

Possible error measuring sound pressure level at an operator position in a closed cabin.

Ing. Michiel van Eeden

Technisch bureau van Eeden 's-Hertogenbosch

Summary

In a small operator cabin a microphone displacement of 9 cm can cause difference in the measured sound pressure level at these positions as large as 6 dB.

Two cases are described: in case 1 the error caused by neglecting the load on a suspended chair is investigated, in case 2 the microphone positions chosen, one for a small, and one for a large operator, both comply ISO11201.

It is suggested that ISO 11200 standards at least contain a instruction to be very careful choosing a microphone position in (small) cabins. Some spatial averaging maybe necessary.

Case 1

Description

Measurements are made in a container mounted winch, typically used for drilling platforms (off shore). The cabin, which offers place to a seated operator, is positioned in the centre of the container, between a power compartment and the winch compartment. Noise sources are a large electromotor, hydraulic pump, hydraulic motor(s) and planetary reduction.

The seat is a suspension type. The cabin is finished with acoustic absorption as much as possible.



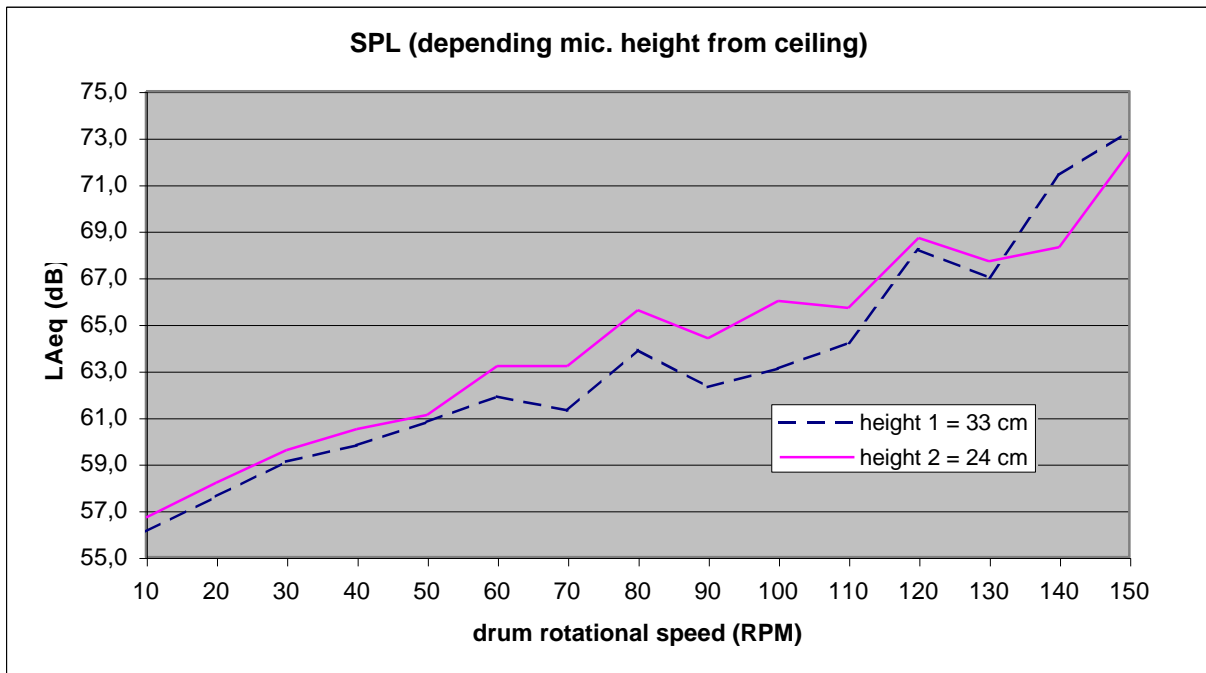
Measurement procedure

Increasing the winch (drum) speed in steps of 10 RPM, from 10 to 150 RPM, the sound pressure level is measured at two different heights at each step. The microphone can quickly be shifted between the two positions. After setting a winch speed, the measurements at the two different heights are made without changing the speed.

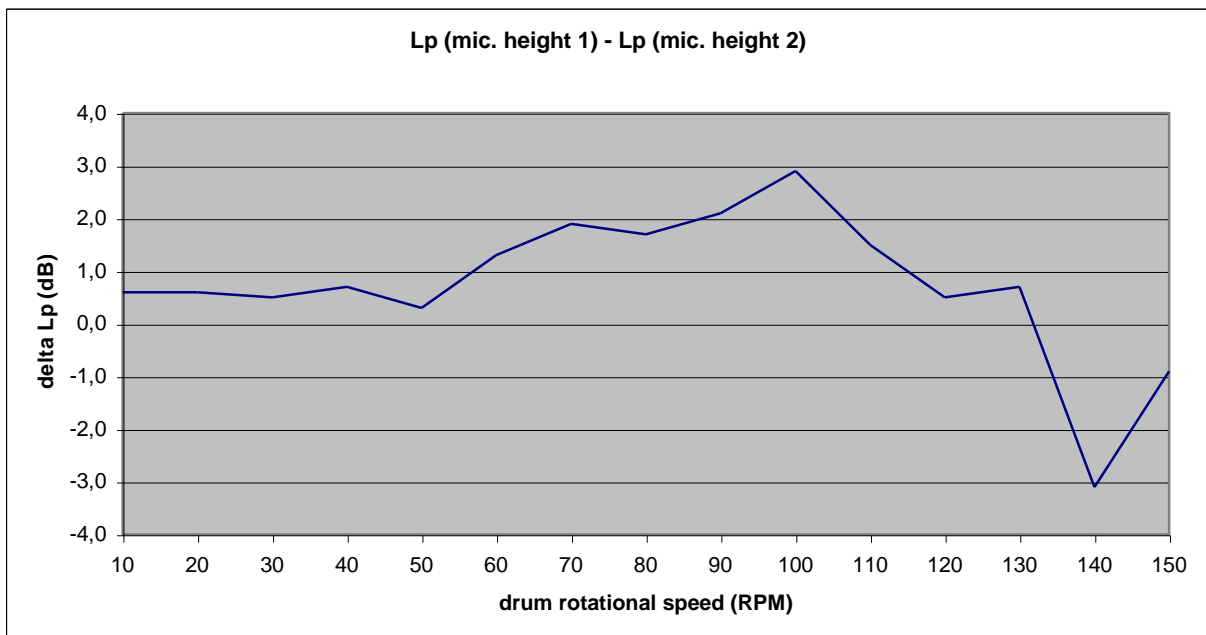
The microphone height is measured with reference to the ceiling. The upper one, 24 cm from the ceiling corresponds to 80 cm above the seating plane of the unloaded chair, the lower one, 33 cm from the ceiling, corresponds approximately to 80 cm above the seating plane of the loaded chair.



Results



Equivalent A-weighted sound pressure level at operator position, 80 cm above the seating plane of the unloaded chair (height 2) and approximately 80 cm above the seating plane of the loaded chair (height 1).



Difference in the sound pressure level at the different heights.

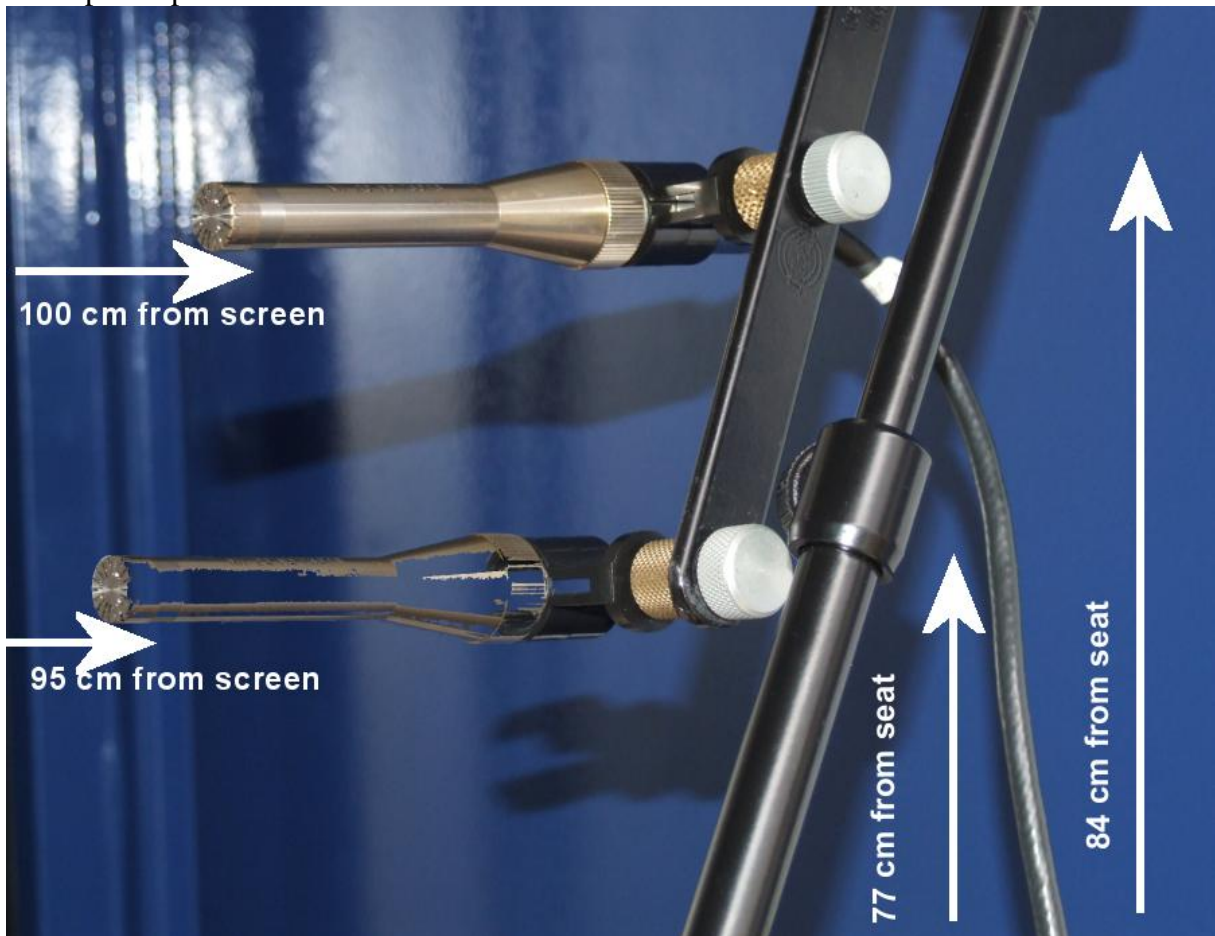
Case 2

The situation is comparable with the latter except for:

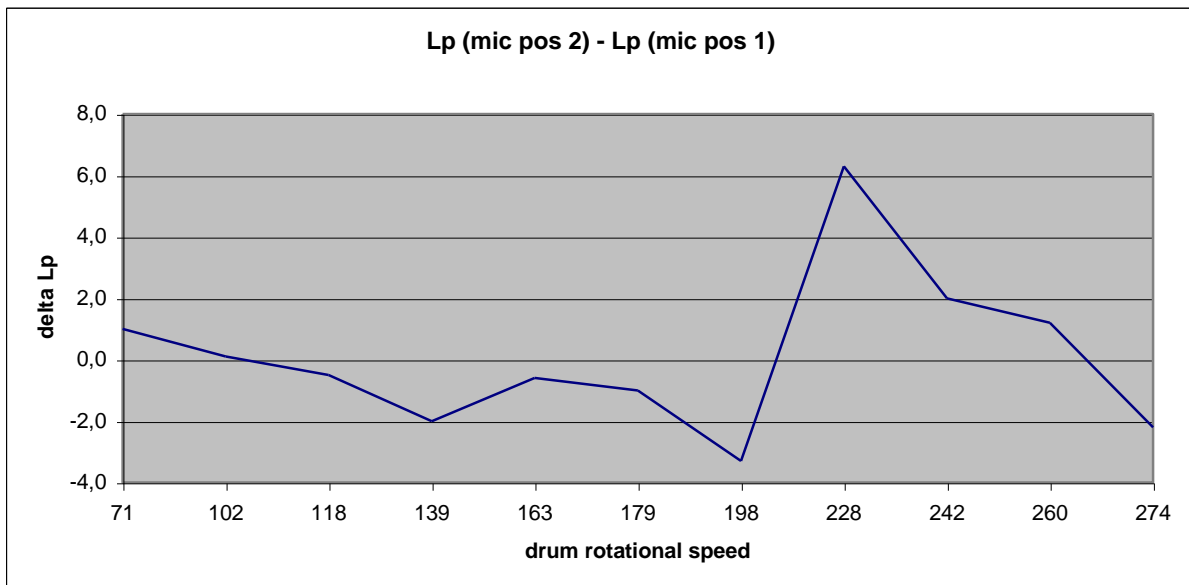
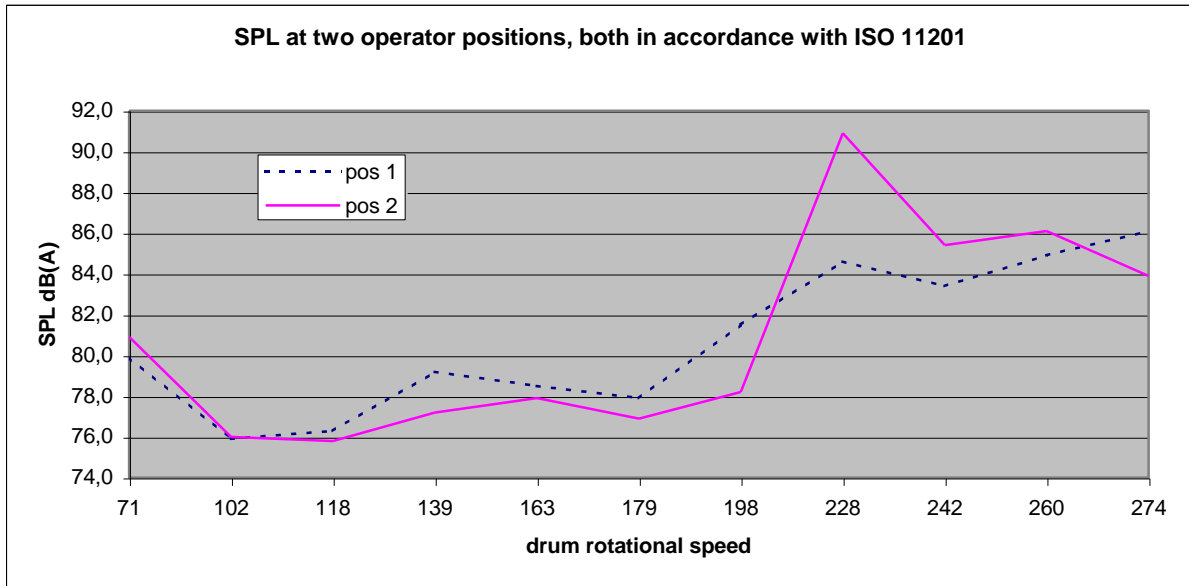
- The cabin is smaller and only the ceiling is equipped with absorbing material;
- The chair position in the cabin is lower than in case 1, thus the distance from the ceiling is larger;
- The 2 microphone positions vary in x and z direction (ISO2631), with $z_{\text{minimum}} = 77$ cm and $z_{\text{maximum}} = 84$ cm, both complying ISO11201. If these values of z are considered as valid for a small and an large person, the values for x chosen approximately follow this.

The distance between the two positions is 9 cm.

Microphone positions case 2:



Results case 2:



Remark: rotational speeds are chosen depending on the ease of adjustment thereof. No effort is made to adjust for maximum difference in SPL between the two microphone positions.

Instrumentation:

RION NA-27 Precision sound level meter, serialnr 570363

Microphone: UC-53 serialnr 75721

Traceable calibration: December 13th 2005

Calibrator: Norsonic 1251 serialnr: 22857

Traceable calibration: December 20th 2006

Date of investigation:

Case 1: February 23rd 2007

Case 2: March 14th 2007