BRITISH THORACIC SOCIETY, 17 DOUGHTY STREET

EXTERNAL PLANT NOISE ASSESSMENT

Acoustics Report A935/R01
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1 Introduction

Ion Acoustics is appointed by the British Thoracic Society to carry out an assessment of external plant noise at their offices at 17 Doughty Street, London. As part of refurbishment works at the offices, three existing condensers at basement level at the rear of the building will be relocated to a new roof which will be constructed at first floor level.

London Borough of Camden has requested a noise impact assessment to determine the implications of the relocation of this plant on external noise levels outside the nearest residential properties.

Ion Acoustics carried out a noise survey at the site to determine the existing baseline noise levels in the absence of the existing plant. The results have been used to assess the noise impact of the relocated plant and at the nearest residential properties. In particular, this report describes:

- A noise survey to determine underlying background noise levels for a representative period during which the plant will be operational;
- Measurements of the existing plant in operation
- London Borough of Camden's standard guidance in relation to external plant noise emissions;
- Calculations of relocated plant to the nearest residential properties and comparison with the local authority guidance;
- Details of noise control measures to ensure that the noise limits are met.

2 External Plant Details

2.1 Existing Plant Details and Location

The existing plant comprises three DX condensers:

- 2 x Sanyo SAP-CRV184EH
- 1 x Sanyo SPW-CR364GVH56B

The condensers are currently located at basement level at the rear of the building, as shown in Figure 1. The condensers are currently shielded from the nearest residential windows on the top floor of 16 Doughty Street by the existing structures. A section indicating the location of the condensers in relation to the existing building is shown in Figure 2.

Figure 1 – Existing plant location at rear of 17 Doughty Street

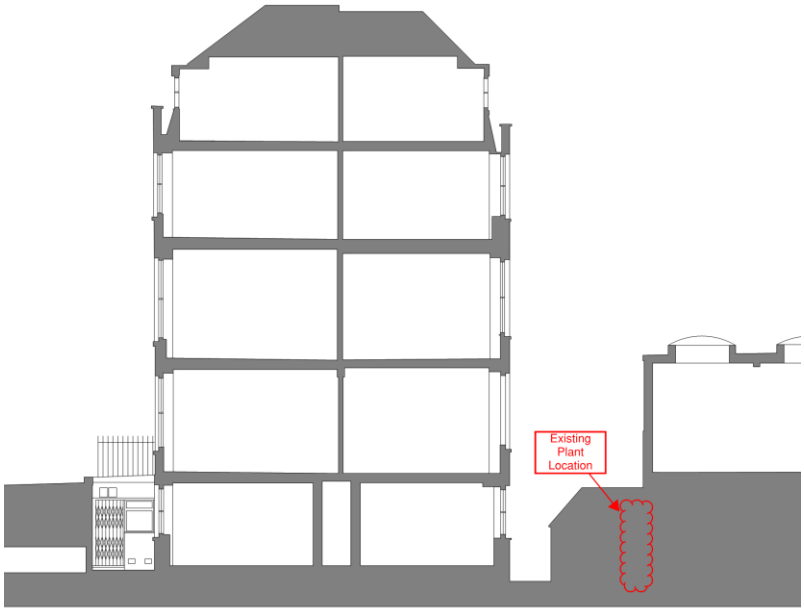

Figure 2 – Section showing existing plant location

2.2 Proposed Plant Location

The refurbishment work at the offices includes the refurbishment of the ground floor reception and kitchen areas and includes construction of a flat infill roof at first floor level. The new roof will be slightly lower than the existing roof of the ground floor meeting room, which is located further to the rear of the existing building. The condensers will be relocated to the new flat roof, as shown in the section plan in Figure 3.

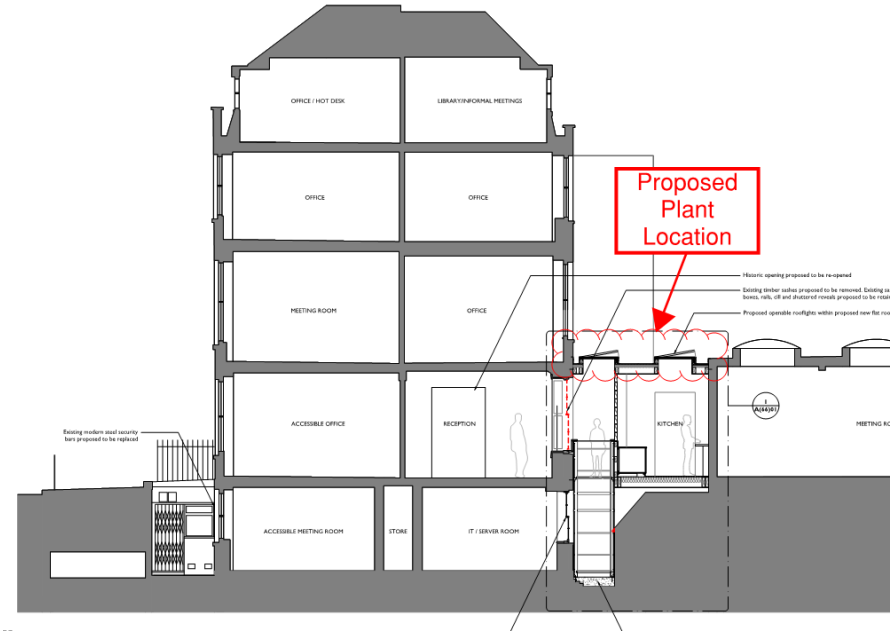

Figure 3 – Section showing proposed plant location

3 Noise Criteria

3.1 Camden Guidance

Camden Council has requested that the noise impact arising from the relocation of the plant be assessed according to "Development Policy 28: Noise and Vibration (DP28)", which forms part of the London Borough of Camden Local Development Framework Development Policies. Noise limits for new external plant are found in Table E of DP28, which is shown below in Figure 4.

Table E: Noise levels from plant and machinery at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000-2400	5dB(A) <LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	0000-2400	55dBL_{Aeq}

Figure 4 – Camden Council DP 28 Table E indicating recommended noise limits for external plant

DP28 requires external noise emission from external plant to be controlled to a level of 5 dB(A) below the background noise level (L_{A90}, dB) during the daytime, evening and night-time periods.

DP28 defines the daytime period as 07:00 to 19:00 hours, the evening period as 19:00 to 23:00 hours and the night-time period as 23:00 hours to 07:00 hours. The noise limit applies at a distance of 1m from the sensitive façade of the nearest residential receptor to the new external plant.

The condensers will only operate during daytime hours so will only require a noise limit to be set between 07:00 and 19:00 hours, in accordance with the DP28 noise limit periods. It has not been necessary to set noise limits for the evening and night-time periods.

DP28 does not state the method by which the background noise level is determined, but does give reference to the now superseded Planning Policy Guidance 24 (PPG24): Planning and Noise. DP28 states: '*…when development that generates noise is proposed, the Council will require an acoustic report to ensure compliance with PPG24: Planning and noise. A condition will be imposed to require that the plant and equipment which may be a source of noise pollution is kept working efficiently and within the required noise limits and time restrictions. Conditions may also be imposed to ensure that attenuation measures are kept in place and effective throughout the life of the development'.*

It is noted that does not include a method for assessing external plant noise, but refers to BS 4142: 'Methods for rating and assessing industrial and commercial sound'. The latest version of BS 4142 was published in 2014, and includes guidance for assessing external plant noise, and for determining the background noise level at a measurement location. An attended noise survey was carried out during a late morning/early afternoon period to determine the background noise levels in the absence of the existing condensers.

4 Noise Survey

4.1 Methodology

An attended noise survey was carried out at the existing building on Thursday 15th October 2015. All measurements were made with a Norsonic Nor 140 sound level meter which was calibrated prior to and on completion of measurements with a Brüel & Kjær Type 4231 calibrator. All measurements were made by Paul Doyle of Ion Acoustics. Weather conditions were dry with very little wind detected. The measurement positions are described below:

Measurement Position P1

Measurements were made at a position P1 to determine the underlying background noise levels in the absence of the existing condensers. Measurements were made at a location representative of the nearest housing at 16 Doughty Street, with all condensers switched off. The sound level meter was mounted on a tripod on the existing flat roof of the basement. The measurement microphone was positioned 1m from the building façade, and measurements therefore include the reflecting effect of the façade, which is taken to result in a 3dB increase when compared to the "free-field" equivalent in the absence of reflections. Measurements were made in consecutive ten-minute periods between 11:50 and 12:50 hours. Measurement position P1 is shown in Figure 5.

Figure 5 –Measurement Position P1 used for determining background noise levels (L_{A90}) in the absence of existing condensers

Measurement Position P2

Measurements were made at position P2 to determine the typical operational source noise levels from the condensers. Measurements were made a position 1m from the existing units, at basement level. All three condensers were operating in cooling mode simultaneously, although it was not possible to determine the duty level at which they were operating. Measurements were made over short one-minute periods, as the noise source was consistent for a short period of time. It was not possible to make more than two measurements, as one of the condensers stopped operating. Measurement position P2 is shown in Figure 6.

Figure 6 –Measurement Position P2 used for determining source noise levels (L_{Aeq}) of existing condensers

4.2 Results

The noise levels measured at measurement position P1 are shown in Table 1, in terms of L_{Aeq}, L_{AFmax} and L_{A90} noise levels in ten-minute periods. The results are also shown in Appendix A. Measurements include the reflecting effect of the building façade, which is taken to result in a 3dB increase when compared to free-field levels.

Table 1: **Summary of noise levels at position P1 in the absence of existing condensers (façade levels)**

Date	Start Time	Measurement Duration	L_{Aeq}, dB	L_{AFmax}, dB	L_{A90}, dB
15/10/2015	11:50	10:00	45.7	58.9	42.6
	12:00	10:00	48.3	62.5	43.6
	12:10	10:00	51.8	68.8	43.3
	12:20	10:00	47.3	65.7	42.6
	12:30	10:00	51.3	72.2	43.8
	12:40	10:00	48.7	59.6	44.3

As Table 1 shows, the measured background noise levels indicated by the L_{A90} noise parameter were quite consistent, between 43dB L_{A90} and 44 dB L_{A90} over the measurement period. Underlying noise levels were characterised by road traffic (cars, buses) in neighbouring streets and general street activity.

The noise levels measured at measurement position P2 are shown in Table 2, in terms of the L_{Aeq}, noise levels.

Table 2: **Summary of noise levels at position P2 with existing three condensers operational**

Date	Start Time	Measurement Duration	L_{Aeq}, dB
15/10/2015	12:57	01:00	62.4
	13:01	01:00	61.6

As Table 2 shows, the source noise levels measured at position P2 were consistent at L_{Aeq} 62dB. These noise levels included reflections from several nearby walls. Note however that the measurement results are somewhat lower than would be predicted using the manufacturer's sound power data and it is assumed that the units were not operating at full duty.

The current configuration has the three condensers stacked vertically on top of one another; the relocated configuration has two of the condensers facing in the direction of Doughty Mews to the rear, and the third condenser located at a 90 degree angle to the other two units. Therefore, the source noise levels measured at position P2 will not be representative of the operational noise levels and for this reason and because of the lower than expected sound levels manufacturer's data has been used in the assessment rather than the measurement data.

4.3 Derived Plant Noise Limits

The noise limits to be applied for the relocated plant will depend on the existing background noise levels (L_{A90}, dB). Background noise levels measured at position P1 were quite consistent over the measurement period, at between 43dB L_{A90} and 44 dB $L_{A90.}$ As the measurements were made over a relatively short period of one hour, the lowest measured background noise level has been used to determine the noise limit for the daytime period. The background noise levels and derived daytime noise limit (07:00 – 19:00 hours) are shown in Table 3.

The Camden Council noise limit will apply at a distance of 1 metre from the nearest residential façade, in accordance with DP 28. Therefore, the noise limit will be based on a noise level which includes the 3dB increase due to the reflecting effect of the façade. As a result, the background noise levels used to determine the noise limits for new external plant include the reflecting effect of the façade as was measured during the noise survey. The nearest residential window is thought to be at the top floor of 16 Doughty Street, which is approximately 10m away from the proposed plant location.

Table 3 – Summary of Measured Background Noise Levels and Derived Noise Limits

Receptor	Period	Measured L_{A90}, dB (façade)	Therefore Noise Limit (1m from façade) dB(A)
16 Doughty Street	Daytime (07:00 to 19:00)	43	38

5 Calculations

The Sanyo SAP-CRV184EH and SPW-CR364GVH56B condensers both have an A-weighted sound power level of 69 dB L_{WA} according to the manufacturer. In the existing location, noise is reduced by distance attenuation and shielding as there is no direct line of sight to the existing units from the residential windows.

Calculations have been made of noise levels produced by the combination of all three condensers operating simultaneously at the nearest residential window on the top floor of 16 Doughty Street. This window will have a direct line of sight to the relocated condensers. The calculations have included a +3dB correction to account for .Calculations indicate that without mitigation, the predicted noise level at 1m from the nearest residential window will be 48dB(A), which is 10dB(A) above Camden Council's daytime noise limit. The calculations are provided in Appendix B.

5.1 Proposed Mitigation

In order to reduce noise levels to meet the daytime noise limit at 16 Doughty Street, mitigation will be required. The mitigation will need to block the line of sight between the window and the condenser units, which are approximately 670mm in height. The proposed mitigation is to provide a partial enclosure around the units, which should be constructed as shown in Figure 7.

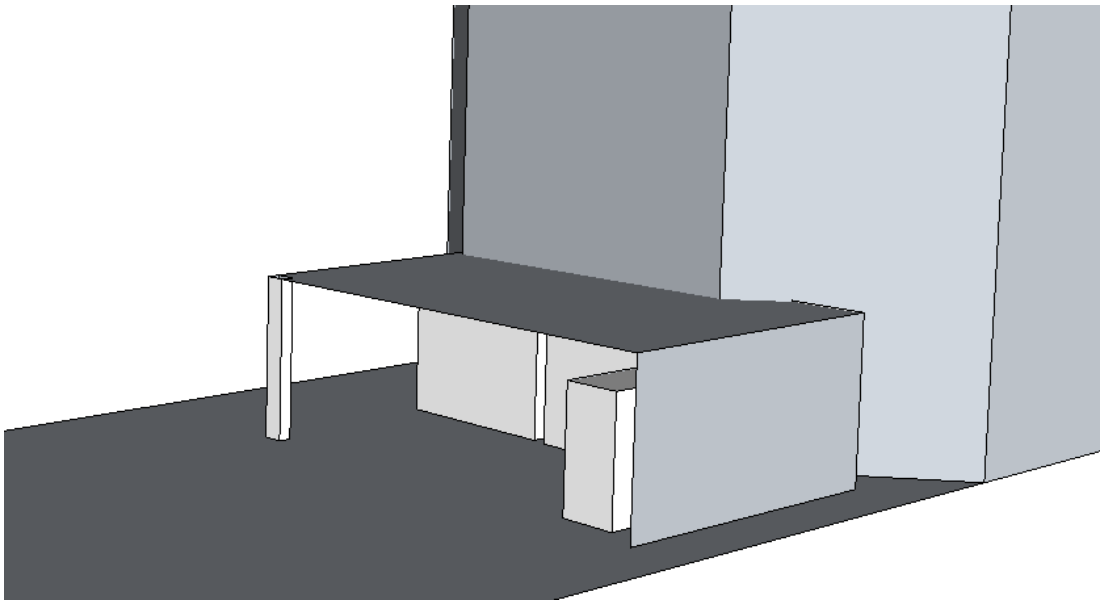

Figure 7 – Proposed form of partial enclosure (indicative only, not to scale)

Note that the enclosure sizing is indicative only and not to scale, but illustrates the principle of the mitigation. The vertical face should completely block the line of sight to 16 Doughty Street and the horizontal face should cover the top of all three condensers. The height of the horizontal face has not specified, as this will depend on air flow requirements. However, the condensers are approximately 670mm in height, to the horizontal face could be under 1m tall. The partial enclosure could be constructed as follows:

- Plywood, steel or cement fibre board on timber or steel stud framework.
- Mineral fibre lining to the interior sides of the enclosure (minimum 33kg/m^3).
- Appropriate weatherproofing would be required.

The mitigation may potentially restrict the airflow to the units. This would need to be assessed by a mechanical services engineer, although it should be noted that the previous location could also be considered a restricted location.

6 Summary

Ion Acoustics has provided a noise impact assessment for the proposed relocation of three existing condenser units at 17 Doughty Street, the offices of the British Thoracic Society. An attended noise survey has been carried out to set daytime plant noise limits for the relocated plant in accordance with Camden Council's standard guidance. Manufacturer's data has been used to predict external noise levels from the three operational condensers at the nearest residential window, at 16 Doughty Street. Mitigation will be required to meet the daytime noise limit, and outline specifications have been provided.

Date	Start Time	Duration	Location	LAeq	LAFmax	LA01	LA10	LA90
				dB	dB	dB	dB	dB
Background noise levels with plant switched off								
15/10/2015	11:50	10:00	Measurement Position P1	45.7	58.9	53.4	47.8	42.6
15/10/2015	12:00	10:00	Measurement Position P1	48.3	62.5	56.4	51.3	43.6
15/10/2015	12:10	10:00	Measurement Position P1	51.8	68.8	63.0	55.8	43.3
15/10/2015	12:20	10:00	Measurement Position P1	47.3	65.7	53.8	50.0	42.6
15/10/2015	12:30	10:00	Measurement Position P1	51.3	72.2	64.1	50.8	43.8
15/10/2015	12:40	10:00	Measurement Position P1	48.7	59.6	57.1	51.0	44.3
Source levels - ALL three condensers operational								
15/10/2015	12:57	01:00	Measurement Position P2	62.4	70.5	65.0	63.7	57.7
15/10/2015	13:01	01:00	Measurement Position P2	61.6	70.0	65.8	64.4	57.7

External plant noise calculation to 16 Doughty Street

Condenser 1				
Sanyo SAP CRV184EH			69	dB LWA
Directivity correction			3	
Corrected Lw			66	
Lp = Lw - 20 log r - 11 + DI				
r	10	20 log r	20.0	
-11			-11	
DI	3 + 3		6	
shielding			0	
façade noise level increase			3	
Lp at housing				44.0 dB(A)
Condenser 2				
Sanyo SAP CRV184EH			69	dB LWA
Directivity correction			3	
Corrected Lw			66	
Lp = Lw - 20 log r - 11 + DI				
r	10	20 log r	20.0	
-11			-11	
DI	3 + 3		6	
shielding			0	
façade noise level increase			3	
Lp at housing				44.0 dB(A)
Condenser 3				
Sanyo CR364			69	dB LWA
Directivity correction			3	
Corrected Lw			66	
Lp = Lw - 20 log r - 11 + DI				
r	10	20 log r	20.0	
-11			-11	
DI	3		3	
shielding			0	
façade noise level increase			3	
Lp				41.0 dB(A)
No Mitigation				
Combined façade Lp from all 3 units				48.0 dB(A)
Limit				38 dB(A)
Margin above limit				10.0 dB
With Mitigation				
Noise level reduction from enclosure				10 dB
Combined façade Lp from all 3 units (with enclosure)				38.0 dB(A)
Limit				38 dB(A)
Margin above limit				0.0 dB