



WESTERN ELECTRO - ACOUSTIC LABORATORY

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TESTING • CALIBRATION • RESEARCH

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Acoustical Test Report S09-102

SOUND PRESSURE LEVEL MEASUREMENTS

on

Bunnell Model #312 Patient Boxes

27 July 2009

**Prepared for
Bunnell Inc.**

**436 Lawndale Drive
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By

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WEAL Project Number: 9100-046

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A handwritten signature in blue ink that reads "Gary E. Mange". The signature is written over a horizontal line.



NVLAP LAB CODE 100256-0

1.0 INTRODUCTION

Western Electro-Acoustic Laboratory (WEAL) conducted a series of sound measurements on the Bunnell Model #312 Patient Boxes. Two different patient boxes, labeled Patient Box #1 and Patient Box #2 which had been modified for noise reduction, were measured. A single patient box driver was used to power each patient box. The measurements were conducted on 24 July 2009.

The patient box under test was placed on a 12 inch by 12 inch (305 mm x 305 mm) table top which was 1 meter (39.4 inches) above the floor grating. The device under test was placed on a small 1/4 inch (6.4 mm) thick neoprene pad to isolate it from the table top.



Bunnell device inside anechoic chamber

2.0 TEST SITE

The measurements were conducted in the WEAL Anechoic Chamber. The dimensions of the chamber are 19.5 feet (5.94 m) by 19 feet (5.79 m) wedge tip to wedge tip and a height of 15 feet (4.57 m) height above the floor grating. The A-weighted background sound levels in the WEAL anechoic chamber were 19 - 22 dBA on the day of the test.

3.0 TEST SAMPLE DESCRIPTION

The devices that were measured were two versions of the Bunnell Model #312 Patient Boxes. A patient box driver was used to power a patient box. The patient box was fitted with a loop of tubing for test purposes. The loop of tubing had a small section on Santoprene material which was placed in the head of the patient box under test.

4.0 TEST EQUIPMENT

The following table lists the equipment used to perform the tests.

Item	Serial Number	Last Calibration
Bruel & Kjaer 4165 Microphone	732091	1/09
Larson Davis PRM902 Microphone Pre-amplifier	0411	5/09
Larson Davis 2200C PreAmp Power Supply	0828	5/09
Frequency Devices 9002 Anti-aliasing filter	167	5/09
National Instruments PCI-MIO-16E-4 multi-function board	C4EADD	-----
Bruel & Kjaer 4230 Calibrator	1169344	2/09

5.0 TEST PROCEDURE

Measurements were conducted with the microphone located perpendicular from the front, left, rear, right, and top of the device under test. ISO standards (e.g. ISO 3744) recommend a measurement distance of 1 meter and measurements were conducted at that distance. Previous measurements had been made at a distance of 1 foot so measurements were also conducted at that distance for comparison purposes.

The measurements consisted of 1/3 octave band L_{eq} averages and A-weighted L_{eq} averages over a 20 second period. In addition, the instantaneous A-weighted fast sound level was recorded each 0.1 seconds during the 20 second averaging period. The maximum occurring A-weighted fast sound level is reported.

The patient box under test was set up on the test table and the tubing loop installed. The device was turned on and allowed to run for several minutes before measurements commenced.

6.0 TEST RESULTS

At the time of the test the temperature ranged from 77.9 to 78.5 degrees F (25.5 to 25.8 degrees C), the relative humidity ranged from 38 to 39 percent, and the atmospheric pressure ranged was 28.28 inches of mercury.

The background sound levels were measured several times during the course of the measurements. The appropriate background levels were used to adjust the measured levels for the device under test. This was only necessary in the 8000 Hz and 10000 Hz bands and the adjustment was never allowed to be more than 2 dB. The A-weighted levels did not need adjustment.

Table 1 presents the A-weighted L_{eq} averages over the 20 second measurement period as well as the maximum occurring A-weighted fast sound level for Patient Box #1.

Table 1. 20 Second Average and Maximum Occurring A-weighted Sound Pressure Levels for Patient Box #1

	1 foot		1 meter	
	Average A-weight	Maximum A-weight	Average A-weight	Maximum A-weight
Front	57.1	59.0	46.6	48.6
Left	55.7	57.6	45.1	46.9
Rear	55.1	57.0	44.6	46.5
Right	55.7	57.6	46.1	48.0
Top	58.7	60.6	49.2	51.1

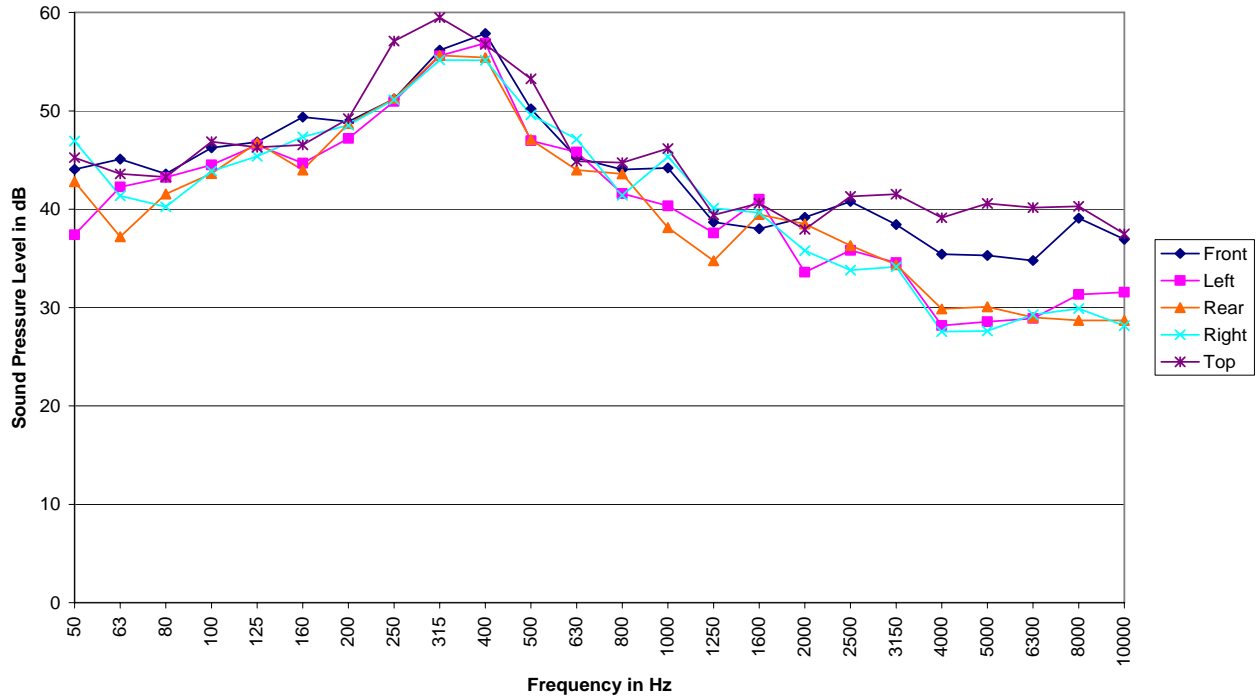
Table 2 presents the A-weighted L_{eq} averages over the 20 second measurement period as well as the maximum occurring A-weighted fast sound level for Patient Box #2.

Table 2. 20 Second Average and Maximum Occurring A-weighted Sound Pressure Levels for Patient Box #2

	1 foot		1 meter	
	Average A-weight	Maximum A-weight	Average A-weight	Maximum A-weight
Front	42.3	43.8	31.8	33.5
Left	40.1	41.5	30.3	32.0
Rear	40.3	41.7	30.2	31.9
Right	40.4	41.8	30.7	32.3
Top	43.8	45.6	35.3	36.9

The following figures show the 1/3 octave band levels for each of the surfaces for patient box #1 and patient box #2. These band levels are L_{eq} averages over the 20 second measurement period.

**Figure 1. Patient Box 1
SPL at 1 foot**



**Figure 2. Patient Box 2
SPL at 1 foot**

