NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorders Division
Washington, D.C. 20594

September 3, 2003

Sound Study

NTSB Accident Number
DCA02MA054

Specialist's Study Report
by Douglass P. Brazy

A. ACCIDENT

Location:	Tallahassee, FL
Date:	July 26, 2002
Time:	0537 Eastern Daylight Time (EDT)
Aircraft:	Boeing B727-232, N497FE
Operator:	Federal Express, Flight 1478

B. GROUP

N/A

C. SUMMARY

On July 26, 2002, at approximately 0537 EDT, a Boeing B-727-232, N497FE, operating as FedEx flight 1478, crashed into trees on short final approach to runway 9 at the Tallahassee Regional Airport (TLH), Tallahassee, Florida. The flight was operating under provisions of Title 14 Code of Federal Regulations Part 121, as a scheduled cargo flight from Memphis, Tennessee (MEM) to TLH. Night visual meteorological conditions prevailed at the time of the accident. The three flight crewmembers were injured, two seriously, and the aircraft was destroyed by impact and resulting fire.

During the review and transcription[1] of the Cockpit Voice Recorder (CVR) recording, the CVR group noted that "sounds similar to breaths or breathing" could be heard throughout the recording on the First Officer's CVR channel. The group observed that some of the breath sounds were found to be comparatively loud, others were found to be quiet and almost imperceptible. In some cases the breath sounds appeared to stop briefly, and in others the breath rate appeared to be relatively fast. The purpose of this study is to document, characterize, and measure the breath sounds in some detail.

D. DETAILS OF INVESTIGATION

Overview

Throughout the recording, sounds similar to breathing (exhaling) can be heard from the First Officer's CVR channel, as captured by his hot, or boom, microphone. These specific sounds are recorded only on the First Officer's CVR channel[2]. As a result, these sounds were not likely heard by any of the crewmembers (including the First Officer) through their headsets. No breath sounds could be heard from the other crewmembers' hot microphones. All 3 crewmembers were using the same model headset, a Telex Airman 750 unit.

While it is somewhat unusual to hear breath sounds on a CVR recording, it is not unprecedented. The position and orientation of the microphone have a strong effect on what sounds it may or may not capture. The position and orientation can and normally do change somewhat throughout the recording. Additionally, the crew is not required by Federal Regulation to wear headsets and boom microphones at all times during the flight[3]. The other predominant factor affecting what the microphone captures is the

[1] The CVR transcript and more detailed information about the CVR system can be found in a separate report entitled Cockpit Voice Recorder Group Chairman's Factual Report – DCA02MA054

[2] Normally, hot microphone signals are only captured on other crewmembers' CVR channels when radio transmissions are made (and the other crewmember is monitoring the radio being used) or when the crew uses an intercom system for intra-cockpit communication.

[3] Boom microphones, when required, must be used below 18,000 feet mean sea level. 14 CFR part 121.359 (g)

relative loudness of the sound at the microphone's location. Many of the breath sounds on this recording are comparatively loud when compared to speech or other ambient sounds in the cockpit. This apparent loudness is likely the result of the microphone position (unusually close to the mouth or nose), a comparably large disturbance of the air (breath) as if flows around the microphone surface, or a combination of the two. Virtually all of the breath sounds appear to be consistent with turbulent airflow over the microphone from a breath *exhale*. A few times, a softer "sniffing" like sound could be heard between exhales. At other times, a softer breath-like sound could be heard between exhales which sounded different from the "sniffing" like sounds. These softer sounds were not heard with any regularity or consistency. Only those sounds that were consistent with exhales were measured and documented in this report. Unless otherwise specified, all references to breaths, breath sounds, or breathing, refer to sounds consistent with exhales.

These breath sounds can be heard regularly starting at about 11:01 CVR Elapsed Time[4], and continue through the end of the recording. Prior to that time, only four voice comments can be heard from the First Officer on his hot microphone, each at a much lower volume than all of the voice comments after 11:01.

Data Acquisition

Several characteristics of the audio signal were measured for each of the 398 breath sounds that could be identified on the recording:

- Elapsed Time at the beginning and end of each breath
- For the amplitude of the audio signal over the duration of the breath:

    1. Mean
    2. Standard Deviation
    3. Average Adjusted Magnitude

[4] All times in this report are "CVR Elapsed Times" which are referenced to a clock used when digitizing the recording. 00:00 CVR Elapsed time is essentially the 'beginning' of the CVR recording. This time may be expressed as minutes:seconds or as the total number of seconds, i.e. 11:01 *or* 661. Eastern Daylight Time can be approximated (to within about 10 seconds) by adding 05:05:05 to the CVR Elapsed Time.

These measurements were made using a computer based sound analysis program that can display the waveform of a digitized signal and collect parametric data from it. Figure 1 is an example of the waveform display.

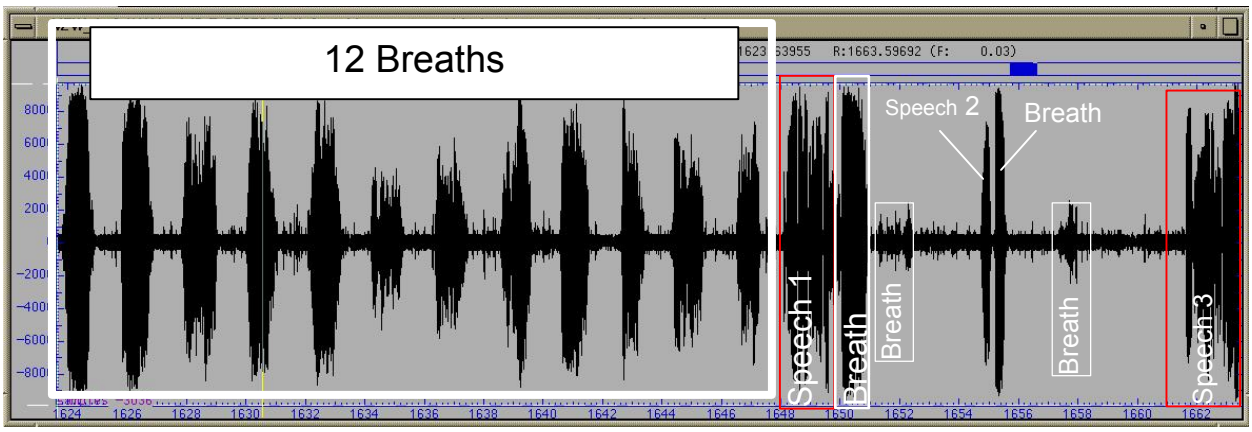


Figure 1 - Waveform Display

This figure is a representation of audio signal amplitude (vertical axis) over time (horizontal axis), or waveform. The amplitude is a dimensionless representation of the relative voltage of the audio signal; the time is in seconds from the beginning of the digitized file. In general, for each breath the height of the waveform indicates the relative loudness of the sound, and the width represents the duration of the breath.

Timing

The collection of the timing of each breath time was straightforward. Markers were placed at the beginning and end of each breath sound as seen in the waveform display, and the elapsed time at each marker was recorded.

Amplitude

The mean, standard deviation, and average adjusted magnitude parameters were all captured from the amplitude data for each breath sound (the region between the beginning and end markers). In the digital audio file, amplitude values are specified

in “levels” which correspond to the voltage of the original analog signal. When the audio is digitized, the voltage of the analog signal is mapped into a range of +/- 32,767 different possible levels[5]. The relationship between voltage and level is established through an adjustable gain setting at the time the signal is digitized. An increase in gain will have the effect of an overall increase in the apparent volume throughout the digitized file, and will result in a higher level value (amplitude) for a given voltage. A decrease in gain will have the opposite effect. As a result, the numerical values of the levels in the digital file and the calculations based on them reflect only the *relative* loudness of any given sound in the file. These numbers cannot be logically compared to levels of any of the other channels on the CVR, or any other recording.

The parametric data collected from the amplitude of the signal was calculated as follows:

For the duration of each breath sound (selected region)

Mean = $$\frac{1}{N}\sum_{i=1}^{N} X_i$$

Standard Deviation = $$\sqrt{\frac{\sum_{i=1}^{N}(x_i - m)^2}{N}}$$

Average Adjusted Magnitude = $$\frac{1}{N}\sum_{i=1}^{N} | X_i - m |$$

Where:

N = total number of samples in the selected region (the digital file was sampled at a rate of 22,050 samples per second)

[5] For 16-bit .wav files.

X = level value for the sample

m = average level value over the selected region

Since amplitude levels are both positive and negative, the mean parameter has little value. However, the mean values suggest that there is a slight DC offset in the digitized signal (see Attachment II). For reference, the average adjusted magnitude was also calculated in one area where there was no speech, breath sounds or other extraneous sounds to measure the level of ambient noise in the cockpit.

Other Observations

In addition to collecting the parametric data, certain observations were noted about many of the breath sounds to aid in the review of the results. These observations are commented in the table in Attachment II. Most of the comments are self explanatory, but a few require definitions.

Modulated means that the volume (amplitude) of the sound appeared to change over the duration of a single breath. This was noted by a general decrease in volume, followed by an increase, which could be heard audibly at least once during the breath sound. Several modulated breaths appear in Figure 2, with arrows denoting the decreasing and increasing trends.

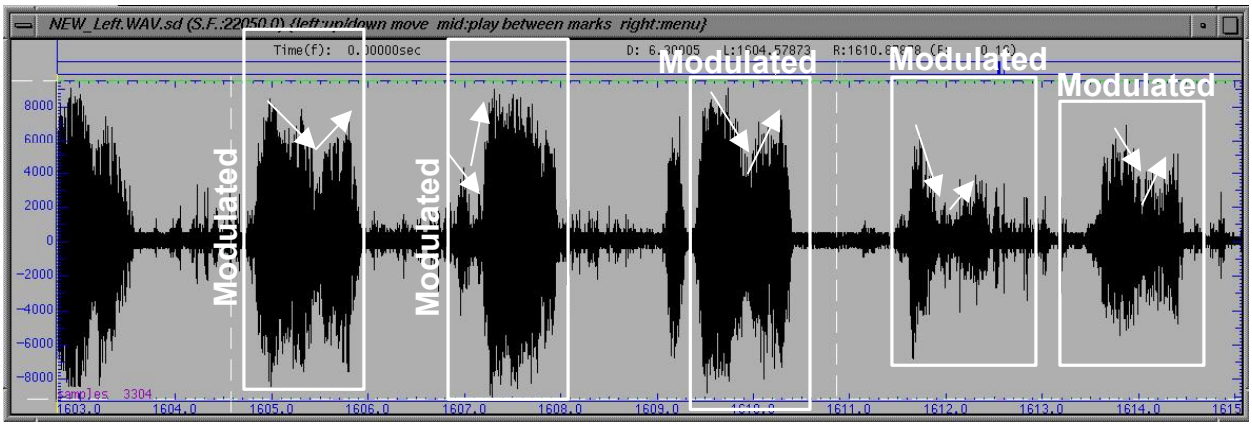


Figure 2 - Examples of Modulated Breath Sounds

Staccato(n) means that the breath sound is comprised of several distinct shorter interrupted breaths, where “n” is the number of elements in the staccato sound. An example of a staccato breath can be seen in Figure 3.

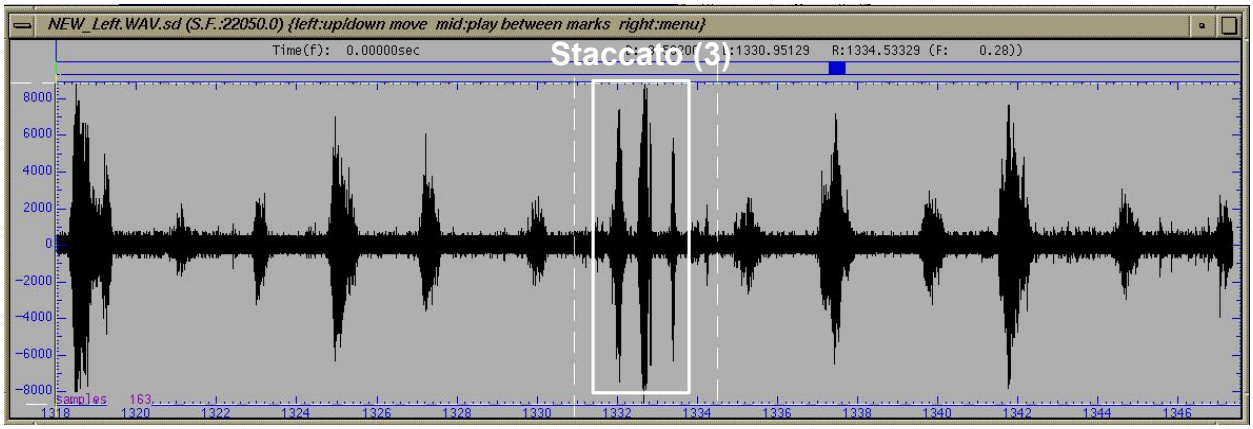


Figure 3 - Staccato Sound

Preceded by speech means that the breath was heard immediately after the First Officer had spoken, with little or no pause between the speech and the breath. This may have an adverse effect on calculations of breathing rate at these times.

Background Noise Contamination: Some comments indicate that there are other noises or speech that can be heard in the background during the breath sound. This may have an adverse effect when measuring the average adjusted magnitude for these breath sounds, because the magnitude is calculated from all the audio in the selected region.

Spindle Characteristic: Another phenomenon that was noticed in several areas when reviewing the breath sounds was a “spindle” characteristic that is manifested in the waveform of several breaths collectively. The spindle shape is caused by a series of breaths that show a trend of progressively increasing volume from one breath to the next, immediately followed by an opposite trend of breaths progressively decreasing in volume, or vice versa. In some areas, this spindle effect repeats itself several times. In at least one case (Figure 4a below), the *duration* of each breath follows a similar trend

– predominantly longer exhales corresponding to the louder portions of the spindle, and comparatively shorter exhales corresponding to the quieter portions. For example, in Figure 4a the duration of the breaths denoted by the letter “A” are slightly more than twice as long as the breath denoted at “B”.

These spindles vary in the number of breaths that comprise them, the overall length of the spindle, and in the relative magnitudes of the individual breaths. Examples of spindles can be seen in Figures 4a and 4b (there is also one within the 12 breaths seen in Figure 1). These figures and the one annotation in Attachment II are only a few examples of the many spindles that can be found throughout the duration of the First Officer’s CVR channel.

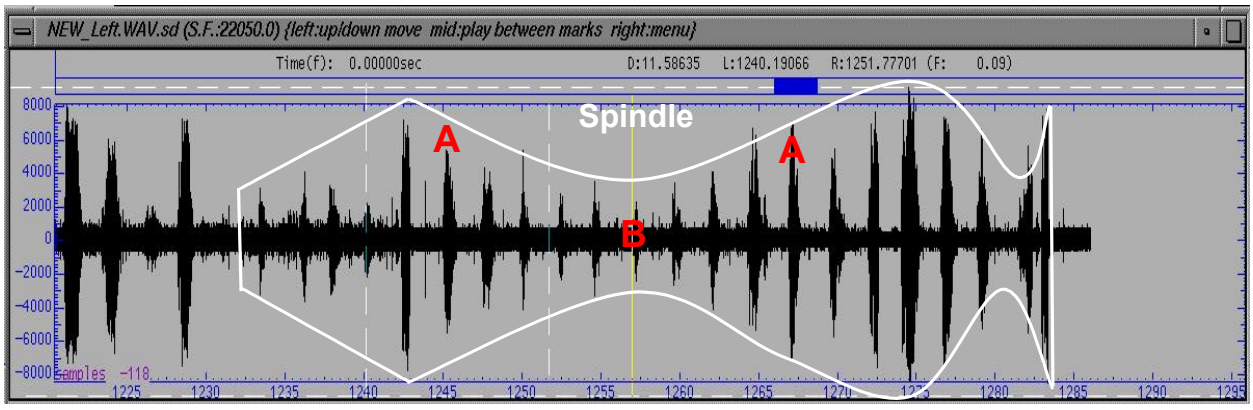


Figure 4a - Spindle characteristic

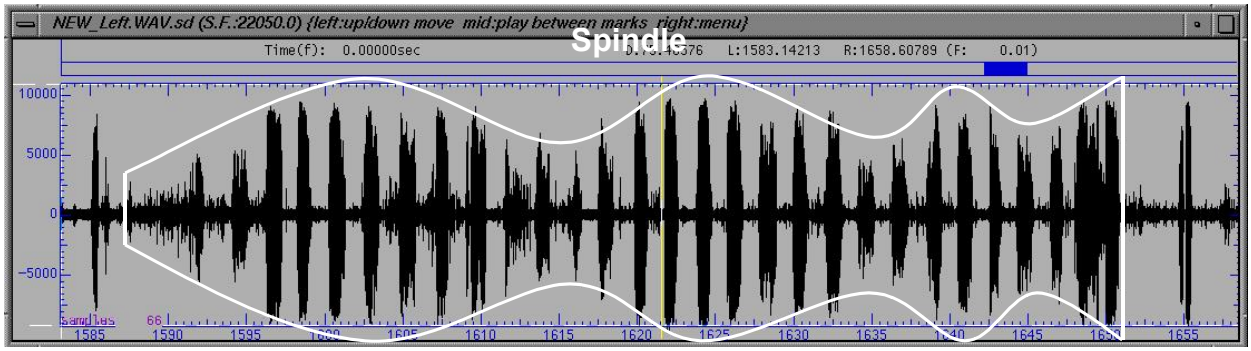


Figure 4b - Spindle characteristic

Data Collection Limitations

The sounds measured in this study were captured by the First Officer's headset microphone. This microphone is mounted on the end of a flexible boom, which can be adjusted to various distances and directions from the mouth. Movement of the microphone (or removal of the headset) during the recording presents the possibility that a breath or series of breaths could be missed during the data collection, resulting in inaccurate calculations of breathing rate. Typically, some type of sound or noise will accompany microphone movements and headset removal/donning. Changes in the background noise and/or the relative volume of all or some of the sounds captured by the microphone will often occur as a result of the movement or removal/donning as well. However, the possibility of an undetected movement still exists. When suspected, possible microphone or headset movements were noted in the comments section of Attachment II.

Another possibility is that the First Officer may have at times redirected the flow of his breath is some way such that it was not captured by the microphone.

Results

The data collected can be found in Attachment II. Some results from a cursory examination of the data collected are provided below.

Breathing rate

The breathing rate was calculated by measuring the elapsed time in seconds from the beginning of one breath to the beginning of the following breath, and converting to a per-minute rate:

$$INSTANTANEOUS\ RATE(BPM) = \frac{1\ Breath}{Elapsed\ Time\ Between\ 2\ Succesive\ Breaths} \times 60$$

The calculated breathing rate fluctuated significantly. Some of the variability can be attributed to interruptions in the breathing by speech. However, there are some areas where the instantaneous breathing rate sharply increased or decreased, in areas where no speech was noted. The instantaneous rate varied between extreme low of 2.6 Breaths Per Minute (BPM) and a maximum of 130.4 BPM. Attachment I contains a chart of the distribution of instantaneous rates over several categories (number of calculated rates less than 10 BPM, between 10 and 20 BPM, etc.). Additionally, a graph of calculated instantaneous breathing rate vs. time for all measured rates is provided in Attachment I.

Additionally, an average of instantaneous breathing rates was calculated over specific regions of time, starting with time the breath sounds could first be regularly heard, continuing through the end of the recording. These specific regions were selected based on the following criteria:

- Each region must contain at least three breaths (resulting in at least two instantaneous rates to compute an average)
- No speech occurs within the region
- Speech may occur before or after the region, but the first breath can not be classified as “preceded by speech” in the comments section of Attachment II
- No evidence of headset moving or microphone position change present during the region

These criteria yielded 19 regions labeled A thru S in Table 1 below.

Table 1 – Average Breathing Rate

REGION	START	REGION DURATION	BREATH COUNT	AVERAGE OF INSTANTANE-OUS RATES	MIN	MAX	STANDARD DEVIATION	AVERAGE BY COUNTS/TIME
A	11:06.4	22.5	6	24.4	4.5	46.9	15.4	13.4
B	14:21.9	6.4	3	19.1	16.2	21.9	4.0	18.6
C	14:50.7	92.6	46	33.3	21.3	109.6	17.1	29.2
D	16:31.8	12.3	7	31.7	21.6	45.9	10.7	29.2
E	19:01.5	17.5	7	26.9	9.8	51.0	14.7	20.6
F	19:32.5	3.4	3	36.7	28.4	45.1	11.8	34.8
G	20:13.6	81.2	34	25.4	11.6	39.9	4.9	24.4
H	21:58.3	51.0	23	27.1	19.2	54.4	7.2	25.9
I	22:53.2	24.0	11	25.1	21.6	28.1	1.9	25.0
J	23:50.3	50.7	20	25.2	9.6	46.6	8.1	22.5
K	25:23.3	15.7	9	33.7	25.6	67.6	14.2	30.6
L	26:06.3	5.8	3	23.0	15.8	30.1	10.1	20.8
M	26:19.1	67.5	31	27.6	13.3	35.1	4.1	26.7
N	27:46.0	11.2	7	36.9	25.1	69.1	17.4	32.2
O	28:03.3	29.1	16	33.0	26.1	55.4	9.9	31.0
P	28:38.9	98.5	43	26.7	14.1	42.4	5.3	25.6
Q	30:30.3	28.5	14	30.3	18.3	51.2	11.2	27.3
R	31:21.3	17.7	10	30.7	26.3	35.3	2.7	30.5
S	31:48.1	26.6	15	31.7	28.2	34.5	2.0	31.6

The data tabulated for each region is defined as:

START Beginning of region in CVR Elapsed time MM:SS.s

REGION DURATION Elapsed time from start of first breath to start of last breath in region, in seconds.

BREATH COUNT Total number of breaths within the region.

AVERAGE OF INSTANTANEOUS RATES Mean of all instantaneous rates calculated between the breaths within the region, in Breaths Per Minute (BPM).

MIN Minimum instantaneous breathing rate within the region (BPM).

MAX Maximum instantaneous breathing rate within the region (BPM).

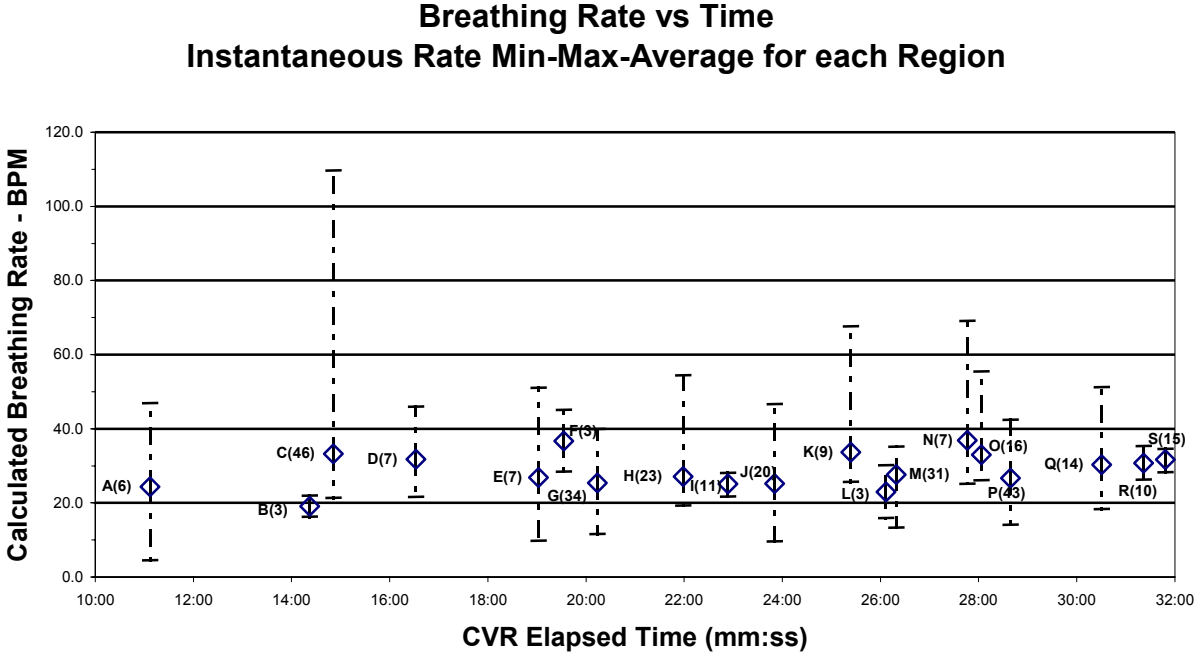
STANDARD DEVIATION Standard deviation of all instantaneous rates within the region (BPM).

AVERAGE BY COUNTS/TIME Alternative method for calculation of breathing rate calculated by:

$$\frac{(Number\ of\ breaths\ in\ region)-1}{duration\ of\ region}\times 60$$

in BPM.

Figure 5 below is a chart depicting the minumum, maximum, and average of the instantaneous breathing rates for each region as a function of CVR Elapsed Time. Annotations depict the Region Name(breath count). The parameters are plotted at the start time for each region.



Magnitude

The average adjusted magnitude was calculated over the duration of each breath sound. The magnitude values ranged from a barely perceptible (to the ear) low of 264, to a high of 3644. The average of all magnitudes measured was about 1400. In comparison, the magnitude of the ambient noise in the cockpit was measured at 186 (between time 1250.8 and 1252.3), and several samples of the First Officer's speech were measured and found to be between 2000 and 2500. An average magnitude over each ½ second interval of the entire recording was also measured and calculated. The highest average value occurred during a breath sound, measured at time 1555.1. A graph of all measured magnitudes as a function of time can be found in Attachment I.

Breath Duration

The duration of each breath sound is calculated from the start and stop elapsed time values for each breath. The shortest breath duration was measured to be 0.1 seconds, the longest was 2.9 seconds, and the average over all measured breaths was 0.8 seconds. A chart showing breath duration as a function of time can be found in Attachment I.

Douglass P. Brazy

Mechanical Engineer (CVR)

Attachment I – Graphs/Charts

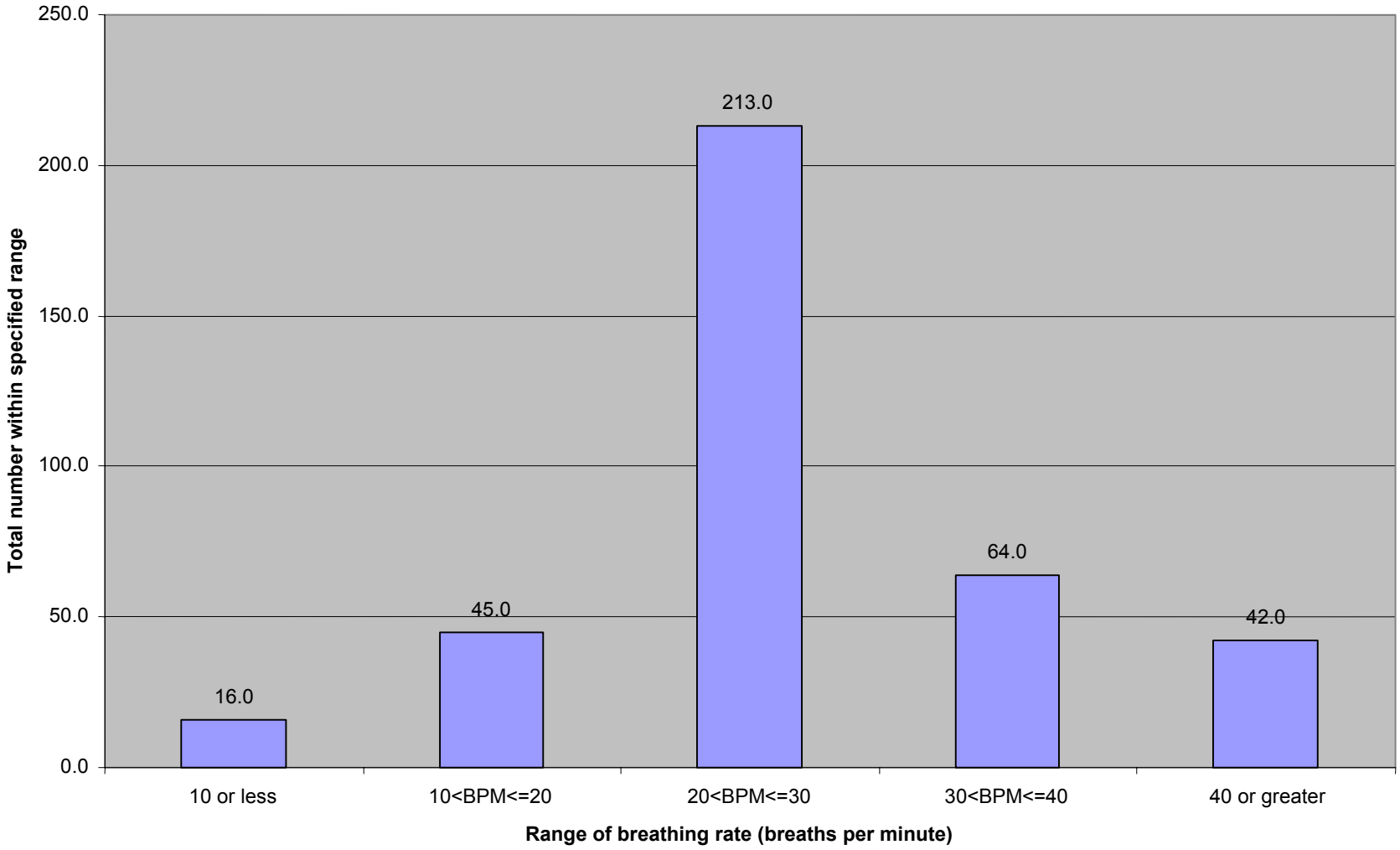
I-1 Distribution of Instantaneous Breathing Rate

I-2 Instantaneous Breathing Rate vs. Time

I-3 Signal Magnitude of Each Breath

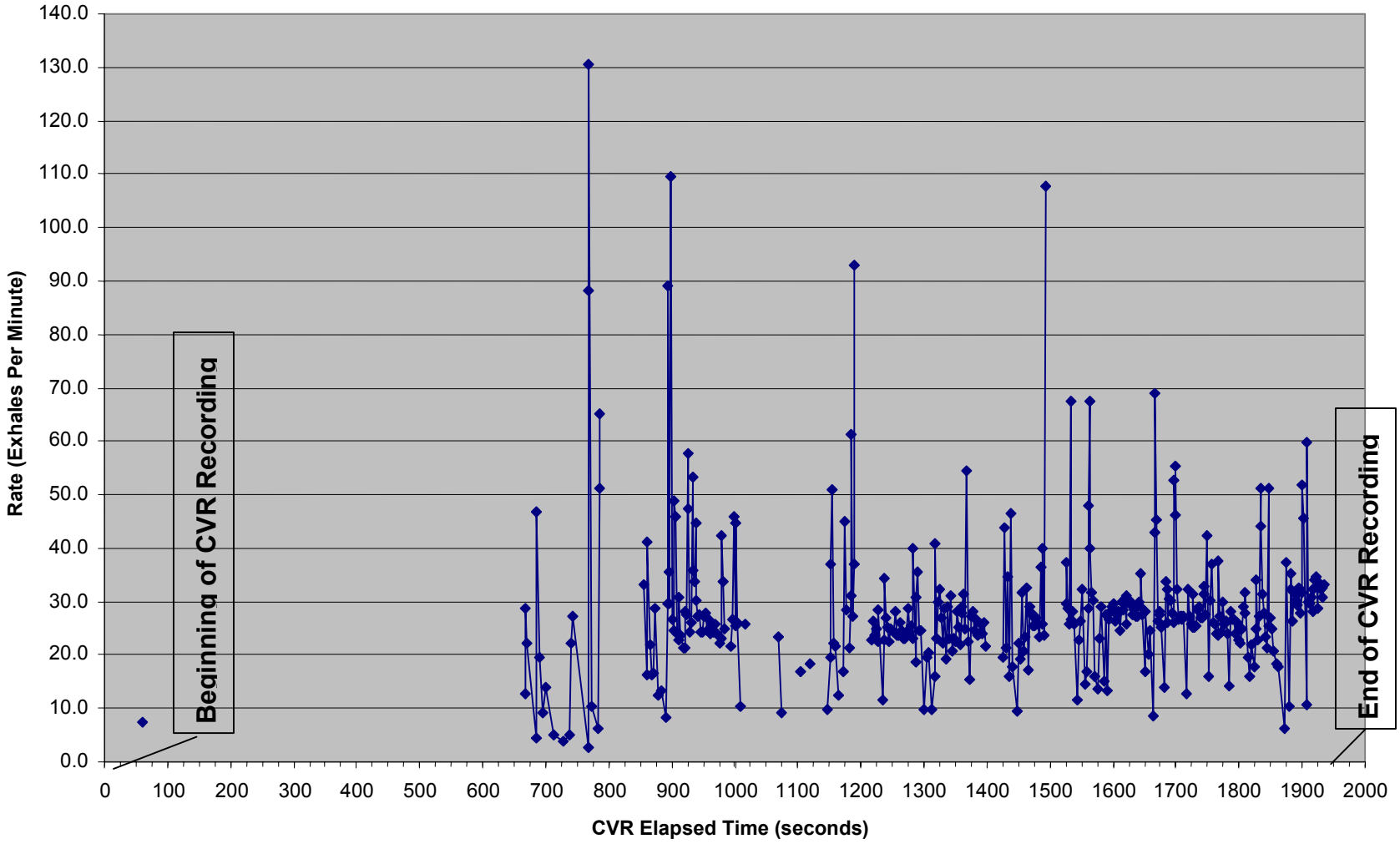
I-4 Breath Duration

I-1 Distribution of Instantaneous Breathing Rate



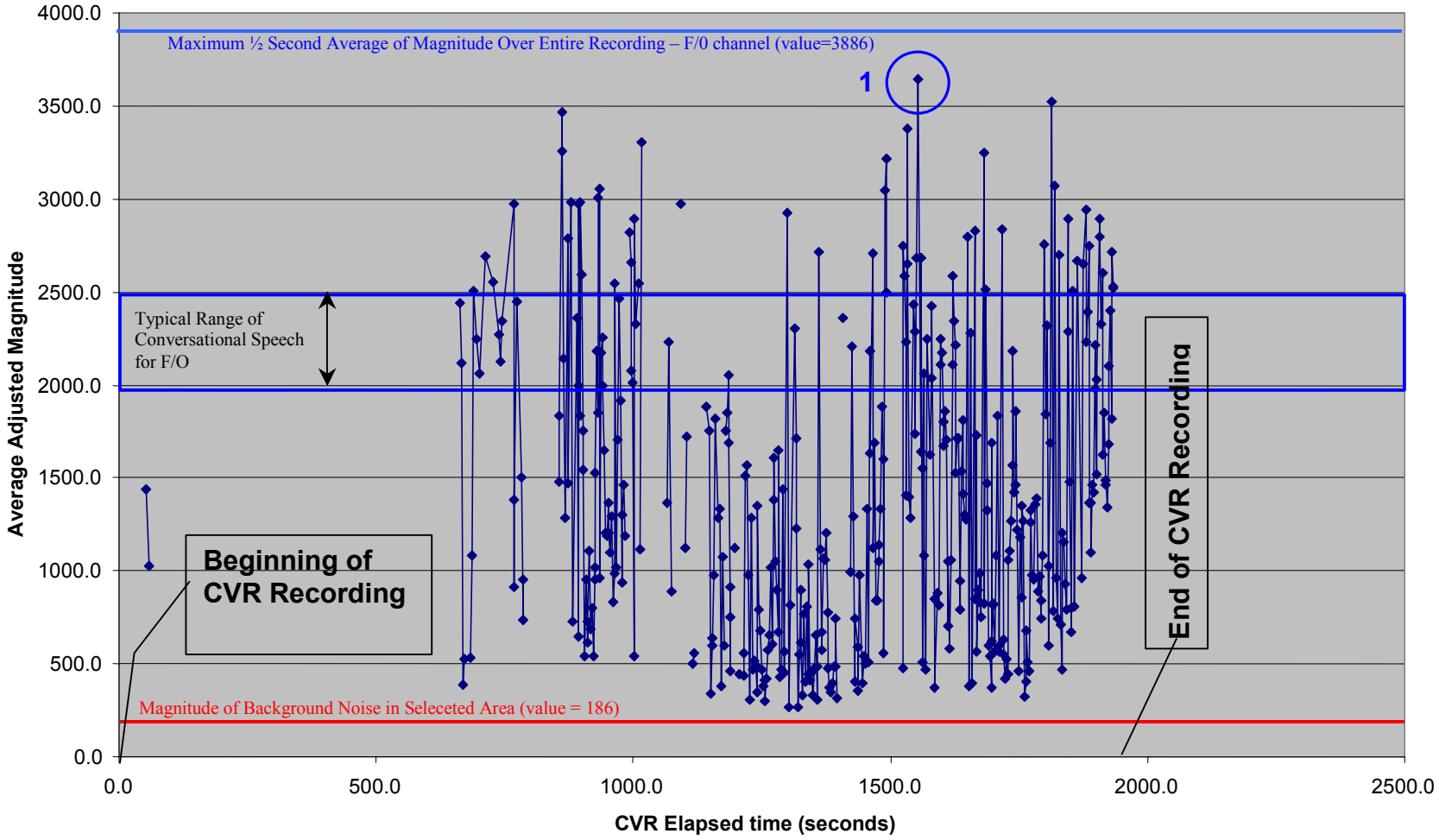
Note: Instantaneous Breathing Rate is calculated for each breath, based on the elapsed time between it and the preceding breath. Speech occurring between successive breaths, or the possibility of a breath(s) occurring but going undetected could have a strong effect on the rate calculation.

I-2 Instantaneous Breathing Rate vs. Time



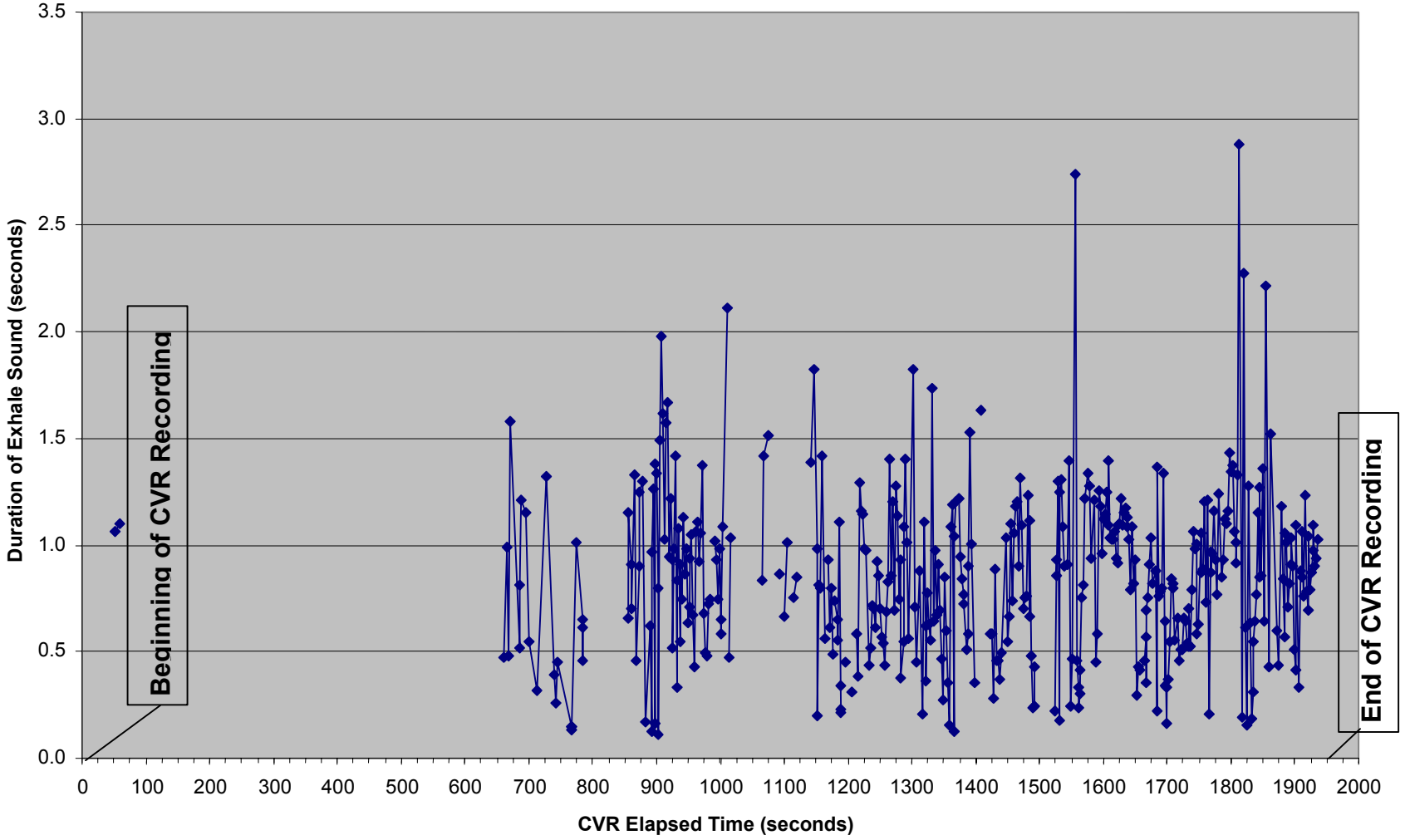
Note: Instantaneous Breathing Rate is calculated for each breath, based on the elapsed time between it and the preceding breath. Speech occurring between successive breaths, or the possibility of a breath(s) occurring but going undetected could have a strong effect on the rate calculation.

I-3 Signal Magnitude of Each Breath



Note: This chart illustrates that the magnitude of the breath sounds varies over a wide range; from very quiet (just above background noise level), up to the loudest sound captured on the F/O's CVR channel. The highest ½ second average of magnitude on the entire channel occurred during the breath denoted as "1" in the figure (this breath was 2.7 seconds long and the resulting average magnitude over the 2.7 seconds was lower than the ½ second peak).
The conversational values provided on this chart are provided to give the reader a sense of what normal conversation loudness was on this channel. They cannot be used to compare the *absolute* volume of the breath sounds to that of any other sound on the recording.

I-4 Breath Duration



Attachment II – Numerical Data

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
1	51.7	52.7	20.0	1891.0	1438.0		#N/A	#N/A	1.1	
2	59.7	60.8	20.4	1372.0	1027.0		8.0	7.5	1.1	
							#N/A	#N/A	#N/A	possibly not wearing headset. No breaths heard in this gap
3	661.7	662.2	19.2	3135.0	2438.0		#N/A	#N/A	0.5	preceded by speech
4	666.4	667.4	20.1	2844.0	2121.0		4.7	12.8	1.0	
5	668.5	669.0	20.0	496.1	390.7		2.1	28.8	0.5	very quiet - in/out?
6	671.2	672.8	20.3	680.5	527.3		2.7	22.1	1.6	
7	684.5	685.0	20.0	693.8	537.1		13.3	4.5	0.5	
8	685.8	686.6	20.7	1441.0	1084.0		1.3	46.9	0.8	
9	688.9	690.1	20.5	3244.0	2509.0		3.1	19.5	1.2	
10	695.4	696.6	20.1	2849.0	2250.0		6.6	9.1	1.1	preceded by speech
11	699.8	700.3	20.5	2681.0	2063.0		4.3	13.9	0.5	preceded by speech
12	711.6	711.9	23.3	3544.0	2688.0		11.8	5.1	0.3	preceded by speech
13	726.7	728.0	19.8	3339.0	2554.0		15.1	4.0	1.3	preceded by speech
14	738.6	739.0	20.4	3276.0	2267.0		12.0	5.0	0.4	mid speech/with cough
15	741.4	741.6	21.2	2886.0	2125.0		2.7	22.1	0.3	preceded by speech
16	743.6	744.0	21.1	3013.0	2344.0		2.2	27.3	0.5	cut off by radio
17	766.8	766.9	20.7	3742.0	2971.0		23.2	2.6	0.1	preceded by speech
18	767.4	767.6	19.2	1211.0	911.2		0.7	88.2	0.1	brief
19	767.9	768.0	19.6	1907.0	1384.0		0.5	130.4	0.1	brief
20	773.7	774.7	20.6	3325.0	2448.0		5.8	10.4	1.0	modulated
21	783.3	783.9	20.0	1990.0	1499.0		9.6	6.2	0.6	
22	784.4	784.9	20.3	1006.0	733.2		1.2	51.3	0.5	brief
23	785.4	786.0	20.4	1340.0	952.6		0.9	65.2	0.6	mic moving? Unusual
							#N/A	#N/A	#N/A	possibly not wearing headset. No breaths heard in this gap
24	855.0	855.6	20.5	1972.0	1478.0		#N/A	#N/A	0.7	possible breath unclear
25	856.8	857.9	20.3	2569.0	1834.0		1.8	33.1	1.1	
26	860.4	861.3	21.3	4262.0	3466.0		3.7	16.4	0.9	with grunt
27	861.9	862.6	20.8	4124.0	3254.0		1.5	41.1	0.7	
28	864.6	866.0	20.4	2926.0	2142.0		2.7	21.9	1.3	

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
29	868.3	868.8	20.4	1744.0	1285.0		3.7	16.2	0.5	
30	871.9	872.8	20.4	3737.0	2790.0		3.6	16.6	0.9	at end of speech?
31	874.0	875.3	20.4	2379.0	1472.0		2.1	28.6	1.3	staccato(4)
32	878.8	880.1	21.2	3852.0	2978.0		4.8	12.6	1.3	at end of speech?
33	883.4	883.5	19.8	990.8	725.3		4.5	13.2	0.2	brief
34	890.7	891.3	20.0	3103.0	2361.0		7.3	8.2	0.6	
35	892.7	892.8	19.8	884.4	645.7		2.0	29.7	0.1	brief
36	893.3	894.3	20.2	2673.0	1993.0		0.7	89.2	1.0	modulated
37	895.0	896.3	20.5	3853.0	2971.0		1.7	35.6	1.3	
38	897.0	897.2	20.4	2666.0	1832.0		2.0	29.7	0.2	brief
39	897.6	899.0	20.2	3789.0	2980.0		0.5	109.6	1.4	
40	899.8	901.2	20.0	3415.0	2593.0		2.2	26.7	1.3	
41	902.3	903.1	20.2	2401.0	1751.0		2.5	24.5	0.8	
42	903.5	903.6	20.6	2233.0	1542.0		1.2	49.0	0.1	brief
43	904.8	906.3	20.3	816.7	540.4		1.3	45.9	1.5	staccato (6) -deceasing amplitude
44	907.3	909.3	20.0	1517.0	949.9		2.5	24.1	2.0	staccato (6)
45	909.9	911.6	20.1	1005.0	612.9		2.6	22.8	1.6	staccato (6)
46	911.9	912.9	20.1	1268.0	726.6		1.9	30.9	1.0	staccato (4)
47	914.4	916.0	20.1	1795.0	1104.0		2.5	23.5	1.6	
48	917.3	918.9	20.2	1080.0	684.5		2.8	21.3	1.7	staccato (7)
49	920.1	921.0	20.2	1320.0	803.9		2.8	21.4	0.9	staccato (4)
50	922.2	923.4	20.0	851.9	540.3		2.1	28.3	1.2	staccato (2)
51	924.4	925.3	20.1	1622.0	1022.0		2.2	27.5	0.9	staccato (3)
52	925.4	925.9	19.8	1523.0	950.9		1.0	57.8	0.5	staccato (3)
53	926.7	927.6	20.0	2317.0	1530.0		1.3	47.4	1.0	staccato (4)
54	929.1	930.6	20.0	2987.0	2184.0		2.5	24.3	1.4	modulated
55	931.4	931.8	19.6	2563.0	1854.0		2.3	26.0	0.3	brief
56	932.6	933.4	20.2	3874.0	3009.0		1.1	53.2	0.8	
57	934.2	935.3	20.3	3838.0	3057.0		1.7	35.8	1.1	
58	936.0	936.6	20.2	1361.0	958.5		1.8	33.7	0.5	modulated
59	937.4	938.3	20.2	3091.0	2172.0		1.3	44.8	0.9	modulated
60	939.4	940.1	20.2	2949.0	2257.0		2.0	30.2	0.7	

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
61	941.6	942.7	20.2	2891.0	2000.0		2.2	27.1	1.1	
62	943.7	944.6	20.1	2406.0	1648.0		2.2	27.5	0.9	modulated
63	946.2	947.2	20.0	1866.0	1202.0		2.5	24.4	1.0	modulated
64	948.7	949.3	19.9	1698.0	1190.0		2.5	24.2	0.6	modulated
65	950.9	951.6	20.3	1963.0	1369.0		2.2	27.1	0.7	modulated
66	953.0	954.0	20.1	1720.0	1201.0		2.1	27.9	0.9	modulated
67	955.5	956.5	20.0	1689.0	1097.0		2.5	24.5	1.0	
68	957.8	958.4	20.0	1751.0	1296.0		2.3	26.5	0.7	
69	960.3	960.7	20.6	1091.0	830.6		2.5	23.9	0.4	
70	962.6	963.7	20.0	1479.0	988.4		2.3	25.7	1.1	
71	965.1	966.2	20.1	3438.0	2543.0		2.5	24.2	1.1	
72	967.4	968.3	20.2	1449.0	1021.0		2.3	25.9	0.9	
73	969.8	970.9	20.2	2337.0	1703.0		2.5	24.4	1.1	
74	972.3	973.7	20.1	3455.0	2468.0		2.5	24.0	1.4	modulated
75	975.1	975.7	20.7	2624.0	1916.0		2.7	22.1	0.7	
76	977.6	978.1	20.3	1324.0	933.7		2.6	23.2	0.5	
77	979.1	979.5	20.2	1788.0	1300.0		1.4	42.5	0.5	
78	980.8	981.6	20.1	2016.0	1462.0		1.8	33.9	0.7	
79	983.2	984.0	20.1	1605.0	1186.0		2.4	24.9	0.7	
							#N/A	#N/A	#N/A	obscured by radio
80	991.8	992.8	20.4	3603.0	2823.0		#N/A	#N/A	1.0	
81	994.6	995.5	20.2	3479.0	2656.0		2.8	21.6	0.9	
82	996.9	997.6	20.3	2660.0	2077.0		2.3	26.5	0.7	
83	998.2	999.1	20.1	2728.0	2009.0		1.3	45.9	1.0	
84	1000.5	1001.1	20.3	726.5	541.9		2.4	25.4	0.6	
85	1001.9	1002.5	20.2	3729.0	2896.0		1.3	44.8	0.7	
86	1004.2	1005.2	20.1	3297.0	2330.0		2.3	26.1	1.1	
87	1009.9	1012.0	19.9	3459.0	2548.0		5.7	10.5	2.1	<---possible true absence of breath for this period - speech precedes this breath
							#N/A	#N/A	#N/A	this exhale lasts 2.1 seconds and ends in a staccato(4)
88	1013.0	1013.5	19.9	1687.0	1115.0		#N/A	#N/A	0.5	staccato (2) - contains background voice audio

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
89	1015.3	1016.4	19.2	4063.0	3305.0		2.3	25.9	1.0	preceded by speech - contains background voice audio
							#N/A	#N/A	#N/A	likely took off headset or moved mic
90	1065.4	1066.3	20.0	1852.0	1362.0		#N/A	#N/A	0.8	
91	1068.0	1069.4	20.0	3202.0	2234.0		2.6	23.2	1.4	preceded by speech
92	1074.6	1076.1	20.2	1182.0	885.7		6.6	9.1	1.5	likely took off headset or moved mic
							#N/A	#N/A	#N/A	
93	1093.4	1094.3	20.3	3689.0	2976.0		#N/A	#N/A	0.9	contains background voice audio
							#N/A	#N/A	#N/A	obscured by radio until next
94	1100.7	1101.3	20.3	1501.0	1126.0		#N/A	#N/A	0.7	
95	1104.2	1105.2	20.1	2285.0	1718.0		3.5	17.0	1.0	
							#N/A	#N/A	#N/A	obscured by radio
96	1115.8	1116.5	20.2	652.1	498.9		#N/A	#N/A	0.8	
97	1119.0	1119.9	20.0	713.2	556.9		3.3	18.3	0.8	
							#N/A	#N/A	#N/A	obscured by radio
98	1141.5	1142.9	20.3	2540.0	1885.0		#N/A	#N/A	1.4	
99	1147.7	1149.5	20.3	2549.0	1756.0		6.1	9.8	1.8	<---possible true absence of breath for this period
100	1150.7	1151.7	20.3	433.3	341.8		3.1	19.6	1.0	difficult to discern, quiet and slow
101	1152.4	1152.6	20.9	866.4	639.9		1.6	37.1	0.2	brief
102	1153.5	1154.3	20.2	804.7	595.2		1.2	51.0	0.8	
103	1156.2	1157.0	20.5	1378.0	979.2		2.7	22.1	0.8	
104	1159.0	1160.5	20.1	2515.0	1821.0		2.8	21.5	1.4	
105	1163.9	1164.4	20.1	2019.0	1282.0		4.8	12.5	0.6	staccato (2)
							#N/A	#N/A	#N/A	
106	1168.9	1169.8	20.3	2002.0	1333.0		#N/A	#N/A	0.9	
107	1172.5	1173.1	20.2	501.4	379.3		3.6	16.7	0.6	<---possible true absence of breath for this period
108	1173.8	1174.6	20.5	1528.0	1073.0		1.3	45.1	0.8	
109	1175.9	1176.4	20.5	860.3	601.6		2.1	28.4	0.5	
							#N/A	#N/A	#N/A	speech in this gap
110	1179.7	1180.4	20.1	2362.0	1750.0		#N/A	#N/A	0.7	
111	1182.5	1183.2	19.1	2516.0	1851.0		2.8	21.4	0.7	preceded by speech

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
112	1184.4	1185.0	22.1	2842.0	2055.0		1.9	31.0	0.6	preceded by cough
113	1185.4	1186.5	20.3	2414.0	1692.0		1.0	61.2	1.1	
114	1187.6	1188.0	20.5	1053.0	750.2		2.2	27.3	0.3	brief
115	1189.2	1189.5	19.8	616.1	463.8		1.6	37.1	0.2	brief (very)
116	1189.9	1190.1	19.2	1198.0	912.5		0.6	93.0	0.2	brief (very)
							#N/A	#N/A	#N/A	likely took off headset or moved mic intermit-tently beginning here
117	1196.7	1197.1	20.3	1529.0	1122.0		#N/A	#N/A	0.4	
							#N/A	#N/A	#N/A	
118	1204.8	1205.1	19.8	573.5	443.6		#N/A	#N/A	0.3	
							#N/A	#N/A	#N/A	likely took off headset or moved mic intermit-tently ending here
119	1213.6	1214.2	20.2	595.5	432.7		#N/A	#N/A	0.6	
120	1216.2	1216.6	20.1	725.3	556.9		2.6	22.7	0.4	
121	1218.5	1219.8	20.4	2048.0	1509.0		2.3	26.2	1.3	
122	1221.0	1222.2	20.2	2119.0	1569.0		2.5	23.7	1.2	
123	1223.4	1224.6	20.2	1347.0	977.8		2.4	25.0	1.1	
124	1226.1	1227.1	20.0	398.1	306.7		2.7	22.4	1.0	quiet
125	1228.2	1229.2	20.2	1770.0	1281.0		2.1	28.4	1.0	
126	1233.4	1233.9	20.4	630.1	472.2		5.2	11.6	0.4	<---possible true absence of breath for this period
127	1236.1	1236.6	20.4	706.9	513.3		2.6	22.7	0.5	
128	1237.8	1238.5	20.3	672.6	496.7		1.7	34.3	0.7	
129	1240.0	1240.7	20.2	459.8	346.2		2.2	27.0	0.7	
130	1242.4	1243.0	20.2	1823.0	1347.0		2.4	25.2	0.6	x peak
131	1245.1	1246.0	20.2	1145.0	794.0		2.7	22.5	0.9	x
132	1247.5	1248.3	20.2	919.7	680.6		2.4	25.0	0.9	x
133	1249.9	1250.6	20.3	692.6	469.4		2.4	24.6	0.7	x
134	1252.4	1253.0	20.2	531.8	381.5		2.5	24.1	0.6	x
135	1254.5	1255.1	20.0	583.7	415.1		2.1	28.1	0.5	x example of characteristic “spindle” waveform pattern
136	1257.1	1257.5	20.1	402.5	296.9		2.5	23.8	0.4	x
137	1259.6	1260.3	20.2	562.7	416.8		2.5	23.5	0.7	x
138	1261.9	1262.7	20.6	815.9	575.9		2.3	26.1	0.8	x

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
139	1264.4	1265.8	20.1	949.4	653.4		2.5	24.5	1.4	x
140	1267.0	1267.8	20.2	1517.0	1019.0		2.6	23.0	0.9	x peak
141	1269.6	1270.8	20.1	901.0	605.7		2.6	23.0	1.2	
142	1272.1	1272.7	20.1	1875.0	1380.0		2.5	24.3	0.7	
143	1274.1	1275.4	20.1	2254.0	1607.0		2.1	28.7	1.3	
144	1276.6	1277.7	20.1	1601.0	1051.0		2.5	24.3	1.1	
145	1279.0	1279.7	20.2	1235.0	897.7		2.4	25.3	0.7	
146	1281.6	1282.5	20.2	984.2	673.6		2.6	23.1	0.9	
147	1283.1	1283.5	20.4	2129.0	1647.0		1.5	39.9	0.4	
148	1286.3	1286.9	20.2	594.7	432.3		3.2	18.6	0.5	
149	1288.3	1289.3	19.6	742.6	466.3		1.9	30.9	1.1	
150	1289.9	1291.3	20.0	1928.0	1438.0		1.7	35.7	1.4	
151	1292.4	1293.4	20.0	620.9	449.1		2.4	24.6	1.0	
152	1294.8	1295.4	19.9	779.0	569.3		2.4	24.6	0.6	
153	1300.9	1302.7	19.9	3739.0	2923.0		6.1	9.9	1.8	<---possible true absence of breath for this period, preceded by speech
154	1304.0	1304.7	20.0	348.5	264.9		3.1	19.7	0.7	
155	1306.9	1307.4	19.9	1290.0	813.3		3.0	20.3	0.4	
156	1313.1	1314.0	19.9	3282.0	2299.0		6.2	9.6	0.9	<---possible true absence of breath for this period, preceded by speech
157	1316.9	1317.1	19.5	2439.0	1713.0		3.7	16.1	0.2	brief, followed by speech
158	1318.3	1319.4	19.9	1803.0	1226.0		1.5	40.8	1.1	modulated
159	1320.9	1321.5	20.0	357.4	264.0		2.6	23.1	0.6	quiet - unclear
160	1322.9	1323.3	20.6	734.9	546.4		2.0	30.0	0.4	
161	1324.8	1325.6	19.9	1272.0	898.4		1.9	32.1	0.8	
162	1327.0	1327.7	20.0	869.6	615.6		2.2	26.9	0.6	
163	1329.7	1330.3	20.1	457.9	335.0		2.7	22.2	0.6	
164	1331.8	1333.6	20.0	1442.0	770.7		2.1	28.7	1.7	staccato (3)
165	1334.9	1335.6	20.2	542.0	403.1		3.1	19.2	0.6	
166	1337.0	1338.0	20.1	1185.0	811.7		2.1	28.9	1.0	
167	1339.6	1340.3	20.1	608.2	442.3		2.6	23.2	0.7	
168	1341.5	1342.5	20.1	1521.0	1033.0		1.9	31.1	0.9	
169	1344.4	1345.1	20.2	560.7	412.4		2.9	20.8	0.7	

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
170	1347.0	1347.5	20.1	612.2	451.9		2.6	23.2	0.5	
171	1349.7	1350.0	20.3	450.1	331.0		2.7	22.5	0.3	brief/weak
172	1351.8	1352.7	20.2	718.0	480.4		2.1	28.0	0.8	
173	1354.2	1354.8	20.1	956.7	657.3		2.4	25.1	0.6	
174	1357.0	1357.3	20.0	400.1	305.2		2.7	21.9	0.4	weak
175	1359.1	1359.3	19.2	695.5	480.9		2.2	27.7	0.2	brief
176	1361.2	1362.3	20.4	3535.0	2714.0		2.1	29.1	1.1	
177	1363.1	1364.3	19.9	1628.0	1118.0		1.9	31.4	1.2	
178	1365.5	1365.6	20.4	919.7	569.8		2.4	24.9	0.1	brief
179	1366.6	1367.7	19.9	943.5	666.9		1.1	54.4	1.0	some quiet audio in background
180	1369.3	1370.5	20.0	1542.0	1070.0		2.7	22.4	1.2	
181	1373.2	1374.4	19.9	1430.0	1059.0		3.9	15.5	1.2	
182	1375.4	1376.3	19.9	1674.0	1202.0		2.2	27.1	0.9	
183	1377.5	1378.3	20.0	1118.0	777.8		2.1	28.1	0.8	
184	1380.0	1380.7	19.9	666.3	477.8		2.4	24.5	0.8	
185	1382.2	1382.9	20.1	502.5	369.6		2.2	26.7	0.7	
186	1384.7	1385.2	19.7	474.1	346.9		2.5	23.7	0.5	
187	1387.2	1387.8	20.2	532.5	395.1		2.5	23.9	0.6	
188	1389.6	1390.5	20.0	680.9	481.8		2.3	25.6	0.9	
189	1392.1	1393.6	20.1	667.3	487.9		2.5	23.9	1.5	
190	1394.4	1395.4	20.1	1099.0	746.5		2.3	25.9	1.0	
191	1397.2	1397.5	20.3	423.7	312.2		2.8	21.6	0.4	
							#N/A	#N/A	#N/A	masked by radio
192	1407.9	1409.5	19.7	3052.0	2362.0		#N/A	#N/A	1.6	background audio at end
							#N/A	#N/A	#N/A	masked by radio
193	1423.1	1423.7	20.1	1376.0	997.4		#N/A	#N/A	0.6	
194	1426.1	1426.7	20.4	3054.0	2207.0		3.1	19.6	0.6	preceded by speech
195	1427.5	1427.8	17.4	1947.0	1295.0		1.4	43.9	0.3	preceded by speech
196	1430.3	1431.2	20.1	556.3	405.7		2.8	21.2	0.9	
197	1432.1	1432.5	20.4	1053.0	745.1		1.7	34.5	0.5	
198	1435.8	1436.3	20.2	811.4	592.4		3.7	16.1	0.5	
199	1437.1	1437.5	20.2	479.0	352.0		1.3	46.6	0.4	brief/weak

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
200	1440.5	1441.0	20.2	1473.0	980.8		3.4	17.8	0.5	
201	1446.7	1447.8	20.2	559.1	397.2		6.3	9.6	1.0	
202	1449.4	1450.0	19.9	745.9	541.7		2.7	22.2	0.5	
203	1452.5	1453.2	20.3	687.8	500.6		3.1	19.3	0.7	
204	1454.4	1455.6	20.1	1854.0	1332.0		1.9	31.5	1.1	
205	1457.3	1458.1	20.1	712.3	507.3		2.9	20.7	0.7	
206	1459.9	1461.0	20.1	2828.0	2180.0		2.6	23.5	1.1	
207	1461.7	1462.9	20.1	2358.0	1634.0		1.8	32.7	1.2	
208	1465.3	1466.5	20.0	3488.0	2706.0		3.5	17.1	1.2	preceded by brief grunt
209	1467.3	1468.2	20.2	1528.0	1125.0		2.1	28.9	0.9	
210	1469.5	1470.8	20.2	2278.0	1687.0		2.2	27.7	1.3	
211	1471.8	1472.9	20.2	1267.0	837.5		2.4	25.5	1.1	
212	1474.1	1474.8	20.3	1224.0	838.2		2.2	27.2	0.7	
213	1476.4	1477.2	20.2	1546.0	1049.0		2.4	25.4	0.8	
214	1478.7	1479.4	20.2	1588.0	1143.0		2.2	26.8	0.8	
215	1481.0	1482.2	20.3	1773.0	1333.0		2.3	25.6	1.2	
216	1483.6	1484.2	20.2	2800.0	1884.0		2.6	23.4	0.7	preceded by speech
217	1485.2	1486.3	20.2	2237.0	1601.0		1.6	36.4	1.1	
218	1487.5	1488.0	20.3	821.1	561.4		2.3	25.8	0.5	contains background voice audio
219	1489.0	1489.3	20.3	4047.0	3044.0		1.5	39.9	0.2	preceded by speech
220	1491.6	1491.8	22.7	4167.0	3214.0		2.5	23.7	0.2	preceded by speech
221	1492.1	1492.5	20.2	3306.0	2500.0		0.6	107.9	0.4	
							#N/A	#N/A	#N/A	masked by radio
222	1523.3	1523.5	20.4	693.1	474.4		#N/A	#N/A	0.2	
223	1525.3	1526.2	20.2	3593.0	2750.0		2.0	29.7	0.9	
224	1526.9	1527.8	20.4	3423.0	2583.0		1.6	37.3	0.9	
225	1529.0	1530.3	19.9	2920.0	2232.0		2.1	28.7	1.3	
226	1531.4	1531.5	20.1	2152.0	1409.0		2.3	25.6	0.2	
227	1532.2	1533.5	20.4	4272.0	3380.0		0.9	67.6	1.2	
228	1534.5	1535.8	20.2	3352.0	2647.0		2.2	26.7	1.3	audio in background
229	1536.6	1537.7	20.1	1951.0	1396.0		2.1	28.2	1.1	audio in background
230	1539.0	1539.9	19.9	1755.0	1285.0		2.3	25.6	0.9	audio in background

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
231	1544.2	1545.1	20.3	3219.0	2429.0		5.2	11.5	0.9	preceded by grunt<---possible true absence of breath for this period
232	1546.8	1548.2	20.2	3069.0	2289.0		2.6	22.7	1.4	modulated
233	1549.1	1549.3	20.9	2896.0	1735.0		2.3	26.4	0.2	brief - followed by speech
234	1550.9	1551.4	19.5	3653.0	2684.0		1.9	32.2	0.5	preceded by speech
235	1555.1	1557.9	20.2	4493.0	3644.0		4.2	14.4	2.7	<---possible true absence of breath for this period-Very long and loud
236	1558.7	1559.1	20.3	2381.0	1640.0		3.6	16.9	0.5	
237	1560.8	1561.1	23.3	3590.0	2682.0		2.1	28.7	0.3	preceded by speech
238	1562.0	1562.2	20.2	780.1	509.3		1.2	48.0	0.2	brief
239	1562.9	1563.2	20.5	2197.0	1549.0		0.9	67.6	0.3	brief
240	1564.4	1564.8	24.4	3070.0	2060.0		1.5	39.9	0.4	preceded by speech
241	1566.3	1567.1	20.2	1678.0	1085.0		1.9	31.7	0.8	contains background clicking audio
242	1568.3	1569.1	20.1	670.5	470.3		2.0	30.1	0.8	
243	1572.1	1573.3	20.2	3022.0	2250.0		3.8	15.8	1.2	
244	1576.5	1577.8	20.2	2243.0	1626.0		4.4	13.6	1.3	preceded by speech
245	1579.1	1580.4	20.5	2749.0	2038.0		2.6	23.0	1.3	modulated
246	1581.2	1582.1	20.3	3176.0	2427.0		2.1	29.0	0.9	
247	1585.1	1586.3	20.1	1499.0	845.2		3.9	15.2	1.2	modulated
248	1587.3	1587.7	20.1	495.0	369.2		2.2	27.6	0.4	
249	1591.8	1592.4	20.0	1220.0	879.5		4.5	13.3	0.6	
250	1594.1	1595.3	20.2	1131.0	812.9		2.3	26.5	1.3	background audio at end
251	1596.2	1597.4	20.3	2982.0	2250.0		2.1	28.1	1.2	
252	1598.3	1599.2	20.1	2910.0	2110.0		2.1	28.9	1.0	
253	1600.3	1601.4	20.3	2930.0	2177.0		2.0	29.7	1.1	
254	1602.4	1603.6	20.2	2496.0	1803.0		2.2	27.8	1.1	
255	1604.7	1606.0	20.2	2253.0	1676.0		2.3	26.3	1.2	background audio /modulated
256	1606.9	1608.0	20.3	2550.0	1862.0		2.2	27.6	1.1	modulated
257	1609.0	1610.4	20.1	2349.0	1703.0		2.1	28.1	1.4	staccato(1) then modulated
258	1611.5	1612.5	20.0	1048.0	700.3		2.4	24.7	1.0	modulated
259	1613.5	1614.5	20.2	1423.0	1053.0		2.0	29.8	1.0	modulated
260	1615.6	1616.6	20.0	870.8	583.8		2.1	28.5	1.0	
261	1617.6	1618.6	20.1	1498.0	1062.0		2.0	30.6	1.1	

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
262	1619.9	1620.8	19.8	2864.0	2108.0		2.3	25.6	0.9	
263	1621.8	1622.7	20.2	3435.0	2583.0		1.9	31.2	0.9	
264	1623.8	1624.9	20.2	3271.0	2344.0		2.0	29.8	1.1	
265	1625.8	1626.9	20.0	2979.0	2218.0		2.0	30.3	1.1	
266	1627.8	1629.1	20.1	2027.0	1531.0		2.0	29.6	1.2	
267	1630.0	1631.1	20.1	2361.0	1712.0		2.2	27.4	1.1	
268	1632.1	1633.2	20.1	2335.0	1712.0		2.1	29.0	1.2	
269	1634.2	1635.4	20.0	1088.0	795.7		2.1	28.5	1.2	
270	1636.4	1637.5	20.1	1297.0	948.4		2.2	27.3	1.1	
271	1638.6	1639.7	19.9	2123.0	1536.0		2.2	27.2	1.1	
272	1640.6	1641.6	19.9	2438.0	1814.0		2.0	30.0	1.0	
273	1642.7	1643.5	20.1	1931.0	1412.0		2.1	29.1	0.8	
274	1644.4	1645.5	20.0	1736.0	1302.0		1.7	35.1	1.1	
275	1646.5	1647.4	20.1	1706.0	1276.0		2.2	27.6	0.8	
276	1650.1	1651.0	20.1	3595.0	2796.0		3.5	16.9	0.9	preceded by speech
277	1652.2	1652.5	19.6	513.8	381.9		2.1	28.1	0.3	weak
278	1655.2	1655.6	20.8	3263.0	2276.0		3.0	20.1	0.4	preceded by speech
279	1657.7	1658.1	20.2	541.1	393.4		2.4	24.5	0.4	
280	1664.6	1665.0	20.9	3761.0	2825.0		6.9	8.7	0.5	preceded by speech
281	1666.0	1666.5	20.1	1290.0	847.9		1.4	43.0	0.6	
282	1666.8	1667.2	20.4	2441.0	1730.0		0.9	69.1	0.4	
283	1668.2	1668.9	20.2	850.8	569.4		1.3	45.2	0.7	
284	1670.4	1671.2	20.1	1244.0	900.4		2.3	26.3	0.8	
285	1672.6	1673.5	20.0	1210.0	829.6		2.2	27.6	0.9	
286	1674.8	1675.8	19.7	1397.0	987.3		2.1	28.2	1.0	
287	1677.1	1678.0	20.0	1073.0	749.9		2.4	25.1	0.8	
288	1681.5	1682.4	20.5	4189.0	3251.0		4.3	13.8	0.9	preceded by speech
289	1683.3	1683.5	20.1	1184.0	820.9		1.8	33.6	0.2	brief
290	1685.1	1686.5	20.0	3356.0	2515.0		1.9	32.2	1.4	modulated (some air noise ?breath? Just before)
291	1687.4	1688.2	20.3	2079.0	1467.0		2.3	26.2	0.8	
292	1689.4	1690.2	20.4	1828.0	1328.0		2.0	30.6	0.8	
293	1691.4	1692.2	20.1	957.7	595.9		2.0	30.1	0.8	

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
294	1693.5	1694.9	20.1	801.8	540.4		2.1	27.9	1.3	modulated
295	1695.8	1696.2	20.1	506.9	372.3		2.3	26.1	0.3	weak
296	1697.0	1697.6	20.2	2320.0	1692.0		1.1	52.5	0.6	<---this high rate looks valid - short shallow breath sounds
297	1698.3	1698.4	19.4	916.7	622.9		1.3	46.2	0.2	brief
298	1699.4	1699.7	20.0	1087.0	820.3		1.1	55.4	0.3	
299	1701.2	1701.6	20.4	1184.0	812.6		1.9	32.2	0.4	odd sounding
300	1703.5	1704.0	20.4	777.4	563.5		2.3	26.6	0.5	
301	1705.7	1706.5	20.1	1545.0	1082.0		2.2	27.2	0.8	
302	1707.9	1708.7	20.3	2459.0	1835.0		2.2	26.7	0.8	
303	1710.1	1710.9	20.1	778.2	564.2		2.2	27.2	0.8	
304	1712.3	1712.9	20.2	824.8	595.6		2.2	27.2	0.6	
305	1717.0	1717.7	19.2	3745.0	2838.0		4.7	12.8	0.7	preceded by speech
306	1718.9	1719.3	19.7	901.3	631.0		1.9	32.4	0.5	audio in background
307	1721.1	1721.6	19.6	759.5	548.7		2.2	27.1	0.5	
308	1723.4	1723.9	20.1	573.8	418.3		2.3	25.7	0.5	audio in background
309	1725.8	1726.5	20.1	764.0	526.3		2.4	25.1	0.7	
310	1727.7	1728.4	19.6	661.3	446.6		1.9	31.4	0.6	
311	1730.1	1730.6	20.6	1449.0	1055.0		2.4	25.3	0.5	audio in background - loud from xmit
312	1732.4	1733.0	20.0	1548.0	1104.0		2.4	25.5	0.5	audio in background - loud from xmit
313	1734.5	1735.3	20.3	1801.0	1268.0		2.1	28.5	0.7	
314	1736.6	1737.2	20.0	2256.0	1569.0		2.1	28.9	0.5	
315	1738.9	1739.6	20.0	2950.0	2183.0		2.2	27.0	0.8	
316	1741.1	1742.1	20.1	2032.0	1422.0		2.2	27.0	1.1	
317	1743.0	1744.0	20.4	2077.0	1465.0		1.9	31.4	1.0	
318	1744.8	1745.8	20.0	2415.0	1855.0		1.8	32.9	1.0	
319	1747.0	1747.6	20.1	1768.0	1220.0		2.2	27.6	0.6	audio in background
320	1748.4	1749.0	19.9	648.8	461.1		1.4	42.4	0.6	
321	1752.2	1753.2	20.0	1653.0	1176.0		3.8	15.9	1.1	<---possible true absence of breath for this period
322	1754.2	1755.0	20.1	1245.0	856.6		2.0	30.1	0.9	
323	1755.8	1756.7	19.9	1868.0	1350.0		1.6	37.0	0.9	
324	1758.1	1759.3	19.9	1795.0	1267.0		2.3	25.9	1.2	

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
325	1760.4	1761.2	20.2	447.5	325.0		2.3	25.8	0.7	weak, modulated
326	1762.9	1764.1	20.1	548.5	403.0		2.5	23.8	1.2	weak, modulated
327	1765.5	1765.7	19.7	992.0	678.7		2.5	23.7	0.2	brief
328	1767.1	1768.0	20.1	863.2	513.1		1.6	37.5	1.0	mic click noise in background
329	1769.3	1770.1	19.9	642.0	461.8		2.2	27.1	0.9	voice audio in background
330	1771.8	1772.7	20.1	1739.0	1262.0		2.5	24.2	1.0	
331	1773.8	1774.9	19.9	1898.0	1326.0		2.0	30.0	1.2	
332	1776.1	1777.0	20.0	1432.0	977.7		2.3	25.7	0.9	
333	1778.4	1779.1	20.0	1349.0	949.9		2.3	26.3	0.8	
334	1780.9	1782.1	19.9	2155.0	1361.0		2.5	23.9	1.2	
335	1785.1	1786.0	20.2	1921.0	1390.0		4.3	14.1	0.8	<---possible true absence of breath for this period
336	1787.3	1788.2	19.9	1300.0	889.3		2.1	28.2	0.9	
337	1789.5	1790.7	20.0	1542.0	970.0		2.3	26.6	1.1	modulated [possible brief inhale at end?]
338	1791.8	1792.9	20.1	1107.0	742.2		2.3	26.6	1.1	modulated [possible brief inhale at end?]
339	1794.3	1795.5	20.2	1174.0	840.8		2.5	23.8	1.2	modulated
340	1796.6	1798.0	20.1	1510.0	1081.0		2.3	26.2	1.4	modulated
341	1799.2	1800.6	20.0	3563.0	2752.0		2.6	22.7	1.3	
342	1801.9	1803.3	20.3	2796.0	1843.0		2.7	22.2	1.4	modulated
343	1804.4	1805.4	20.0	3158.0	2321.0		2.4	24.8	1.1	
344	1806.4	1807.5	19.9	910.3	598.8		2.1	28.9	1.0	
345	1808.6	1809.5	20.1	1389.0	1023.0		2.1	27.9	0.9	
346	1810.5	1811.8	20.1	2362.0	1690.0		1.9	31.7	1.3	modulated
347	1813.6	1816.4	20.0	4335.0	3521.0		3.1	19.5	2.9	very loud, very long
348	1817.4	1817.5	19.8	1114.0	780.3		3.8	15.8	0.2	brief
349	1820.1	1822.4	20.7	3893.0	3068.0		2.8	21.8	2.3	preceded by speech, very loud very long
350	1823.5	1824.1	20.2	1384.0	960.9		3.4	17.6	0.6	modulated
351	1825.9	1826.1	20.2	1110.0	745.7		2.4	25.0	0.2	brief
352	1827.7	1829.0	19.8	3578.0	2701.0		1.8	34.0	1.3	preceded by speech, very loud, kinda long
353	1830.3	1830.9	20.2	1053.0	713.3		2.6	22.8	0.6	
354	1832.5	1832.7	18.8	1010.0	708.5		2.2	27.1	0.2	brief
355	1833.7	1834.0	20.6	657.4	465.2		1.2	51.2	0.3	brief
356	1835.1	1835.6	19.6	1799.0	1203.0		1.4	44.2	0.5	staccato (3)

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
357	1837.0	1837.6	19.7	1688.0	1152.0		1.9	31.4	0.6	loud voice in background - radio xmit
358	1839.1	1839.9	20.3	1295.0	931.0		2.2	27.7	0.8	loud voice in background - radio xmit
359	1841.7	1842.9	20.1	1124.0	791.9		2.6	23.3	1.2	
360	1844.5	1845.4	20.6	3771.0	2890.0		2.8	21.3	0.8	loud
361	1845.7	1847.0	20.2	3153.0	2286.0		1.2	51.2	1.3	loud
362	1848.0	1848.9	20.1	2133.0	1475.0		2.4	25.5	0.9	modulated
363	1850.3	1851.6	20.2	1142.0	799.9		2.2	27.0	1.4	modulated background voice noise
364	1852.7	1853.3	19.98	904.4	674.5		2.4	24.9	0.6	
365	1855.6	1857.8	20.1	3333.0	2507.0		2.9	20.7	2.2	loud background noise (briefly)
366	1858.9	1859.3	20.8	1068.0	808.4		3.3	18.3	0.4	background voice
367	1862.3	1863.8	20.7	3423.0	2666.0		3.4	17.7	1.5	preceded by speech
368	1872.0	1872.6	20.1	1328.0	963.4		9.7	6.2	0.6	
369	1873.6	1874.1	20.4	3575.0	2649.0		1.6	37.3	0.4	
370	1879.4	1880.6	20.2	3858.0	2939.0		5.8	10.3	1.2	preceded by speech
371	1881.3	1882.1	20.0	3026.0	2231.0		1.9	32.2	0.8	
372	1883.0	1883.6	20.4	3211.0	2394.0		1.7	35.3	0.6	
373	1885.3	1886.3	20.2	3591.0	2749.0		2.3	26.3	1.1	
374	1887.2	1888.2	20.1	2056.0	1364.0		1.9	31.5	1.0	modulated
375	1889.2	1889.9	20.3	2017.0	1365.0		2.0	30.3	0.7	staccato (2)
376	1891.0	1891.9	20.3	1515.0	1097.0		1.9	31.7	0.8	
377	1893.1	1894.0	20.2	1975.0	1464.0		2.0	29.3	0.9	
378	1894.9	1896.0	20.3	2039.0	1422.0		1.8	32.5	1.0	modulated/possible inhale at end]
379	1897.1	1898.0	20.0	2944.0	2218.0		2.2	27.8	0.9	
380	1899.0	1899.5	20.4	2758.0	1979.0		1.9	31.7	0.5	
381	1900.2	1900.6	19.0	2220.0	1516.0		1.2	51.7	0.4	preceded by speech
382	1901.5	1902.6	20.3	2718.0	2028.0		1.3	45.5	1.1	
383	1907.1	1907.5	24.0	3823.0	2892.0		5.7	10.6	0.3	preceded by speech
384	1908.1	1909.0	20.2	3546.0	2798.0		1.0	59.7	0.9	
385	1910.1	1911.0	20.3	3054.0	2326.0		2.0	30.0	0.8	
386	1912.2	1913.2	20.0	3346.0	2603.0		2.0	29.7	1.1	audio voice in background
387	1914.1	1914.9	19.6	2245.0	1625.0		2.0	30.7	0.8	
388	1916.0	1917.2	20.2	2472.0	1852.0		1.9	32.2	1.2	audio voice in background - loud xmit

	XWaves									
	Times					background noise 1250.8 to 1252.3 (baseline) mag is about 186				
	22K .sdFile - Redigitized lower level					several samples of speech (after 661) yielded mag between 2000 and 2500				
Breath	**Start**	**Stop**	**Mean**	**std dev**	**Mag**		**Delta T**	**BPM**	**duration**	**note/comment**
389	1918.1	1918.9	20.3	2190.0	1466.0		2.1	28.2	0.8	mic click in background
390	1919.9	1920.5	20.3	2065.0	1483.0		1.8	34.2	0.7	
391	1921.6	1922.6	20.2	2057.0	1340.0		1.7	34.5	1.0	modulated/possible inhale at end
392	1923.7	1924.5	20.1	2248.0	1684.0		2.1	28.7	0.8	
393	1925.5	1926.4	20.1	2970.0	2098.0		1.8	33.2	0.9	audio in background
394	1927.3	1928.3	20.2	3133.0	2404.0		1.8	33.4	1.0	
395	1929.1	1930.2	20.2	2477.0	1817.0		1.9	32.2	1.1	modulated
396	1931.1	1932.0	20.0	3535.0	2716.0		2.0	30.7	0.9	
397	1932.9	1933.9	20.3	3280.0	2532.0		1.8	32.5	0.9	
398	1934.7	1935.8	20.0	3304.0	2520.0		1.8	33.2	1.0	
							avg	28.6	all	
							avg	31.7	1911 to 1936	
				Magnitude			avg	37.0	891 to 921	
				min	264.0		avg	25.3	1237 to 1268	
				max	3644.0		avg	28.6	1610 to 1642	
				avg	1400.2		avg	28.1	1722 1753	
	0.1		16.0	10 or less				16	<=10	
	2.9		45.0	10<BPM<=20				61	<=20	
	0.8		213.0	20<BPM<=30				274	<=30	
			64.0	30<BPM<=40				338	<=40	
			42.0	40 or greater				42	>=40	
								11	>=60	
								380	tot	