

Technical Note

Project name **Henry Royce Institute - L1 Hydrogen Autoclave Fan**
Project no. **1620007999**
Client **University of Manchester**
Memo no. **2024/1**
Version **1**
To **Mark Pitts, Tim Farnworth**
From **Ryan McNulty**
Copy to **Gerald Pepper, Stuart Moses, Elliot Quinn**

Prepared by **Ryan McNulty**
Checked by **Simon Taylor**
Approved by **Simon Taylor**

Henry Royce Institute - L1 Hydrogen Autoclave Fan

Date 18/09/2024

1 Introduction and Background

Ramboll UK (RUK) has been appointed by Arcadis to provide a technical review of a proposed extract fan, which will be sited on the roof of the Henry Royce Institute at the University of Manchester.

The purpose of the fan is to extract air from within the building and is required to maintain safe conditions for a specific item of research equipment.

It is important that noise emissions from external plant items serving the Henry Royce Institute are controlled to appropriate levels at the nearest sensitive receptors. Therefore, this brief note considers the manufacturer's sound level data for this new fan and the expected impact on the nearest sensitive receptors.

Ramboll
Arkwright House
Parsonage Gardens
Manchester M3 2LF
United Kingdom

T +44 161 827 1890
<https://uk.ramboll.com>

2 Criteria

2.1 Manchester City Council – Planning and Noise, Technical Guidance

Planning permission for the Henry Royce institute was granted in 2017 under application 114430/FO/2016 ([click here](#)).

Ramboll has previously prepared a full assessment of all installed external plant items serving the Henry Royce Institute (report ref: 6479-RAM-XX-ZZ-RP-YA PC17 discharge report dated 14/01/2020. This report was prepared to confirm that the as installed plant meets the requirements of Manchester City Council's 'Planning and Noise, Technical Guidance'. 2022¹.

The guidance states:

¹ https://www.manchester.gov.uk/downloads/download/5199/information_for_developers

'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 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location'

The assessment methodology and definition of a 'rating level' are from the following British Standard.

2.2 British Standard 4142:2014+A1:2019 Method for rating and assessing industrial and commercial sound

BS 4142:2014+A1:2019² (BS4142) provides a method for rating industrial and commercial sound and method for assessing resulting impacts upon people. The method is applicable to fixed plant installations, sound from industrial and manufacturing process and other associated activities.

The basis of BS4142 is a comparison between the background noise level in the vicinity of residential locations and the rating level of the noise source under consideration. The relevant parameters in this instance are as follows:

- Background Level, $L_{A90,T}$: defined in the Standard as the 'A' weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, and quoted to the nearest whole number of decibels;
- Specific Level, $L_{Aeq,T}$: the equivalent continuous 'A' weighted sound pressure level at the assessment location due to the specific sound source under consideration, over a given time interval, T; and
- Rating Level, $L_{Ar,T}$: the specific sound level plus any adjustment made for the characteristic features of the noise.

Potential impacts are predicted from the difference between the representative background level at a noise sensitive receptor and the rating level from the noise source considered. The standard suggests that the greater the difference, the greater the magnitude of impact.

Section 11 of BS4142 gives guidance for significance of impacts in reference to comparing rating noise levels against existing background noise levels:

- i. Typically, the greater this difference, the greater the magnitude of the impact;
- ii. A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- iii. A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- iv. The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

² British Standards Institute, 2014 and 2019. British Standard BS 4142+A1:2019: Methods for rating and assessing industrial and commercial sound. BSI.

2.2.1 BS4142 Noise Characteristics and Penalties

BS4142 applies different penalties for noise sources that have an acoustic feature. These penalties are applied to the plant noise level where such features increase attention to the noise, such as tonality and intermittent operation.

BS4142 gives a guide to the level of penalty that should be applied, summarised below.

Tonality

- Tone just perceptible at the noise receptor: +2dB
- Tone clearly perceptible: +4dB
- Tone highly perceptible: +6dB

Intermittency

- Identifiable on/off conditions, readily distinctive against the residual acoustic environment: +3dB

3 Existing Background Levels

The Ramboll assessment prepared in 2020 summarises the background noise levels measured during a noise survey in 2016 where the nearest noise sensitive receptors were found to be the adjacent Alan Turing Building and student accommodation on 43 Upper Brook Street. The Alan Turing Building is not in use overnight.

Based on the survey data the following noise limits apply to plant serving the Henry Royce Institute.

Table 1 - Daytime and nighttime plant noise limits at NSRs based on typical background level (L_{A90})

Location	Daytime 07:00-23:00		Night time 23:00-07:00	
	Measured background level, L_{A90}	Plant noise emission limit (rating), $L_{Ar,Tr}$	Measured background level, L_{A90}	Plant noise emission limit (rating), $L_{Ar,Tr}$
Rear of Alan Turing Building	52	47	-	-
43 Upper Brook Street / front of Alan Turing Building	59	54	49	44

4 Proposed Fan and Location

The location of the fan is generally a central part of the roof as shown on Ramboll drawings 6479-RAM-XX-09-DR-ME-570901 and 6479-RAM-XX-09-DR-ME-570902. As shown on these drawings, the duct outlet is 3m above roof level.

The specific fan model is:

- **System Air** PRF-EX 315D4 Ex d³

Table 2 - PRF-EX 315D4 Ex d sound power data

Description	Overall, dBA	Sound power level, dB, @ octave band centre frequency							
		63	125	250	500	1k	2k	4k	8k
Inlet – in duct SWL	54	43	60	53	53	49	41	31	17
Outlet – in duct SWL	55	44	61	54	54	50	42	32	18

5 Assessment

The outlet for the proposed fan terminates at 3m above the roof level. Therefore, reflections will be limited but to provide a robust assessment it has been assumed the reflections of a single surface apply (i.e. off the roof).

The ductwork connecting the fan is >25m in length and has a minimum of 4.no radiused bends. Duct losses have been applied as based on standard acoustic resources such as CIBSE and Sound Research Laboratories. The end reflection for the outlet are also considered.

Finally, the nearest receptor is the Alan Turing Building which is at least 15m from the proposed outlet.

Based on the above considerations, the following table calculates the sound pressure level of the outlet at 15m.

³ [PRF-EX Centrifugal Fans - Systemair](#)

Table 3 – Calculated noise to atmosphere

Description	Overall, dBA	dB @ Octave band centre frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
Fan Outlet - in duct SWL	55	44	61	54	54	50	42	32	18
Losses for >25m ductwork @ 350mm ø	--	-2	-3	-3	-4	-6	-6	-6	-6
4.no radiused bends @ 350mm ø	--	0	0	-8	-32	-20	-12	-12	-12
End reflection @ 350mm ø	--	-12	-7	-3	-1	0	0	0	0
Distance correction @ 15m (spherical)	--	-34	-34	-34	-34	-34	-34	-34	-34
Directivity for outlet @ 0.096 m ² (inc. one surface)	--	+3	+4	+6	+7	+8	+9	+9	+9
TOTAL sound pressure level at 15m	7	0	21	12	0	0	0	0	0

The above table shows that predicted noise levels from the proposed fan outlet would be < 10 dBA at the Alan Turing Building and would be even lower to other receptors such as 43 Upper Brook Street since they are further away (approx. 85m).

Using the predicted level from Table 3, a BS4142 assessment has been carried out as presented in Table 4. Since a noise level of 7 dBA would be inaudible at 15m due to the masking effects of the existing noise climate no acoustic penalties are applied.

Table 4 – BS4142 Assessment

Description	Noise level at nearest sensitive receptor, dB(A)			
	Alan Turing Building		43 Upper Brook Street	
	Day	Night	Day	Night
Noise level predicted at receptor (Specific Sound Level, $L_{Aeq, 1hour}$)	7	- -	0	0
Acoustic feature corrections	0	- -	0	0
Rating level ($L_{Ar, Tr}$)	7	- -	0	0
Background level (L_{A90})	52	- -	59	49
Excess of rating level over background	-45	- -	-59	-49
Rating level complies with MCC requirements?	✓	✓	✓	✓

The above table shows that predicted rating noise levels from the new fan as assessed using the methodology of BS4142 will be more than 5 dB below the existing background noise climate. This meets the criterion set by Manchester City Council for new plant items and no mitigation measures are required.

5.1 Uncertainty

The noise survey used for this assessment was initially done in 2016, but even allowing for some difference in noise levels in 2024 it is not expected that background noise levels will have changed much or enough to affect the outcome of this assessment.

All distances used in this report are based on linear measurements in plan. It is expected that distances will be greater in practice since the new fan will be at roof level.

No reduction of noise levels as a result of intervening structures such as the roof parapet are included in this assessment. Where present such features will reduce noise levels further.

6 Conclusion

Ramboll UK has reviewed the noise data for a proposed extract fan, which will be sited on the roof of the Henry Royce Institute at the University of Manchester.

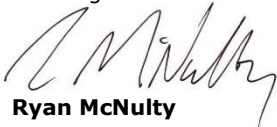
The fan will extract air from within the building and is required to maintain safe conditions for a specific item of research equipment.

Based on noise data provided by the manufacturer of the fan, together with information for the ductwork between the fan outlet and fan location it has been determined that noise levels from the proposed plant item will be significantly lower than existing background noise levels at the nearest sensitive receptors. In reaching this conclusion, Ramboll has referred to a noise survey from 2016. However, since predicted noise levels are so low it is not expected that the outcome of this assessment would change even if more up to date measurements were obtained.

Noise levels from the proposed fan meet the criterion set by Manchester City Council for new plant items and no mitigation measures are required.

I trust the assessment within this letter report are clear. Should any further information be required please do not hesitate to contact me.

Kind regards



Ryan McNulty
BA(Hons) MIOA

Acoustics

D +44 161 827 1890

M +44 7976 448682

ryan.mculty@ramboll.co.uk