

APPENDIX F
AE RESULTS

Review and summary of the acoustic emission data collected from the relief valve tests for NTSB

PN1006947CRA

1. Introduction

Acoustic Emission Testing (AET) equipment was utilized to monitor a pilot valve and a relief valve during a series of pressure tests, at Stress Engineering Services, Inc.'s laboratory in Houston, Texas. All tests were carried out during the week of September 18 through 22, 2000.

2. Objectives

The **main** objective of the AET monitoring was twofold. The **first** was to determine the onset of mechanical movement within the pilot valve and within the relief valve. The second was to measure the delta time differential between mechanical movement **within** the pilot valve and the relief valve. **This** delta time was expected to be very short, possibly in the milliseconds range. The AET technique was selected due to its **high** sensitivity to **high** frequency sound, and due to the **high** accuracy and definition of the AET system's internal clock, allowing the determination of the delta-T.

3. Technique

Two piezoelectric transducers, with resonant frequency peak sensitivity centered at 60 KHZ, were selected for use. The sensors produce an electrical signal in the microvolt range. A pre-amplifier was connected to each transducer to boost the signal to the milli-volt range, thus allowing the signal to travel **through** a **RG-58** coaxial cable and reach the AET instrument. The AET instrument used was a Spartan AT with 18 channels.

The AET transducers were coupled to **the** pilot valve (sensor # **1**), and to the relief valve (sensor # **2**) via Silicone grease and tape. Prior to a new test, or after mechanical work had been performed **on** the valve, and at the beginning of each day, both **sensors** were checked for sensitivity and signal continuity (calibration).

Data being collected by the AET instrumentation was displayed in two different formats. The first was via a series of graphs. These **graphs** correlated **several** AE parameters (Amplitude, Number of Counts, Frequency, Elapsed Time, Pressure from a pressure transducer, and others). The second format is called the line display. On this format, each AET signal being recorded is displayed **on** the screen **as** a line with numbers. Each line includes information such **as** the date, hour, minutes, seconds, **mili-seconds**, **micro seconds**, nano-seconds, **sensor** number, amplitude, rise-time, **counts**, duration, energy, threshold, pressure, and others, all related to each single AE signal (or hit).

The graphs were used to determine the **nature** of the signals being detected, while the line data was used to determine the first AE signals being produced by the pilot valve and the Delta-T between the pilot valve and the relief valve.

4- Results

A total of **35** individual data files were recorded. From this total, **13** files were related to actual tests on the valve. From these **13 AE** data files, two (**2**) files actually contain data, which suggests mechanical movement within the pilot valve, immediately followed by mechanical movement within the relief valve. These two files are **6947T32.DTA**, and **6947T35.DTA**. All thirteen *.DTA files were converted to ASCII format files, and are being provided to the group in a CD.

File **6947T32.DTA** contains **six (6)** pairs of **AE** signals, originated from the pair of sensors **1 – 2** (in **this** order), which matches the expected profile of mechanical noise within the pilot valve, immediately followed by mechanical noise within the relief valve. These **six** pairs were characterized by a **100dB** signal at sensor number **1** (pilot valve), followed by a lower amplitude signal at sensor number **2** (relief valve). Since these events were always followed by a significant amount of flow noise and other noises, only the first pair of signals was picked for determination of the delta-time interval.

File **6947T35.DTA** contains four (**4**) pairs of AE signals, originated from the pair of sensors **1 – 2** (in **this** order), which matches the expected profile of mechanical noise within the pilot valve, immediately followed by mechanical noise within the relief valve. These four pairs were characterized by a amplitudes in the **89 to 92 dB** range at sensor number **1** (pilot valve), followed by a lower amplitude signal (in the range of **65 to 82 dB**) at sensor number **2** (relief valve). Since these events were always followed by a significant amount of flow noise and other noises, only the first pair of signals was picked for determination of the delta-time interval.

The attached pages include the **two** above referred files, with the **six** pairs and the four pairs of **data** highlighted for easy reference. Next to each highlighted pair of values, the “delta-time” difference between sensor **1** and **2** is indicated in microseconds.

5- Conclusions

AE monitoring techniques were successfully applied on several pressure tests conducted at **SES** facilities to determine the onset of movement and the time interval between a pilot valve and the relief valve. A total of **10** such combinations were detected, from two different tests. The results indicate relief valve **opening** followed pilot valve opening with a delta time difference in the range from **880** microseconds to **177,000** microseconds.

FILE NAME
C:6947T32.DTA

FILE SIZE
519259

FILE DATE & TIME
Sun Jan 6 16:53:04 1980

TEST LABEL
Relief Valve Test for NTSB - PN6947

TEST BEGIN DATE
Sun Jan 6 15:38:54 1980

ACTIVE CHANNELS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

ACTIVE AE DATA SET PARAMETERS

ID DDD HH:MM:SS.mmmuuun PARAI CH COUN DURATION AMP FREQ THR

ACTIVE TIME DRIVEN DATA SET PARAMETERS

ID DDD HH:MM:SS.mmmuuun PARAI

Event Data Display ON. Hit Data Display ON. TIME Data Display ON.

ID	DDD	HH:MM:SS.mmmmmmm	PARA1	CH	COUN	DURATION	AMP	FREQ	THR
1	0	00:44:38.9137647	532.33	2	2	72	64	27	60
1	0	00:44:38.9355170	552.41	2	42	1180	71	35	60
1	0	00:44:38.9437043	552.41	2	31	2147	68	14	60
1	0	00:44:38.9505920	552.41	2	4	469	67	8	60
1	0	00:44:38.9530243	552.41	2	5	79	67	63	60
1	0	00:44:38.9850295	582.53	2	180	3803	77	47	60
1	0	00:44:38.9895140	637.75	1	11705	190022	100	61	60
1	0	00:44:38.9911325	592.57	2	354	6032	84	58	60
1	0	00:44:39.0069555	587.55	2	29	957	71	30	60
1	0	00:44:39.0175335	597.59	2	61	5009	72	12	60
1	0	00:44:39.0240643	612.65	2	2	465	68	4	60
1	0	00:44:39.0254480	612.65	2	194	7335	73	26	60
1	0	00:44:39.0340823	607.63	2	1	3	64	333	60
1	0	00:44:39.0354945	607.63	2	1	20	64	50	60
1	0	00:44:39.0418395	607.63	2	1	1	64	1000	60
1	0	00:44:39.0426845	622.69	2	3	118	66	25	60
1	0	00:44:39.0438775	622.69	2	6	489	69	12	60
1	0	00:44:39.0456725	622.69	2	1	4	65	250	60
1	0	00:44:39.0472517	622.69	2	46	5289	69	8	60
1	0	00:44:39.0571705	622.69	2	1	138	66	7	60
1	0	00:44:39.0602390	622.69	2	17	1274	72	13	60
1	0	00:44:39.0849270	637.75	2	10	502	67	19	60
1	0	00:44:39.1491685	642.77	2	1	2	65	500	60
1	0	00:44:39.1532603	642.77	2	1	37	64	27	60
1	0	00:44:39.1818953	637.75	2	1	4	64	250	60
1	0	00:44:39.1832697	637.75	1	67	1654	87	40	60
1	0	00:44:39.1857990	637.75	1	4	117	69	34	60
1	0	00:44:39.1935240	637.75	1	10	262	72	38	60
1	0	00:44:39.2114370	632.73	2	1	2	62	500	60
1	0	00:44:39.2227393	617.67	2	1	4	65	250	60
1	0	00:44:39.2300013	622.69	1	36	738	84	48	60
1	0	00:44:39.2353037	607.63	2	1	1	65	1000	60
1	0	00:44:39.2527690	612.65	2	47	4434	69	10	60
1	0	00:44:39.2589797	612.65	2	1	1	64	1000	60
1	0	00:44:39.2614470	612.65	2	1	2	65	500	60
1	0	00:44:39.2626467	612.65	2	1	2	62	500	60
1	0	00:44:39.3093820	597.59	1	1	4	65	250	60
1	0	00:44:39.3175467	597.59	2	1	2	64	500	60
1	0	00:44:39.3192615	597.59	2	1	1	63	1000	60
1	0	00:44:39.3282010	592.57	2	1	2	64	500	60
1	0	00:44:39.3295407	592.57	2	1	160	64	6	60
1	0	00:44:39.3305250	592.57	2	1	164	64	6	60
1	0	00:44:39.3319087	592.57	2	1	4	62	250	60
1	0	00:44:39.3367000	592.57	2	21	2721	69	7	60
1	0	00:44:39.3445915	597.59	2	46	5751	71	7	60
1	0	00:44:39.3516053	597.59	2	1	4	66	250	60
1	0	00:44:39.3525385	597.59	2	8	1550	67	5	60
1	0	00:44:39.3553583	597.59	2	2	231	67	8	60
1	0	00:44:39.3564505	597.59	2	2	446	67	4	60
1	0	00:44:39.3582240	597.59	2	8	1739	66	4	60
1	0	00:44:39.3612390	597.59	2	2	292	64	6	60
1	0	00:44:39.3632253	597.59	2	1	2	66	500	60
1	0	00:44:39.3648310	597.59	2	1	254	64	3	60
1	0	00:44:39.3661827	597.59	2	3	510	64	5	60
1	0	00:44:39.3677120	597.59	2	1	163	67	6	60
1	0	00:44:39.3686990	597.59	2	1	3	64	333	60
1	0	00:44:39.3717255	597.59	2	69	5923	71	11	60
1	0	00:44:39.3785080	612.65	2	573	42645	72	13	60
1	0	00:44:39.3988390	597.59	1	8	379	71	21	60

1618 mkl

ID	DDD	HH:MM:SS.mmmuuun	PARA1	CH	COUN	DURATION	AMP	FREQ	THR
1	0	00:48:08.2343180	532.33	1	6	130	72	46	60
1	0	00:48:08.2366020	532.33	1	1	24	67	41	60
1	0	00:48:08.2416863	532.33	1	7	283	71	24	60
1	0	00:48:08.2430020	547.39	1	6	484	69	12	60
1	0	00:48:08.2448023	547.39	1	7	397	72	17	60
1	0	00:48:08.2464477	547.39	1	3	70	67	42	60
1	0	00:48:08.2554497	552.41	1	1	30	64	33	60
1	0	00:48:08.2591590	552.41	1	7	317	68	22	60
1	0	00:48:08.2634130	552.41	2	48	1470	74	32	60
1	0	00:48:08.2688745	557.43	1	30	1205	71	24	60
1	0	00:48:08.2709003	637.75	1	11684	167691	100	69	60
1	0	00:48:08.2810865	572.49	2	138	2902	76	47	60
1	0	00:48:08.2935147	577.51	2	1	2	64	500	60
1	0	00:48:08.2944053	577.51	2	3	118	65	25	60
1	0	00:48:08.2965633	577.51	2	1	24	64	41	60
1	0	00:48:08.2989915	577.51	2	2	115	63	17	60
1	0	00:48:08.3034637	597.59	2	104	6251	71	16	60
1	0	00:48:08.3105577	592.57	2	52	4675	71	11	60
1	0	00:48:08.3162930	592.57	2	3	1098	67	2	60
1	0	00:48:08.3187367	592.57	2	1	18	69	55	60
1	0	00:48:08.3196843	592.57	2	1	23	67	43	60
1	0	00:48:08.3207585	612.65	2	52	5494	69	9	60
1	0	00:48:08.3271507	612.65	2	1	4	66	250	60
1	0	00:48:08.3282107	612.65	2	3	400	68	7	60
1	0	00:48:08.3295510	617.67	2	1	4	66	250	60
1	0	00:48:08.3305570	617.67	2	6	1054	67	5	60
1	0	00:48:08.3325550	617.67	2	7	1644	69	4	60
1	0	00:48:08.3353515	617.67	2	25	2327	68	10	60
1	0	00:48:08.3385143	617.67	2	3	621	69	4	60
1	0	00:48:08.3402907	617.67	2	1	290	67	3	60
1	0	00:48:08.3419980	617.67	2	1	1	65	1000	60
1	0	00:48:08.3435725	632.73	2	10	1352	67	7	60
1	0	00:48:08.3458503	632.73	2	1	51	66	19	60
1	0	00:48:08.3467340	632.73	2	19	1639	69	11	60
1	0	00:48:08.3492620	632.73	2	83	6039	74	13	60

10.186 μ mC

ID	DDD	HH:MM:SS.mmmmmmm	PARA1	CH	COUN	DURATION	AMP	FREQ	THR
1	0	00:55:28.8781985	301.41	1	13		479 73	27	60
	0	00:55:28.8836995	301.41	1	1		72 64	13	60
	0	00:55:28.8968167	301.41	1	483	11405	84	42	60
1	0	00:55:28.9098170	301.41	1	30	719	78	41	60
1	0	00:55:28.9122723	301.41	1	9	247	71	36	60
1	0	00:55:28.9177487	311.45	1	1	15	65	66	60
1	0	00:55:28.9494587	331.53	2	213	3254	73	65	60
1	0	00:55:28.9640857	356.63	2	80	1867	73	42	60
1	0	00:55:28.9668645	356.63	2	1	2	65	500	60
1	0	00:55:28.9674117	356.63	1	16	1002	69	15	60
1	0	00:55:28.9677697	371.69	2	83	2007	72	41	60
1	0	00:55:28.9693547	356.63	1	1	5	66	200	60
1	0	00:55:28.9724253	371.69	1	1	24	65	41	60
1	0	00:55:28.9751610	371.69	1	2	97	69	20	60
1	0	00:55:28.9860340	371.69	2	1	1	63	1000	60
1	0	00:55:28.9883790	376.71	2	158	2504	76	63	60
1	0	00:55:28.9948963	401.81	2	111	2463	77	45	60
1	0	00:55:28.9973103	401.81	1	1	1	63	1000	60
1	0	00:55:29.0032415	401.81	2	2	49	64	40	60
1	0	00:55:29.0082430	421.89	2	19	1552	70	12	60
1	0	00:55:29.0126467	421.89	2	24	778	67	30	60
1	0	00:55:29.0168093	431.93	2	29	836	72	34	60
1	0	00:55:29.0211920	431.93	2	1	11	64	90	60
1	0	00:55:29.0223513	431.93	1	1	114	67	8	60
1	0	00:55:29.0234045	446.99	1	1	23	66	43	60
1	0	00:55:29.0242887	446.99	1	34	1193	75	28	60
1	0	00:55:29.0256960	446.99	2	65	1453	72	4.4	60
1	0	00:55:29.0282590	592.57	1	6477	86677	100	74	60
1	0	00:55:29.0339447	446.99	2	20	666	69	30	60
1	0	00:55:29.0437037	472.09	2	2	207	66	9	60
1	0	00:55:29.0447463	532.33	2	660	26973	91	24	60
1	0	00:55:29.0773013	542.37	2	1	4	63	250	60
1	0	00:55:29.0783547	542.37	2	1	40	64	25	60
1	0	00:55:29.0796263	542.37	2	1	5	63	200	60
1	0	00:55:29.0810550	562.45	2	1	4	65	250	60
1	0	00:55:29.0846107	562.45	2	2	256	65	7	60
1	0	00:55:29.0860505	562.45	2	1	306	64	3	60
1	0	00:55:29.0872427	562.45	2	1	2	63	500	60
1	0	00:55:29.0880885	577.51	2	222	15620	74	14	60
1	0	00:55:29.1046207	612.65	2	247	21180	72	11	60
1	0	00:55:29.1175023	597.59	1	2	329	68	6	60
1	0	00:55:29.1256677	597.59	1	1	14	67	71	60
1	0	00:55:29.1269295	612.65	2	12	1623	68	7	60
1	0	00:55:29.1296957	612.65	2	1	121	64	8	60

5685 μ sec

ID	DDD	HH:MM:SS	mmmmuuuu	PARA1	CH	COUN	DURATION	AMP	FREQ	THR
1	0	00:58:55	.2417353	477.11	2	1	20	61	50	60
		00:58:55	.2485160	482.13	2	168	3787	73	44	60
		00:58:55	.2559597	492.17	2	2	151	65	13	60
1	0	00:58:55	.2719367	502.21	2	5	250	65	20	60
1	0	00:58:55	.2824395	502.21	1	108	1592	77	67	60
1	0	00:58:55	.2893767	517.27	1	3	577	67	5	60
1	0	00:58:55	.2922607	517.27	1	2	133	76	15	60
1	0	00:58:55	.2932320	517.27	1	60	1382	83	43	60
1	0	00:58:55	.2965130	517.27	1	9	375	72	24	60
1	0	00:58:55	.2978473	632.73	1	9740	140702	100	69	60
1	0	00:58:55	.2983915	517.27	2	154	3205	76	48	60
1	0	00:58:55	.3204327	537.35	2	1	20	68	50	60
1	0	00:58:55	.3212665	577.51	2	648	31950	75	20	60
1	0	00:58:55	.3541747	607.63	2	714	40628	93	17	60
1	0	00:58:55	.3957325	622.69	2	11	1522	69	7	60
1	0	00:58:55	.3982493	622.69	2	62	6510	71	9	60
1	0	00:58:55	.4055827	627.71	2	23	2120	69	10	60
1	0	00:58:55	.4085275	632.73	2	401	14159	97	28	60
1	0	00:58:55	.4236475	622.69	2	2	295	65	6	60
1	0	00:58:55	.4248797	622.69	2	3	727	65	4	60
1	0	00:58:55	.4273585	622.69	2	6	1328	66	4	60
1	0	00:58:55	.4301605	632.73	2	1	2	63	500	60
1	0	00:58:55	.4310660	632.73	2	1	3	66	333	60
1	0	00:58:55	.4322513	632.73	2	1	62	63	16	60
1	0	00:58:55	.4332973	632.73	2	1	20	65	50	60
1	0	00:58:55	.4342055	632.73	2	3	1087	65	2	60
1	0	00:58:55	.4369195	622.69	2	17	1765	68	9	60
1	0	00:58:55	.4398640	622.69	1	1	52	67	19	60
1	0	00:58:55	.4412953	622.69	2	1	4	66	250	60
1	0	00:58:55	.4438823	622.69	1	1	1	63	1000	60
1	0	00:58:55	.4438833	622.69	2	1	4	63	250	60
1	0	00:58:55	.4453270	632.73	2	1	266	64	3	60
1	0	00:58:55	.4472723	632.73	1	1	17	65	58	60
1	0	00:58:55	.4484355	632.73	2	1	35	66	28	60
1	0	00:58:55	.4498387	632.73	2	1	266	62	3	60
1	0	00:58:55	.4522585	622.69	2	1	2	65	500	60
1	0	00:58:55	.4532160	622.69	2	1	1	64	1000	60
1	0	00:58:55	.4546420	622.69	2	1	1	63	1000	60
1	0	00:58:55	.4707880	622.69	2	7	945	65	7	60

544 MRL

ID	DDD	HH:MM:SS.mmmuuuuu	PARA1	CH	COUN	DURATION	AMP	FREQ	THR
1	0	01:02:23.3373685	537.35	2	1		2 62	500	60
1	0	01:02:23.3382153	537.35	2	154		3196 76	48	60
1	0	01:02:23.3448257	537.35	2	1		83 64	12	60
1	0	01:02:23.3553955	552.41	2	1		3 64	333	60
1	0	01:02:23.3629893	552.41	1	3		114 69	26	60
1	0	01:02:23.3756335	557.43	1	4		146 65	27	60
1	0	01:02:23.3777980	557.43	1	45		1852 75	24	60
1	0	01:02:23.3826137	557.43	1	22		1336 73	16	60
1	0	01:02:23.3847917	562.45	1	83		2752 76	30	60
1	0	01:02:23.3889853	562.45	1	55		1366 87	40	60
1	0	01:02:23.3911643	637.75	1	13472		210713 100	63	60
1	0	01:02:23.4097807	637.75	2	4394		184532 94	23	60
ID DDD HH:MM:SS.mmmuuuuu PARA1									
2	0	01:02:23.4788675	632.73						
ID DDD HH:MM:SS.mmmuuuuu PARA1 CH COUN DURATION AMP FREQ THR									
1	0	01:02:23.5955847	642.77	2	1		108 67	9	60
1	0	01:02:23.5968285	642.77	2	1		2 64	500	60
1	0	01:02:23.5976857	637.75	2	4		489 68	8	60
1	0	01:02:23.5993070	637.75	2	1		96 64	10	60
1	0	01:02:23.6002750	637.75	2	1		6 65	166	60
1	0	01:02:23.6021613	637.75	2	1		42 68	23	60
1	0	01:02:23.6030487	637.75	1	24		885 73	27	60
1	0	01:02:23.6048527	637.75	2	1		2 63	500	60
1	0	01:02:23.6055653	637.75	1	1		2 65	500	60
1	0	01:02:23.6078605	637.75	2	1		36 63	27	60
1	0	01:02:23.6249810	637.75	2	1		2 63	500	60
1	0	01:02:23.6580437	617.67	2	1		3 64	333	60
1	0	01:02:23.6655815	617.67	2	1		1 63	1000	60
1	0	01:02:23.6991443	612.65	2	4		929 65	4	60
1	0	01:02:23.7058970	607.63	2	14		1758 67	7	60
1	0	01:02:23.7177295	597.59	2	1		1 64	1000	60
1	0	01:02:23.7740175	582.53	2	1		41 65	24	60
1	0	01:02:23.7764050	587.55	2	1		2 64	500	60
1	0	01:02:23.8031587	587.55	2	1		2 64	500	60
1	0	01:02:23.8068703	597.59	2	1		97 64	10	60
1	0	01:02:23.8079667	597.59	2	1		2 63	500	60

18016 μ sec

ID	DDD	HH	MM	SS	mmmmuuun	PARAL	CH	COUN	DURATION	AMP	FREQ	THR
1	0	01	06	37	5566855	462.05	2	2	37	64	54	60
ID	DDD	HH	MM	SS	mmmmuuun	PARAL						
2	0	01	06	37	8303665	517.27						
ID	DDD	HH	MM	SS	mmmmuuun	PARAL	CH	COUN	DURATION	AMP	FREQ	THR
1	0	01	06	37	8461510	517.27	2	11	336	66	32	60
1	0	01	06	37	8689385	522.29	2	87	1602	80	54	60
1	0	01	06	37	8721243	522.29	2	19	549	66	34	60
1	0	01	06	37	9105255	557.43	2	13	859	65	15	60
1	0	01	06	37	9155990	557.43	2	27	606	71	44	60
1	0	01	06	37	9186303	557.43	1	2	99	65	20	60
1	0	01	06	37	9195807	637.75	1	12434	188451	100	65	60
1	0	01	06	37	9378187	637.75	2	4485	164082	99	27	60
1	0	01	06	38	1043257	637.75	2	1	3	62	333	60
1	0	01	06	38	1054387	637.75	2	1	2	62	500	60
1	0	01	06	38	1066000	637.75	2	54	3935	72	13	60
1	0	01	06	38	1098223	637.75	1	1	3	67	333	60
1	0	01	06	38	1114703	637.75	1	1	89	67	11	60
1	0	01	06	38	1115275	637.75	2	2	671	65	2	60
1	0	01	06	38	1131237	637.75	1	1	64	77	15	60
1	0	01	06	38	1137147	637.75	2	1	60	65	16	60

18238 μ cc.

FILE NAME
C:6947T35.DTA

FILE SIZE
41054

FILE DATE & TIME
Mon Jan 7 16:55:40 1980

TEST LABEL
Relief Valve Test for NTSB - PN6947

TEST BEGIN DATE
Mon Jan 7 15:08:23 1980

ACTIVE CHANNELS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

ACTIVE AE DATA SET PARAMETERS

ID DDD HH:MM:SS.mmmuuuuu PARAL CH COUN DURATION AMP PREQ THR

ACTIVE TIME DRIVEN DATA SET PARAMETERS

ID DDD HH:MM:SS.mmmuuuuu PARAL

Event Data Display ON. Hit Data Display ON. TIME Data Display ON.

ID	DDD	HH:MM:SS.mmmmmmm	PARA1	CH	COUN	DURATION	AMP	FREQ	THR
1	0	00:02:11.9018167	5.23	1	1	109	65	9	60
1	0	00:02:12.0127980	5.23	1	12	697	66	17	60
1	0	00:02:12.0320133	0.21	1	5	348	68	14	60
1	0	00:02:12.0642850	0.21	1	1	14	67	71	60
1	0	00:02:12.0747233	5.23	1	15	880	68	17	60
1	0	00:02:12.1119753	0.21	1	1	2	65	500	60
1	0	00:02:12.1137683	0.21	1	4	347	68	11	60
1	0	00:02:12.1238825	5.23	1	50	1287	75	38	60
1	0	00:02:12.3003805	5.23	1	1	1	64	1000	60
1	0	00:02:12.4329097	5.23	1	6	386	66	15	60
1	0	00:02:12.6565503	0.21	1	1	25	67	40	60
1	0	00:02:12.8228633	5.23	1	2	292	64	6	60
1	0	00:02:14.6581970	5.23	1	93	1946	85	47	60
1	0	00:02:14.6590845	5.23	2	20	1462	67	13	60
1	0	00:02:14.7262415	5.23	1	60	1180	79	50	60
1	0	00:02:14.7602243	5.23	1	1	3	63	333	60
1	0	00:02:14.8273523	5.23	1	64	1359	83	47	60
1	0	00:02:14.8529633	5.23	1	1	124	64	8	60
1	0	00:02:17.8038067	60.45	1	139	2883	84	48	60
1	0	00:02:17.8048483	65.47	2	47	1918	75	24	60
1	0	00:02:17.8080733	65.47	'2	2	121	66	16	60
1	0	00:02:18.1155810	105.63	1	1	6	63	166	60
1	0	00:02:18.4711450	201.01	1	74	1928	87	38	60
1	0	00:02:18.4898055	201.01	1	72	1532	80	46	60
1	0	00:02:18.5142980	216.07	2	2	488	66	4	60
1	0	00:02:18.5269365	221.09	1	43	1645	79	26	60
1	0	00:02:18.5330253	221.09	1	8	226	73	35	60
1	0	00:02:18.6483463	276.31	2	1	4	64	250	60
1	0	00:02:18.6627805	276.31	2	3	98	64	30	60
1	0	00:02:18.6906175	296.39	2	7	339	67	20	60
1	0	00:02:18.7061165	296.39	2	1	4	63	250	60
1	0	00:02:18.7122915	296.39	1	8	580	69	13	60
1	0	00:02:18.7410977	316.47	2	30	1416	72	21	60
1	0	00:02:18.7509400	316.47	2	5	80	65	62	60
1	0	00:02:18.7831930	331.53	2	14	153	64	91	60
1	0	00:02:18.7914853	336.55	2	1	3	62	333	60
1	0	00:02:18.8032275	336.55	2	107	2661	72	40	60
1	0	00:02:18.8322313	356.63	2	1	95	64	10	60
1	0	00:02:18.8353820	356.63	2	1	4	64	250	60
1	0	00:02:18.8765480	376.71	2	1	32	64	31	60
1	0	00:02:18.8946793	376.71	2	1	5	65	200	60
1	0	00:02:18.9126497	396.79	2	4	250	67	16	60
1	0	00:02:18.9140743	396.79	2	1	2	64	500	60
1	0	00:02:18.9169665	391.77	2	1	16	62	62	60
1	0	00:02:18.9249577	391.77	2	1	2	64	500	60
1	0	00:02:18.9284073	396.79	2	1	33	66	30	60
1	0	00:02:18.9320430	396.79	2	1	1	64	1000	60

887 μ m

ID DDD HH:MM:SS.mmmuuun PARAI

2 0 00:27:10.0009325 527.31

ID	DDD	HH:MM:SS.mmmuuun	PARAI	CH	COUN	DURATION	AMP	FREQ	THR
1	0	00:27:14.4804255	487.15	2	1	3	64	333	60
1	0	00:27:17.5045395	457.03	1	70	1460	91	47	60
1	0	00:27:17.5181203	446.99	2	29	1516	82	19	60
1	0	00:27:17.5605103	436.95	2	2	34	65	58	60
1	0	00:27:17.6101737	406.83	2	1	22	65	45	60
1	0	00:27:17.6132957	406.83	2	4	50	68	80	60
1	0	00:27:17.6252553	406.83	2	59	2329	82	25	60
1	0	00:27:17.6687125	381.73	2	61	2320	88	26	60
1	0	00:27:17.7245545	356.63	2	2	22	64	90	60
1	0	00:27:17.7598535	336.55	2	83	2721	85	30	60
1	0	00:27:17.7868615	326.51	2	12	393	73	30	60
1	0	00:27:17.8097280	321.49	2	1	10	63	100	60
1	0	00:27:17.8845003	296.39	2	1	102	62	9	60
1	0	00:27:18.0604477	256.23	2	2	54	67	37	60
1	0	00:27:18.1335743	236.15	2	11	402	75	27	60
1	0	00:27:18.1603175	236.15	2	4	55	69	72	60
1	0	00:27:18.1616275	236.15	2	21	1127	81	18	60
1	0	00:27:18.3027473	211.05	2	1	11	65	90	60
1	0	00:27:18.4302183	206.03	2	17	1376	72	12	60
1	0	00:27:18.4944943	201.01	2	1	12	64	83	60
1	0	00:27:18.5979107	206.03	2	2	47	67	42	60
1	0	00:27:18.6563703	206.03	2	1	2	62	500	60
1	0	00:27:18.7514537	201.01	2	1	18	65	55	60
1	0	00:27:19.0167363	206.03	2	1	16	65	62	60

ID DDD HH:MM:SS.mmmuuun PARAI

13581 / uuc

ID	DDD	HH:MM:SS.mmmuuun	PARA1	CH	COUN	DURATION	AMP	FREQ	THR
1	0	00:33:02.4632045	386.75	2	15	1332	67	11	60
1	0	00:33:02.4843870	421.89	2	11	261	72	42	60
1	0	00:33:02.5002420	457.03	2	115	2576	76	44	60
1	0	00:33:02.5121330	477.11	2	114	2781	74	40	60
1	0	00:33:02.5396935	517.27	2	118	3045	74	38	60
1	0	00:33:07.6997123	517.27	2	2	358	64	5	60
1	0	00:33:09.3244503	497.19	2	1	36	65	27	60
1	0	00:33:09.4581750	502.21	2	3	295	65	10	60
1	0	00:33:09.7351577	497.19	2	1	26	66	38	60
ID	DDD	HH:MM:SS.mmmuuun	PARA1						
2	0	00:33:10.0009295	492.17						
ID	DDD	HH:MM:SS.mmmuuun	PARA1	CH	COUN	DURATION	AMP	FREQ	THR
1	0	00:33:12.5599300	457.03	1	a3	1319	90	62	60
1	0	00:33:12.7371865	386.75	2	6	108	74	55	60
1	0	00:33:12.8321025	336.55	2	2	26	67	76	60
1	0	00:33:12.8965730	316.47	2	5	61	70	81	60
1	0	00:33:12.9659055	296.39	2	4	87	68	45	60
1	0	00:33:13.0420205	266.27	2	8	78	73	102	60
1	0	00:33:13.1328717	246.19	2	9	244	72	36	60
1	0	00:33:13.1726360	246.19	2	1	2	62	500	60
1	0	00:33:13.2876343	221.09	2	2	54	69	37	60
1	0	00:33:13.3915567	216.07	2	17	331	76	51	60
1	0	00:33:13.8316660	195.99	2	1	2	62	500	60
1	0	00:33:14.3987173	195.99	2	60	967	81	62	60
1	0	00:33:14.4836203	201.01	2	1	22	65	45	60
ID	DDD	HH:MM:SS.mmmuuun	PARA1						
2	0	00:33:20.0009275	195.99						

177256 μ Kc

ID	DDD	HH:MM:SS.mmmuuun	PARA1	CH	COUN	DURATION	AMP	FREQ	THR
1	0	01:16:12.0973340	175.91	1	138	2799	92	48	60
1	0	01:16:12.1012980	175.91	2	85	1838	75		
1	0	01:16:12.1057995	175.91	1	13	860	66	15	60
1	0	01:16:12.1060697	175.91	2	2	266	66	7	60
1	0	01:16:12.1092923	175.91	1	246	5051	82	48	60
1	0	01:16:12.1142163	195.99	2	10	486	69	20	60
1	0	01:16:12.1156063	195.99	2	1	2	64	500	60
1	0	01:16:12.1156693	195.99	1	98	2064	80	47	60
1	0	01:16:12.1201230	195.99	2	1	5	62	200	60
1	0	01:16:12.1214585	206.03	2	1	4	65	250	60
1	0	01:16:12.1244065	206.03	2	8	260	65	30	60
1	0	01:16:12.1277965	206.03	2	4	106	69	37	60
1	0	01:16:12.1315945	206.03	2	37	1674	69	22	60
1	0	01:16:12.1386983	221.09	2	21	202	71	103	60
1	0	01:16:12.1432583	221.09	2	14	810	69	17	60
1	0	01:16:12.1462900	221.09	2	5	486	66	10	60
1	0	01:16:12.1484980	221.09	2	50	1462	84	34	60
1	0	01:16:12.1532380	236.15	2	19	1018	67	18	60
1	0	01:16:12.1556587	236.15	2	1	3	65	333	60
1	0	01:16:12.1598425	236.15	2	15	882	75	17	60
1	0	01:16:12.1619673	256.23	2	10	1383	71	7	60
1	0	01:16:12.1661213	256.23	2	1	3	62	333	60
1	0	01:16:12.1695033	256.23	1	5	150	69	33	60
1	0	01:16:12.1698190	281.33	2	1	133	66	7	60
1	0	01:16:12.1710695	281.33	1	16	344	82	46	60

3964 m/c.

1	0	01:01:25.6250130	55.43	2	4	139	69	28	60
1	0	01:01:25.6278335	55.43	2	2	325	63	6	60
1	0	01:01:25.6296653	55.43	2	1	3	62	333	60
1	0	01:01:25.6359923	55.43	2	1	2	64	500	60
1	0	01:01:25.6449450	60.45	2	1	3	63	333	60
1	0	01:01:25.6542900	60.45	2	4	114	65	35	60
1	0	01:01:25.6577323	60.45	2	6	238	69	25	60
1	0	01:01:25.6629193	60.45	2	1	119	64	8	60
1	0	01:01:25.6739853	65.47	2	3	105	67	28	60
1	0	01:01:25.6778893	65.47	2	6	625	67	9	60
1	0	01:01:25.6904437	65.47	2	3	672	66	4	60
1	0	01:01:25.6928923	65.47	2	112	4314	76	25	60
1	0	01:01:25.7225595	70.49	2	2	41	64	48	60
1	0	01:01:25.7332635	70.49	1	89	2906	89	30	60
1	0	01:01:25.7417967	70.49	2	10	267	66	37	60
1	0	01:01:25.7609445	85.55	1	53	911	82	58	60
1	0	01:01:25.7611620	85.55	2	4	544	68	7	60
1	0	01:01:25.7628140	85.55	2	1	2	65	500	60
1	0	01:01:25.7704755	85.55	1	36	778	78	46	60
1	0	01:01:25.8699923	145.79	2	15	444	70	33	60
1	0	01:01:25.8841540	175.91	2	10	280	67	35	60
1	0	01:01:25.8844047	175.91	1	160	3325	80	48	60
1	0	01:01:25.8884690	175.91	2	95	1759	76	54	60
1	0	01:01:25.8912820	180.93	2	1	2	64	500	60
1	0	01:01:25.9087123	195.99	2	1	166	64	6	60
1	0	01:01:25.9102143	195.99	2	5	82	72	60	60
1	0	01:01:25.9146063	206.03	2	4	154	65	25	60
1	0	01:01:25.9160070	206.03	2	40	1637	71	24	60
1	0	01:01:25.9227790	221.09	2	10	507	82	19	60
1	0	01:01:25.9241120	221.09	2	15	1004	70	14	60
1	0	01:01:25.9273507	221.09	2	3	63	66	47	60

8533 JMC



Conam Inspection Inc
Inspection & Quality Services
3214 East Pasadena Freeway
Pasadena, Texas 77503
Telephone +1 713-473-6111
Facsimile +1 713-473-6161
<http://www.conaminsp.com>



IS LINE SERVICES
ATTN: Daniel Pitts

REGARDING: CERTIFICATE OF CALIBRATION (SPARTAN A.E. SYSTEM)

PAGES: 4

Dallas Snyder
Advanced Services
Conam Inspection Inc.
713-473-6111
dallas.snyder@conaminsp.com

A handwritten signature in black ink, appearing to read "D. Snyder".

CERTIFICATE OF CALIBRATION

CUSTOMER: CON AM
 CERTIFICATE NO.: 00042502 MODEL : 8200
 DESCRIPTION: AECAL-2
 DATE CAL.: 04/25/00 SERIAL NO.: 424
 DATE DUE: 04/25/01 CALIBRATED BY: S.Boyle
 ORDER OR RMA #: RMA 000227

CALIBRATION PERFORMED AT TEMPERATURE OF 74° F AND RELATIVE HUMIDITY OF 32 %.

MEASURING AND TEST EQUIPMENT USED

MFG. / MODEL #	SERIAL NUMBER	DATE CALIBRATED	DATE DUE
BK Precision	00622	10/20/99	10/20/00
Fluke/8050A	3600535	8/18/99	8/18/00

The above described instrument was calibrated at Physical Acoustics Corporation and is certified to meet its published specifications in accordance with MIL-STD-45662A, ANSI/NCCL Z540-1-1994, ISO 9001-1994 and ISO 10012-1-1992. Measuring and test equipment used in the performance of the above calibration is traceable directly or indirectly to the U.S. National Institute of Standards and Technology. The collective uncertainties of measuring and test equipment do not exceed 25 % tolerance of the characteristics being calibrated. Documentation relative to traceability is on file at this office and is available for examination upon request. Do not reproduce except in full, without written approval.

QUALITY ASSURANCE: *Steve P. Boyle*



195 Clarksville Road • Princeton Junction • New Jersey 08550-5303

SPARTANAT INSTRUMENT PERFORMANCE VERIFICATION

Model SPARTAN AT
 Main/Expansion VIOLET

Serial No. 122,127
 Examiner/Date DALLAS SNYDER

	0.0 ± 0.1V	1.1 ± 0.1V	5.5 ± 0.1V	9.9 ± 0.1V
Digital Parametric Output				
As Found		N/A		
As Returned				
Parametric Ch. Input				
As Found	0.0	1.2	5.5	9.9
As Returned	0.0	1.2	5.5	9.9

Ch. No.	Amplitude Input ± 2 dB						Energy ± 5%		Duration ± 10%	Counts ± 5%	Risetime ± 5%	Avg. Thr. dB
	Nominal	90	80	70	60	50	40	800	51	1000	150	
F 1	89	78	68	59	50	40	803	51	1011	158	102	
L 1	91	80	70	60	51	41	803	51	1011	158	102	
F 2	87	78	68	58	49	40	785	50	1012	158	103	
L 2	86	79	70	60	50	40	785	51	1012	158	103	
F 3	89	77	67	60	50	40	801	49	1005	158	103	
L 3	91	80	70	60	50	40	801	51	1005	158	103	
F 4	87	78	67	58	48	39	661	40	1005	158	102	
L 4	86	79	70	60	50	39	661	51	1005	158	102	
F 5	89	77	69	59	50	40	788	50	1004	159	102	
L 5	91	80	70	60	50	40	788	51	1004	159	102	
F 6	89	78	69	59	50	38	801	51	1008	159	103	
L 6	91	80	70	60	50	38	801	51	1008	159	103	
F 7	89	78	69	58	49	40	796	50	1011	158	103	
L 7	91	80	70	60	50	40	796	51	1011	158	103	
F 8	89	78	68	58	49	39	648	49	1007	158	103	
L 8	91	80	70	60	50	39	648	51	1007	158	103	
F 9	89	78	69	59	50	40	814	50	1009	158	103	
L 9	91	80	70	60	50	40	814	51	1009	158	103	
F 10	89	78	68	60	50	39	802	48	1007	158	103	
L 10	91	80	70	60	50	39	802	51	1007	158	103	
F 11	88	78	68	58	50	40	841	50	1016	158	103	
L 11	90	80	70	60	50	40	841	51	1016	158	103	
F 12	88	78	69	58	50	39	705	50	1010	158	102	
L 12	90	80	70	60	50	39	705	51	1010	158	102	
F 13	91	80	70	60	51	41	791	50	1005	159	103	
L 13	91	80	70	60	51	41	791	51	1005	159	103	
F 14	88	78	69	59	49	40	799	51	1012	158	103	
L 14	90	80	70	60	50	40	799	51	1012	158	103	
F 15	88	78	68	59	50	40	801	50	1005	158	103	
L 15	90	80	70	60	50	40	801	50	1005	158	103	
F 16	89	79	69	60	50	40	810	51	1006	158	103	
L 16	91	80	70	60	50	40	810	51	1006	158	103	
F 17	90	80	70	60	50	41	815	51	1004	158	103	
L 17	90	80	70	60	50	41	815	51	1004	158	103	

Ch. No.	Amplitude Input ± 2 dB							Energy ± 5%		Duration ± 10%	Counts ± 5%	Risetime ± 5%	Avg. Thr. dB
	Nominals	90	80	70	60	50	40	800	51	1000	150	100	
F 18	90	79	69	59	49	40	824	51	1012	158	103		
L 18	90	79	69	59	49	40	824	51	1012	158	103		
F 19	89	79	69	59	50	40	811	53	1011	158	102		
L 19	89	79	69	59	50	40	811	53	1011	158	102		
F 20	88	78	69	58	50	40	807	45	1008	158	102		
L 20	88	78	69	58	50	40	807	45	1008	158	102		
F 21	87	76	66	59	50	42	810	55	1004	158	103		
L 21	87	76	66	59	50	42	810	55	1004	158	103		
F 22	88	78	69	59	50	39	806	53	1007	158	100		
L 22	88	78	69	59	50	39	806	53	1007	158	100		
F 23	90	79	69	60	51	42	805	52	1013	158	103		
L 23	90	79	69	60	51	42	805	52	1013	158	103		
F 24	89	78	69	59	49	40	824	53	1009	158	102		
L 24	89	78	69	59	49	40	824	53	1009	158	102		
F 25	88	78	68	59	50	40	804	53	1006	158	104		
L 25	88	78	68	59	50	40	804	53	1006	158	104		
F 26	89	79	69	59	49	40	795	53	1008	158	102		
L 26	89	79	69	59	49	40	795	53	1008	158	102		
F 27	90	80	70	60	51	41	832	53	1003	158	103		
L 27	90	80	70	60	51	41	832	53	1003	158	103		
F 28	88	78	69	57	45	38	604	54	1010	158	99		
L 28	88	78	69	57	45	38	604	54	1010	158	99		
F 29	89	79	69	59	50	40	807	54	1004	158	103		
L 29	89	79	69	59	50	40	807	54	1004	158	103		
F 30	89	78	69	59	50	46	827	55	1007	158	100		
L 30	89	78	69	59	50	46	827	55	1007	158	100		
F 31	89	78	68	58	49	40	814	54	1006	158	103		
L 31	89	78	68	58	49	40	814	54	1006	158	103		
F 32	89	78	69	59	50	40	820	54	1008	158	105		
L 32	89	78	69	59	50	40	820	54	1008	158	105		
F 33	89	78	69	59	50	41	820	52	1011	158	103		
L 33	89	78	69	59	50	41	820	52	1011	158	103		
F 34	90	80	70	60	50	41	825	54	1013	158	100		
L 34	90	80	70	60	50	41	825	54	1013	158	100		
F 35	89	79	69	60	55	41	795	53	1011	158	97		
L 35	89	79	69	60	55	41	795	53	1011	158	97		
F 36	90	80	69	58	49	40	800	54	1010	158	102		
L 36	90	80	69	58	49	40	800	54	1010	158	102		
F 37	90	80	69	58	48	38	836	58	1011	158	100		
L 37	90	80	69	58	48	38	836	58	1011	158	100		
F 38	90	80	69	59	49	40	837	58	1006	158	103		
L 38	90	80	69	59	49	40	837	58	1006	158	103		

Comments (Repair/out-of-tolerance/amendments): AMPLITUDE ADJUSTMENTS WERE MADE ON THE FOLLOWING CHANNELS: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 24, 25, 26, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38

ENERGY ADJUSTMENTS WERE MADE ON THE FOLLOWING CHANNELS: 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 15, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38

Examiner

Dallas Snyder Date

9-18-00