Hush Acoustics - ROOFING

HUSH FR ROOFING MEMBRANE

Airborne and impact noise should be considered when designing all flat roof constructions. The aim of this document is to show that Hush Acoustics are able to design lightweight flat roof constructions which meet a variety of airborne and impact noise requirements.

When creating a flat roof solution, airborne and rain impact noise are two considerations that should be placed high on the agenda. This is especially true when designing for education and health sector buildings where indoor acoustic comfort is of particular importance. (More details of performance standards for school buildings are detailed in Building Bulletin 93, and for healthcare buildings in Health Technical Memorandum 08-01: Acoustics.)

This document demonstrates that a Hush Acoustics lightweight flat roofing solution can accommodate both airborne and rain impact noise performance requirements, while still delivering significant benefits in terms of thermal insulation, outstanding performance and project costs.

The data contained in this document was drawn from tests carried out by the UKAS accredited Sound Research Laboratories (SRL) based in Sudbury.

Their aim was to identify:

- The airborne acoustic performance of various roof constructions in accordance with BS EN ISO 140-3:1995
- The impact acoustic performance of various flat roof constructions generated by rainfall in accordance with BS EN ISO 140-18:2006

Further predictions of the change in airborne sound insulation and rain noise intensity level have been undertaken by engineering and design consultants WSP Group based on the incorporation of the following ceiling systems:

1. Metal framed ceiling comprising metal or mineral fibre lay-in-grid tiles of surface mass 4kg/m², suspended beneath the roof systems creating 300mm deep cavity
2. Metal framed ceiling comprising metal or mineral fibre lay-in-grid tiles of surface mass 4kg/m², suspended beneath the roof systems creating 300mm deep cavity, with 50mm thick mineral wool insulation of density 10kg/m3
3. Metal framed suspended ceiling comprising two layers 15mm thick plasterboard of total surface mass 20kg/m², suspended beneath the roof systems creating 300mm deep cavity
4. Metal framed suspended ceiling comprising two layers 15mm thick plasterboard of total surface mass 20kg/m², suspended beneath the roof systems creating 300mm deep cavity, with 50mm thick mineral wool insulation of density 10kg/m3

The Marshall Day Acoustics computer modelling software Insul (v6.4) has been used to predict the likely resultant sound reduction indices and rain noise intensity levels through incorporation of the various ceiling systems.

SUMMARY OF RESULTS

The SRL tests clearly indicate that the use of different materials within a flat roof construction can benefit a building's acoustic performance. The Hush FR Roofing Membrane used in the tests was shown to significantly improve both airborne and rain impact acoustic performance.

HUSH ACOUSTICS

TEL: 0151 933 2026

EMAIL: info@hushacoustics.co.uk

www.hushacoustics.co.uk

hush-acoustics

@hushacoustics hushuk.acoustics

44 Canal Street, Bootle, Liverpool L20 8QU

Offices also based in London and Yorkshire

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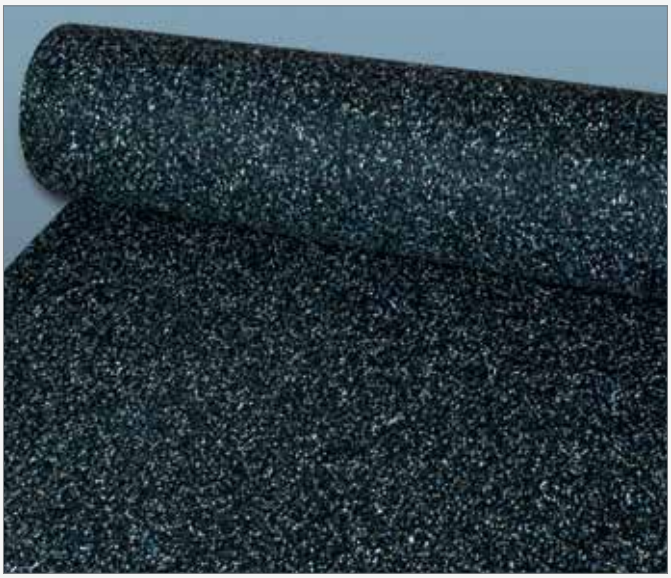
Hush Acoustics **FR ROOFING MEMBRANE**

APPLICATION

Hush FR Roofing Membrane should be used in conjunction with Hush Acoustics Flat Roof solutions in the reduction of airborne and impact noise (e.g. rainwater)

TECHNICAL DATA

Format	Roll
Material	Recycled rubber crumb bonded with polyurethane
Length	6.0m
Width	1250mm
Thickness	10mm
Density	Approx 770 kg/m3
Weight	58kg
Tensile Strength	Approx 0.8 N/mm² (DIN EN ISO 1798)
Elongation at break	Approx 125 % (DIN EN ISO 1798)
Fire Resistance	Efl (EN 13501-1)
Service Temperature range	-30°C to + 80°C
Chemical Resistance	Conditionally resistant to acids and bases
Environmental Resistance	Rot-proof and water resistant



AIRBORNE SOUND INSULATION TEST

Five different roof constructions were tested, 2 without the Hush Membrane, 3 with the Hush Membrane. The test carried out were for airborne sound insulation performance in accordance with BS EN ISO 140-3:1995

FLAT ROOF CONSTRUCTION

TYPE 1: 120mm Powerdeck F insulation on a galvanised steel deck, mechanically fixed single ply membrane and polythene vapour control layer*

CONSTRUCTION	Sound reduction index at octave Band centre frequency (hz)						R_w
	125	250	500	1000	2000	4000	
***Flat roof construction Type 1 without suspended ceiling**	19	19	25.9	28.3	42.1	51.3	29
**Flat roof construction Type 1 with suspended ceiling (1)	19	26	36	47	65	77	38
**Flat roof construction Type 1 with suspended ceiling (2)	26	35	43	49	65	77	46
**Flat roof construction Type 1 with suspended ceiling (3)	26	37	49	60	76	85	49
**Flat roof construction Type 1 with suspended ceiling (4)	39	48	55	61	76	85	59

* SRL Test Report C/21963/R01a

** WSP Group Acoustic Predictions Report 32480.001

KEY

CEILING SYSTEM (1)

Metal framed ceiling comprising metal or mineral fibre lay-in-grid tiles of surface mass 4kg/m2, suspended beneath the roof systems creating 300mm deep cavity.

CEILING SYSTEM (2)

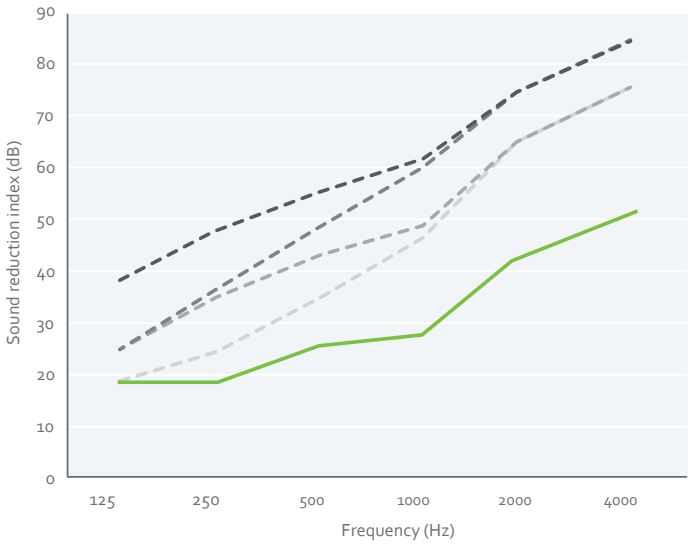
Metal framed ceiling comprising metal or mineral fibre lay-in-grid tiles of surface mass 4kg/m2, suspended beneath the roof systems creating 300mm deep cavity, with 50mm thick mineral wool insulation of density 10kg/m3.

CEILING SYSTEM (3)

Metal framed ceiling comprising two layers 15mm thick plasterboard of total surface mass 20kg/m2, suspended beneath the roof systems creating 300mm deep cavity.

CEILING SYSTEM (4)

Metal framed ceiling comprising two layers 15mm thick plasterboard of total surface mass 20kg/m2, suspended beneath the roof systems creating 300mm deep cavity with 50mm thick mineral wool insulation of density 10kg/m3.



HUSH ACOUSTICS

TEL: 0151 933 2026

EMAIL: info@hushacoustics.co.uk

www.hushacoustics.co.uk

hush-acoustics

@hushacoustics hushuk.acoustics

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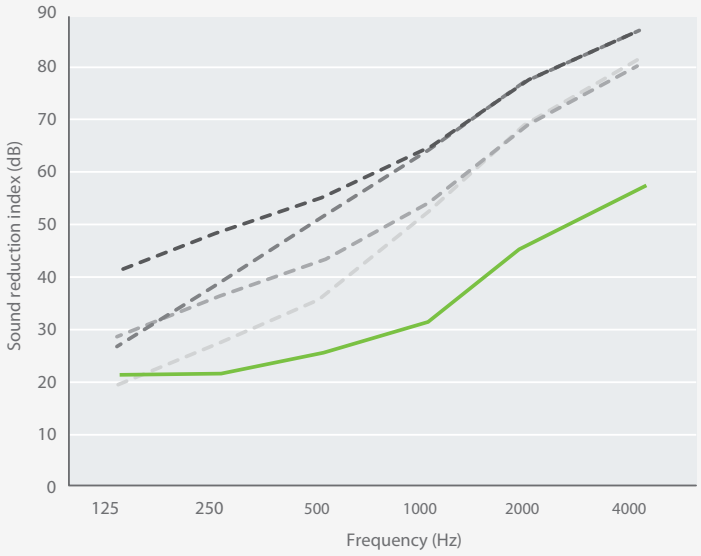
AIRBORNE SOUND INSULATION TEST

FLAT ROOF CONSTRUCTION

TYPE 2: 120mm Powerdeck F insulation on a galvanised steel deck, mechanically fixed single ply membrane and felt vapour control layer*



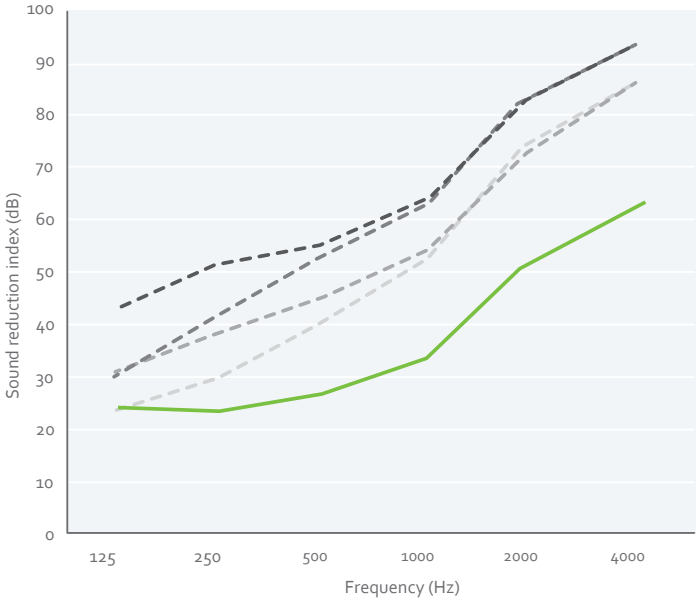
CONSTRUCTION	Sound reduction index at octave Band centre frequency (hz)						R_w
	125	250	500	1000	2000	4000	
***Flat roof construction Type 2 without suspended ceiling**	21.9	22.5	25.8	31.7	46.3	58.2	31
**Flat roof construction Type 2 with suspended ceiling (1)	20	28	36	52	69	81	40
**Flat roof construction Type 2 with suspended ceiling (2)	29	37	43	54	69	80	48
**Flat roof construction Type 2 with suspended ceiling (3)	28	39	51	63	78	88	50
**Flat roof construction Type 2 with suspended ceiling (4)	41	49	55	64	78	88	60

* SRL Test Report C/21963/R01a

** WSP Group Acoustic Predictions Report 32480.001

FLAT ROOF CONSTRUCTION

TYPE 3: 120mm Powerdeck F insulation with 10mm Hush FR Roofing Membrane on a galvanised steel deck, mechanically fixed single ply membrane and polythene vapour control layer*



CONSTRUCTION	Sound reduction index at octave Band centre frequency (hz)						R_w
	125	250	500	1000	2000	4000	
***Flat roof construction Type 3 without suspended ceiling**	24.1	23.6	27.7	33.7	50.9	63.4	33
**Flat roof construction Type 3 with suspended ceiling (1)	24	30	40	52	74	87	42
**Flat roof construction Type 3 with suspended ceiling (2)	31	39	45	54	73	87	50
**Flat roof construction Type 3 with suspended ceiling (3)	30	41	52	63	82	94	52
**Flat roof construction Type 3 with suspended ceiling (4)	43	51	56	64	82	94	61

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hush-acoustics

@hushacoustics hushuk.acoustics

44 Canal Street, Bootle, Liverpool L20 8QU

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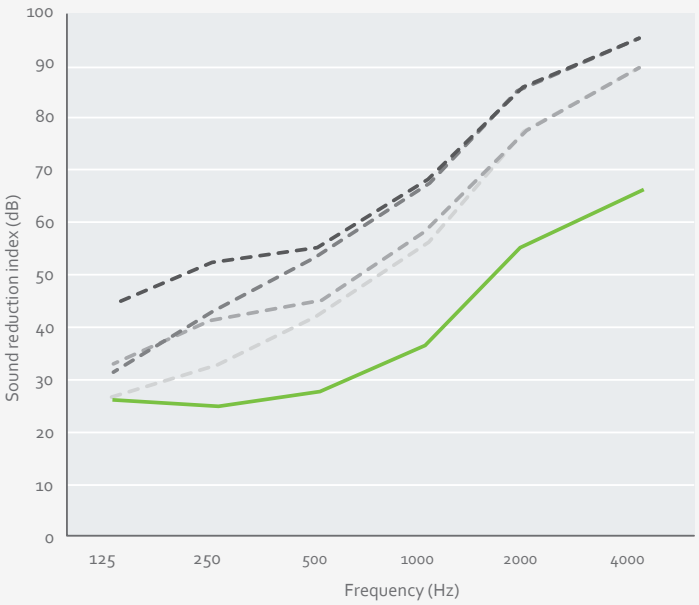
AIRBORNE SOUND INSULATION TEST

FLAT ROOF CONSTRUCTION

TYPE 4: 120mm Powerdeck F insulation with 2 layers of 10mm Hush FR Roofing Membrane on a galvanised steel deck, mechanically fixed single ply membrane and polythene vapour control layer*



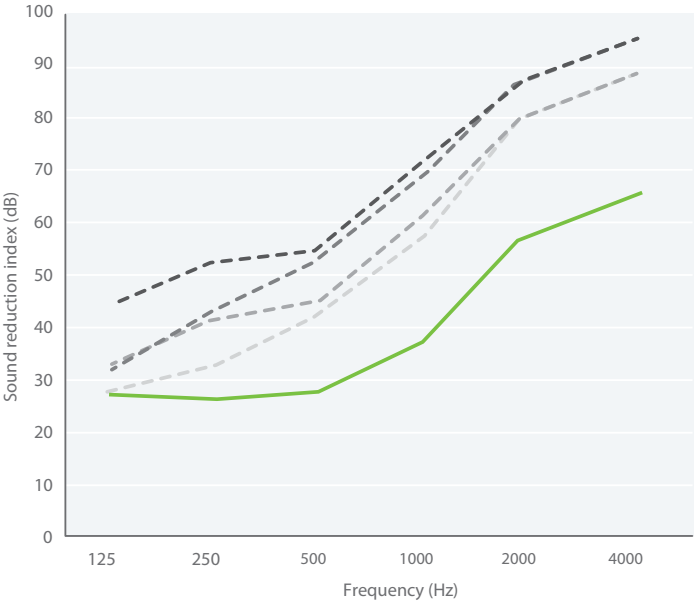
CONSTRUCTION	Sound reduction index at octave Band centre frequency (hz)						R_w
	125	250	500	1000	2000	4000	
***Flat roof construction Type 4 without suspended ceiling**	26.9	25.7	28.6	37.4	55.4	66.7	35
**Flat roof construction Type 4 with suspended ceiling (1)	27	32	41	57	78	90	43
**Flat roof construction Type 4 with suspended ceiling (2)	33	41	46	59	78	90	51
**Flat roof construction Type 4 with suspended ceiling (3)	31	43	53	68	86	96	54
**Flat roof construction Type 4 with suspended ceiling (4)	45	52	56	69	86	96	62

* SRL Test Report C/21963/R01a

** WSP Group Acoustic Predictions Report 32480.001

FLAT ROOF CONSTRUCTION

TYPE 5: 120mm Powerdeck F insulation with 2 layers of 10mm Hush FR Roofing Membrane on a galvanised steel deck, mechanically fixed fleece backed single ply membrane and polythene vapour control layer*



CONSTRUCTION	Sound reduction index at octave Band centre frequency (hz)						R_w
	125	250	500	1000	2000	4000	
***Flat roof construction Type 5 without suspended ceiling**	27.8	27.5	28.7	37.9	57.0	66.4	36
**Flat roof construction Type 5 with suspended ceiling (1)	28	32	41	58	80	89	43
**Flat roof construction Type 5 with suspended ceiling (2)	33	41	46	61	80	89	51
**Flat roof construction Type 5 with suspended ceiling (3)	32	43	52	70	87	95	54
**Flat roof construction Type 5 with suspended ceiling (4)	45	52	55	71	87	95	62

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www.hushacoustics.co.uk

hush-acoustics

@hushacoustics hushuk.acoustics

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RAIN NOISE INTENSITY TEST

The sound generated by rainfall was measured for two different roof constructions in accordance with BS EN ISO 140-18:2006

KEY

CEILING SYSTEM (1)

Metal framed ceiling comprising metal or mineral fibre lay-in-grid tiles of surface mass 4kg/m2, suspended beneath the roof systems creating 300mm deep cavity.

CEILING SYSTEM (2)

Metal framed ceiling comprising metal or mineral fibre lay-in-grid tiles of surface mass 4kg/m2, suspended beneath the roof systems creating 300mm deep cavity, with 50mm thick mineral wool insulation of density 10kg/m3.

CEILING SYSTEM (3)

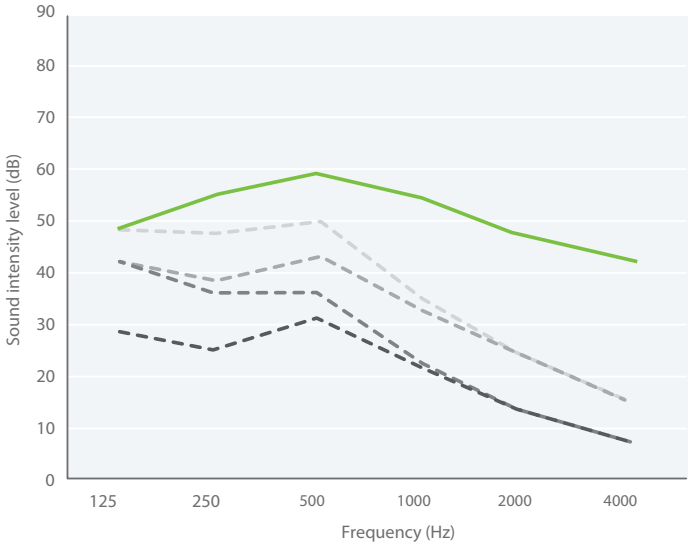
Metal framed ceiling comprising two layers 15mm thick plasterboard of total surface mass 20kg/m2, suspended beneath the roof systems creating 300mm deep cavity.

CEILING SYSTEM (4)

Metal framed ceiling comprising two layers 15mm thick plasterboard of total surface mass 20kg/m2, suspended beneath the roof systems creating 300mm deep cavity with 50mm thick mineral wool insulation of density 10kg/m3.

FLAT ROOF CONSTRUCTION

TYPE 1: 120mm Powerdeck F insulation on a galvanised steel deck, mechanically fixed single ply membrane and polythene vapour control layer*



CONSTRUCTION	Sound reduction index at octave Band centre frequency (hz)						L_{IA} (dB)
	125	250	500	1000	2000	4000	
***Flat roof construction Type 1without suspended ceiling**	48.9	55.1	59.5	54.1	48	42.4	59.2
**Flat roof construction Type 1 with suspended ceiling (1)	49	48	50	35	25	16	48
**Flat roof construction Type 1 with suspended ceiling (2)	42	39	43	33	25	16	41
**Flat roof construction Type 1 with suspended ceiling (3)	42	37	37	22	14	8	35
**Flat roof construction Type 1 with suspended ceiling (4)	29	26	31	21	14	8	29

* SRL Test Report C/21963/R02a

** WSP Group Acoustic Predictions Report 32480.001

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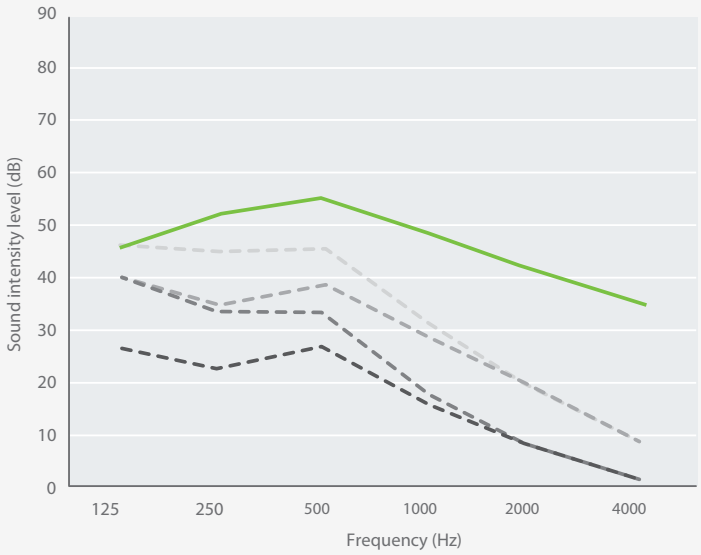
RAIN NOISE INTENSITY TEST

FLAT ROOF CONSTRUCTION

TYPE 2: 120mm Powerdeck F insulation on a galvanised steel deck, one layer of Hush FR Roofing Membrane, a mechanically fixed single ply membrane and polythene vapour control layer*



CONSTRUCTION	Sound reduction index at octave Band centre frequency (hz)						L_{IA} (dB)
	125	250	500	1000	2000	4000	
***Flat roof construction Type 2 without suspended ceiling**	46.7	52.3	55.9	49.6	42.7	35.1	55.1
**Flat roof construction Type 2 with suspended ceiling (1)	47	45	46	31	20	9	44
**Flat roof construction Type 2 with suspended ceiling (2)	40	36	39	29	20	9	37
**Flat roof construction Type 2 with suspended ceiling (3)	40	34	33	18	9	1	32
**Flat roof construction Type 2 with suspended ceiling (4)	27	23	27	17	9	1	25

* SRL Test Report C/21963/R02a

** WSP Group Acoustic Predictions Report 32480.001

APPENDIX A

ACOUSTIC TERMINOLOGY

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10-6 Pascals) on a decibel scale.
Sound Power	The sound energy radiated per unit time by a sound source. Measured in Watts (W).
Sound Intensity	The sound energy passing through a unit area of space. Measured in Watts/m2.
Sound Power Level, LW	Sound power measured on a decibel scale, relative to a reference value of 10-12 W.
Sound Intensity Level, LI	A Sound intensity measured on a decibel scale, relative to a reference value of 10-12 W/m3.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Sound Reduction Index	Equal to the number of decibels by which sound power, which is incident on a partition, is reduced by transmission through it.

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