

Johns Manville Technical Center Acoustical Laboratories

Contract Report 500-2350 (A2003-091)

May 1, 2003

Subject:

Sound Power Measurements of a Nightstar® Flashlight

For:

**Applied Innovative Technologies, Inc.
1310 Factory Circle
Fort Lupton, CO 80621**

Submitted by:

**Johns Manville Technical Center
P. O. Box 625005
Littleton, CO 80162-5005**

Reported By:

This electronic copy of this report is provided as a courtesy by the issuing laboratory for reference and informational purposes only.

**Parker Stone
Research Engineer
Acoustical Research & Testing
JMTC Materials Performance Technology**

Approved By:

To be officially valid, this document MUST contain all the signatures indicated on this page.

**Francis Babin
Manager
Physical Properties Research & Testing
JMTC Materials Performance Technology**

NOTE: THE CONTENT OF THIS REPORT RELATES ONLY TO THE ITEMS TESTED AND THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE PRIOR CONSENT OF THE ISSUING LABORATORY. USE OF THIS REPORT TO CLAIM PRODUCT ENDORSEMENT BY NVLAP OR ANY AGENCY OF THE U.S. GOVERNMENT IS PROHIBITED.

Accredited by Department of Commerce, National Voluntary Laboratory Accreditation Program for Selected Test Methods for Acoustics.

INTRODUCTION

A series of measurements were made on April 11, 2003 at the Johns Manville Technical Center (JMTC) Acoustical Laboratories to determine the sound power levels emitted by a Nightstar® Flashlight, provided by Applied Innovative Technologies, Inc. Measurements were made in full accordance with the requirements of current ANSI standard test method S12.31-1990.

TEST SPECIMENS

The specimen submitted for testing was delivered on March 14, 2003. The three test configurations of the flashlight are described as follows:

- A2003-091-1: Nightstar® Flashlight recharged “horizontally”. The flashlight was shaken left to right with a frequency of approximately 2 Hz by a person with the flashlight’s long dimension parallel to the reverberation room floor.
- A2003-091-2: Nightstar® Flashlight recharged “vertically”. The flashlight was shaken up and down with a frequency of approximately 2 Hz by a person with the flashlight’s long dimension perpendicular to the reverberation room floor.
- A2003-091-3: Nightstar® Flashlight shaken “side-to-side” to simulate a person running with the light. The flashlight was shaken left to right with a frequency of approximately 3 Hz by a person with the flashlight’s long dimension perpendicular to the reverberation room floor.

TEST METHOD

The sound power tests were conducted in full accordance with the American National Standards Institute (ANSI) method S12.31-1990, "Precision Methods for the Determination of Sound Power Levels of Broad-band Noise Sources in Reverberation Rooms". Calculations were conducted in accordance with section 7.3 of the standard, the “Comparison Method”.

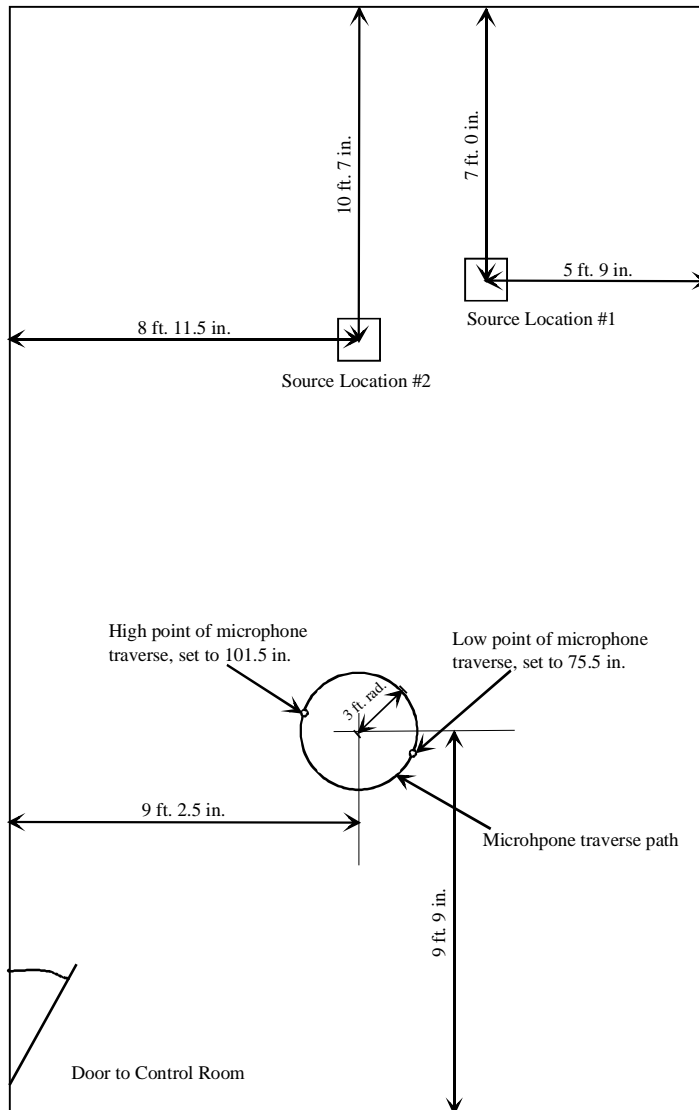
ANSI S12.31-1990, section 7.3

The specimens were tested by comparing sound pressure levels (SPLs) produced in the JMTC large reverberation room by a reference sound source and the test specimen. The locations of the sound source measurements and of the microphone traverse pattern are shown below in Figure 1.

NOTE: THE CONTENT OF THIS REPORT RELATES ONLY TO THE ITEMS TESTED AND THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE PRIOR CONSENT OF THE ISSUING LABORATORY. USE OF THIS REPORT TO CLAIM PRODUCT ENDORSEMENT BY NVLAP OR ANY AGENCY OF THE U.S. GOVERNMENT IS PROHIBITED.

Accredited by Department of Commerce, National Voluntary Laboratory Accreditation Program for Selected Test Methods for Acoustics.

Figure 1. Microphone and Source Locations in the JMTC Acoustics Lab Large Reverberation Room for an ANSI S12.31-1990 Sound Power Measurement by the Comparison Method



Background levels were first measured, and then SPLs were measured with the reference sound source and test specimens at each source location. Measured SPLs at each location were then averaged and the averaged values were used in the sound power calculations. All sound pressure levels were measured in decibels, re: 20 μPa , and all sound power levels were calculated in decibels, re: 1 pW.

NOTE: THE CONTENT OF THIS REPORT RELATES ONLY TO THE ITEMS TESTED AND THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE PRIOR CONSENT OF THE ISSUING LABORATORY. USE OF THIS REPORT TO CLAIM PRODUCT ENDORSEMENT BY NVLAP OR ANY AGENCY OF THE U.S. GOVERNMENT IS PROHIBITED.

Accredited by Department of Commerce, National Voluntary Laboratory Accreditation Program for Selected Test Methods for Acoustics.

Test Chambers

The JMTC reverberation rooms are constructed of 305 mm [12 inch] thick, reinforced concrete, surrounded by 203 mm [8 inch] thick solid concrete block walls which are spaced from the reinforced concrete walls a distance of 203 mm [8 inches]. The large reverberation room has interior dimensions of 8.66 m [28 feet-5 inches] in length by 5.49 m [18 feet] in width with a height of 6.71 m [22 feet], for a total volume of 319 cubic meters [11,253 cubic feet].

Instrumentation

All sound pressure levels were measured using a Brüel and Kjær ½ in. type 4165 condenser microphone operating on a Brüel and Kjær type 3923 rotating microphone boom. The microphone was calibrated immediately before all measurements were started using a Brüel and Kjær type 4220 pistonphone with output corrected for local barometric pressure.

The microphone was connected to a Norwegian Electronics type NE-830 digital frequency analyzer, which was configured to linearly average the microphone output over a sampling period of 64 seconds. Measurements were made at the third-octave bands covering a center frequency range from 100 Hz to 10,000 Hz.

TEST RESULTS

The detailed results of the test, including third-octave-band emitted sound power levels (L_w) and A-weighted sound power levels (L_{WA}) are shown in Table 1 on page 5. Test data sheets of the specimens' performance, as printed by the test equipment, are kept on record within the laboratory.

NOTE: THE CONTENT OF THIS REPORT RELATES ONLY TO THE ITEMS TESTED AND THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE PRIOR CONSENT OF THE ISSUING LABORATORY. USE OF THIS REPORT TO CLAIM PRODUCT ENDORSEMENT BY NVLAP OR ANY AGENCY OF THE U.S. GOVERNMENT IS PROHIBITED.

Accredited by Department of Commerce, National Voluntary Laboratory Accreditation Program for Selected Test Methods for Acoustics.

Table 1: Emitted Sound Power Levels of a Nightstar® Flashlight

Frequency (Hz)	Emitted Sound Power Levels, L_W (dB re: 1 pW)		
	A2003-091-1	A2003-091-2	A2003-091-3
100	45.2*	45.0*	45.4*
125	50.5*	50.6*	51.1*
160	37.8*	38.1*	37.6*
200	39.4	39.7	39.8
250	42.2*	42.2*	41.9*
315	38.8	38.9	38.8
400	42.3	44.1	41.9
500	46.4	50.2	44.5
630	46.3	50.3	51.0
800	52.9	54.6	56.8
1000	49.7	53.1	57.8
1250	51.0	55.9	51.7
1600	57.4	59.5	57.5
2000	57.7	56.2	58.7
2500	49.5	50.7	51.3
3150	47.7	49.8	52.7
4000	46.3	49.5	49.7
5000	48.4	52.5	50.6
6300	43.5	48.6	47.3
8000	37.6	43.4	41.8
10000	33.3	38.9	38.1
Overall A-Weighted Sound Power Levels, L_{WA} (dB re: 1 pW)	63.6*	65.3*	65.7*

** Specimen Sound Pressure Level is less than 6 dB above Background. The calculated sound power level should only be considered an upper limit estimate of the true sound power emitted by the specimen in the effected bands.*

NOTE: THE CONTENT OF THIS REPORT RELATES ONLY TO THE ITEMS TESTED AND THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE PRIOR CONSENT OF THE ISSUING LABORATORY. USE OF THIS REPORT TO CLAIM PRODUCT ENDORSEMENT BY NVLAP OR ANY AGENCY OF THE U.S. GOVERNMENT IS PROHIBITED.

Accredited by Department of Commerce, National Voluntary Laboratory Accreditation Program for Selected Test Methods for Acoustics.