We help ideas meet the real world

Technical Note

Noise emission from Dehumidifier Type C35E-3.3 and Type C35E-5.6

Performed for COTES A/S

TC-100902
Project no.: T211658

15 January 2016

DELTA
Venlighedsvej 4
2970 Hørsholm
Denmark

Tel. +45 72 19 40 00
Fax +45 72 19 40 01
www.delta.dk
VAT No. 12275110

Title
Noise emission from Dehumidifier Type C35E-3.3 and Type C35E-5.6

Journal no.	**Project no.**	**Our ref.**
TC-100902	T211658	MAB/JEL/CB/ilk

Client
COTES A/S
Ndr. Ringgade 70c
4200 Slagelse
Denmark

Client ref.
Thomas Rønnow Olesen

Laboratory
DELTA
Agro Food Park 13
8200 Aarhus N
Denmark

Test conditions
DS/EN ISO 11202:2010
DS/EN ISO 3744:2010

Results

The dehumidifier type C35E-3.3 and type C35E-5.6 have been tested on 15 October 2015 and the sound pressure level was measured 1 metre from the dehumidifier in four positions.

The maximum A-weighted sound pressure level, L_{pA} at 1 metre distance was measured in position D (right side) at nominal flow mode:

Minimum effect: 53.5 dB re 20 µPa

Maximum effect: 60.5 dB re 20 µPa

Standard deviation is σ_{tot} = 1.6 dB.

Remarks

The results apply only to the object tested. Results are rounded to the nearest 0.5 dB.

DELTA, 15 January 2016

Jens Elgaard Laursen
Senior Specialist, Acoustics

Contents

1. Introduction

On behalf of COTES A/S, DELTA has performed sound measurements on a dehumidifier type C35E-3.3 and C35E-5.6. The noise measurements were performed according to DS/EN ISO 11202:2010.

2. Test Object

Type	C35E-3.3	C35E-5.6
Make	COTES A/S	COTES A/S
Serial No.	14-12269	14-12269
Process Flow	750 m^3/h	1000 m^3/h
Reg. Flow	135 m^3/h	233 m^3/h
Power	5.1 kW	8.8 kW
Dimensions (both)	L 532 mm / W 756 mm / H 1090 mm	

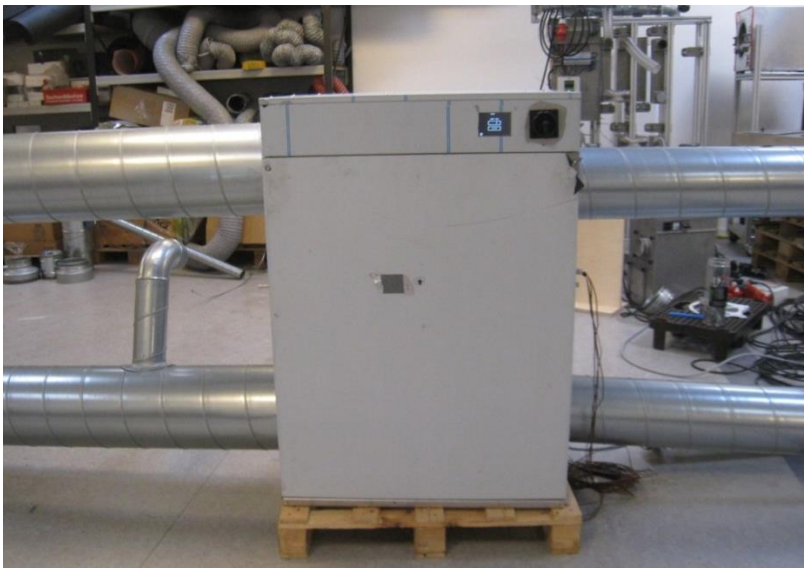


Figure 1
Test set-up for the dehumidifier C35E-3.3 and C35E-5.6. The front here is Position A (see Annex 1).

2.1 Operating Conditions during Test

The dehumidifier was tested at nominal flow mode.

The noise emission was steady for the specified operating mode.

3. Acoustic Environment

The dehumidifier was placed indoor in a large workshop room at COTES, Rudolfgårdsvej 1A, 8260 Viby, Denmark (see Figure 1). On the ceiling of the workshop were mounted acoustic absorbing panels. The main dimensions of the room are 13.5 m × 8 m × 2.8 m (length × width × height).

The acoustic quality of the test room was measured with a reference sound source from Brüel & Kjær type 4204. The measurements were performed by Jens Elgaard Laursen, DELTA Acoustics, on 9 December 2015 and were performed according to ISO 3744 in order to calculate the test rooms environmental correction factor K_{2A}. The largest value was found to be K_{2A} (50 Hz) = 5.2 dB in position B (left side of the test object). The K_{2A} values were all lower than 7 dB, and the test room therefore qualifies for sound pressure measurements according to DS/EN ISO 11202. The sound power level values of the reference sound source are enclosed in Annex 3.

4. Measurement Methods

The measurements were performed according to standard DS/EN ISO 11202. The sound pressure level was measured in a number of positions on a virtual measuring surface at 1 metre distance from the test object as illustrated in Annex 1. A photo of the measuring set-up is shown in Figure 1.

The measurements of the test object were performed on 15 October 2015 by Marina Brandt, DELTA Acoustics. The used instruments are listed in Annex 2.

All measurements were performed with the test object in nominal flow mode.

5. Sound Pressure Measurements and Corrections

In each of the measurement positions the sound pressure level was measured for minimum 60 seconds. The background noise in the test room was measured while the dehumidifier was turned off.

The measured time-averaged sound pressure levels $\overline{L_{pA}}'$ are corrected for each microphone position according to the following formula:

$$\overline{L_{pA}} = \overline{L_{pA)}}' - K_{1A} - K_{3A}.$$

Where $\overline{L_{pA}}$ is the energy A-weighted sound pressure level on the measuring surface, corrected for K_{1A} and K_{3A}.

K_{1A} is the A-weighted correction for background noise level

K_{3A} is an environmental correction depending of reflecting surroundings.

The measurements were calculated and corrected in one-third octave frequency bands 50-10.000 Hz before summing up.

According to Annex A in DS/EN ISO 11202, the local environmental correction K_{3A} is dependent of the absorption area of the room surfaces: $K_{3A} = 10 \log (1 + 4S/A)$, where S is the area of a hemisphere with a radius of 1 metre: $S = 2 \cdot \pi \cdot r^2 = 6.28\ m^2$.
A is the total absorption area of the room: $A = \alpha \cdot S_V$, where $\alpha = 0.3$ is an estimate of the mean absorption coefficient of the room surfaces. S_V is the total area of the test room (walls, ceiling and floor), $S_V = 336\ m^2$.

6. Test Results

6.1 Sound Pressure Levels

In Table 1 the measurement results are shown as the A-weighted sound pressure level in each of the four microphone positions: A-D (see illustration in Annex 1).

C35E-3.3 and C35E-5.6		**Sound pressure levels, $\overline{L_{pA}}$ in dB re 20 µPa**				
	Measurement position:	**A**	**B**	**C**	**D**	**Mean value**
C35E-3.3	Nominal flow mode	50.8	53.7	50.3	51.7	**51.8**
C35E-5.6	Nominal flow mode	57.7	60.7	56.7	56.7	**58.3**

Table 1
Type C35E-3.3 and C35E-5.6. Measured and corrected, averaged, A-weighted sound pressure levels $\overline{L_{pA}}$, in dB re 20 µPa corrected for background noise (K_{1A}) and the environment correction (K_{3A}).

The highest value was found in position B on the left side of both of the two test object:

Type C35E-3.3: 53.7 dB(A)

Type C35E-5.6: 60.7 dB(A)

The background noise 26.2 dB(A) was measured in one position (Position D).

The standard deviation of the measurements is $\sigma_{R0} = 1.5$ dB (accuracy grade 2). The operating and mounting conditions are $\sigma_{omc} = 0.5$ dB and the total standard deviation is $\sigma_{tot} = 1.6$ dB.

The corrected, averaged (four positions), A-weighted sound pressure levels per 1/1-octave frequency band are shown in Table 2.

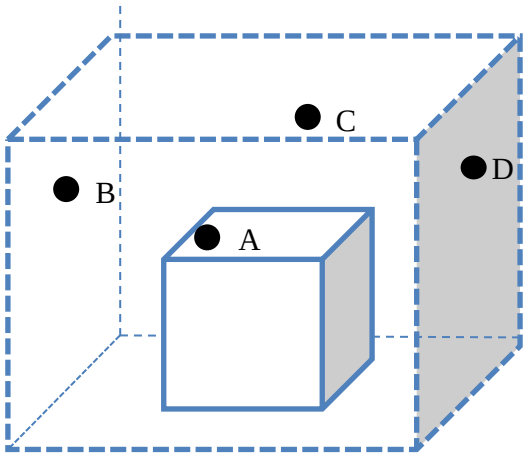
Type	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**	**8000 Hz**	**SUM**
C35E-3.3	26.7	34.2	46.6	46.2	44.3	44.4	38.0	27.4	**51.8**
C35E-5.6	32.9	41.6	53.9	51.9	50.6	50.6	44.6	35.1	**58.3**

Table 2
C35E-3.3 and C35E-5.6. Corrected, averaged, A-weighted sound pressure levels per 1/1-octave frequency band in dB re 20 µPa.

Annex 1 – Measurement Points

The dashed lines show the measurement surface located at d = 1 metre from the reference box containing the test object.

Four microphone positions were placed at height 1.5 m above the floor.



Set-up for the sound pressure measurements (not in scale).

Annex 2 – Instrumentation

Instruments used for the sound measurements on 15 October 2015:

No.	Equipment	Make	Type	Calibration	
				Last	Next
02L023	Sound Level Calibrator	Brüel & Kjær	4231	11-08-2015	11-02-2016
08L034	Sound Level Analyzer	Brüel & Kjær	2250	19-01-2015	19-01-2017
06L058	½" Microphone	G.R.A.S.	40AE	16-01-2015	16-01-2016

Instruments and analysis software used for the sound measurements on 9 December 2015:

No.	Equipment	Make	Type	Calibration	
				Last	Next
1190 L	Sound Level Calibrator	Brüel & Kjær	4231	29.07.2015	29-01-2016
1370 L	Hard Disc Recorder	Sound Device	744	11-08-2015	12-08-2017
4181 L	½" Microphone	Brüel & Kjær	4188	02-07-2015	02-07-2016
4182 L	½" Microphone	Brüel & Kjær	4188	02-07-2015	02-07-2016
0131 T	Reference Sound Source	Brüel & Kjær	4204	19-11-2011	-
1505 L	Hygrometer	QEO fennel	FHT 70	21-03-2014	-
-	Multimeter	Fluke	77	-	-
-	Noise Analyzer	noiseLAB 4.0	Capture	-	-
-	Noise Analyzer	noiseLAB 4.0	Batch	-	-

The measurement set-up was calibrated before and after the measurements. All instruments are calibrated regularly in accordance with our DANAK guidelines.

Annex 3 – Sound Power Levels for Reference Sound Source B&K 4204

Sound power level values from Exova Metech calibration certificate no. 435983.

Test room parameters on 9 December 2015: Voltage: 231.3 V. Humidity: 37.7 %. Temperature: 23.7 °C.

Calibration Certificate

Certifcate no. 435983
Journal no. 27171
Page 4 of 5

Exova METECH

1. Sound Power Level

Frequency [Hz]	L_P [dB re 1pW]	Uncertainty [±dB]
50	*73.8*	*4.0*
63	*73.5*	*4.0*
80	*76.1*	*4.0*
100	*75.2*	*1.6*
125	*75.5*	*1.6*
160	*75.8*	*1.6*
200	*76.8*	*1.0*
250	*77.1*	*1.0*
315	*77.3*	*1.0*
400	*77.4*	*1.0*
500	*77.1*	*1.0*
630	*77.9*	*1.0*
800	*79.6*	*1.0*
1.0k	*80.6*	*1.0*
1.25k	*82.1*	*1.0*
1.6k	*82.2*	*1.0*
2.0k	*81.4*	*1.0*
2.5k	*79.7*	*1.0*
3.15k	*79.4*	*1.0*
4.0k	*79.4*	*2.0*
5.0k	*78.5*	*2.0*
6.3k	*77.1*	*2.0*
8.0k	*74.7*	*2.0*
10.0k	*72.9*	*2.0*
LIN 50Hz - 20 kHz	*92.1*	*1.0*
A weighted	*91.4*	*1.0*

Table 1 Sound power level

The measuring uncertainty stated in Table 1 is the standard deviation of the reproducibility given in ISO 6926 for 20 discrete measuring positions multiplied with a coverage factor 2 to achieve a 95 % confidence level.

Comment

It is valuated that the measuring uncertainty given in ISO 6926 at 50 – 80 Hz is too large. Due to the large semi-anechoic chamber the measuring uncertainty is estimated to 2 – 3 dB.