Cole Jarman

Domino's, 35 Pratt Street, Camden

# Plant Noise Assessment

Report 18/0393/R01

Domino's, 35 Pratt Street, Camden

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Report 18/0393/R01

Domino's Pizza UK & Ireland Ltd

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| Revision | Description | Date | Prepared | Approved |
|---|---|---|---|---|
| 0 | 1st Issue | 28 August 2018 | Josh Large | Adam Sharpe |



RSK
An RSK company

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# Plant Noise Assessment

## 1 Introduction

1.1 It is proposed to convert the vacant restaurant at 35 Pratt Street, Camden to a Domino's Pizza outlet. As part of this conversion, an assessment of noise emissions from the unit's proposed mechanical services scheme is necessary.

1.2 Cole Jarman have undertaken an unattended noise survey on site in order to quantify the existing noise climate to inform a subsequent assessment of mechanical services noise.

1.3 This report contains full details of the environmental noise survey, assessment methodology and required mitigation measures in order to meet the services noise limits in accordance with Local Authority requirements.

## 2 Site Description

2.1 The site is located at 35 Pratt Street, Camden Town, London, NW1 0BG, and previously traded as a Japanese Restaurant. It occupies the ground floor with an additional basement, and has 2 storeys of residences above.

2.2 Bounded to the south eastern side of the site is Pratt Street, which similarly features restaurants with residences above running along its northern edge. Further to the south east is a residential area and underground car park. To the north of the site is St. Martin's Gardens, a local communal park. To the west of site is Bayham Street, a busy road consisting of commercial units and offices.

2.3 The noise climate perceived on site was most notably caused by road traffic on Pratt Street, with construction noise audible in the distance at the time of equipment setup.

2.4 The site falls under the jurisdiction of the London Borough of Camden.

## 3 Background Noise Survey

### 3.1 **Methodology**

3.1.1 An unattended noise survey was undertaken at the site commencing at 1200 hours on 15 August, concluding at 1200 hours on 16 August 2018.

3.1.2 Measurements of background noise levels were made at one position. This has been illustrated in attached site plan 18/0393/SP1 and is described below.

- MP1 – Approximately 2m above ground level outside the rear kitchen window, approximately 1m from the façade.

3.1.3 This position was selected to quantify background noise levels representative of those at the nearest noise sensitive receivers.

3.1.4 Measurements of the $L_{Aeq}$, $L_{Amax}$ and $L_{A90}$ indices were recorded over consecutive 15 minute periods for the duration of the survey using the equipment listed within table T1 (see attached Glossary of Acoustic Terms for an explanation of the noise units used).

| Item | Manufacturer | Type |
|---|---|---|
| Sound Level Analyser | Brüel & Kjær | 2260 |
| Acoustic Calibrator | Brüel & Kjær | 4231 |
| Weatherproof windshield | Brüel & Kjær | UA1404 |

T1 Equipment used during noise survey.

3.1.5 The microphone was fitted within a weatherproof enclosure, and the sound level meter calibrated before and after the survey in order to confirm an acceptable level of accuracy. No significant drift was noted to have occurred.

3.1.6 The weather conditions when setting up the equipment were mild and cloudy, with a light breeze. When collecting the equipment, the weather conditions were mild with light rainfall. The periods affected by rainfall (taken to be from 0700 onwards on 16 August) have been omitted from our results.

## 3.2 Results

3.2.1 The results of the noise measurements are presented in attached figure 18/0393/TH01.

3.2.2 The representative background noise levels recorded during the day and night time measurement hours during the survey duration are set out in table T2 below:

| Location | Representative Background Noise Level, dB(A) | |
|---|---|---|
| | Daytime (0700-2300) | Night time (2300-0700) |
| MP1: Approximately 2m above ground level outside the rear kitchen window | 45 | 40 |

T2 Measured representative background noise levels, $L_{A90}$.

# 4 Plant Noise Limits

4.1 The site falls under the jurisdiction of the London Borough of Camden.

4.2 Policy A4 of the London Borough of Camden's *Local Plan 2017* relates specifically to noise:

*We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity.*

*Planning conditions will be imposed to require that plant and equipment which may be a source of noise 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 are effective throughout the life of the development.*

4.3 With regard to noise from new mechanical services plant, Appendix 3 of the Local Plan sets out the following:

*A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion).*

4.4 Based on the results of our background noise survey set out within table T2, in addition to the guidance set out above, we recommend that the following plant emission limits are to apply at the nearest noise sensitive premises, illustrated in 18/0393/SP2.

| **Location** | **Noise Emission Limit, dB** | |
|---|---|---|
| | **Daytime (0700-2300)** | **Night time (2300-0700)** |
| AP1 – 1st floor residential window on rear façade of site | 35 | 30 |
| AP2 – 1st floor residential window on eastern façade of site | 35 | 30 |
| AP3 – 1st floor window at residence to east of site | 35 | 30 |

T3 Plant noise emission limits at the nearest residential properties.

4.5 To put the recommended night-time limit of 30dB(A) in context, allowing for a typical loss of 12dB(A) from a partially open window would result in noise levels below 20dB(A) inside any residences exposed to this level of external plant noise.

4.6 Internal noise levels below 20dB(A) are more than 10dB(A) below the guideline level of $L_{Aeq,8h}$ 30dB suggested in BS8233:2014[1], as being appropriate or bedrooms to provide suitable conditions for sleeping.

4.7 The noise limits will be applied at the nearest noise sensitive dwellings.

4.8 The noise limits apply at 1m from the outside of the closest residential windows. Plant noise that includes a tonal component would also be subject to 5 dB penalty as set out in the planning condition.

# 5 Plant Noise Assessment

## 5.1 Proposed Installation

5.1.1 The specification for the proposed plant is as follows:

- AC Condenser — Mitsubishi Heavy Industries FDC100VNX;
- Cold Room Condenser — Karbox 2464;
- AHU Supply Fan — Air Vent Tech Model 5;
- Kitchen Extract Fan — Vent Axia Black Sabre BSC500/4.

5.1.2 The air conditioning unit, cold room condenser and extract fan have all been installed on the site's northern façade, while the supply fan is on the eastern side.

5.1.3 It has been assumed that all four units will be running during the site's opening hours of 1100 hours to 2300 hours, however only the cold room condenser will be operational during the store's closing times.

## 5.2 Methodology

5.2.1 Our assessment has used manufacturer's noise data for all units. This has been set out on the attached schedule 18/0393/PNS1. The noise data suggests that no tonality correction need be applied.

5.2.2 The noise levels generated by the plant have been calculated by correcting the noise levels for distance, radiation, duct and screening losses, and façade reflections where appropriate.

5.2.3 Details of our calculations are set out on attached sheets 18/0393/CS1-CS21

[1] British Standard 8233:2014 - Guidance and sound insulation and noise reduction for buildings

## 5.3 Results

5.3.1 The results of our assessment indicate that mitigation of noise emissions will be required on all plant units in order to meet the Local Authority's noise emission limits.

5.3.2 It will be necessary to house both the AC and Cold Room condensers within acoustic enclosures.

5.3.3 The required enclosures can either be custom made using high performance acoustic louvres or manufactured enclosures. Examples of companies which produce high performance enclosures include Environ Technologies Ltd[2] and Sound Planning[3]. The minimum insertion loss requirements for these enclosures can be found in table T4 below.

The enclosure must be sized to allow sufficient airflow to the condenser unit and installed on suitable vibration isolation mounts.

5.3.4 In addition, it will also be necessary to attenuate the AHU Supply and Kitchen Extract fans through the provision of in-duct silencers.

| Column Title | Insertion Loss at Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| ENC-1: Acoustic Enclosure | 12 | 13 | 20 | 29 | 36 | 37 | 39 | 39 |
| AS-1: AHU Supply | 8 | 16 | 28 | 43 | 47 | 47 | 39 | 22 |
| AS-2: Kitchen Extract | 8 | 17 | 32 | 40 | 42 | 30 | 23 | 13 |

T4 Required insertion losses

5.3.5 The silencers should be located within the demise of the building, close to the fans so that noise breakout from the ducts is also attenuated. The kitchen extract fan silencer should be Melinex-faced to allow for cleaning.

5.3.6 We would expect the insertion losses required for the silencers set out above to be achieved with the following configurations:

- AS-1: 1800mm, 35% free area;
- AS-2: 1800mm, 38% free area (Melinex-faced).

[2] http://www.Environ.co.uk
[3] http://www.soundplanning.co.uk/

5.3.7 These descriptions are only a guide and the figures in table T4 should be met. It should be noted that in order for these silencers to be applied, the ductwork will need to be extended.

5.3.8 Any pressure drops from the attenuators or the atmospheric duct termination grilles should be limited to 40Pa to avoid regenerated noise.

5.3.9 The fresh air intake and extract air discharge louvres should be sized at a face velocity of no more than 2m/s to avoid regenerated noise.

5.3.10 The rating noise levels calculated with the mitigation measures specified above are shown in table T5.

| **Location** | **Rating Noise Level, dB(A)** *(Limit)* | |
|---|---|---|
| | **Daytime (0700-2300)** | **Night time (2300-0700)** |
| AP1 – Residence at rear façade of site, at first floor level | 26 *(35)* | 17 *(30)* |
| AP2 – Residence at eastern façade of site, at first floor level | 29 *(35)* | 0 *(30)* |
| AP3 – Residence to east of site, at first floor level | 34 *(35)* | 12 *(30)* |

T5 Plant noise emission limits at the nearest residential properties.

# 6 Conclusions

6.1 It is proposed to convert the vacant restaurant at 35 Pratt Street, Camden to a Domino's Pizza outlet. As part of this conversion, an assessment of noise emissions from the unit's proposed mechanical services scheme is necessary.

6.2 Cole Jarman have undertaken an unattended noise survey on site in order to quantify the existing noise climate to inform a subsequent assessment of mechanical services noise.

6.3 Noise mitigation measures have been recommended on the basis of this assessment and it has been shown that the limits would be met at all times.

End of Section

# Glossary of Acoustic Terms

$L_{Aeq}$:

The notional steady sound level (in dB) which over a stated period of time, would have the same A-weighted acoustic energy as the A-weighted fluctuating noise measurement over that period. Values are sometimes written using the alternative expression dB(A) $L_{eq}$.

$L_{Amax}$:

The maximum A-weighted sound pressure level recorded over the period stated. $L_{Amax}$ is sometimes used in assessing environmental noise when occasional loud noises occur, which may have little effect on the $L_{Aeq}$ noise level. Unless described otherwise, $L_{Amax}$ is measured using the "fast" sound level meter response.

$L_{A10}$ & $L_{A90}$:

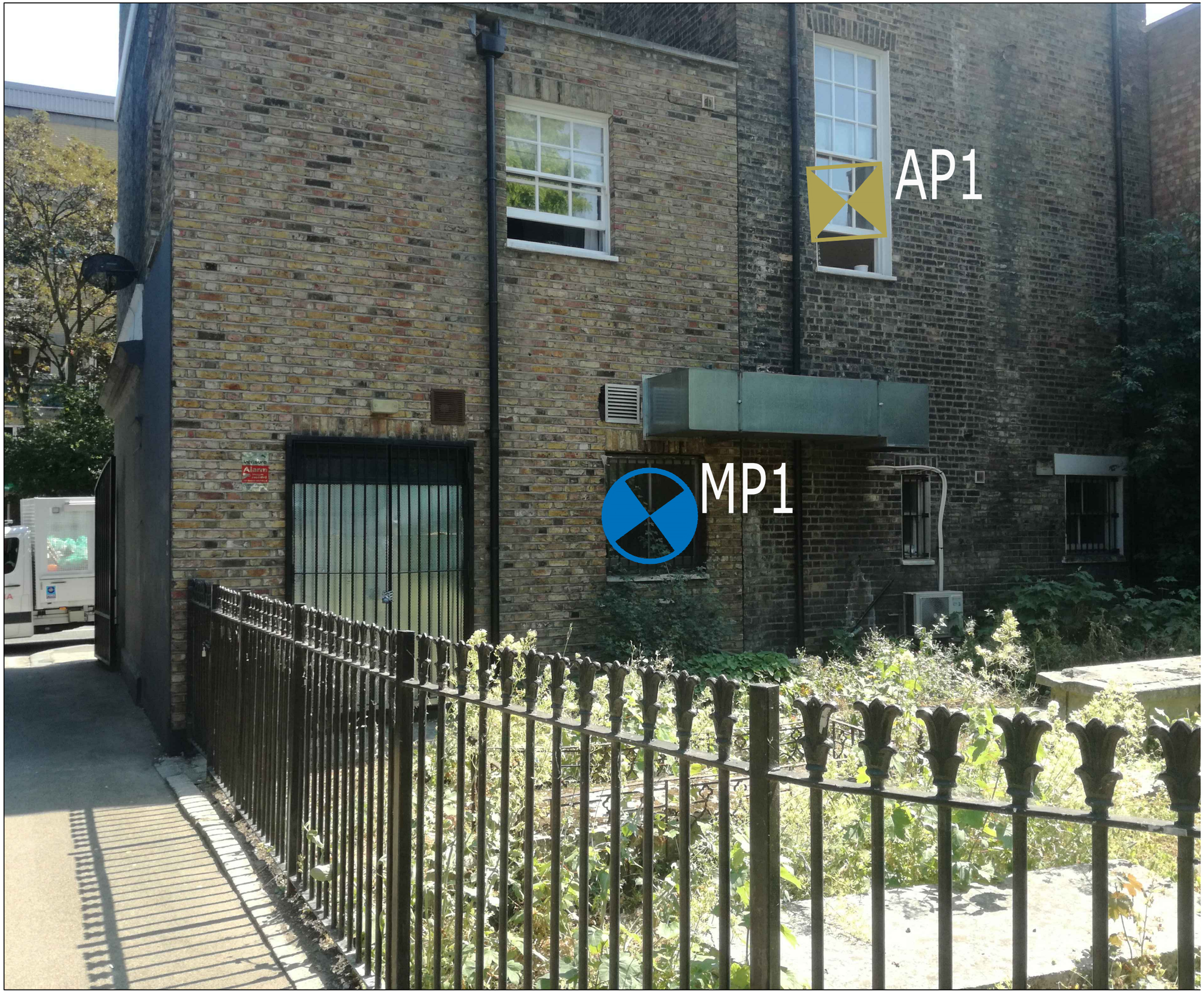
If non-steady noise is to be described, it is necessary to know both its level and degree of fluctuation. The $L_{An}$ indices are used for this purpose. The term refers to the A-weighted level (in dB) exceeded for n% of the time specified. $L_{A10}$ is the level exceeded for 10% of the time and as such gives an indication of the upper limit of fluctuating noise. Similarly, $L_{A90}$ gives an indication of the lower levels of fluctuating noise. It is often used to define the background noise.

$L_{A10}$ is commonly used to describe traffic noise. Values of dB $L_{An}$ are sometimes written using the alternative expression dB(A) $L_{n}$.

$L_{AX}$, $L_{AE}$ or SEL

The single event noise exposure level which, when maintained for 1 second, contains the same quantity of sound energy as the actual time varying level of one noise event. $L_{AX}$ values for contributing noise sources can be considered as individual building blocks in the construction of a calculated value of $L_{Aeq}$ for the total noise. The $L_{AX}$ term can sometimes be referred to as Exposure Level ($L_{AE}$) or Single Event Level (SEL).

End of Section

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# Figure 18/0393/SP1

Title:

Site Plan illustrating Measurement and Assessment positions, at rear of site

Measurement Position

Assessment Position

Project:

Domino's, 35 Pratt Street, Camden

Date:

August 2018

Revision:

-

Scale:

Not to scale

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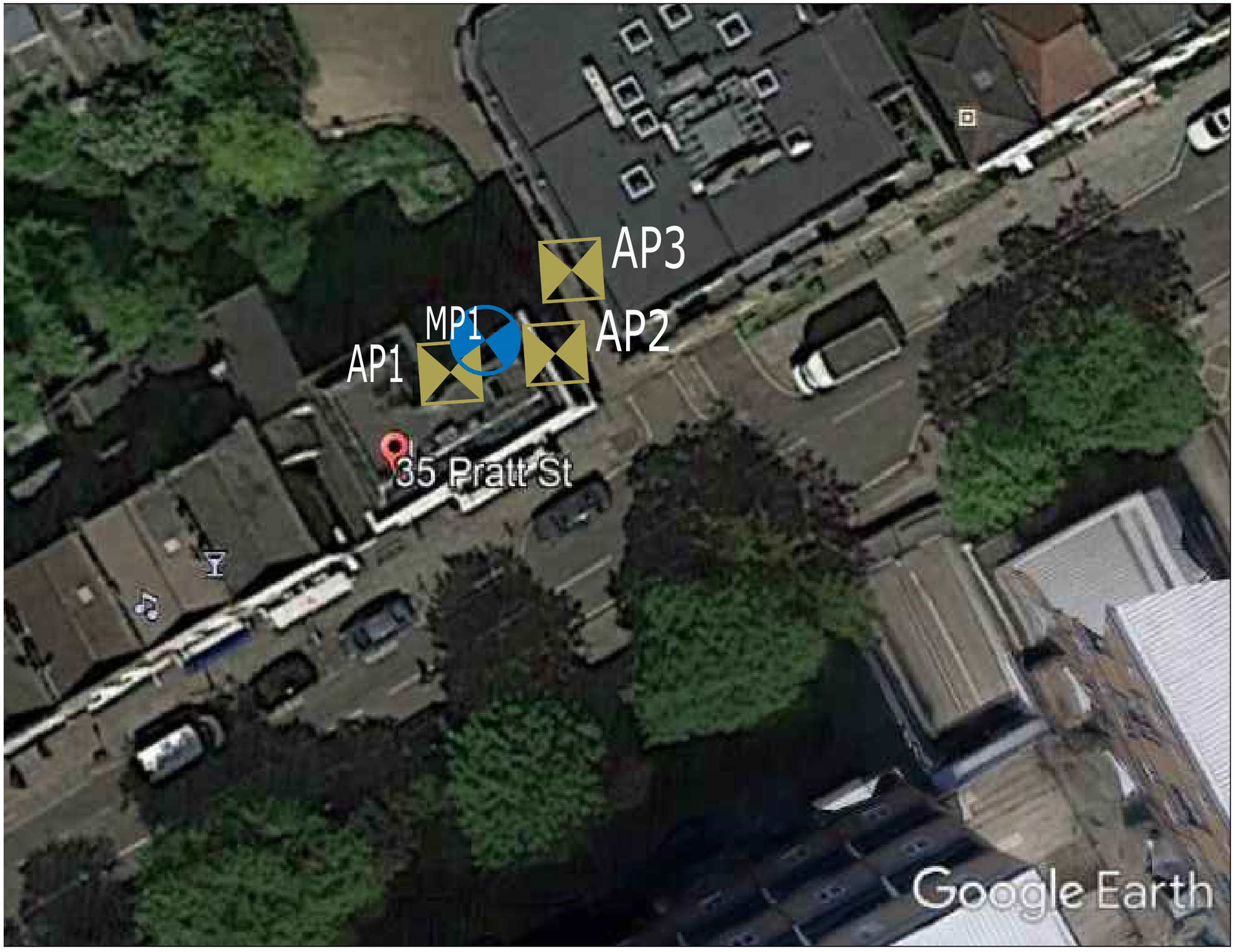


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# Figure 18/0393/SP2

Title:

Site Plan illustrating Measurement and Assessment positions, at rear of site

Measurement Position

Assessment Position

Project:

Domino's, 35 Pratt Street, Camden

Date: August 2018

Revision: -

Scale: Not to scale

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Noise Level Time History at Position MP1, 15 to 16 August 2018

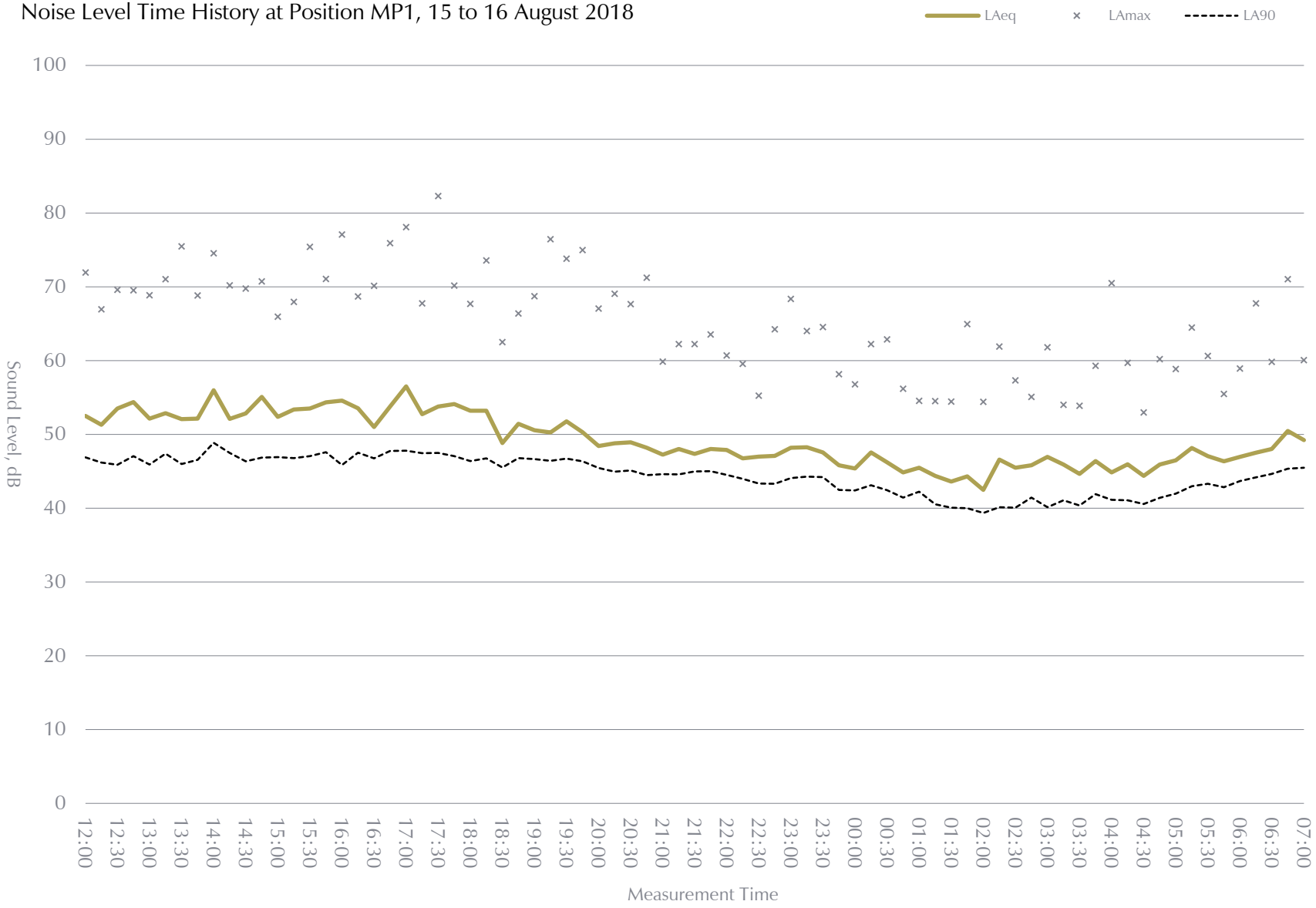


Figure 18/0393/TH01

Schedule of Plant and Air Handling Equipment Sound Levels, dB

| Reference | Description | Data Source[1] | Noise Level Type | Noise Levels (dB) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Supply Fan | Air Vent Tech Model 5 | Man | Sound Power, Lw | 77 | 79 | 73 | 74 | 77 | 77 | 74 | 69 |
| AC Condenser | Mitsubishi Heavy Industries FDC100VNX | Man | Sound Power, Lw | 49 | 56 | 60 | 62 | 59 | 56 | 52 | 44 |
| Cold Room Condenser | Karbox 2464 | Man | Sound Power, Lw | 64 | 61.5 | 61.5 | 63 | 59.4 | 57.3 | 54.1 | 46.9 |
| Extract Fan | Vent Axia Black Sabre BSC500/4 | Man | Sound Power, Lw | 80 | 79 | 76 | 72 | 75 | 75 | 68 | 61 |

Notes

1 - Man refers to data supplied by the equipment manufacturer or supplier, Emp refers to data calculated using empirical formulae, and Meas refers to data measured by Cole Jarman

AC Condenser to AP1 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - AC Condenser | | | | | | | | | |
| **Sound Power Levels** | | **49** | **56** | **60** | **62** | **59** | **56** | **52** | **44** |
| ***Silencer*** | | | | | | | | | |
| Silencer - ENC-1 | | | | | | | | | |
| | | *-12* | *-13* | *-20* | *-29* | *-36* | *-37* | *-39* | *-39* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Quarterspherical | | | | | | | | | |
| | | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 5 | | | | | | | | |
| | | *-14* | *-14* | *-14* | *-14* | *-14* | *-14* | *-14* | *-14* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP1 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **18** | **24** | **21** | **14** | **4** | **0** | **-6** | **-14** |

Cold Room Condenser to AP1 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Cold Room Condenser | | | | | | | | | |
| **Sound Power Levels** | | **64** | **62** | **62** | **63** | **59** | **57** | **54** | **47** |
| ***Silencer*** | | | | | | | | | |
| Silencer - ENC-1 | | | | | | | | | |
| | | *-12* | *-13* | *-20* | *-29* | *-36* | *-37* | *-39* | *-39* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Quarterspherical | | | | | | | | | |
| | | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 6 | | | | | | | | |
| | | *-16* | *-16* | *-16* | *-16* | *-16* | *-16* | *-16* | *-16* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP1 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **31** | **28** | **21** | **13** | **3** | **0** | **-5** | **-13** |

Calculation Sheet 18/0393/CS9

Cold Room Condenser to AP1 Night

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Cold Room Condenser | | | | | | | | | |
| **Sound Power Levels** | | **64** | **62** | **62** | **63** | **59** | **57** | **54** | **47** |
| ***Silencer*** | | | | | | | | | |
| Silencer - ENC-1 | | | | | | | | | |
| | | *-12* | *-13* | *-20* | *-29* | *-36* | *-37* | *-39* | *-39* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Quarterspherical | | | | | | | | | |
| | | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 6 | | | | | | | | |
| | | *-16* | *-16* | *-16* | *-16* | *-16* | *-16* | *-16* | *-16* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP1 Night | | | | | | | | | |
| **Sound Pressure, Lp** | | **31** | **28** | **21** | **13** | **3** | **0** | **-5** | **-13** |

Extract Fan to AP1 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Extract Fan | | | | | | | | | |
| **Sound Power Levels** | | **80** | **79** | **76** | **72** | **75** | **75** | **68** | **61** |
| ***Silencer*** | | | | | | | | | |
| Silencer - AS-2 | | | | | | | | | |
| | | *-8* | *-17* | *-32* | *-40* | *-42* | *-30* | *-23* | *-13* |
| ***Circular Unlined Duct Losses CJ*** | | | | | | | | | |
| Diameter (mm) | 500 | | | | | | | | |
| Length (m) | 1 | | | | | | | | |
| | | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***End Reflection*** | | | | | | | | | |
| Width/Diameter (m) | 0.5 | | | | | | | | |
| Length (m) | 0.5 | | | | | | | | |
| Rec or Circ - Rectangular | | | | | | | | | |
| Free or Flush - Flush | | | | | | | | | |
| | | *-9* | *-4* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***External Grille Directivity*** | | | | | | | | | |
| Width (m) | 0.65 | | | | | | | | |
| Height (m) | 0.65 | | | | | | | | |
| Vertical (°) | 90 | | | | | | | | |
| Horizontal (°) | 160 | | | | | | | | |
| | | *-2* | *-3* | *-6* | *-11* | *-18* | *-21* | *-21* | *-21* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Hemispherical | | | | | | | | | |
| | | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* |

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 2.5 | | | | | | | | |
| | | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP1 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **45** | **39** | **22** | **5** | **-1** | **8** | **8** | **11** |

Calculation Sheet 18/0393/CS11

Supply Fan to AP1 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Supply Fan | | | | | | | | | |
| **Sound Power Levels** | | **77** | **79** | **73** | **74** | **77** | **77** | **74** | **69** |
| ***Silencer*** | | | | | | | | | |
| Silencer - AS-1 | | | | | | | | | |
| | | *-8* | *-16* | *-28* | *-43* | *-47* | *-47* | *-39* | *-22* |
| ***Circular Unlined Duct Losses CJ*** | | | | | | | | | |
| Diameter (mm) | 400 | | | | | | | | |
| Length (m) | 1 | | | | | | | | |
| | | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***End Reflection*** | | | | | | | | | |
| Width/Diameter (m) | 0.4 | | | | | | | | |
| Length (m) | 0.4 | | | | | | | | |
| Rec or Circ - Rectangular | | | | | | | | | |
| Free or Flush - Flush | | | | | | | | | |
| | | *-10* | *-6* | *-1* | *0* | *0* | *0* | *0* | *0* |
| ***External Grille Directivity*** | | | | | | | | | |
| Width (m) | 0.55 | | | | | | | | |
| Height (m) | 0.55 | | | | | | | | |
| Vertical (°) | 175 | | | | | | | | |
| Horizontal (°) | 10 | | | | | | | | |
| | | *-1* | *-2* | *-3* | *-7* | *-8* | *-8* | *-8* | *-8* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Hemispherical | | | | | | | | | |
| | | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* |

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 7.7 | | | | | | | | |
| | | *-18* | *-18* | *-18* | *-18* | *-18* | *-18* | *-18* | *-18* |
| ***Maekawa Screening Loss*** | | | | | | | | | |
| Path Difference (m) | 1 | | | | | | | | |
| | | *-10* | *-12* | *-15* | *-18* | *-20* | *-20* | *-20* | *-20* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP1 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **22** | **18** | **0** | **-20** | **-24** | **-24** | **-19** | **-7** |

AC Condenser to AP2 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - AC Condenser | | | | | | | | | |
| **Sound Power Levels** | | **49** | **56** | **60** | **62** | **59** | **56** | **52** | **44** |
| ***Silencer*** | | | | | | | | | |
| Silencer - ENC-1 | | | | | | | | | |
| | | *-12* | *-13* | *-20* | *-29* | *-36* | *-37* | *-39* | *-39* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Quarterspherical | | | | | | | | | |
| | | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 10 | | | | | | | | |
| | | *-20* | *-20* | *-20* | *-20* | *-20* | *-20* | *-20* | *-20* |
| ***Maekawa Screening Loss*** | | | | | | | | | |
| Path Difference (m) | 1 | | | | | | | | |
| | | *-10* | *-12* | *-15* | *-18* | *-20* | *-20* | *-20* | *-20* |
| ***Facade Reflection*** | | | | | | | | | |
| Reflection (dB) | 3 | | | | | | | | |
| | | *3* | *3* | *3* | *3* | *3* | *3* | *3* | *3* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP2 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **5** | **9** | **3** | **-7** | **-19** | **-23** | **-29** | **-37** |

Calculation Sheet 18/0393/CS13

Cold Room Condenser to AP2 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Cold Room Condenser | | | | | | | | | |
| **Sound Power Levels** | | **64** | **62** | **62** | **63** | **59** | **57** | **54** | **47** |
| ***Silencer*** | | | | | | | | | |
| Silencer - ENC-1 | | | | | | | | | |
| | | *-12* | *-13* | *-20* | *-29* | *-36* | *-37* | *-39* | *-39* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Quarterspherical | | | | | | | | | |
| | | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 11.5 | | | | | | | | |
| | | *-21* | *-21* | *-21* | *-21* | *-21* | *-21* | *-21* | *-21* |
| ***Maekawa Screening Loss*** | | | | | | | | | |
| Path Difference (m) | 1 | | | | | | | | |
| | | *-10* | *-12* | *-15* | *-18* | *-20* | *-20* | *-20* | *-20* |
| ***Facade Reflection*** | | | | | | | | | |
| Reflection (dB) | 3 | | | | | | | | |
| | | *3* | *3* | *3* | *3* | *3* | *3* | *3* | *3* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP2 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **19** | **13** | **3** | **-7** | **-20** | **-23** | **-28** | **-35** |

Calculation Sheet 18/0393/CS14

Cold Room Condenser to AP2 Night

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Cold Room Condenser | | | | | | | | | |
| **Sound Power Levels** | | **64** | **62** | **62** | **63** | **59** | **57** | **54** | **47** |
| ***Silencer*** | | | | | | | | | |
| Silencer - ENC-1 | | | | | | | | | |
| | | *-12* | *-13* | *-20* | *-29* | *-36* | *-37* | *-39* | *-39* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Quarterspherical | | | | | | | | | |
| | | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 11.5 | | | | | | | | |
| | | *-21* | *-21* | *-21* | *-21* | *-21* | *-21* | *-21* | *-21* |
| ***Maekawa Screening Loss*** | | | | | | | | | |
| Path Difference (m) | 1 | | | | | | | | |
| | | *-10* | *-12* | *-15* | *-18* | *-20* | *-20* | *-20* | *-20* |
| ***Facade Reflection*** | | | | | | | | | |
| Reflection (dB) | 3 | | | | | | | | |
| | | *3* | *3* | *3* | *3* | *3* | *3* | *3* | *3* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP2 Night | | | | | | | | | |
| **Sound Pressure, Lp** | | **19** | **13** | **3** | **-7** | **-20** | **-23** | **-28** | **-35** |

Extract Fan to AP2 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Extract Fan | | | | | | | | | |
| **Sound Power Levels** | | **80** | **79** | **76** | **72** | **75** | **75** | **68** | **61** |
| ***Silencer*** | | | | | | | | | |
| Silencer - AS-2 | | | | | | | | | |
| | | *-8* | *-17* | *-32* | *-40* | *-42* | *-30* | *-23* | *-13* |
| ***Circular Unlined Duct Losses CJ*** | | | | | | | | | |
| Diameter (mm) | 500 | | | | | | | | |
| Length (m) | 1 | | | | | | | | |
| | | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***End Reflection*** | | | | | | | | | |
| Width/Diameter (m) | 0.5 | | | | | | | | |
| Length (m) | 0.5 | | | | | | | | |
| Rec or Circ - Rectangular | | | | | | | | | |
| Free or Flush - Flush | | | | | | | | | |
| | | *-9* | *-4* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***External Grille Directivity*** | | | | | | | | | |
| Width (m) | 0.65 | | | | | | | | |
| Height (m) | 0.65 | | | | | | | | |
| Vertical (°) | 30 | | | | | | | | |
| Horizontal (°) | 100 | | | | | | | | |
| | | *0* | *0* | *0* | *-2* | *-8* | *-8* | *-8* | *-8* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Hemispherical | | | | | | | | | |
| | | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* |

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 7 | | | | | | | | |
| | | *-17* | *-17* | *-17* | *-17* | *-17* | *-17* | *-17* | *-17* |
| ***Maekawa Screening Loss*** | | | | | | | | | |
| Path Difference (m) | 1 | | | | | | | | |
| | | *-10* | *-12* | *-15* | *-18* | *-20* | *-20* | *-20* | *-20* |
| ***Facade Reflection*** | | | | | | | | | |
| Reflection (dB) | 3 | | | | | | | | |
| | | *3* | *3* | *3* | *3* | *3* | *3* | *3* | *3* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP2 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **31** | **24** | **7** | **-10** | **-17** | **-6** | **-6** | **-3** |

Supply Fan to AP2 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Supply Fan | | | | | | | | | |
| **Sound Power Levels** | | **77** | **79** | **73** | **74** | **77** | **77** | **74** | **69** |
| ***Silencer*** | | | | | | | | | |
| Silencer - AS-1 | | | | | | | | | |
| | | *-8* | *-16* | *-28* | *-43* | *-47* | *-47* | *-39* | *-22* |
| ***Circular Unlined Duct Losses CJ*** | | | | | | | | | |
| Diameter (mm) | 400 | | | | | | | | |
| Length (m) | 1 | | | | | | | | |
| | | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***End Reflection*** | | | | | | | | | |
| Width/Diameter (m) | 0.4 | | | | | | | | |
| Length (m) | 0.4 | | | | | | | | |
| Rec or Circ - Rectangular | | | | | | | | | |
| Free or Flush - Flush | | | | | | | | | |
| | | *-10* | *-6* | *-1* | *0* | *0* | *0* | *0* | *0* |
| ***External Grille Directivity*** | | | | | | | | | |
| Width (m) | 0.55 | | | | | | | | |
| Height (m) | 0.55 | | | | | | | | |
| Vertical (°) | 90 | | | | | | | | |
| Horizontal (°) | 0 | | | | | | | | |
| | | *0* | *0* | *0* | *0* | *-4* | *-7* | *-7* | *-7* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Hemispherical | | | | | | | | | |
| | | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* |

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 2.5 | | | | | | | | |
| | | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP2 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **43** | **42** | **28** | **15** | **10** | **7** | **12** | **24** |

AC Condenser to AP3 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - AC Condenser | | | | | | | | | |
| **Sound Power Levels** | | **49** | **56** | **60** | **62** | **59** | **56** | **52** | **44** |
| ***Silencer*** | | | | | | | | | |
| Silencer - ENC-1 | | | | | | | | | |
| | | *-12* | *-13* | *-20* | *-29* | *-36* | *-37* | *-39* | *-39* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Quarterspherical | | | | | | | | | |
| | | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 14 | | | | | | | | |
| | | *-23* | *-23* | *-23* | *-23* | *-23* | *-23* | *-23* | *-23* |
| ***Facade Reflection*** | | | | | | | | | |
| Reflection (dB) | 3 | | | | | | | | |
| | | *3* | *3* | *3* | *3* | *3* | *3* | *3* | *3* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP3 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **12** | **18** | **15** | **8** | **-2** | **-6** | **-12** | **-20** |

Calculation Sheet 18/0393/CS18

Cold Room Condenser to AP3 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Cold Room Condenser | | | | | | | | | |
| **Sound Power Levels** | | **64** | **62** | **62** | **63** | **59** | **57** | **54** | **47** |
| ***Silencer*** | | | | | | | | | |
| Silencer - ENC-1 | | | | | | | | | |
| | | *-12* | *-13* | *-20* | *-29* | *-36* | *-37* | *-39* | *-39* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Quarterspherical | | | | | | | | | |
| | | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 15.5 | | | | | | | | |
| | | *-24* | *-24* | *-24* | *-24* | *-24* | *-24* | *-24* | *-24* |
| ***Facade Reflection*** | | | | | | | | | |
| Reflection (dB) | 3 | | | | | | | | |
| | | *3* | *3* | *3* | *3* | *3* | *3* | *3* | *3* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP3 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **26** | **23** | **16** | **8** | **-2** | **-5** | **-11** | **-18** |

Cold Room Condenser to AP3 Night

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Cold Room Condenser | | | | | | | | | |
| **Sound Power Levels** | | **64** | **62** | **62** | **63** | **59** | **57** | **54** | **47** |
| ***Silencer*** | | | | | | | | | |
| Silencer - ENC-1 | | | | | | | | | |
| | | *-12* | *-13* | *-20* | *-29* | *-36* | *-37* | *-39* | *-39* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Quarterspherical | | | | | | | | | |
| | | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* | *-5* |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 15.5 | | | | | | | | |
| | | *-24* | *-24* | *-24* | *-24* | *-24* | *-24* | *-24* | *-24* |
| ***Facade Reflection*** | | | | | | | | | |
| Reflection (dB) | 3 | | | | | | | | |
| | | *3* | *3* | *3* | *3* | *3* | *3* | *3* | *3* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP3 Night | | | | | | | | | |
| **Sound Pressure, Lp** | | **26** | **23** | **16** | **8** | **-2** | **-5** | **-11** | **-18** |

Extract Fan to AP3 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Extract Fan | | | | | | | | | |
| **Sound Power Levels** | | **80** | **79** | **76** | **72** | **75** | **75** | **68** | **61** |
| ***Silencer*** | | | | | | | | | |
| Silencer - AS-2 | | | | | | | | | |
| | | *-8* | *-17* | *-32* | *-40* | *-42* | *-30* | *-23* | *-13* |
| ***Circular Unlined Duct Losses CJ*** | | | | | | | | | |
| Diameter (mm) | 500 | | | | | | | | |
| Length (m) | 1 | | | | | | | | |
| | | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***End Reflection*** | | | | | | | | | |
| Width/Diameter (m) | 0.5 | | | | | | | | |
| Length (m) | 0.5 | | | | | | | | |
| Rec or Circ - Rectangular | | | | | | | | | |
| Free or Flush - Flush | | | | | | | | | |
| | | *-9* | *-4* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***External Grille Directivity*** | | | | | | | | | |
| Width (m) | 0.65 | | | | | | | | |
| Height (m) | 0.65 | | | | | | | | |
| Vertical (°) | 10 | | | | | | | | |
| Horizontal (°) | 90 | | | | | | | | |
| | | *0* | *0* | *0* | *0* | *-4* | *-7* | *-7* | *-7* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Hemispherical | | | | | | | | | |
| | | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* |

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 11 | | | | | | | | |
| | | *-21* | *-21* | *-21* | *-21* | *-21* | *-21* | *-21* | *-21* |
| ***Facade Reflection*** | | | | | | | | | |
| Reflection (dB) | 3 | | | | | | | | |
| | | *3* | *3* | *3* | *3* | *3* | *3* | *3* | *3* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP3 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **38** | **32** | **18** | **6** | **3** | **12** | **12** | **15** |

Supply Fan to AP3 Day

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Noise Source*** | | | | | | | | | |
| Noise Source - Supply Fan | | | | | | | | | |
| **Sound Power Levels** | | **77** | **79** | **73** | **74** | **77** | **77** | **74** | **69** |
| ***Silencer*** | | | | | | | | | |
| Silencer - AS-1 | | | | | | | | | |
| | | *-8* | *-16* | *-28* | *-43* | *-47* | *-47* | *-39* | *-22* |
| ***Circular Unlined Duct Losses CJ*** | | | | | | | | | |
| Diameter (mm) | 400 | | | | | | | | |
| Length (m) | 1 | | | | | | | | |
| | | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***End Reflection*** | | | | | | | | | |
| Width/Diameter (m) | 0.4 | | | | | | | | |
| Length (m) | 0.4 | | | | | | | | |
| Rec or Circ - Rectangular | | | | | | | | | |
| Free or Flush - Flush | | | | | | | | | |
| | | *-10* | *-6* | *-1* | *0* | *0* | *0* | *0* | *0* |
| ***External Grille Directivity*** | | | | | | | | | |
| Width (m) | 0.55 | | | | | | | | |
| Height (m) | 0.55 | | | | | | | | |
| Vertical (°) | 10 | | | | | | | | |
| Horizontal (°) | 30 | | | | | | | | |
| | | *1* | *2* | *3* | *4* | *4* | *6* | *6* | *6* |
| ***Point Source Radiation Loss*** | | | | | | | | | |
| Radiation - Hemispherical | | | | | | | | | |
| | | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* | *-8* |

| | | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| ***Point Source Distance Loss*** | | | | | | | | | |
| Start Distance (m) | 1 | | | | | | | | |
| End Distance (m) | 5 | | | | | | | | |
| | | *-14* | *-14* | *-14* | *-14* | *-14* | *-14* | *-14* | *-14* |
| ***Facade Reflection*** | | | | | | | | | |
| Reflection (dB) | 3 | | | | | | | | |
| | | *3* | *3* | *3* | *3* | *3* | *3* | *3* | *3* |
| ***External Receiver*** | | | | | | | | | |
| External Receiver - AP3 Day | | | | | | | | | |
| **Sound Pressure, Lp** | | **41** | **41** | **28** | **16** | **16** | **17** | **22** | **34** |

RSK
An RSK company

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