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AIR FORCE BOOM EVENT ANALYZER RECORDER (BEAR): Comparison with NASA Boom Measurement System

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Harry G. Armstrong Aerospace Medical Research Laboratory

JULY 1988

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AAMRL-TR-88-039

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FOR THE COMMANDER

Henning E. von Gierke

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Director
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During 16 - 18 September 1986 AAMRL and NASA conducted a joint sonic boom test at Edwards AFB to field check the AAMRL Boom Event Analyzer Recorder (BEAR). Sonic boom overpressures were generated over the range of 0.5 pounds per square foot (PSF) to 36 PSF to verify the capability and establish the credibility of the BEAR over its full design range. These booms were simultaneously collected using the AAMRL BEARs and the long-established NASA Analog Sonic Boom Recording Systems. This report documents the results of these tests that show great agreement between the two systems and fully validates the BEAR systems for future Air Force boom measurement programs. This report also shows the AAMRL inverted microphone mount configuration obtains identical results as the flush microphone mount for recording sonic boom events. The BEAR system is described in detail in a companion AAMRL report.

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PREFACE

This report was prepared by the Biodynamic Environment Branch, Armstrong Aerospace Medical Research Laboratory, under Project/Task 723134, Exploratory Noise and Sonic Boom Research with partial funding from the Noise and Sonic Boom Impact Technology (NSBIT) Advance Development Program Office under Project Number 3037.

The author gratefully acknowledges the NASA and NASA support personnel, Mr Dominic Maglieri, Mr Ralph Lewis, Mr Bob Cohn, Mr Dennis Bessette, Mr Art Lavoie, Mr John Stanley, Mr Herbert Henderson, Mr Thomas Baxter, Mr Jack Marquard and Mr Eugene Stansbery for their assistance in acquiring and analyzing all the data collected using the NASA Analog Sonic Boom Measurement Systems. The author also wishes to acknowledge Ms Barbara Palmer of System Research Laboratory for her assistance in acquisition of the AAMRL data, Mr Craig Zielazny, and Mr Henry Mohlman of UDRI for their work in the analysis of the boom data, Mr John N. Cole for his editorial comments and Ms Mary Bader for the typing and preparation of this report.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

As part of its exploratory noise and sonic boom research program, the Armstrong Aerospace Medical Research Laboratory (AAMRL) with its contractor, Systems Research Laboratory (SRL), designed and built a Sonic Boom Event Analyzer Recorder (BEAR) system. The intent of this development was to provide the Air Force with a readily portable, unmanned recording system which could efficiently and accurately monitor the acoustic environment and identify and record full sonic boom pressure-time signatures while rejecting unwanted noise events produced by subsonic aircraft, ground vehicles, gunfire, wind and other sources.

The BEAR system, which is described in the next section, was extensively checked and calibrated in the Laboratory during development. The purpose of the boom measurement program described in this report was to field-check twelve BEAR systems with actual sonic boom environments in order to verify their capabilities and establish their credibility over their full design range. Accordingly, AAMRL conducted tests at Edwards AFB, CA on 16-18 Sep 86 with the support and interest of NASA who simultaneously deployed their analog, manned, sonic boom recorder systems. The specific approach was to compare in detail the data gathered by the Air Force BEARs with those gathered by the NASA systems. This report documents the results of this test program.

DESCRIPTION OF TEST

AAMRL Full Signature Sonic Boom Recorder

The Boom Event Analyzer Recorder (BEAR) is a 16 bit microprocessor-based instrument that continuously samples the acoustic environment then captures and stores the digital waveform of any loud impulsive noise (Figure 1). The recorder can discern a sonic boom from the normal background noise and capture it in permanent solid state random access memory (RAM) storage for later analysis. The RAM modules can then be interfaced with a Data Retrieval Unit (DRU) and the information on the DRU transferred to a Zenith Z-100 microcomputer (Figure 2). The microcomputer displays each recorded event, time of occurrence and summary information for all the data stored.

The BEAR digitizes the noise environment at an 8 kHz sampling rate and analyzes it during the downtime between the sampling intervals giving it real-time screening for sonic boom events. The BEAR examines the event level, duration, pulse time and risetime to determine if it should be stored as a boom event. These parameters are selectable via the input keypad to make the BEAR a very flexible instrument with which to capture a wide variety of impulsive events. Along with setting the boom evaluation criteria, the keypad allows input of date, time, test number, location and serial number of the unit. This information is stored in the same RAM modules as data every time any parameter is changed. The operator can also select three other modes from this keypad: calibration, clear memory or data save. In the calibration mode the BEAR simply displays the root-mean-square level of two seconds of the input signal to the microphone for checking against a standard 124 dB sound pressure level, piston-phone calibrator. No data are saved to the RAM modules in this mode. The clear memory mode asks the operator to input a special code and, when entered, simply erases the RAM modules and runs the BEAR unit through the internal self-test routines that verify all the hardware components are working properly. The third mode allows the operator to collect one second of data with no screening. This allows the operator to collect and store background noise or the calibrator signal or anything that is desired. The BEAR has a frequency response of 0.5 Hz to 2,500 Hz for reproducing a sonic boom time history adequate for environmental impact analysis. The maximum overpressure the BEAR is designed for is 155.3 dB (24.4 pounds per square foot or 1170 pascal) with an 80 dB useable dynamic range. The RAM modules on a single unit have 512K bytes of memory allowing the BEAR to store over 100 "normal" sonic booms. The BEAR is designed to operate with a PCB-Piezo resistive microphone that is totally sealed and extremely rugged. This microphone is mounted inverted over an 18" diameter steel plate in a vibration isolation mount. A 4" diameter foam windscreen inside a 18" diameter inverted cone covers the microphone and provides wind noise reduction and rain protection. This makes the BEAR able to operate in all kinds of environmental extremes.

Once the sonic boom data are collected, the RAM modules are transferred to the DRU for downloading the data. The Z-100 initiates its communications program (COMM) to accept this data from the DRU. These data are stored as two large raw data files (ABEARDAT.-B- & BBEARDAT.-B-) inside the Z-100. This file contains the BEAR setup parameters, boom data, captured data and parameter changes all separated by a series of three "barker codes" (hexidecimal values of 90 EB). The Z-100's process program then reads this file and breaks it up into individual files on each event that contain the data, plus all the BEAR parameter sets at the time that data were taken. Each file is given a specific file name corresponding to the date, time and location of its occurrence according to the following scheme. (i.e. PSSHHmmI.MDD, where P indicates a processed event, SS = site number, HHmm = local time in hours and minutes, I = incrementer (A..Z) to differentiate between events that occurred in the same minute at the same location, MDD = month and day). For this test the serial number of each BEAR was input as the site number since all were located at the same location. These files are stored on a floppy disk in a binary format and can be graphically displayed on the Z 100 by invoking the VIEW command.

Each BEAR system was carefully calibrated in the Laboratory to balance each microphone to the BEAR A to D circuitry and adjusted to a precision voltage source to verify the absolute levels recorded. In addition, each BEAR was checked with a 124 dB 250 Hz piston-phone calibrator before and after each aircraft flight. This calibration signal was saved by each BEAR to form a permanent record of the stability of each system. This procedure is used to verify an end to end acoustic calibration traceable to the National Bureau of Standards. The BEAR systems are explained in greater detail in a companion AAMRL report.[1]

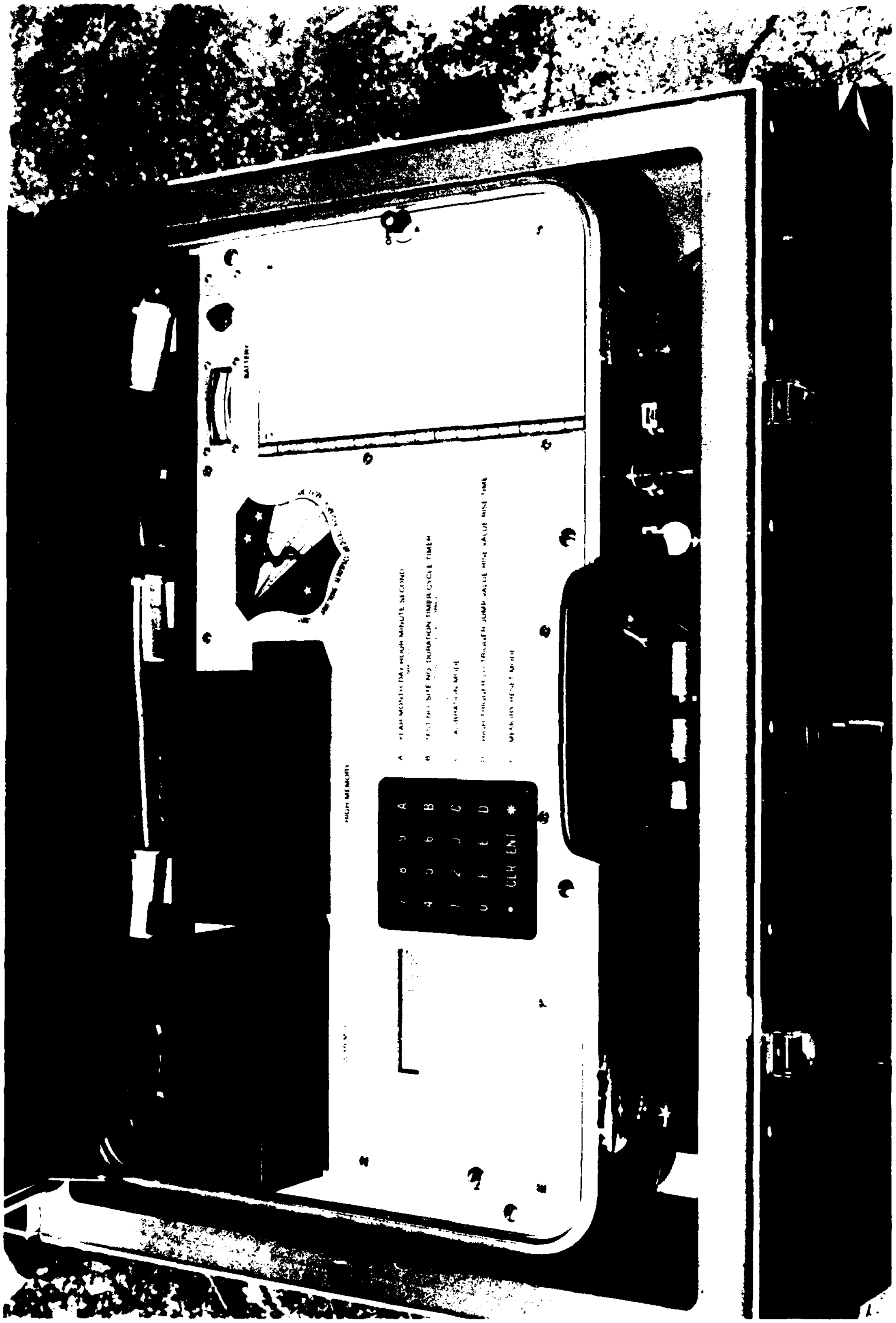


Figure 1. Boom Event Analyzer Recorder (BEAR)

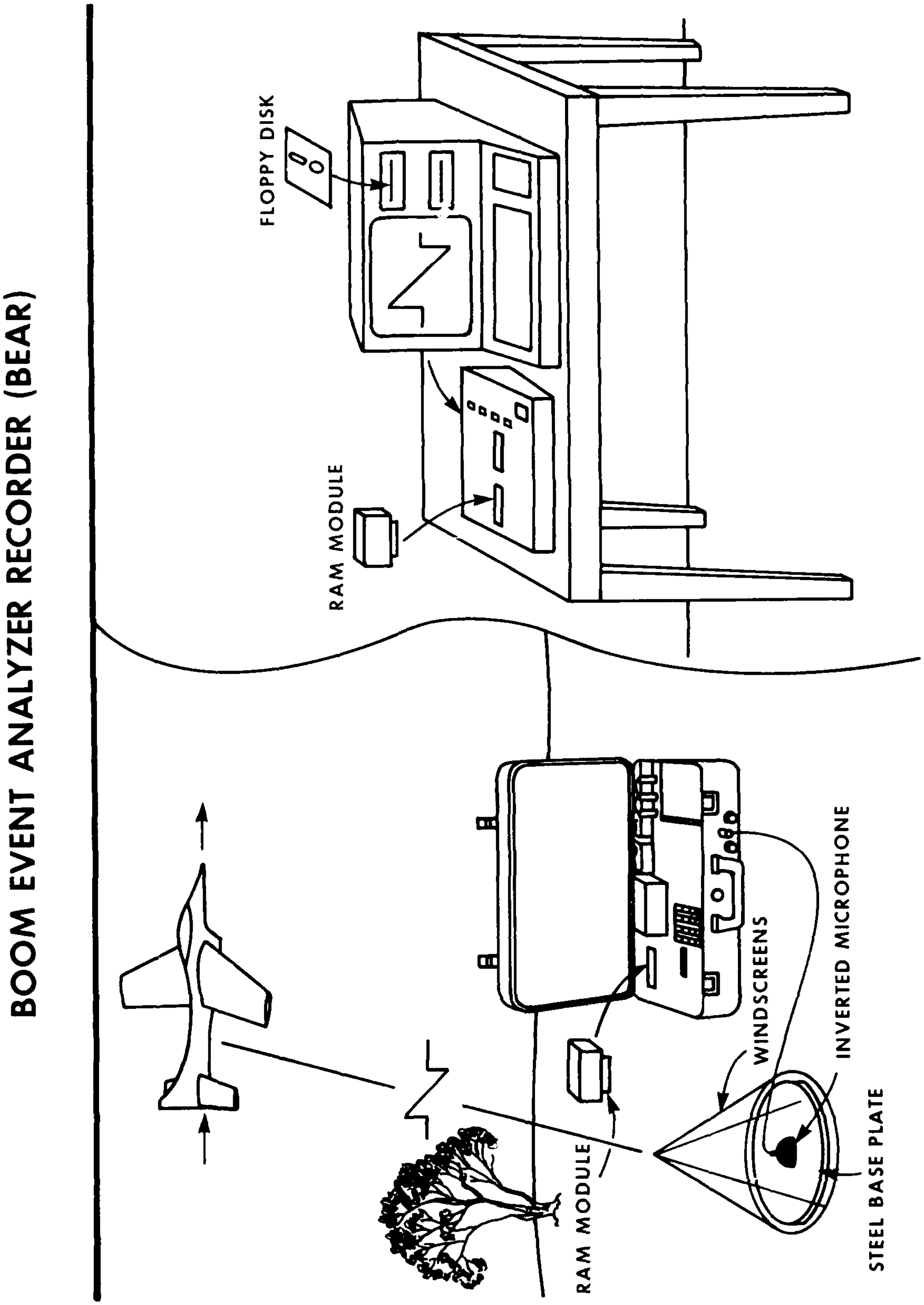


Figure 2. BEAR Field/Lab Setup

NASA Analog Sonic Boom Measurement System

The NASA analog sonic boom measurement system has been used in previous aircraft, Apollo, Skylab, and space shuttle sonic boom measurement programs and consists of pressure transducer, Dynagage (oscillator-detector circuit), instrumentation amplifier, FM magnetic tape recorder, and satellite time code receiver. The pressure transducer is a commercially available condenser microphone considered to have a flat frequency response for the lower frequencies required for sonic boom measurement. The microphone used for sonic boom measurements and in conjunction with the model DG-605 Dynagage system has a high frequency response essentially flat to 10K Hz, with the low end frequency response averaging approximately -5 dB at .01 Hz. Basically, the microphone has a small capillary hole through the housing which allows some air flow so that the static pressure within the capsule always equals the ambient atmospheric pressure. Thus, the acoustic loading is the same on both sides of the diaphram even at frequencies well below 20 Hz. This technique will allow adequate provisions for system balancing and tuning in addition to coping with various ranges of temperature and atmospheric pressure changes that could occur during diversified field measurement operations.

The Dynagage consists of a radio frequency oscillator coupled to a diode detector circuit whereby small changes in capacity of the pressure transducer will produce relatively large changes in the diode detector. The output of the detector is therefore proportional to the pressure applied to the transducer diaphram. The Dynagage output is fed into an instrumentation amplifier which provides a gain of 0 to 60 dB in steps of 2 dB with a flat frequency response of D.C. to 20 KHz.

The measurement system used frequency modulated magnetic tape recorders operating at 30 ips in the intermediate band with a frequency response of D.C. to 20 KHz. Electrical power was furnished by portable gasoline generators. This instrumentation was mounted in a covered truck 1000 ft from the 4 x 4 ft ground board.

All microphones were covered with wind screens consisting of three layers of cheesecloth to minimize effects of surface winds on the microphone readings and also to provide shade from the sun and protection from blowing sand particles. The output of the microphones were routed through the instrumentation amplifiers thus allowing for the setting of a range of overpressure levels (a precaution necessary to allow for errors in the predictive method or anomalous overpressures caused by unusual atmospheric or focusing conditions). Twelve channels of overpressure data were recorded along with time code signal, and voice annotation. All systems were "warmed up" for 2 hours prior to each test. All tape recorder data channels were calibrated using a precision voltage source to verify center frequency stability, all microphones were calibrated at both "pre" and "post" flight conditions using a fixed frequency sound pressure level calibrator to verify an end-to-end acoustic calibration Traceable to the National Bureau of Standards. A block diagram and photograph of a typical data acquisition system is shown in figures 3 and 4 respectively.

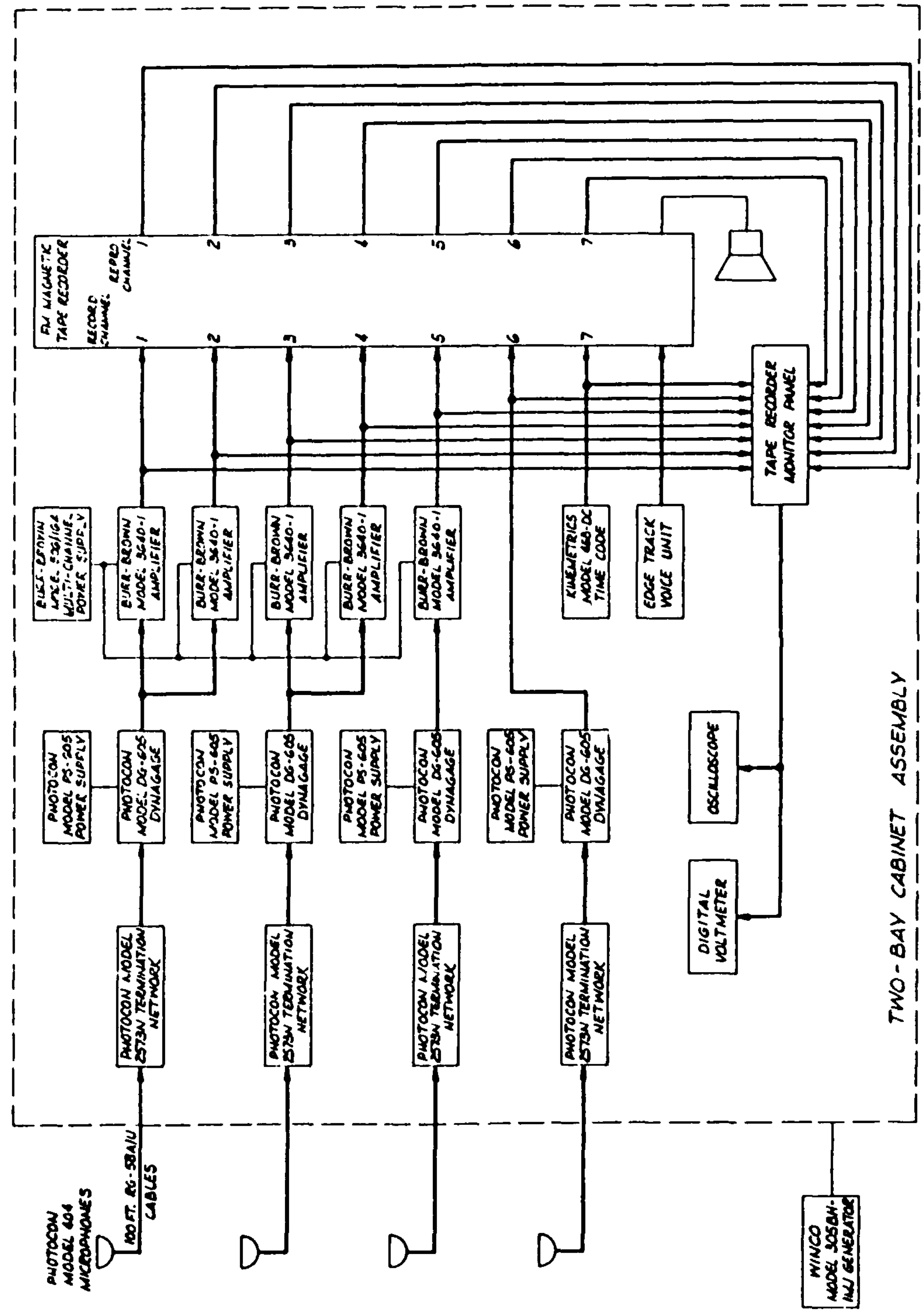


Figure 3. Block Diagram of NASA Analog Sonic Boom Measurement System

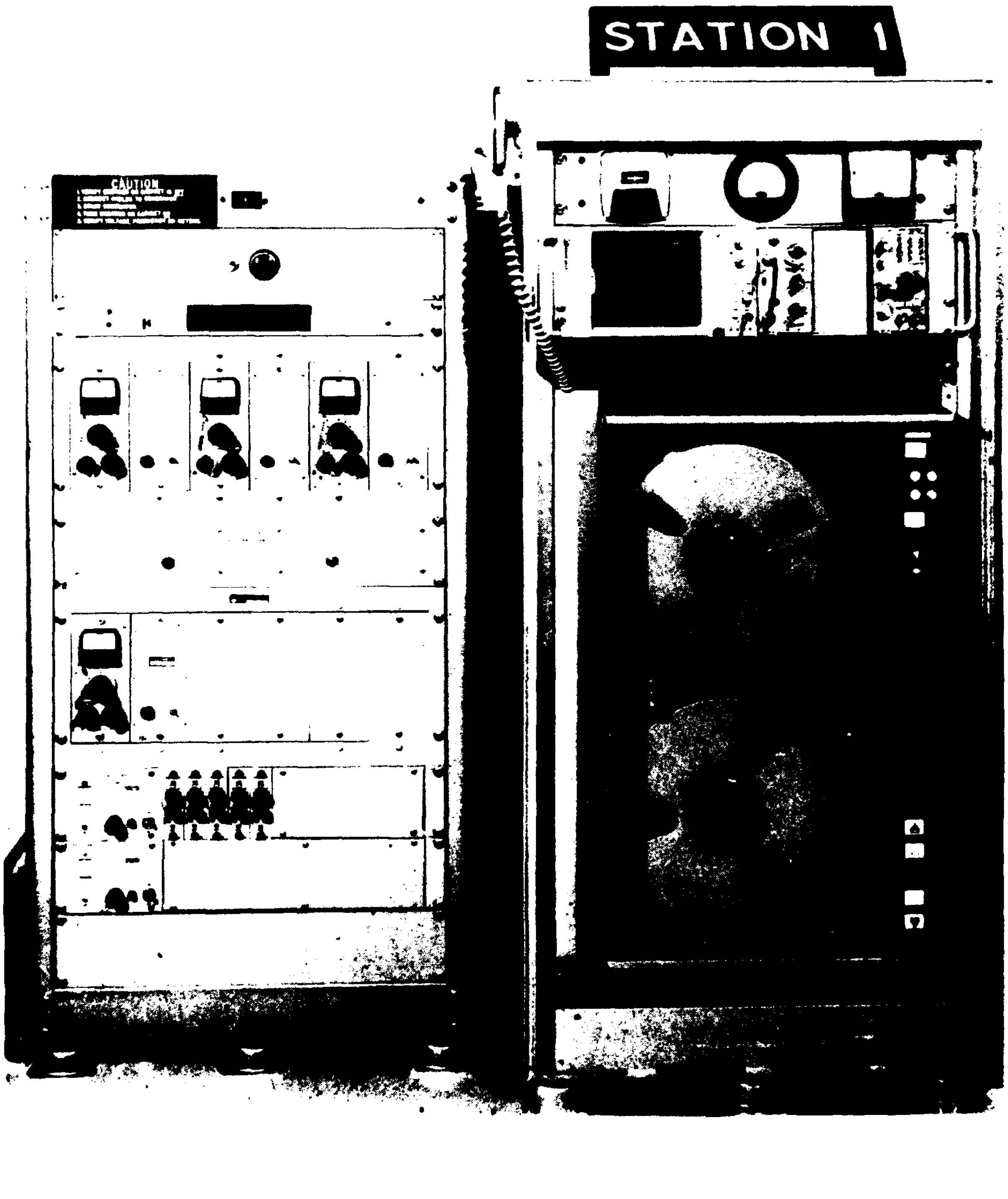


Figure 4. NASA Analog Sonic Boom Measurement System

Comparison Test at Edwards Air Force Base

Sonic boom measurements were conducted on 16 - 18 Sep 86 at Edwards AFB CA under the Alpha Supersonic Corridor. Twelve BEAR units and the NASA analog system with 12 microphones were used for this test. The first day was used to compare outputs in the normal NASA microphone configuration (flush mounted) to give a comparison of similar signature outputs of both systems. (Figure 5) For this test all the BEARs and four NASA microphones were mounted in a 1 foot square phenolic holder which was mounted to a 4 x 4 sheet of 3/4 inch plywood. (Figure 6) A hole was dug and the plywood placed over the hole allowing all the microphones to be be flush mounted within a one square foot area. In addition to the microphones to be used for the comparison test, NASA microphones were placed on a 30 ft mast to collect data for full field comparisons. (Figure 7) With all the equipment set up and verified the F-4 aircraft conducted the supersonic overpasses as per Table 1. Each evening these data were collected and downloaded to be prepared for the next days test.

The second day was used to check the proposed AAMRL configuration of an inverted microphone and compare the results with the flush mounted approach. For this test all the NASA microphones remained the same as the first day's test. The BEAR microphones were rearranged as per Figure 8. The BEAR systems 1 through 3 were left flush mounted. The AAMRL Inverted Microphone Mount (Figure 9) was used for BEAR systems 8 through 13. The angle bracket (Figure 10) was used on BEAR systems 4 through 7 to test the effect of the boom shock wave striking the microphone diaphragm at various angles.

Figure 11 shows this 17 Sep 86 setup. The F-4 and F-111 aircraft flew the supersonic overpasses as per Table 2.

The third day was not originally scheduled for the comparison test but presented an opportunity to collect several F-4 supersonic overpasses at a different location. This test demonstrated the BEAR's versatility and mobility. We were able to set up 5 BEARs at a completely new location within 30 minutes of the overflights. All five of these BEARs were set up using the AAMRL Inverted Microphone Mount. The F-4 aircraft flew the supersonic overpasses as per Table 3.

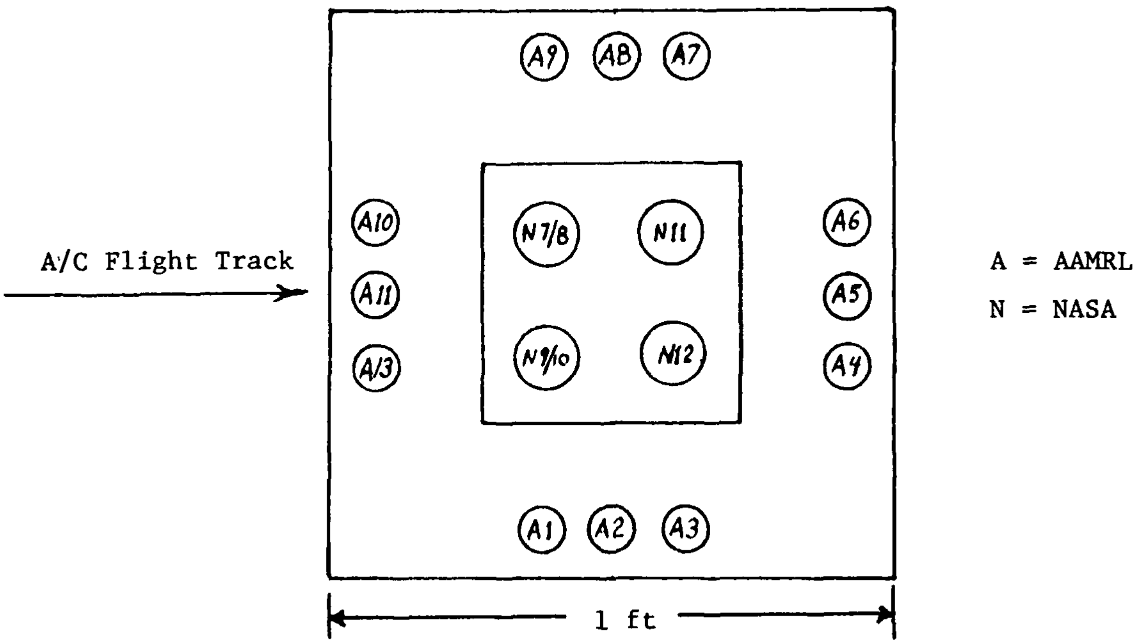


Figure 5. Microphone Setup for 16 Sep 86

Figure 6. Microphone Flush Mount Bracket

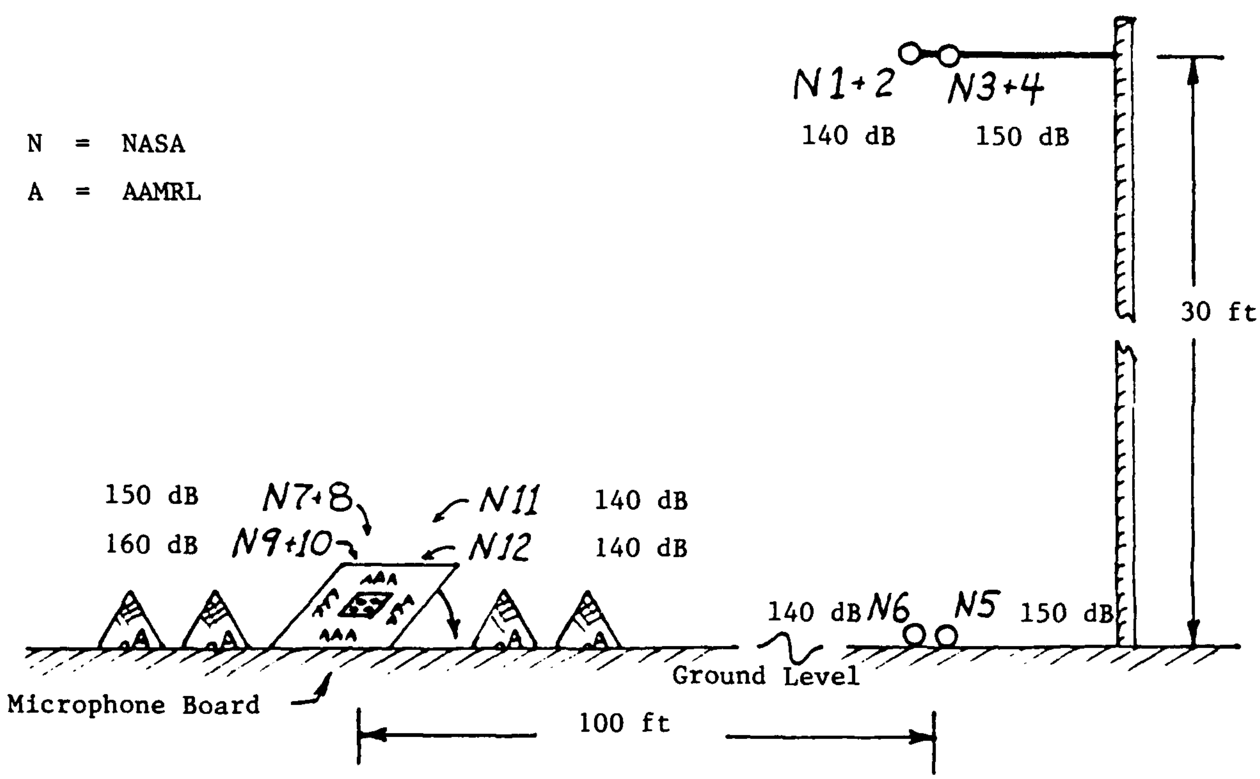


Figure 7. NASA Analog Tape Recorder Channel Assignment

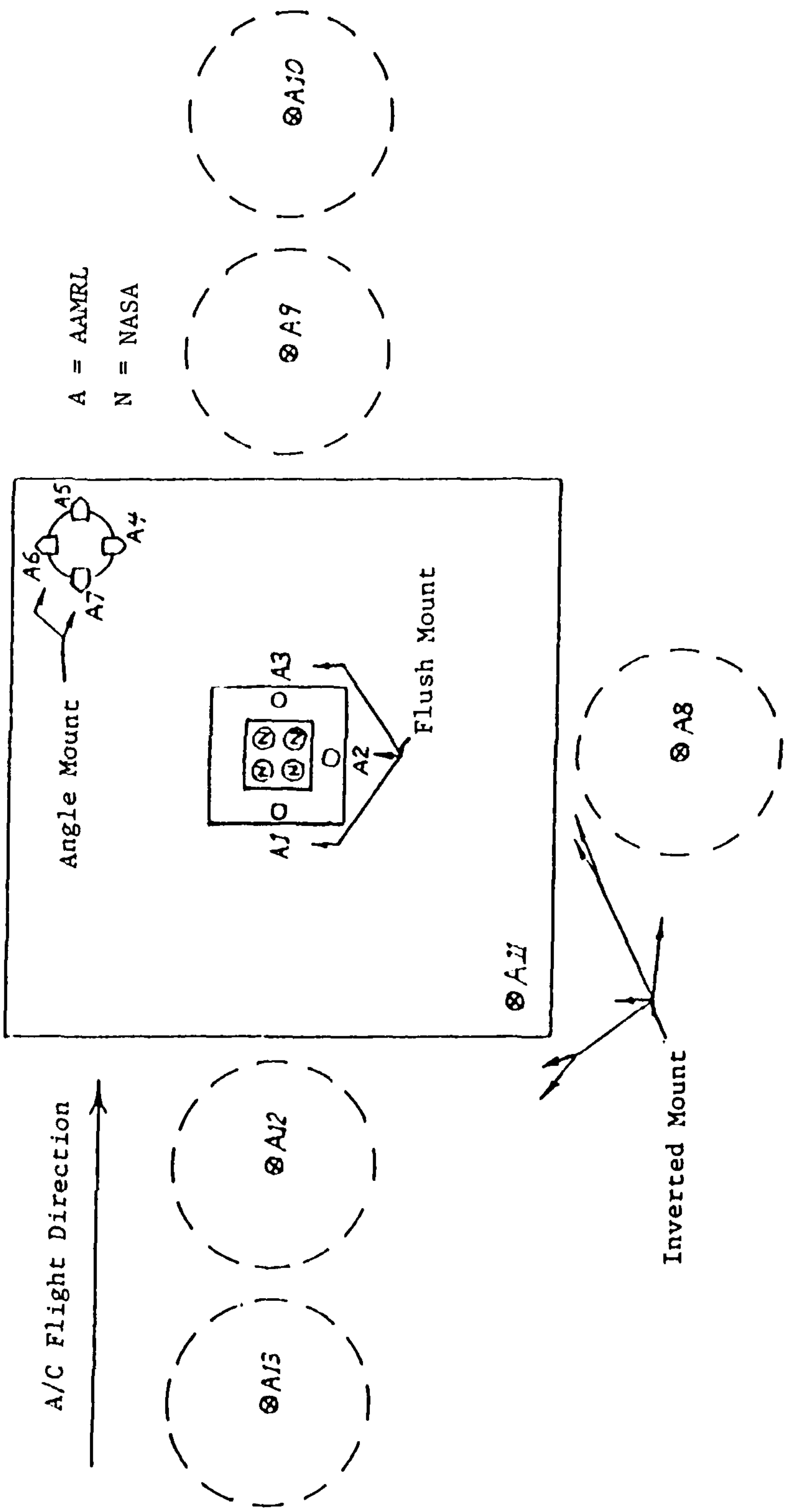


Figure 8. Microphone Setup for 17 Sep 86

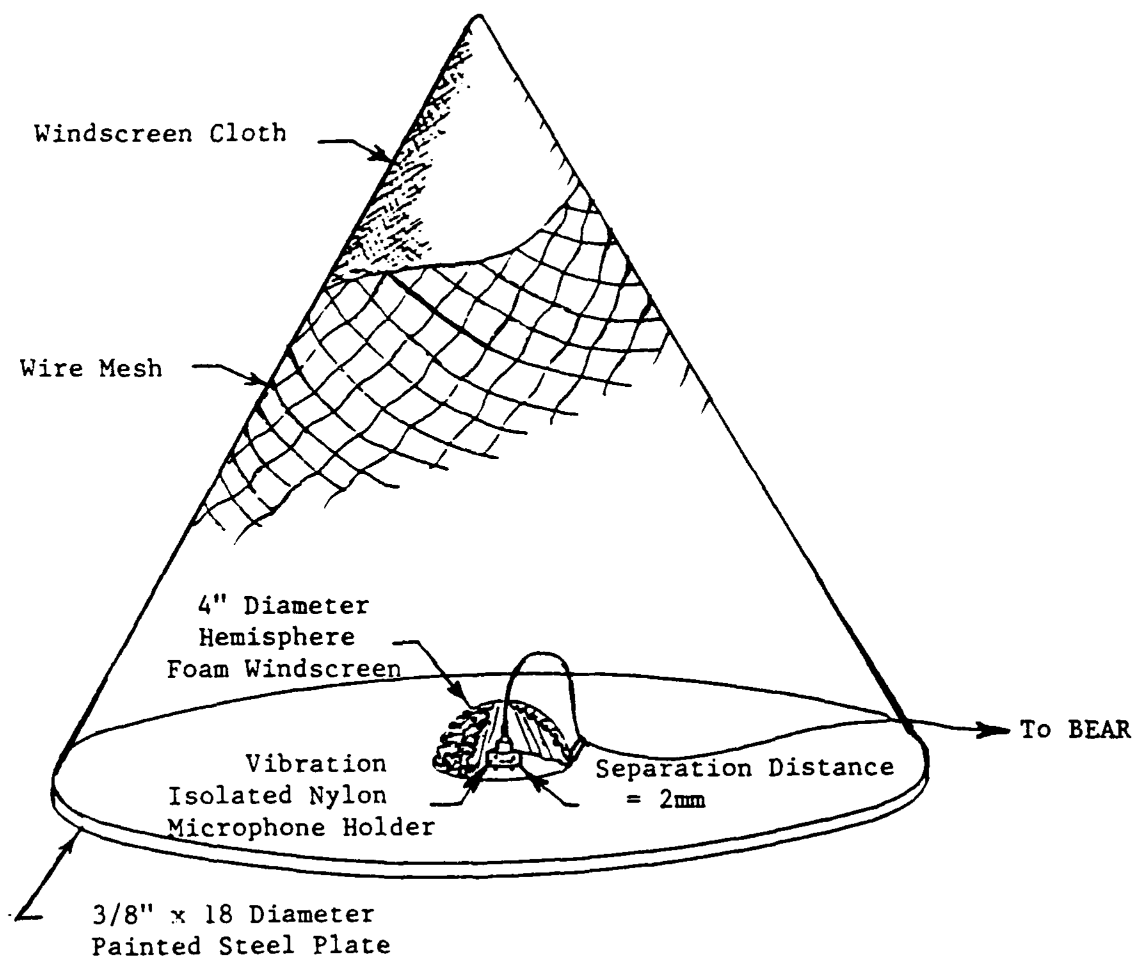


Figure 9. AAMRL Inverted Microphone Mount

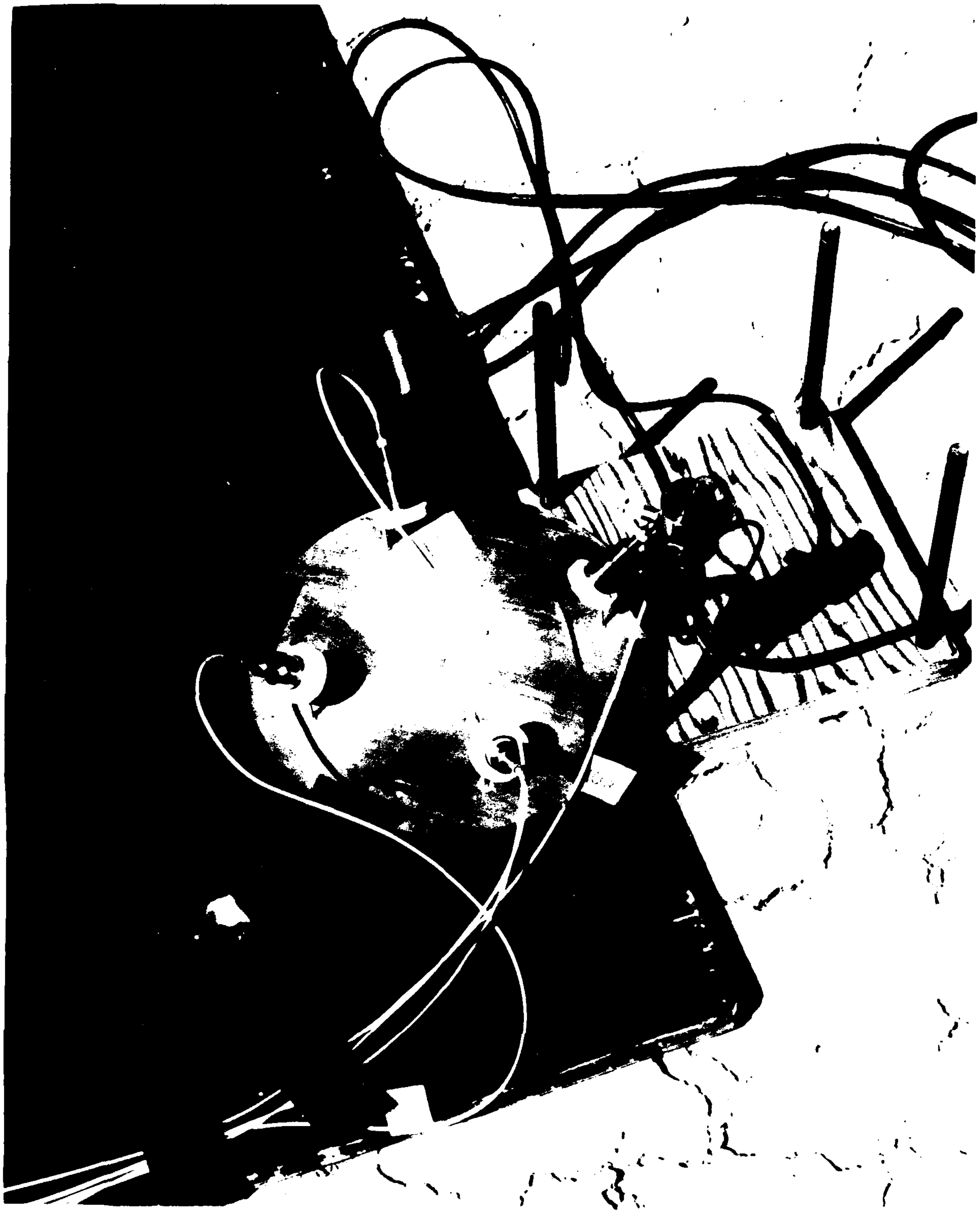


Figure 10. Microphone Angle Bracket

Figure 11. 17 Sep 86 Sonic Boom Test at Edwards AFB

TABLE 1

16 Sep 86 Boom Overflight Description

Air Force - NASA BEAR Calibration Test at Edwards AFB

EVENT #	NASA MISSION #	A/C	Mach Number	ALT (AGL) (feet)	Track Offset (feet)	BOOM Time (local)	BOOM Time (zulu)
2	19K-2	F-4	1.2	18,900	0	8:16	15:16:38
3	5K-1	F-4	1.15	6,000	0	8:20	15:20:08
4	35K-1	F-4	1.45	35,000	60600	8:33	15:33:04
5	19K-1	F-4	1.2	20,700	0	16:17	23:17:47
6	5K-2	F-4	1.15	5,500	0	16:22	23:22:22
7	35K-2	F-4	1.45	35,100	60600	16:31	23:31:45
8	5K-3	F-4	1.15	5,200	0	16:35	23:35:18

TABLE 2

17 Sep 86 Boom Overflight Description

Air Force - NASA BEAR Calibration Test at Edwards AFB

Event #	NASA MISSION #	A/C	Mach Number	ALT (AGL) (feet)	Track Offset (feet)	BOOM Time (local)	BOOM Time (zulu)
1	19K-4	F-4	1.2	19,000	0	14:11	21:11:59
2	35K-3	F-4	1.42	34,900	60600	14:20	21:20:54
3	35K-4	F-4	1.35	35,200	60600	14:26	21:26:16
4	5K-4	F-4	1.13	5,700	0	14:31	21:31:08
1	1K-1	F-111A	1.03	1,200	0	15:02	22:02:33
2	1K-2	F-111A	1.04	1,200	0	15:07	22:07:49

TABLE 3

18 Sep 86 Boom Overflight Description

Air Force - NASA BEAR Calibration Test at Edwards AFB

EVENT #	NASA MISSION	A/C	Mach Number	ALT (AGL) (feet)	Track Offset (feet)	BOOM Time (local)	BOOM Time (zulu)
1	35K-5	F-4	1.22	34,200	0	9:09	16:09
2	35K-6	F-4	1.28	32,900	0	9:16	16:16
3	35K-7	F-4	1.14	34,700	0	No Boom	
4	35K-8	F-4	1.35	34,100	0	9:32	16:32

RESULTS

SIGNATURE COMPARISONS

The aircraft overflights were flown to provide boom overpressures from less than 1 PSF to over 20 PSF to check the BEAR over the range of booms generated by typical Air Force operations. When comparing the NASA signatures to the AAMRL BEAR signatures it must be remembered there is a difference in low frequency cut-off between the two different microphone systems. The NASA microphones have a low frequency response down to .01 Hz. AAMRL designed the analog front end of the BEAR systems to a .5 Hz requirement. This low frequency cut-off difference will cause the AAMRL signatures to vary slightly from the NASA measurements. An idealized N-wave with duration typical of those collected (less than 200 milliseconds) passed through a .5 Hz high pass filter vs a perfect DC high pass filter will introduce an error of less than 1 dB in the peak pressure value and less than .5 dB in the flat weighted sound exposure level (SEL).[2] This was an acceptable compromise for the BEAR system design.

Flush Mount Microphone

Figures 12 through 15 are the pressure-time history comparisons of the AAMRL BEARs to the NASA boom measurement systems, both using flush mounted microphones. Each of these plots represent all the data that were recorded for a particular overflight. These figures show the variability of the boom signatures as measured within the 1 square foot area containing all the microphones. Figure 16 shows a similar pressure-time history comparison but with a very pronounced oscillation in several of the BEAR system signatures. We believe that this is due to a resonance of the one square foot plate on which the BEAR microphone is mounted being forced by the sonic boom. This boom occurred at 8:19 on 16 Sep 86. BEAR microphones 4 & 5 were perpendicular to the boom (see figure 5). Microphone 5 was in the center where you would expect the most oscillation, and microphone 4 was closer to where the holder was fastened to the plywood. In the individual signatures (see Appendix) we see that the oscillation starts at microphone 4, builds to a maximum at microphone 5, with no detectable oscillation on the other BEAR microphones. Except for this oscillation, all the other BEAR collected signatures show great agreement with the signatures collected by the NASA systems.

Inverted to Flush Mount Comparisons

Figures 17, 18 and 19 are comparisons of three BEAR-collected pressure-time histories using the flush mounted BEAR microphones and the AAMRL inverted microphone mount (see Figure 9). These signatures and the following comparisons are representative of the BEAR outputs with each comparison showing all the data that were collected on each boom (several BEAR signatures were lost due to voltage drift of the microphone caused by thermal overload that was not accounted for). NOTE: This problem was corrected in the BEARs after completion of this test. Except for the normal differences between each microphone, these data show great agreement between these two mount configurations over the complete BEAR pressure range.

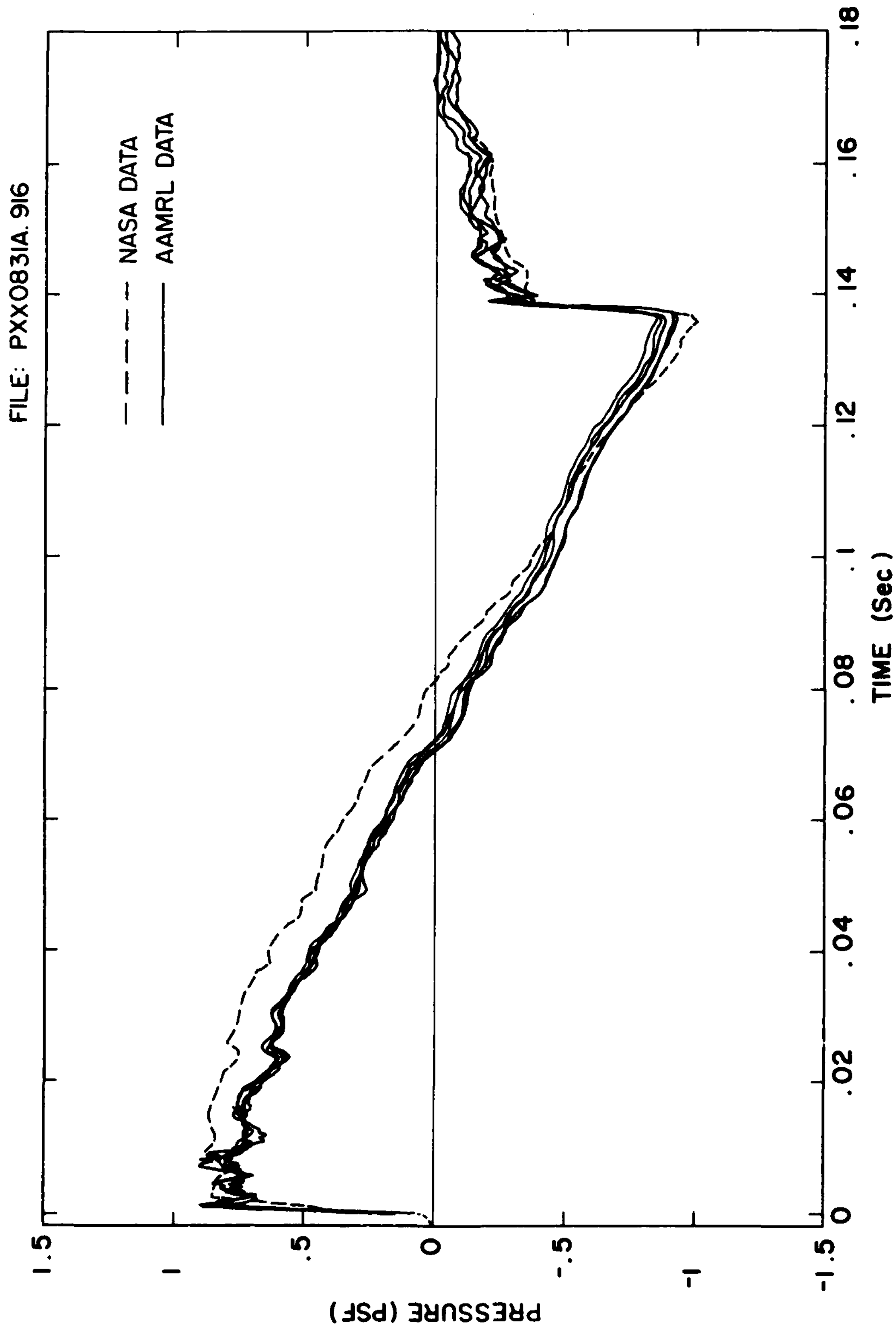


Figure 12. 1 PSF Boom Signature Comparison

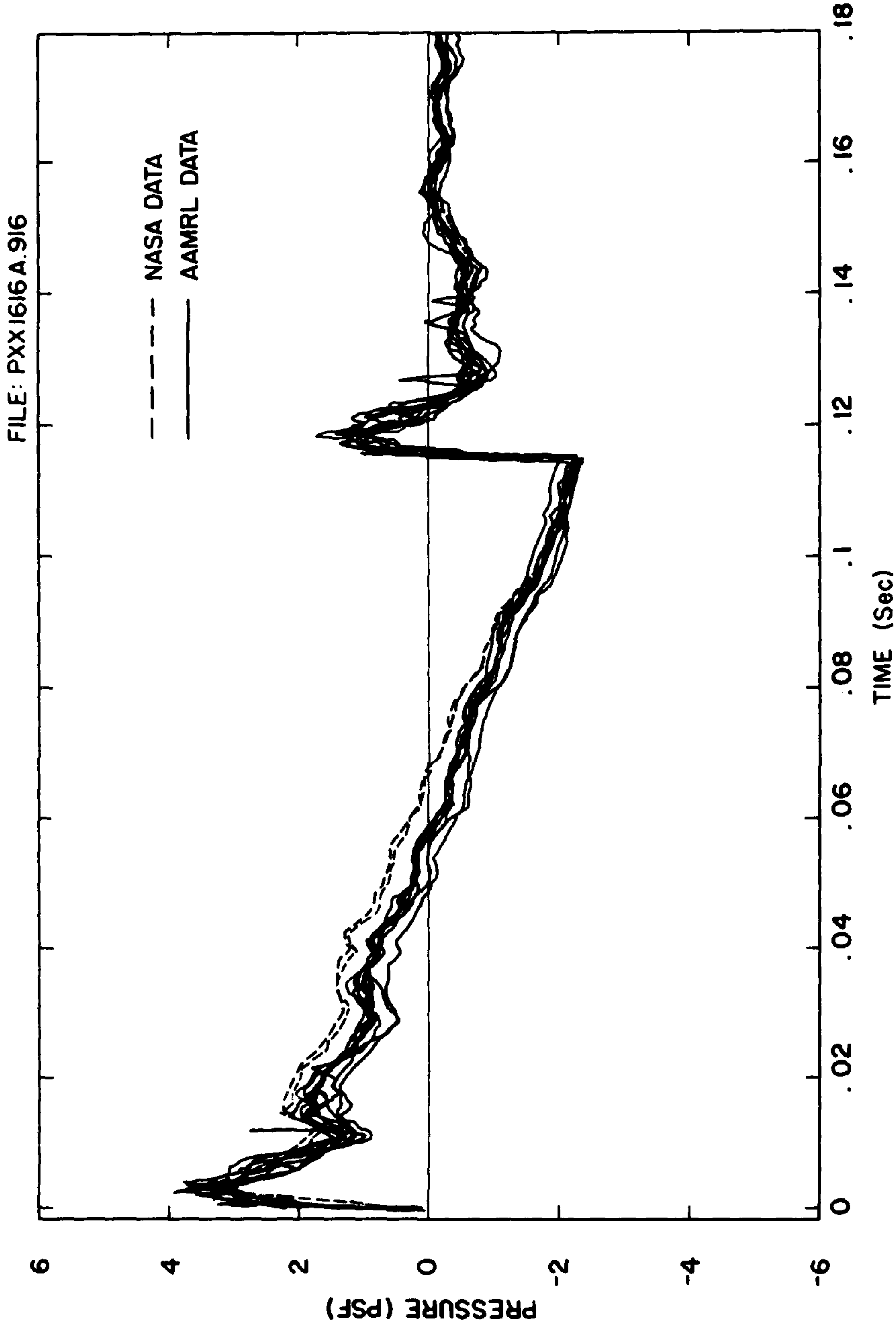


Figure 13. 4 PSF Boom Signature Comparison

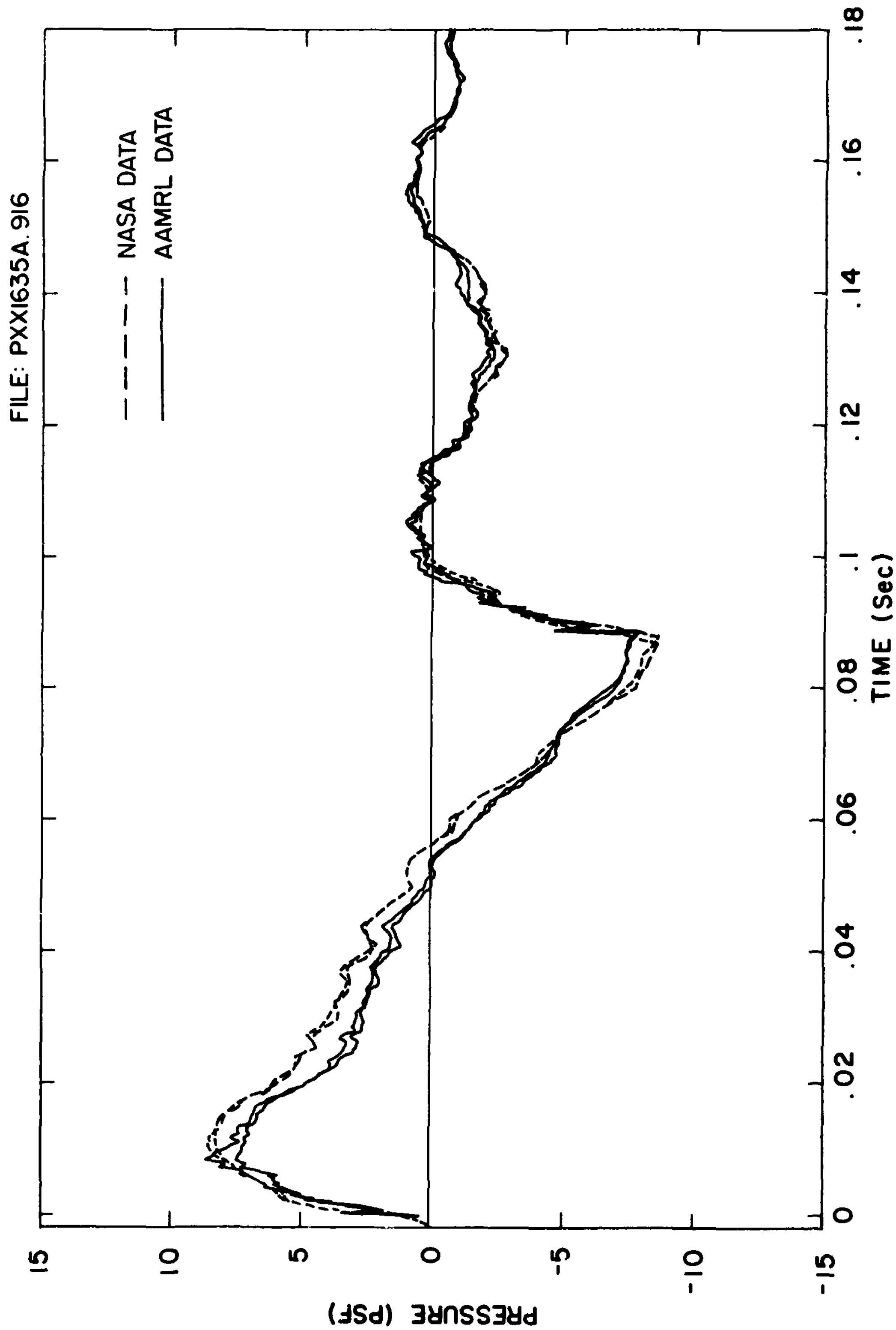


Figure 14. 9 PSF Boom Signature Comparison

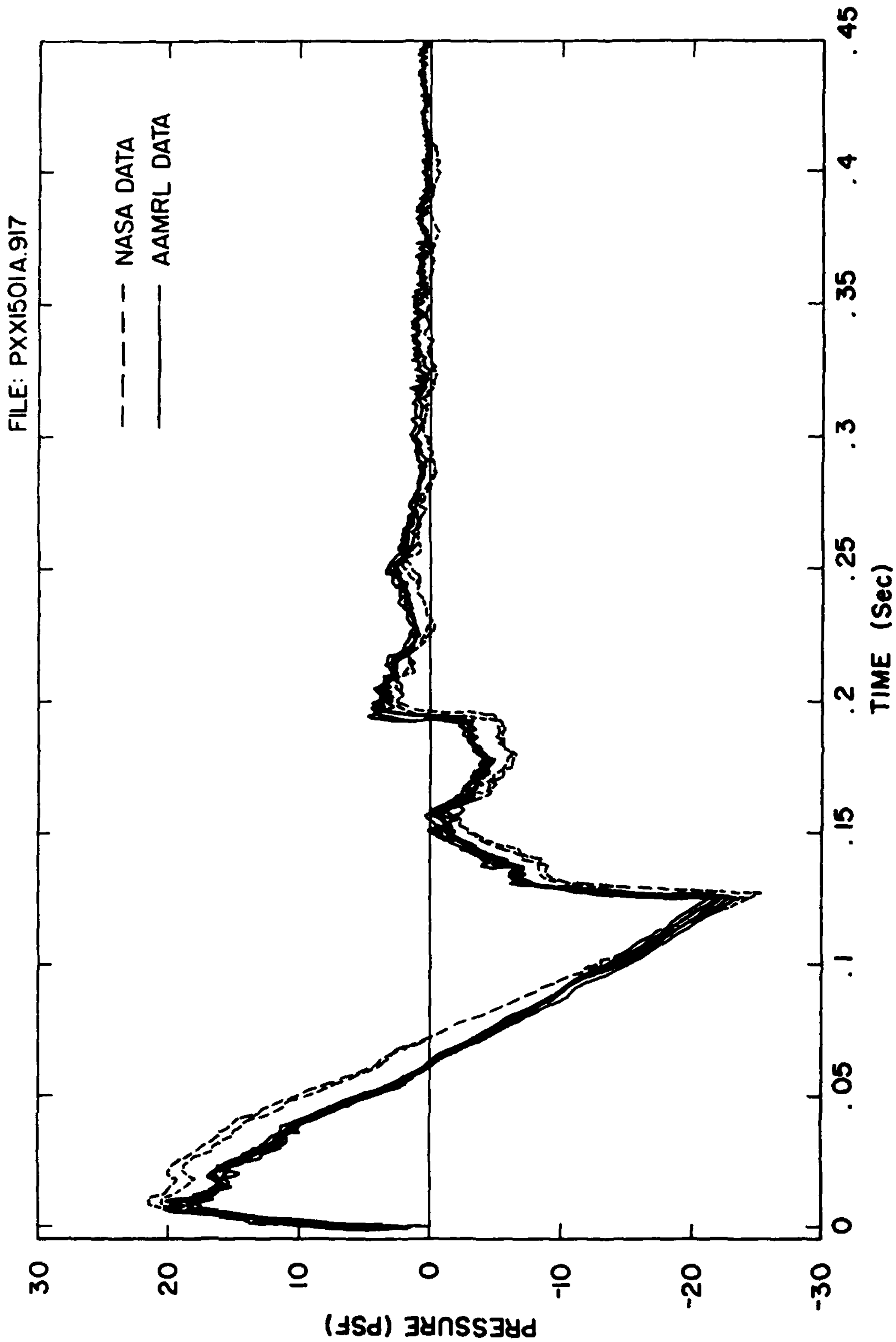


Figure 15. 20 PSF Boom Signature Comparison

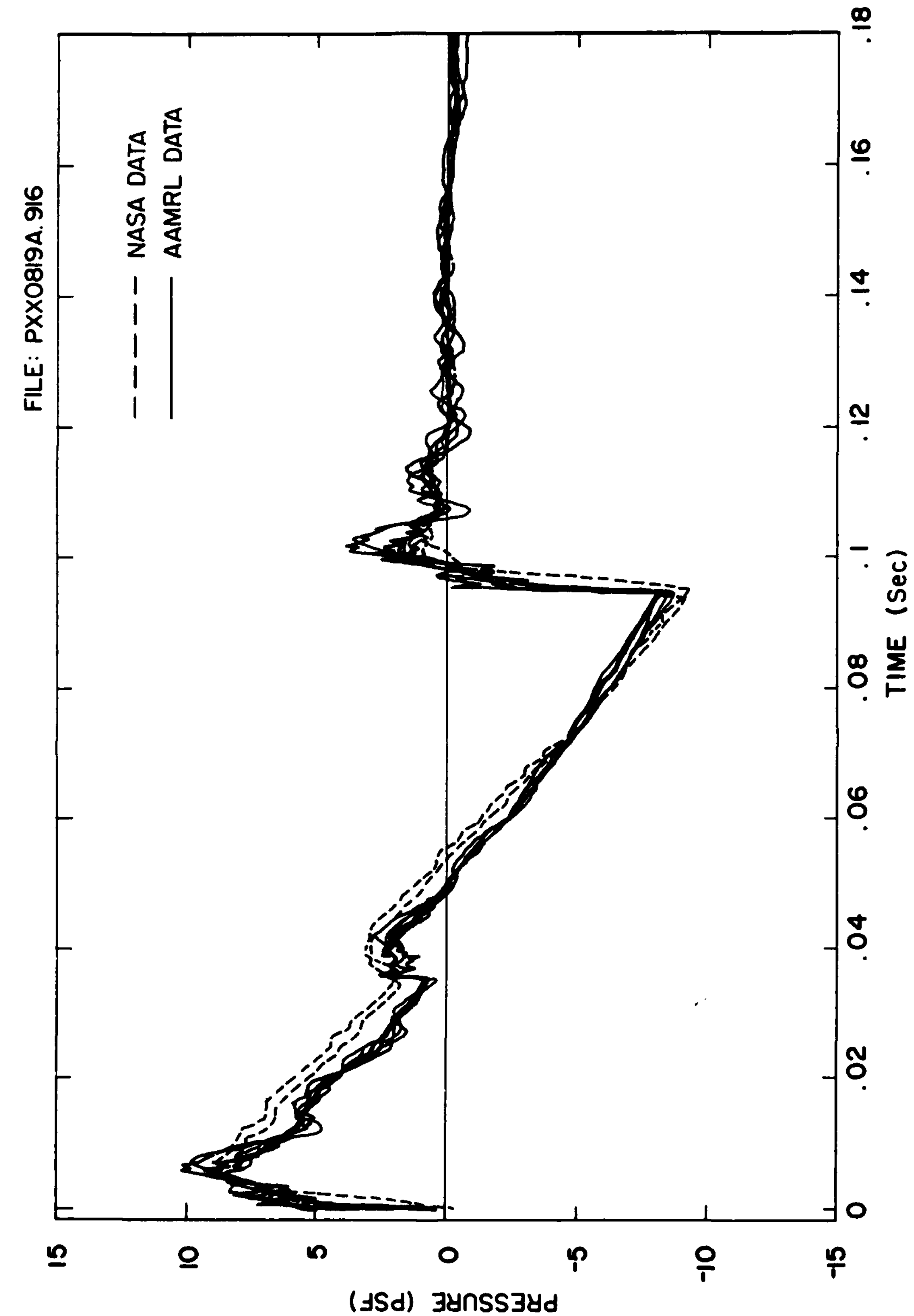


Figure 16. 10 PSF Boom with Resonance from Board Mount

Angle Mount Comparisons

Figures 20, 21 and 22 are comparisons of three BEAR collected pressure-time histories using the flush mounted microphone and the angle mounted microphones (see Figure 10). Again, we see great agreement between these mount configurations. Since the angled microphones were mounted on an angled wire mount, they were also very susceptible to boom induced oscillation. This can also be seen on several of these boom comparisons and is not indicative of the BEAR performance.

Figures 23, 24 and 25 are comparisons of three BEAR collected pressure-time histories using the AAMRL inverted microphone mount and the angle mounted microphones. Again, we see great agreement between these mount configurations.

Table 4 summarizes these differences for the three mount configurations across these three events. The positive peak pressure values (in dB and PSF), as well as the time integrated values of non-weighted sound exposure level (FSEL), C-weighted sound exposure level (CSEL) and A-weighted sound exposure level (ASEL) are shown for all these events. Table 4 shows the FSEL and CSEL all agree within about .5 dB whereas the ASEL has variations of up to 3 dB for the same event.

The ASEL metric itself as applied to sonic booms causes large variations in the ASEL values. The major part of the energy of a sonic boom is at its fundamental frequency usually below 10 Hz. The A-weighting greatly reduces the contribution of the low frequencies making the higher frequencies dominate the ASEL Metric. These higher frequencies are more susceptible to local conditions from microphone to microphone contributing to the variation in the ASEL metric. Note that these variations in the ASEL are not due to mount configuration because some of the largest variations are between the same mount configuration.

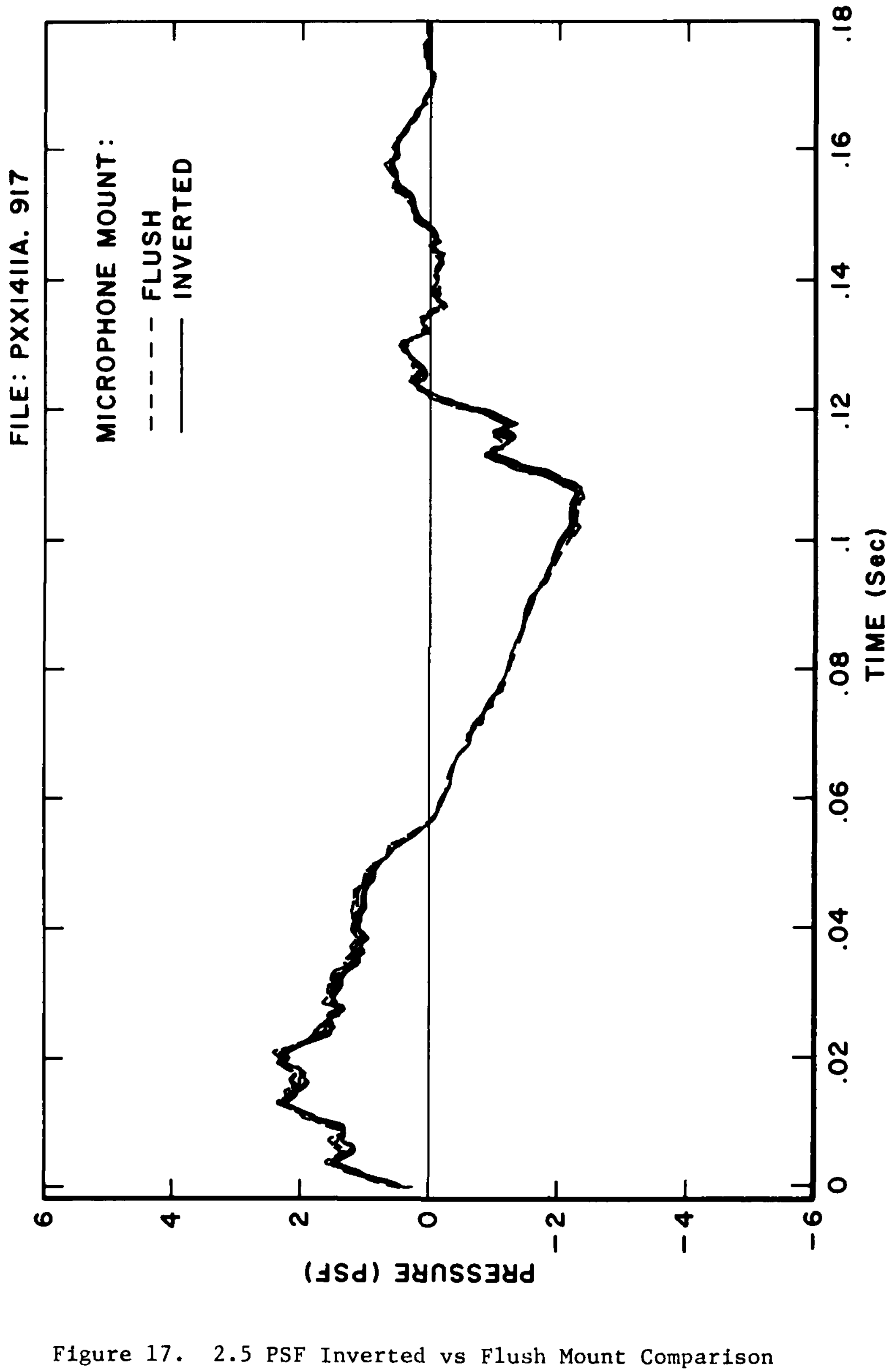


Figure 17. 2.5 PSF Inverted vs Flush Mount Comparison

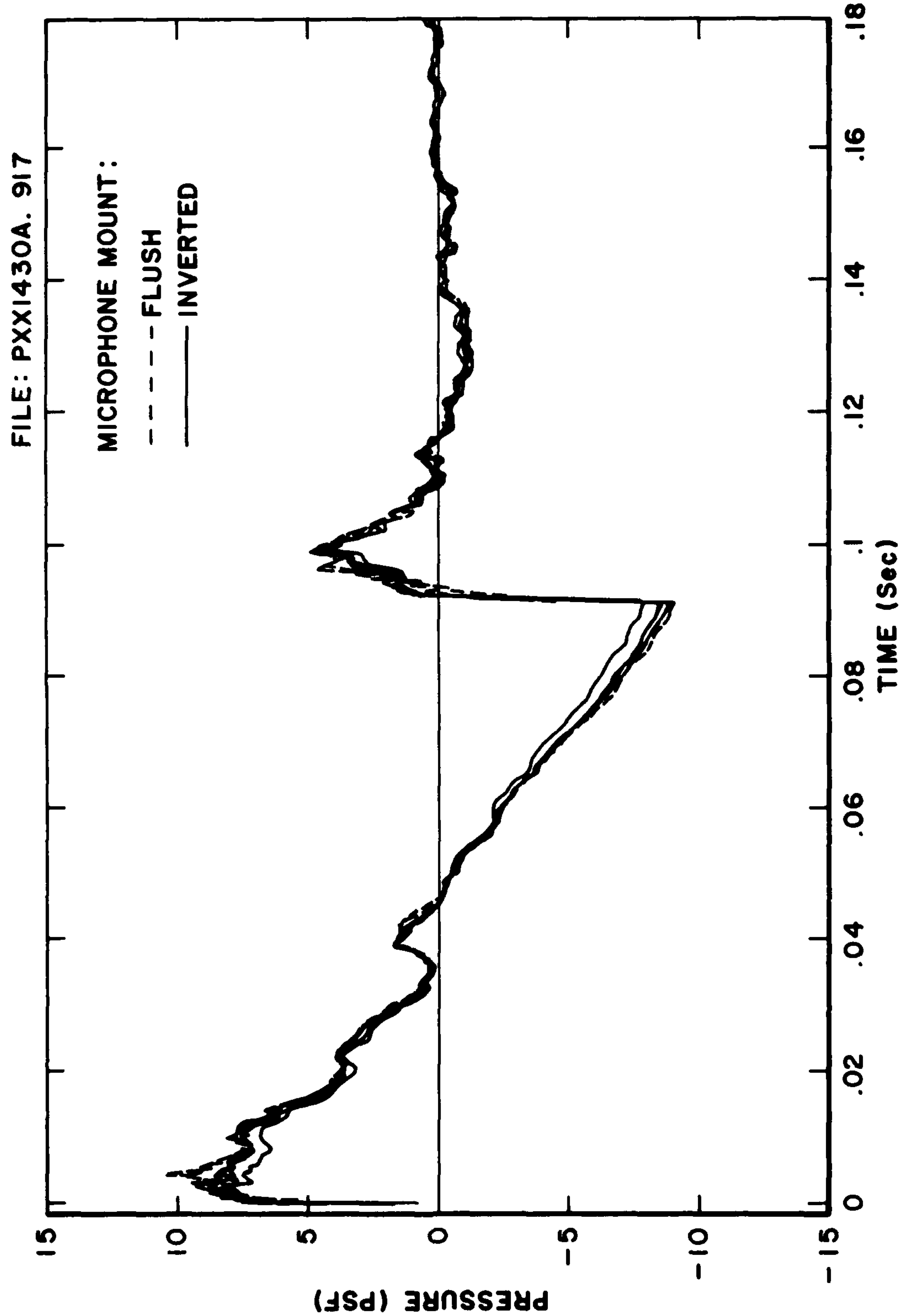


Figure 18. 10 PSF Inverted vs Flush Mount Comparison

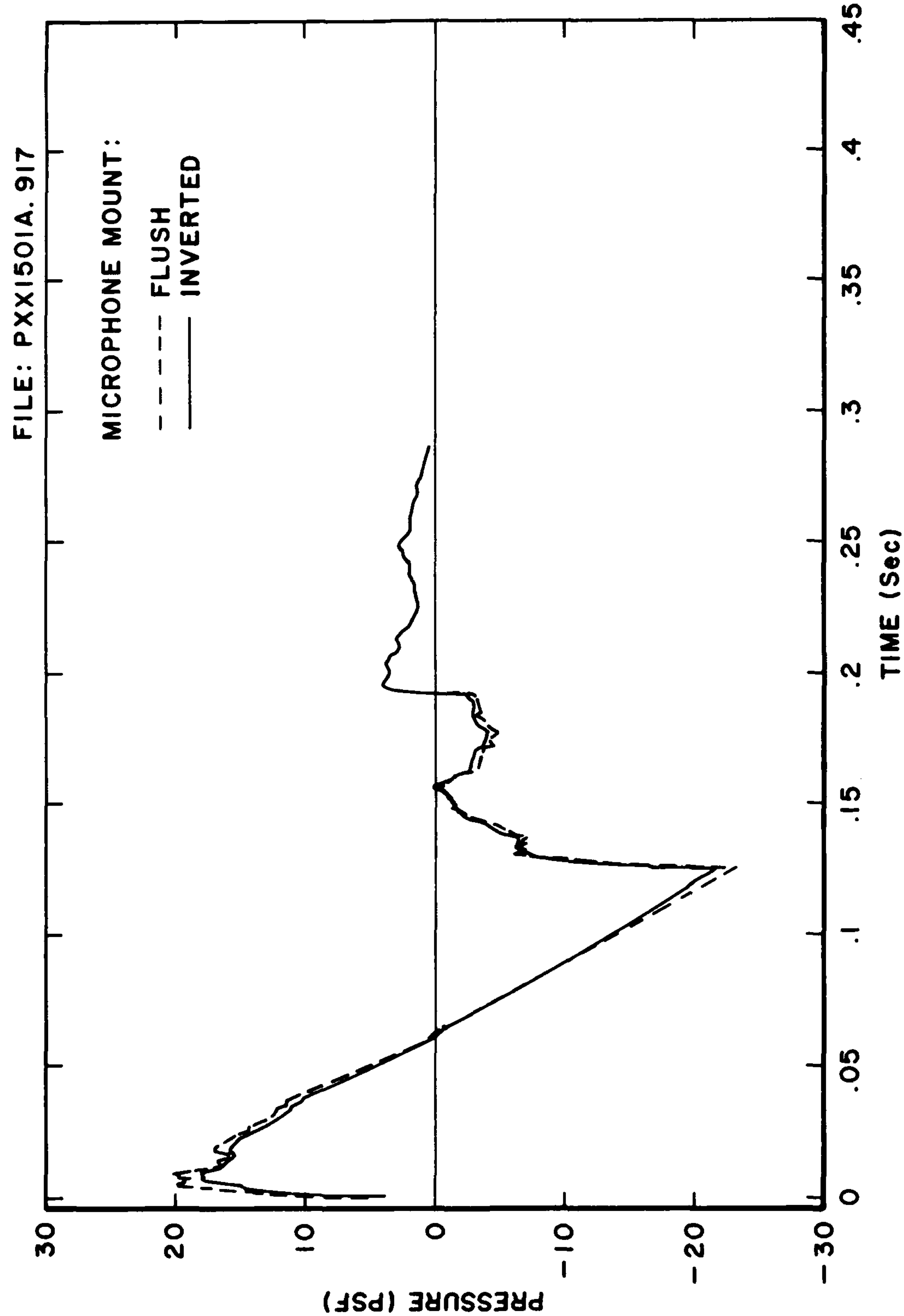


Figure 19. 20 PSF Inverted vs Flush Mount Comparison

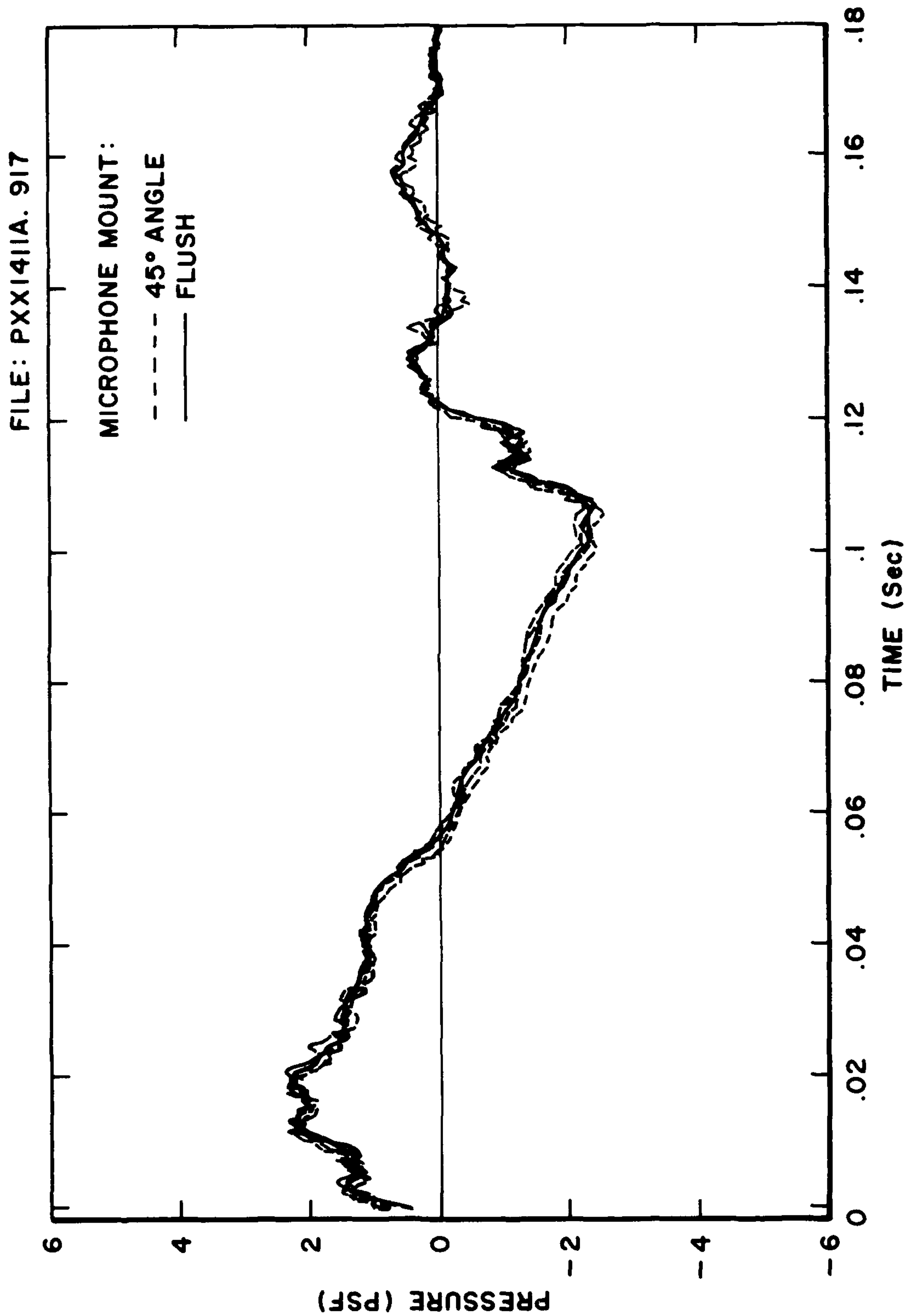


Figure 20. 2.5 PSF Angle vs Flush Mount Comparison

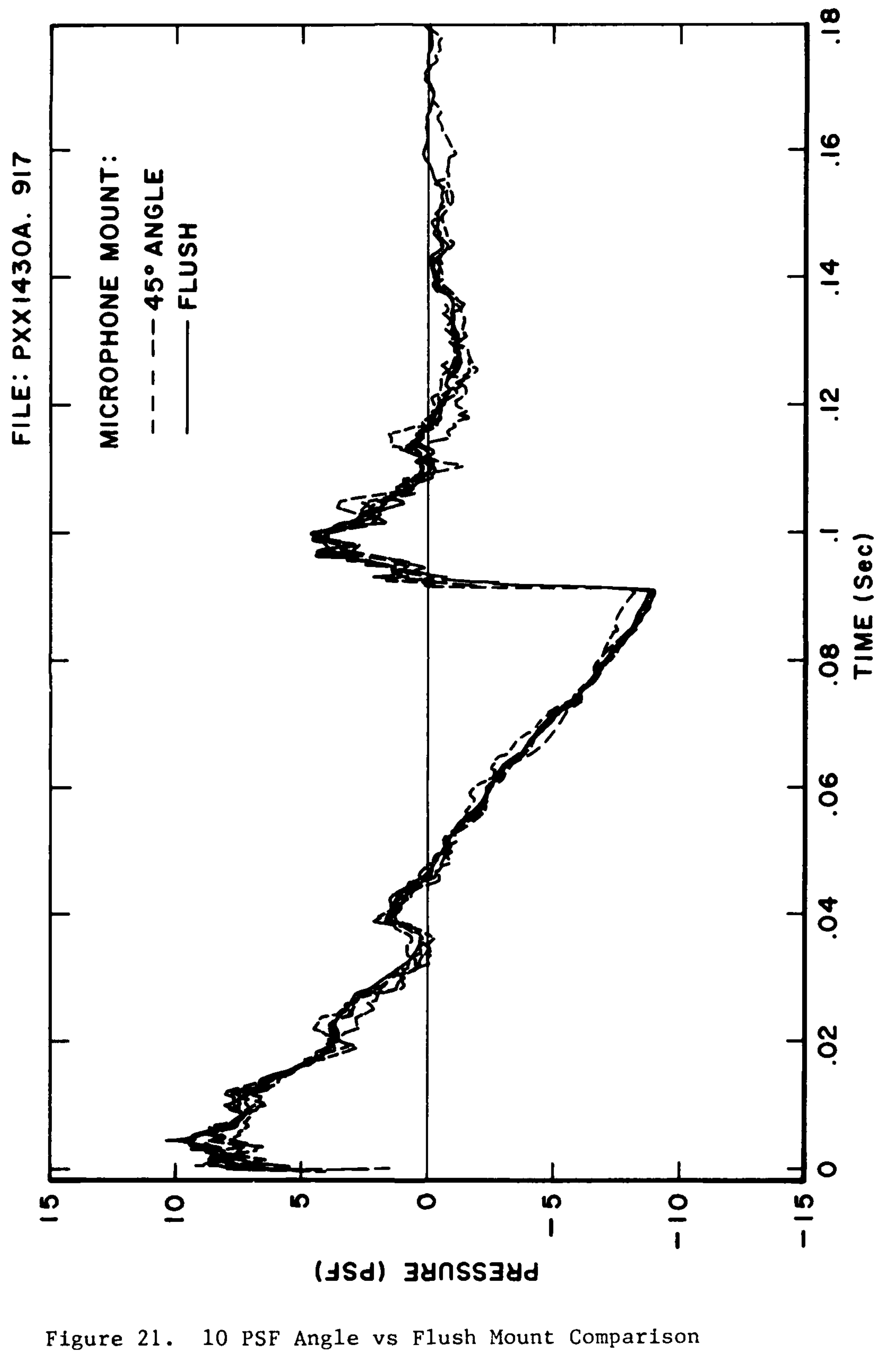


Figure 21. 10 PSF Angle vs Flush Mount Comparison

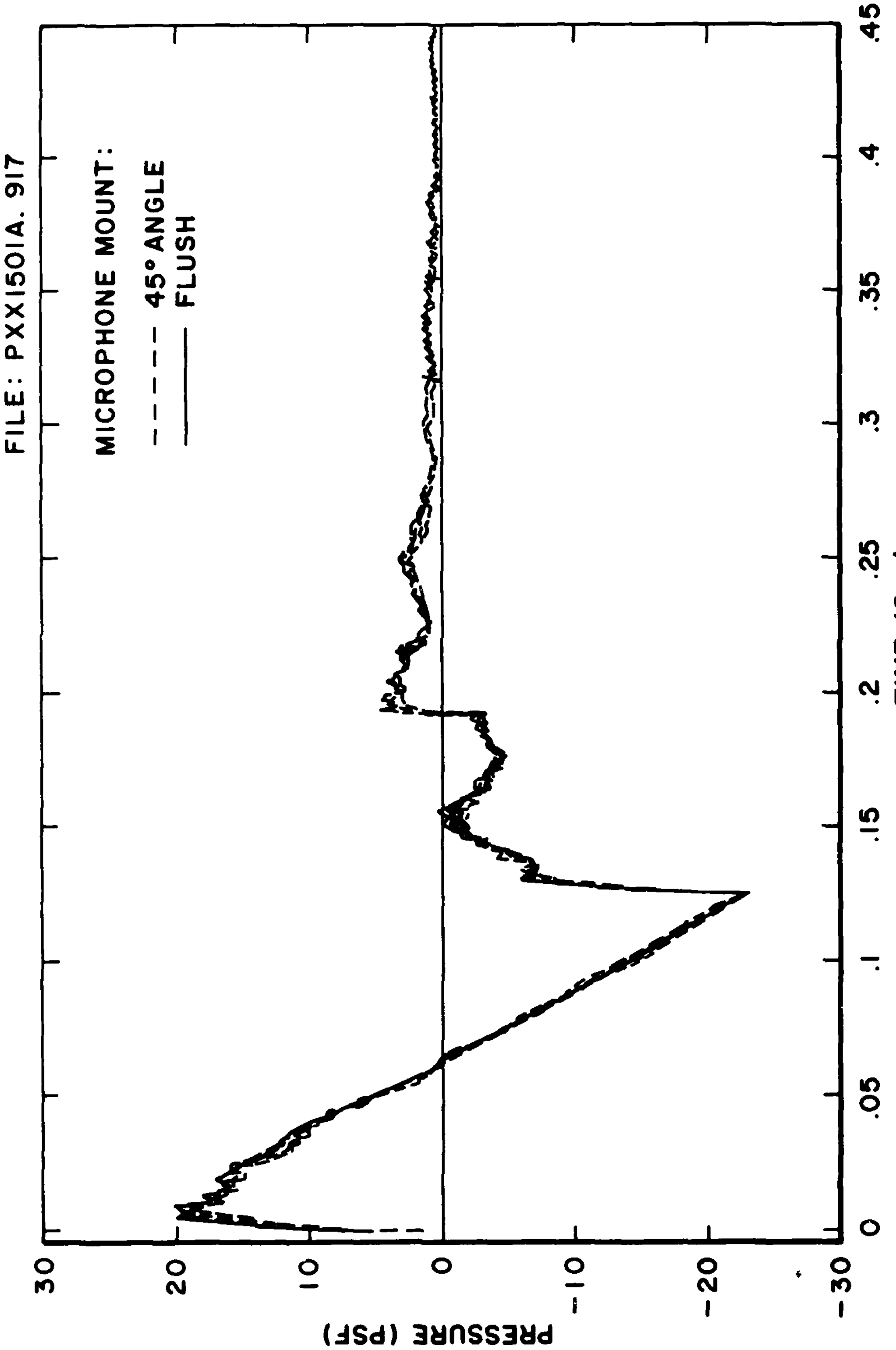


Figure 22. 20 PSF Angle vs Flush Mount Comparison

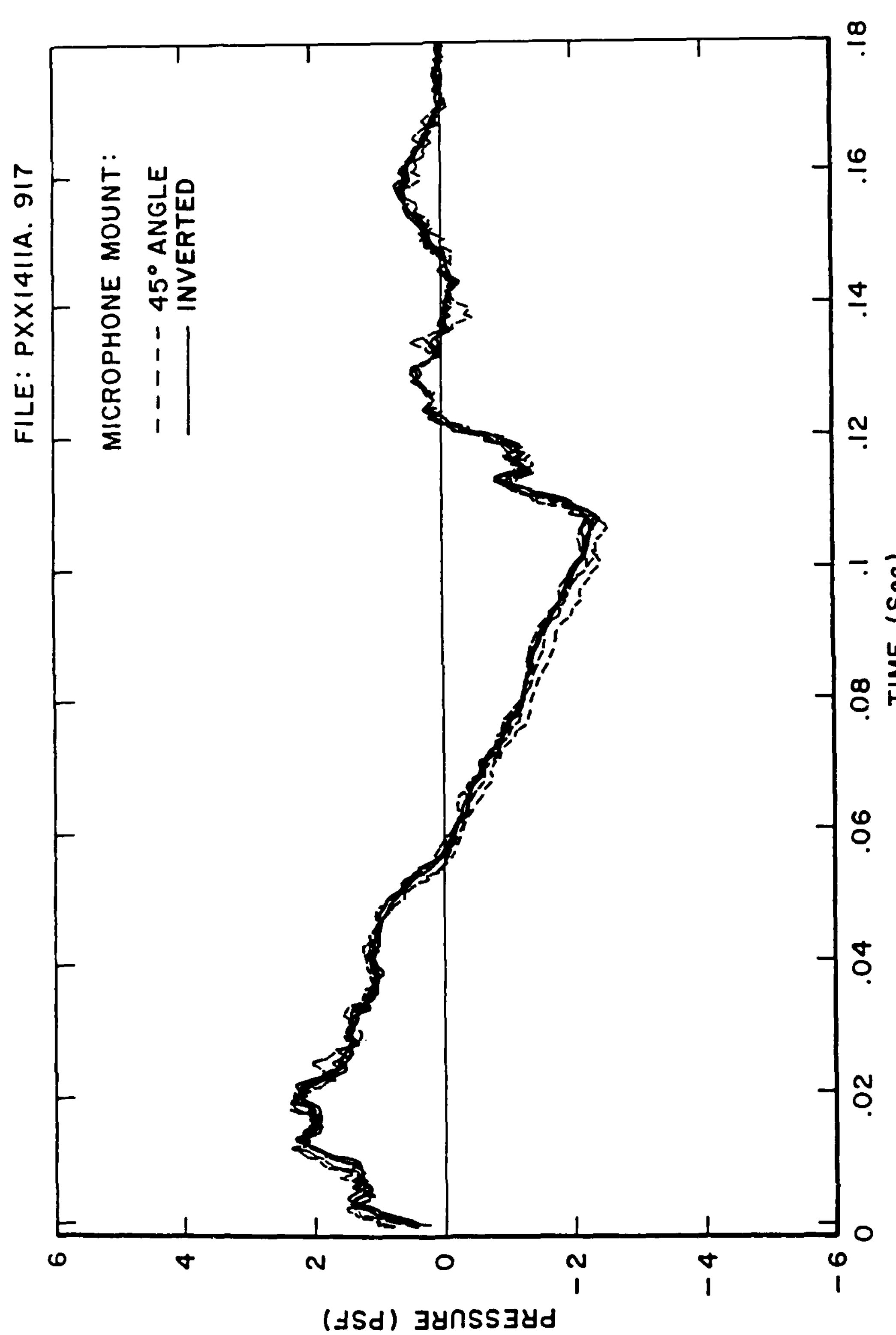


Figure 23. 2.5 PSF Angle vs AAMRL Inverted Mount Comparison

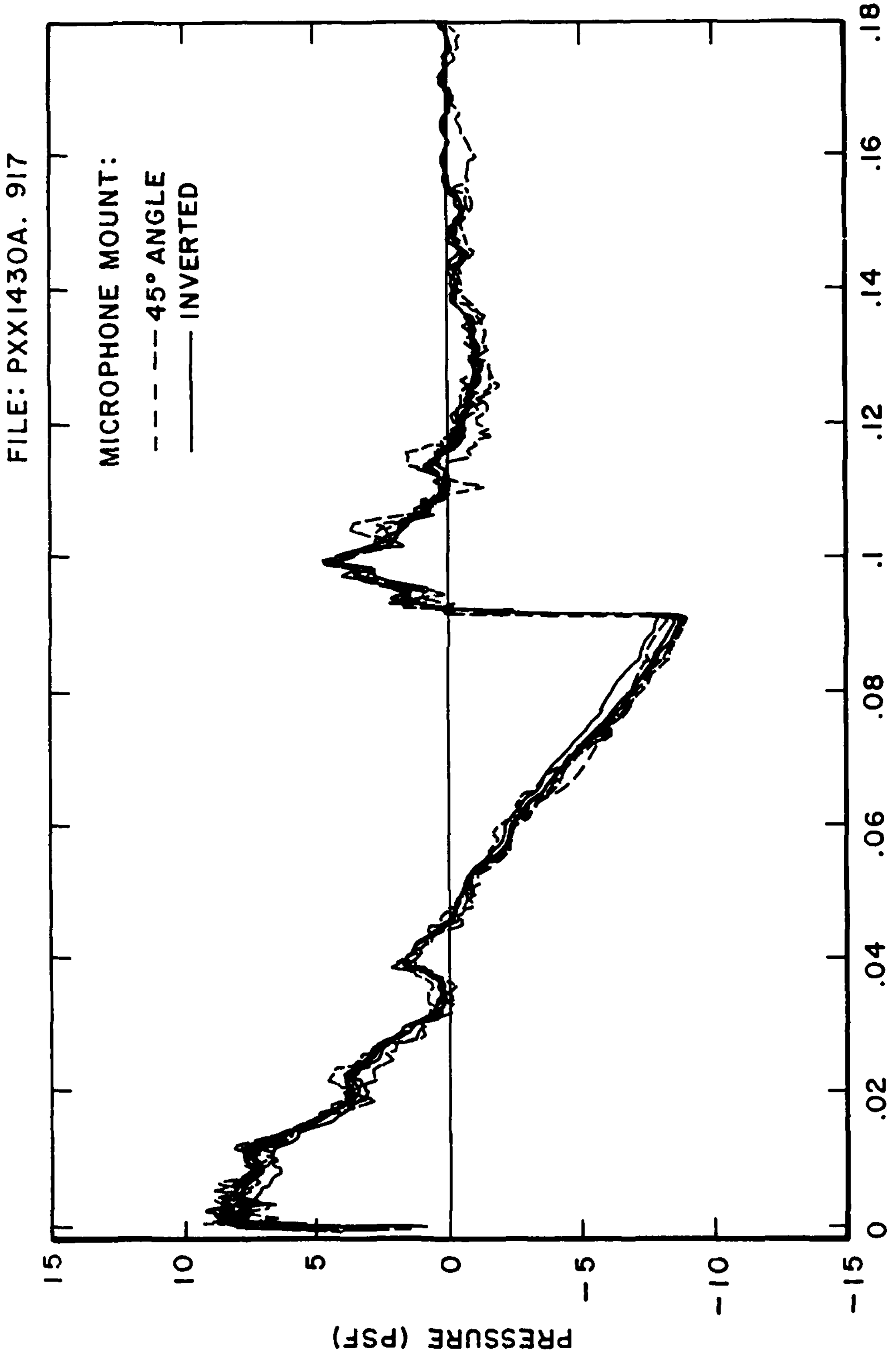


Figure 24. 10 PSF Angle vs AAMRL Inverted Mount Comparison

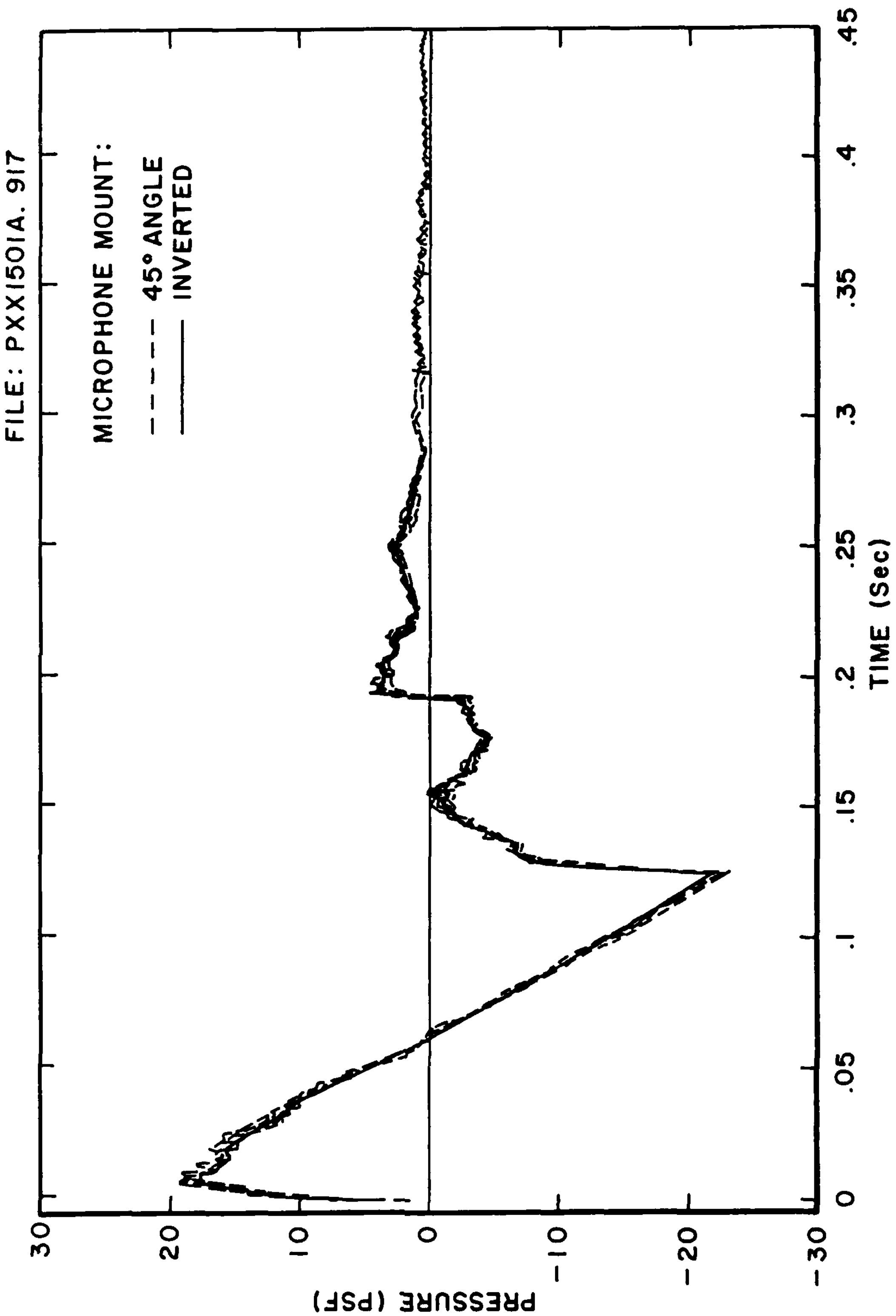


Figure 25. 20 PSF Angle vs AAMRL Inverted Mount Comparison

TABLE 4

Microphone Mount Comparisons

****

DATE	BEAR SN	CONFIGURATION	PK (dB)	PK (PSF)	ASEL	CSEL	FSEL
17 SEP 86	1	FLUSH MOUNT	135.0	2.3	89.4	109.0	122.0
14:11 pm	3	FLUSH MOUNT	135.6	2.5	91.1	109.4	122.2
	4	45 DEG ANGLE	135.4	2.5	92.4	109.5	122.2
	5	45 DEG ANGLE	135.3	2.4	92.5	109.0	122.3
	6	45 DEG ANGLE	135.4	2.5	91.8	109.3	122.0
	7	45 DEG ANGLE	135.3	2.4	92.2	108.4	121.7
	8	BBE MOUNT	134.7	2.3	89.8	108.5	121.3
	9	BBE MOUNT	135.2	2.4	89.6	109.2	121.9
	10	BBE MOUNT	135.0	2.3	90.2	108.8	121.6

****

DATE	BEAR SN	CONFIGURATION	PK (dB)	PK (PSF)	ASEL	CSEL	FSEL
17 SEP 86	1	FLUSH MOUNT	147.5	9.9	105.9	124.3	131.9
14:30 pm	3	FLUSH MOUNT	148.2	10.7	108.2	124.6	132.0
	4	45 DEG ANGLE	147.2	9.6	109.6	124.2	131.6
	5	45 DEG ANGLE	146.8	9.1	108.4	124.5	132.0
	6	45 DEG ANGLE	146.1	8.4	108.7	124.3	131.9
	7	45 DEG ANGLE	146.3	8.6	108.5	124.1	131.9
	8	BBE MOUNT	146.1	8.4	107.5	123.9	131.3
	9	BBE MOUNT	146.7	9.0	107.4	124.3	131.8
	10	BBE MOUNT	146.4	8.7	107.2	124.1	131.5
	11	BBE MOUNT	146.6	8.9	107.0	123.9	131.4
	12	BBE MOUNT	146.9	9.2	107.3	124.3	131.8

****

DATE	BEAR SN	CONFIGURATION	PK (dB)	PK (PSF)	ASEL	CSEL	FSEL
17 SEP 86	2	FLUSH MOUNT	154.1	21.1	110.3	128.0	141.5
15:01 pm	3	FLUSH MOUNT	153.9	20.7	108.7	127.9	141.5
	4	45 DEG ANGLE	153.5	19.7	109.8	127.7	141.4
	5	45 DEG ANGLE	153.8	20.4	108.8	128.0	141.8
	6	45 DEG ANGLE	153.6	20.0	110.5	127.9	141.6
	7	45 DEG ANGLE	153.3	19.3	110.1	127.6	141.4
	8	BBE MOUNT	152.7	18.0	107.5	127.1	140.9

FREQUENCY ANALYSIS COMPARISON

Both the AAMRL BEAR and the NASA analog system collected data were processed to obtain the one hertz band width sound exposure spectrum level plots, Flat Weighted Sound Exposure Levels (FSEL), A-weighted Sound Exposure Levels (ASEL) and the C-weighted Sound Exposure Levels (CSEL). The BEAR data were transferred to the AAMRL mainframe computer and processed through the AAMRL BOOMBEAR Program. The BOOMBEAR Program takes the BEAR pressure-time digitized waveform and transforms it into a pressure-frequency plot using the Fast Fourier Transform (FFT). Since the BEAR captures just the boom signature, typically around 200 milliseconds, the event was zero filled out to one second before inputting to the BOOMBEAR program. This zero filling technique adds a sound pressure value of zero to the event effectively adding no energy but allows direct comparison to the NASA data that always used one second of the analog recording that contained the sonic boom. The NASA data were first digitized at 8000 points per second and then run through the NASA SBFFT program; the NASA SBFFT Program also converts from the pressure-time plots to the pressure-frequency plots via the FFT algorithm. Since this one second contained background and electronic noise floor data of the NASA recording system, some of the NASA events show higher levels at the higher frequencies that are not dominated by the boom event.

Figures 26 through 30 are the frequency comparisons for several booms ranging from more than 20 PSF to less than 1 PSF. Figures 27 and 28 show the results of two similar runs (F-4 at 5000 ft altitude AGL) during morning and afternoon runs. Figure 27 from the morning run, had a fairly clean distinctive F-4 N-wave. Figure 28 from the afternoon run, had a slightly distorted (from the atmospheric disturbance) N-wave that shows up in the slightly distorted frequency plots.

Table 5 presents the single metric comparisons between the two systems. The comparisons are made with representative signatures from the BEAR and NASA systems. There is good agreement between these values for the two systems except for the A-weighted SEL's. (See Table 6) This is due to the high frequency components that are in the NASA data discussed above. This is not part of the sonic boom but is due to the limited dynamic range of the instrumentation that was used by NASA. The low frequency energy is heavily weighted and virtually ignored with the A-weighting. Therefore, the low-level higher-frequency data, including the electronic noise floor of the recording system, become important to the A-weighted metric but are not representative of the major energy of a typical sonic boom.

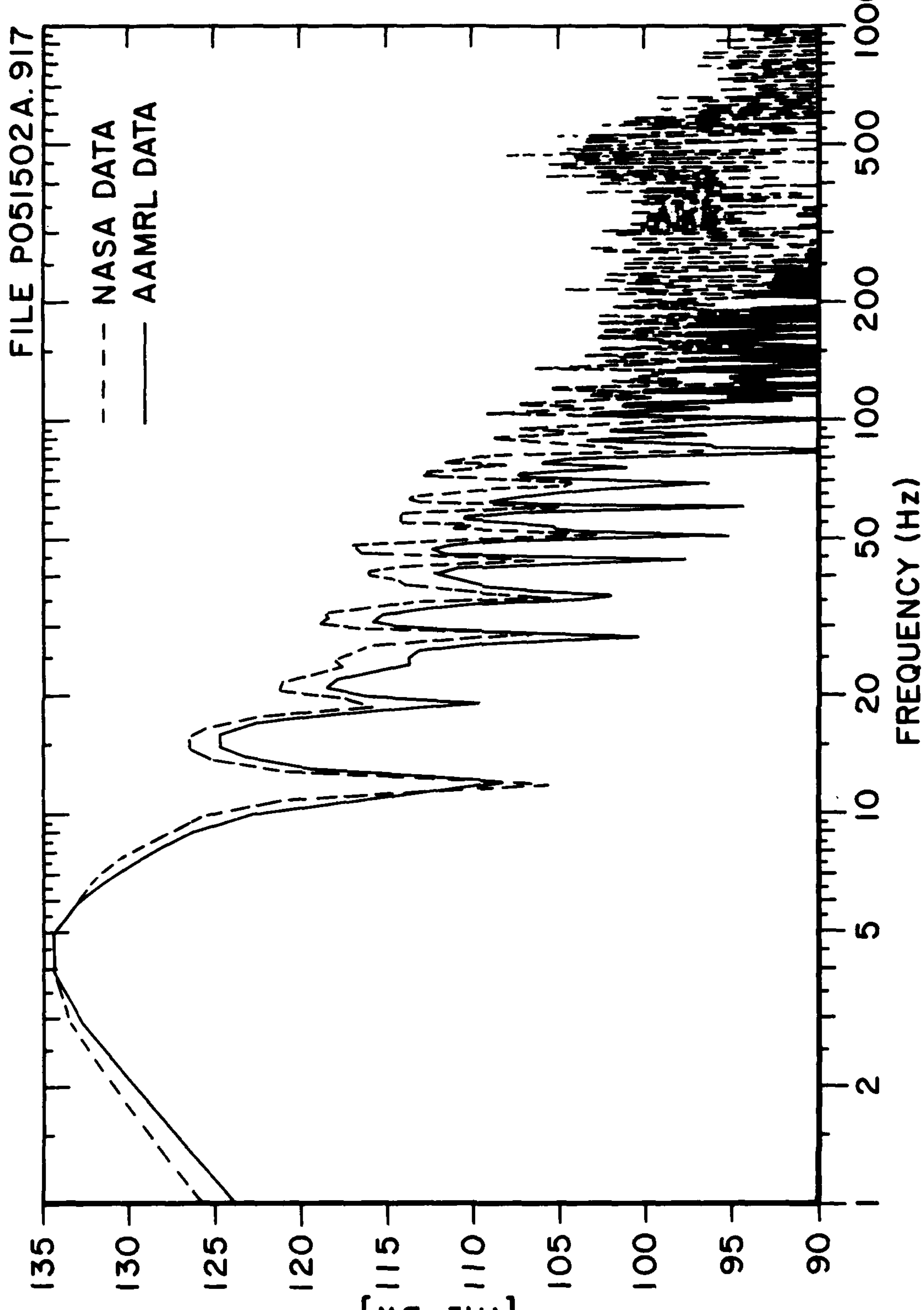


Figure 26. 20 PSF Boom Spectrum Comparison

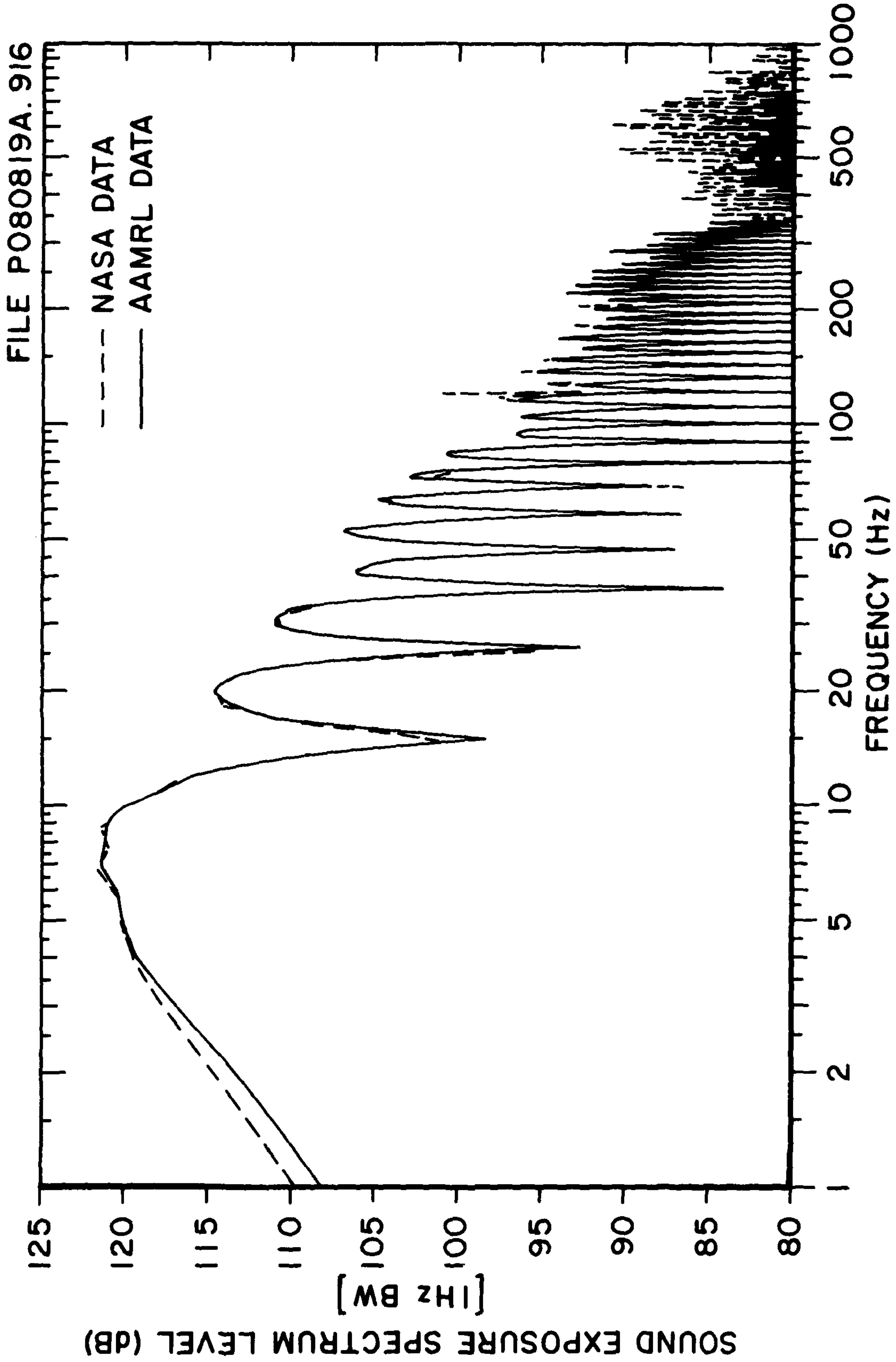


Figure 27. 8 PSF Clean Boom Spectrum Comparison

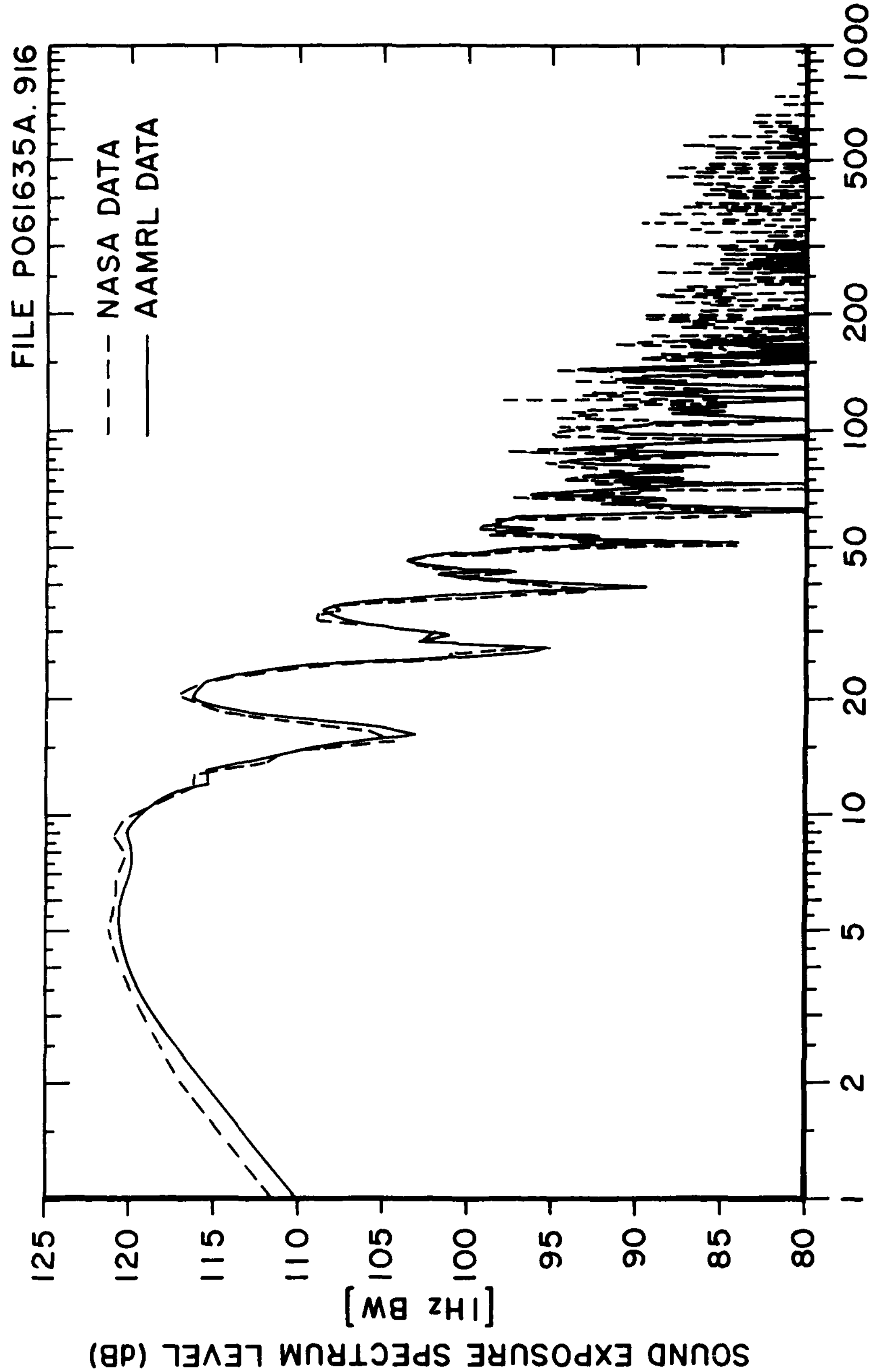


Figure 28. 8 PSF Distorted Boom Spectrum Comparison

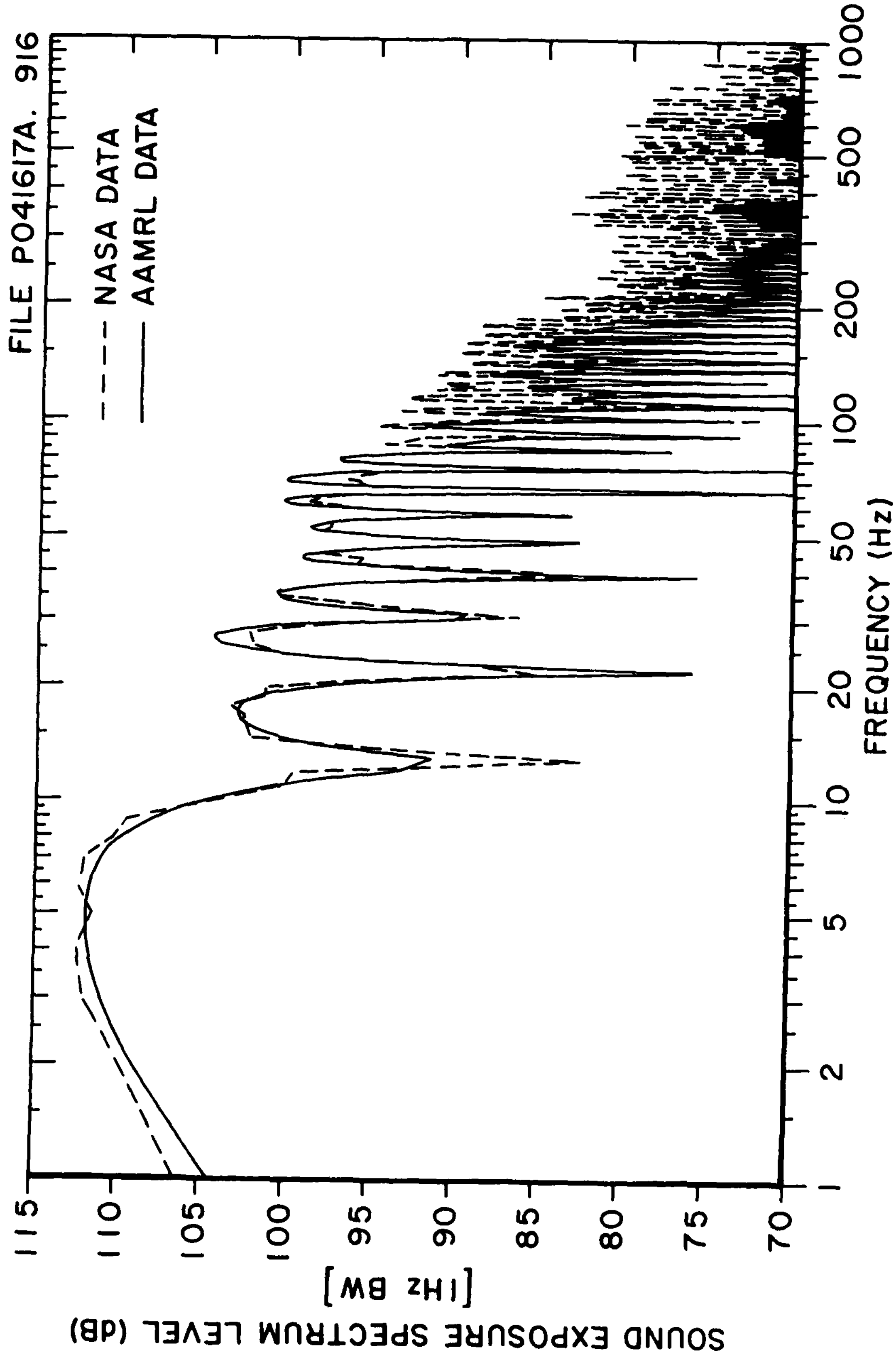


Figure 29. 3.6 PSF Boom Spectrum Comparison

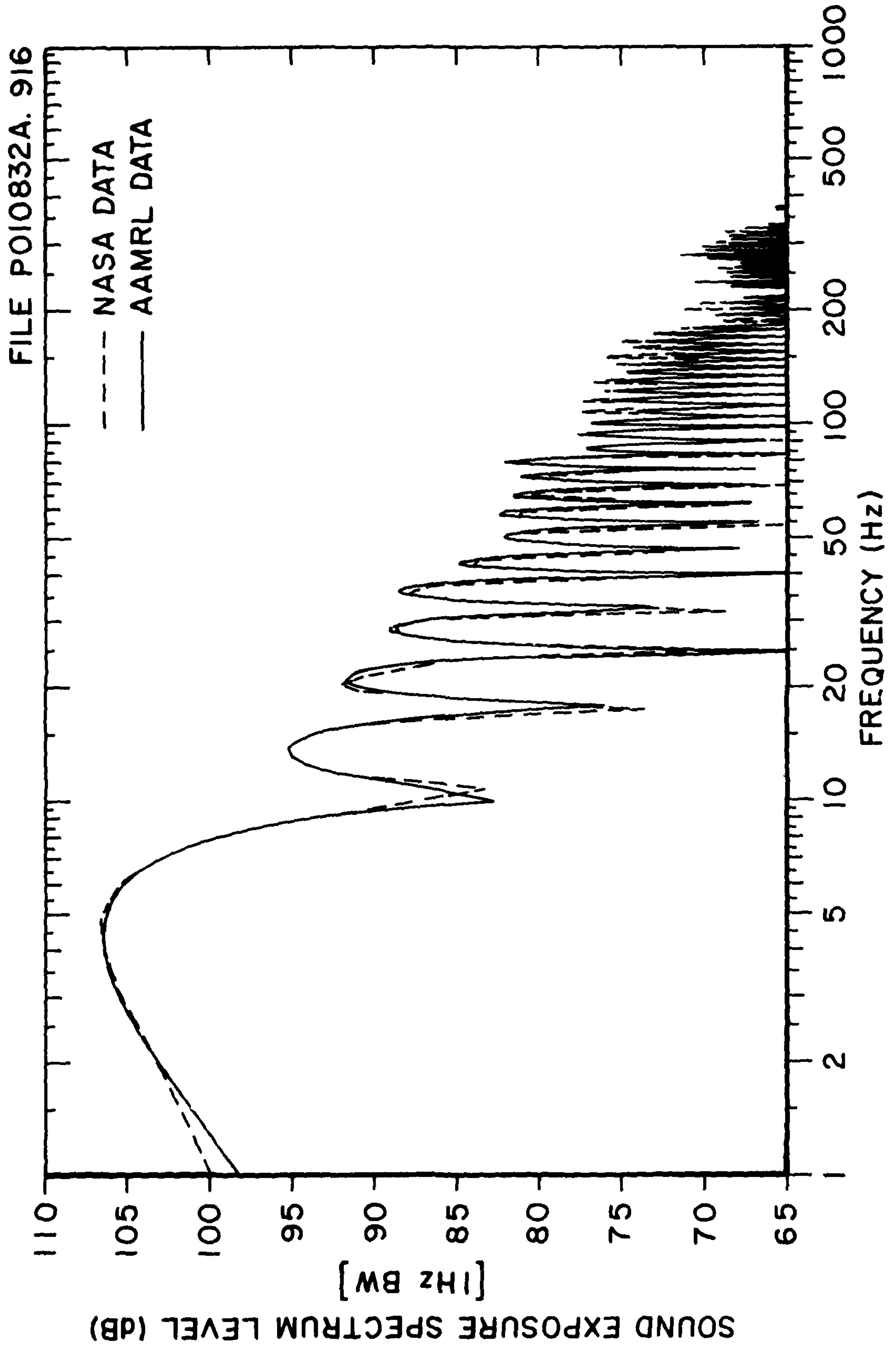


Figure 30. .9 PSF Boom Spectrum Comparison

TABLE 5

NASA to Air Force Single Metric System Comparisons

NASA FLIGHT #	Time	AAMRL SINGLE METRIC				BEAR SYSTEM NUMBER	NASA SINGLE METRIC				NASA SYSTEM NUMBER
		Peak	FSEL	CSEL	ASEL		PEAK	FSEL	CSEL	ASEL	
35K-1	8:32 16Sep86	126.7	114.0	100.9	84.7	1001	127.4	114.2	100.7	87.8	CH-7
19K-3	16:17 16Sep86	139.3	121.8	114.0	97.5	1003	139.6	122.2	114.5	102.6	CH-9
5K-1	8:19 16Sep86	146.5	131.4	122.6	106.1	1010	146.5	131.4	122.6	111.2	CH-10
5K-3	16:35 16Sep86	146.5	131.2	121.2	101.6	1004	146.4	131.7	121.5	107.7	CH-10
1K-1	15:01 17Sep86	153.9	141.5	127.9	108.7	1003	154.1	141.8	128.3	116.3	CH-9

TABLE 6

NASA to Air Force Single Metric Systems Differences

NASA Flight #	Time	Peak*	FSEL*	CSEL*	ASEL*	BEAR System Number	NASA System Number
35K-1	8:32 16Sep86	0.7	0.2	0.2	3.1	1001	CH-7
19K-3	16:17 16Sep86	0.3	0.4	0.5	5.1	1003	CH-9
5K-1	8:19 16Sep86	0.0	0.0	0.0	5.1	1010	CH-10
5K-3	16:35 16Sep86	-0.1	0.5	0.3	6.1	1004	CH-10
1K-1	15:01 17Sep86	0.2	0.3	0.4	7.6	1003	CH-9

* Values are NASA system values minus AAMRL BEAR values.

OTHER FACTORS

Clipped Signal

The last run of the F-111 aircraft on 17 Sep 86 created a boom of approximately 36 PSF overpressure. Since the BEAR's range was designed for 23.4 PSF maximum, this run demonstrated the operation of the BEAR in an overload condition. Since the BEAR is a digital system , when it is overloaded the signal is just clipped but not distorted unless the capacity of the microphone is exceeded (at 185 dB). The BEAR software still evaluates this event as a boom and captures it. Figure 31 shows this 36 PSF boom captured by the BEAR system and a NASA system. As can be seen, this clipped boom could be estimated fairly easily by extending the major slope of the N-wave. This would allow a person to recreate, with a reduced degree accuracy, a boom that was beyond the range of the BEAR's design.

Echos and Secondary Booms

Quite frequently when sonic booms occur, secondary booms occur from the same flight. These can be caused by the boom echoing off a nearby surface or the boom arriving from a slightly different ray path. If the separation of these booms is less than the event separation timer (timer 2) set value, the BEAR will simply capture both of these events on a single file. Figure 32 shows an example of how the BEAR captured this kind of secondary boom event. If the secondary boom were to occur later than what is set by timer 2, the BEAR would evaluate it as a separate boom event and store it in its own file. This allows the BEAR to capture any combination of booms occurring within the same time frame.

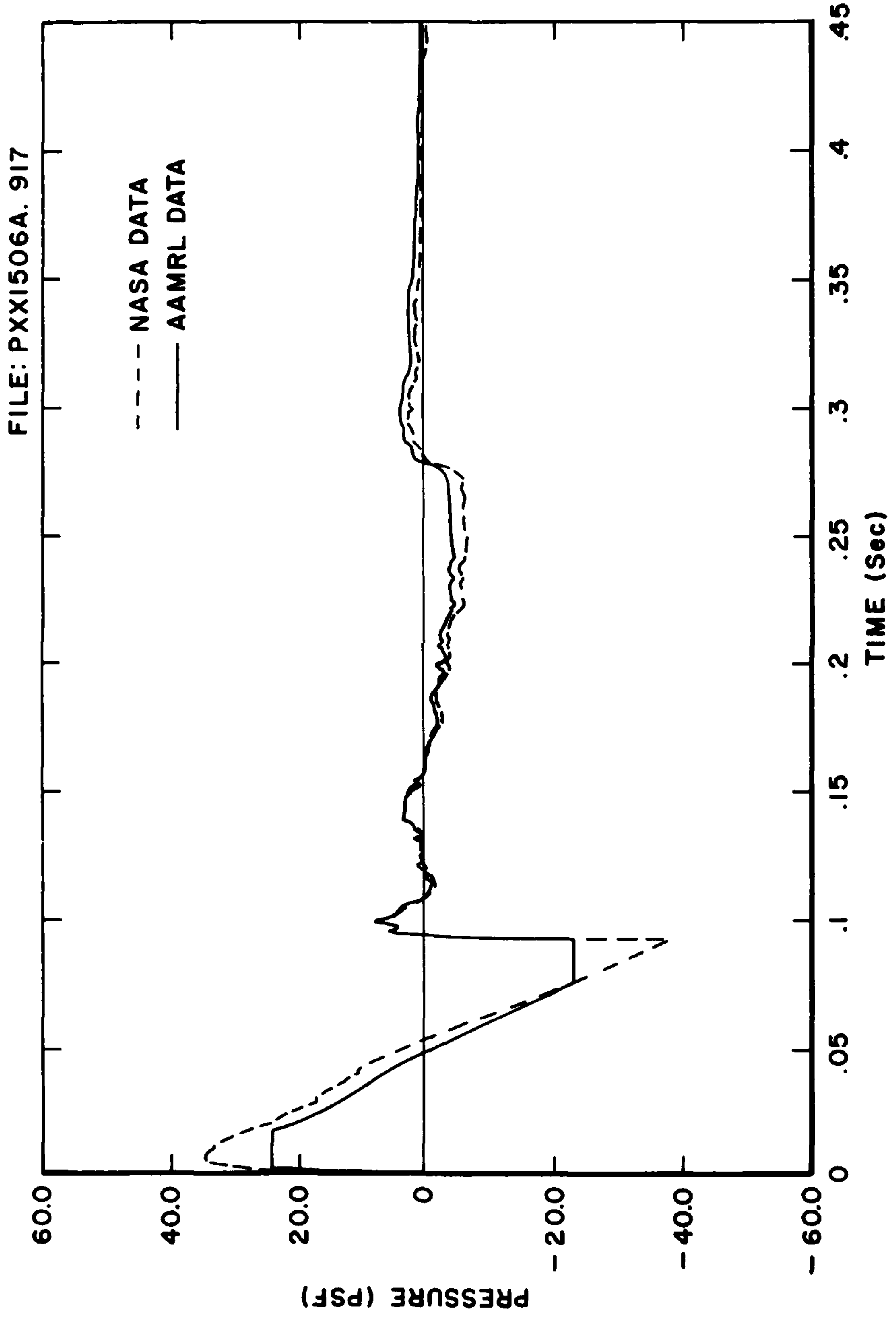


Figure 31. 36 PSF Clipped BEAR Signature

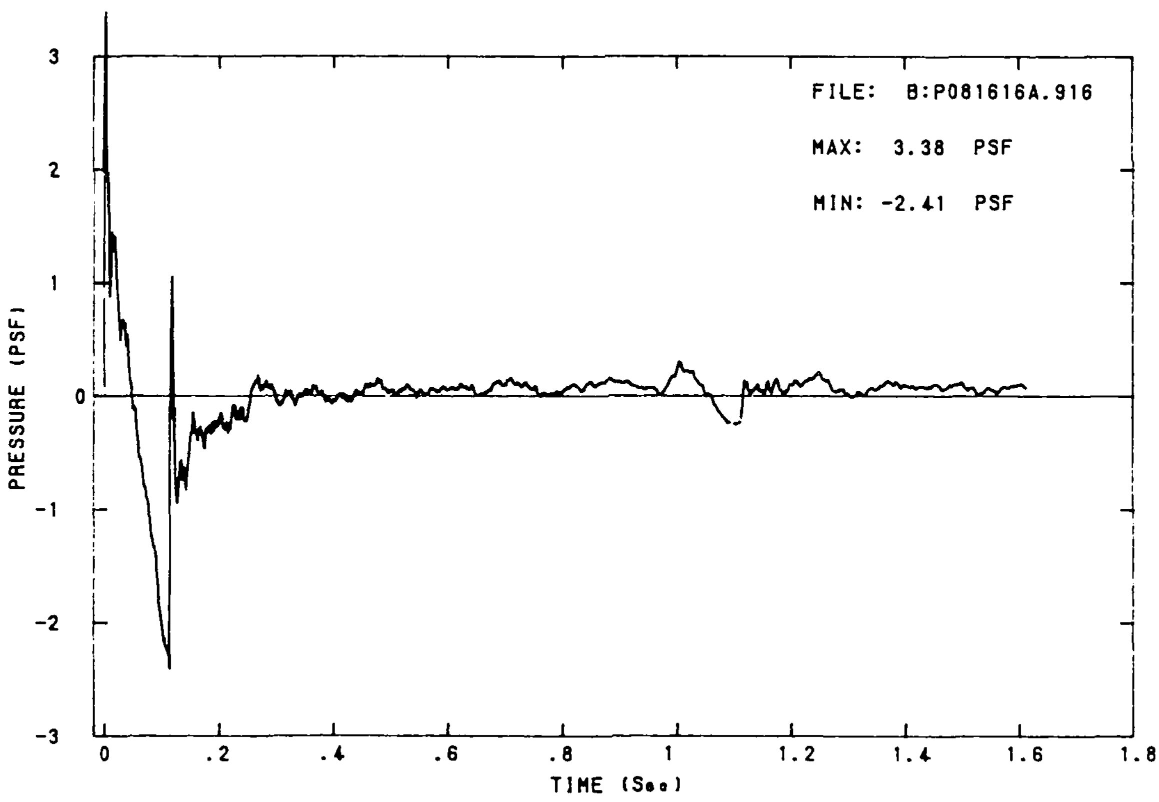


Figure 32. Secondary Boom

SUMMARY

This test demonstrated that the AAMRL BEAR systems are functionally equivalent to the NASA analog systems for capturing sonic boom waveforms. Typically the duration of sonic booms from supersonic military aircraft is around 200 milliseconds. The BEAR low-frequency cutoff of .5 Hz will introduce less than .5 dB error in the FSEL value at these durations. If the BEAR systems were to be used to collect boom waveforms greater than 500 milliseconds, the microphone and the interface amplifiers to the BEAR's A/D converter should be changed to a lower low-frequency cutoff specification. This is fairly easy to do given the modular design of the BEAR system. This test also demonstrated that the proposed AAMRL inverted microphone mount is functionally equivalent to a flush mounted microphone for capture of sonic booms and can be used for future boom studies.

Several findings from these tests led to improvements in the BEAR's operation. Since the PCB microphones used with the BEAR can handle up to 185 dB and we don't need levels down to 65 dB, the BEAR operating range was shifted upwards by 10 dB. The BEARs now cover the range from 75 dB to 165 dB allowing capture of a boom up to 76.4 PSF without clipping. The non-boom rejection routines were improved to better compensate for the wind and thermal drift problems. Functionally the improvements do not affect the way the BEAR handles the incoming signal but only how it is interpreted once it comes through the A to D converter. Therefore, these changes will not affect these comparison results.

These BEARS were used in August 1987 to collect over 500 signatures from USAF and USN supersonic aircraft with greater than a 99% success rate in capturing the boom signatures. These data are presented in a companion report.[3]

REFERENCES

1. Lee, Robert A.; Crabill, Monty; Palmer Barbara; Mazurek, Douglas, Ovenshire, David; Nuse, Kevin; Air Force Boom Event Analyzer Recorder (BEAR): System Description, AAMRL-TR-88-039 , (in publication process).

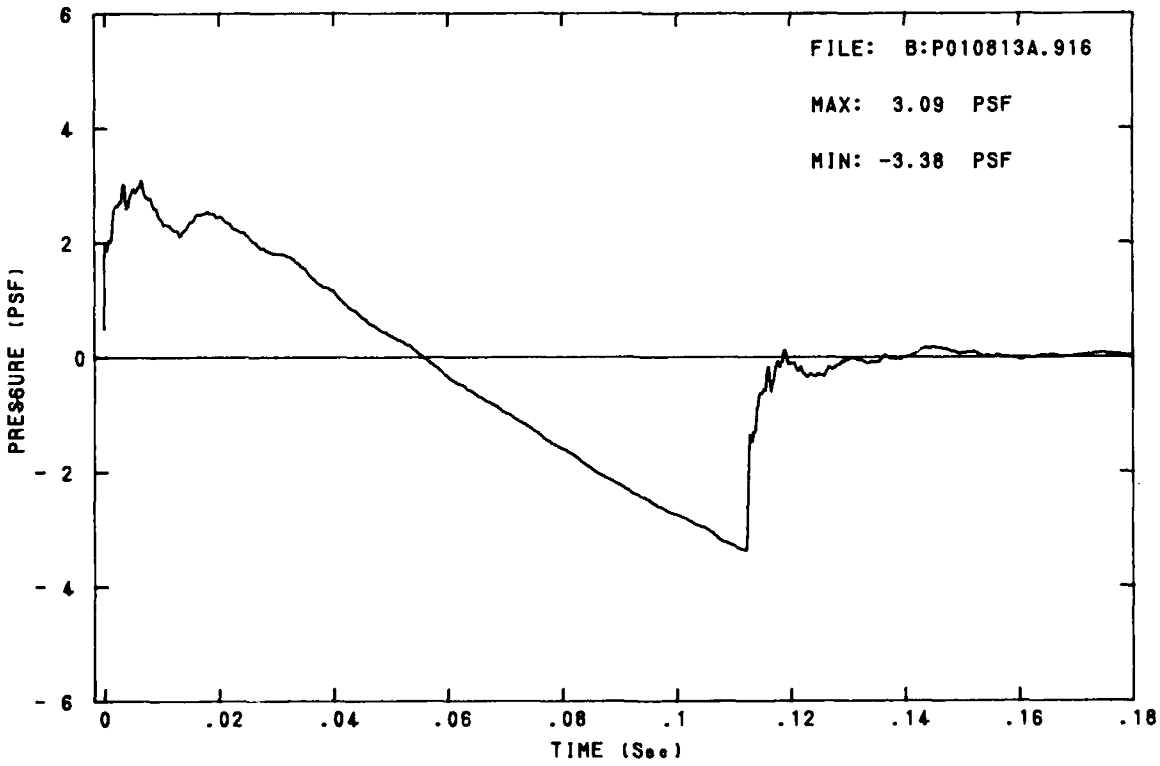
2. Galloway, William, BBN Technical Memorandum to AAMRL, 6 July 1984

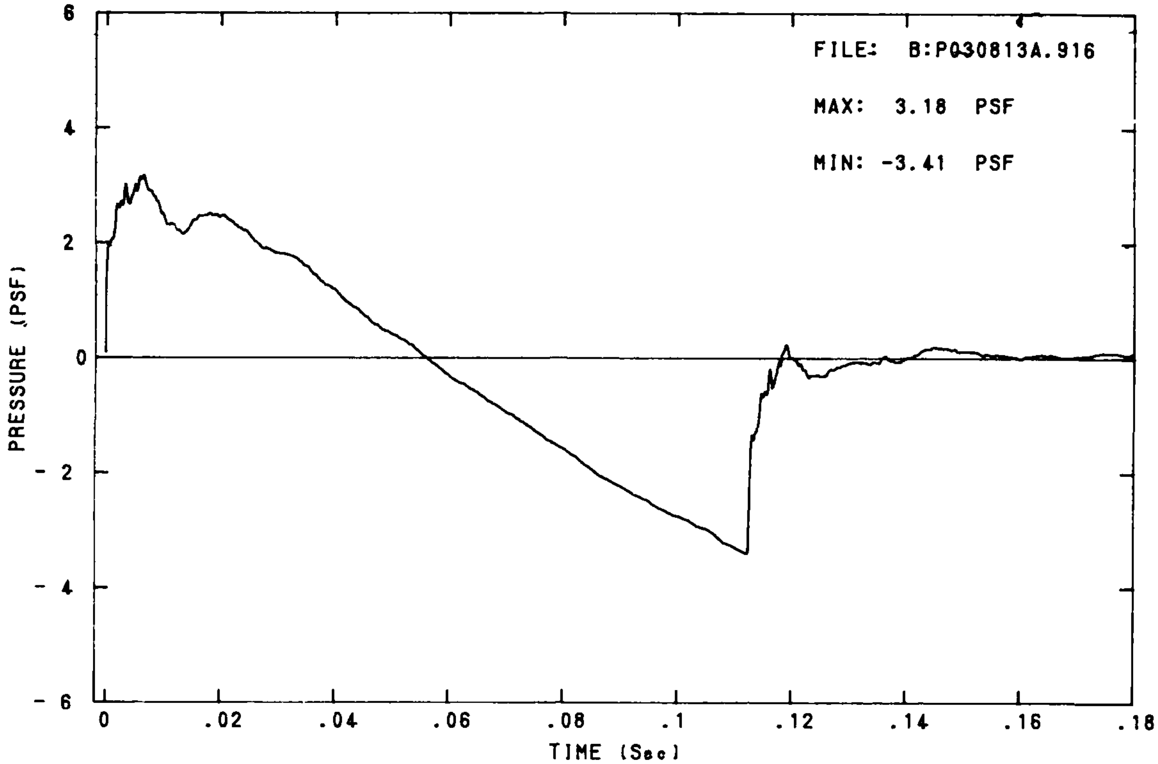
3. Lee, Robert A., AAMRL-TR-88-039, Sonic Booms Produced by USAF and USN Aircraft: Measured Data (in publication process).

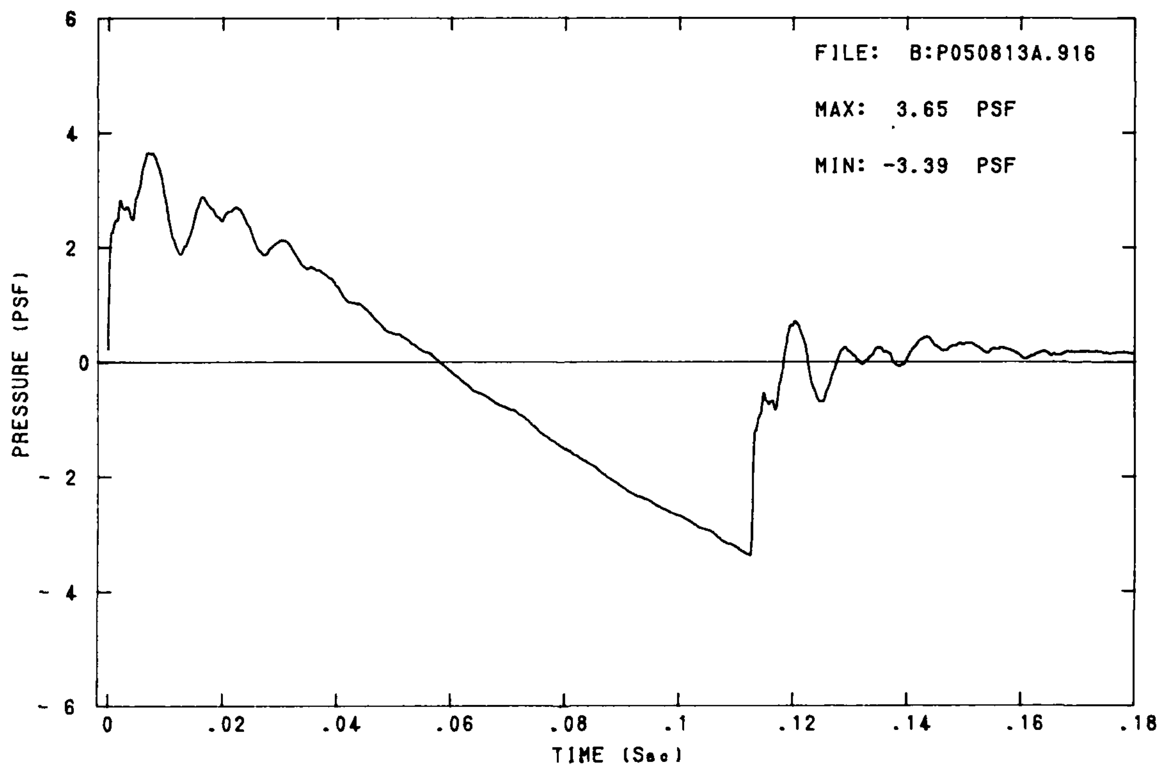
APPENDIX A

BOOM SIGNATURES

BOOM SIGNATURES from F-4 flying at 1.2 MACH, 18,900 ft AGL, and 0 ft. track offset occuring at 15:16:38 GMT, 16 Sep 86.




FILE: B:P030813A.916
MAX: 3.18 PSF
MIN: -3.41 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
- 2
- 4
- 6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P050813A.916
MAX: 3.65 PSF
MIN: -3.39 PSF
PRESSURE (PSF)
TIME (Sec)
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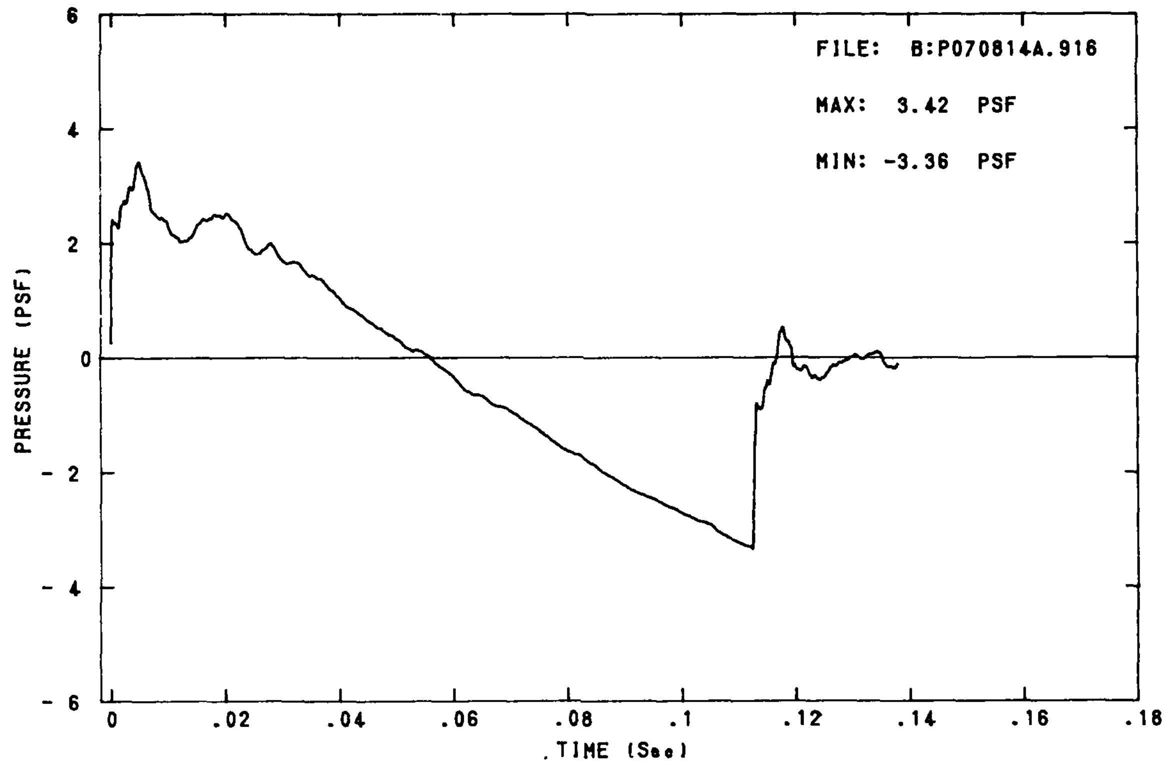
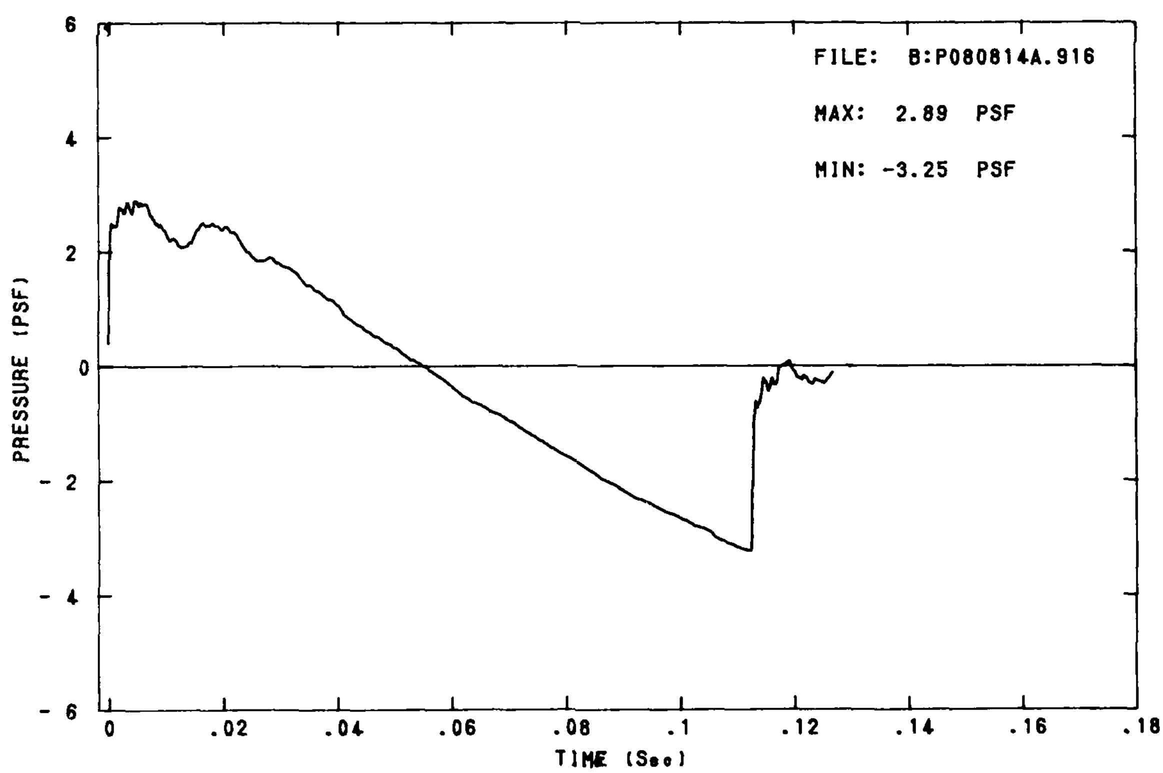
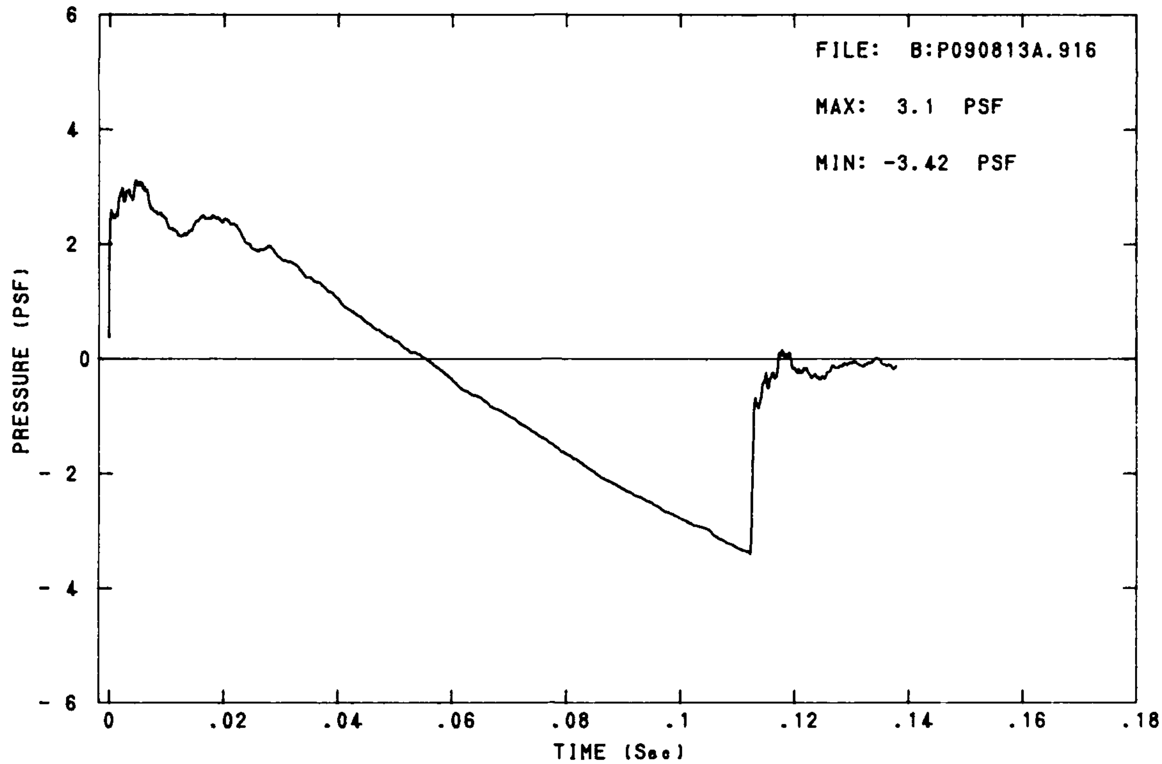
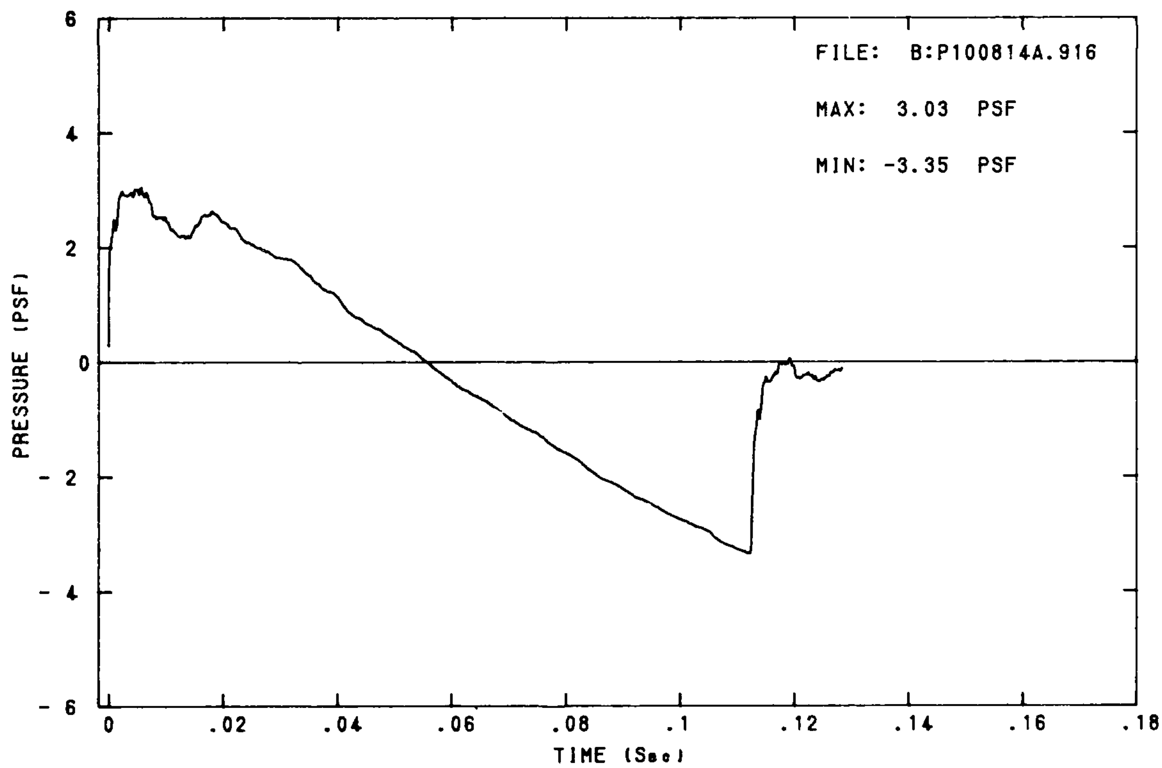
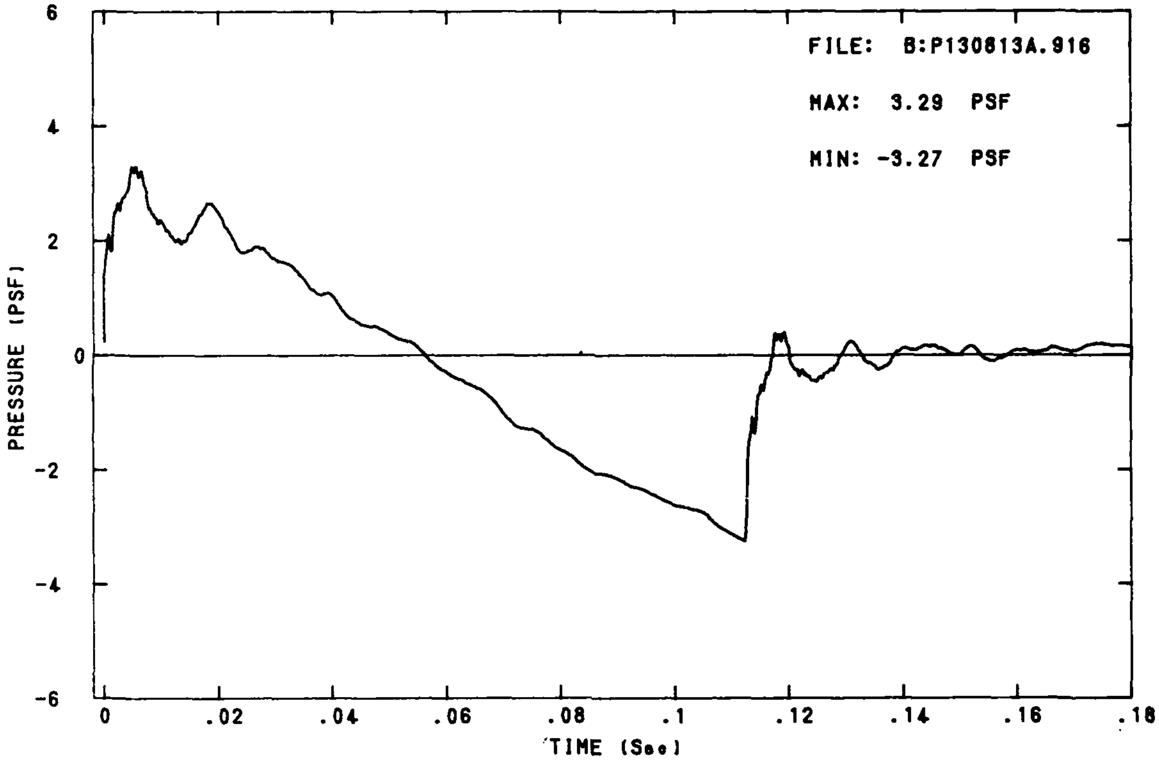
4
2
0
- 2
- 4
- 6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

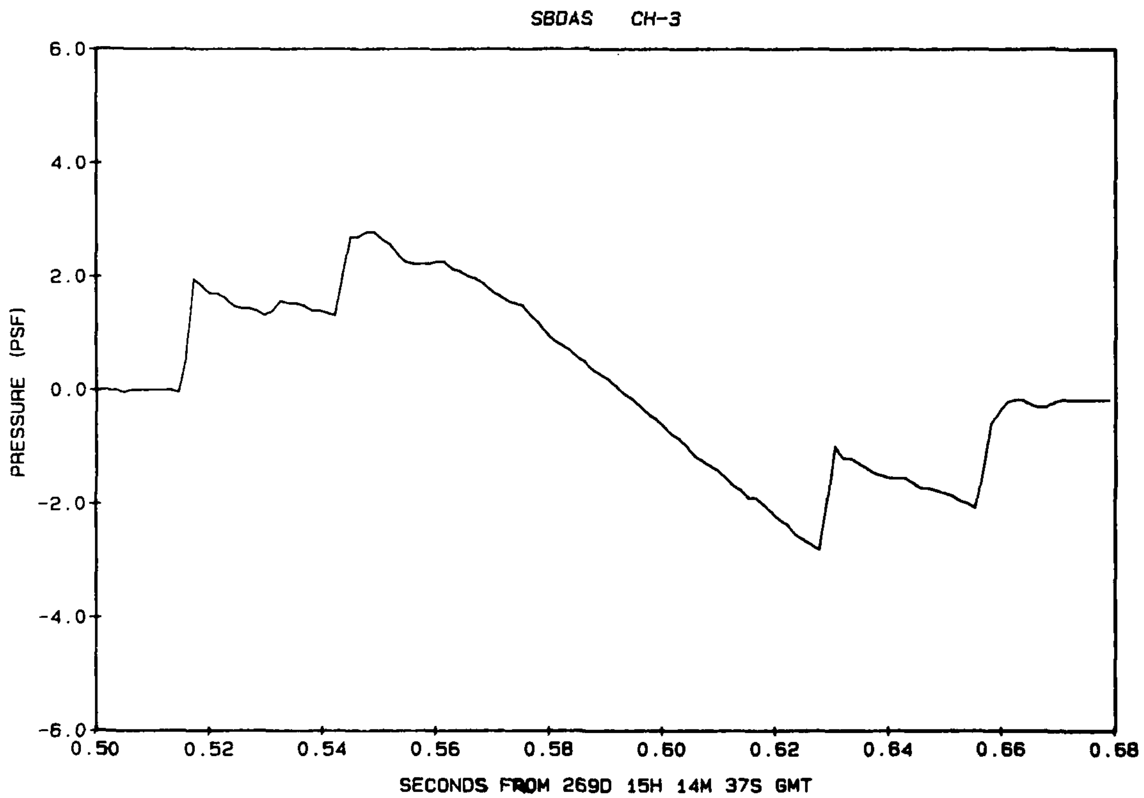

FILE: B:P070814A.916
MAX: 3.42 PSF
MIN: -3.36 PSF
PRESSURE (PSF)
TIME (Sec)


FILE: B:P080814A.916
MAX: 2.89 PSF
MIN: -3.25 PSF
PRESSURE (PSF)
TIME (Sec)

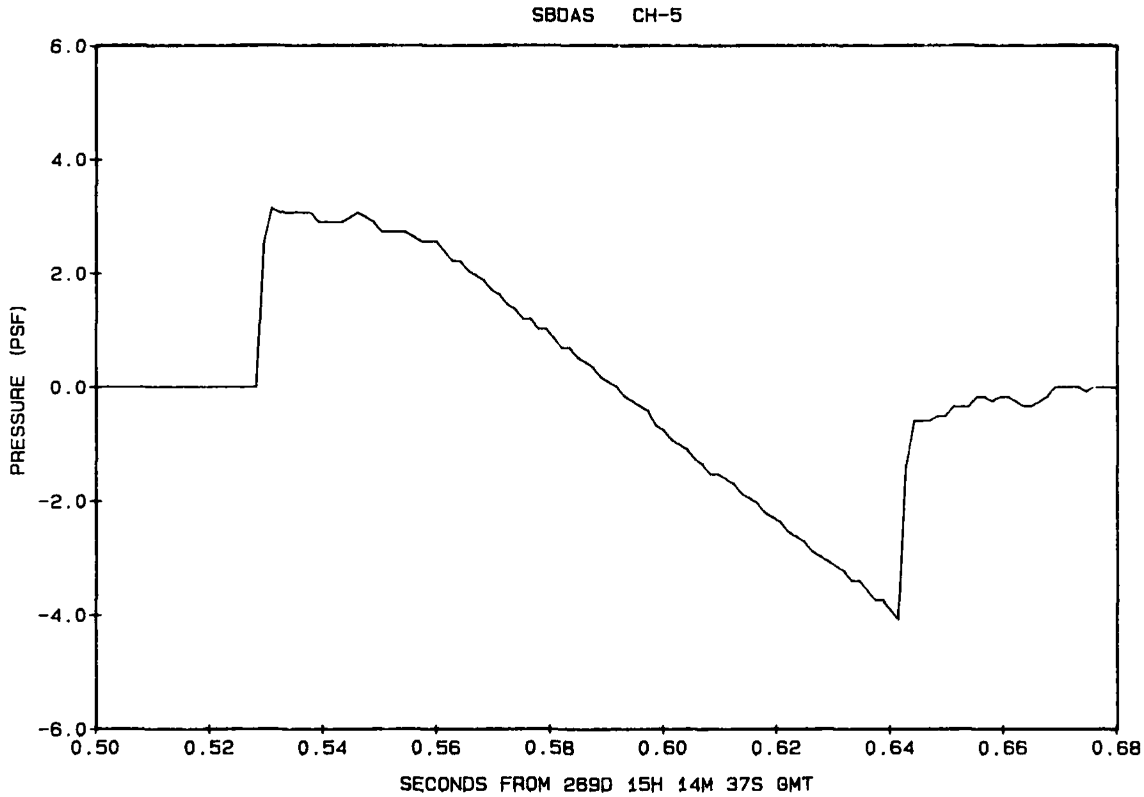

FILE: B:P090813A.916
MAX: 3.1 PSF
MIN: -3.42 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P100814A.916
MAX: 3.03 PSF
MIN: -3.35 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P130813A.916
MAX: 3.29 PSF
MIN: -3.27 PSF
PRESSURE (PSF)
TIME (Sec)


SBDAS CH-3
PRESSURE (PSF)
SECONDS FROM 269D 15H 14M 37S GMT

F4   19K-2



SBDAS CH-5
PRESSURE (PSF)
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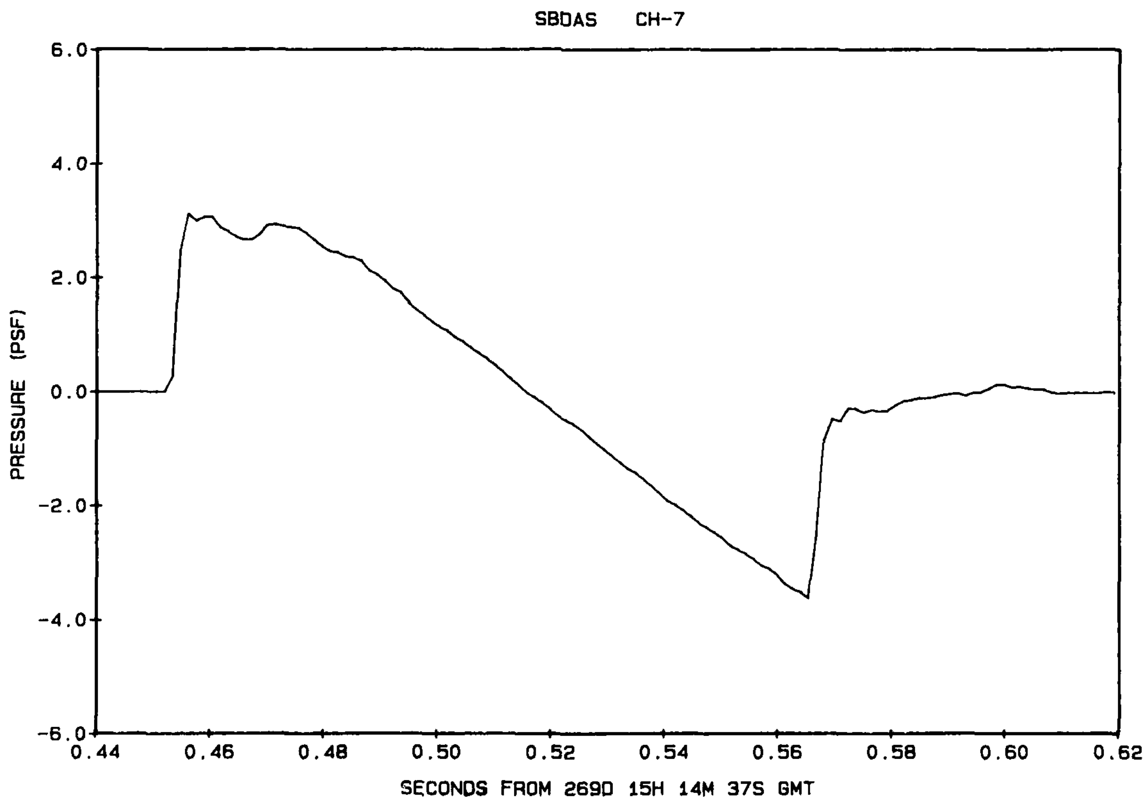
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.50
0.52
0.54
0.56
0.58
0.60
0.62
0.64
0.66
0.68
SECONDS FROM 269D 15H 14M 37S GMT



SBDAS CH-7
PRESSURE (PSF)
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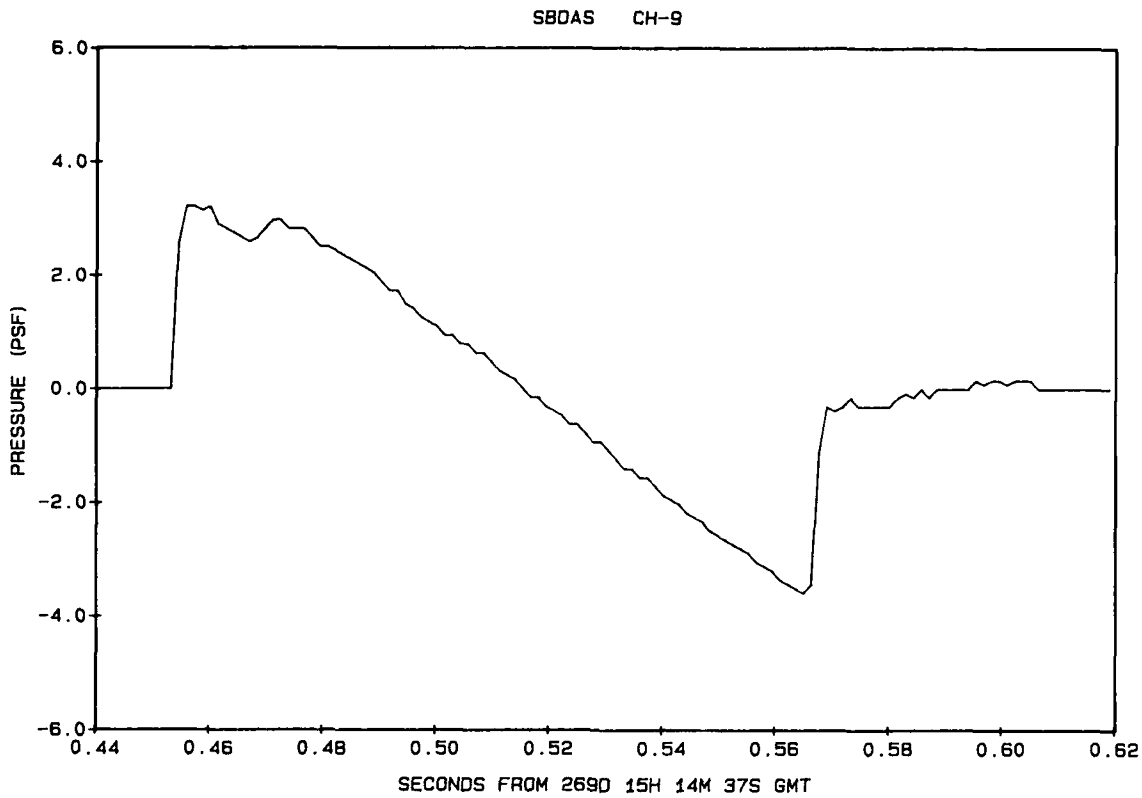
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.44
0.46
0.48
0.50
0.52
0.54
0.56
0.58
0.60
0.62
SECONDS FROM 269D 15H 14M 37S GMT

F4 19K-2



SBDAS CH-9
PRESSURE (PSF)
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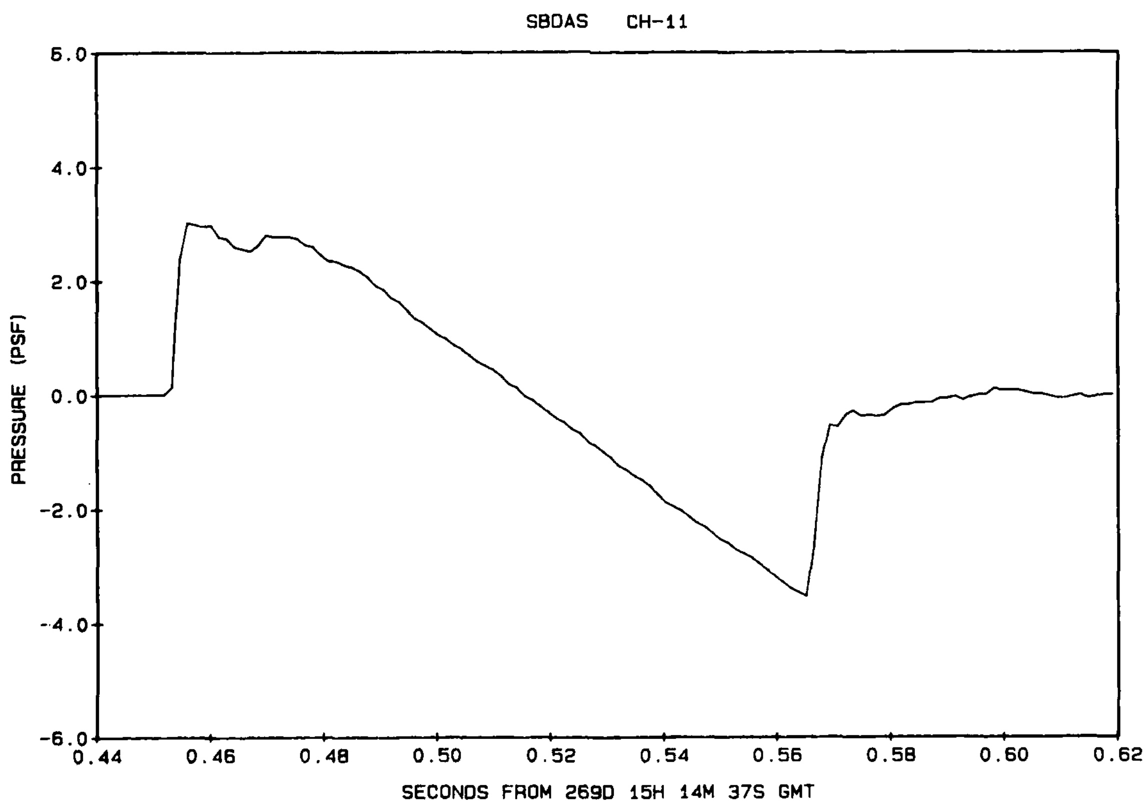
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.44 0.46 0.48 0.50 0.52 0.54 0.56 0.58 0.60 0.62
SECONDS FROM 269D 15H 14M 37S GMT



SBDAS CH-11
PRESSURE (PSF)
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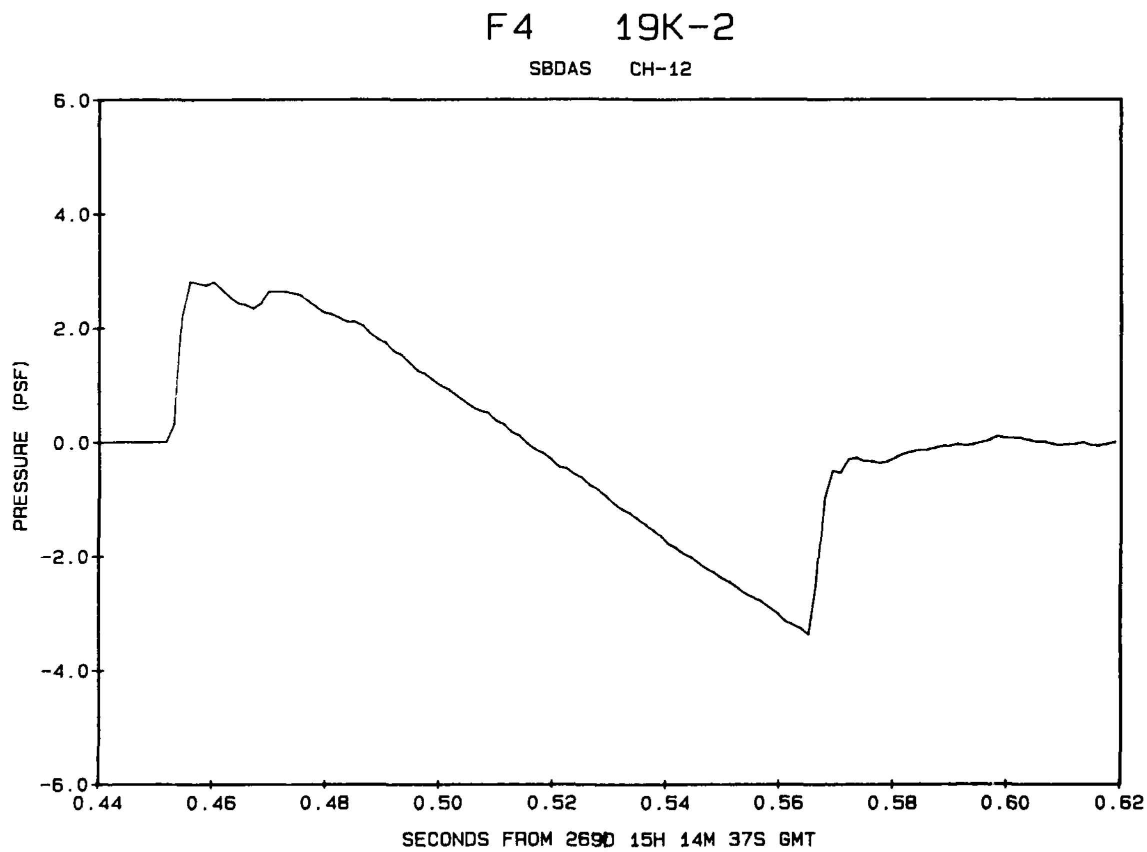
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.44 0.46 0.48 0.50 0.52 0.54 0.56 0.58 0.60 0.62
SECONDS FROM 269D 15H 14M 37S GMT


F4 19K-2
SBDAS CH-12
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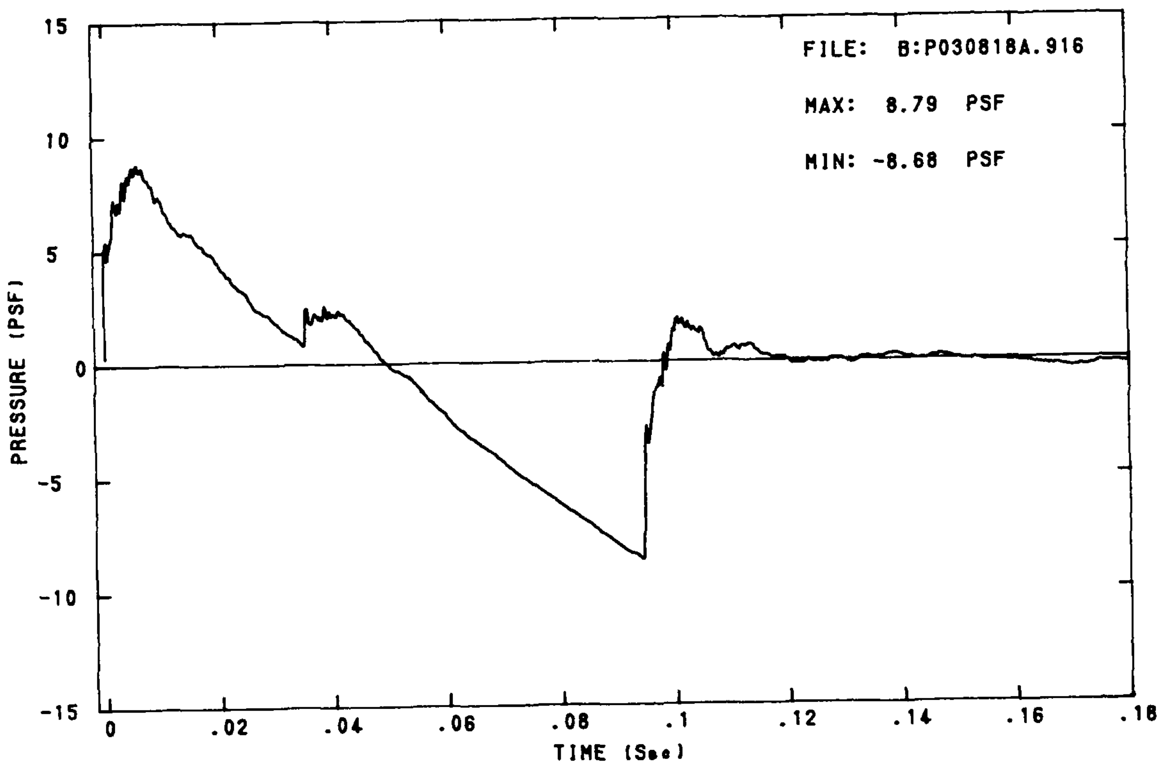
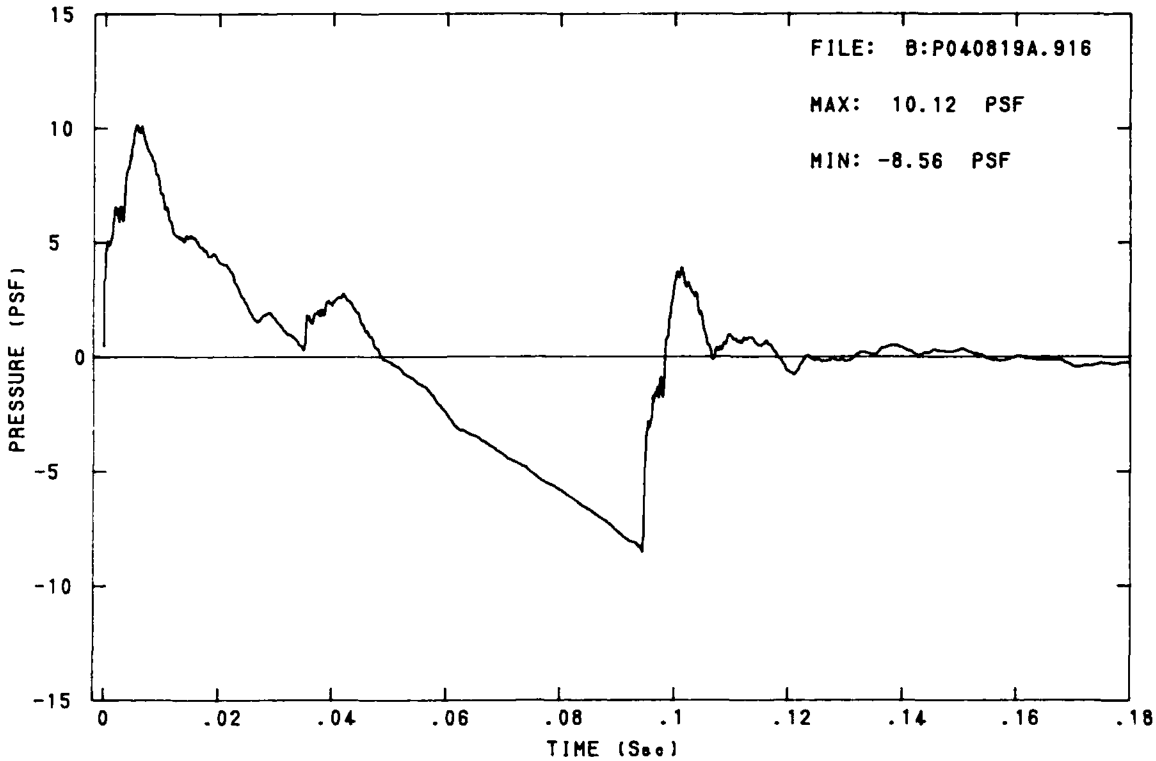
4.0
2.0
0.0
-2.0
-4.0
-6.0
PRESSURE (PSF)
0.44
0.46
0.48
0.50
0.52
0.54
0.56
0.58
0.60
0.62
SECONDS FROM 269D 15H 14M 37S GMT

BOOM SIGNATURES from F-4 flying at 1.15 MACH, 6,000 ft AGL,

and 0 ft. track offset occuring at 15:20:08 GMT, 16 Sep 86.





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MIN: -8.56 PSF
PRESSURE (PSF)
TIME (Sec)
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-10
-15
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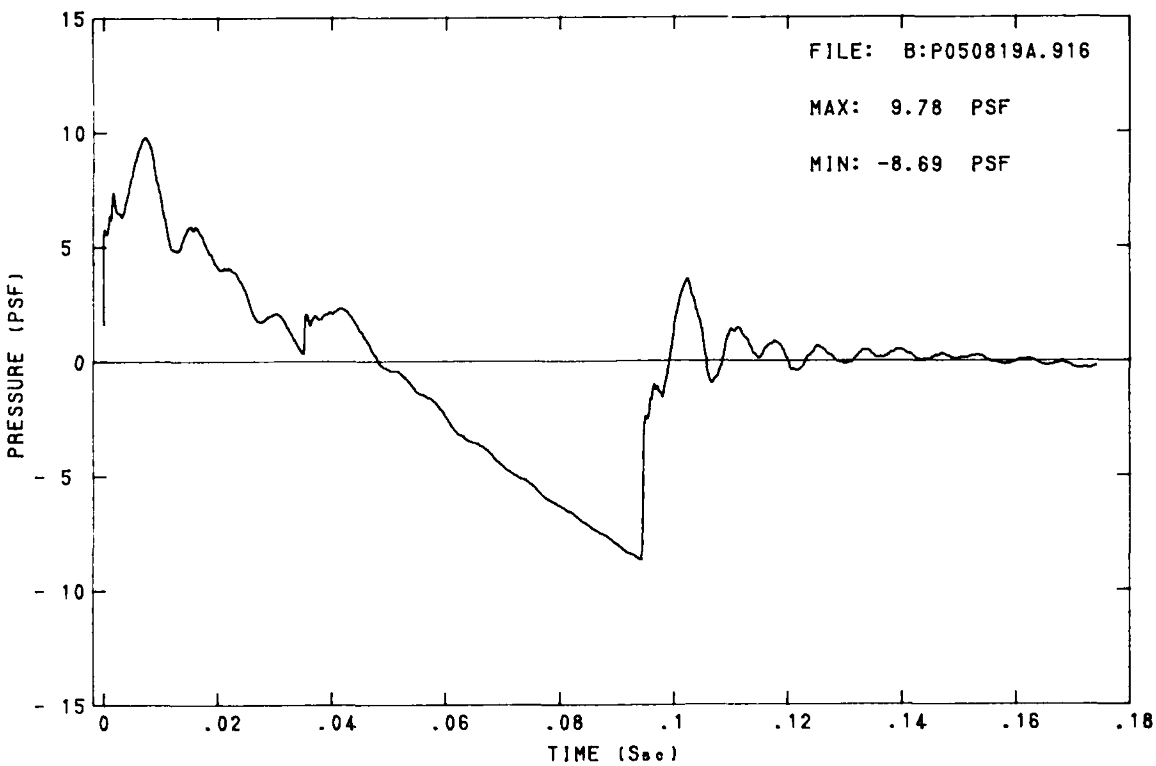
.02
.04
.06
.08
.1
.12
.14
.16
.18



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MIN: -8.69 PSF
PRESSURE (PSF)
TIME (Sec)
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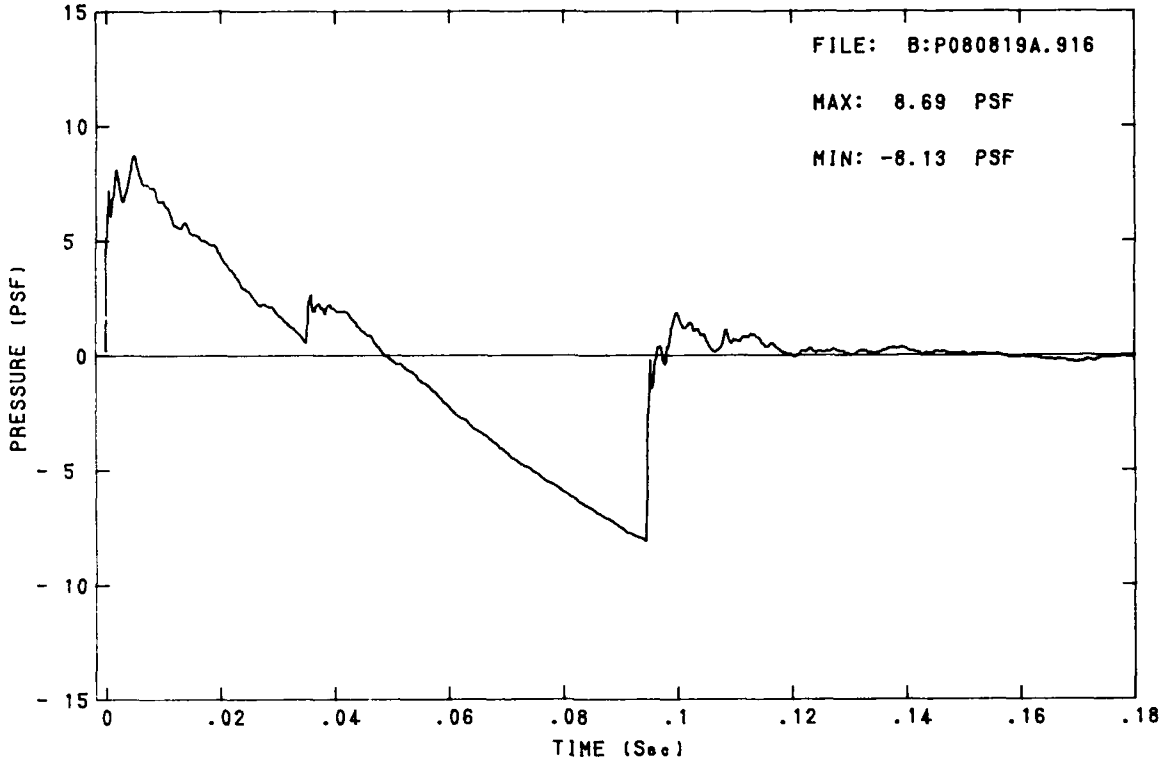
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18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MAX: 8.69 PSF
MIN: -8.13 PSF
PRESSURE (PSF)
TIME (Sec)
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5
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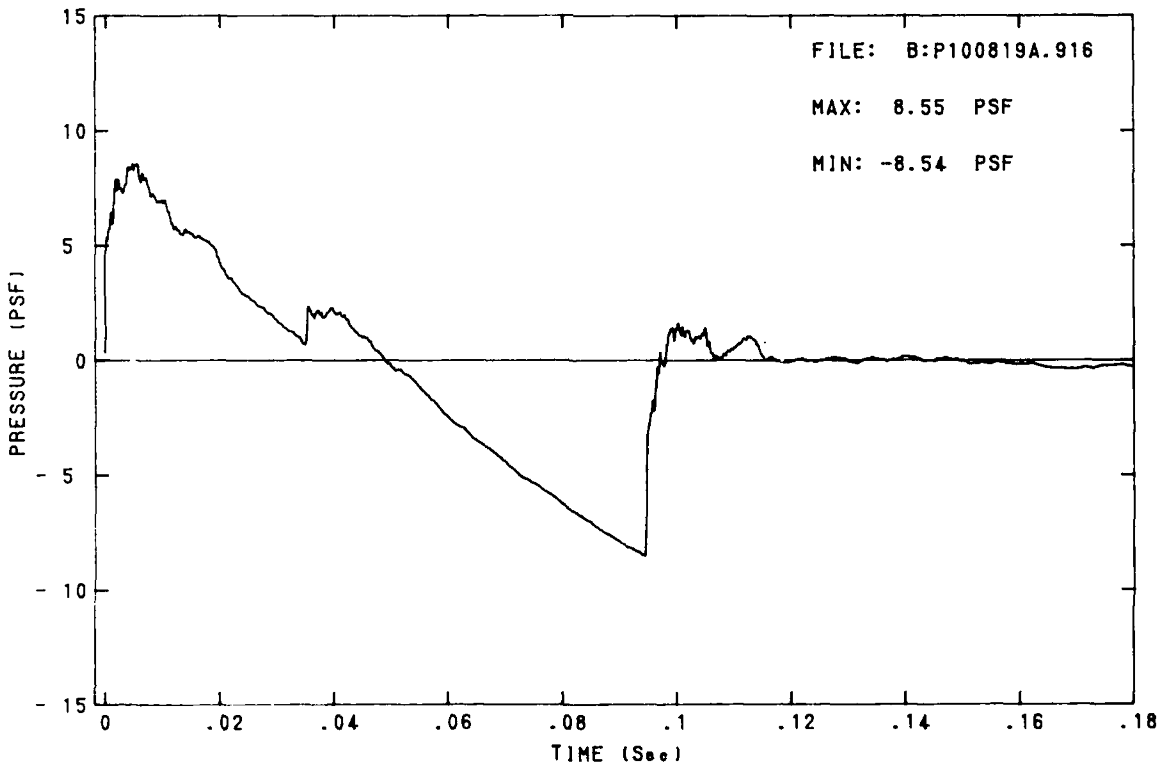
- 5
- 10
- 15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18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MIN: -8.54 PSF
PRESSURE (PSF)
TIME (Sec)
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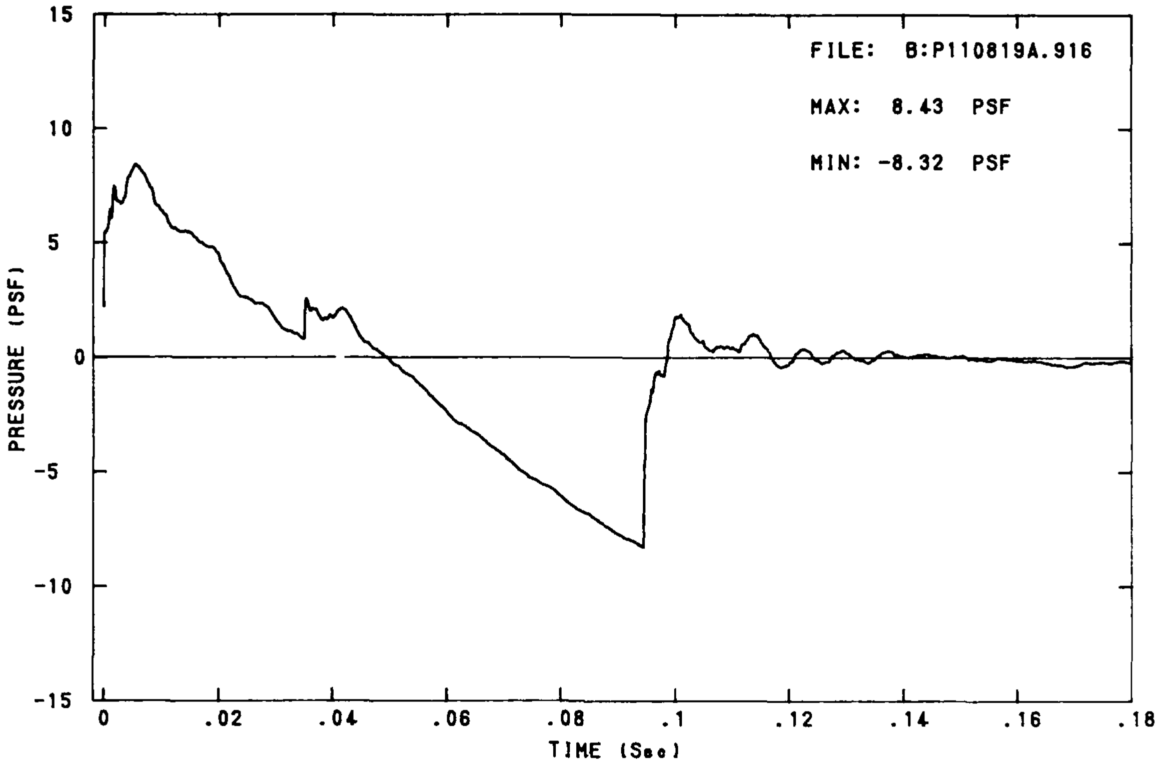
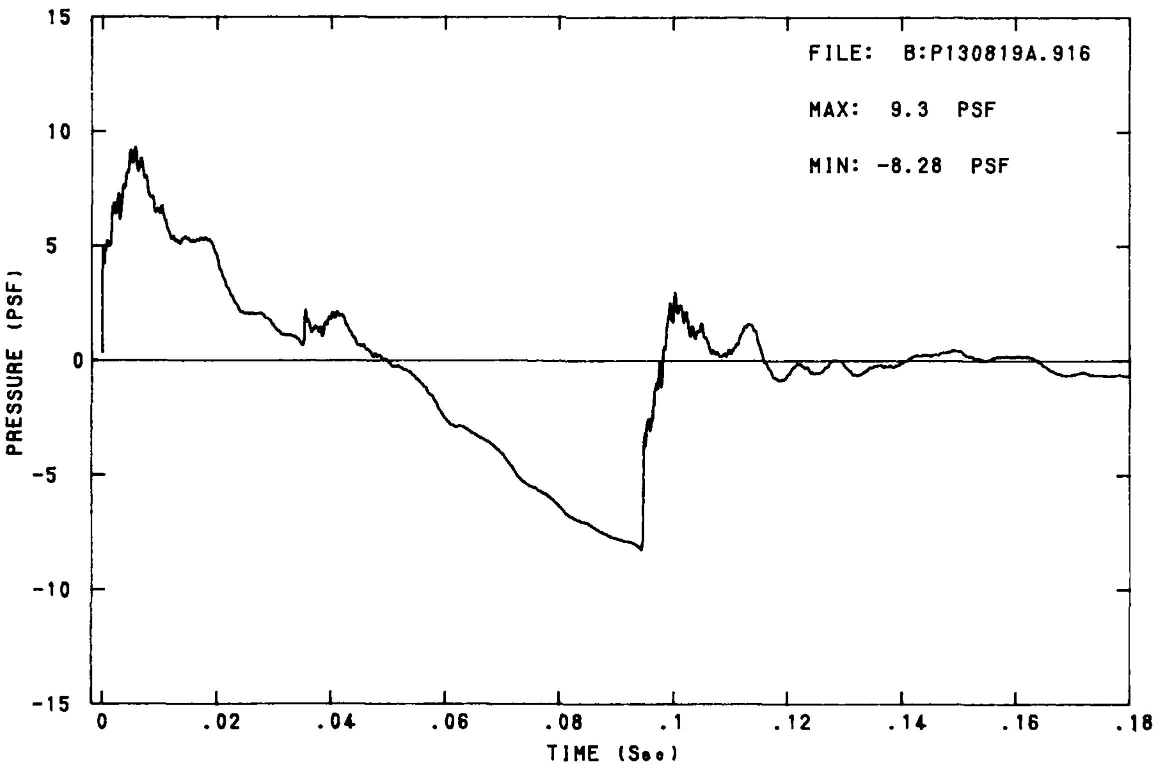
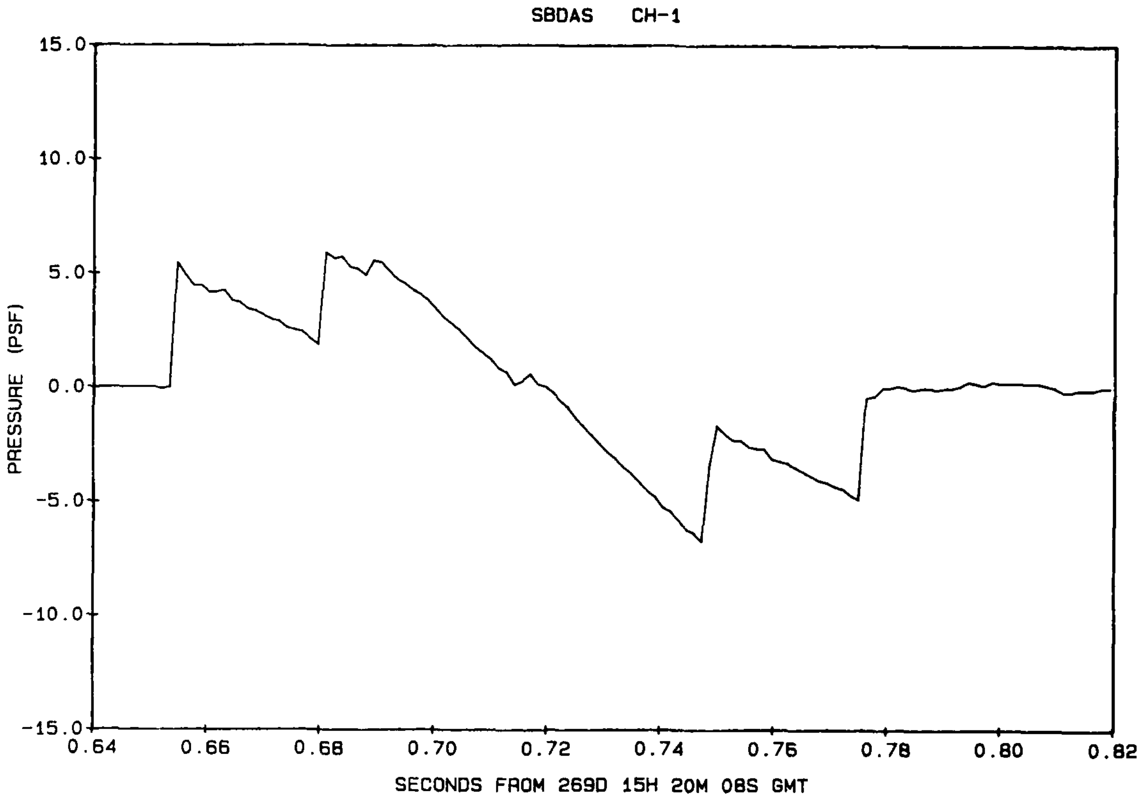
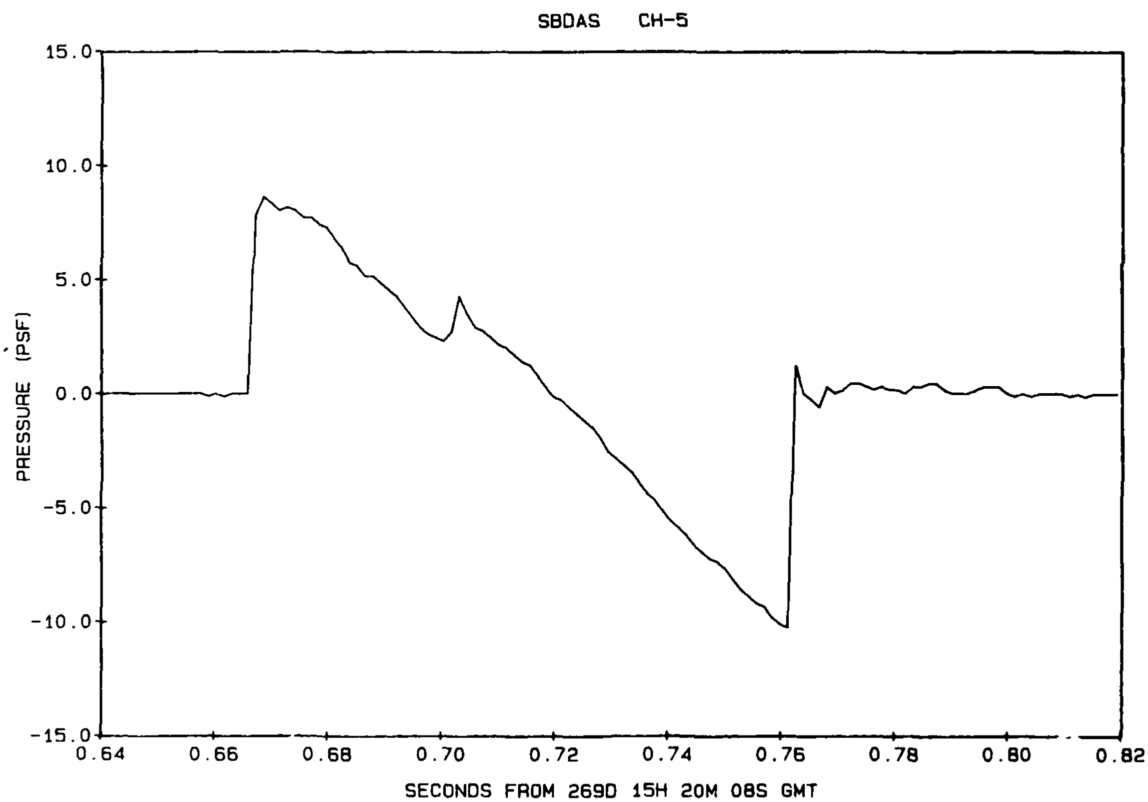
- 5
- 10
- 15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P110819A.916
MAX: 8.43 PSF
MIN: -8.32 PSF
PRESSURE (PSF)
TIME (Sec)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P130819A.916
MAX: 9.3 PSF
MIN: -8.28 PSF
PRESSURE (PSF)
TIME (Sec)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

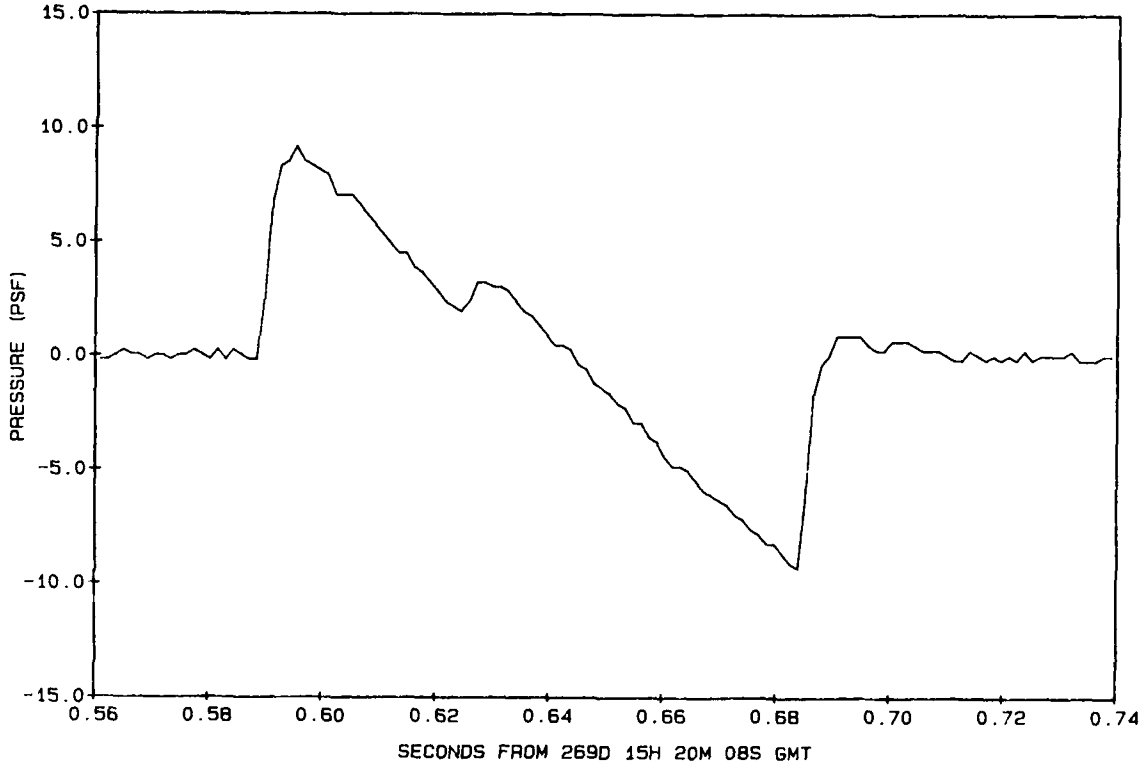
F4 5K-1


SBDAS CH-1
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.64
0.66
0.68
0.70
0.72
0.74
0.76
0.78
0.80
0.82
SECONDS FROM 269D 15H 20M 08S GMT

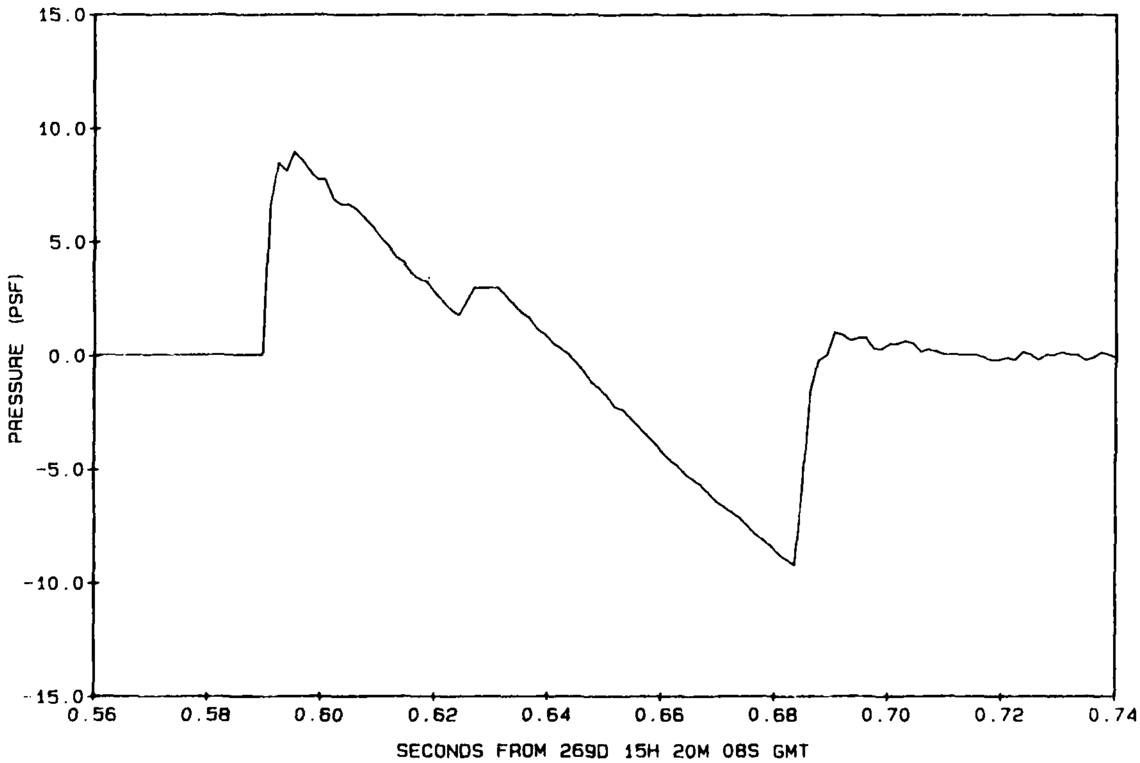

SBDAS CH-5
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.64
0.66
0.68
0.70
0.72
0.74
0.76
0.78
0.80
0.82
SECONDS FROM 269D 15H 20M 08S GMT

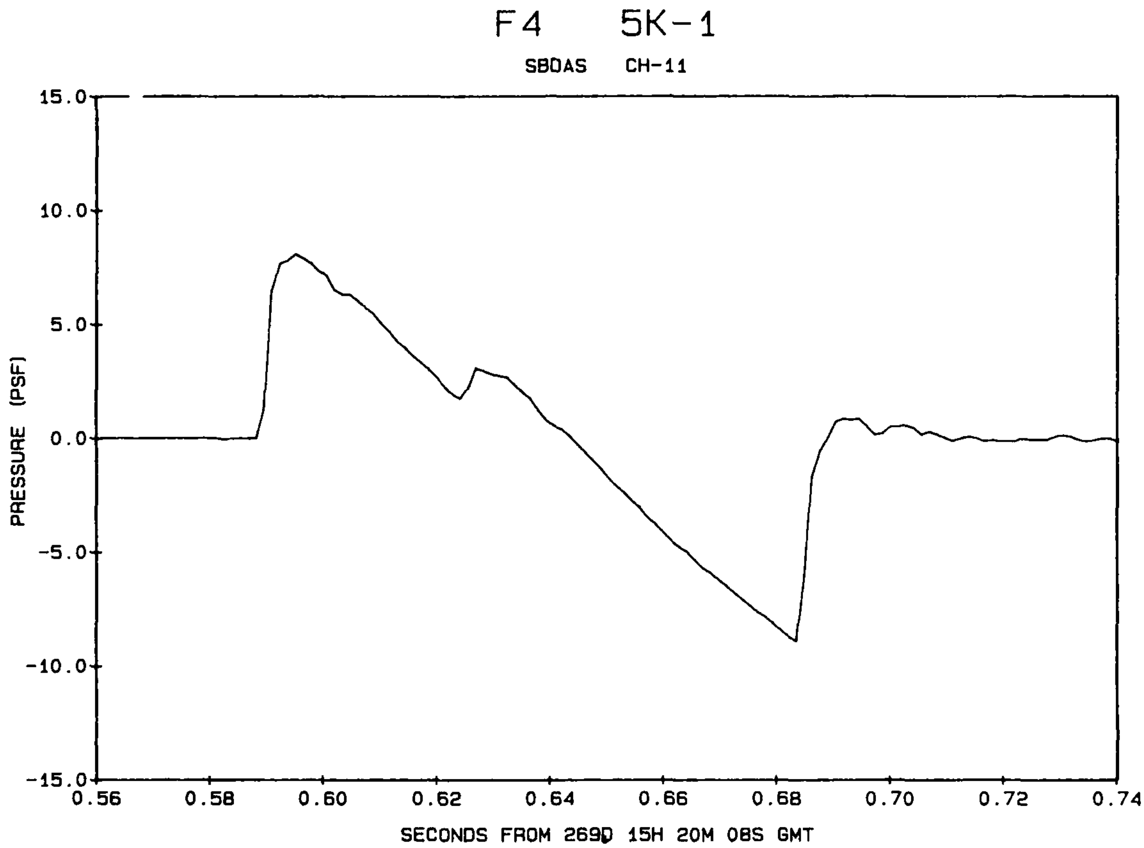
F4 5K-1

SBDAS CH-8

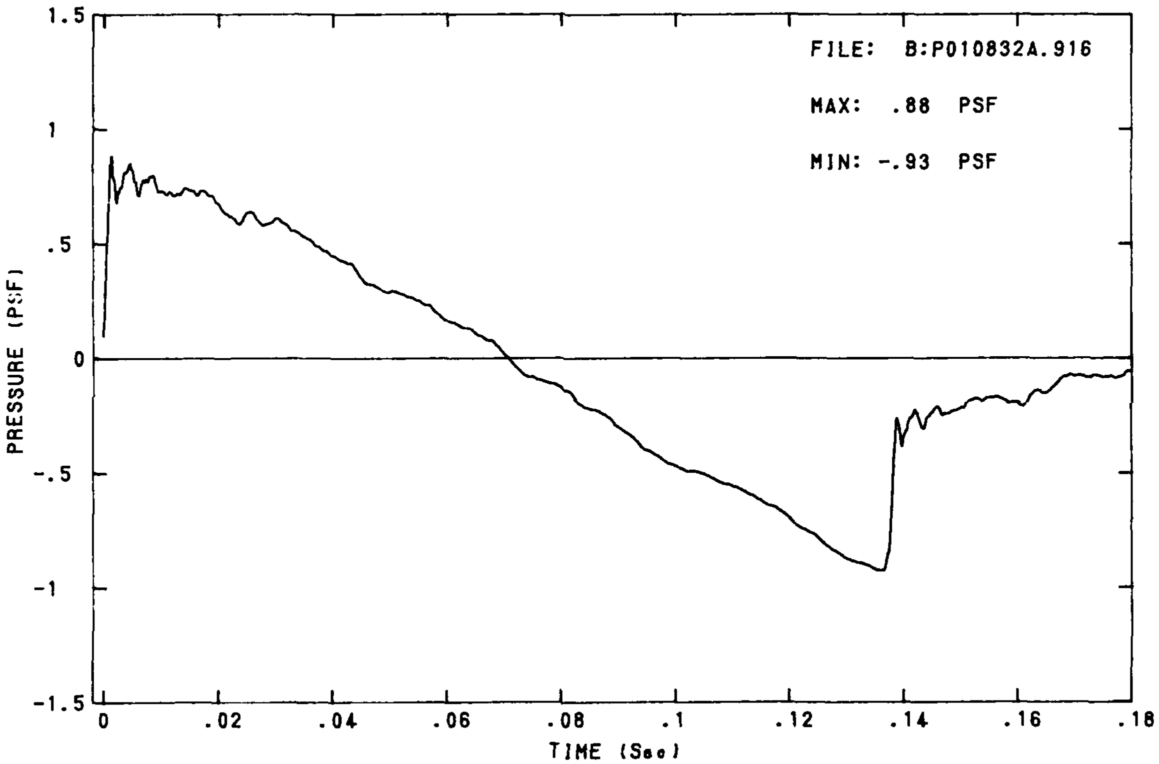


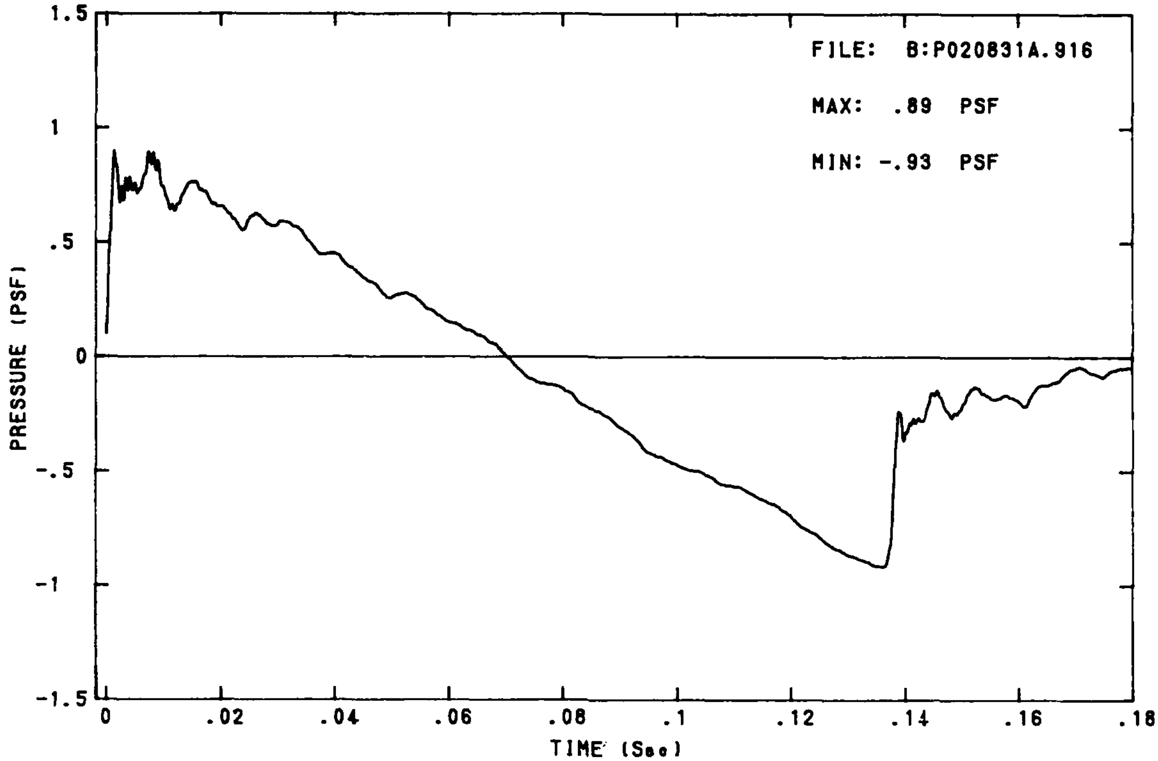
SBDAS CH-10

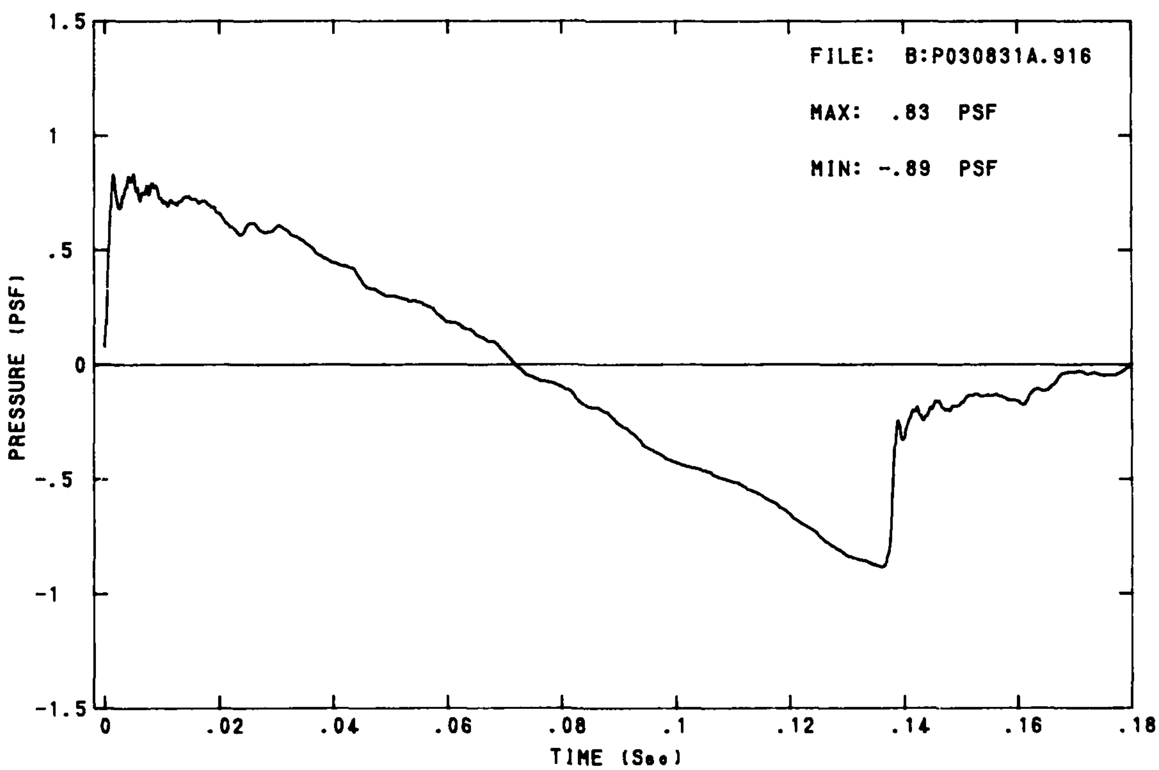


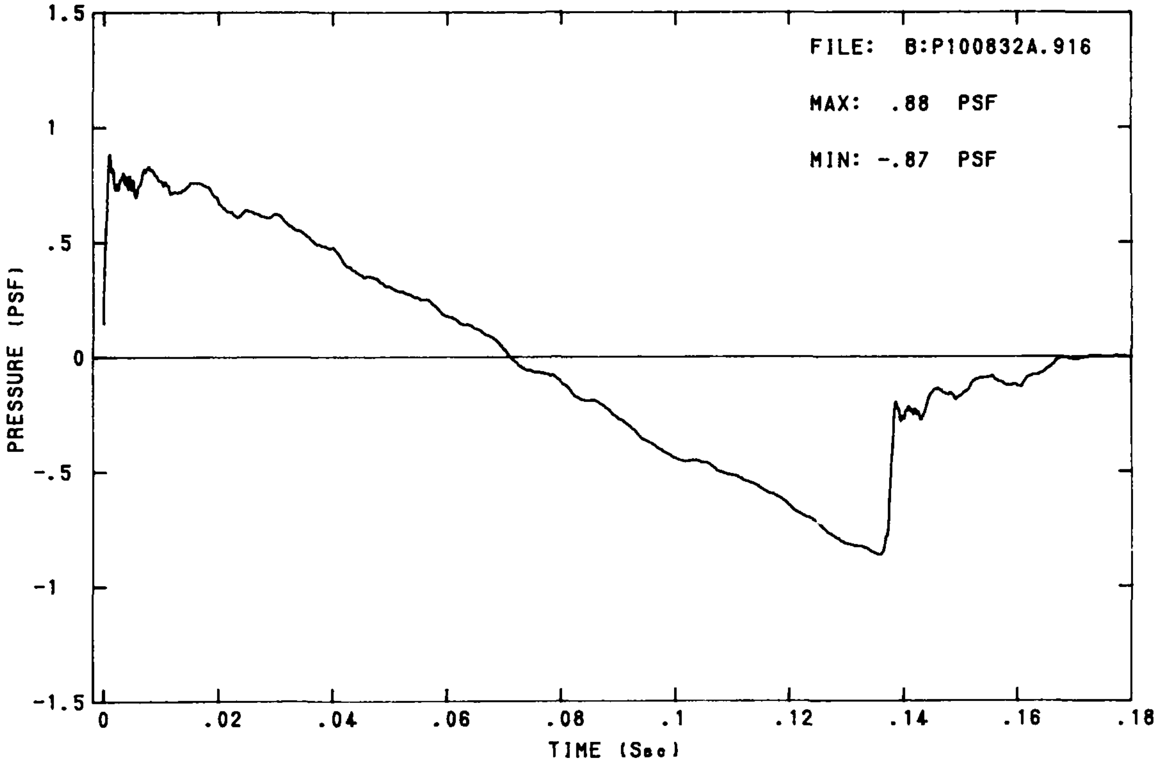

F4 5K-1
SBDAS CH-11
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.56
0.58
0.60
0.62
0.64
0.66
0.68
0.70
0.72
0.74
SECONDS FROM 269D 15H 20M 08S GMT

BOOM SIGNATURES from F-4 flying at 1.45 MACH, 35,000 ft AGL, and 60600 ft. track offset occuring at 15:33:04 GMT, 16 Sep 86.

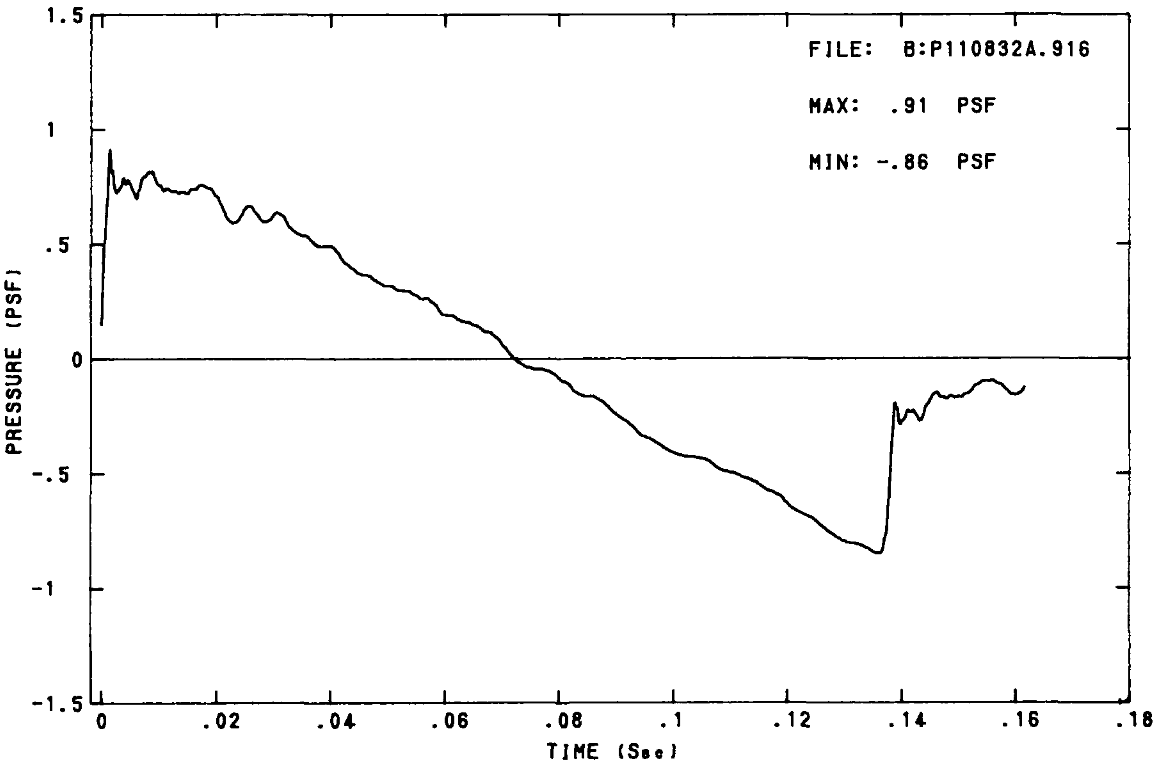



FILE: B:P020831A.916
MAX: .89 PSF
MIN: -.93 PSF
PRESSURE (PSF)
TIME (Sec)


FILE: B:P030831A.916
MAX: .83 PSF
MIN: -.89 PSF
PRESSURE (PSF)
TIME (Sec)



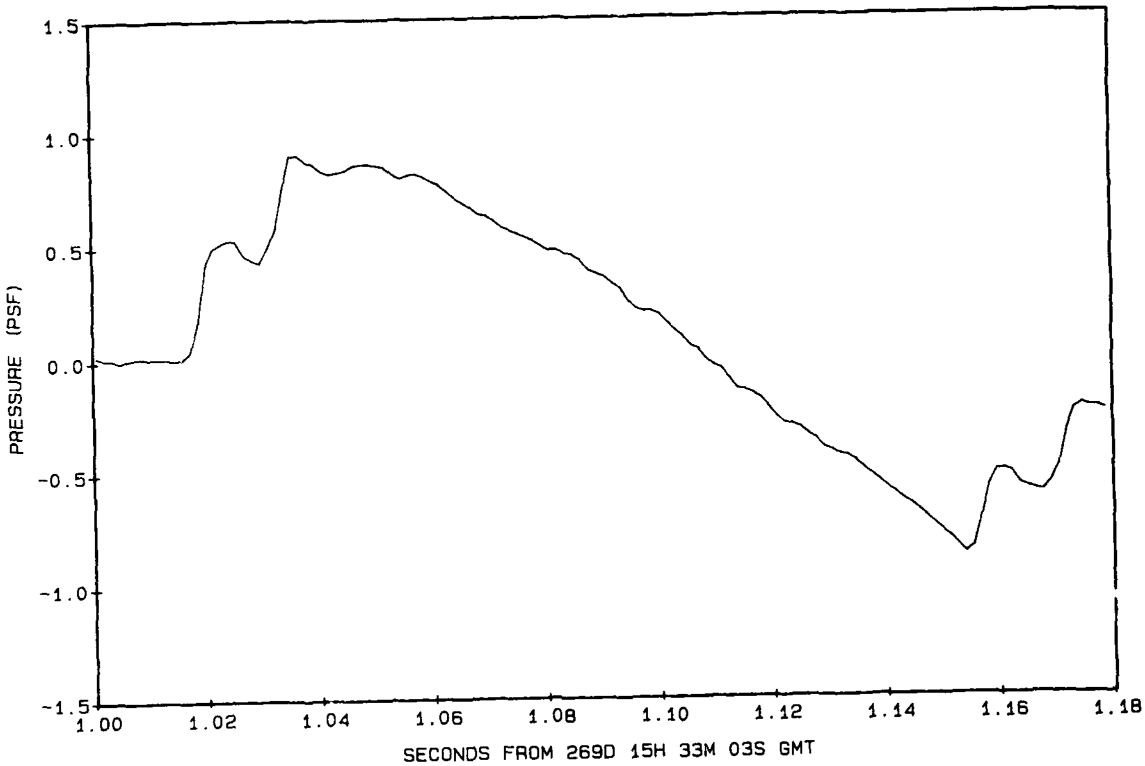
FILE: B:P100832A.916
MAX: .88 PSF
MIN: -.87 PSF
PRESSURE (PSF)
1.5
1
.5
0
-.5
-1
-1.5
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)



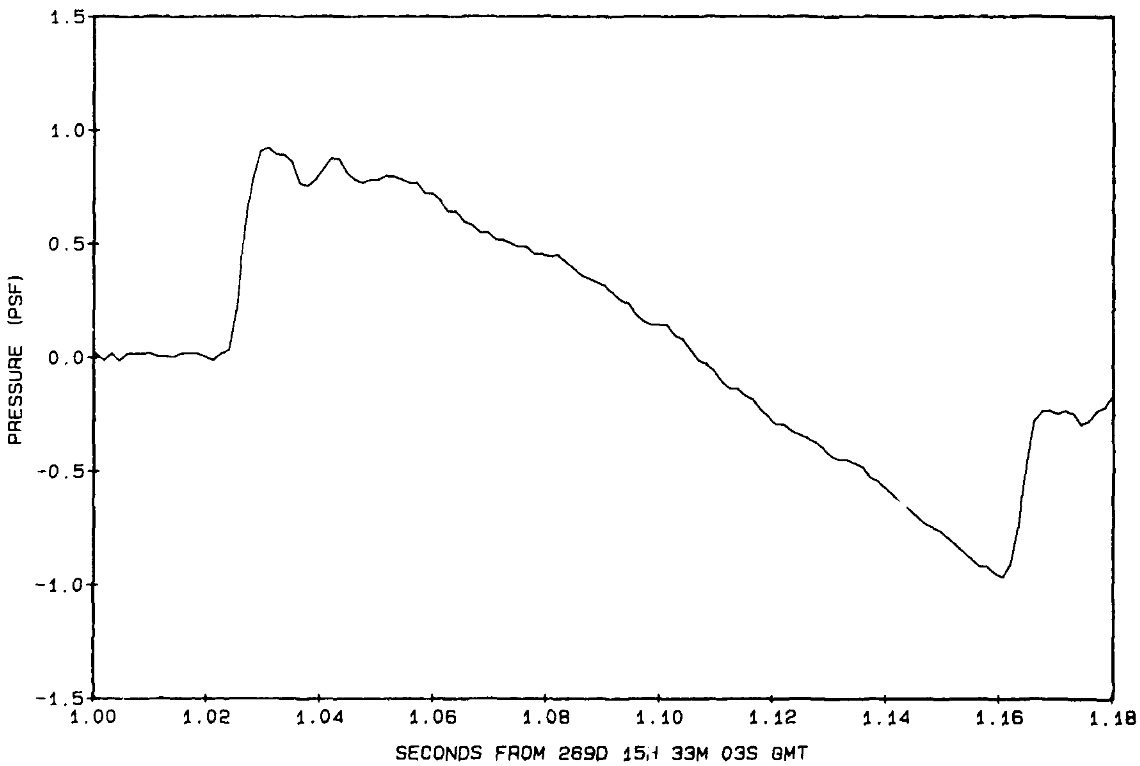
FILE: B:P110832A.916
MAX: .91 PSF
MIN: -.86 PSF
PRESSURE (PSF)
1.5
1
.5
0
-.5
-1
-1.5
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)

F4 35K-1

SBDAS CH-1

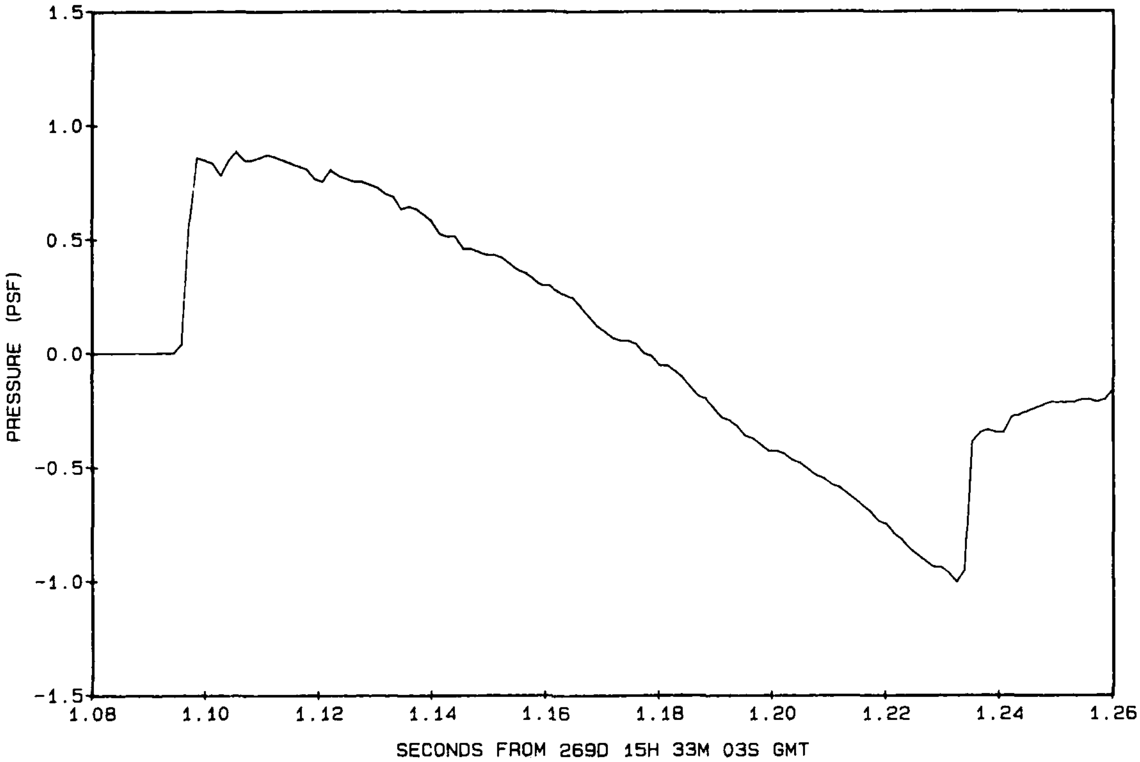


SBDAS CH-6

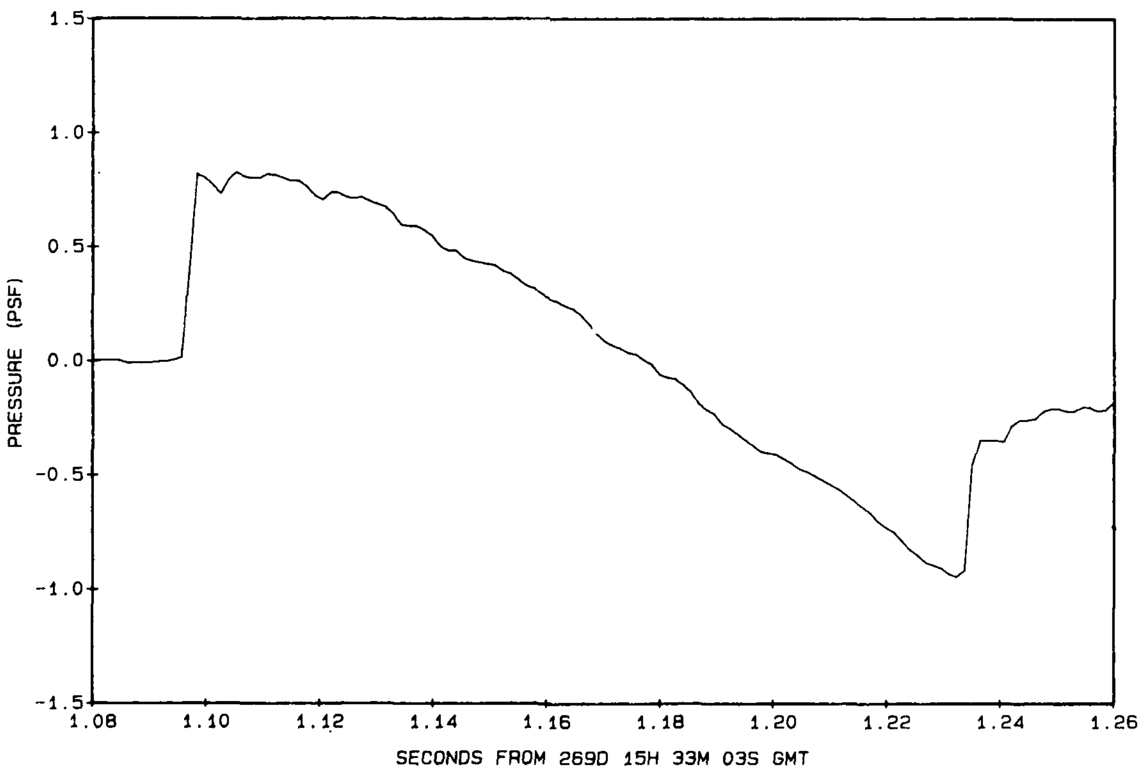


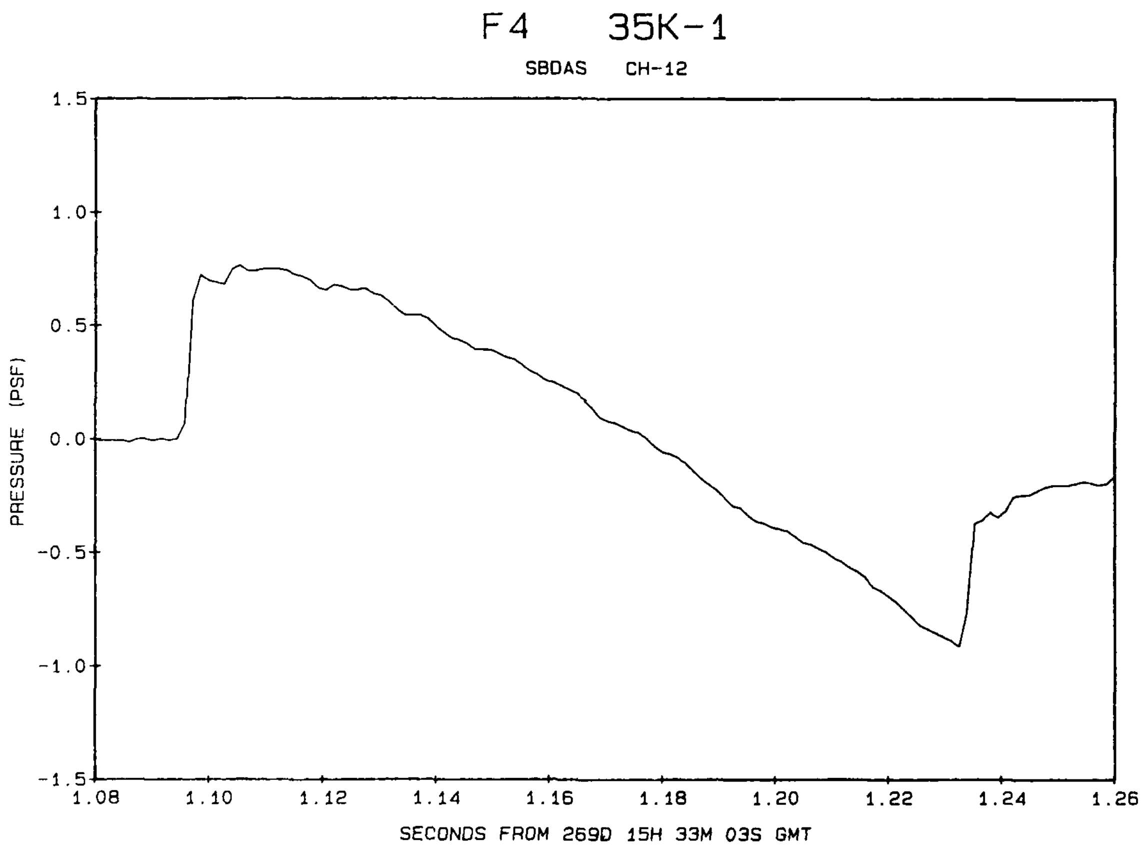
F4 35K-1

SBDAS CH-8

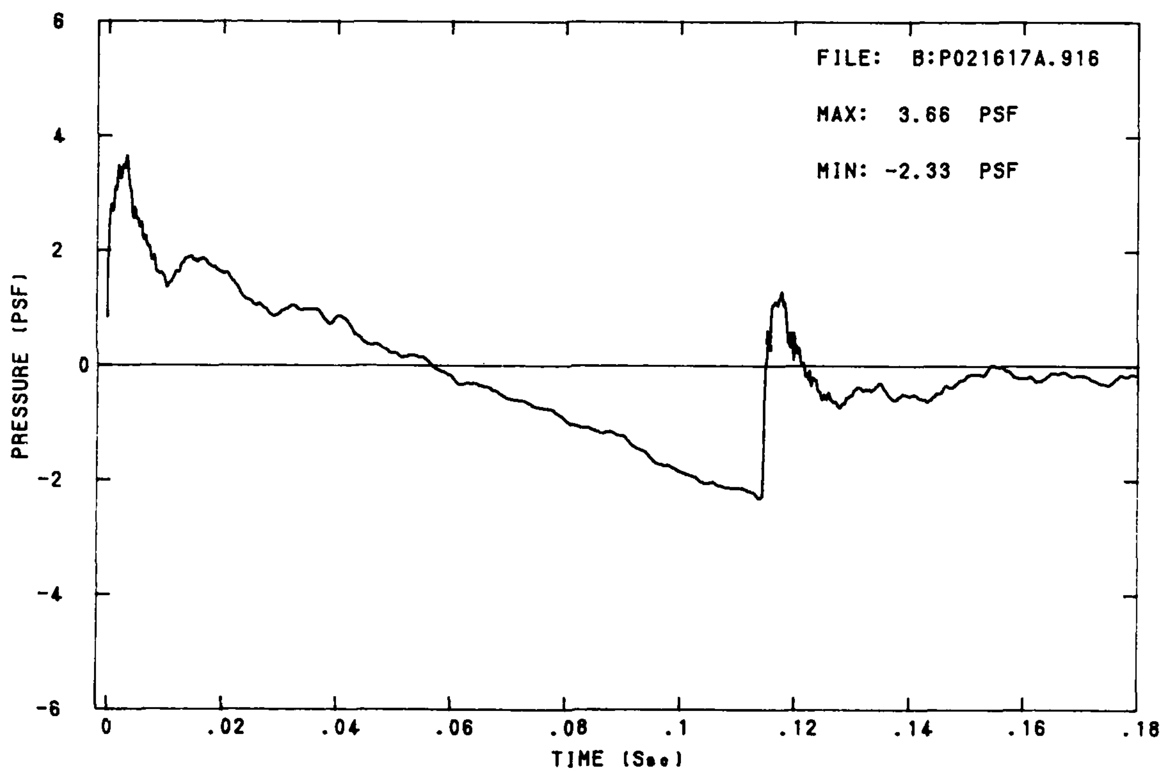


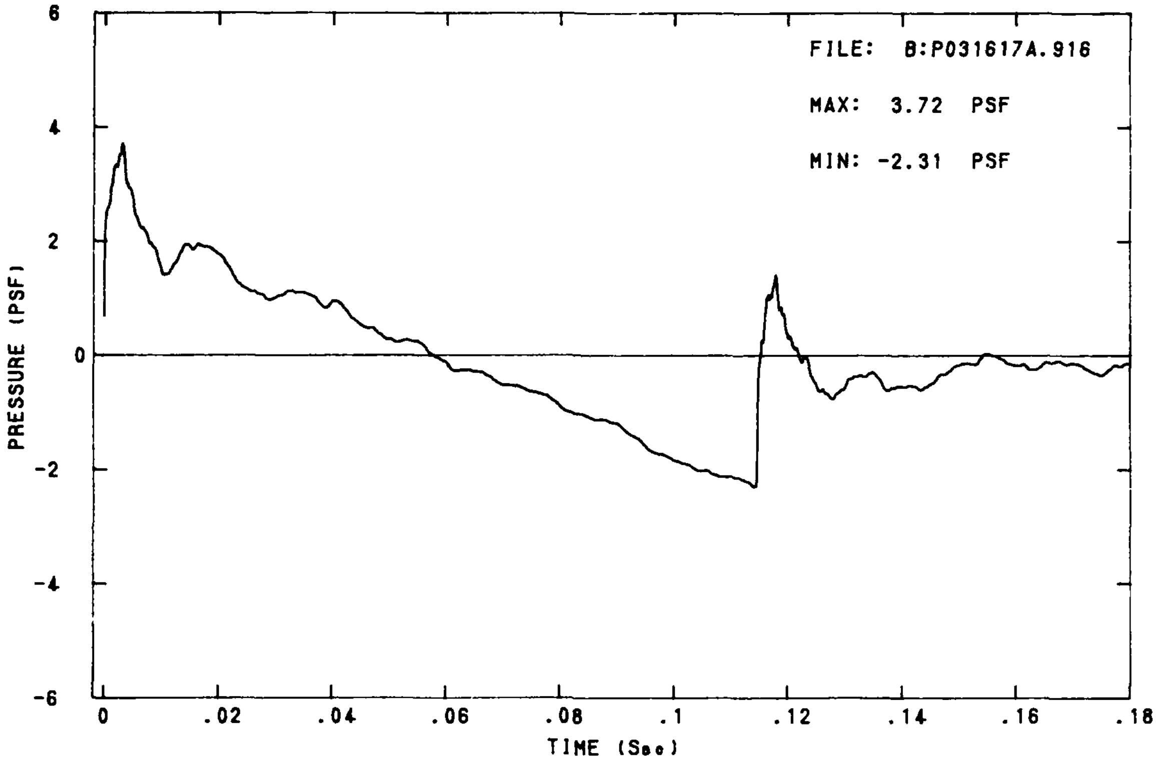
SBDAS CH-11

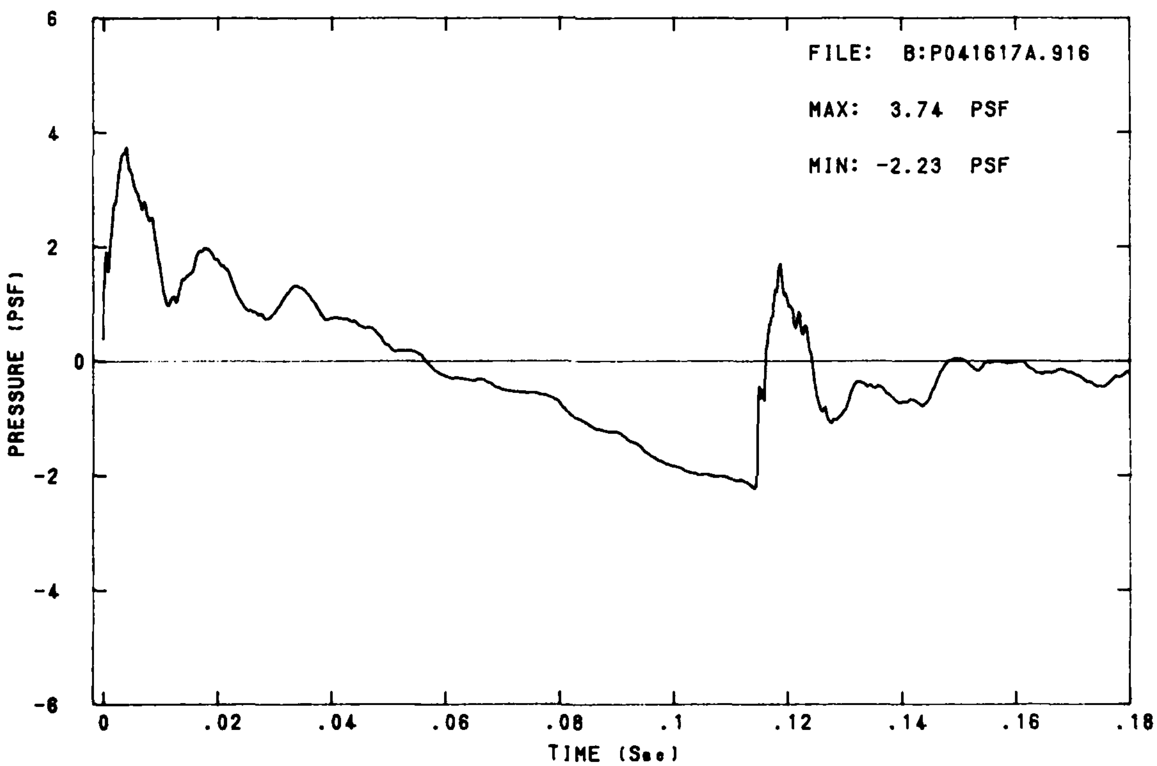


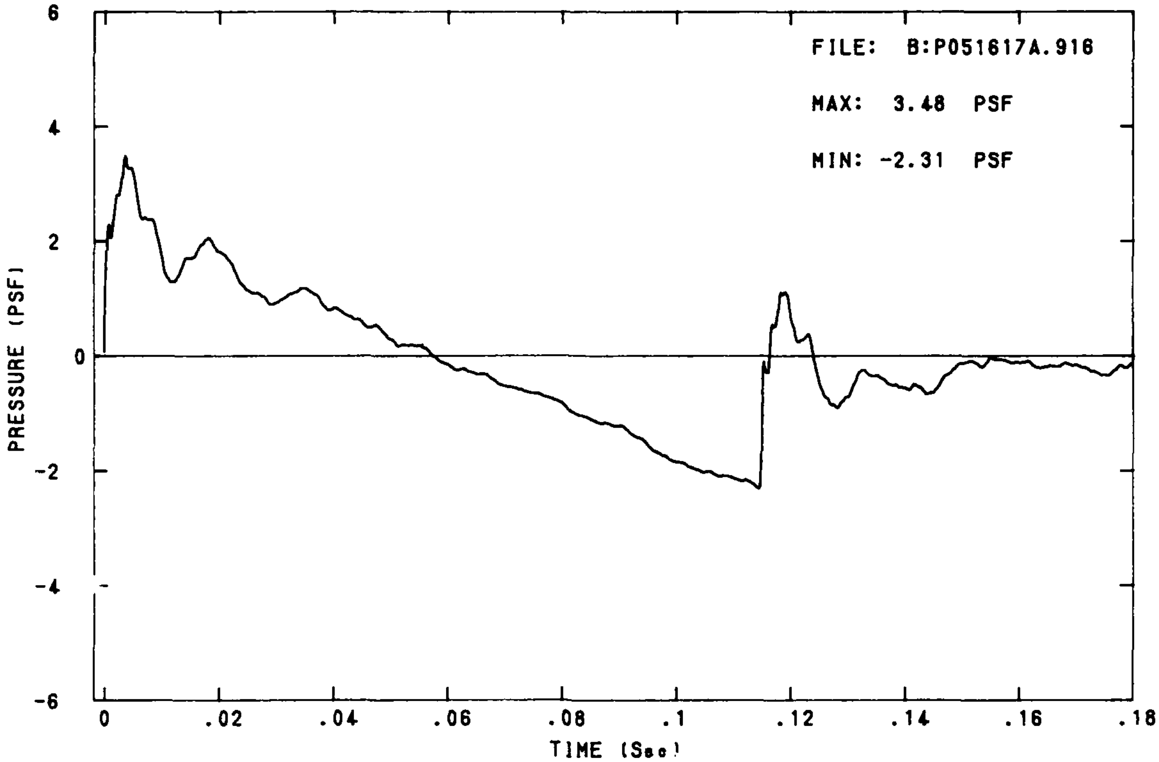

F4 35K-1
SBDAS CH-12
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
PRESSURE (PSF)
1.08
1.10
1.12
1.14
1.16
1.18
1.20
1.22
1.24
1.26
SECONDS FROM 269D 15H 33M 03S GMT

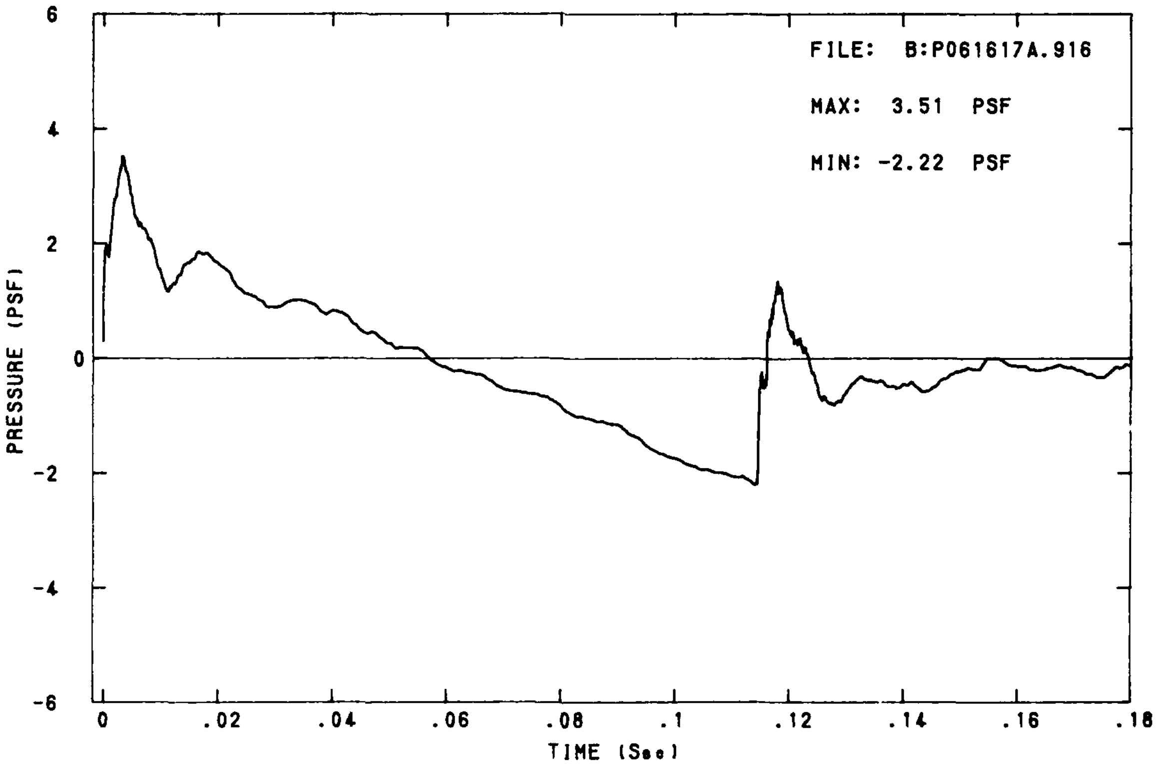
BOOM SIGNATURES from F-4 flying at 1.2 MACH, 20,700 ft AGL, and 0 ft. track offset occuring at 23:17:47 GMT, 16 Sep 86.

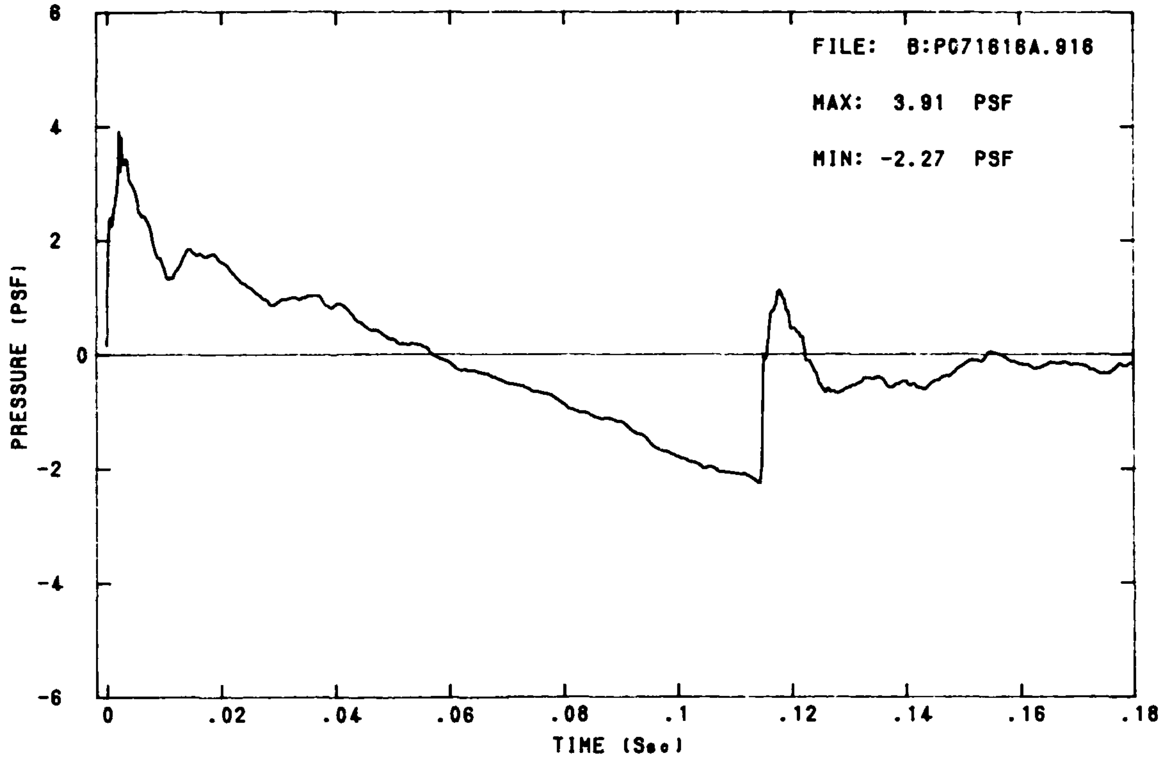


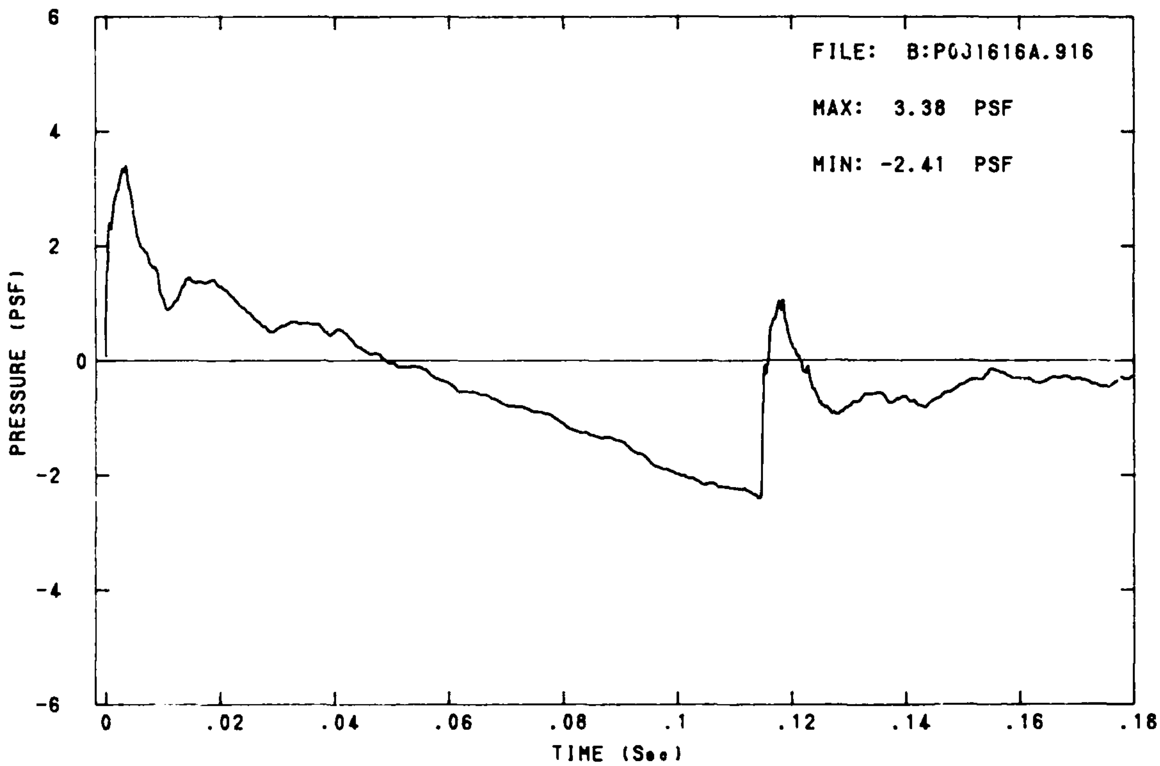

FILE: B:P031617A.916
MAX: 3.72 PSF
MIN: -2.31 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

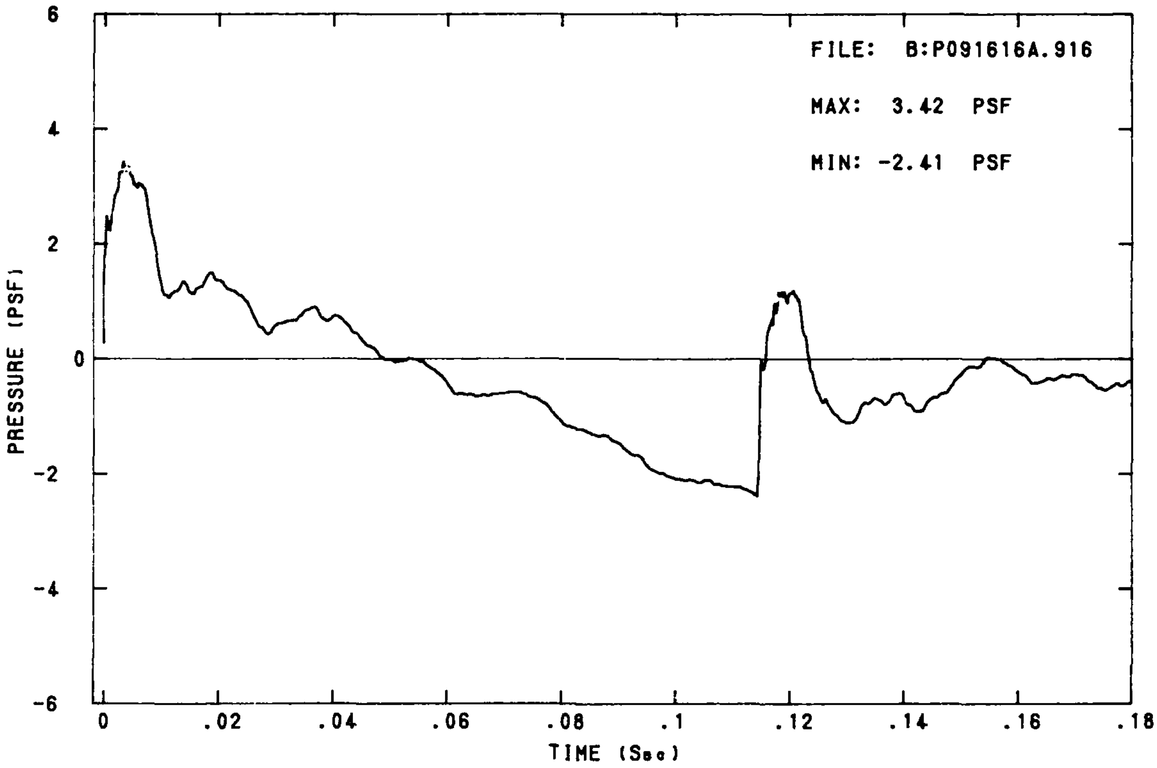

FILE: B:P041617A.916
MAX: 3.74 PSF
MIN: -2.23 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

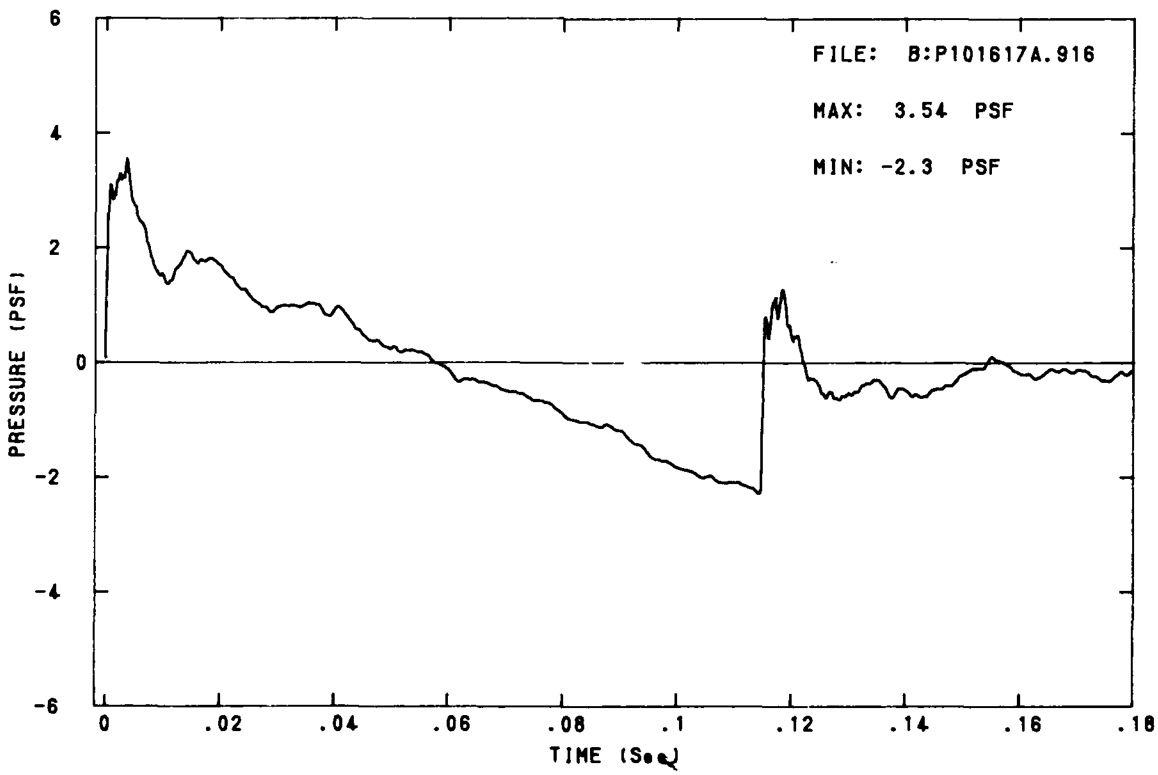

FILE: B:P051617A.916
MAX: 3.48 PSF
MIN: -2.31 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

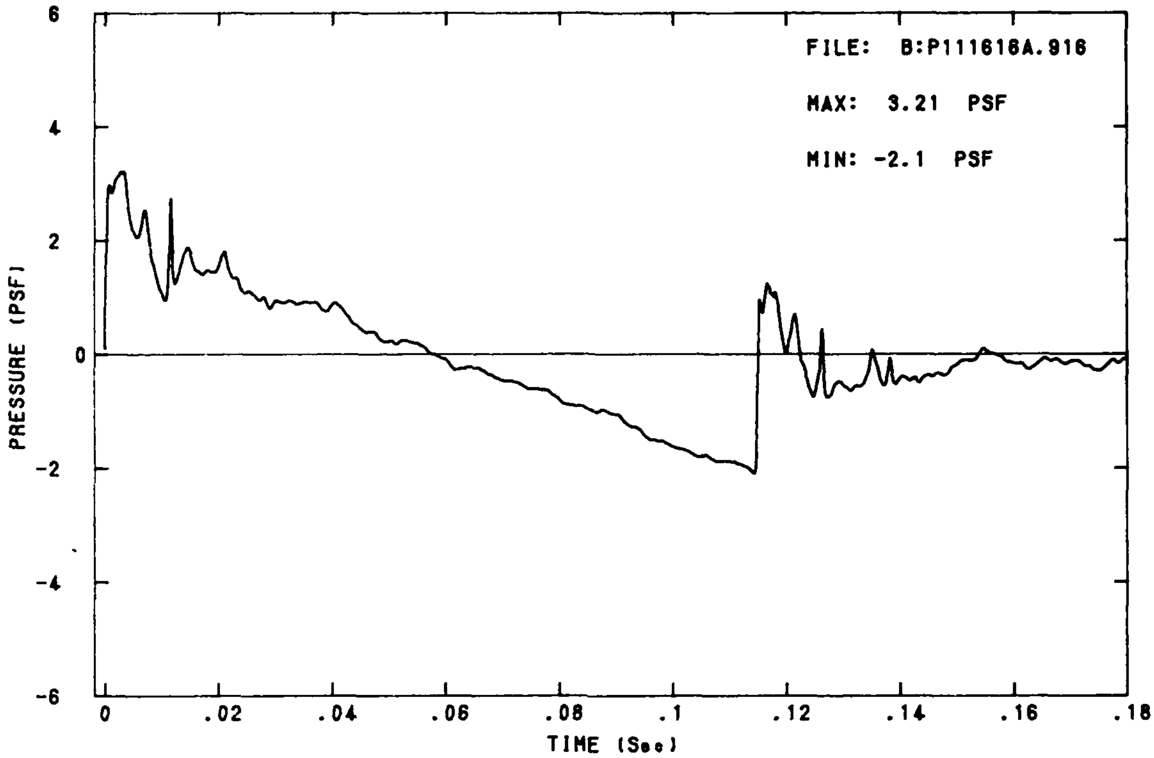

FILE: B:P061617A.916
MAX: 3.51 PSF
MIN: -2.22 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

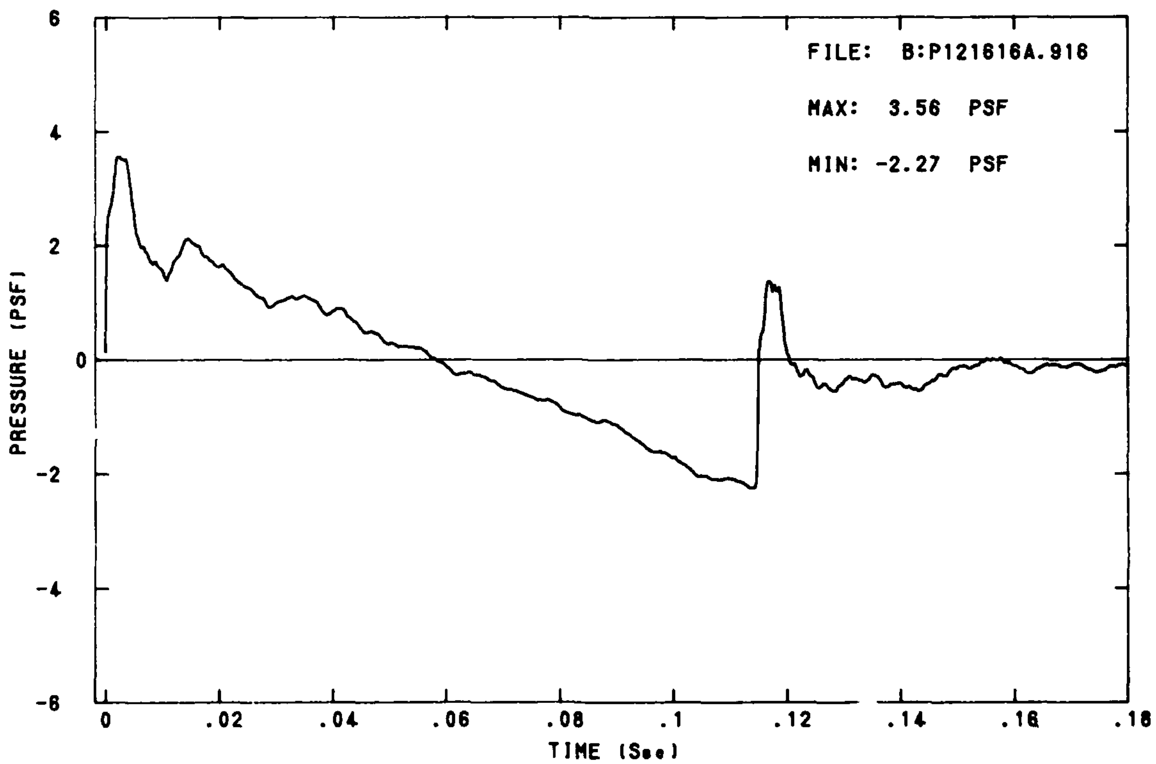

FILE: B:PC71616A.916
MAX: 3.91 PSF
MIN: -2.27 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

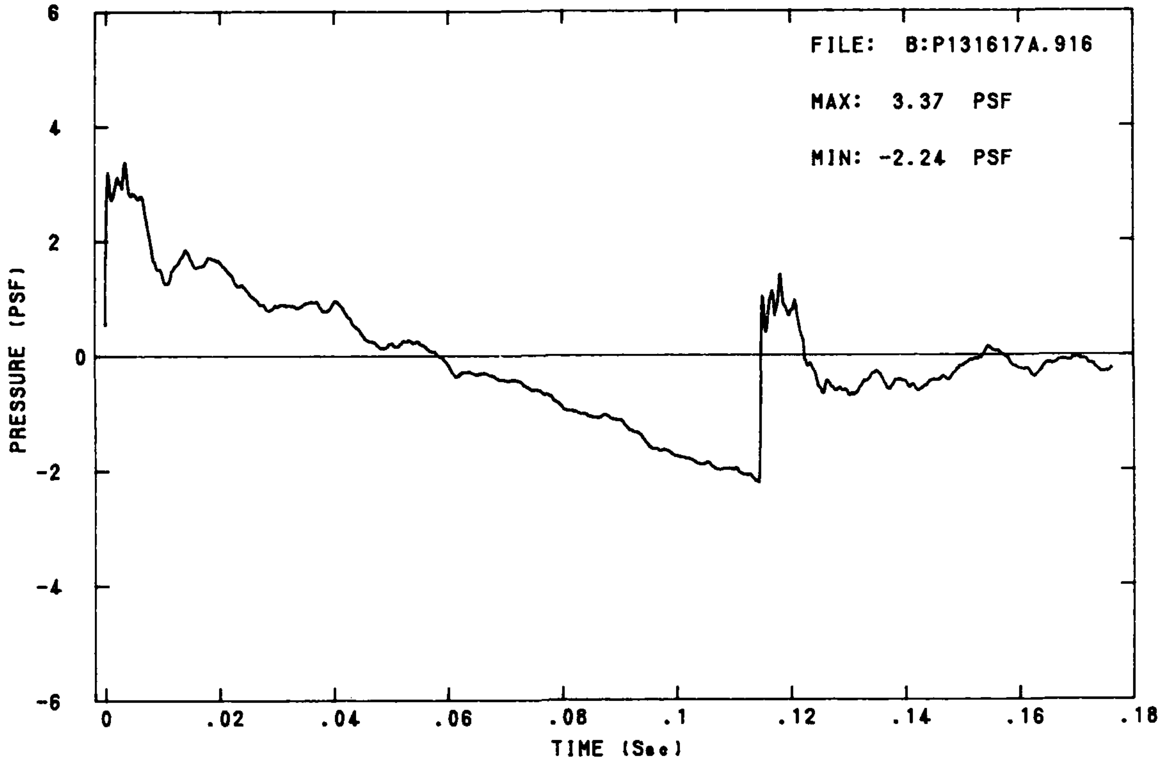

FILE: B:P031616A.916
MAX: 3.38 PSF
MIN: -2.41 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

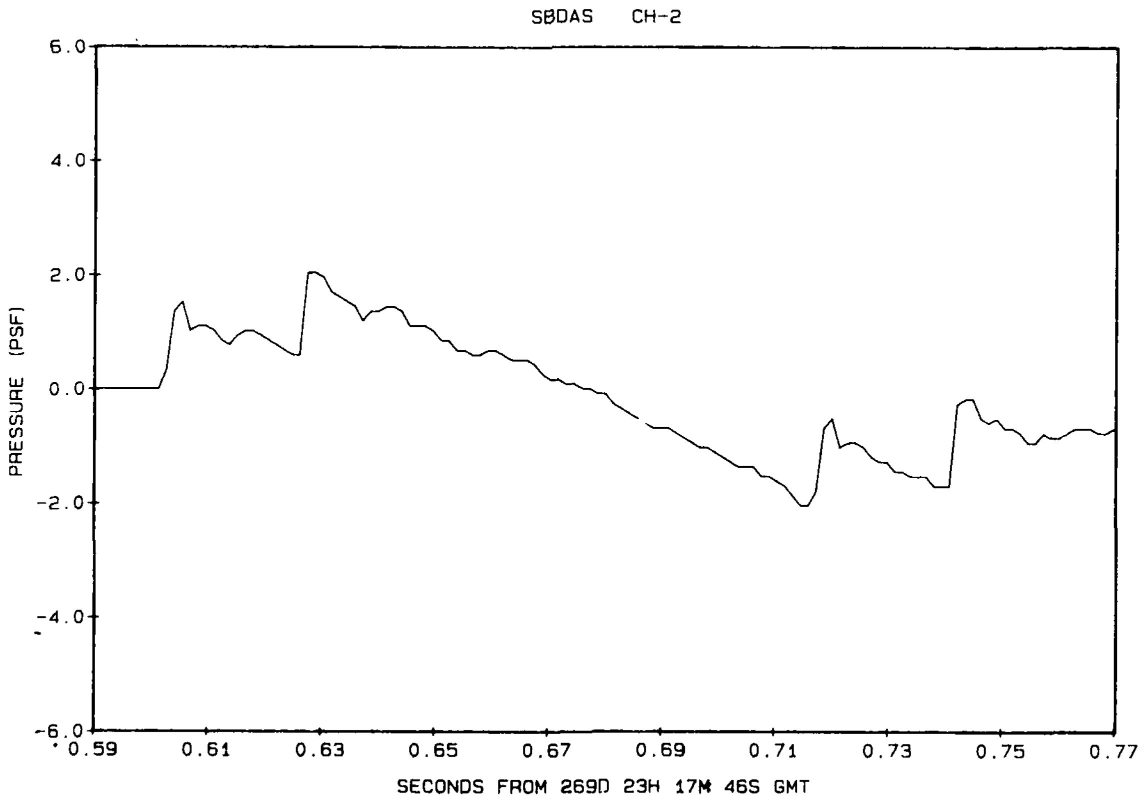

FILE: B:P091616A.916
MAX: 3.42 PSF
MIN: -2.41 PSF
PRESSURE (PSF)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)


FILE: B:P101617A.916
MAX: 3.54 PSF
MIN: -2.3 PSF
PRESSURE (PSF)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)

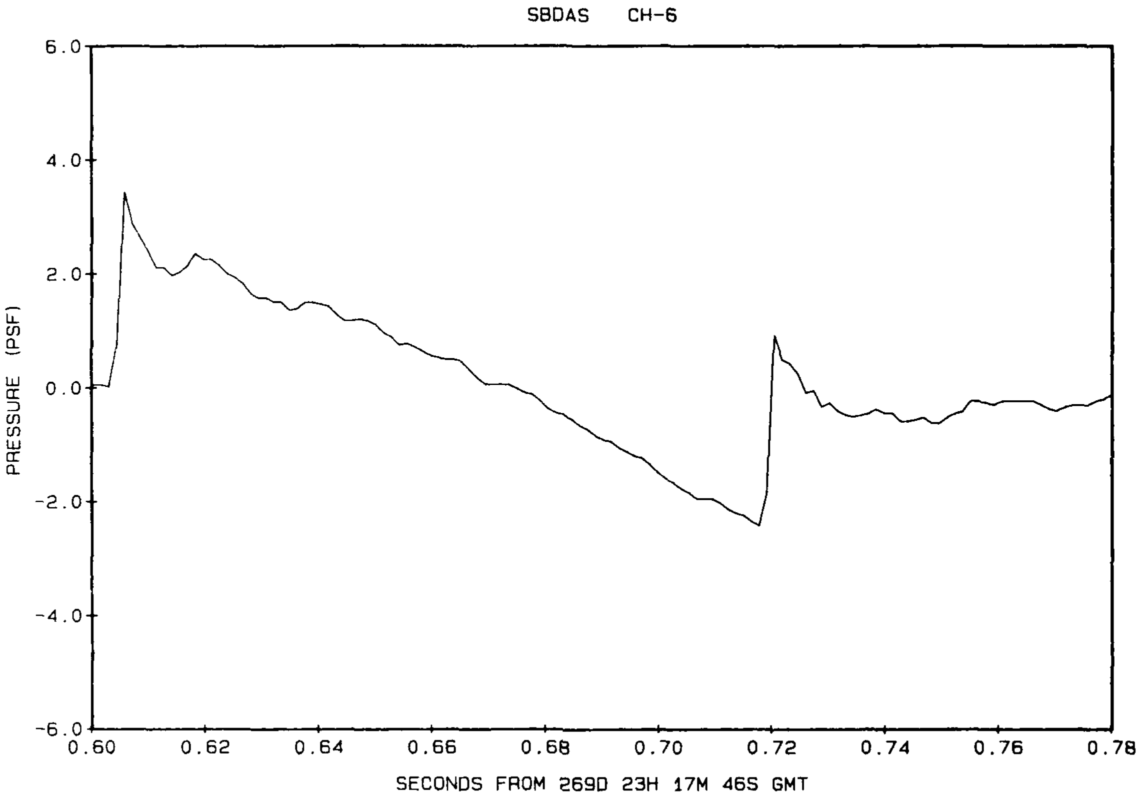

FILE: B:P111616A.916
MAX: 3.21 PSF
MIN: -2.1 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

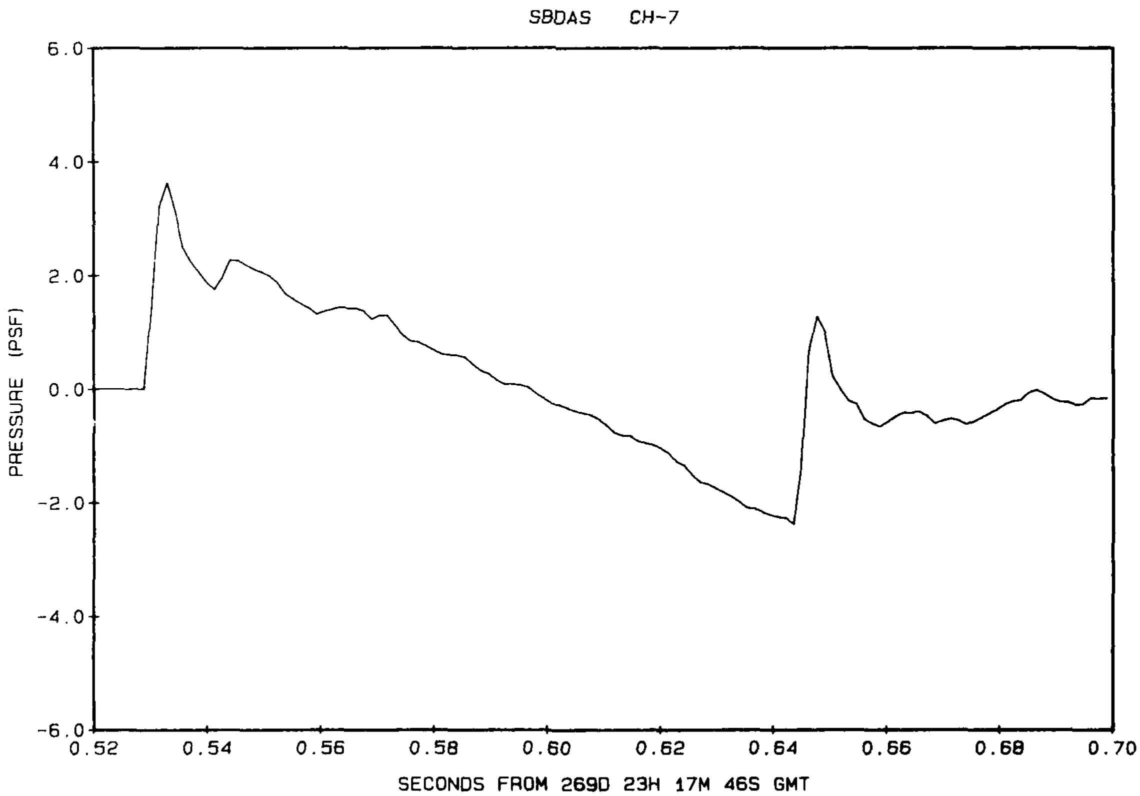

FILE: B:P121616A.916
MAX: 3.56 PSF
MIN: -2.27 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P131617A.916
MAX: 3.37 PSF
MIN: -2.24 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

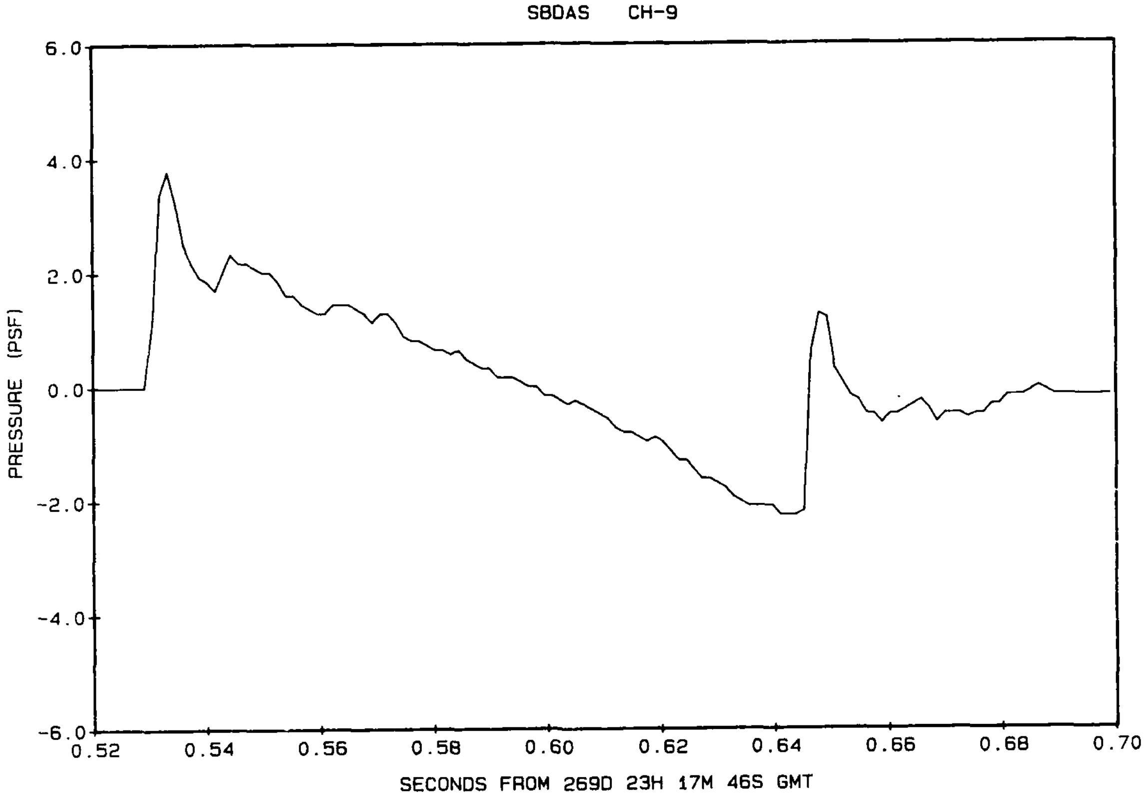

SBDAS CH-2
PRESSURE (PSF)
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.59
0.61
0.63
0.65
0.67
0.69
0.71
0.73
0.75
0.77
SECONDS FROM 269D 23H 17M 46S GMT

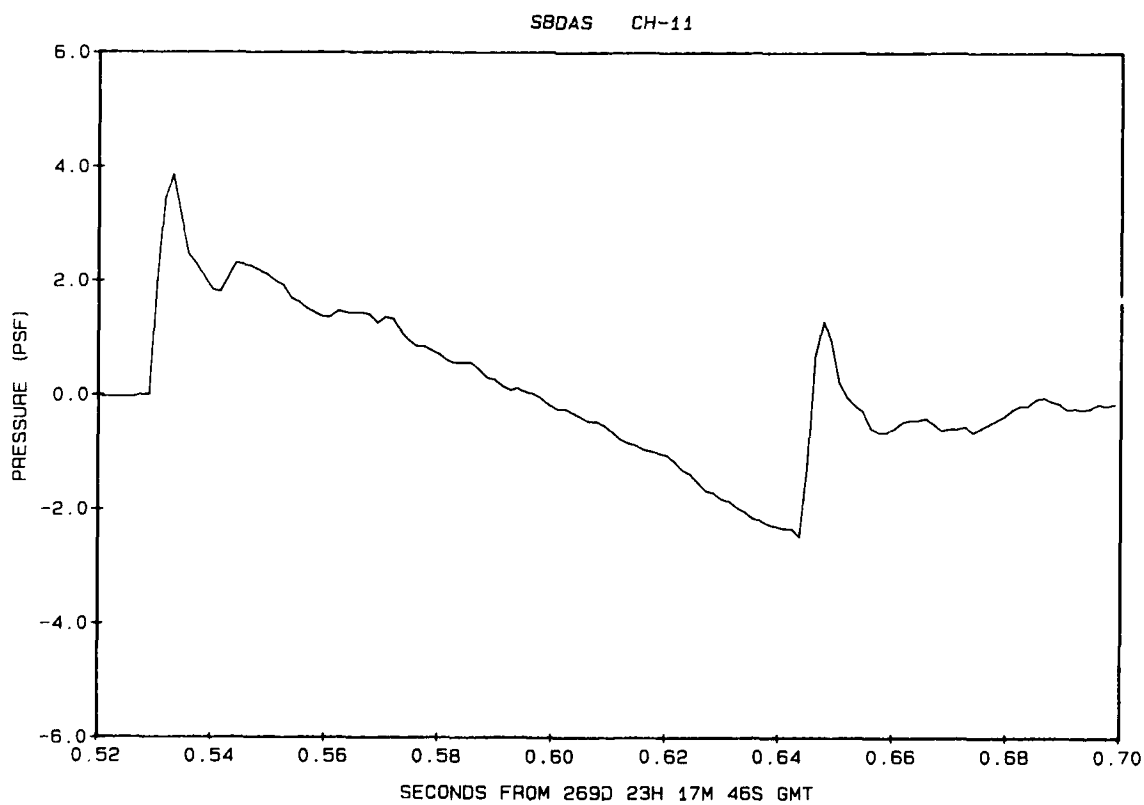
F4 19K-3


SBDAS CH-6
PRESSURE (PSF)
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.60
0.62
0.64
0.66
0.68
0.70
0.72
0.74
0.76
0.78
SECONDS FROM 269D 23H 17M 46S GMT

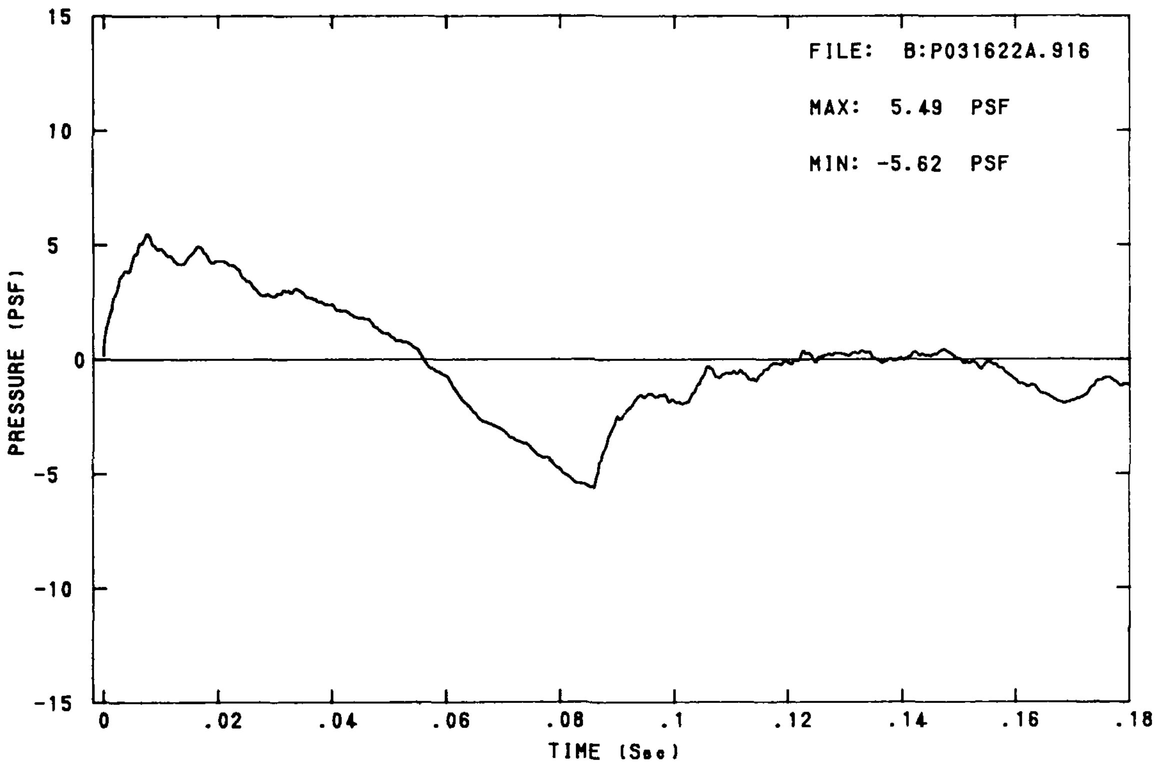

SBDAS CH-7
PRESSURE (PSF)
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
0.52
0.54
0.56
0.58
0.60
0.62
0.64
0.66
0.68
0.70
SECONDS FROM 269D 23H 17M 46S GMT

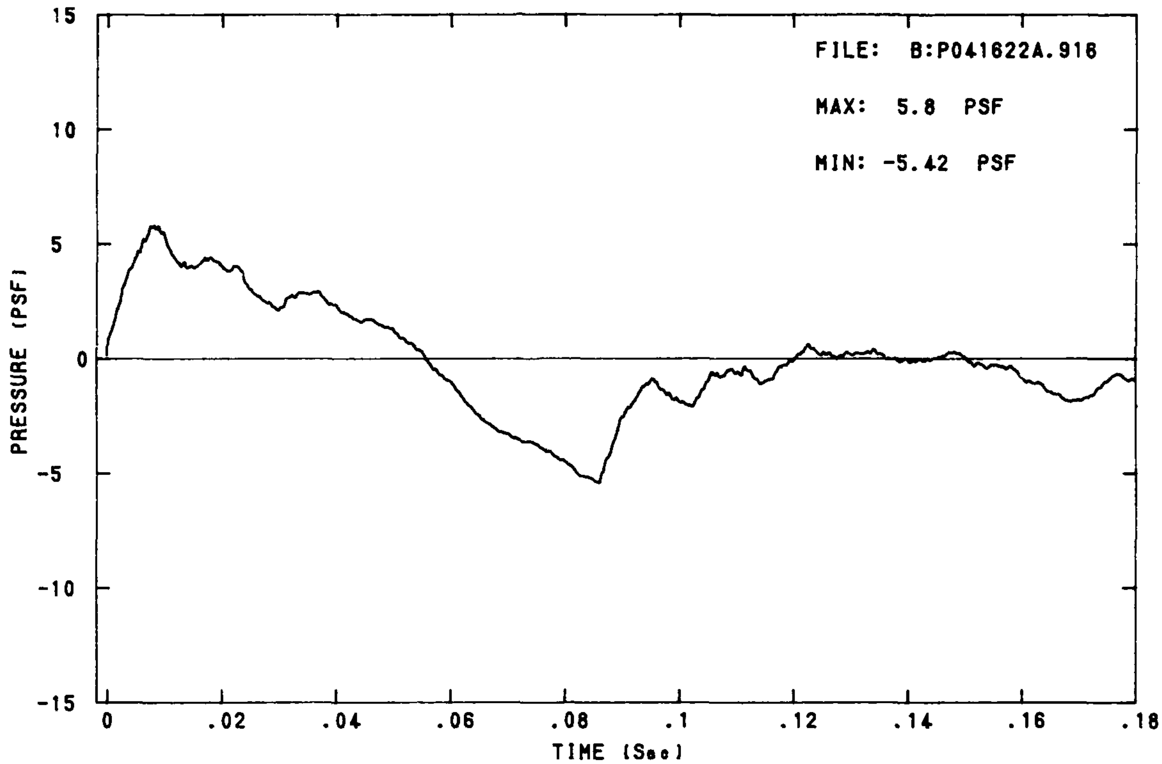
F4 19K-3

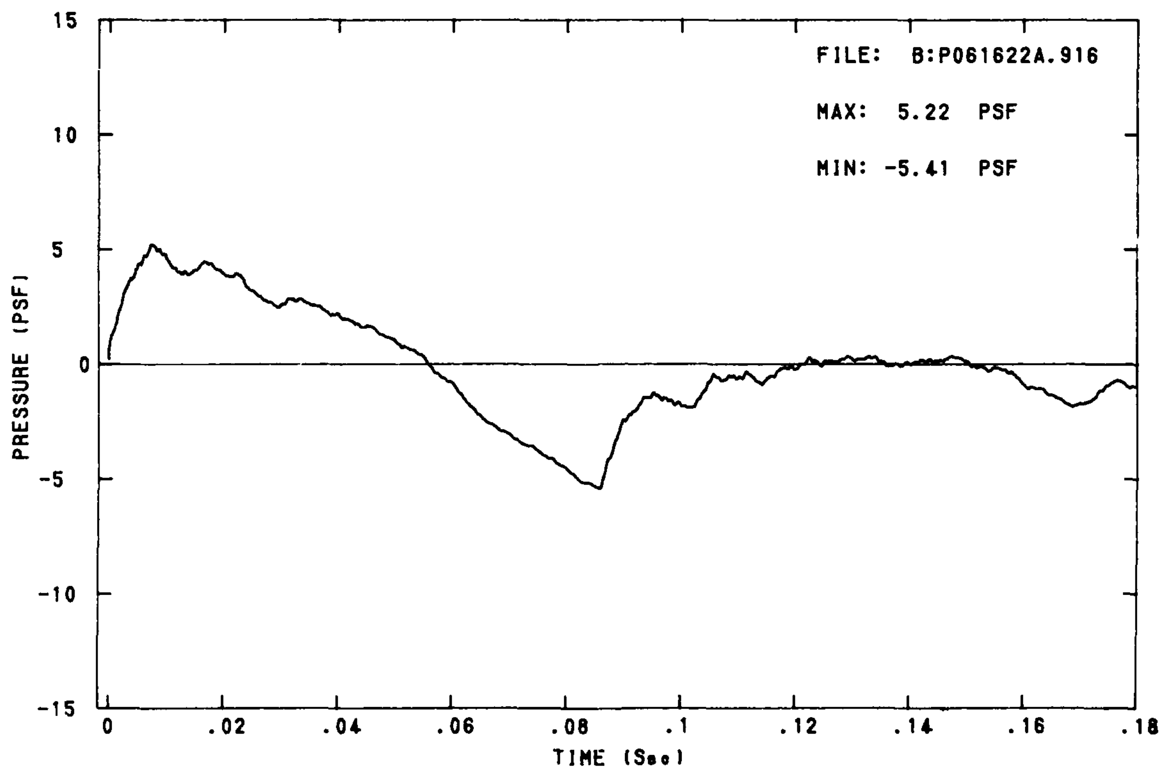

SBDAS CH-9
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
PRESSURE (PSF)
0.52
0.54
0.56
0.58
0.60
0.62
0.64
0.66
0.68
0.70
SECONDS FROM 269D 23H 17M 46S GMT

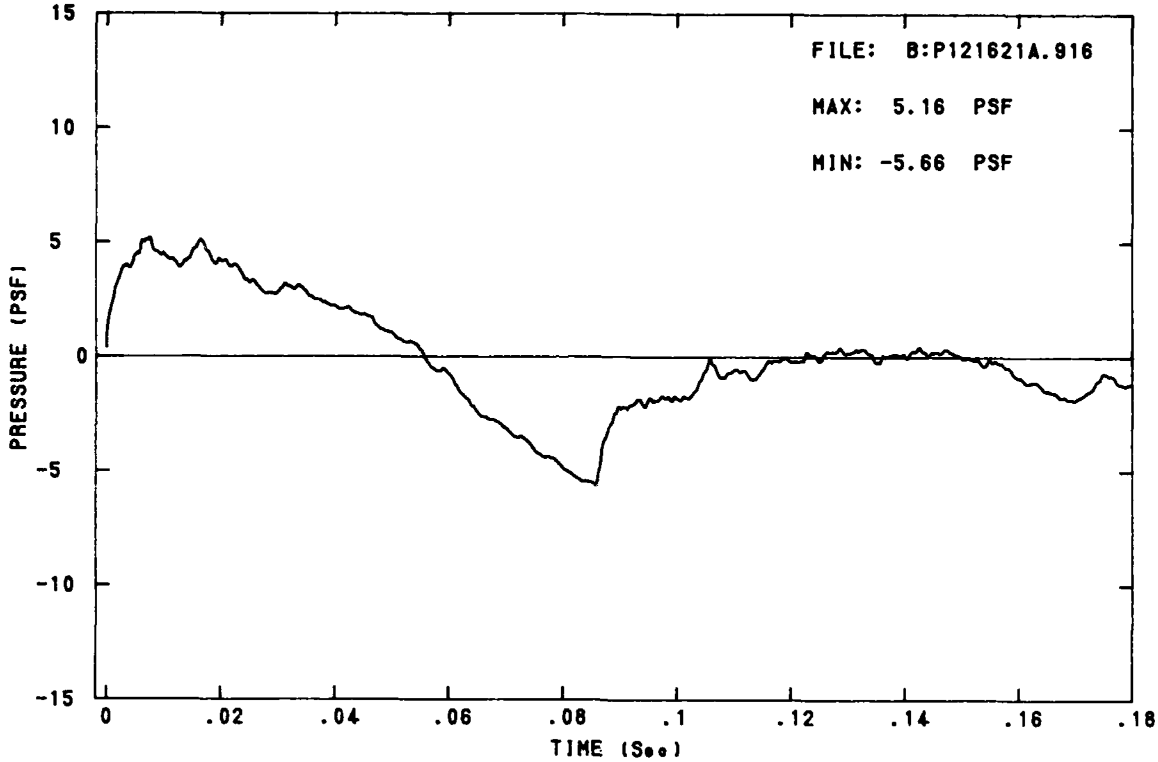

SBDAS CH-11
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
PRESSURE (PSF)
0.52
0.54
0.56
0.58
0.60
0.62
0.64
0.66
0.68
0.70
SECONDS FROM 269D 23H 17M 46S GMT

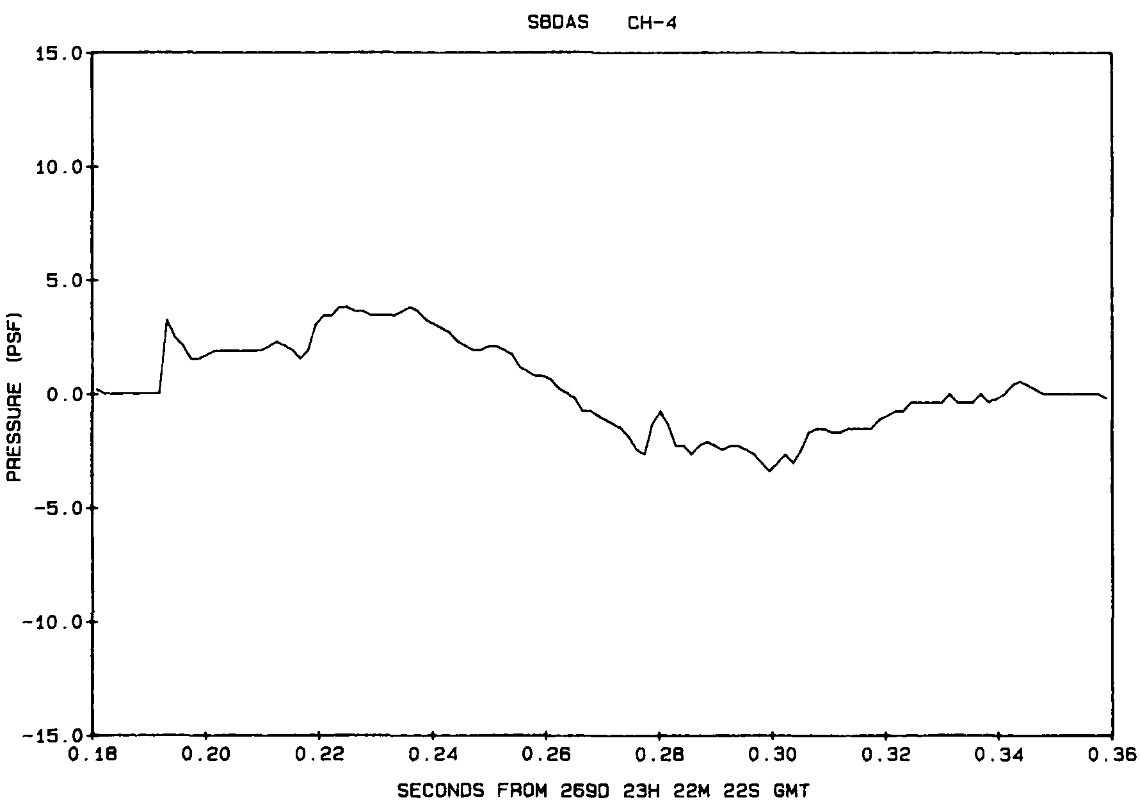
BOOM SIGNATURES from F-4 flying at 1.15 MACH, 5,500 ft AGL, and 0 ft. track offset occuring at 23:22:22 GMT, 16 Sep 86.



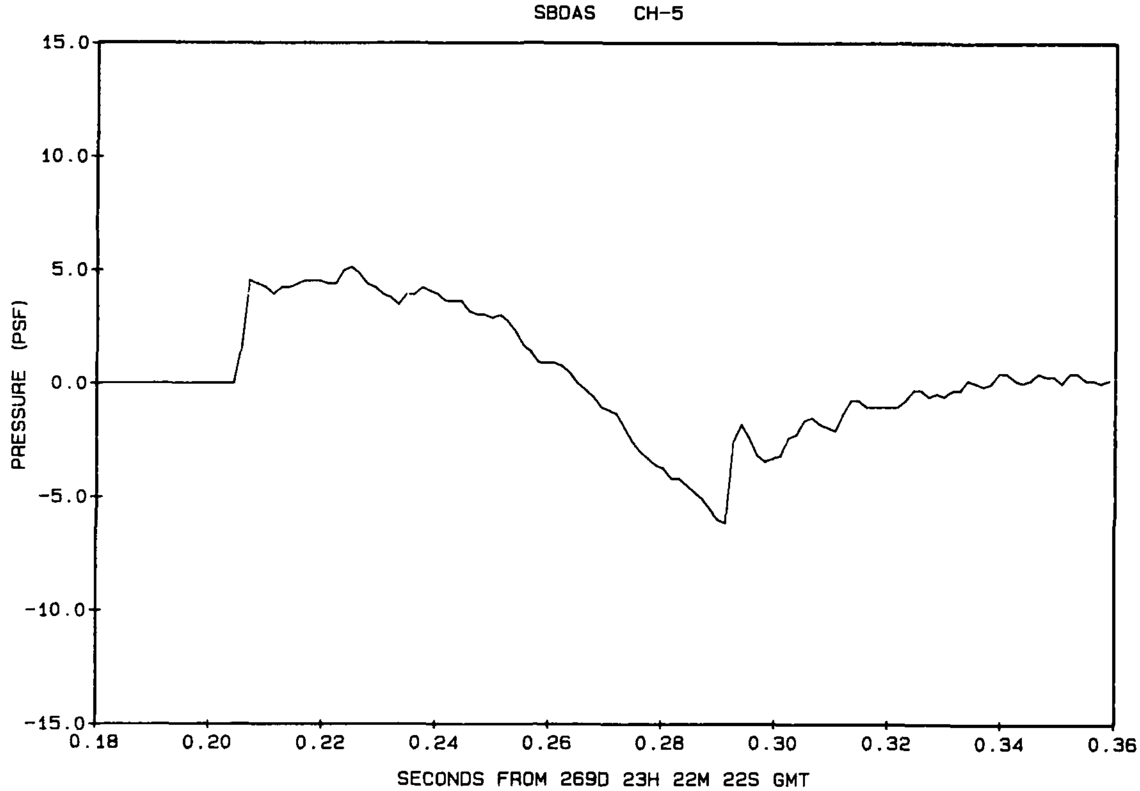

FILE: B:P041622A.916
MAX: 5.8 PSF
MIN: -5.42 PSF
PRESSURE (PSF)
TIME (Sec)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

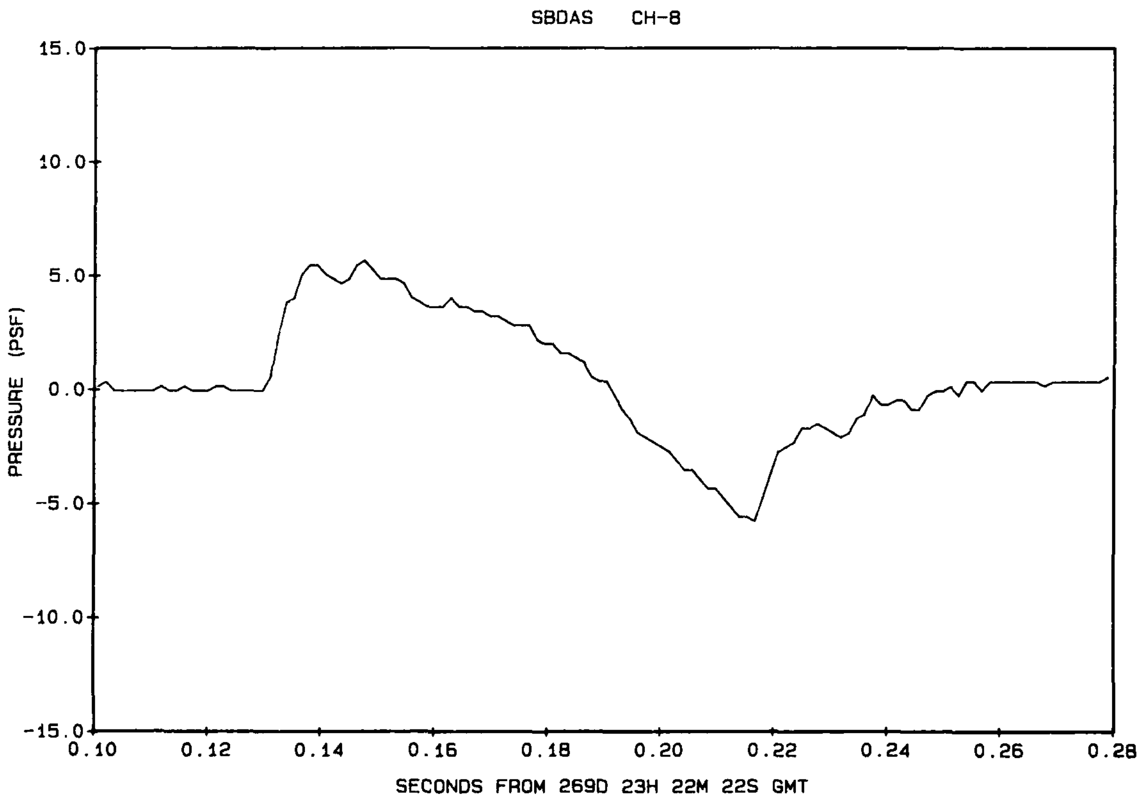

FILE: B:P061622A.916
MAX: 5.22 PSF
MIN: -5.41 PSF
PRESSURE (PSF)
TIME (Sec)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P121621A.916
MAX: 5.16 PSF
MIN: -5.66 PSF
PRESSURE (PSF)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)

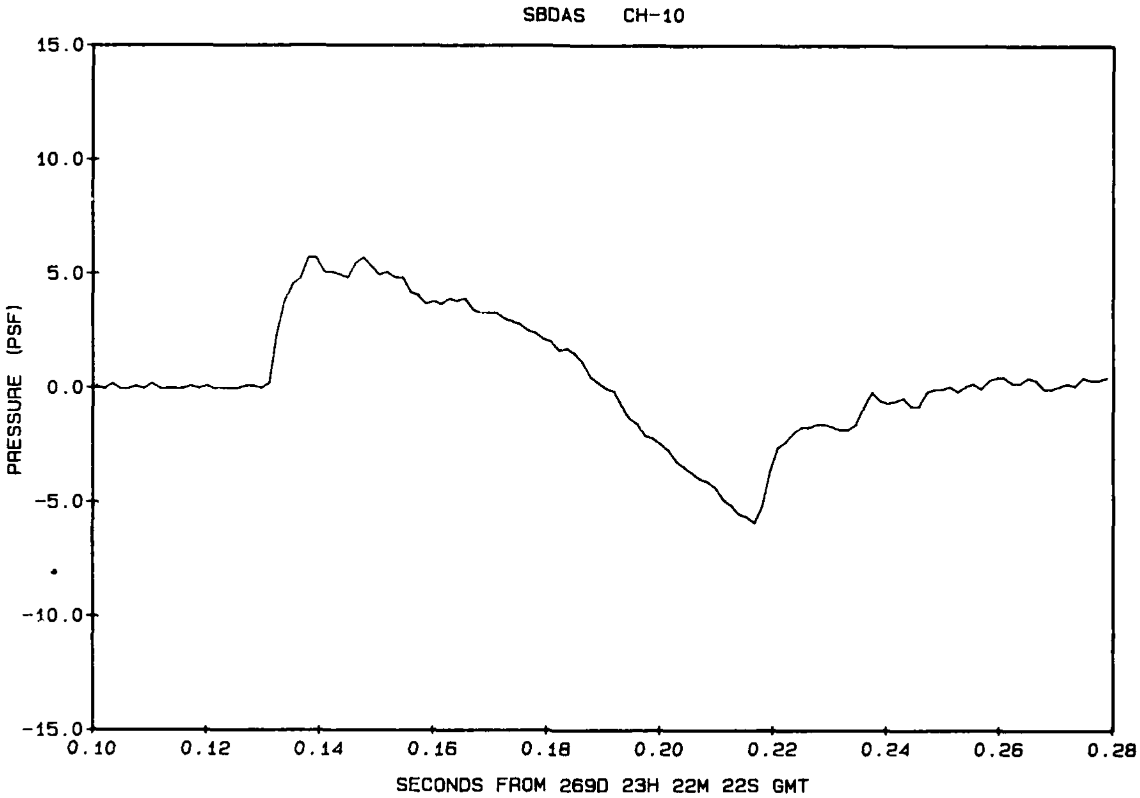

SBDAS CH-4
PRESSURE (PSF)
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
0.18
0.20
0.22
0.24
0.26
0.28
0.30
0.32
0.34
0.36
SECONDS FROM 269D 23H 22M 22S GMT

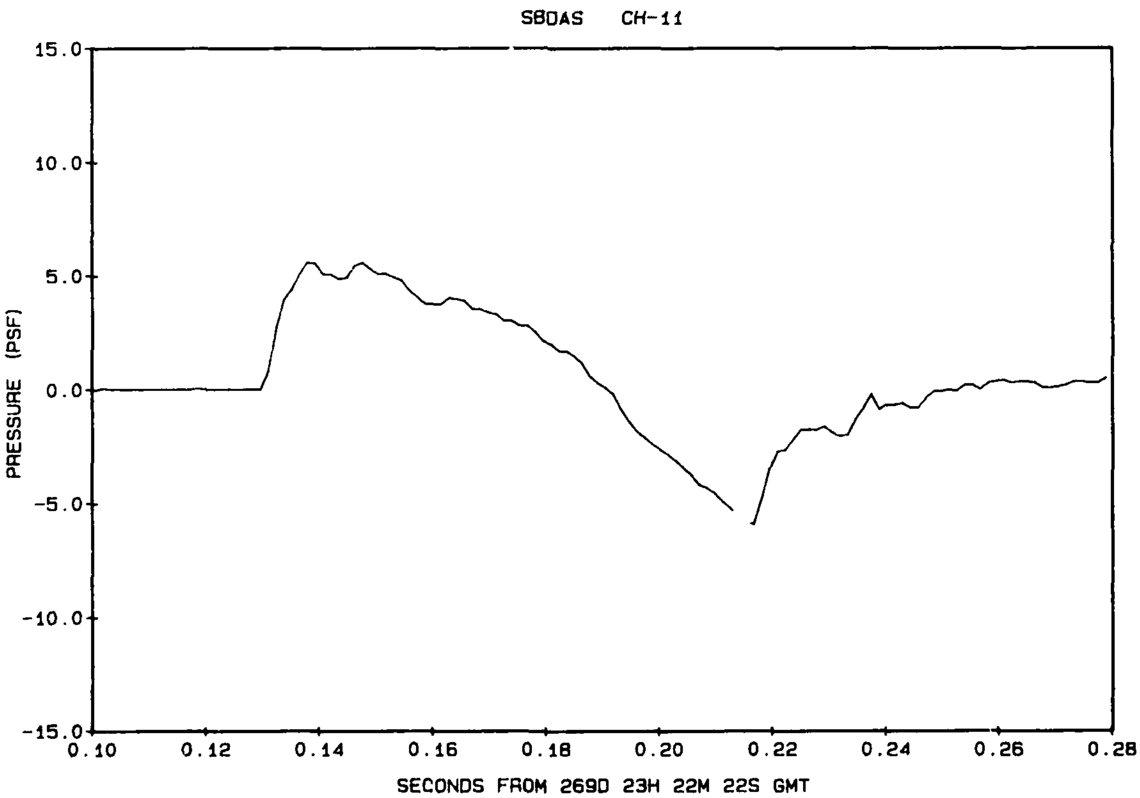
F4 5K-2


SBDAS CH-5
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.18
0.20
0.22
0.24
0.26
0.28
0.30
0.32
0.34
0.36
SECONDS FROM 269D 23H 22M 22S GMT

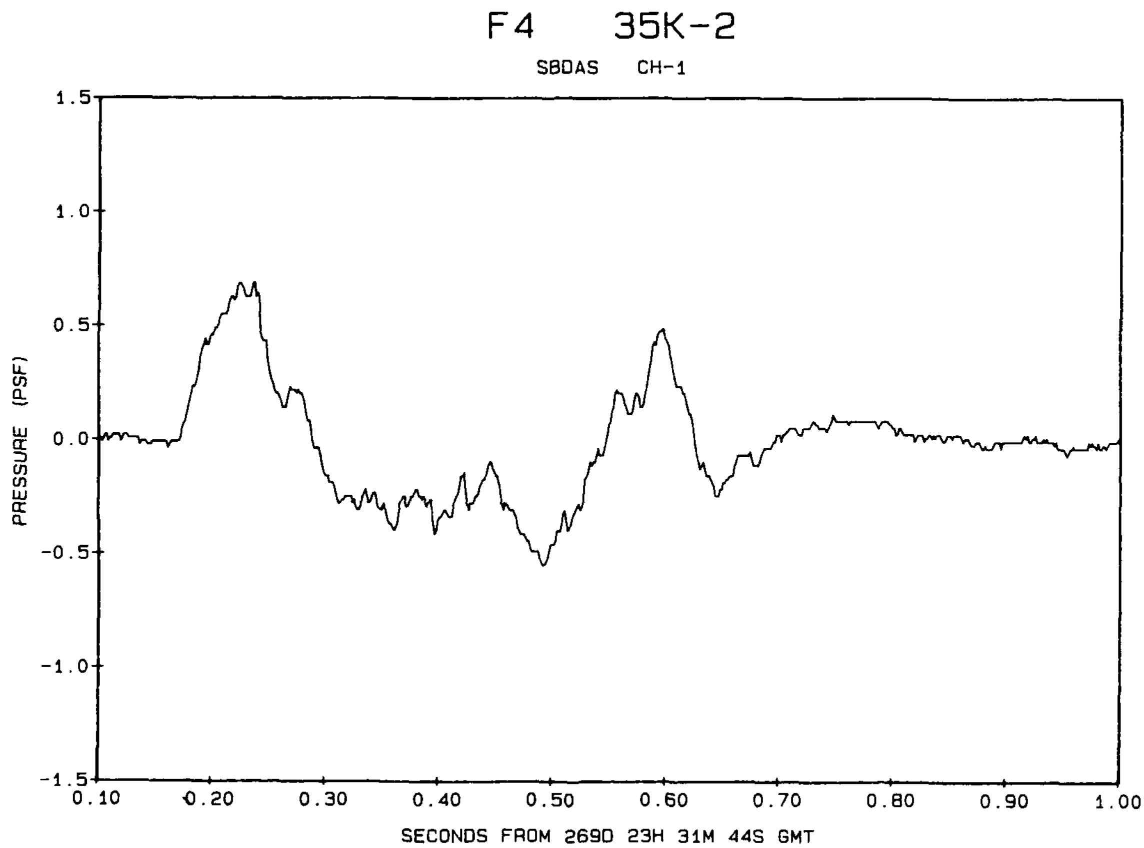

SBDAS CH-8
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
SECONDS FROM 269D 23H 22M 22S GMT

F4 5K-2

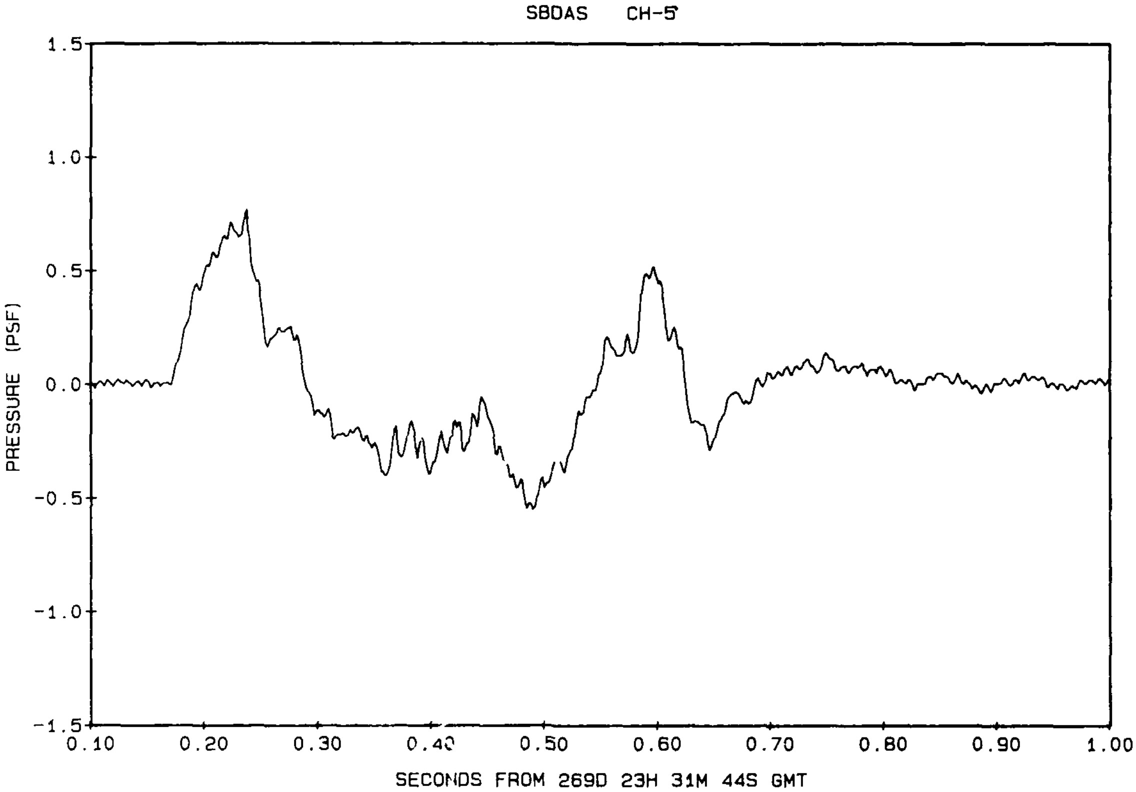

SBDAS CH-10
PRESSURE (PSF)
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
SECONDS FROM 269D 23H 22M 22S GMT

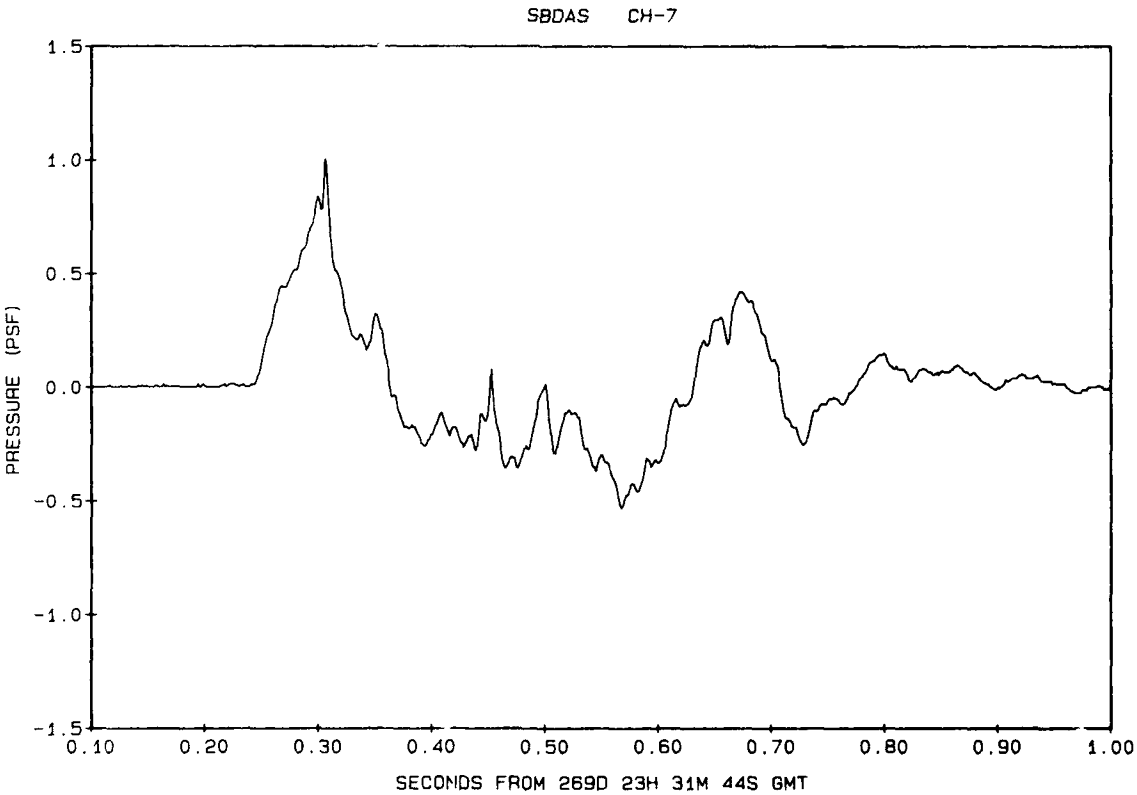

SBDAS CH-11
PRESSURE (PSF)
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
SECONDS FROM 269D 23H 22M 22S GMT

BOOM SIGNATURES from F-4 flying at 1.45 MACH, 35,100 ft AGL, and 60,600 ft. track offset occuring at 23:31:45 GMT, 16 Sep 86.

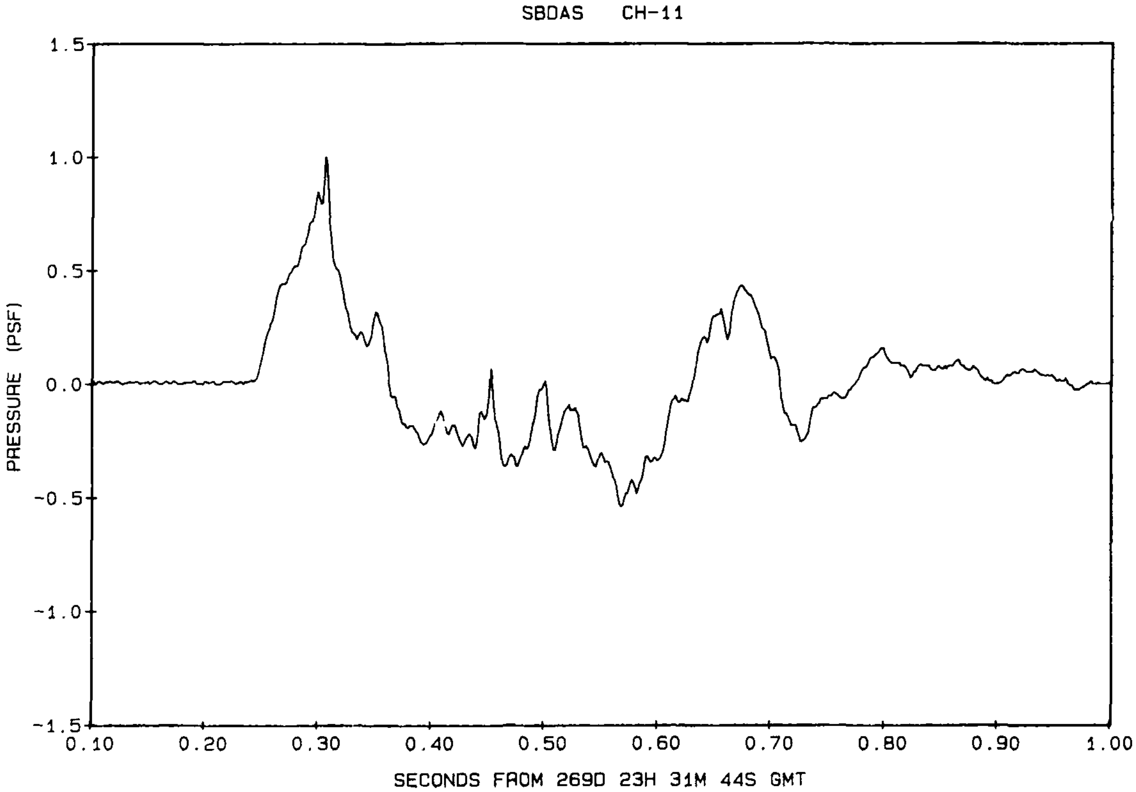


F4 35K-2

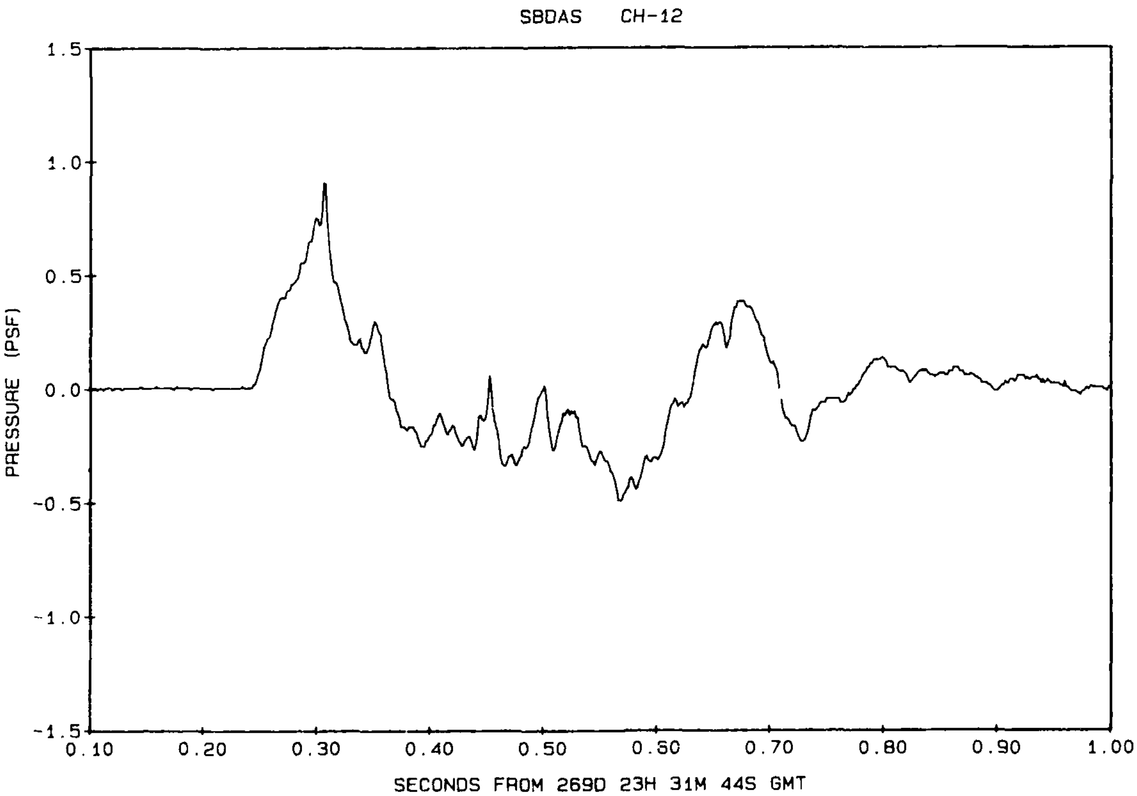

SBDAS CH-5
PRESSURE (PSF)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
SECONDS FROM 269D 23H 31M 44S GMT


SBDAS CH-7
PRESSURE (PSF)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
SECONDS FROM 269D 23H 31M 44S GMT

F4 35K-2

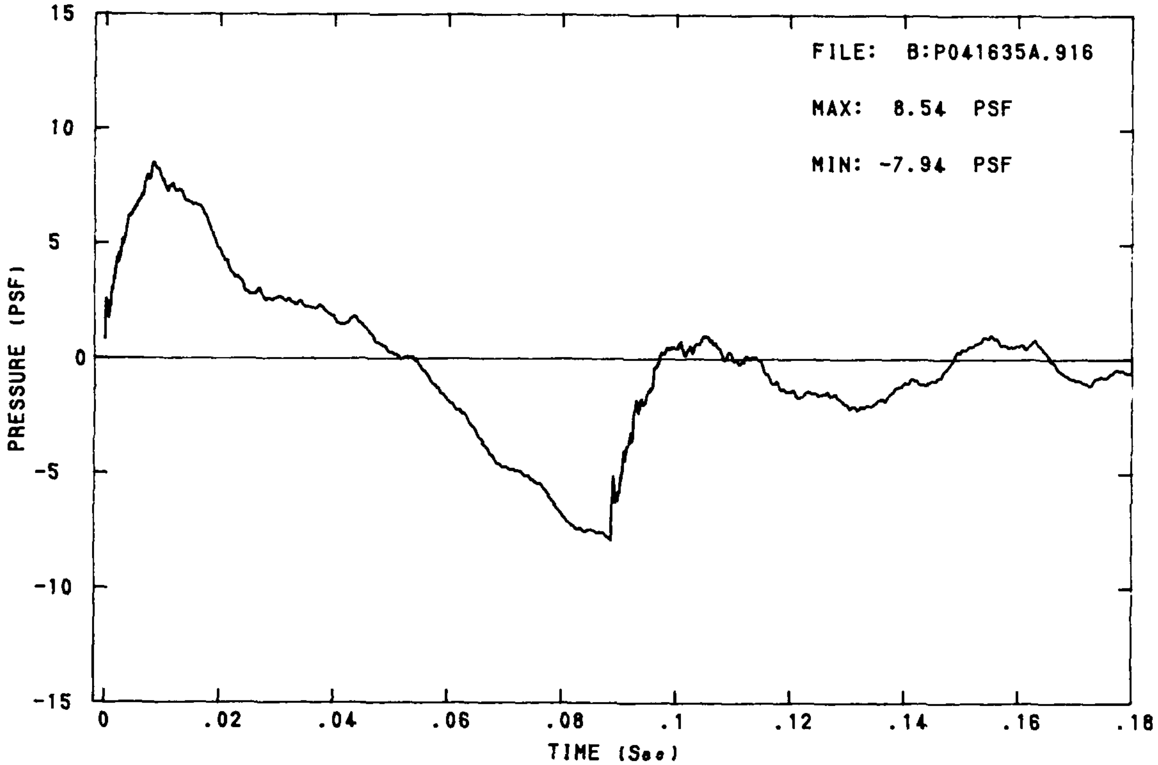


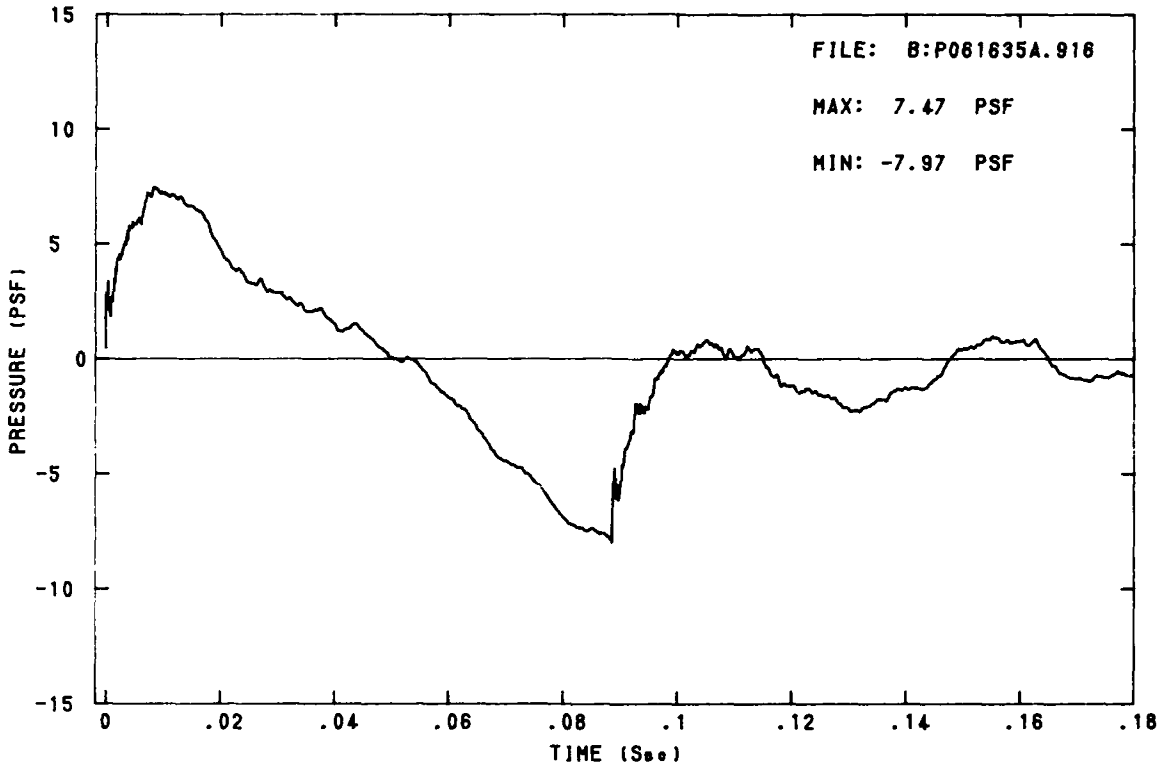
SBDAS CH-11
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
PRESSURE (PSF)
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
SECONDS FROM 269D 23H 31M 44S GMT

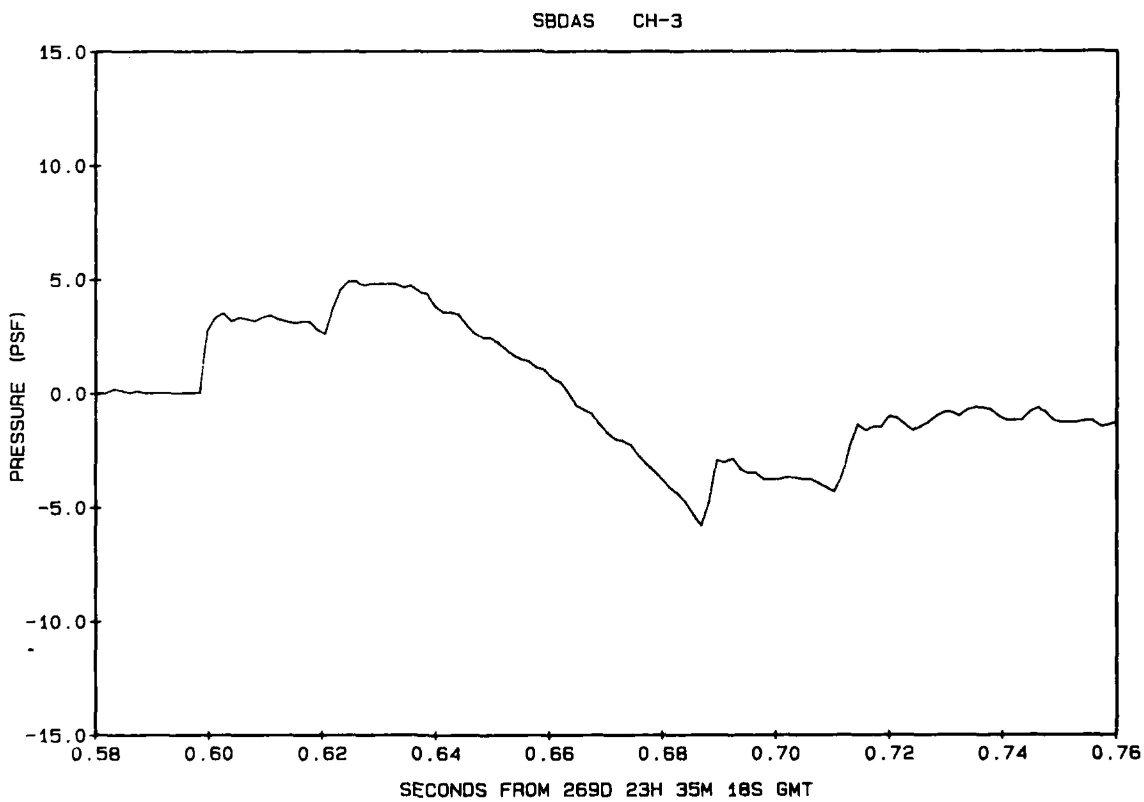


SBDAS CH-12
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
PRESSURE (PSF)
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
SECONDS FROM 269D 23H 31M 44S GMT

BOOM SIGNATURES from F-4 flying at 1.15 MACH, 5,200 ft AGL, and 0 ft. track offset occuring at 23:35:18 GMT, 16 Sep 86.

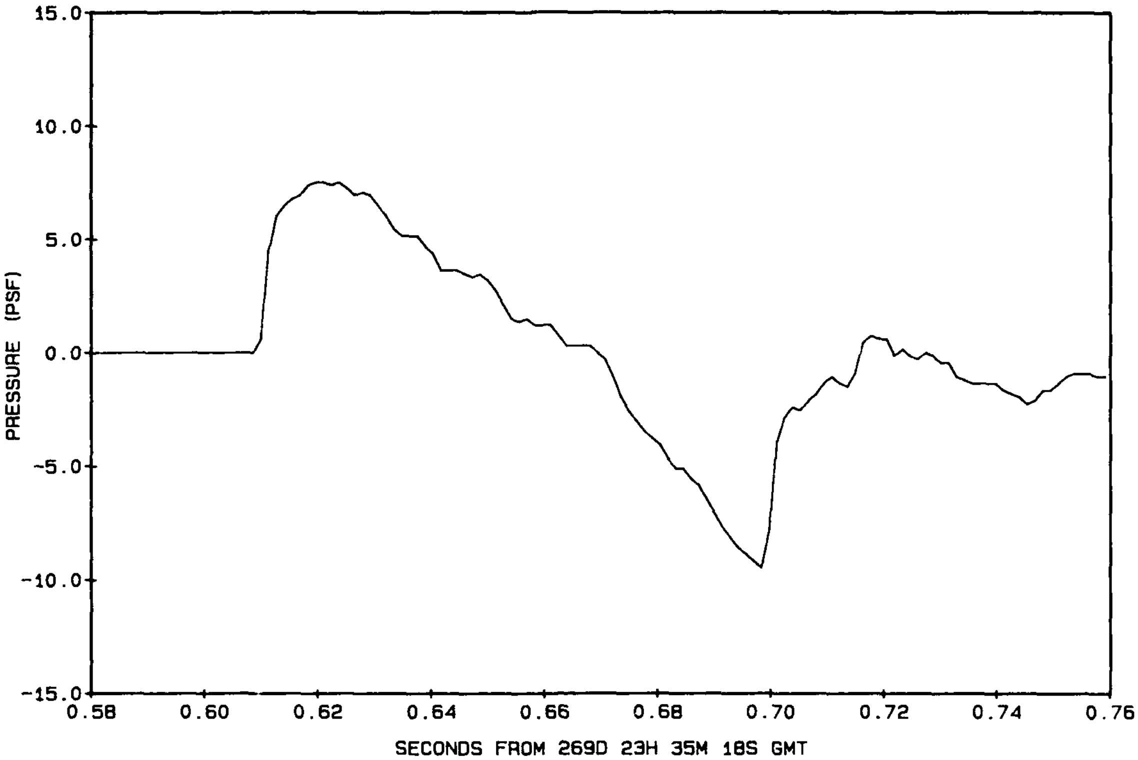



FILE: B:P061635A.916
MAX: 7.47 PSF
MIN: -7.97 PSF
PRESSURE (PSF)
TIME (Sec)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

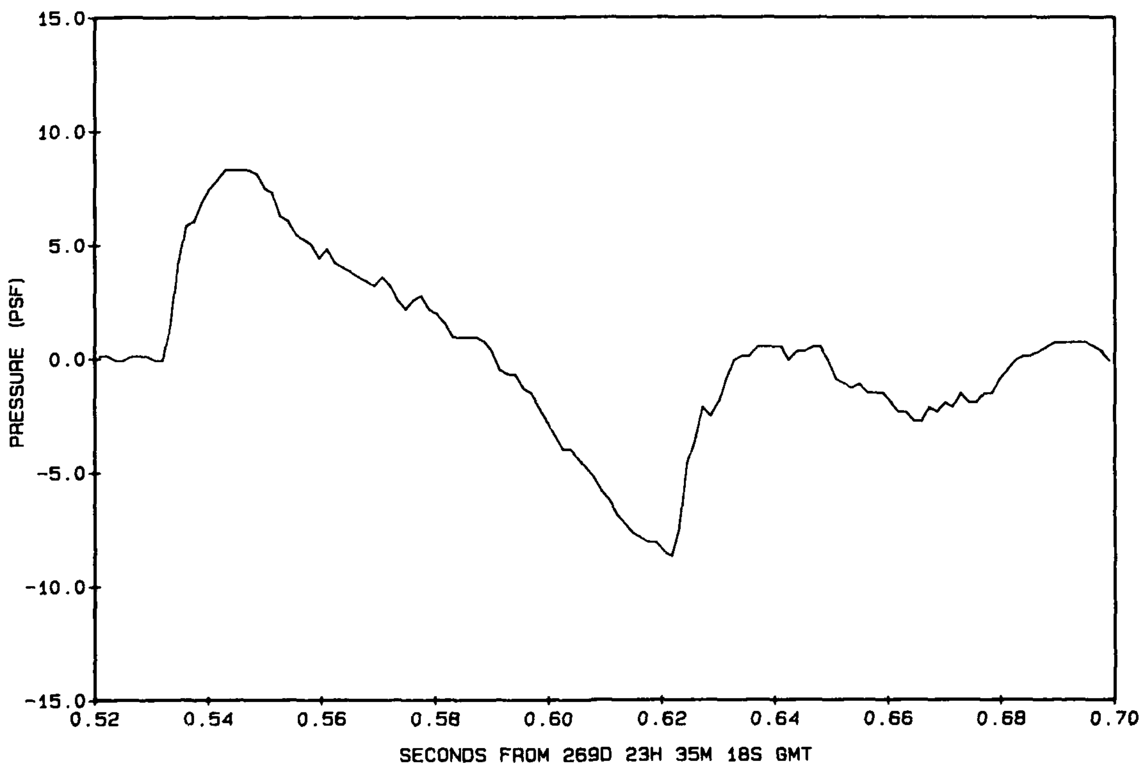

SBDAS CH-3
PRESSURE (PSF)
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
0.58
0.60
0.62
0.64
0.66
0.68
0.70
0.72
0.74
0.76
SECONDS FROM 269D 23H 35M 18S GMT

F4 5K-3

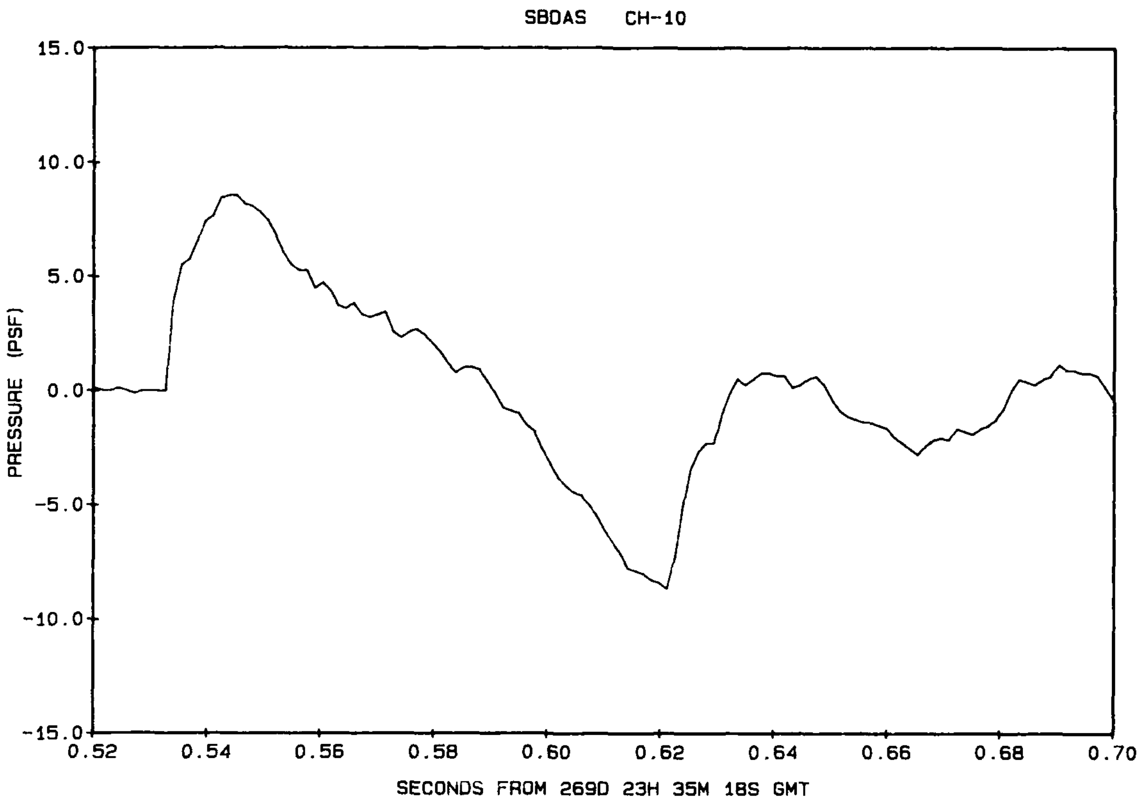
SBDAS CH-5



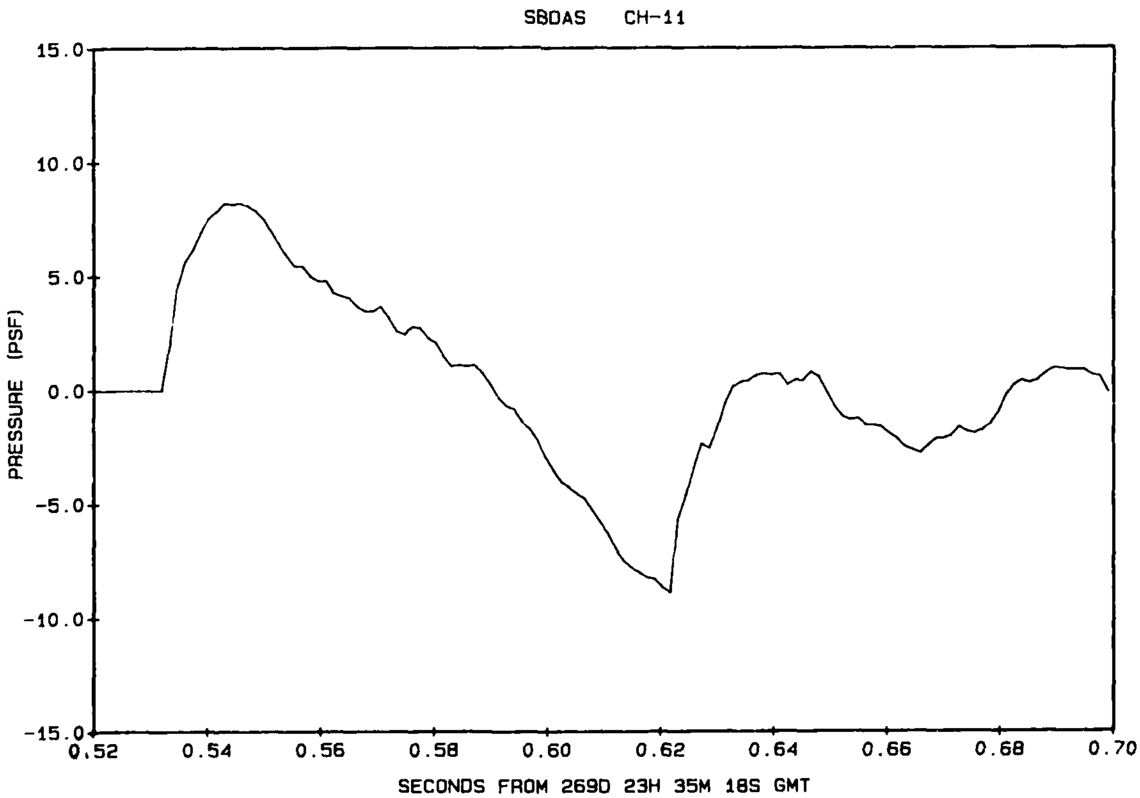
SBDAS CH-8



F4 5K-3

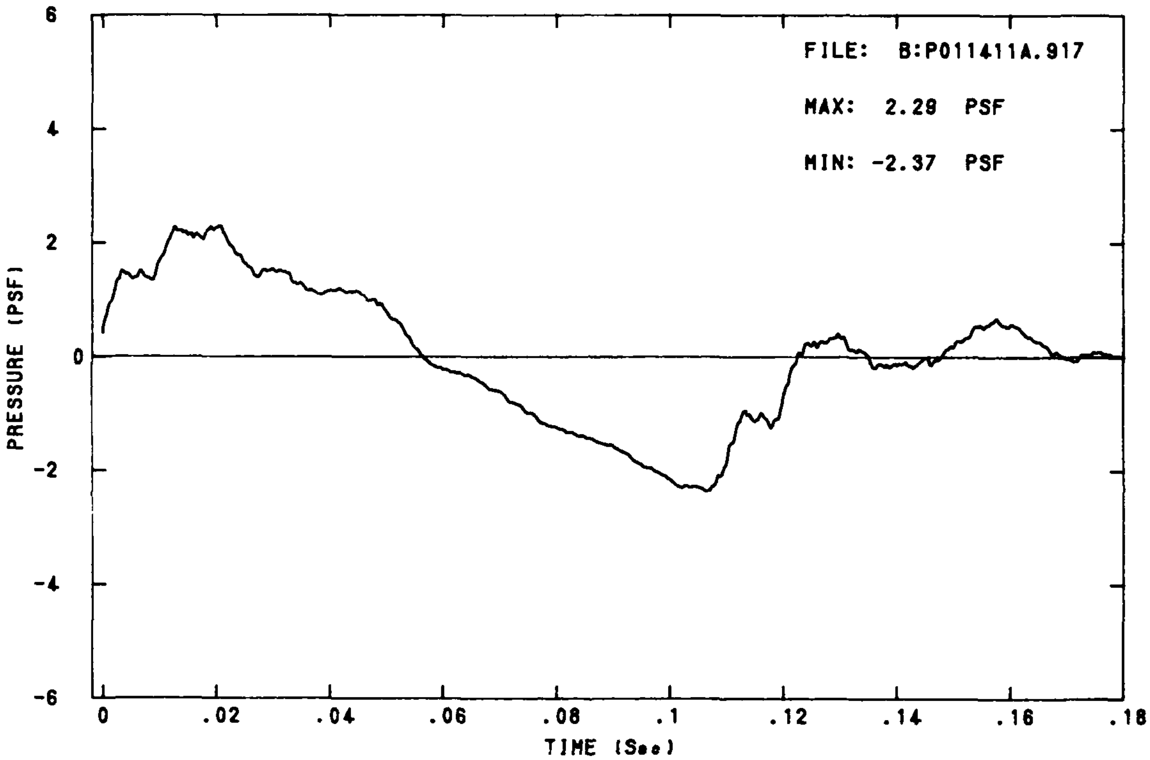


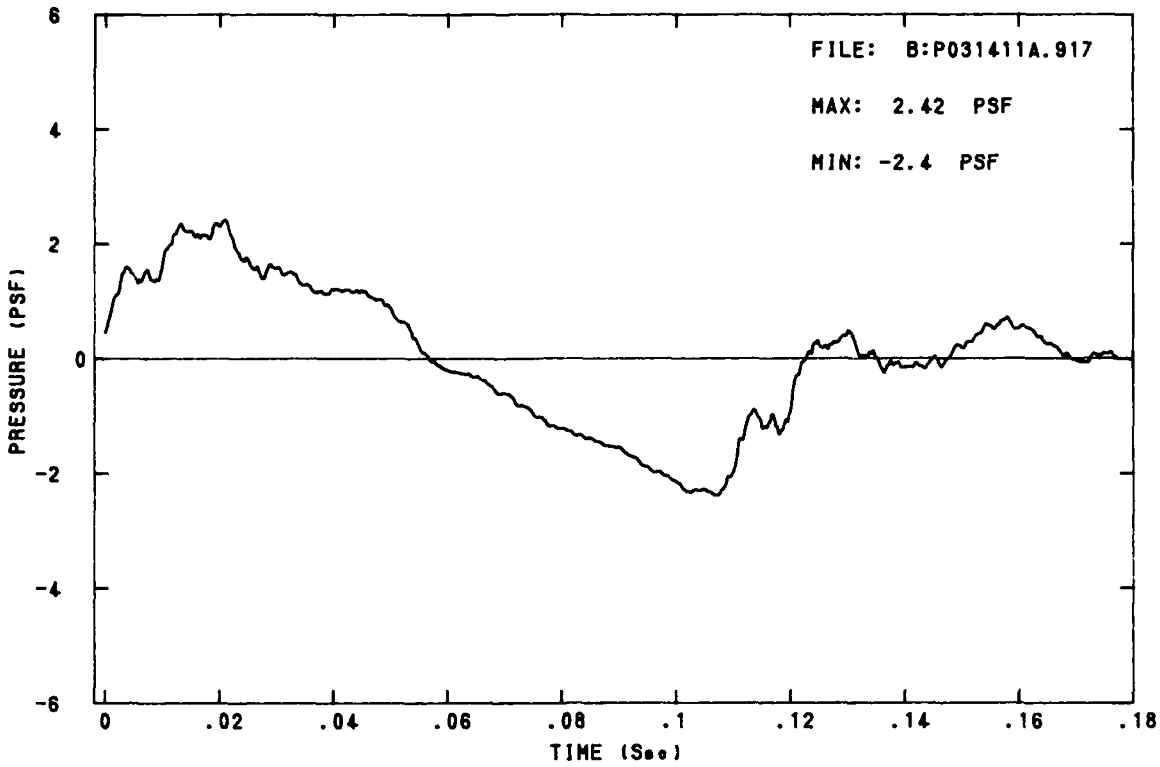
SBDAS CH-10
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.52
0.54
0.56
0.58
0.60
0.62
0.64
0.66
0.68
0.70
SECONDS FROM 269D 23H 35M 18S GMT

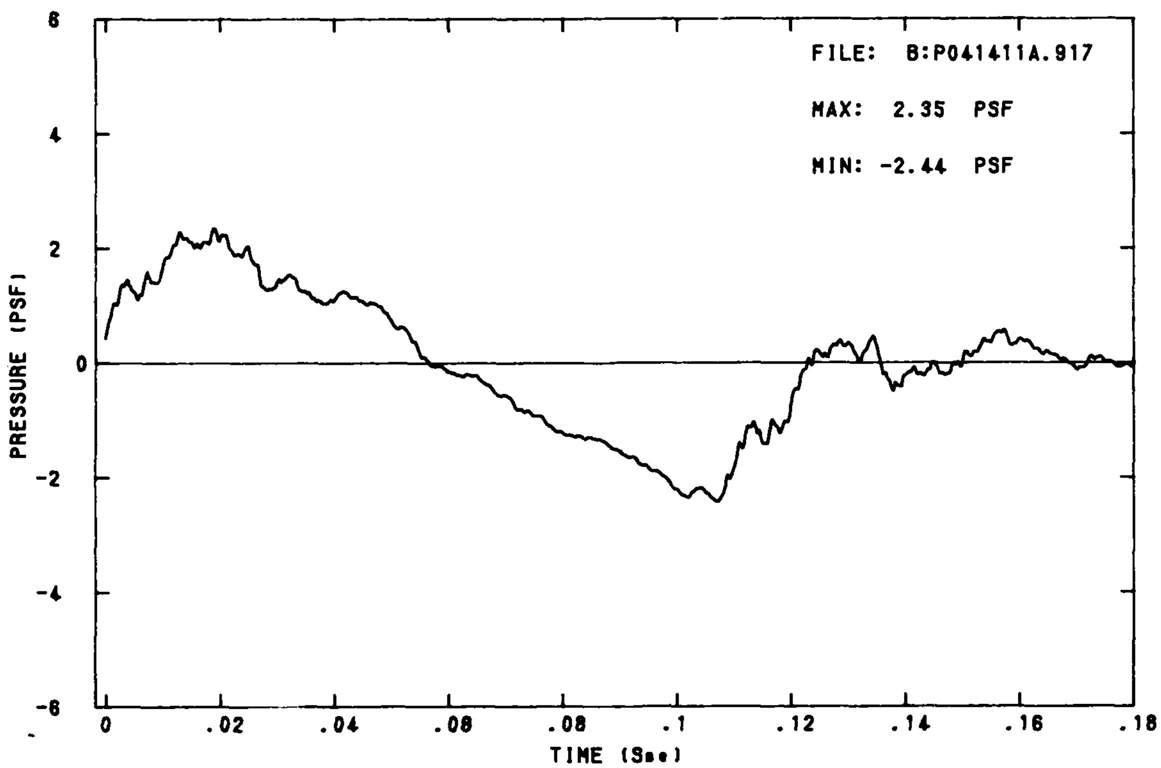


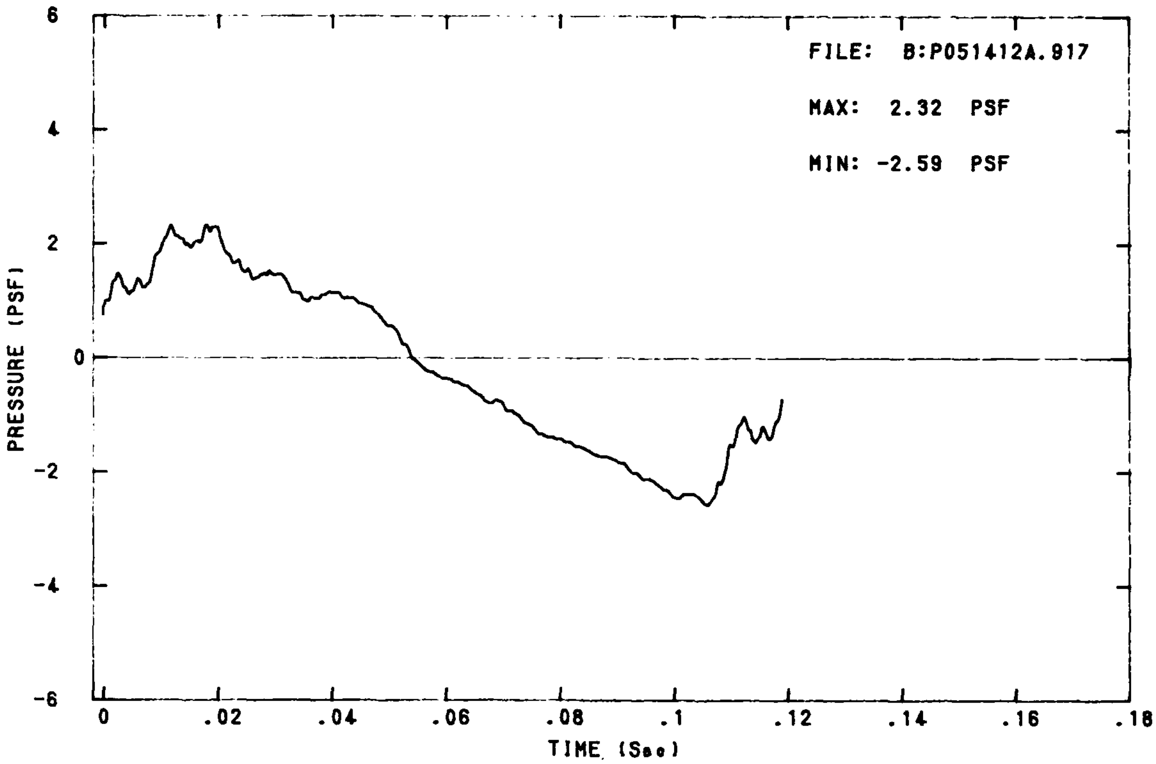
SBDAS CH-11
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.52
0.54
0.56
0.58
0.60
0.62
0.64
0.66
0.68
0.70
SECONDS FROM 269D 23H 35M 18S GMT

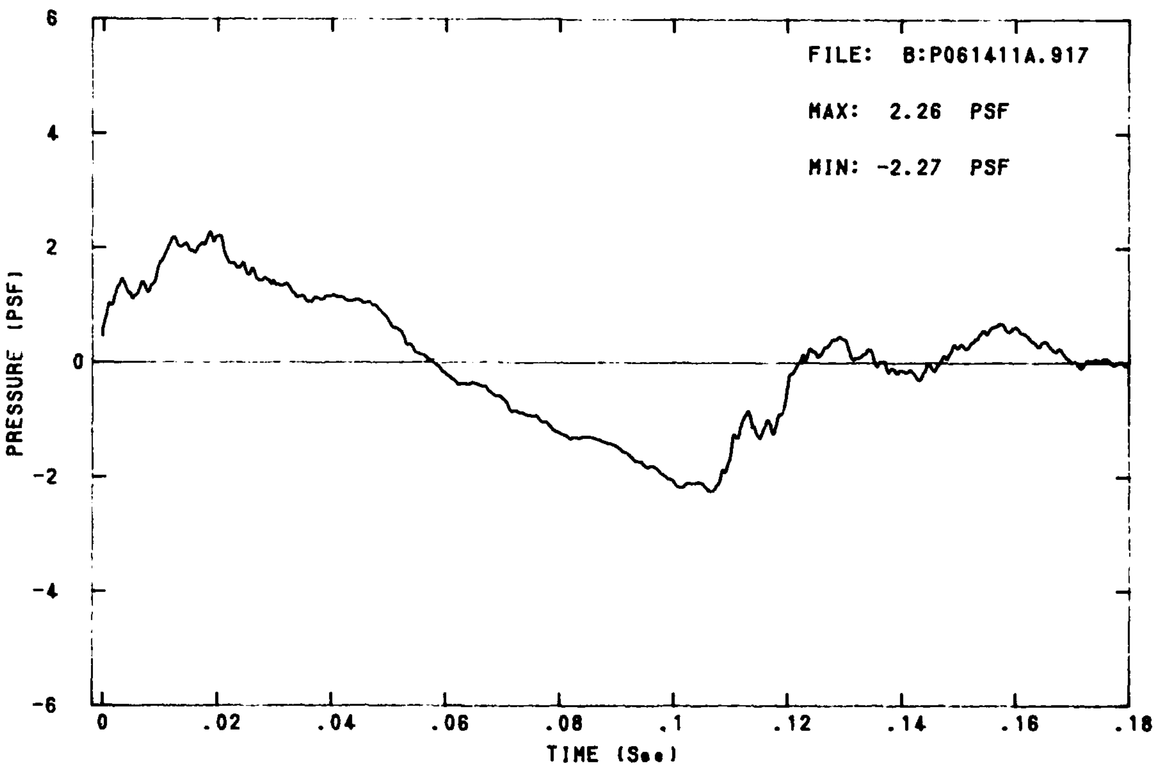
BOOM SIGNATURES from F-4 flying at 1.2 MACH, 19,000 ft AGL, and 0 ft. track offset occuring at 21:11:59 GMT, 17 Sep 86.

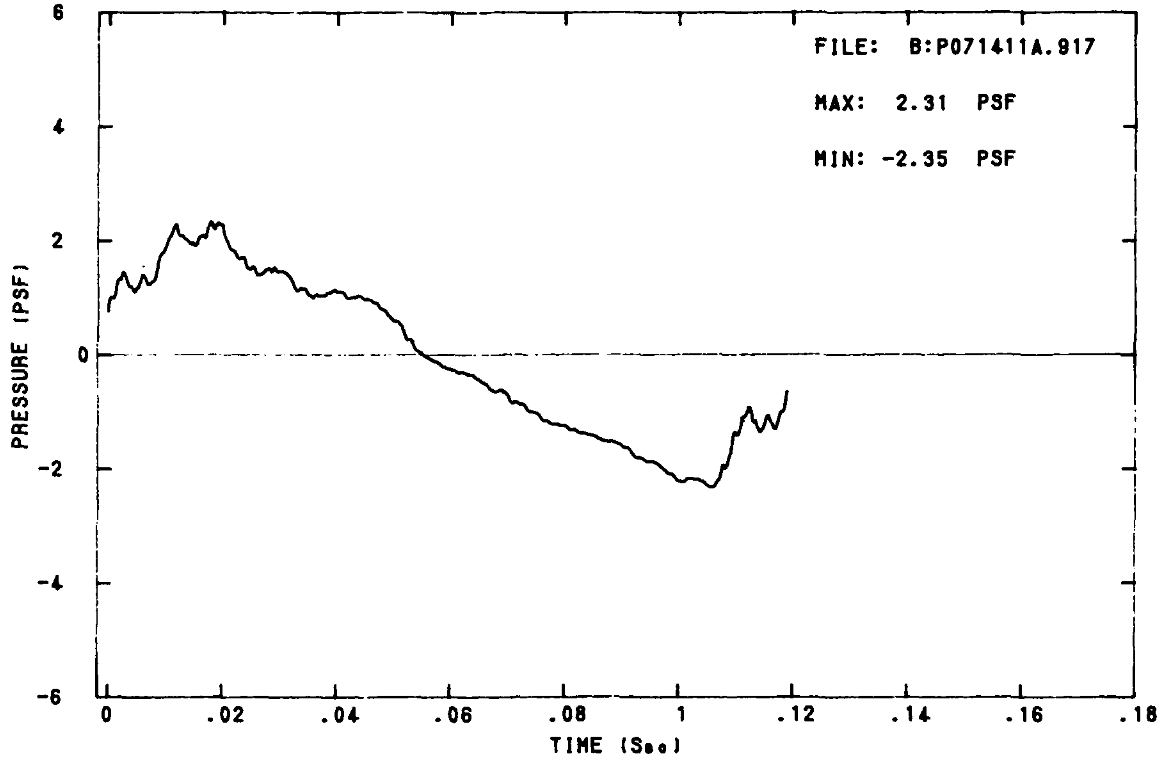


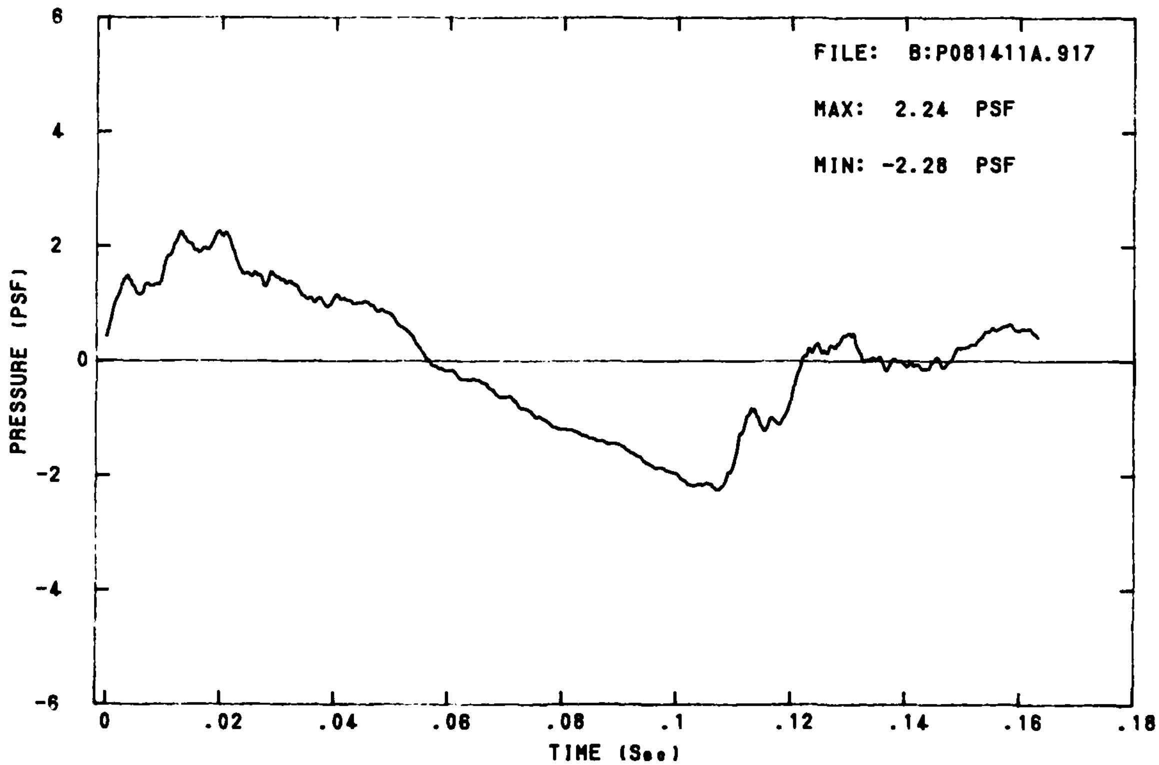

FILE: B:P031411A.917
MAX: 2.42 PSF
MIN: -2.4 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

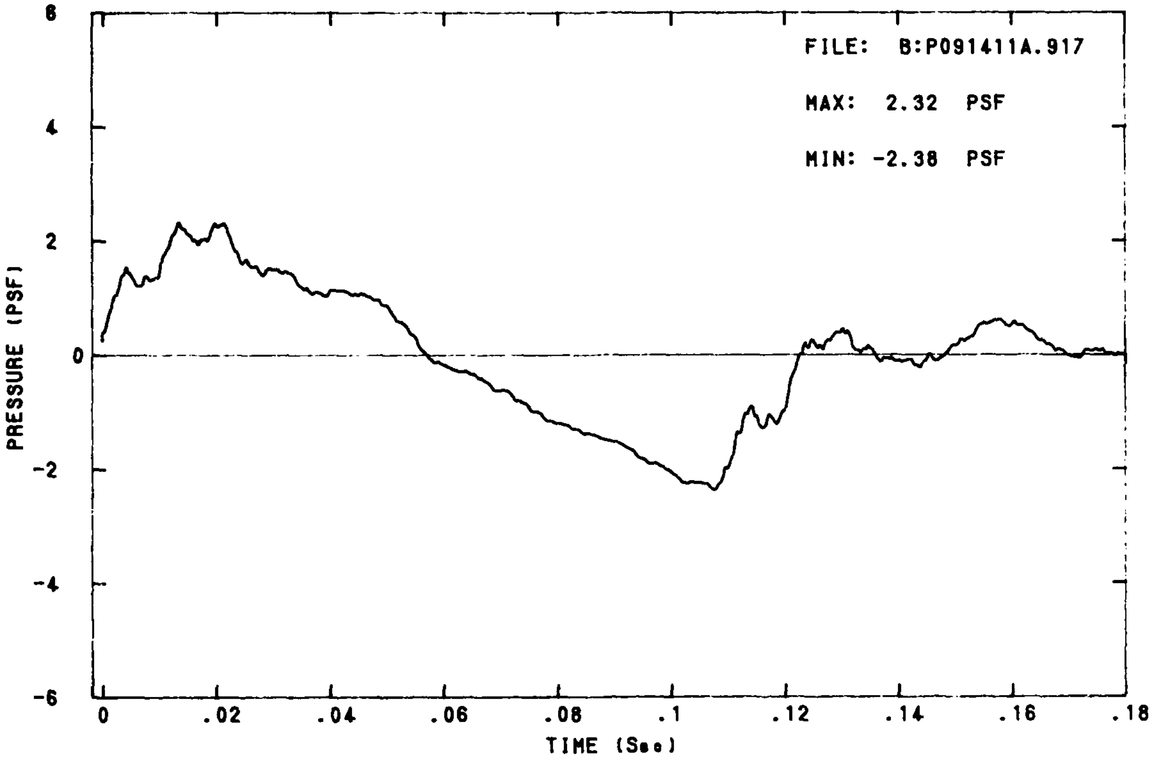

FILE: B:P041411A.917
MAX: 2.35 PSF
MIN: -2.44 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.08
.08
.1
.12
.14
.16
.18

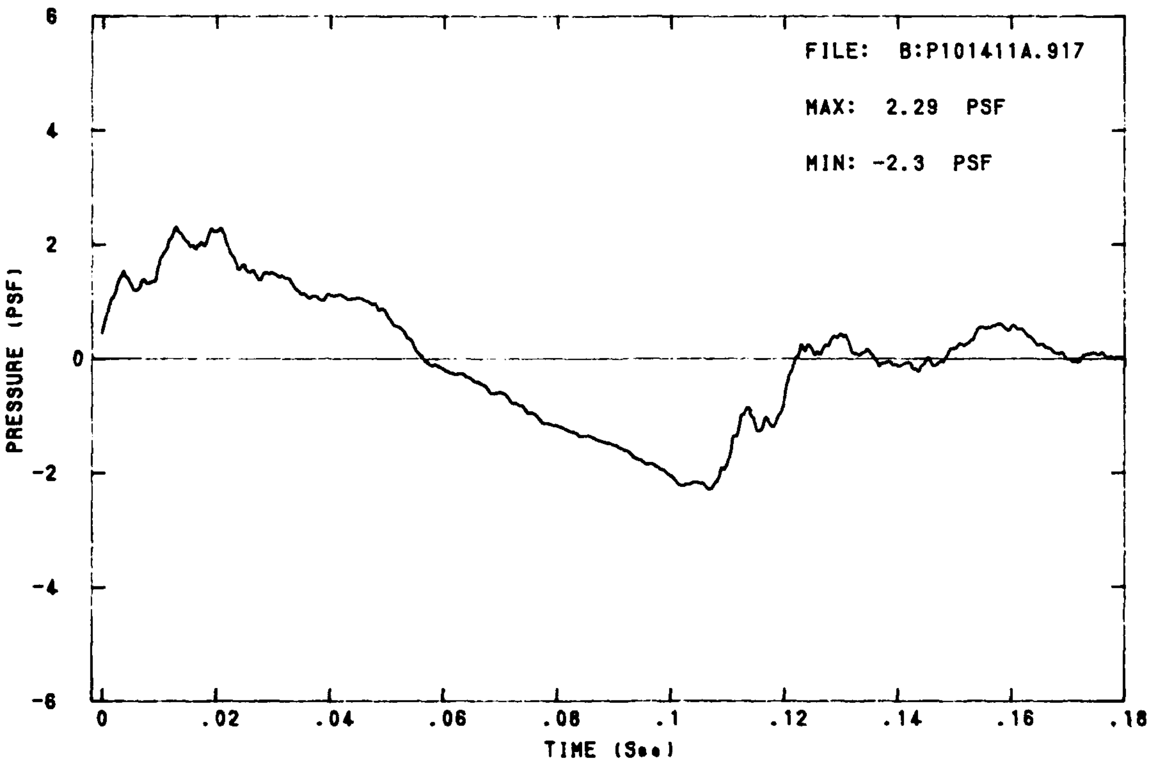

FILE: B:P051412A.917
MAX: 2.32 PSF
MIN: -2.59 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P061411A.917
MAX: 2.26 PSF
MIN: -2.27 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

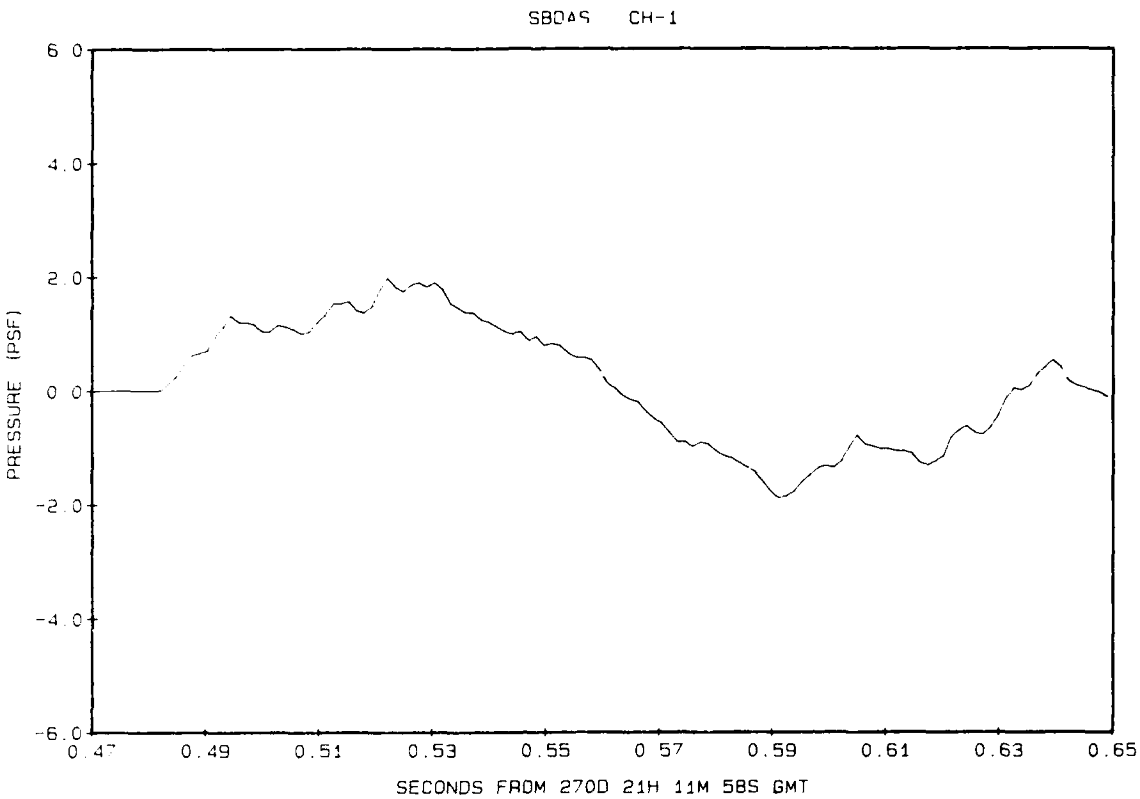

FILE: B:P071411A.917
MAX: 2.31 PSF
MIN: -2.35 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
1
.12
.14
.16
.18

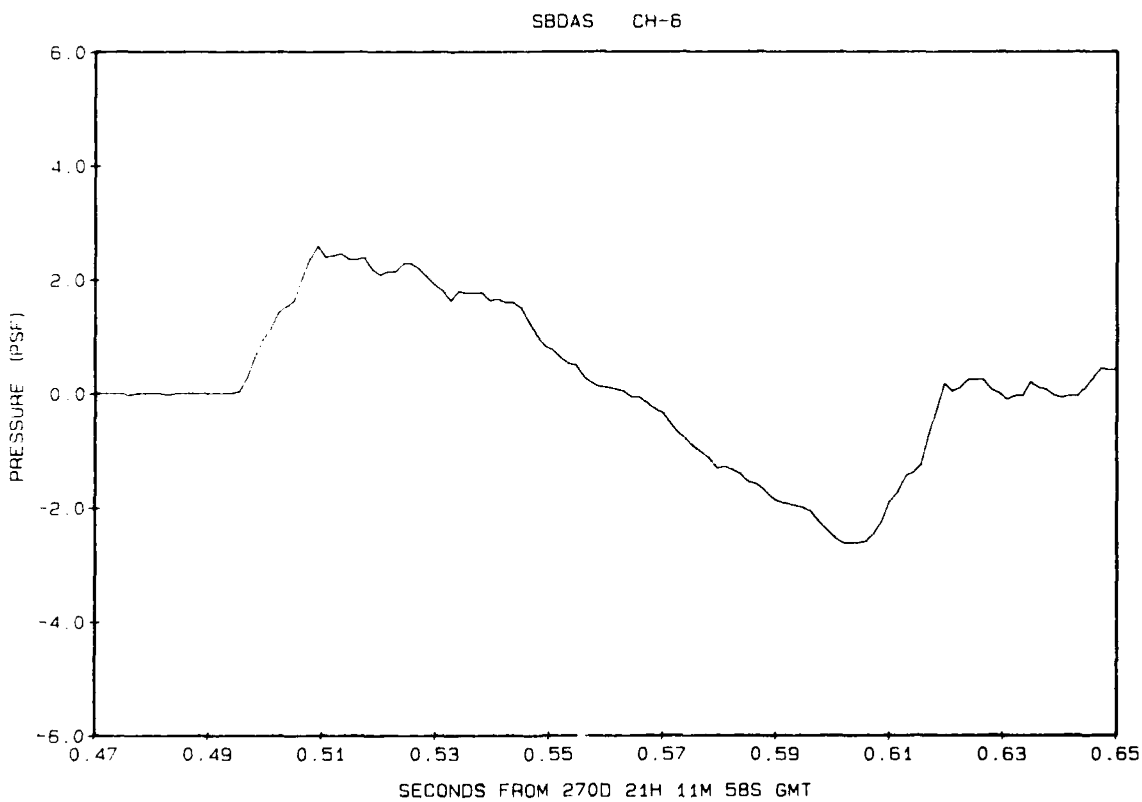

FILE: B:P081411A.917
MAX: 2.24 PSF
MIN: -2.28 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P091411A.917
MAX: 2.32 PSF
MIN: -2.38 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18


FILE: B:P101411A.917
MAX: 2.29 PSF
MIN: -2.3 PSF
PRESSURE (PSF)
TIME (Sec)
6
4
2
0
-2
-4
-6
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

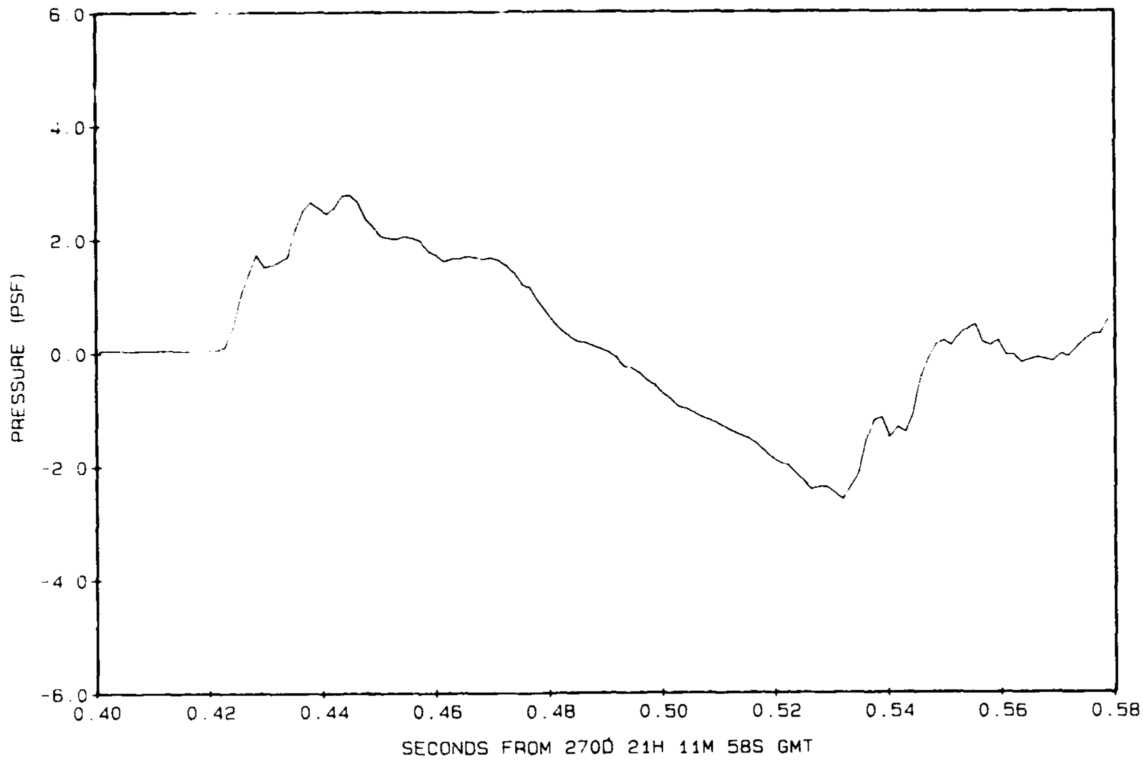
F4 19K-4


SBDAS CH-1
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
PRESSURE (PSF)
0.47
0.49
0.51
0.53
0.55
0.57
0.59
0.61
0.63
0.65
SECONDS FROM 270D 21H 11M 58S GMT

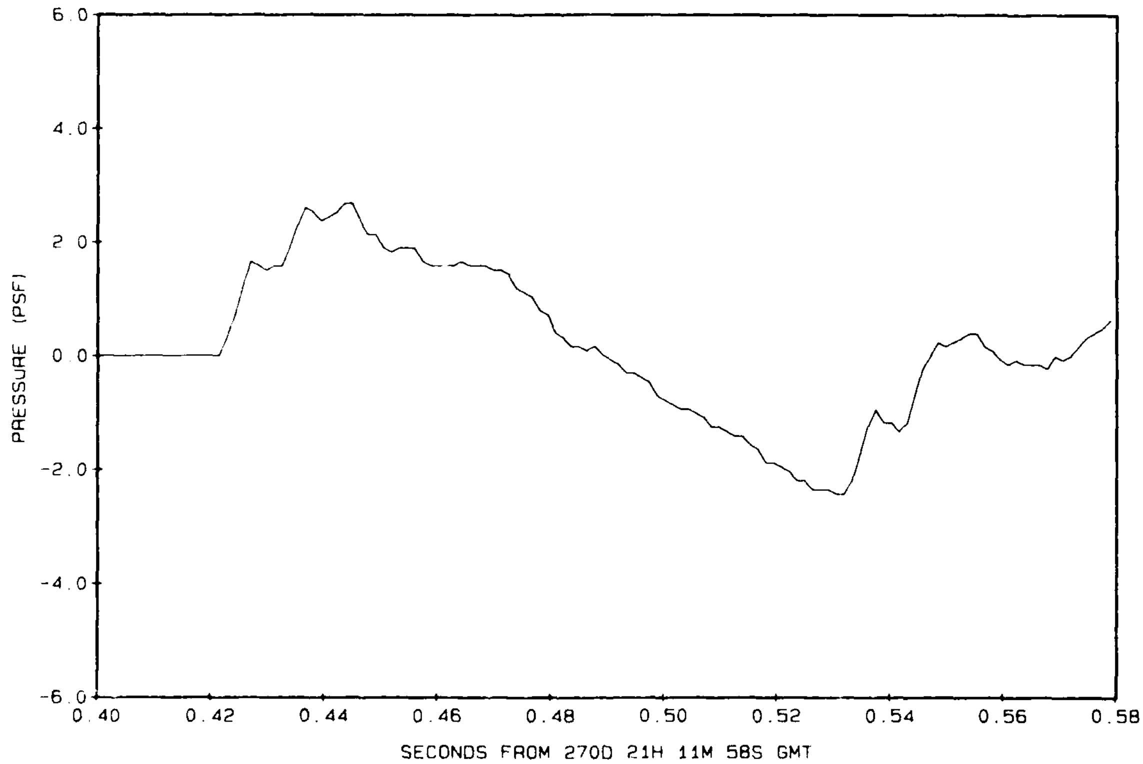

SBDAS CH-6
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
PRESSURE (PSF)
0.47
0.49
0.51
0.53
0.55
0.57
0.59
0.61
0.63
0.65
SECONDS FROM 270D 21H 11M 58S GMT

F4 19K-4

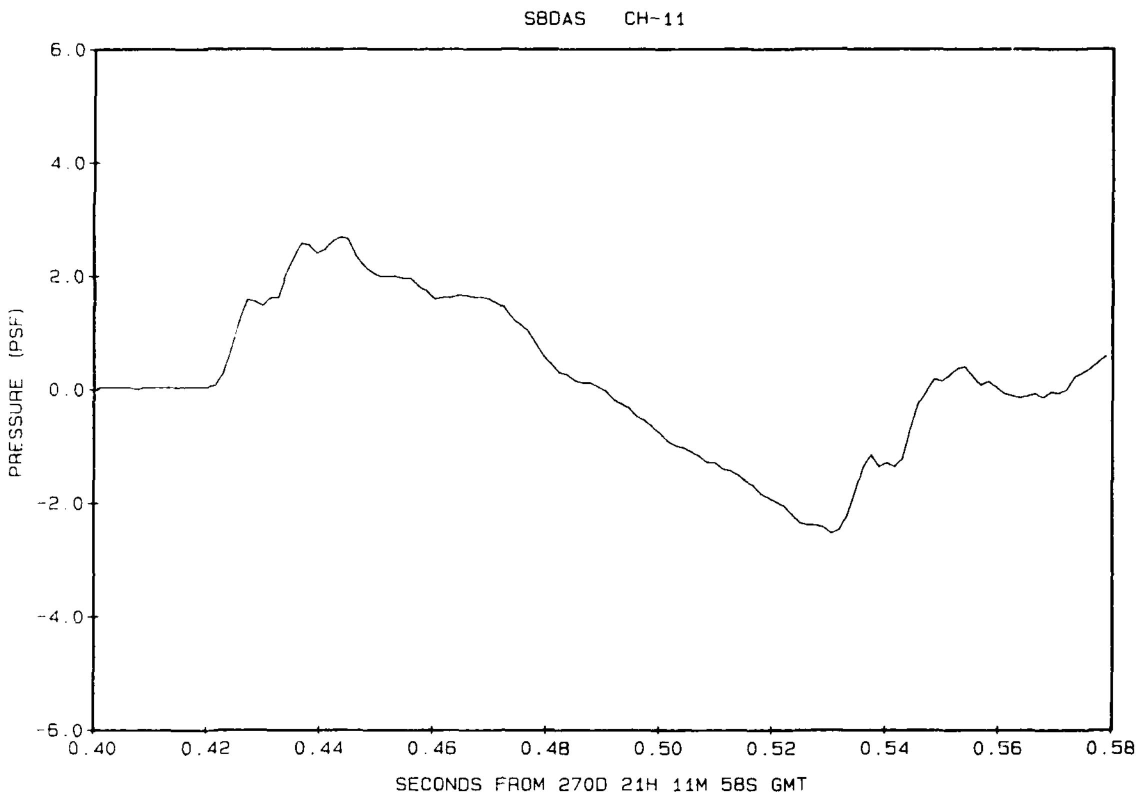
SBDAS CH-7.

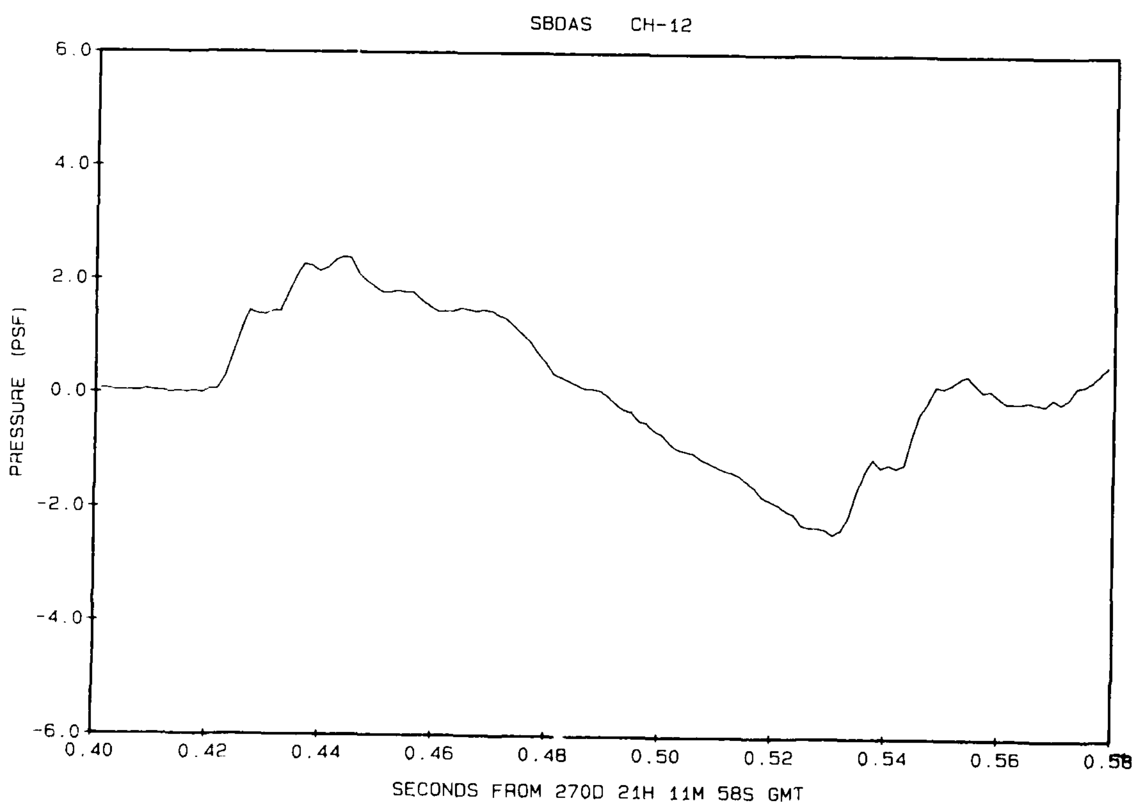


SBDAS CH-10

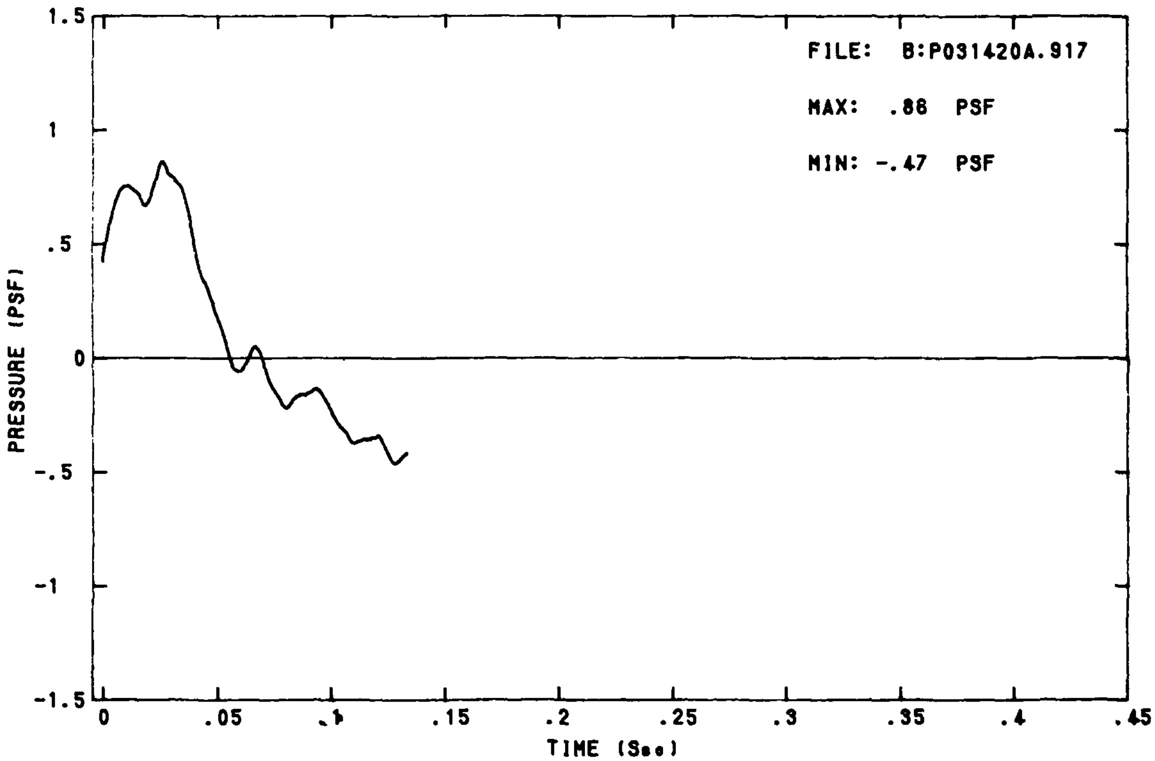


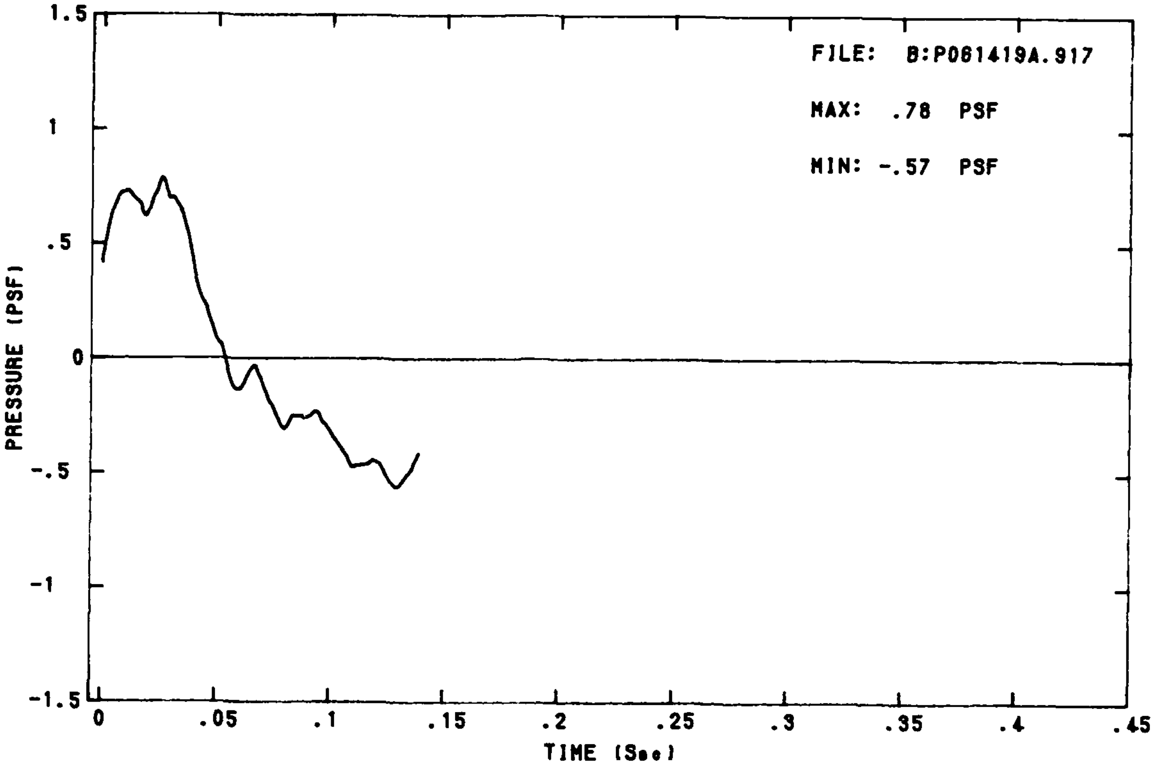
F4 19K-4

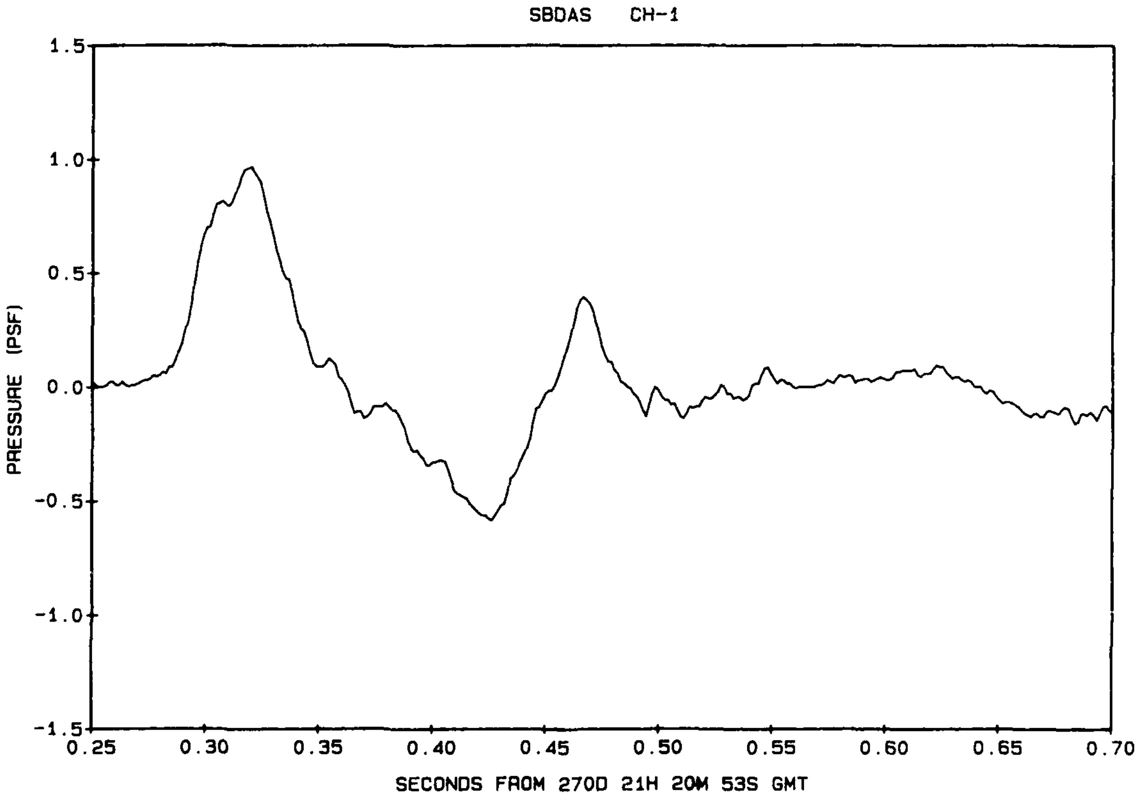

SBDAS CH-11
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
PRESSURE (PSF)
0.40
0.42
0.44
0.46
0.48
0.50
0.52
0.54
0.56
0.58
SECONDS FROM 270D 21H 11M 58S GMT


SBDAS CH-12
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
PRESSURE (PSF)
0.40
0.42
0.44
0.46
0.48
0.50
0.52
0.54
0.56
0.58
SECONDS FROM 270D 21H 11M 58S GMT

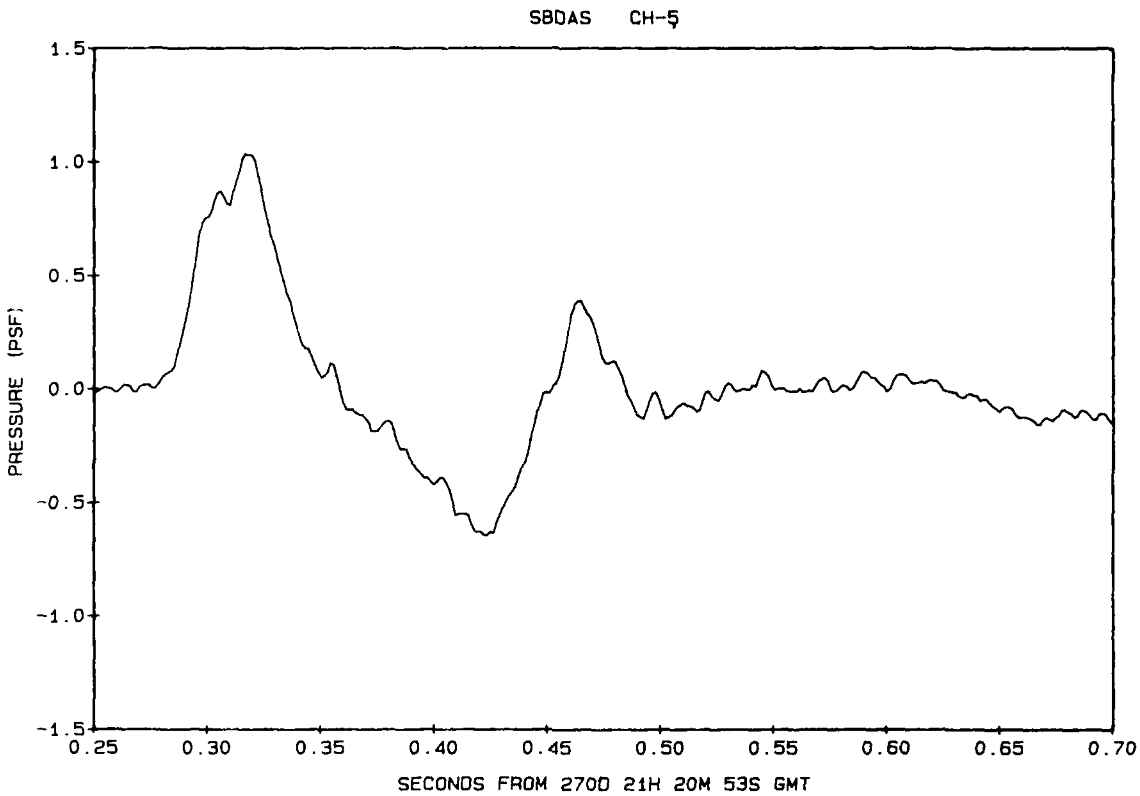
BOOM SIGNATURES from F-4 flying at 1.42 MACH, 34,900 ft AGL, and 60,000 ft. track offset occuring at 21:20:54 GMT, 17 Sep 86.

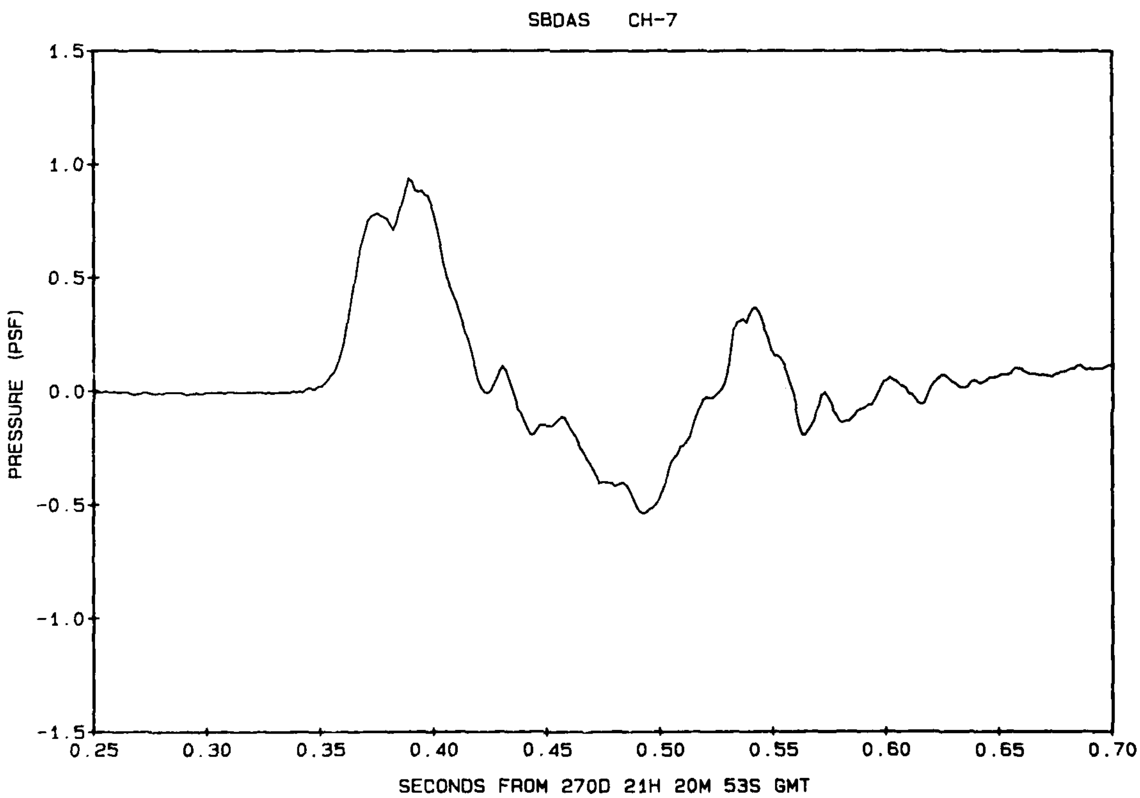



FILE: B:P081419A.917
MAX: .78 PSF
MIN: -.57 PSF
PRESSURE (PSF)
TIME (Sec)

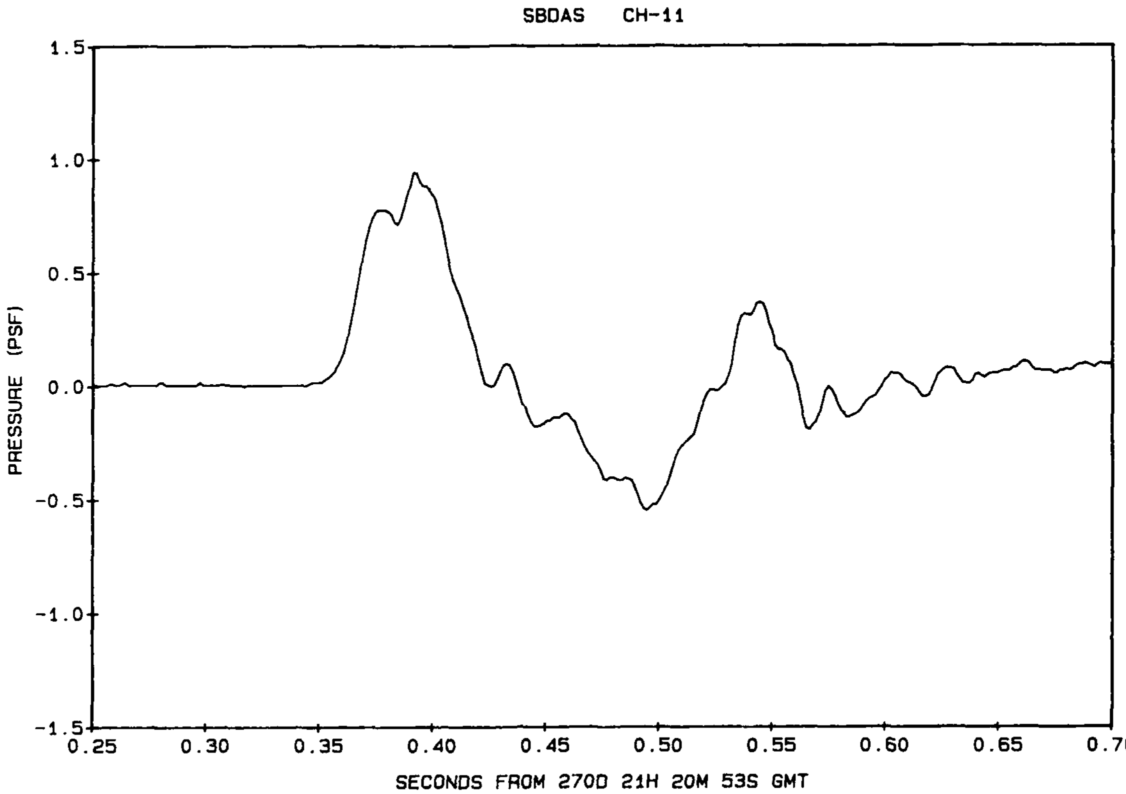

SBDAS CH-1
PRESSURE (PSF)
SECONDS FROM 270D 21H 20M 53S GMT

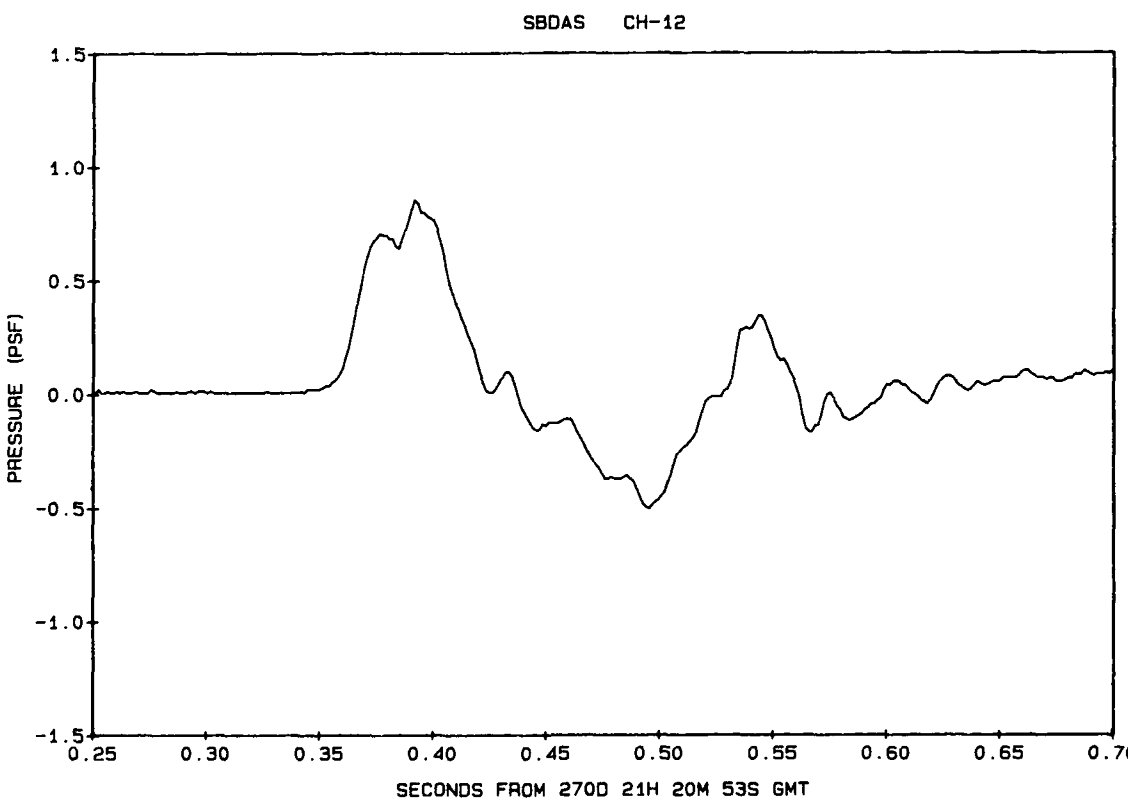
F4 35K-3


SBDAS CH-5
PRESSURE (PSF)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
SECONDS FROM 270D 21H 20M 53S GMT

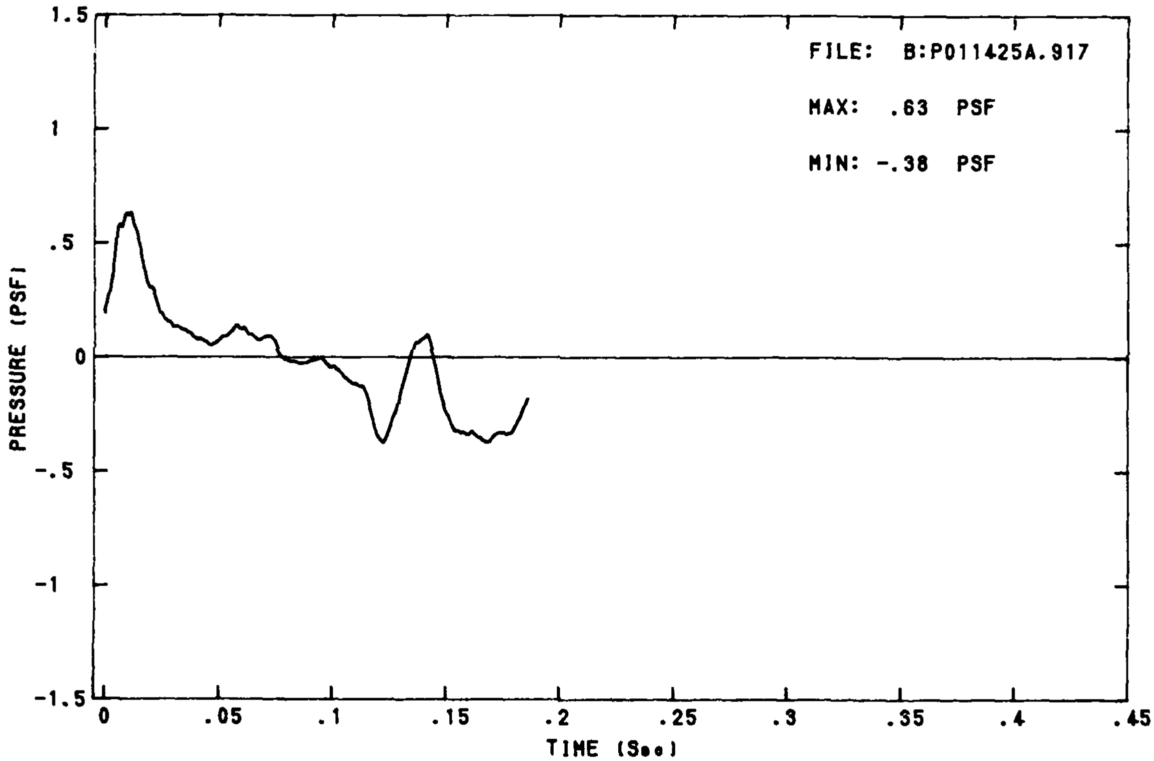

SBDAS CH-7
PRESSURE (PSF)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
SECONDS FROM 270D 21H 20M 53S GMT

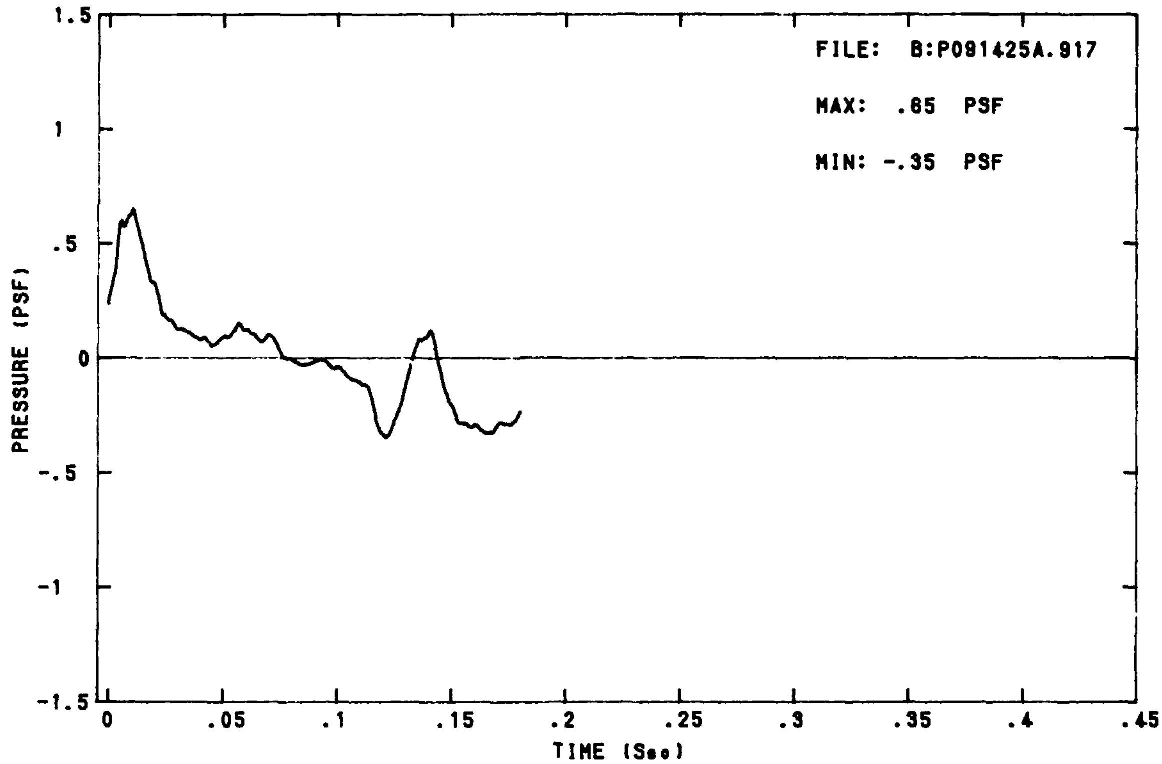
F4 35K-3

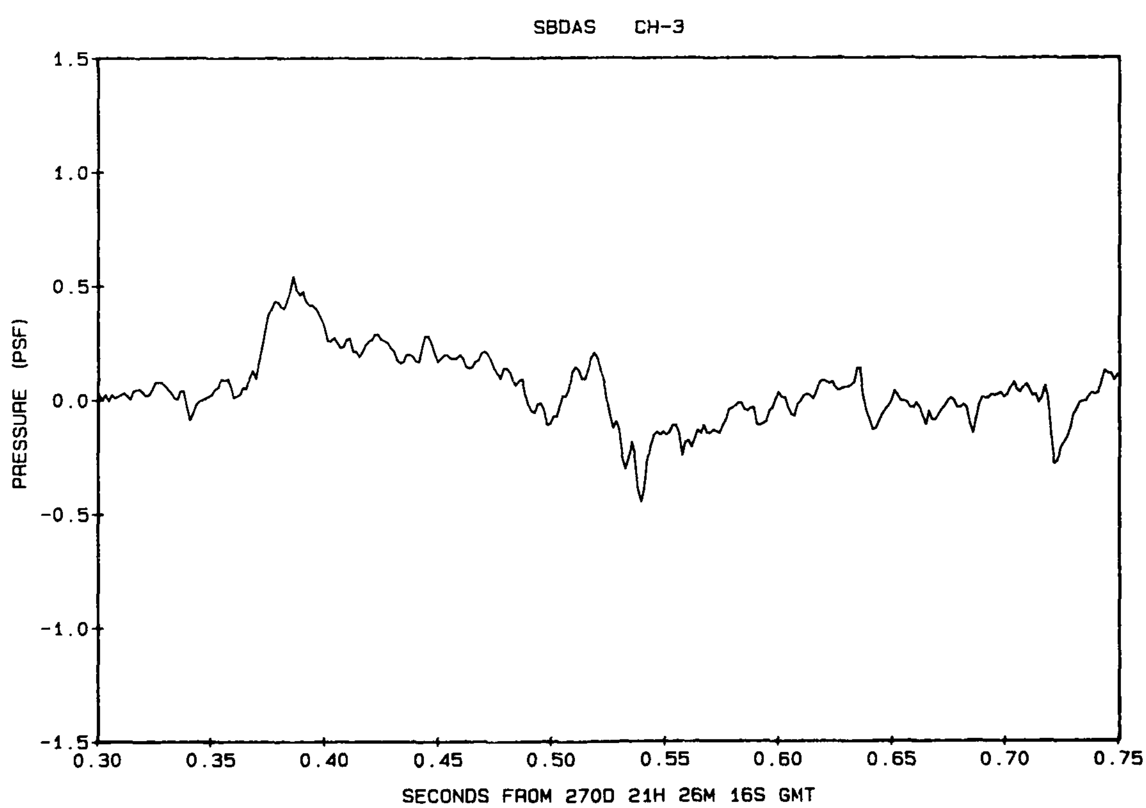

SBDAS CH-11
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
PRESSURE (PSF)
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
SECONDS FROM 270D 21H 20M 53S GMT


SBDAS CH-12
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
PRESSURE (PSF)
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
SECONDS FROM 270D 21H 20M 53S GMT

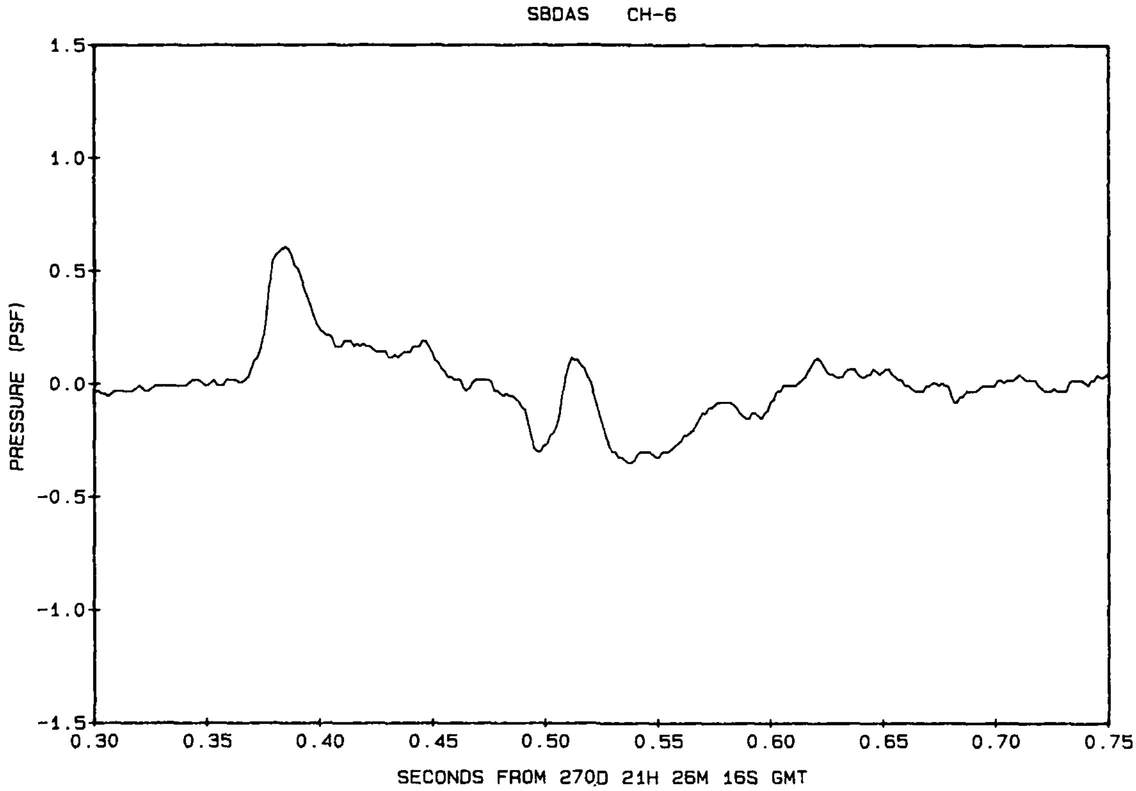
BOOM SIGNATURES from F-4 flying at 1.35 MACH, 35,200 ft AGL, and 60,000 ft. track offset occuring at 21:26:16 GMT, 17 Sep 86.

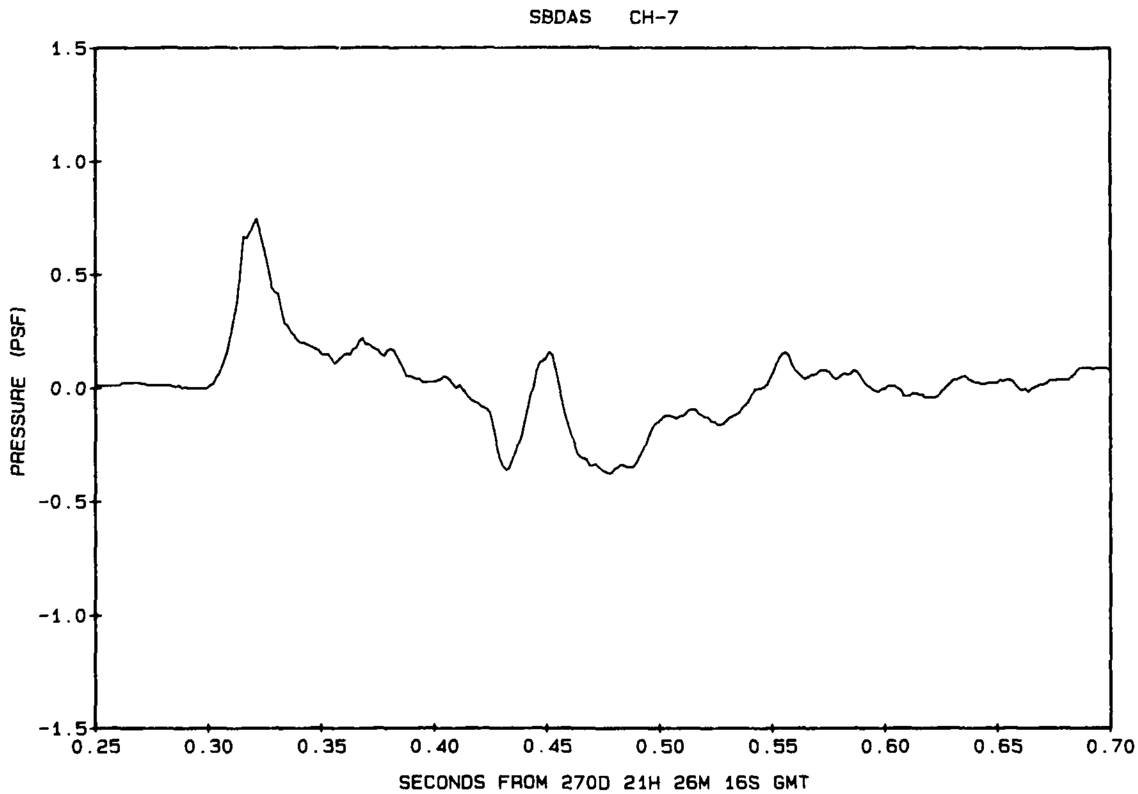



FILE: B:P091425A.917
MAX: .65 PSF
MIN: -.35 PSF
PRESSURE (PSF)
1.5
1
.5
0
-.5
-1
-1.5
0
.05
.1
.15
.2
.25
.3
.35
.4
.45
TIME (Sec)


SBDAS CH-3
PRESSURE (PSF)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
SECONDS FROM 270D 21H 26M 16S GMT

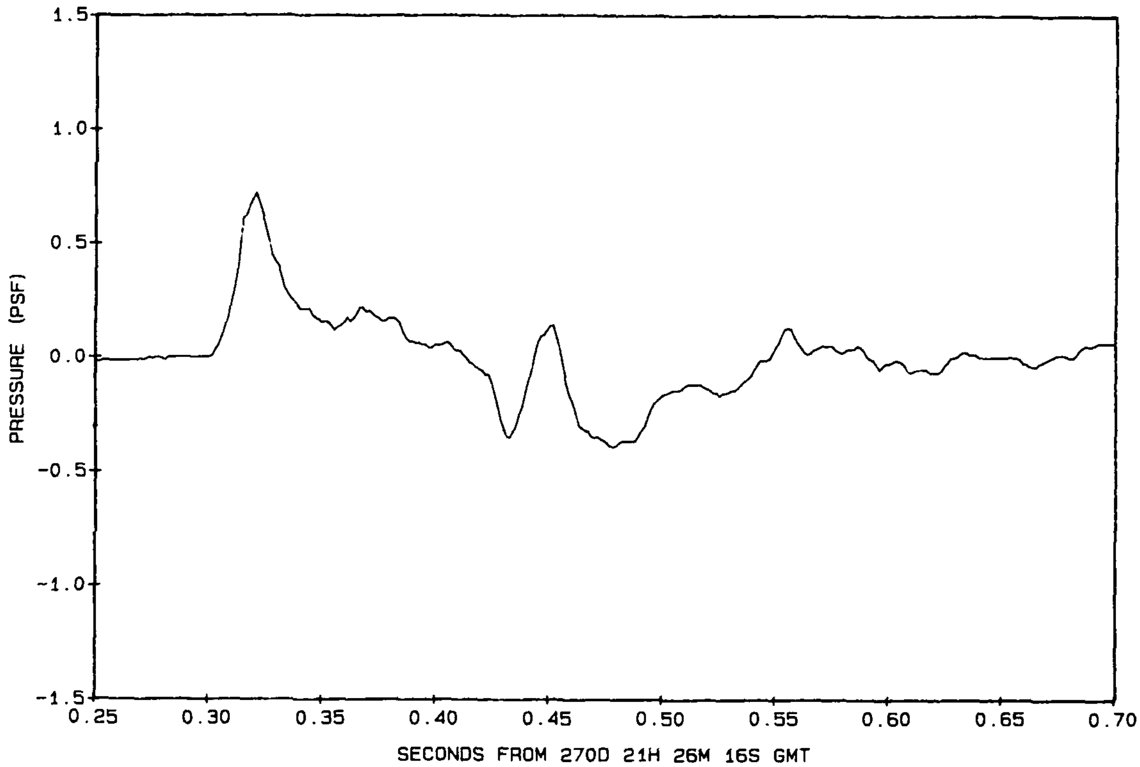
F4 35K-4


SBDAS CH-6
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
PRESSURE (PSF)
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
SECONDS FROM 270D 21H 26M 16S GMT

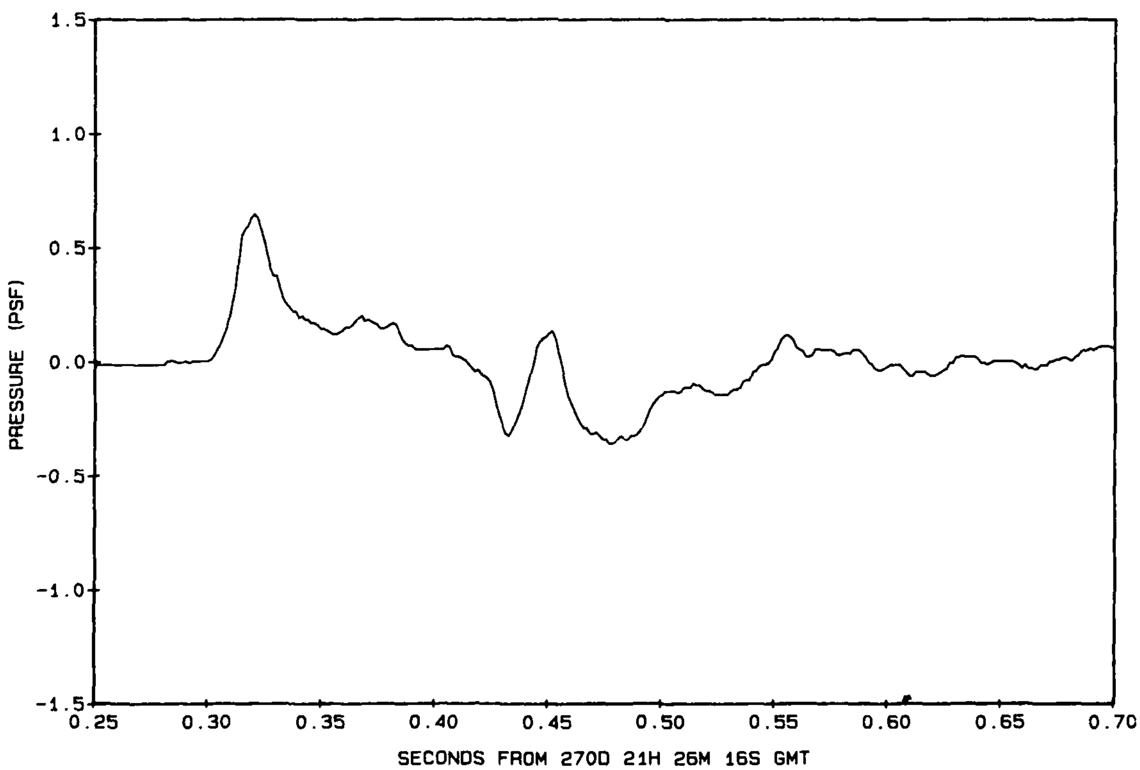

SBDAS CH-7
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
PRESSURE (PSF)
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
SECONDS FROM 270D 21H 26M 16S GMT

F4 35K-4

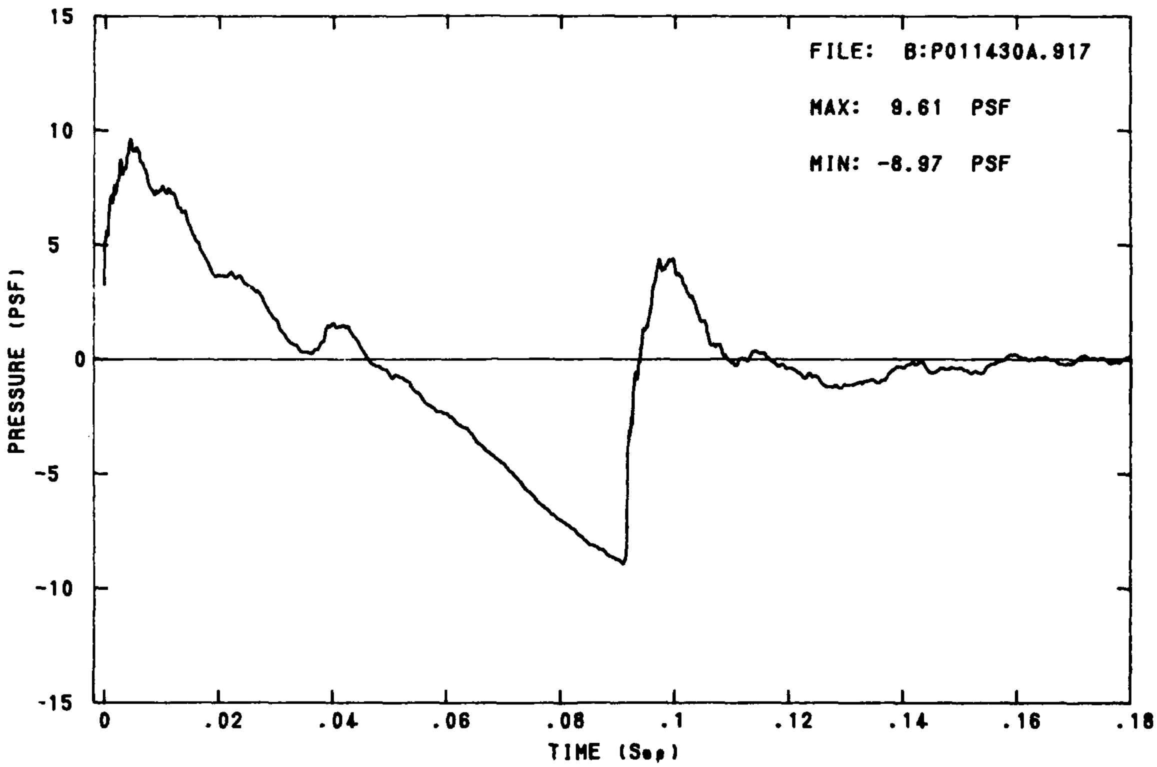
SBDAS CH-11

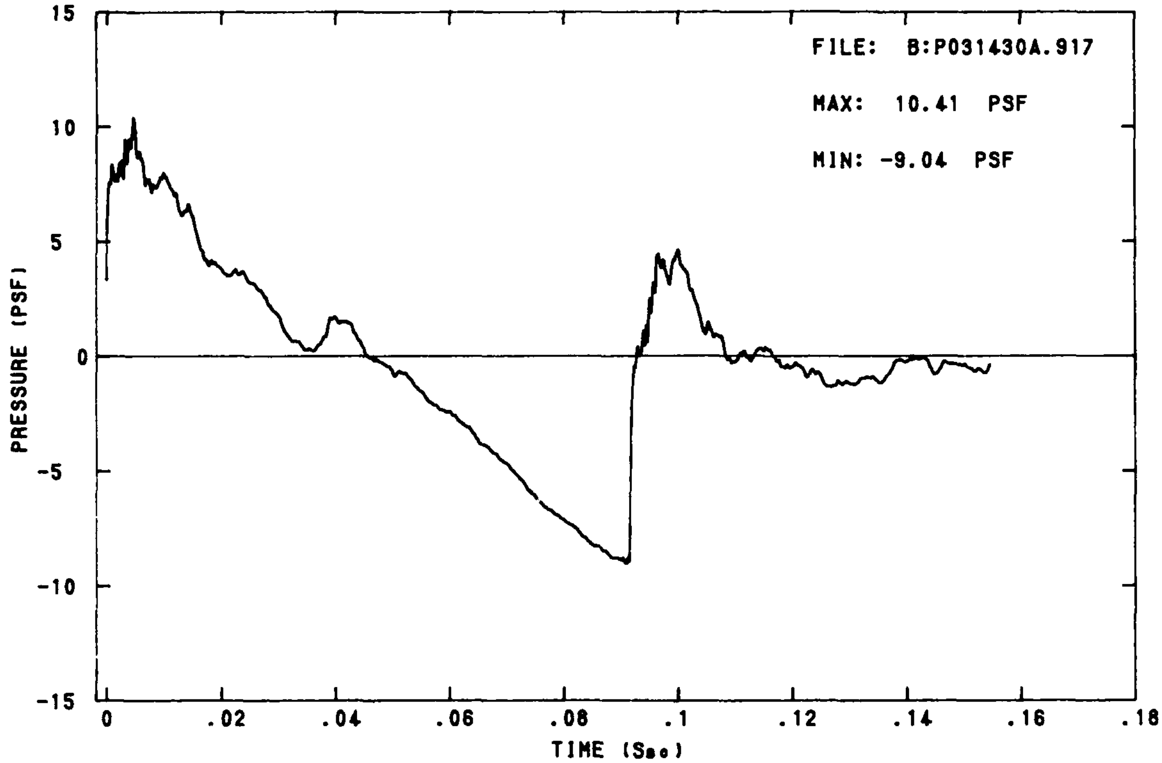


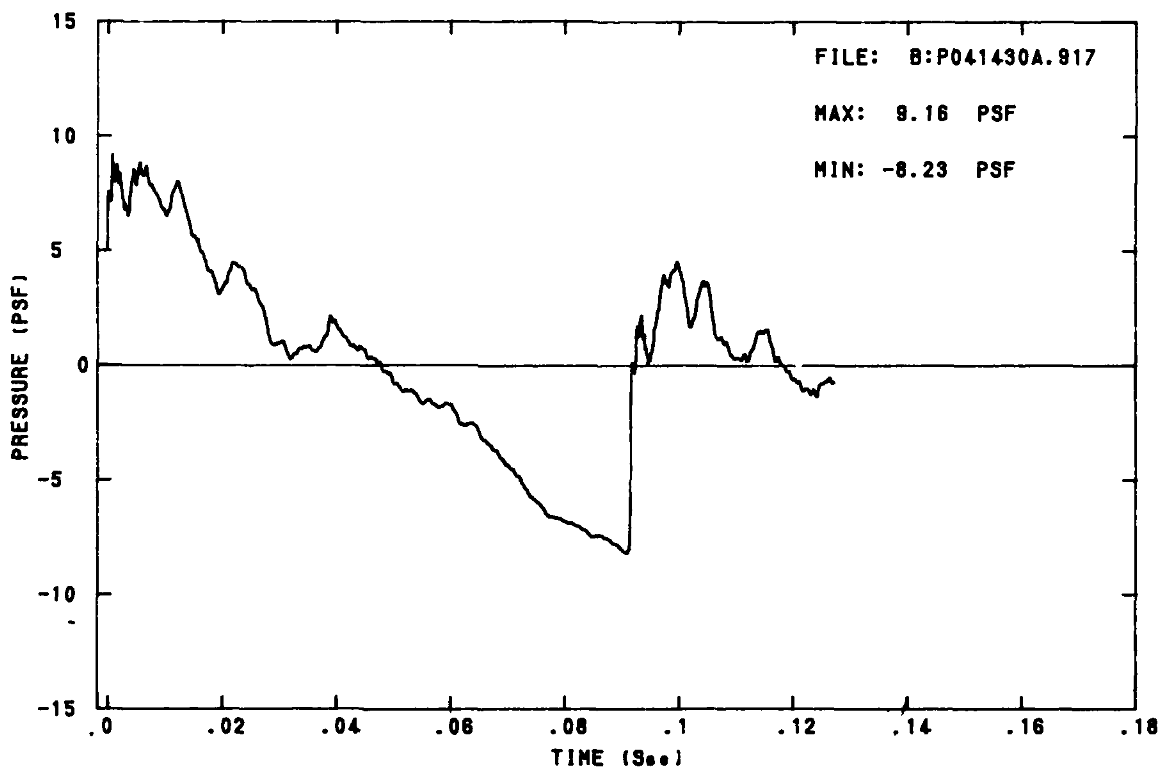
SBDAS CH-12

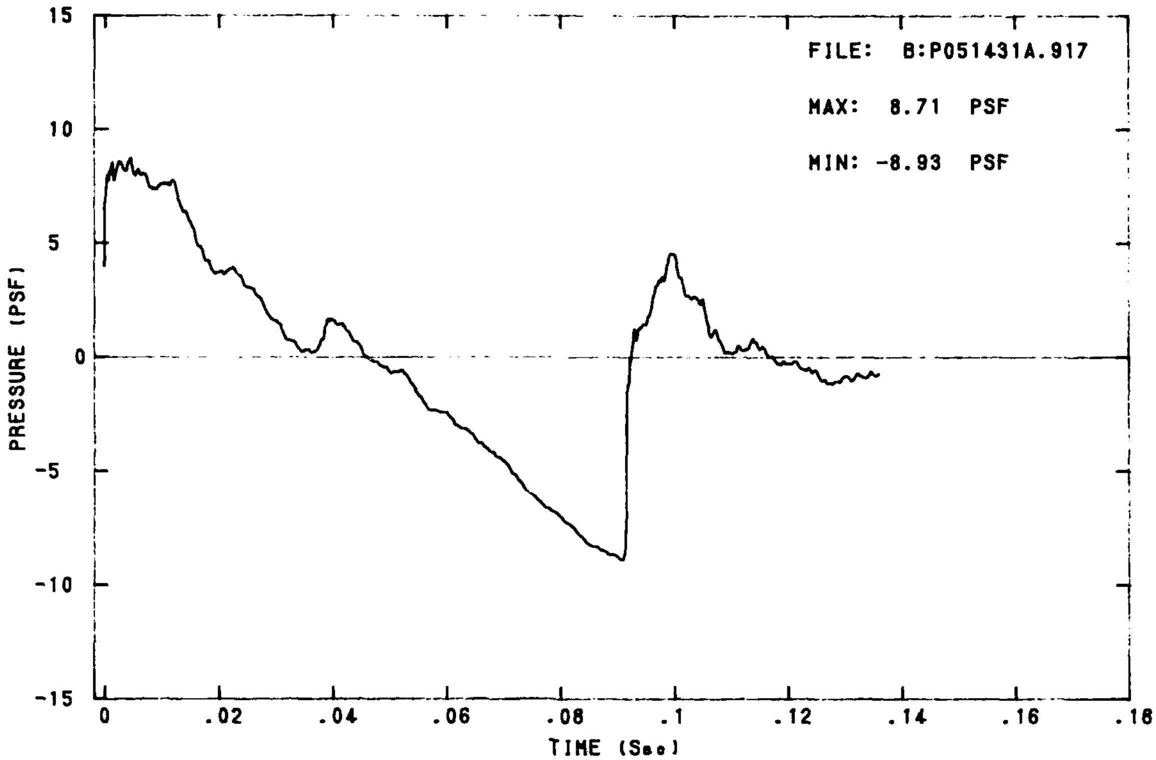


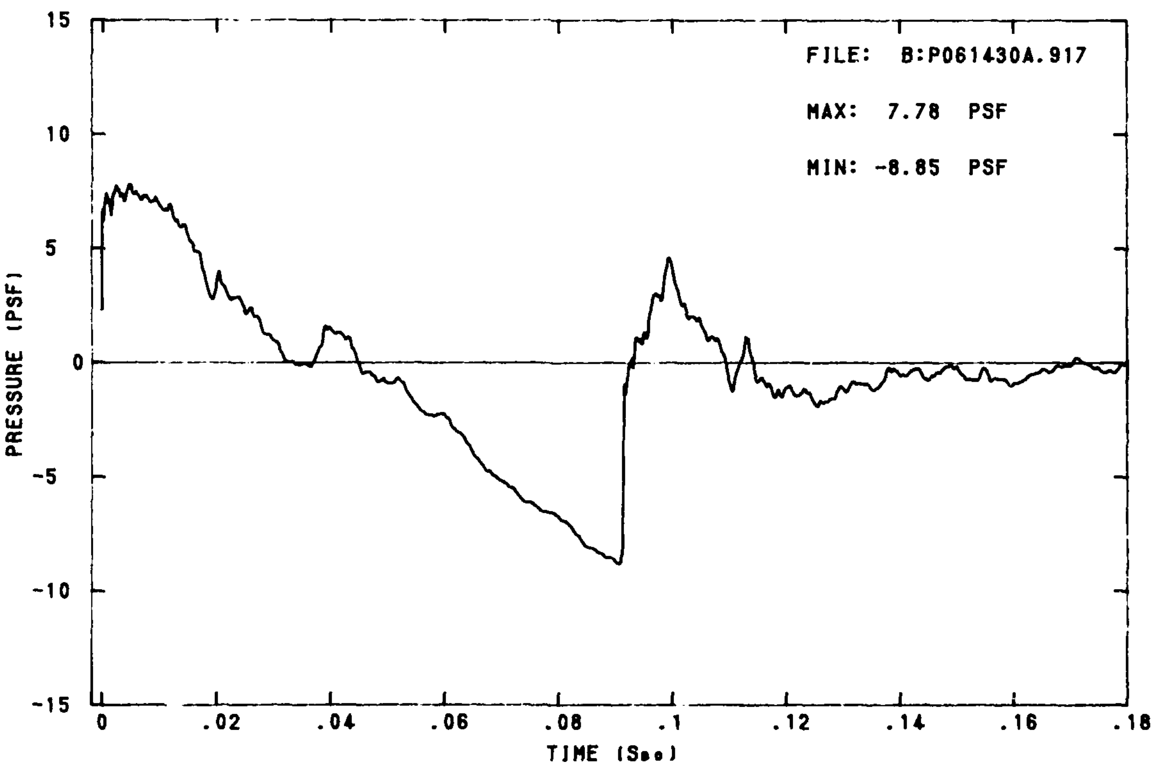
BOOM SIGNATURES from F-4 flying at 1.13 MACH, 5,700 ft AGL, and 0 ft. track offset occuring at 21:31:08 GMT, 17 Sep 86.

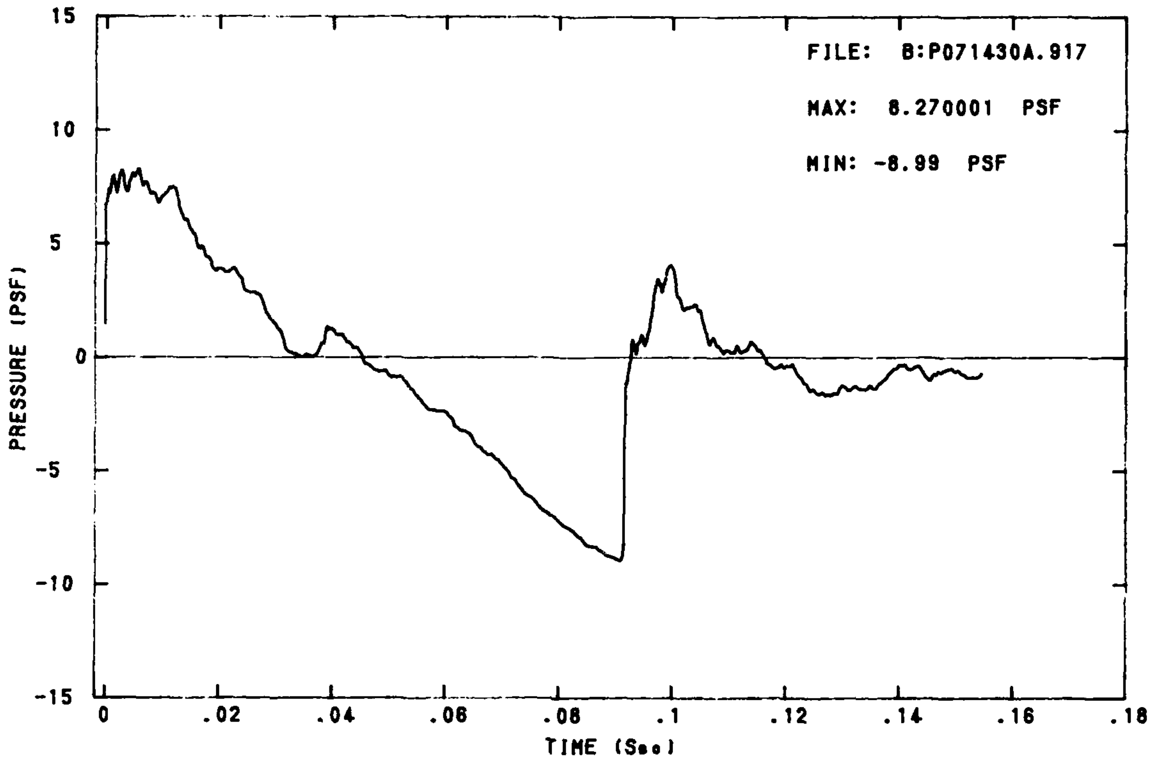


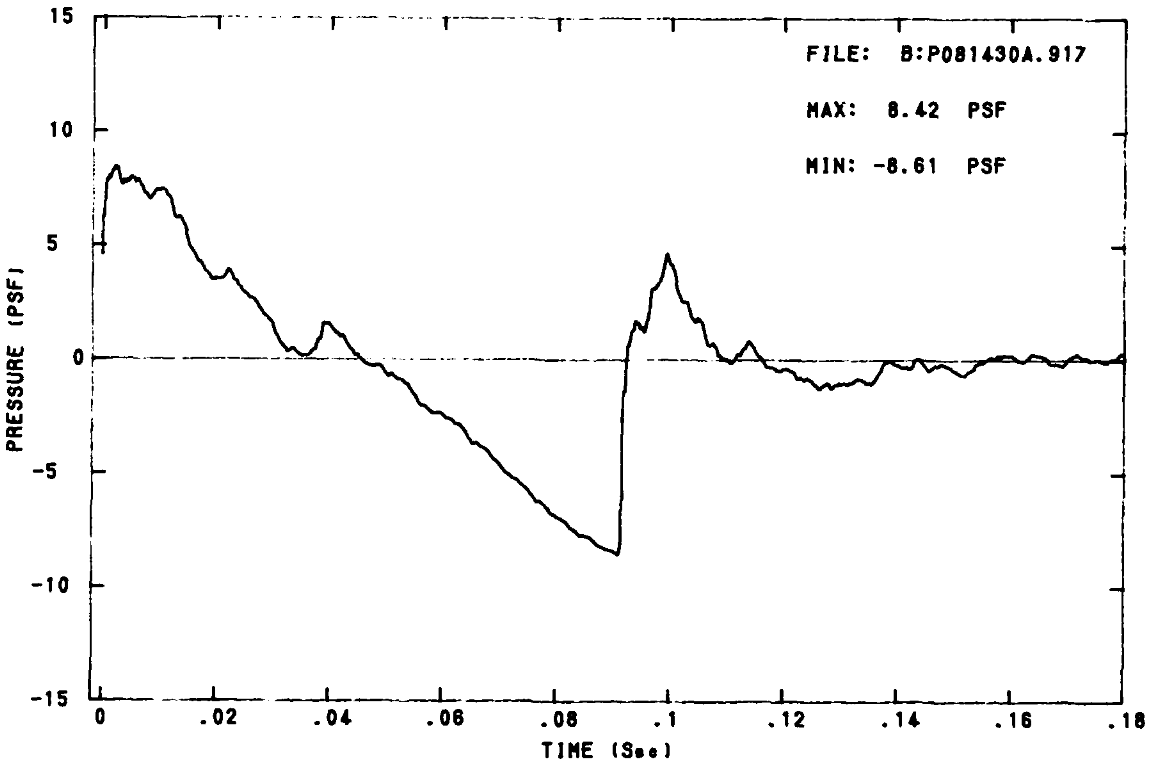

FILE: B:P031430A.917
MAX: 10.41 PSF
MIN: -9.04 PSF
PRESSURE (PSF)
TIME (Sec)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

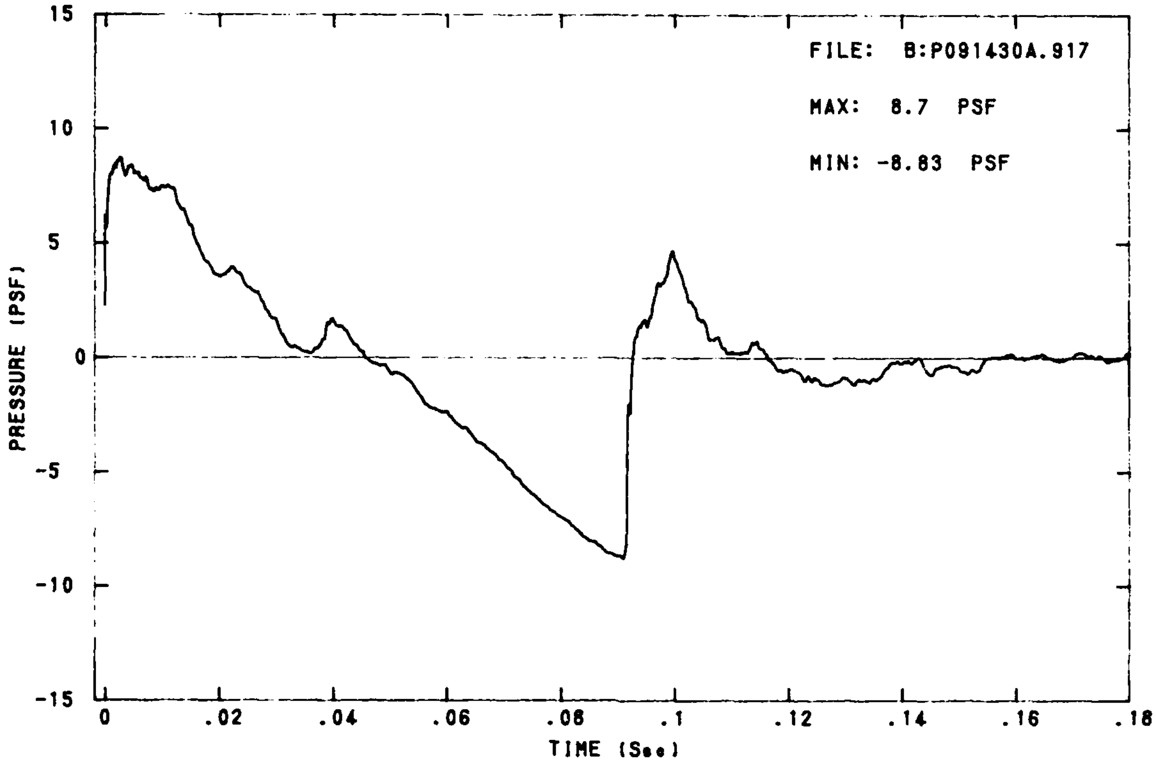

FILE: B:P041430A.917
MAX: 9.16 PSF
MIN: -8.23 PSF
PRESSURE (PSF)
TIME (Sec)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

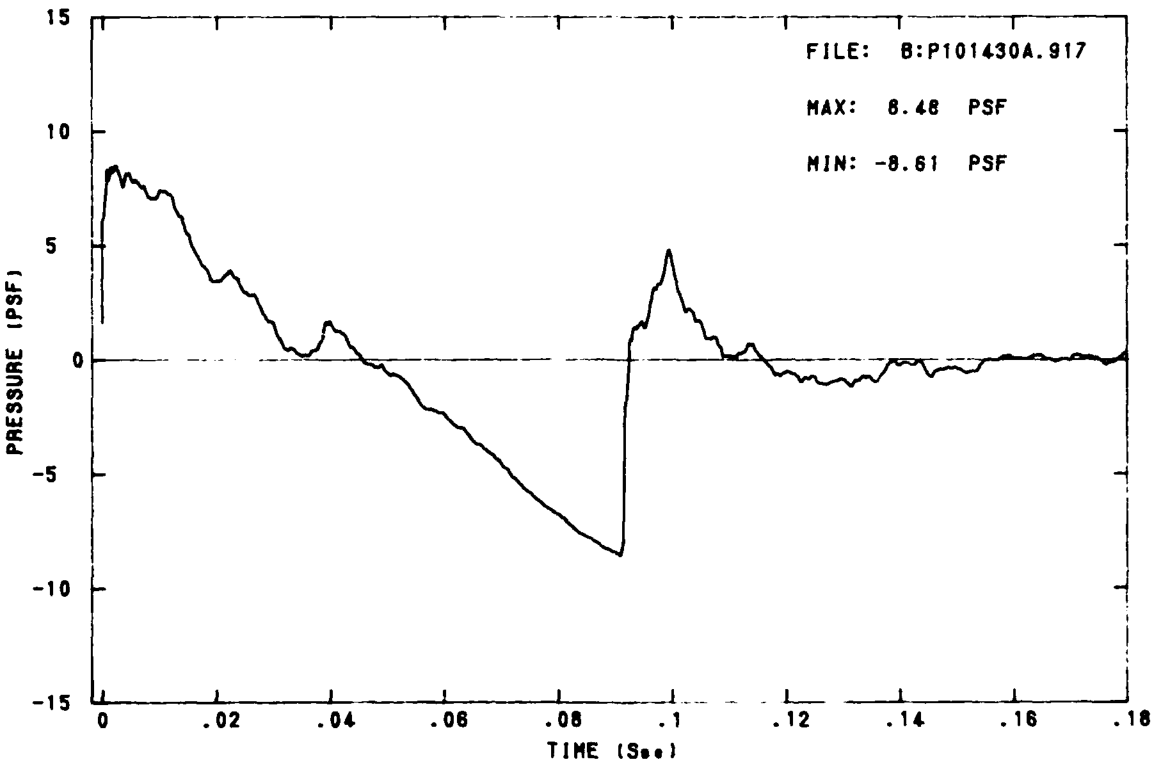

FILE: B:P051431A.917
MAX: 8.71 PSF
MIN: -8.93 PSF
PRESSURE (PSF)
TIME (Sec)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

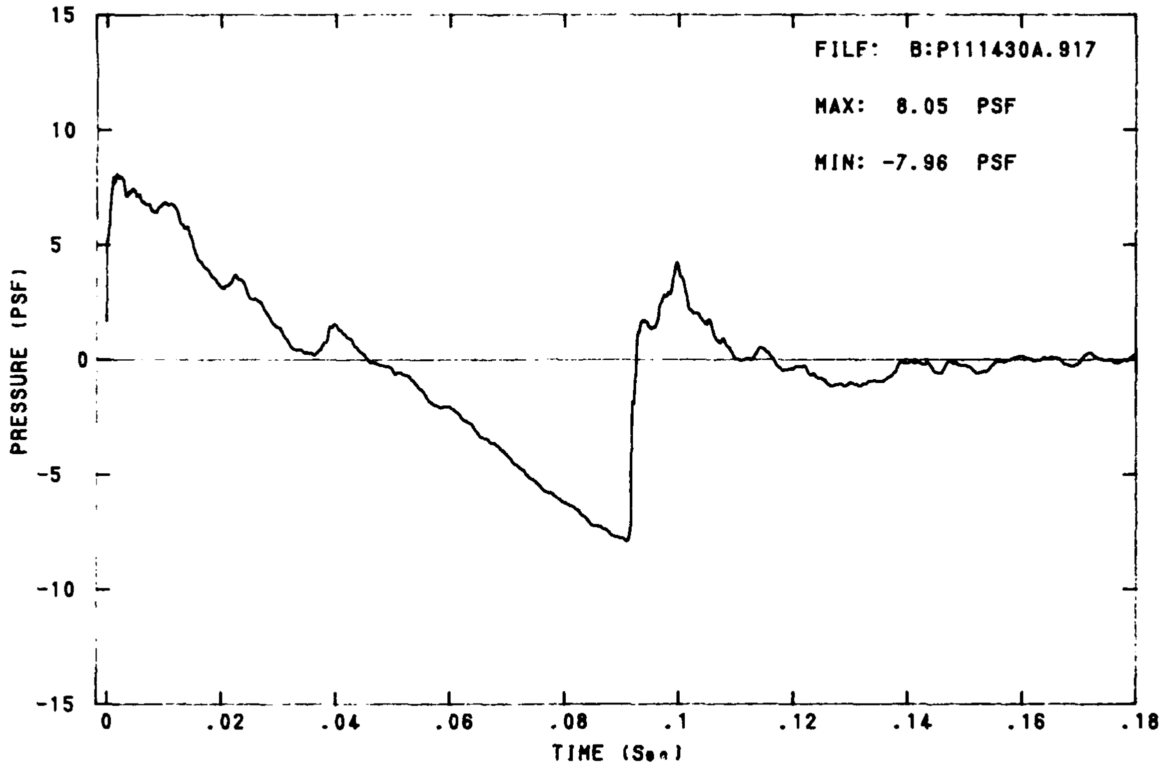

FILE: B:P061430A.917
MAX: 7.78 PSF
MIN: -8.85 PSF
PRESSURE (PSF)
TIME (Sec)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

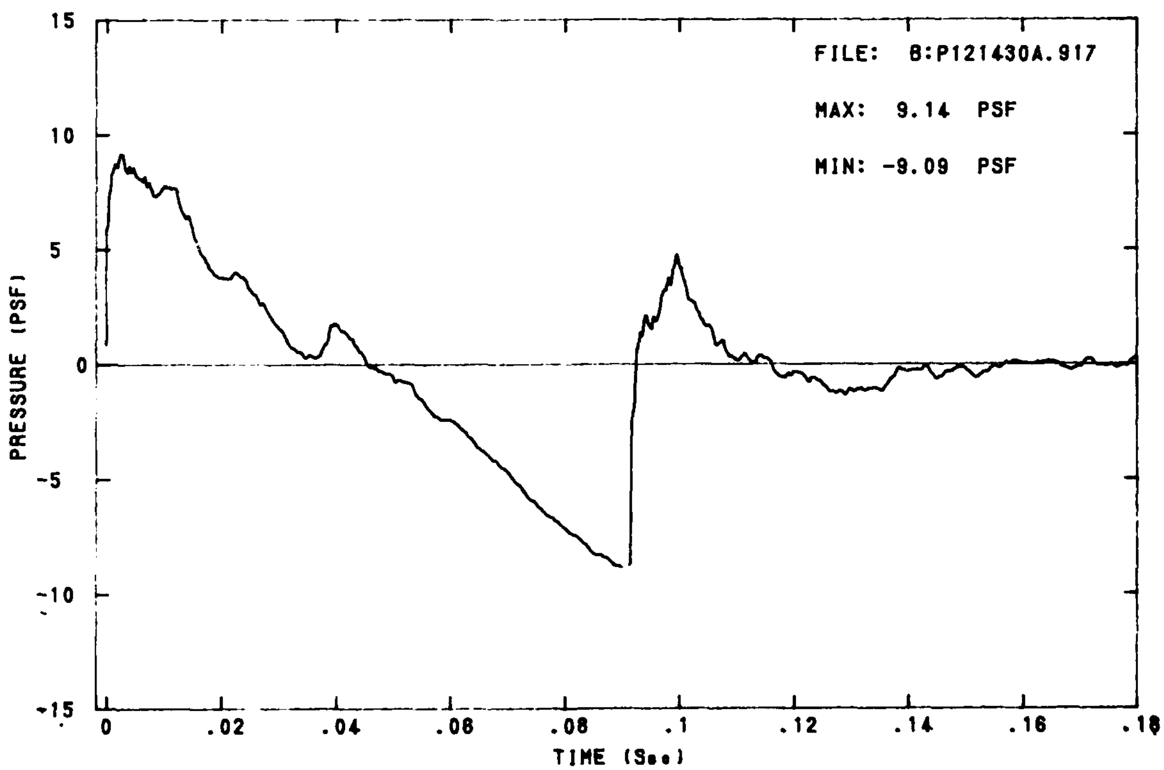

FILE: B:P071430A.917
MAX: 8.270001 PSF
MIN: -8.99 PSF
PRESSURE (PSF)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)


FILE: B:P081430A.917
MAX: 8.42 PSF
MIN: -8.61 PSF
PRESSURE (PSF)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)

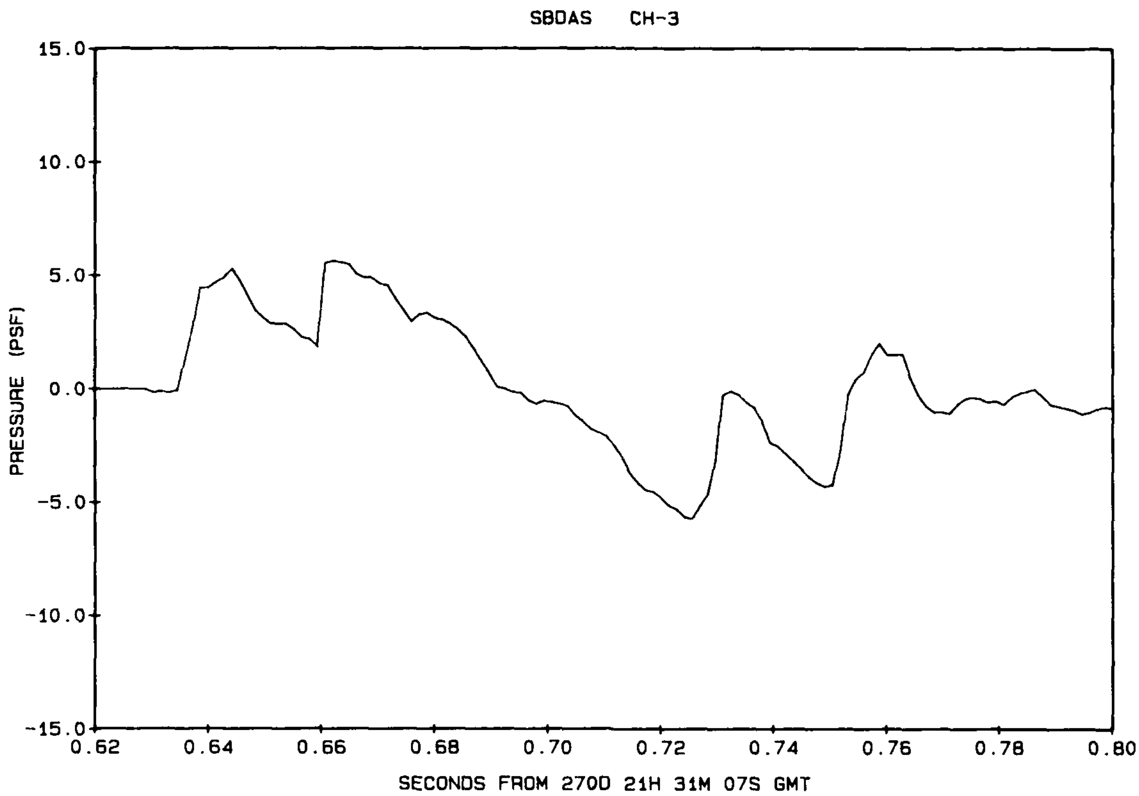

FILE: B:P091430A.917
MAX: 8.7 PSF
MIN: -8.83 PSF
PRESSURE (PSF)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)

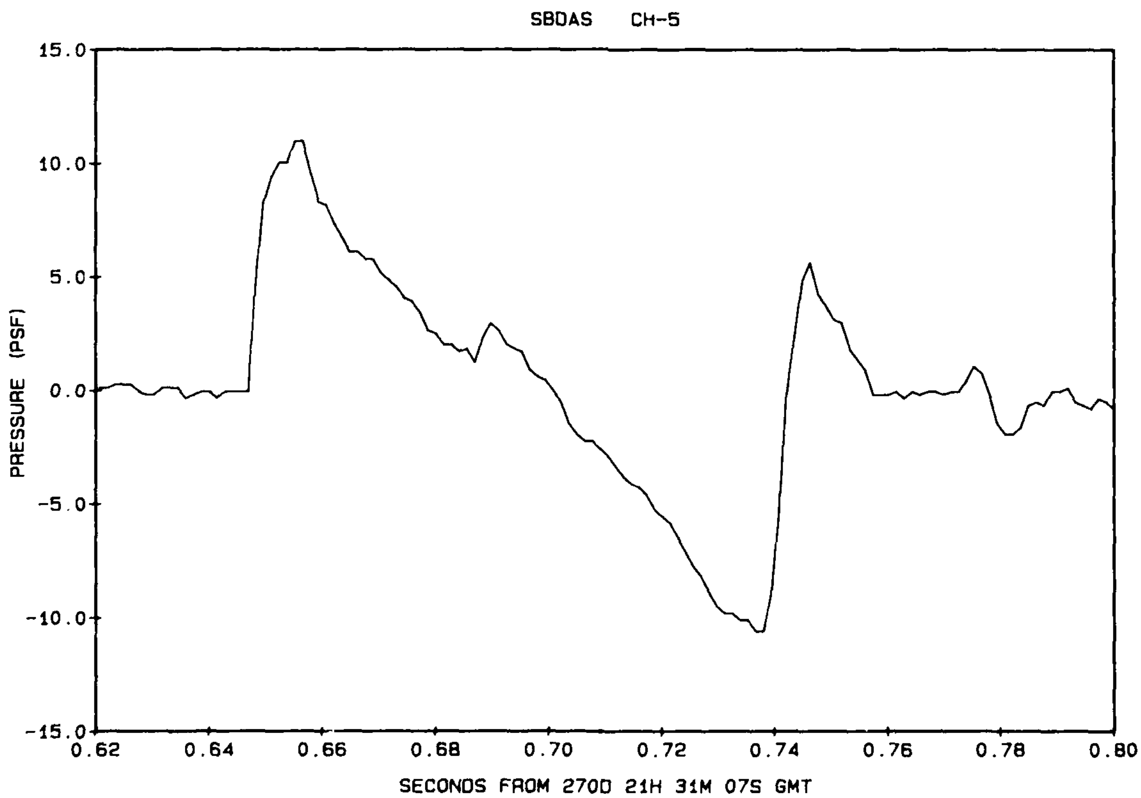

FILE: B:P101430A.917
MAX: 8.48 PSF
MIN: -8.61 PSF
PRESSURE (PSF)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)


FILF: B:P111430A.917
MAX: 8.05 PSF
MIN: -7.96 PSF
PRESSURE (PSF)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)

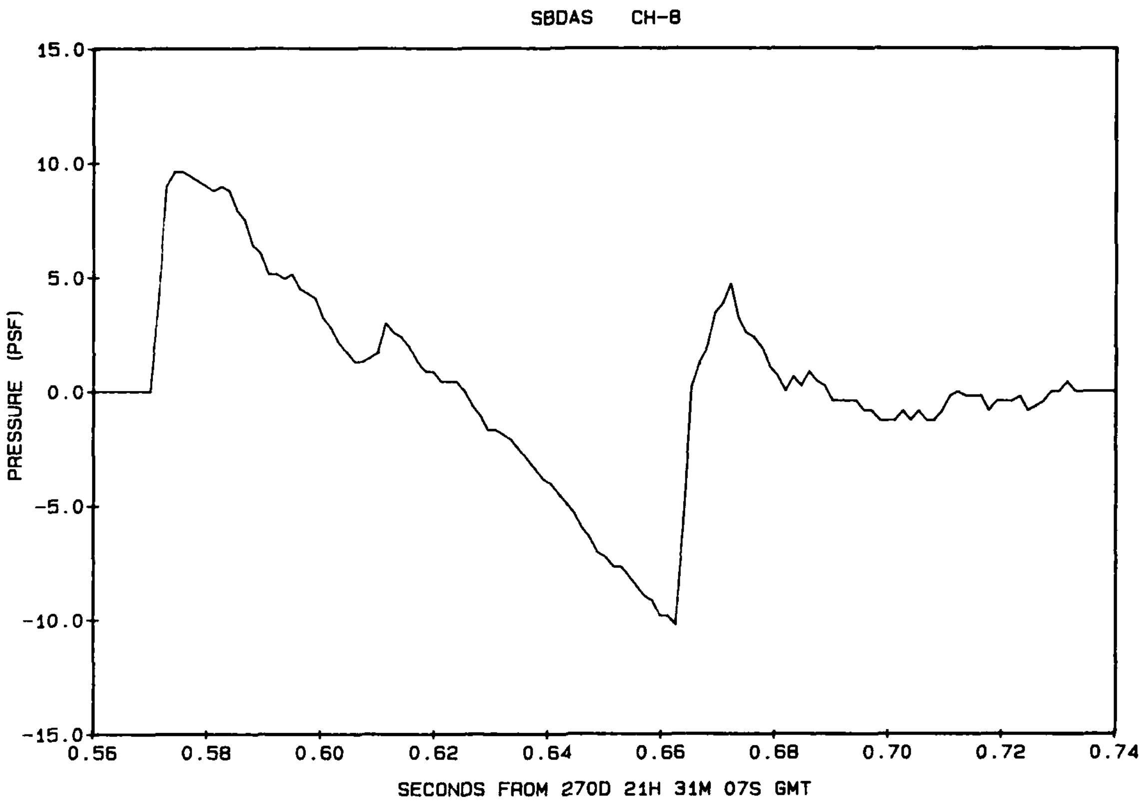

FILE: B:P121430A.917
MAX: 9.14 PSF
MIN: -9.09 PSF
PRESSURE (PSF)
15
10
5
0
-5
-10
-15
0
.02
.04
.06
.08
.1
.12
.14
.16
.18
TIME (Sec)

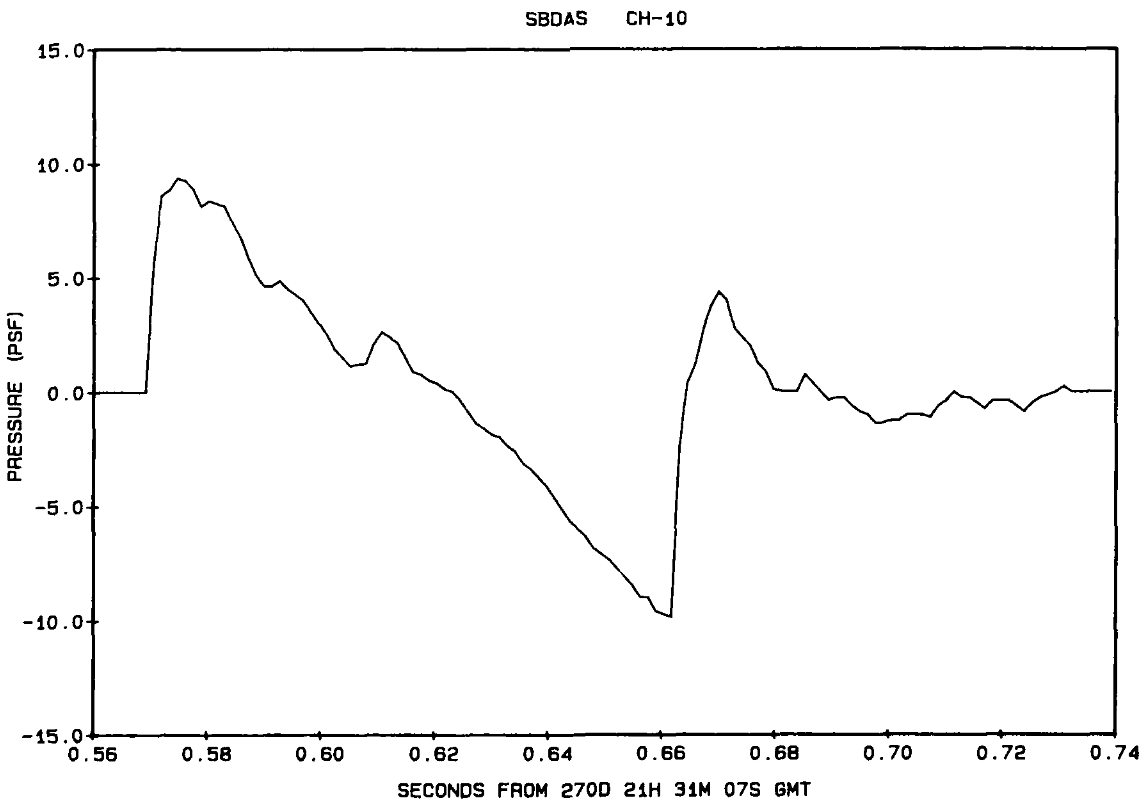
F4 5K-4

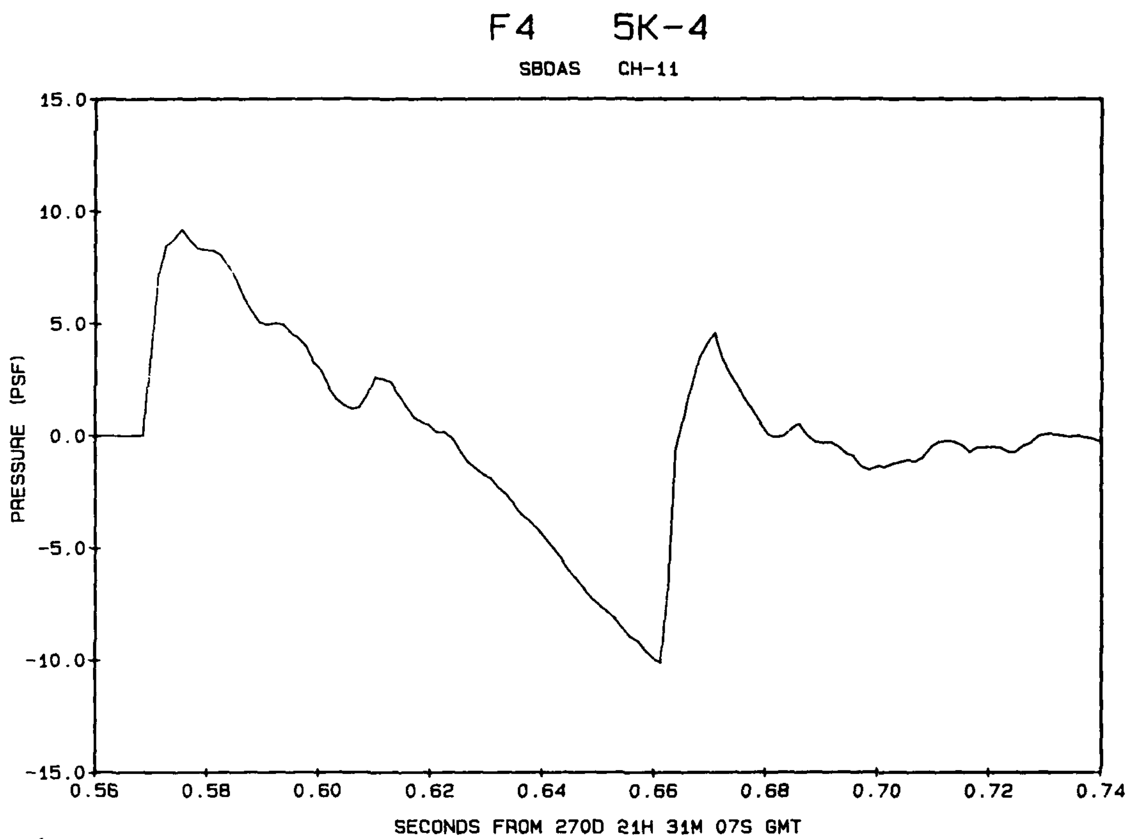

SBDAS CH-3
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.62
0.64
0.66
0.68
0.70
0.72
0.74
0.76
0.78
0.80
SECONDS FROM 270D 21H 31M 07S GMT


SBDAS CH-5
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.62
0.64
0.66
0.68
0.70
0.72
0.74
0.76
0.78
0.80
SECONDS FROM 270D 21H 31M 07S GMT

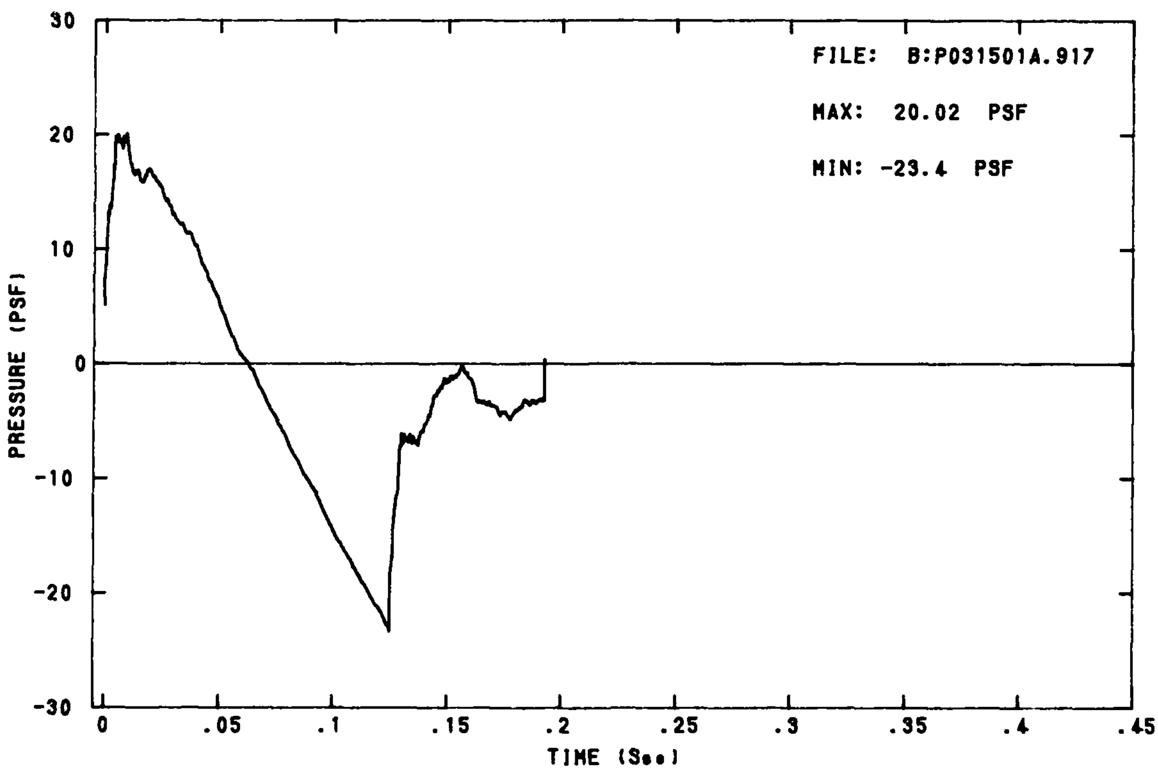
F4 5K-4

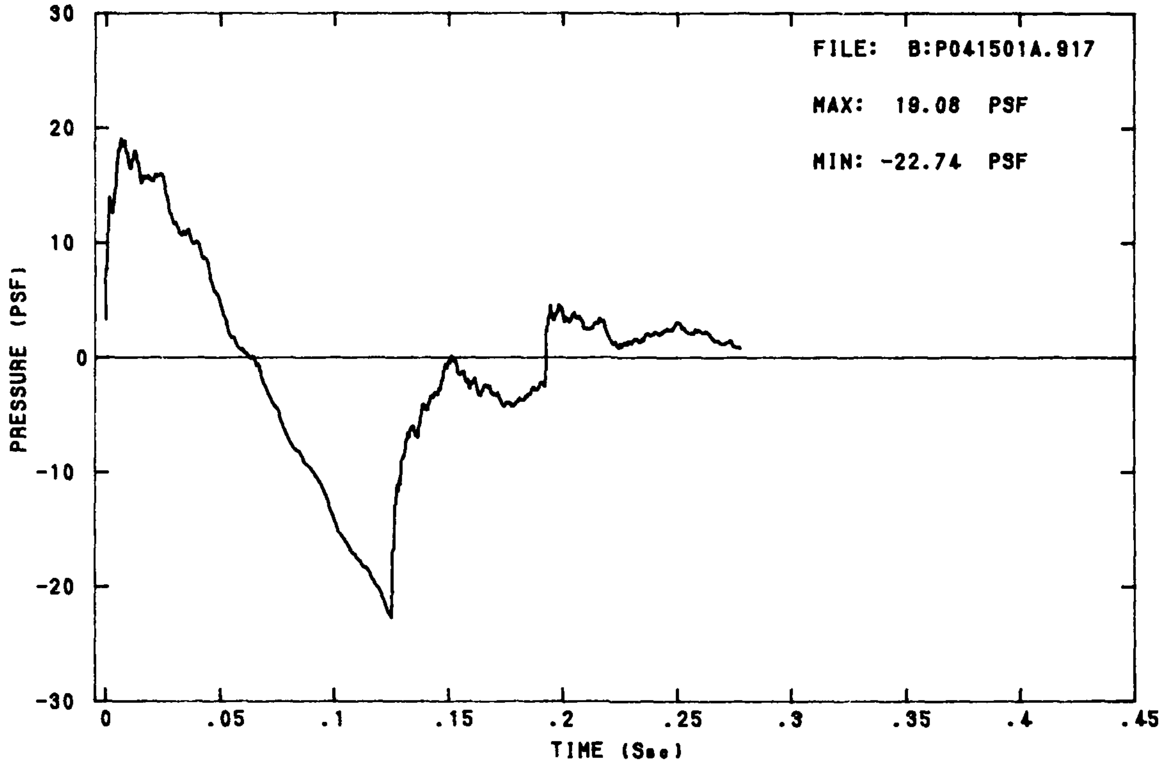

SBDAS CH-8
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.56
0.58
0.60
0.62
0.64
0.66
0.68
0.70
0.72
0.74
SECONDS FROM 270D 21H 31M 07S GMT

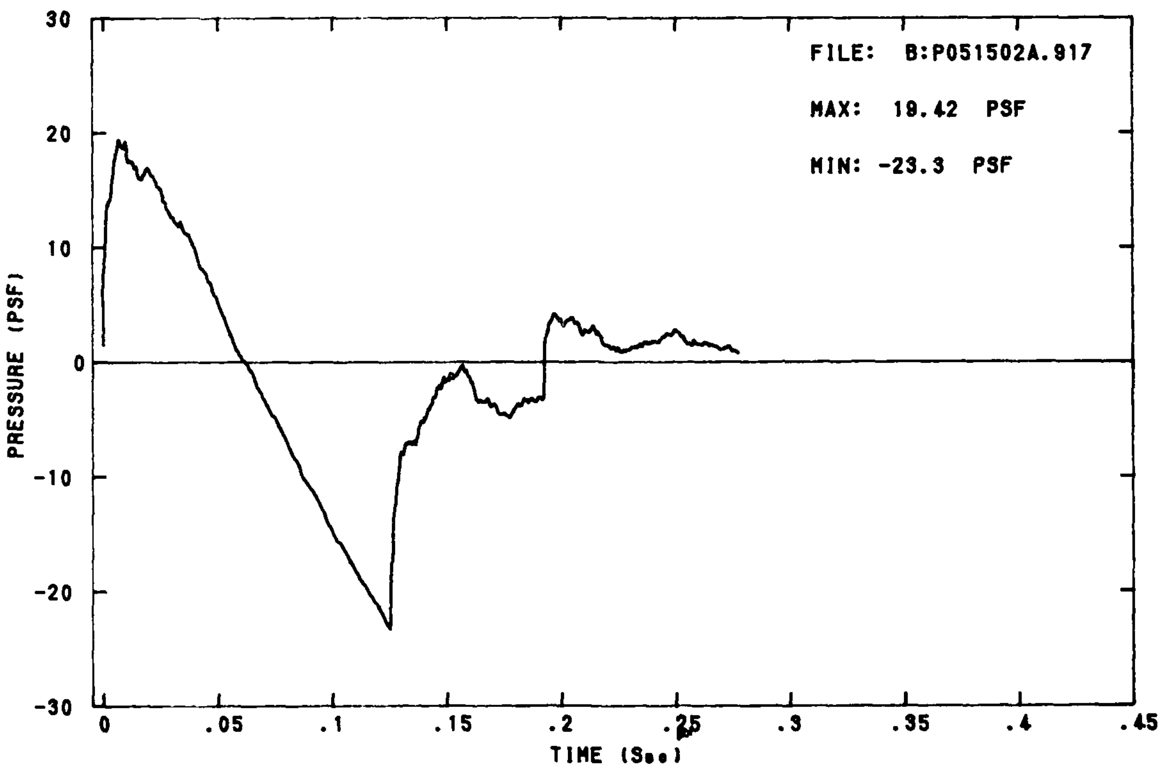

SBDAS CH-10
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.56
0.58
0.60
0.62
0.64
0.66
0.68
0.70
0.72
0.74
SECONDS FROM 270D 21H 31M 07S GMT

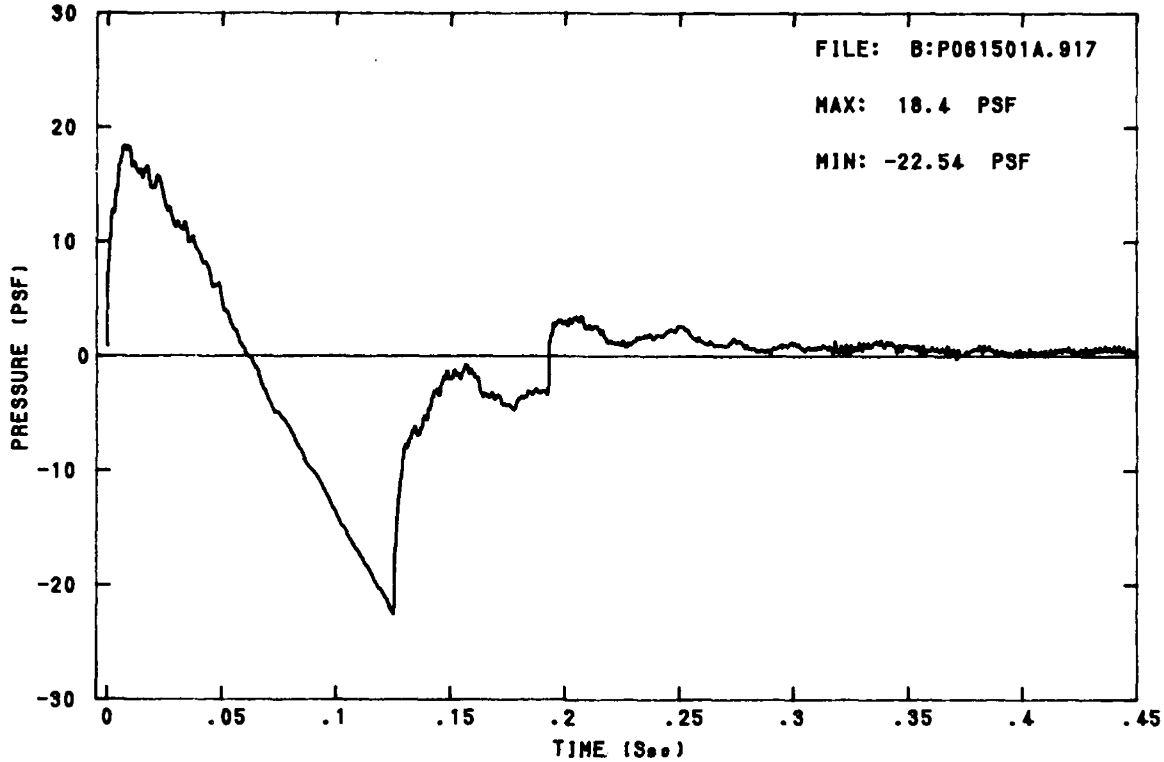

F4 5K-4
SBDAS CH-11
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
PRESSURE (PSF)
0.56
0.58
0.60
0.62
0.64
0.66
0.68
0.70
0.72
0.74
SECONDS FROM 270D 21H 31M 07S GMT

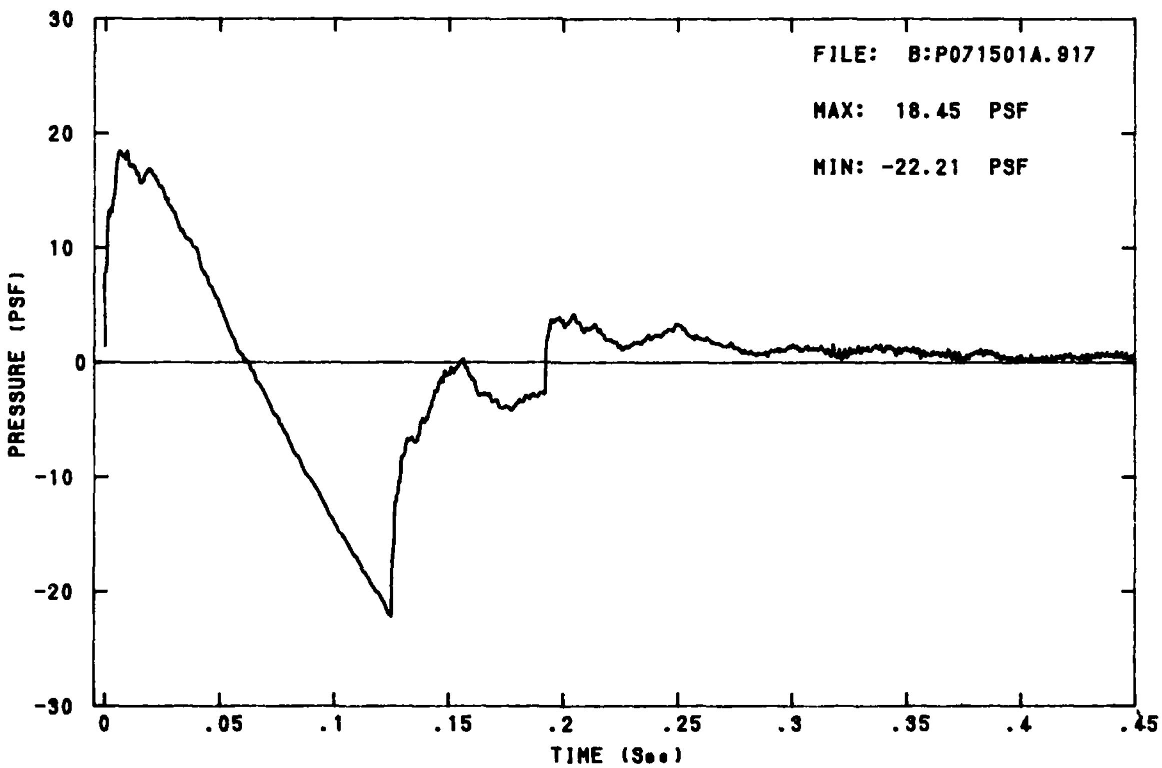
BOOM SIGNATURES from F-111A Flying at 1.03 MACH, 1,200 ft AGL, and 0 ft. track offset occuring at 22:02:33 GMT, 17 Sep 86.

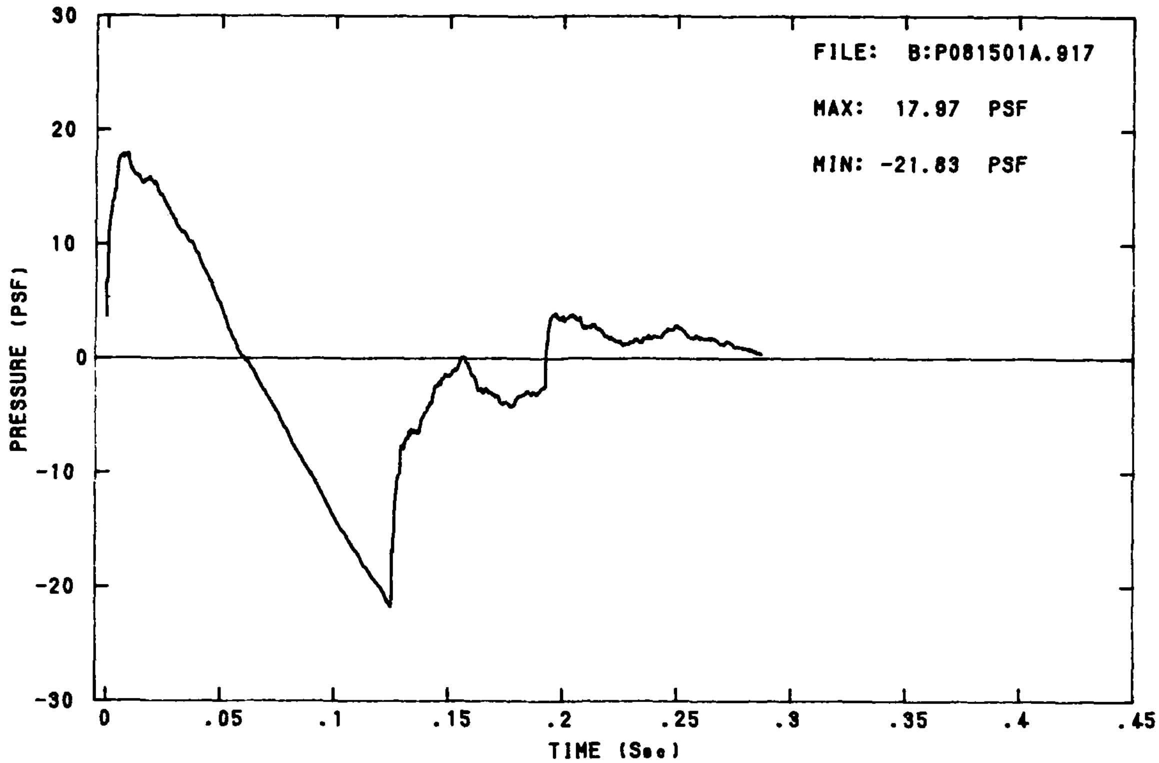


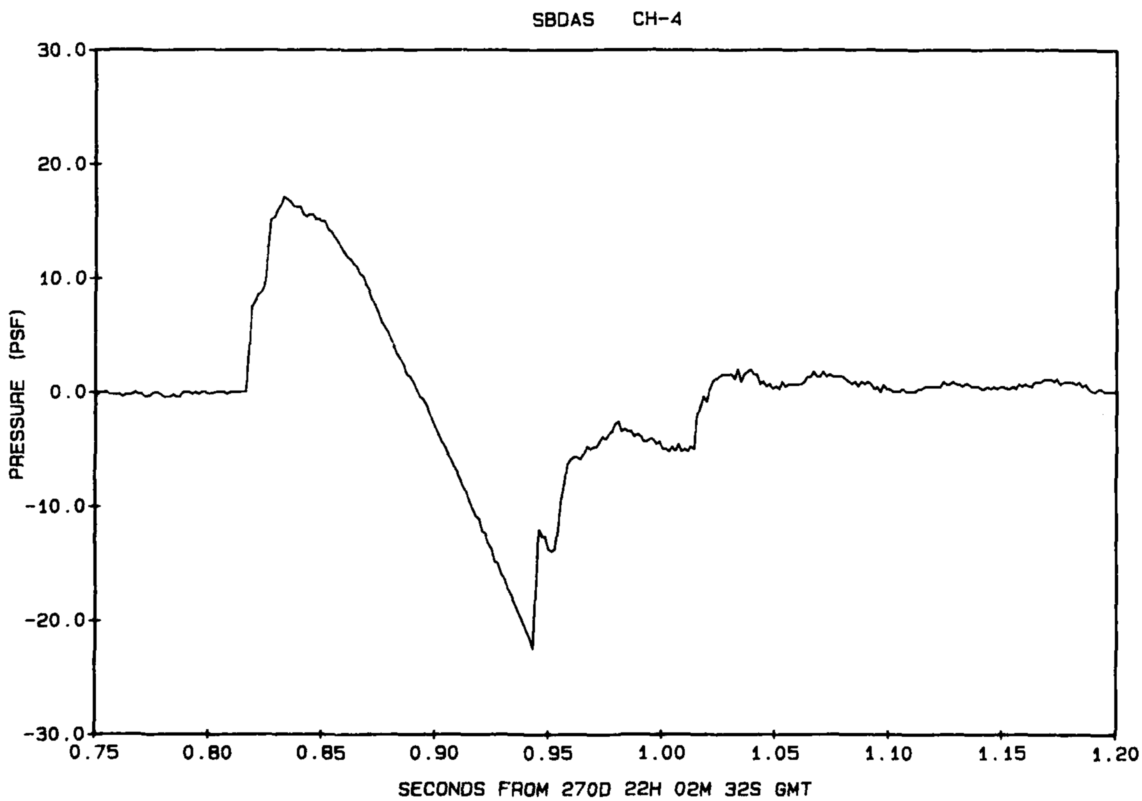

FILE: B:P041501A.917
MAX: 19.08 PSF
MIN: -22.74 PSF
PRESSURE (PSF)
TIME (Sec)
30
20
10
0
-10
-20
-30
0
.05
.1
.15
.2
.25
.3
.35
.4
.45


FILE: B:P051502A.917
MAX: 19.42 PSF
MIN: -23.3 PSF
PRESSURE (PSF)
TIME (Sec)
30
20
10
0
-10
-20
-30
0
.05
.1
.15
.2
.25
.3
.35
.4
.45


FILE: B:P061501A.917
MAX: 18.4 PSF
MIN: -22.54 PSF
PRESSURE (PSF)
30
20
10
0
-10
-20
-30
0
.05
.1
.15
.2
.25
.3
.35
.4
.45
TIME (Sec)

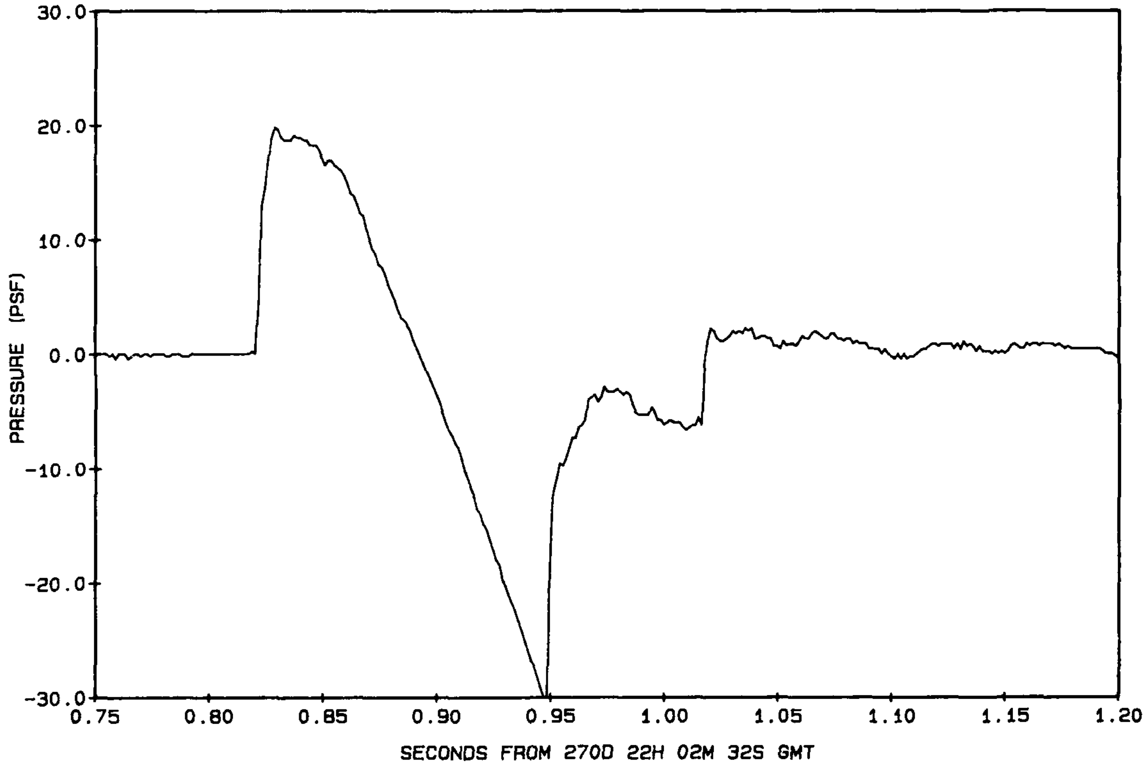

FILE: B:P071501A.917
MAX: 18.45 PSF
MIN: -22.21 PSF
PRESSURE (PSF)
30
20
10
0
-10
-20
-30
0
.05
.1
.15
.2
.25
.3
.35
.4
.45
TIME (Sec)


FILE: B:P081501A.917
MAX: 17.97 PSF
MIN: -21.83 PSF
PRESSURE (PSF)
TIME (Sec)
30
20
10
0
-10
-20
-30
0
.05
.1
.15
.2
.25
.3
.35
.4
.45

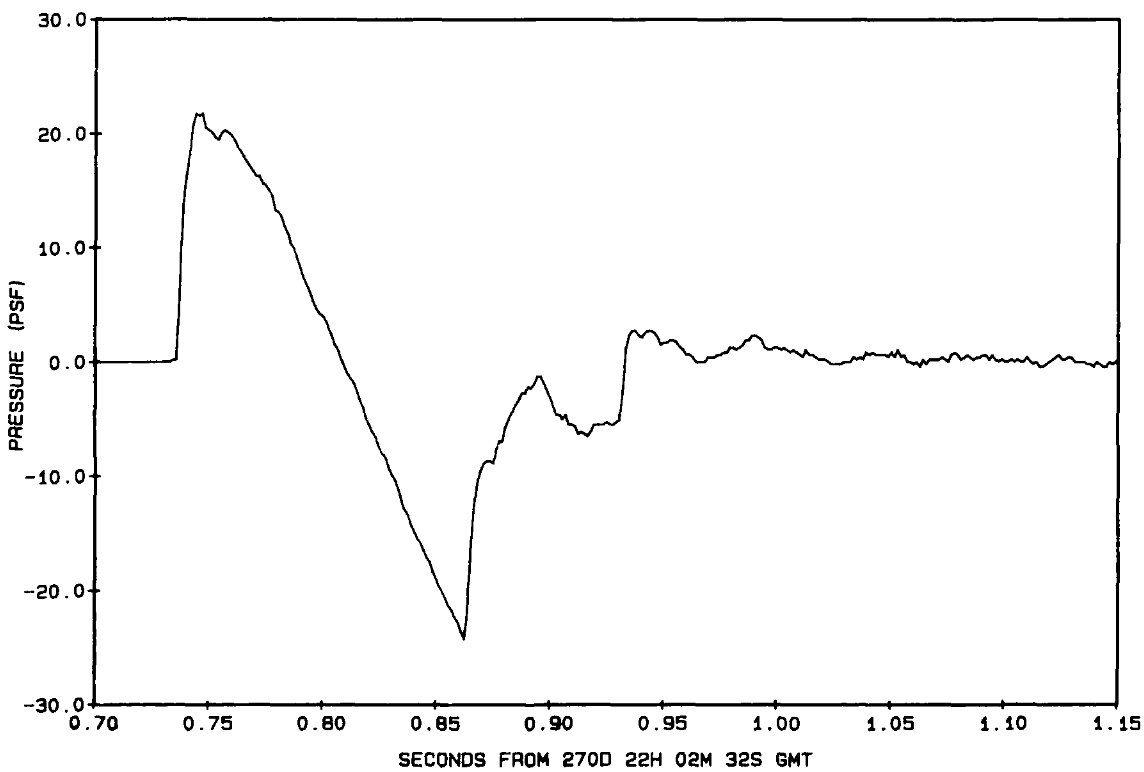

SBDAS CH-4
PRESSURE (PSF)
SECONDS FROM 270D 22H 02M 32S GMT
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.75
0.80
0.85
0.90
0.95
1.00
1.05
1.10
1.15
1.20

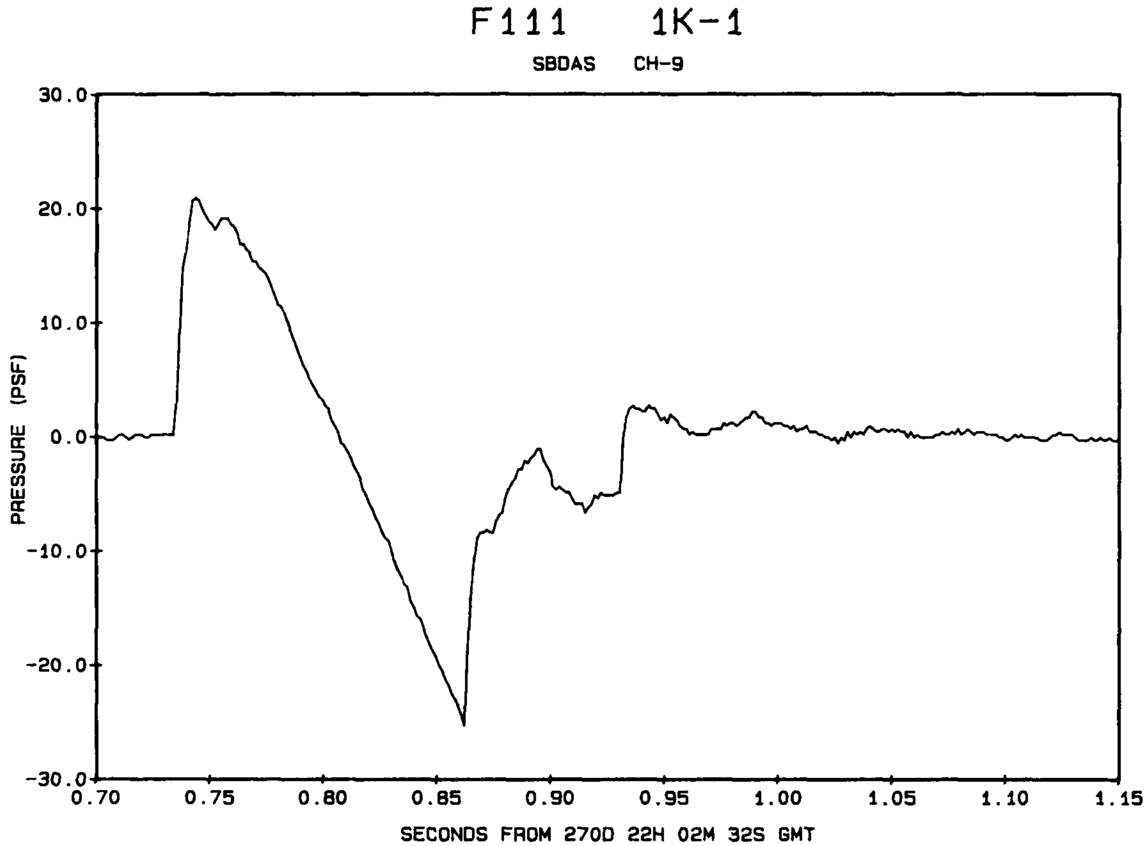
F111 1K-1

SBDAS CH-5

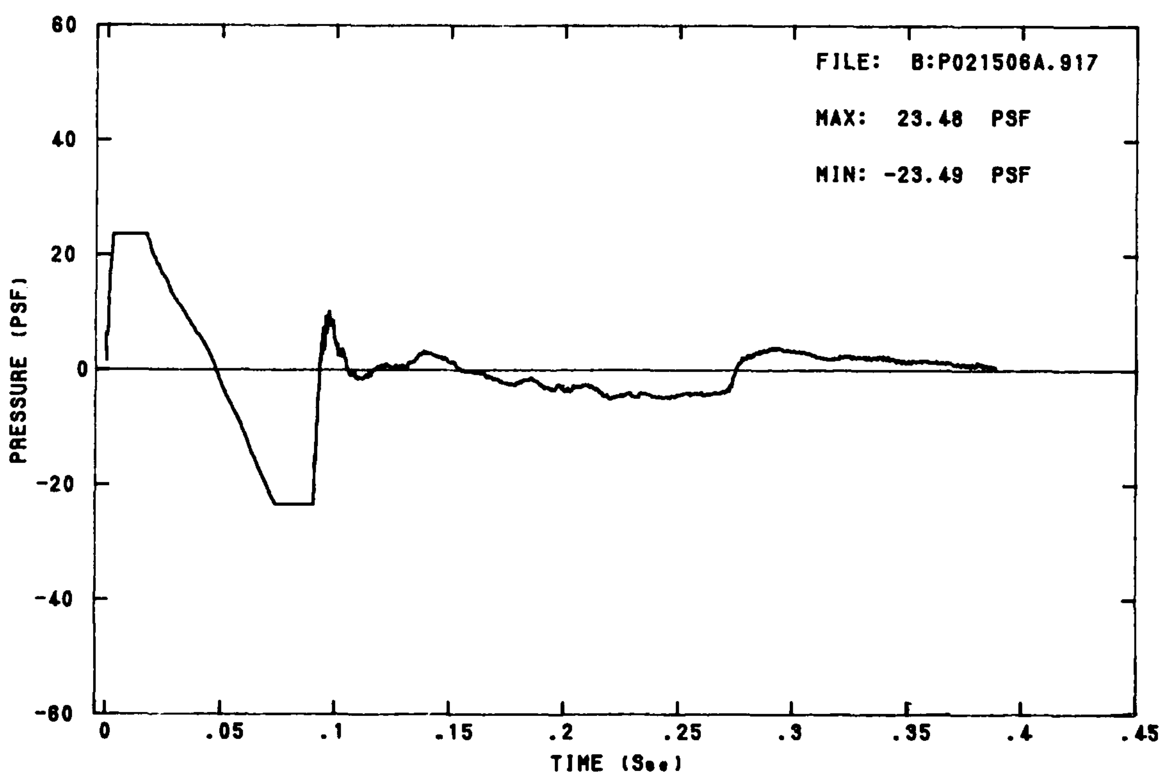


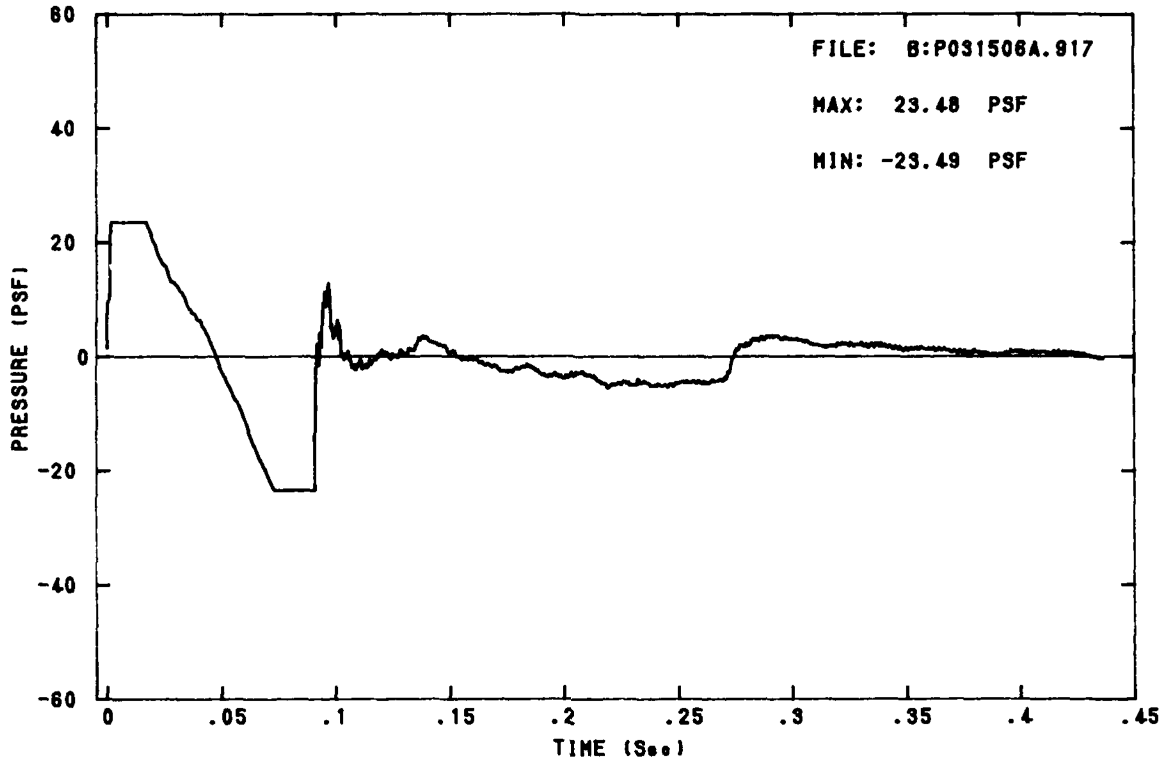
SBDAS CH-7



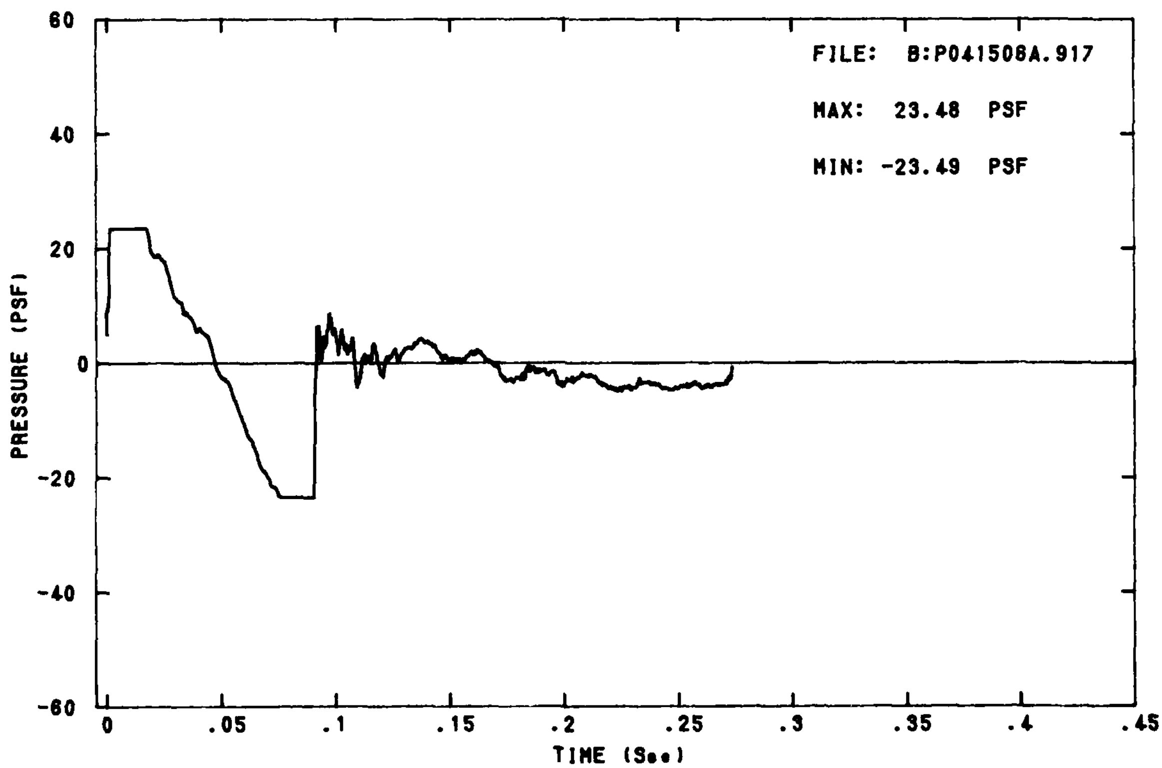

F111 1K-1
SBDAS CH-9
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
PRESSURE (PSF)
0.70
0.75
0.80
0.85
0.90
0.95
1.00
1.05
1.10
1.15
SECONDS FROM 270D 22H 02M 32S GMT

BOOM SIGNATURES from F-111A Flying at 1.04 MACH, 1,200 ft AGL, and 0 ft. track offset occuring at 22:07:49 GMT, 17 Sep 86.

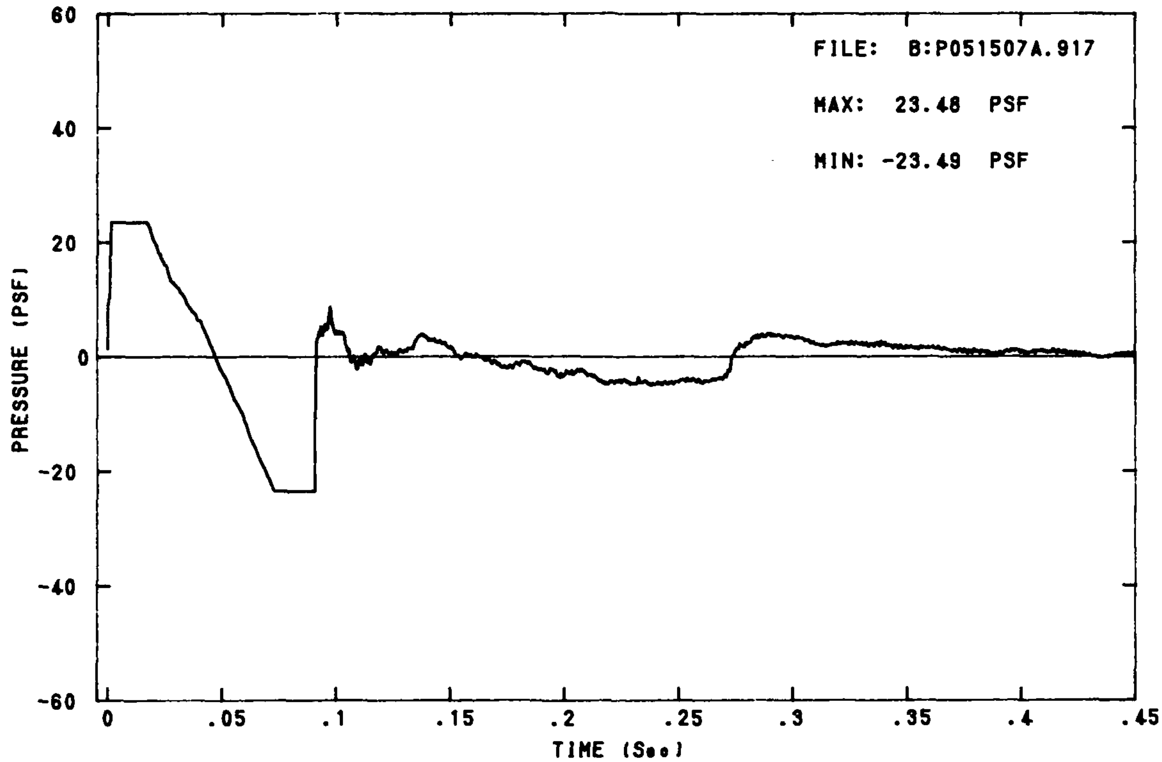


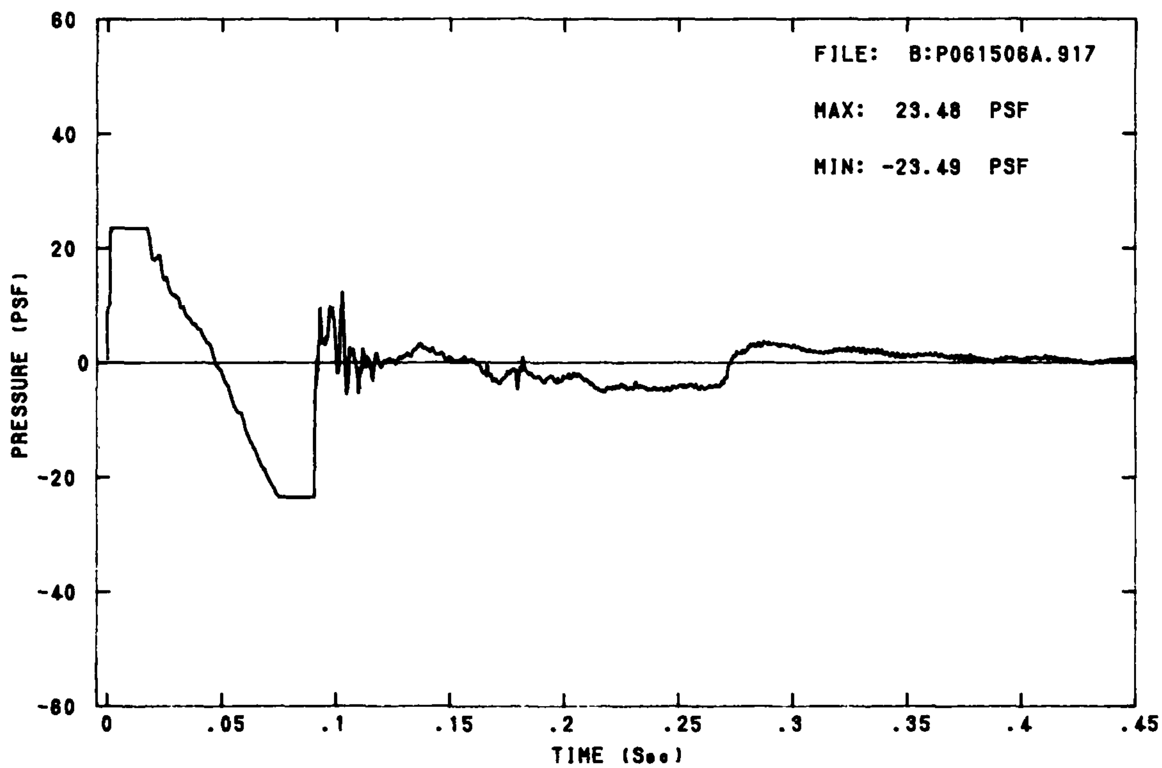


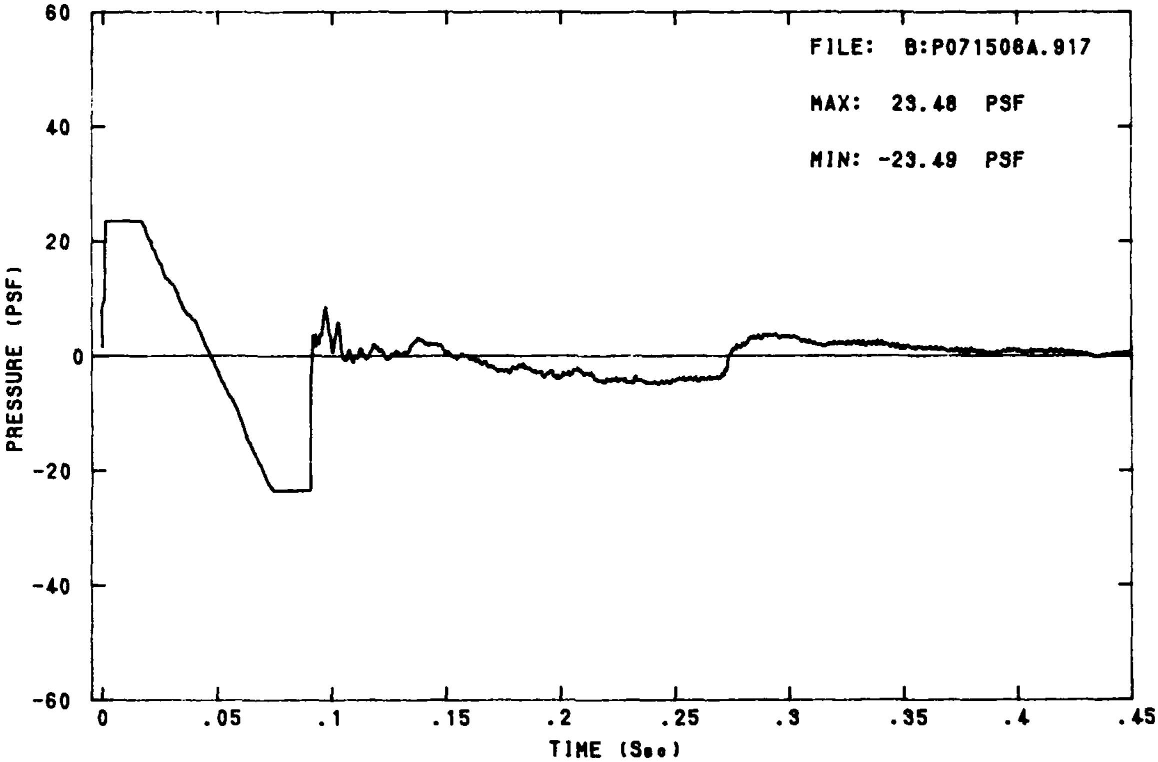
FILE: B:P031506A.917
MAX: 23.48 PSF
MIN: -23.49 PSF
PRESSURE (PSF)
TIME (Sec)



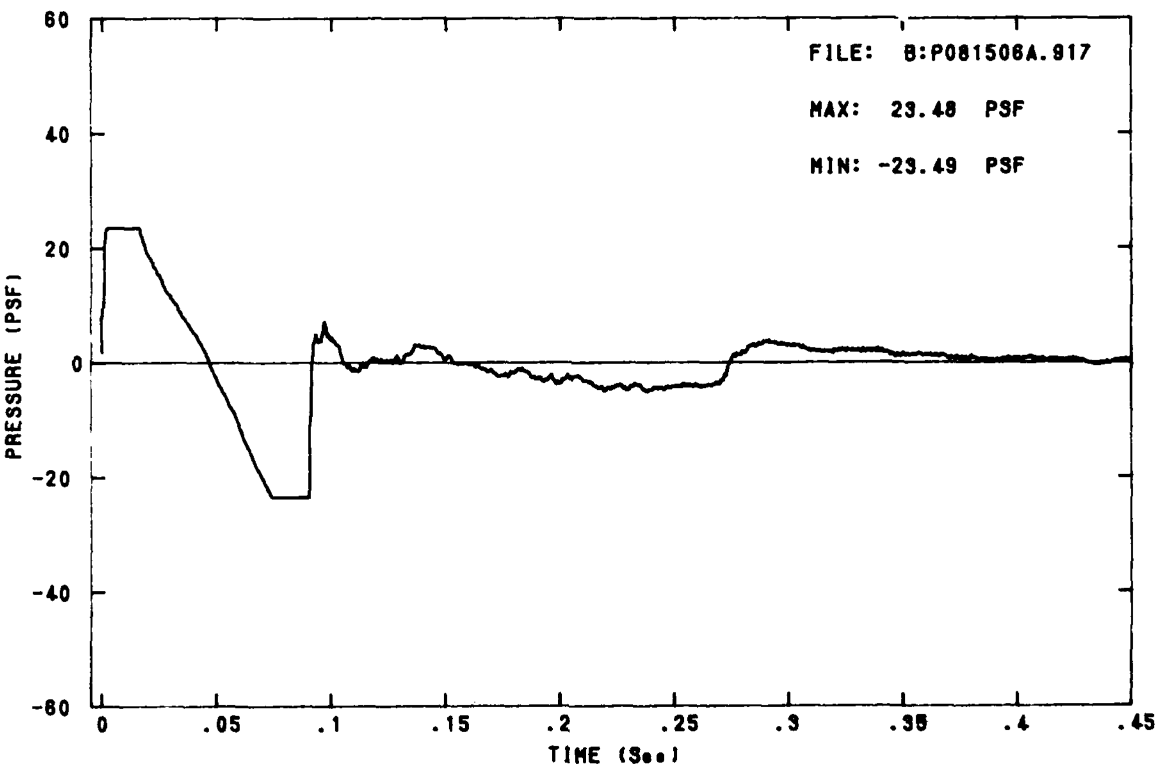
FILE: B:P041506A.917
MAX: 23.48 PSF
MIN: -23.49 PSF
PRESSURE (PSF)
TIME (Sec)


FILE: B:P051507A.917
MAX: 23.48 PSF
MIN: -23.49 PSF
PRESSURE (PSF)
60
40
20
0
-20
-40
-60
0
.05
.1
.15
.2
.25
.3
.35
.4
.45
TIME (Sec)

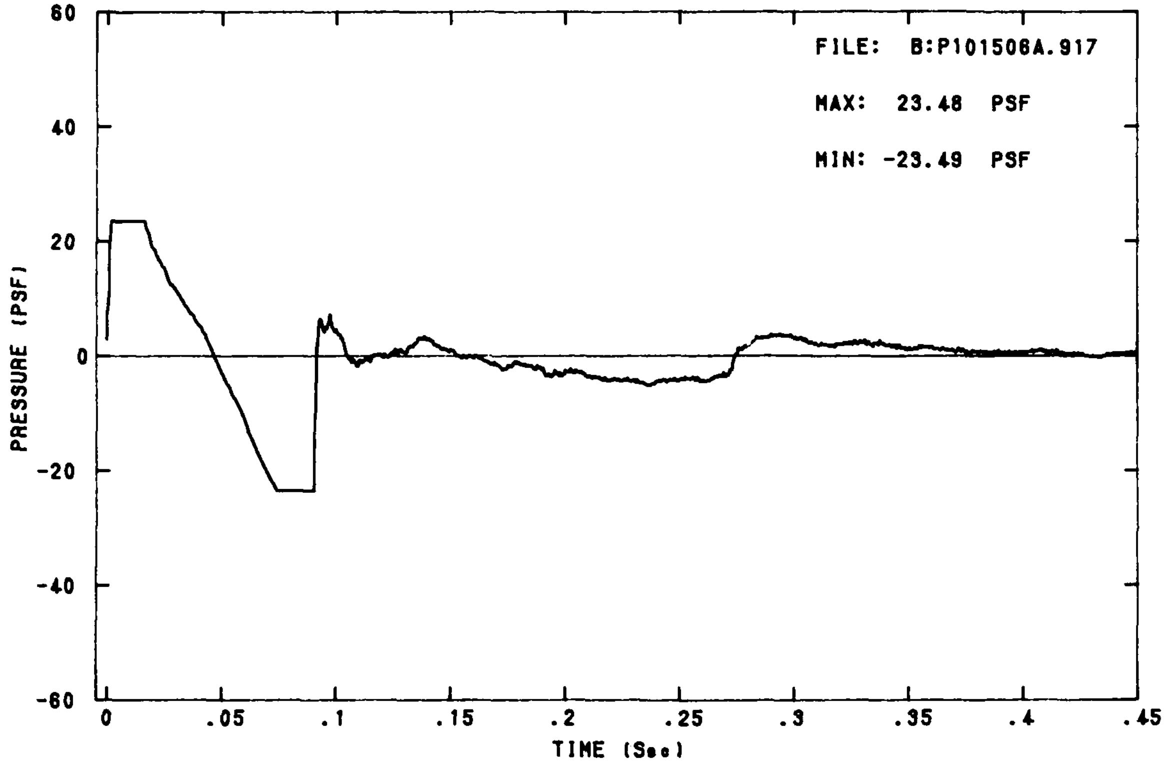

FILE: B:P061506A.917
MAX: 23.48 PSF
MIN: -23.49 PSF
PRESSURE (PSF)
60
40
20
0
-20
-40
-60
0
.05
.1
.15
.2
.25
.3
.35
.4
.45
TIME (Sec)

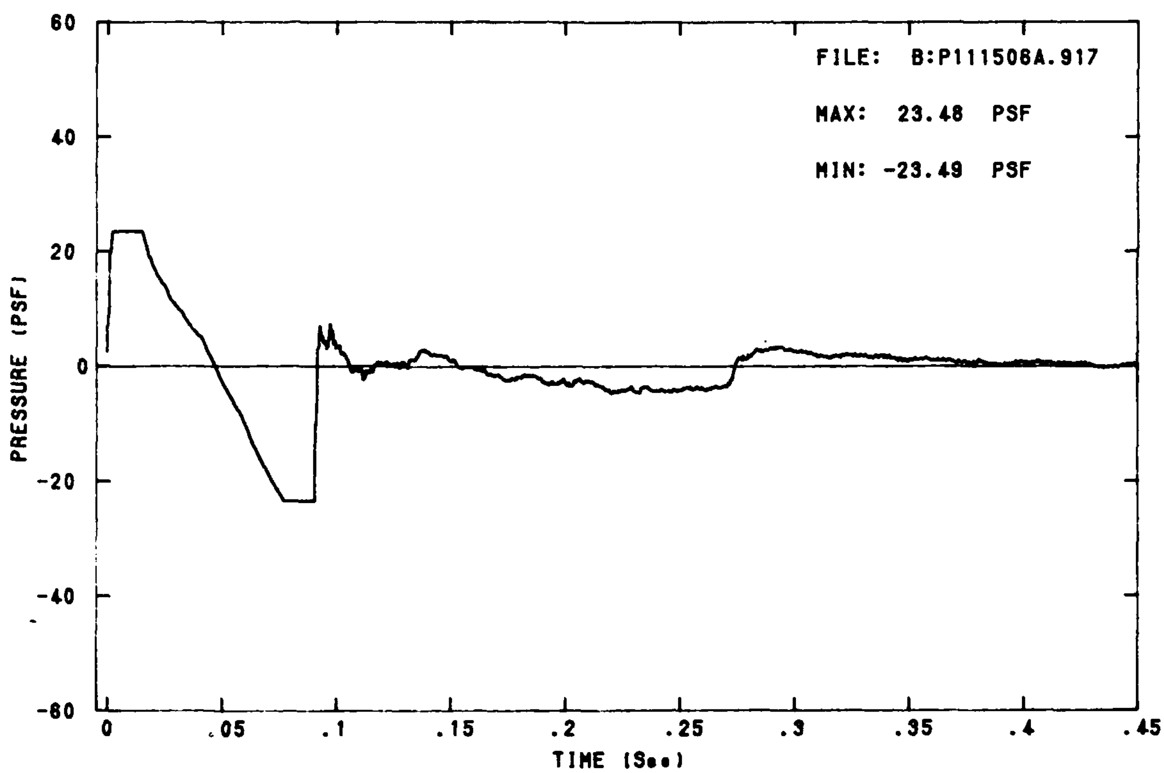


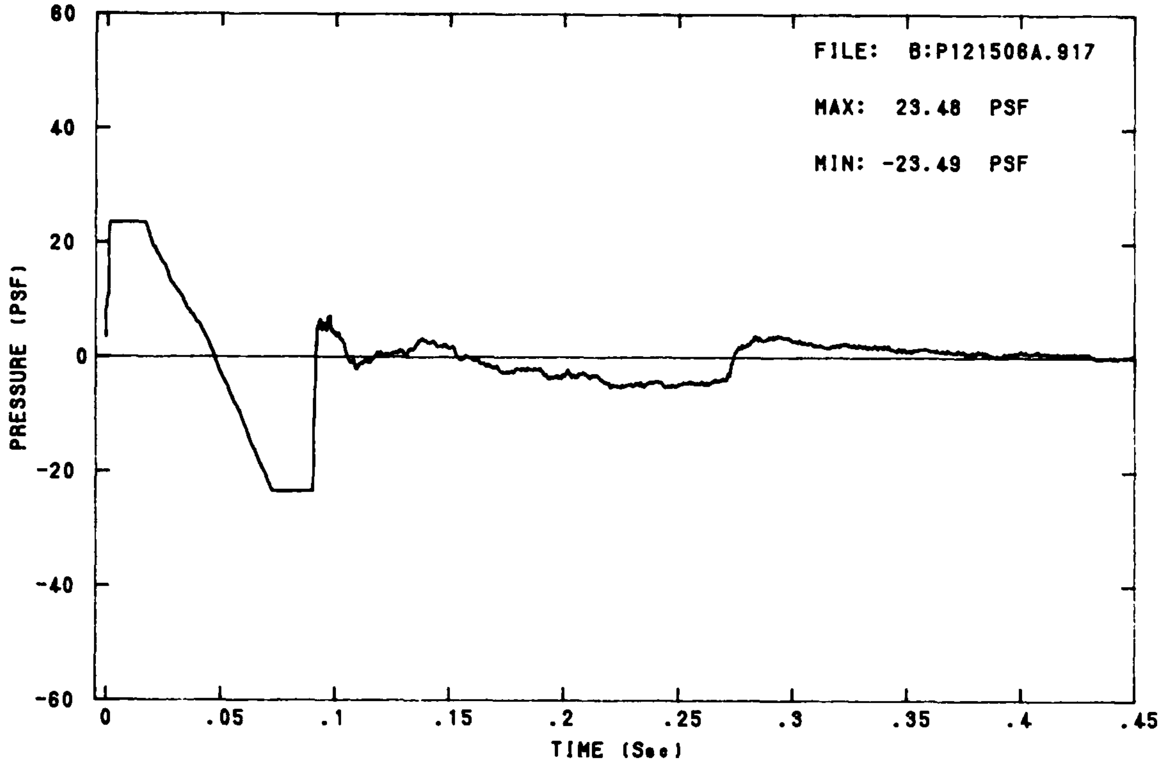
FILE: B:P071506A.917
MAX: 23.48 PSF
MIN: -23.49 PSF
PRESSURE (PSF)
TIME (Sec)
60
40
20
0
-20
-40
-60
0
.05
.1
.15
.2
.25
.3
.35
.4
.45

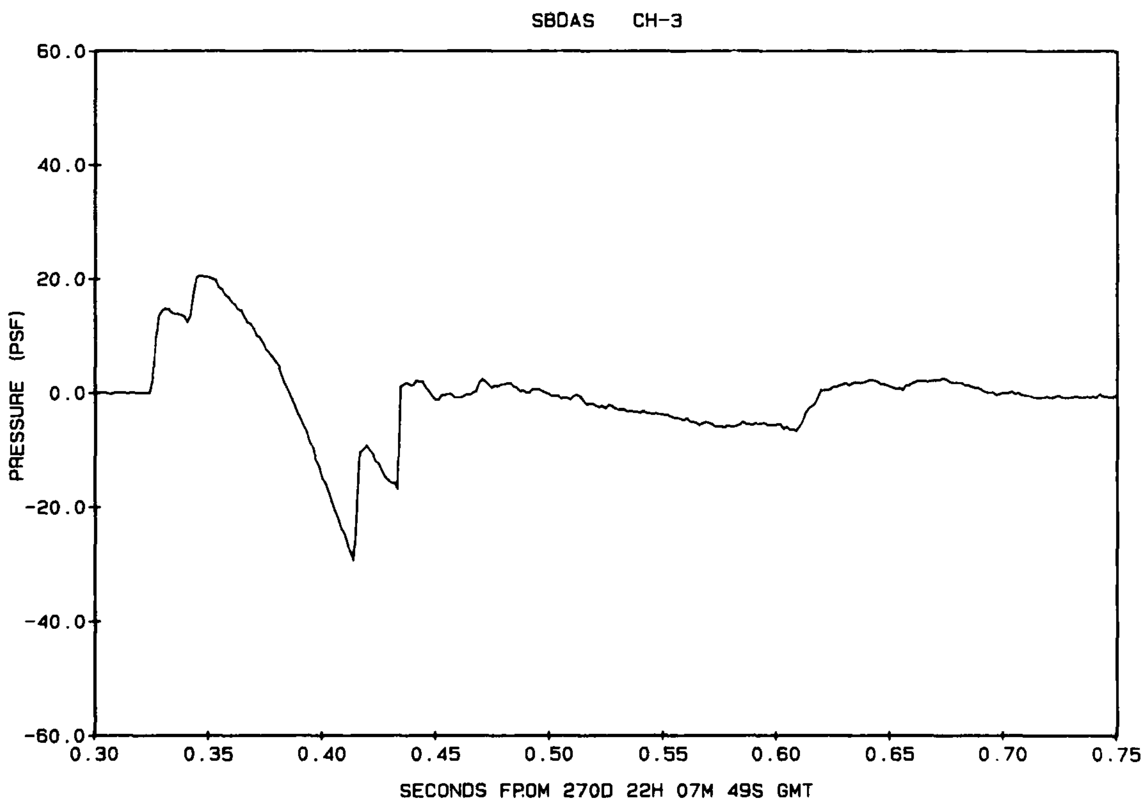


FILE: B:P081506A.917
MAX: 23.48 PSF
MIN: -23.49 PSF
PRESSURE (PSF)
TIME (Sec)
60
40
20
0
-20
-40
-60
0
.05
.1
.15
.2
.25
.3
.35
.4
.45


FILE: B:P101506A.917
MAX: 23.48 PSF
MIN: -23.49 PSF
PRESSURE (PSF)
60
40
20
0
-20
-40
-60
0
.05
.1
.15
.2
.25
.3
.35
.4
.45
TIME (Sec)

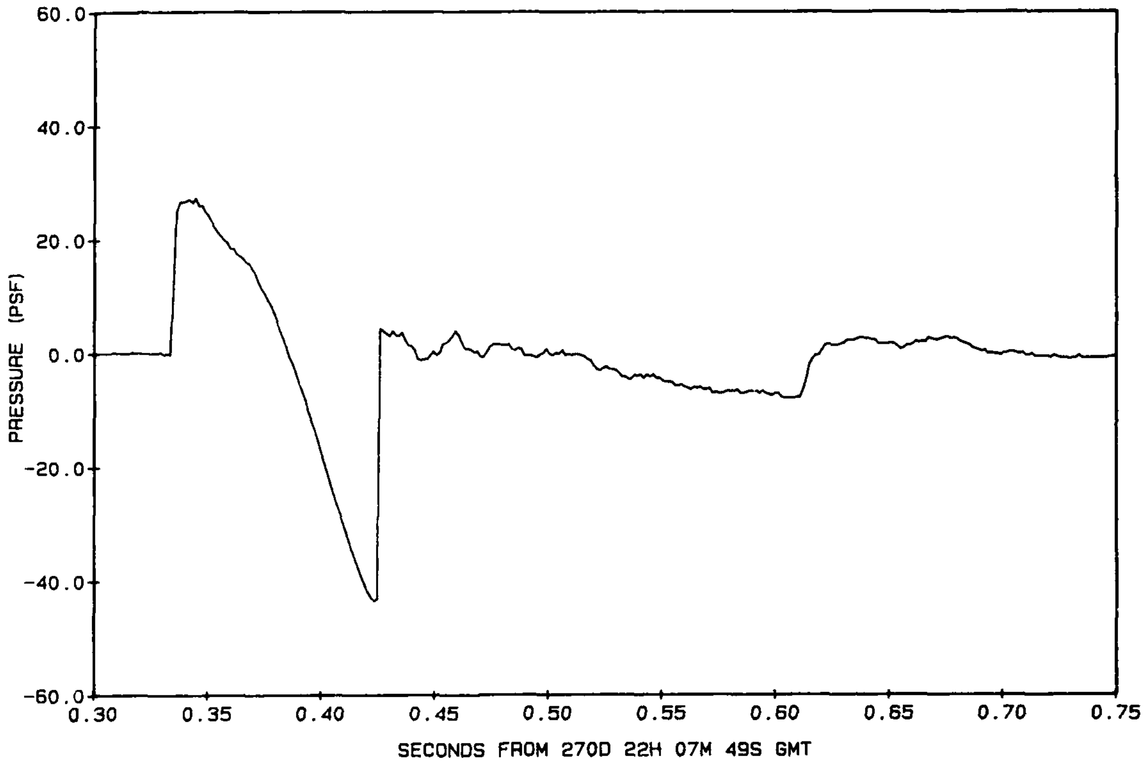

FILE: B:P111506A.917
MAX: 23.48 PSF
MIN: -23.49 PSF
PRESSURE (PSF)
60
40
20
0
-20
-40
-60
0
.05
.1
.15
.2
.25
.3
.35
.4
.45
TIME (Sec)


FILE: B:P121506A.917
MAX: 23.48 PSF
MIN: -23.49 PSF
PRESSURE (PSF)
TIME (Sec)
60
40
20
0
-20
-40
-60
0
.05
.1
.15
.2
.25
.3
.35
.4
.45

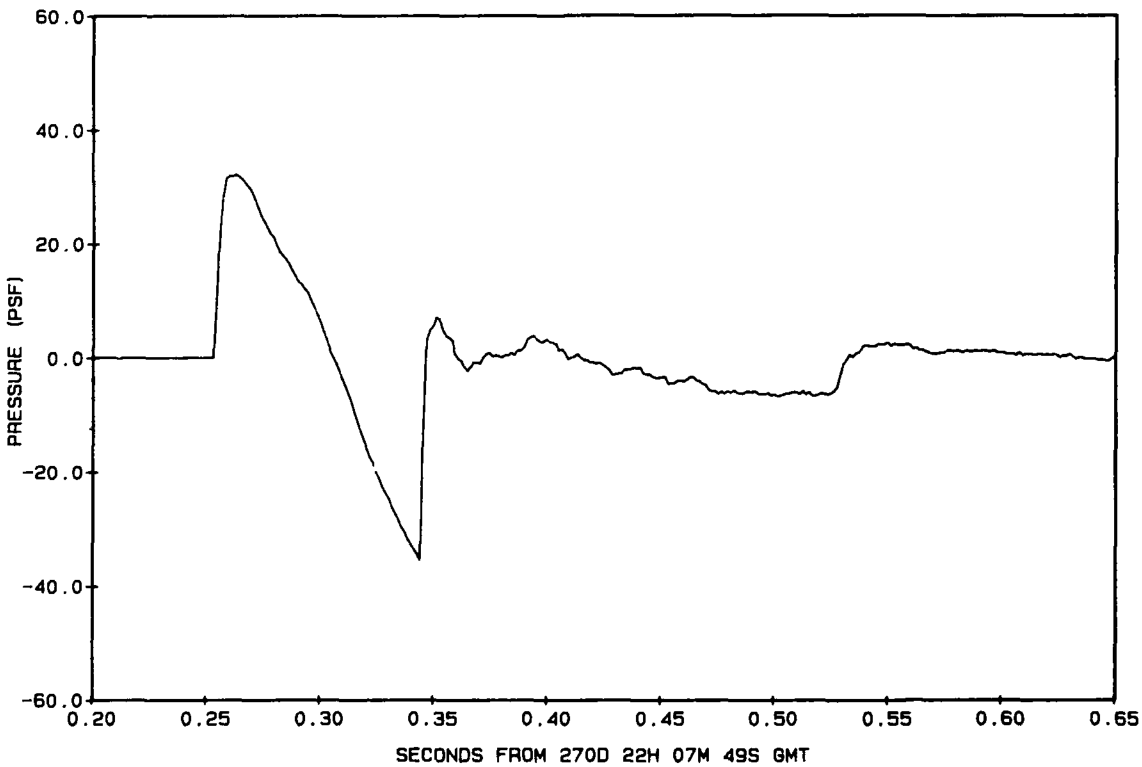

SBDAS CH-3
PRESSURE (PSF)
SECONDS FROM 270D 22H 07M 49S GMT
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75

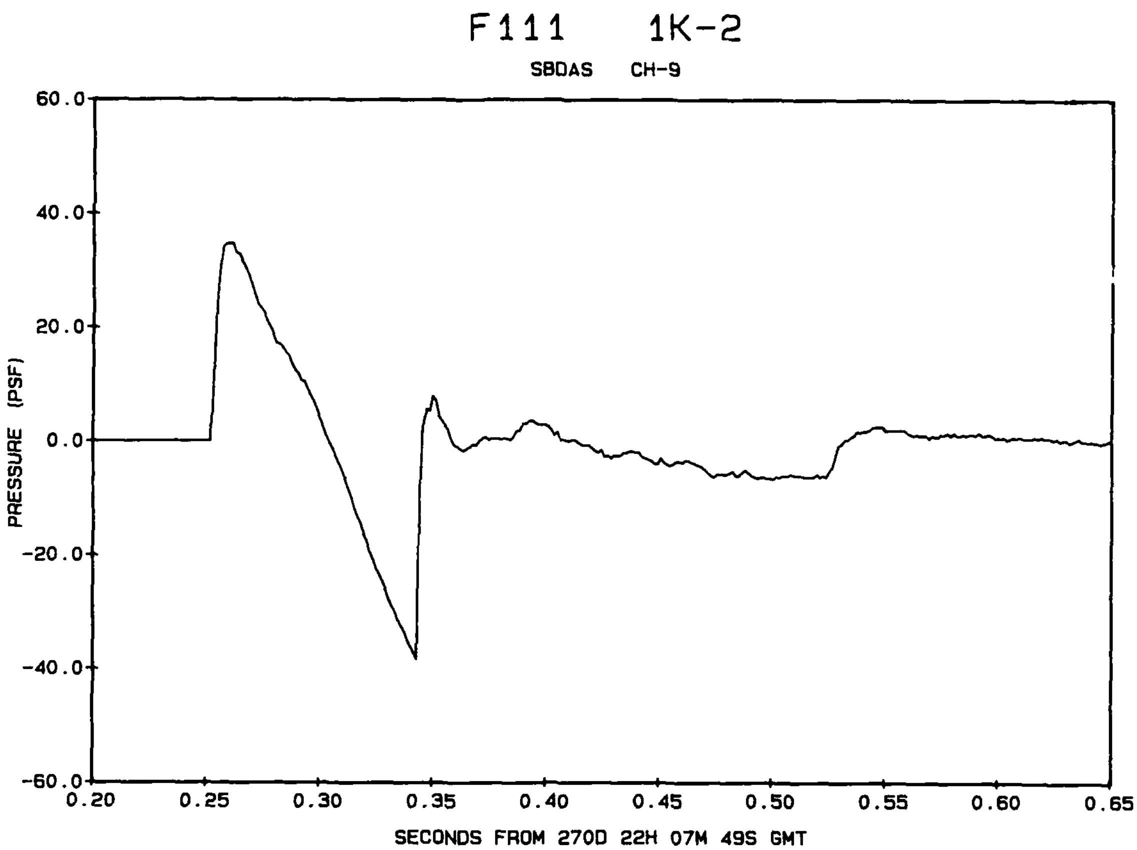
F111 1K-2

SBDAS CH-5

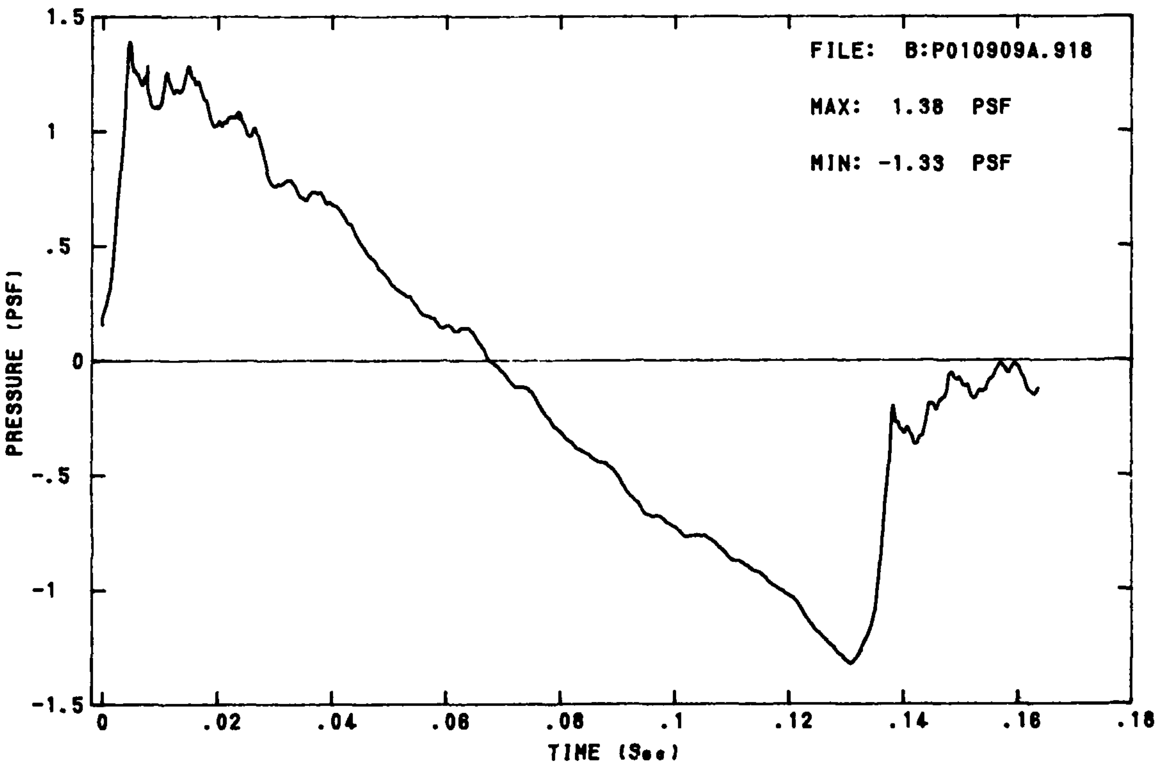


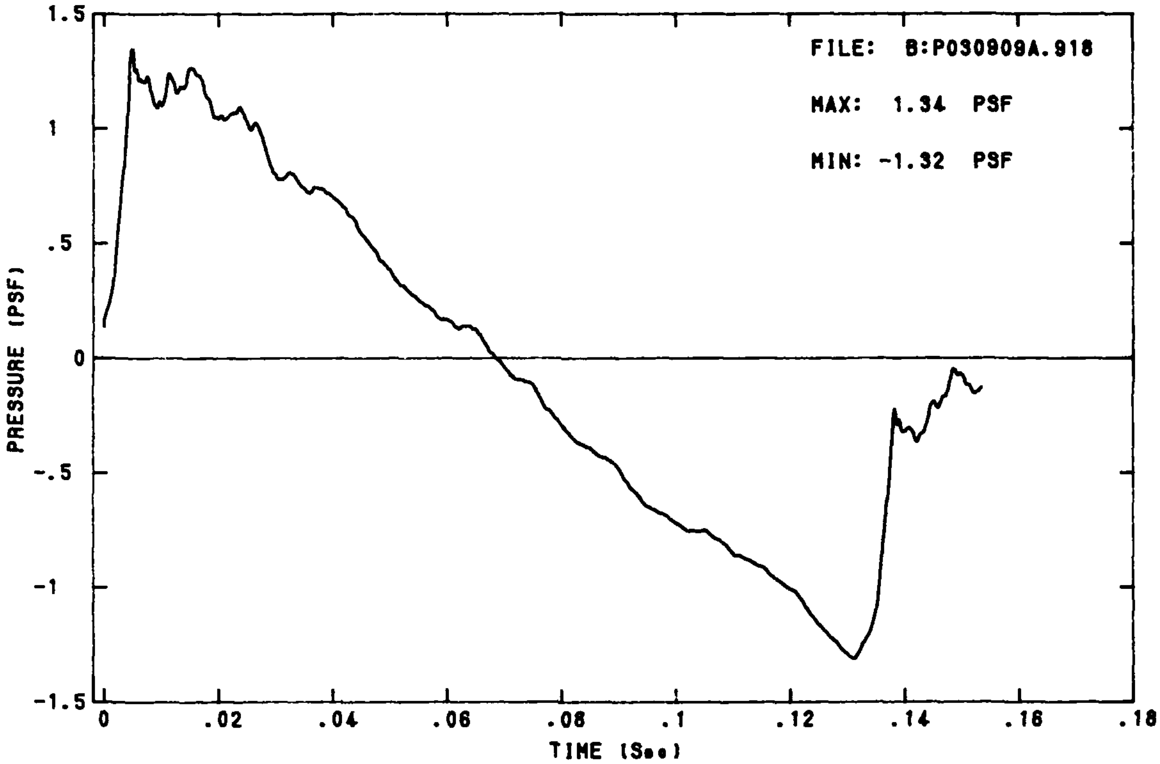
SBDAS CH-7

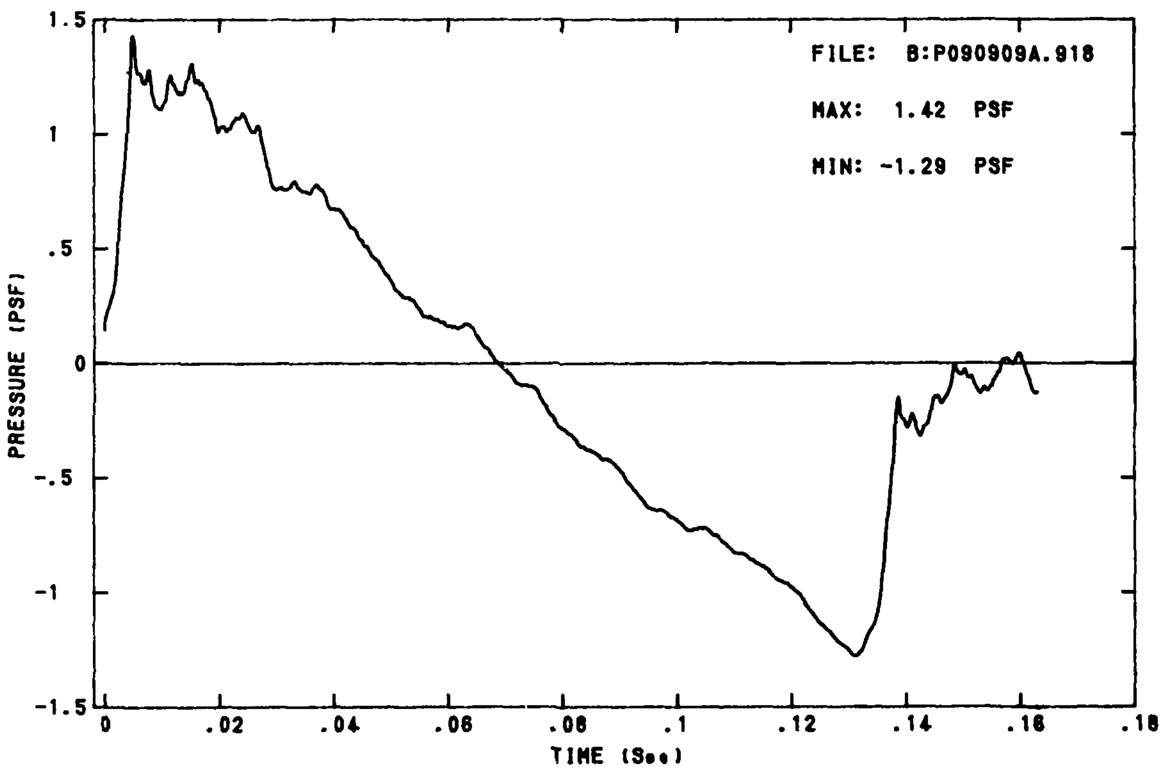


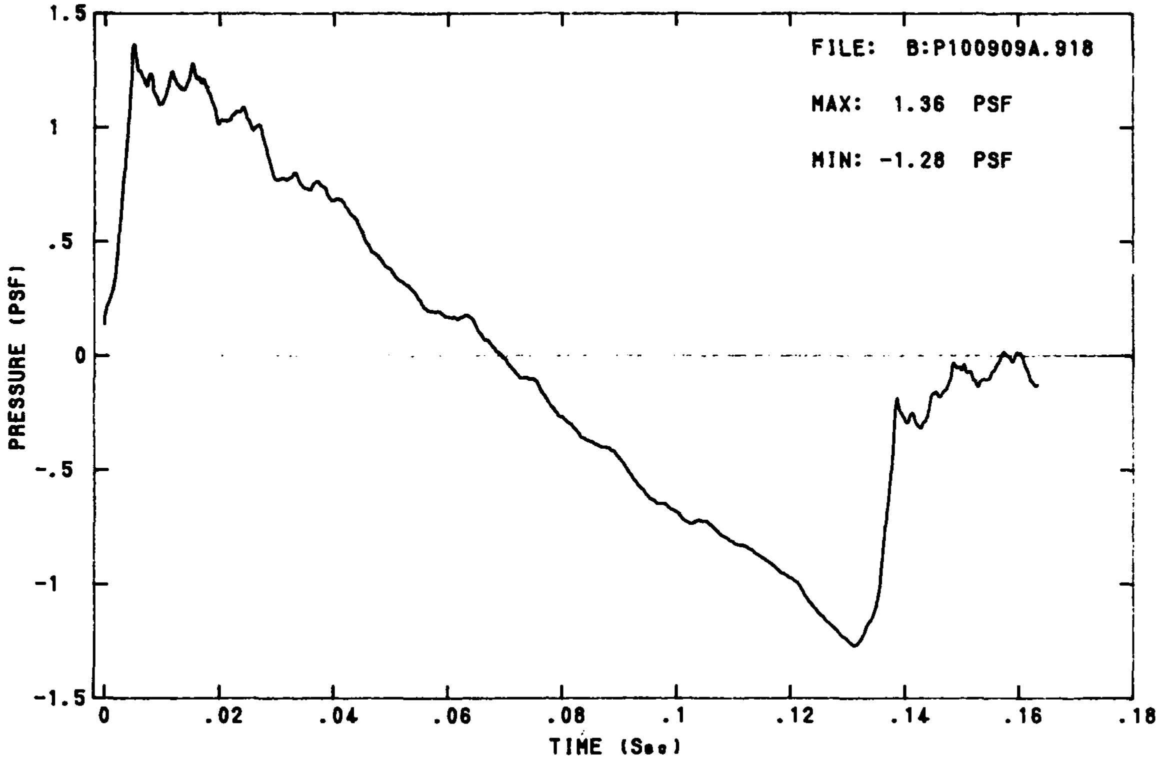

F111 1K-2
SBDAS CH-9
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
PRESSURE (PSF)
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
SECONDS FROM 270D 22H 07M 49S GMT

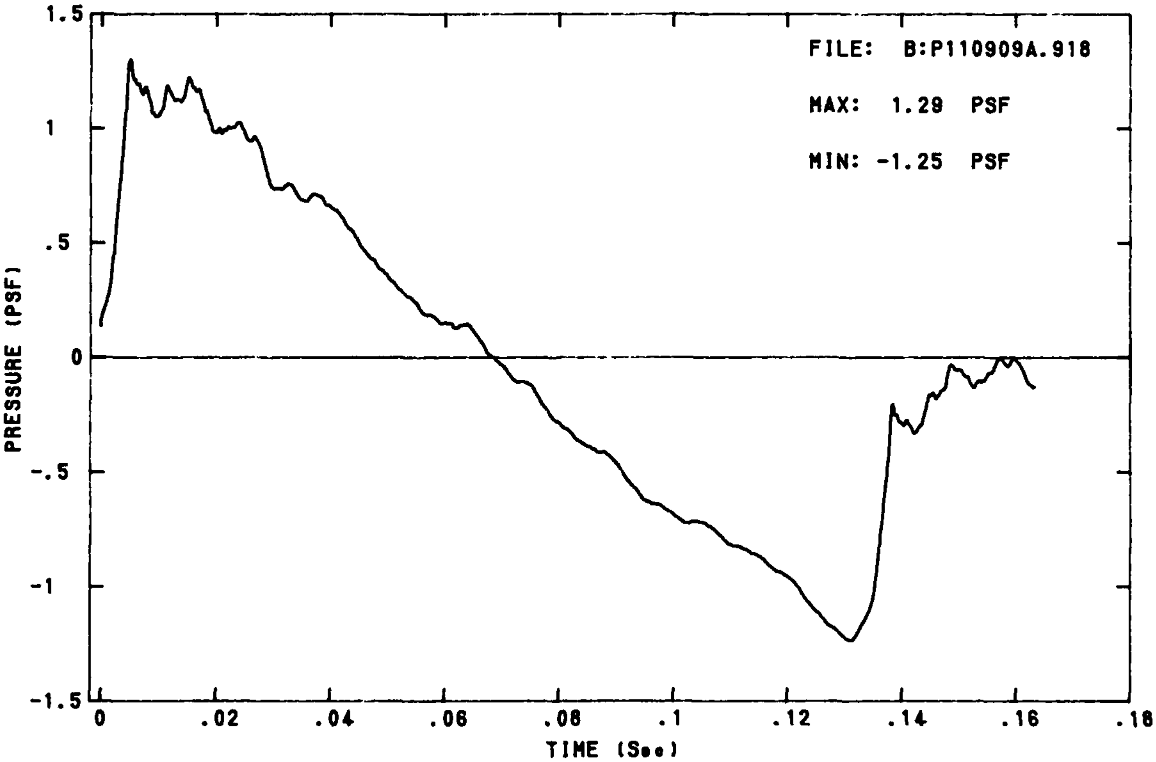
BOOM SIGNATURES from F-4 Flying at 1.22 MACH, 34,200 ft AGL, and 0 ft. track offset occuring at 16:09 GMT, 18 Sep 86.



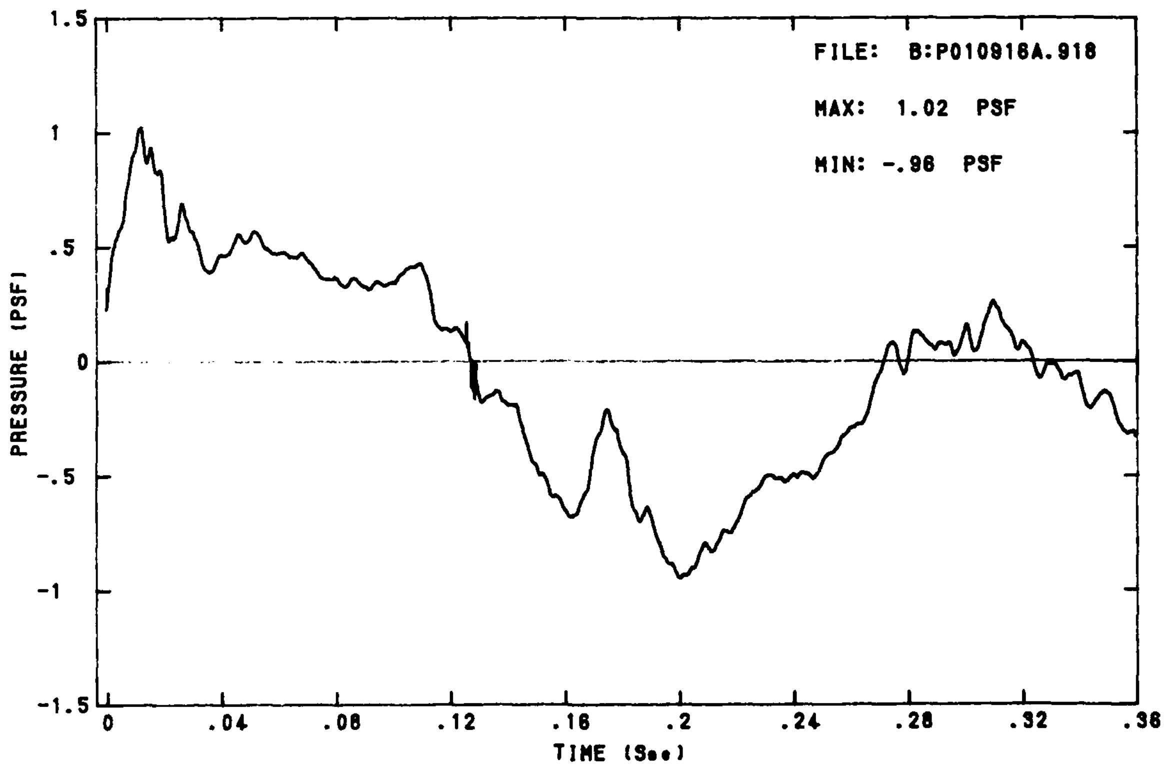

FILE: B:P030909A.918
MAX: 1.34 PSF
MIN: -1.32 PSF
PRESSURE (PSF)
TIME (Sec)
1.5
1
.5
0
-.5
-1
-1.5
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

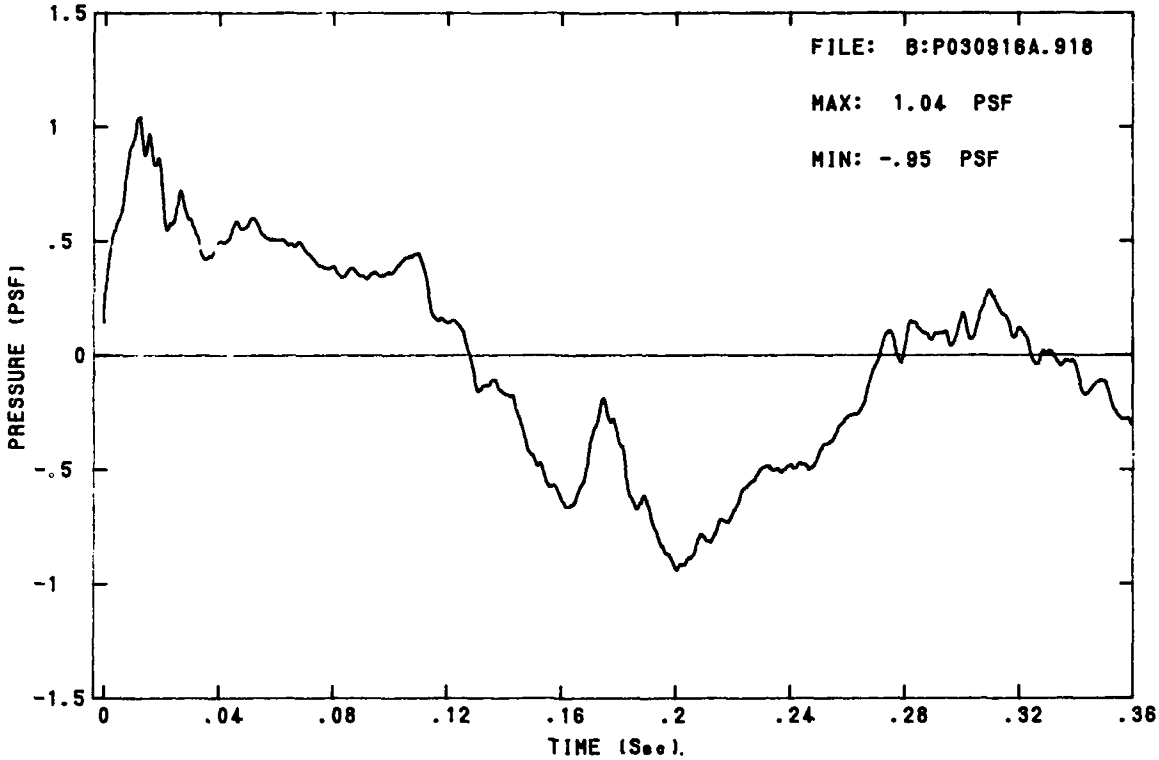

FILE: B:P090909A.918
MAX: 1.42 PSF
MIN: -1.29 PSF
PRESSURE (PSF)
TIME (Sec)
1.5
1
.5
0
-.5
-1
-1.5
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

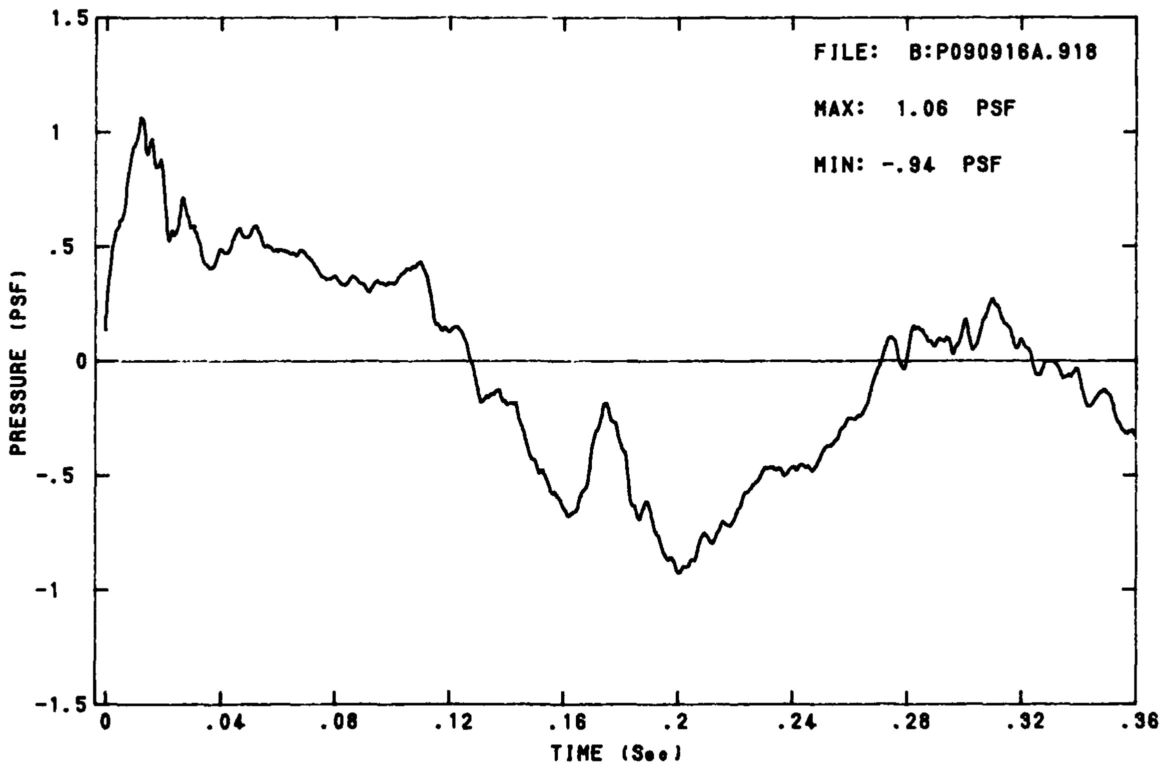

FILE: B:P100909A.918
MAX: 1.36 PSF
MIN: -1.28 PSF
PRESSURE (PSF)
TIME (Sec)
1.5
1
.5
0
-.5
-1
-1.5
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

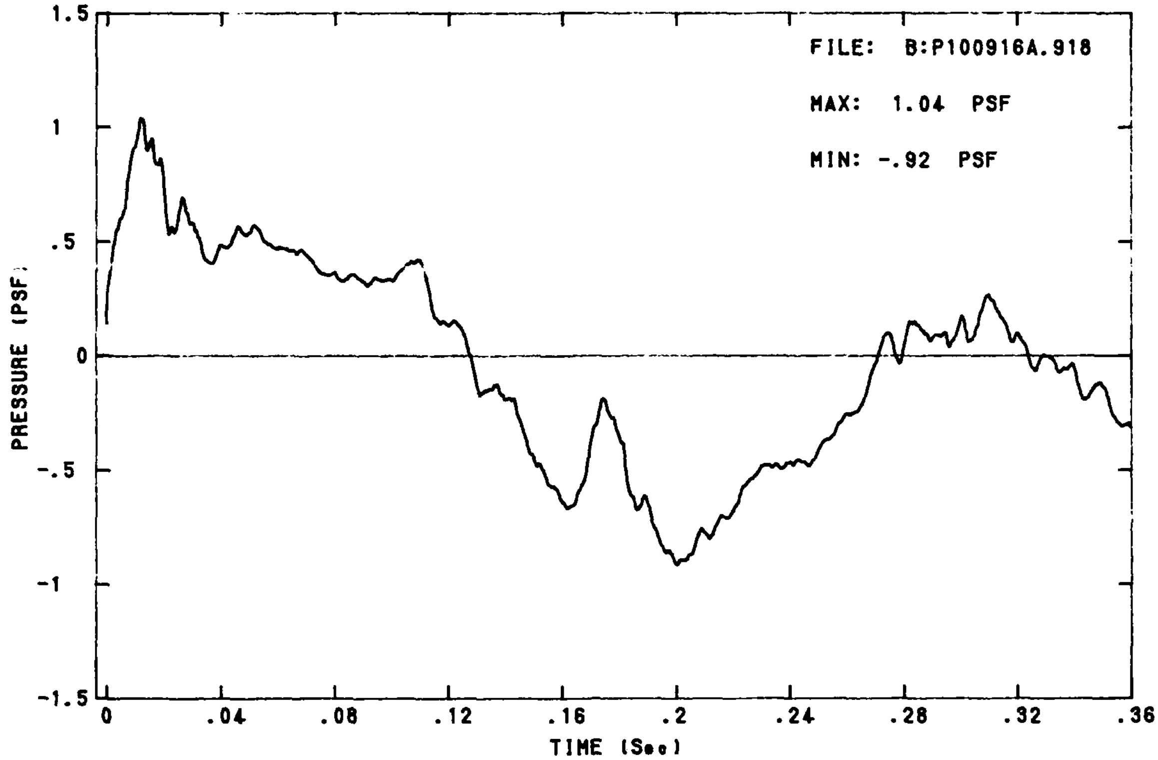

FILE: B:P110909A.918
MAX: 1.29 PSF
MIN: -1.25 PSF
PRESSURE (PSF)
TIME (Sec)
1.5
1
.5
0
-.5
-1
-1.5
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

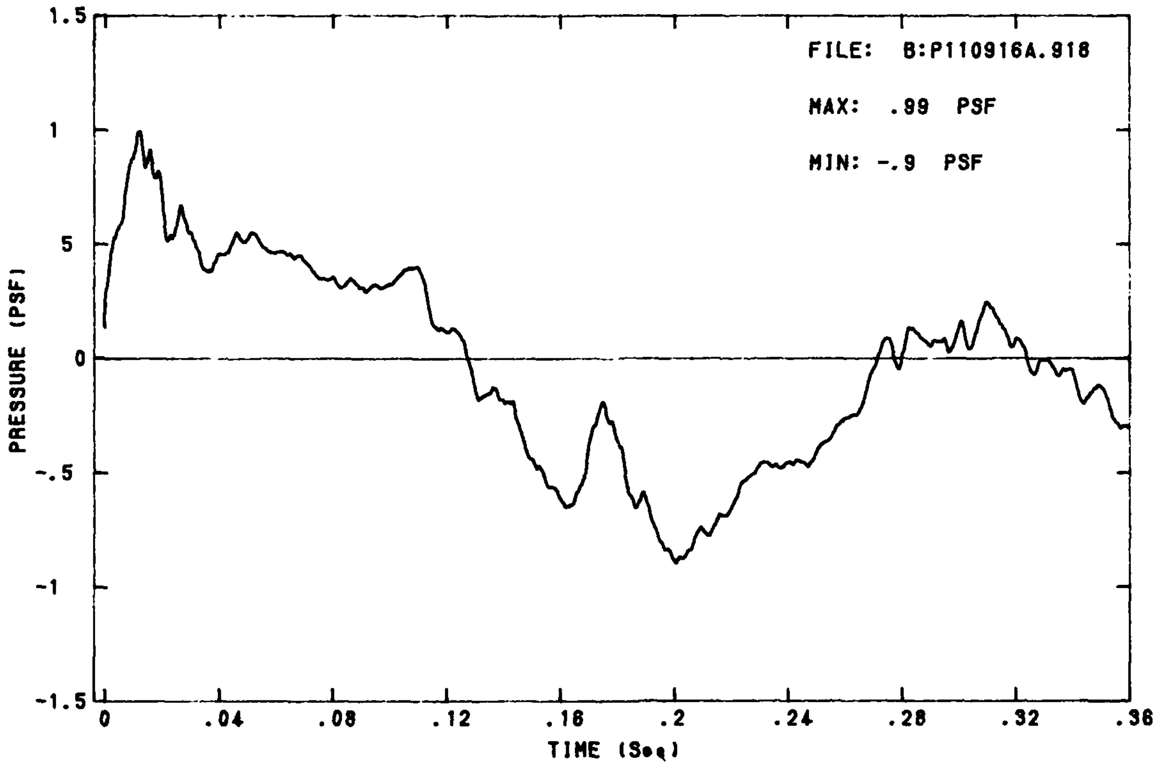
BOOM SIGNATURES from F-4 Flying at 1.28 MACH, 32,900 ft AGL, and 0 ft. track offset occuring at 16:16 GMT, 18 Sep 86.



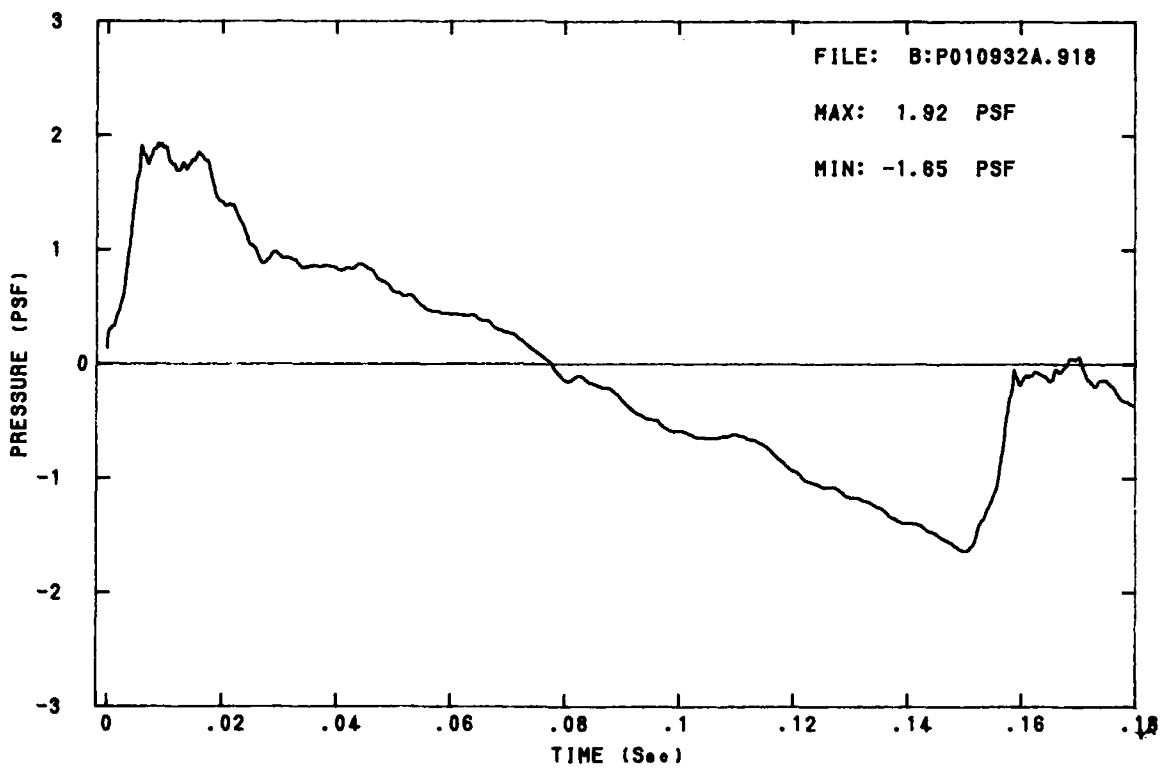

FILE: B:P030916A.918
MAX: 1.04 PSF
MIN: -.95 PSF
PRESSURE (PSF)
TIME (Sec)
1.5
1
.5
0
-.5
-1
-1.5
0
.04
.08
.12
.16
.2
.24
.28
.32
.36

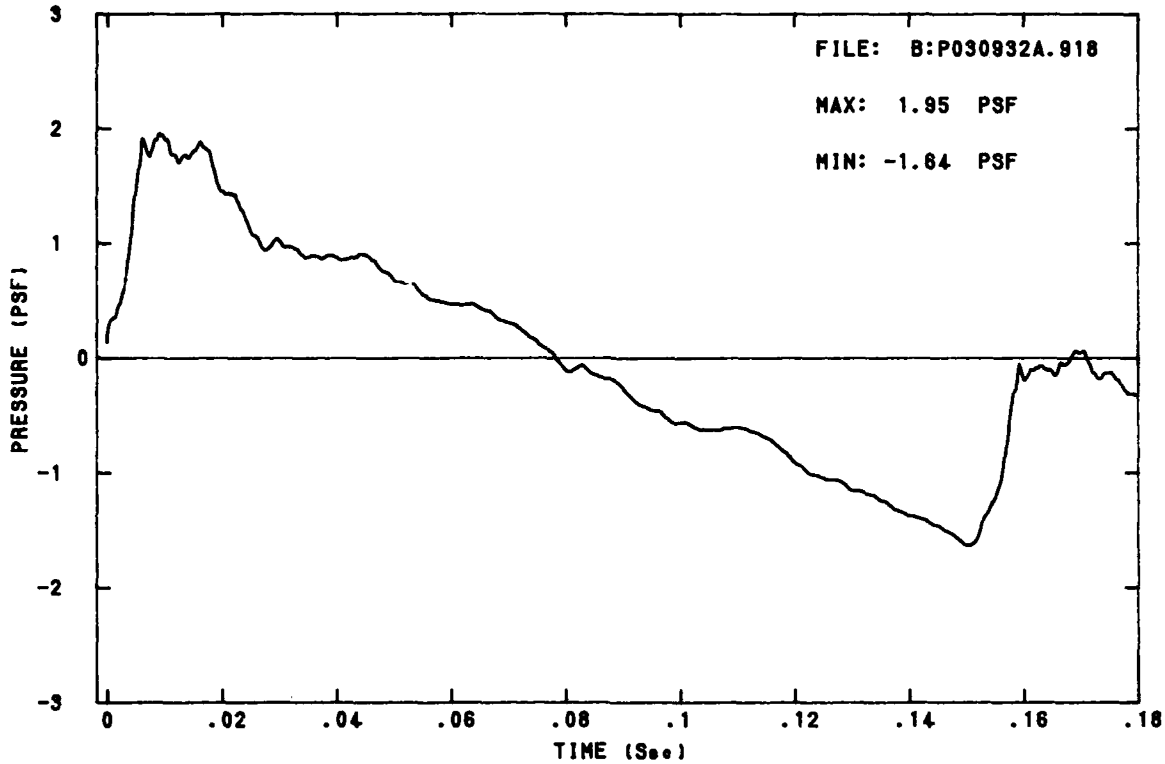

FILE: B:P090916A.918
MAX: 1.06 PSF
MIN: -.94 PSF
PRESSURE (PSF)
TIME (Sec)
1.5
1
.5
0
-.5
-1
-1.5
0
.04
.08
.12
.16
.2
.24
.28
.32
.36

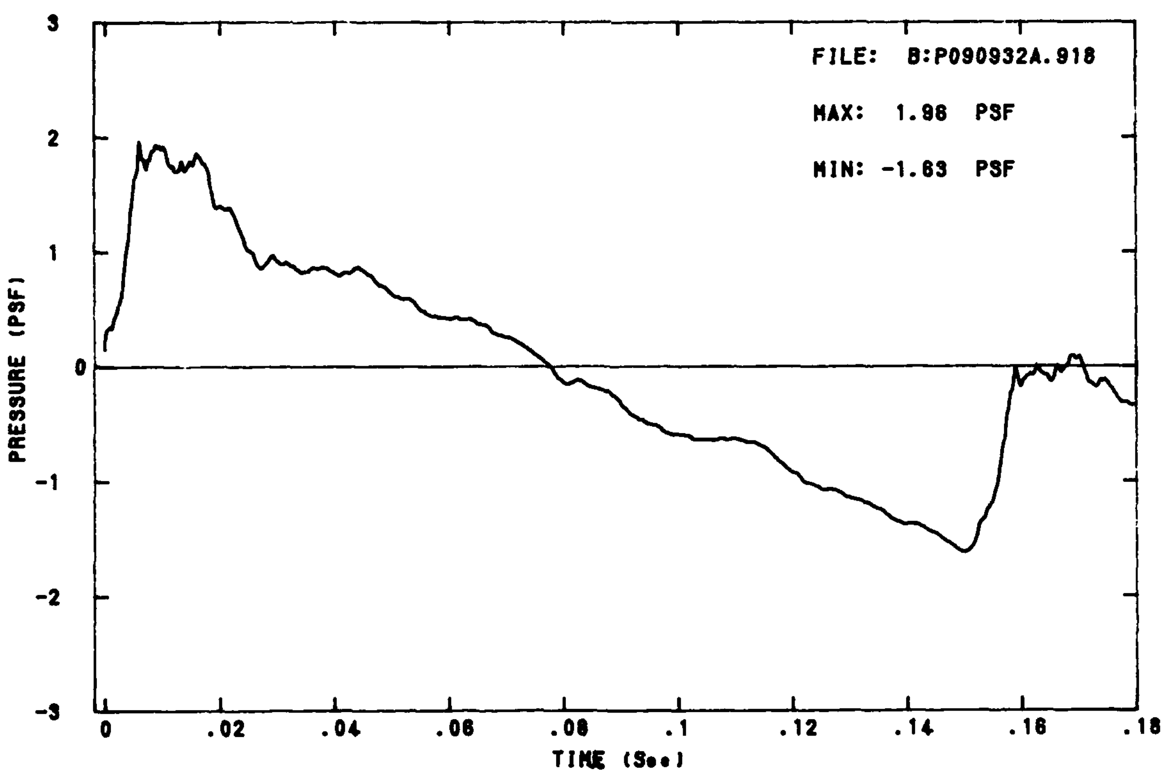

FILE: B:P100916A.918
MAX: 1.04 PSF
MIN: -.92 PSF
PRESSURE (PSF)
TIME (Sec)
1.5
1
.5
0
-.5
-1
-1.5
0
.04
.08
.12
.16
.2
.24
.28
.32
.36

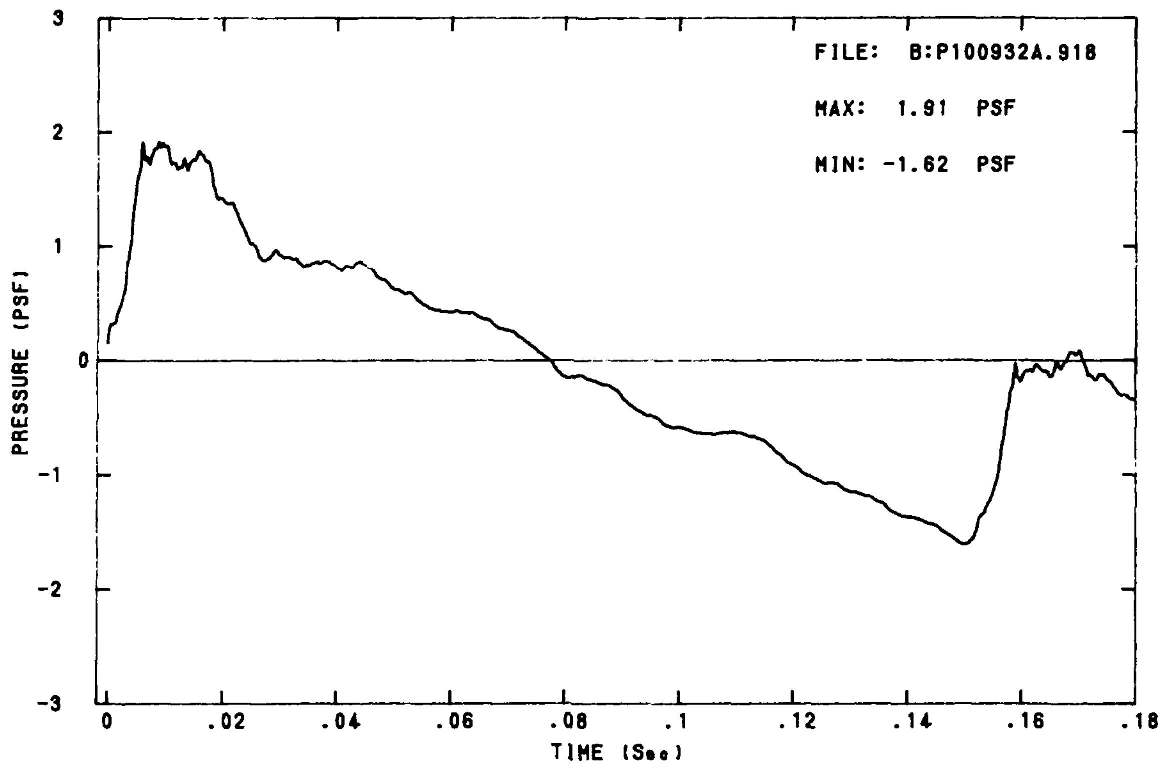

FILE: B:P110916A.918
MAX: .99 PSF
MIN: -.9 PSF
PRESSURE (PSF)
TIME (Seq)
1.5
1
5
0
-.5
-1
-1.5
0
.04
.08
.12
.16
.2
.24
.28
.32
.36

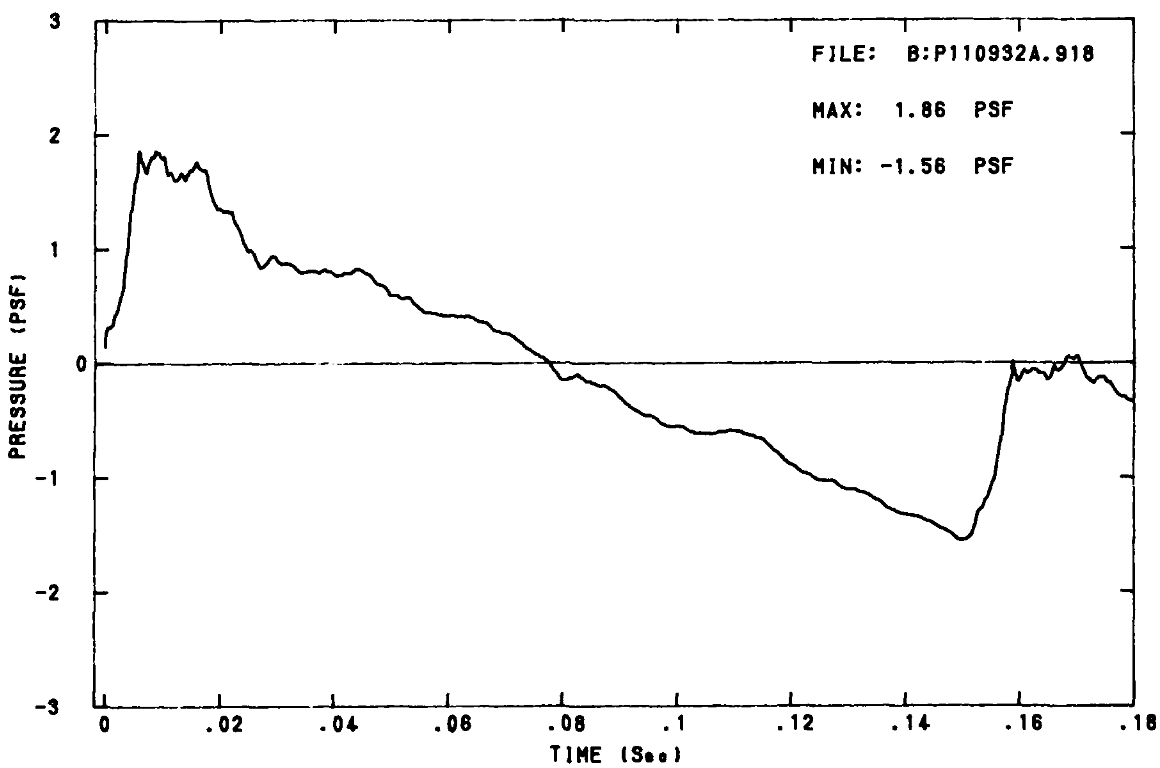
BOOM SIGNATURES from F-4 Flying at 1.35 MACH, 34,100 ft AGL, and 0 ft. track offset occuring at 16:32 GMT, 18 Sep 86.




FILE: B:P030932A.918
MAX: 1.95 PSF
MIN: -1.64 PSF
PRESSURE (PSF)
TIME (Sec)
3
2
1
0
-1
-2
-3
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

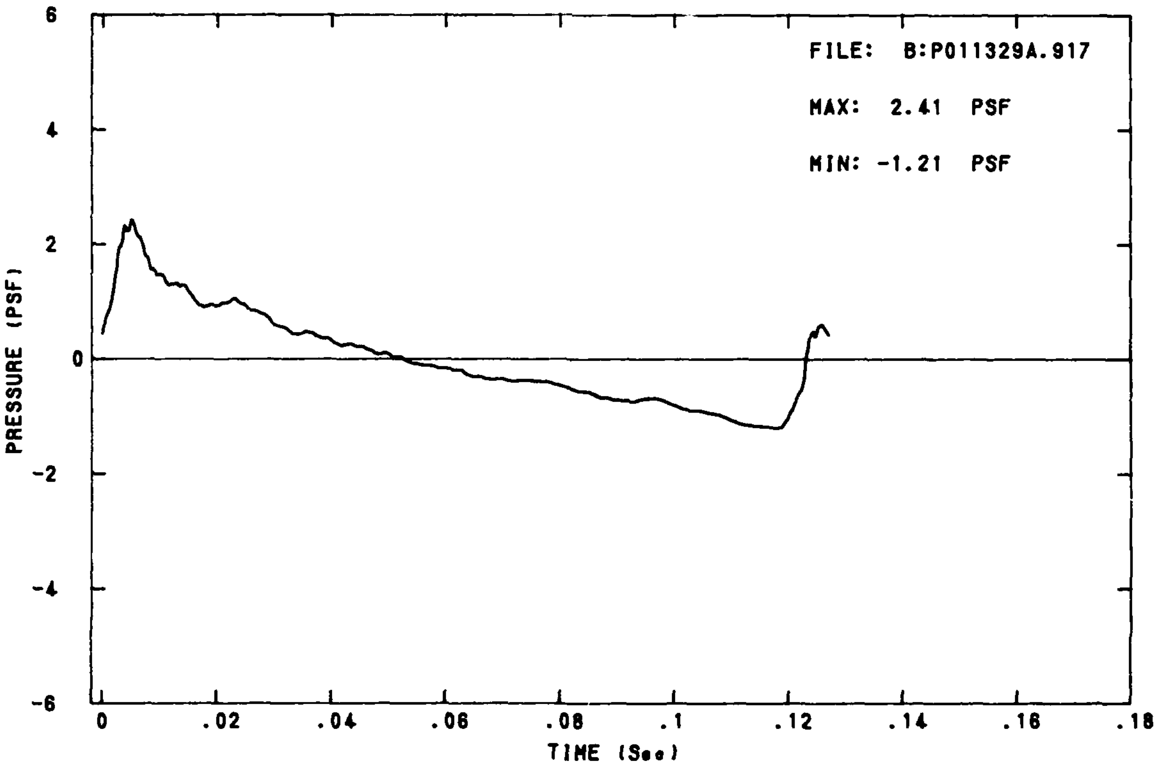

FILE: B:P090932A.918
MAX: 1.96 PSF
MIN: -1.63 PSF
PRESSURE (PSF)
TIME (Sec)
3
2
1
0
-1
-2
-3
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

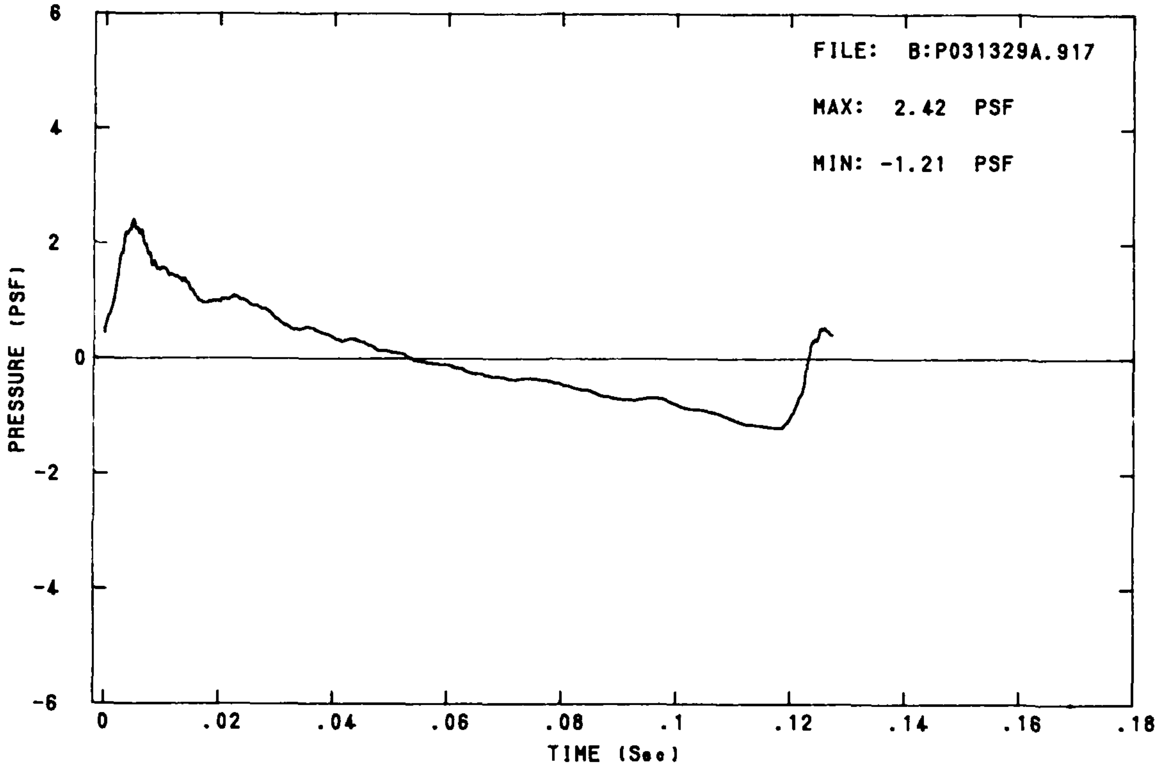

FILE: B:P100932A.918
MAX: 1.91 PSF
MIN: -1.62 PSF
PRESSURE (PSF)
TIME (Sec)
3
2
1
0
-1
-2
-3
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

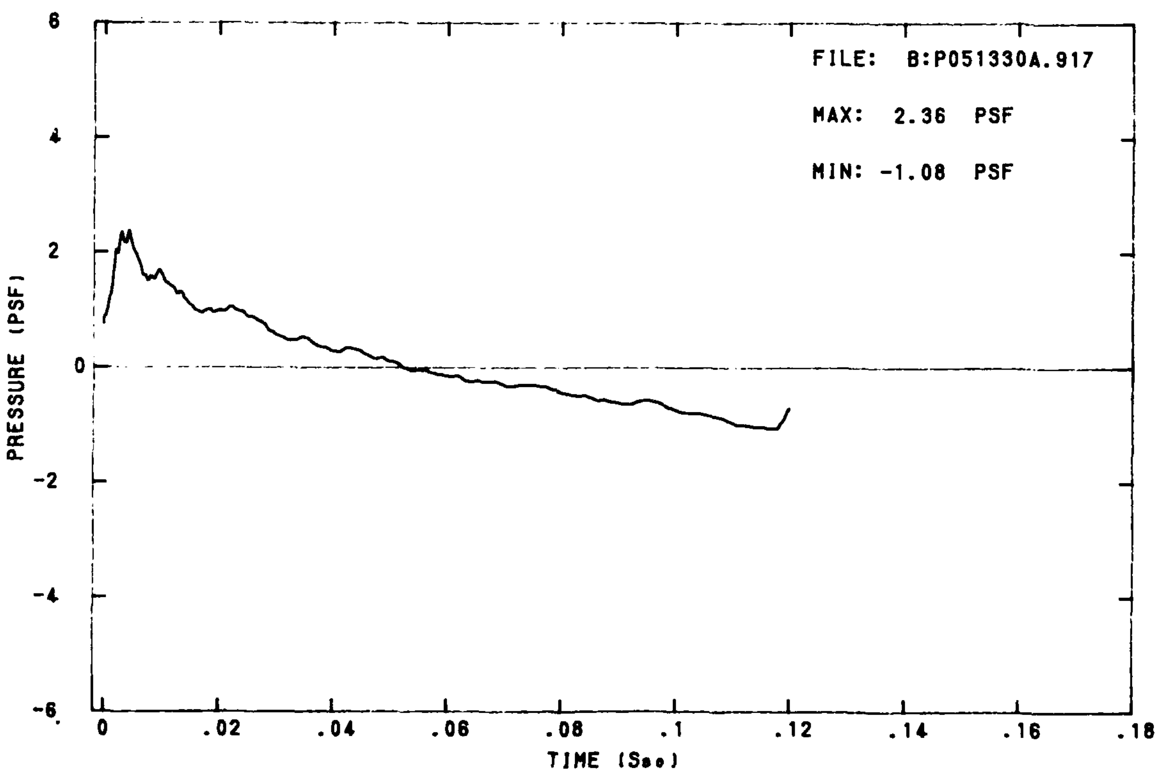

FILE: B:P110932A.918
MAX: 1.86 PSF
MIN: -1.56 PSF
PRESSURE (PSF)
TIME (Sec)
3
2
1
0
-1
-2
-3
0
.02
.04
.06
.08
.1
.12
.14
.16
.18

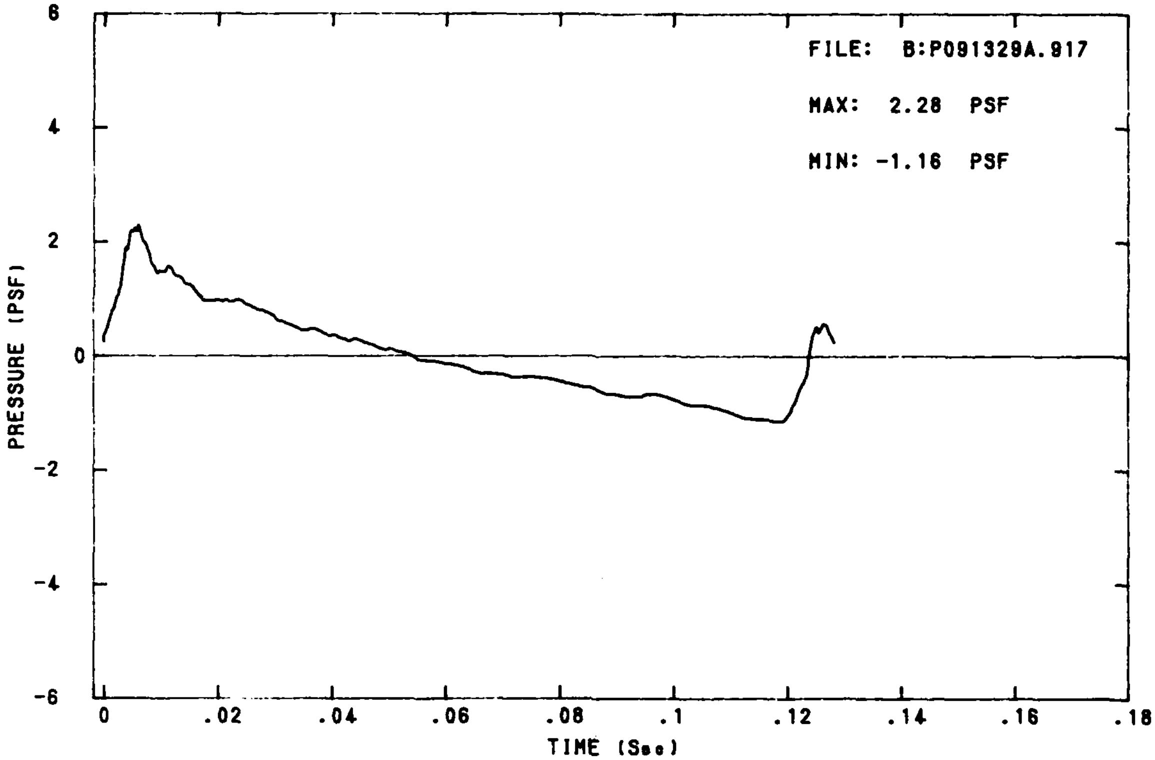
BOOM SIGNATURES from Unidentified Aircraft

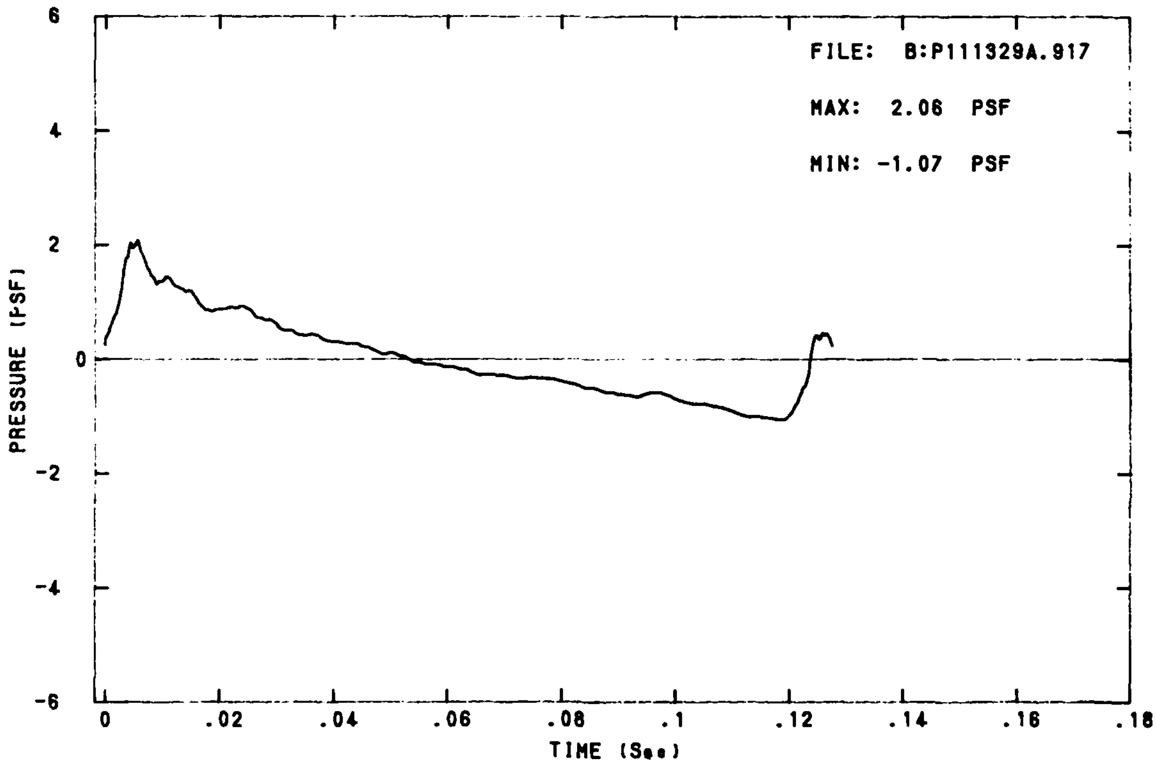
Occuring at 20:29 GMT, 17 Sep 86.




FILE: B:P031329A.917
MAX: 2.42 PSF
MIN: -1.21 PSF
PRESSURE (PSF)
TIME (Sec)


FILE: B:P051330A.917
MAX: 2.36 PSF
MIN: -1.08 PSF
PRESSURE (PSF)
TIME (Sec)

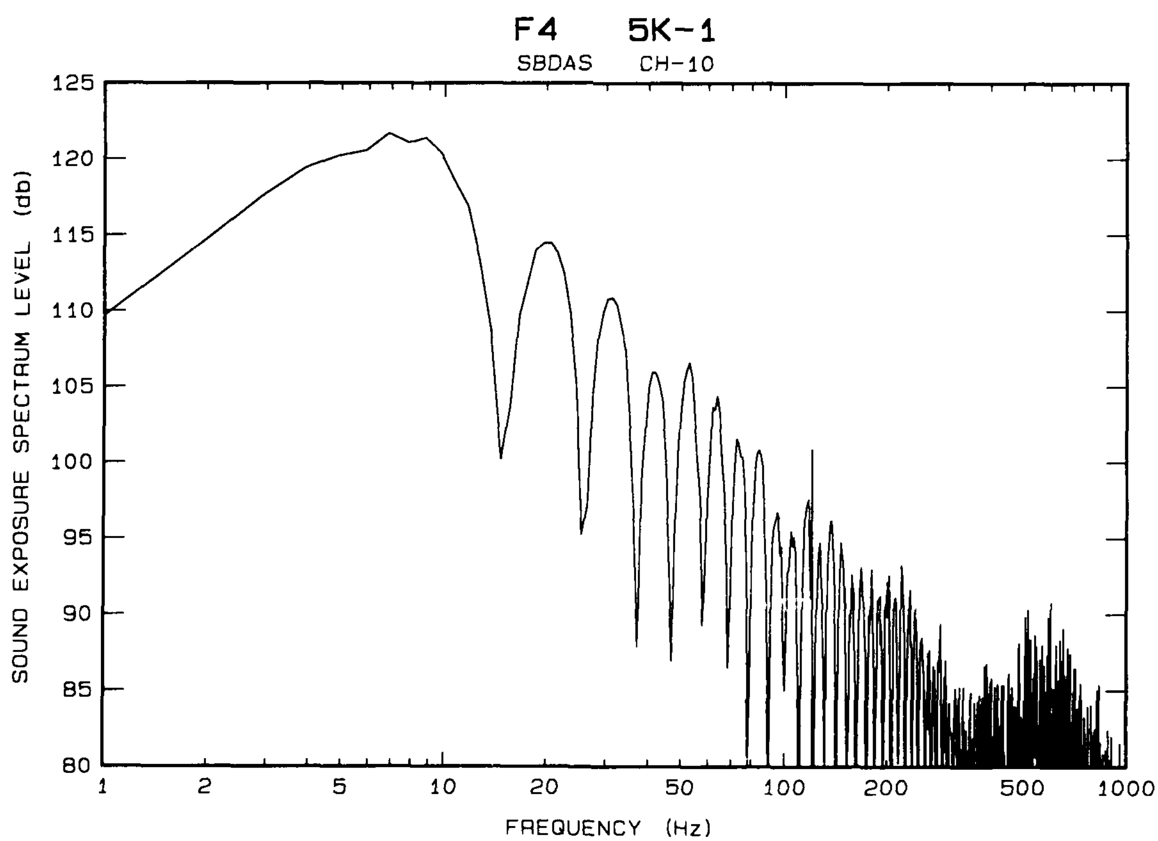

FILE: B:P091329A.917
MAX: 2.28 PSF
MIN: -1.16 PSF
PRESSURE (PSF)
TIME (Sec)

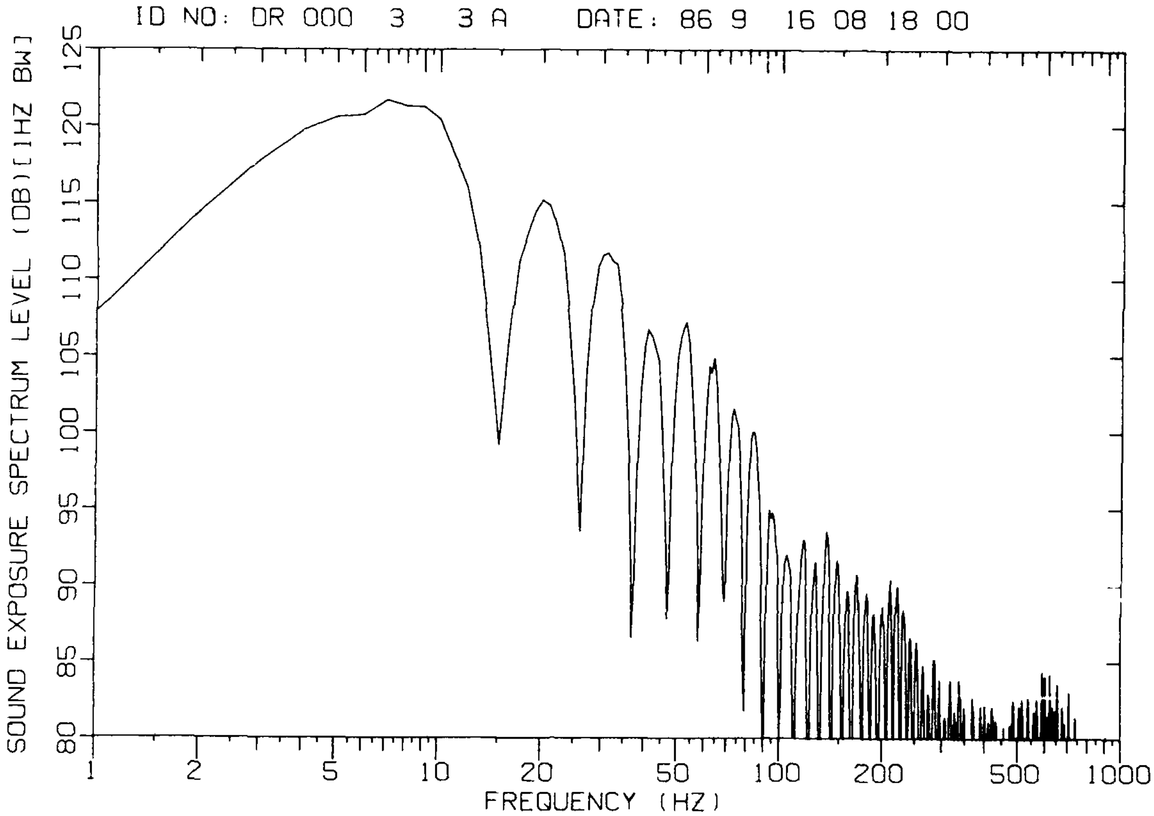

FILE: B:P111329A.917
MAX: 2.06 PSF
MIN: -1.07 PSF
PRESSURE (PSF)
TIME (Sec)

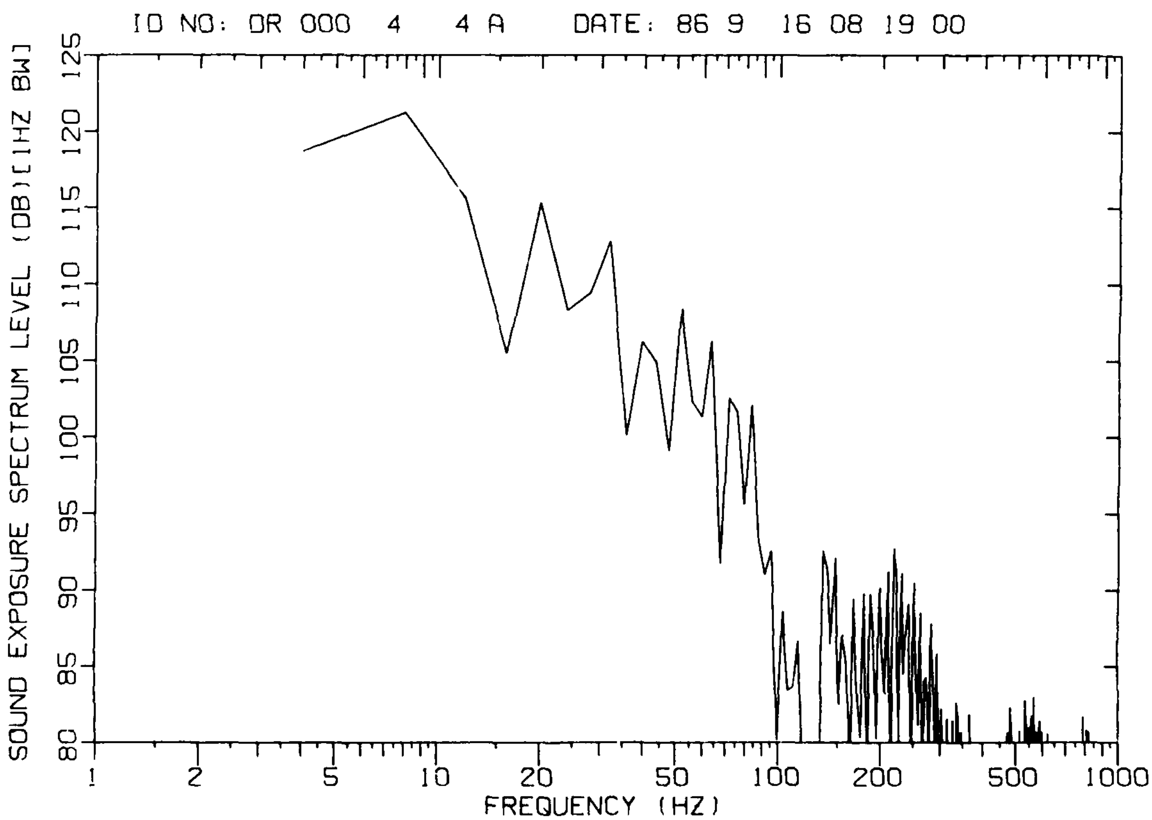
APPENDIX B

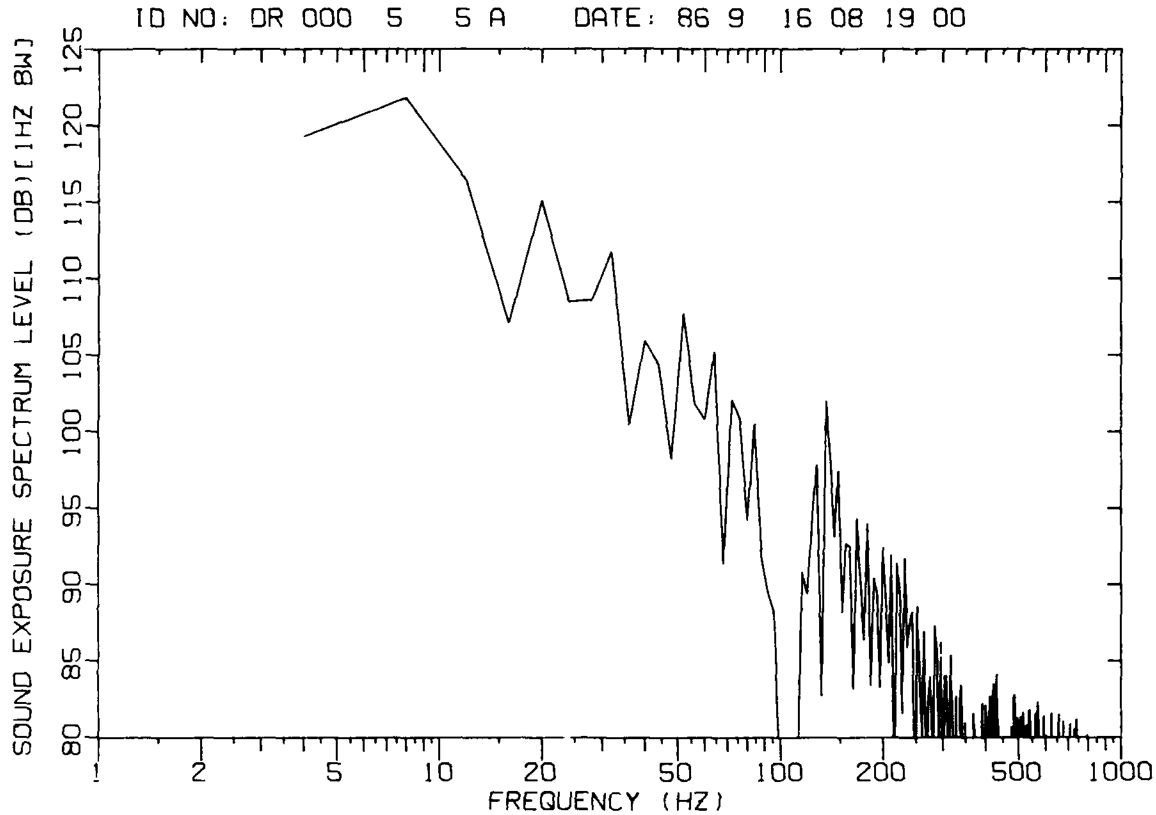
BOOM SPECTRUM LEVELS

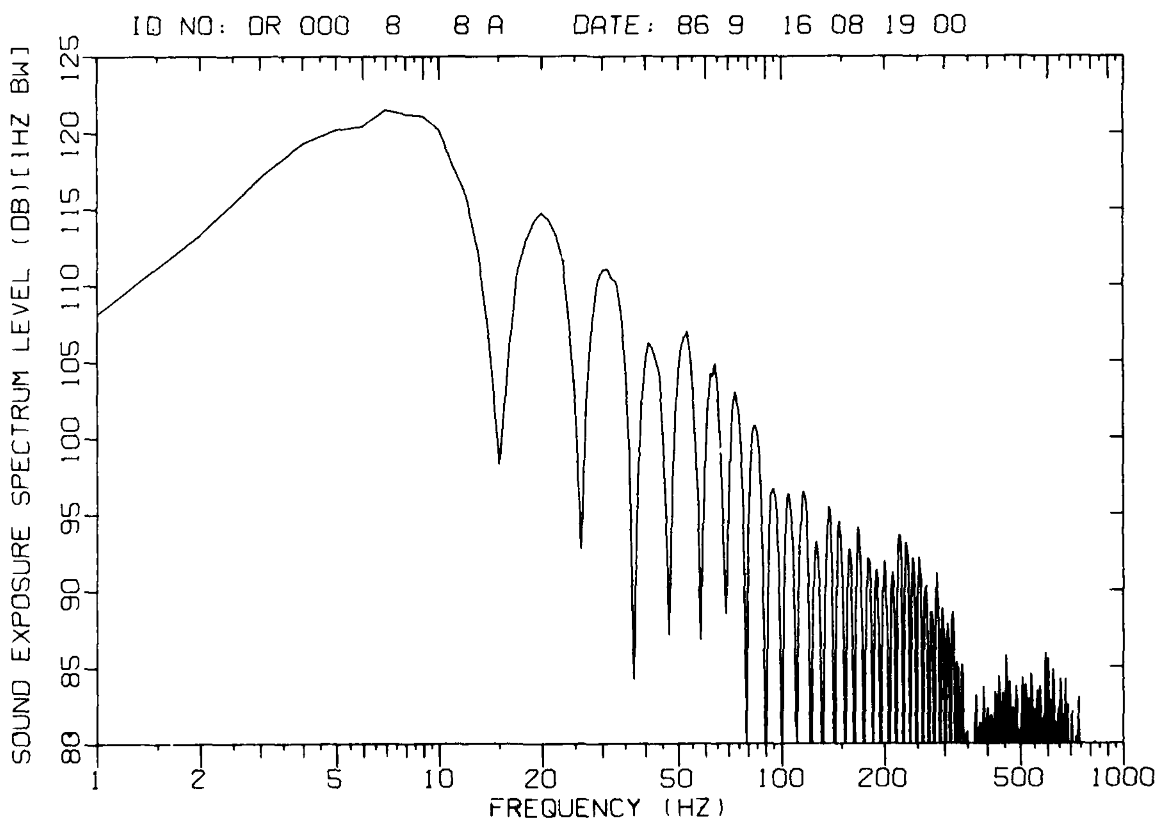
Sound Exposure Spectrum Level vs Frequency Plots of Sonic Boom from F-4 flying at 1.15 MACH, 6,000 ft. AGL, and 0 ft. track offset occuring at 15:20:08 GMT, 16 Sep 86.

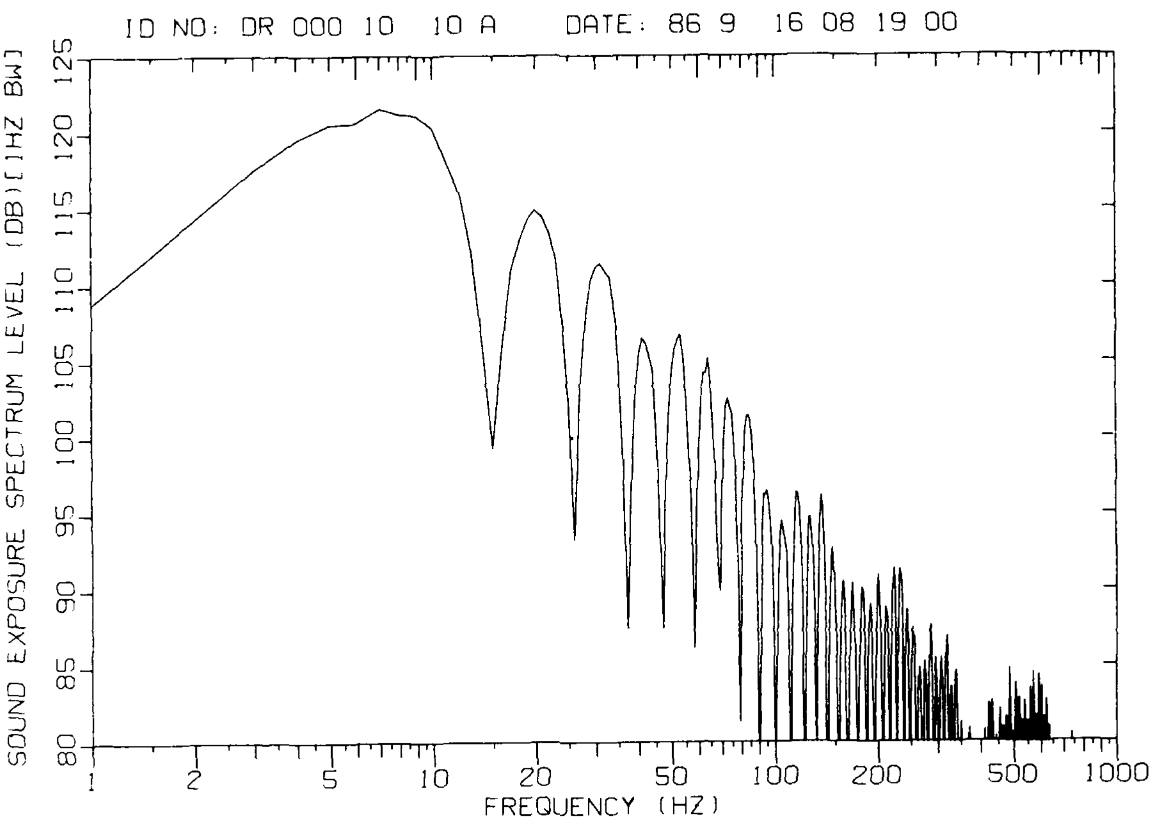



ID NO: DR 000 3 3 A DATE: 86 9 16 08 18 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
125
120
115
110
105
100
95
90
85
80
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

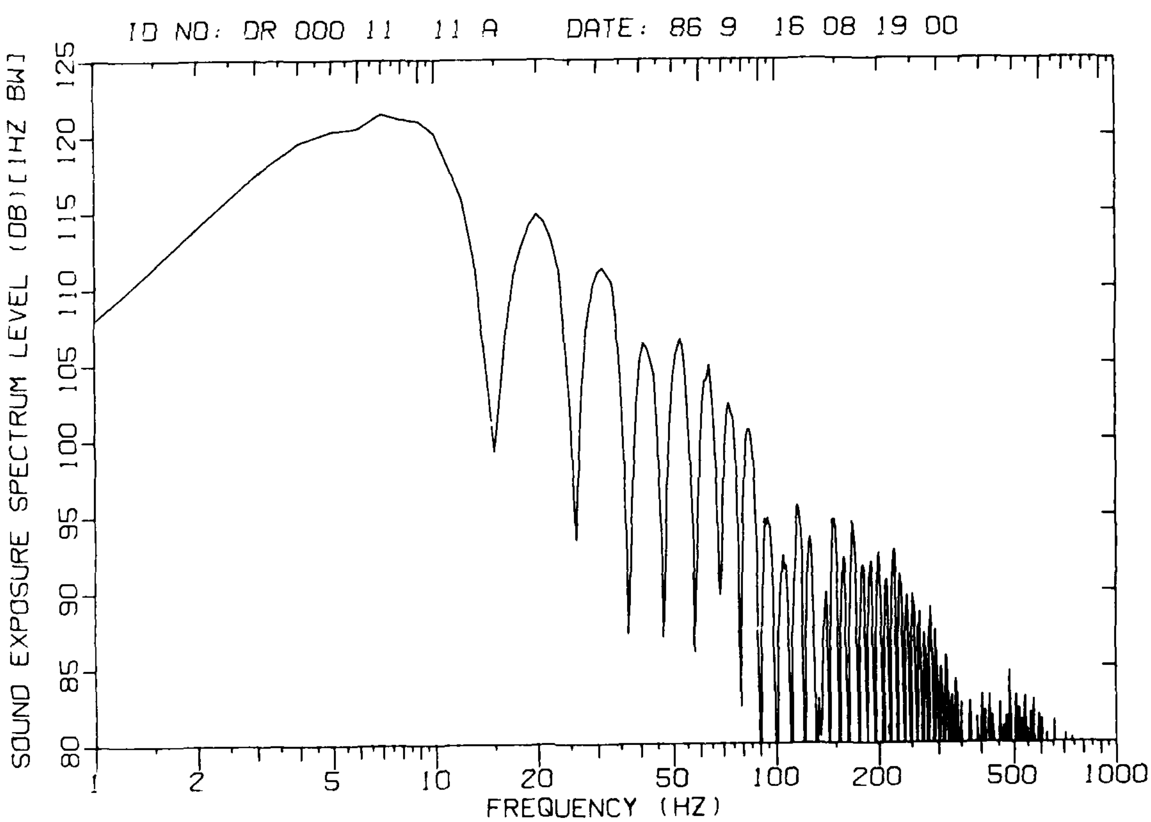

ID NO: DR 000 4 4 A DATE: 86 9 16 08 19 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
125
120
115
110
105
100
95
90
85
80
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)


ID NO: DR 000 5 5 A DATE: 86 9 16 08 19 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
125
120
115
110
105
100
95
90
85
80
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

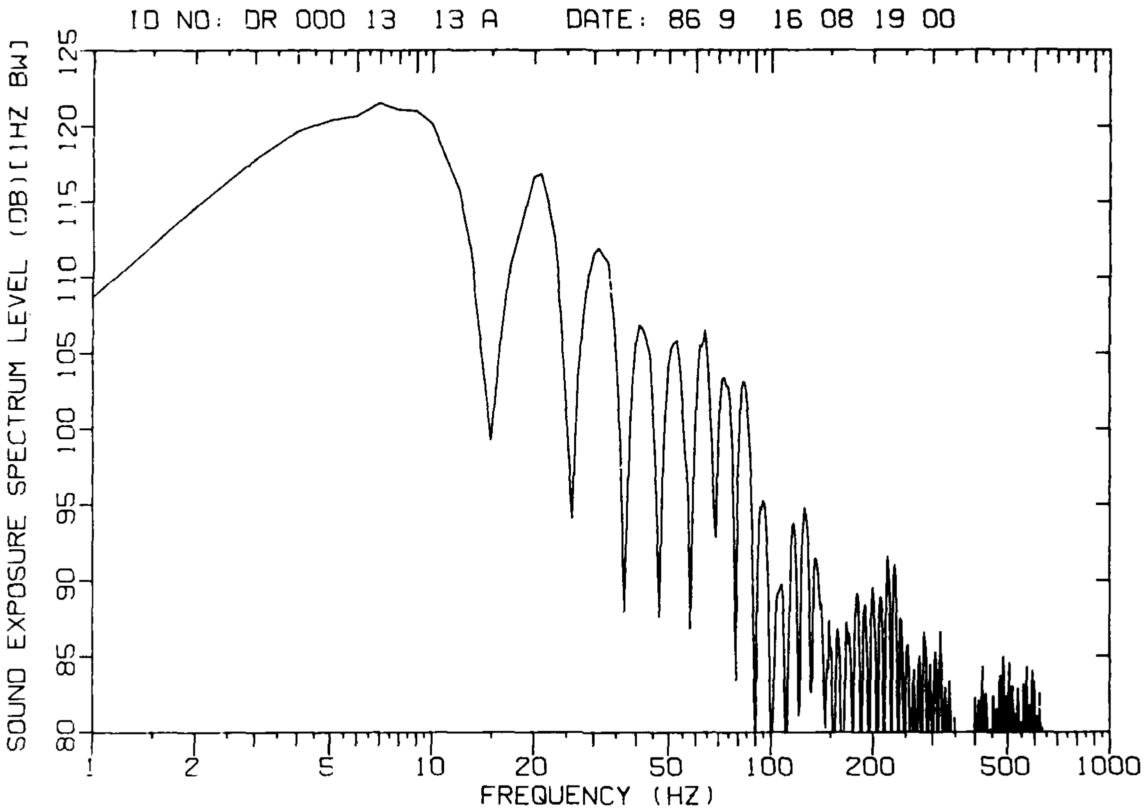

ID NO: DR 000 8 8 A DATE: 86 9 16 08 19 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
125
120
115
110
105
100
95
90
85
80
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)



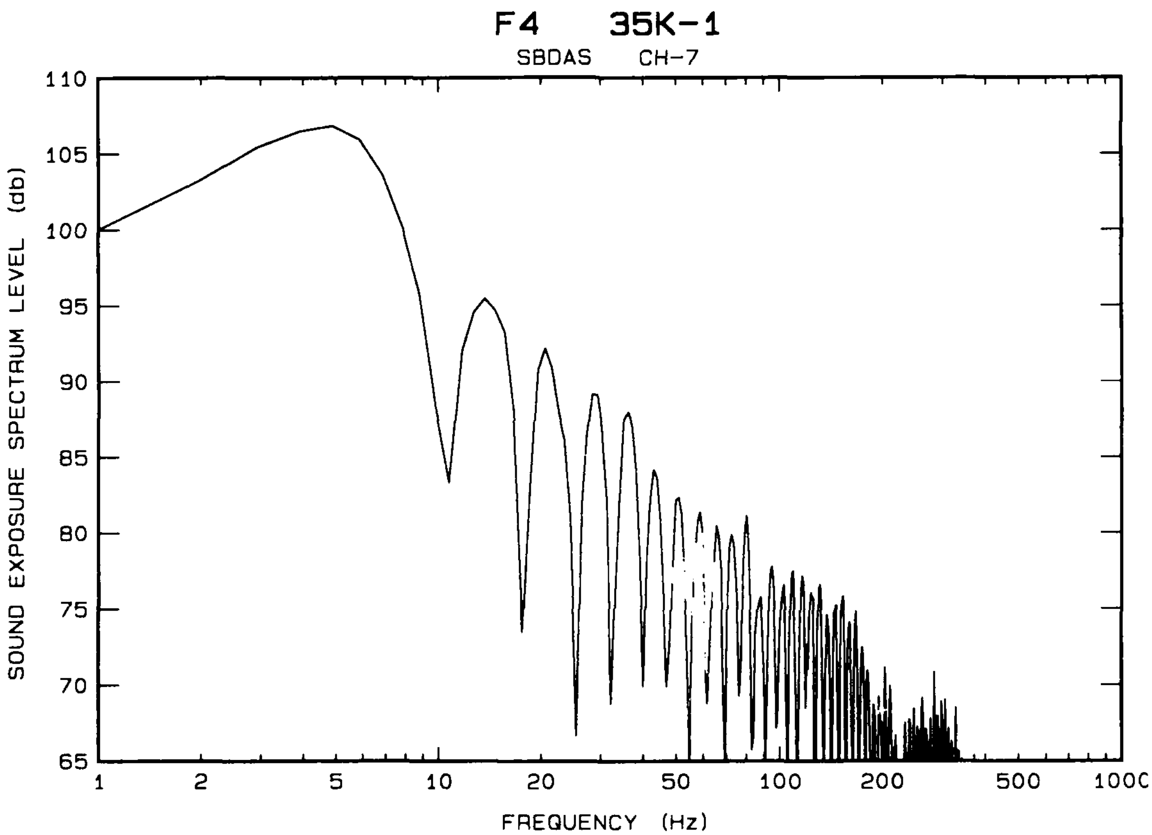
ID NO: DR 000 10 10 A DATE: 86 9 16 08 19 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
80
85
90
95
100
105
110
115
120
125
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

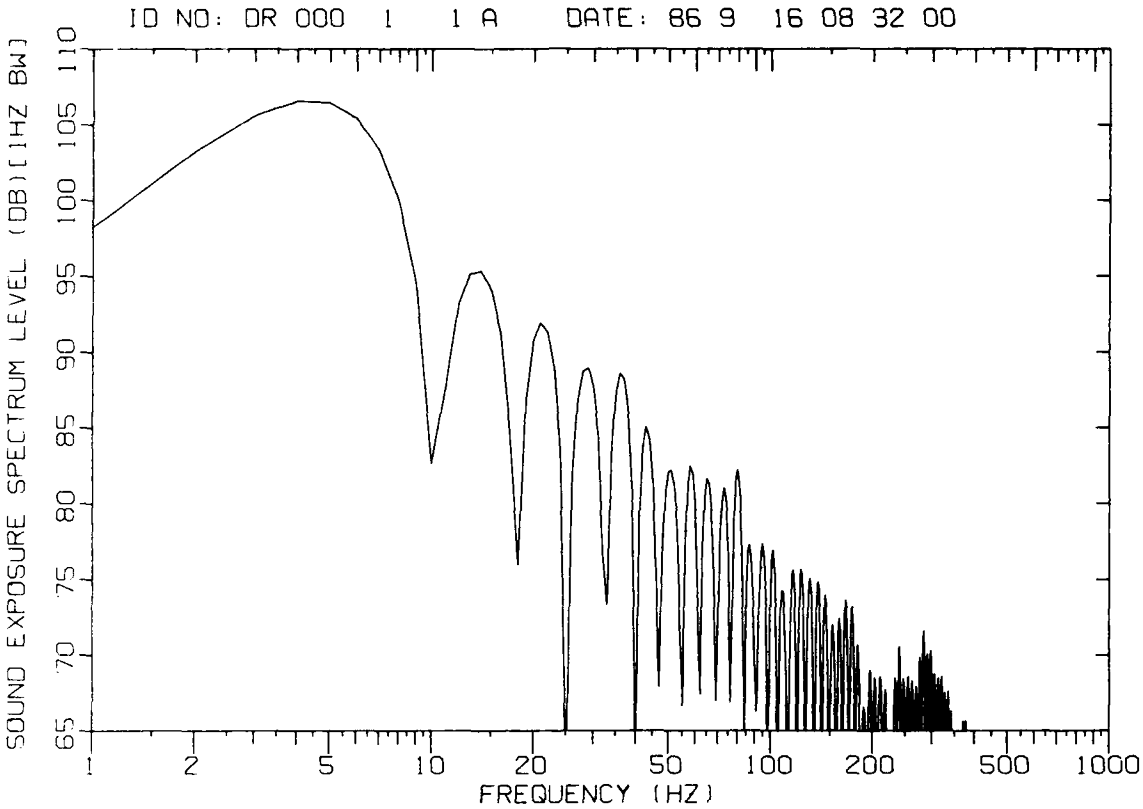


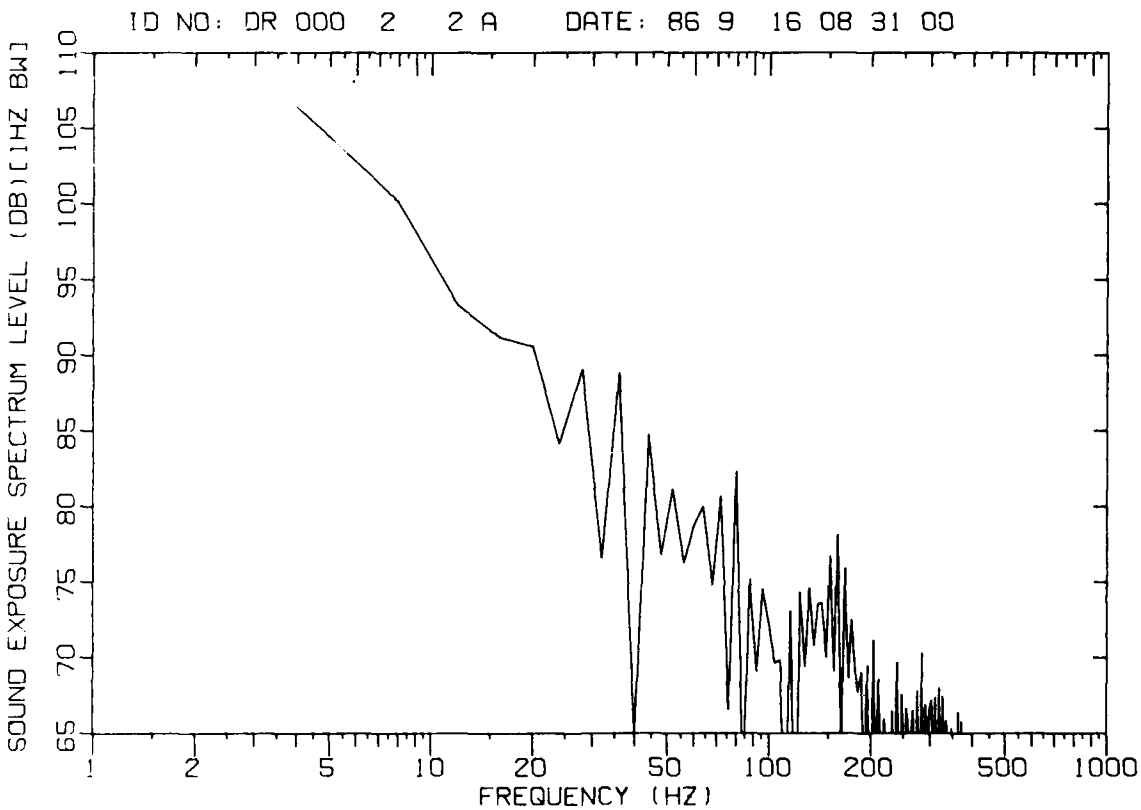
ID NO: DR 000 11 11 A DATE: 86 9 16 08 19 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
80
85
90
95
100
105
110
115
120
125
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

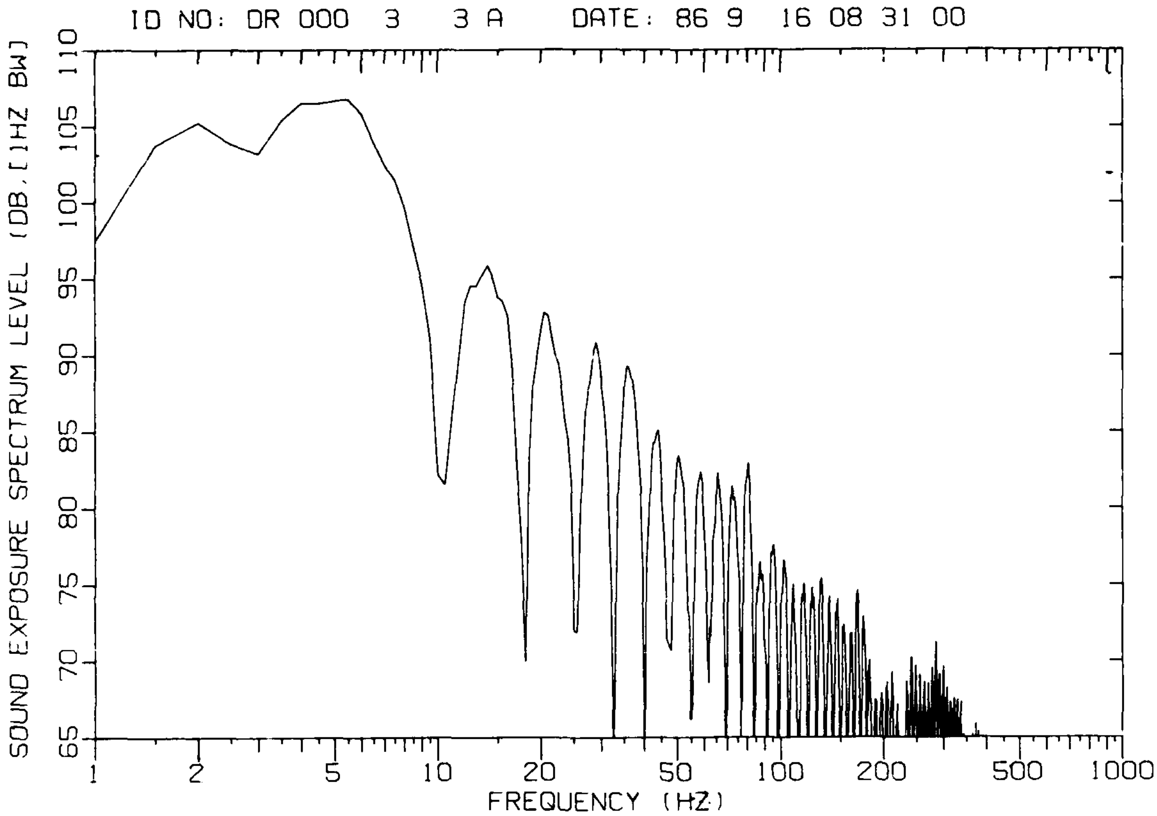

ID NO: DR 000 13 13 A DATE: 86 9 16 08 19 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
125
120
115
110
105
100
95
90
85
80
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

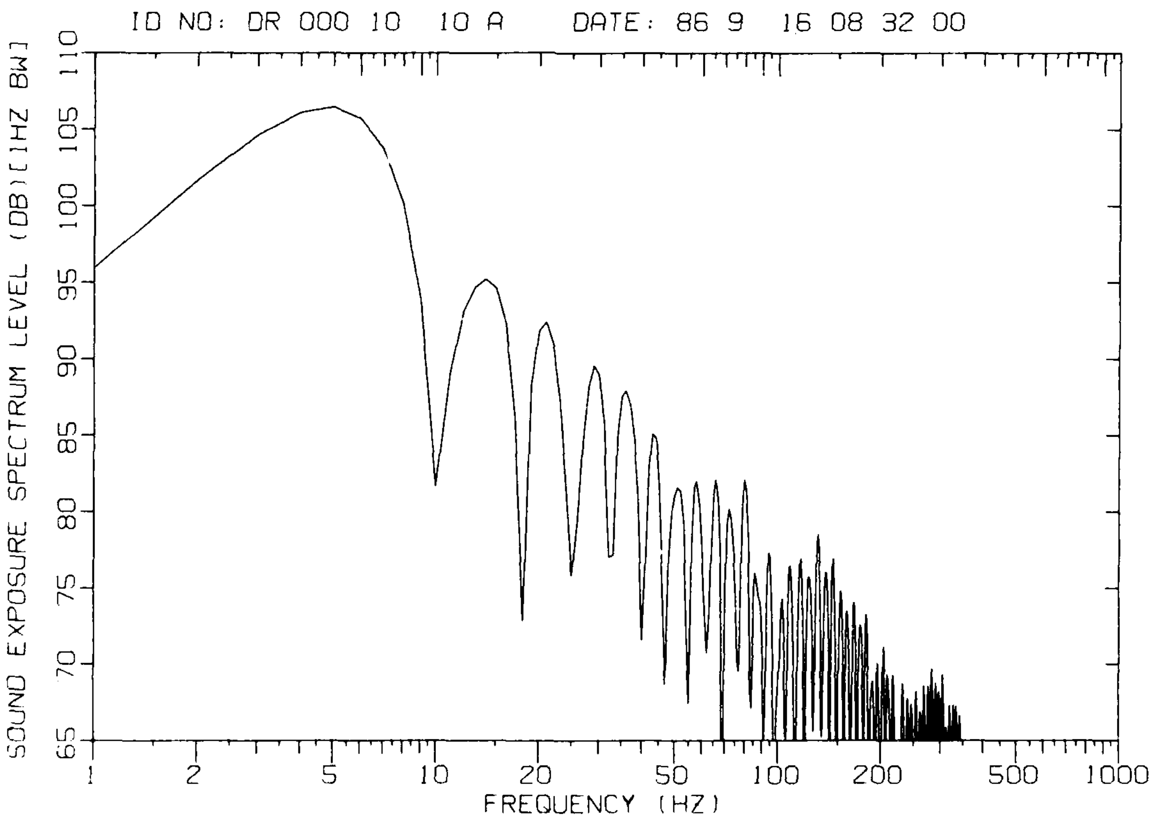
Sound Exposure Spectrum Level vs Frequency Plots of Sonic Boom from F-4 flying at 1.45 MACH, 35,000 ft. AGL, and 60,600 ft. track offset occuring at 15:33:04 GMT, 16 Sep 86.

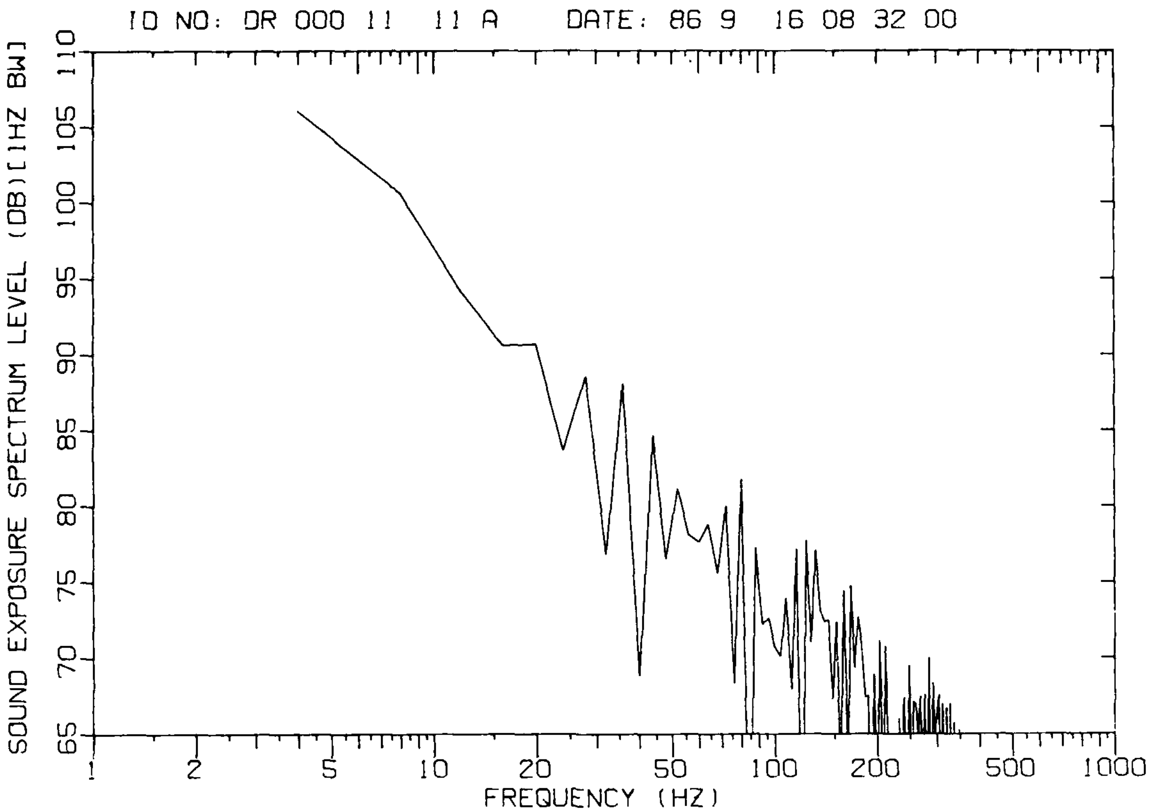



ID NO: DR 000 1 1 A DATE: 86 9 16 08 32 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
110
105
100
95
90
85
80
75
70
65
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

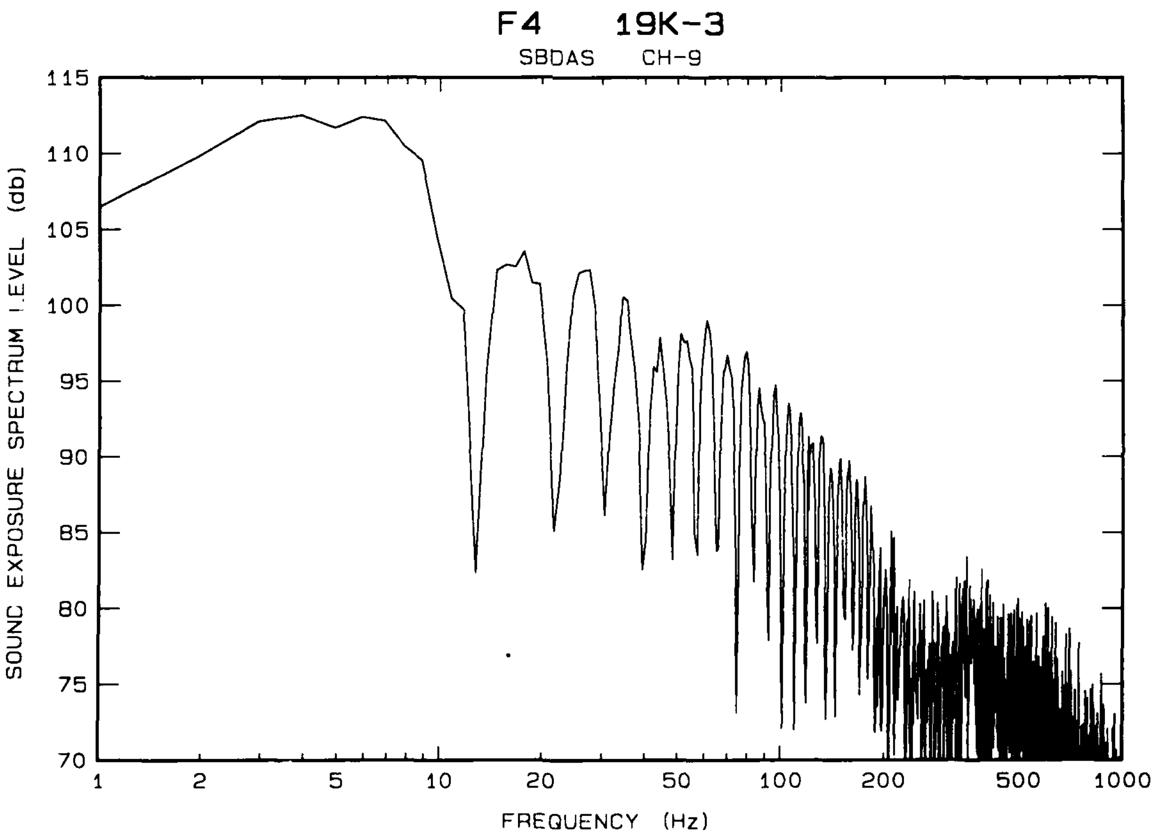

ID NO: DR 000 2 2 A DATE: 86 9 16 08 31 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
110
105
100
95
90
85
80
75
70
65
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

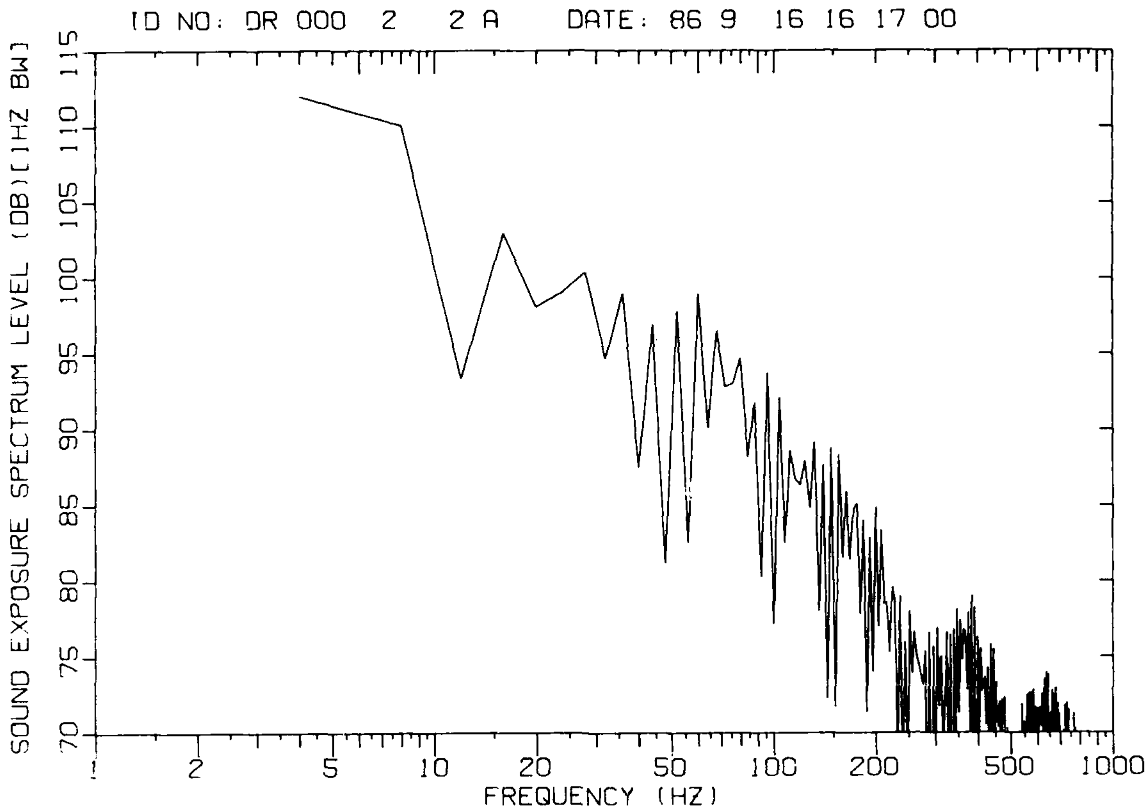

ID NO: DR 000 3 3 A DATE: 86 9 16 08 31 00
SOUND EXPOSURE SPECTRUM LEVEL (DB,[1HZ BW]
110
105
100
95
90
85
80
75
70
65
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

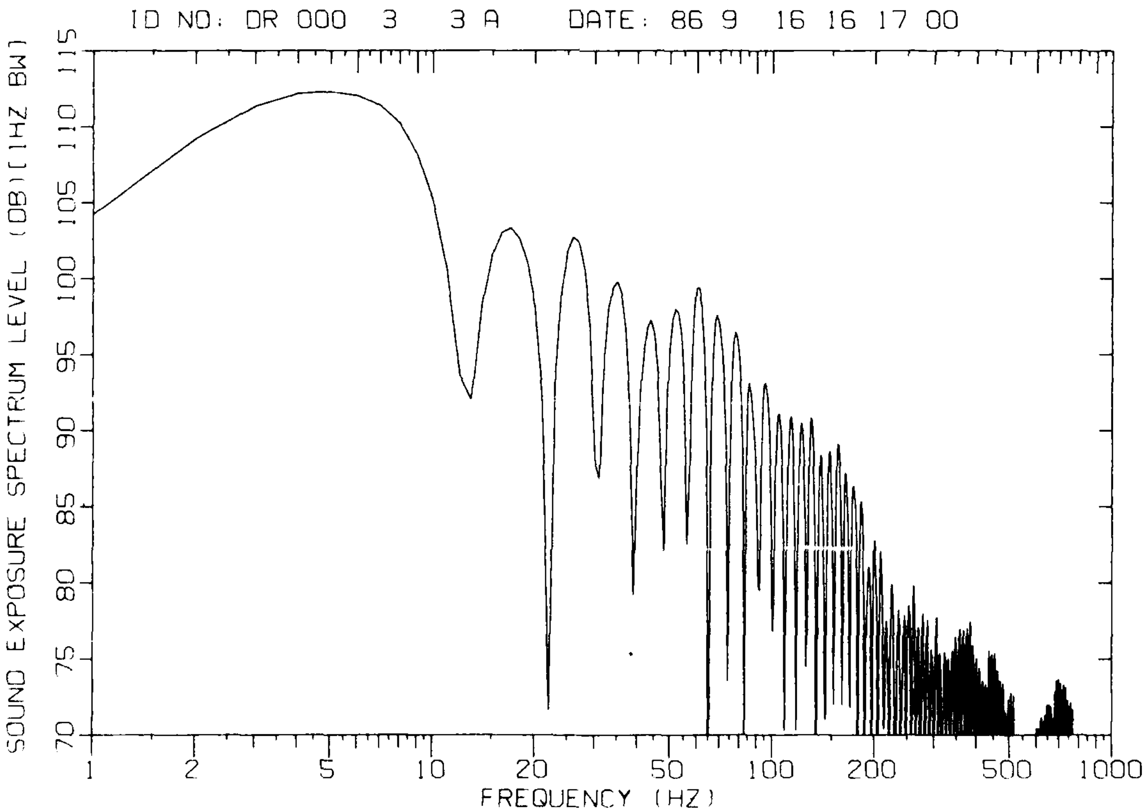

ID NO: DR 000 10 10 A DATE: 86 9 16 08 32 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
110
105
100
95
90
85
80
75
70
65
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

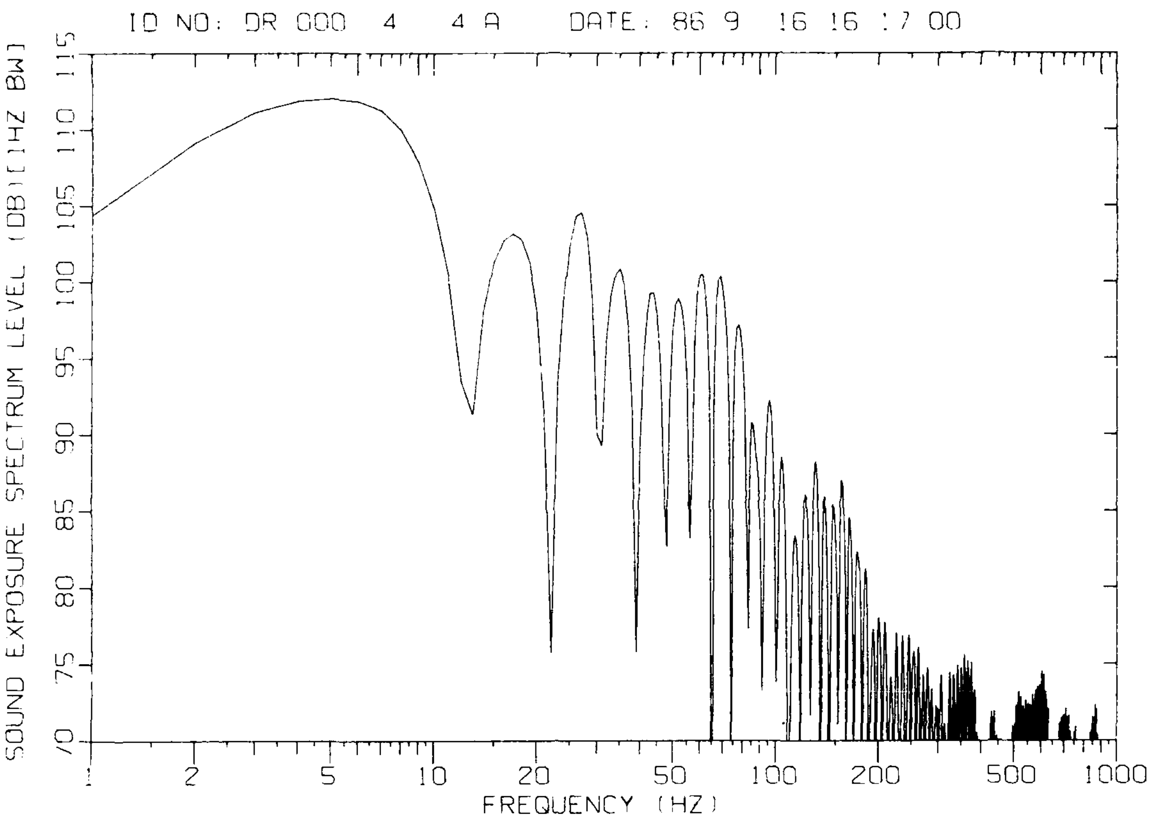

ID NO: DR 000 11 11 A DATE: 86 9 16 08 32 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
110
105
100
95
90
85
80
75
70
65
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

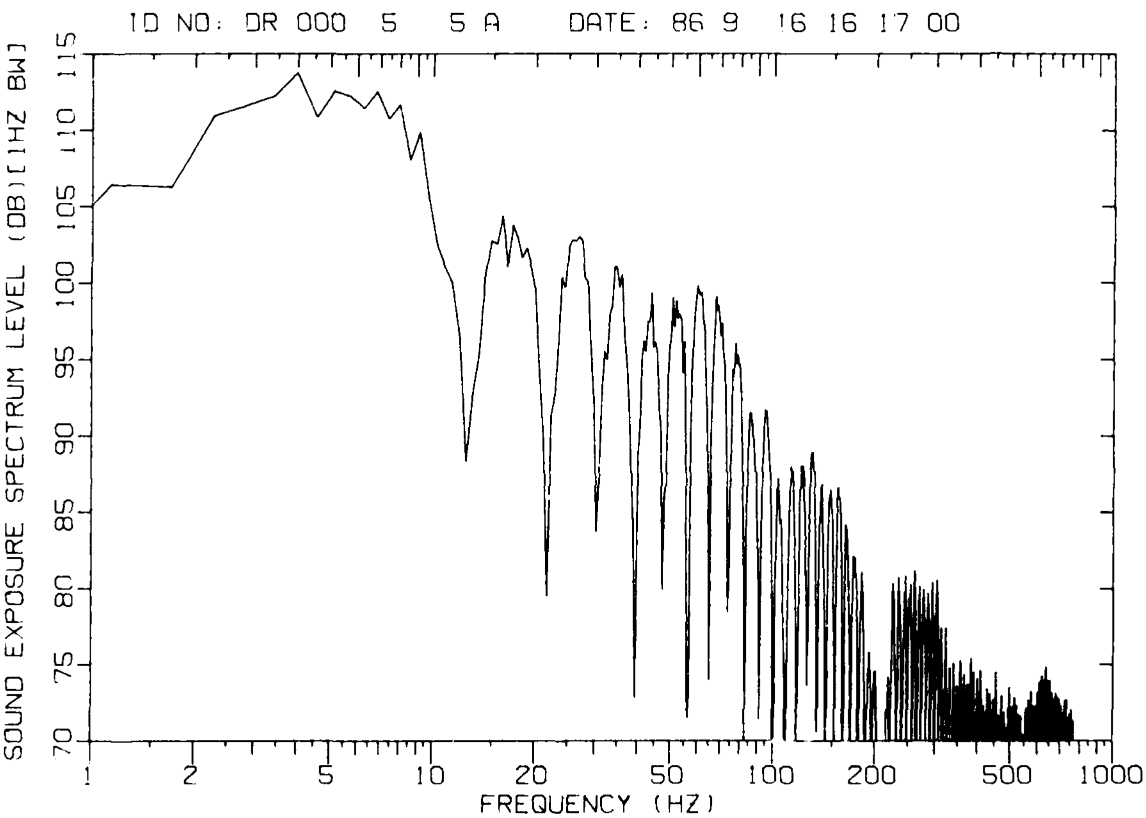
Sound Exposure Spectrum Level vs Frequency Plots of Sonic Boom from F-4 flying at 1.2 MACH, 25,700 ft. AGL, and 0 ft. track offset occuring at 23:17:47 GMT, 16 Sep 86.

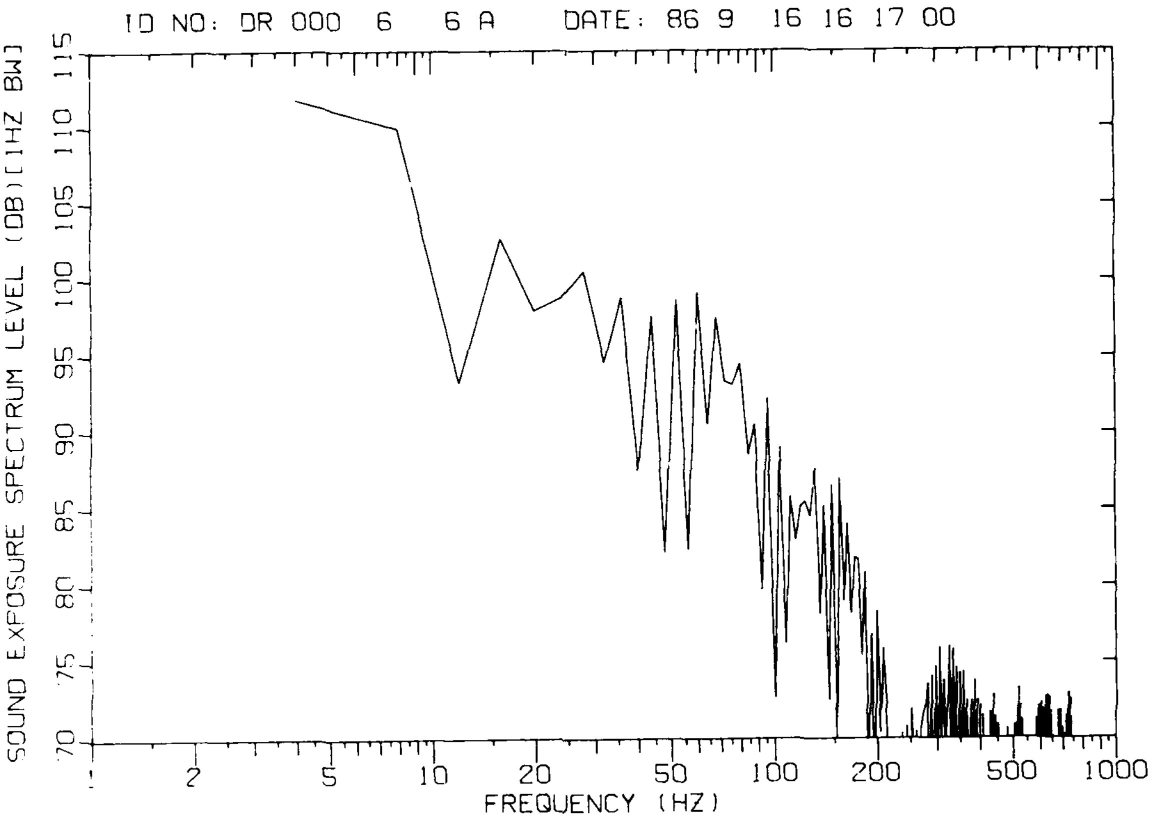


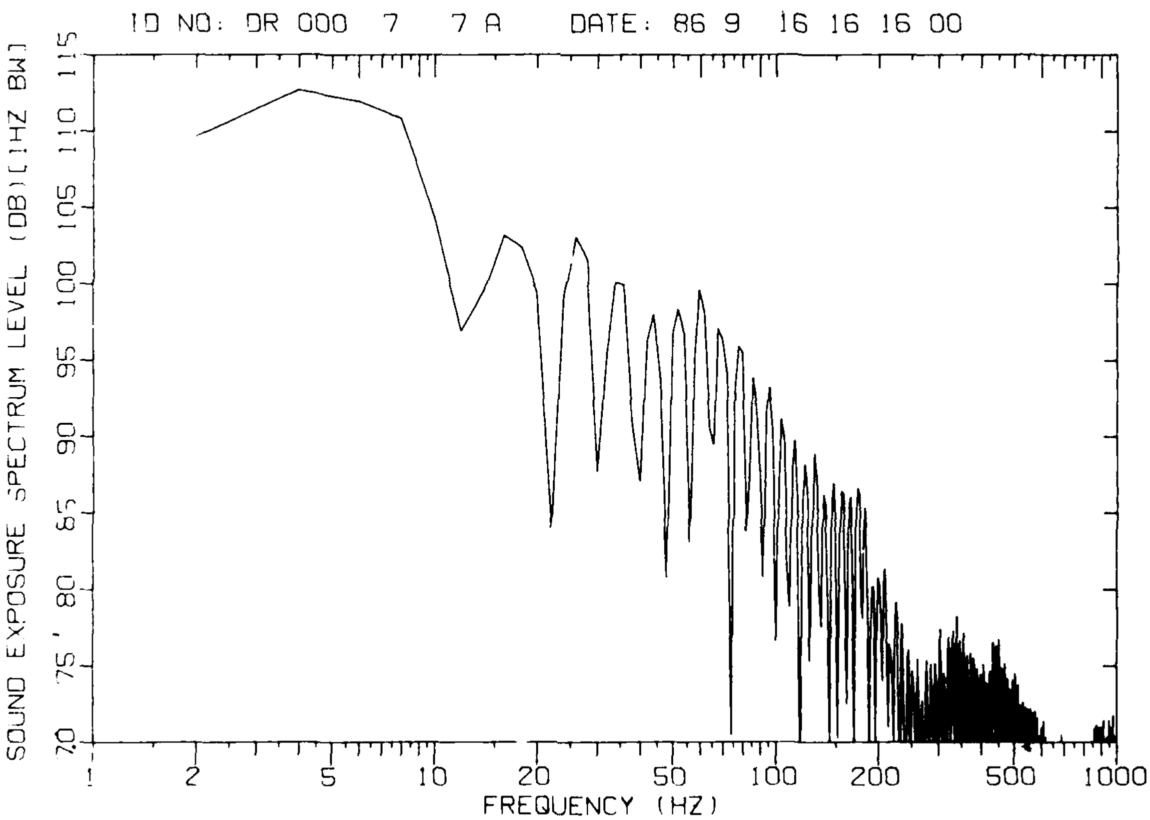

ID NO: DR 000 2 2 A DATE: 86 9 16 16 17 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)(1HZ BW)
115
110
105
100
95
90
85
80
75
70
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

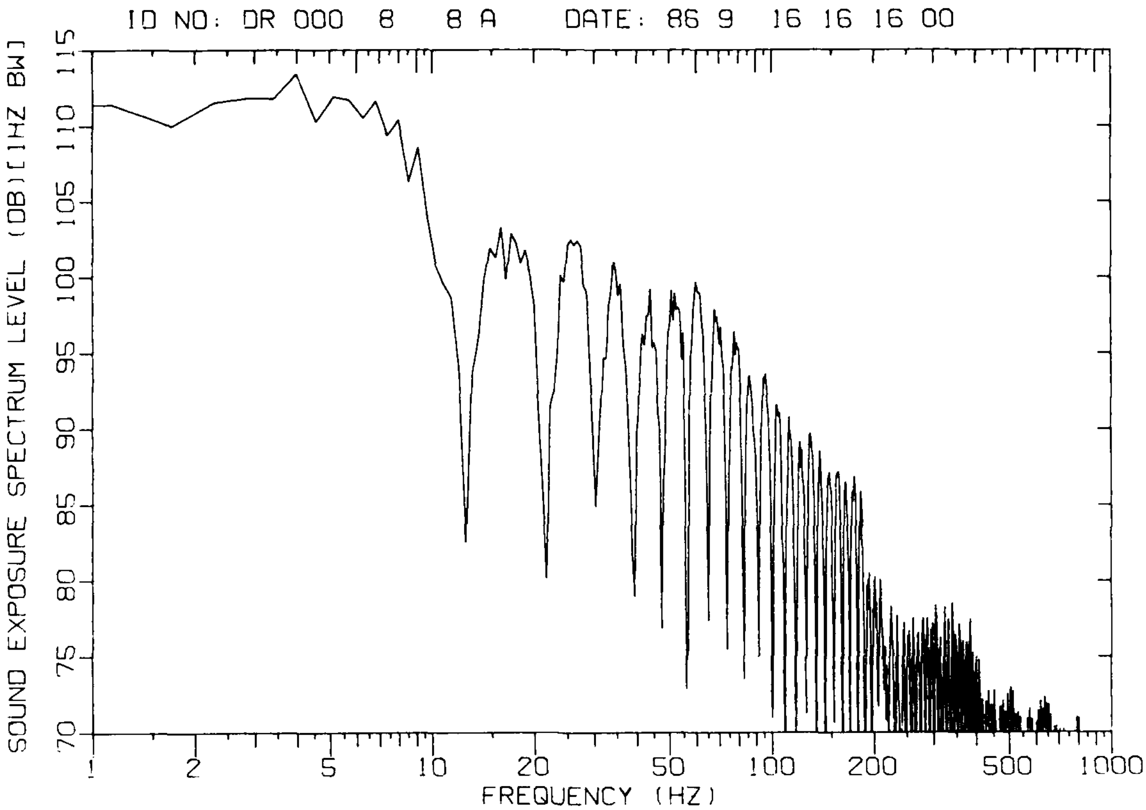

ID NO: DR 000 3 3 A DATE: 86 9 16 16 17 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)(1HZ BW)
115
110
105
100
95
90
85
80
75
70
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

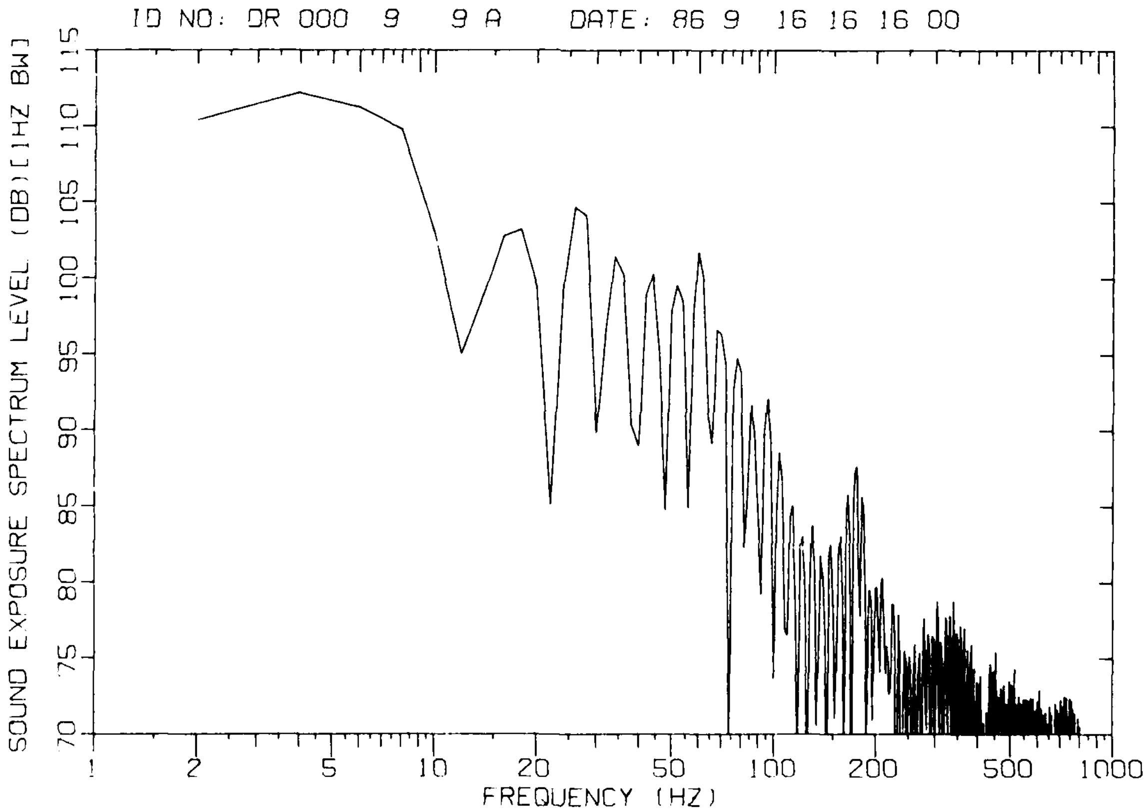

ID NO: DR 000 4 4 A DATE: 86 9 16 16 17 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
70
75
80
85
90
95
100
105
110
115
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

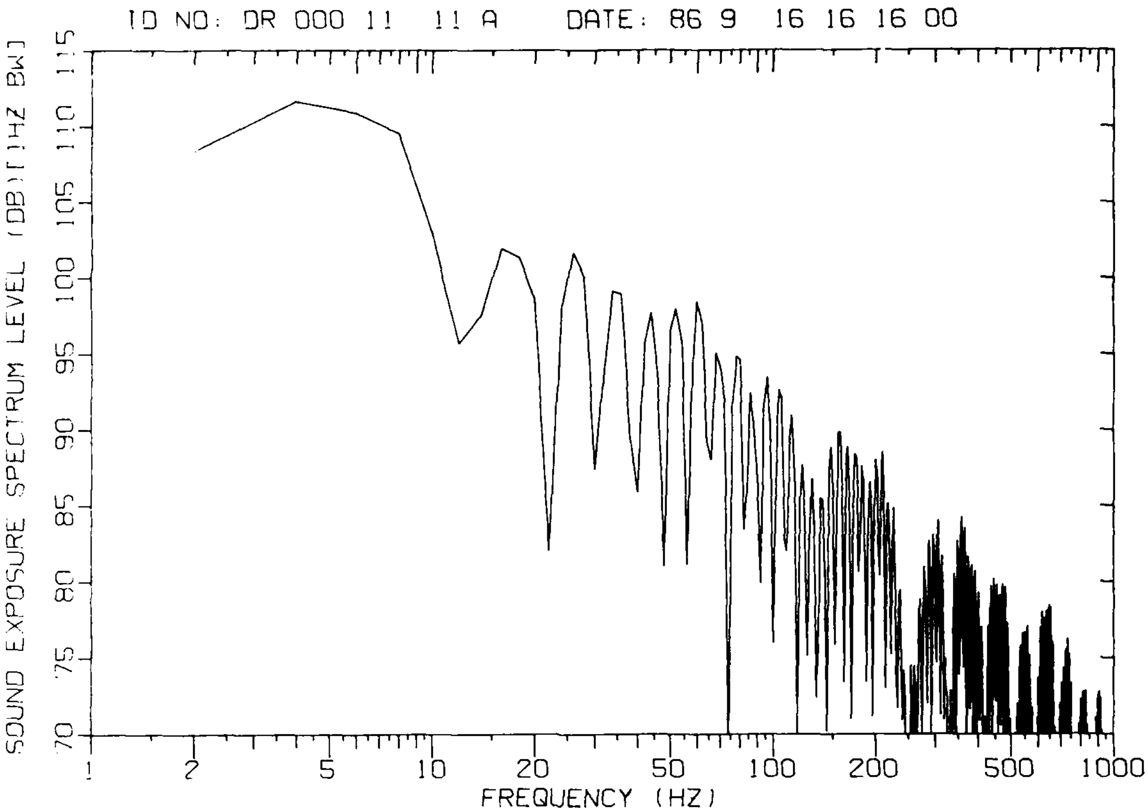

ID NO: DR 000 5 5 A DATE: 86 9 16 16 17 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
70
75
80
85
90
95
100
105
110
115
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

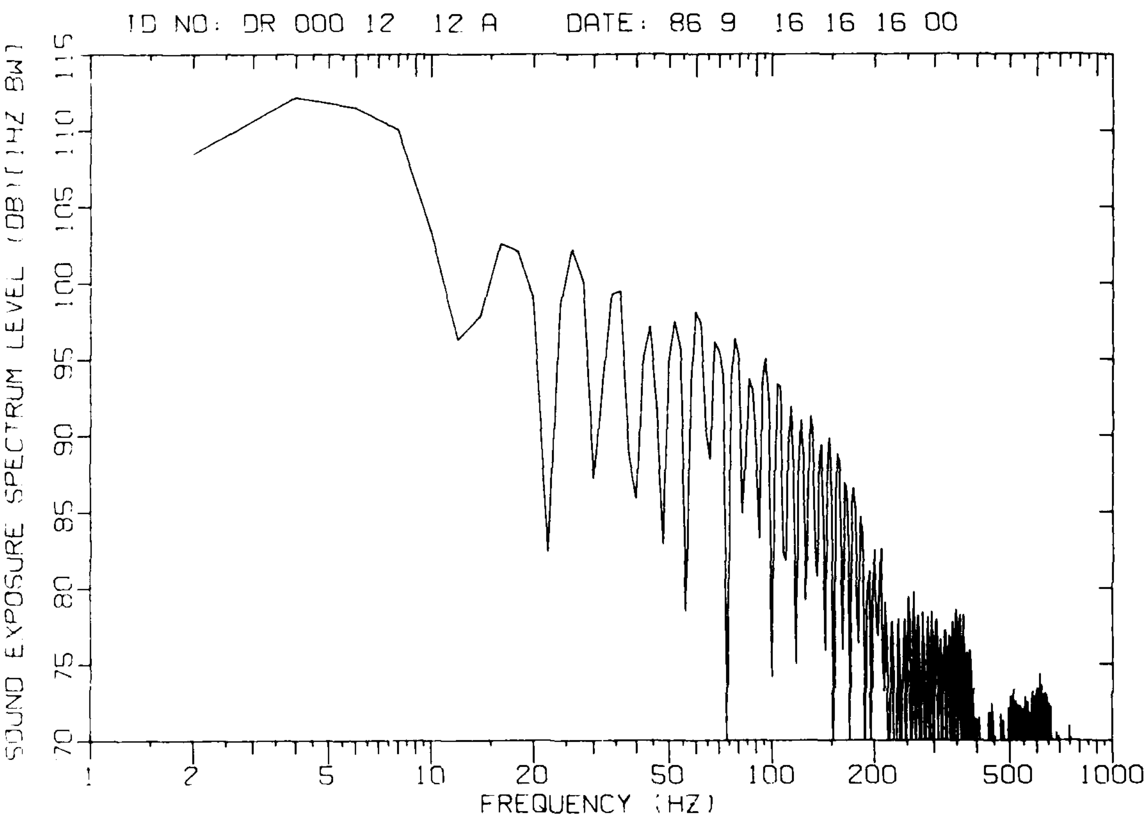

ID NO: DR 000 6 6 A DATE: 86 9 16 16 17 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115
110
105
100
95
90
85
80
75
70
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

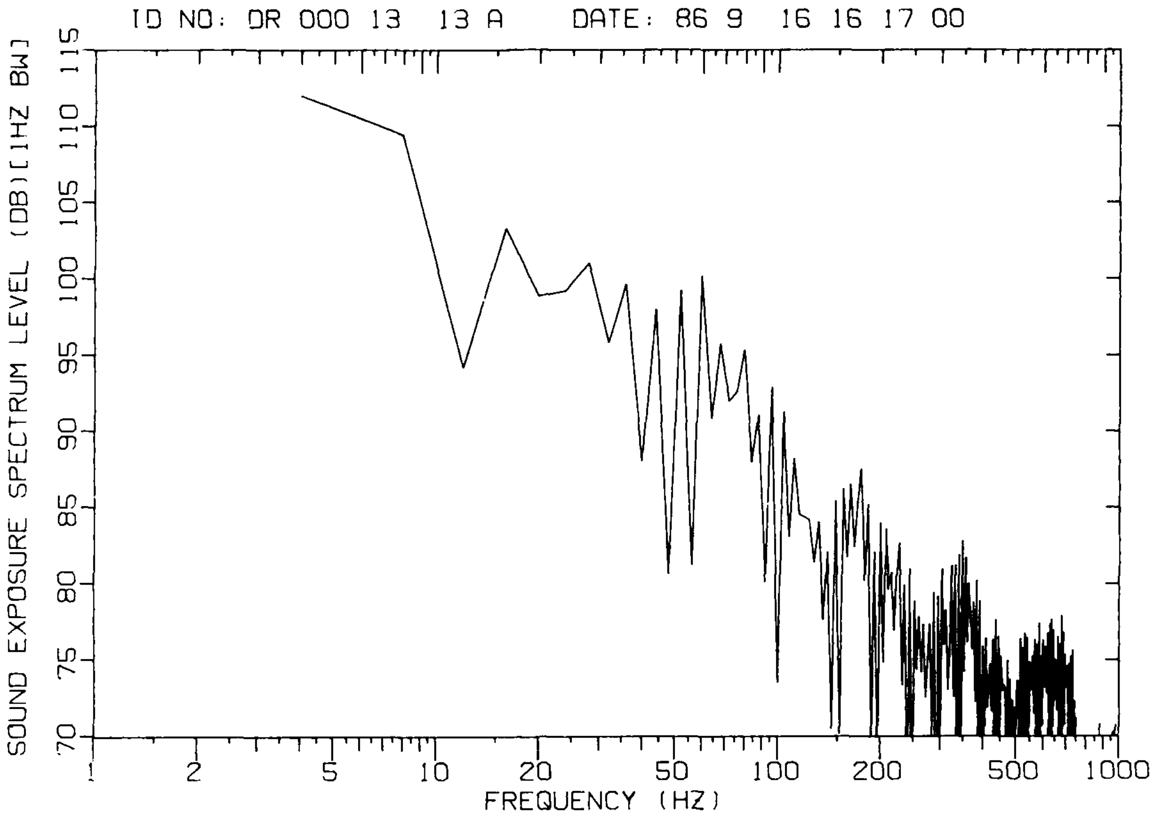

ID NO: DR 000 7 7 A DATE: 86 9 16 16 16 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115
110
105
100
95
90
85
80
75
70
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)


ID NO: DR 000 8 8 A DATE: 86 9 16 16 16 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115
110
105
100
95
90
85
80
75
70
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

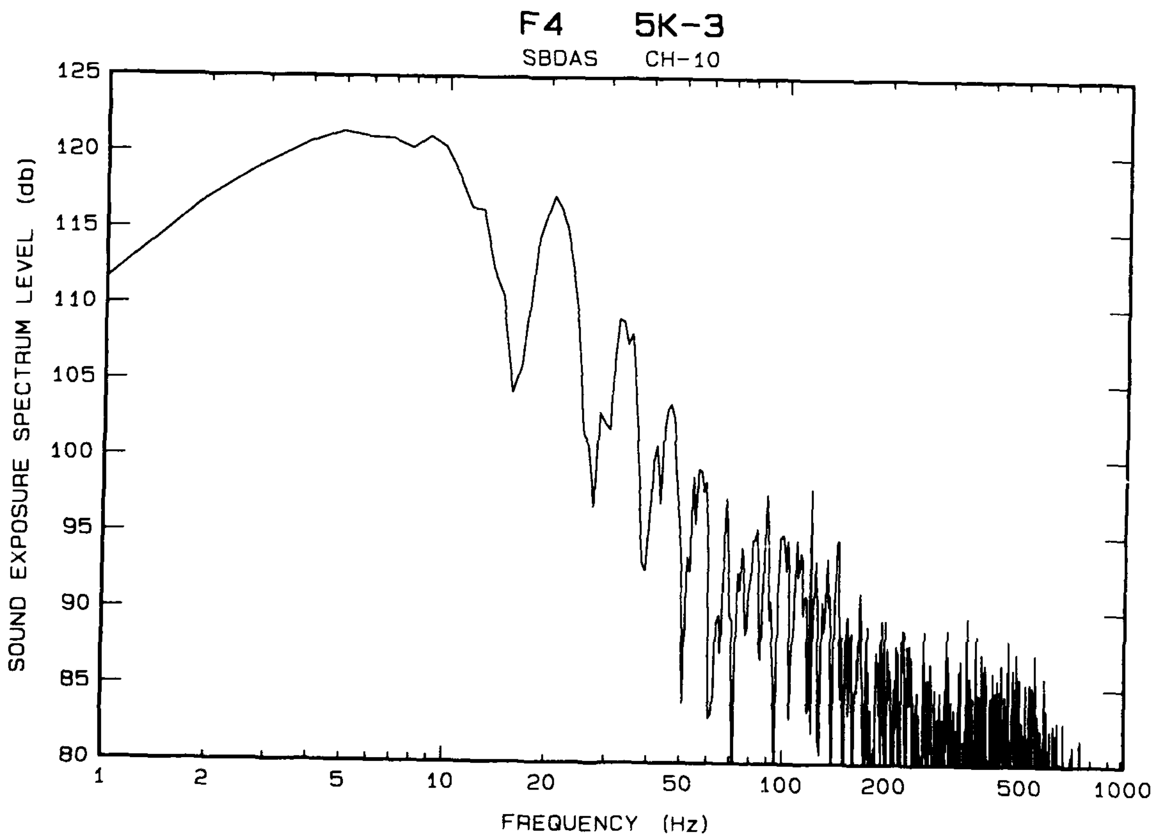

ID NO: DR 000 9 9 A DATE: 86 9 16 16 16 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115
110
105
100
95
90
85
80
75
70
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

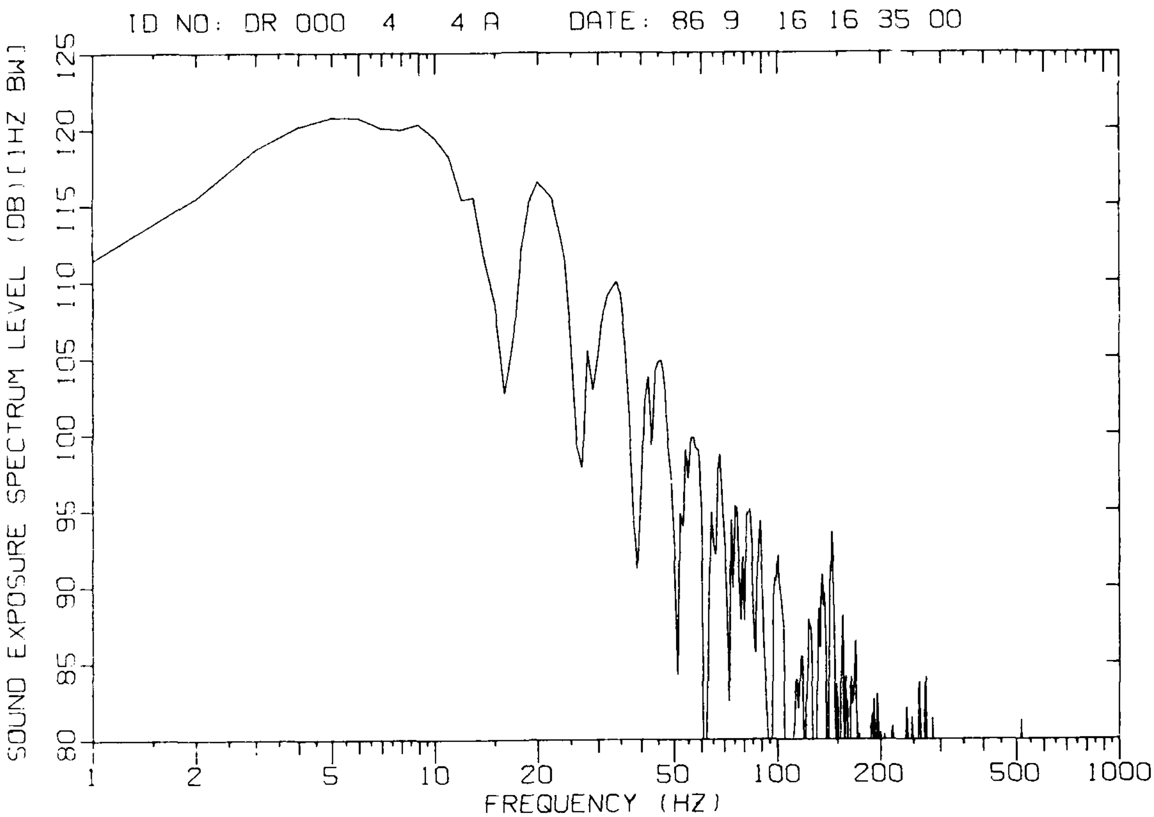

ID NO: DR 000 11 11 A DATE: 86 9 16 16 16 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115
110
105
100
95
90
85
80
75
70
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)


ID NO: DR 000 12 12 A DATE: 86 9 16 16 16 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115
110
105
100
95
90
85
80
75
70
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

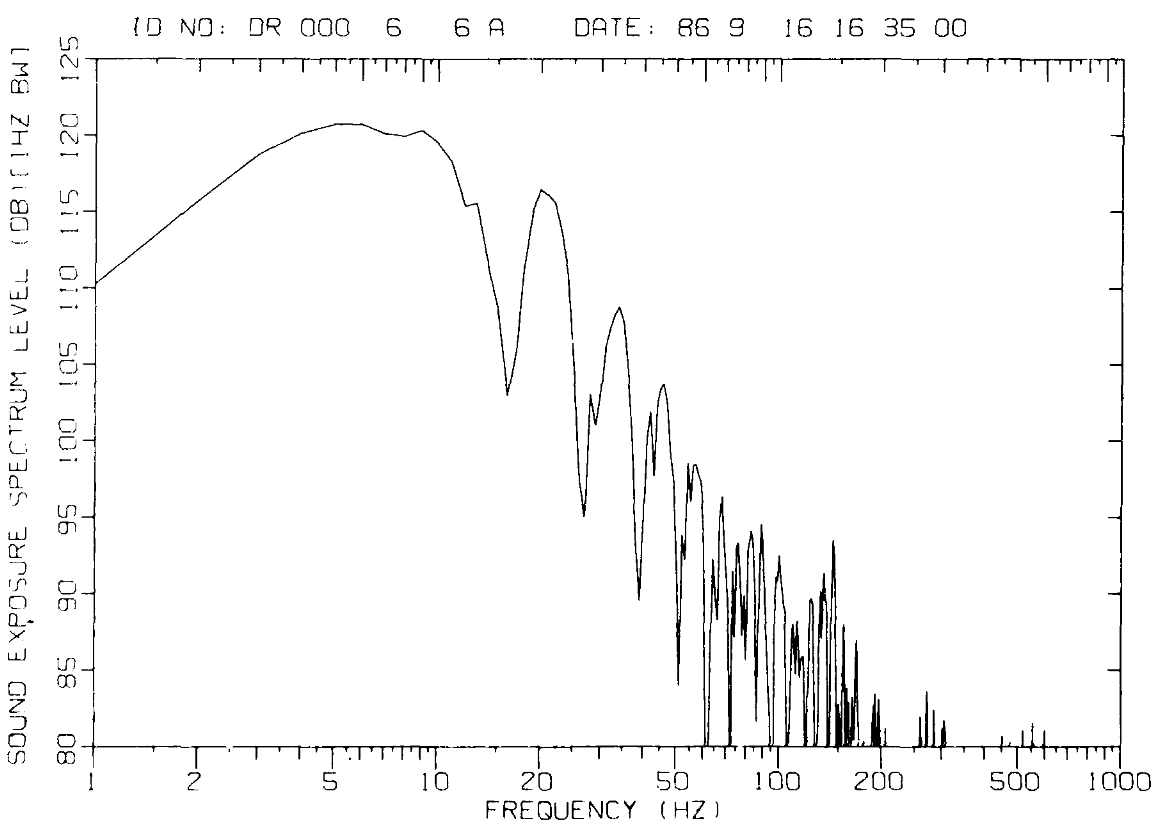

ID NO: DR 000 13 13 A DATE: 86 9 16 16 17 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115
110
105
100
95
90
85
80
75
70
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

Sound Exposure Spectrum Level vs Frequency Plots of Sonic Boom from F-4 flying at 1.15 MACH, 5,200 ft. AGL, and 0 ft. track offset occuring at 23:35:18 GMT, 16 Sep 86.



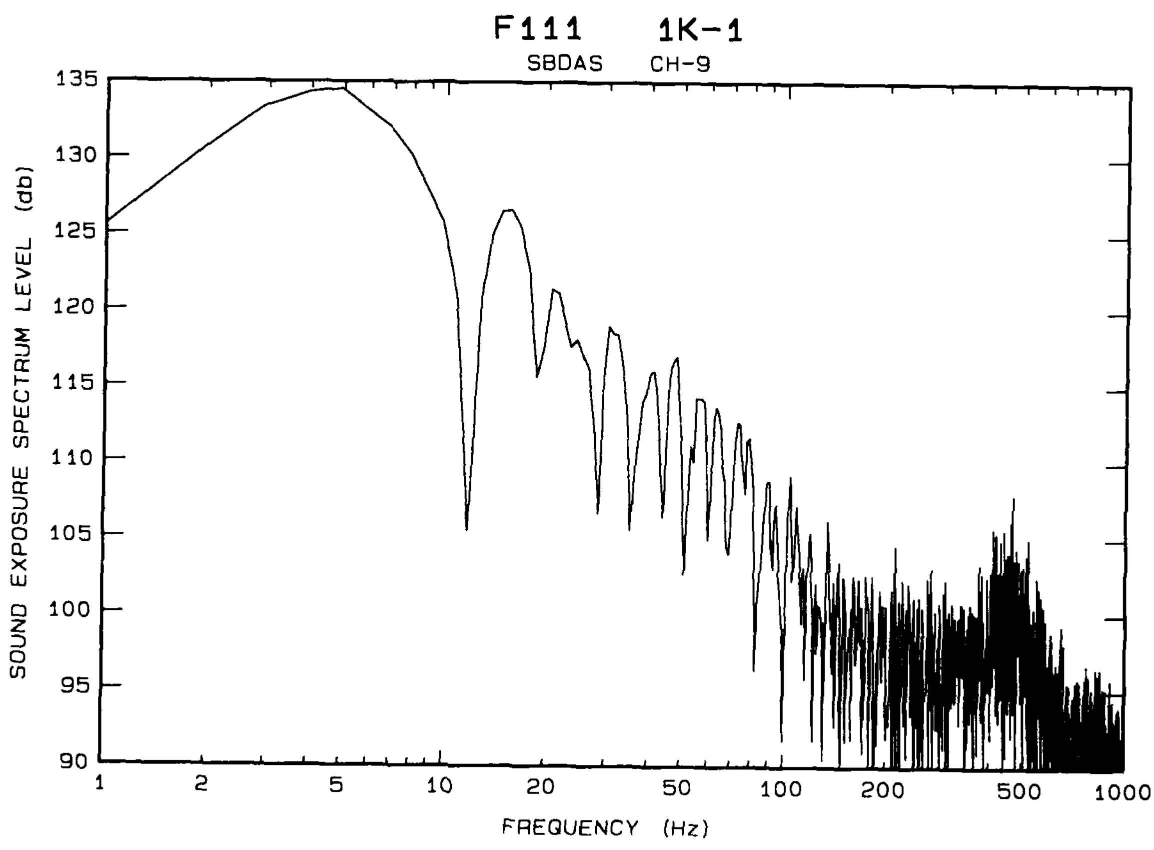


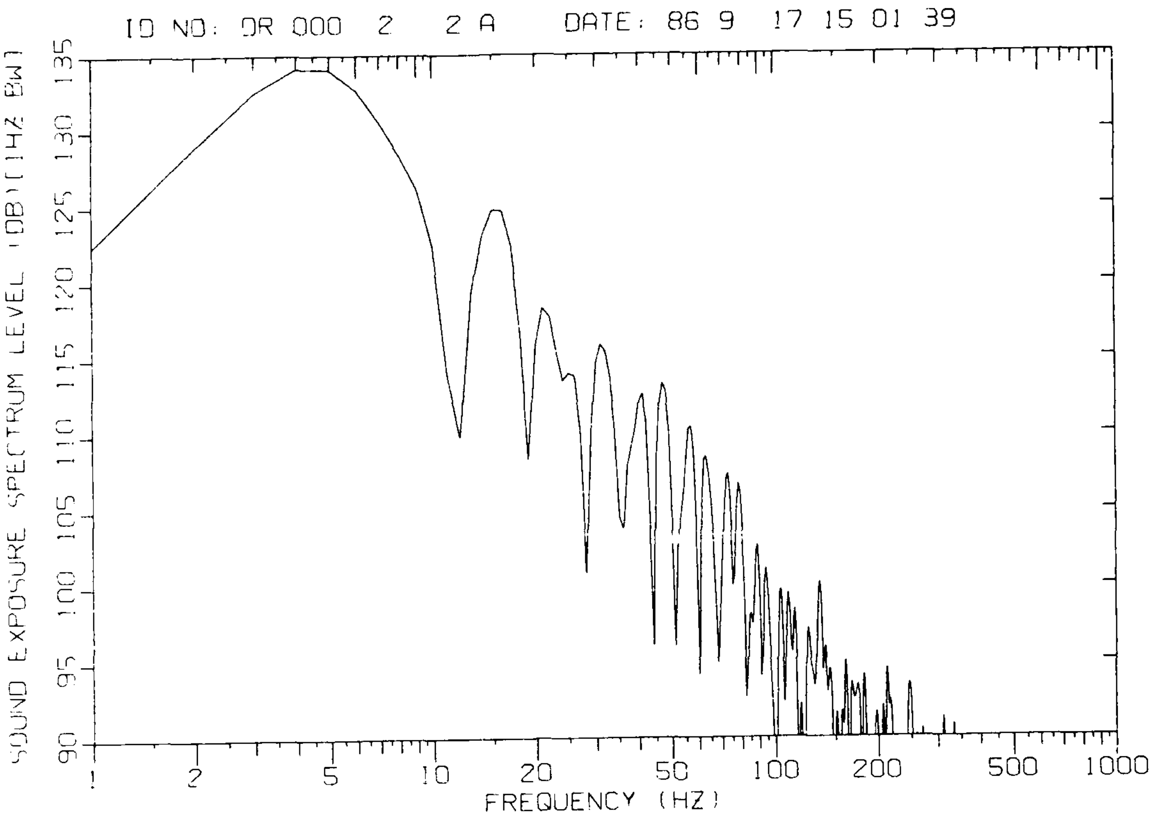
ID NO: DR 000 4 4 A DATE: 86 9 16 16 35 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
125
120
115
110
105
100
95
90
85
80
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)



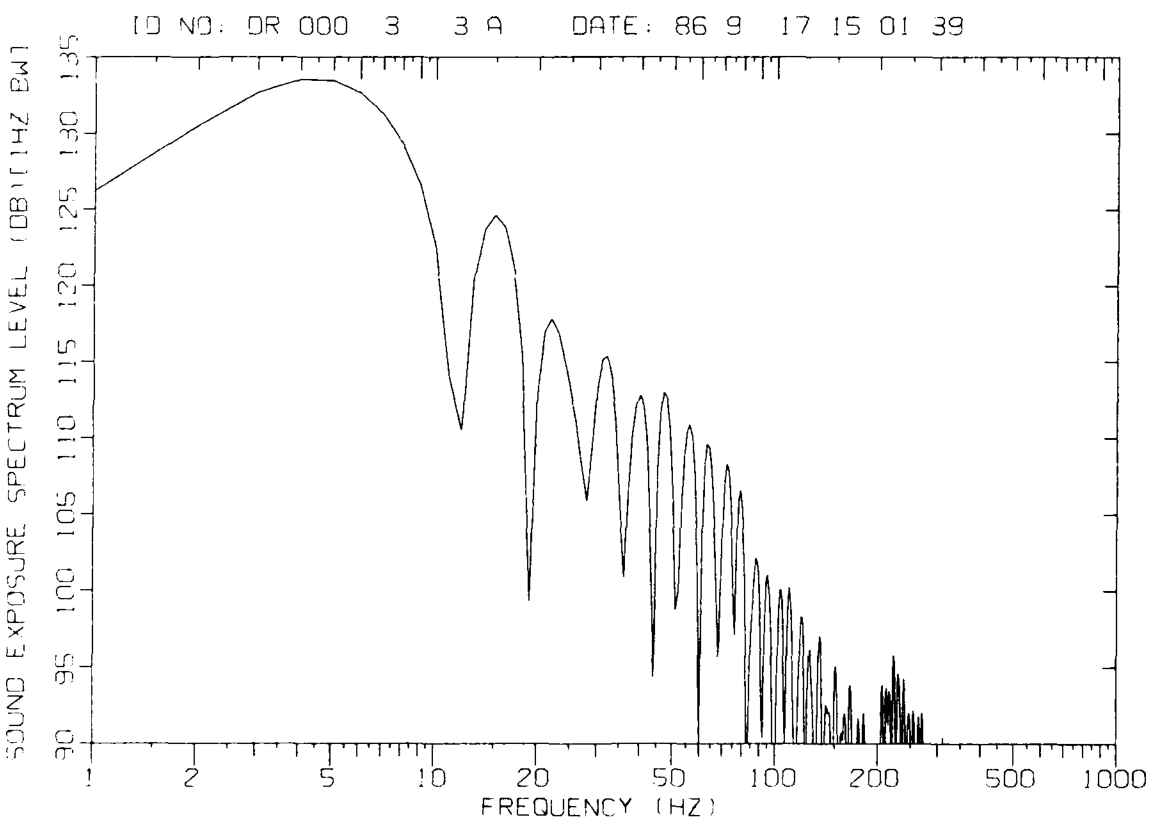
ID NO: DR 000 6 6 A DATE: 86 9 16 16 35 00
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
125
120
115
110
105
100
95
90
85
80
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

Sound Exposure Spectrum Level vs Frequency Plots of Sonic Boom from F-111A flying at 1.03 MACH, 1,200 ft. AGL, and 0 ft. track offset occuring at 22:02:33 GMT, 17 Sep 86.

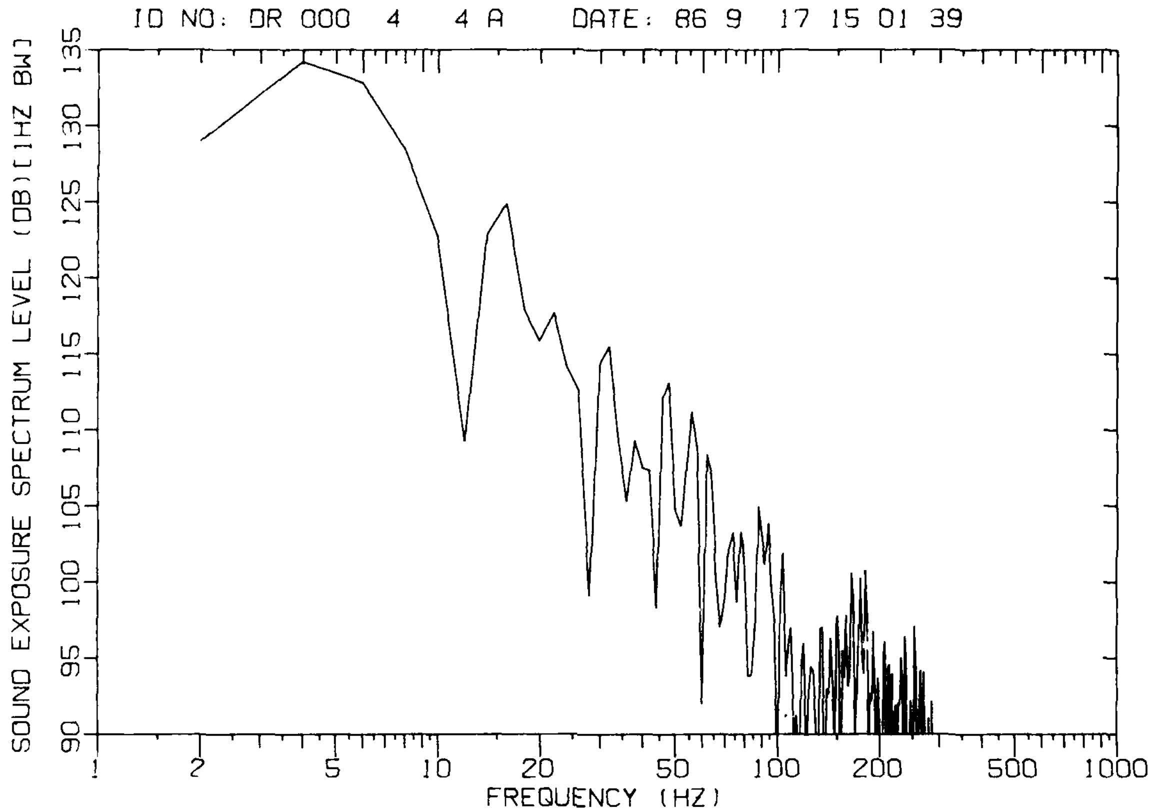


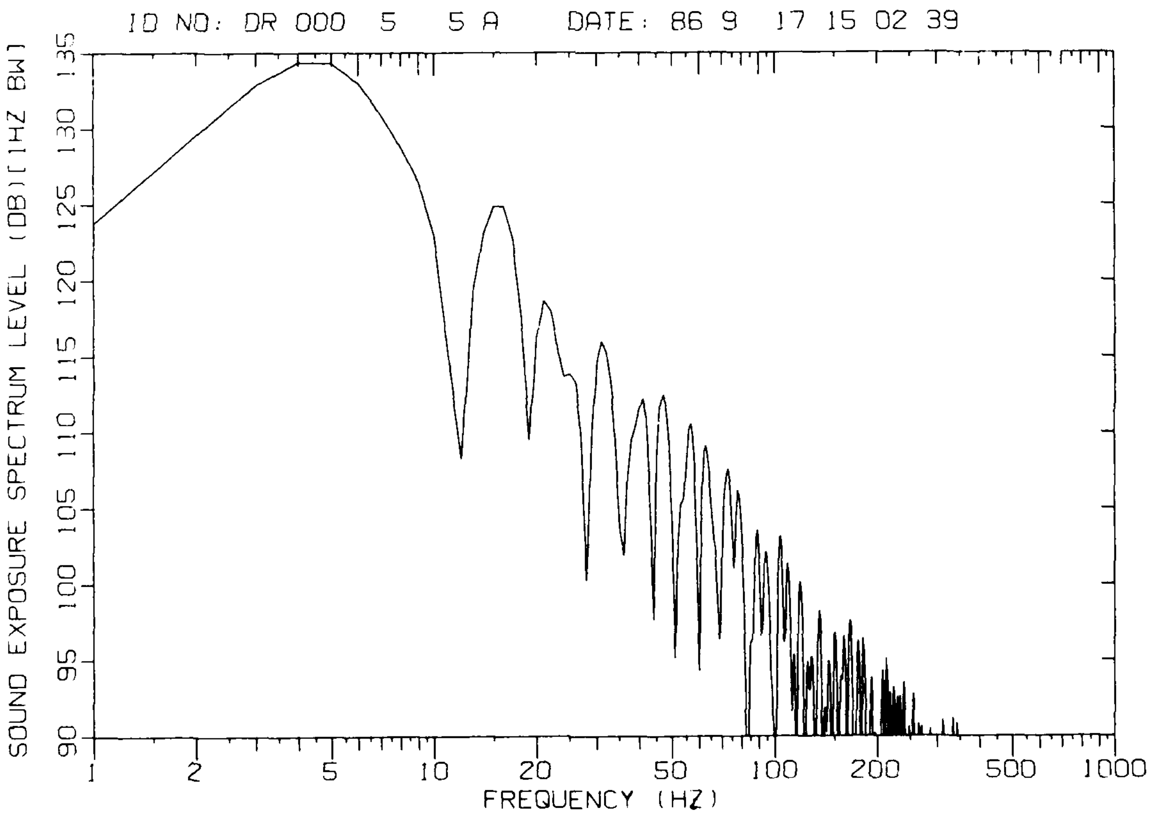


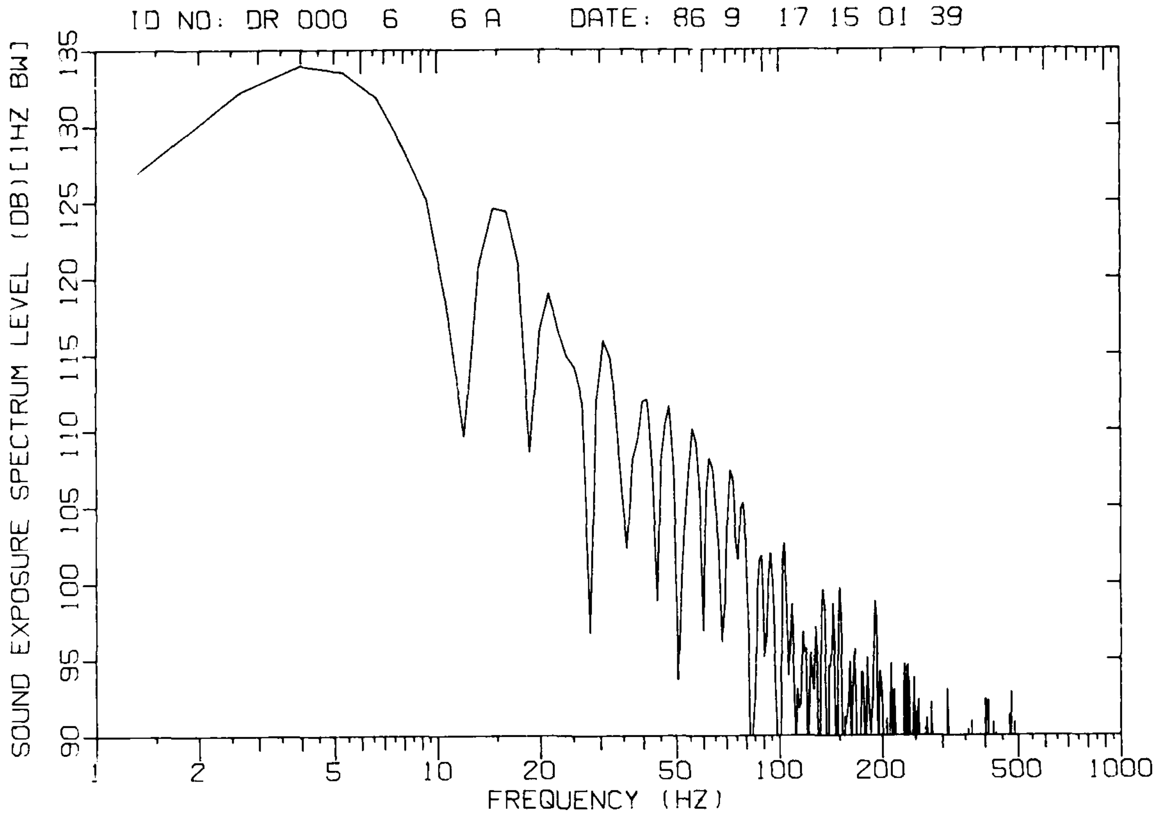
ID NO: DR 000 2 2 A DATE: 86 9 17 15 01 39
SOUND EXPOSURE SPECTRUM LEVEL (DB)(1HZ BW)
135
130
125
120
115
110
105
100
95
90
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

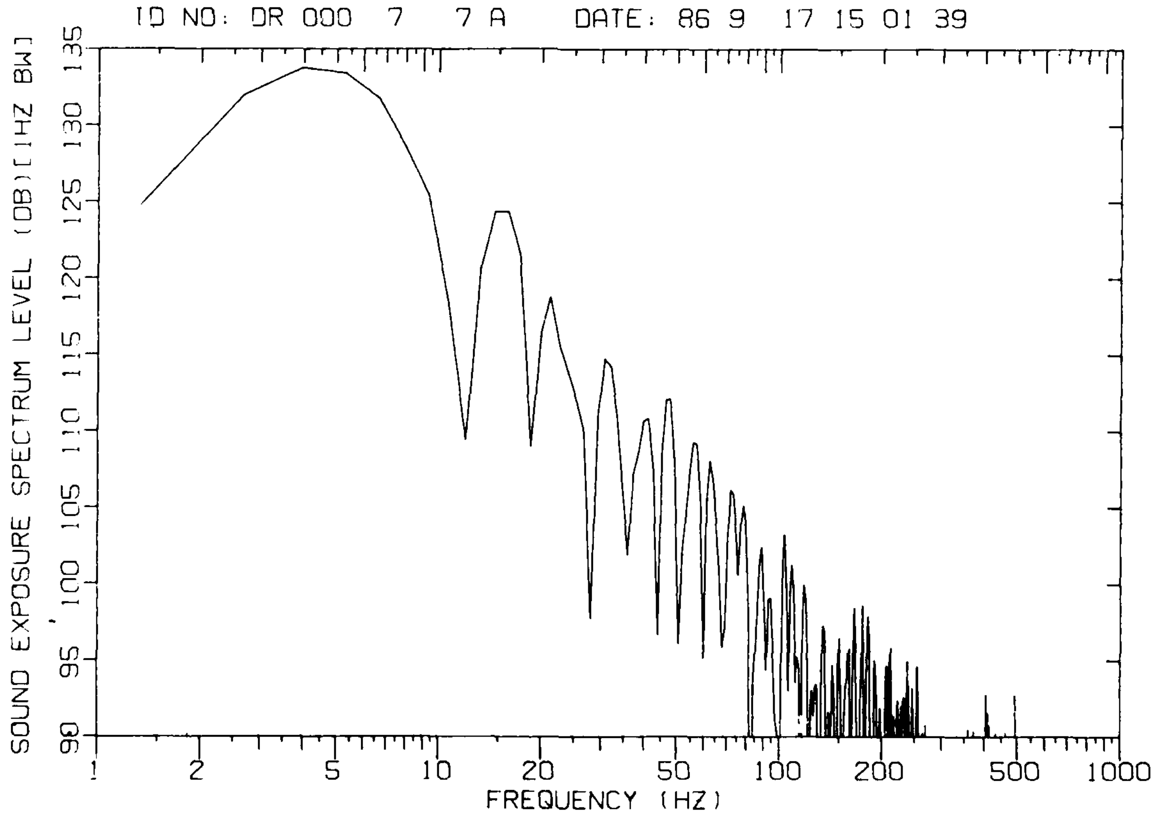


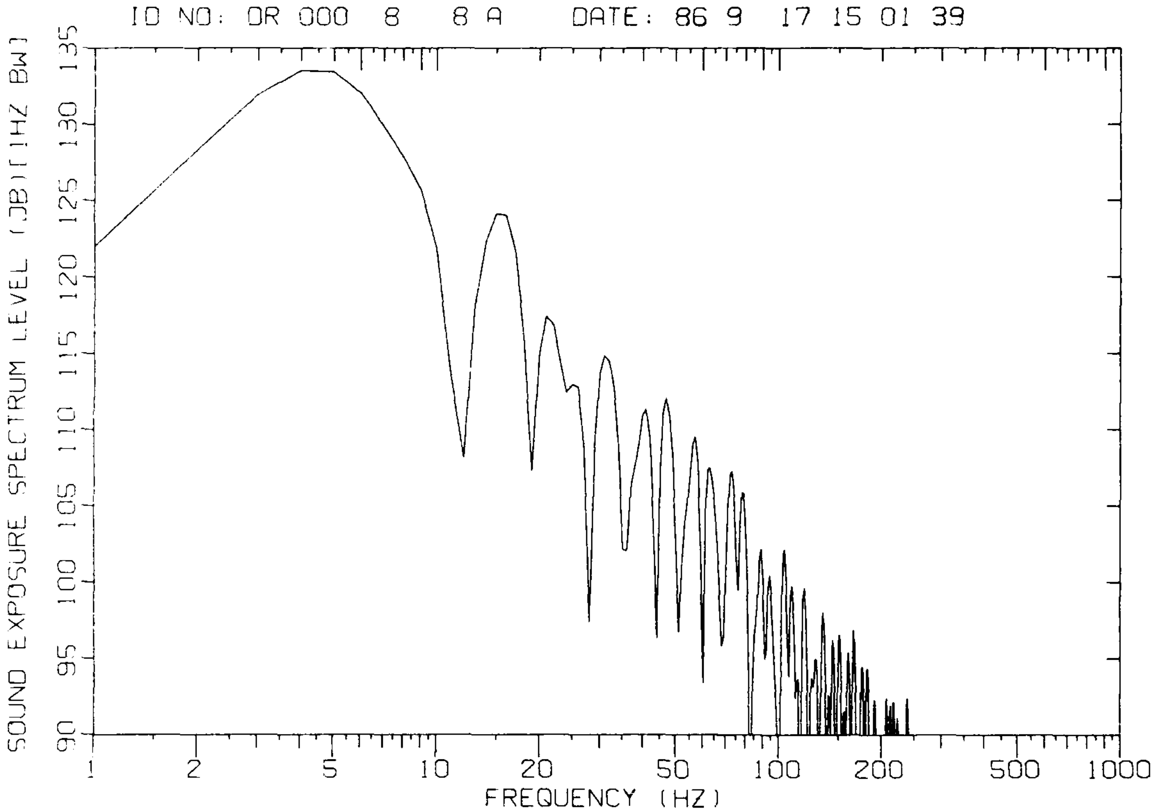
ID NO: DR 000 3 3 A DATE: 86 9 17 15 01 39
SOUND EXPOSURE SPECTRUM LEVEL (DB)(1HZ BW)
135
130
125
120
115
110
105
100
95
90
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)


ID NO: DR 000 4 4 A DATE: 86 9 17 15 01 39
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
135
130
125
120
115
110
105
100
95
90
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)


ID NO: DR 000 5 5 A DATE: 86 9 17 15 02 39
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
135
130
125
120
115
110
105
100
95
90
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)


ID NO: DR 000 6 6 A DATE: 86 9 17 15 01 39
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
135
130
125
120
115
110
105
100
95
90
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)


ID NO: DR 000 7 7 A DATE: 86 9 17 15 01 39
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
135
130
125
120
115
110
105
100
95
90
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)


ID NO: DR 000 8 8 A DATE: 86 9 17 15 01 39
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
135
130
125
120
115
110
105
100
95
90
1
2
5
10
20
50
100
200
500
1000
FREQUENCY (HZ)

APPENDIX C

SINGLE METRIC TABLE

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1. 16 SEPT 86 8:12 am

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	FLUSH MOUNT	137.6	1.233	96.7	112.4	124.3
2	FLUSH MOUNT					
3	FLUSH MOUNT	138.0	1.342	96.2	113.0	124.4
4	FLUSH MOUNT					
5	FLUSH MOUNT	139.3	1.400	96.8	113.9	124.8
6	FLUSH MOUNT					
7	FLUSH MOUNT	138.6	0.138	97.7	113.5	124.3
8	FLUSH MOUNT	137.3	0.127	97.4	113.2	124.3
9	FLUSH MOUNT	137.7	0.138	98.0	113.3	124.4
10	FLUSH MOUNT	137.5	0.129	96.2	113.1	124.4
11	FLUSH MOUNT					
12	FLUSH MOUNT					
13	FLUSH MOUNT	138.5	0.220	96.2	113.4	124.3

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2. 16 SEPT 86 8:19 am

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	FLUSH MOUNT					
2	FLUSH MOUNT					
3	FLUSH MOUNT	146.8	0.857	106.4	122.5	131.5
4	FLUSH MOUNT	148.0	0.190	105.6	123.4	131.5
5	FLUSH MOUNT	147.8	0.174	107.0	123.3	131.8
6	FLUSH MOUNT					
7	FLUSH MOUNT					
8	FLUSH MOUNT	146.9	0.910	107.6	122.6	131.3
9	FLUSH MOUNT					
10	FLUSH MOUNT	146.5	0.849	106.1	122.6	131.4
11	FLUSH MOUNT	146.5	0.849	106.3	122.4	131.3
12	FLUSH MOUNT	146.5 *				
13	FLUSH MOUNT	147.5	0.846	106.5	123.0	131.6

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3. 16 SEPT 86 8:32 am

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	FLUSH MOUNT	126.7	0.189	83.7	100.9	114.0
2	FLUSH MOUNT	126.9	0.188	84.3	101.0	114.0
3	FLUSH MOUNT	126.3	0.604	83.2	100.9	114.0
4	FLUSH MOUNT					
5	FLUSH MOUNT					
6	FLUSH MOUNT					
7	FLUSH MOUNT					
8	FLUSH MOUNT					
9	FLUSH MOUNT					
10	FLUSH MOUNT	126.8	0.218	84.0	101.0	113.8
11	FLUSH MOUNT	127.2	0.162	83.8	100.9	113.8
12	FLUSH MOUNT	126.8 *				
13	FLUSH MOUNT					

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4. 16 SEPT 86 16:17 pm

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	FLUSH MOUNT		DATA LOST	DURING	TRANSFER	
2	FLUSH MOUNT	139.1	0.245	98.6	114.0	121.7
3	FLUSH MOUNT	139.3	0.245	97.5	114.0	121.8
4	FLUSH MOUNT	139.4	0.252	96.6	114.7	121.9
5	FLUSH MOUNT	138.9	1.504	96.9	113.8	121.9
6	FLUSH MOUNT	139.0	0.249	96.6	113.7	121.5
7	FLUSH MOUNT	140.3	0.399	100.3	114.3	122.1
8	FLUSH MOUNT	138.7	1.614	97.0	113.8	121.5
9	FLUSH MOUNT	138.6	0.432	97.6	114.8	122.0
10	FLUSH MOUNT	138.9	1.504	98.8	114.0	121.7
11	FLUSH MOUNT	138.2	0.485	100.6	113.9	121.1
12	FLUSH MOUNT	138.7	0.483	97.9	114.0	121.5
13	FLUSH MOUNT	138.7	0.177	100.2	114.3	121.7

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5. 16 SEPT 86 16:22 pm

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	FLUSH MOUNT		DATA LOST DURING TRANSFER			
2	FLUSH MOUNT	CAPTURED WIND NOISE AS EVENT				
3	FLUSH MOUNT	142.7	1.614	96.0	116.6	128.5
4	FLUSH MOUNT	143.2	1.651	97.6	117.3	128.2
5	FLUSH MOUNT					
6	FLUSH MOUNT	142.4	1.615	95.4	117.0	128.5
7	FLUSH MOUNT					
8	FLUSH MOUNT					
9	FLUSH MOUNT					
10	FLUSH MOUNT					
11	FLUSH MOUNT					
12	FLUSH MOUNT	141.9	1.256	97.1	116.8	128.4
13	FLUSH MOUNT	CAPTURED WIND NOISE AS EVENT				

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6. 16 SEPT 86 16:35 pm

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	FLUSH MOUNT	DATA LOST DURING TRANSFER				
2	FLUSH MOUNT					
3	FLUSH MOUNT					
4	FLUSH MOUNT	146.5	0.993	101.6	121.2	131.2
5	FLUSH MOUNT					
6	FLUSH MOUNT	145.5	0.993	102.4	120.8	131.1
7	FLUSH MOUNT					
8	FLUSH MOUNT					
9	FLUSH MOUNT	CAPTURED WIND NOISE AS EVENT				
10	FLUSH MOUNT					
11	FLUSH MOUNT					
12	FLUSH MOUNT					
13	FLUSH MOUNT					

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7. 17 SEPT 86 13:29 pm

BEAR	SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
	1	FLUSH MOUNT	135.5	0.127	88.7	108.7	117.4
	2	FLUSH MOUNT					
	3	FLUSH MOUNT	135.6	0.127	88.5	108.6	117.6
	4	45 T FLTTRK					
	5	45 F FLTTRK	135.5	0.120	91.2	108.2	117.1
	6	45 T FLTTRK					
	7	45 B FLTTRK					
	8	BBE MOUNT					
	9	BBE MOUNT	135.1	0.129	86.7	108.1	117.2
	10	BBE MOUNT					
	11	BBE MOUNT	134.8	0.128	87.6	107.9	117.0
	12	BBE MOUNT					
	13	BBE MOUNT	SYSTEM MALFUNCTIONING (break in cable				

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8. 17 SEPT 86 14:11 pm

BEAR	SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
	1	FLUSH MOUNT	135.0	0.227	89.4	109.0	122.0
*	2	FLUSH MOUNT	137.2	0.332	108.3	115.6	123.1
	3	FLUSH MOUNT	135.6	0.228	91.1	109.4	122.2
	4	45 T FLTTRK	135.4	0.270	92.4	109.5	122.2
	5	45 F FLTTRK	135.3	0.119	92.5	109.0	122.3
	6	45 T FLTTRK	135.4	0.227	91.8	109.3	122.0
	7	45 B FLTTRK	135.3	0.119	92.2	108.4	121.7
	8	BBE MOUNT	134.7	0.163	89.8	108.5	121.3
	9	BBE MOUNT	135.2	0.330	89.6	109.2	121.9
	10	BBE MOUNT	135.0	0.225	90.2	108.8	121.6
	11	BBE MOUNT					
	12	BBE MOUNT					
	13	BBE MOUNT	SYSTEM NONFUNCTIONING (break in cable				

* SPIKES ON DATA

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9. 17 SEPT 86 14:2Ø pm

BEAR	SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
	1	FLUSH MOUNT					
	2	FLUSH MOUNT					
	3	FLUSH MOUNT	126.6	Ø.134	84.9	99.7	112.7
	4	45 T FLTTRK					
	5	45 F FLTTRK					
	6	45 T FLTTRK	126.2	Ø.139	85.2	1ØØ.1	112.9
	7	45 B FLTTRK					
	8	BBE MOUNT					
	9	BBE MOUNT					
	1Ø	BBE MOUNT					
	11	BBE MOUNT					
	12	BBE MOUNT					
	13	BBE MOUNT	SYSTEM MALFUNCTIONING (break in cable				

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1Ø. 17 SEPT 86 14:25 pm

BEAR	SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
	1	FLUSH MOUNT	123.8	Ø.186	78.2	98.9	1Ø8.2
	2	FLUSH MOUNT					
	3	FLUSH MOUNT					
	4	45 T FLTTRK					
	5	45 F FLTTRK					
	6	45 T FLTTRK					
	7	45 B FLTTRK					
	8	BBE MOUNT					
	9	BBE MOUNT	124.1	Ø.181	8Ø.2	99.Ø	1Ø7.8
	1Ø	BBE MOUNT					
	11	BBE MOUNT					
	12	BBE MOUNT					
	13	BBE MOUNT	SYSTEM MALFUNCTIONING (break in cable				

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11. 17 SEPT 86 14:3Ø pm

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	FLUSH MOUNT	147.5	Ø.538	1Ø5.9	124.3	131.9
2	FLUSH MOUNT					
3	FLUSH MOUNT	148.2	Ø.155	1Ø8.2	124.6	132.Ø
4	45 T FLTTRK	147.2	Ø.128	1Ø9.6	124.2	131.6
5	45 F FLTTRK	146.8	Ø.136	1Ø8.4	124.5	132.Ø
6	45 T FLTTRK	146.1	Ø.2Ø4	1Ø8.7	124.3	131.9
7	45 B FLTTRK	146.3	Ø.155	1Ø8.5	124.1	131.9
8	BBE MOUNT	146.1	Ø.53Ø	1Ø7.5	123.9	131.3
9	BBE MOUNT	146.7	Ø.859	1Ø7.4	124.3	131.8
1Ø	BBE MOUNT	146.4	Ø.529	1Ø7.2	124.1	131.5
11	BBE MOUNT	146.6	Ø.536	1Ø7.Ø	123.9	131.4
12	BBE MOUNT	146.9	Ø.531	1Ø7.3	124.3	131.8
13	BBE MOUNT	SYSTEM MALFUNCTIONING (break in cable				

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12. 17 SEPT 86 15:Ø1 pm

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	FLUSH MOUNT					
2	FLUSH MOUNT	154.1	Ø.285	11Ø.3	128.Ø	141.5
3	FLUSH MOUNT	153.9	Ø.193	1Ø8.7	127.9	141.5
4	45 T FLTTRK	153.5	Ø.278	1Ø9.8	127.7	141.4
5	45 F FLTTRK	153.8	Ø.278	1Ø8.8	128.Ø	141.8
6	45 T FLTTRK	153.6	Ø.738	11Ø.5	127.9	141.6
7	45 B FLTTRK	153.3	Ø.742	11Ø.1	127.6	141.4
8	BBE MOUNT	152.7	Ø.287	1Ø7.5	127.1	14Ø.9
9	BBE MOUNT					
1Ø	BBE MOUNT					
11	BBE MOUNT					
12	BBE MOUNT					
13	BBE MOUNT	SYSTEM MALFUNCTIONING (break in cable				

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13. 17 SEPT 86 15:Ø6 pm

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	FLUSH MOUNT					
2	FLUSH MOUNT	155.2	Ø.389	113.Ø	132.4	142.7
3	FLUSH MOUNT	155.3	Ø.437	116.Ø	133.Ø	142.8
4	45 T FLTTRK	155.3	Ø.274	117.2	132.8	142.6
5	45 F FLTTRK	155.4	Ø.69Ø	116.5	132.9	142.9
6	45 T FLTTRK	155.7	Ø.942	118.7	133.4	143.Ø
7	45 B FLTTRK	155.4	Ø.69Ø	116.5	132.7	142.7
8	BBE MOUNT	155.Ø	1.433	117.8	132.3	142.3
9	BBE MOUNT					
1Ø	BBE MOUNT	155.2	1.226	114.8	132.6	142.5
11	BBE MOUNT	155.9	1.437	114.8	133.2	142.9
12	BBE MOUNT	155.1	1.435	114.9	132.5	142.6
13	BBE MOUNT	SYSTEM MALFUNCTIONING (break in cable				

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14. 18 SEPT 86 9:Ø9 am

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	BBE MOUNT	13Ø.7	Ø.164	83.3	1Ø4.1	117.3
3	BBE MOUNT	13Ø.3	Ø.154	82.4	1Ø3.7	117.2
9	BBE MOUNT	13Ø.8	Ø.163	83.5	1Ø4.Ø	117.Ø
1Ø	BBE MOUNT	13Ø.4	Ø.164	82.7	1Ø3.7	117.Ø
11	BBE MOUNT	13Ø.5	Ø.164	82.5	1Ø3.9	117.2

****

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15. 18 SEPT 86 9:16 am

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	BBE MOUNT	128.1	0.791	80.6	102.4	117.4
3	BBE MOUNT	128.1	0.795	80.9	102.3	117.3
9	BBE MOUNT	128.3	0.703	81.2	102.4	117.1
10	BBE MOUNT	128.1	0.790	80.8	102.2	117.0
11	BBE MOUNT	128.2	0.790	81.0	102.4	117.3

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16. 18 SEPT 86 9:32 am

BEAR SN	DISCRIPTION	PEAK	DURATION	ASEL	CSEL	FSEL
1	BBE MOUNT	133.6	0.464	84.6	107.5	120.0
3	BBE MOUNT	133.6	0.466	84.5	107.4	120.0
9	BBE MOUNT	133.6	0.465	85.3	107.4	119.8
10	BBE MOUNT	133.4	0.250	85.3	107.3	119.6
11	BBE MOUNT	133.6	0.465	85.5	107.5	119.9

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