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DyeMansion GmbH

Determination of the A-weighted emission sound pressure level according to ISO 11204 as well as the sound power level of Powershot C

Report No. M150787/02

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Table of contents

Summary		**3**
1	**Task**	**5**
2	**Documents**	**5**
3	**Measurement report**	**6**
3.1	Machine tested and operating conditions	6
3.2	Measuring conditions	6
3.3	Test environment	6
3.4	Instrumentation	7
3.5	Specified measuring positions	7
3.6	Results	7

Appendix A: Position of the measuring points

Determination of the equivalent sound-absorbing surface area of the test room

Appendix B: Evaluation of the measurements

Summary

The emission sound pressure level L_p as well as the sound power level L_{WA} of the Powershot C of DyeMansion GmbH had to be determined.

Since the machine can only be operated within the company building, the emission sound pressure level was determined in accordance with ISO 11204. The required environmental correction was evaluated using a reference sound source. The measurement uncertainty is u = 2.5 dB(A).

The measurements were carried out while the machine was operating in automatic mode and in stand-by mode.

The post-processing of the measured data led to the following result:

In stand-by mode the A-weighted emission sound pressure level L_p at the operator position (MP1) and the C-weighted peak sound pressure level L_{Cpeak} is:

$$\boldsymbol{L_p = 65.5\ dB(A),}$$

$$\boldsymbol{L_{Cpeak} = 79\ dB(C).}$$

The determined sound power level L_{WA} is:

$$\boldsymbol{L_{WA} = 85.0\ dB(A).}$$

In automatic mode (2.5 bar blasting pressure) the A-weighted emission sound pressure level L_p at the operator position (MP1) and the C-weighted peak sound pressure level L_{Cpeak} is:

$$\boldsymbol{L_p = 75.0\ dB(A),}$$

$$\boldsymbol{L_{Cpeak} = 83\ dB(C).}$$

The sound power level L_{WA} is:

$$\boldsymbol{L_{WA} = 87.0\ dB(A).}$$

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1 Task

The emission sound pressure level L_p as well as the sound power level L_{WA} of the Powershot C of DyeMansion GmbH is to be determined.

Since the machine can only be operated within the company building, the emission sound pressure level is determined in accordance with ISO 11204. The required environmental correction is evaluated using a reference sound source. The measurement uncertainty is u = 2.5 dB(A).

The measurements are carried out while the machine is operating in automatic mode and in stand-by mode.

In this report the sound emission measurements according to ISO 11204 as well as the evaluation and presentation of the results is documented.

2 Documents

[1] ISO 11 200: Acoustics – Noise emitted by machinery and equipment – Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified position, 2014.

[2] ISO 11 204: Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Method requiring environmental corrections, 2010.

[3] ISO 3746: Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane. March 2011.

[4] IEC 61 672-1: Electroacoustics – Sound level meter – Part 1: Requirements, 2013.

[5] IEC 60 942: Electroacoustics – Sound calibrators, 2003.

3 Measurement report

3.1 Machine tested and operating conditions

Powershot C for surface-protected de-powdering of 3D printed components.

The measurements were carried out while the machine was operating in automatic mode with 2.5 bar blasting pressure and in stand-by mode (with interval filter blow-off). During the cleaning cycle in automatic mode the pressure of the vibration module was 0.5 bar.

3.2 Measuring conditions

The noise measurements were carried out by Dr. Maximilian Zahn and M.Sc. Matthias Müller, Müller-BBM GmbH, on July 8th, 2019 in the “On Demand Blasting Area” in the DyeMansion company building in Planegg, Germany. The background noise level in this test room was < 54 dB(A). The employees of DyeMansion were responsible for the operation of the machine.

3.3 Test environment

The “On Demand Blasting Area” is a room (L x W x H: 7.5 m x 5.4 m x 3.2 m) with sound-scattering objects (other machines etc.), carpeting, sound-absorbing ceiling elements and concrete walls. All measuring positions used had a distance of at least 1.5 m from the walls. The equivalent sound-absorbing surface area of this room was determined by measurements with an omnidirectional reference noise source using the following method (see Appendix A):

$$A = 4 \cdot S_{\text{Hemi}} / \left(10^{0.1 \cdot K_{2\text{Ah}}} - 1\right) \quad \text{with}$$

A	equivalent sound absorbing surface area of the room in m²,
S_{Hemi}	enveloping surface of the omnidirectional reference sound source at a measuring distance of r = 1.5 m: 16.0 m²,
$K_{2\text{Ah}}$	global environmental correction; it was determined by three direct measurements with the omnidirectional reference sound source.

According to Appendix A, the room reflection measurements led to the following results:

DyeMansion – “On Demand Blasting Area”, Planegg:

$K_{2\text{Ah}}$ = 2.74 dB(A),
A = 73 m².

3.4 Instrumentation

Table 1. Measuring instruments used.

Instrument	Manufacturer	Type	Serial-No.
Modular precision sound analyser (1)	Brüel & Kjaer	2260	2124589
Condenser microphone	Brüel & Kjaer	4189	2117876
Acoustic calibrator	Brüel & Kjaer	4231	1883308
Reference sound source	Norsonic	NOR-250	31451
Noise generator/power amplifier	Norsonic	NOR-280	2803682

The sound level meter and the calibrator comply with Class 1 requirements according to EN 61 672-1 (sound level meters [4]) or EN 60 942 (calibrators [5]), respectively. The sound level meter was checked before and after the measurements by use of the calibrator. No deviations were observed. A wind screen was used in all measurements.

3.5 Specified measuring positions

The operator position in front of the machine, where the Powershot C is controlled, was selected as measuring point MP1 at a height of 1.55 m to determine the A-weighted emission sound pressure level of the machine.

In addition, the auxiliary measuring points H1 to H3 as well as one measuring point above the machine were used to calculate the local environmental correction K_{3A} and the sound power level L_{WA}. The measuring height of the auxiliary points is also 1.55 m. The lateral distance from the machine edges is 0.5 m.

Note: For the determination of the local environmental correction K_{3A} the auxiliary point above the machine is not taken into account.

All measuring positions are shown in the layout plan of the machine in Appendix A.

3.6 Results

The measured sound pressure levels and the determined background noise levels are listed in Appendix B. The readings of the L_{AFm} for each measuring point are listed in the respective line. The averaging time in stand-by mode was approx. 60 s per measurement and one full cycle (2 min blasting, 2 min cleaning) in automatic mode.

The results were determined according to [2]:

$$L_{pA} = L'_{pA} - K_{1A} - K_{3A} \text{ with}$$

L_{pA} A-weighted emission sound pressure level,

L'_{pA} measured A-weighted sound pressure level L_{eq},

K_{1A} correction for background noise,

K_{3A} local environmental correction.

All calculations were performed with full accuracy. Only in the last step the results were rounded to half dB.

Correction for background noise

The background noise in the test room was < 54 dB(A). Therefore, no background noise correction had to be applied, i.e. K_{1A} = 0 dB(A) for all measurements.

Local environmental correction

The local environmental correction for all measurements in automatic mode was $K_{3A} \leq 4$ dB(A). Therefore, the overall result of the noise test complies with grade 2 accuracy according to [2].

In stand-by mode the local environmental correction was $K_{3A} \leq 7$ dB(A). The overall result of this noise test thus complies with grade 3 accuracy.

Measurement uncertainty

The measurement uncertainty is u = 2.5 dB(A) according to [1] and [2].

The post-processing of the measured data led to the following result for the A-weighted emission sound pressure level L_p at the operator position (MP1) and the C-weighted peak sound pressure level L_{Cpeak} in stand-by mode:

$$\boldsymbol{L_p = 65.5\ dB(A),}$$

$$\boldsymbol{L_{Cpeak} = 79\ dB(C).}$$

According to ISO 3746 [3], the determined sound power level L_{WA} is:

$$\boldsymbol{L_{WA} = 85.0\ dB(A).}$$

In automatic mode (2.5 bar blasting pressure) the A-weighted emission sound pressure level L_p at the operator position (MP1) and the C-weighted peak sound pressure level L_{Cpeak} is:

$$\boldsymbol{L_p = 75.0\ dB(A),}$$

$$\boldsymbol{L_{Cpeak} = 83\ dB(C).}$$

The sound power level L_{WA} is:

$$\boldsymbol{L_{WA} = 87.0\ dB(A)}$$

Appendix A

Position of the measuring points

Determination of the equivalent sound-absorbing surface area of the test room

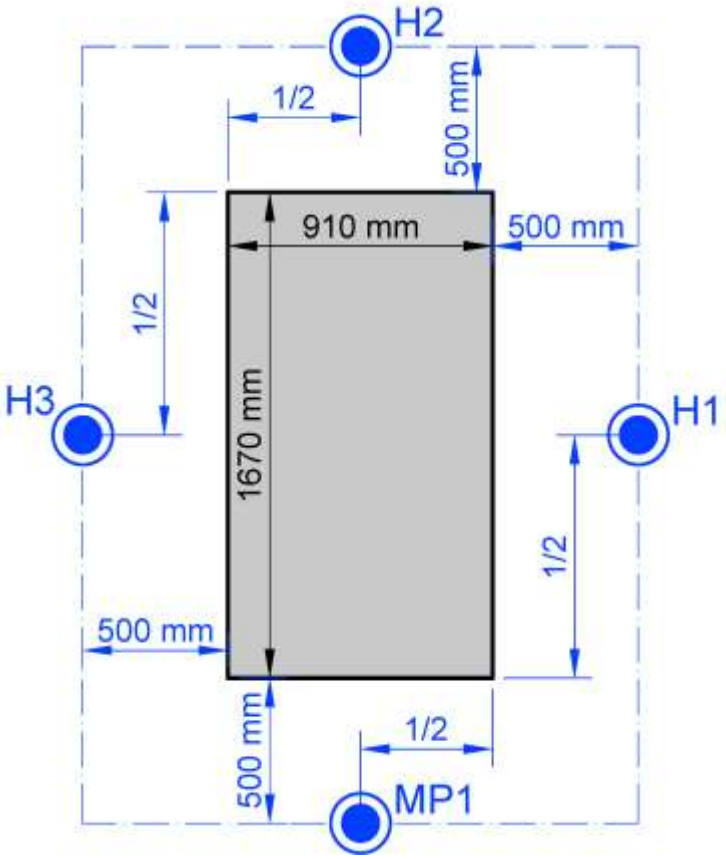

Figure 1. Position of the measuring point (MP1) and auxiliary points (H1 to H3) around the Powershot C machine.

Table 2. Determination of the equivalent sound-absorbing surface area of the test room.

Project:	**M150787 / Fa. DyeMansion**						**MÜLLER - BBM GmbH**		
Determination of equivalent sound absorbing surface area using a reference sound soure									
Location:	On Demand Blasting Area					Date of measurement:			
						08.07.2019			
Reference Sound Source			**Hemi 2**		Norsonic	NOR-250	31451		
					Noise generator/power amplifier:	Norsonic	NOR-280	280 3682	
Measuring distance:				m:	1.50	Meas. surface, m²:	16.0		
						dB:	12.0		
Measured sound pressure level, 3 measurements									
	MP - free field, L_{AFm}					**MP - in testroom, L_{AFm}**			
Meas. point:	MP outside					MP inside			
1. Meas.	91.5					94.3			
2. Meas.	91.5					94.3			
3. Meas.	91.5					94.2			
Mean values:									
Meas. point:	MP outside					MP inside			
max. Diff:	0.0					0.1			
Means:	91.50					94.27			
Mean:	**91.50**	Uncertainty:	0.00	dB(A)		**94.27**	Uncertainty:	0.02	dB(A)
Environmental correction K2A for the reference sound source:									
Legend:	*K2A is the difference (MP inside) - (MP outside):*								
K2A av.:	2.77	Uncertainty:	0.02	dB(A)					
K2A max:	2.79								
K2A min:	**2.74**								
Equivalent sound absorbing surface area "A" of the room:									
Legend:	*Due to the measurement uncertainty, the smallest value of K2A must be used to calculate the largest possible absorption area of the test room.*								
A av.:	72	m²							
A min:	71	m²							
A max:	**73**	**m²**							

Appendix B

Evaluation of the measurements

Table 3. Measured sound pressure levels in stand-by mode and the determined background noise levels.

Project:	**M150787 / Fa. DyeMansion**	**MÜLLER - BBM GmbH**
Location:	On Demand Blasting Area	Name: Müller / Zahn
Machine:	Powershot C	Date: 08.07.2019
	Standby mode	SLM: B&K 2260 2124589

Meas. Value in dB(A)	**MP1 und H1**				**MP2 und H2**			
	LAFm	Lcpeak		H1,LAFm	LAFm	Lcpeak		H2,LAFm
backgr. Noise	53.3	--	--	53.3				53.3
1. Meas.	71.3	78.6		73.2				72.2
2. Meas.	71.4							
3. Meas.								
Arithm. MW	**71.4**	*78.6*		**73.2**				**72.2**

Meas. Value in dB(A)	**MP3 und H3**				**MP4 und H4**			
	LAFm	Lcpeak		H3,LAFm	LAFm	Lcpeak		H4,LAFm
backgr. Noise				53.3				53.3
1. Meas.				73.0				78.1
2. Meas.								
3. Meas.								
Arithm. MW				**73.0**				**78.1**

Table 4. Post-processing: emission sound pressure level and sound power level in stand-by mode.

Project:	**M150787 / Fa. DyeMansion**					**MÜLLER - BBM GmbH**		
Determination of the A-weighted emission sound pressure level according to ISO 11204								
Machine:	**Powershot C**					Date of measurement:		
						08.07.2019		
Location:	On Demand Blasting Area				Equiv. sound-absorb. area , m²	73.0		
					Meas. surface S, m²:	25.9		
Measurement uncertainty u:					Uncertainty,dB:	**2.50**		
Correction for background noise K1A:								
Meas. point:	MP1							
delta L:	18.1							
Validity:	**ok**							
K1A:	0.00							
K1A value:								
Position:	operator position							
Meas. point:	MP1							
K1A:	**0.00**							
Local environmental correction K3A:								
Position:	operator position							
Meas. point:	MP1	class of						
L´jm:	71.35	accuracy						
K3A:	**6.27**	**3**						
	L´m:	72.50		L´m for LWA:	74.33	**K2A:**	3.84	
	A/4S:	0.70						
LCpeak in dB(C):					**Sound power level LWA in dB(A)**			
Position:	operator position				Powershot C			
Meas. point:	MP1							
max LCpeak:	**79**	**dB(C)**			**85.0**	**dB(A)**		
A-weighted emission sound pressure level LpA:					Limit, dB(A):	**85.0**		
Position:	operator position							
Meas. point:	MP1							
uncertainty.:	2.50							
LpA, exact:	65.08	Assessment						
LpA, round.:	**65.5**	**OK**						

Table 5. Measured sound pressure levels in automatic mode and the determined background noise levels.

Project:	**M150787 / Fa. DyeMansion**	**MÜLLER - BBM GmbH**
Location:	On Demand Blasting Area	Name: Müller / Zahn
Machine:	Powershot C	Date: 08.07.2019
	Automatic mode	SLM: B&K 2260 2124589

Meas. Value in dB(A)	**MP1 und H1**				**MP2 und H2**			
	LAFm	Lcpeak		H1,LAFm	LAFm	Lcpeak		H2,LAFm
backgr. Noise	53.3	--	--	53.3				53.3
1. Meas.	77.1	83.1		75.1				75.0
2. Meas.								
3. Meas.								
Arithm. MW	**77.1**	*83.1*		**75.1**				**75.0**

Meas. Value in dB(A)	**MP3 und H3**				**MP4 und H4**			
	LAFm	Lcpeak		H3,LAFm	LAFm	Lcpeak		H4,LAFm
backgr. Noise				53.3				53.3
1. Meas.				75.0				78.9
2. Meas.								
3. Meas.								
Arithm. MW				**75.0**				**78.9**

Table 6. Post-processing: emission sound pressure level and sound power level in automatic mode.

Project:	**M150787 / Fa. DyeMansion**					**MÜLLER - BBM GmbH**		
Determination of the A-weighted emission sound pressure level according to ISO 11204								
Machine:	**Powershot C**					Date of measurement:		
						08.07.2019		
Location:	On Demand Blasting Area				Equiv. sound-absorb. area , m²	73.0		
					Meas. surface S, m²:	25.9		
Measurement uncertainty u:					Uncertainty,dB:	**2.50**		
Correction for background noise K1A:								
Meas. point:	MP1							
delta L:	23.8							
Validity:	**ok**							
K1A:	0.00							
K1A value:								
Position:	operator position							
Meas. point:	MP1							
K1A:	**0.00**							
Local environmental correction K3A:								
Position:	operator position							
Meas. point:	MP1	class of						
L´jm:	77.10	accuracy						
K3A:	**2.37**	**2**						
	L´m:	75.65		L´m for LWA:	76.52	**K2A:**	3.84	
	A/4S:	0.70						
LCpeak in dB(C):					**Sound power level LWA in dB(A)**			
Position:	operator position				Powershot C			
Meas. point:	MP1							
max LCpeak:	**83**	**dB(C)**			**87.0**	**dB(A)**		
A-weighted emission sound pressure level LpA:					Limit, dB(A):	**85.0**		
Position:	operator position							
Meas. point:	MP1							
uncertainty.:	2.50							
LpA, exact:	74.73	Assessment						
LpA, round.:	**75.0**	**OK**						