Belvedere House

Noise Impact Assessment

Deka Immobilien Investment GmbH

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Contents

1.0

Introduction

1.0 Introduction

1.1 Site Context

Belvedere House is an eight-storey commercial building located in Manchester city centre. The building is bounded by Fountain Street to the south east, Booth Street to the north east, Kennedy Street to the south west and connecting properties to the north west.

The project comprises the replacement of the existing air-cooled chillers on the roof of Belvedere House with heat pumps, as per Option 5 of the Cundall Zero Carbon Feasibility Report (1027438-RPT-001 Rev A).

The location of the chiller compound is highlighted below.

Figure 1-1: Location of Belvedere House chiller compound (red outline)

1.2 Existing plant installation

Cundall visited site on 16 June 2020 to discuss the project with the Facilities Management Team. The current noise generating plant located on the roof of Belvedere House that will be replaced consists of the following:

- Two containerised air-source chillers, Carrier type 30XA0602SA/BSE with a 619KW capacity each. Chillers are connected via CHW Primary Pumps 1 & 2 located on the external plant area on level 08.
- Primary chilled water pumps are Grundfoss 125-140/6
- Secondary distribution is done via two sets of pumps:
  - CHW Secondary Pumps east 1 & 2 (on L08) are Grundfoss TDP/125-360/4
  - CHW Secondary Pumps West 1 & 2 (on L08) Grundfoss TDP/125-320/4

The chiller compound is pictured in Figure 1-2.

Figure 1-2: Chiller compound

From inspection of the equipment and discussion with manufacturers, it is our understanding that the units are provided with the following options:

- Dx Free Cooling system on two circuits
- BacNet gateway

An extract from the technical data sheet for this unit is provided as Appendix I, with the unit size (602) and type (standard unit) highlighted. There are no sound reducing options provided for the units. From the technical datasheet the above provided options do not affect noise emission levels.

1.3 Proposed new replacement plant

The proposed new plant will consist of three multifunction units and one heat recovery unit as follows:

- **Multifunction unit**: Climaveneta FOCS-N-G05 /SL-CA 2022 Reversible unit, air source for outdoor installation
- **Heat recovery unit**: Climaveneta ERACS2-Q-G05 /SL-CA 1062 Integra unit for 4-pipe systems, air source for outdoor installation

Indicative locations of the proposed units are provided as Figure 1-3. Extracts from the technical data sheets for the above units are provided as Appendix II.

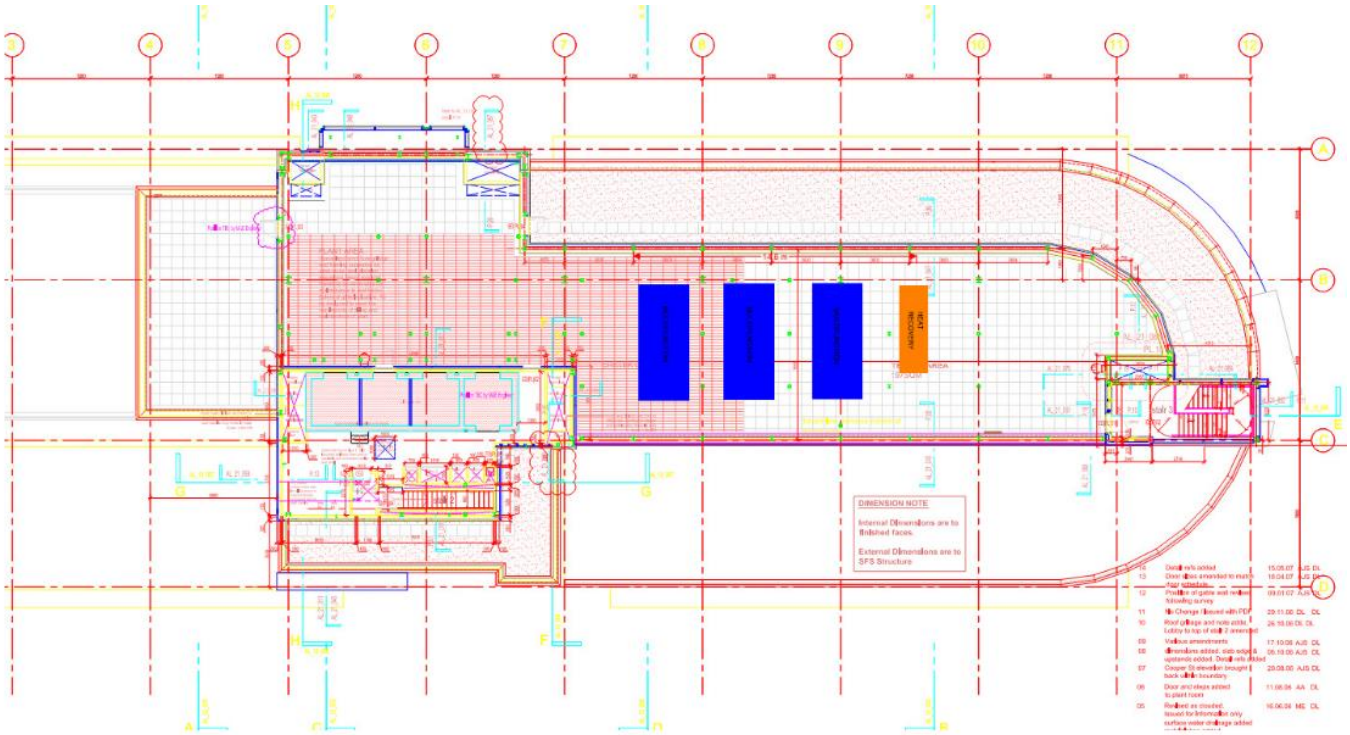


Figure 1-3: Proposed location of three multifunction units (blue) and one heat recovery unit (orange)

2.0

Assessment criteria

2.0 Assessment criteria

This section of the report outlines the key legislation and guidance relevant to the assessment of noise for a development of this type.

2.1 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) was published by Defra in March 2010. This NPSE sets out the long-term vision of Government noise policy:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."

The NPSE long term vision is supported by the following aims:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life."*

2.2 National Planning Policy Framework

The National Planning Policy Framework (NPPF) was originally published in March 2012 and amended in July 2019. The NPPF is part of government reform to make the planning system less complex and more accessible, and to promote sustainable growth. It replaced existing national planning policies such as Planning Policy Guidance PPG24: Planning and Noise.

The NPPF states:

"170 - Planning policies and decisions should contribute to and enhance the natural and local environment by;

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or ***noise pollution*** *or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;"*

and

"180 - Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;"

2.3 Planning Practice Guidance

In March 2014 Planning Practice Guidance for noise was published. This online document advises on how planning can manage potential noise impacts in new development.

2.4 Local Authority requirements

Section 3.6.1.5.1 of the Manchester City Council (MCC) 'Planning & Noise - Technical Guidance' document (December 2015) relates to noise limits for building services plant and states:

"Many of the noise complaints Environmental Health receive about noise from plant, equipment and machinery specifically concern the character of the noise emitted. Any noise assessment needs to consider not only the overall level of noise emitted but also its particular characteristics. The noise assessment should be based on BS 4142: 2014 and any application for fixed plant, equipment or machinery must demonstrate that:

Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5 dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location."

2.5 Comparative assessment approach

The existing units are considered to have been installed in compliance with Local Authority Requirements as described in Section 2.4 above. As such, any new unit that is has identical or lower noise emissions is by default considered to be adequate for use and in compliance with the Local Authority Requirements.

Considering the above, a comparative study is proposed for the assessment of any new noise impact. Representative noise emissions of the existing units are not able to be measured, considering reduced operation of the units due to atypical occupancy of Belvedere house due to COVID-19. As such, the assessment will be undertaken based on comparison of noise emission information provided by the manufacturers of the existing units and the new, alternative and more energy efficient units.

The manufacturers data is relevant to newly installed units. However, it can be safely assumed that as plant equipment ages, noise levels tend to increase due to wear and tear on moving parts and weathering due to environmental conditions. This assessment does not consider the potential increases in noise caused by these factors, including any potential annoyance features of the existing noise emissions such as tonality or impulsiveness. Therefore, the assessment is considered worst case.

3.0

Assessment

3.0 Assessment

The noise impact assessment of the proposed units will consist of a direct comparison of the cumulative sound pressure levels generated by the existing units and the cumulative sound pressure levels generated by the proposed units. Worst case cumulative sound pressure levels will then be calculated at the nearest roof parapet for both scenarios.

3.1 Existing chiller units

The datasheet for the existing chiller units provides broadband sound pressure levels at 10 m distance from the unit. The sound pressure levels are in dB ref 20µPa, (A) weighting. Declared dual number noise emission values in accordance with ISO 4871 (with an associated uncertainty of +/-3dB(A)). The sound pressure levels are calculated from the sound power level Lw(A). To enable a frequency-based prediction of noise levels a typical spectrum of noise levels has been sourced from a similar sized unit (Trane 140 RTAC air cooled chiller containing a screw compressor). The following table highlights the noise levels used in calculations.

Unit	SPL / SWL	Sound level (dB) in octave frequency bands (Hz)								dB(A)
		63	125	250	500	1000	2000	4000	8000	
Example chiller spectrum *	L_w	102	103	99	98	97	92	87	81	101
Carrier 30XA 602, manufacturer data	L_p @10m									67
Carrier 30XA 602, calibrated spectrum	L_p @10m	68	69	65	64	63	58	53	50	67
Table notes * *Trane 140 High RTAC unit size 60Hz. Unattenuated.*										

Table 3-1: Existing chiller units sound levels used in calculations

The distances used in calculations are indicated below.

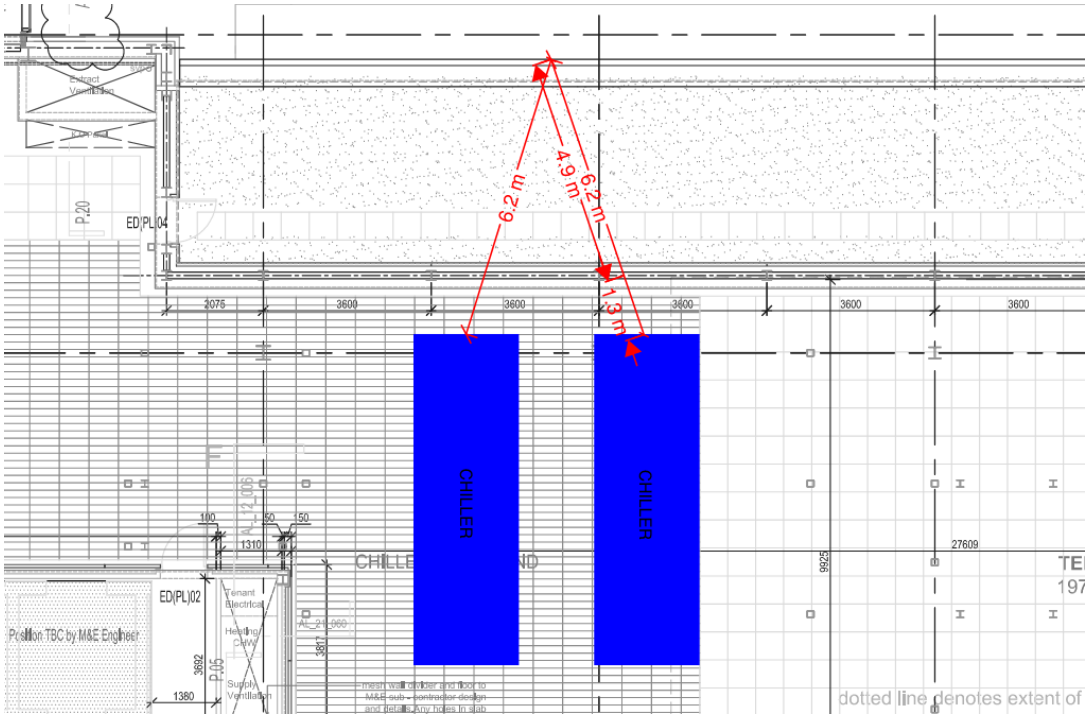


Figure 3-1: Distances used in calculations, existing plant

3.2 Proposed units

The following table highlights the noise levels used in calculations for the proposed new replacement units.

Unit	SPL	Sound level (dB) in octave frequency bands (Hz)								dB(A)
		63	125	250	500	1000	2000	4000	8000	
Climaveneta FOCS-N-G05	L_{pA} @ 1m	62	60	63	67	68	59	47	40	70
Climaveneta ERACS2-Q-G05	L_{pA} @1m	58	49	52	54	52	44	38	33	55

Table 3-2: Proposed replacement plant units sound levels used in calculations

The distances used in calculations are indicated below.

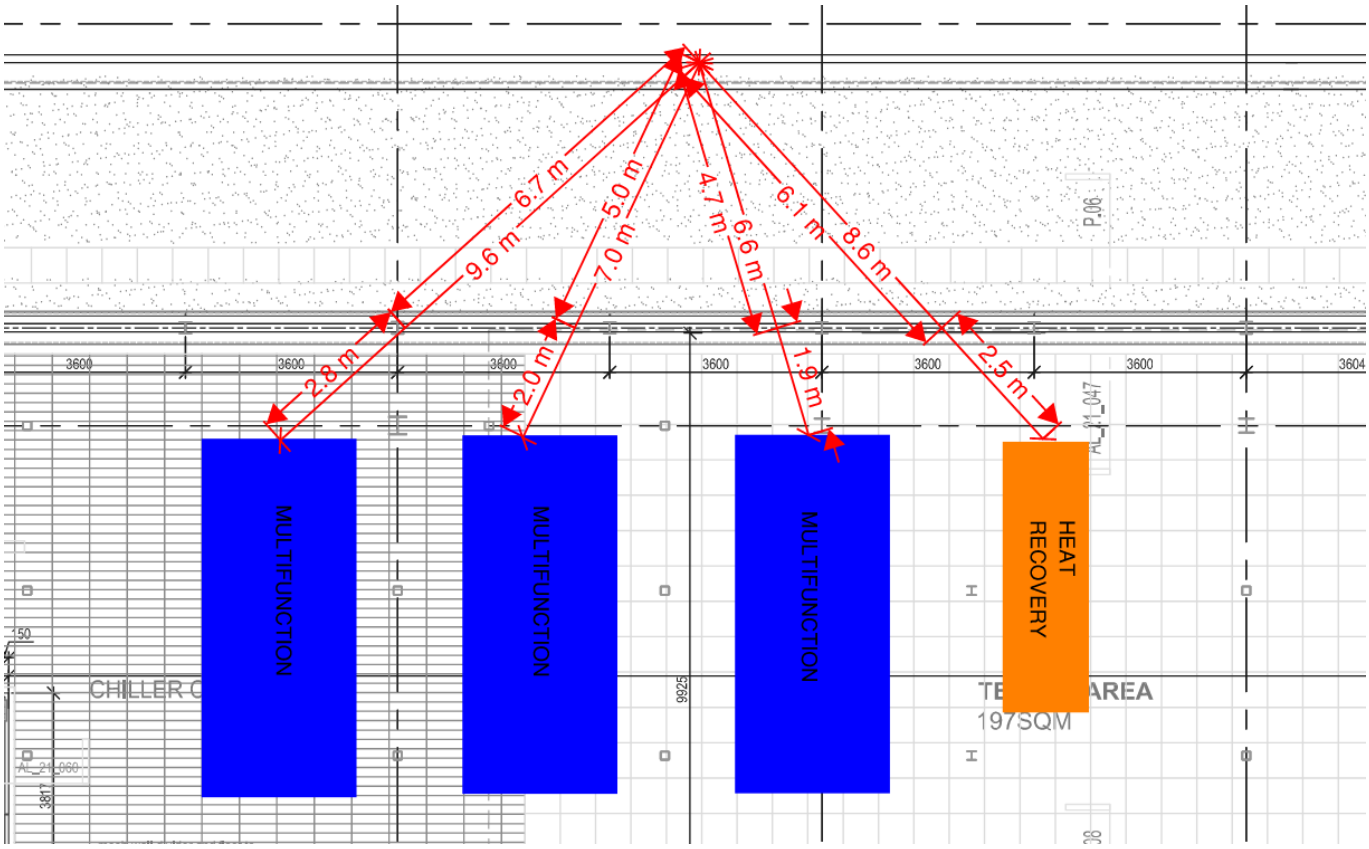


Figure 3-2: Distances used in calculations, proposed new replacement plant

3.3 Barrier attenuation

The roof top plant area is surrounded by a 2.5 m high barrier (pictured in Figure 1-2). The receiver point used in calculations is the nearest, or worst case affected point of the building parapet for each scenario as identified in Figure 3-1 and Figure 3-2. Using these distances, along with relative heights of noise source, receiver and barrier, calculations of barrier attenuation in octave bands is carried out using the Maekawa equation:

$$IL = -\left[5 + 20\log_{10}\left(\frac{\sqrt{2\pi N_F}}{\tanh\left(\sqrt{2\pi N_F}\right)}\right)\right] \qquad N_F = 2\left(\frac{\delta}{\lambda}\right)$$

Where:

3.4 Results

A summary of the predicted noise levels at the worst-case locations of the building parapet are provided below. Detailed calculations are provided in Appendix III.

Unit	Sound level (dB) in octave frequency bands (Hz)								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Existing cumulative plant sound pressure level at building parapet	67	66	59	55	52	44	36	30	58
Proposed cumulative plant sound pressure level at building parapet	41	37	38	39	37	25	10	0	40

Table 3-3: Proposed replacement plant units sound levels used in calculations

As can be seen from the results provided above, there is a significant reduction in noise emissions (18 dB) when comparing the existing chiller plant with the proposed new, replacement units. Furthermore, the level of reduction is at least 10 dB in each individual octave band.

With the additional screening afforded by the building parapet (considering no residential buildings are overlooking Belvedere house) the above noise levels are expected to be further reduced.

4.0

Conclusions

4.0 Conclusions

An assessment of potential noise impact due to proposed new, replacement external plant associated with Belvedere House in Manchester city centre has been carried out.

This assessment has been based on comparing plant noise level data for the existing units located at roof level, and the proposed replacement units to be installed in the same location. Sound level data for both existing and proposed units has been sourced from manufacturers.

Calculations have been carried out using empirical formula to predict noise levels at the worst case affected building parapet. Results show that the proposed replacement plant selections are significantly quieter than existing.

Under the assumption that the existing plant was installed following the requirements of Section 3.6.1.5.1 of the Manchester City Council (MCC) 'Planning & Noise - Technical Guidance' document (December 2015), the proposed plant will also meet these requirements and is suitable for use.

Appendices

Appendix I Existing plant technical datasheet

4.1 - Physical data 30XA 252-852 - standard units and units with option 119*

30XA		252	302	352	402	452	504	502	602	702	752	802	854	852
Sound levels - Standard unit														
Sound power level***	dB(A)	99	99	99	98	101	-	98	100	98	103	102	-	100
Sound pressure level at 10 m****	dB(A)	67	67	67	65	69	-	65	67	65	70	70	-	67
Standard unit + option 279*														
Sound power level***	dB(A)	89	89	89	92	93	-	93	95	94	96	96	-	95
Sound pressure level at 10 m****	dB(A)	57	57	57	60	61	-	61	62	61	63	64	-	63
Standard unit + option 257*														
Sound power level***	dB(A)	87	87	87	90	91	-	91	93	92	94	94	-	94
Sound pressure level at 10 m****	dB(A)	55	55	55	58	59	-	59	60	59	61	61	-	61
Standard unit + option 258*														
Sound power level***	dB(A)	-	-	-	-	89	-	89	91	90	91	92	-	91
Sound pressure level at 10 m****	dB(A)	-	-	-	-	57	-	56	58	57	59	59	-	59
Standard unit + option 119*														
Sound power level***	dB(A)	100	100	100	100	102	100	100	102	100	104	104	102	102
Sound pressure level at 10 m****	dB(A)	68	68	68	68	70	68	68	69	68	71	71	70	69
Standard unit + option 119* + 279*														
Sound power level***	dB(A)	94	94	95	96	96	96	96	98	97	98	99	98	98
Sound pressure level at 10 m****	dB(A)	62	62	63	64	64	64	64	66	64	65	66	65	65
Dimensions - standard unit														
Length	mm	3604	3604	3604	4798	4798	4798	5992	7186	7186	7186	7186	7186	8380
Width	mm	2253	2253	2253	2253	2253	2253	2253	2253	2253	2253	2253	2253	2253
Height	mm	2297	2297	2297	2297	2297	2297	2297	2297	2297	2297	2297	2297	2297
Operating weight**														
Standard unit and unit + option 119*	kg	3410	3450	3490	4313	4883	4903	4814	5707	5857	6157	6457	6496	6958
Compressors		06T semi-hermetic screw compressors, 50 r/s												
Circuit A		1	1	1	1	1	1	1	1	1	1	1	1	1
Circuit B		1	1	1	1	1	1	1	1	1	1	1	1	1
Refrigerant -Standard unit**		R-134a												
Circuit A	kg	37	35	35	50,5	52	53,5	58,5	58	58	65	69	69	72
	teqCO_2	52,9	50,1	50,1	72,2	74,4	76,5	83,7	82,9	82,9	93,0	98,7	98,7	103,0
Circuit B	kg	38,5	36	37	36,5	37	32,5	36	59	62	58	65	65	63
	teqCO_2	55,1	51,5	52,9	52,2	52,9	46,5	51,5	84,4	88,7	82,9	93,0	93,0	90,1
Oil charge														
Circuit A	l	20,8	20,8	20,8	23,5	23,5	23,5	23,5	23,5	23,5	27,6	27,6	27,6	27,6
Circuit B	l	20,8	20,8	20,8	20,8	20,8	20,8	20,8	23,5	23,5	23,5	23,5	23,5	23,5
Capacity control		Touch Pilot, electronic expansion valve (EXV)												
Minimum capacity	%	15	15	15	15	15	15	15	15	15	15	15	15	15
Condensers		All-aluminium microchannel heat exchanger (MCHE)												
Fans - Standard unit		Axial Flying Bird IV fans with rotating shroud												
Quantity		6	6	6	8	8	-	9	11	12	12	12	-	14
Maximum total air flow	l/s	20500	20500	20500	27333	27333	-	30750	37583	41000	41000	41000	-	47833
Maximum Rotation speed	r/s	11,7	11,7	11,7	11,7	11,7	-	11,7	11,7	11,7	11,7	11,7	-	11,7
Standard unit + option 119*														
Quantity		6	6	6	8	8	8	9	11	12	12	12	12	14
Maximum total air flow	l/s	27083	27083	27083	36111	36111	36111	40825	49653	54167	54167	54167	54167	63194
Maximum Rotation speed	r/s	15,7	15,7	15,7	15,7	15,7	15,7	15,7	15,7	15,7	15,7	15,7	15,7	15,7
Evaporator		Flooded multi-pipe type												
Water content	l	58	61	61	66	70	77	77	79	94	98	119	119	119
Without hydronic module														
Water inlet/outlet connections		Victaulic												
Nominal diameter	in	5	5	5	5	5	5	5	5	6	6	6	6	6
Actual outside diameter	mm	141,3	141,3	141,3	141,3	141,3	141,3	141,3	141,3	168,3	168,3	168,3	168,3	168,3
Maximum water-side pressure†	kPa	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
With hydronic module (option 116)														
Water inlet/outlet connections		Victaulic												
Nominal diameter	in	4	4	4	4	4	-	4	-	-	-	-	-	-
Actual outside diameter	mm	114,3	114,3	114,3	114,3	114,3	-	114,3	-	-	-	-	-	-
Expansion tank volume	l	50	50	50	50	50	-	80	-	-	-	-	-	-
Maximum water-side pressure	kPa	400	400	400	400	400	-	400	-	-	-	-	-	-
Chassis paint colour		Colour code: RAL7035												

* Options: 119 = High energy efficiency, 257 = low noise level, 279 = compressor enclosure, 258,= very low sound level

** Weights are guidelines only. Refer to the unit nameplate.

*** in dB ref=10-12 W, (A) weighting. Declared dualnumber noise emission values in accordance with ISO 4871 (with an associated uncertainty of +/-3dB(A)). Measured in accordance with ISO 9614-1 and certified by Eurovent.

**** in dB ref 20µPa, (A) weighting. Declared dualnumber noise emission values in accordance with ISO 4871 (with an associated uncertainty of +/-3dB(A)). For information, calculated from the sound power level Lw(A).

† Max. water-side operating pressure without hydronic module.

Note: Unit sizes 30XA 1402 to 1702 are supplied in two field-assembled modules.

EUROVENT CERTIFIED PERFORMANCE

Eurovent certified values

Appendix II Proposed plant technical datasheets

TECHNICAL SELECTION - EN 14511 - EN 14825 Page 3 / 5

FOCS-N-G05 /SL-CA 2022

Software version: ELCA World 1.5.1.0
Database version: 1.6.1.0
User: Craig Newsham
Print data: 29/03/2021 20:49
Calculation type: EN 14511 - EN 14825

EUROVENT CERTIFIED PERFORMANCE
Check ongoing validity of certificate: www.eurovent-certification.com

HEATING COOLING AXIAL SCREW R513A

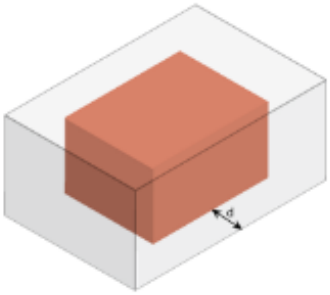
COMPRESSORS

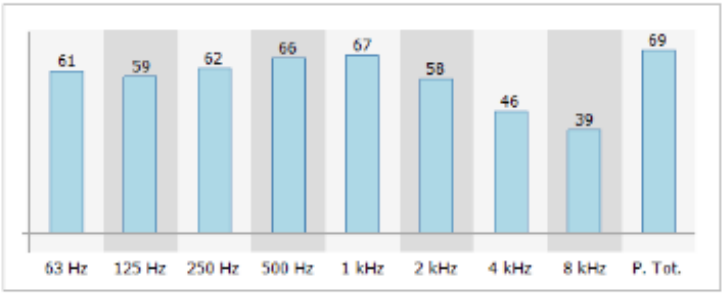
Compressor type		SCREW
Compressors nr.	N°	2
No. Circuits	N°	2
Refrigerant		R513A
Number of capacity steps	N°	0
Min. capacity step	%	25
Regulation		STEPLESS
Oil charge	kg	44.0
Refrigerant charge	kg	243
F.L.I. - Max absorbed power	kW	2 x 89,8
F.L.A. - Max absorbed current	A	2 x 143,9
L.R.A. - Locked rotor amperes for single compressor	A	2 x 225

NOISE DATA

SOUND DATA COLD

Frequencies	Hz	63	125	250	500	1000	2000	4000	8000
Sound power (spectrum)	dB	81	79	82	86	87	78	66	59
Sound power level in cooling	dB(A)				89				
Sound pressure level (spectrum)	dB	61	59	62	66	67	58	46	39
Sound Pressure	dB(A)				69				





SOUND DATA OUTDOOR HOT

Sound power level in heating	dB(A)	90

Note

Distance	m	1
Note		Average sound pressure level at 1 m distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level. Sound power on the basis of measurements taken in compliance with ISO 9614.

The performance shown are obtained from theoretical calculations and tolerances will apply.
Rpt version: 1.0.3.0

CLIMAVENETA

TECHNICAL SELECTION - EN 14511 - EN 14825 Page 3 / 6

ERACS2-Q-G05 /SL-CA 1062

Software version: ELCA World 1.5.0.0
Database version: 1.6.0.0
User: Craig Newsham
Print data: 26/01/2021 10:41
Calculation type: EN 14511 - EN 14825

EUROVENT CERTIFIED PERFORMANCE
Check ongoing validity of certificate: www.eurovent-certification.com

HEATING | AXIAL | SCREW | R 513A

HEATING

Quantity	N°	6
Fans power input	kW	0.90
Air flow	m³/s	18.30
Fan available static pressure	Pa	0

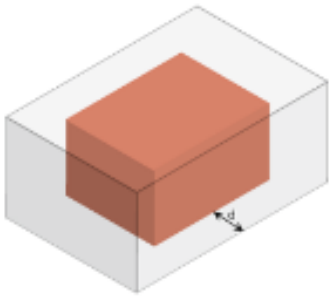
COMPRESSORS

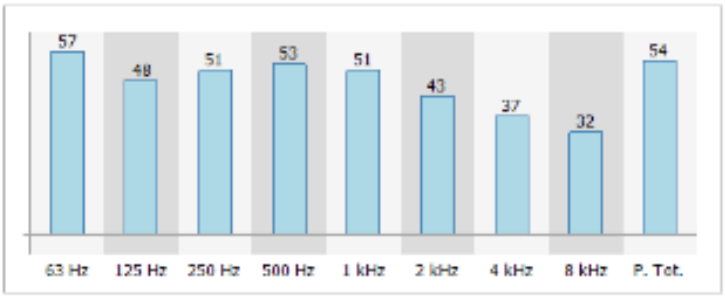
Compressor type		SCREW
Compressors nr.	N°	2
No. Circuits	N°	2
Refrigerant		R513A
Number of capacity steps	N°	6
Min. capacity step	%	25
Regulation		STEPS
Oil charge	kg	19.0
Refrigerant charge	kg	101
F.L.I. - Max absorbed power	kW	2x40.5
F.L.A. - Max absorbed current	A	2x67.1
L.R.A. - Locked rotor amperes for single compressor	A	2x169

NOISE DATA

SOUND DATA COLD

Frequencies	Hz	63	125	250	500	1000	2000	4000	8000
Sound power (spectrum)	dB	89	80	83	85	83	75	69	64
Sound power level in cooling	dB(A)				88				
Sound pressure level (spectrum)	dB	57	48	51	53	51	43	37	32
Sound Pressure	dB(A)				54				





SOUND DATA OUTDOOR HOT

Sound power level in heating	dB(A)	87

Note

Distance	m	10
Note		Average sound pressure level at 10 m distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level. Sound power on the basis of measurements taken in compliance with ISO 9614.

The performance shown are obtained from theoretical calculations and tolerances will apply.
Rpt.version: 1.0.3.0

CLIMAVENETA

Appendix III Detailed calculations

Existing plant calculations

		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dBA
Existing plant SPL @ 10m										
Sound Pressure Levels @ 10m, 30XA 602 no options		68	69	65	64	63	58	53	50	67
Multiple units										
No. of Sources	2									
Container Link In		68	69	65	64	63	58	53	50	
Container Link Out		71	72	68	67	66	61	56	53	70
Point source distance loss										
Start Distance (m)	10									
End Distance (m)	6.1									
Losses (positive values)		4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	
Levels Before Loss		71	72	68	67	66	61	56	53	
Levels After Loss		75.3	76.3	72.3	71.3	70.3	65.3	60.3	57.3	74
Maekawa screening loss										
Source Height (m)	2.5									
Barrier Height (m)	2.5									
Plant to Barrier (m)	1.6									
Reciever Height (m)	0									
Barrier to Reciever (m)	4.8									
Direct Path (m)	6.4									
Barrier attenuation		-8.7	-10.8	-13.2	-15.9	-18.7	-21.6	-24.6	-27.6	
Levels before barrier loss		75.3	76.3	72.3	71.3	70.3	65.3	60.3	57.3	
Levels after barrier loss		66.6	65.5	59.1	55.4	51.6	43.7	35.7	29.7	58
External Receiver @ building parapet										
Sound Pressure, Lp		**67**	**66**	**59**	**55**	**52**	**44**	**36**	**30**	**58**

Proposed plant calculations

		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB(A)
Unit 1, proposed plant SPL @ 1m										
FOCS-H, sound Pressure Levels @ 1m		62	60	63	67	68	59	47	40	70
Point source distance loss										
Start Distance (m)	1									
End Distance (m)	9.6									
Losses		-19.6	-19.6	-19.6	-19.6	-19.6	-19.6	-19.6	-19.6	
Levels After Loss		42.4	40.4	43.4	47.4	48.4	39.4	27.4	20.4	50
Maekawa screening loss										
Source Height (m)	2.5									
Barrier Height (m)	2.5									
Plant to Barrier (m)	2.8									
Reciever Height (m)	0									
Barrier to Reciever (m)	6.7									
Direct Path (m)	9.5									
Losses		-8	-9.8	-12.1	-14.7	-17.5	-20.3	-23.3	-26.3	
OutLink Output (Row A)		**34.4**	**30.5**	**31.3**	**32.7**	**30.9**	**19**	**4.1**	**-5.9**	**34**
Unit 1, proposed plant SPL @ 1m										
FOCS-H, sound Pressure Levels @ 1m		62	60	63	67	68	59	47	40	70
SPL at building parapet										
Start Distance (m)	1									
End Distance (m)	7									
Losses		-16.9	-16.9	-16.9	-16.9	-16.9	-16.9	-16.9	-16.9	
Levels After Loss		45.1	43.1	46.1	50.1	51.1	42.1	30.1	23.1	53
Maekawa screening loss										
Source Height (m)	2.5									
Barrier Height (m)	2.5									
Plant to Barrier (m)	2									
Reciever Height (m)	0									
Barrier to Reciever (m)	5									
Direct Path (m)	7									

Losses		-8.7	-10.6	-13.1	-15.7	-18.6	-21.5	-24.4	-27.4	
OutLink Output (Row B)		**36.4**	**32.5**	**33**	**34.4**	**32.5**	**20.6**	**5.7**	**-4.3**	**36**
Unit 1, proposed plant SPL @ 1m										
FOCS-H, sound Pressure Levels @ 1m		62	60	63	67	68	59	47	40	70
SPL at building parapet										
Start Distance (m)	1									
End Distance (m)	6.6									
Losses		-16.4	-16.4	-16.4	-16.4	-16.4	-16.4	-16.4	-16.4	
Levels After Loss		45.6	43.6	46.6	50.6	51.6	42.6	30.6	23.6	54
Maekawa screening loss										
Source Height (m)	2.5									
Barrier Height (m)	2.5									
Plant to Barrier (m)	1.9									
Reciever Height (m)	0									
Barrier to Reciever (m)	4.7									
Direct Path (m)	6.6									
Losses		-8.8	-10.8	-13.3	-16	-18.8	-21.7	-24.7	-27.7	
OutLink Output (Row C)		**36.8**	**32.8**	**33.4**	**34.7**	**32.8**	**20.9**	**5.9**	**-4.1**	**36**
Unit 4, proposed plant SPL @ 1m										
ERACS-H, sound Pressure Levels @ 1m		58	49	52	54	52	44	38	33	55
SPL at building parapet										
Start Distance (m)	1									
End Distance (m)	8.6									
Losses		-18.7	-18.7	-18.7	-18.7	-18.7	-18.7	-18.7	-18.7	
Levels After Loss		39.3	30.3	33.3	35.3	33.3	25.3	19.3	14.3	37
Maekawa screening loss										
Source Height (m)	2.5									
Barrier Height (m)	2.5									
Plant to Barrier (m)	2.5									
Reciever Height (m)	0									
Barrier to Reciever (m)	6.1									
Direct Path (m)	8.6									

Losses		-8.2	-10.1	-12.4	-15	-17.8	-20.7	-23.7	-26.7	
OutLink Output (Row D)		**31.1**	**20.2**	**20.9**	**20.3**	**15.5**	**4.6**	**-4.4**	**-12.3**	**21**
External Receiver @ building parapet										
Output from Row A		34.4	30.5	31.3	32.7	30.9	19	4.1	-5.9	34
Output from Row B		36.4	32.5	33	34.4	32.5	20.6	5.7	-4.3	36
Output from Row C		36.8	32.8	33.4	34.7	32.8	20.9	5.9	-4.1	36
Output from Row D		31.1	20.2	20.9	20.3	15.5	4.6	-4.4	-12.3	21
Total Sound Pressure Level (dB)		**41**	**37**	**38**	**39**	**37**	**25**	**10**	**0**	**40**

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