

# WORKSHOP

SOUND POWER LEVEL  
by an intensity probe



The measurements were carried out in an acoustic chamber with absorbing walls and reflecting floor.

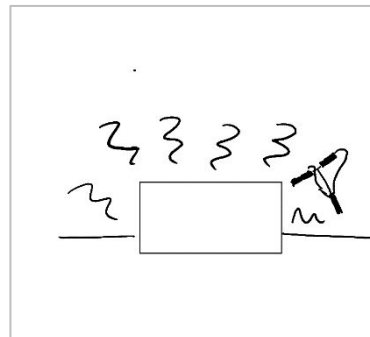
The participants were confronted by the task to measure the Sound Power Level of an ordinary vacuum cleaner by the intensity probe, although in two configurations:

- I. Without any additional sound sources
- II. With a reference source with white noise in a 2 m distance from the main sound source.

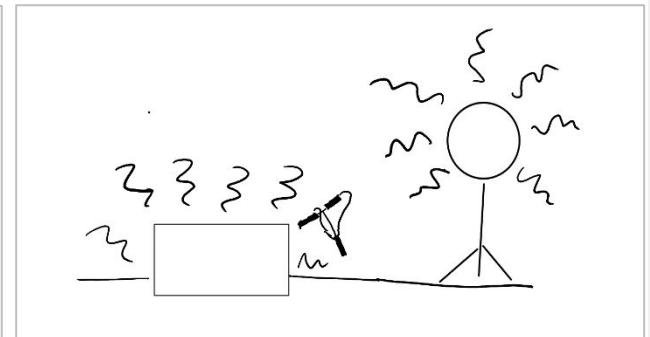


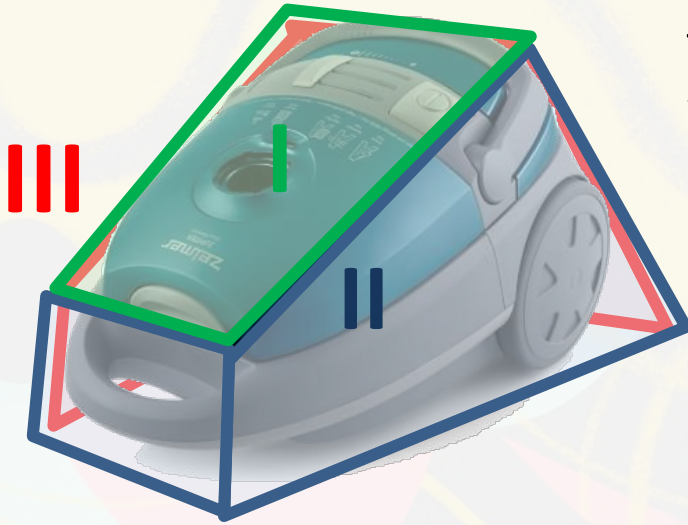
Sound intensity probe (taken from:  
<https://www.gras.dk/products/special-microphone/intensity-probes/product/709-50ai-l>)

I



II





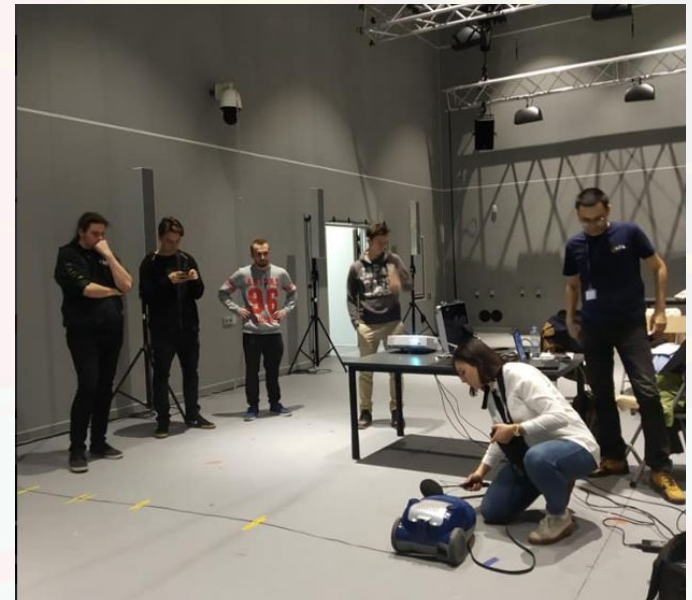
The sound source was divided into the 3 surfaces, with areas equal to:

I	0,29 m <sup>2</sup>
II	0,28 m <sup>2</sup>
III	0,34 m <sup>2</sup>

Each one was then scanned by the sound intensity probe in two perpendicular directions.

The next steps towards the final results consisted of:  
 1) averaging the results, 2) calculating the acoustic power on every surface with regard to its area and  
 3) summing up power level for whole device.

To check the influence of the additional source, one have to compare the results of Sound Intensity Level and Sound Pressure Level. That is because the sound intensity measurements should be insensitive to additional noise sources.





# Test results – Case I

To make room for additional test (described later), the Sound Power Level for the case I was measured inly once by the team I. The results are as follows:

	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3150 Hz	4000 Hz	5000 Hz	6300 Hz	8000 Hz	10000 Hz	12500 Hz
	SOUND INTENSITY LEVEL [dB]																									
TEAM I	24	24	25	26	47	35	40	59	54	63	69	60	63	65	66	65	66	67	66	69	68	63	65	58	0	0
	SOUND PRESSURE LEVEL [dB]																									
TEAM I	14	17	20	27	51	38	42	61	55	65	71	62	65	68	68	67	69	69	68	73	71	68	74	68	64	67



LW[dB]
SOUND INTENSITY LEVEL [dB]
77,7
SOUND PRESSURE LEVEL [dB]
81,6

# Test results – Case II

The results with an additional source are as follows:

	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3150 Hz	4000 Hz	5000 Hz	6300 Hz	8000 Hz	10000 Hz	12500 Hz
	SOUND INTENSITY LEVEL [dB]																									
TEAM I	51	52	54	54	56	56	56	57	55	58	67	60	62	63	65	64	66	67	66	68	67	63	64	56	0	0
TEAM II	45	46	49	48	51	47	44	57	54	60	68	60	62	65	66	65	65	68	67	67	70	64	63	70	0	0
TEAM III	60	59	63	62	64	61	60	60	64	67	68	68	65	67	67	66	65	69	68	67	71	66	62	68	0	0
TEAM IV	38	42	46	49	51	48	44	54	55	60	67	61	62	64	65	64	64	66	66	68	66	62	67	53	0	0
	SOUND PRESSURE LEVEL [dB]																									
TEAM I	42	45	49	51	55	57	60	62	65	68	72	69	68	70	70	70	71	72	72	73	71	69	74	68	64	67
TEAM II	35	39	44	44	53	50	55	60	62	68	72	67	66	69	69	69	69	72	72	71	73	70	74	82	65	65
TEAM III	50	54	57	59	62	64	66	68	70	72	75	73	73	74	74	72	74	77	77	74	77	75	75	82	71	69
TEAM IV	31	36	41	45	53	52	56	59	63	68	71	67	66	69	69	69	68	70	72	73	70	68	77	66	64	69

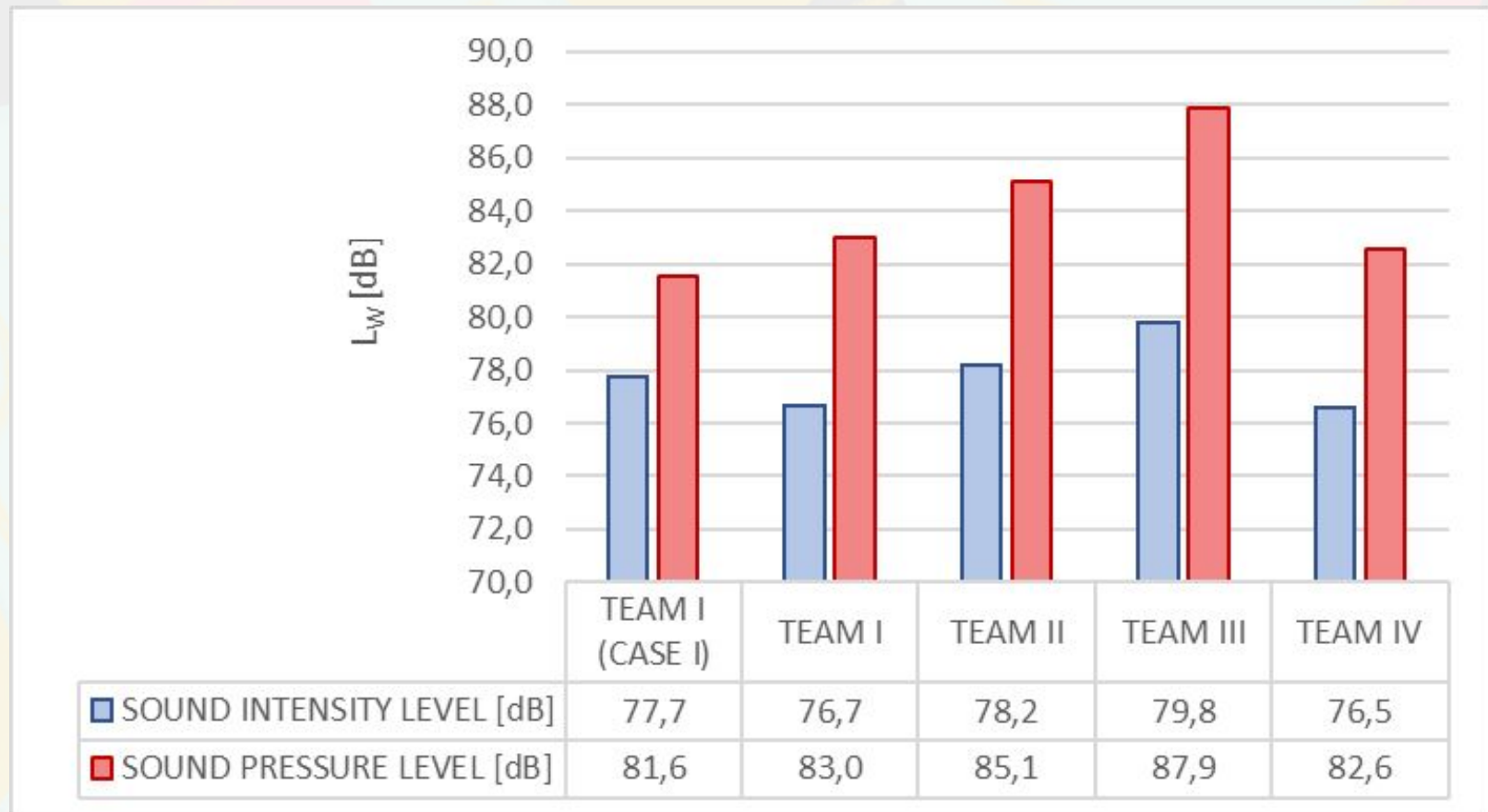
# Comparison (for the TEAM I)





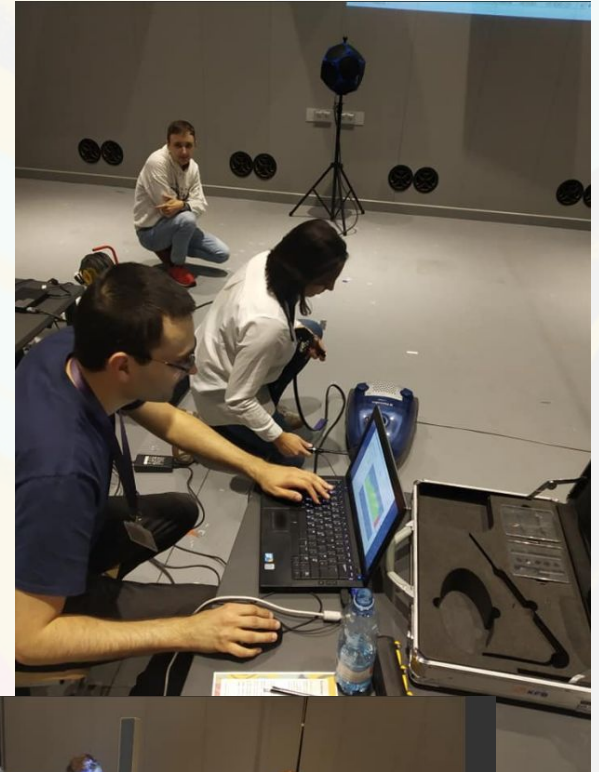
# Total Sound Power Levels

Total Sound Power



# SUMMARY

The difference between Sound Power Level defined by an intensity and pressure measurements is much larger for the case I. Each group had an opportunity to compare these two procedures methods. Participants found the sound intensity method superior to the sound pressure measurements method, while dealing with an indelible source of noise.

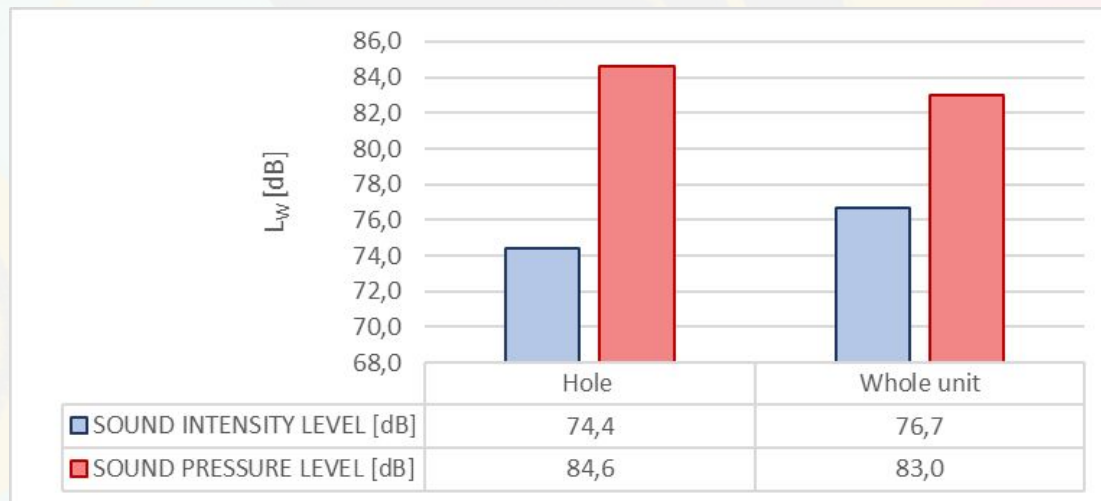




# ADDITIONAL MEASUREMENTS

After completing the task, some groups realized another measurement – they have chosen one part of the vacuum cleaner (in this case the hole for the vacuum tube) and compared its Sound Power Level to the Sound Power Level of the whole unit. Exemplary results are shown below.

elow.	SOUND INTENSITY LEVEL [dB]																											
Hole	54	57	60	61	59	59	57	59	58	57	61	58	59	60	61	60	61	65	64	63	67	60	54	-72	-60	-58		
Whole unit	51	52	54	54	56	56	56	57	55	58	67	60	62	63	65	64	66	67	66	68	67	63	64	56	0	0		
	SOUND PRESSURE LEVEL [dB]																											
Hole	43	50	55	58	60	62	63	65	67	68	70	70	70	71	71	72	72	72	72	73	72	72	78	71	70			
Whole unit	42	45	49	51	55	57	60	62	65	68	72	69	68	70	70	70	71	72	72	73	71	69	74	68	64	67		



In the case of sound intensity measurement, the  $L_w$  of the hole is 74,4 dB and is about 60% of the energy of the whole unit.

In the case of sound pressure measurement, the hole  $L_w$  is larger than this of the whole, which is not possible. This aberration is due to the influence of other parts of the device on the measurement.