



TfL Technical Services Report

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ACOUSTIC SURVEY IN PASSENGER CAR OF 1992 TUBE STOCK

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Prepared by: M McIlraith MIOA

*M McIlraith*

\_\_\_\_\_  
Noise and Vibration Engineer

Reviewed by: C McCollin MIOA

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Noise and Vibration Engineer

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## INTRODUCTION

1. The 1992 Tube Stock (92TS) Fleet are to be fitted with a new Passenger Information System (PIS), supplied by EKE Electronics, as part of the Central Line Improvement Programme. The process for validating the acoustic performance of the system against TfL Requirements Documents are described elsewhere (LTG Document No 3044325). TfL Technical Services were tasked to acquire acoustic data in the passenger saloon of 92TS to support the acoustic testing of the new PIS. This report provides a summary of the acoustic data obtained during a 92TS test run between Ruislip Garden and Hainault stations on 08 July 2023.

## EQUIPMENT AND PROCEDURE

### The vehicle

2. The London Underground 1992 Stock is the type of rolling stock in service on the Central Line. The rail vehicles were manufactured by ABB Transportation and entered service in April 1993. Normal formation for 1992 Tube Stock comprises eight cars (Central Line) with a maximum full load standing capacity of 930 people. This vehicle is equipped for Automatic Train Operation (ATO) and automatic train protection (ATP) and can be operated manually if required. Automatic train operation is utilised across the Central Line network.

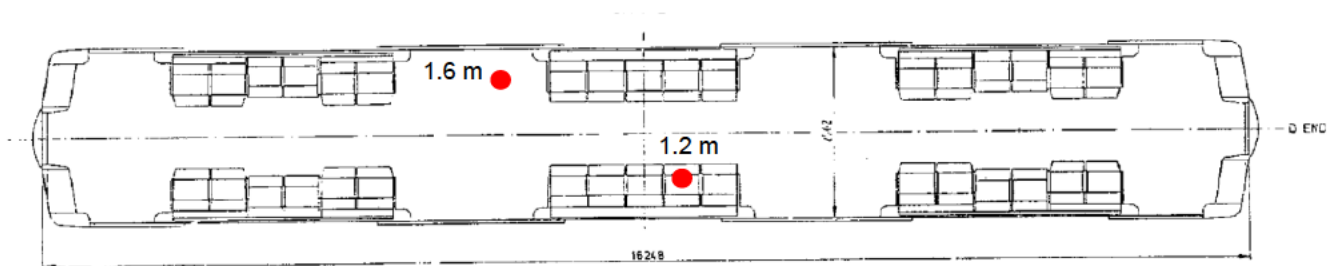


Figure 1. Approximate measurement locations in passenger car.

### Acoustic measurements

3. Acoustic measurements were obtained in a 92TS on 08 July 2023 whilst the vehicle was operating at normal line speed between Ruislip Gardens and Hainault stations. Measurement equipment was installed in a mid-train passenger saloon car (unit 3 off 8). Sound pressure data were acquired at two measurement locations within the saloon using integrating sound level meters (SLMs) with combined ½" microphone and preamplifier sets. The measurement systems were configured for use with external microphone set-up. The microphones were positioned at 1.6 m (standing) and 1.2 m (seated) height from the deck and more than 0.3 m distance from a reflecting surface; cabling was secured to handrail using cable ties, duct tape and 2.5 mm string. Figure 1 shows the approximate measurement locations in the passenger car. Further details of the measurement equipment are shown in Table 1. Measurements were made by Technical Services Senior Engineer (James Carey).



4. Field calibration of the SLMs were performed using an acoustic calibrator which gave a sinusoidal calibration tone of 94 dB at a frequency of 1000 Hz. The field calibration was carried out before and after the survey; the measurements remained stable throughout. The SLMs and acoustic calibrator conform to 'class 1' specifications for corresponding equipment defined in British Standards BS EN 61672-1:2013, BS EN 61260-3:2016 and BS EN 60942:2018. The SLMs had been calibrated to traceable standards within the preceding two years, and the acoustic calibrators within the preceding 12 months.

Table 1 Details of Sound Level Meters and Field Calibrator.

Item (height)	Manufacturer	Type	Serial No	Certificate No	Date
SLM (1.6 m)	01dB	Fusion	12501	191694	05/05/2023
SLM (1.2 m)	01dB	Fusion	10758	10758/79580	29/07/2021
Calibrator	Svantek	SV36	79808	1503419-2	24/10/2022

5. The data were analysed using 01 dBTrait software (version 6.3.1 build 1) and the following parameters were determined for station-to-station transit: the frequency-weighted equivalent continuous sound pressure level ( $L_{Aeq,T}$  and  $L_{Ceq,T}$ ), the C-weighted peak sound pressure level ( $L_{Cpeak}$ ); and one-third octave band unweighted equivalent continuous sound pressure level ( $L_{eqT}$ ) for centre band frequencies 20 Hz to 20,000 Hz.

## RESULTS

6. The A-weighted equivalent continuous sound pressure levels ( $L_{Aeq}$ ) obtained for each station-to-station section are shown in Table 2 (eastbound) and Table 3 (westbound). All acoustic data are presented in the Appendix, for completeness. The train number/reference was 775/1005134. The passenger car was unoccupied for the duration of the test run and all passenger announcements were disabled throughout.

7. Operating conditions for the vehicle are representative of normal service. Except for Wanstead to Leytonstone on the westbound route, there were no notable delays reported during the measurement run. Data were excluded between Wanstead and Leytonstone on the westbound line where the vehicle was stationary mid-journey; brief pauses in vehicle transit were included in the analysis.



Table 2 Eastbound station-to-station  $L_{AeqT}$  measured at standing and seated position on 92TS during normal operations on the Central Line 08 July 2023

Station	Duration (mm:ss)	$L_{Aeq}$ dB(A)	
		Standing (1.6 m)	Seated (1.2 m)
Ruislip Gardens to South Ruislip	01:10	77	75
South Ruislip to Northolt	02:17	79	77
Northolt to Greenford	01:51	82	79
Greenford to Perivale	01:46	80	77
Perivale to Hanger Lane	02:04	80	79
Hanger Lane to North Acton	02:50	78	76
North Acton to East Acton	01:29	76	74
East Acton to White City	03:21	75	73
White City to Shepherd's Bush	02:35	87	85
Shepherd's Bush to Holland Park	01:17	86	83
Holland Park to Notting Hill Gate	00:58	100	100
Notting Hill Gate to Queensway	01:02	85	83
Queensway to Lancaster Gate	01:14	87	85
Lancaster Gate to Marble Arch	01:49	84	82
Marble Arch to Bond Street	00:54	84	82
Bond Street to Oxford Circus	00:57	86	83
Oxford Circus to Tottenham Court Road	00:55	85	82
Tottenham Court Road to Holborn	01:55	88	86
Holborn to Chancery Lane	00:50	78	77
Chancery Lane to St Paul's	01:39	84	82
St Paul's to Bank	01:31	88	86
Bank to Liverpool Street	02:08	85	83
Liverpool Street to Bethnal Green	02:48	94	92
Bethnal Green to Mile End	01:49	92	89
Mile End to Stratford	03:08	96	93
Stratford to Leyton	02:23	104	102
Leyton to Leytonstone	03:04	72	71
Leytonstone to Wanstead	02:02	91	89
Wanstead to Redbridge	01:27	98	97
Redbridge to Gants Hill	01:31	88	86
Gants Hill to Newbury Park	02:35	95	93
Newbury Park to Barkingside	01:25	78	76
Barkingside to Fairlop	01:29	77	75
Fairlop to Hainault	02:16	73	71



Table 3 Westbound station-to-station  $L_{AeqT}$  measured at standing and seated position on 92TS during normal operations on the Central Line 08 July 2023.

Station	Duration (mm:ss)	$L_{Aeq}$ dB(A)	
		Standing (1.6 m)	Seated (1.2 m)
Hainault to Fairlop	01:40	73	72
Fairlop to Barkingside	01:47	75	73
Barkingside to Newbury Park	02:59	72	70
Newbury Park to Gants Hill	03:06	88	86
Gants Hill to Redbridge	01:44	85	83
Redbridge to Wanstead	01:33	85	83
Wanstead to Leytonstone*	01:04	87	84
Leytonstone to Leyton	03:09	73	72
Leyton to Stratford	02:16	89	88
Stratford to Mile End	02:55	90	88
Mile End to Bethnal Green	01:51	89	87
Bethnal Green to Liverpool Street	02:57	90	88
Liverpool Street to Bank	01:35	91	89
Bank to St Paul's	01:32	87	85
St Paul's to Chancery Lane	02:05	86	83
Chancery Lane to Holborn	00:55	80	78
Holborn to Tottenham Court Road	01:30	94	92
Tottenham Court Road to Oxford Circus	01:46	79	77
Oxford Circus to Bond Street	01:40	80	78
Bond Street to Marble Arch	01:19	79	78
Marble Arch to Lancaster Gate	01:50	87	84
Lancaster Gate to Queensway	01:59	83	81
Queensway to Notting Hill Gate	01:26	82	79
Notting Hill Gate to Holland Park	01:12	88	85
Holland Park to Shepherd's Bush	01:41	85	83
Shepherd's Bush to White City	02:56	89	87
White City to East Acton	03:07	77	75
East Acton to North Acton	02:00	76	75
North Acton to Hanger Lane	03:19	77	76
Hanger Lane to Perivale	02:35	77	75
Perivale to Greenford	02:09	75	73
Greenford to Northolt	02:18	76	74
Northolt to South Ruislip	02:36	75	74
South Ruislip to Ruislip Gardens	01:16	74	73

\* Data excluded when vehicle stationary.



## REFERENCES

British Standards Institution (2018) Electroacoustics – Sound calibrators. BS EN 60942 (2018). BSI Publications 2018.

British Standards Institution (2016) Electroacoustics – Octave-band and fractional-octave-band filters Periodic tests. BS EN 61260-3 (2016). BSI Publications 2016.

British Standards Institution (2013) Electroacoustics – Sound level meters – Part 1: Specifications. BS EN 61672-1 (2013). BSI Publications 2013.

Luminator Technology Group (2023) 72TS/92TS PIS PASSENGER INFORMATION SYSTEM STIPA Measurement Description. Document No 3044325 Rev A. LTGRail, Canada 18 April 2023

## DISTRIBUTION [By Email]

Andrew Oates                      Senior Engineer (LU Renewals and Enhancements – Fleet)

Emil Tschopp                      Senior Engineering Leader (Technical Services)



## APPENDIX

Tables A1 to A6 present acoustic data measured in the passenger saloon car (unit 3 off 8) of 92TS on 08 July 2023 between Ruislip Gardens and Hainault stations

Table A1 Station-to-station frequency-weighted sound pressure levels from Ruislip Gardens to Hainault.

Section	Duration	Standing (1.6 m)			Seated (1.2 m)		
		L <sub>AeqT</sub>	L <sub>CeqT</sub>	L <sub>Cpeak</sub>	L <sub>AeqT</sub>	L <sub>CeqT</sub>	L <sub>Cpeak</sub>
	mm:ss	dB(A)	dB(C)	dB(C)	dB(A)	dB(C)	dB(C)
RUG-SOR	01:10	76.9	82.8	102.3	75.0	82.1	101.8
SOR-NOR	02:17	79.3	84.8	104.7	77.2	84.2	104.1
NOR-GRE	01:51	81.5	87.0	109.1	79.2	86.2	104.7
GRE-PER	01:46	79.5	85.1	104.7	77.4	84.6	101.1
PER-HAL	02:04	80.1	86.2	108.6	78.5	86.2	108.0
HAL-NOA	02:50	78.2	85.5	106.1	76.2	85.2	102.9
NOA-EAA	01:29	75.7	83.8	107.4	73.7	84.1	105.4
EAA-WHC	03:21	74.6	83.2	105.5	73.0	83.4	106.7
WHC-SHB	02:35	86.6	92.0	116.3	84.7	90.3	114.0
SHB-HOP	01:17	85.5	90.5	113.5	82.8	89.6	111.1
HOP-NHG	00:58	99.8	101.0	125.1	100.3	101.6	122.5
NHG-QUE	01:02	85.1	92.1	121.0	82.9	91.2	120.9
QUE-LAG	01:14	87.2	93.8	112.3	84.9	92.4	110.7
LAG-MAA	01:49	84.3	90.1	111.4	82.0	88.4	109.5
MAA-BOS	00:54	83.9	91.9	109.4	82.4	91.6	109.1
BOS-OXC	00:57	85.6	90.7	112.3	83.1	89.0	109.0
OXC-TCR	00:55	84.9	91.6	106.3	82.2	90.1	105.4
TCR-HOL	01:55	88.2	90.9	117.6	86.4	89.5	114.7
HOL-CHL	00:50	77.6	86.1	103.9	76.7	87.0	104.4
CHL-STP	01:39	84.3	91.9	109.9	82.2	90.9	107.9
STP-BAN	01:31	87.7	92.4	113.4	86.2	91.0	113.4
BAN-LIS	02:08	85.2	92.2	114.5	83.0	90.5	110.6
LIS-BEG	02:48	93.9	96.4	119.1	91.6	94.5	115.6
BEG-MIE	01:49	91.6	96.0	116.5	89.4	94.5	114.8
MIE-STR	03:08	95.5	98.4	117.9	93.0	96.4	115.0
STR-LEY	02:23	103.8	107.2	126.1	101.8	105.3	126.0
LEY-LET <sub>st</sub>	03:04	72.2	82.3	105.6	70.9	82.8	105.7
LEY <sub>st</sub> -WAN	02:02	91.2	94.3	114.3	89.1	92.9	113.6
WAN-RED	01:27	97.7	99.9	121.5	96.6	99.1	118.9
RED-GAH	01:31	87.8	91.7	109.4	86.0	91.4	108.2
GAH-NEP	02:35	94.9	97.7	118.6	92.9	96.1	116.5
NEP-BAR	01:25	77.9	86.6	117.8	75.7	86.3	117.6
BAR-FAI	01:29	76.8	83.7	104.3	75.1	84.3	102.1
FAI-HAI	02:16	72.6	84.8	116.5	71.3	84.9	116.5



Table A2 Station-to-station frequency-weighted sound pressure levels from Hainault to Ruislip Garden.

Section	Duration mm:ss	Standing (1.6 m)			Seated (1.2 m)		
		L <sub>AeqT</sub> dB(A)	L <sub>CeqT</sub> dB(C)	L <sub>Cpeak</sub> dB(C)	L <sub>AeqT</sub> dB(A)	L <sub>CeqT</sub> dB(C)	L <sub>Cpeak</sub> dB(C)
HAI-FAI	01:40	73.2	85.1	106.3	72.0	86.0	108.3
FAI-BAR	01:47	75.3	81.4	103.0	73.4	80.3	99.8
BAR-NEP	02:59	71.9	80.8	105.3	70.4	80.5	103.7
NEP-GAH	03:06	87.7	92.1	114.0	85.5	91.1	112.4
GAH-RED	01:44	85.4	90.2	107.1	83.3	89.6	106.6
RED-WAN	01:33	84.9	90.6	107.4	82.7	90.2	106.3
WAN-LEY <sup>st</sup>	01:04	87.4	93.3	112.0	83.9	87.5	108.8
LEY <sup>st</sup> -LEY	03:09	73.2	83.1	104.0	71.5	83.5	101.5
LEY-STR	02:16	89.3	93.3	113.0	87.8	92.9	112.3
STR-MIE	02:55	89.6	93.7	116.3	87.6	92.7	113.6
MIE-BEG	01:51	88.8	92.6	113.0	86.8	92.1	111.4
BEG-LIS	02:57	90.4	93.9	115.9	88.4	92.3	114.4
LIS-BAN	01:35	91.3	97.7	118.5	88.9	95.1	114.5
BAN-STP	01:32	86.5	92.4	110.4	85.0	91.5	110.7
STP-CHL	02:05	85.6	92.2	114.3	83.3	90.3	112.7
CHL-HOL	00:55	80.4	89.8	105.8	78.4	88.9	104.5
HOL-TCR	01:30	94.1	97.1	118.8	91.8	95.1	117.7
TCR-OXC	01:46	78.7	87.0	107.1	76.8	86.5	103.5
OXC-BOS	01:40	79.5	88.9	108.8	77.6	87.7	107.0
BOS-MAA	01:19	79.2	87.2	104.0	77.6	87.0	103.9
MAA-LAG	01:50	86.7	91.4	114.2	84.4	89.9	112.3
LAG-QUE	01:59	83.4	91.5	110.6	81.4	90.4	107.9
QUE-NHG	01:26	81.9	89.2	106.1	79.2	88.3	101.5
NHG-HOP	01:12	87.6	92.8	114.5	85.2	90.7	113.1
HOP-SHB	01:41	85.4	92.8	114.0	82.9	90.7	109.6
SHB-WHC	02:56	89.2	97.0	118.9	86.8	94.9	116.3
WHC-EAA	03:07	76.9	85.5	106.8	75.1	85.7	105.7
EAA-NOA	02:00	76.0	83.7	104.6	74.5	84.4	103.9
NOA-HAL	03:19	77.1	84.3	102.9	75.7	85.3	101.4
HAL-PER	02:35	76.5	82.2	102.4	74.8	82.1	100.1
PER-GRE	02:09	74.6	82.2	101.7	72.8	82.1	100.0
GRE-NOR	02:18	75.9	83.4	105.6	74.2	82.6	104.1
NOR-SOR	02:36	75.3	83.2	106.5	73.6	82.9	105.0
SOR-RUG	01:16	74.2	81.4	104.3	72.5	80.8	101.6





Table A3 Station to station unweighted one-third octave band  $L_{eq}$  at 1.6 m standing position (Ruislip Gardens to Hainault)

	Centre Frequency (Hz)																														
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
RUG-SOR	71.9	76.2	75.3	72.7	72.5	71.8	65.8	68.8	70.3	66.2	70.8	69.8	69.4	67.7	68.4	69.6	69.9	69.8	65.5	63.1	62.2	64.5	61.5	59.2	55.0	49.2	44.3	43.0	39.1	33.2	22.8
SOR-NOR	75.8	76.7	76.9	74.6	72.4	74.3	69.5	70.3	72.1	68.3	72.9	71.4	68.7	70.4	71.0	72.2	72.1	71.5	68.8	66.2	66.0	67.1	63.1	61.9	57.9	52.5	47.4	45.1	41.9	36.4	26.5
NOR-GRE	78.0	79.6	77.7	74.4	73.6	77.6	72.5	72.0	73.1	70.2	74.2	75.0	73.2	75.2	73.6	74.7	74.1	74.2	70.8	67.6	67.3	66.7	63.6	61.8	58.0	52.3	47.5	44.4	42.2	36.7	26.2
GRE-PER	76.3	76.9	77.4	73.1	73.1	76.6	70.5	70.3	72.6	68.5	71.7	71.8	70.3	70.8	71.3	73.1	71.9	70.9	68.8	66.5	66.3	67.4	63.7	62.4	58.7	53.1	47.8	45.3	42.6	36.7	26.5
PER-HAL	77.4	78.1	75.9	73.2	73.1	76.6	71.6	72.0	76.0	73.0	75.3	73.6	71.4	71.3	72.1	73.2	72.3	71.6	69.9	67.0	66.9	67.7	63.5	62.3	58.7	53.2	47.8	45.5	42.6	37.0	26.8
HAL-NOA	78.0	79.4	77.1	73.6	74.1	74.6	69.7	71.5	76.1	71.5	74.5	71.5	70.2	69.1	70.2	72.2	71.5	69.9	66.4	64.1	63.2	63.9	61.8	60.0	56.0	50.4	45.7	44.4	40.7	35.1	25.6
NOA-EAA	77.0	80.5	76.9	73.7	73.7	68.7	66.2	70.5	72.3	67.8	70.8	66.8	67.6	67.3	67.8	70.7	68.8	67.3	63.1	61.8	60.2	60.9	59.6	57.0	53.0	47.9	43.9	42.8	39.1	33.4	24.9
EAA-WHC	77.3	79.1	76.0	72.2	73.6	70.3	66.6	69.7	72.4	67.6	70.3	65.8	66.5	65.3	66.7	69.5	67.4	66.9	62.5	60.2	58.9	59.8	57.9	56.2	51.7	47.4	43.1	42.6	38.8	33.9	24.6
WHC-SHB	77.7	83.8	77.8	74.6	77.1	76.1	74.1	74.9	78.4	73.6	83.2	78.8	78.9	86.3	82.0	80.8	77.2	74.6	70.7	69.0	67.0	66.7	62.1	58.9	57.8	52.5	49.4	48.8	44.6	39.8	30.6
SHB-HOP	82.0	87.5	79.5	76.3	77.9	71.1	74.4	73.4	74.2	70.3	72.4	72.9	78.6	81.7	79.9	78.9	79.0	76.7	73.9	72.7	68.8	67.7	66.3	62.5	59.3	53.7	50.8	48.7	45.3	38.6	28.9
HOP-NHG	77.7	84.2	80.7	74.3	75.4	70.3	70.9	72.9	73.7	68.2	73.2	74.2	87.6	88.0	94.3	90.9	92.8	95.1	91.0	86.1	82.2	78.9	74.0	68.9	63.3	58.6	53.2	50.3	47.1	41.5	32.4
NHG-QUE	85.6	84.4	88.0	85.5	78.9	76.2	75.2	75.8	76.3	73.7	75.4	75.8	78.4	80.7	78.5	79.0	78.0	75.2	73.2	72.4	70.0	68.6	68.1	66.7	64.8	61.2	58.0	55.1	53.8	49.9	42.8
QUE-LAG	85.1	88.8	86.8	79.5	79.1	79.4	79.7	80.8	81.2	77.8	81.8	79.0	81.9	84.1	80.2	81.3	79.8	77.6	75.3	74.0	70.7	69.0	67.4	64.1	60.4	56.4	53.9	51.9	49.4	42.9	35.1
LAG-MAA	80.9	79.0	79.5	76.7	75.8	73.3	75.5	79.9	80.9	75.6	77.1	75.6	78.8	79.0	77.7	78.6	76.8	77.1	71.7	69.8	67.7	66.2	64.3	60.9	58.3	53.4	50.1	48.1	43.8	38.6	28.6
MAA-BOS	82.4	87.5	87.3	78.6	78.6	79.3	78.9	78.9	79.3	76.0	79.5	76.8	79.6	81.1	76.9	78.2	75.7	73.5	71.6	70.3	66.6	65.2	63.7	60.4	57.4	52.7	49.6	49.0	44.7	40.2	30.1
BOS-OXC	81.1	79.3	79.2	75.7	75.1	74.8	74.7	77.2	79.7	76.3	79.3	77.3	78.4	80.6	83.1	78.0	77.6	77.7	71.7	69.9	68.0	65.5	63.0	60.2	56.8	52.2	49.0	46.4	43.9	38.0	28.6
OXC-TCR	79.6	87.8	82.3	74.6	76.7	72.8	77.1	82.8	83.3	76.5	77.2	75.9	77.1	77.8	78.0	79.2	77.0	79.5	73.1	69.4	66.4	64.5	63.1	59.6	57.3	52.2	49.5	48.2	43.8	38.7	28.3
TCR-HOL	76.6	81.3	79.1	73.4	75.0	72.4	74.5	76.6	76.3	71.6	73.3	78.1	79.1	76.7	81.0	80.0	83.3	82.6	78.2	74.0	71.0	68.0	63.9	59.6	55.6	51.2	47.0	45.2	41.8	36.4	27.0
HOL-CHL	77.4	84.5	79.5	73.2	75.6	71.3	72.5	73.9	71.7	68.0	71.3	70.3	73.3	72.3	71.0	72.8	69.9	68.0	66.2	62.3	59.3	59.6	58.6	55.5	53.5	49.1	45.9	46.3	39.7	34.5	24.9
CHL-STP	83.8	87.1	87.2	79.1	77.9	77.8	78.7	80.5	79.7	75.7	79.5	76.6	78.5	80.0	76.7	78.6	76.1	73.9	72.8	71.7	69.2	68.1	67.3	63.3	62.3	56.6	55.4	52.7	52.0	45.7	35.6
STP-BAN	79.3	78.3	79.6	80.7	77.2	79.1	76.4	77.6	76.4	71.5	82.1	78.9	81.0	84.4	85.3	79.0	80.7	78.1	74.1	71.0	70.1	67.9	63.9	61.2	59.9	55.1	52.3	52.3	49.5	45.5	37.1
BAN-LIS	77.2	85.4	77.2	75.0	78.3	78.3	79.6	80.4	82.3	78.2	83.5	81.3	81.6	81.3	81.0	78.6	75.2	73.8	70.9	69.4	67.5	69.4	62.9	60.3	58.9	53.7	49.9	50.2	48.1	42.8	33.7
LIS-BEG	84.2	85.9	82.9	77.6	77.0	74.8	75.7	78.8	79.9	75.1	79.0	78.7	83.5	86.8	86.1	88.4	88.2	87.2	82.4	80.6	78.1	76.2	73.6	70.1	66.1	60.7	56.9	54.0	51.5	44.6	35.9
BEG-MIE	87.1	87.2	83.4	78.7	78.4	77.0	78.8	80.9	85.8	82.4	82.5	81.0	85.1	87.3	83.8	85.0	85.3	84.2	79.5	77.8	75.5	72.4	70.4	67.1	62.7	58.0	54.0	51.3	49.5	43.0	35.4
MIE-STR	86.5	87.2	84.1	78.4	78.1	77.0	77.8	79.9	80.3	78.5	81.9	81.2	87.4	91.5	88.2	89.9	89.6	85.8	83.9	83.1	79.9	78.0	76.1	72.3	68.0	62.0	59.7	56.6	54.0	47.2	38.8
STR-LEY	84.3	85.8	81.6	76.8	77.5	74.1	73.2	74.6	74.9	71.2	79.2	82.2	94.3	104.8	96.2	98.5	95.1	93.1	88.9	86.5	83.0	81.6	78.1	72.7	68.5	63.8	58.6	57.0	55.0	48.7	39.2
LEY-LETst	75.5	78.5	76.3	72.6	73.4	69.3	66.3	69.2	70.9	66.1	69.2	66.8	65.3	64.1	64.2	67.9	64.9	63.9	58.9	56.5	55.0	53.9	53.1	51.2	48.1	44.1	40.7	41.8	37.4	33.2	24.8
LETst-WAN	82.7	87.4	85.1	75.3	77.2	74.4	74.5	79.6	80.8	76.8	80.5	77.5	79.3	81.0	82.3	84.3	87.6	85.6	76.6	74.4	70.9	69.9	65.9	64.0	58.6	54.3	50.2	48.4	45.8	39.1	31.6
WAN-RED	82.5	78.3	78.4	74.2	74.6	71.3	71.6	74.6	71.8	67.5	70.3	68.8	74.8	83.8	97.7	88.7	86.9	92.1	81.5	81.3	79.5	74.2	70.9	66.6	62.6	57.6	53.3	50.8	47.6	41.5	33.1
RED-GAH	83.5	87.5	81.1	76.0	78.0	74.2	73.7	73.2	72.9	69.8	73.4	71.8	77.5	80.6	81.0	81.8	83.0	80.7	75.3	74.0	69.9	67.7	66.0	63.1	58.9	54.1	51.3	48.2	46.5	39.4	31.3
GAH-NEP	85.7	86.0	82.1	77.5	77.6	75.1	75.2	76.2	76.8	72.7	75.9	74.3	80.2	89.2	93.8	85.0	88.1	87.9	79.9	78.9	75.6	73.1	69.5	66.0	62.8	57.5	53.7	50.8	48.7	42.3	34.2
NEP-BAR	81.0	79.0	83.3	79.0	72.9	76.6	69.9	70.8	73.2	68.5	71.9	70.8	69.1	68.9	70.3	72.2	70.5	69.3	66.1	63.6	63.7	63.6	62.2	62.0	59.4	55.6	52.6	50.1	48.4	45.0	37.4
BAR-FAI	75.4	75.3	75.9	74.4	72.8	77.2	66.6	67.8	71.4	67.1	69.9	67.7	67.3	67.8	68.4	70.7	70.5	68.7	65.8	63.0	62.4	63.4	60.5	59.0	54.6	49.0	43.5	40.9	38.8	33.0	22.8
FAI-HAI	79.8	79.5	82.5	78.4	72.5	69.9	66.8	70.9	72.1	67.2	68.3	65.4	65.3	65.2	65.6	67.5	64.4	62.4	59.4	57.7	57.3	59.2	57.2	56.4	54.5	50.4	46.8	46.0	44.4	41.6	34.0



Table A4 Station to station unweighted one-third octave band  $L_{eq}$  at 1.6 m standing position (Hainault to Ruislip Gardens)

	Centre Frequency (Hz)																														
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
HAI-FAI	79.5	80.8	79.9	74.7	73.2	76.3	71.5	73.5	73.5	67.9	69.5	66.5	65.6	66.2	66.2	68	65.6	63.3	60.2	58.1	58	58.4	56.1	54.3	51.2	47	43.4	44.5	40	36.7	27.4
FAI-BAR	71.5	71.3	72.3	69.9	73.3	64.9	63.8	68.3	71.2	67.4	69.8	67.0	66.8	67.3	67.9	70.6	68.3	66.6	63.2	60.4	59.5	61.1	58.6	56.0	51.3	46.1	41.6	40.2	34.8	28.4	19.6
BAR-NEP	72.7	76.2	74.1	70.9	72.8	66.3	64.2	67.5	70.7	65.8	66.5	64.6	64.4	63.9	64.3	67.2	65.2	63.1	59.4	56.7	55.4	57.0	54.7	51.8	48.1	43.1	39.4	39.7	33.4	28.0	19.7
NEP-GAH	83.3	85.9	82.3	76.6	76.9	75.0	75.5	77.3	77.6	73.4	76.9	76.0	79.7	83.1	82.0	81.5	81.6	80.2	75.1	73.9	71.4	68.3	66.9	63.3	59.7	55.0	52.6	49.3	46.3	40.0	31.5
GAH-RED	80.9	87.1	84.4	74.8	75.9	72.6	72.0	71.4	71.0	68.5	71.5	70.2	74.3	77.5	79.2	82.8	77.7	75.6	75.1	71.1	67.0	67.5	64.5	60.4	57.4	51.8	48.8	46.9	42.8	36.5	27.0
RED-WAN	84.3	86.0	85.1	77.8	76.6	74.0	74.4	75.4	75.2	71.3	73.6	72.3	76.1	78.4	77.5	81.0	79.6	75.2	73.0	71.4	67.0	64.8	63.7	60.3	57.0	51.8	48.6	47.2	43.5	37.8	28.8
WAN-LEYst*	78.8	87.2	82.7	75.3	75.8	72.5	76.6	86.8	83.6	72.4	79.6	76.8	78.5	82.2	82.2	83.1	80.9	79.3	73.5	69.9	68.0	65.1	62.5	58.9	56.2	51.9	49.3	49.3	52.0	43.7	32.8
LEYst-LEY	77.0	79.5	77.0	73.4	72.7	69.4	67.6	69.9	71.1	69.1	70.2	67.0	66.5	65.5	65.8	69.5	65.7	63.5	59.7	57.2	55.3	55.1	54.5	52.4	50.1	45.4	42.3	42.6	36.1	31.4	22.9
LEY-STR	84.8	86.5	82.9	78.6	77.4	78.0	75.8	79.0	78.9	74.3	77.0	76.1	79.5	83.3	83.0	84.4	83.7	81.8	77.0	75.5	71.2	69.2	67.1	63.9	59.3	54.7	51.2	49.4	48.2	41.5	33.1
STR-MIE	85.6	87.2	83.6	77.3	77.1	75.9	75.9	82.0	81.5	73.5	76.9	76.1	78.7	81.9	83.5	84.0	84.5	82.5	77.2	75.0	71.7	68.9	66.8	63.6	59.8	55.2	51.4	49.6	47.8	42.5	35.3
MIE-BEG	84.9	88.1	83.6	77.2	77.3	74.1	74.5	74.3	73.5	69.5	71.8	71.0	76.1	82.0	82.2	83.9	83.4	80.9	76.8	75.4	72.8	70.1	68.6	64.6	61.1	56.2	53.2	51.1	49.5	44.9	37.9
BEG-LIS	83.6	85.6	83.4	76.5	76.4	75.5	77.4	79.2	82.9	77.5	78.9	76.9	79.8	81.9	82.2	85.3	84.5	84.5	78.8	76.3	73.7	71.5	68.8	65.4	61.7	57.5	52.9	50.4	48.4	42.7	34.6
LIS-BAN	80.7	88.4	84.9	82.7	81.5	80.4	80.2	83.0	84.6	80.4	91.9	87.9	86.0	88.9	86.8	83.7	81.2	79.8	77.3	76.5	74.6	71.8	68.3	70.2	66.3	60.3	58.6	58.0	56.3	51.2	43.4
BAN-STP	78.9	86.3	80.4	75.1	78.2	77.4	77.5	80.3	80.0	76.1	80.7	78.7	79.9	79.6	87.0	78.3	73.8	76.6	69.0	68.2	66.6	65.4	61.4	58.2	56.9	52.8	49.4	47.0	44.9	40.8	32.6
STP-CHL	80.5	82.0	80.8	78.0	77.0	78.2	78.8	82.9	84.0	78.2	81.2	78.8	80.0	82.0	80.1	79.6	76.7	76.4	73.2	71.6	69.5	67.6	65.5	62.2	59.3	55.8	53.2	51.4	49.1	42.9	34.5
CHL-HOL	79.8	87.0	81.0	76.3	76.1	74.9	78.7	80.6	81.0	75.6	76.6	74.5	75.8	75.6	74.7	73.7	71.5	72.5	68.2	64.3	62.4	61.0	59.7	56.6	54.3	50.5	47.5	48.2	42.2	37.3	28.0
HOL-TCR	79.1	84.1	84.7	79.3	77.0	77.7	77.8	79.7	80.0	74.8	78.0	76.4	82.5	92.6	85.8	83.4	90.1	84.7	82.6	78.8	77.4	75.8	71.6	68.3	66.2	59.2	55.6	54.4	51.7	46.6	37.7
TCR-OXC	78.1	80.1	79.0	75.6	74.7	75.5	76.4	77.5	76.0	71.9	76.9	72.1	73.3	73.4	71.0	72.3	70.1	71.2	67.4	64.2	61.3	60.5	58.6	55.6	52.8	48.9	45.9	44.3	40.1	35.5	25.6
OXC-BOS	78.0	88.5	85.6	74.2	76.3	71.8	73.9	75.5	75.0	69.2	70.2	69.1	71.7	72.0	72.0	73.3	71.6	74.4	68.3	64.6	61.6	60.5	58.8	55.2	53.2	48.6	45.8	45.9	39.6	34.7	25.0
BOS-MAA	77.9	82.1	79.8	75.8	75.2	74.5	75.8	76.9	76.9	71.7	74.8	72.2	73.3	74.1	71.9	72.9	71.5	71.4	67.9	65.0	61.6	60.9	59.5	56.7	53.9	49.8	46.8	46.2	43.5	36.1	25.9
MAA-LAG	80.4	79.5	80.4	76.0	75.3	77.0	77.2	81.3	81.7	75.2	77.8	77.1	79.2	80.8	79.5	80.9	79.4	80.7	75.0	71.2	69.1	67.0	64.5	61.4	58.0	53.2	49.6	47.3	43.7	39.5	29.8
LAG-QUE	79.7	86.8	84.9	74.7	76.6	77.3	80.0	81.3	83.3	77.2	78.6	76.7	78.1	78.4	76.6	77.3	74.8	76.3	71.0	68.0	66.0	64.1	61.6	58.1	55.4	50.9	47.6	45.7	42.1	38.2	29.2
QUE-NHG	77.7	86.6	82.0	72.7	76.7	71.6	72.1	73.1	73.3	69.2	81.9	78.3	74.3	76.3	74.9	76.1	74.6	74.2	69.0	65.3	62.4	61.4	60.5	56.9	54.7	49.8	46.9	45.4	40.5	35.1	25.6
NHG-HOP	79.2	77.7	80.4	81.3	76.0	75.5	76.3	75.8	75.1	70.9	82.1	82.2	83.3	87.4	81.9	80.0	79.0	76.9	73.0	69.6	67.6	65.3	62.3	59.9	59.6	52.4	50.2	51.1	47.5	42.3	32.9
HOP-SHB	78.5	88.1	88.3	74.0	76.3	77.7	81.0	81.6	83.4	79.0	81.3	76.3	76.9	78.2	79.7	78.3	80.3	78.1	73.1	70.3	65.7	63.9	62.3	58.5	55.6	51.2	47.4	47.1	40.8	35.5	26.2
SHB-WHC	81.9	85.2	84.4	81.7	83.2	85.7	86.9	87.6	85.4	82.0	88.4	85.5	86.4	86.5	83.6	83.3	79.6	77.6	74.4	73.1	70.3	68.2	65.0	65.4	60.7	56.7	52.4	51.5	49.7	44.6	36.7
WHC-EAA	78.2	79.8	77.6	73.5	74.1	72.7	69.9	72.4	73.5	73.2	77.4	70.9	70.2	69.1	68.4	69.1	68.4	71.8	62.5	60.8	58.7	57.8	56.7	57.3	52.2	47.8	48.1	44.4	41.9	38.3	30.5
EAA-NOA	77.7	79.1	77.2	73.2	72.6	68.9	68.5	71.1	71.8	67.8	70.1	68.0	68.0	66.9	66.7	68.5	68.4	72.1	62.6	60.7	58.4	57.8	56.0	53.7	50.7	46.3	42.5	41.9	38.2	34.0	26.3
NOA-HAL	78.3	78.4	76.7	73.0	72.7	75.1	69.2	71.1	71.6	67.8	71.3	68.5	68.6	68.0	68.3	70.3	70.5	71.9	64.4	62.4	60.8	60.8	58.4	57.1	53.0	48.0	43.3	43.5	39.0	34.3	25.7
HAL-PER	75.5	74.2	74.1	69.6	71.9	66.0	65.9	69.1	69.6	65.6	69.1	68.2	68.2	66.7	68.4	70.7	69.7	70.7	63.8	61.2	59.6	60.4	59.1	57.4	53.0	47.7	44.1	40.8	38.8	33.9	25.0
PER-GRE	75.7	77.8	74.4	71.3	73.0	68.4	66.3	69.5	70.4	66.5	68.5	66.2	66.9	66.6	68.0	69.1	67.6	65.6	62.4	60.1	59.3	60.4	58.9	56.9	52.3	47.0	43.0	41.6	38.8	34.1	25.1
GRE-NOR	75.2	77.7	76.9	71.8	72.8	70.7	66.8	69.8	71.6	68.5	70.6	69.0	68.4	68.0	68.8	70.2	69.6	67.4	63.8	60.8	59.6	60.7	59.3	57.2	52.5	47.4	43.0	42.1	38.6	34.3	25.0
NOR-SOR	76.2	78.6	75.6	71.9	72.6	70.4	69.1	70.6	70.7	67.6	72.3	68.6	67.6	67.5	68.0	69.2	68.7	66.7	63.2	60.6	59.8	60.5	59.4	57.6	52.9	48.4	43.8	42.3	40.0	35.1	26.5
SOR-RUG	73.6	74.4	74.1	70.9	71.0	69.4	67.4	69.0	70.6	65.2	68.7	65.7	65.7	65.8	66.6	68.2	67.7	66.3	62.3	59.6	58.4	59.4	58.2	56.6	52.0	46.8	42.0	39.2	37.6	32.1	23.2

\*Rail vehicle stationary mid-journey, actual transit time between stations was 255 seconds ( $L_{eq64s}$ ).



Table A5 Station to station unweighted one-third octave band  $L_{eq}$  at 1.2 m seated position (Ruislip Gardens to Hainault)

	Centre Frequency (Hz)																														
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
RUG-SOR	73.7	80.1	74.0	69.7	70.7	72.9	63.1	66.5	65.3	65.8	66.2	64.1	68.8	66.9	66.5	67.2	68.2	67.7	63.9	61.3	60.3	63.2	59.4	56.5	52.0	46.1	40.0	37.1	32.5	26.5	18.9
SOR-NOR	78.1	79.7	73.2	71.3	70.9	78.0	68.3	68.4	67.1	67.9	67.2	65.9	68.6	70.0	69.2	69.7	70.3	69.2	66.8	64.0	63.6	64.8	60.7	59.2	54.7	49.1	42.7	38.9	34.9	29.0	22.0
NOR-GRE	81.3	82.9	74.5	72.2	73.0	79.0	70.8	69.8	67.2	69.2	69.2	68.7	70.8	72.9	70.7	72.4	71.9	72.2	69.0	65.8	65.1	64.4	61.2	58.8	54.5	48.7	42.5	38.7	35.0	29.5	23.1
GRE-PER	78.3	79.6	76.2	70.5	72.0	78.6	69.3	69.0	67.0	68.3	66.5	66.3	69.9	70.1	69.2	70.7	70.0	68.8	66.9	64.3	63.8	65.2	61.2	59.5	55.3	49.6	42.9	39.2	35.5	29.4	21.4
PER-HAL	80.0	81.7	73.8	72.5	72.4	79.9	71.6	70.7	70.4	72.3	70.5	69.4	73.1	71.4	70.6	71.5	70.8	69.9	68.5	65.0	64.8	65.9	61.5	59.9	55.7	49.7	43.2	39.5	35.7	29.9	22.5
HAL-NOA	80.3	83.4	73.5	71.7	73.5	76.9	67.8	69.8	69.4	70.5	68.8	66.4	70.0	68.7	68.5	70.1	69.7	68.0	64.6	62.2	60.9	61.9	59.5	57.3	52.8	47.2	41.2	38.0	33.8	28.0	21.0
NOA-EAA	79.2	84.5	73.7	71.4	72.6	70.1	63.2	69.0	66.9	66.9	65.3	62.6	67.4	66.8	66.0	68.3	66.9	65.6	61.5	60.0	58.1	58.9	57.2	54.1	50.1	44.8	39.5	36.7	32.4	26.7	19.7
EAA-WHC	79.0	83.0	73.1	69.5	71.9	72.8	63.6	67.8	66.8	67.2	65.6	61.4	66.5	65.2	64.9	67.2	65.9	65.5	61.3	59.1	57.3	59.7	56.1	53.7	49.5	44.5	39.0	36.3	31.9	26.4	19.5
WHC-SHB	80.6	86.8	76.5	72.4	76.0	76.4	71.1	73.1	71.2	72.0	75.8	72.7	78.3	85.0	80.0	78.4	75.4	72.9	69.2	67.4	65.2	66.7	60.4	57.0	55.4	49.7	45.2	43.4	38.4	33.5	27.8
SHB-HOP	84.4	89.7	75.8	75.2	76.3	72.8	70.8	71.1	67.8	68.9	66.8	68.9	76.8	79.6	76.9	75.3	76.4	73.9	71.5	70.0	66.2	64.9	63.4	59.5	56.0	50.4	45.9	42.8	38.7	33.8	31.7
HOP=NHG	82.7	82.5	77.0	75.2	74.7	73.3	68.9	72.6	69.7	68.8	68.8	73.2	90.7	89.7	94.5	90.3	93.5	95.7	91.7	86.5	82.5	79.4	74.2	69.0	63.0	58.4	52.0	48.3	44.2	39.0	34.0
NHG-QUE	87.1	87.4	85.2	84.1	79.3	78.0	71.7	74.3	71.1	73.3	70.2	71.0	77.9	80.2	75.5	75.9	75.7	72.8	71.0	70.1	67.5	66.2	65.7	63.5	61.4	56.9	53.2	50.5	48.4	45.4	39.6
QUE-LAG	87.5	90.1	84.1	79.0	78.6	80.9	76.3	78.2	75.1	77.1	75.0	74.7	80.9	82.0	77.7	78.2	77.8	75.1	73.3	71.8	68.3	66.8	64.8	61.3	57.3	53.0	48.8	46.0	42.2	36.7	33.7
LAG-MAA	84.0	82.3	75.6	74.7	75.2	75.0	72.0	77.9	74.4	73.7	71.5	72.0	77.9	76.9	75.2	75.5	74.8	74.8	69.8	67.6	65.4	64.1	61.7	58.1	55.1	50.1	45.4	42.1	37.6	33.7	31.7
MAA-BOS	86.2	90.1	83.7	78.9	79.2	81.5	77.3	77.6	73.8	76.1	74.4	73.4	79.0	79.9	75.1	75.9	74.6	72.3	70.8	69.3	65.3	63.9	62.1	58.6	55.3	50.1	45.9	43.8	39.0	34.6	31.9
BOS-OXC	83.5	82.1	76.0	74.7	74.6	76.5	71.7	75.5	74.2	75.5	73.5	72.8	77.8	78.4	80.3	74.7	75.3	75.4	69.7	67.8	65.5	63.2	60.6	57.3	53.6	49.1	44.5	41.1	37.5	33.4	31.8
OXC-TCR	82.1	89.8	78.1	73.3	76.2	74.2	74.0	80.6	77.1	73.9	71.4	70.7	76.0	75.7	74.9	75.5	74.7	76.8	70.9	67.1	64.0	62.3	60.6	56.9	54.4	49.2	45.0	42.4	37.9	33.9	31.5
TCR-HOL	79.9	82.5	78.6	73.7	74.6	74.5	71.3	74.1	69.8	70.8	70.4	75.2	79.0	75.3	79.5	77.0	81.5	80.7	76.5	72.1	68.8	65.9	61.8	57.4	52.9	48.4	43.3	40.1	35.8	31.4	28.5
HOL-CHL	82.1	88.2	74.3	73.5	75.3	73.8	70.3	72.9	68.4	68.3	67.3	68.0	74.6	72.5	70.1	70.4	68.7	67.2	65.0	62.1	58.5	58.6	57.4	53.9	51.4	46.9	42.8	40.7	34.9	31.0	28.9
CHL-STP	87.0	89.1	82.8	78.2	77.4	80.0	76.7	78.0	74.2	75.3	73.6	72.3	77.6	78.3	74.6	75.7	74.4	72.2	71.2	69.9	67.2	66.3	65.2	60.8	59.6	53.6	50.7	47.0	45.1	39.0	33.5
STP-BAN	82.2	81.9	77.2	79.7	76.8	81.1	73.7	75.6	70.7	71.4	74.0	74.3	80.5	83.1	83.5	76.4	80.0	76.7	73.1	69.4	68.3	67.6	62.2	59.2	57.6	52.0	48.0	46.8	42.9	38.6	32.6
BAN-LIS	80.5	88.6	74.7	73.9	77.3	79.5	77.2	77.9	75.5	76.8	77.2	77.0	80.2	79.6	78.6	75.7	73.2	71.8	69.2	67.5	65.7	70.4	61.0	57.9	57.5	50.7	45.7	44.3	40.5	36.0	30.7
LIS-BEG	86.7	88.2	79.4	76.9	76.8	76.7	72.5	76.8	74.0	73.5	72.3	74.7	82.5	84.5	83.5	85.3	86.3	84.8	80.4	78.4	75.8	73.8	71.1	67.3	62.8	57.3	52.0	48.3	44.7	38.5	34.5
BEG-MIE	89.6	89.8	80.4	78.6	78.5	78.9	75.5	79.1	78.8	80.2	77.2	78.1	84.1	84.7	81.5	82.2	83.4	82.3	77.8	75.9	73.3	70.4	68.2	64.4	59.7	54.8	49.5	45.9	42.8	37.7	34.8
MIE-STR	88.6	88.5	80.8	77.8	77.6	78.8	74.0	76.8	74.8	78.0	75.9	77.3	86.3	89.1	85.3	86.6	87.6	83.3	81.7	80.7	77.5	75.6	73.4	69.3	64.5	58.4	54.3	50.5	46.9	40.8	35.9
STR-LEY	87.0	88.1	79.4	76.6	76.8	76.0	70.6	74.0	70.4	70.6	71.8	80.2	93.7	102.8	93.8	96.0	93.7	90.9	87.5	84.7	80.9	79.6	75.8	70.2	65.6	60.8	54.7	52.4	48.8	43.1	37.0
LEY-LETst	78.9	82.5	74.4	69.8	72.0	71.0	63.4	67.5	66.6	65.7	64.9	62.2	66.4	64.8	63.4	63.9	63.7	63.7	58.9	56.8	54.7	53.4	52.2	49.6	46.4	42.0	37.3	34.8	30.5	25.4	19.1
LETst-WAN	85.5	88.9	82.9	74.5	76.4	76.3	71.8	78.2	75.0	75.7	75.2	72.8	78.9	79.1	80.0	81.6	85.9	83.3	74.7	72.0	68.6	67.6	63.7	61.0	55.9	51.3	46.1	42.9	39.5	34.8	32.9
WAN-RED	84.8	81.7	75.7	73.8	74.5	73.8	68.8	73.0	68.1	66.9	64.9	65.5	74.5	82.0	97.5	86.6	85.2	89.9	79.5	79.4	77.5	72.5	68.9	64.3	59.9	54.7	49.2	45.5	41.6	36.7	34.1
RED-GAH	86.9	89.5	79.1	75.9	76.8	77.0	70.8	72.0	68.1	69.0	68.1	68.7	77.7	79.0	79.0	79.3	81.5	79.0	74.0	72.5	68.2	66.0	64.2	60.9	56.5	51.5	47.6	44.0	40.9	36.0	33.9
GAH-NEP	88.1	88.5	79.2	77.0	77.0	77.2	71.8	74.8	71.1	71.8	70.3	70.8	80.0	87.3	91.3	82.7	86.4	86.3	78.2	77.1	73.7	71.2	67.4	63.5	60.0	54.5	49.3	45.8	42.4	37.2	34.4
NEP-BAR	81.7	83.2	80.1	77.2	73.0	79.2	67.6	69.8	68.9	68.7	66.8	65.1	69.2	68.8	68.0	69.2	68.9	67.4	63.9	61.5	61.1	61.3	59.5	58.5	55.2	51.1	47.3	44.7	42.3	39.3	31.7
BAR-FAI	79.4	79.4	74.0	71.7	72.1	80.2	66.6	66.5	66.0	66.7	65.4	63.5	67.6	67.6	67.2	68.0	69.0	67.2	64.2	61.3	60.3	61.6	58.6	56.6	52.0	46.1	39.6	36.0	32.2	26.2	19.0
FAI-HAI	81.5	84.2	79.1	77.0	71.8	72.1	65.1	69.5	68.5	66.8	64.3	61.1	66.3	65.2	64.4	64.2	63.2	62.6	58.9	57.6	56.4	57.6	56.2	53.9	51.7	47.6	43.4	41.5	40.4	39.8	32.6



Table A6 Station to station unweighted one-third octave band  $L_{eq}$  at 1.2 m seated position (Hainault to Ruislip Gardens)

	Centre Frequency (Hz)																														
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
HAI-FAI	82.4	85.5	78.6	71.8	72.5	77.0	68.2	71.8	69.1	67.9	65.7	62.3	68.7	66.2	65.1	64.5	64.1	63.0	59.7	57.7	56.7	57.2	54.9	52.5	49.0	44.1	39.3	37.5	33.0	28.4	21.4
FAI-BAR	73.7	74.3	68.7	68.4	71.4	66.8	60.9	66.2	67.0	66.8	65.6	62.7	68.4	67.2	66.5	66.1	66.5	65.3	61.9	59.2	57.7	59.7	56.9	53.8	48.9	43.5	37.8	34.0	29.1	22.4	15.2
BAR-NEP	75.2	79.7	71.5	67.7	70.8	67.7	61.1	65.3	65.6	65.0	63.4	60.8	65.8	63.7	63.0	62.7	63.4	63.1	58.9	56.6	54.4	55.9	53.4	50.0	46.3	40.9	36.1	33.5	27.8	22.2	15.9
NEP-GAH	86.4	87.7	79.6	76.7	76.2	77.1	72.5	74.6	71.6	72.5	72.0	72.0	78.7	81.2	79.2	78.6	79.7	78.0	73.3	71.8	69.3	66.1	64.4	60.7	56.7	51.8	47.7	44.0	40.4	35.2	32.7
GAH-RED	83.8	89.0	81.6	74.5	75.5	74.2	68.8	70.0	66.5	68.2	66.8	66.2	73.6	75.7	77.1	80.2	76.0	73.7	73.5	69.2	65.1	65.7	62.4	58.2	54.9	49.1	44.9	41.8	37.7	33.3	31.7
RED-WAN	87.3	88.3	83.4	77.5	76.3	75.9	70.8	73.1	69.8	70.1	68.5	68.1	75.5	76.5	75.2	77.9	77.8	73.0	71.1	69.3	64.8	62.8	61.6	57.9	54.5	48.9	44.5	41.5	38.0	33.8	32.4
WAN-LEYst*	80.8	79.8	74.1	73	73	72	69.5	71.8	70.7	69.4	66.8	66.5	73	73.3	76	79.6	79.5	77.2	71.4	67.2	63.9	62.5	60.5	56.5	52.4	47.9	43.3	39.5	35.7	32.1	31.5
LEYst-LEY	79.5	83.4	74.3	71.0	71.6	70.9	64.3	67.7	66.7	68.5	66.8	62.6	66.1	65.1	64.3	65.8	64.1	63.3	59.3	57.1	54.5	54.2	53.2	50.7	47.8	42.7	38.0	35.6	30.1	24.6	17.9
LEY-STR	87.9	89.3	81.5	78.3	77.9	79.4	73.2	76.8	73.8	74.5	73.1	72.5	79.5	82.3	81.2	82.1	82.6	80.3	75.8	73.7	69.4	67.6	65.3	61.9	57.2	52.3	47.2	44.5	41.9	36.5	33.4
STR-MIE	88.9	88.5	81.4	77.6	77.3	77.9	72.7	78.6	75.2	72.7	72.1	72.1	78.0	80.1	81.2	81.3	83.1	80.4	75.6	73.2	69.8	67.1	64.9	61.4	57.3	52.5	47.3	44.5	41.8	37.5	35.2
MIE-BEG	87.9	90.3	81.3	77.4	76.9	75.9	70.4	72.1	68.3	68.9	67.6	67.1	75.2	80.2	79.6	81.1	81.8	79.0	75.1	73.4	70.9	68.2	66.5	62.3	58.4	53.4	49.1	46.1	43.8	40.2	36.4
BEG-LIS	86.3	87.1	79.9	75.9	75.8	76.8	74.5	77.0	75.2	75.2	73.5	72.9	79.0	79.8	80.2	82.5	83.0	82.6	77.0	74.3	71.6	69.6	66.6	63.0	58.9	54.4	48.7	45.2	42.2	37.4	34.1
LIS-BAN	83.6	90.9	81.4	81.3	81.0	82.4	77.3	79.7	77.2	79.8	84.7	81.5	85.2	87.1	84.8	81.2	79.4	78.0	75.6	74.6	72.5	69.9	66.2	67.0	63.1	57.2	53.7	52.8	49.8	45.2	38.7
BAN-STP	81.5	89.0	80.0	73.8	77.6	79.4	75.2	78.8	74.8	75.6	75.5	74.9	79.4	78.6	85.4	76.5	72.6	74.9	67.9	66.8	65.3	65.5	60.2	56.7	54.8	50.4	45.8	42.9	39.6	36.1	31.1
STP-CHL	83.7	84.8	77.6	77.1	76.7	79.7	77.0	79.7	77.2	76.3	75.6	74.4	79.5	79.9	77.9	76.4	74.5	74.3	71.4	69.5	67.0	65.4	63.1	59.9	56.7	53.0	48.7	45.5	41.9	36.8	32.5
CHL-HOL	82.3	88.9	80.0	75.4	75.9	76.1	75.7	78.7	74.1	72.8	71.6	70.8	75.0	73.4	72.1	70.9	69.9	70.0	67.6	64.4	61.8	60.5	59.3	55.7	53.1	48.9	44.8	42.7	37.0	32.0	28.4
HOL-TCR	82.0	85.5	82.4	79.7	77.5	78.7	75.1	78.0	73.6	73.2	73.0	72.2	81.7	90.6	83.2	80.0	87.6	82.1	80.5	76.4	74.8	73.3	69.0	65.4	62.8	55.8	50.8	48.7	44.8	40.0	34.3
TCR-OXC	81.1	84.4	78.9	75.5	75.1	77.4	74.2	75.2	71.2	71.1	70.5	68.1	72.6	71.5	68.6	69.3	68.5	68.6	67.0	64.2	61.0	60.0	58.6	54.9	51.8	47.9	43.6	40.1	35.4	30.6	27.8
OXC-BOS	80.5	88.0	82.2	74.9	76.0	73.4	71.1	74.5	69.6	67.9	66.9	66.3	71.6	70.1	69.5	70.2	70.1	71.8	67.4	64.4	61.1	60.2	58.8	54.8	52.5	48.0	44.0	41.3	36.3	32.3	30.3
BOS-MAA	81.1	85.0	79.2	75.2	75.8	77.0	73.3	75.2	72.2	71.0	70.1	68.5	72.9	72.6	70.0	70.2	70.1	69.2	67.6	64.9	61.4	60.4	59.2	55.8	52.6	48.5	44.3	41.2	36.7	31.7	29.2
MAA-LAG	83.5	82.8	79.5	76.1	76.2	78.1	74.5	79.5	75.8	73.4	73.0	72.8	78.7	78.5	76.7	77.6	77.6	78.3	73.4	69.5	67.1	65.3	62.7	59.3	55.7	50.9	46.3	42.8	38.5	34.4	32.2
LAG-QUE	83.2	89.7	82.8	74.2	76.2	77.6	77.0	79.1	77.0	75.1	73.9	72.6	77.4	76.8	74.4	74.6	73.3	74.1	69.9	67.2	64.7	63.0	60.8	57.0	54.0	49.5	45.2	42.1	37.8	34.1	32.2
QUE-NHG	80.7	88.7	82.5	72.9	75.8	73.6	69.1	71.8	68.9	68.1	72.5	71.4	73.6	74.2	72.4	72.8	72.5	71.1	68.0	64.8	61.6	60.7	59.8	55.8	53.4	48.7	44.5	41.4	36.6	32.5	30.5
NHG-HOP	82.2	81.7	79.0	80.3	77.1	77.1	73.5	74.7	70.6	70.1	74.1	76.9	82.0	85.1	79.4	77.5	77.0	74.2	71.6	68.1	65.8	63.8	61.1	58.2	57.5	50.4	46.7	45.9	42.0	36.9	31.7
HOP-SHB	81.0	88.7	85.9	73.3	75.5	78.7	76.8	79.2	76.7	76.8	75.8	71.3	76.2	76.3	76.7	75.0	77.9	75.4	71.4	68.5	64.2	62.7	61.0	57.1	54.2	49.6	44.9	42.0	37.0	32.3	29.4
SHB-WHC	84.6	87.6	82.5	80.1	82.3	87.8	84.3	85.2	79.9	80.5	80.9	80.3	85.2	84.9	81.0	80.3	77.7	75.1	72.9	71.2	68.3	66.3	63.1	62.0	57.6	53.7	48.0	46.2	42.8	39.0	32.1
WHC-EAA	82.5	84.3	77.1	72.6	74.5	73.9	67.1	72.0	69.5	72.8	71.7	66.8	69.9	68.7	67.1	67.1	67.1	67.3	64.4	62.6	59.6	58.7	57.6	55.8	51.8	47.4	43.9	40.1	36.1	31.7	25.7
EAA-NOA	82.0	82.5	76.9	72.4	73.0	71.2	66.0	71.1	67.9	67.0	66.9	65.5	68.0	66.4	65.4	66.8	66.9	67.8	64.4	62.8	59.7	58.7	57.4	54.0	50.9	46.8	42.0	39.1	34.2	29.4	24.1
NOA-HAL	82.0	82.6	77.0	72.3	73.1	78.5	67.5	71.1	68.3	67.7	67.5	65.8	67.9	67.4	66.9	68.4	68.6	68.9	65.2	63.4	60.7	60.6	58.7	56.3	52.3	47.6	42.3	39.4	34.7	29.2	22.4
HAL-PER	77.5	77.4	75.1	70.2	71.6	68.7	63.8	69.0	66.6	65.7	66.6	65.5	67.8	66.2	66.3	68.0	67.6	68.2	64.1	62.2	59.5	59.8	58.4	55.9	51.6	46.8	42.1	38.0	34.1	28.6	21.8
PER-GRE	78.1	81.5	70.8	69.1	72.0	69.9	63.3	67.7	65.8	66.3	65.1	62.0	66.6	66.0	66.0	66.3	65.9	64.7	61.1	58.8	57.3	58.7	56.9	54.5	49.9	44.5	39.5	36.6	33.0	27.8	20.9
GRE-NOR	76.8	80.9	74.0	68.9	72.1	71.6	63.8	68.0	66.8	67.9	66.8	64.1	67.4	67.3	67.2	67.9	67.9	66.1	62.3	59.3	57.7	59.1	57.4	54.9	50.1	44.8	39.4	36.6	32.8	27.6	20.7
NOR-SOR	77.8	81.8	72.3	69.3	72.2	72.1	64.5	68.4	66.7	67.1	67.9	64.2	67.4	67.2	66.3	66.9	66.9	65.4	61.6	59.1	57.9	58.8	57.4	55.2	50.4	45.5	40.0	37.1	33.9	28.3	21.8
SOR-RUG	75.8	77.6	71.1	69.4	70.6	72.3	63.2	66.2	64.9	64.6	64.6	61.4	66.2	65.5	64.7	65.7	65.8	65.1	60.8	58.3	56.6	57.7	56.1	54.2	49.2	44.0	38.3	34.6	31.5	25.6	19.9

\*Rail vehicle stationary mid journey, actual transit time between stations was 255 seconds ( $L_{eq64s}$ ).