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APPLICATION NOTE 2015

Sales & Application
DEWESoft Slovenia

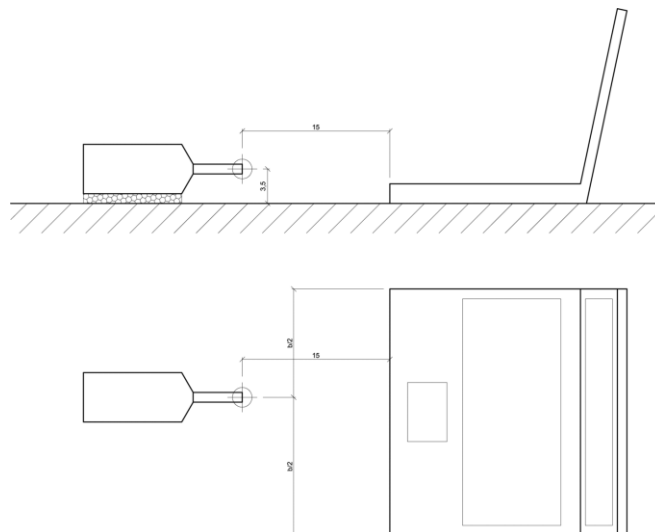
Abstract: This application note shows a measurement with DEWESoft sound power measurement system and [GRAS 67HA Hemisphere](#). The object under test was a standard notebook, the measurement was done according to ISO 3744 in a semi-anechoic chamber.1101

Key-Words: sound power, sound level, microphone, ISO 3744, hemisphere

1. INTRODUCTION

Test Criteria - Noise Emission

We use a **noise level gauge** (Voltcraft SL-300 or similar) and a standard test setup to measure the emissions of a test model. The gauge is fixed 15 cm from the notebook and is secured against vibrations emanating from the test model. The measurements are taken in **dB(A) (Decibel)**.



The following are our test categories:

- **Idle**
 - Minimum:* minimum noise emission while laptop is idle (Windows power plan: "Energy Saving")
 - Medium:* Average noise emission recorded while laptop is idle (Power Plan: "Energy Saving")
 - Maximum:* Highest noise emission measured while the laptop is idle (Power Plan: "High Performance")
- **High System Use**
 - Medium:* Average noise emission while the computer is running at high level of system use. (3D Mark 2006, Power plan: Power Plan: "High Performance")
 - Maximum:* Highest possible noise emission while the system is under heavy load (Power Plan: "High Performance", 100% CPU and GPU usage - thanks to Prime95 and Furmark)

The following may help the reader better understand the results:



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In a quiet room, the human ear can hear background noise, which should amount to around 28 dB. A conversation at a normal volume ranges at 60 dB. All these values are dependent on the distance from the source of the noise. This is why we fix our gauge into place at a constant distance from our test models. This allows us to get clear results which can be compared with each other. The measurements are presented graphically and can be judged subjectively:

- **Under 30 dB:** barely audible
- **Up to 35 dB:** audible but not distracting. Ideal level of noise emission for a laptop running office programs.
- **Up to 40 dB:** clearly audible, and might be distracting after a while
- **Up to 45 dB:** might disturb the user if s/he is in a quiet room. Still acceptable while playing games.
- **Over 50 dB:** notebook emissions over this level are uncomfortably loud

2. MEASUREMENT SETUP

2.1 Used equipment

- Data acquisition system
 - SIRIUSi-HD-ACC, USB-based 16 channel IEPE/Voltage unit
- Sensors and transducers
 - 10 microphones GRAS Type 26CA (scaling: -40/-55 mV/Pa)
- GRAS 67HA 1m CCP hemisphere kit (diagonal: 2716 mm, height: 1283 mm)
- 10 BNC cables (10 meters)

2.2 Used software

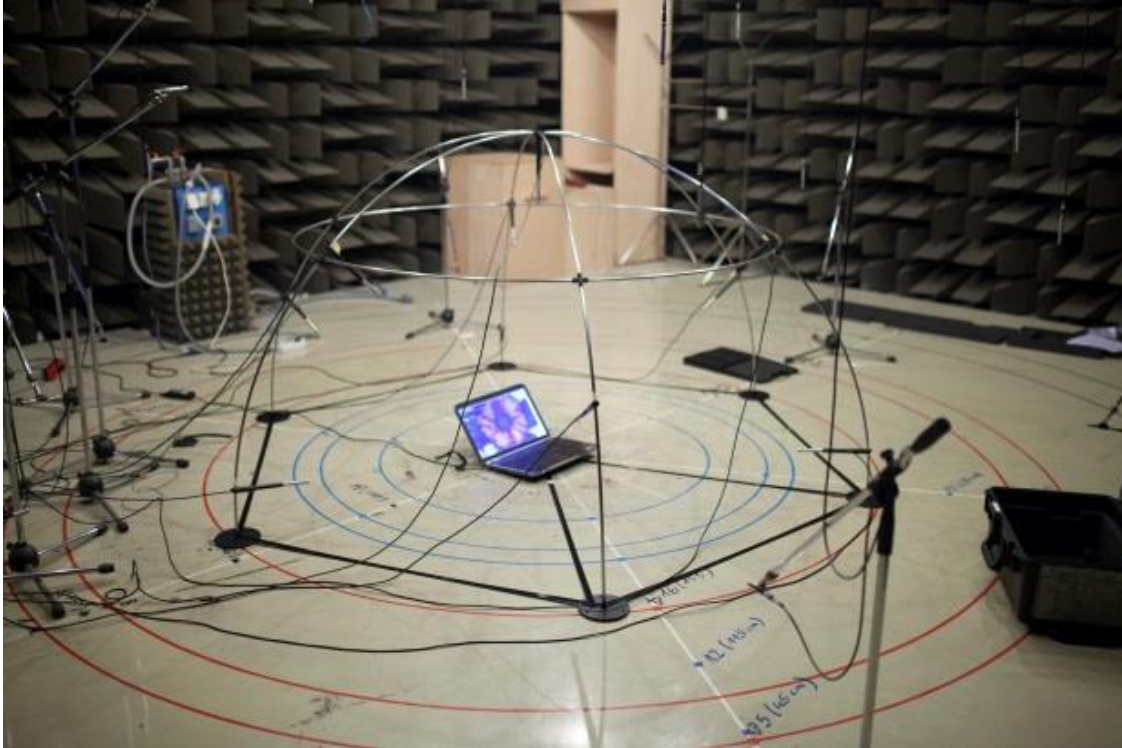
- DEWESoft X2
 - DSA package
 - Sound Power plugin



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2.3 Photos of setup





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2.4 Hemisphere kit setup

We used the hemisphere kit from GRAS with 10 microphones and a radius of 1.36 meters. The distance from the sound source to the microphones was 1 meter. The grid is very simple to assemble if you follow the attached instruction manual. It took us approximately 30 minutes to prepare everything.

First we had to put together the metal sticks and attached them together, to get a nice hemisphere structure. The next step was to put the microphones in the right positions according to the standards. The grid supports 10 or 20 microphones, so we had to select the right position for microphone mounting. The positions had to be the same as in standards and they are already predefined with small screws of different colors. We used 10 BNC cables that were 10 meters long, so that measurement equipment was outside of the semi-anechoic room. This is very important for reducing background noise to minimum. Microphones had TEDS chip, and were calibrated in the factory. The whole data acquisition process took us approximately 10 minutes. We measured laptop in three different states and the minimum measurement time for one measurement is 20 seconds (according to standard).

2.5 Sound Power setup

The according setup was chosen from the dropdown menu (ISO 3744, hemisphere), 10 microphones are mounted around the sound source in 1m radius, in the table you see the exact positions (x, y, z). Barometric pressure was measured and entered, the K1 (background measurement) correction method was additionally selected.

The screenshot shows the DEWESoft X - Datafile software interface. The main window is titled "DEWESoft X - Datafile" and has a menu bar with "Data files", "Setup", "Review", "Print", and "Export". Below the menu bar is a toolbar with icons for "Channels", "Events", "Math", "Sound level", "Sound power", "More...", and "Remove".

The interface is divided into several sections:

- Basic:** ISO Standard (ISO 3744), Microphone positions (Hemisphere), Device type/size (Normal), Number of positions (10).
- Microphone setup:** Microphone positions table.
- Octave settings:** Octave (cpb) type (1/3).
- Bandwidth:** Lower mid-band freq. (100 [Hz]), Upper mid-band freq. (10000 [Hz]).
- Spl weighting:** A weighting (selected).
- Measurement time:** Averaging duration (20 [sec]).
- Repeatability:** Show history channels (Lw and Lw-avg) (checked).
- Correction methods:** C1 correction (not used), C2 correction (not used), K1 method (checked), K2 method (not used).
- Temperature:** 23 [°C], 101,325 [kPa], 0 [m].
- Room dimensions:** Room height (5 [m]), Room width (5 [m]), Room depth (5 [m]).
- Mean absorption grade:** 0,5 (ISO 3745).

The "Microphone positions" table is as follows:

ID	Channel	X [m]	Y [m]	Z [m]	Group
1	Microphone 1	-0,99	0,00	0,15	Group A
2	Microphone 2	0,50	-0,86	0,15	Group A
3	Microphone 3	0,50	0,86	0,15	Group A
4	Microphone 4	-0,45	0,77	0,45	Group A
5	Microphone 5	-0,45	-0,77	0,45	Group A
6	Microphone 6	0,89	0,00	0,45	Group A
7	Microphone 7	0,33	0,57	0,75	Group A
8	Microphone 8	-0,66	0,00	0,75	Group A
9	Microphone 9	0,33	-0,57	0,75	Group A
10	Microphone 10	0,00	0,00	1,00	Group A

The "Geometry" section shows a diagram of a hemisphere with 10 microphone positions marked. The radius (r) is 1 meter. The diagram includes labels for various distances and positions relative to the center and the sound source.

The "Surface correction factor" section shows: $L_s = 7,981799$ [dB] (Surface = 6,283185 [m²]).

The "Geometry distances" section shows: Radius (r) 1 [m].



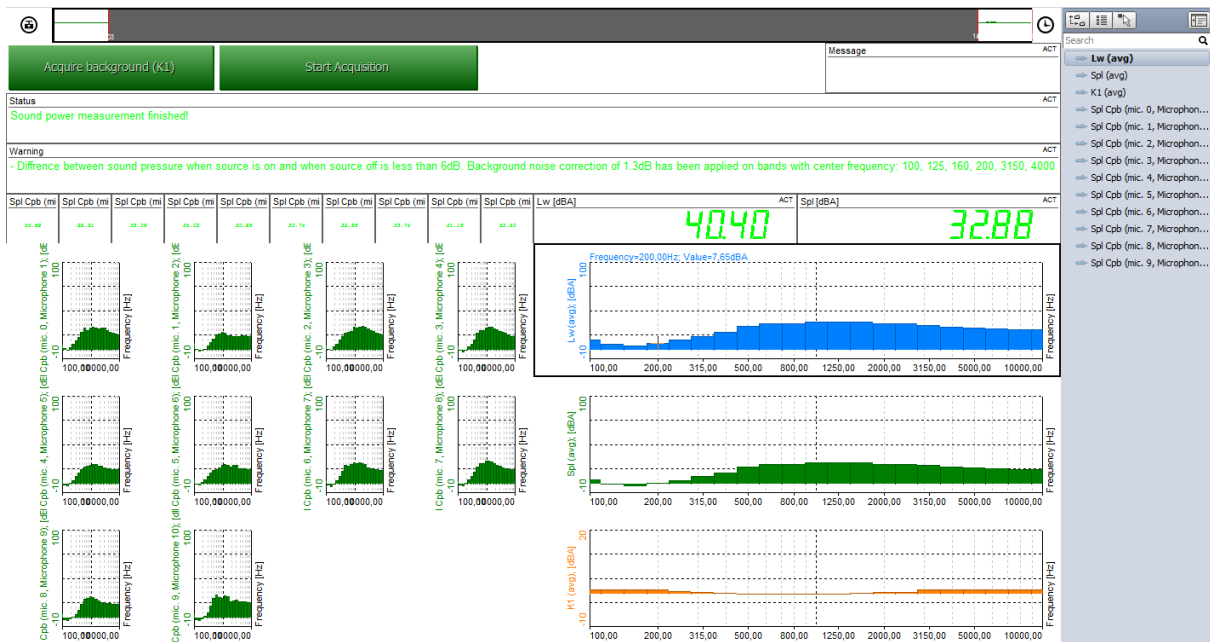
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2.6 Measurement screen

The SoundPower-Plugin in DEWESoft guides us through the procedure. At first the background noise measurement is done, with sound source (laptop) switched off. Then the laptop is switched on, configured to “idle mode” or “high system use”, and the measurement is performed. According to the standard data has to be collected for at least 20 seconds for each step. The green action buttons allow interaction (Acquire background, start acquisition).

The text boxes below show status messages and warnings.



On the left side there are the 10 octave plots of all microphones, on the right you see the three graphs of the result: on top, most important: Sound Power, followed by Sound Level and the correction data.

3. RESULTS AND REPORT

The noise levels of the 17-inch notebook are very good. It is always audible because the fan never stops spinning. The noise is very low during **idle** at **32 db(A)**. In this scenario, the fan speed is more or less constant and therefore very convenient for office use. The **hard drive** can be a bit disturbing with the clatter of the read/write heads, we measured **37.6 db (A)** during high activity.

When we demand the **highest performance** of the 17R, the noise rises up to **40.4 db (A)** (stress test CPU+GPU-FurMark). When we just play a game or run 3DMark 2006, we measured a moderate **36.4 db (A)**. In these cases the speed of the fan is also **constant** and there is no annoying pulsating.



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measurement innovation

SOUND POWER LEVEL REPORT

Project number:	000002
Project description:	SPL of laptop with power supply
Date of measurement:	14.7.2015
Company:	Dewesoft d.o.o.
Report version:	1.0

Standard:	ISO 3744
Location of measurement:	
Responsible person:	Dewesoft

Machine type:	Laptop
Machine description:	
Length [m]:	0.27
Width [m]:	0.028
Height [m]:	0.41
Fan speed [RPM]:	3963,00
Additional information:	Laptop was running under performance test FurMark 1.16.0.0 (same as in Appendix A)

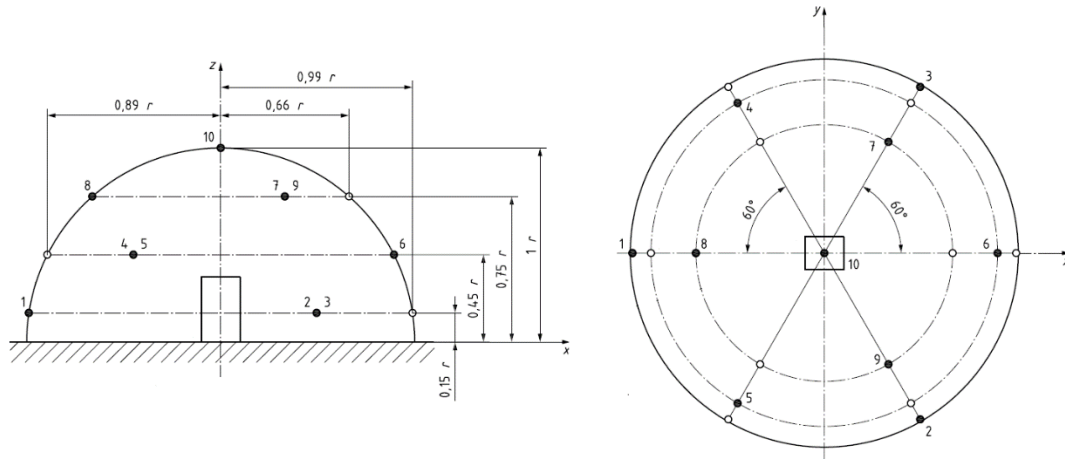
High-precision sound power meter:	Dewesoft
Measuring amplifiers:	Sirius ACC
Hemisphere:	GRAS (1 m)
Microphones:	GRAS
Data recording and analysis software:	DEWESoft X2 SP3
Calibrator:	GRAS calibrator



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Microphone position:	hemisphere
Radius [m]:	1
Number of microphones:	10
Type of room:	semi-anechoic



Weather:	sunny
Temperature [°C]:	22
Pressure [kPa]:	1000
Relative humidity [%]:	45

Measurement duration [s]:	20
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K1 [dB]:	1,30
K2 [dB]:	0,00

Sound Power Level [dB(A)]:	40,4
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Frequency [Hz]	Lw (avg) [dBA]
100	11,4
125	6,14
160	4,81
200	7,65
250	11,18
315	15,58
400	20,47
500	26,84
630	30,07
800	29,52
1000	31,89
1250	32,22



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1600	31,56
2000	29,73
2500	29,51
3150	27,51
4000	25,69
5000	24,95
6300	23,99
8000	23,28
10000	22,7

