Danish Acoustical Institute
The Danish Academy of Technical Sciences

STATENS
TEKNISKE
PRØVENÆVN
DANISH NATIONAL TESTING BOARD
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TEST REPORT

The report contains the results of an authorized technical test per-

1. INTRODUCTION

By request of Pogro Trading ApS, now Fresh Danmark A/S, laboratory measurements of unit insulation, D_I, were carried out for outdoor air intakes type Fresh 80-dB intended for mounting in a wall.

[redacted]

Measurement 1: Intake mounted in 400 mm wall
Measurement 2: Intake mounted in 300 mm wall
Measurement 3: Intake mounted in 200 mm wall

The measurements were carried out in 1983, and the results were reported in the Danish Test Report LI 1187/83, STP 100/10.

The present report is a translation from Danish. In its main contents the present report is identical with the original report.

The supplementary information in Section 8 is not found in the Danish original Test Report LI 1187/83.

2. DESCRIPTION OF THE OUTDOOR AIR INTAKES ON THE BASIS OF THE CLIENT'S SPECIFICATIONS

The outdoor air intakes type Fresh 80-dB consist of an inner openable valve, an intermediate tube, and an outer grating. A sectional drawing of the outdoor air intake is shown on the graph sheets of the report.

The inner valve is circular and is mounted on a square cover plate of 210 mm × 210 mm. The valve and the cover plate are

ther, the valve is provided with a dust filter 20 PPI of plastic fabric.

The connecting piece to the intermediate tube has an outer diameter of 80 mm.

The intermediate tube has an outer diameter of 140 mm. It is constructed from 1 mm galvanized steel plate with an inner coating of 30 mm tubular glass wool. The specific weight of the glass wool is 70 kg/m³.

The inner diameter of the tube is thus approx. 80 mm. The tube length is adapted to the wall thickness.

The outer grating is 88 mm × 88 mm and is mounted on a square cover plate of 210 mm × 210 mm. The grating and the cover plate are made from ABS-plastic with an average thickness of approx. 2 mm. There are 5 slits in the grating, each with an area of approx. 80 mm × 9 mm. The free area of the grating is thus approx. 36 cm².

The connecting piece to the intermediate tube has an outer diameter of 80 mm.

3. MOUNTING IN THE LABORATORY

Two outdoor air intakes were at the same time mounted in a test wall, which was erected between two reverberation rooms.

The test wall was a 375 mm double wall, erected in a 3.70 m wide and 2.69 m high opening in a concrete frame between the two reverberation rooms.

In the wall there was an opening of 1.21 m × 1.21 m. This opening was covered with 22 mm chipboards, which were mounted in such a way that the wall thickness in the covered opening was 380 mm, 300 mm, and 200 mm, respectively, during the three measurements. The cavity between the chipboards was filled with mineral wool.

The sound transmission through the wall without intakes, ex-

with the below values as a result:

380 mm wall: $D_{IF,w}$ = 57 dB
300 mm wall: $D_{IF,w}$ = 57 dB
200 mm wall: $D_{IF,w}$ = 55 dB

At the mounting of the intakes a narrow stripe of plastic joint filler was placed under the square plastic cover plates.

The two intakes were mounted diagonally on the chipboard in such a way that their mutual centre distance was 1.33 m. The height above the floor was 0.85 m and 1.74 m, respectively.

The outdoor air intakes were mounted through the chipboards in ϕ150 mm holes. In order to increase the intake length to about 400 mm at measurement no. 1, chipboards of 300 mm × 300 mm with holes of ϕ150 mm were mounted below the two outer gratings. At measurement no. 2 and 3 there was a niche depth of 80 mm and 180 mm, respectively, at the inner wall part.

During the three measurements the length of the intermediate tube was:

Measurement no. 1: Tube length 380 mm
Measurement no. 2: Tube length 300 mm
Measurement no. 3: Tube length 200 mm

At measurement no. 1 the intermediate tube was one unbroken

insulation of building elements". Calculation of the test results as unit insulation was made according to the requirements of Nordtest Method ACOU 037-1982. During the measurements two identical intakes were mounted at the same time.

5. INSTRUMENTATION

The following instruments were used for the test:

Instrument	Type	LI No.
Building Acoustics Analyzer	B&K 4418	757L
Measuring Microphone	B&K 4144	717L
Measuring Microphone	B&K 4144	730L
Microphone Preamplifier	B&K 2619	621L
Microphone Preamplifier	B&K 2619	719L
Microphone Power Supply	B&K 2804/5217	620L
Microphone Power Supply	B&K 2804/WG1051	721L
Sound Level Calibrator	B&K 4230	646L

The instruments used have been checked in accordance with the regulations of the Danish National Testing Board (Statens Tekniske Prøvenævn).

6. MEASUREMENT CONDITIONS

Correction for sound transmission through the surrounding wall construction was made according to the requirements of Nordtest Method ACOU 037-1982.

In certain frequency ranges the sound transmission through the surrounding wall construction was larger than 1/3 of the sound transmission through the test objects. Therefore it is not possible to make an exact correction for the sound transmission throgh the surrounding wall. At the frequencies in question the correction has therefore been reduced corresponding to a transmission ratio of 1:3.

The corrections and the limitations of the corrections have not had any influence on the calculation of $D_{I,w}$.

Frequency ranges, where the correction is limited to a transmission ration of 1:3, are given below:

Measurement no. 1: 100-125 Hz and 2500 and 3150 Hz
Measurement no. 2: 100-160 Hz and 3150 Hz
Measurement no. 3: 100-160 Hz

Date of test: 1983-08-22 and 1983-09-09.

7. TEST RESULTS

The unit insulation, D_I, per 1/3 octave from 100 Hz to 3150 Hz is shown in tabular form and presented graphically on the following graph sheets.

The weighted unit insulation, $D_{I,w}$, has been found by using the evaluation method of ISO 717/3-1982. Description of the evaluation method is found in the Appendix.

The results are:

Measurement no. 1, wall thickness 400 mm
$D_{I,w}$ = 44 dB, Δ_{max} = 6.4 dB

Measurement no. 2, wall thickness 300 mm
$D_{I,w}$ = 40 dB, Δ_{max} = 5.9 dB

Measurement no. 3, wall thickness 200 mm
$D_{I,w}$ = 36 dB, Δ_{max} = 7.2 dB

8. SUPPLEMENTARY INFORMATION

In the original Danish Test Report LI 1187/83 the results were only expressed as unit insulation, D_I, and weighted unit insulation index, $D_{I,w}$.

In relation to this translation two more weighting indices are given as supplementary information:

- The weighted sound reduction index, R_w, evaluated from the sound reduction index, R, according to ISO 717/3-1982. The sound reduction index, R, is evaluated using an area S = 0.02 m² of the test specimen equal to the free test opening (ϕ150 mm holes).
- The weighted element normalized level difference, $D_{n,e,w}$, as defined in ISO/DP 140-10 and evaluated according to ISO 717/3-1982.

The test results are:

	$D_{I,w}$ (S_0 = 1 m²)	R_w (S = 0.02 m²)	$D_{n,e,w}$ (A_0 = 10 m²)
Measurement no. 1 Wall thickness 400 mm	44 dB	27 dB	54 dB
Measurement no. 2 Wall thickness 300 mm	40 dB	23 dB	50 dB
Measurement no. 3 Wall thickness 200 mm	36 dB	19 dB	46 dB

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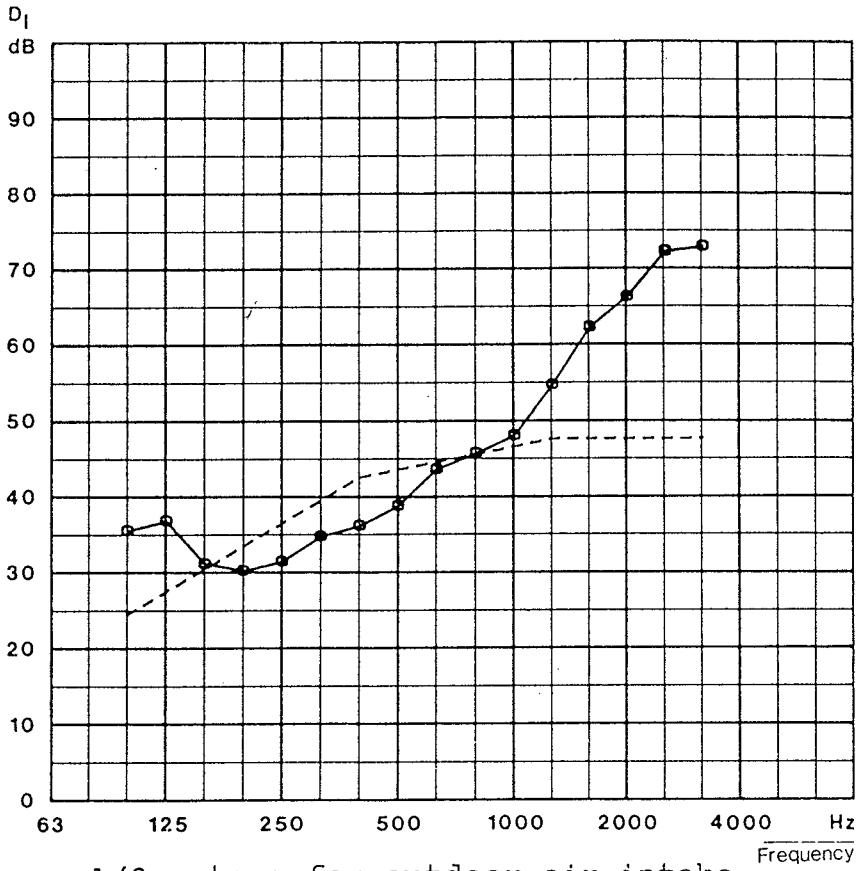
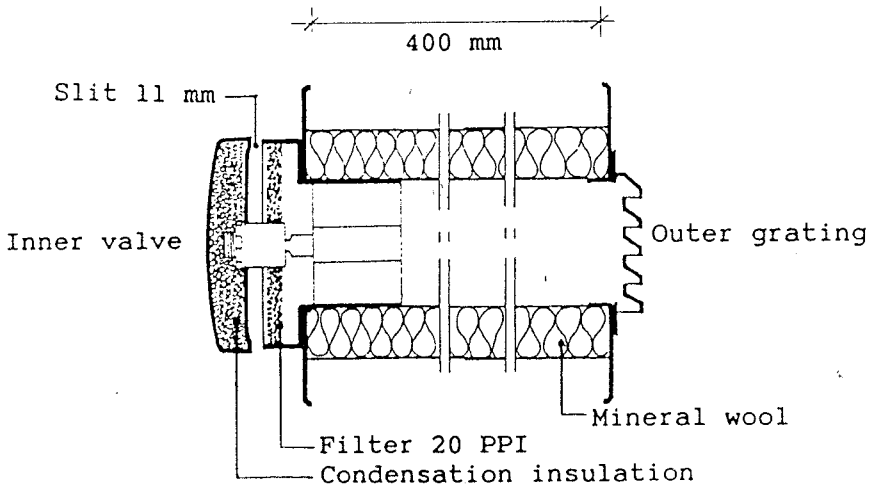
Report	LI 835/91 STP 100/247
Graph sheet	1 Page 8 of 13
Date	1983-08-22
Signature	SDK
Test area	1 m² reference area
Source room	230 m³ / 215 m³
Receiving room	215 m³ / 230 m³
Microphones	φ2.50 m circles

Laboratory Measurement of Unit Insulation. Method: ISO 140/3-1978 and Nordtest Method ACOU 037-1982.

Frequency Hz	D_I dB
100	36.0
125	37.3
160	31.6
200	30.7
250	31.9
315	35.2
400	36.6
500	39.2
630	44.0
800	46.1
1000	48.4
1250	55.1
1600	62.7
2000	66.7
2500	72.7
3150	73.3
$D_{I,w}$	44
Δ_{max}	6.4



Unit insulation, D_I, per 1/3 octave for outdoor air intake type Fresh 80-dB mounted in a 400 mm wall. The $D_{I,w}$ reference curve is shown as a dotted line.



Horizontal section of outdoor air intake. Scale 1:5.

Descriptions of materials and measurement conditions are given in the report.

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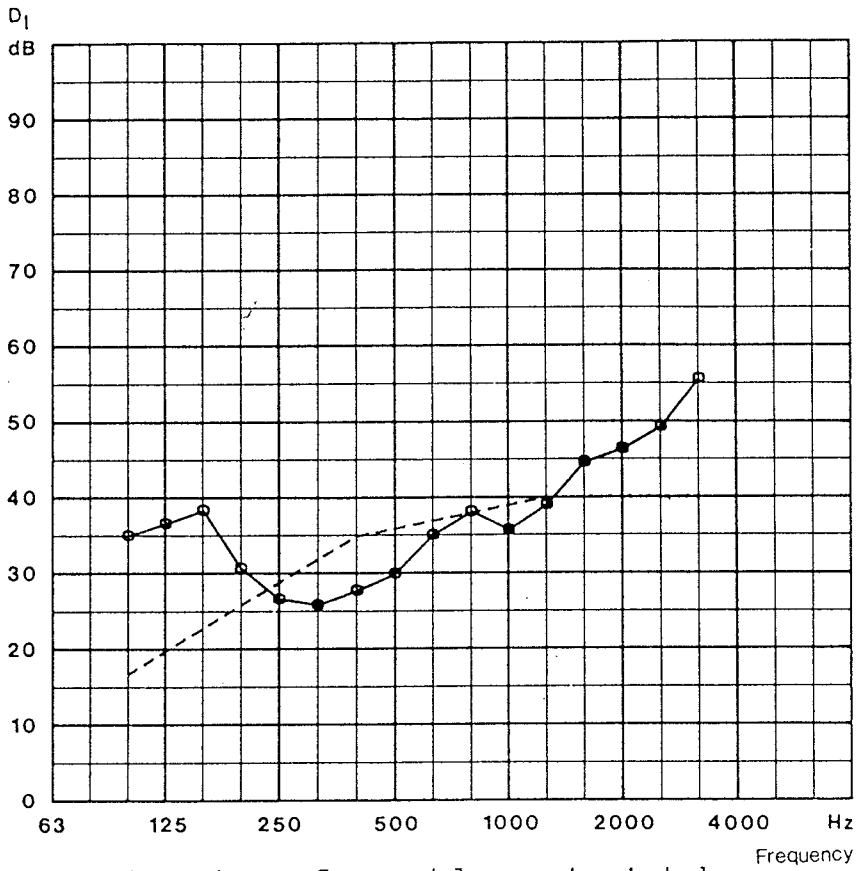
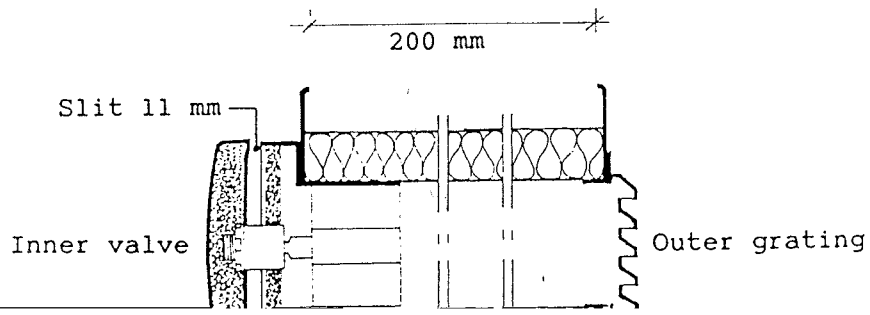
Report	LI 835/91 STP 100/247
Graph sheet	3 Page 10 of 13
Date	1983-09-09
Signature	SDK
Test area	1 m² reference area
Source room	230 m³ / 215 m³
Receiving room	215 m³ / 230 m³
Microphones	φ2.50 m circles

Laboratory Measurement of Unit Insulation. Method: ISO 140/3-1978 and Nordtest Method ACOU 037-1982.

Frequency Hz	D_I dB
100	35.2
125	36.8
160	38.5
200	30.8
250	26.7
315	25.9
400	27.8
500	30.0
630	35.1
800	38.1
1000	35.7
1250	39.0
1600	44.6
2000	46.3
2500	49.2
3150	55.5
$D_{I,w}$	36
Δ_{max}	7.2



Unit insulation, D_I, per 1/3 octave for outdoor air intake type Fresh 80-dB mounted in a 200 mm wall. The $D_{I,w}$ reference curve is shown as a dotted line.



DESCRIPTION OF TEST ROOMS

The measurements are performed in two adjacent reverberation rooms (004 and 003). The width of the rooms is 6.25 m, and the height is 4.95 m. Room 004 is 7.85 m long, while room 003 is 7.65 m long. Between the 100 mm and 300 mm end walls of the rooms there is an 800 mm concrete frame with a 2.69 m high and 3.70 m wide opening. The other walls, ceiling, and floor of the rooms are made of 300 mm concrete. Both rooms and the concrete frame are built on separate foundations. Sound diffusing elements of concrete and of damped steel plate are situated on two of the walls and on the ceiling, and the volumes of the rooms are approx. 230 m^3 (room 004) and approx. 215 m^3 (room 003).

The outdoor air intakes were mounted in a test opening in a

TEST METHOD

The airborne sound insulation for small building elements, among these outdoor air intakes, is characterized by the unit

[redacted]

For other building elements the airborne sound insulation is characterized by the sound reduction index R which is measured according to ISO 140/3-1978.

Measurement of R implies a well defined test area. In the case of small building elements the test area is not necessarily the same in source and receiving room. It may also be difficult to determine the test area exactly. Therefore, a reference area of 1 m² is used instead. This also makes comparison between test results for building elements of different design more easy. The sound insulation measured according to this method is denoted D_I. In other respects, the measurements are carried out according to the requirements of ISO 140/3-1978.

Measurements of D_I for building elements are made with different positions in the wall; simultaneous measurements can be performed on more than one building element.

The test specimens are placed between a source room and a receiving room, which satisfy the requirements of ISO 140/1-1978, and the unit insulation is determined by means of the below formula, presupposing diffuse sound fields in the rooms.

The measurement was carried out with 1/3 octave band-limited pink noise emitted by a loudspeaker placed in a corner of the source room. The sound pressure levels of the source room and the receiving room were averaged within a period of 16 seconds corresponding to one revolution of a rotation microphone system with sloping path and a diameter of approx. 1.25 m. Filters with a band-width of 1/3 octave were used both for the

$$D_I = L_S - L_M + 10 \log_{10}(S_O/A_M) \quad \text{and} \quad A_M = \frac{0.163 \cdot V_M}{T_M}$$

D_I = Unit insulation [dB]

L_S = Sound pressure level in source room [dB re 20 µPa]

L_M = Sound pressure level in receiving room [dB re 20 µPa]

S_O = Reference area = 1 m²

A_M = Equivalent sound absorption area in receiving room [m²]

V_M = Volume of receiving room [m³]

T_M = Reverberation time in receiving room [s]

EVALUATION METHOD

To evaluate the airborne sound insulation of the test specimen the weighted unit insulation index, $D_{I,w}$, is used. The value is determined according to ISO 717/3-1982.

When determining the evaluation value, $D_{I,w}$, the measured results of D_I per 1/3 octave from 100 Hz to 3150 Hz is compared with a reference curve which is rising by 3 dB per 1/3 octave from 100 Hz to 400 Hz and by 1 dB per 1/3 octave from 400 Hz to 1250 Hz, whereupon the curve takes on a constant value. An unfavourable deviation occurs at a certain frequency when the test result is less than the value of the reference curve. The mean unfavourable deviation is calculated by dividing the sum of these deviations by the total number of measurement frequencies.

The $D_{I,w}$-value is found by shifting the reference curve in steps of 1 dB till the mean unfavourable deviation is as large as possible, but does not exceed 2.0 dB.

The evaluation value is determined from the shifted reference curve as the value in dB at 500 Hz.

The maximum unfavourable deviation shall be reported if it exceeds 8.0 dB.