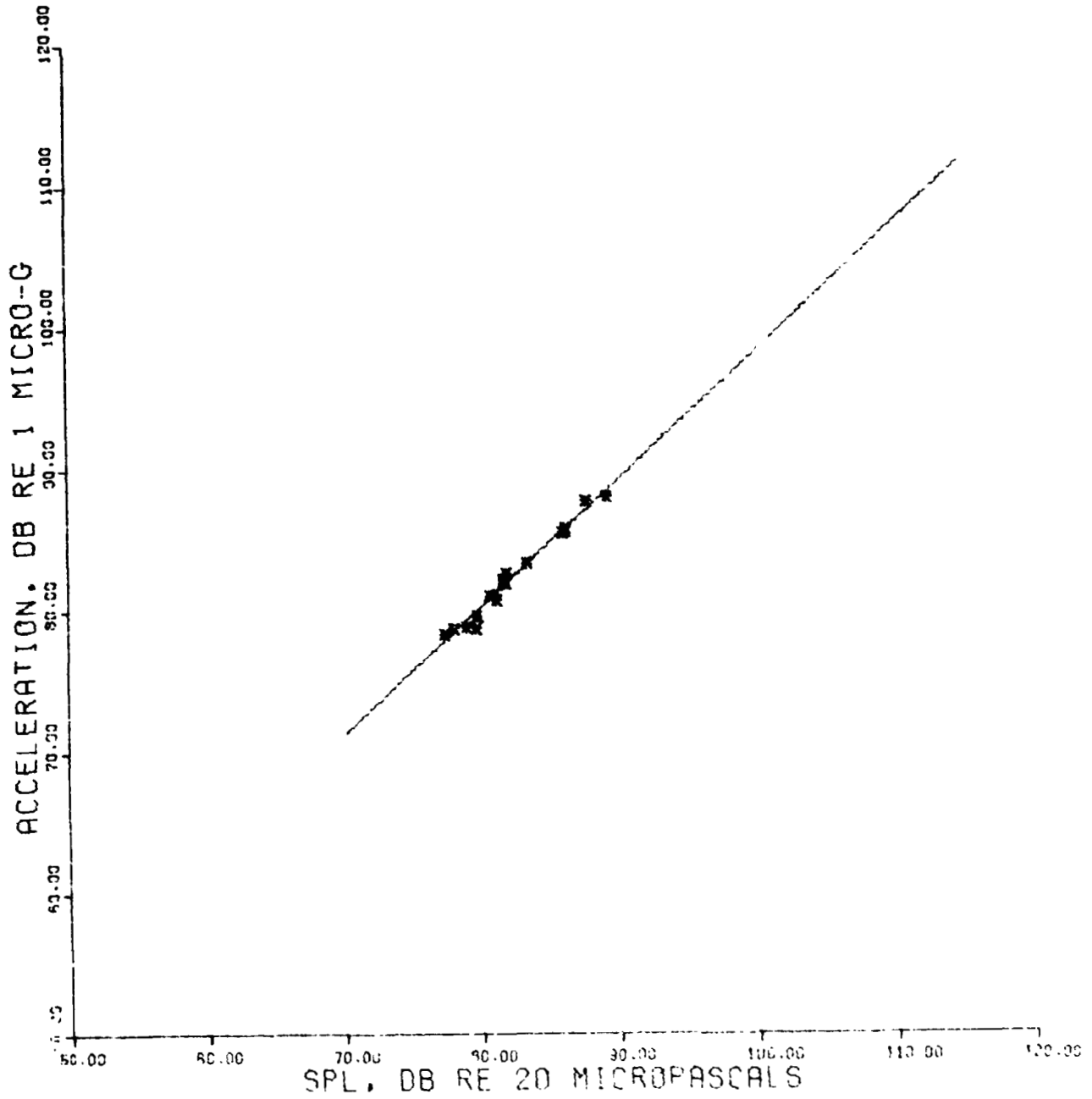


Figure A-5.- Composite window vibration response signature for DC-9 approach at site 2 (1 flyover).



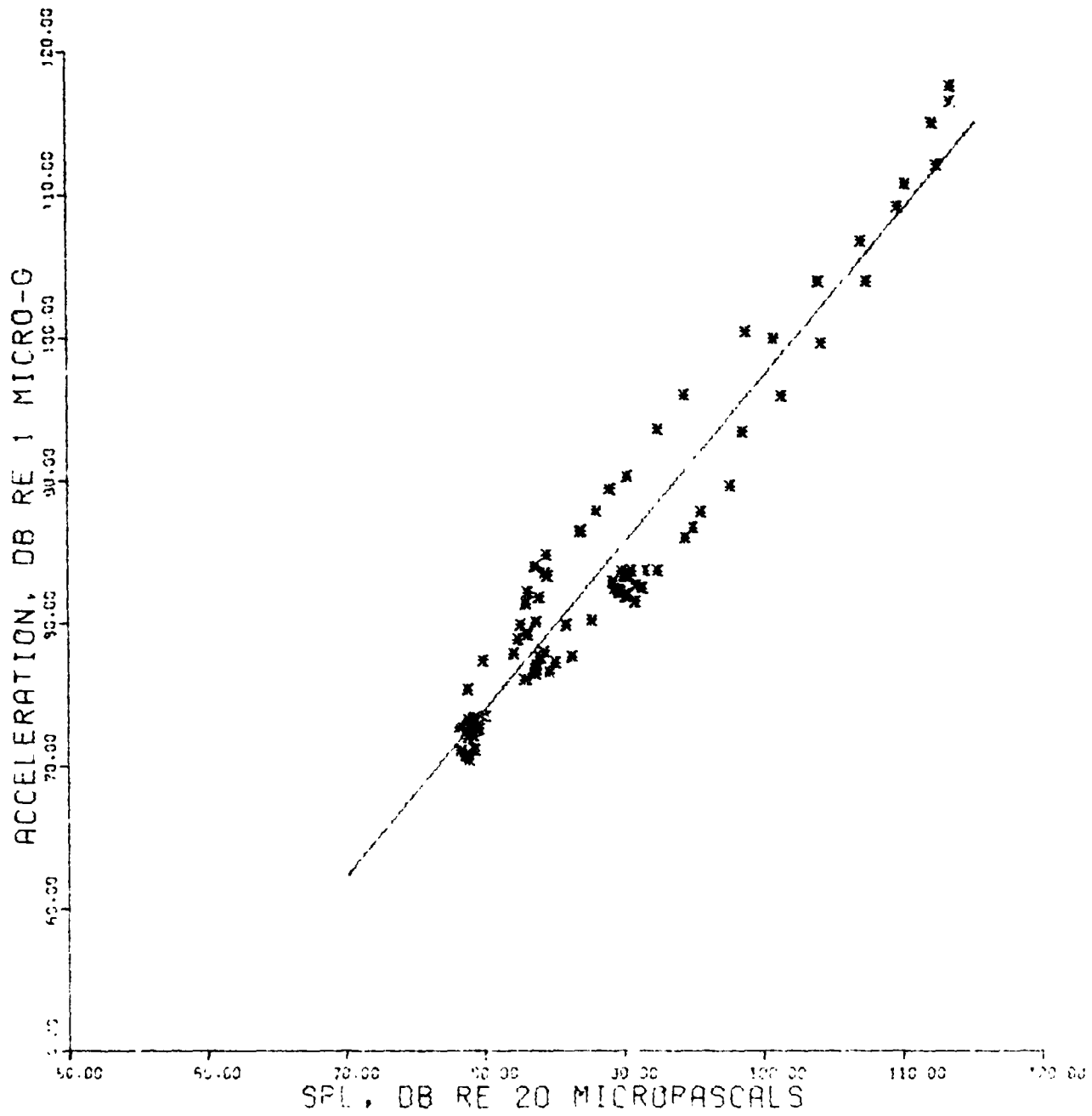


Figure A-6.- Composite window vibration response signature for SST approach at site 4 (1 flyover).

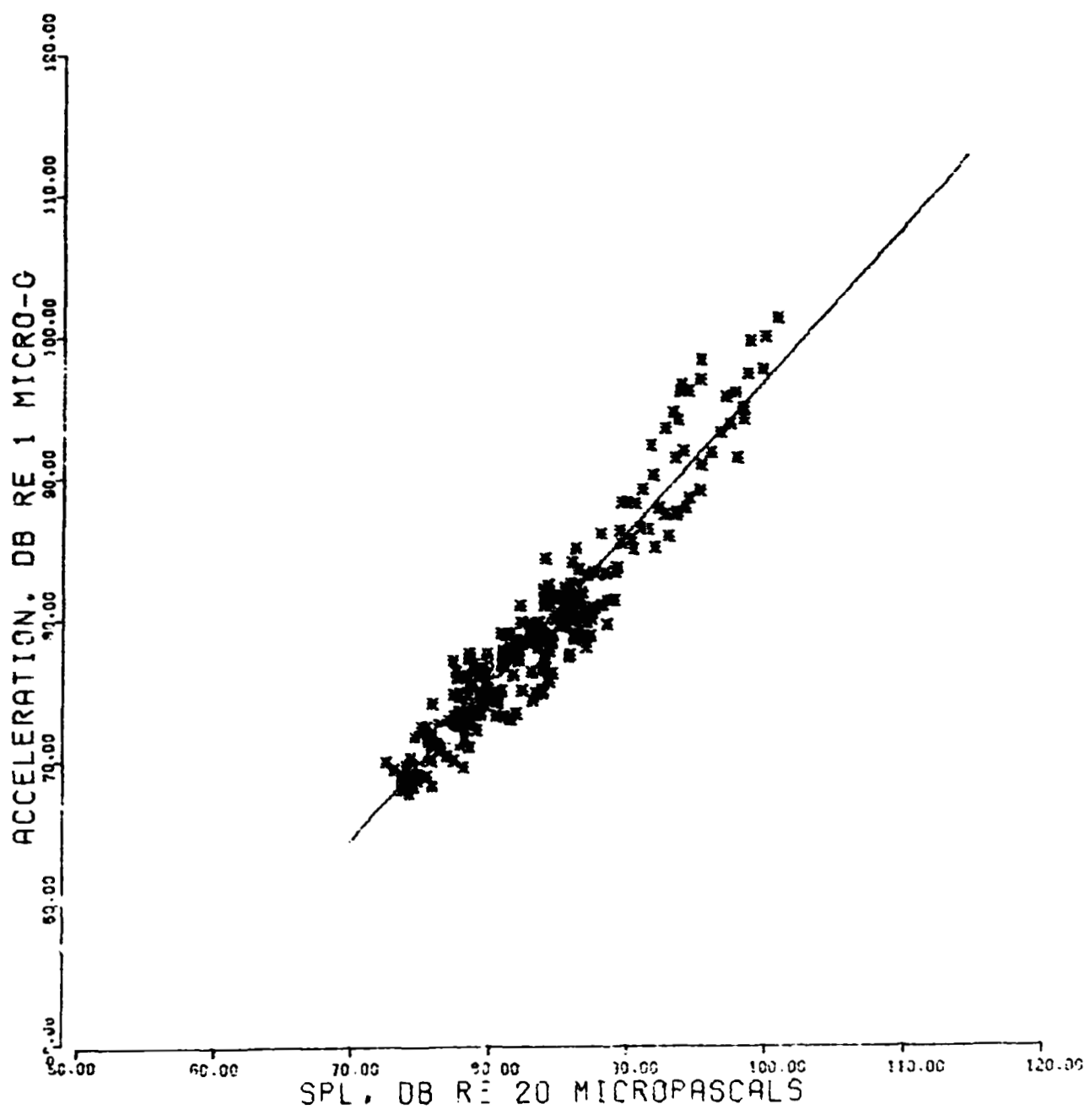


Figure A-7.- Composite window vibration response signature for B747 takeoff at site 4 (4 flyovers).

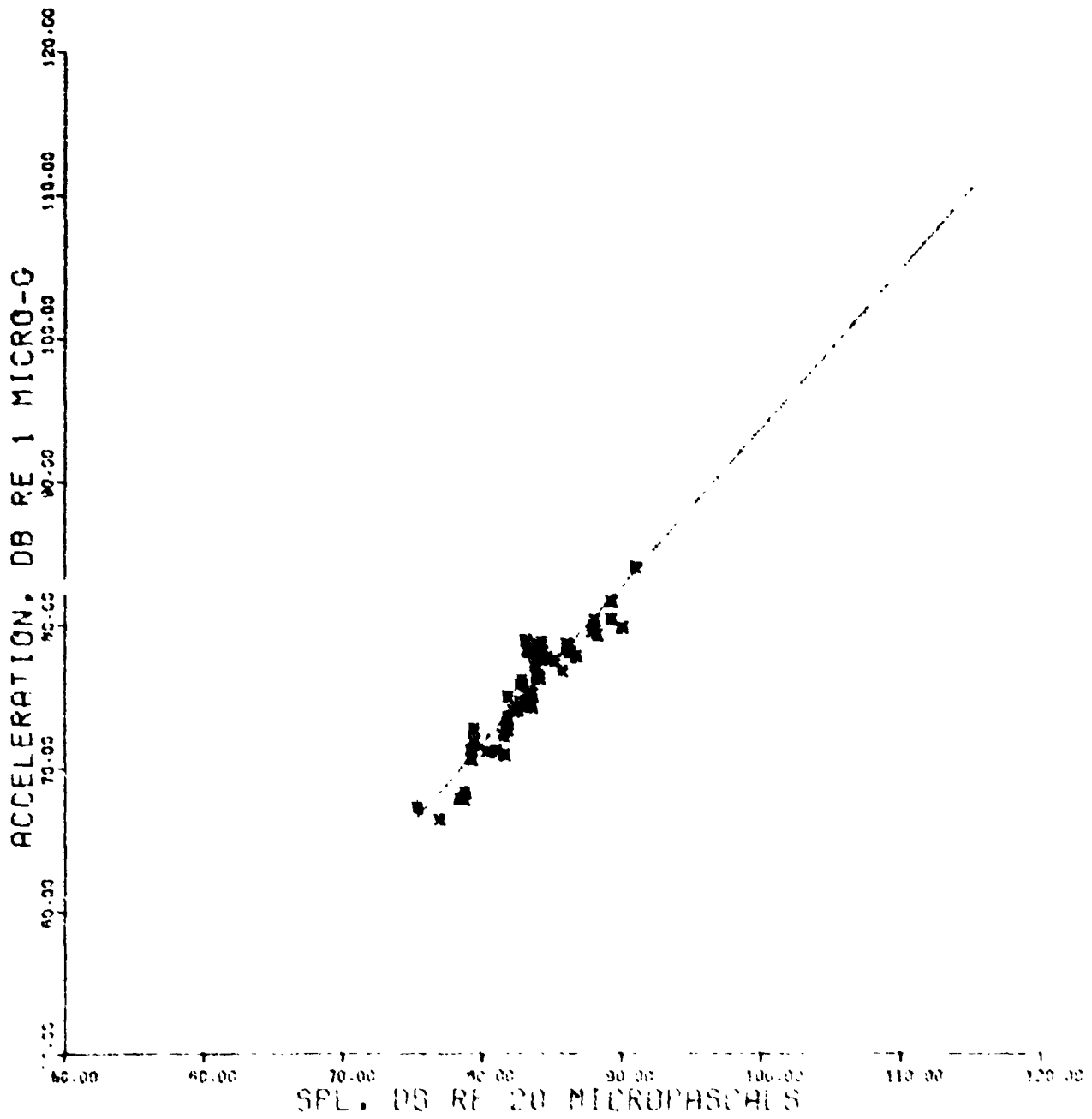


Figure A-8.- Composite window vibration response signature for DC-10 takeoff at site 4 (2 flyovers).

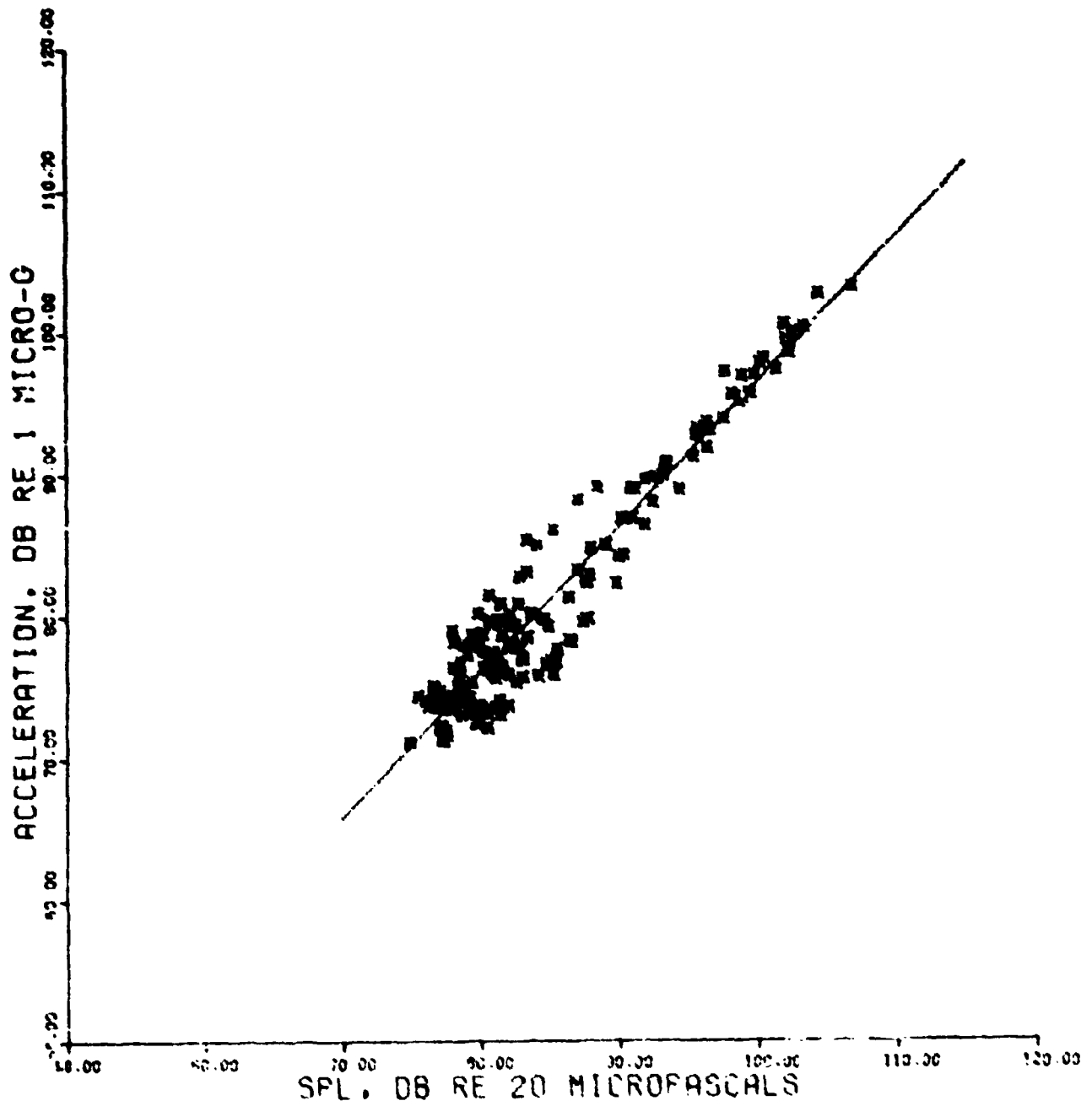


Figure A-9.- Composite window vibration response signature for B707 approach at site 4 (4 flyovers).

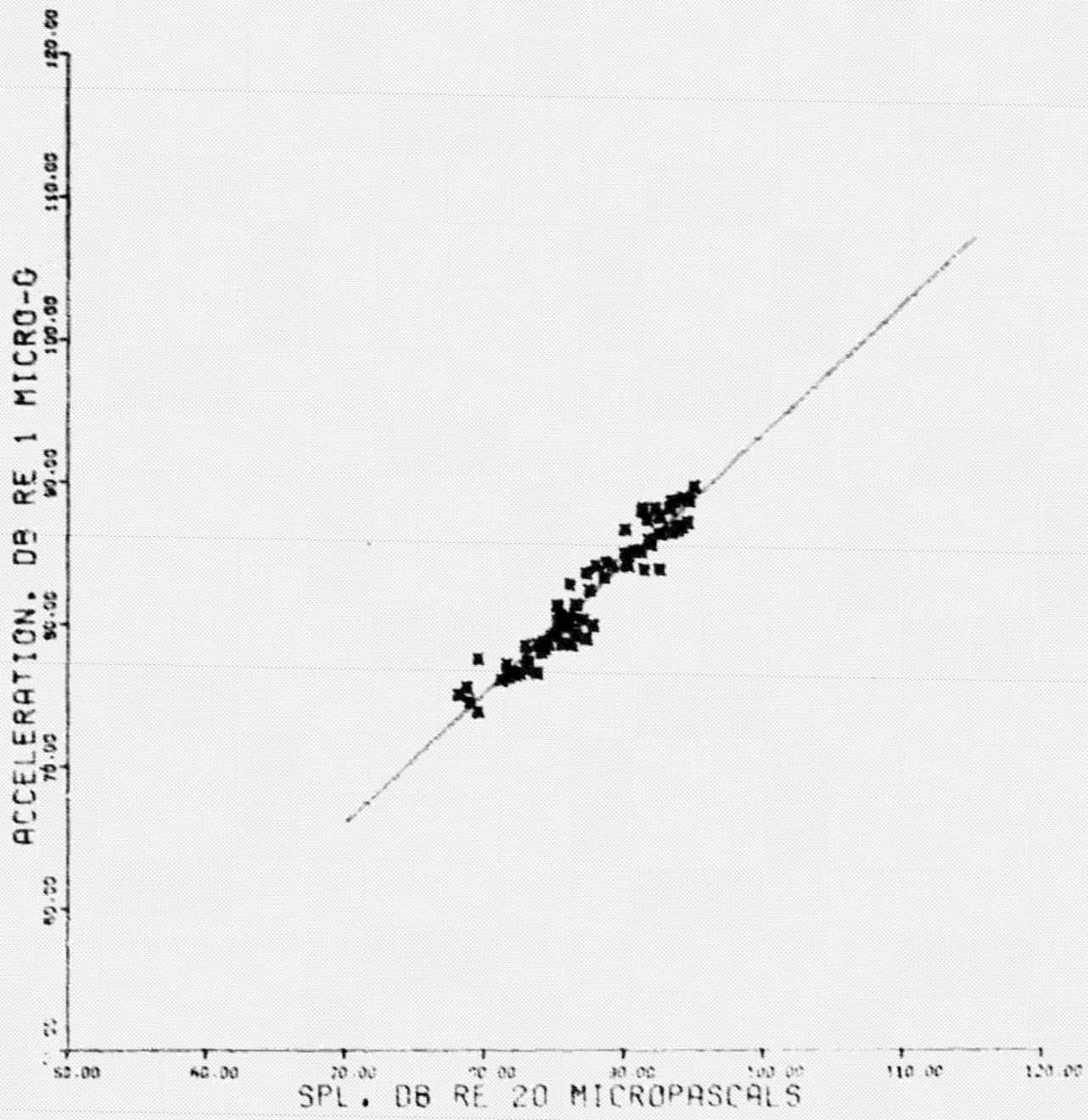


Figure A-10.- Composite window vibration response signature for B727 takeoff at site 4 (1 flyover).

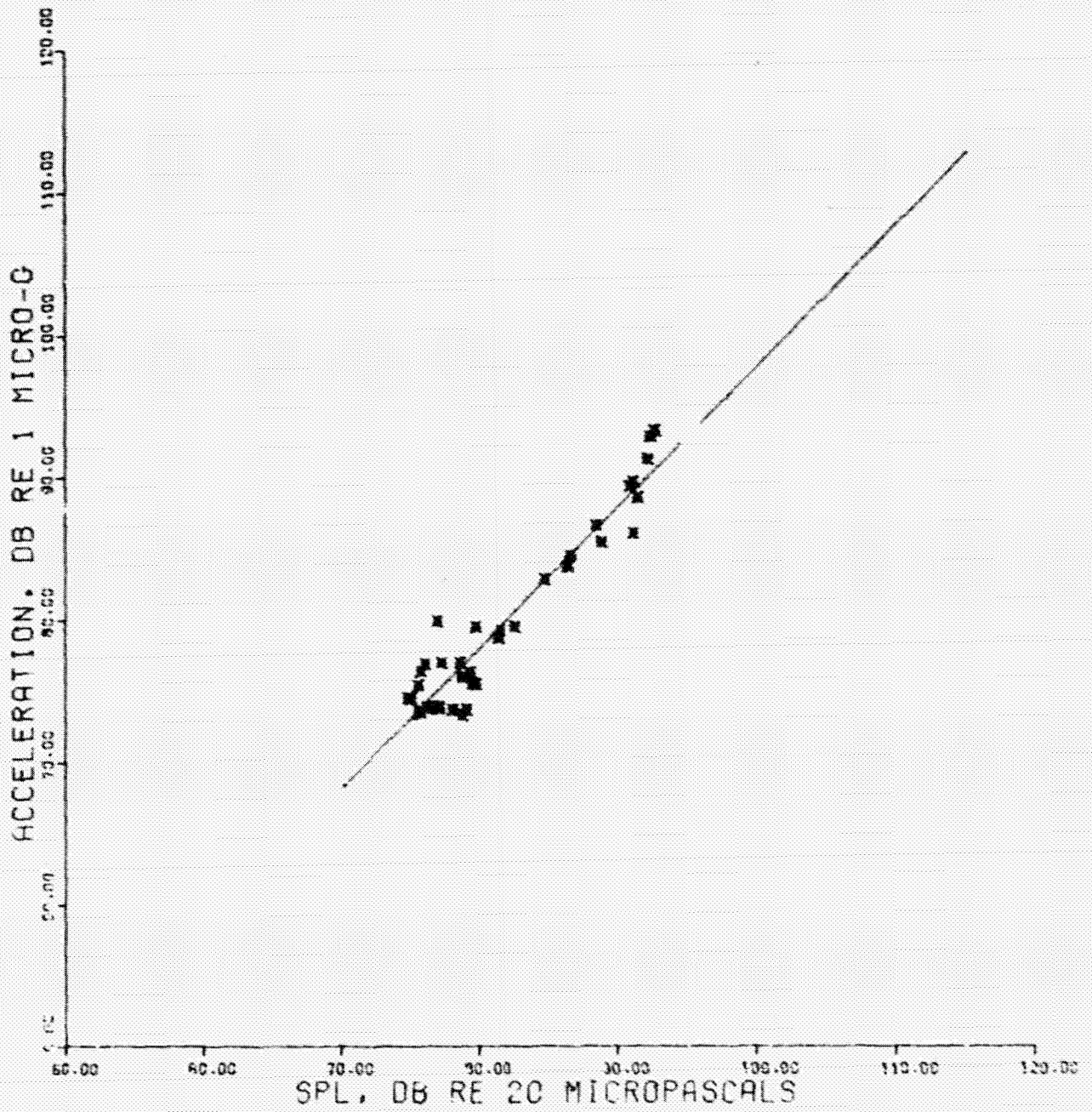


Figure A-11.- Composite window vibration response signature for DC-9 approach at site 4 (1 flyover).

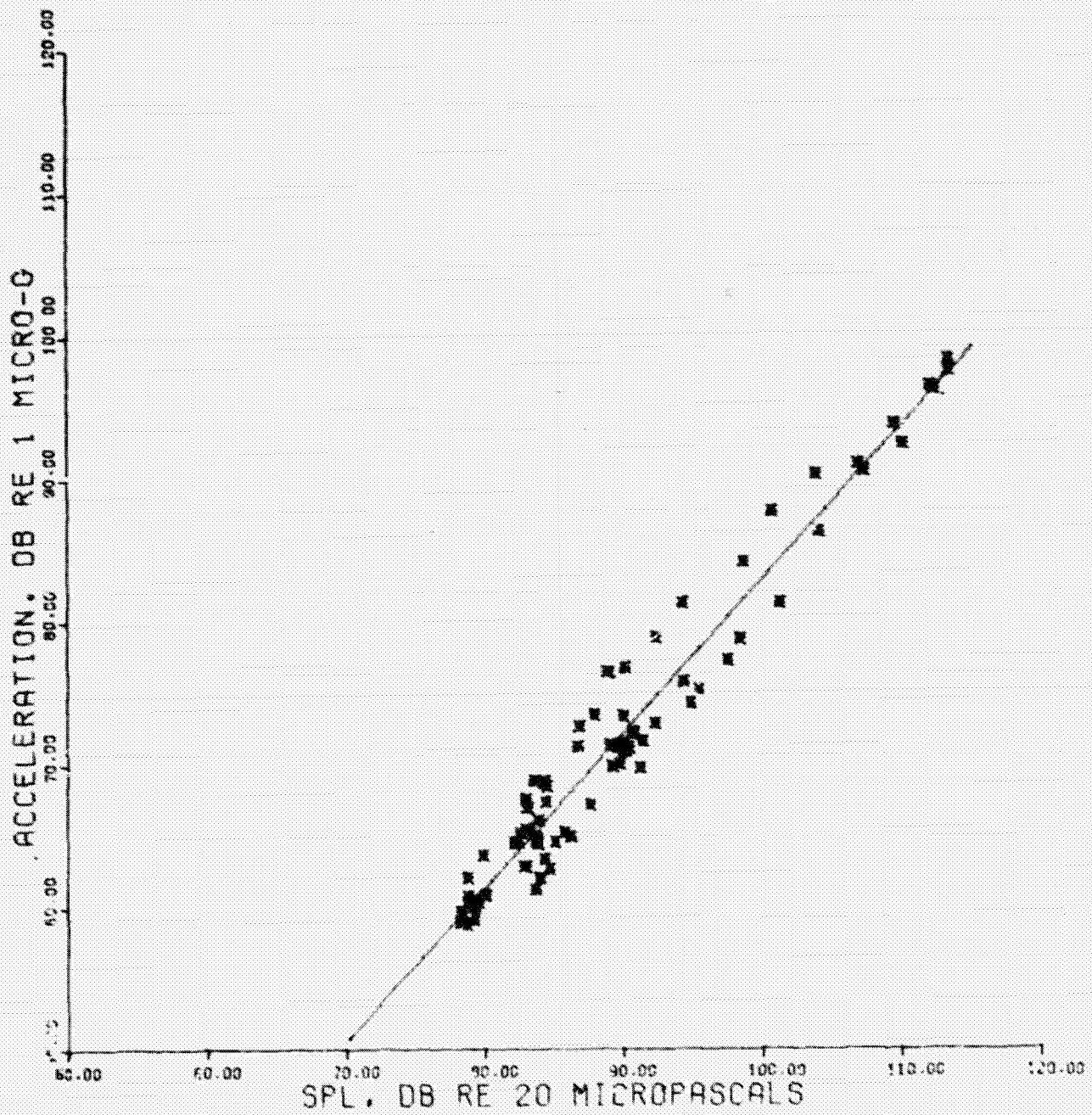


Figure A-12.- Composite wall vibration response signature for SST approach at site 4 (1 flyover).

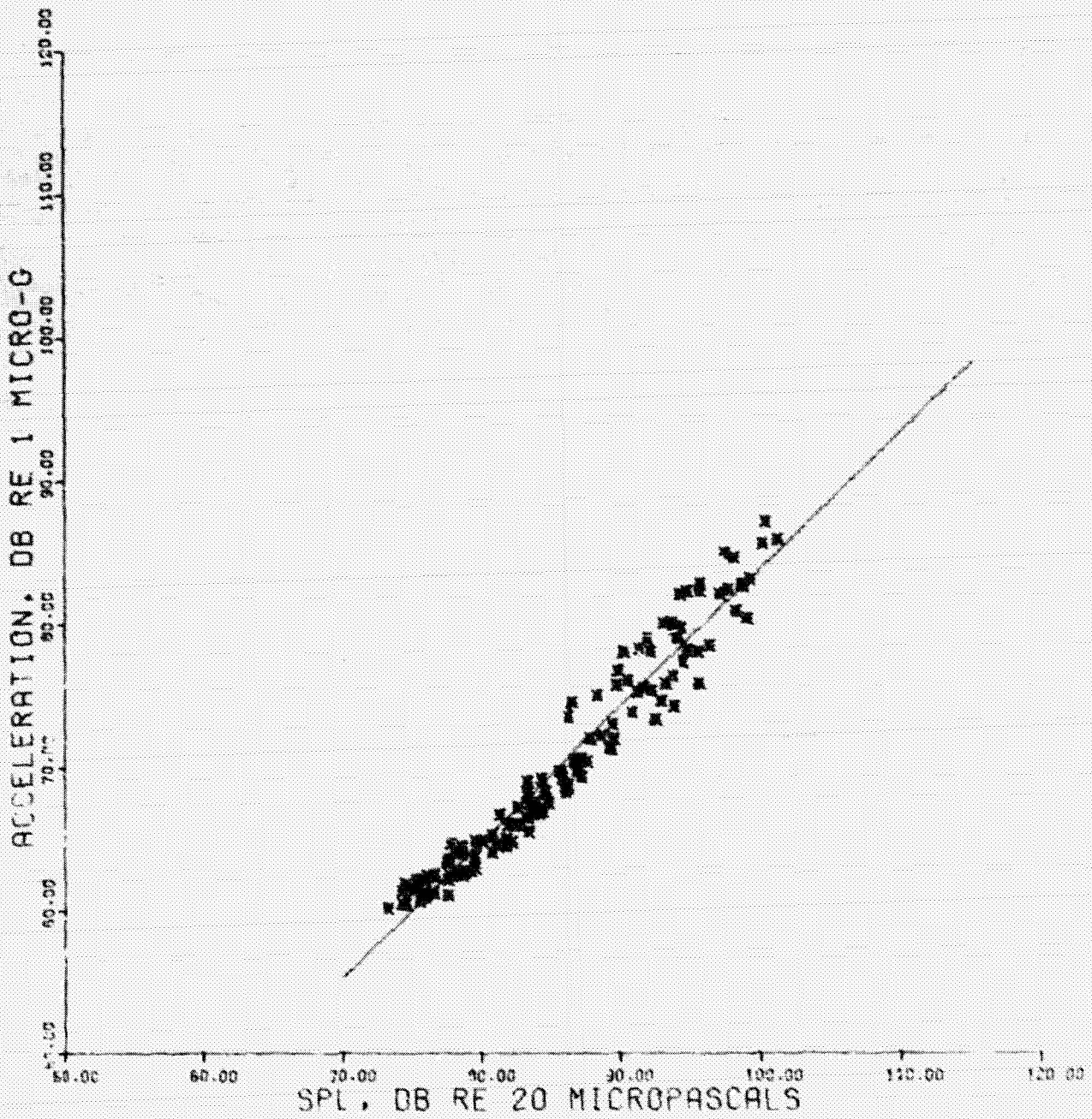


Figure A-13.- Composite wall vibration response signature for B747 takeoff at site 4 (2 flyovers).



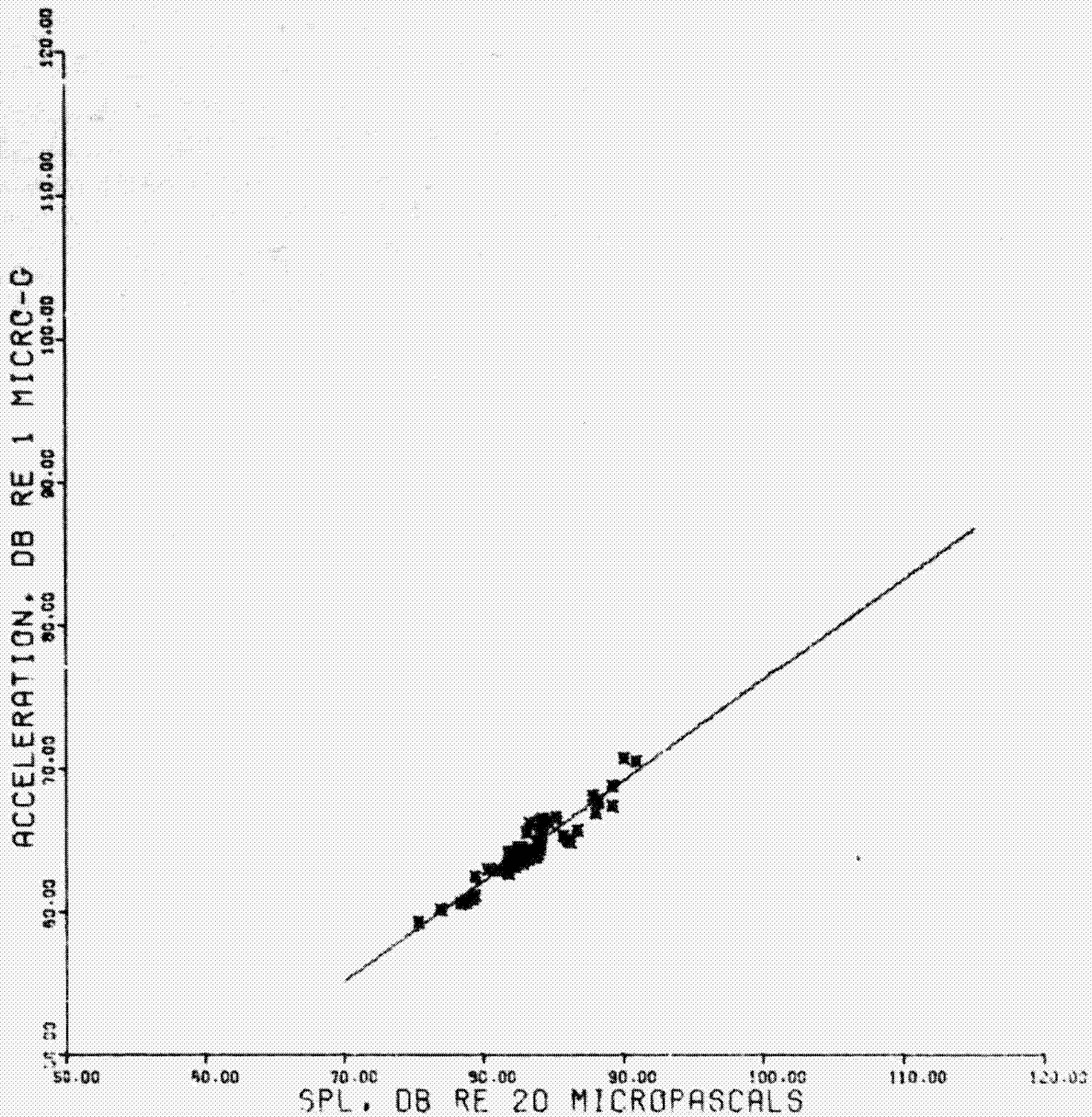


Figure A-14.- Composite wall vibration response signature for DC-10 takeoff at side 4 (2 flyovers).

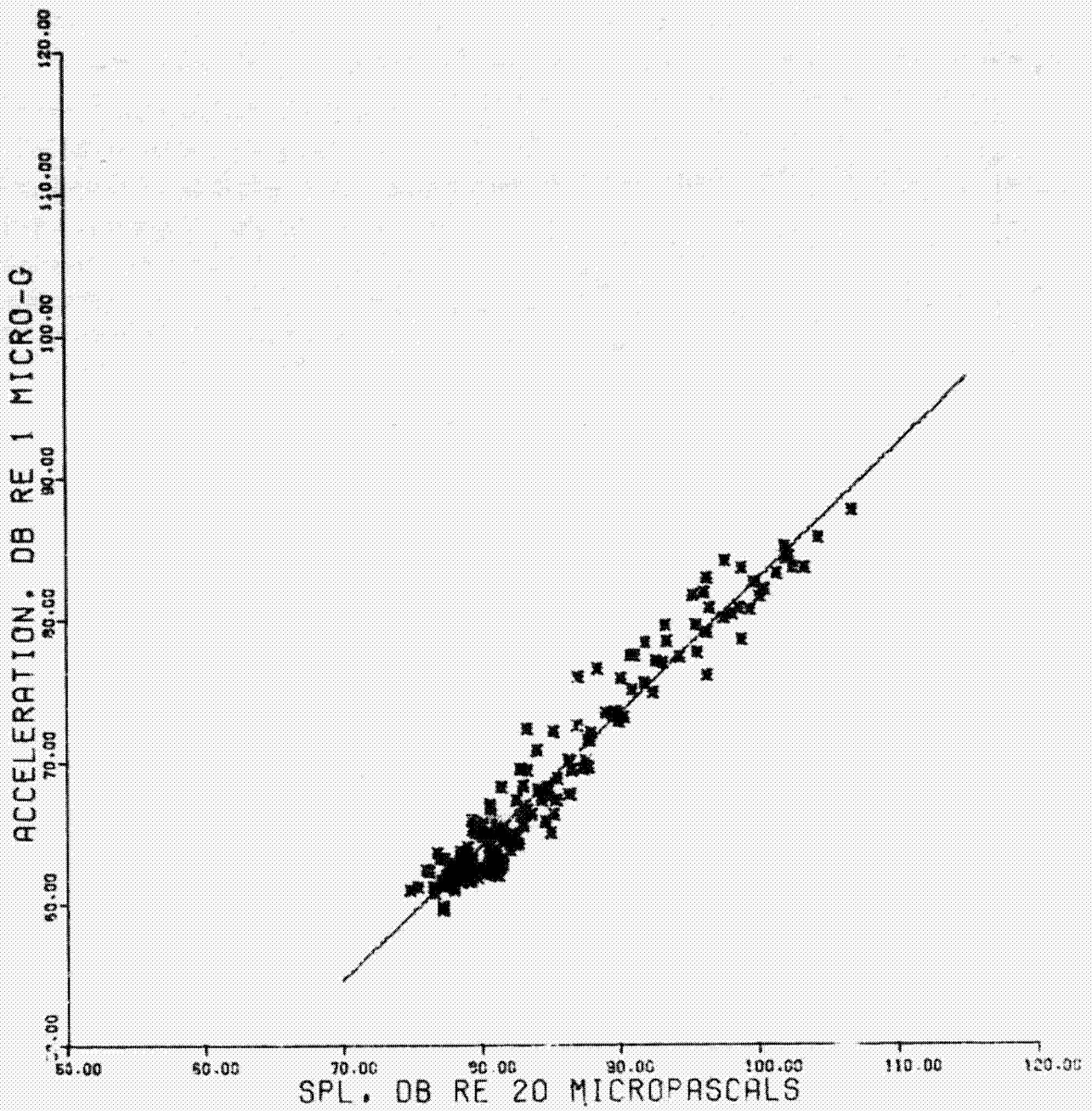


Figure A-15.- Composite wall vibration response signature for B707 approach at site 4 (4 flyovers).

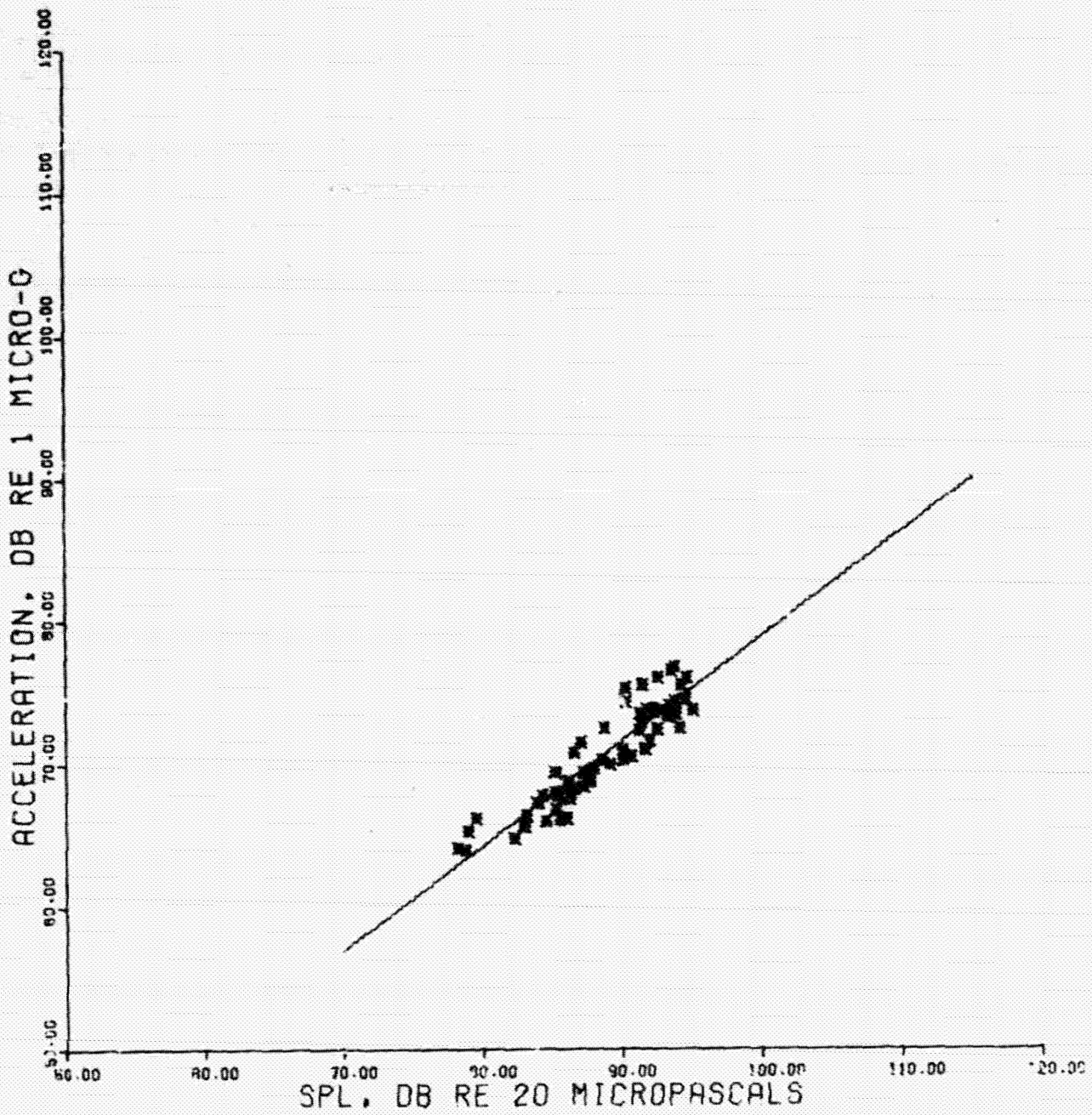


Figure A-16.- Composite wall vibration response signature for B727 takeoff at site 4 (1 flyover).

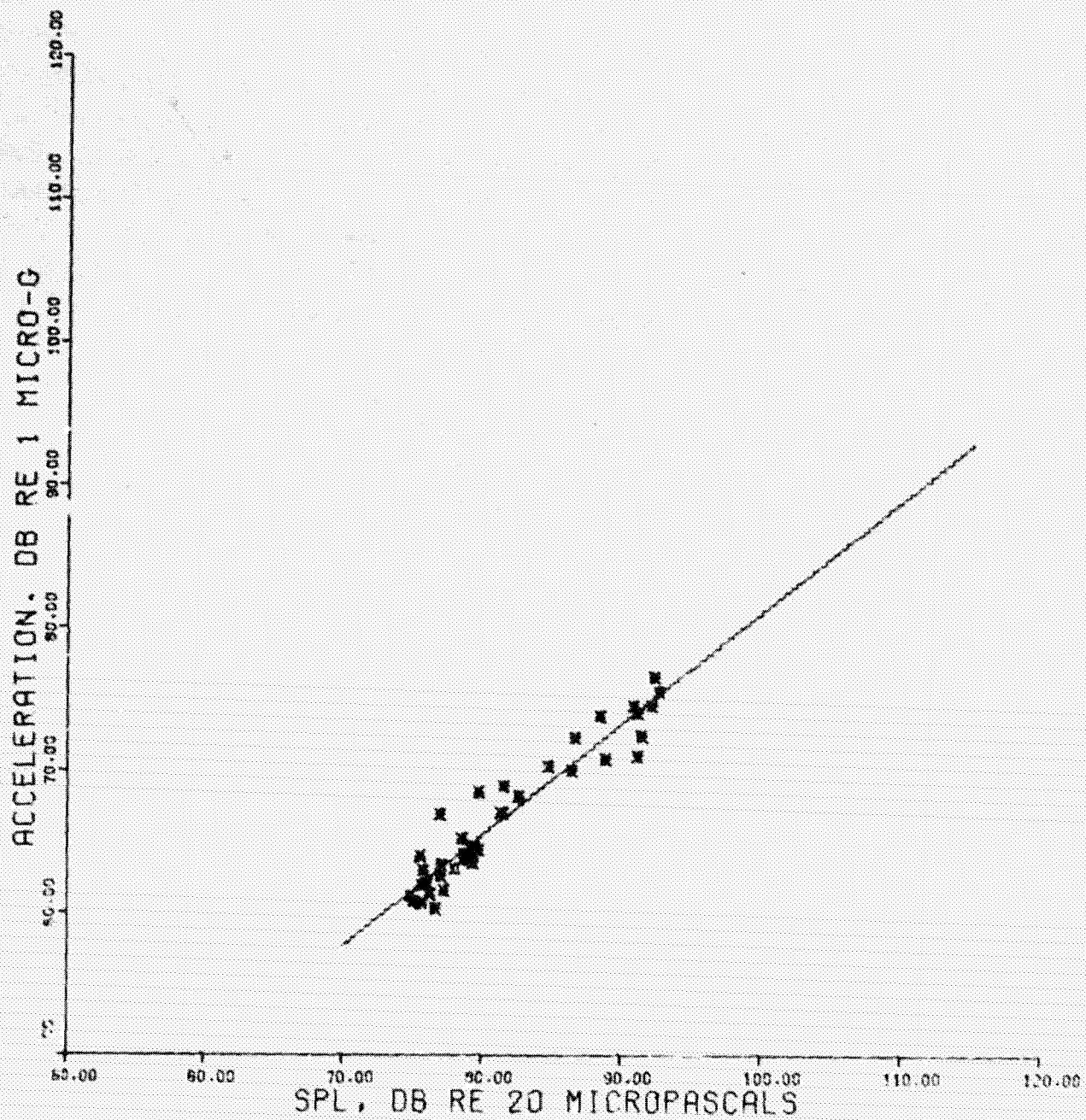


Figure A-17.- Composite wall vibration response signature for DC-9 approach at site 4 (1 flyover).

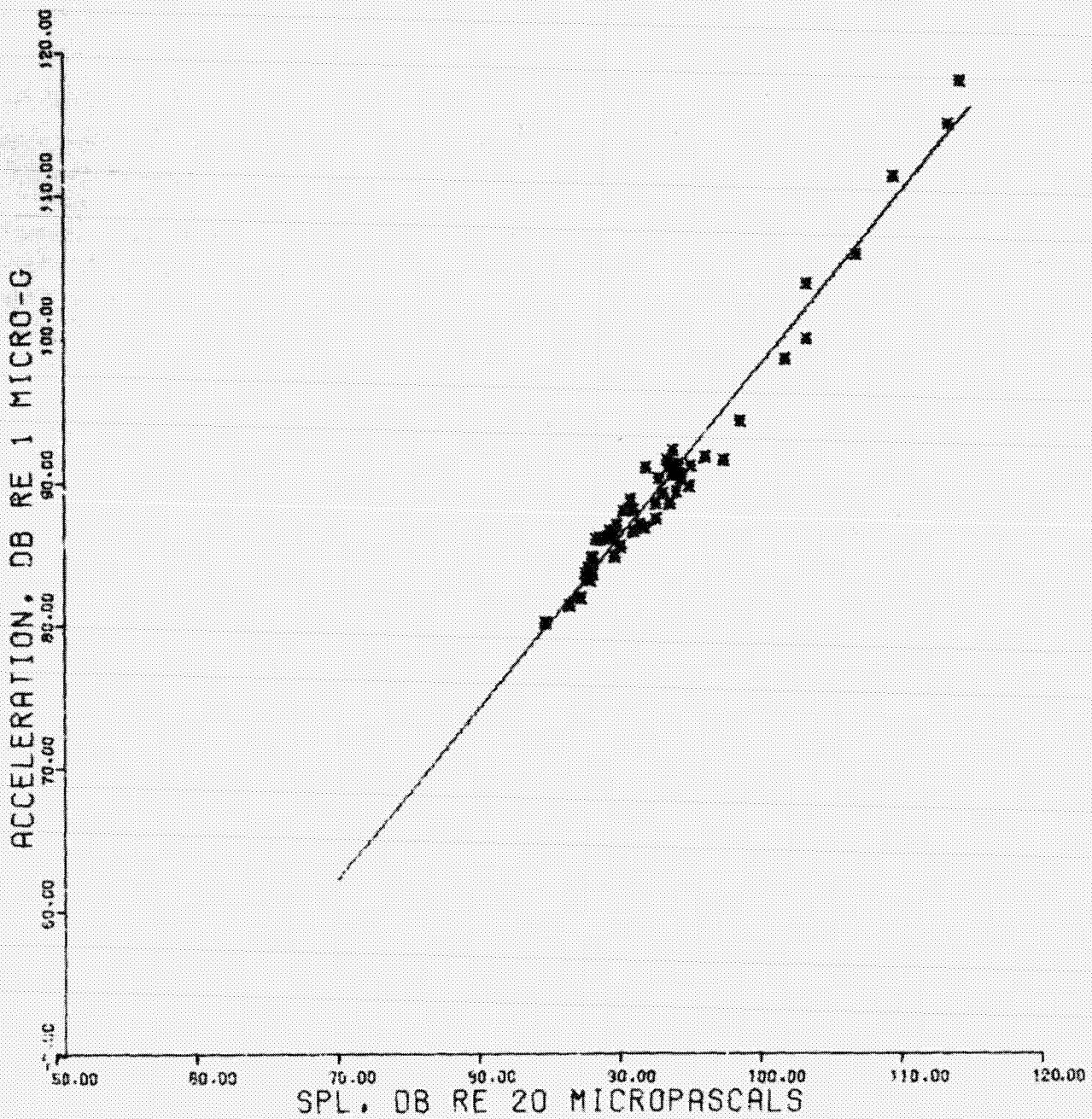


Figure A-18.- Composite window vibration response signature for SST approach at site 11 (1 flyover).

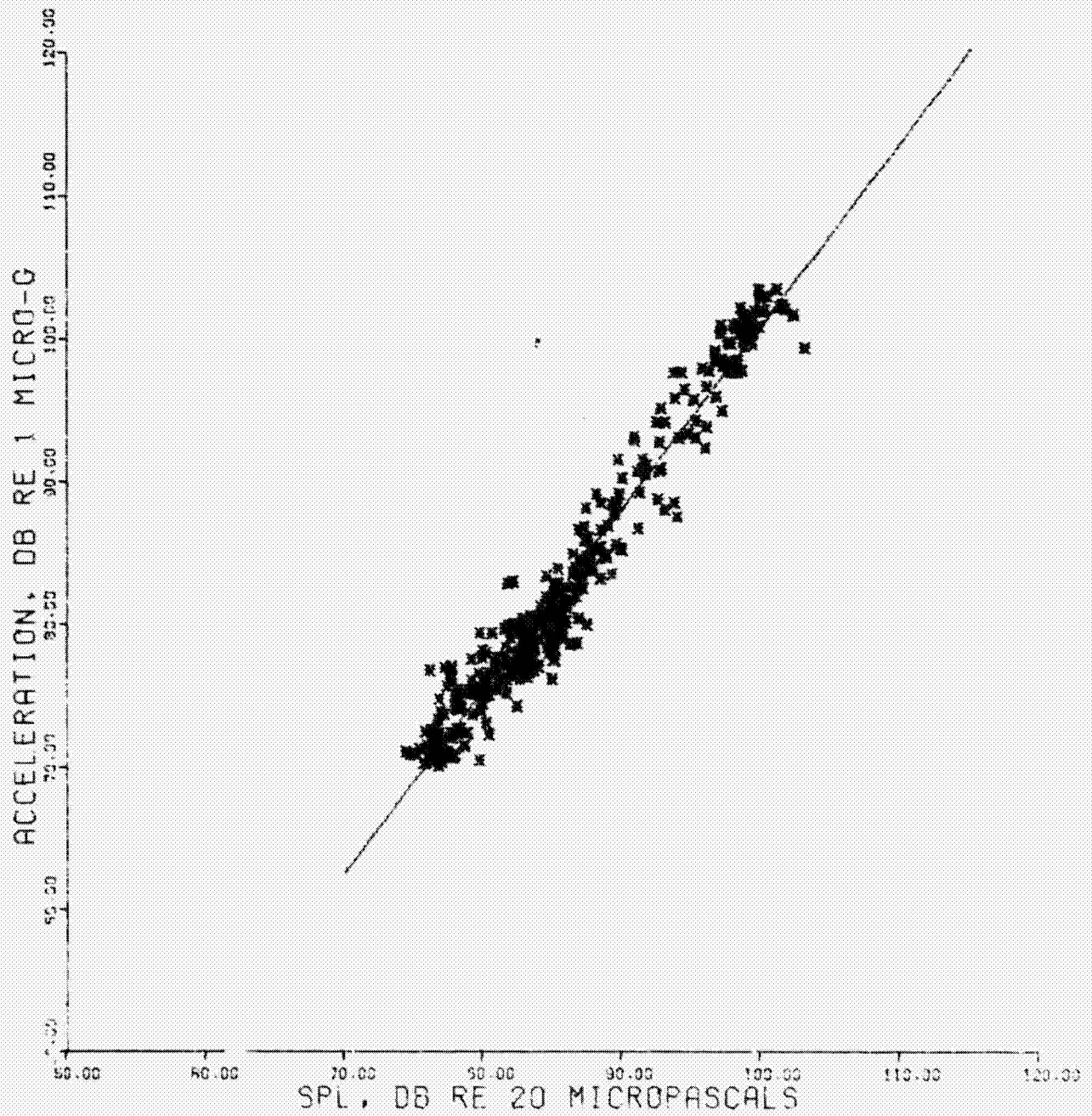


Figure A-19.- Composite window vibration response signature for B-747 approach at site 11 (9 flyovers).

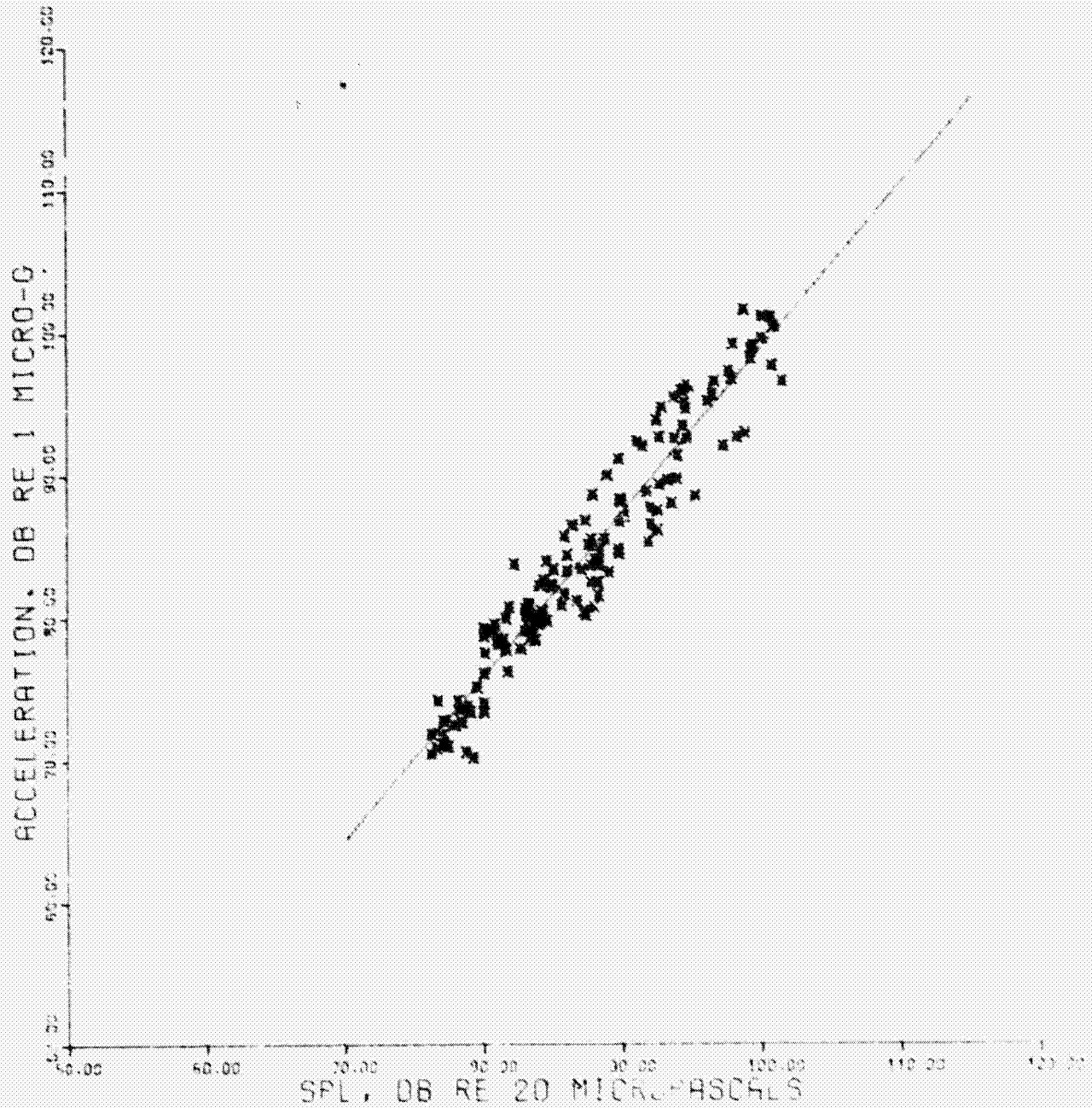


Figure A-20.- Composite window vibration response signature for DC-10 approach at site 11 (4 flyovers).

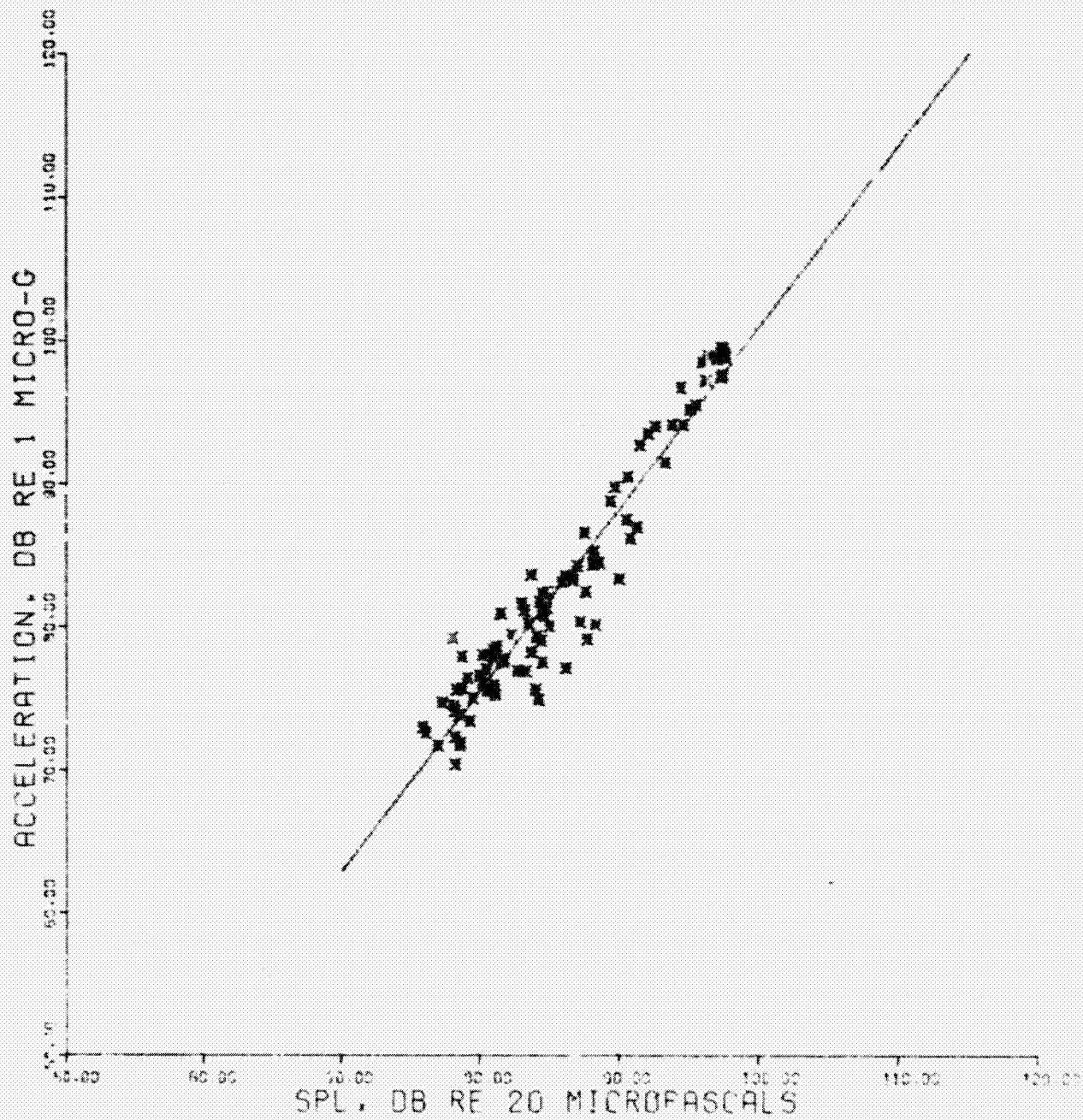


Figure A-21.- Composite window vibration response signature for L1011 approach at site 11 (3 flyovers).



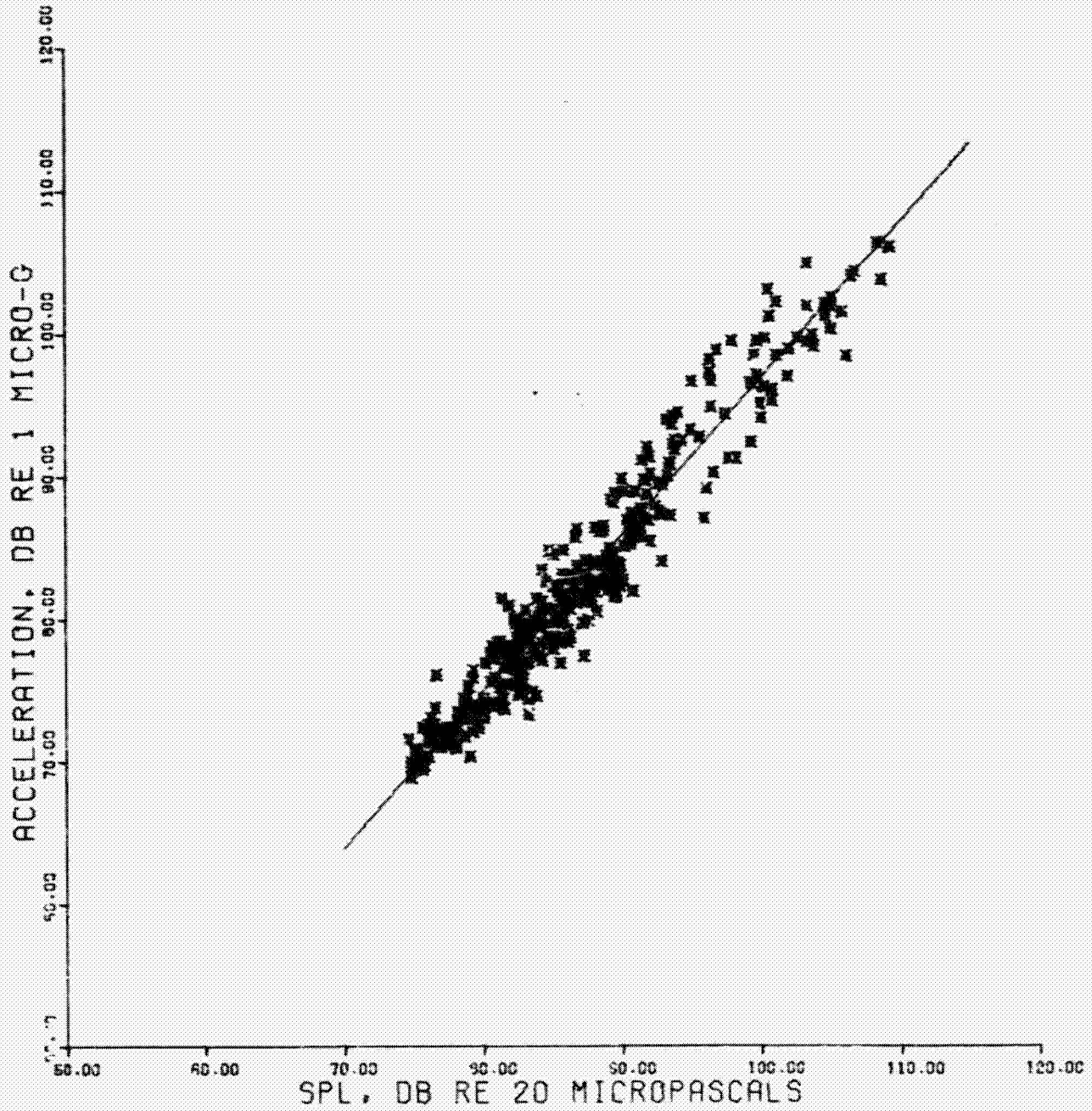


Figure A-22.- Composite window vibration response signature for B707 approach at site 11 (11 flyovers).

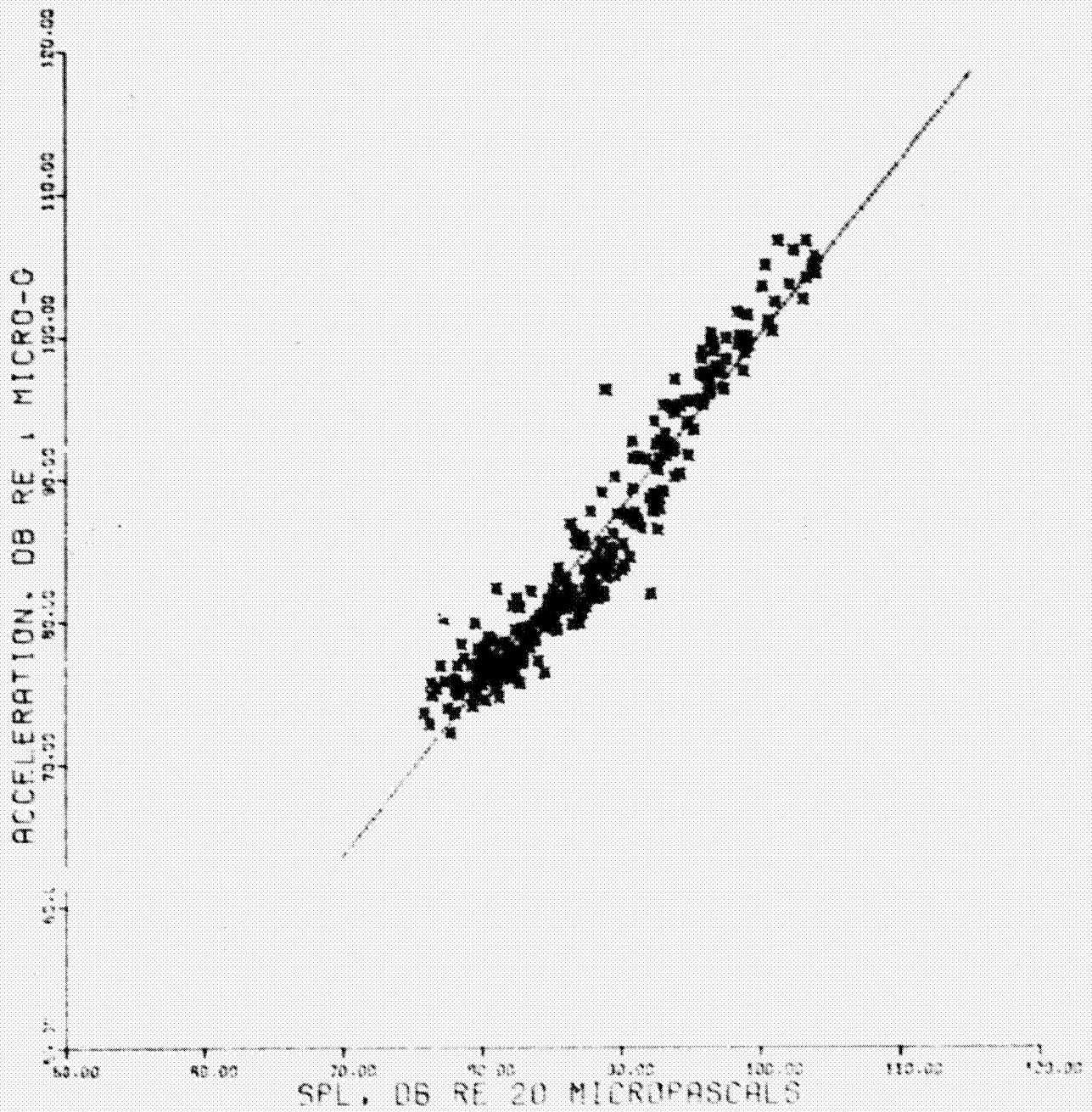


Figure A-23.- Composite window vibration response signature for B727 approach at site 11 (9 flyovers).

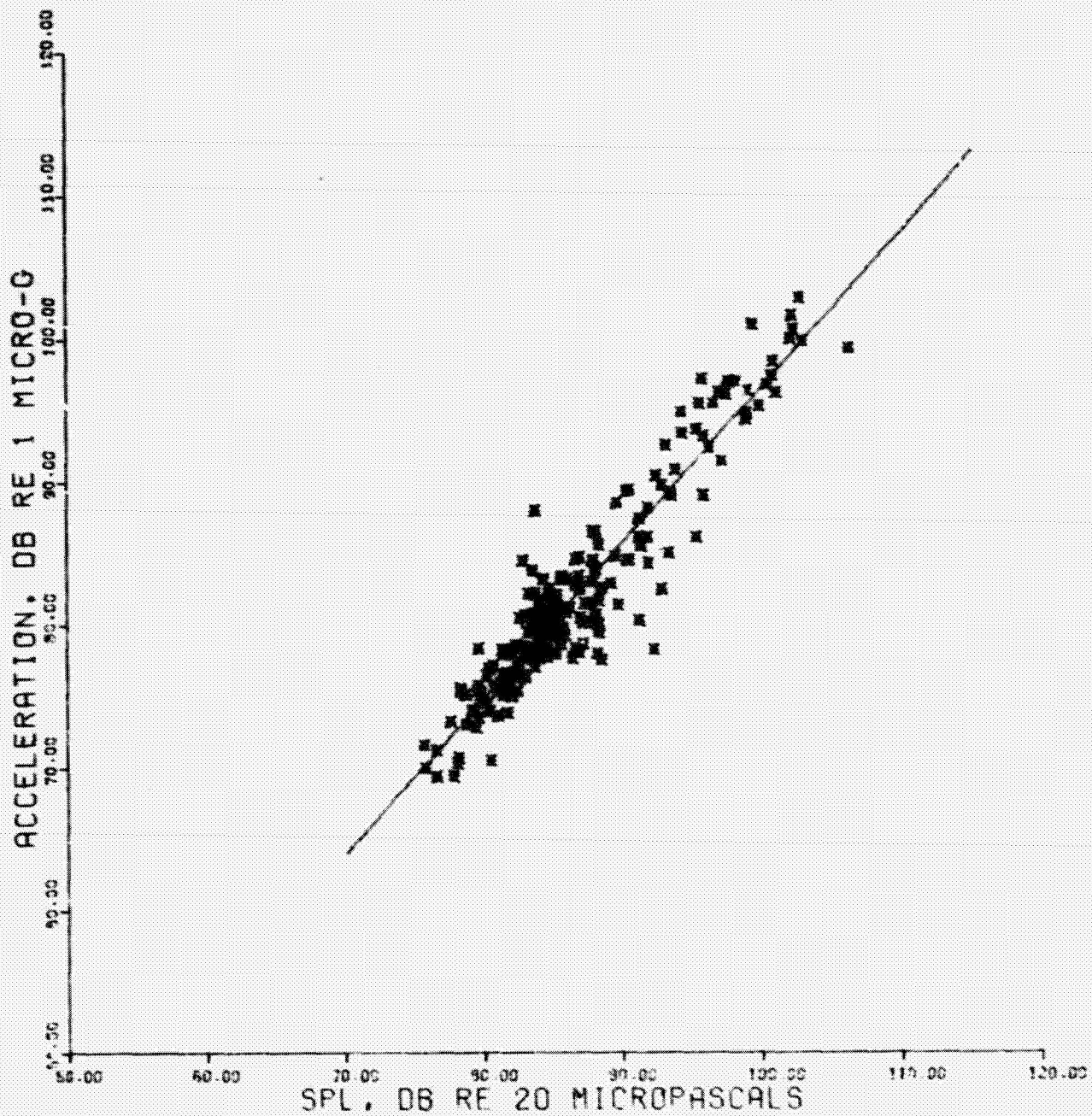


Figure A-24.- Composite window vibration response signature for DC-8 approach at site 11 (6 flyovers).

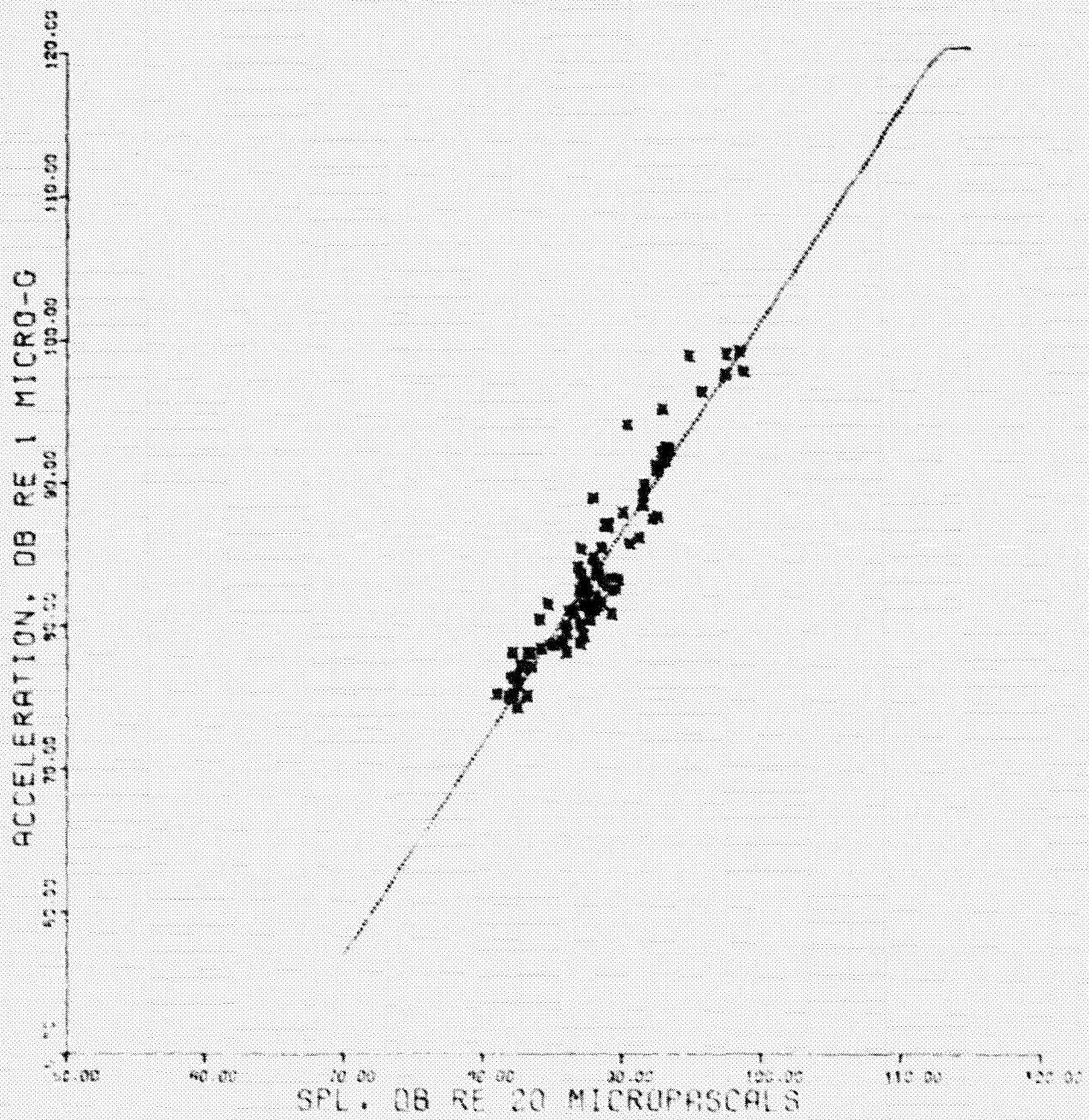


Figure A-25.- Composite window vibration response signature for DC-9 approach at site 11 (3 flyovers).

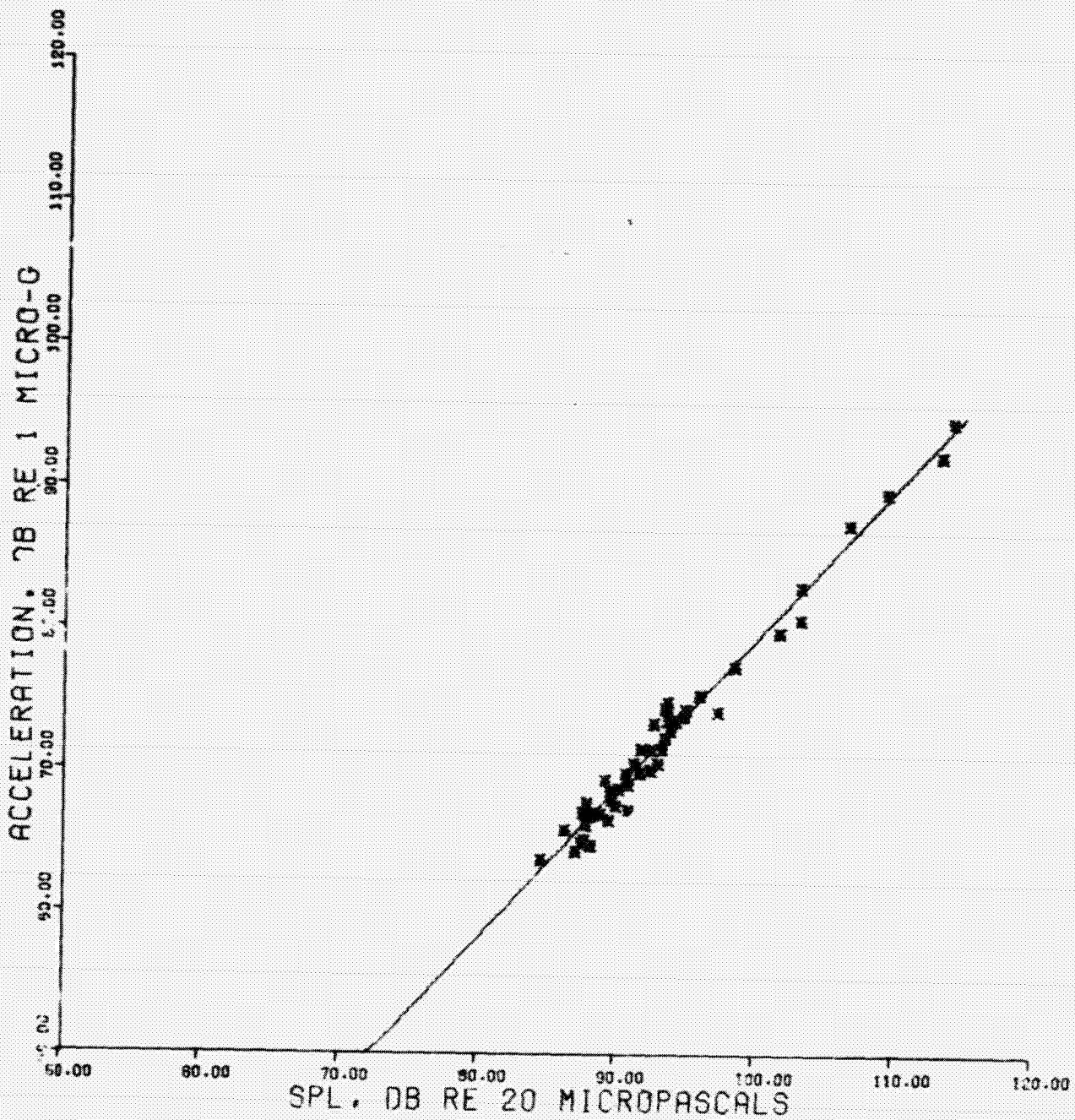


Figure A-26.- Composite wall vibration response signature for SST approach at site II (1 flyover).

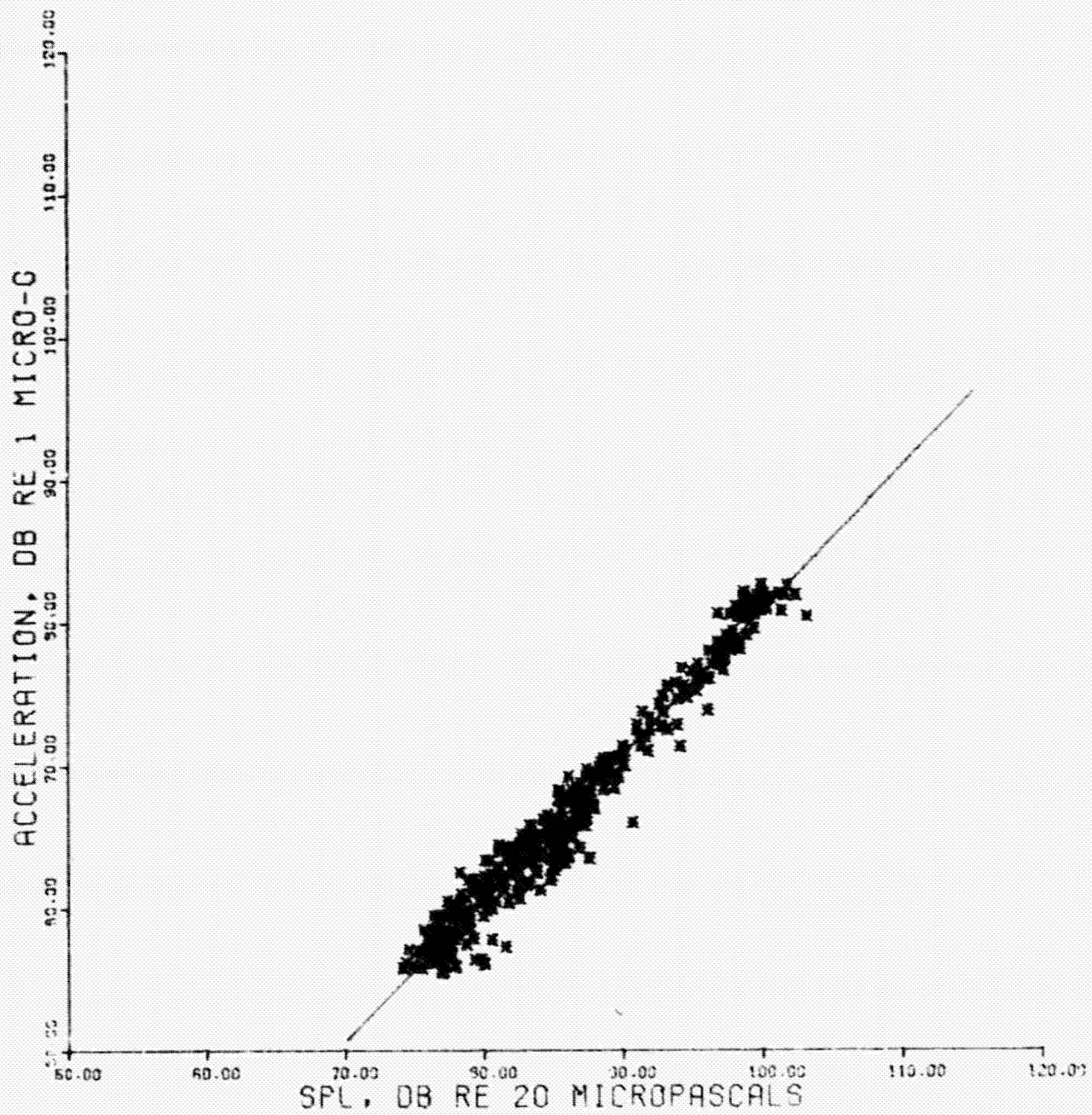


Figure A-27.- Composite wall vibration response signature for B747 approach at site 11 (9 flyovers).

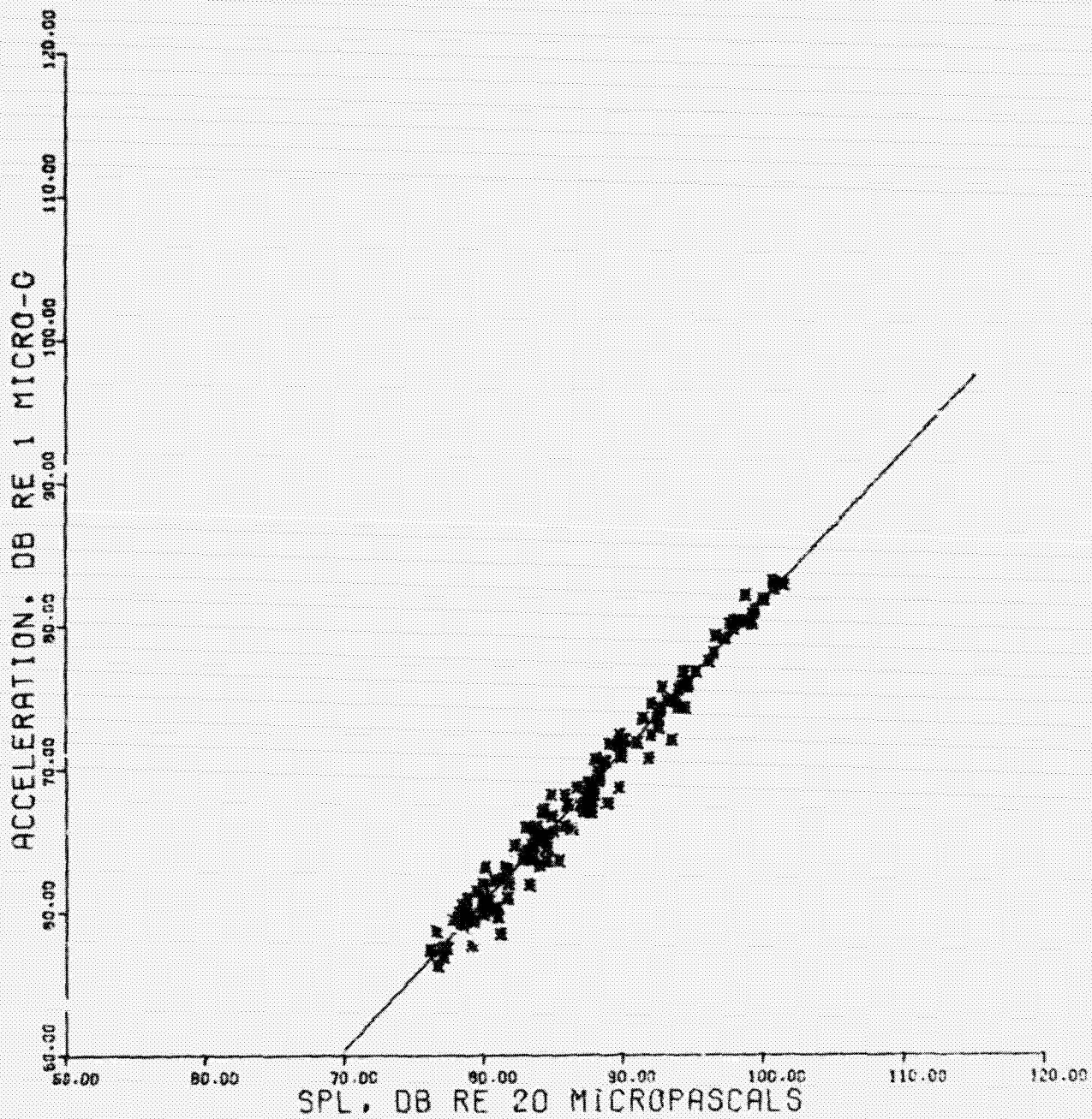


Figure A-28.- Composite wall vibration response signature for DC-10 approach at site 11 (4 flyovers).

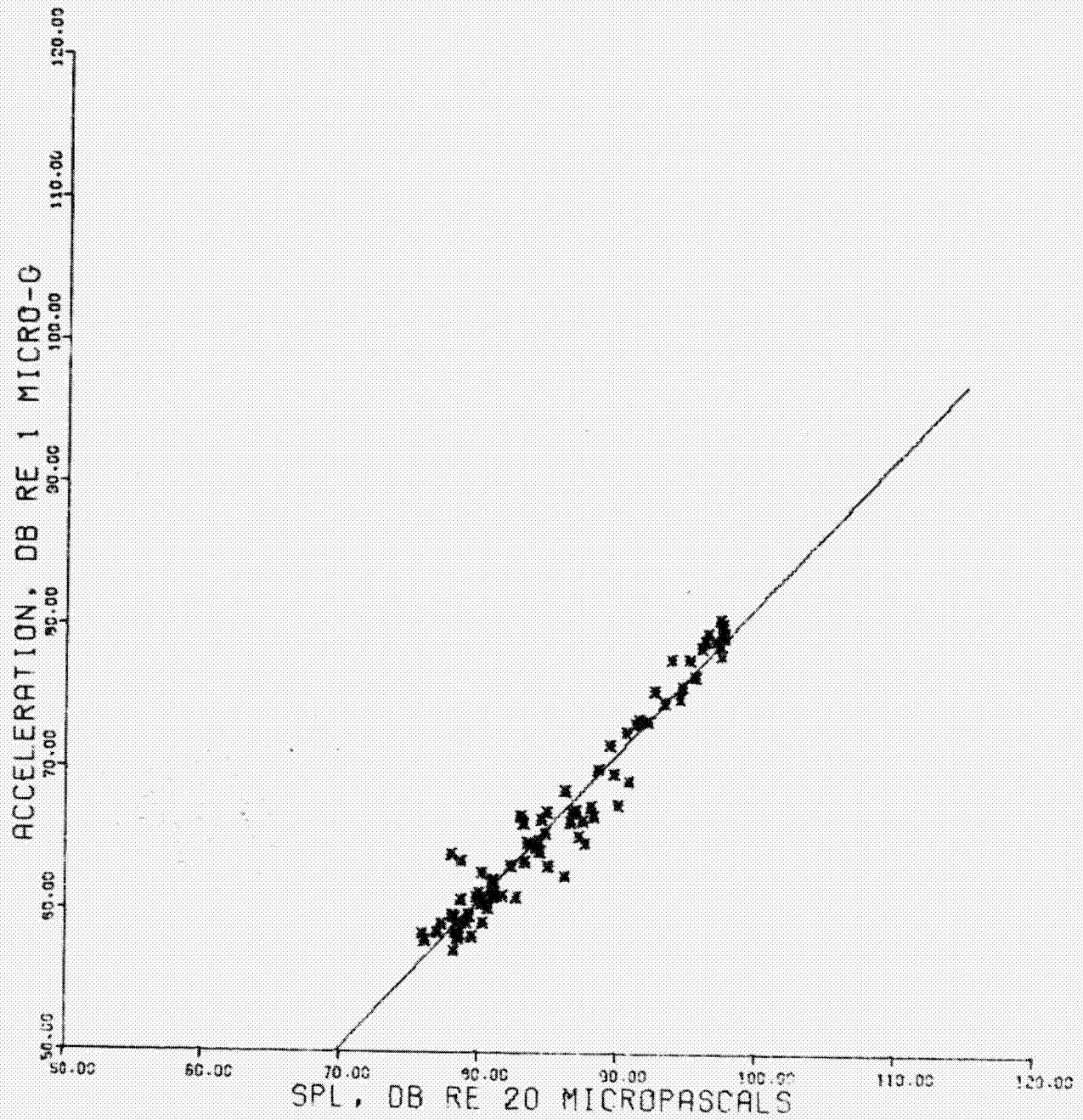


Figure A-29.- Composite wall vibration response signature for L1011 approach at site 11 (3 flyovers).



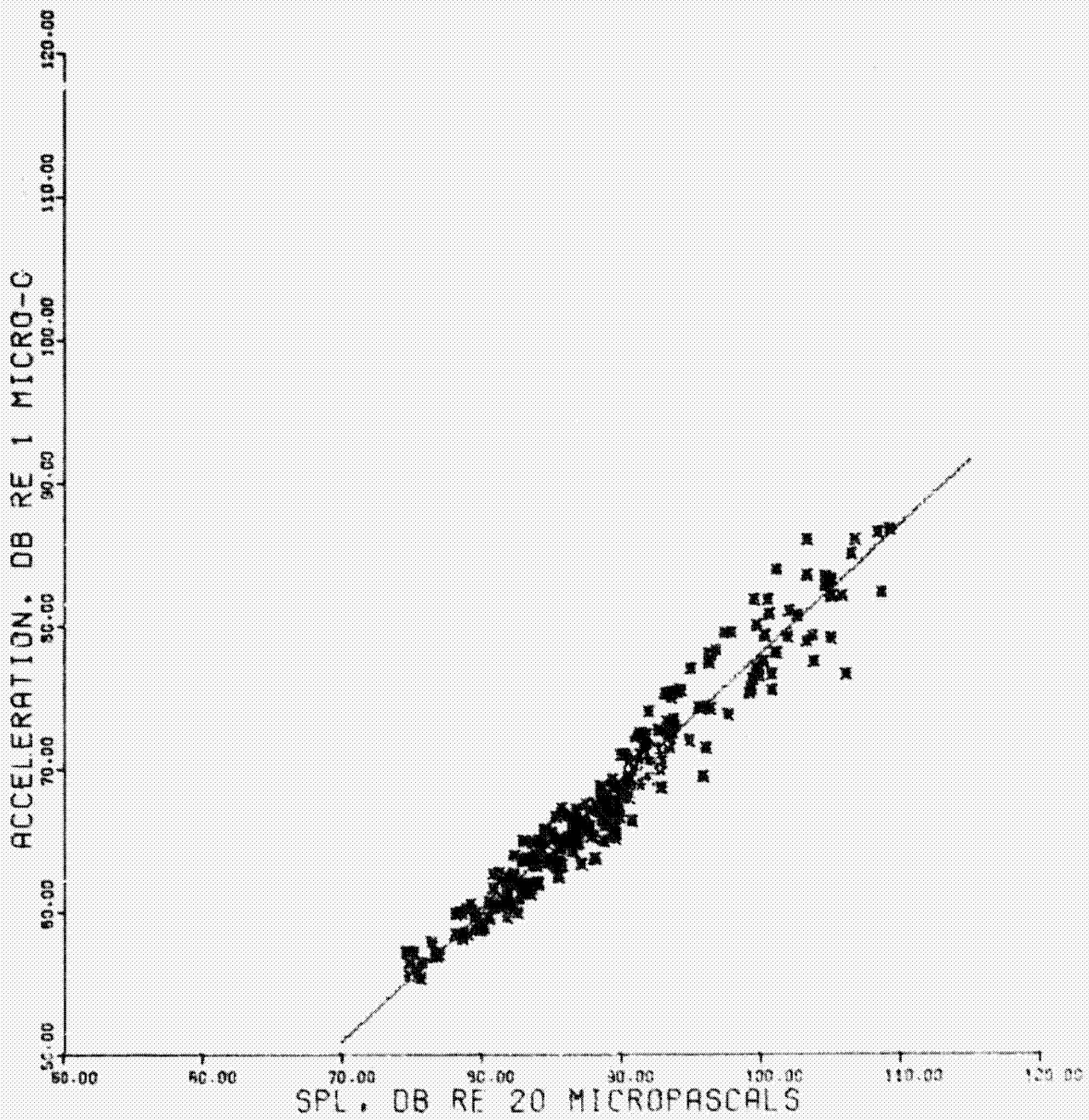


Figure A-30.- Composite wall vibration response signature for B707 approach at site 11 (11 flyovers).

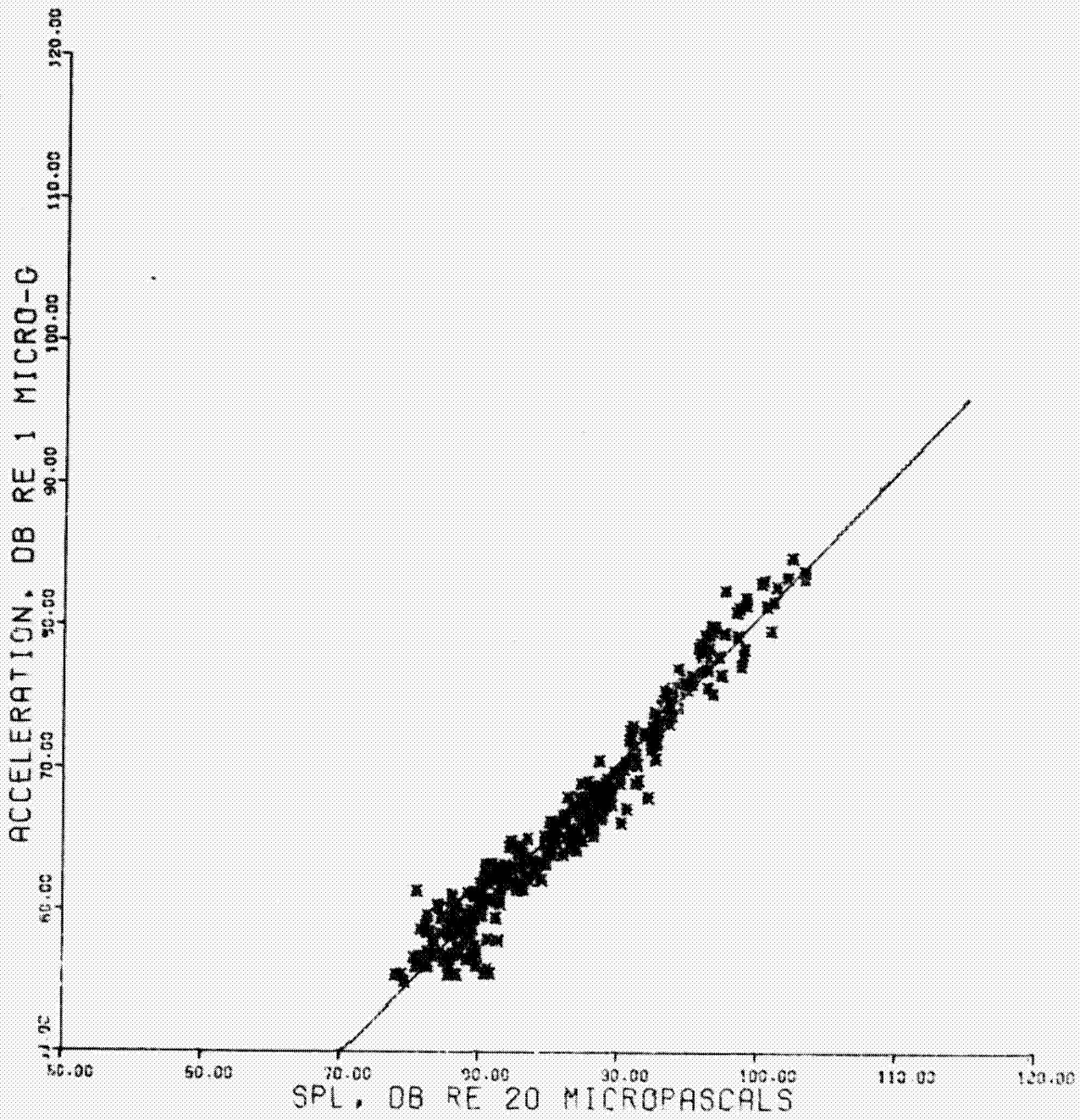


Figure A-31.- Composite wall vibration response signature for B727 approach at site 11 (9 flyovers).

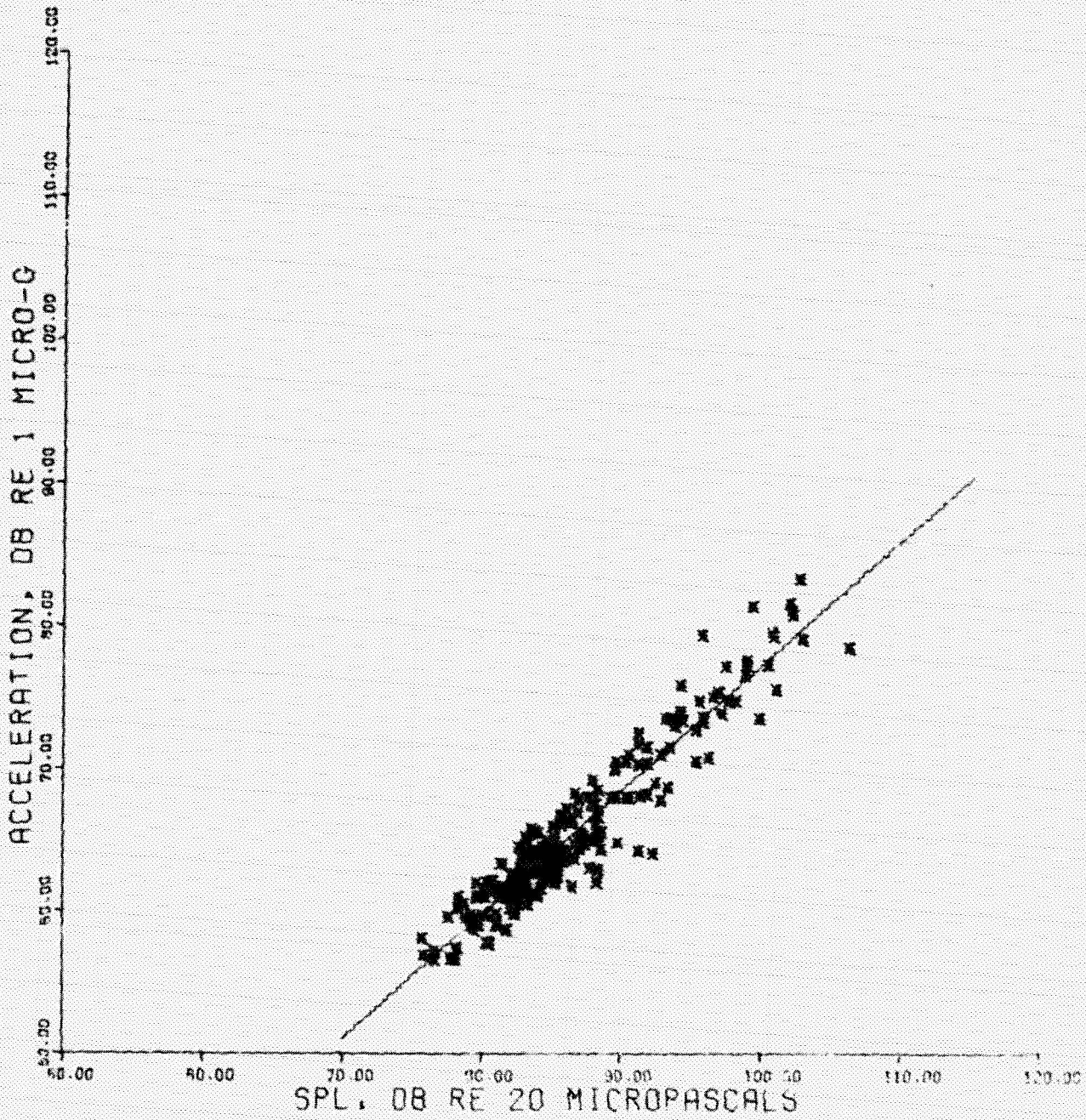


Figure A-32.- Composite wall vibration response signature for DC-8 approach at site 11 (6 flyovers).

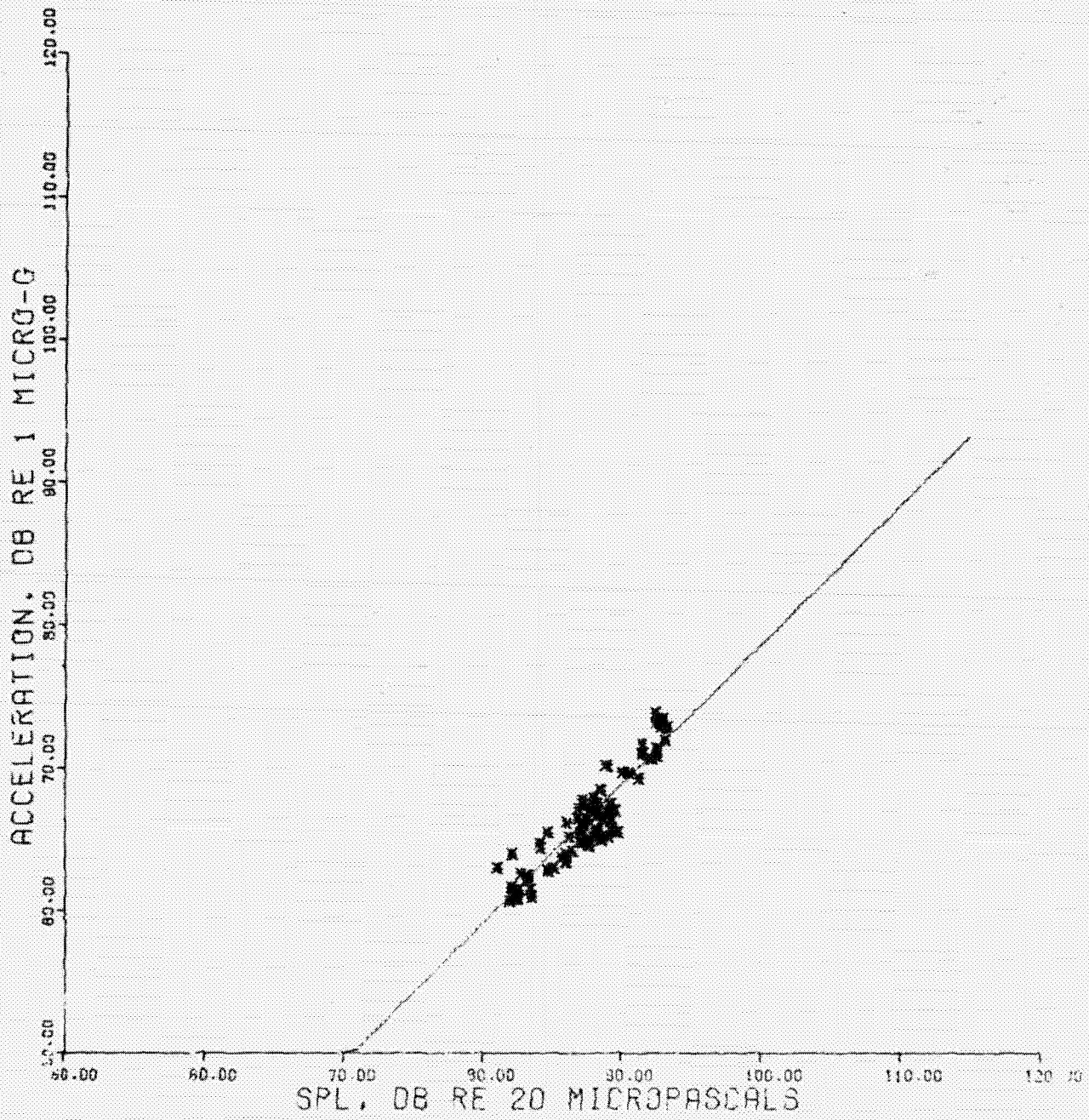


Figure A-33.- Composite wall vibration response signature for DC-9 approach at site 11 (2 flyovers).

1. Report No. <b>Technical Memorandum 78676</b>	2. Government Accession No.	3. Recipient's Catalog No.													
4. Title and Subtitle <b>CONCORDE NOISE-INDUCED BUILDING VIBRATIONS JOHN F. KENNEDY INTERNATIONAL AIRPORT REPORT NUMBER 2</b>		5. Report Date <b>February 1978</b>	6. Performing Organization Code												
7. Author(s) <b>Staff-Langley Research Center*</b>		8. Performing Organization Report No.													
9. Performing Organization Name and Address <b>NASA Langley Research Center Hampton, VA 23665</b>		10. Work Unit No. <b>505-09-13-11</b>	11. Contract or Grant No.												
12. Sponsoring Agency Name and Address <b>National Aeronautics and Space Administration Washington, DC 20546</b>		13. Type of Report and Period Covered <b>Technical Memorandum</b>													
14. Sponsoring Agency Code															
15. Supplementary Notes															
<table border="0"> <tr> <td>*ANRD</td> <td>*IRD</td> <td>*OSD</td> <td>*SiIPD</td> </tr> <tr> <td>W. H. Mayes, D. G. Stephens,</td> <td>H. K. Holmes</td> <td>B. G. Holliday</td> <td>D. W. Ward</td> </tr> <tr> <td>R. DeLoach, J. M. Cawthorn</td> <td>R. B. Lewis</td> <td>W. T. Miller</td> <td></td> </tr> </table>				*ANRD	*IRD	*OSD	*SiIPD	W. H. Mayes, D. G. Stephens,	H. K. Holmes	B. G. Holliday	D. W. Ward	R. DeLoach, J. M. Cawthorn	R. B. Lewis	W. T. Miller	
*ANRD	*IRD	*OSD	*SiIPD												
W. H. Mayes, D. G. Stephens,	H. K. Holmes	B. G. Holliday	D. W. Ward												
R. DeLoach, J. M. Cawthorn	R. B. Lewis	W. T. Miller													
16. Abstract															
<p>The NASA, in cooperation with the FAA, made measurements of noise-induced building vibrations near John F. Kennedy International Airport on January 18-19 and on February 3-5, 1978, as part of the Concorde monitoring program. The outdoor and indoor noise levels resulting from aircraft flyovers and certain nonaircraft events were recorded at eight homesites and a school along with the associated vibration levels in the walls, windows, and floors of these test sites. In addition, limited subjective tests were conducted to examine the human detection and annoyance thresholds for building vibration and rattle caused by aircraft noise. The following results are offered:</p> <ul style="list-style-type: none"> <li>o Both vibration and rattle were detected subjectively in several houses for some operations of both the Concorde and subsonic aircraft.</li> <li>o The relationship between structural vibration and aircraft noise is: <ul style="list-style-type: none"> <li>- linear, with vibration levels being accurately predicted from OASPL levels measured near the structure</li> <li>- consistent from flyover to flyover for a given aircraft type</li> <li>- the same for approach and departure operations</li> <li>- the same for Concorde and conventional jet transports</li> </ul> </li> <li>o Relatively high levels of structural vibration measured during Concorde operations are due more to higher OASPL levels than to unique Concorde-source characteristics.</li> </ul> <p>Follow-on reports will contain the results of further analyses of the data currently in progress.</p>															
17. Key Words (Suggested by Author(s)) <b>Noise, Building Vibrations, Structural Response to Noise</b>  <u>71</u>		18. Distribution Statement <b>Unclassified</b>  <b>Unlimited</b>													
19. Security Classif. (of this report) <b>Unclassified</b>	20. Security Classif. (of this page) <b>Unclassified</b>	21. No. of Pages <b>67</b>	22. Price* <b>\$5.25</b>												