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ARMSTRONG LABORATORY

MEASUREMENT AND EVALUATION OF BLAST OVERPRESSURE DURING F-15A CREW STATION VULNERABILITY ASSESSMENT TEST

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DECEMBER 1991

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AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6573

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Peter A. Lurker

PETER A. LURKER, Lt Col, USAF, BSC
Acting Director
Biodynamics and Biocommunications Division
Armstrong Laboratory

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From March 1991 to May 1991 blast overpressures were measured from 21 different projectiles striking a section of the F-15 fuselage to assess potential crew hazards. The velocity of the fired projectiles ranged from 1500 ft/sec to 5000 ft/sec and the lowest overpressure which was recorded was 7 PSF or 145 dB and the highest level recorded was 1875 PSF or 194 dB sound pressure level (re 20 μ Pa). Time histories for each recording and the sound exposure spectrum levels as a function of frequency are presented. A hearing damage risk assessment was made in the context of the Air Force hearing damage risk criteria (AFR 161-35) and laboratory data regarding the effects of high level impulses on man.

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PREFACE

This report was prepared by the Noise Effects Branch, Armstrong Laboratory in conjunction with a vulnerability assessment test of the F-15A crew station conducted by the Survivability Enhancement Branch, WL/FIST.

The author gratefully acknowledges Capt Denise West, AL/CFBA for her assistance in preparing the hearing assessment chapter, and Mr Henry T. Mohlman for his assistance in the graphic display of the data. The author is also thankful to Ms Jackie Brennaman and Ms Bea Heflin for the preparation of this report for publishing and to Mr Jerry Speakman for his editorial comments.

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INTRODUCTION

A live fire test was conducted to evaluate the vulnerability of a F-15 pilot to the impact of ballistic projectiles striking the F-15 crew station. The primary emphasis of this test program was the evaluation of pilot shielding, premature initiation of the emergency escape system and the possible disabling of the mechanical and electrical flight control system. As part of this test program the blast overpressure was measured from 21 different projectiles/velocities/directions striking a section of the F-15 fuselage (Fuselage Station FS 250.5 to FS 415) to assess potential crew hazards. A manikin placed in the cockpit was instrumented with four pressure transducers to measure the overpressure at the right and left ear and at the upper and lower torso. Time histories for each recording and the sound exposure spectrum levels as a function of frequency are presented. A hearing damage risk assessment is made in the context of the Air Force hearing damage risk criteria (AFR 161-35)[3], and laboratory data[4] regarding the effects of intense blast overpressures on man.

TEST CONDITIONS AND PROCEDURES

During this program tests were conducted using 21 different projectiles aimed and fired at the F-15 fuselage section, installed at Range 2 of the Aircraft Survivability Research Facility (ASRF), WPAFB,OH. The F-15 cockpit with manikin was installed in a fixture, to allow a rotation in place to achieve shotlines from above, below and either side. The projectiles used for each test with the different charges, velocities and directions are listed in Table 1 TEST MATRIX. The tests were typically conducted every two days to allow time for repair of damages to the fuselage section caused by the different projectile strikes and for removal and examination of the manikin.

The gun, firing the different projectiles, was placed for most tests at a distance of 15 feet from the crew station. The velocity of the fired projectiles ranged from 1500 ft/sec to 5000 ft/sec and by computing and comparing the traveling times of the projectiles and the speed of sound, in most cases the actual overpressure from the impact of the projectile was recorded. Although at the lower projectile velocities contamination of the recorded signal from the gun fire noise may have occurred due to the small difference in the velocity of the projectile and the speed of sound.

Instrumentation

The cockpit with the manikin in place was instrumented with four pressure transducers. One each transducer was mounted at the seat approximately 4 inches away from the helmet of the manikin next to the area of the right and left ear. One transducer was placed near the midline of the upper torso and the fourth transducer was positioned near the midline of the lower torso. The placement of the transducers with a dimension of 0.7 inches in diameter and 1.6 inches long did not interfere with the positioning of the ballistic projectile strikes to the manikin. The transducers were piezo-electric microphones with a frequency response from 0.5 Hz - 10000 Hz and a measurement range from 0.005 psf to 1200 psf (80 dB to 190 dB SPL sound pressure level). They are totally sealed and the extreme environments experienced during these tests did not affect the accuracy.

The signal from each transducer was recorded by the BOOM EVENT ANALYZER RECORDER (BEAR).[1] Four such devices were employed since this unit is a single channel instrument specially developed for recording impulsive type overpressures. This instrument is based on a 16 bit microprocessor that continuously samples the background noise and captures and stores the waveforms of any intense impulsive noise. The BEAR digitizes the signal from the microphone at a sampling rate of 8 kHz and has a frequency range

from 0.5 Hz to 2500 Hz with a dynamic range of 80 dB. The data from the BEAR is stored in removable RAM modules with a memory of 512 kbytes. The data on the modules are transferred via a Data Retrieval Unit (DRU) and then interfaced with a computer and existing software for processing. The unit is selfcontained and can operate for up to seven days without replacing the batteries.

An acoustical calibration signal was applied to each system shortly before each test to assure proper operation. Any change in signal level was adjusted to obtain an accuracy of +/- 1 dB for all test data.

Four additional pressure transducers were installed alongside the BEAR microphones. The output of these transducers were connected to the ASRF on-site data aquisition system and provided an instantaneous readout of the overpressures generated during the impact of projectiles. This additional capability complimented the BEAR instrumentation. It extended the measurement range of up to 50 psi (7200 psf) or 204 dB sound pressure level.

Data Analysis

In these tests, the BEAR recorder was triggered by the overpressure generated from the projectile impact and/or explosion inside the crew station and the captured acoustical signal was stored in the RAM modules. The data stored in these modules were transferred through the Data Retrieval Unit (DRU) to a Z-100 computer which processed and displayed each recorded event, time of occurrence and summary information for all data stored. This analysis was performed the same day after each test, to ensure proper operation of the systems and allow for any adjustments necessary for the next test. The overpressures were analyzed in terms of maximum overpressure in pounds/sqft, max sound pressure level in dB re 20 μPa and sound exposure spectrum level (1Hz bandwidth) as a function of frequency. In addition a time history was plotted for each recorded firing. Reviewing the analyzed data of the blast overpressures with such sharp rise times, one would expect significant energy at higher frequencies. However the frequency spectrum analysis of the data showed that the levels at 2500 Hz were significantly reduced. Therefore the peak noise levels should not be affected since they are only partly influenced by the high frequency content of the spectrum.

The data are plotted in Fig.1 through Fig.50. The lowest overpressure which was recorded was 7 psf or 145 dB and the highest level recorded was 1875 psf or 193 dB sound pressure level. Table 2 COCKPIT MAX OVERPRESSURE (PSF) and MAX SPL (dB) summarizes the data for each test and location. During some tests a signal was not recorded due to electro-magnetic interference which rendered the system inoperable or the threshold levels were set too high and the BEAR did not record the event. However, it can be seen that the sound pressure levels recorded in the cockpit are fairly uniformly distributed, although the projectiles were fired from different elevations and

azimuths.

In Table 3 COMPARISON OF MAX OVERPRESSURE a comparison was made between overpressures as recorded by the BEARs and as measured by the ASRF on-site data acquisition system. The levels as recorded by the on-site system are listed in italics. Agreement between the two recorded overpressures is reasonable since one can expect a difference in level due to the placement and mounting of the microphone.

Transducers were also installed at the upper torso and lower torso. The data were analyzed and are presented in the same format as the data recorded at earlevel. Analysis for nonauditory damage such as injury to the lung or other internal organs was not performed. In the literature the estimated threshold for lung damage is reported to occur at overpressures of 2160 PSF or 194 dB SPL[2].

HEARING DAMAGE RISK ASSESSMENT

The AFR 161-35[3] is used for the assessment of Hazardous Noise Exposure of Air Force personnel exposed to continuous noise environs and impulse noise such as gun fire and similiar phenomena. For impulse noise it requires that the waveform of the impulse be analyzed for the peak overpressure and for two different durations, the pressure-wave (A) duration and the pressure-envelope (B) duration of the impulse signal. The limiting exposures for a 100 msec impulse without reflection ("A" duration) is 152 dB SPL and 140 dB SPL for impulses with reflected wave components ("B" duration). These values are valid for an exposure of 100 pulses/day over a period not less than 4 min per day. This criteria cannot be applied to the Live Fire Test. In a real world scenario a pilot would experience only one or two exposure during a day with a much higher peak overpressure level. For this reason the AFR 161-35 was not used for this study in the hearing risk assessment.

However, data obtained from a recent US Army study[4] can be compared with the Live Fire blast overpressure measurements. In that study human subjects were exposed to the noise from explosive charges and the temporary hearing loss was measured. The subjects wore muff type hearing protection and were exposed to a series of 50 blasts on the same day with a peak level of 193 dB sound pressure level (SPL). For these subjects a temporary change in hearing of less than 15 dB was observed which is a mild temporary hearing loss and should not result in any loss of auditory function.

The Live Fire Tests were conducted under similiar conditions. However the numbers of exposures as reported in the US Army study far exceed the single exposures analyzed for the Joint Live Fire Tests. The highest level measured was 193 dB (Test Nr. 26) and the crew member (manikin) was wearing the standard Air Force flight helmet type HGU 55/P which provides hearing protection in the frequency range from 125 Hz to 8 kHz and to some degree in the lower frequencies. In these tests only one projectile was fired per day which represents a real live scenario during a air-to-air combat engagement. Comparing the measured levels recorded during the live fire test with the finding of the US Army study[4], the impact on the hearing and communication of the pilot or crew member during the Live Fire Test can be estimated. From these Live Fire exposures crew members could experience a mild reduction in hearing but these hearing changes would not be sufficient to impair communication capability.

CONCLUSION

The maximum blast overpressure (193 dB) measured during this test was higher than an individual would normally experience. Comparing the findings of the US Army study[4] with the data of the Live Fire Test, only mild temporary hearing losses can be expected by the F-15 pilots and crewmembers and it should not affect their ability to communicate with ground stations and/or other aircraft.

Little information in the literature is available on the response of humans to impulse or blast overpressure levels of this magnitude, except for subjective reports from voluntary subjects exposed to higher than normal overpressure levels. These observations and some predictions have been tabulated in Table 4 AUDITORY RESPONSE TO BLAST OVERPRESSURE[2].

F-15A LIVE FIRE TEST
TEST MATRIX

TEST NR.	IMPACT AREA	THREAT	AZ/EL	VELOCITY
5	Left Side Fuselage	12.7mm API	90/0 deg	1500 ft/s
6	Left Side Fuselage	12.7mm API	90/30 deg	1500 ft/s
8	Left Side Rear	12.7mm API	120/30 deg	1500 ft/s
9	Right Side Rear Avionic Bay	23 mm HEI/MG-25	225/45 deg	2200 ft/s
10	Left Center Fuselage	110 gr fragm.	60/60 deg	5000 ft/s
11	Left Center Fuselage	12.7 mm API	60/60 deg	1500 ft/s
12	Left Rear Fuselage	12.7mm API	150/45 deg	1500 ft/s
14	Right Front Fuselage	23 mm API	345/45 deg	2200 ft/s
15	Ctr Front Fuselage	23 mm API	0/15 deg	2200 ft/s
16	Right Front Fuselage	23 mm HEI/MG-25	315/45 deg	2200 ft/s
17	Left Front Fuselage	30 mm HEI/A-30	15/45 deg	2000 ft/s
18	Left Ctr Fuselage	110 gr fragm.	60/30 deg	5000 ft/s
19	Canopy from Rear	110 gr fragm.	150/30 deg	5000 ft/s
20	Canopy from Rear	12.7 mm API	150/30 deg	1500 ft/s
22	Left through Canopy	23 mm HEI/MG-25	45/0 deg	2200 ft/s

F-15A LIVE FIRE TEST
TEST MATRIX

TEST NR.	IMPACT AREA	THREAT	AZ/EL	VELOCITY
23	Right Side Fuselage	23 mm HEI/MG-25	270/0 deg	2200 ft/s
24	Right Side Fuselage	12.7 mm API	270/0 deg	1500 ft/s
25	Left Side Fuselage	30 mm HEI/A-30	135/0 deg	2000 ft/s
26	Bottom Landiong Gear	23mm HEI/MG-25	180/60 deg	2200 ft/s
27		unknown		

Table 1

F-15A LIVE FIRE TEST

COCKPIT MAX OVERPRESSURE (PSF) - MAX SPL (dB)

TEST NR.	RIGHT EAR		LEFT EAR		UPPER TORSO		LOWER TORSO	
	PSF	SPL	PSF	SPL	PSF	SPL	PSF	SPL
5	83	166	65	164	-	-	53	162
6	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-
9	396	179	212	174	148	171	128	170
10	-	-	21	154	25	155	-	-
11	-	-	43	160	50	161	67	164
12	-	-	10	148	-	-	7	145
14	-	-	-	-	-	-	45	161
15	-	-	-	-	77	165	70	164
16	-	-	-	-	-	-	-	-
17	115	169	100	168	-	-	123	169
18	-	-	-	-	77	165	77	165
19	89	167	91	167	73	165	37	159
20	368	179	295	177	117	169	130	170
22	872	186	-	-	-	-	1285	190
23	595	183	653	184	744	185	700	185
24	98	167	88	166	73	165	98	167
25	444	181	-	-	399	180	335	178

PSF in lbs/sqft

SPL in dB re .00002 N/sqm

F-15A LIVE FIRE TEST

COCKPIT MAX OVERPRESSURE (PSF) - MAX SPL (dB)

TEST NR.	RIGHT EAR		LEFT EAR		UPPER TORSO		LOWER TORSO	
	PSF	SPL	PSF	SPL	PSF	SPL	PSF	SPL
26	1875	193	1866	193	1830	193	1481	191
27	1016	188	1062	188	1183	189	1050	188

PSF in lbs/sqft

SPL in dB re .00002 N/sqm

TABLE 2

F-15A LIVE FIRE TEST
COMPARISON OF MAX OVERPRESSURE

TEST NR.		RIGHT EAR		LEFT EAR		UPPER TORSO		LOWER TORSO	
		PSF	SPL	PSF	SPL	PSF	SPL	PSF	SPL
5	B	83	166	65	164	-	-	53	162
	K	*174*	*172*	*114*	*169*	*133*	*170*	*108*	*168*
9	B	396	179	212	174	148	171	128	170
	K	*146*	*171*	*258*	*176*	*141*	*171*	*174*	*172*
16	B	-	-	-	-	-	-	-	-
	K	*259*	*176*	*262*	*176*	*229*	*175*	*259*	*176*
17	B	115	169	100	168	-	-	123	169
	K	*117*	*169*	*104*	*168*	*94*	*167*	*94*	*167*
18	B	-	-	-	-	-	-	-	-
	K	*165*	*172*	*187*	*173*	*288*	*177*	*396*	*180*
19	B	89	167	91	167	73	165	37	159
	K	*115*	*169*	*139*	*170*	*84*	*166*	*50*	*161*
20	B	368	179	295	177	117	169	130	170
	K	-	-	-	-	*203*	*174*	*194*	*173*

B - Bear Transducer
K - Kistler Transducer

PSF in lbs/sqft
SPL in dB re .00002 N/sqm

F-15A LIVE FIRE TEST
COMPARISON OF MAX OVERPRESSURE

TEST NR.		RIGHT EAR		LEFT EAR		UPPER TORSO		LOWER TORSO	
		PSF	SPL	PSF	SPL	PSF	SPL	PSF	SPL
22	B	872	186	-	-	-	-	1285	190
	K	1267	189	-	-	-	-	626	184
23	B	595	183	653	184	744	185	700	185
	K	*662*	*184*	*720*	*185*	*691*	*184*	*669*	*184*
25	B	444	181	-	-	399	180	335	178
	K	*720*	*185*	*864*	*186*	*360*	*179*	*353*	*179*
26	B	1875	193	1866	193	1830	193	1491	191
	K	*3168*	*198*	*1958*	*193*	*2232*	*195*	*2232*	*195*
27	B	1016	188	1062	188	1183	189	1050	188
	K	-	-	*1339*	*190*	*1440*	*191*	*1037*	*188*

B - Bear Transducer
K - Kistler Transducer

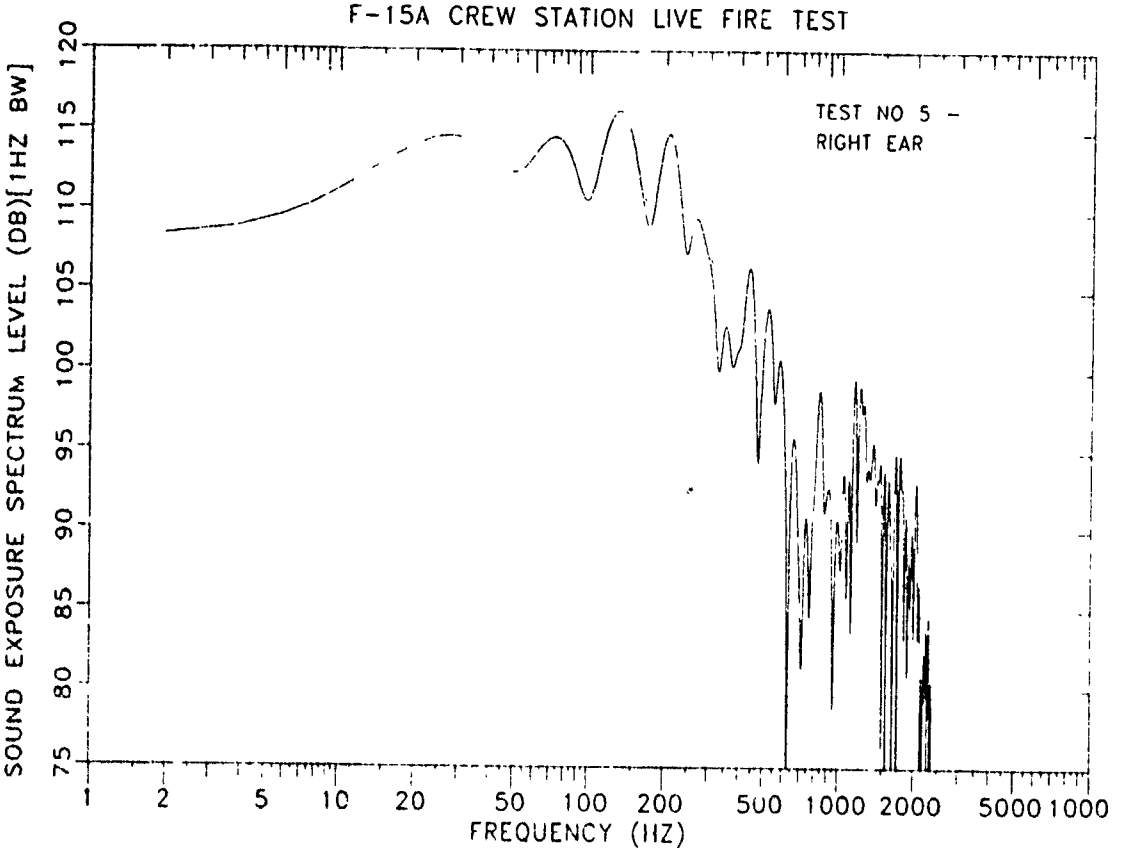
PSF in lbs/sqft
SPL in dB re .00002 N/sqm

Table 3

Auditory Response to Blast Overpressure

Nature of Auditory Response	Blast Overpressure Experience or Prediction
Rupture of the Tympanic Membrane	None Expected Below 720 PSF None Observed up to 144 PSF
Aural Pain	None Observed up to 144 PSF
Short Temporary Fullness, Tinnitus	Reported Above 95 PSF
Hearing Loss: Permanent	None Expected from Frequency and Intensity of Blast Overpressure Occurrence
Hearing Loss: Temporary	Mild Temporary Hearing Loss Measured at Exposure of 1875 PSF

TABLE 4


F-15A CREW STATION LIVE FIRE TEST
TEST NO 5 -
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
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1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

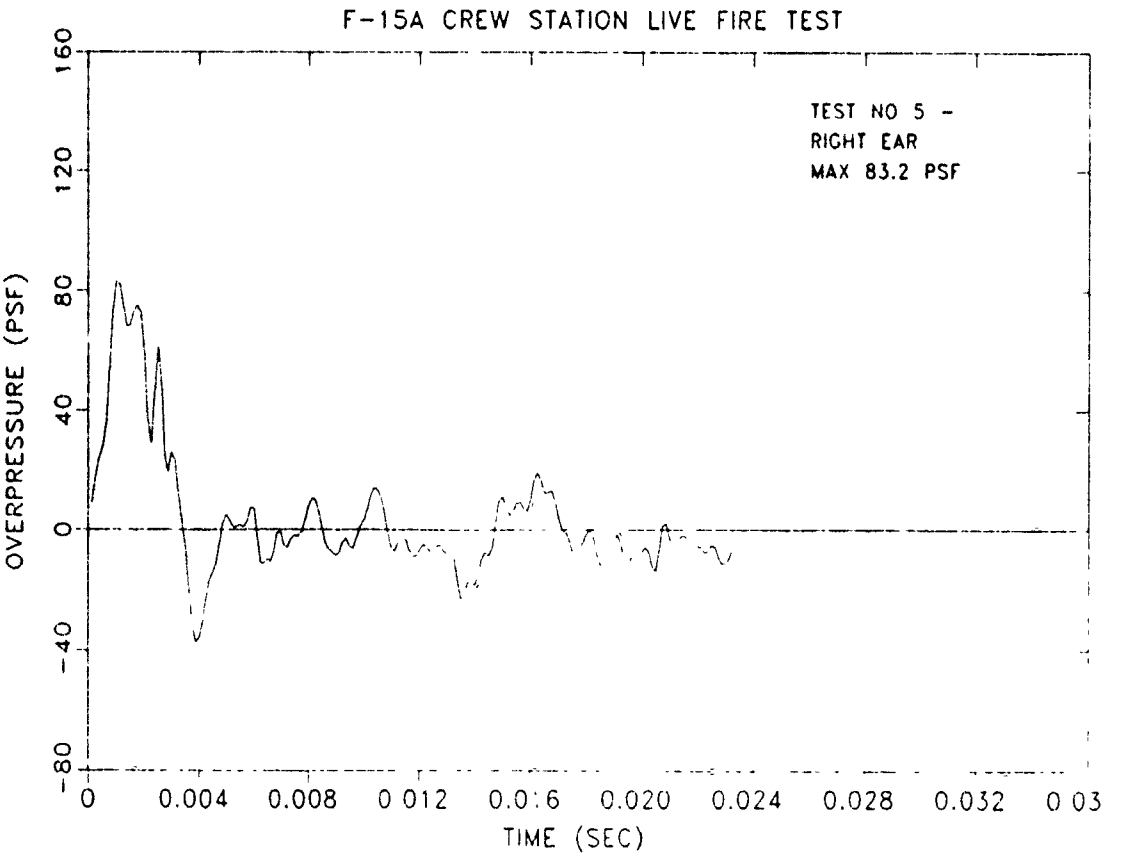
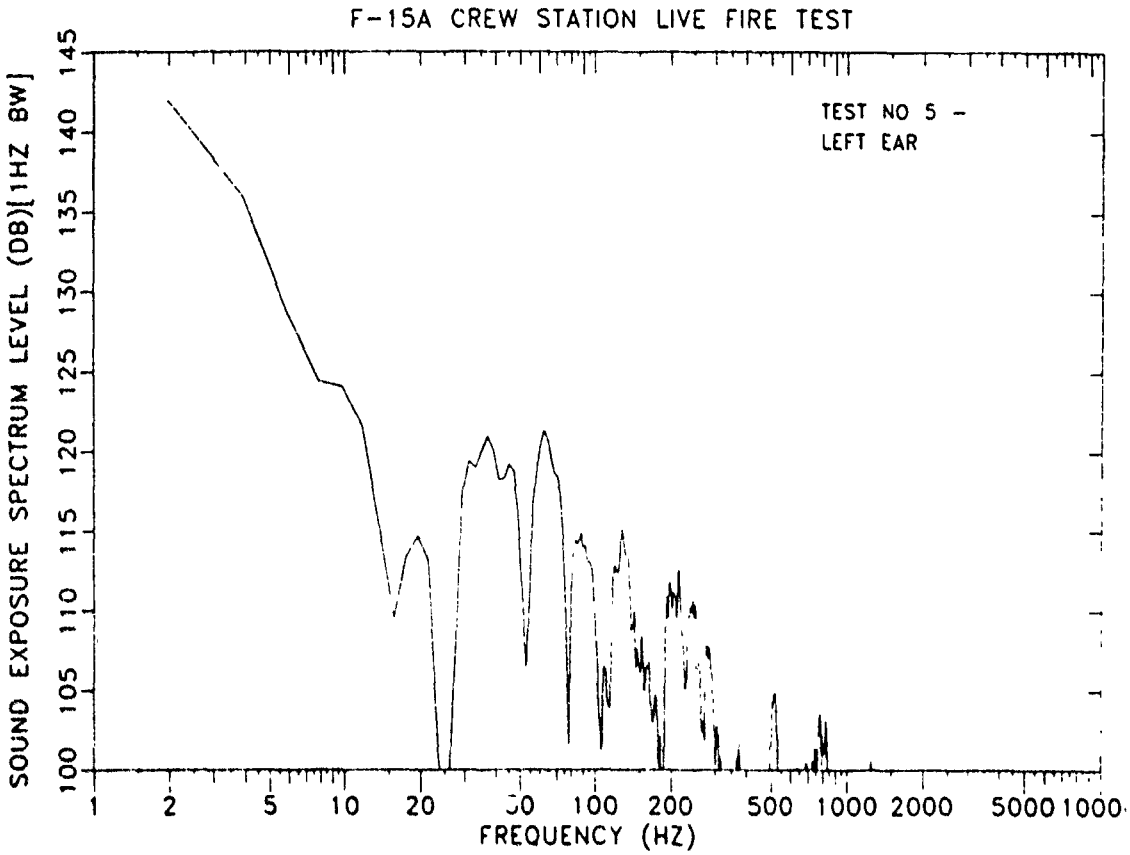

F-15A CREW STATION LIVE FIRE TEST
TEST NO 5 -
RIGHT EAR
MAX 83.2 PSF
OVERPRESSURE (PSF)
-80 -40 0 40 80 120 160
0 0.004 0.008 0 012 0.0:6 0.020 0.024 0.028 0.032 0 03
TIME (SEC)

Figure 1


F-15A CREW STATION LIVE FIRE TEST
TEST NO 5 -
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
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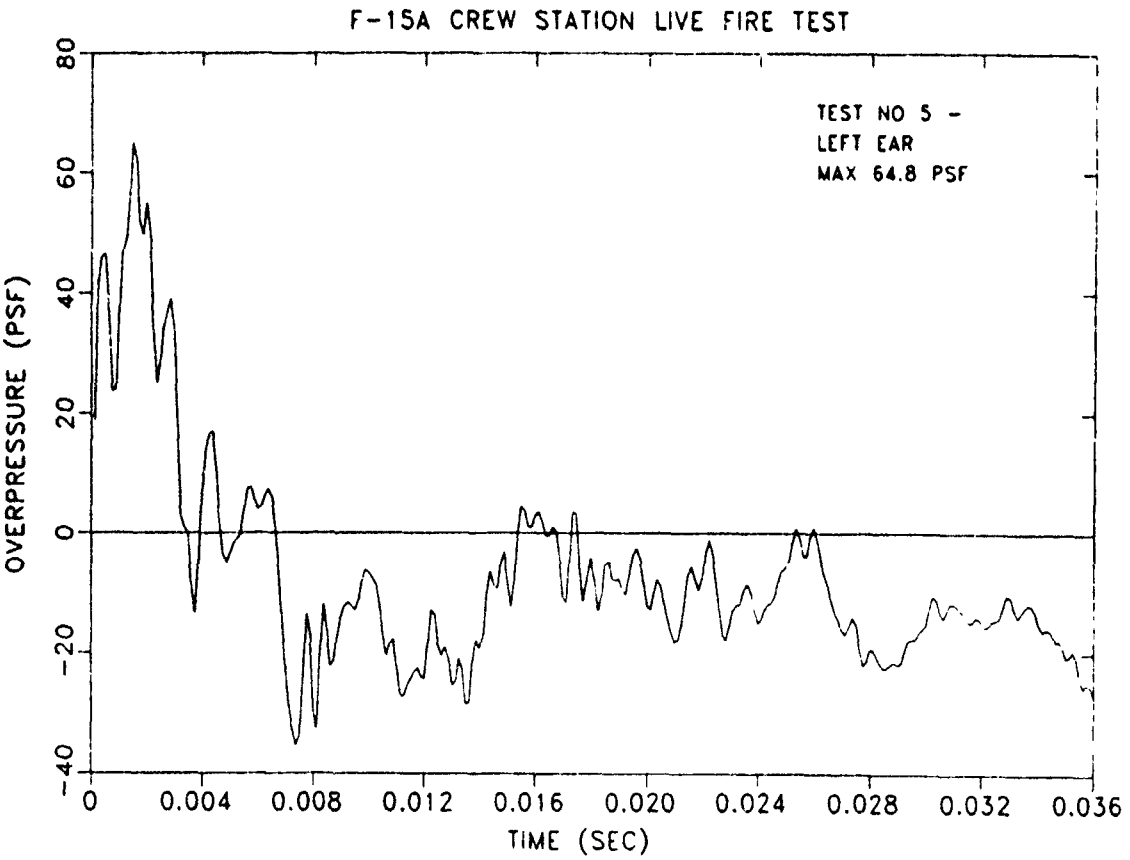
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)


F-15A CREW STATION LIVE FIRE TEST
TEST NO 5 -
LEFT EAR
MAX 64.8 PSF
OVERPRESSURE (PSF)
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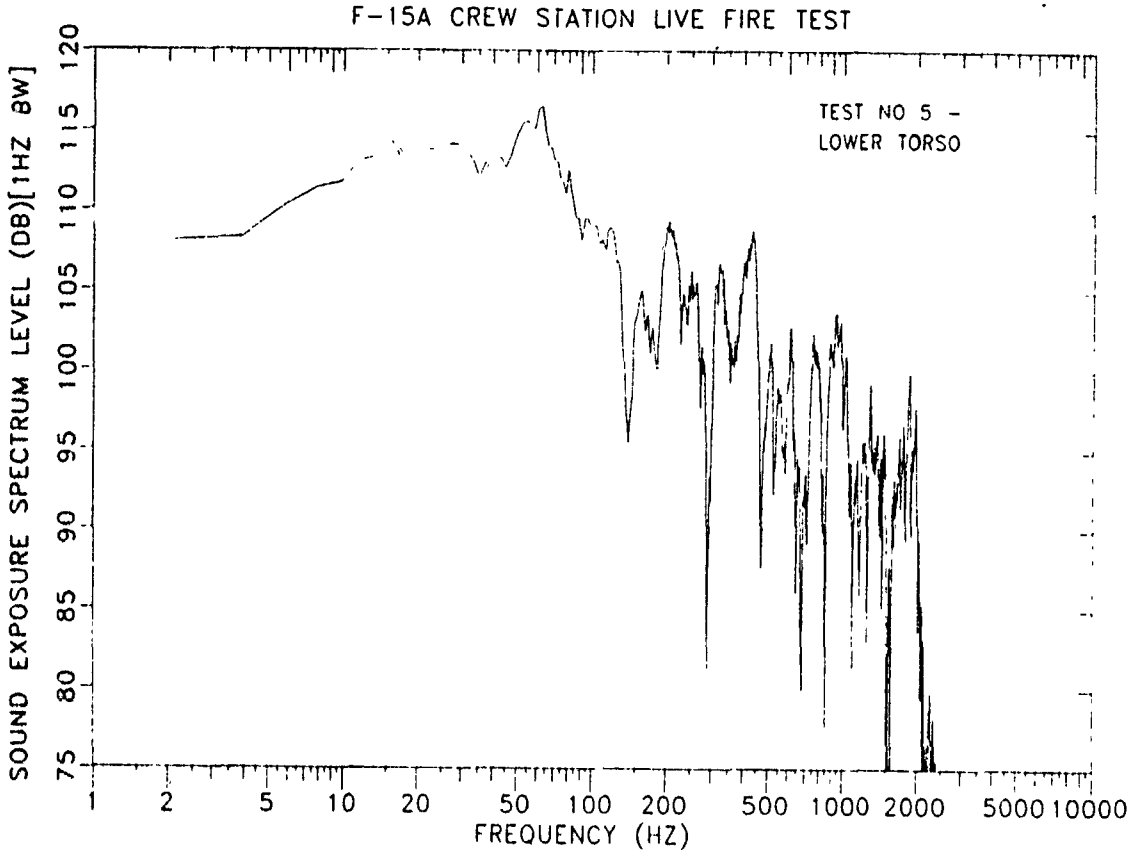
TIME (SEC)

Figure 2


F-15A CREW STATION LIVE FIRE TEST
TEST NO 5 -
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
75
80
85
90
95
100
105
110
115
120
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

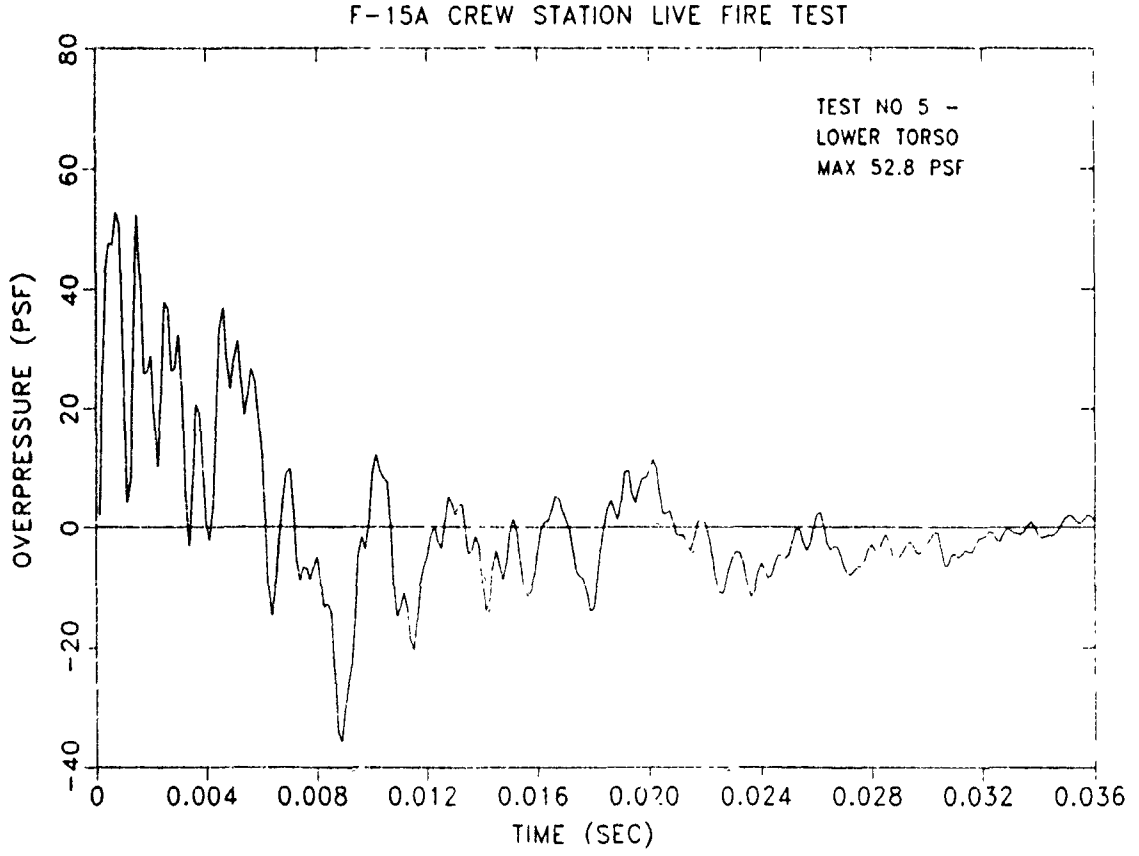
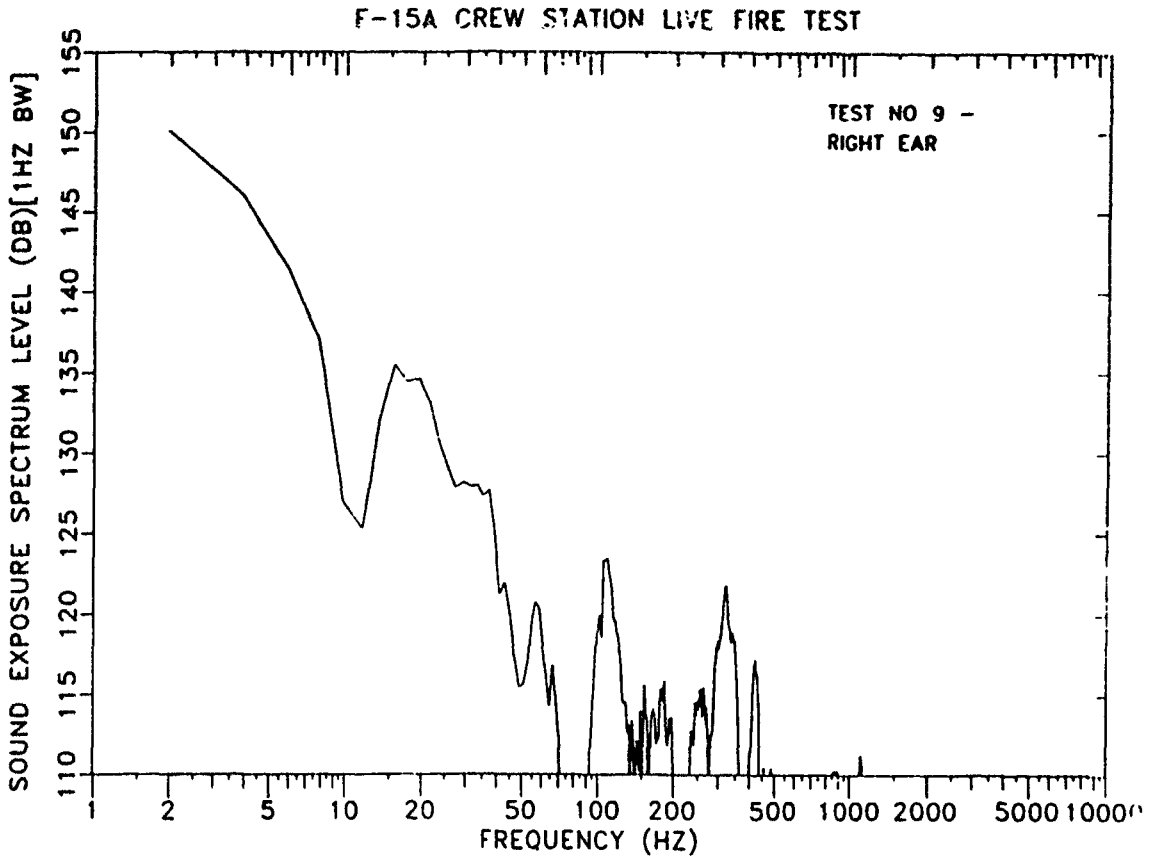

F-15A CREW STATION LIVE FIRE TEST
TEST NO 5 -
LOWER TORSO
MAX 52.8 PSF
OVERPRESSURE (PSF)
80
60
40
20
0
-20
-40
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 3


F-15A CREW STATION LIVE FIRE TEST
TEST NO 9 -
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
110 115 120 125 130 135 140 145 150 155
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

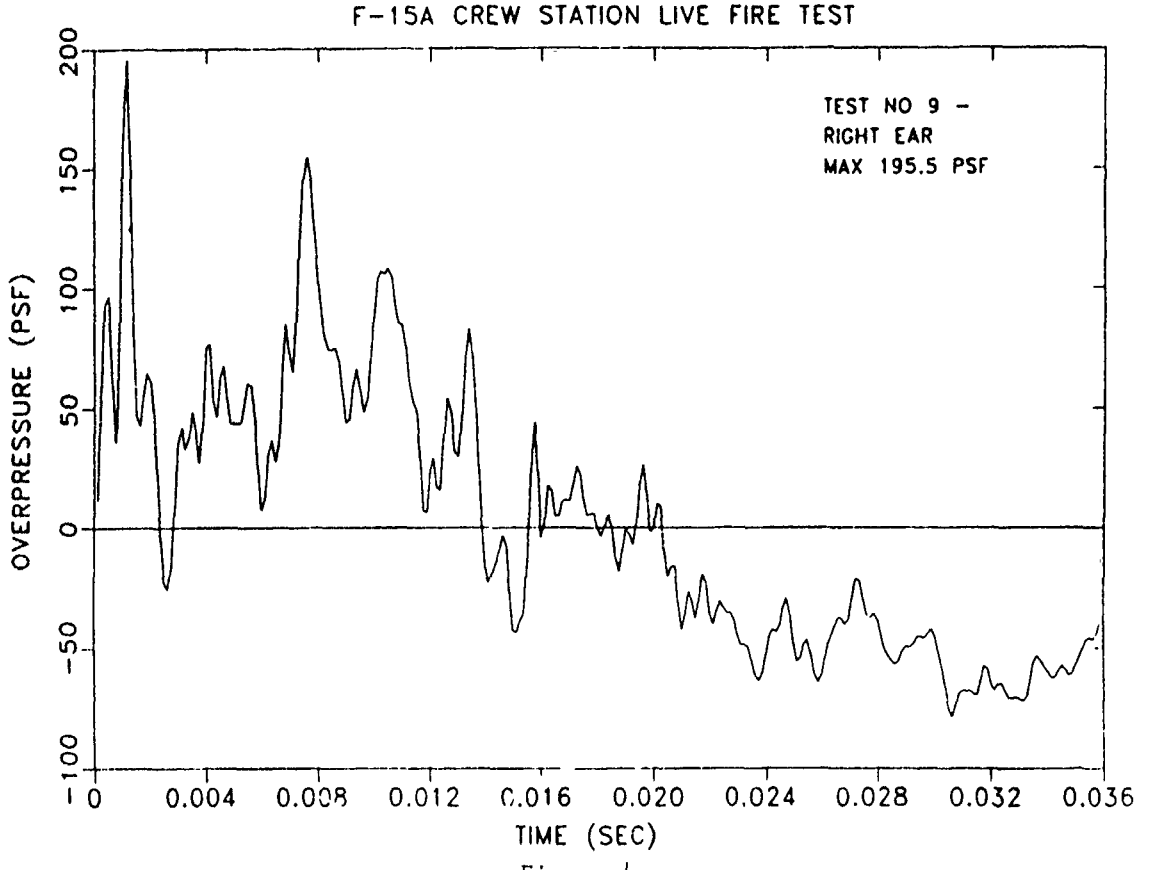
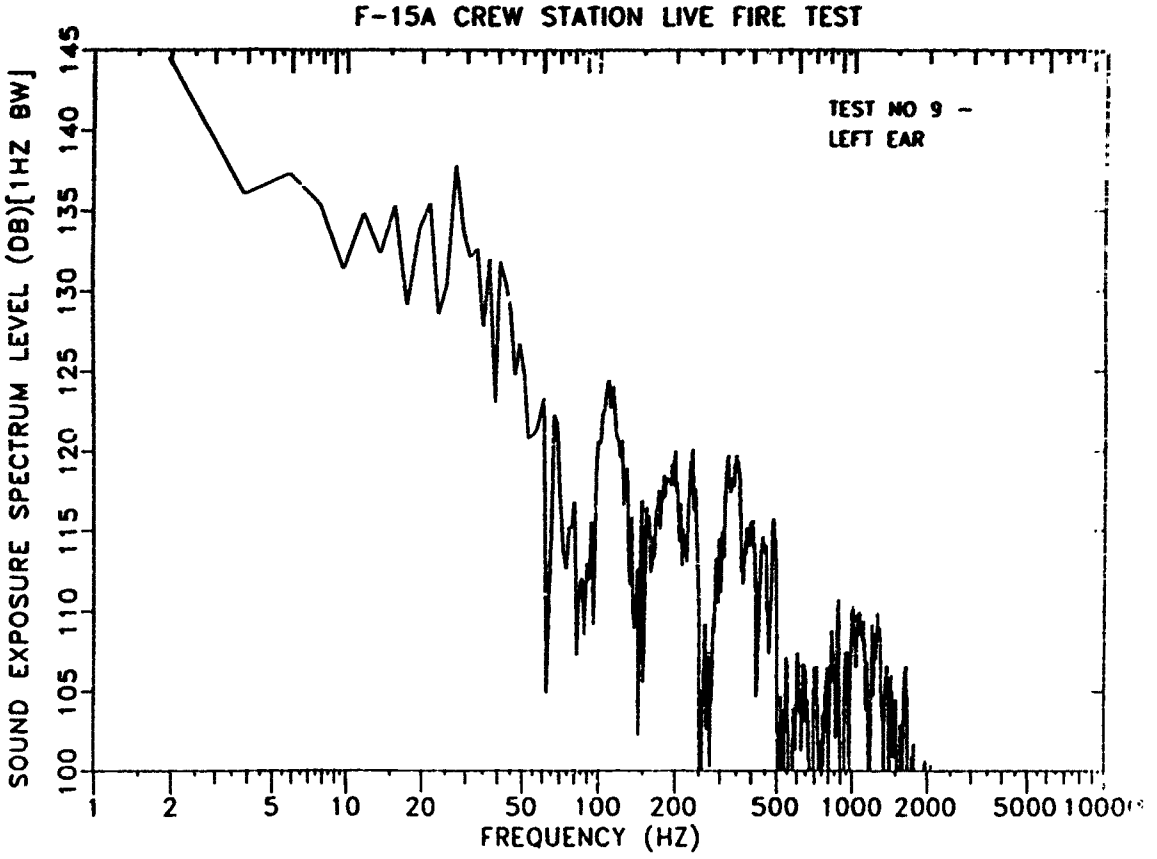

F-15A CREW STATION LIVE FIRE TEST
TEST NO 9 -
RIGHT EAR
MAX 195.5 PSF
OVERPRESSURE (PSF)
-100 -50 0 50 100 150 200
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 4


F-15A CREW STATION LIVE FIRE TEST
TEST NO 9 -
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
100 105 110 115 120 125 130 135 140 145
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

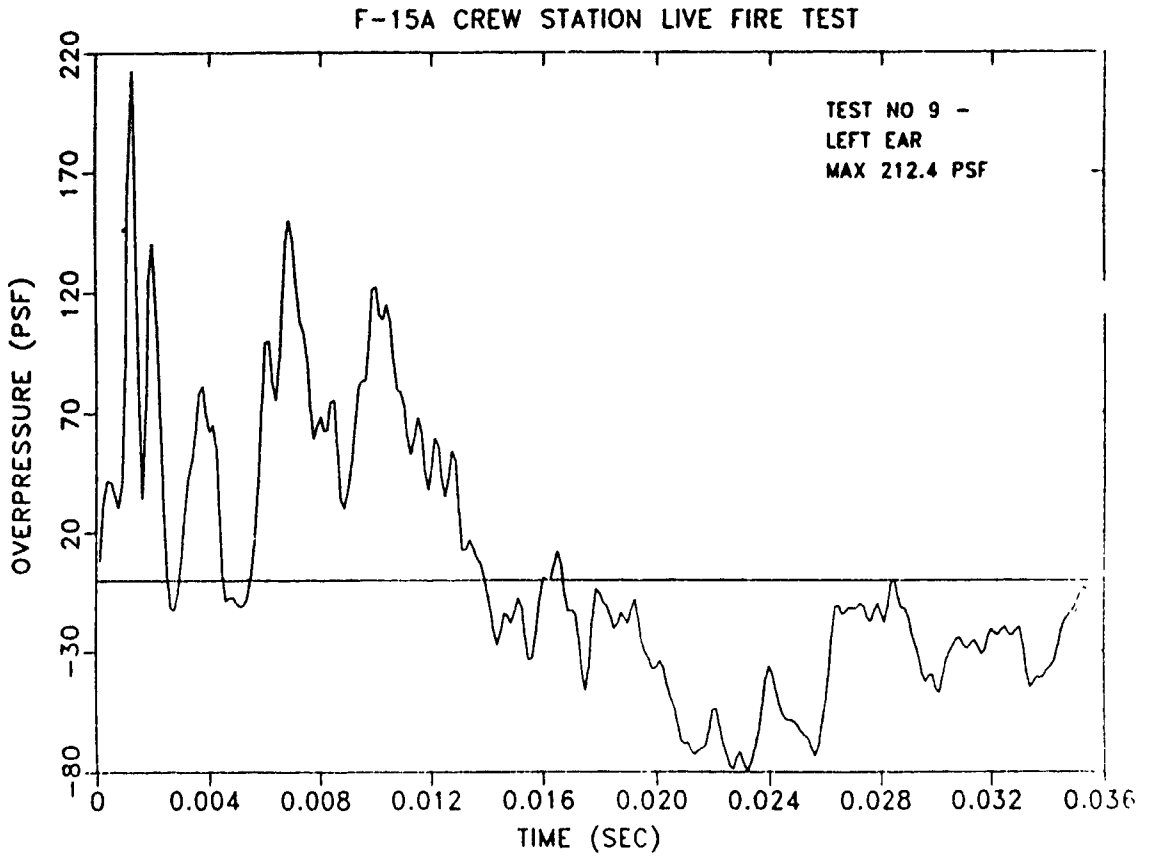
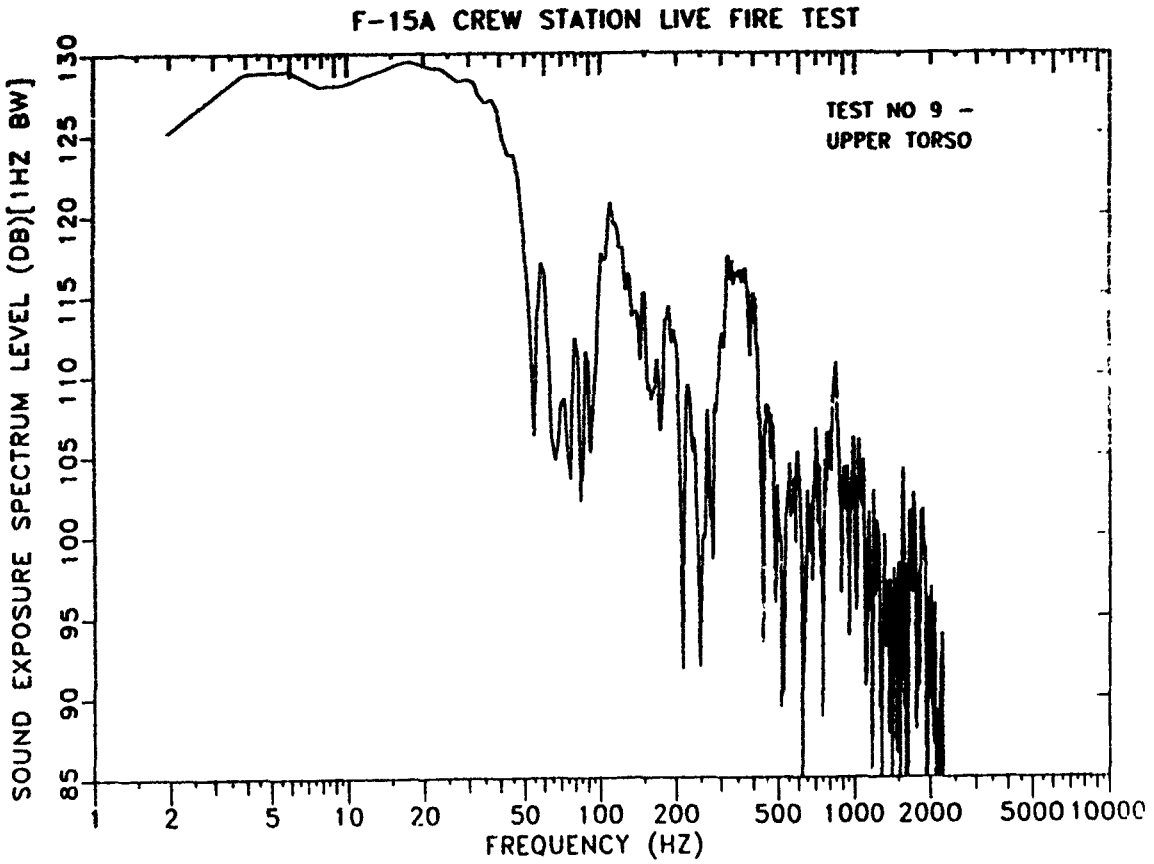

F-15A CREW STATION LIVE FIRE TEST
TEST NO 9 -
LEFT EAR
MAX 212.4 PSF
OVERPRESSURE (PSF)
-80 -30 20 70 120 170 220
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 5


F-15A CREW STATION LIVE FIRE TEST
TEST NO 9 -
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
85
90
95
100
105
110
115
120
125
130
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

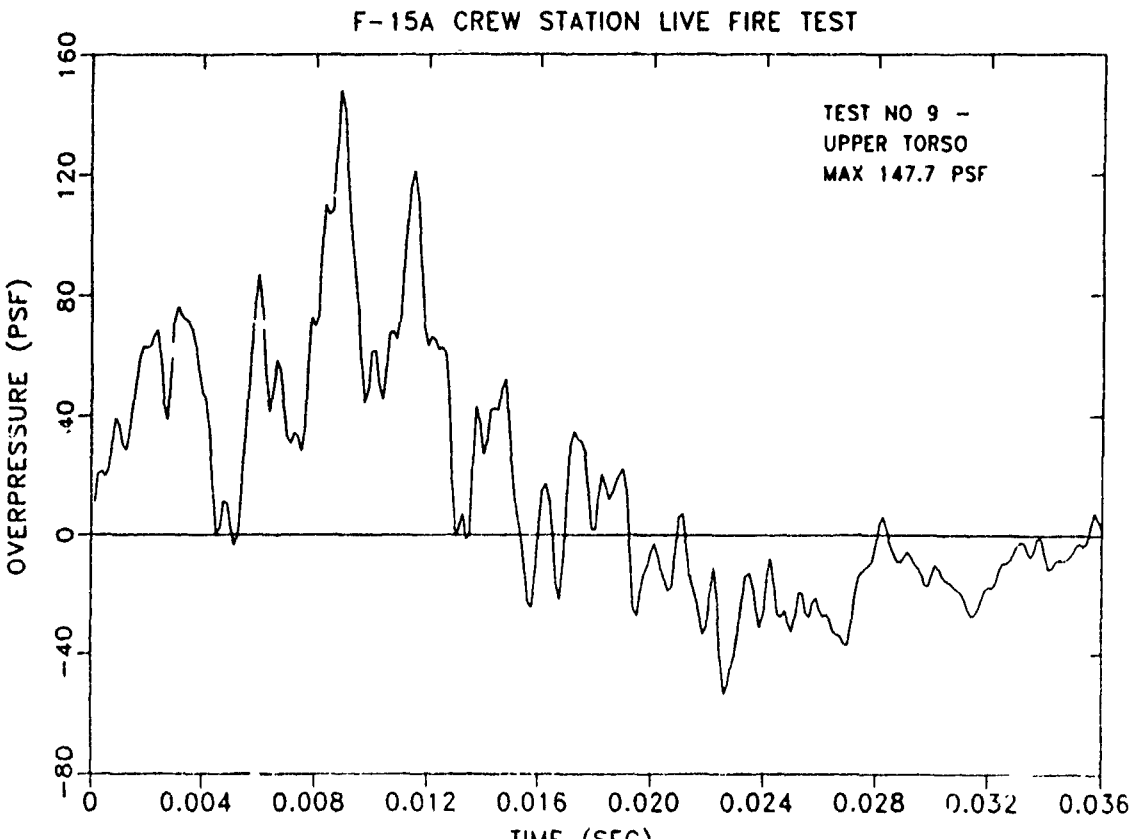
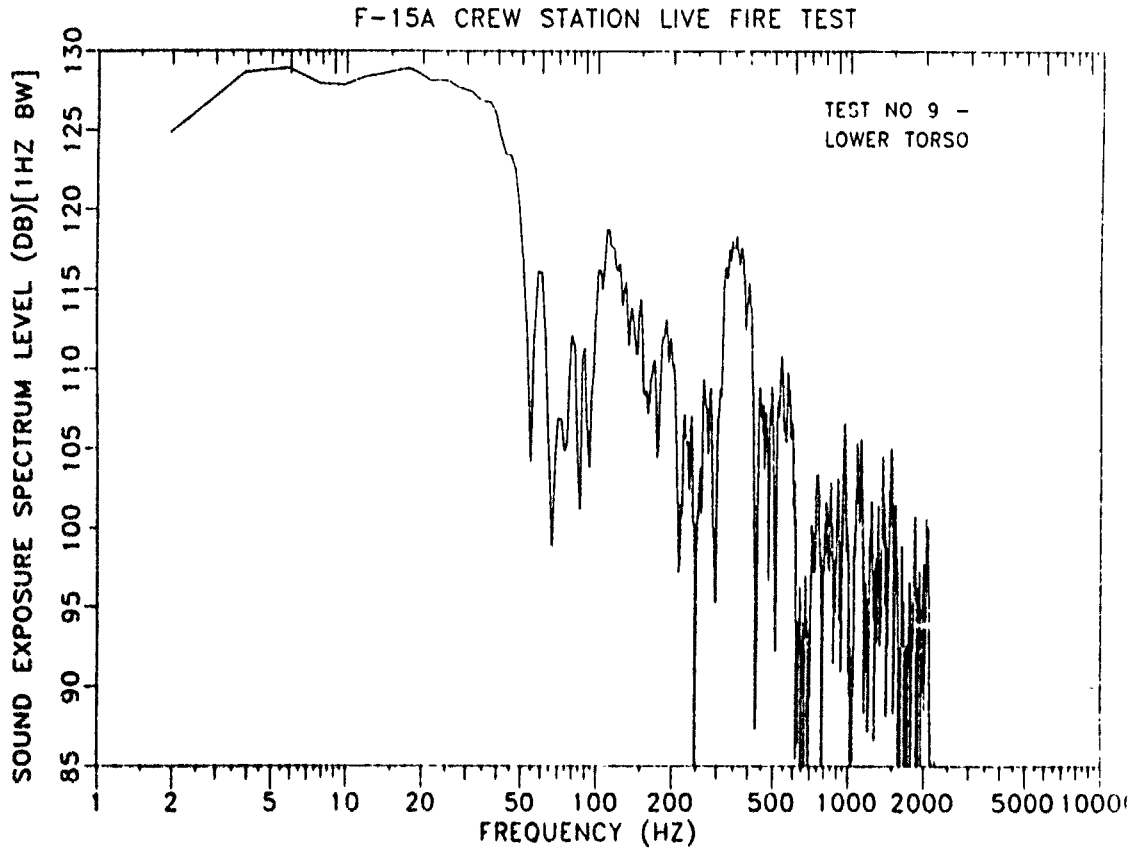

F-15A CREW STATION LIVE FIRE TEST
TEST NO 9 -
UPPER TORSO
MAX 147.7 PSF
OVERPRESSURE (PSF)
160
120
80
40
0
-40
-80
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 6


F-15A CREW STATION LIVE FIRE TEST
TEST NO 9 -
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
85
90
95
100
105
110
115
120
125
130
1
2
5
10
20
50
100
200
500
1000
2000
5000
FREQUENCY (HZ)

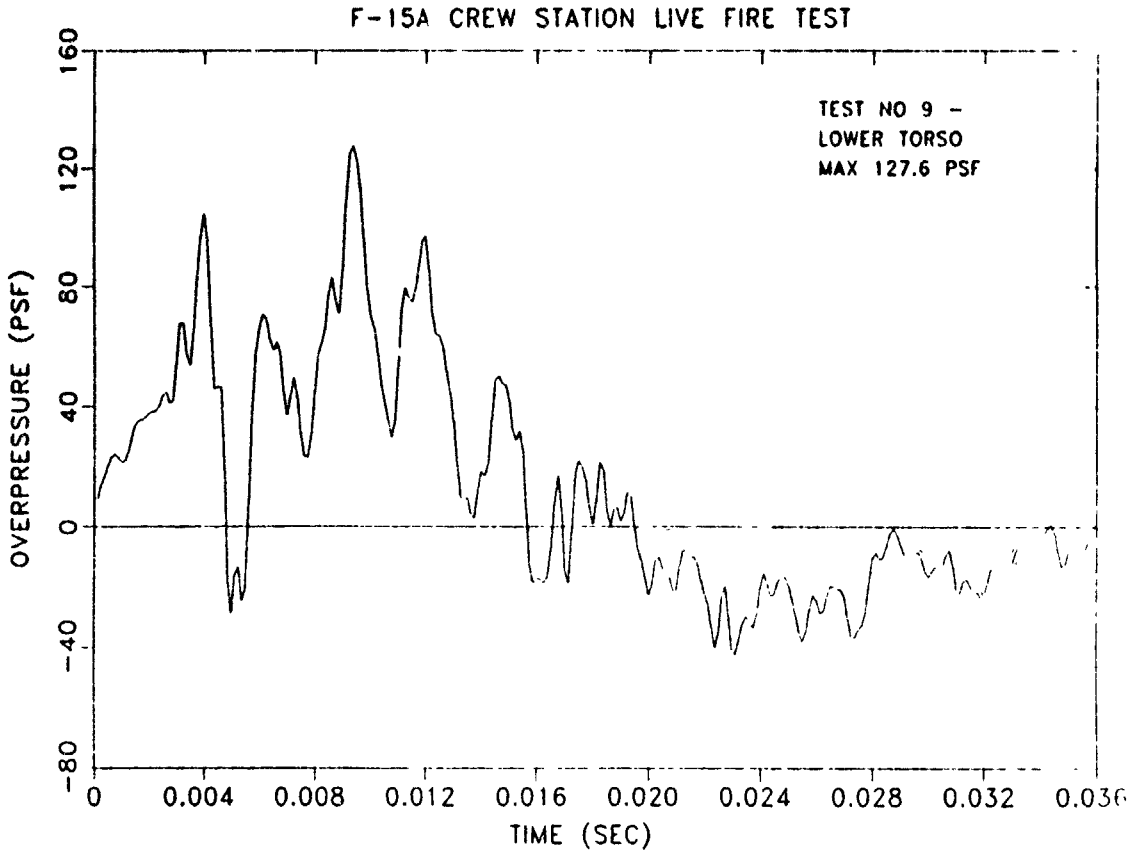
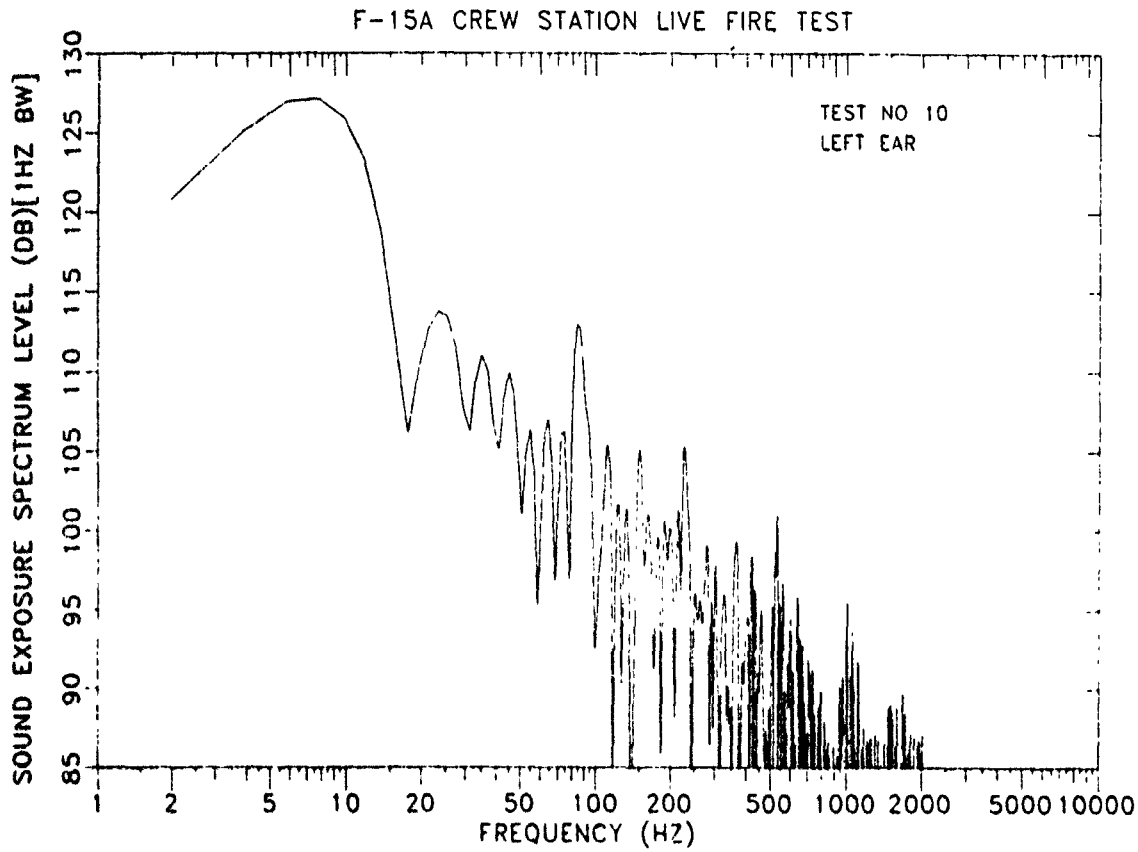

F-15A CREW STATION LIVE FIRE TEST
TEST NO 9 -
LOWER TORSO
MAX 127.6 PSF
OVERPRESSURE (PSF)
160
120
80
40
0
-40
-80
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
TIME (SEC)

Figure 7


F-15A CREW STATION LIVE FIRE TEST
TEST NO 10
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
85 90 95 100 105 110 115 120 125 130
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

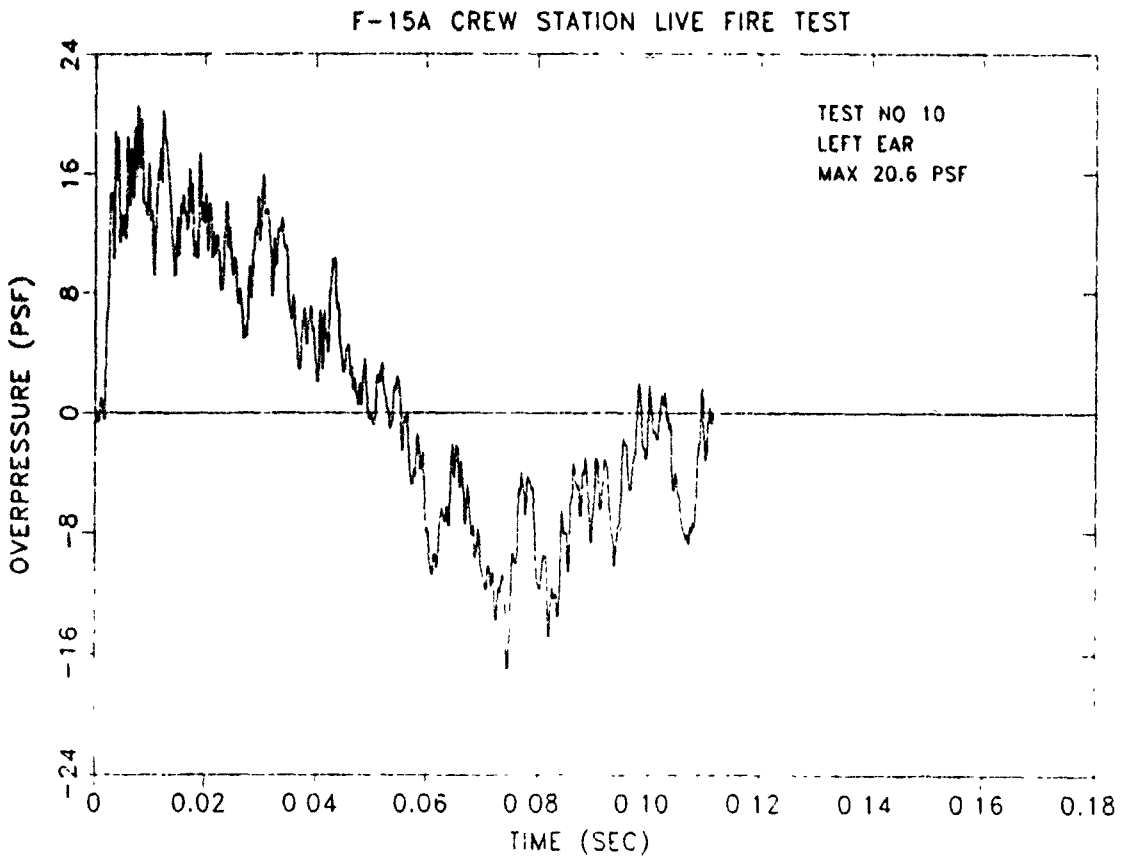
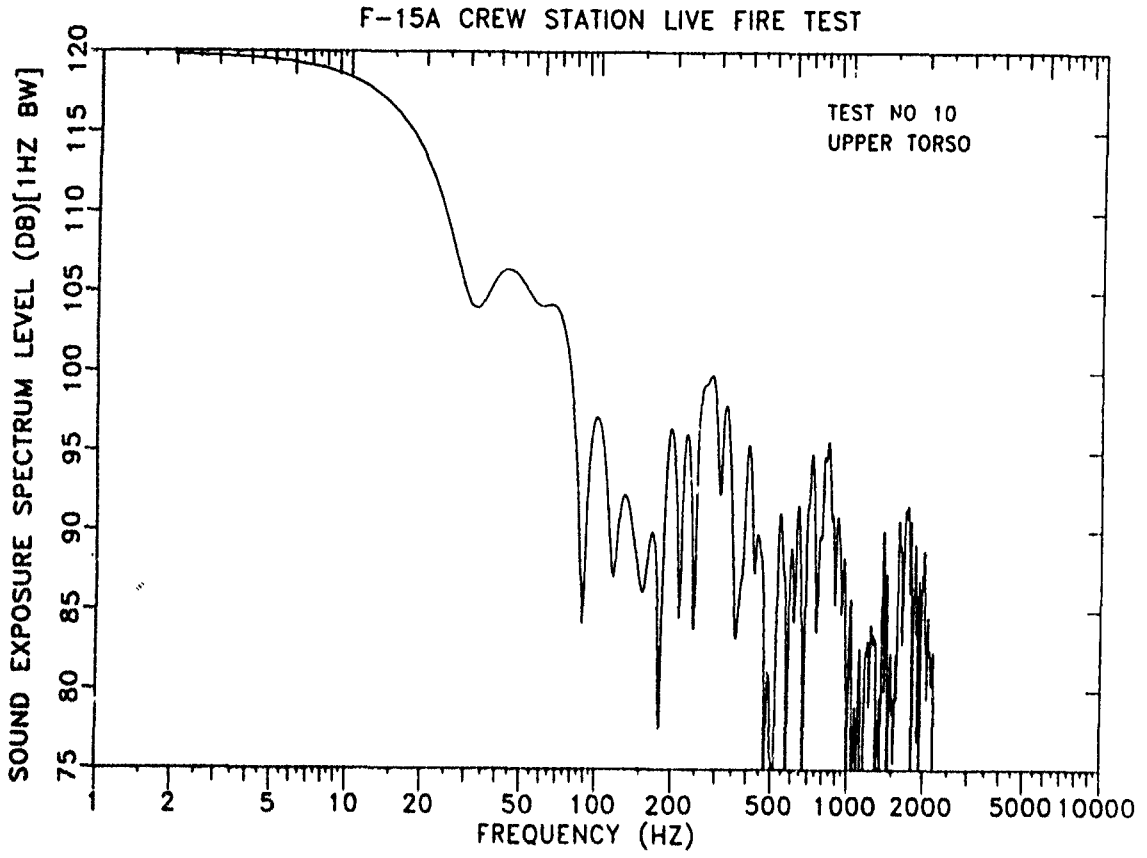

F-15A CREW STATION LIVE FIRE TEST
TEST NO 10
LEFT EAR
MAX 20.6 PSF
OVERPRESSURE (PSF)
24 16 8 0 -8 -16 -24
0 0.02 0 04 0.06 0 08 0 10 0 12 0 14 0 16 0.18
TIME (SEC)

Figure 8


F-15A CREW STATION LIVE FIRE TEST
TEST NO 10
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
75
80
85
90
95
100
105
110
115
120
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

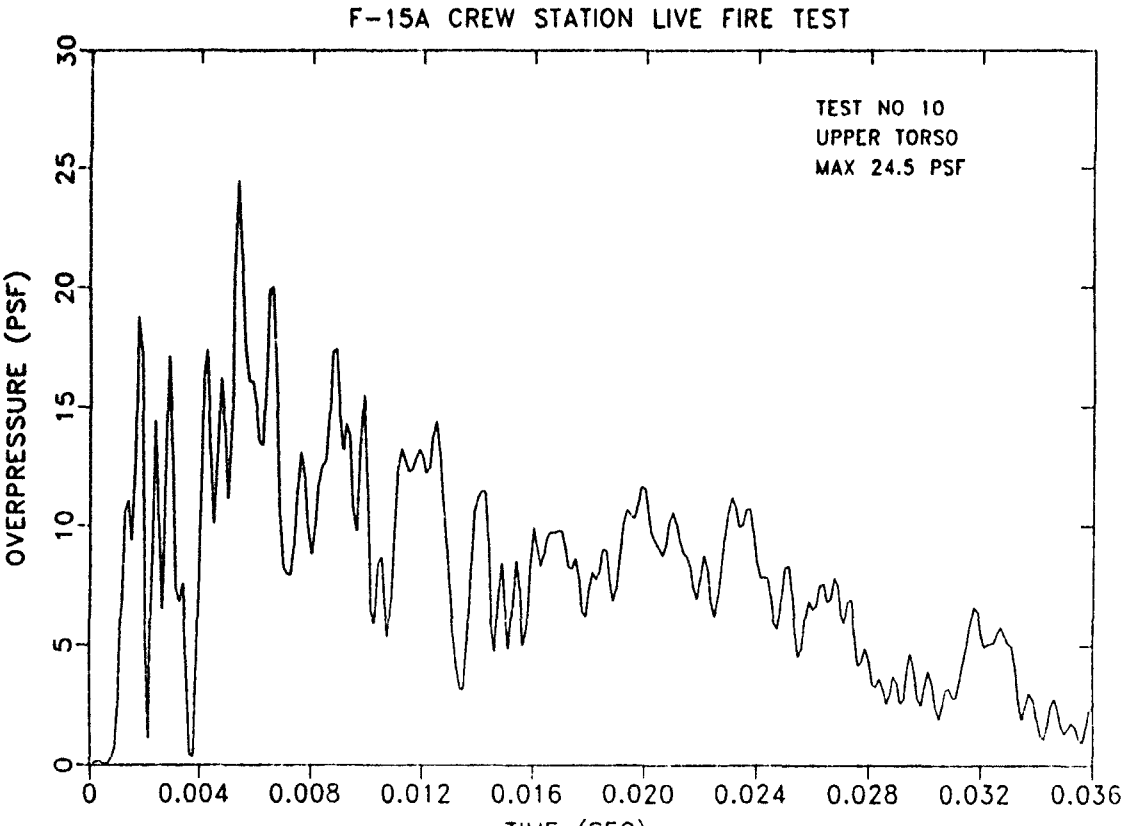
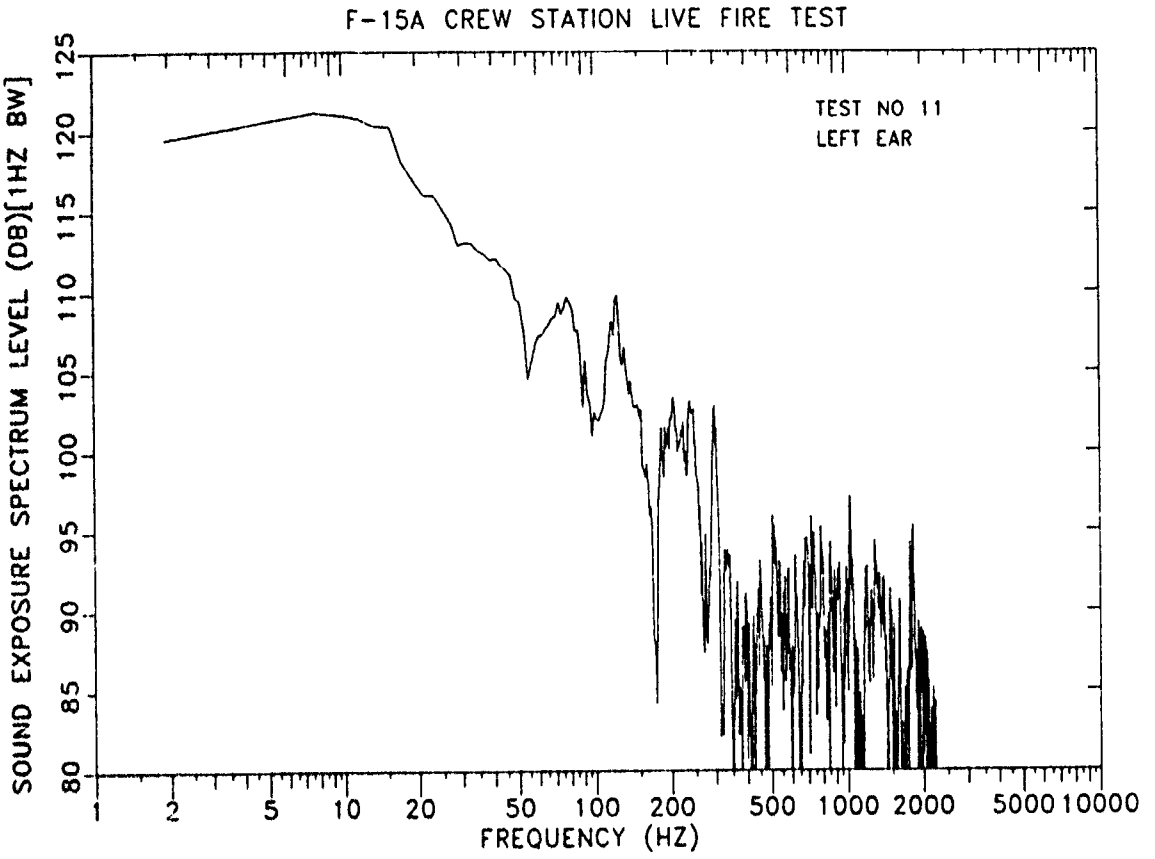

F-15A CREW STATION LIVE FIRE TEST
TEST NO 10
UPPER TORSO
MAX 24.5 PSF
OVERPRESSURE (PSF)
0
5
10
15
20
25
30
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 9


F-15A CREW STATION LIVE FIRE TEST
TEST NO 11
LEFT EAR
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
2000
5000
10000
FREQUENCY (HZ)

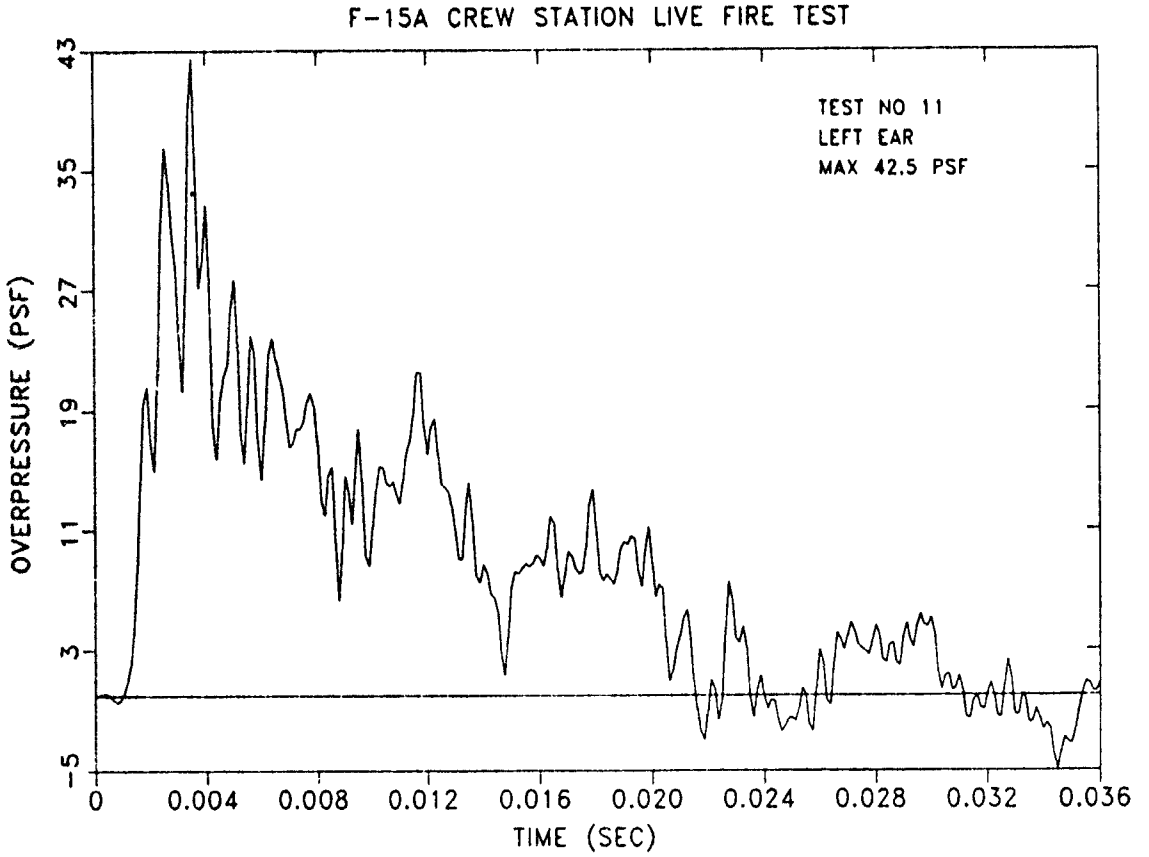
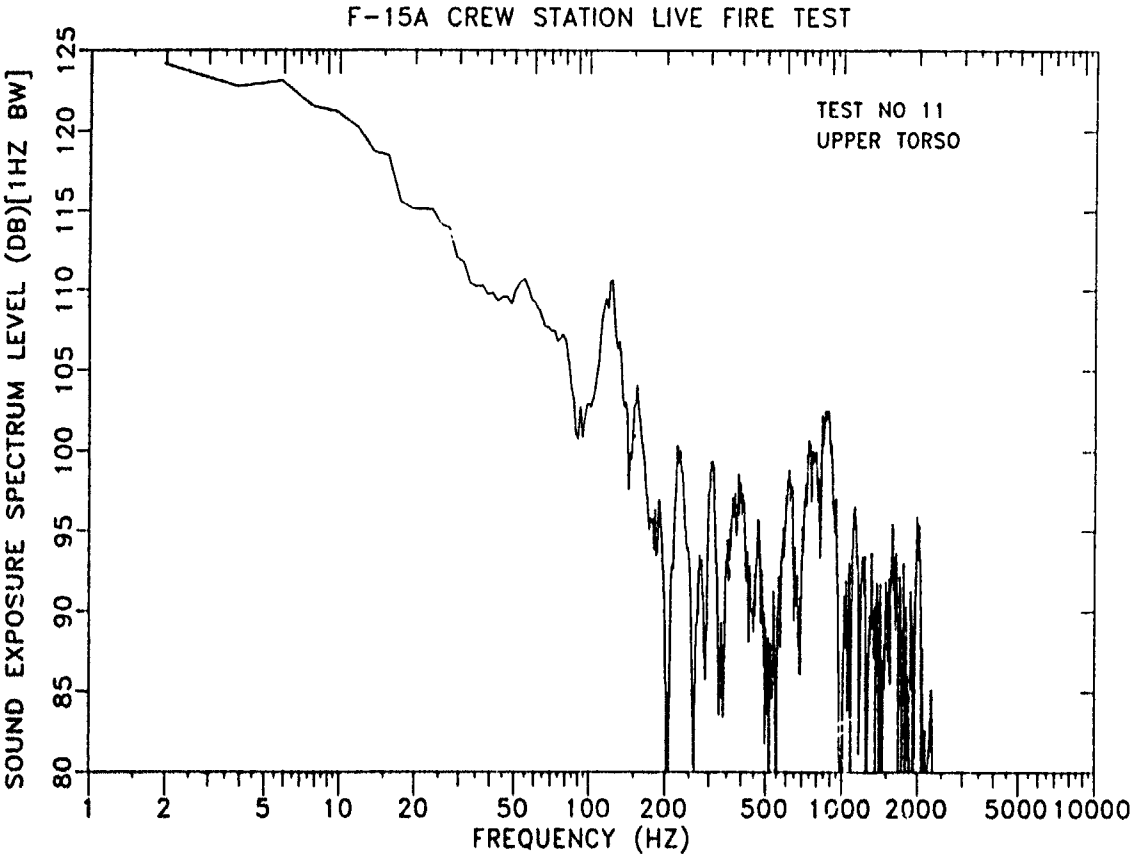

F-15A CREW STATION LIVE FIRE TEST
TEST NO 11
LEFT EAR
MAX 42.5 PSF
OVERPRESSURE (PSF)
-5
3
11
19
27
35
43
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 10


F-15A CREW STATION LIVE FIRE TEST
TEST NO 11
UPPER TORSO
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
2000
5000
10000
FREQUENCY (HZ)

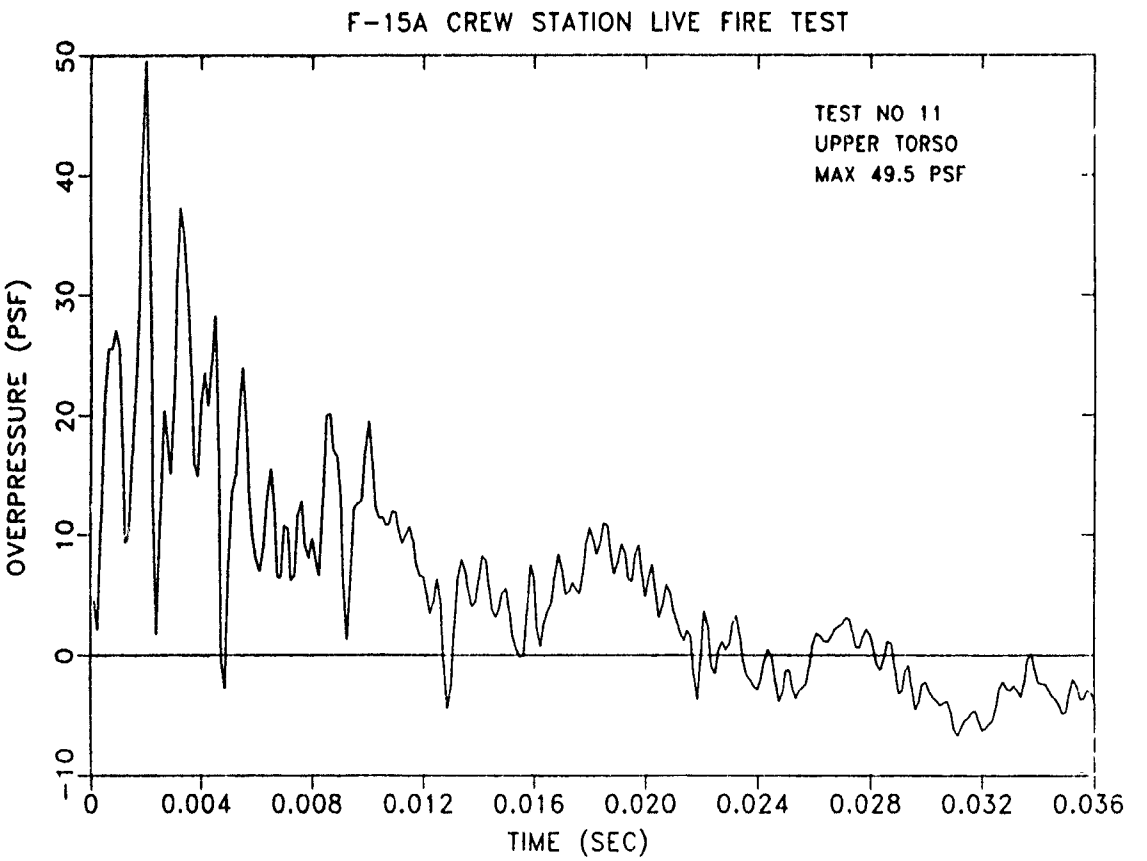
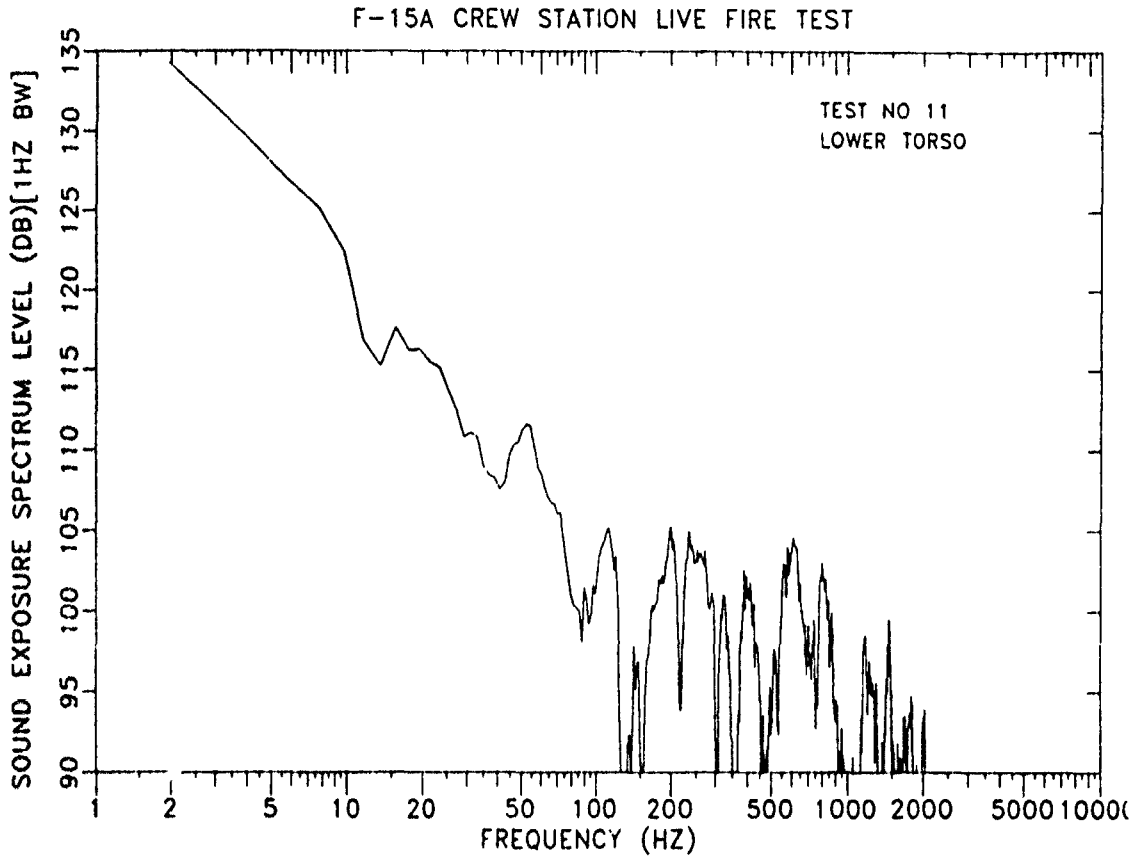

F-15A CREW STATION LIVE FIRE TEST
TEST NO 11
UPPER TORSO
MAX 49.5 PSF
OVERPRESSURE (PSF)
-10
0
10
20
30
40
50
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 11


F-15A CREW STATION LIVE FIRE TEST
TEST NO 11
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
90 95 100 105 110 115 120 125 130 135
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

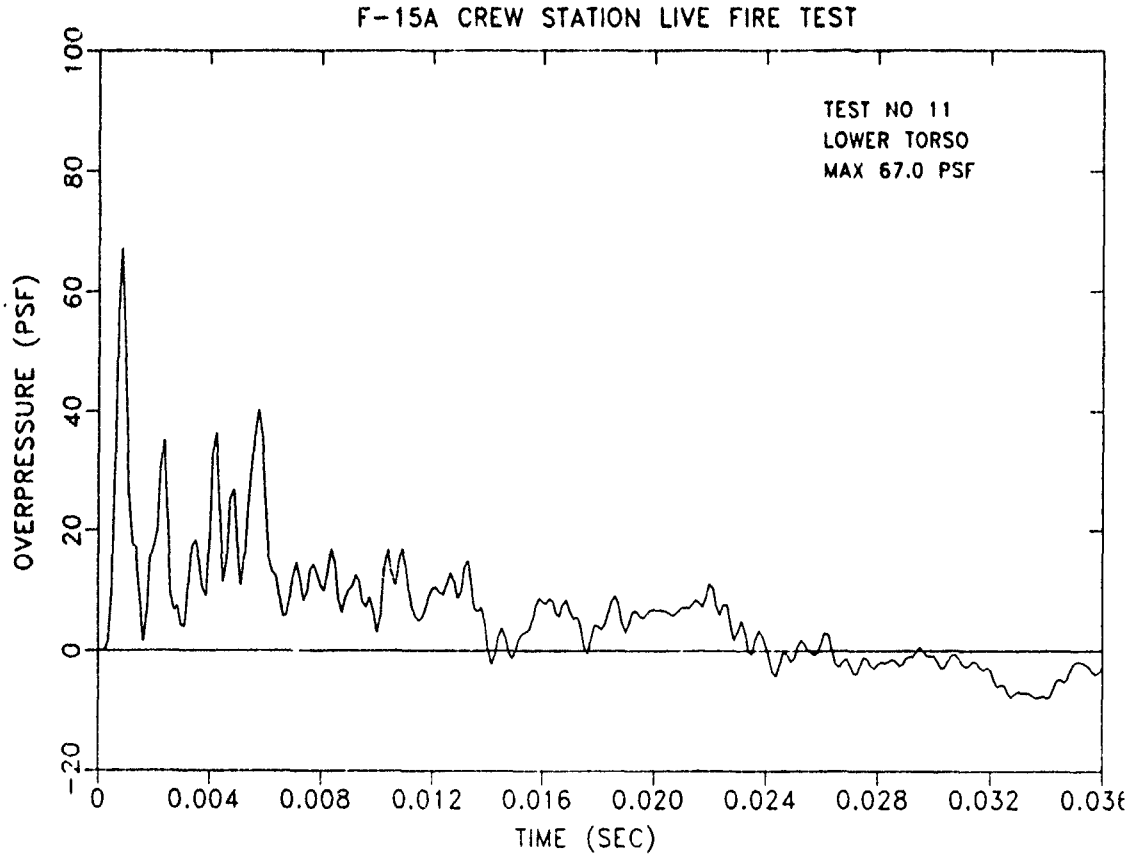
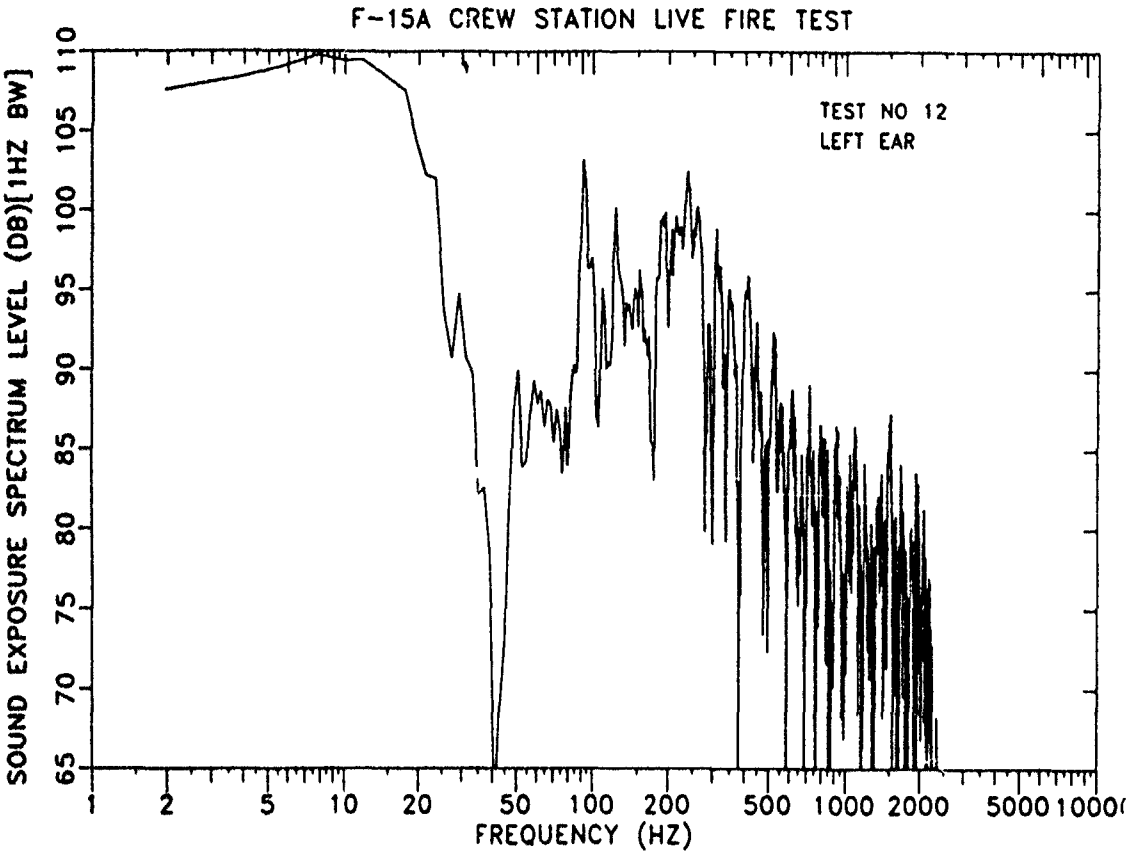

F-15A CREW STATION LIVE FIRE TEST
TEST NO 11
LOWER TORSO
MAX 67.0 PSF
OVERPRESSURE (PSF)
-20 0 20 40 60 80 100
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 12


F-15A CREW STATION LIVE FIRE TEST
TEST NO 12
LEFT EAR
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
2000
5000
FREQUENCY (HZ)

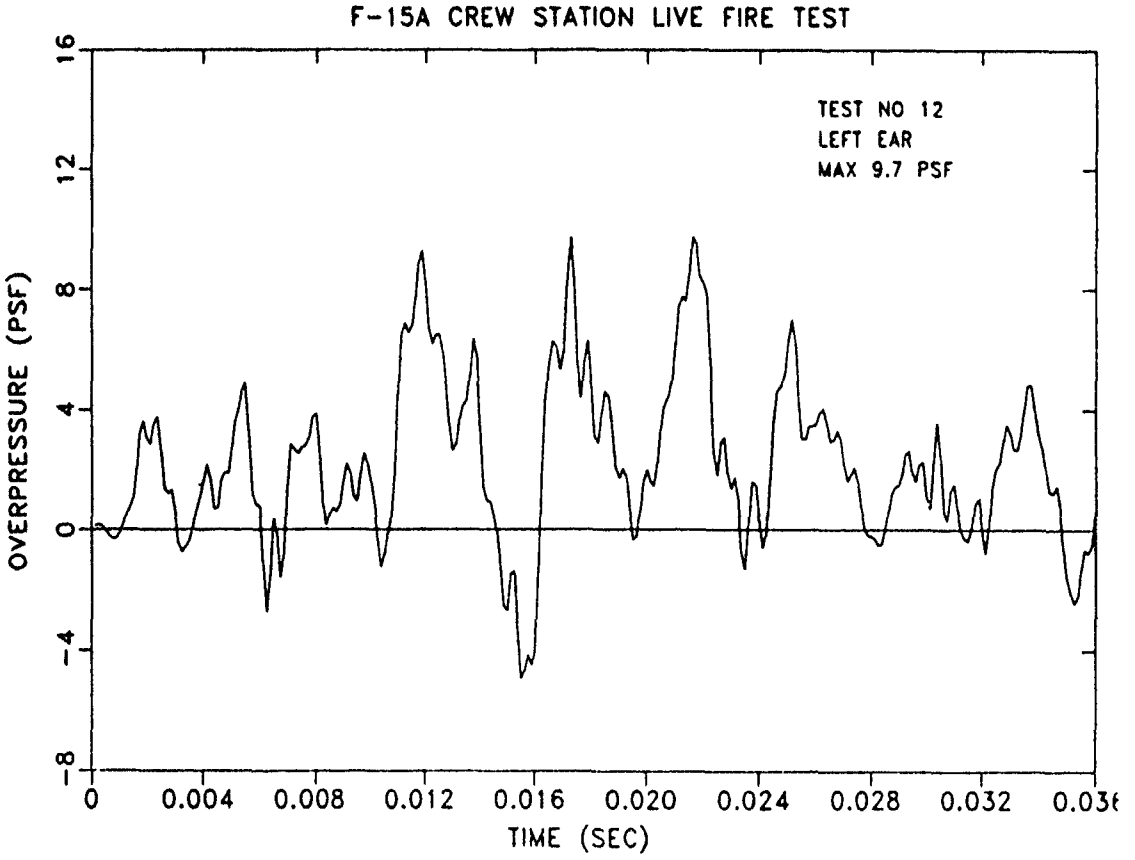
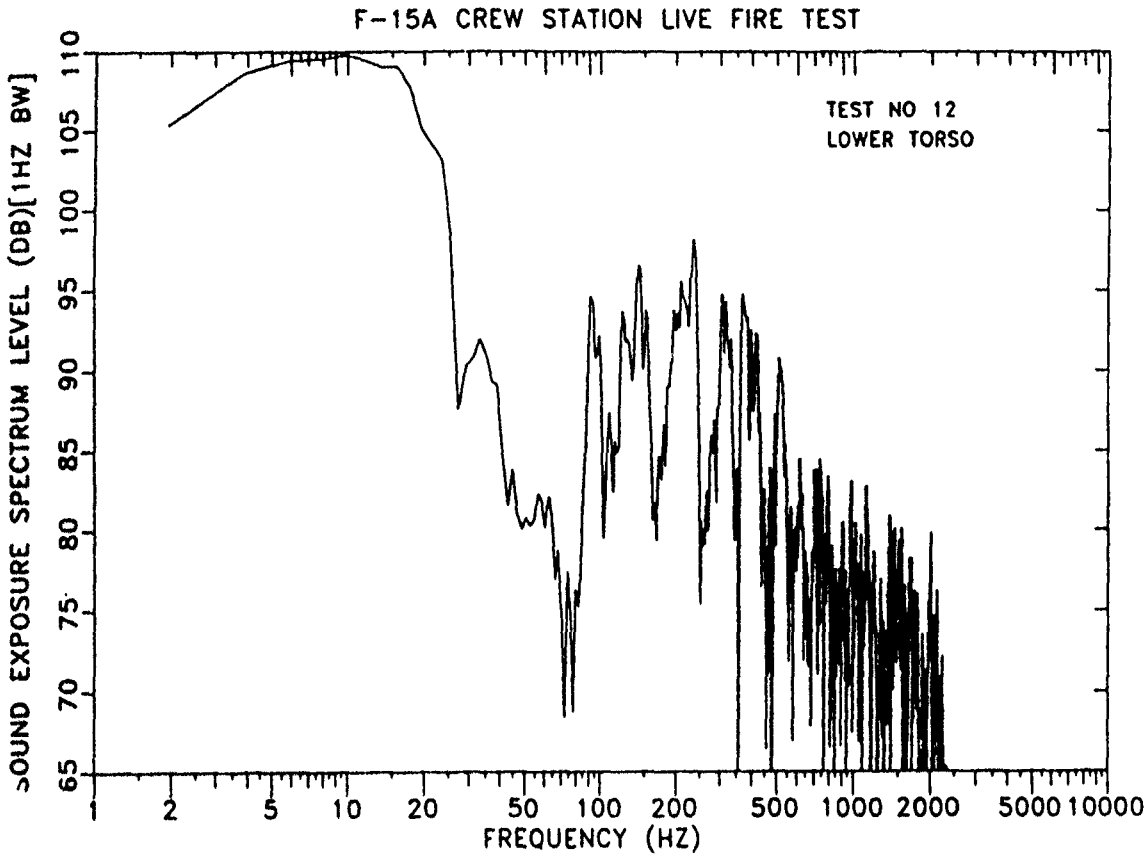

F-15A CREW STATION LIVE FIRE TEST
TEST NO 12
LEFT EAR
MAX 9.7 PSF
OVERPRESSURE (PSF)
16
12
8
4
0
-4
-8
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
TIME (SEC)

Figure 13


F-15A CREW STATION LIVE FIRE TEST
TEST NO 12
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
65
70
75
80
85
90
95
100
105
110
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

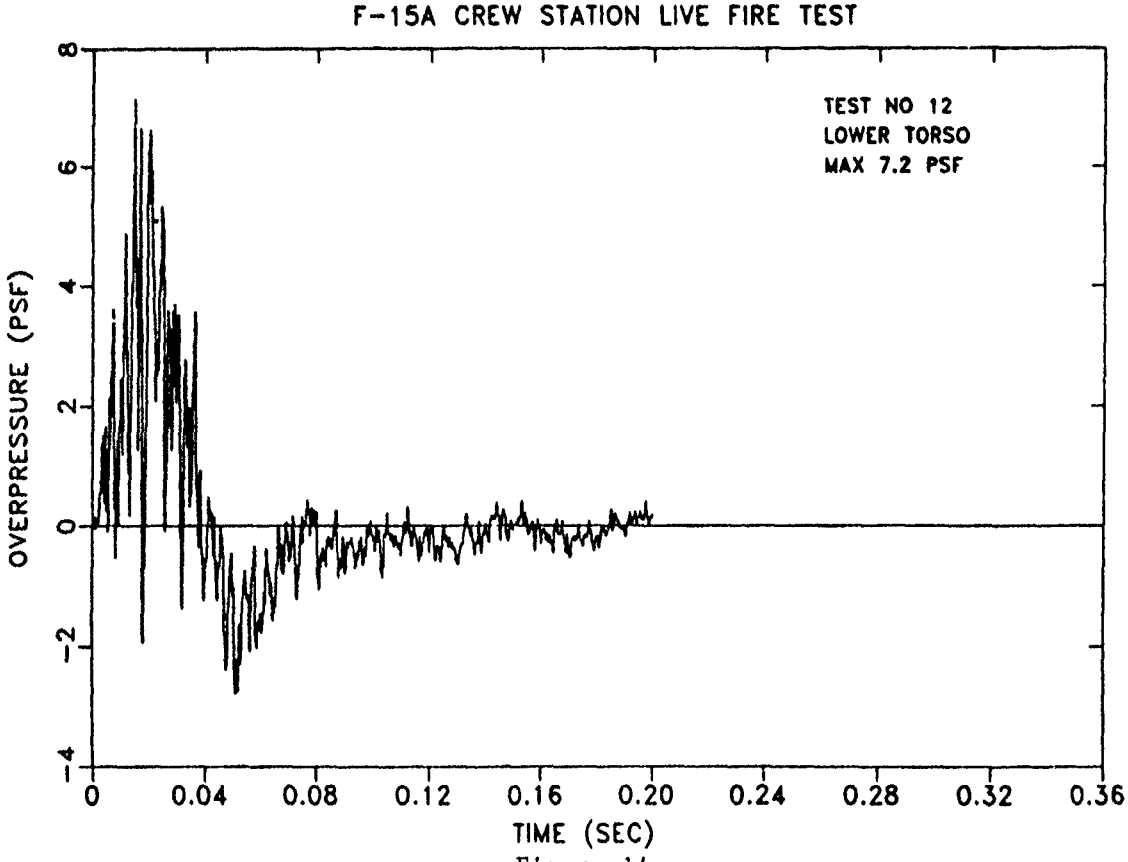
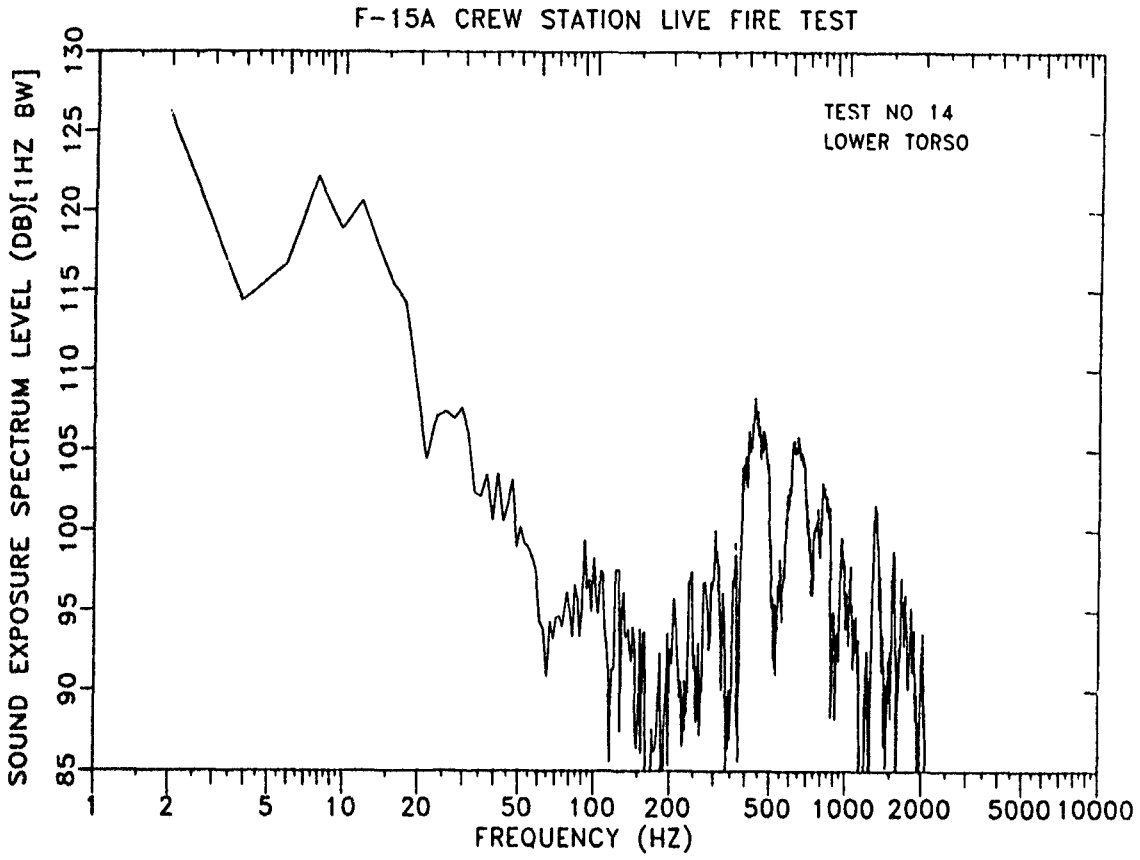

F-15A CREW STATION LIVE FIRE TEST
TEST NO 12
LOWER TORSO
MAX 7.2 PSF
OVERPRESSURE (PSF)
8
6
4
2
0
-2
-4
0
0.04
0.08
0.12
0.16
0.20
0.24
0.28
0.32
0.36
TIME (SEC)

Figure 14


F-15A CREW STATION LIVE FIRE TEST
TEST NO 14
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
85
90
95
100
105
110
115
120
125
130
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

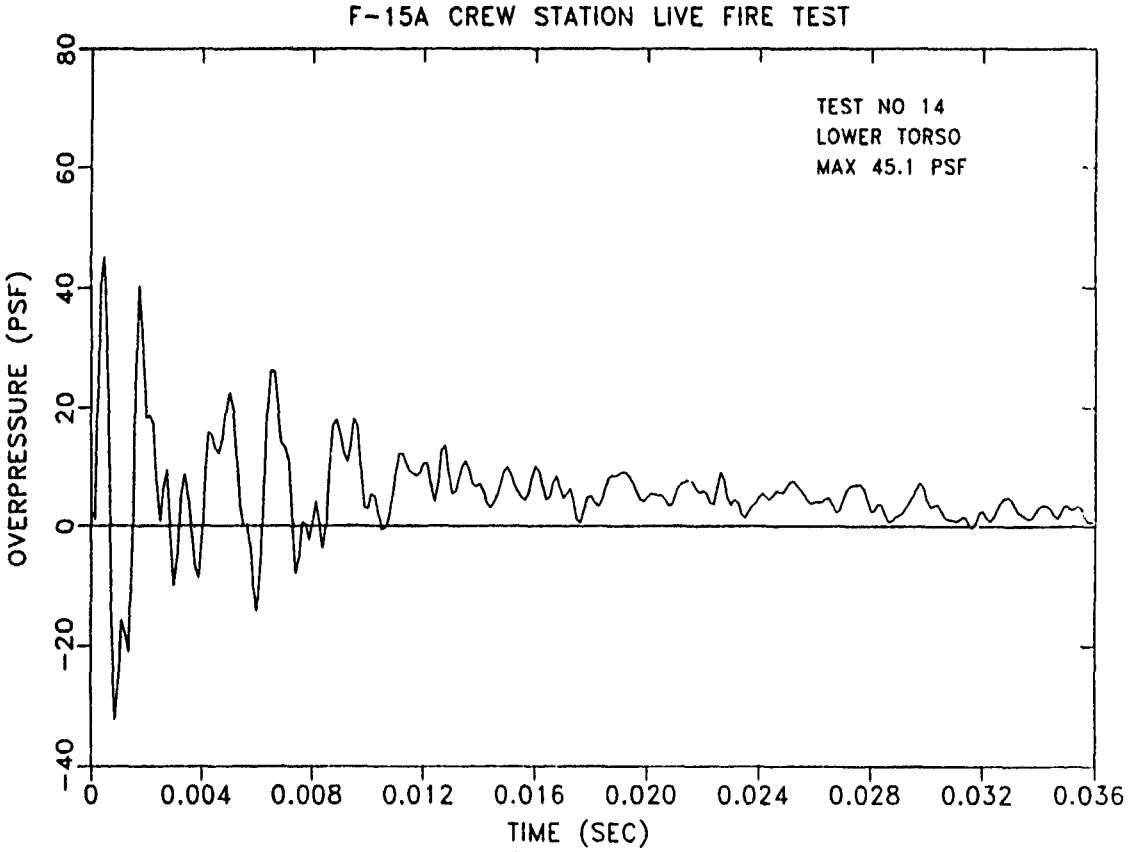
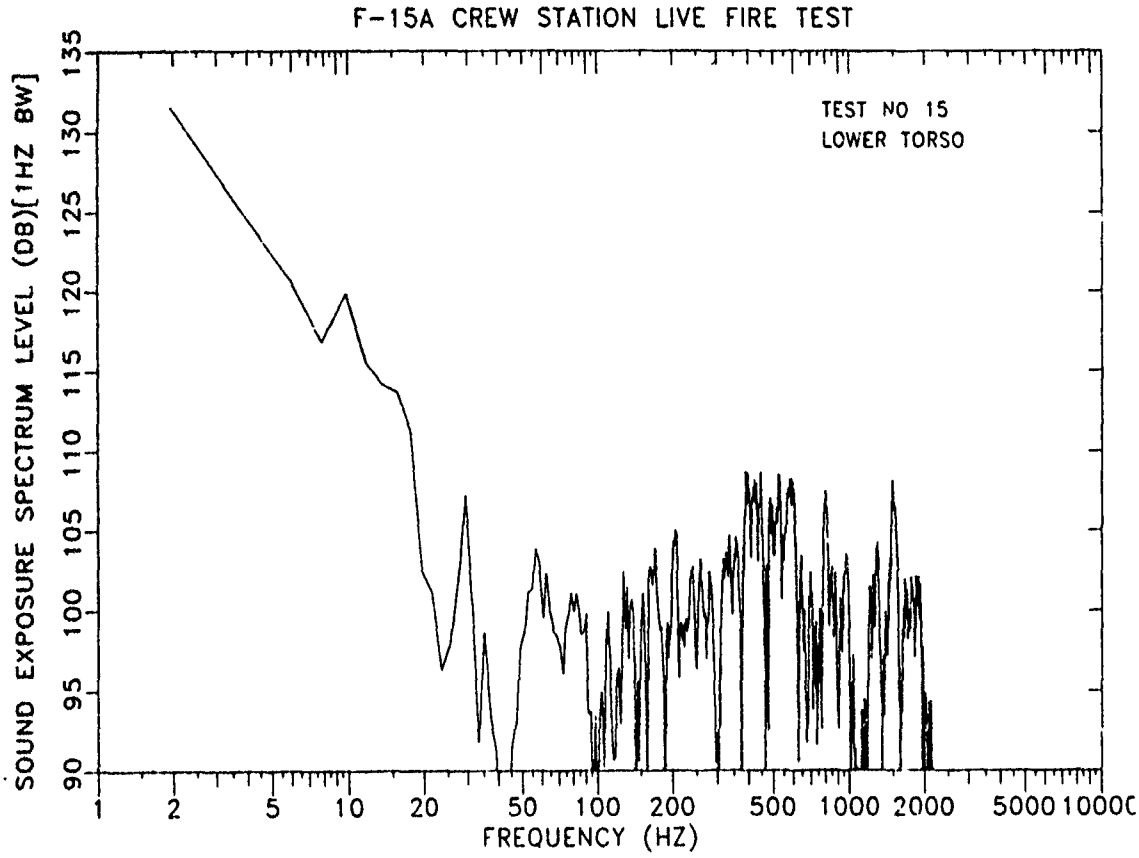

F-15A CREW STATION LIVE FIRE TEST
TEST NO 14
LOWER TORSO
MAX 45.1 PSF
OVERPRESSURE (PSF)
-40
-20
0
20
40
60
80
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 15


F-15A CREW STATION LIVE FIRE TEST
TEST NO 15
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
90
95
100
105
110
115
120
125
130
135
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

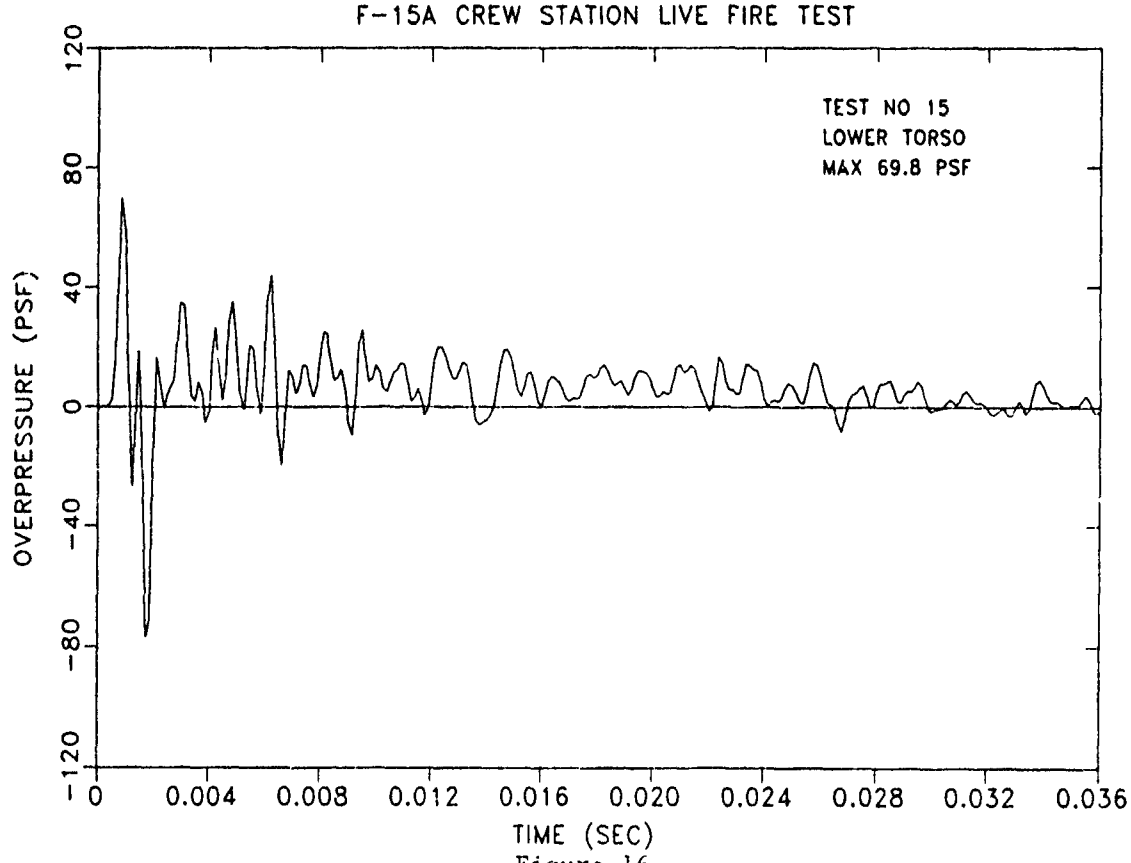
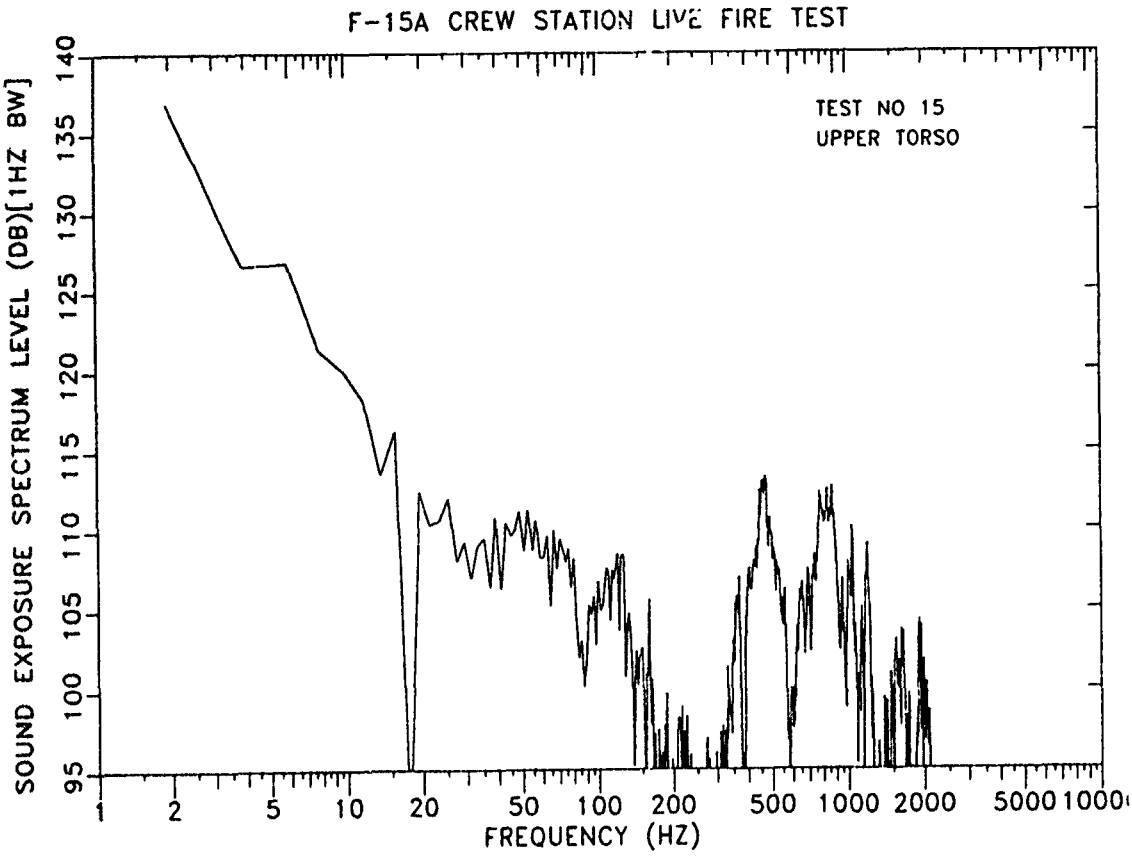

F-15A CREW STATION LIVE FIRE TEST
TEST NO 15
LOWER TORSO
MAX 69.8 PSF
OVERPRESSURE (PSF)
120
80
40
0
-40
-80
-120
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 16


F-15A CREW STATION LIVE FIRE TEST
TEST NO 15
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
95
100
105
110
115
120
125
130
135
140
1
2
5
10
20
50
100
200
500
1000
2000
5000
FREQUENCY (HZ)

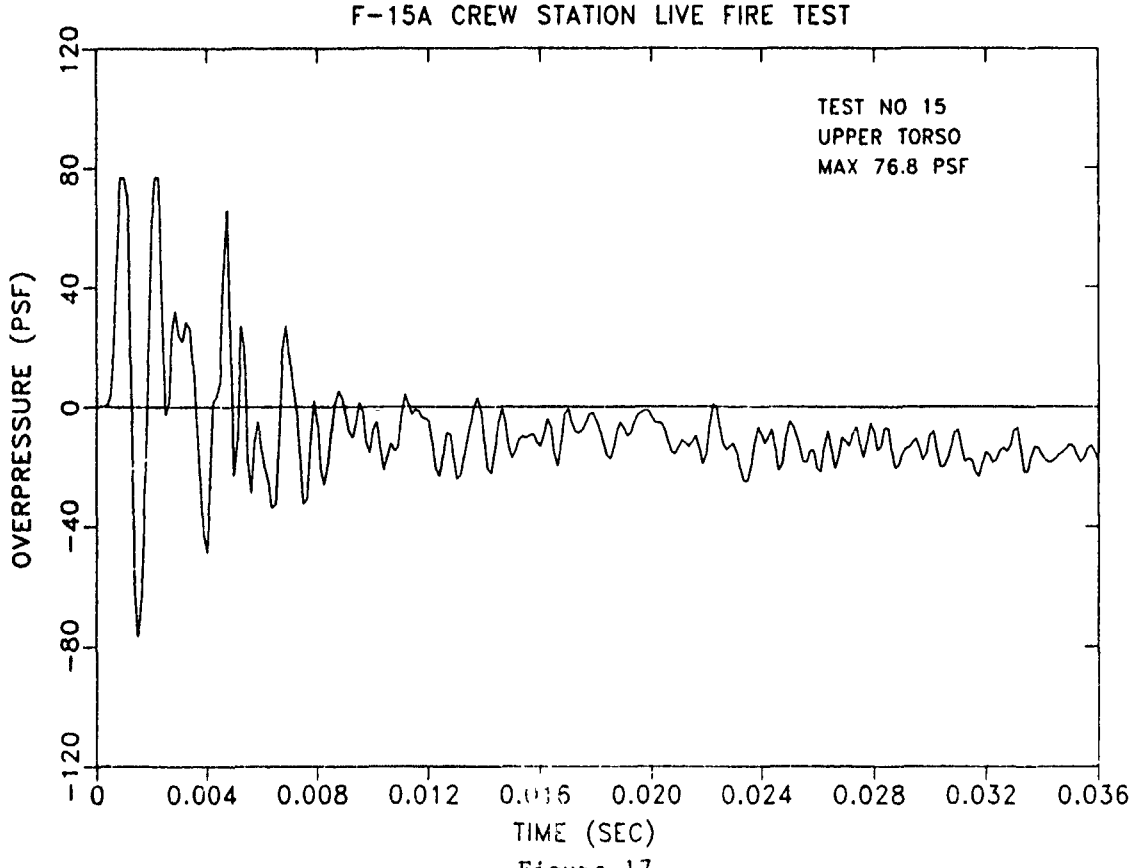
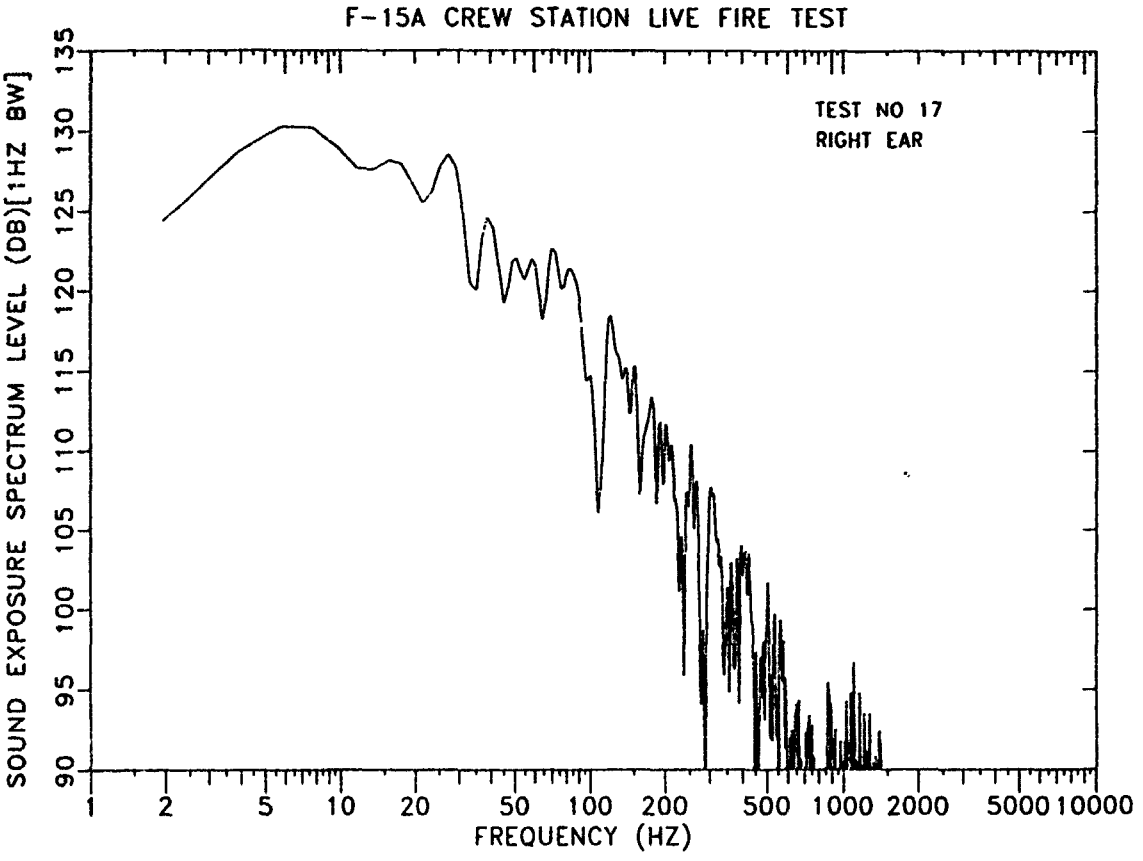

F-15A CREW STATION LIVE FIRE TEST
TEST NO 15
UPPER TORSO
MAX 76.8 PSF
OVERPRESSURE (PSF)
120
80
40
0
-40
-80
-120
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 17


F-15A CREW STATION LIVE FIRE TEST
TEST NO 17
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
90 95 100 105 110 115 120 125 130 135
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

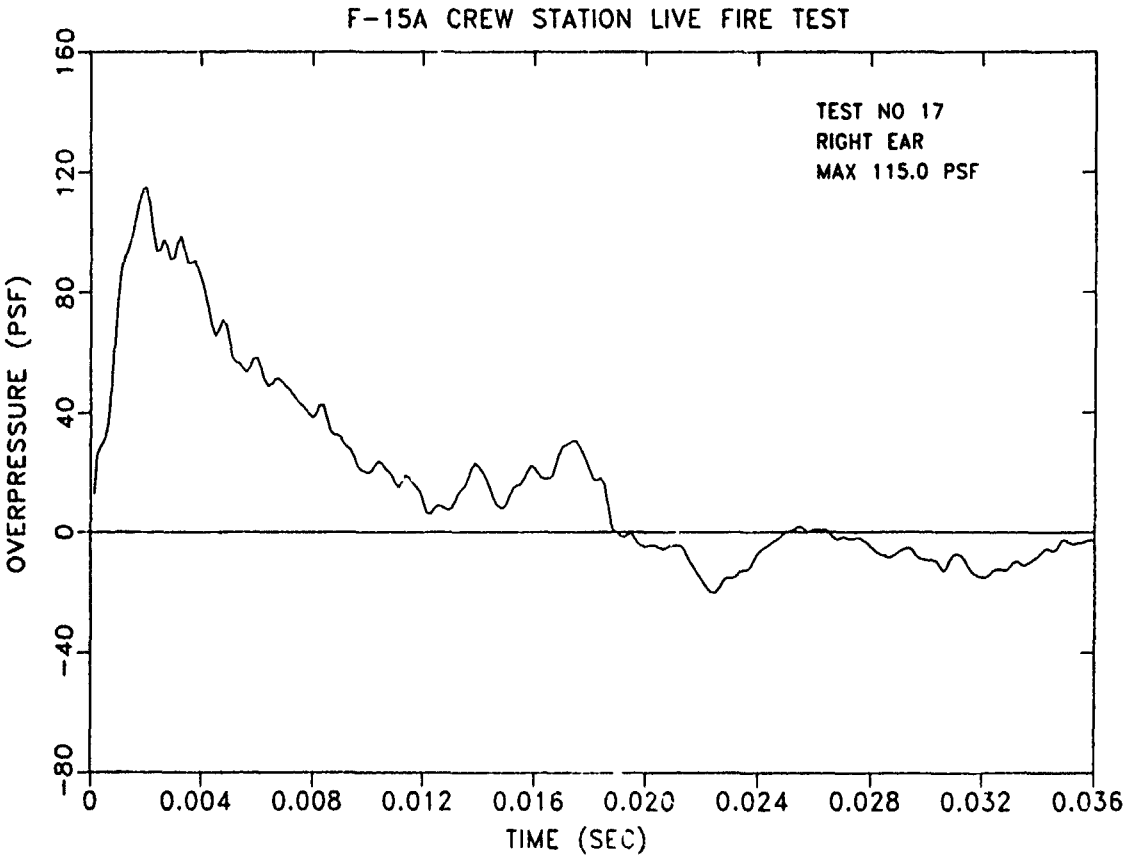
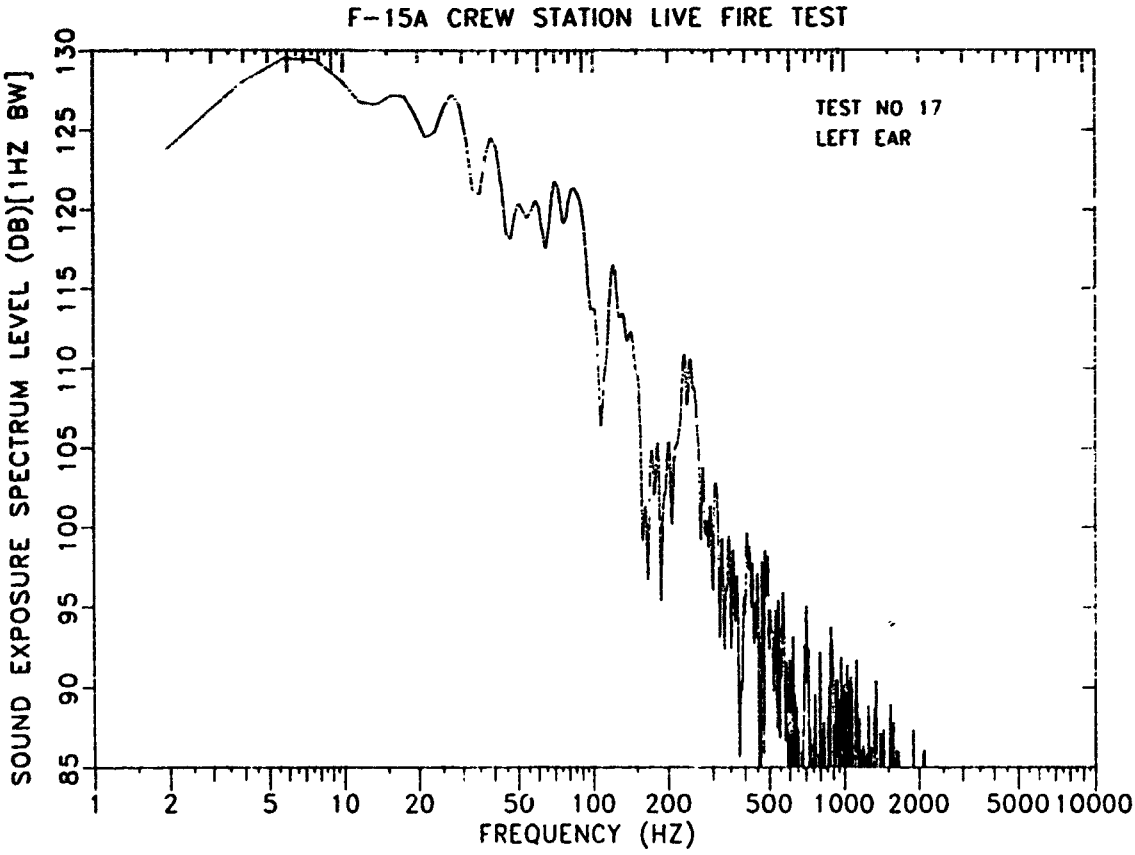

F-15A CREW STATION LIVE FIRE TEST
TEST NO 17
RIGHT EAR
MAX 115.0 PSF
OVERPRESSURE (PSF)
160 120 80 40 0 -40 -80
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 18


F-15A CREW STATION LIVE FIRE TEST
TEST NO 17
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
85
90
95
100
105
110
115
120
125
130
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

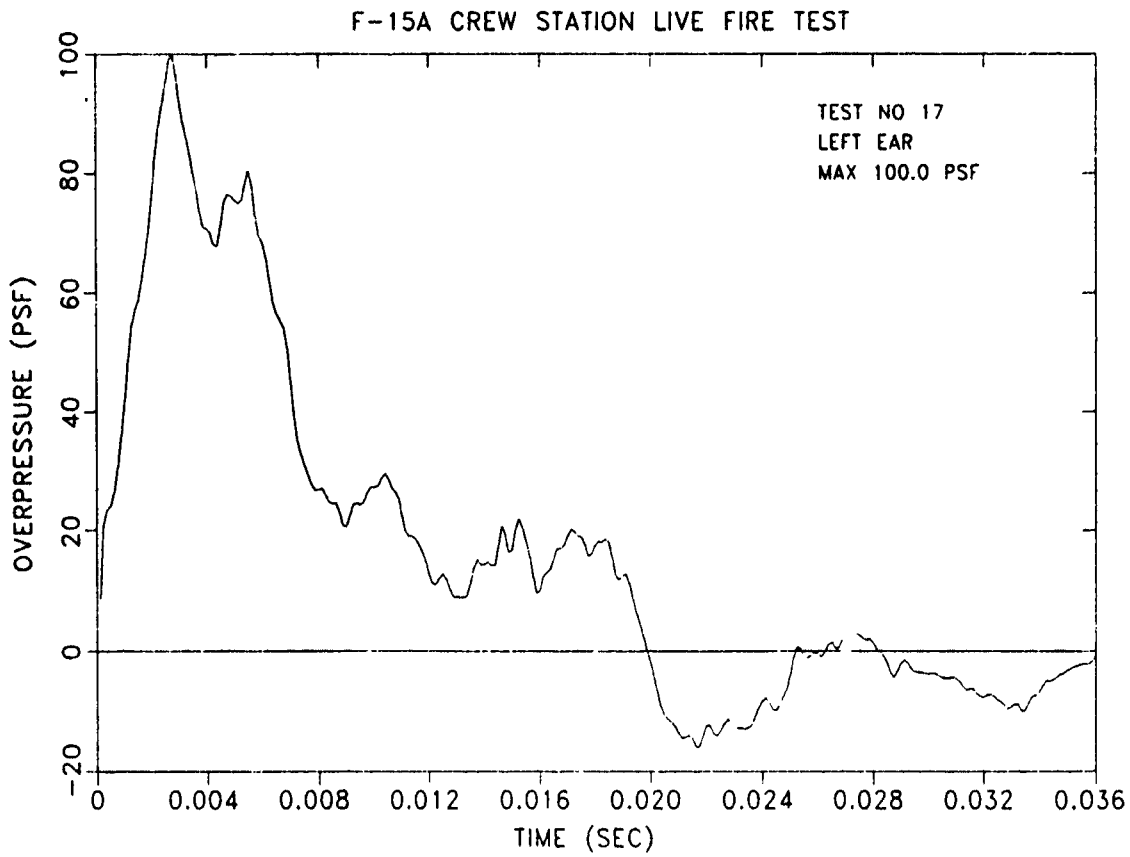
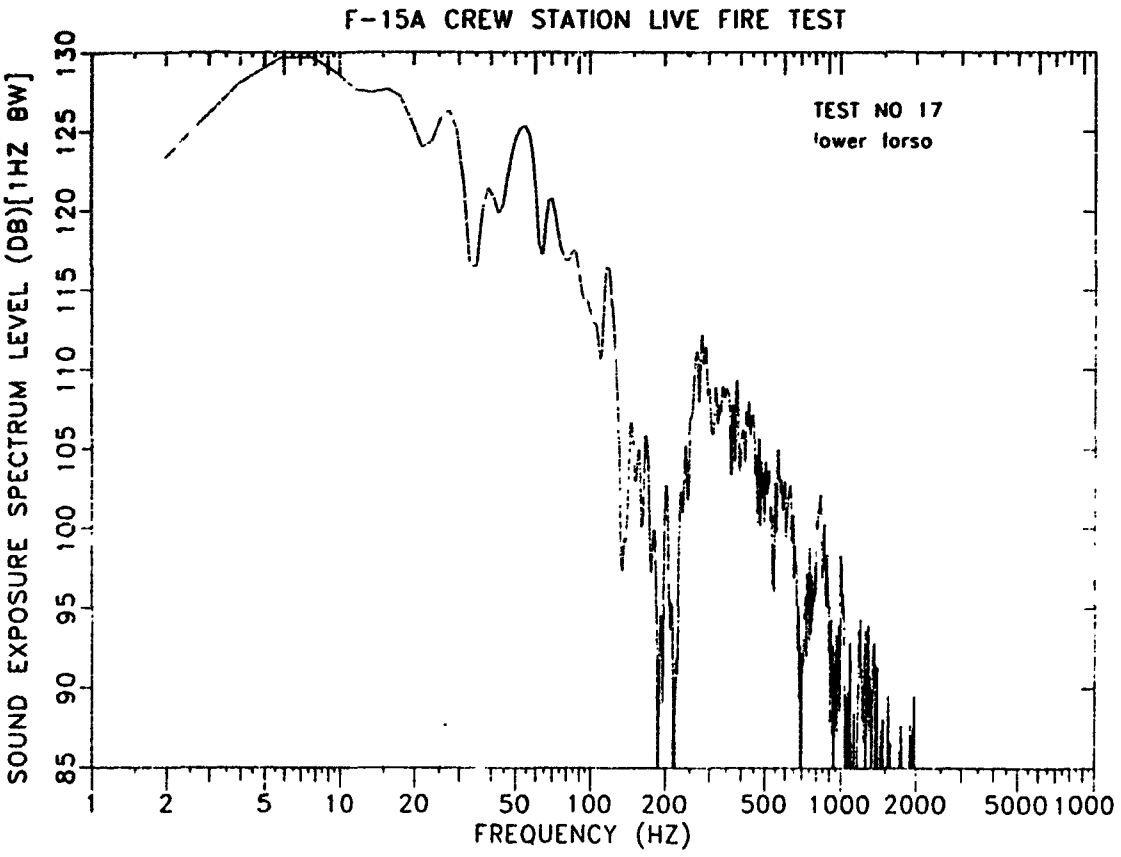

F-15A CREW STATION LIVE FIRE TEST
TEST NO 17
LEFT EAR
MAX 100.0 PSF
OVERPRESSURE (PSF)
-20
0
20
40
60
80
100
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 19


F-15A CREW STATION LIVE FIRE TEST
TEST NO 17
lower torso
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
85 90 95 100 105 110 115 120 125 130
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

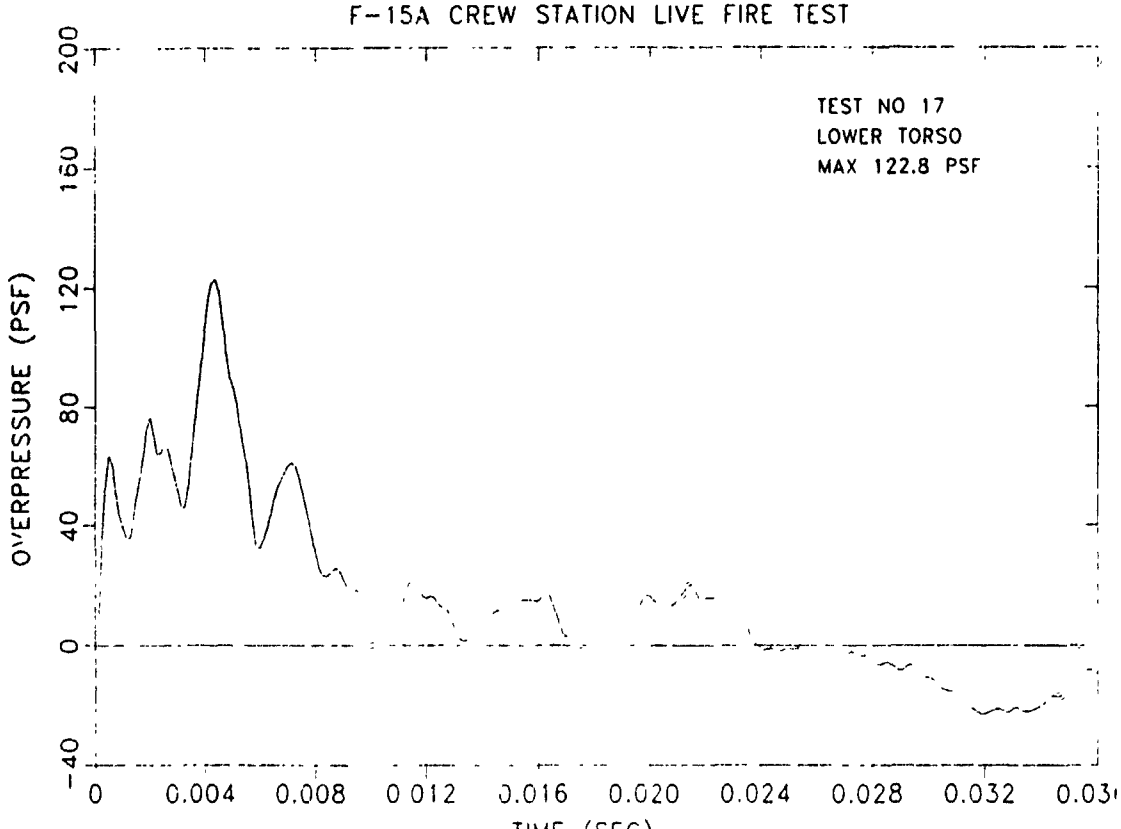
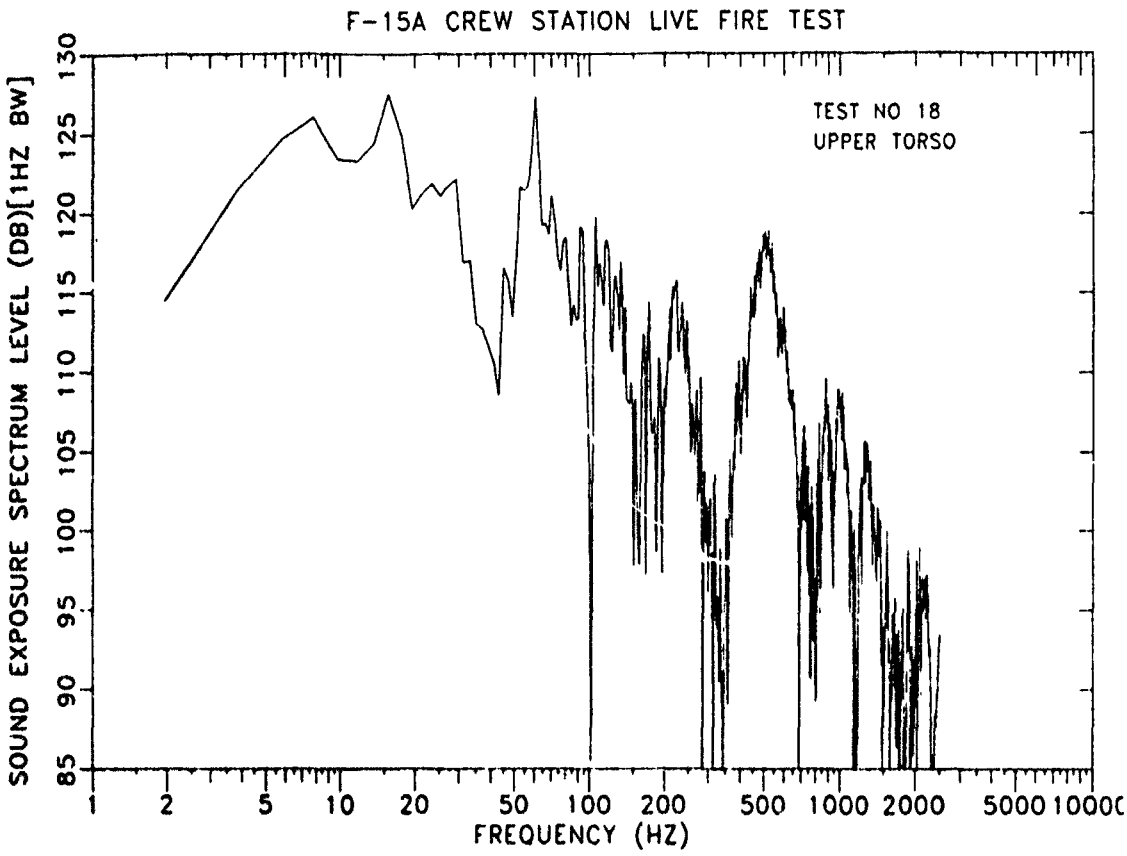

F-15A CREW STATION LIVE FIRE TEST
TEST NO 17
LOWER TORSO
MAX 122.8 PSF
OVERPRESSURE (PSF)
200 160 120 80 40 0 -40
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032
TIME (SEC)

Figure 20


F-15A CREW STATION LIVE FIRE TEST
TEST NO 18
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
85
90
95
100
105
110
115
120
125
130
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

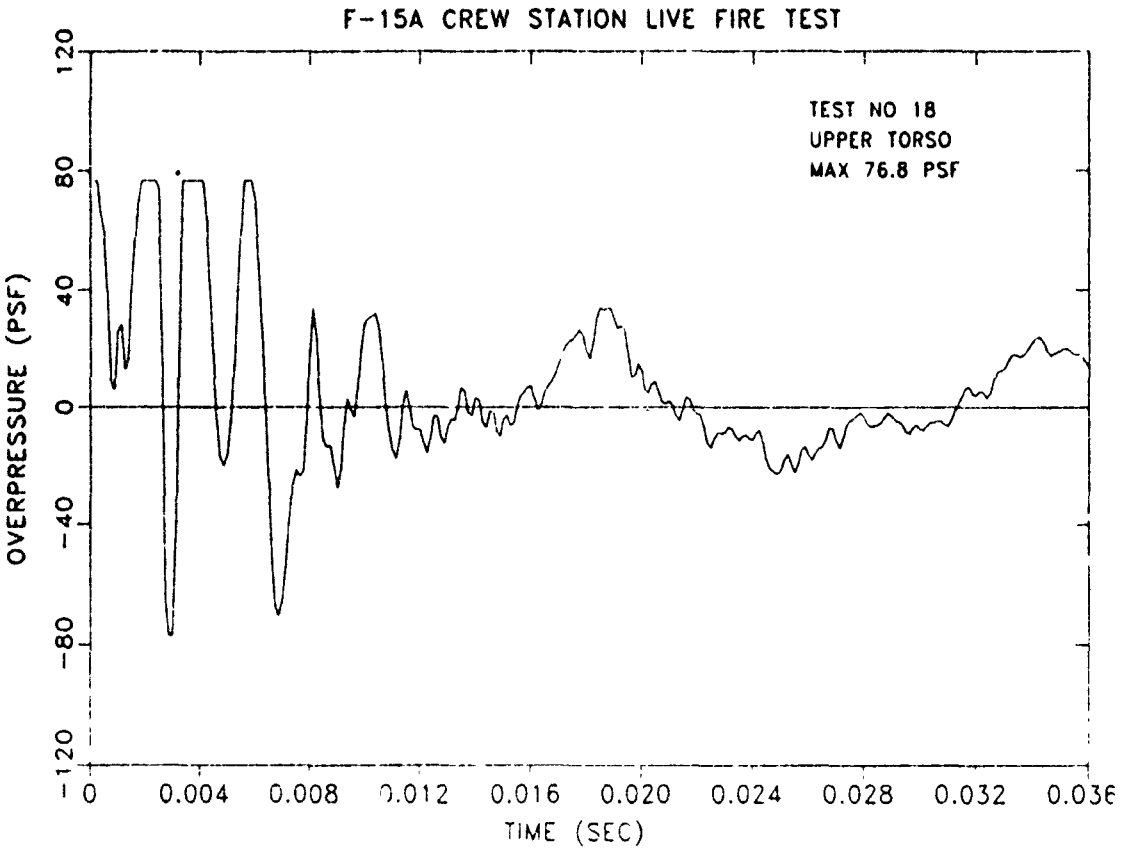
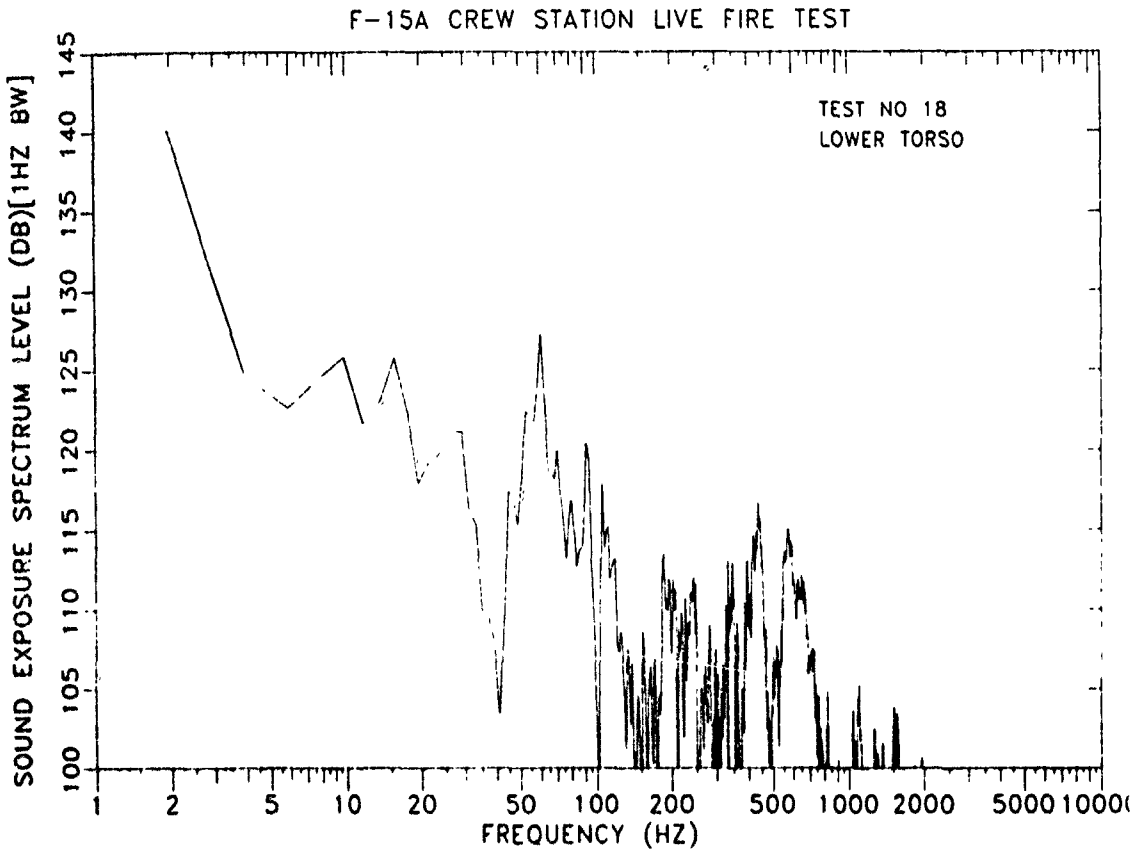

F-15A CREW STATION LIVE FIRE TEST
TEST NO 18
UPPER TORSO
MAX 76.8 PSF
OVERPRESSURE (PSF)
120
80
40
0
-40
-80
-120
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 21


F-15A CREW STATION LIVE FIRE TEST
TEST NO 18
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
100 105 110 115 120 125 130 135 140 145
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

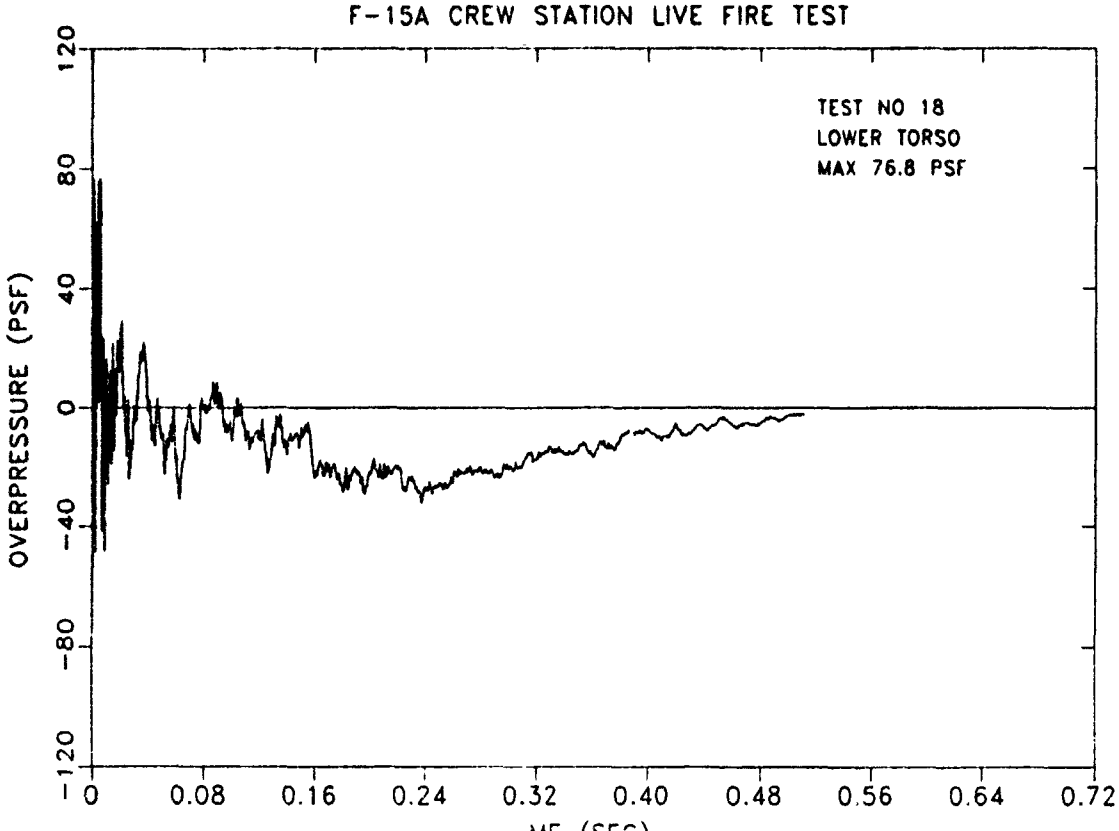
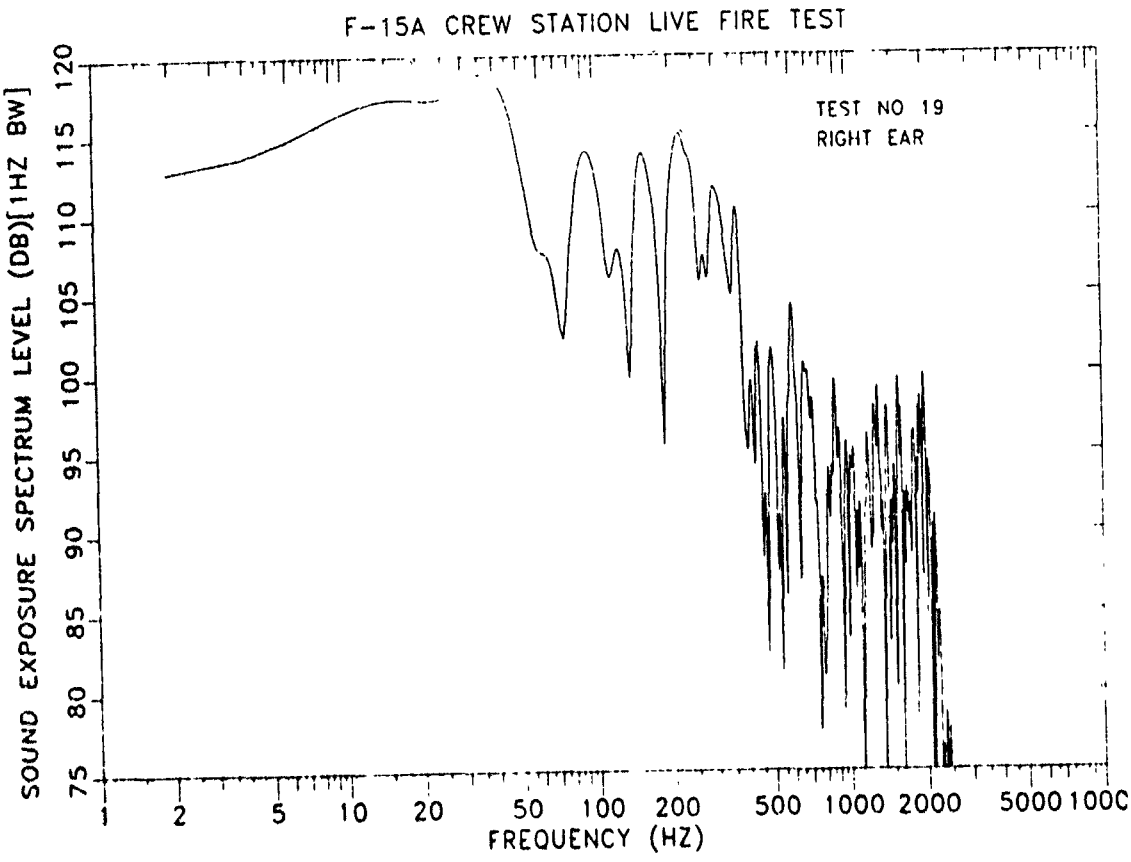

F-15A CREW STATION LIVE FIRE TEST
TEST NO 18
LOWER TORSO
MAX 76.8 PSF
OVERPRESSURE (PSF)
120 80 40 0 -40 -80 -120
0 0.08 0.16 0.24 0.32 0.40 0.48 0.56 0.64 0.72
..ME (SEC)

Figure 22


F-15A CREW STATION LIVE FIRE TEST
TEST NO 19
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
75
80
85
90
95
100
105
110
115
120
1
2
5
10
20
50
100
200
500
1000
2000
5000
FREQUENCY (HZ)

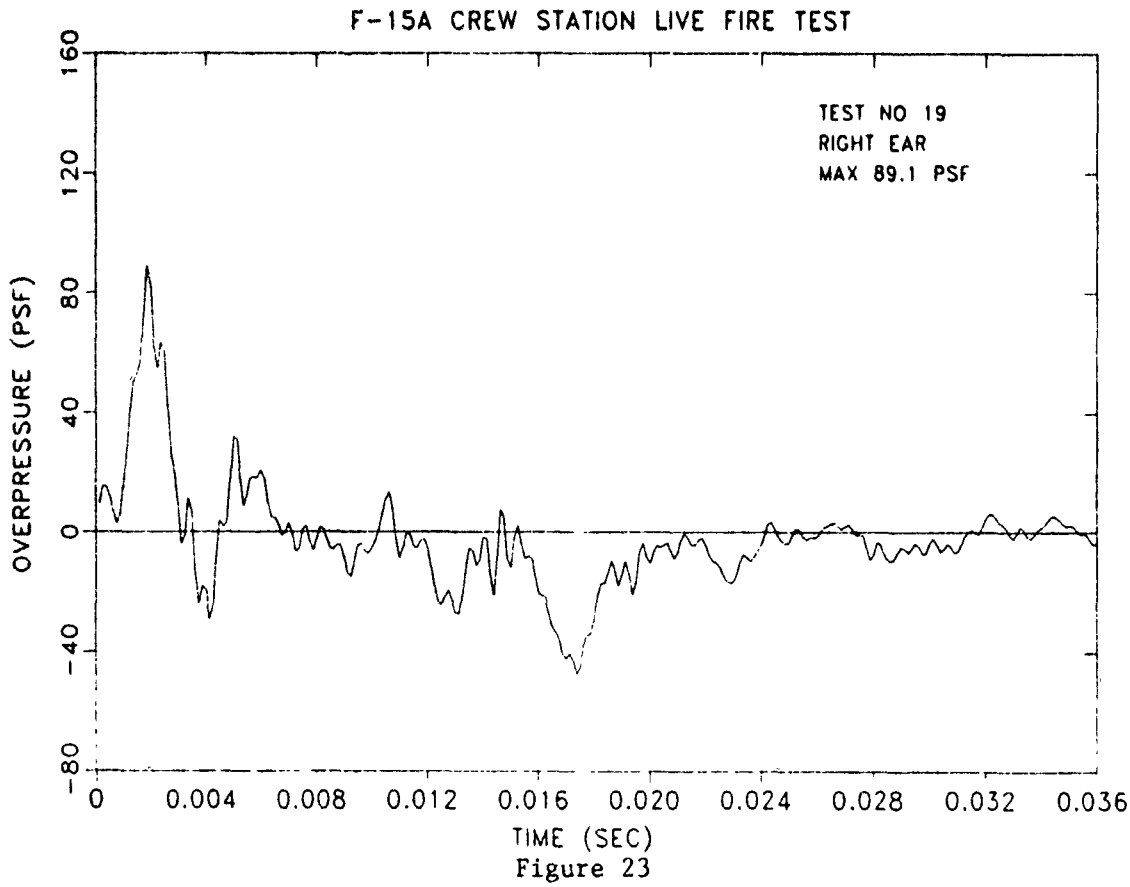
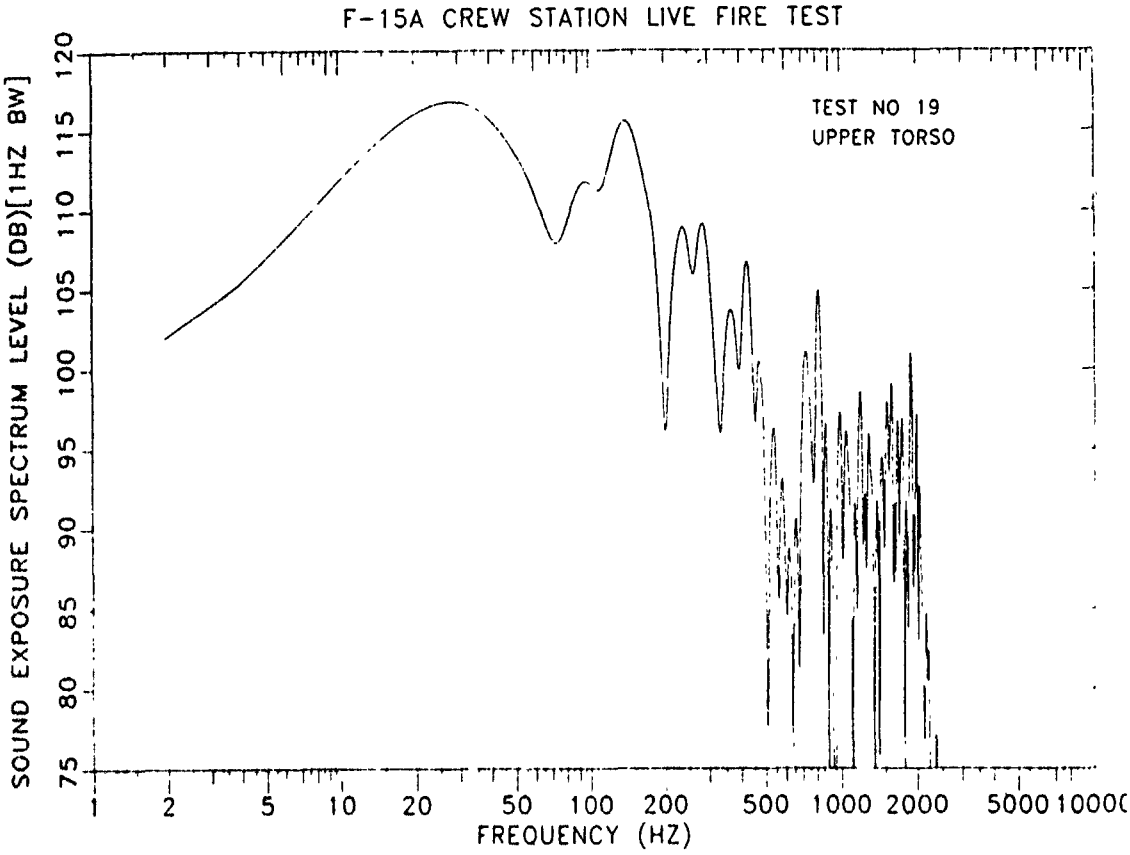

F-15A CREW STATION LIVE FIRE TEST
TEST NO 19
RIGHT EAR
MAX 89.1 PSF
OVERPRESSURE (PSF)
160
120
80
40
0
-40
-80
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 23


F-15A CREW STATION LIVE FIRE TEST
TEST NO 19
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
75 80 85 90 95 100 105 110 115 120
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

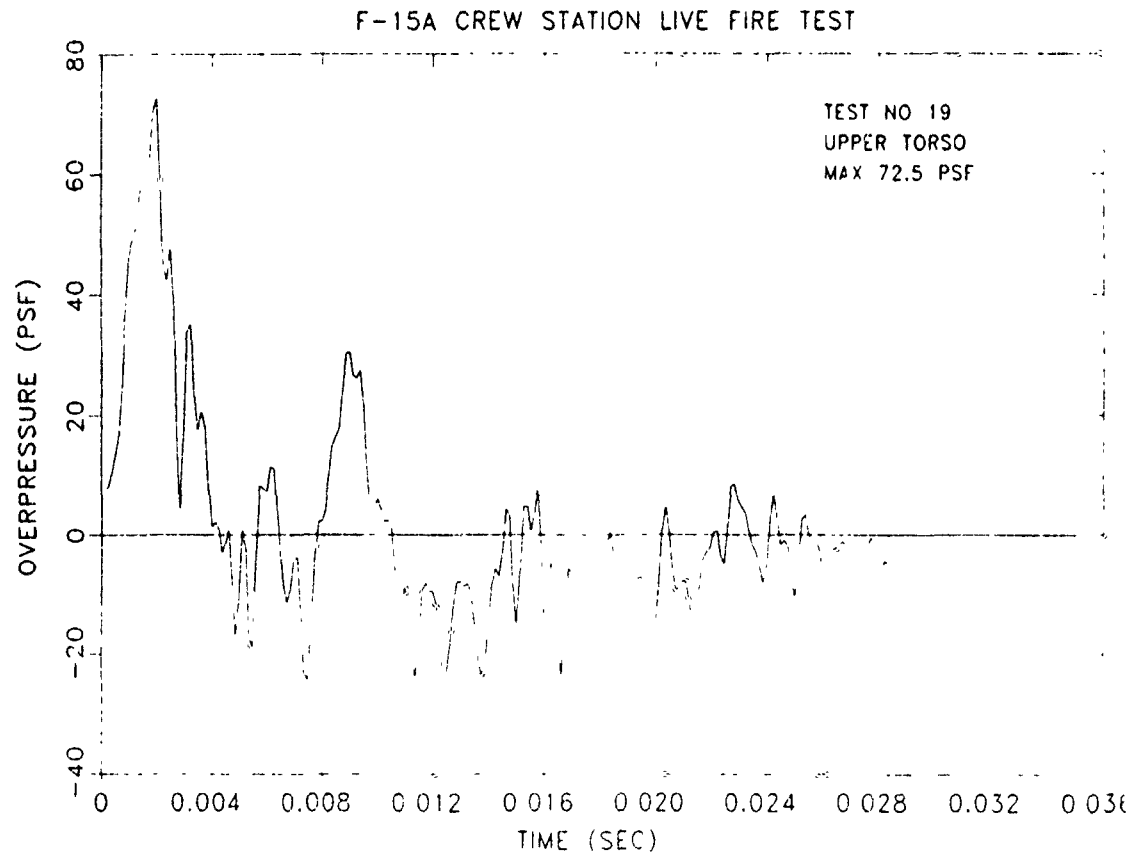
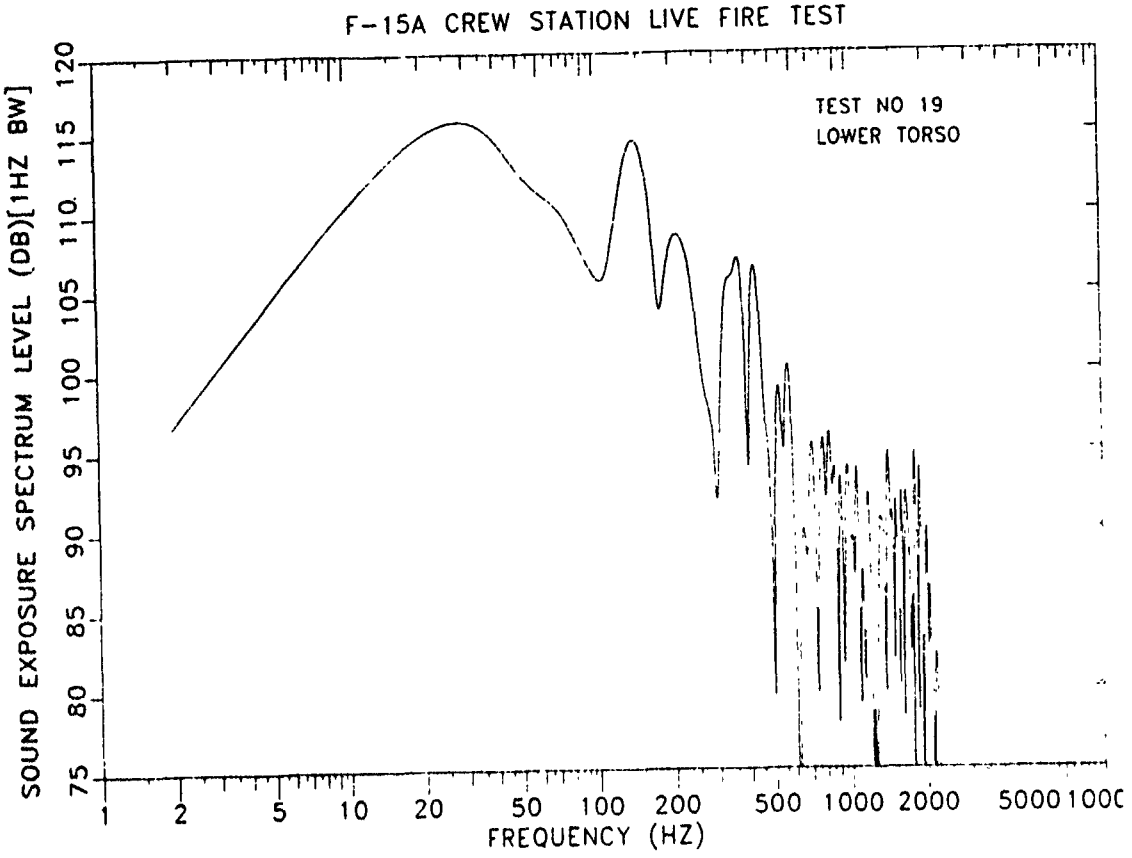

F-15A CREW STATION LIVE FIRE TEST
TEST NO 19
UPPER TORSO
MAX 72.5 PSF
OVERPRESSURE (PSF)
-40 -20 0 20 40 60 80
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 24


F-15A CREW STATION LIVE FIRE TEST
TEST NO 19
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
75
80
85
90
95
100
105
110
115
120
1
2
5
10
20
50
100
200
500
1000
2000
5000
FREQUENCY (HZ)

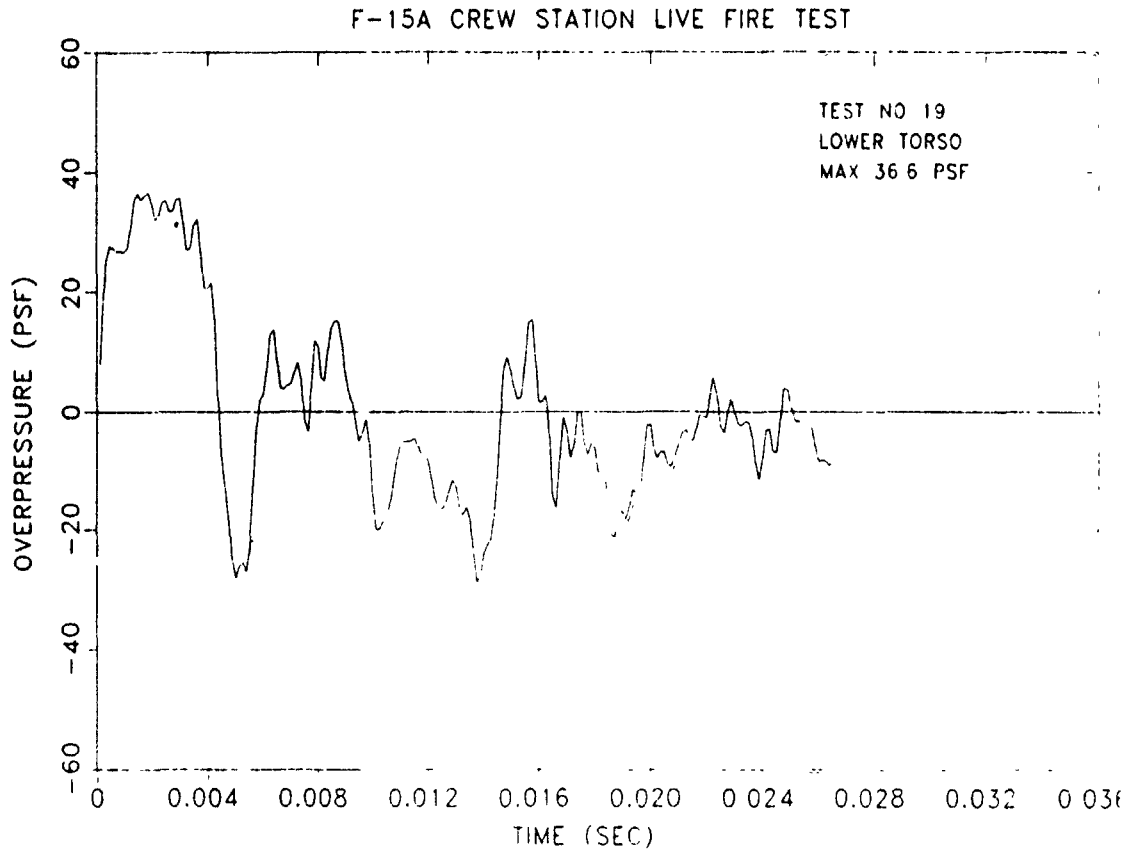
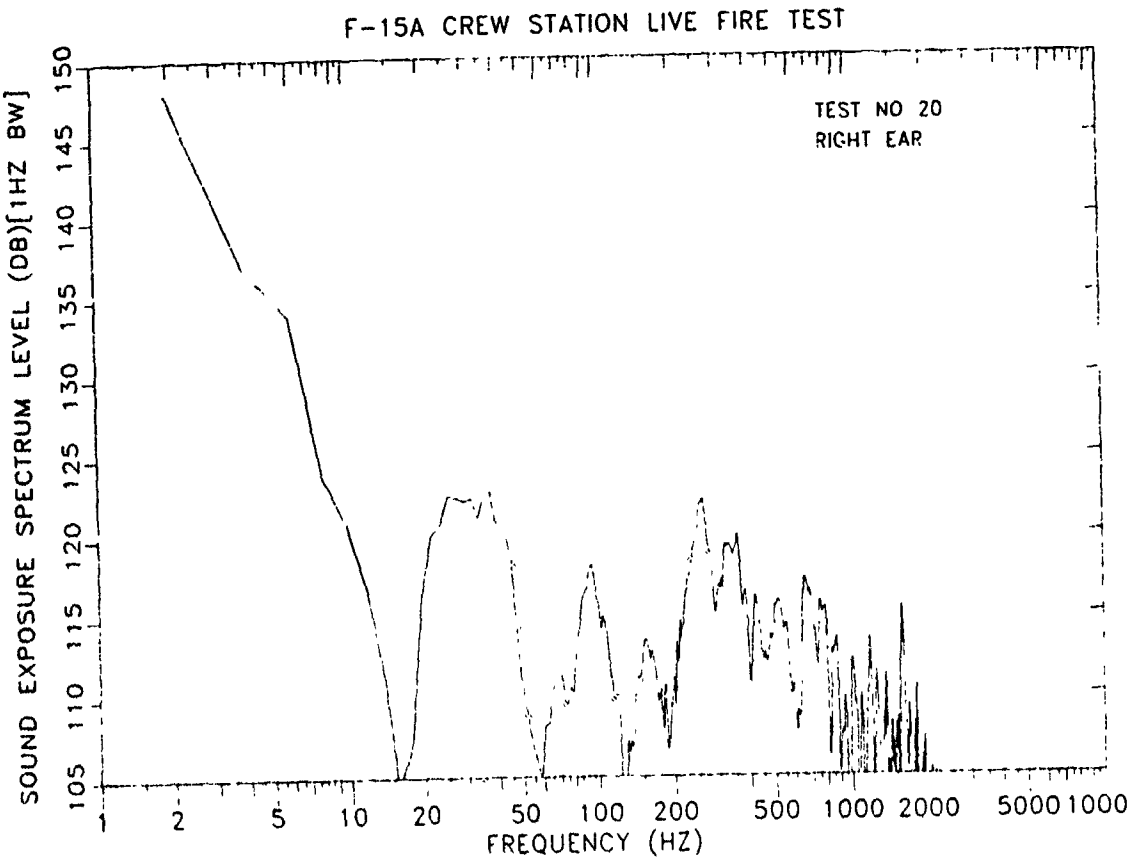

F-15A CREW STATION LIVE FIRE TEST
TEST NO 19
LOWER TORSO
MAX 36 6 PSF
OVERPRESSURE (PSF)
60
40
20
0
-20
-40
-60
0
0.004
0.008
0.012
0.016
0.020
0 024
0.028
0.032
TIME (SEC)

Figure 25


F-15A CREW STATION LIVE FIRE TEST
TEST NO 20
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
105 110 115 120 125 130 135 140 145 150
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

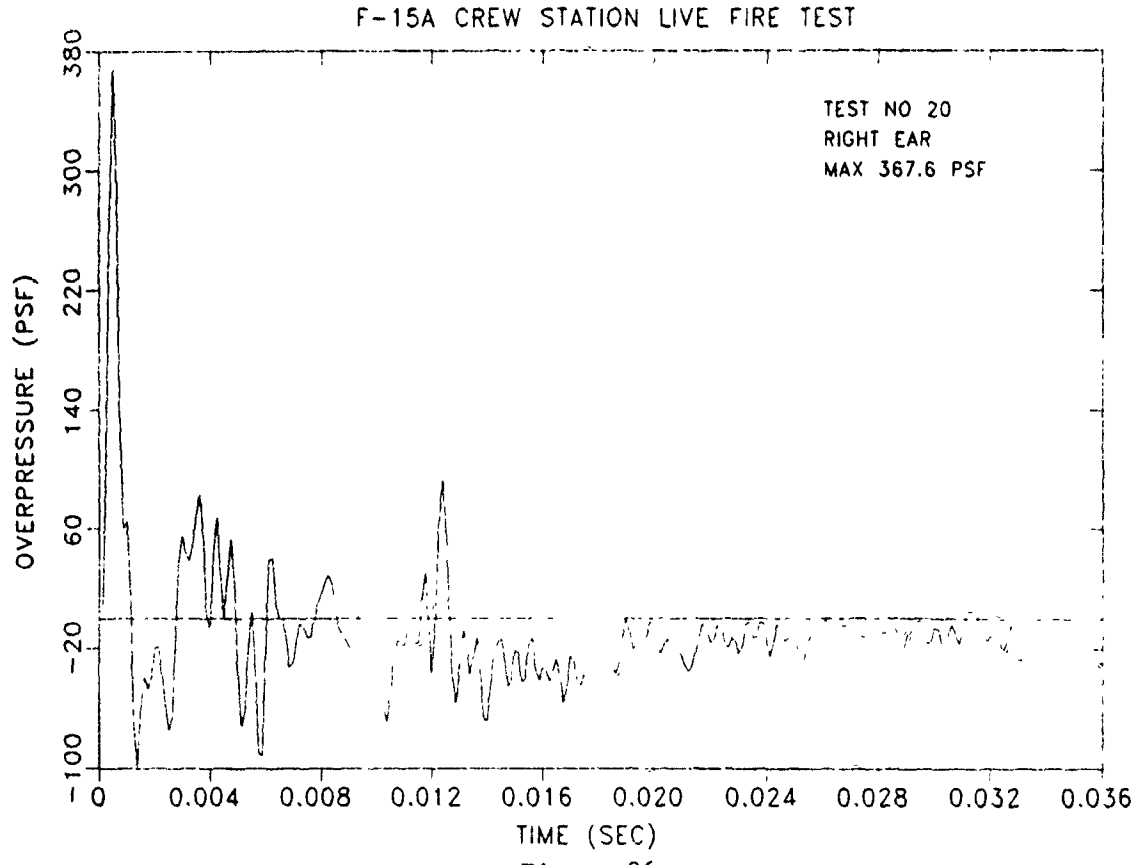
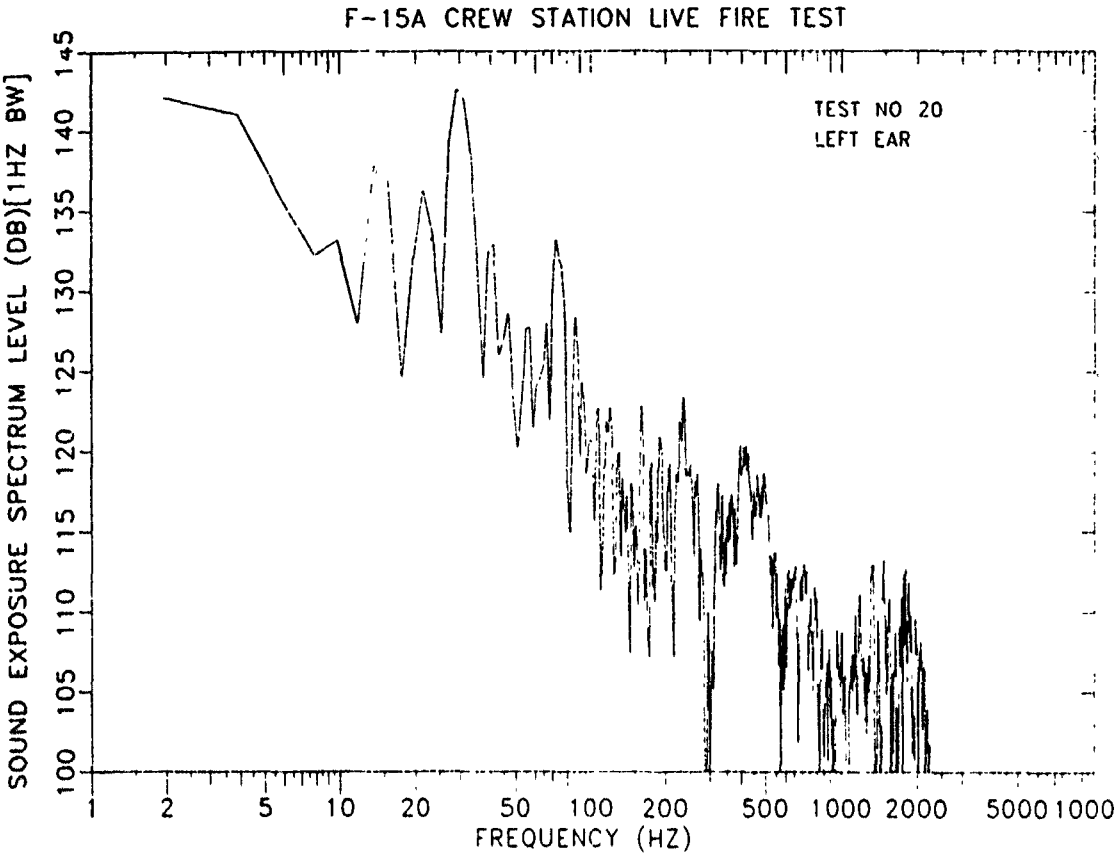

F-15A CREW STATION LIVE FIRE TEST
TEST NO 20
RIGHT EAR
MAX 367.6 PSF
OVERPRESSURE (PSF)
-100 -20 60 140 220 300 380
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 26


F-15A CREW STATION LIVE FIRE TEST
TEST NO 20
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
100 105 110 115 120 125 130 135 140 145
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

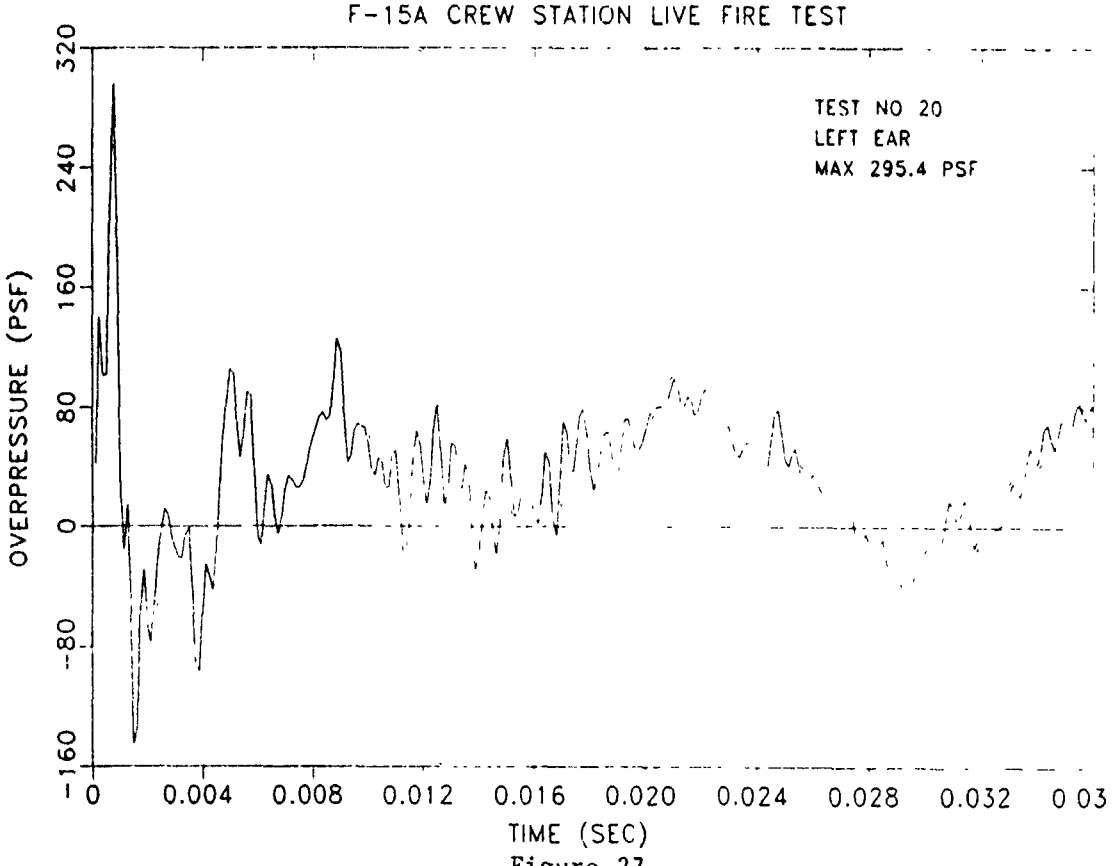
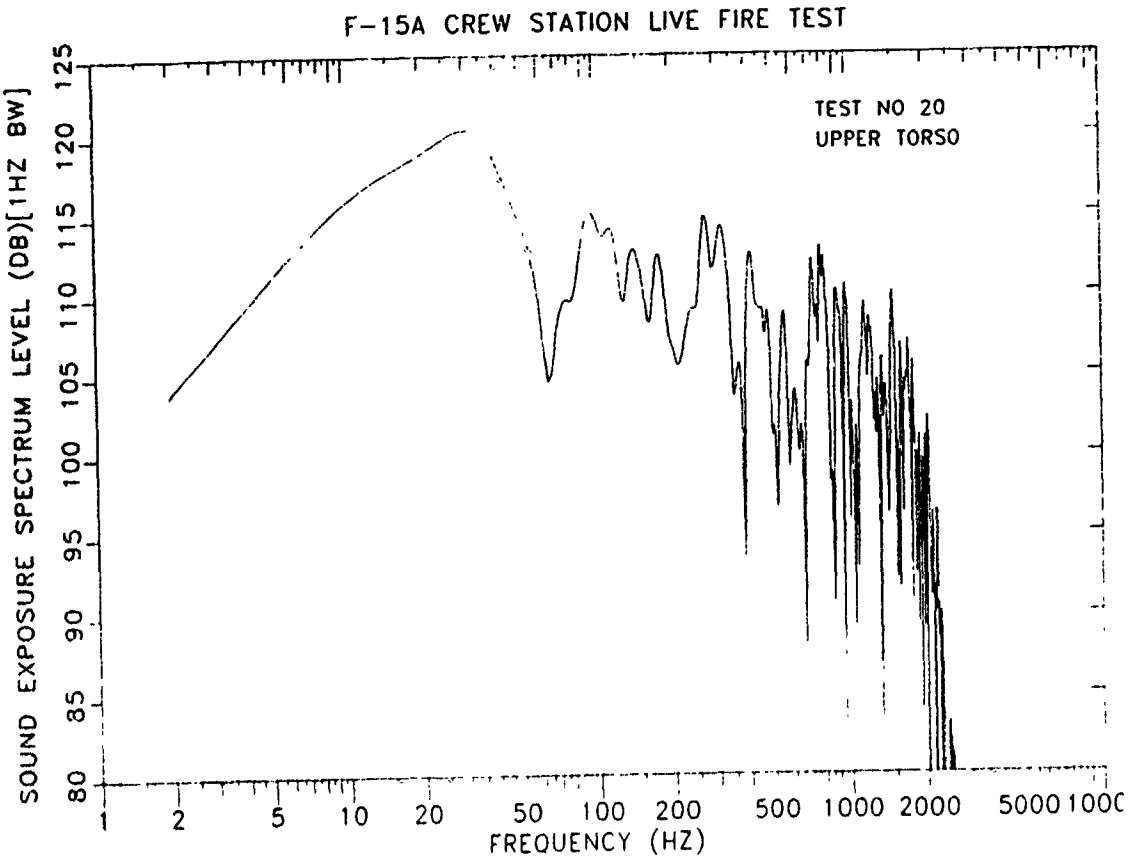

F-15A CREW STATION LIVE FIRE TEST
TEST NO 20
LEFT EAR
MAX 295.4 PSF
OVERPRESSURE (PSF)
320 240 160 80 0 -80 -160
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0 03
TIME (SEC)

Figure 27


F-15A CREW STATION LIVE FIRE TEST
TEST NO 20
UPPER TORSO
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
2000
5000
FREQUENCY (HZ)

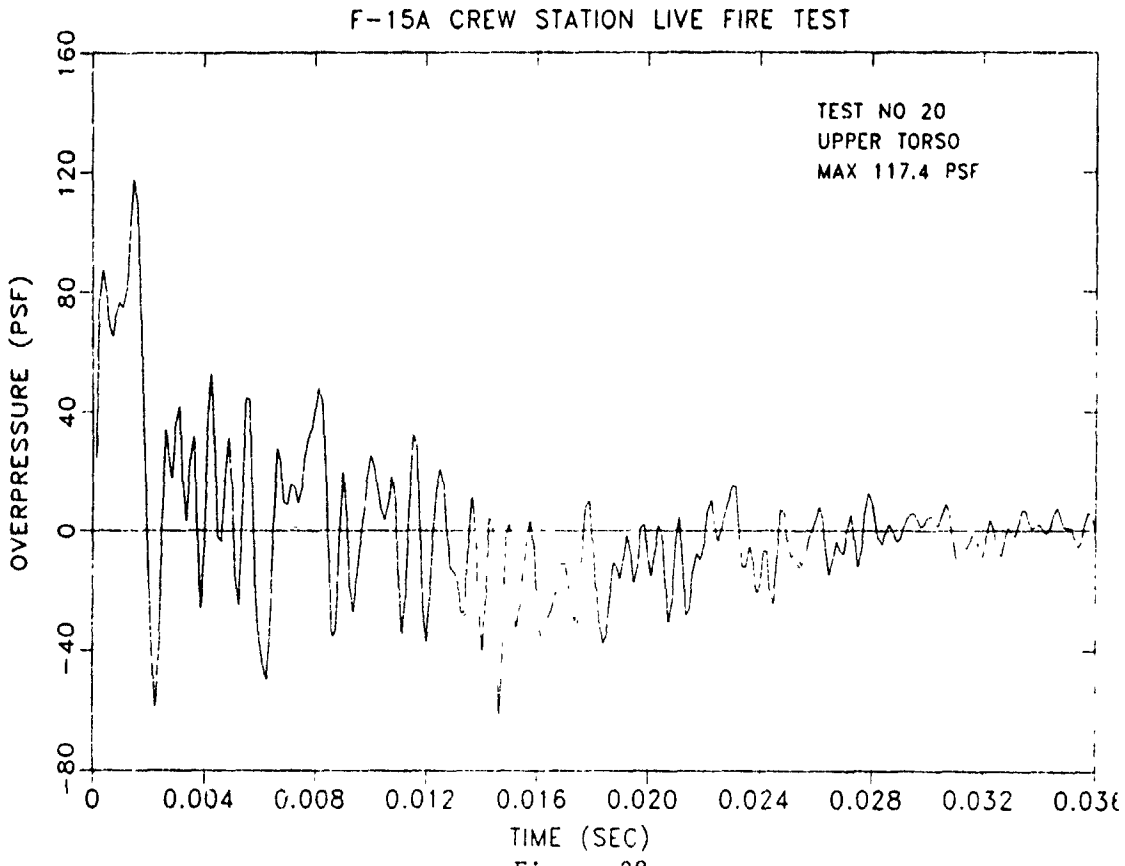
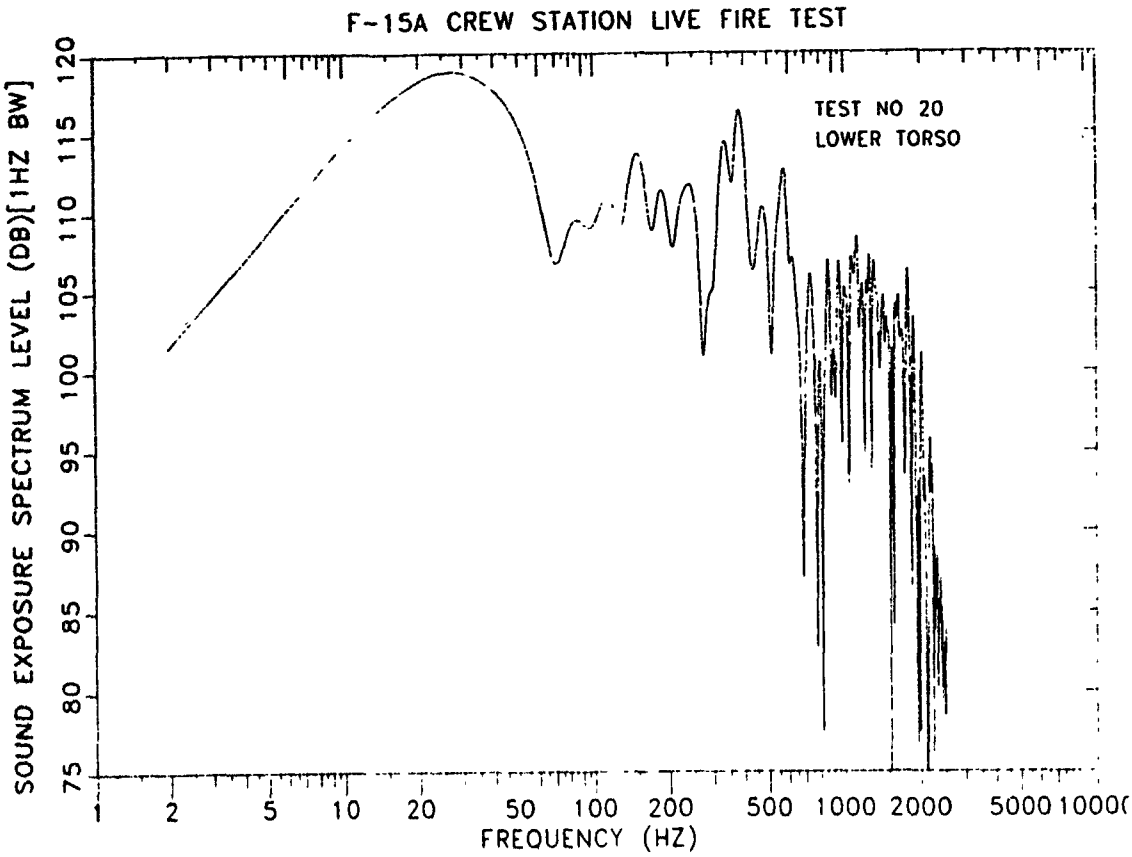

F-15A CREW STATION LIVE FIRE TEST
TEST NO 20
UPPER TORSO
MAX 117.4 PSF
OVERPRESSURE (PSF)
160
120
80
40
0
-40
-80
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
TIME (SEC)

Figure 28


F-15A CREW STATION LIVE FIRE TEST
TEST NO 20
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
75
80
85
90
95
100
105
110
115
120
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

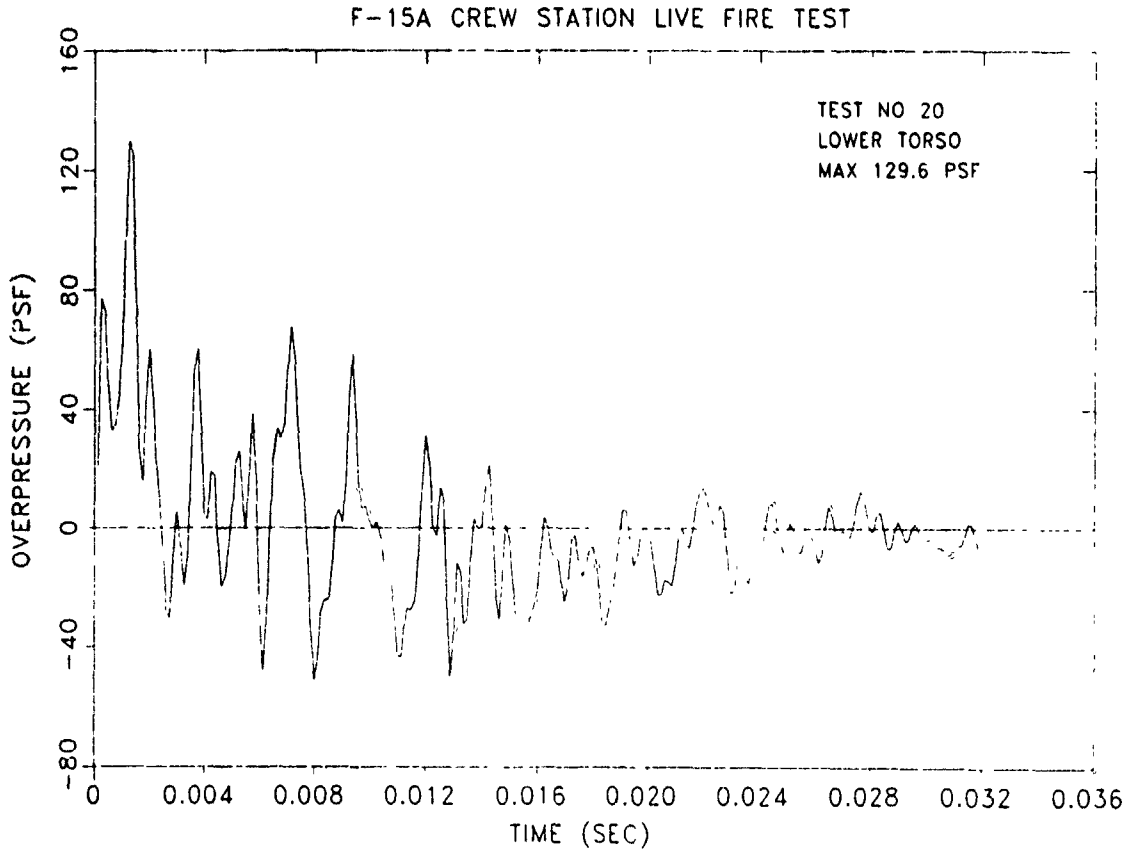
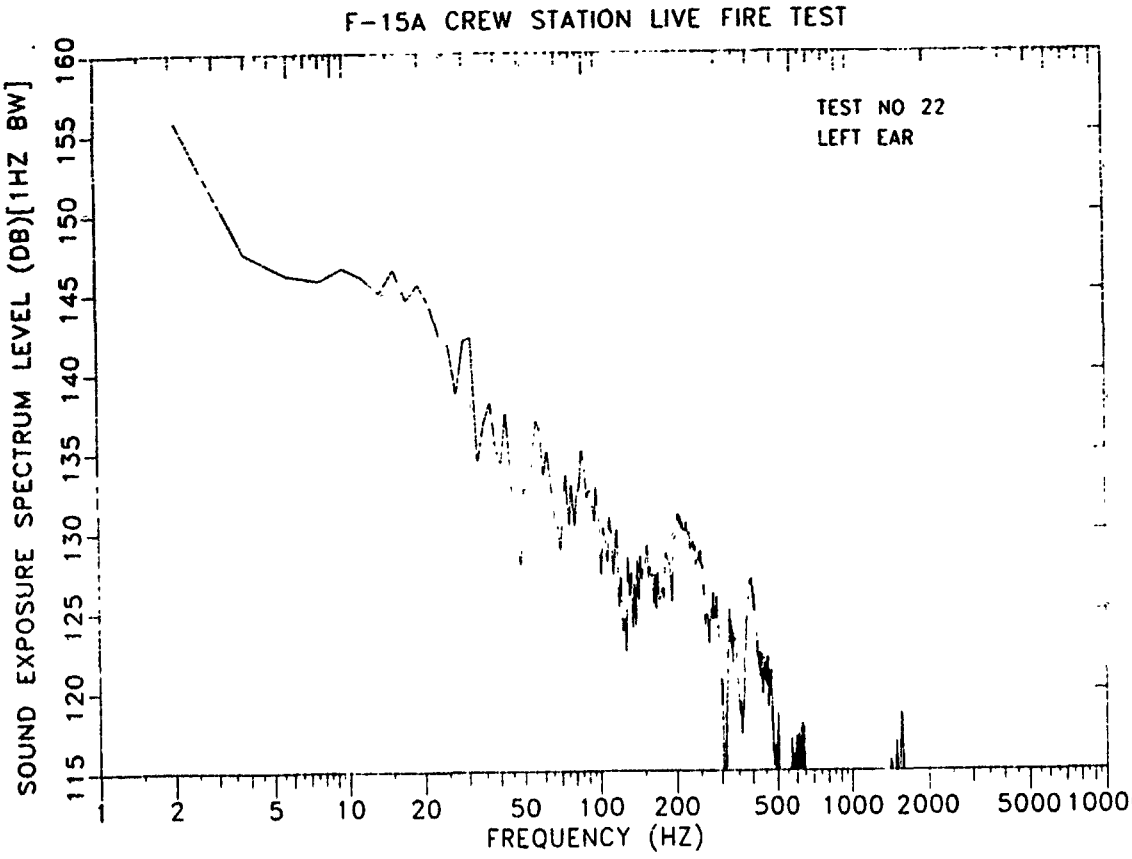

F-15A CREW STATION LIVE FIRE TEST
TEST NO 20
LOWER TORSO
MAX 129.6 PSF
OVERPRESSURE (PSF)
160
120
80
40
0
-40
-80
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 29


F-15A CREW STATION LIVE FIRE TEST
TEST NO 22
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115 120 125 130 135 140 145 150 155 160
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

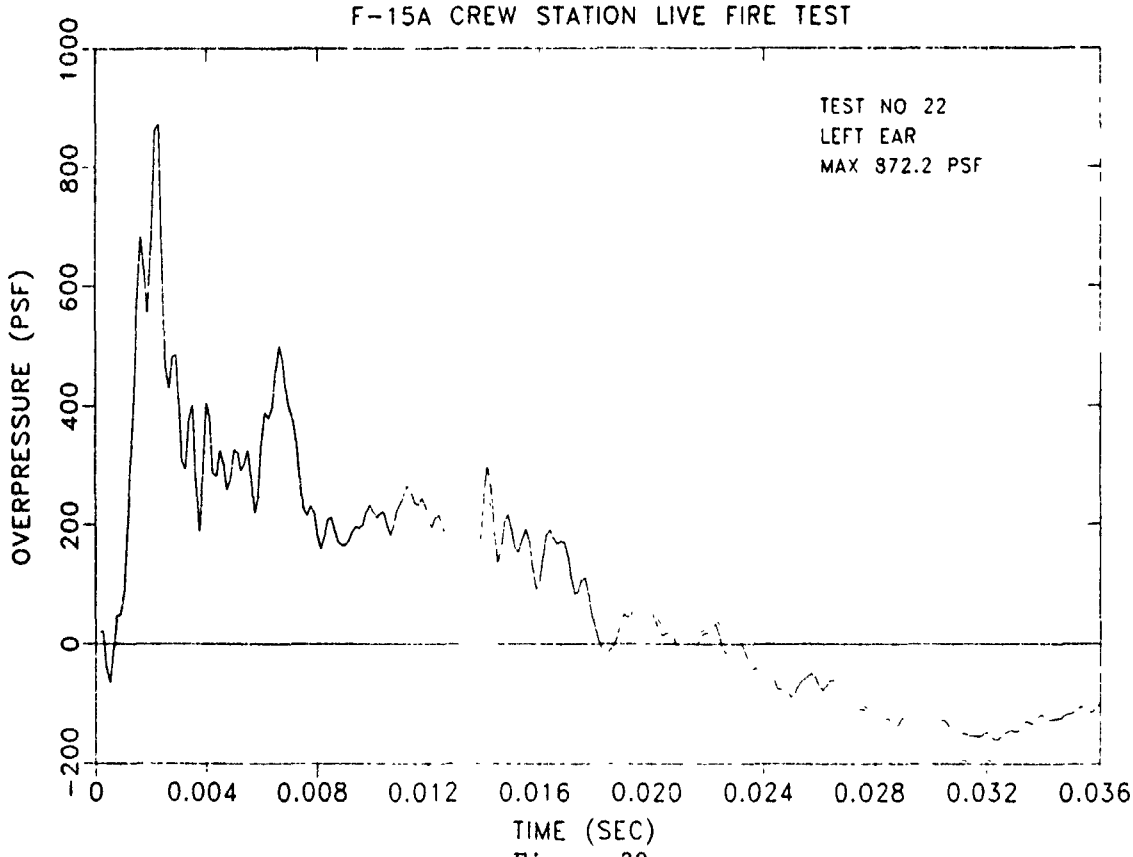
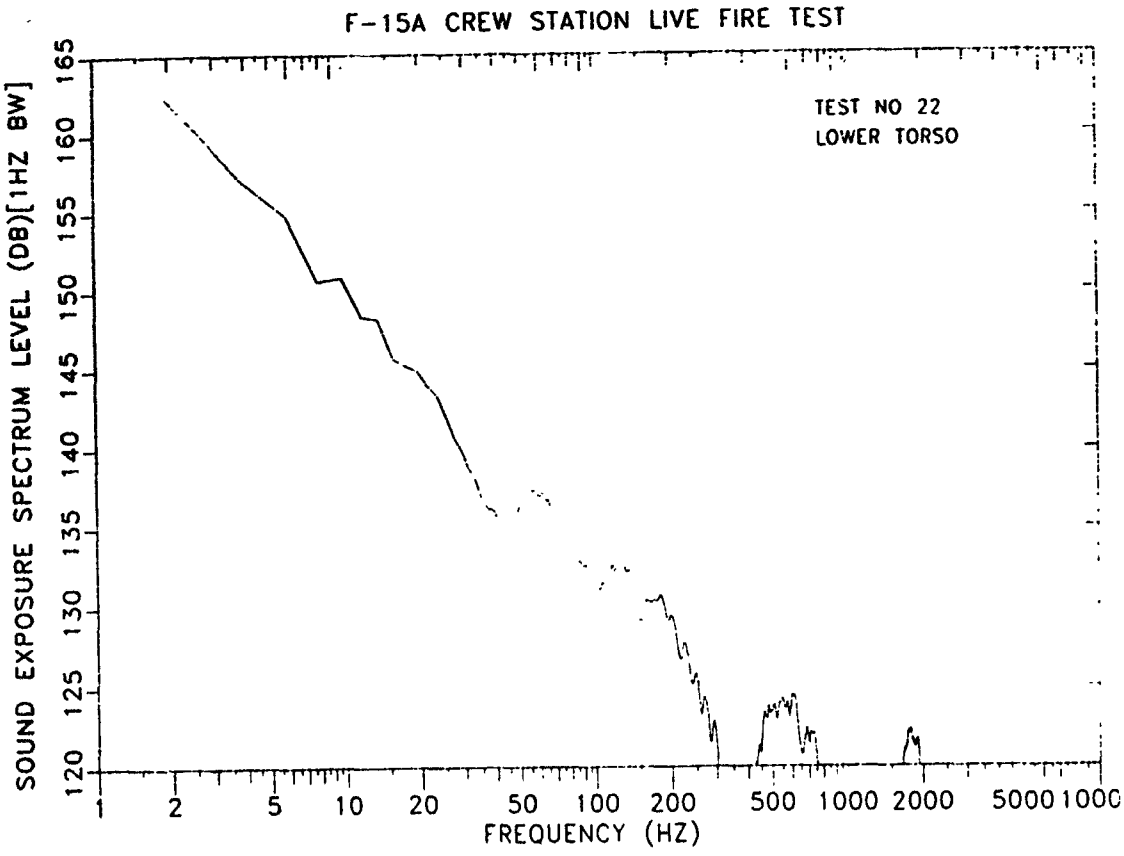

F-15A CREW STATION LIVE FIRE TEST
TEST NO 22
LEFT EAR
MAX 872.2 PSF
OVERPRESSURE (PSF)
-200 0 200 400 600 800 1000
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 30


F-15A CREW STATION LIVE FIRE TEST
TEST NO 22
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
120 125 130 135 140 145 150 155 160 165
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

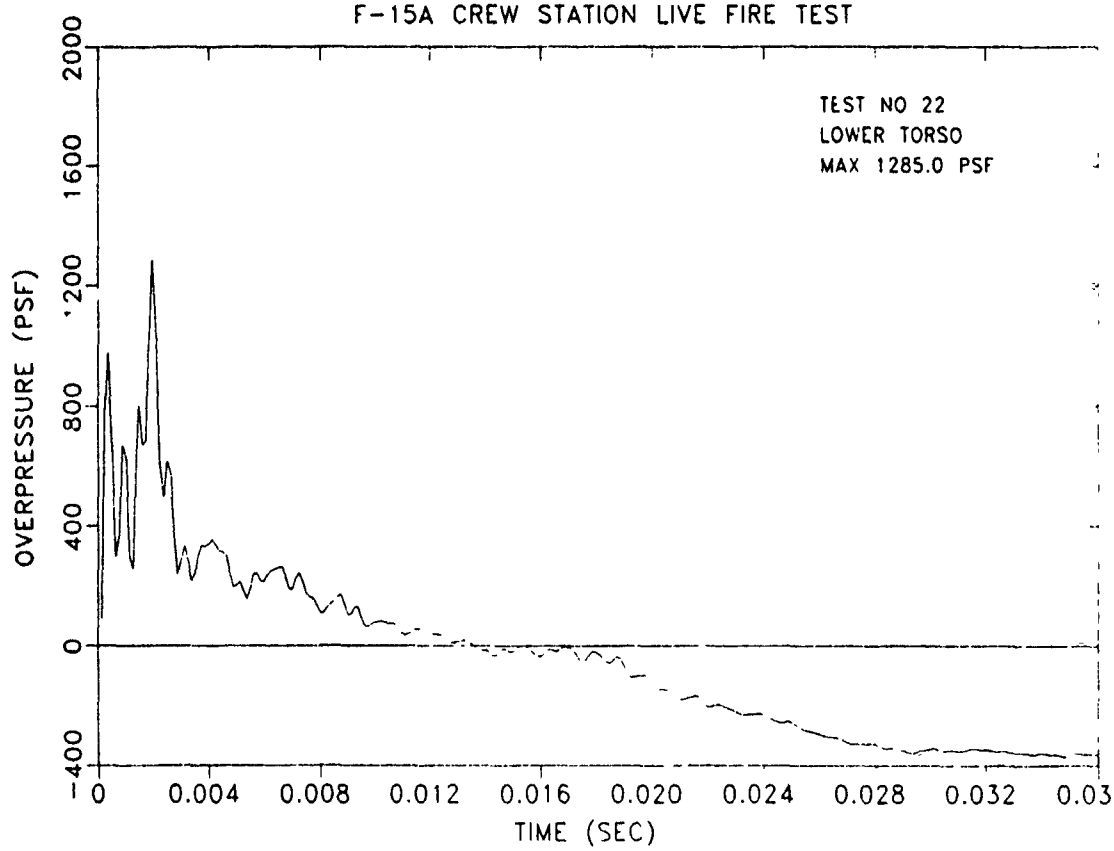
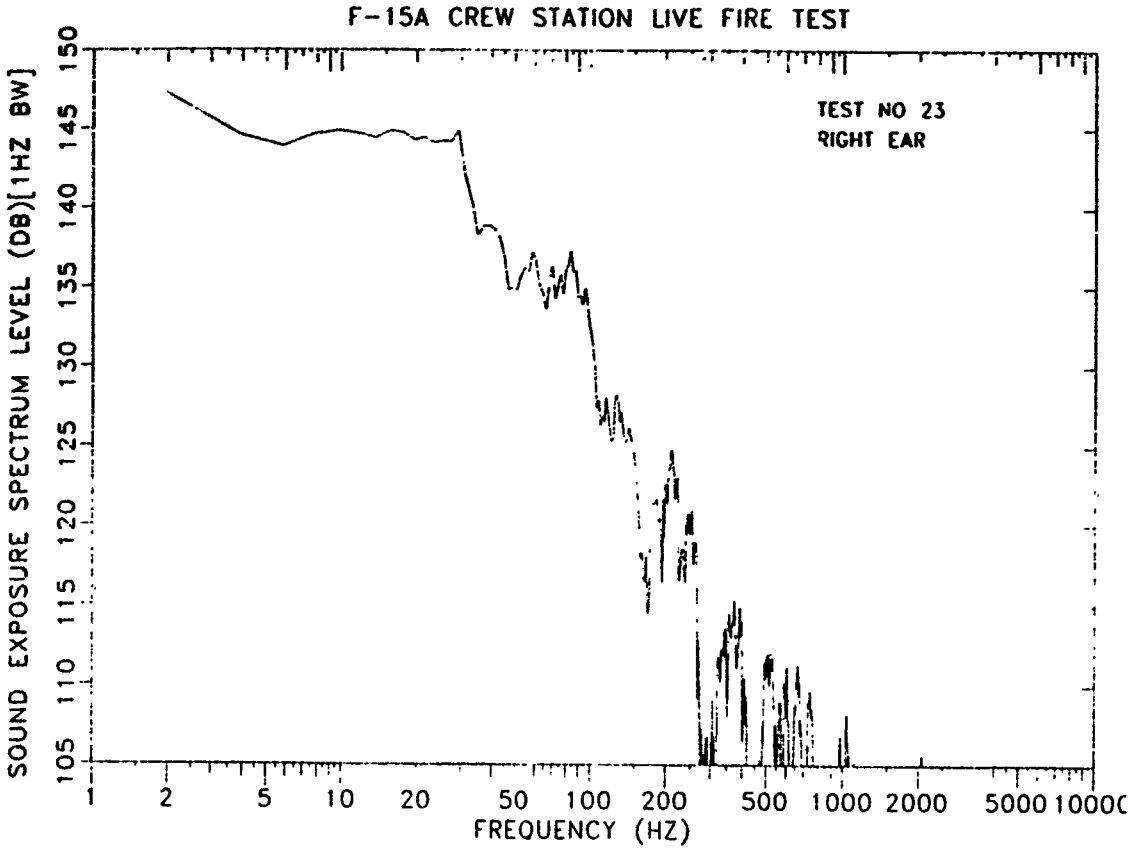

F-15A CREW STATION LIVE FIRE TEST
TEST NO 22
LOWER TORSO
MAX 1285.0 PSF
OVERPRESSURE (PSF)
-400 0 400 800 1200 1600 2000
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 31


F-15A CREW STATION LIVE FIRE TEST
TEST NO 23
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
105 110 115 120 125 130 135 140 145 150
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

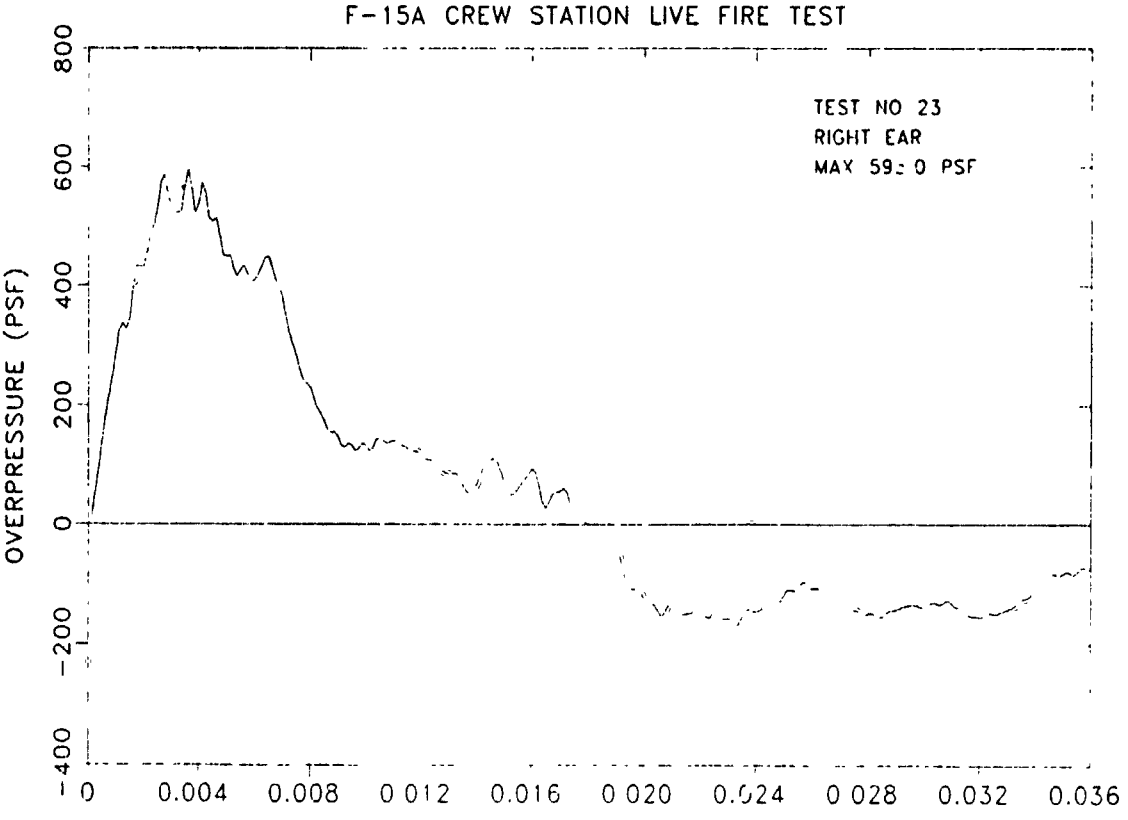
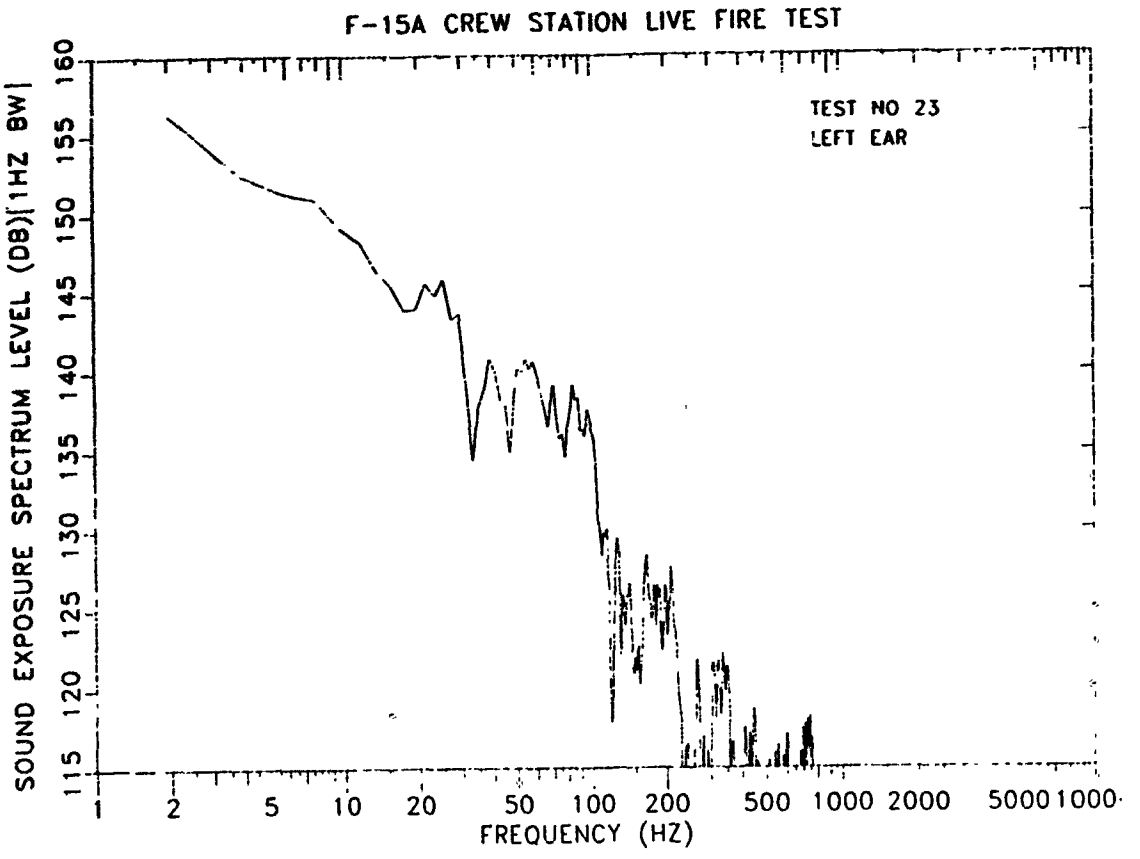

F-15A CREW STATION LIVE FIRE TEST
TEST NO 23
RIGHT EAR
MAX 59: 0 PSF
OVERPRESSURE (PSF)
800 600 400 200 0 -200 -400
0 0.004 0.008 0 012 0.016 0 020 0.024 0 028 0.032 0.036
TIME (SEC)

Figure 32


F-15A CREW STATION LIVE FIRE TEST
TEST NO 23
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115 120 125 130 135 140 145 150 155 160
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

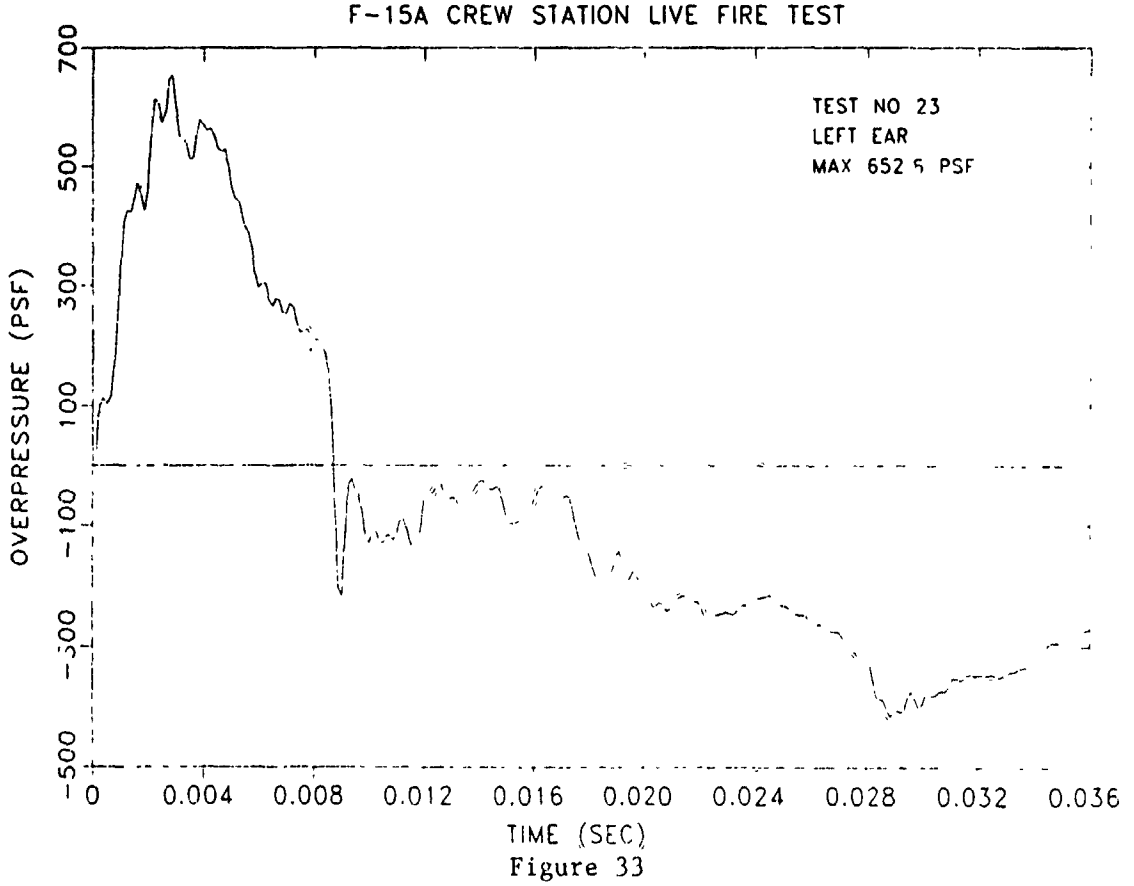
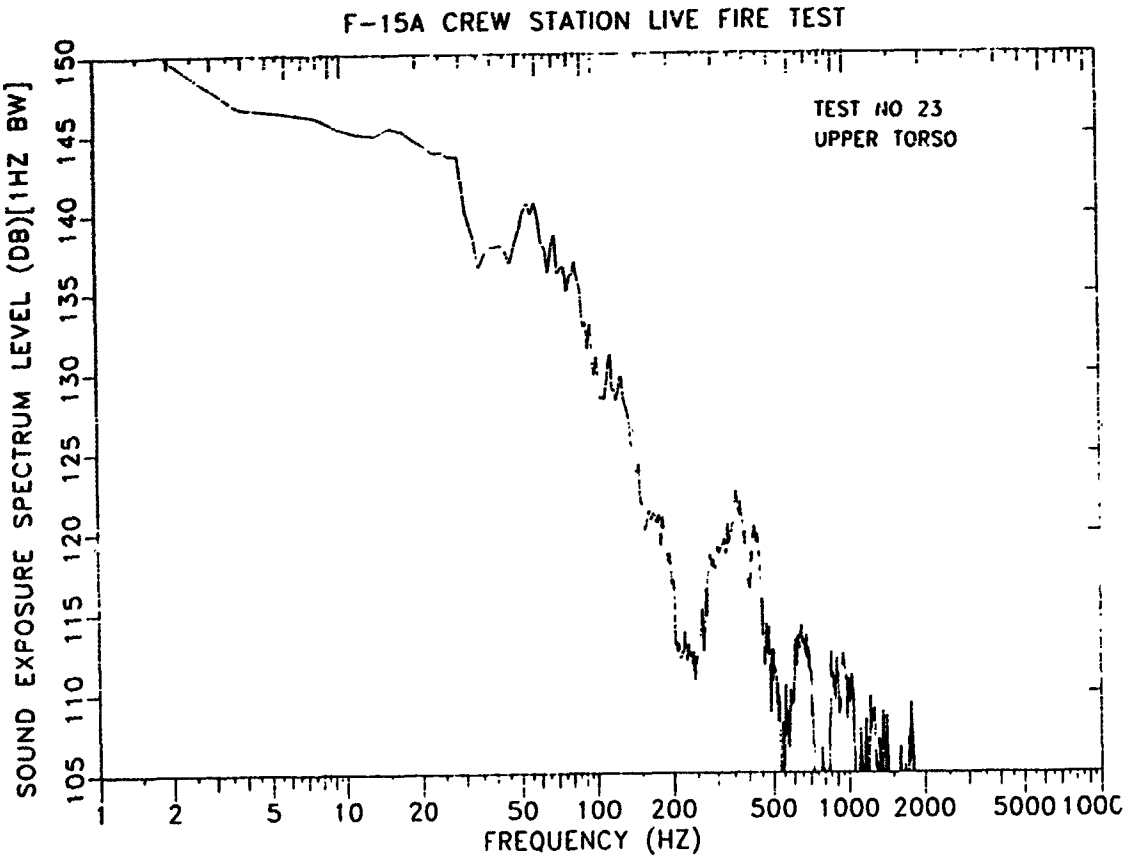

F-15A CREW STATION LIVE FIRE TEST
TEST NO 23
LEFT EAR
MAX 652.5 PSF
OVERPRESSURE (PSF)
-500 -300 -100 100 300 500 700
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 33


F-15A CREW STATION LIVE FIRE TEST
TEST NO 23
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
105 110 115 120 125 130 135 140 145 150
1 2 5 10 20 50 100 200 500 1000 2000 5000 100C
FREQUENCY (HZ)

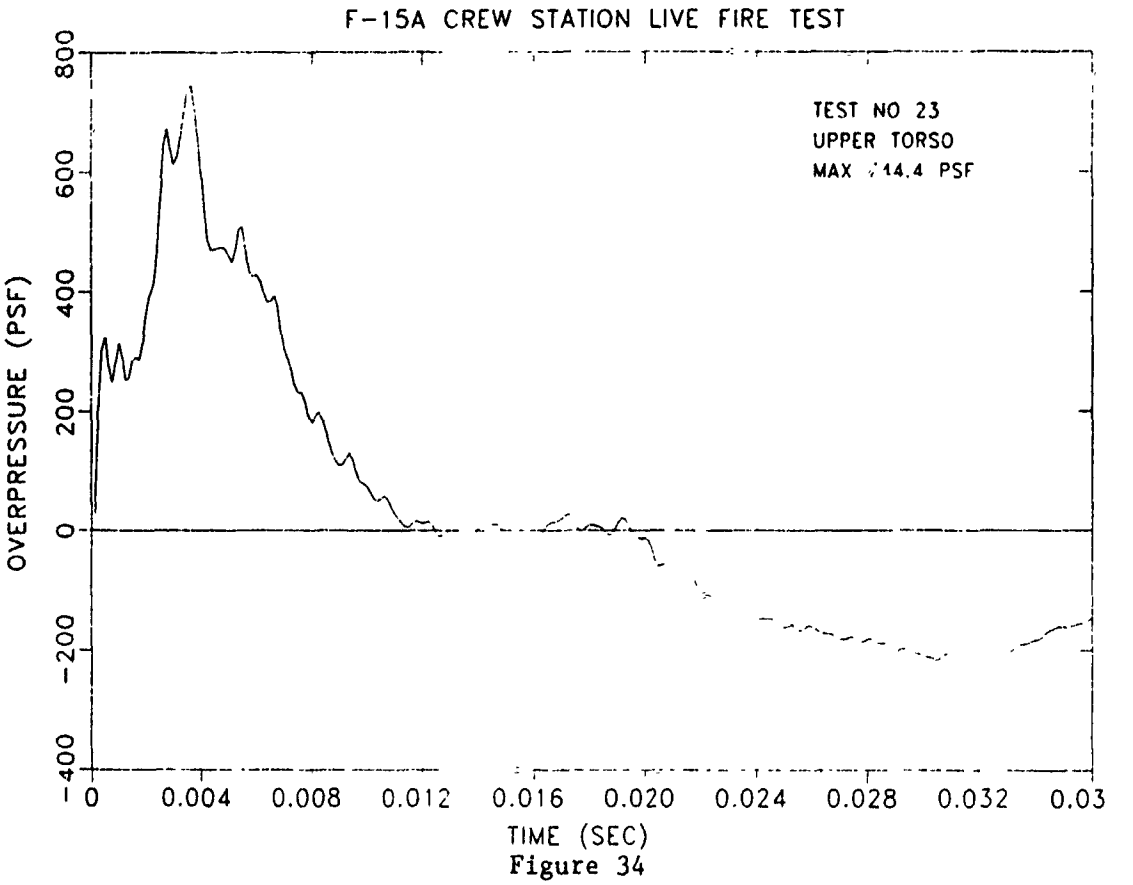
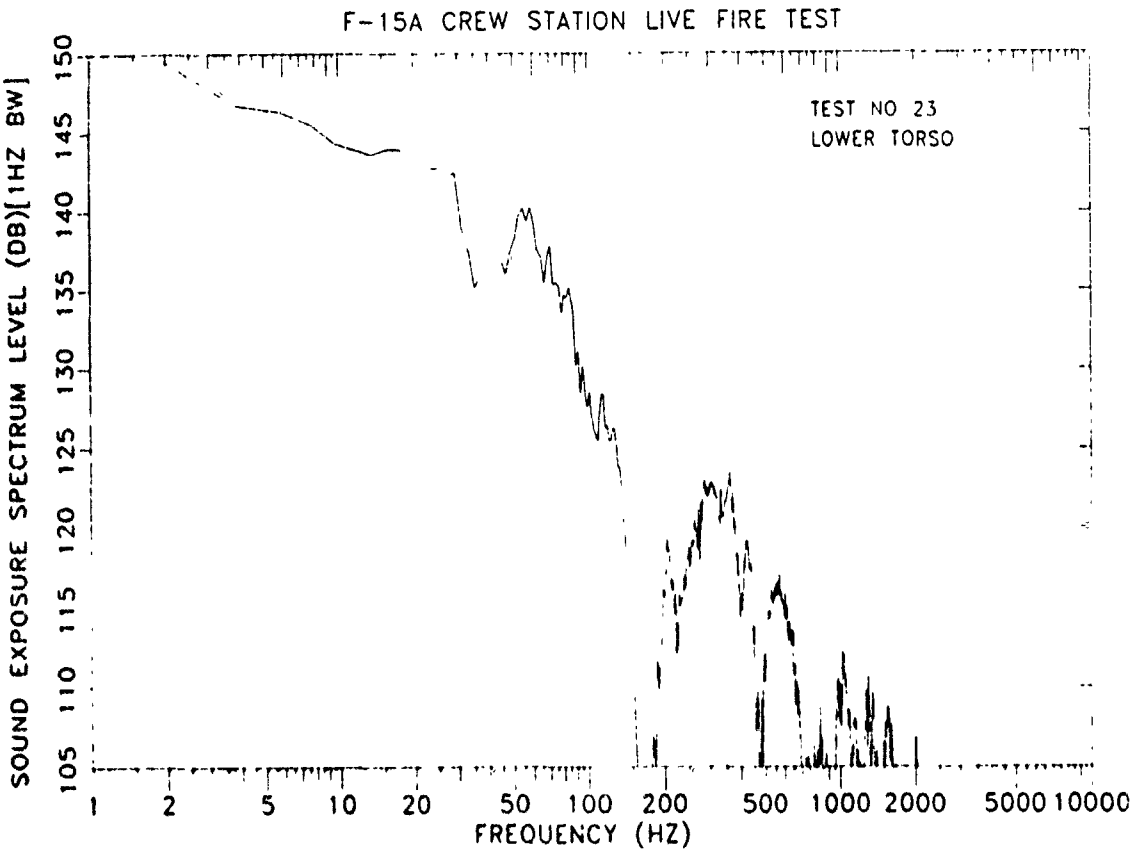

F-15A CREW STATION LIVE FIRE TEST
TEST NO 23
UPPER TORSO
MAX 714.4 PSF
OVERPRESSURE (PSF)
800 600 400 200 0 -200 -400
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.03
TIME (SEC)

Figure 34


F-15A CREW STATION LIVE FIRE TEST
TEST NO 23
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
105 110 115 120 125 130 135 140 145 150
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

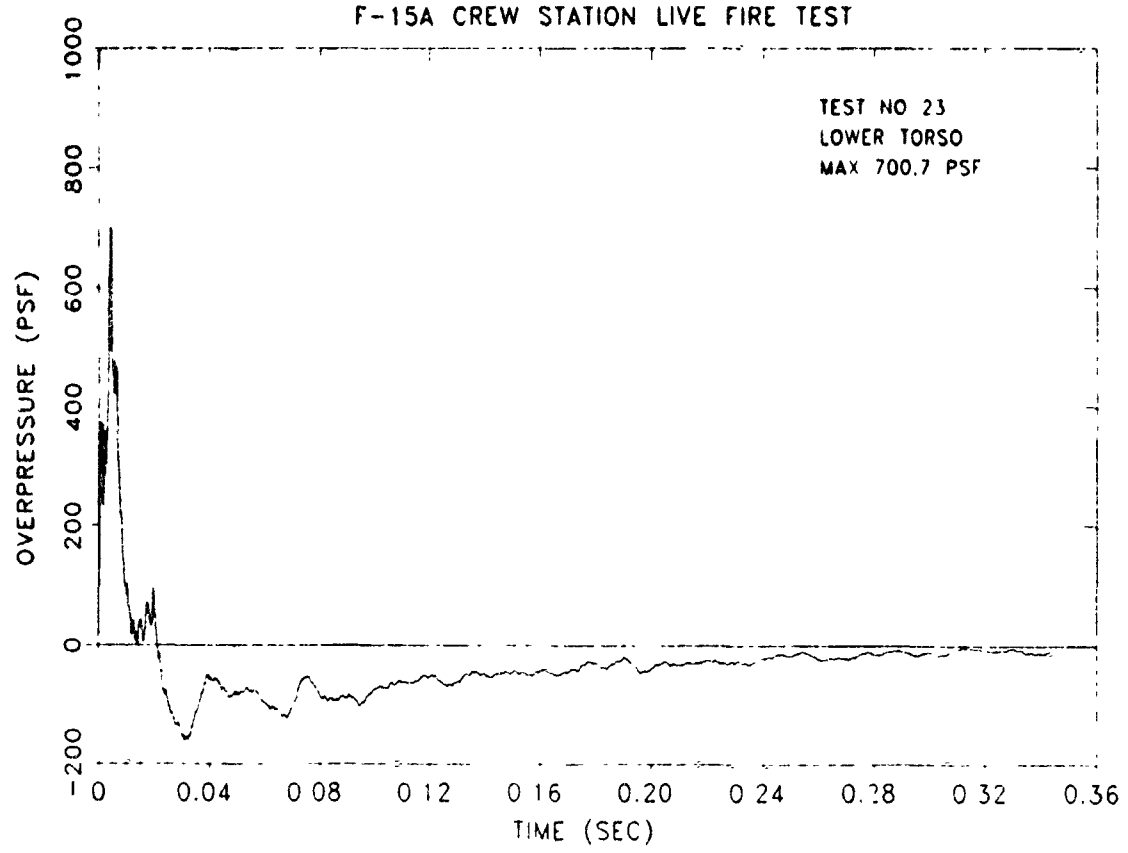
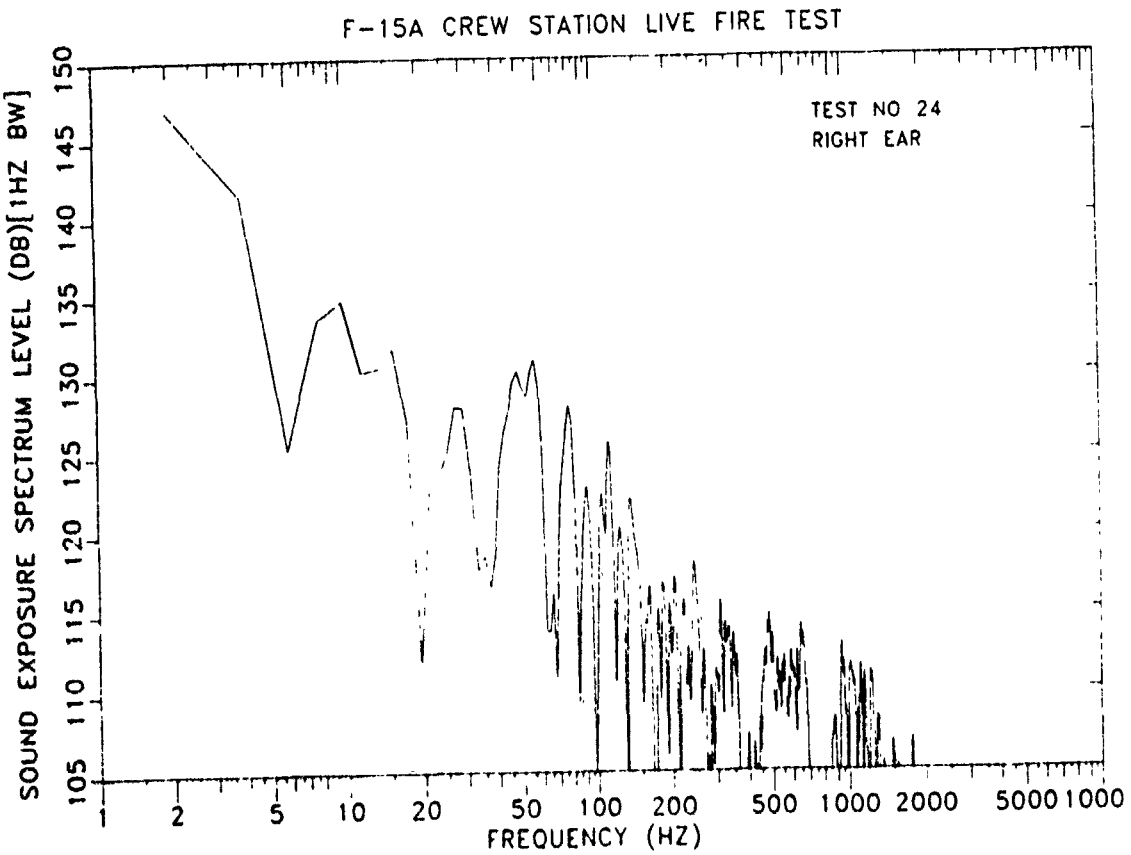

F-15A CREW STATION LIVE FIRE TEST
TEST NO 23
LOWER TORSO
MAX 700.7 PSF
OVERPRESSURE (PSF)
-200 0 200 400 600 800 1000
0 0.04 0.08 0.12 0.16 0.20 0.24 0.28 0.32 0.36
TIME (SEC)

Figure 35


F-15A CREW STATION LIVE FIRE TEST
TEST NO 24
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
105 110 115 120 125 130 135 140 145 150
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

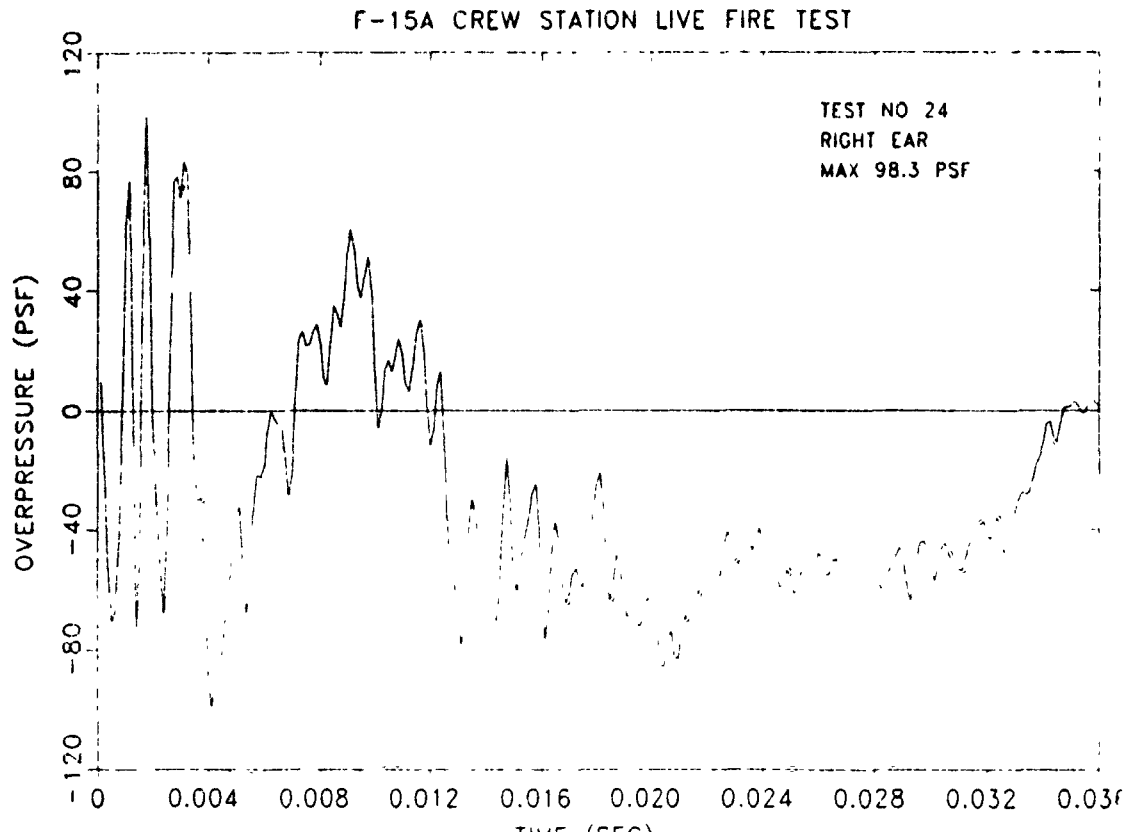
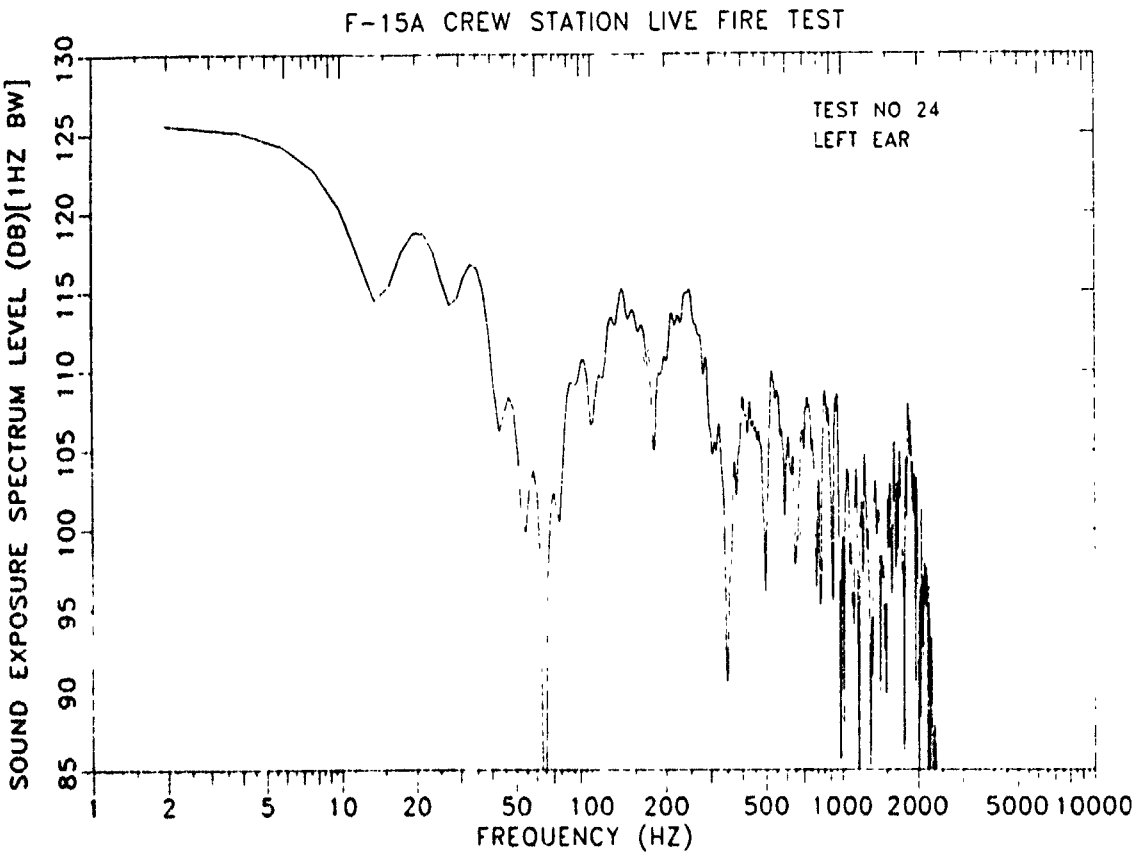

F-15A CREW STATION LIVE FIRE TEST
TEST NO 24
RIGHT EAR
MAX 98.3 PSF
OVERPRESSURE (PSF)
120 80 40 0 -40 -80 -120
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.03
TIME (SEC)

Figure 36


F-15A CREW STATION LIVE FIRE TEST
TEST NO 24
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
85 90 95 100 105 110 115 120 125 130
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

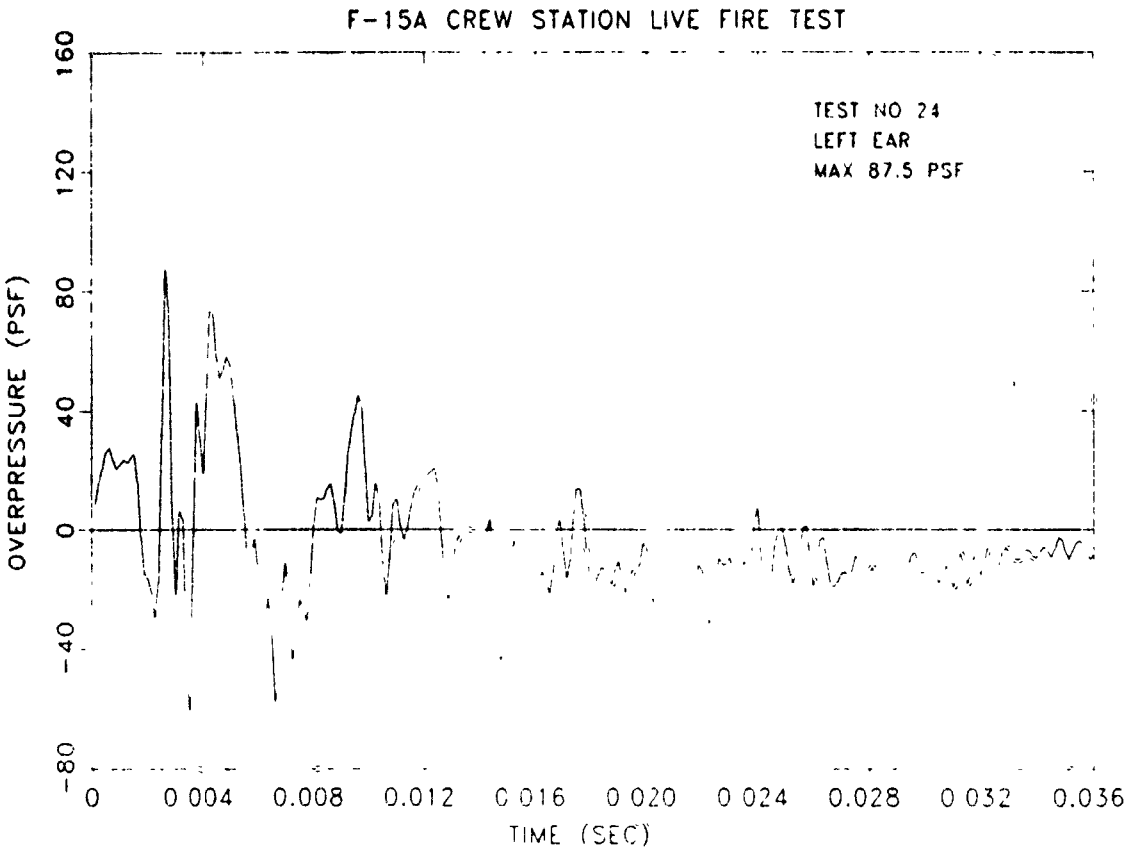
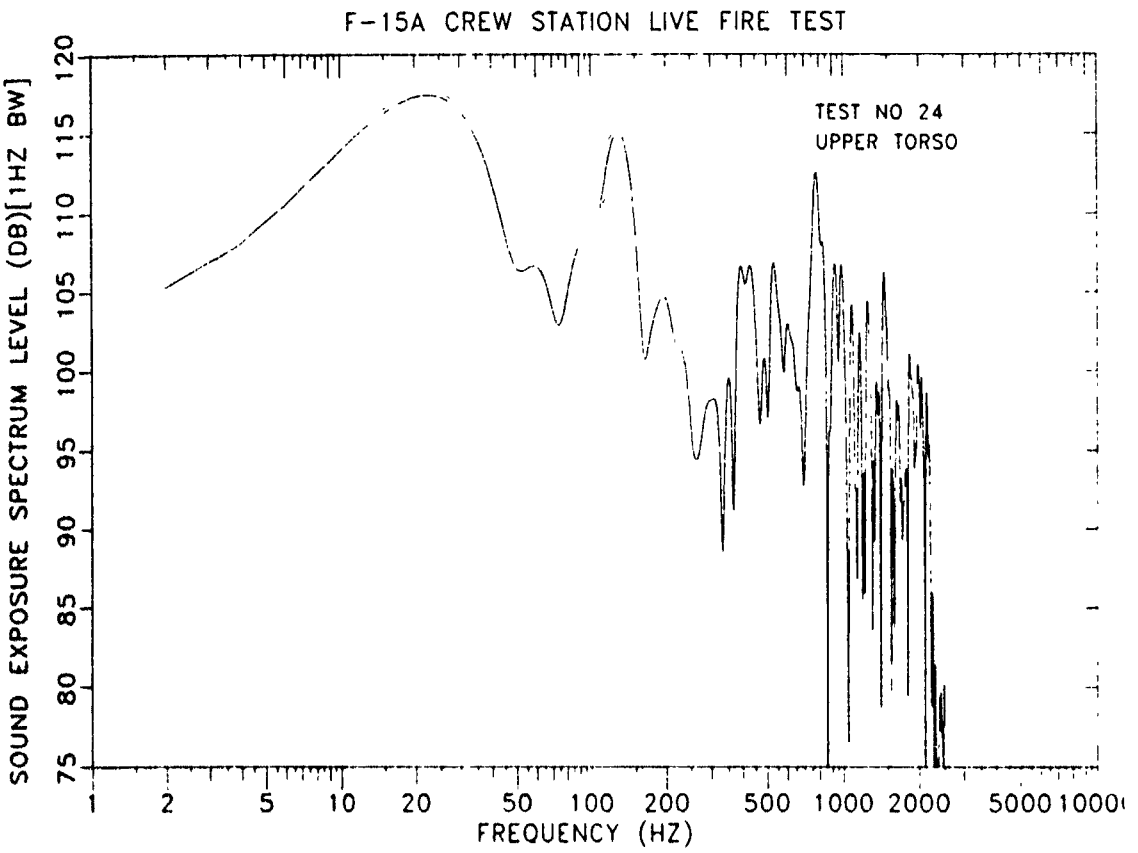

F-15A CREW STATION LIVE FIRE TEST
TEST NO 24
LEFT EAR
MAX 87.5 PSF
OVERPRESSURE (PSF)
160 120 80 40 0 -40 -80
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 37


F-15A CREW STATION LIVE FIRE TEST
TEST NO 24
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
75 80 85 90 95 100 105 110 115 120
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

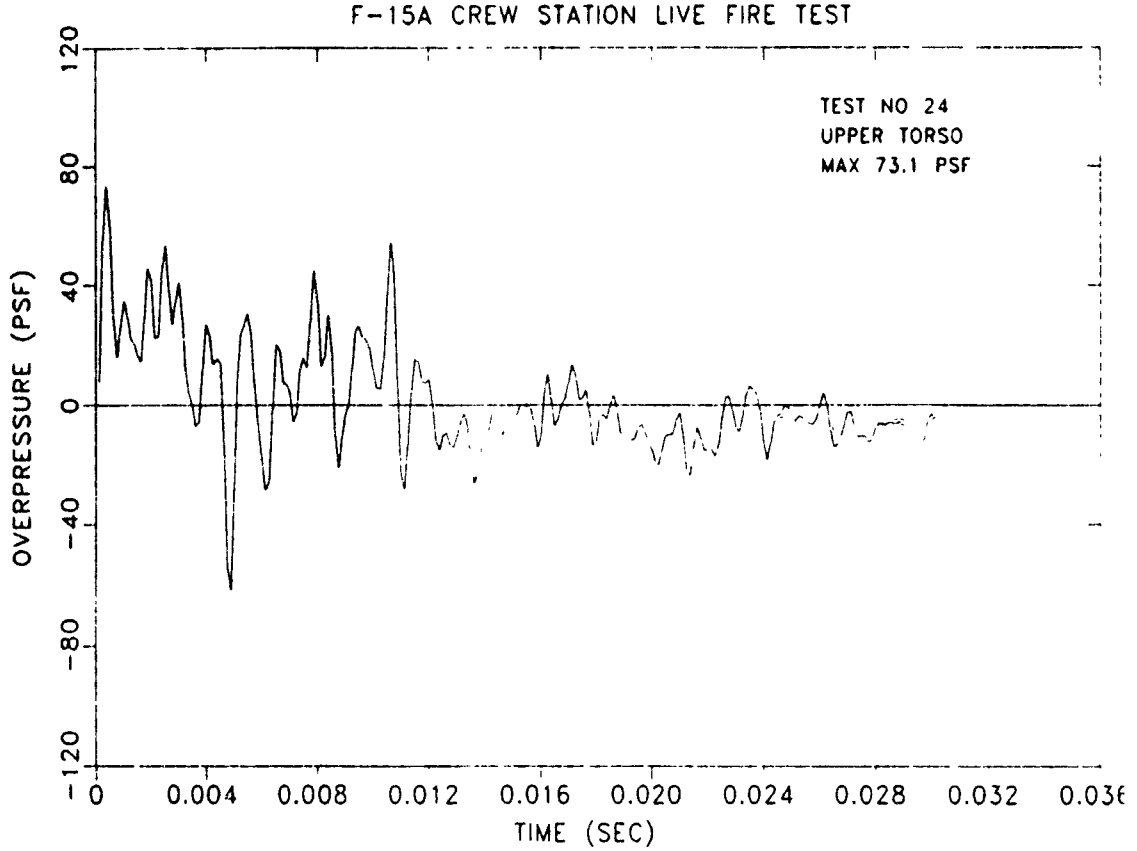
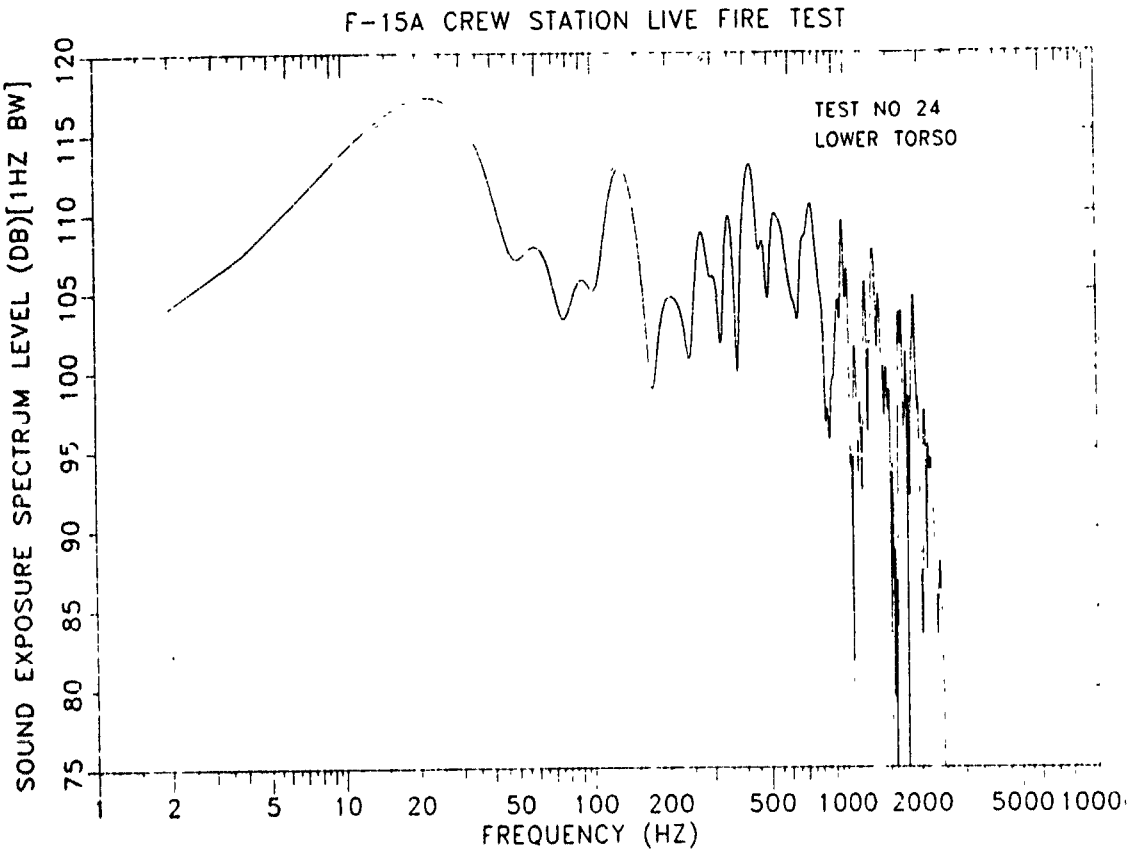

F-15A CREW STATION LIVE FIRE TEST
TEST NO 24
UPPER TORSO
MAX 73.1 PSF
OVERPRESSURE (PSF)
-120 -80 -40 0 40 80 120
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 38


F-15A CREW STATION LIVE FIRE TEST
TEST NO 24
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
75 80 85 90 95 100 105 110 115 120
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

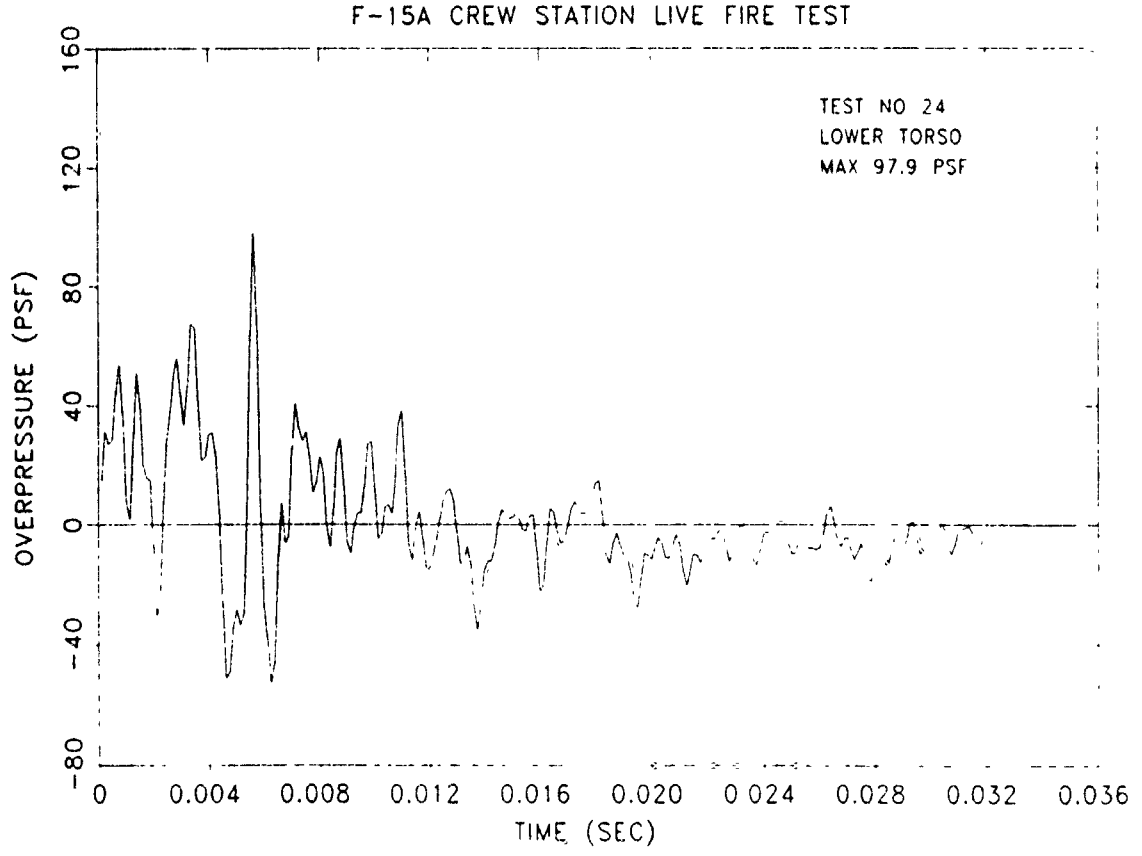
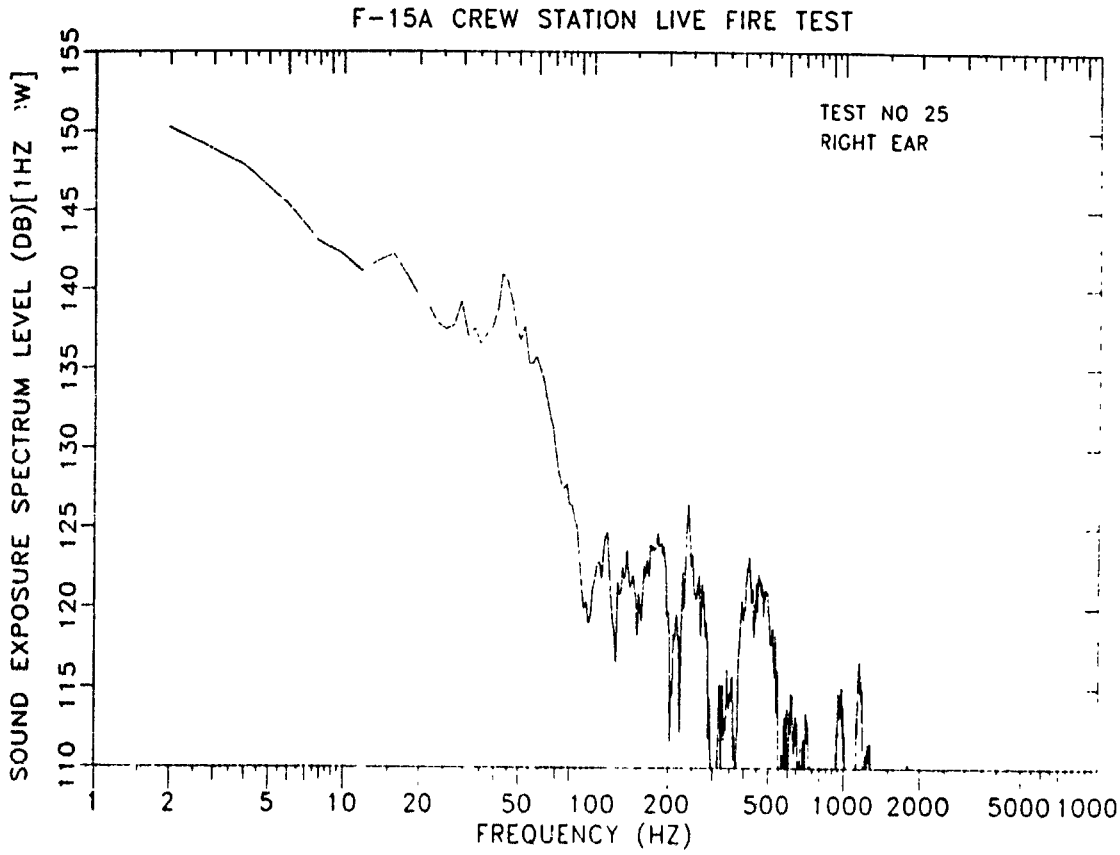

F-15A CREW STATION LIVE FIRE TEST
TEST NO 24
LOWER TORSO
MAX 97.9 PSF
OVERPRESSURE (PSF)
-80 -40 0 40 80 120 160
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 39


F-15A CREW STATION LIVE FIRE TEST
TEST NO 25
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ W]
110 115 120 125 130 135 140 145 150 155
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

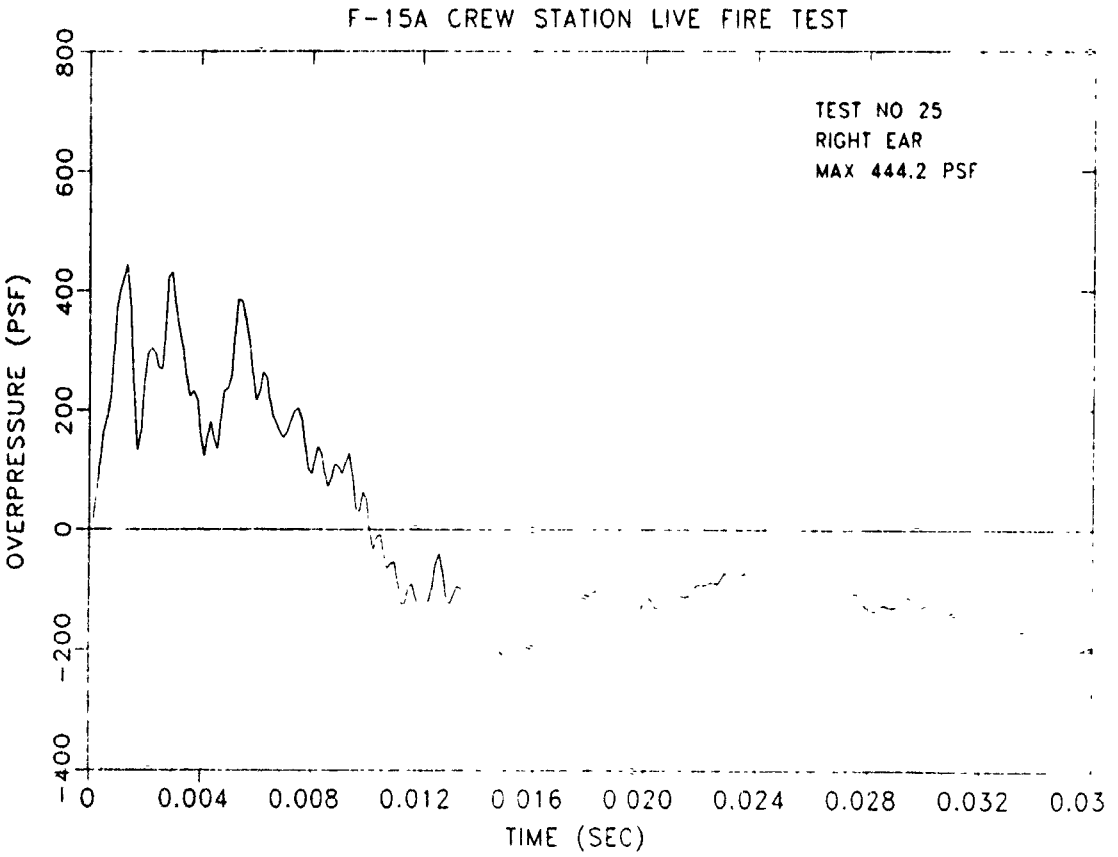
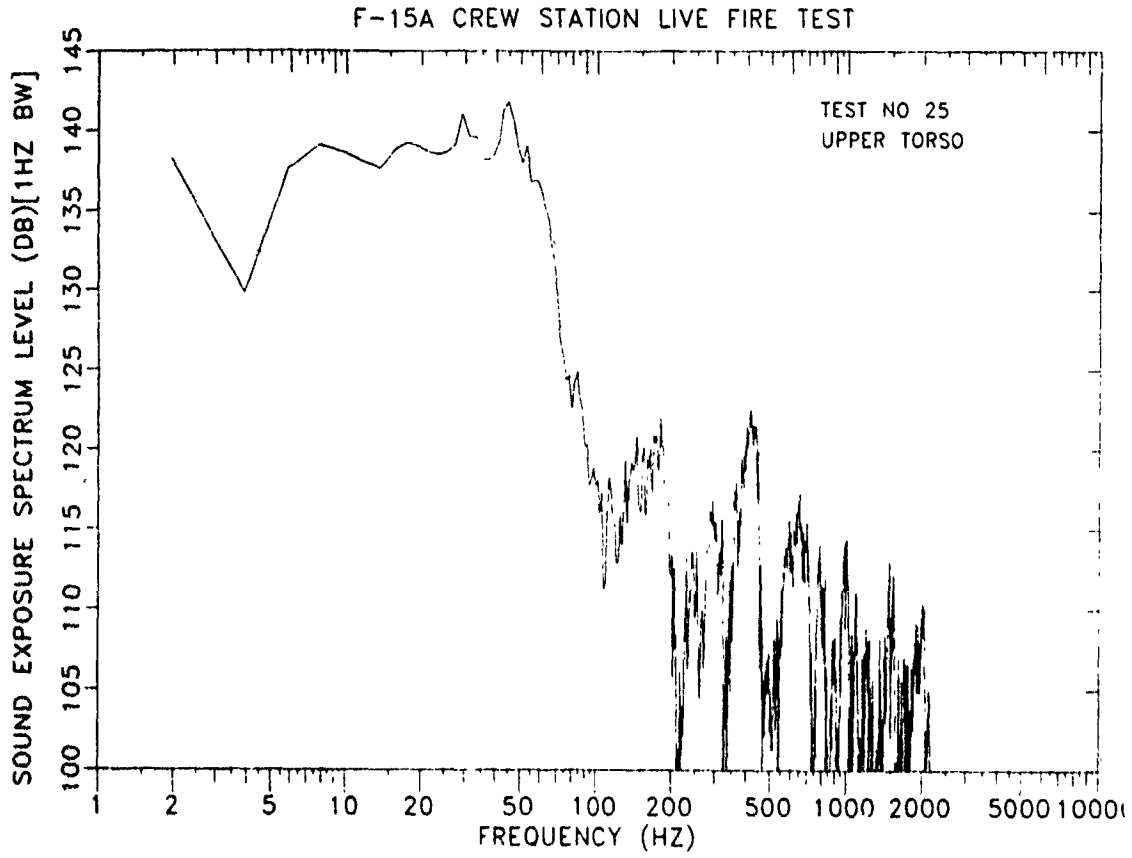

F-15A CREW STATION LIVE FIRE TEST
TEST NO 25
RIGHT EAR
MAX 444.2 PSF
OVERPRESSURE (PSF)
-400 -200 0 200 400 600 800
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.03
TIME (SEC)

Figure 40


F-15A CREW STATION LIVE FIRE TEST
TEST NO 25
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
100 105 110 115 120 125 130 135 140 145
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

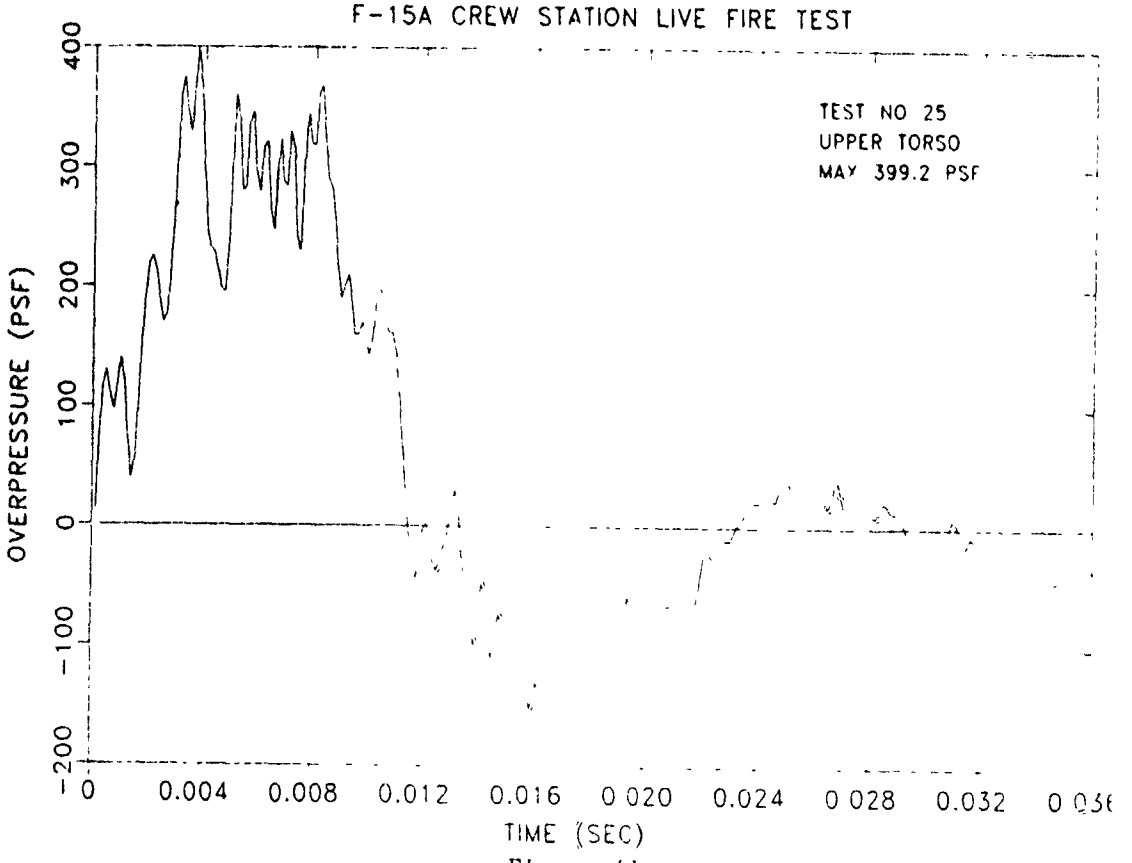
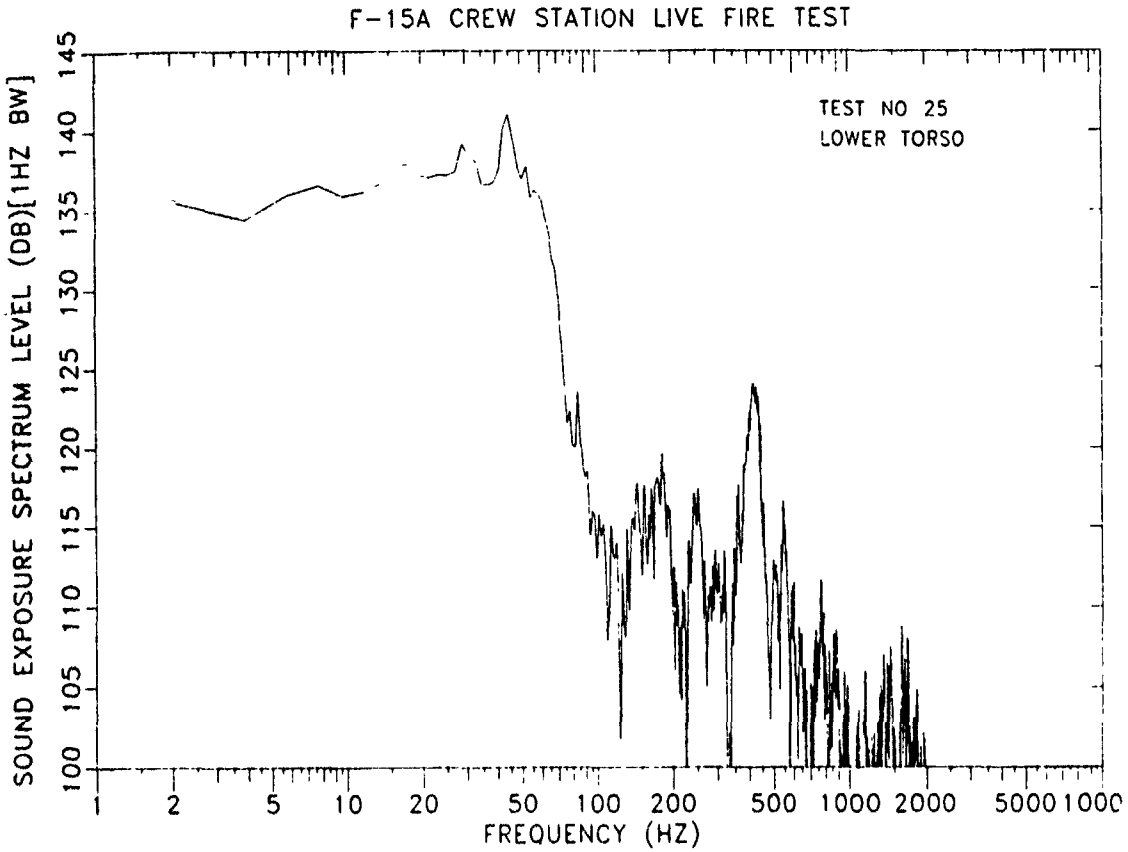

F-15A CREW STATION LIVE FIRE TEST
TEST NO 25
UPPER TORSO
MAX 399.2 PSF
OVERPRESSURE (PSF)
400 300 200 100 0 -100 -200
0 0.004 0.008 0.012 0.016 0 020 0.024 0 028 0.032
TIME (SEC)

Figure 41


F-15A CREW STATION LIVE FIRE TEST
TEST NO 25
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
100 105 110 115 120 125 130 135 140 145
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

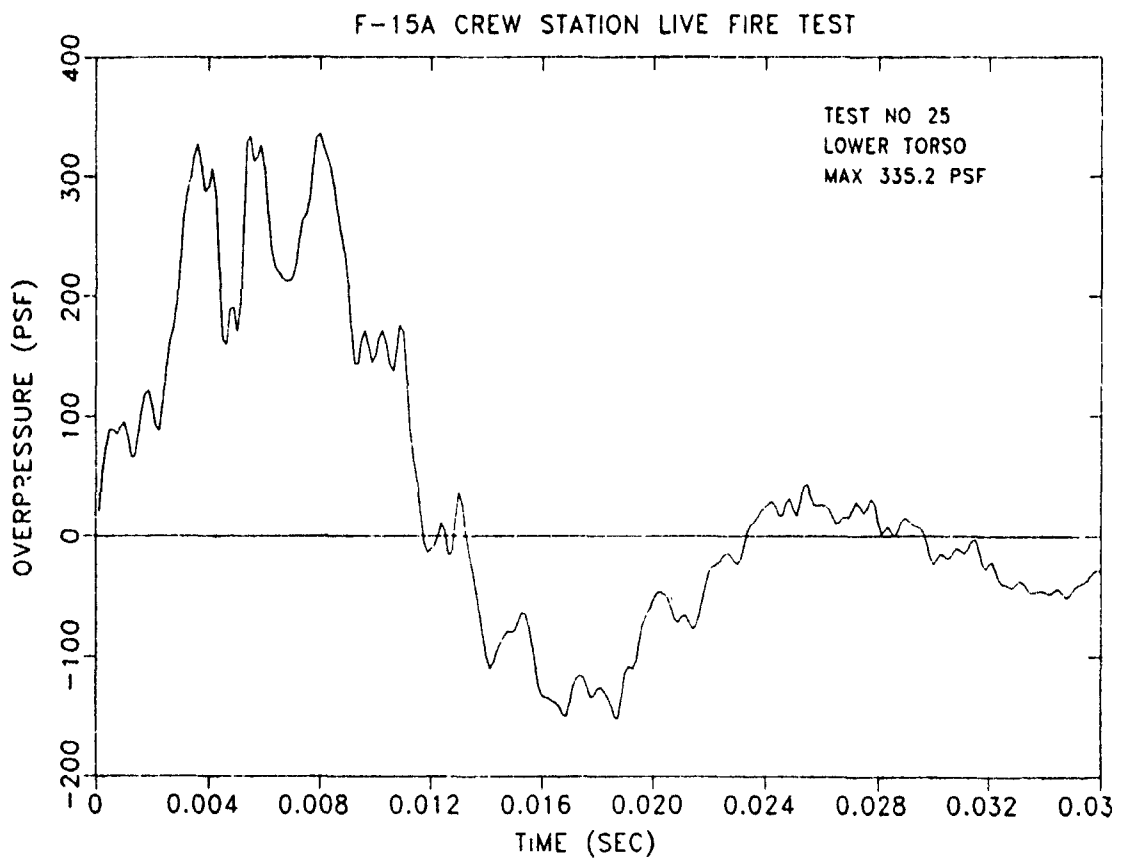
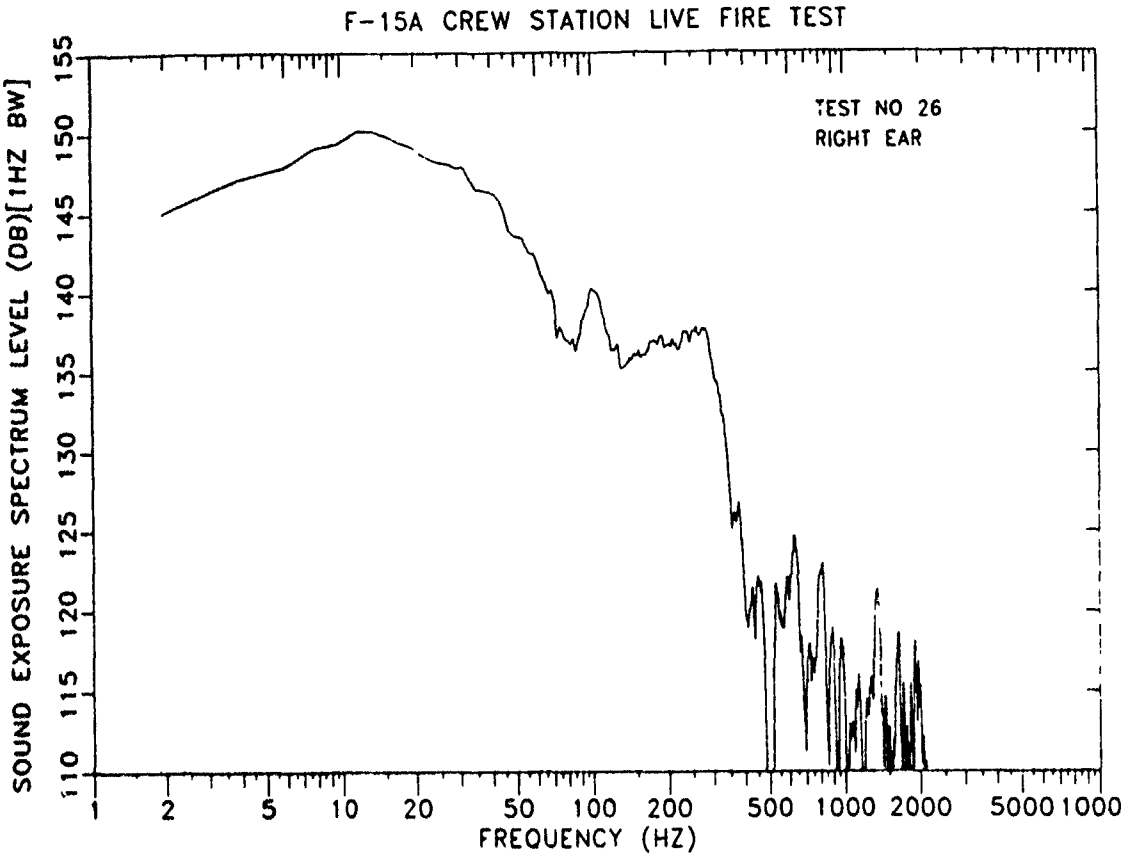

F-15A CREW STATION LIVE FIRE TEST
TEST NO 25
LOWER TORSO
MAX 335.2 PSF
OVERPRESSURE (PSF)
400 300 200 100 0 -100 -200
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.03
TIME (SEC)

Figure 42


F-15A CREW STATION LIVE FIRE TEST
TEST NO 26
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (OB)[1HZ BW]
110 115 120 125 130 135 140 145 150 155
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

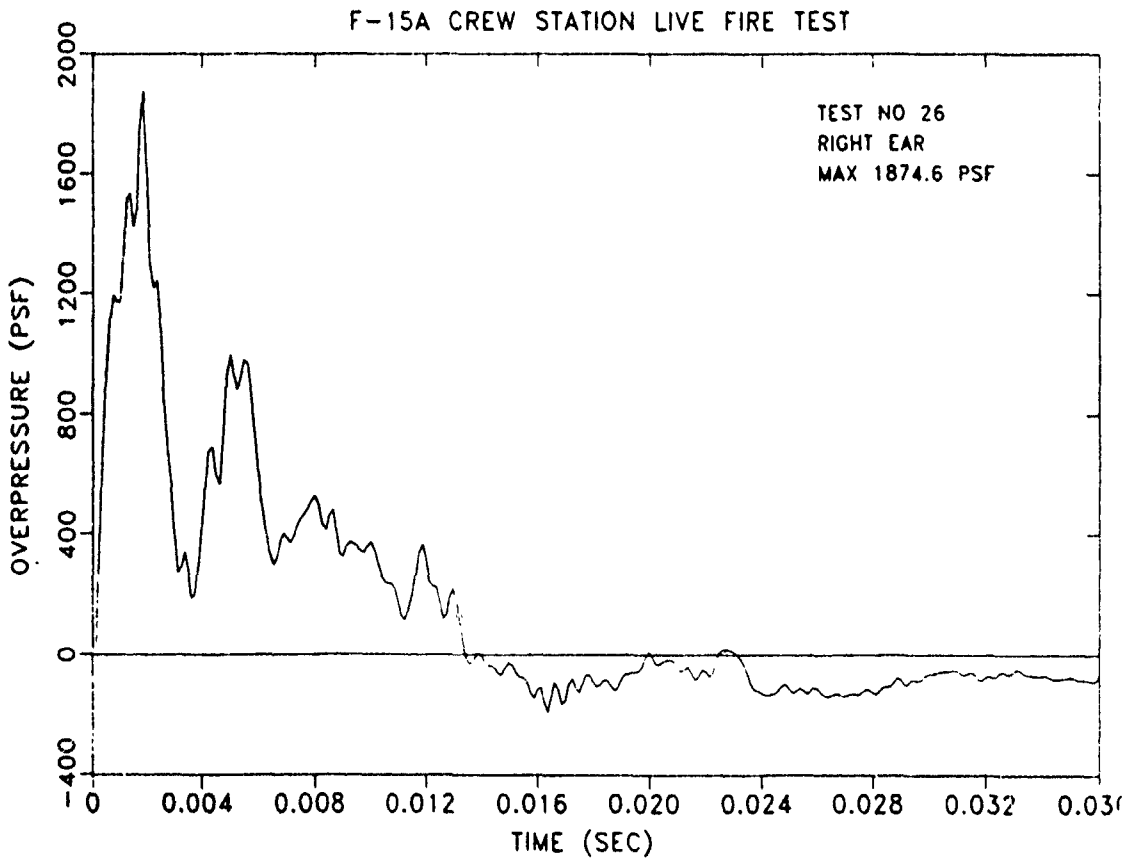
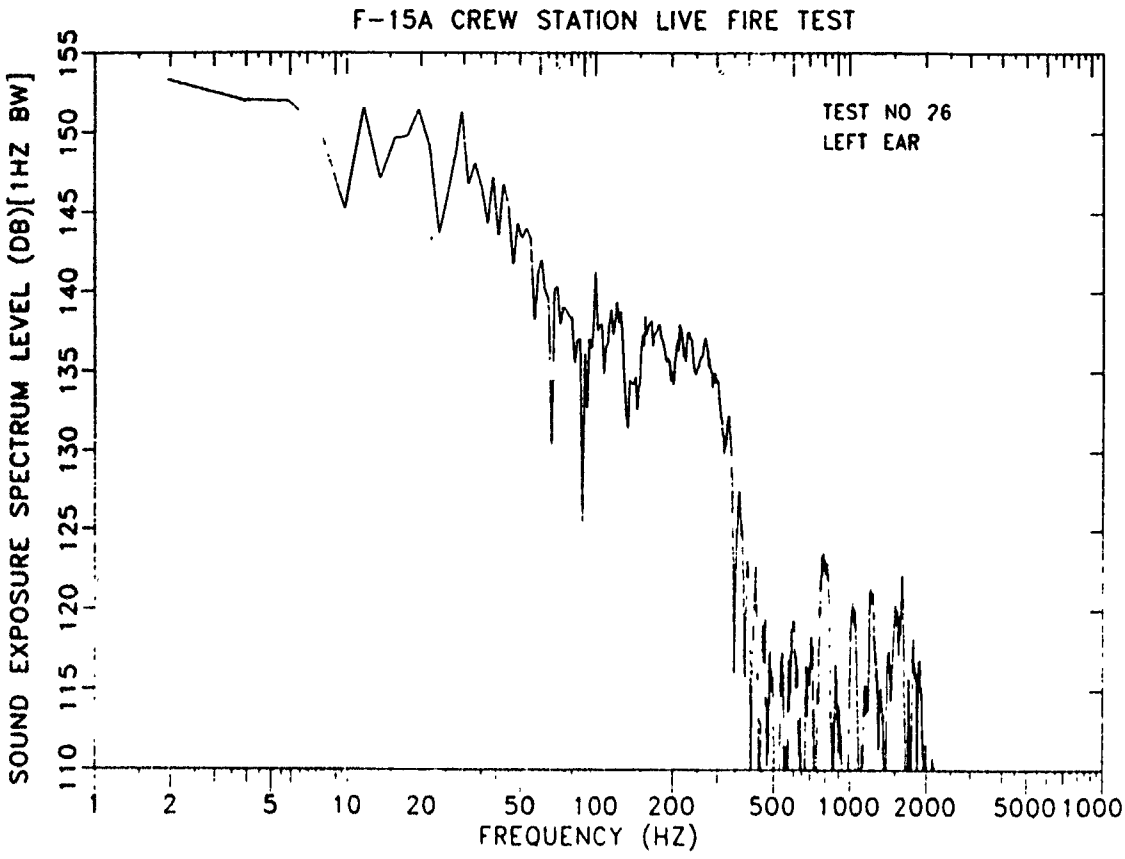

F-15A CREW STATION LIVE FIRE TEST
TEST NO 26
RIGHT EAR
MAX 1874.6 PSF
OVERPRESSURE (PSF)
-400 0 400 800 1200 1600 2000
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032
TIME (SEC)

Figure 43


F-15A CREW STATION LIVE FIRE TEST
TEST NO 26
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
110 115 120 125 130 135 140 145 150 155
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

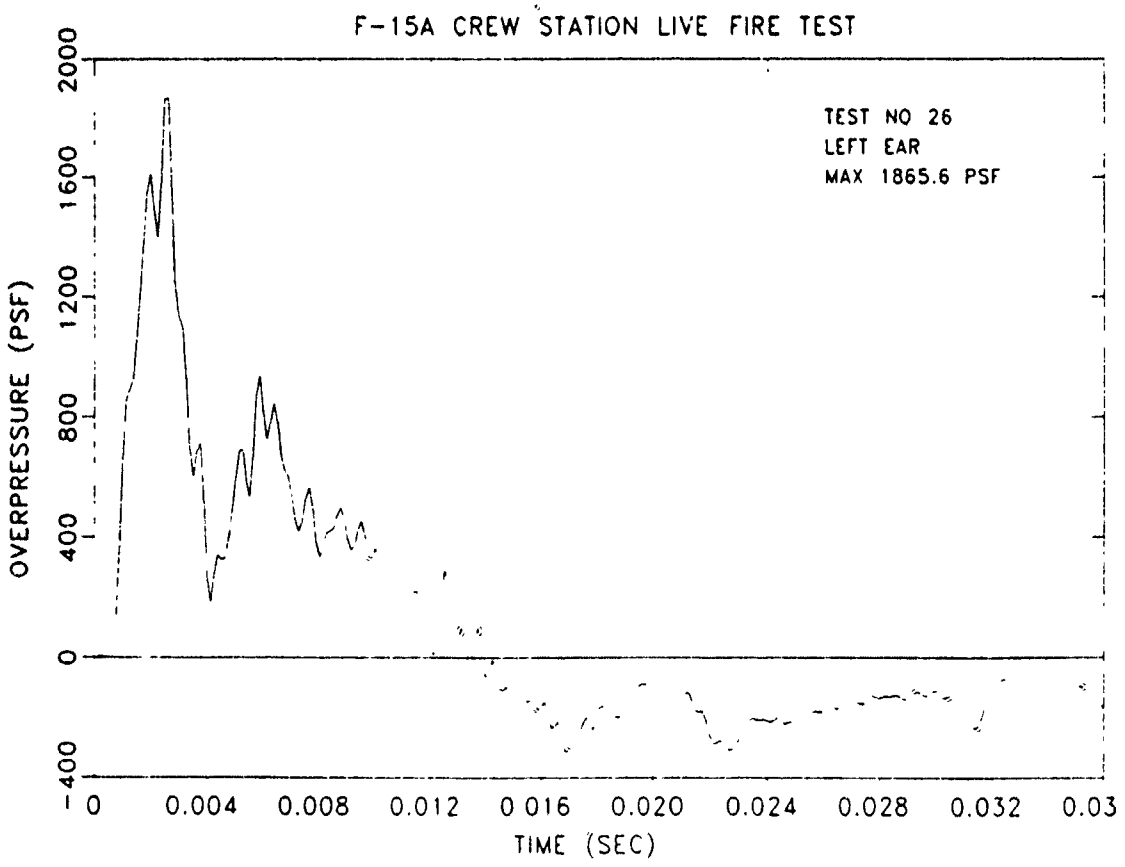
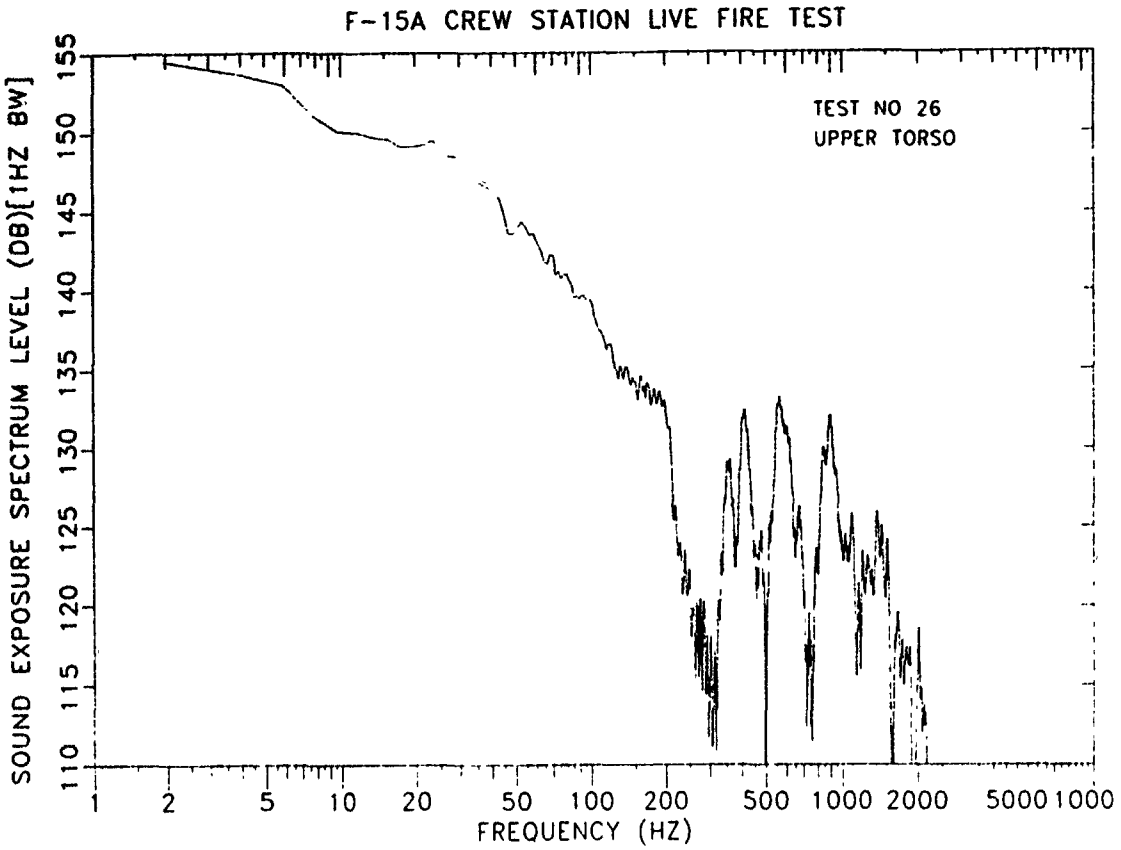

F-15A CREW STATION LIVE FIRE TEST
TEST NO 26
LEFT EAR
MAX 1865.6 PSF
OVERPRESSURE (PSF)
2000 1600 1200 800 400 0 -400
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.03
TIME (SEC)

Figure 44


F-15A CREW STATION LIVE FIRE TEST
TEST NO 26
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
110 115 120 125 130 135 140 145 150 155
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

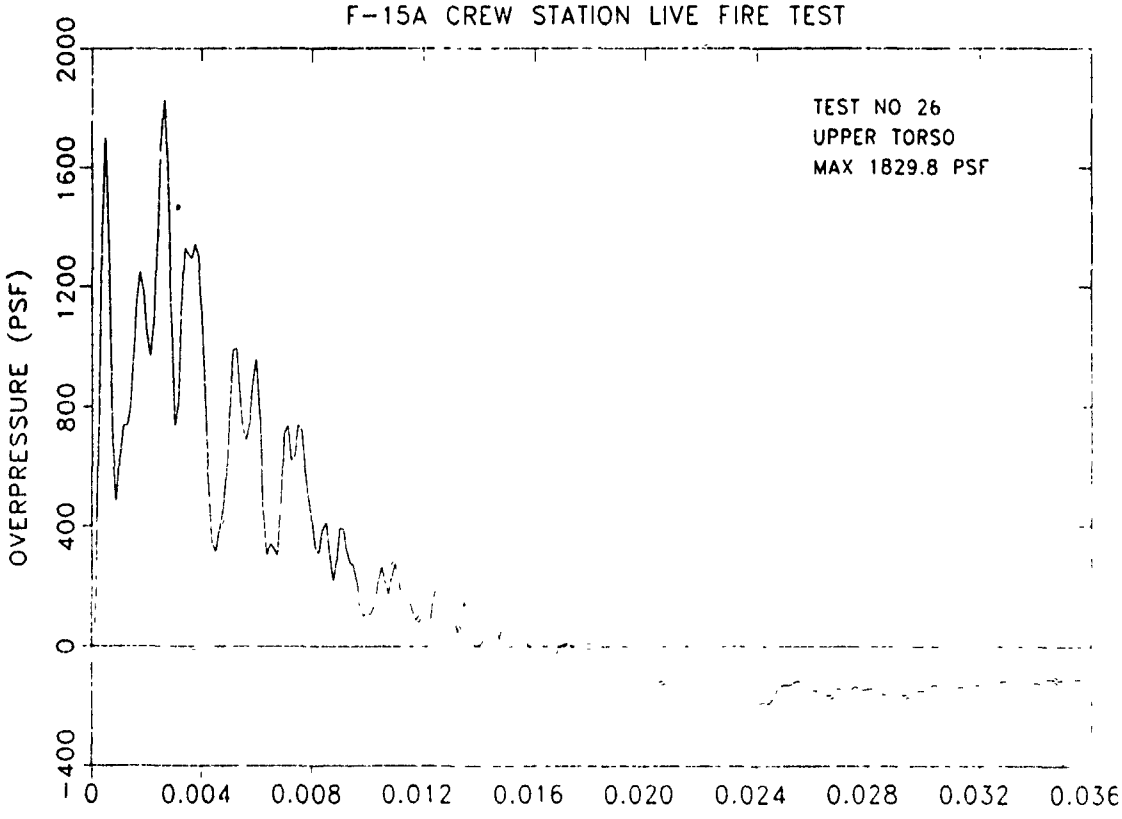
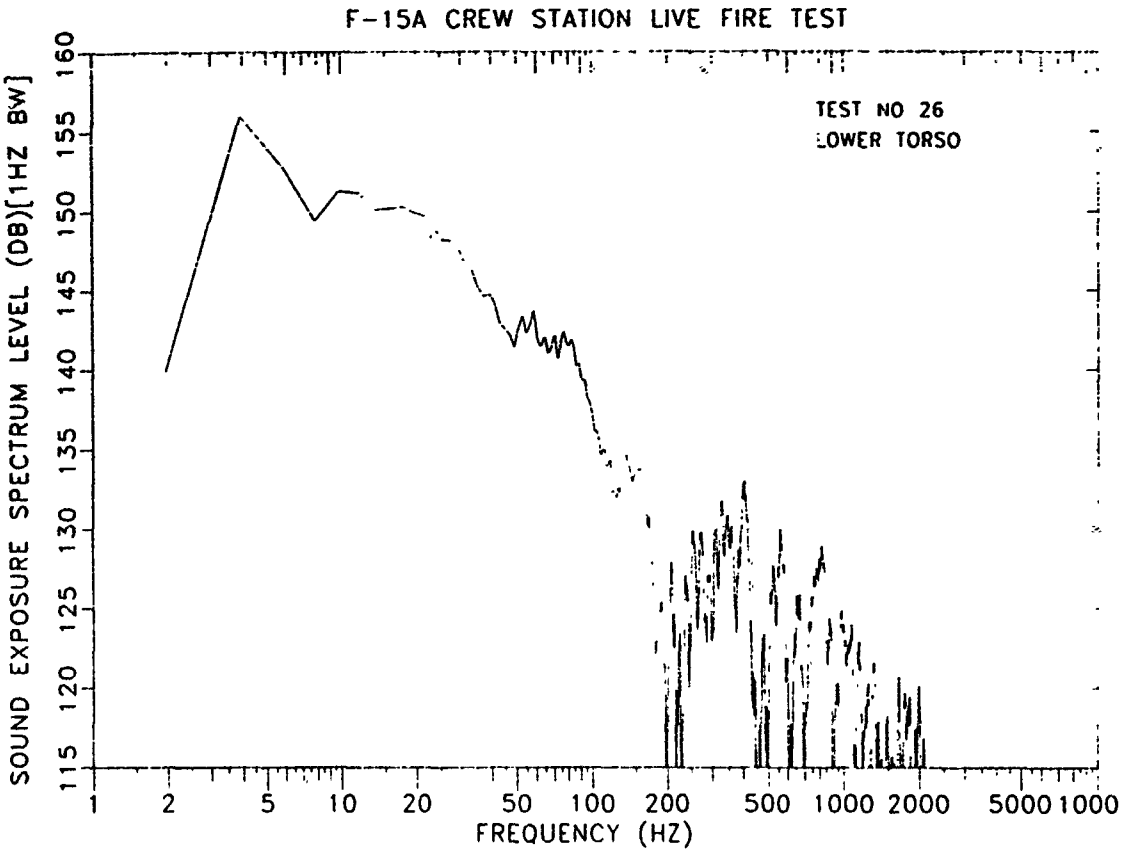

F-15A CREW STATION LIVE FIRE TEST
TEST NO 26
UPPER TORSO
MAX 1829.8 PSF
OVERPRESSURE (PSF)
-400 0 400 800 1200 1600 2000
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 45


F-15A CREW STATION LIVE FIRE TEST
TEST NO 26
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115 120 125 130 135 140 145 150 155 160
1 2 5 10 20 50 100 200 500 1000 2000 5000 1000
FREQUENCY (HZ)

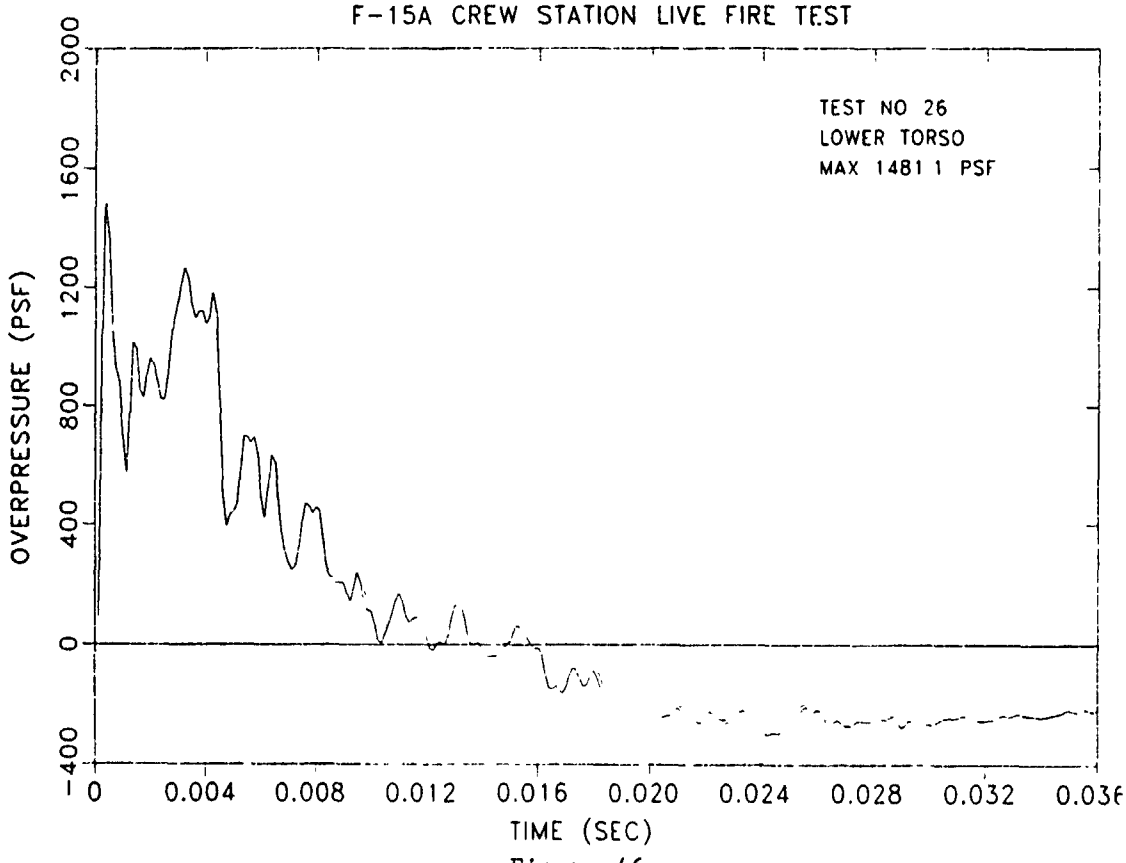
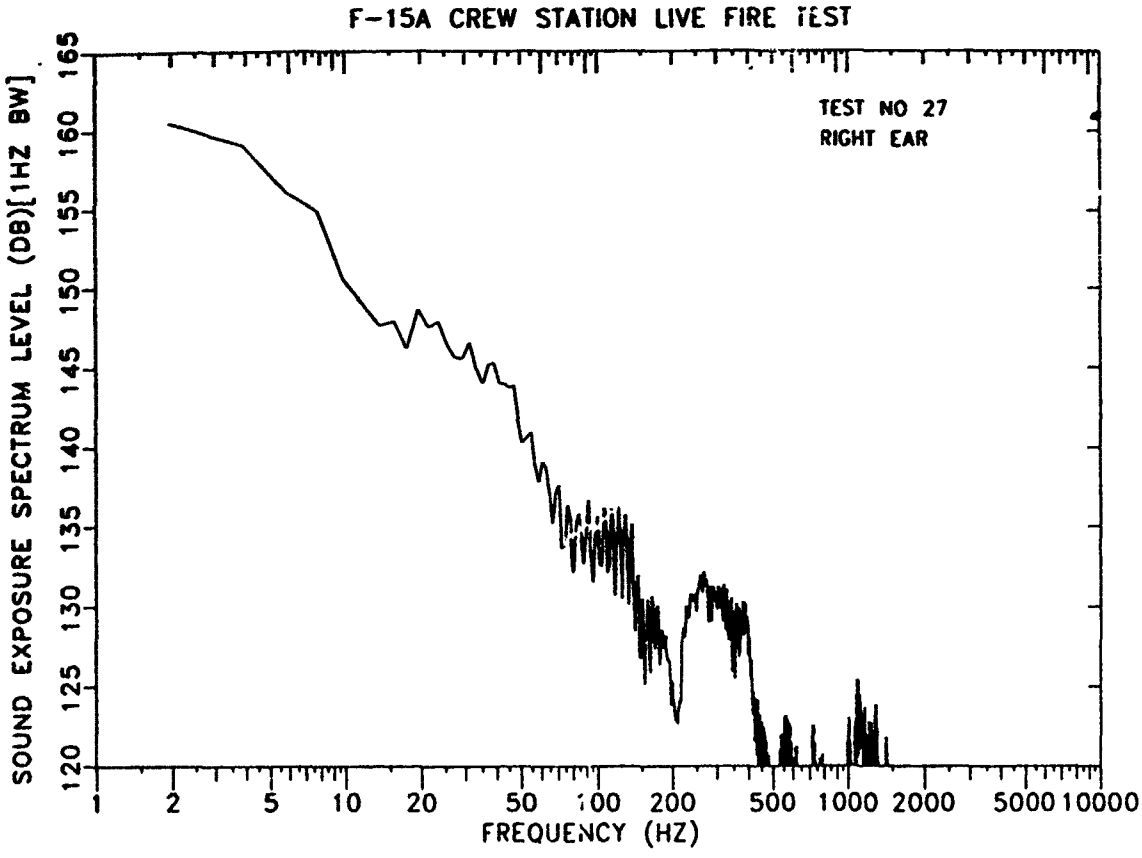

F-15A CREW STATION LIVE FIRE TEST
TEST NO 26
LOWER TORSO
MAX 1481 1 PSF
OVERPRESSURE (PSF)
-400 0 400 800 1200 1600 2000
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 46


F-15A CREW STATION LIVE FIRE TEST
TEST NO 27
RIGHT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
120 125 130 135 140 145 150 155 160 165
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

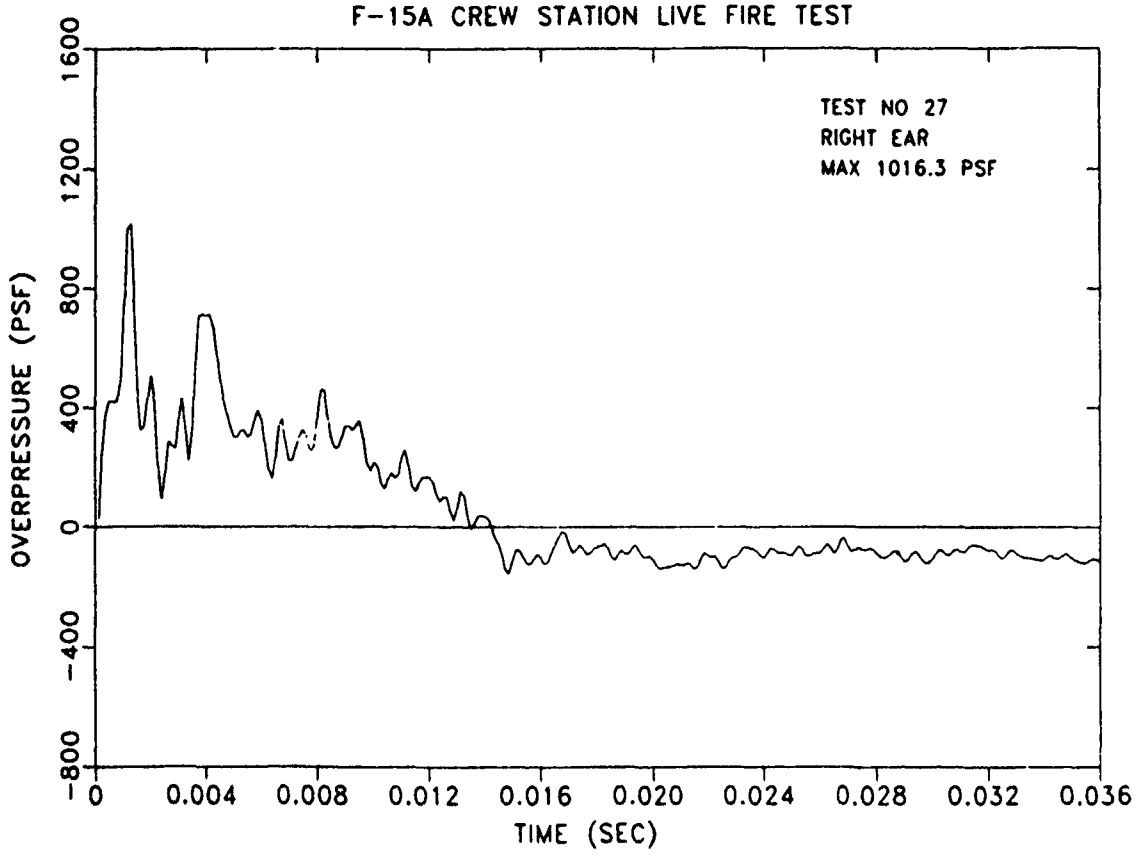
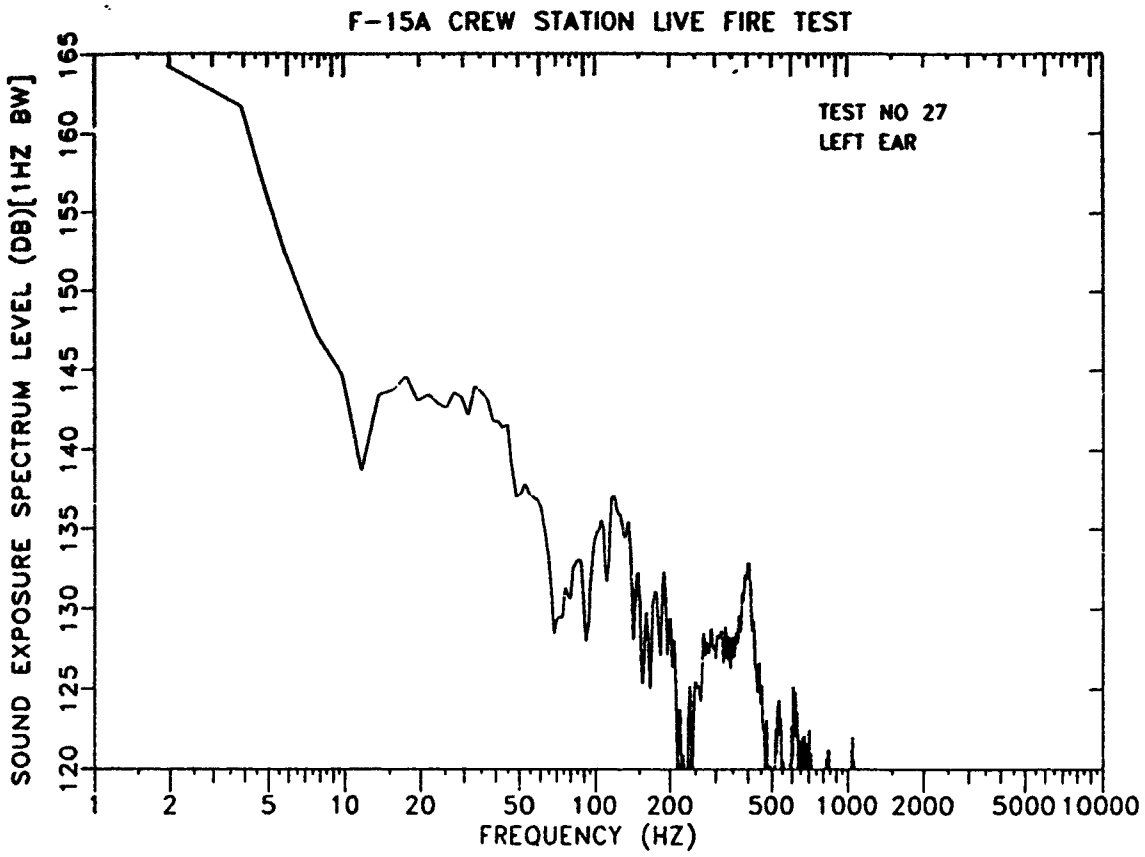

F-15A CREW STATION LIVE FIRE TEST
TEST NO 27
RIGHT EAR
MAX 1016.3 PSF
OVERPRESSURE (PSF)
-800 -400 0 400 800 1200 1600
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 47


F-15A CREW STATION LIVE FIRE TEST
TEST NO 27
LEFT EAR
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
120 125 130 135 140 145 150 155 160 165
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

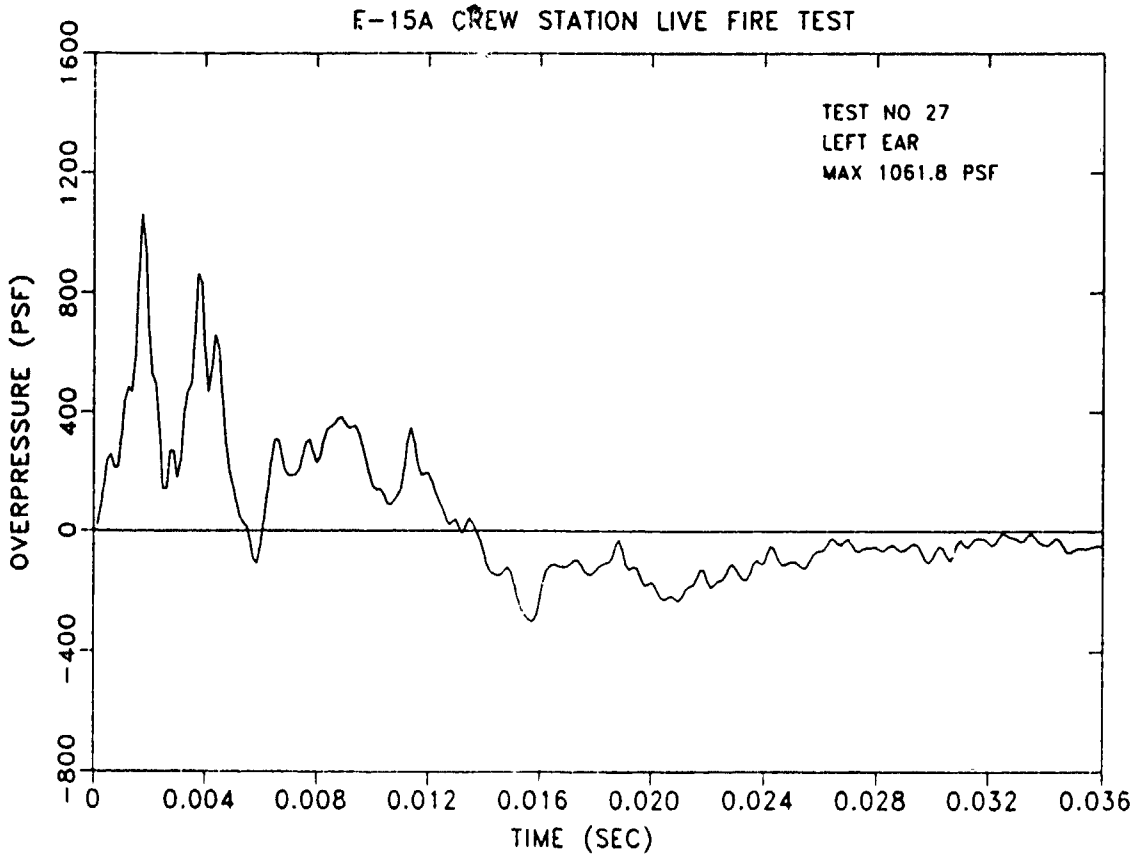
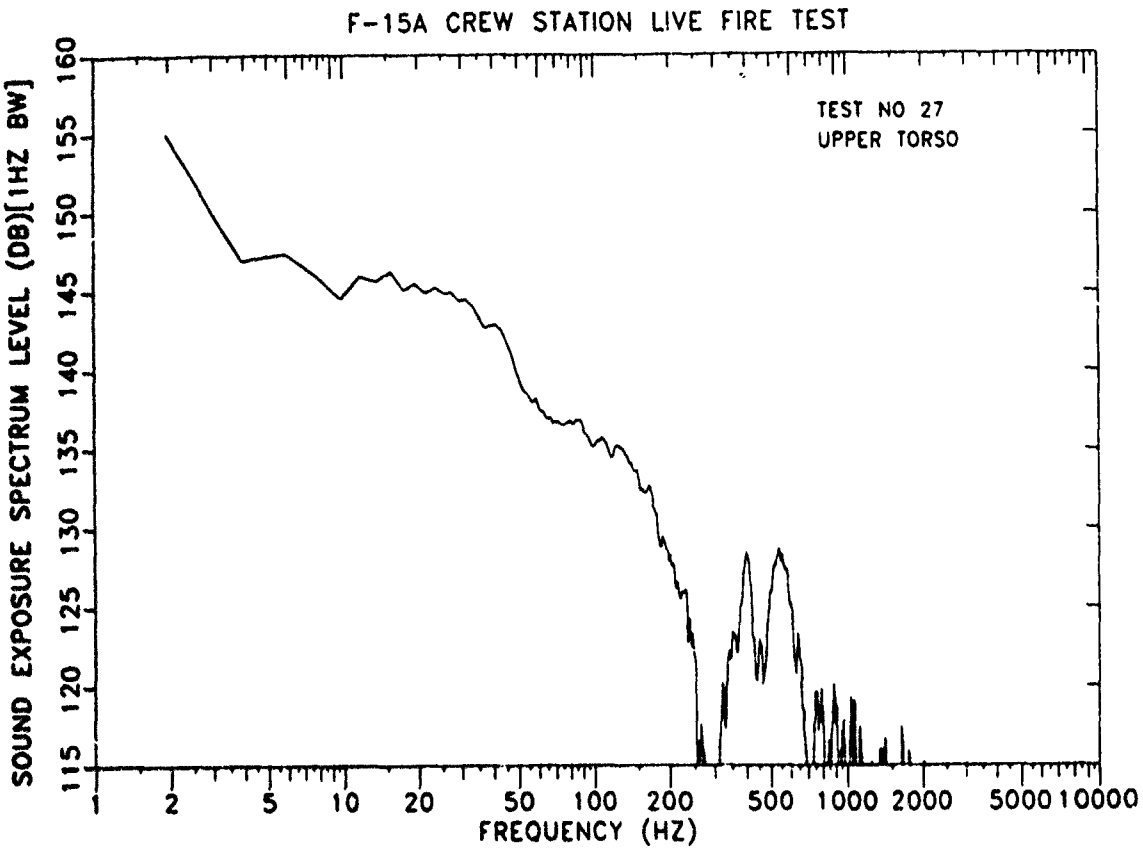

F-15A CREW STATION LIVE FIRE TEST
TEST NO 27
LEFT EAR
MAX 1061.8 PSF
OVERPRESSURE (PSF)
-800 -400 0 400 800 1200 1600
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 48


F-15A CREW STATION LIVE FIRE TEST
TEST NO 27
UPPER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
115 120 125 130 135 140 145 150 155 160
1 2 5 10 20 50 100 200 500 1000 2000 5000 10000
FREQUENCY (HZ)

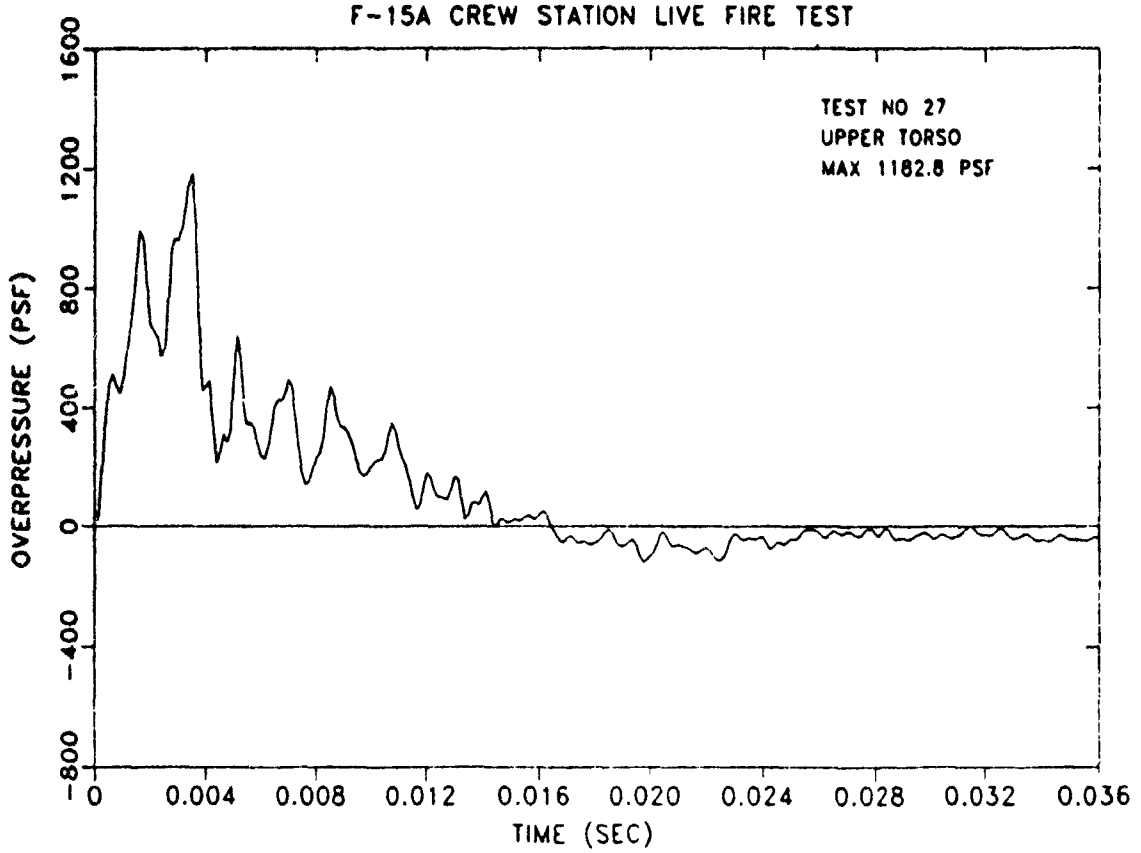
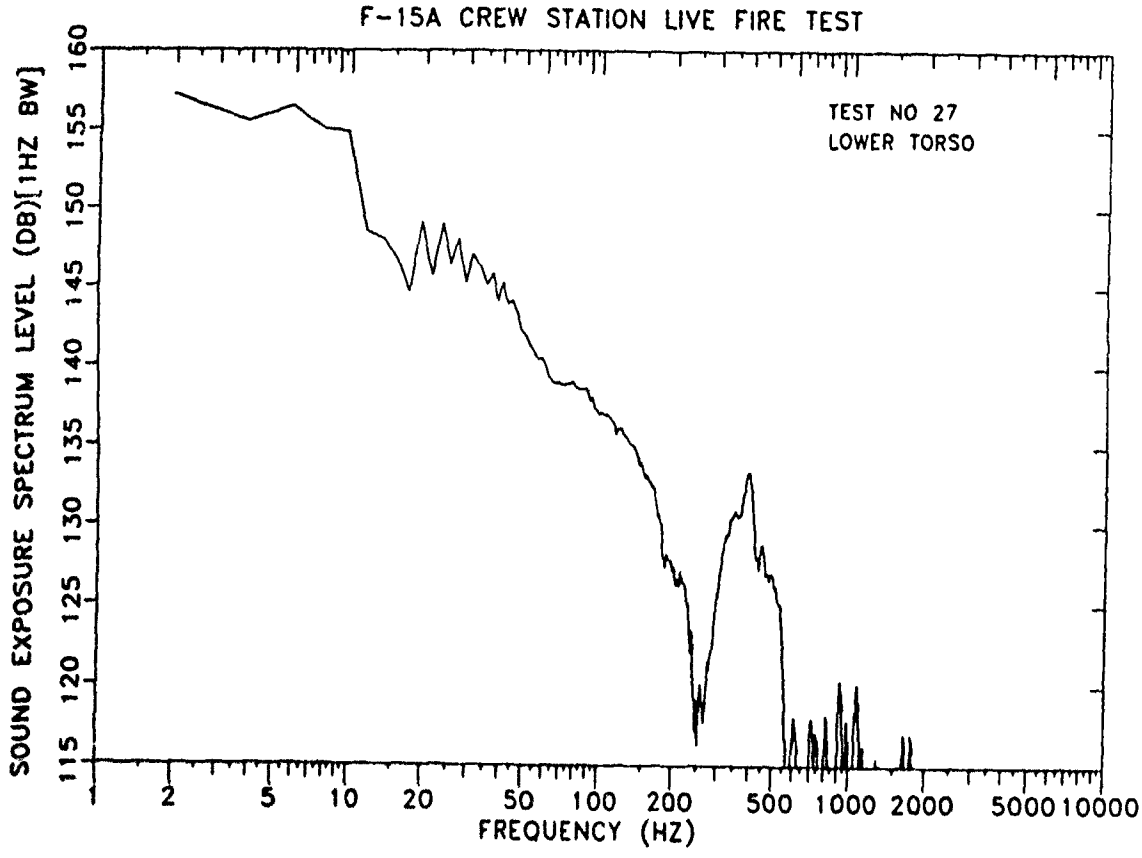

F-15A CREW STATION LIVE FIRE TEST
TEST NO 27
UPPER TORSO
MAX 1182.8 PSF
OVERPRESSURE (PSF)
-800 -400 0 400 800 1200 1600
0 0.004 0.008 0.012 0.016 0.020 0.024 0.028 0.032 0.036
TIME (SEC)

Figure 49


F-15A CREW STATION LIVE FIRE TEST
TEST NO 27
LOWER TORSO
SOUND EXPOSURE SPECTRUM LEVEL (DB)[1HZ BW]
160
155
150
145
140
135
130
125
120
115
2
5
10
20
50
100
200
500
1000
2000
5000
10000
FREQUENCY (HZ)

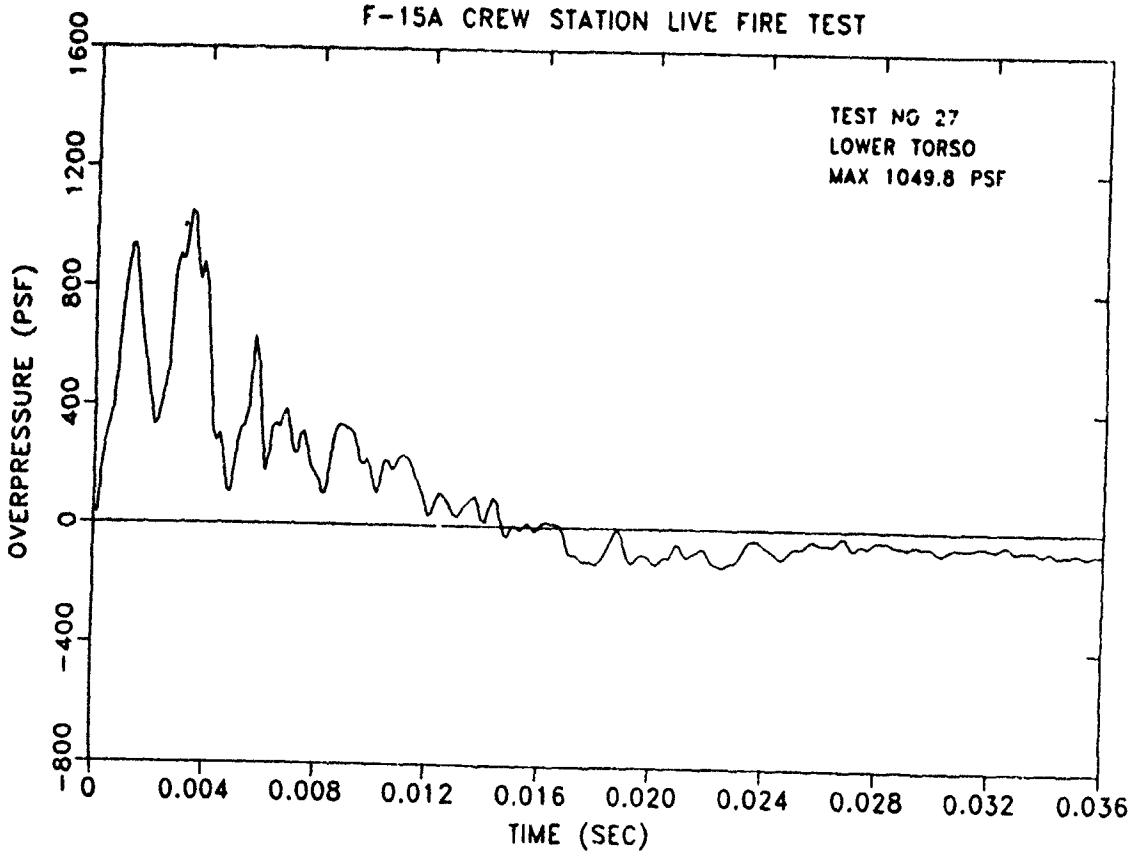

F-15A CREW STATION LIVE FIRE TEST
TEST NO 27
LOWER TORSO
MAX 1049.8 PSF
OVERPRESSURE (PSF)
1600
1200
800
400
0
-400
-800
0
0.004
0.008
0.012
0.016
0.020
0.024
0.028
0.032
0.036
TIME (SEC)

Figure 50

REFERENCES

1. Lee, R.A., et al, Boom Event Analyzer Recorder (Bear): System Description, AAMRL-TR-89-035, August 1989

2. von Gierke, H.E., Effects of Sonic Boom on People: Review and Outlook, AMRL-TR-65-195, May 1966

3. Hazardous Noise Exposure, AF Regulation 161-35, 9 April 1982

4. Johnson, D.L., Department of the Army, Sandia Laboratories, private communication, July 1991.

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