BOYLAND
JOINERY LIMITED

Boyland Joinery

Test Report for Fully Reversible Weather Acoustic Window

Report No. CNR-IVALSA-ECWINS-B1

CNR-IVALSA
TREES AND TIMBER INSTITUTE

Summary

As part of the ECWINS project the following window made by Boyland Joinery Ltd, Inghilterra was tested by the institutes CNR-IVALSA, Trees and Timber Institute, Italy and VTT, Technical Research Centre of Finland and TNO Built Environment and Geosciences, Netherlands. Tests and calculations were done according to EN 14351-1:2006 'Windows and doors – Product standard, performance characteristics – Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics'.
Top hung fully reversible window on wood (dimensions 900 mm x 1200 mm). The window had a single sash with 4-16-4 Float Low E glazing.
The code of the window inside the ECWINS project was B1UK5
The classification of the tested window is as follows:

Characteristics	Standard	Classification / Value
Resistance to wind load - Test pressure P1 (Pa)	EN 12210	Class 3 (1200)
Resistance to wind load - Frame deflection	EN 12210	Class C
Water tightness – Non-shielded (A)	EN 12208	Class 1A
Load-bearing capacity of safety devices	EN 14609	-
Air permeability Max. test pressure (Pa) Reference air permeability at 100 Pa ($m^3/(h.m^2)$ or $m^3/(h.m)$)	EN 12207	4 (600) (0.73 or 0,21)
Acoustic performance Sound insulation R_w (dB) R_w+C (dB) R_w+C_{tr} (dB)	EN ISO 717-1	 35 33 30
Thermal transmittance Uw ($W/(m^2 \cdot K)$)	By calculation EN ISO 10077-1	1.82 W/m²K
Thermal transmittance Uw ($W/(m^2 \cdot K)$)	EN ISO 10077-2	1.71 W/m²K

VTT TNO | Kennis voor zaken EMI CNR-IVALSA TREES AND TIMBER INSTITUTE

CNR-IVALSA
TREES AND TIMBER INSTITUTE

Requested by Boyland Joinery Ltd
Stonny Lane, Christchurch
Dorset BH23 1EZ
Tel. 01202 499499, Fax.01202 499037

Order ECWINS/PROJECT

Contact person

CNR-IVALSA, TREES AND TIMBER INSTITUTE
Research Scientist Gaeti Nadia and Jan-Willem van de Kuilen
38010 San Michele a/Adige, Italia
Tel. + 39 0461 660 217-111, Fax + 39 0461 650 045
E-mail: gaeti@ivalsa.cnr.it

the thermal transmittance calculation:
TNO, Build Environment and Geosciences
Research Scientist Peter Bouma
P.O. Box 49
2600 AA Delft, The Netherlands
Tel. + 31152763518, Fax + 31152763010
E-mail: peter.bouma@tno.nl

acoustic performance, sound insulation calculation:
Research scientist Eddy Gerretsen
P.O. box 155
2600 AA Delft, The Netherlands
Tel. + 31 152 692 461, Fax + 31 152 692 111
E-mail: eddy.gerretsen@tno.nl

Contents

CNR-IVALSA
TREES AND TIMBER INSTITUTE

1) Introduction

The "Fachverband des Tischlerhandwerk" from Northrhine-Westphalia (Germany) has launched in 2006 the ECWINS-Project together with 30 other partners from 8 different EU-Countries. This project is supported by the Sixth Framework Program of the EU. The main objectives of this project are:

- avoiding physical testing to obtain the CE-Standard;
- designing and manufacturing of windows suitable for SMEs and craft firms;
- improving the tradability between EU-countries;
- strengthen the competitiveness of SME with regard to the industrialized window manufacturer.

To reach this goal a lot of windows are tested. The windows were made by small and medium Enterprises from the EU-countries. The following tests are performed on every window:

- Water tightness
- Air permeability
- Resistance to wind load
- Load bearing capacity of safety devices (only when relevant)
- Airborne sound insulation
- Thermal transmittance

To perform these tests four research institutes are involved in this project:

- VTT, Technical Research Centre of Finland
- UWH, University of West Hungary
- TNO Built Environment and Geosciences, Netherlands
- CNR, National Research Council Italy

The company “Boyland Joinery Ltd” is one of the many Small and Medium Enterprises which supported the project by delivering one or more windows to the test institutes. Every delivered window was tested and the test report was made. The test and the test report of the window described in this test report are performed by:

		VTT	UWH	TNO	CNR
1	Water tightness				X
2	Air permeability				X
3	Resistance to wind load				X
4	Load-bearing capacity of safety devices	-	-	-	-
5	Acoustic performance: Airborne sound insulation			X	
6	Thermal transmittance			X	

X = test institute that performed the test, - = test was not relevant for the window

Every test institutes involved in this project is a notified body and approves the results as described in this report.

CNR-IVALSA
TREES AND TIMBER INSTITUTE

2) Structure of the window

Top hung fully reversible window on wood (dimensions 900 mm x 1200 mm). The window had a single sash with 4-16-4 Float Low E glazing. The structure of the window is illustrated in Appendix 3. According to customers information the details of the tested window were as follows:

Dimensions and frame depth	Width x Height, Frame depth 91mm 900 mm x 1200 mm
Producer	Boyland Joinery Ltd.
Type	fully reversible wooden window
Code	B1UK5
Materials	Frame: Laminated European Redwood Casements: Laminated European Redwood Glass battens: Laminated European Redwood
Joints	-Frame: (Kodrin470 / Kodrin456) -Casement: (Kodrin470 / Kodrin456)
Glasses	-Casement: glass Planibel G 4-16-4. U-value:1.5
Fixing of glasses/sealants	Fixed with wooden battens and sealing with Silicon Silfix U90
Hardware	Hinges: -Casement: 2 hinges (Ground Top Turn G2475/2495) Locks: -Casement: 2 locks (Multi point locking system) Maico Espagnolettes
Weather strips	- Frame: Two rubber strips fixed on a pre made grove. Outside weather strip Acquamac 4846 and inside Acquamac 4846 / Schlegel
Surface treatment	Frame and Casements: painted (Osmose protim 418 preservative / Sadolin WOP307)
Water drainage	none

The code of the window in the ECWINS project is: B1UK5

3) Performance of the task

3.1 Weather resistance

The producer supplied to the laboratory an outwards opening wood window. The window was received on 29 november 2007. The weather resistance was tested on 30 November 2007.

The window was installed by CNR-IVALSA into the measurement frame (with aperture of 2500 mm by 2300 mm). The window was sealed to the frame from the outer side with wooden strips and silicone.

The air permeability class of the window was determined according to the standards EN 1026 [1] and EN 12207 [2]. Respectively, the water tightness class was determined according to the standards EN 1027 [3] and EN 12208 [4]), and classification for resistance to wind load according to the standards EN 12211 [6] and EN 12210 [7]. Test procedures are illustrated in Appendix 2.

Dates of installation and measurement: 29 november 2007. Temperature, relative air humidity and air pressure during the tests were as follows:

- air temperature in the laboratory 19 °C
- relative humidity in the laboratory 50 % RH
- air pressure 101 kPa

3.2 Load-bearing capacity of safety devices

No testing was performed

3.3 Acoustic performance

The producer supplied to TNO-s acoustic laboratory a similar window.
The sound insulation was tested on 21.2.2008.
The sound transmission room meet the requirements of ISO140-1:1997. The test opening for window(pane)s meets ISO 140-3;1995 [1] and the standard floor meets ISO 140-8:1997.
The measurement procedure with two loudspeaker positions and a rotating microphone meets the requirements of ISO 140-3:1995 and the measurement procedure with four positions of the tapping machine and a rotating microphone meets the requirements of ISO 140:6:1998.

With these procedure the requirements for repeatability and reproducibility of ISO 140-2:1991 are met.

The equipment used is given in the next table.

Instrument	manufacturer	type	Ser. Nr.	TNO nr.
Sound Level Calibrator	Bruël & Kjær	4231	2147248	15366
Condenser Microphone	Bruël & Kjær	4190	2238412	17245
Preamplifier	Bruël & Kjær	2639	1414648	07080
Conditioning Amplifier	Bruël & Kjær	2804	1798703	10752
Rotating Microphone Boom	Bruël & Kjær	3923	779877	3882
Rotating Microphone Boom	Bruël & Kjær	3923	702578	
Omnidirectional Sound Source	Bruël & Kjær	4296	2103343	15169
2x100W Amplifier	Quad	405	22553	03488
1x50W Amplifier	Quad	50E	9908	3719
Real-Time Frequency Analyzer	Bruël & Kjær	2133	1469056	15131

3.4 Thermal transmittance

The producer supplied the research institute with AutoCAD drawings of the window (Appendix 3). The window is calculated with software program called COMSOL Multiphysics, toolbox: Heat Transfer by Conduction. The Thermal Transmittance is calculated according standard EN ISO 10077-2003.

The used materials and their thermal conductivity are listed in the following table:

Group	Material	Density[(1)] Kg/m^3	Thermal Conductivity W/(m.K)
Frame	Wood (Pine)	500	0,113
Glass Glass-filling	Soda Lime glass Argon	2500 >	1,0 λ eq. = 0,033 when Uglass = 1,5 W/m2.K
Thermal break	-	-	-
Weather stripping	Elastomeric foam, flexible Mohair (polyester) sweep	60-80	0,05 0,14
Sealant and glass edge material	Polysulfide Black glazing tape	1700 920	0,4 0,33

[(1)] if wood: 12% MC

4. Results

4.1 Water tightness

At pressure 50 Pa some water dripping was noticed at the lower right corner. The phenomenon was classified as leakage.

4.2 Air permeability

Air permeability of the window at different pressures both before and after wind load resistance test are presented in Tables 2 and 3. The results and the classification of air permeability per window area ($m^3/m^2/h$) and per sealant length ($m^3/m/h$) according to the standard EN 12207 [4] are presented graphically in Appendix 1.

Table 2. Air permeability of the window before wind load resistance test.

Pressure Pa	Air permeability (over pressure)		Air permeability (under pressure)	
	per window area	per sealant length	per window area	per sealant length
	$m^3/h/m^2$	$m^3/h/m$	$m^3/h/m^2$	$m^3/h/m$
50	0,00	0,00	-0,06	-0,02
100	0,73	0,21	0,70	0,21
150	0,10	0,03	0,24	0,07
200	0,34	0,10	0,91	0,27
250	0,28	0,08	0,25	0,07
300	0,29	0,08	0,22	0,07
450	0,54	0,16	0,33	0,10
600	0,44	0,13	1,49	0,44

Table 3. Air permeability of the window after wind load resistance test.

Pressure Pa	Air permeability (over pressure)		Air permeability (under pressure)	
	per window area	per sealant length	per window area	per sealant length
	$m^3/h/m^2$	$m^3/h/m$	$m^3/h/m^2$	$m^3/h/m$
50	-0,03	-0,01	-0,06	-0,02
100	0,18	0,05	0,22	0,07
150	0,01	0,00	-0,40	-0,12
200	0,20	0,06	-0,22	-0,07

250	0,18	0,05	0,23	0,07
300	0,20	0,06	0,06	0,02
450	0,19	0,05	0,32	0,10
600	-0,01	0,00	0,18	0,05

Differences in the air permeability tests before and after wind load resistance test were insignificant and had no effect on the classification.

4.3 Resistance to wind load

The frontal relative deflections of the sash were at positive 1200 Pa and negative pressure 0,35 and -0,43 ‰, and thus they were less than the maximum relative deflection 3.3 ‰ (1/300) allowed for class C3. The deflections at positive and negative pressure are presented in Appendix 1. No visual or functional damages were noticed after the wind load or safety tests.

4.4 Load bearing capacity of safety devices

No testing was performed due to absence of a safety device

4.5 Acoustic performance Sound

The sound reduction index R by 1/3-octaves is presented in Appendix 1. The sound insulation of window as single-numbered values R_w, $R_w + C$ and $R_w + C_{tr}$ (ISO 140-3 and ISO 717-1) are presented in table below.

Description of window			R_w	$R_w + C$	$R_w + C_{tr}$
glasses, mm	air gaps, mm	seals	dB	dB	dB
4, 4 and 4	16	2 (2 on top)	35	33	30

In laboratories, a repeatability of 1dB is normally achievable for single-number quantities [9] .

4.6 Thermal transmittance

The window is calculated according standard EN ISO 10077-2003. The results are:

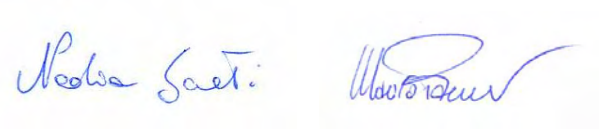
Description	**Values (W/m²K)**	
	(ISO -10077-1)	(ISO 10077-2)
the thermal transmittance the window Uw	1.82	1.71
- the thermal transmittance of the frame section Uf	1.7	1.300 (j, s) 1.252 (h)
the thermal transmittance of the central area of the glazing Ug	1.50	1.50
the linear thermal transmittance ψ	0.10	0.099

(s) = sill, (h)= head, (j)= jamb

All the presented results in this report are valid only for the measured window

CNR-IVALSA
TREES AND TIMBER INSTITUTE

San Michele all'Adige, 03 Februar 2009



Nadia Gaeti
and
Jan-Willem van de Kuilen
Research Scientist

Mauro Passer
and
Gaia Pasetto
Research assistant

CNR-IVALSA is notified body No. NB 2127

VTT is notified body No. NB 0809 and is accredited (No. T001, FINAS-accreditation) by Centre for Metrology and Accreditation to carry out the test mentioned here.

TNO is notified body No. 1153
Our laboratory (No. T001, FINAS-accreditation) is accredited by Centre for Metrology and Accreditation to carry out these tests.

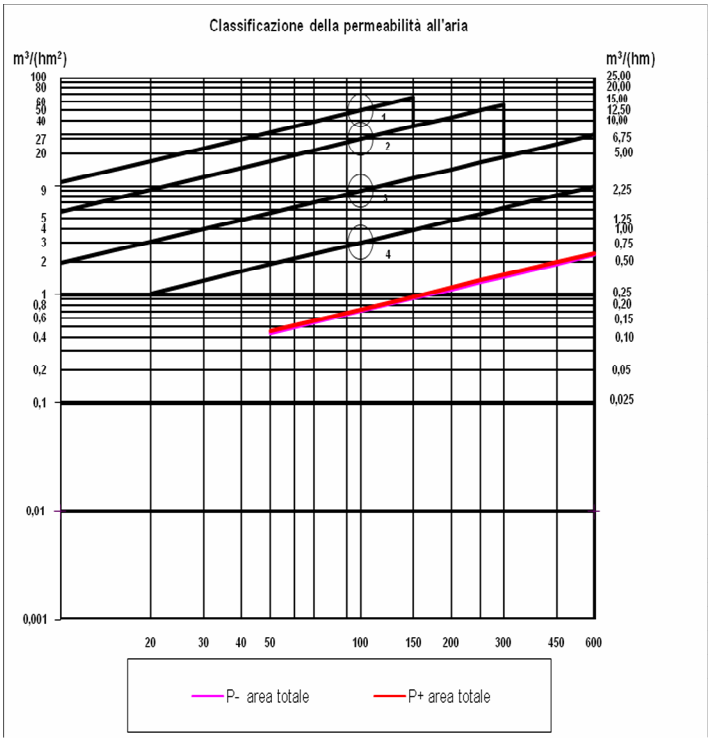
CNR-IVALSA
TREES AND TIMBER INSTITUTE

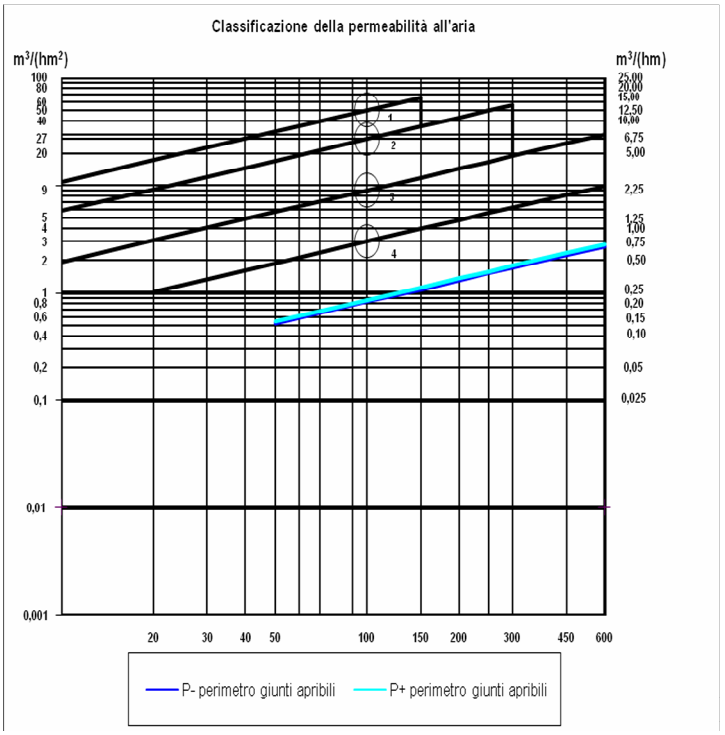
References

[1] *ISO 140: Acoustics - Measurement of sound insulation in buildings and of building elements - Part 3:1995 Laboratory measurements of airborne sound insulation of building elements*
[2] *ISO 717: Acoustics - Rating of sound insulation in buildings and of building elements - Part 1:1996: Airborne sound insulation*
[3] *EN 1026 Windows and doors - Air permeabitity - Test method*
[4] *EN12207 Windows and doors - Air permeabitity - Classification.*
[5] *EN 1027 Windows and doors - Watertightness - Test method*
[6] *EN12208 Windows and doors - Watertightness - Classification*
[7] *EN 12211 Windows and doors - Resistance to wind load - Test method*
[8] *EN12210 Windows and doors - Resistance to wind load – Classification*
[9] *ISO 140: Acoustics - Measurement of sound insulation in buildings and of building elements - Part 2:1991: Determination, verification and application of precision data*
[10] *EN ISO 10077-22003 Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames (ISO 10077-2:2003)*

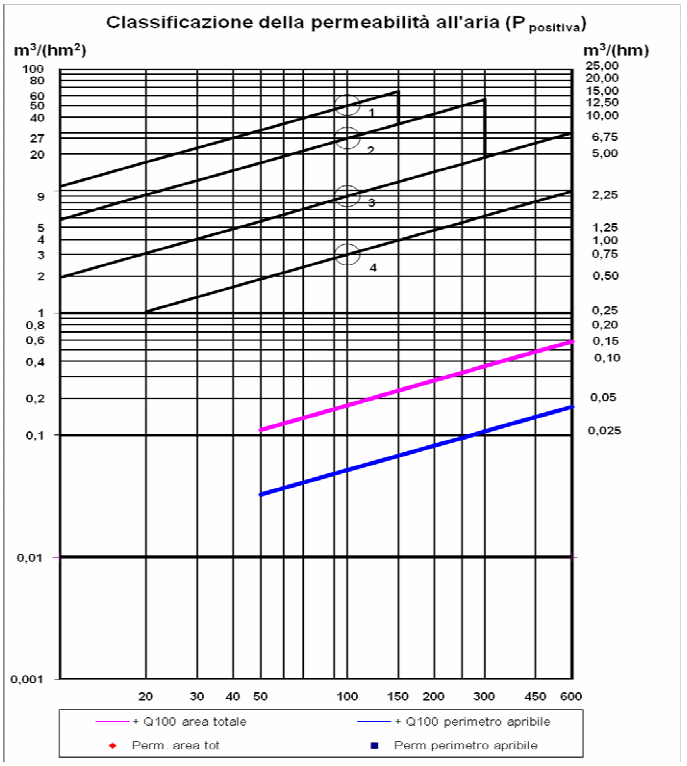
Appendices 4

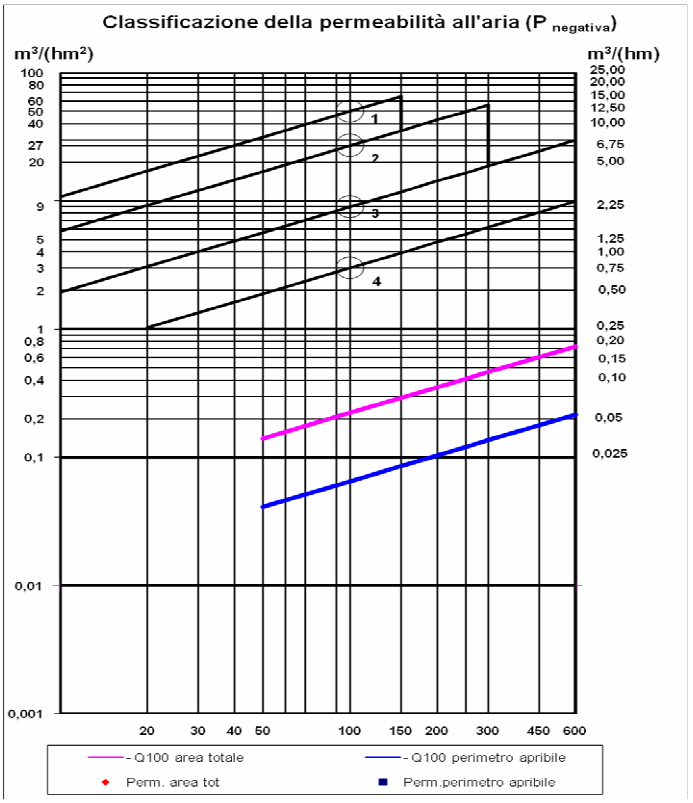
RESULTS OF AIR PERMEABILITY





Air permeability by area and length, positive and negative pressure difference, first test





Air permeability by area and length, positive and negative pressure difference, second test

Resistance to wind load

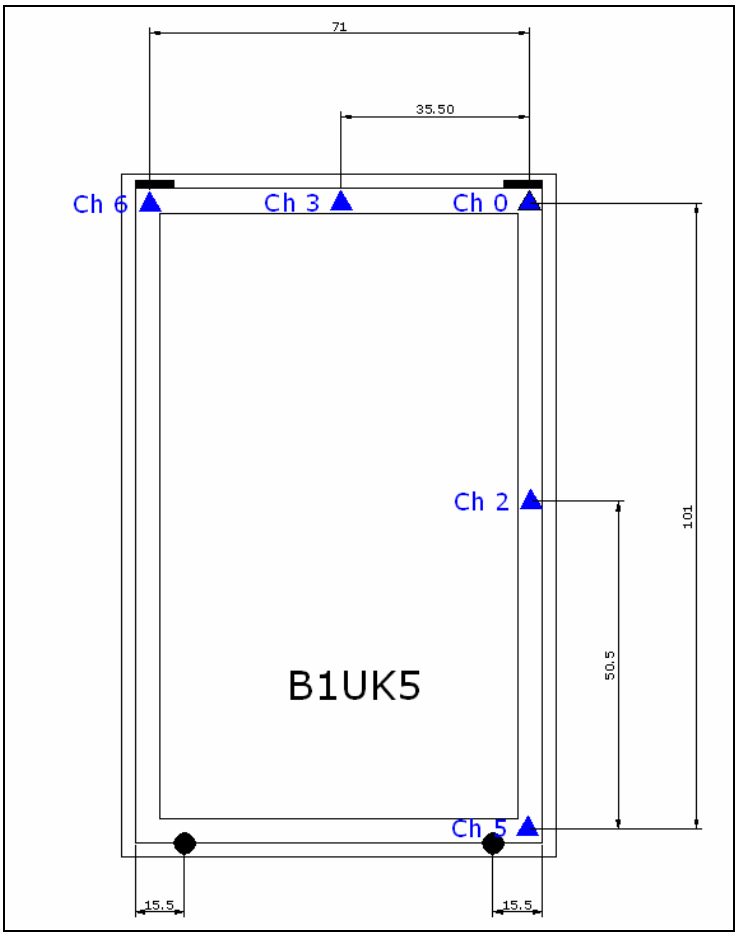


Figure. Location dial gauges (1 - 6)

Table. Deflections of sash at positive and negative pressures. Deflection determined at span with of 1010 mm.

Positive pressure [Pa]	CH00 [mm]	02 [mm]	05 [mm]	Rel. deflection [‰]
0	0	0	0	0
1200	0,19	0,61	0,33	0,35
0	0	-0,01	0	0,01
Negative pressure [Pa]				
0	0	0	0	0
-1200	-0,37	-0,75	-0,27	-0,43
0	-0,02	-0,03	-0,01	-0,01

* The maximum relative deflection for class C3 is 1/300 (3.3‰)

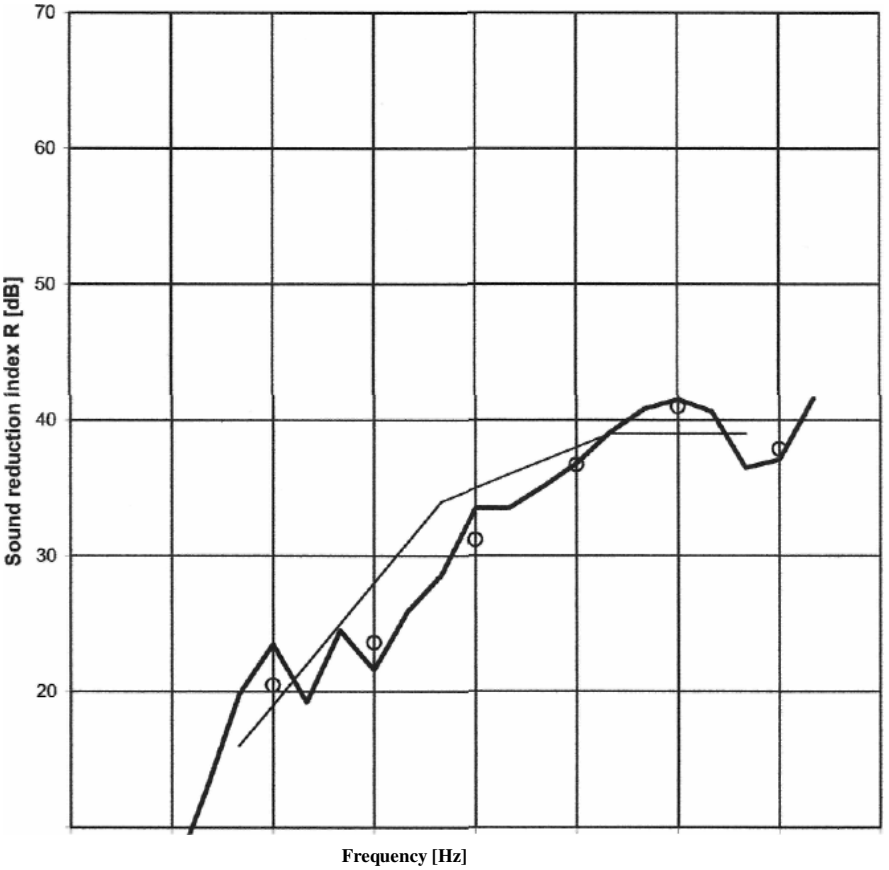
AIRBORNE SOUND INSULATION **in accordance with EN-ISO 140-3**

Client	EC-Wins	Product	B1UK5
Projectnummer	034.68633	Test room	TNO rooms 3-4
Mounted by	TNO / Kunz	Testdate	2008-02-21

Description specimen : window: mahogany/167//58mm; glassi 4-16-4; seal: ?? 2x

Mass	20 kg/m^2	Source room volume :	102 m^3
Surface area	1,1 m^2	Receiving room volume :	102 m^3

Freq.	R	
Hz	1/3 od dB	1/1 oct dB
50		
63	6,2	9,9
80	12,6	
100	19,8	
125	23,5	20,5
160	19,2	
200	24,5	
250	21,6	23,6
315	25,9	
400	28,6	
500	33,5	31,2
630	33,5	
800	35,1	
1000	36,8	36,7
1250	39,1	
1600	40,8	
2000	41,5	40,9
2500	40,6	
3150	36,5	
4000	37,1	37,9
5000	41,6	

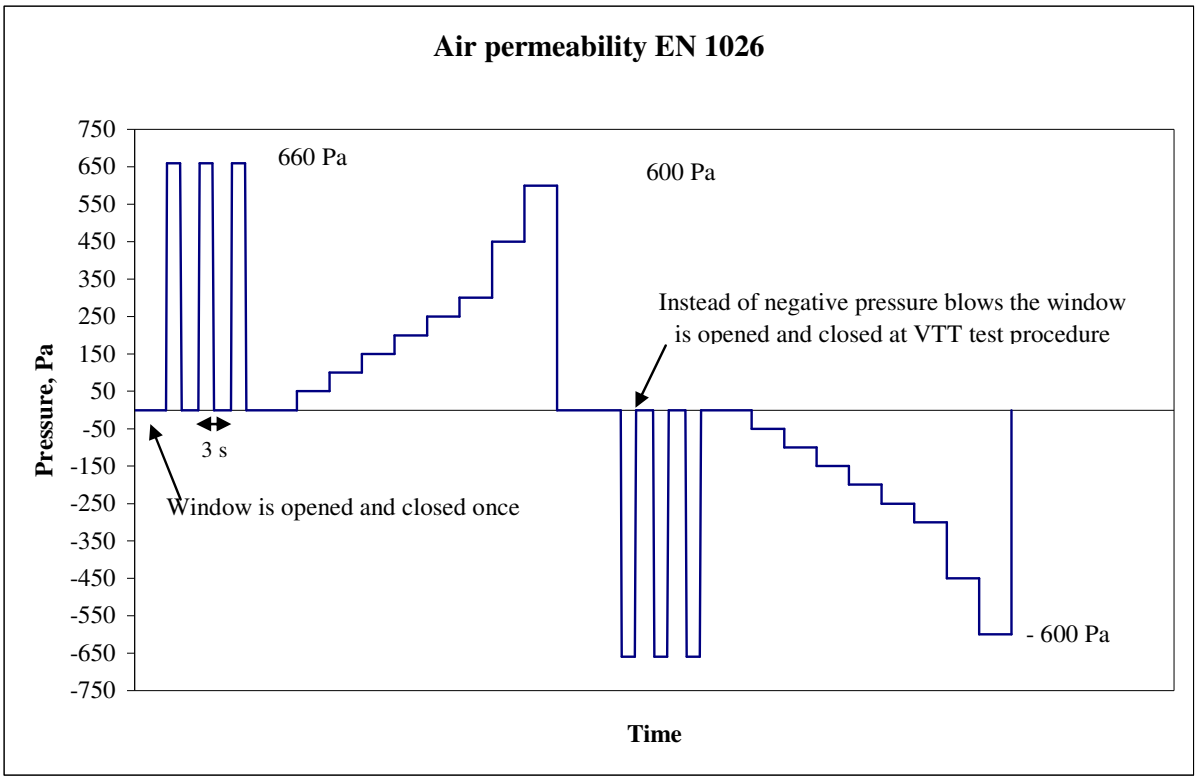


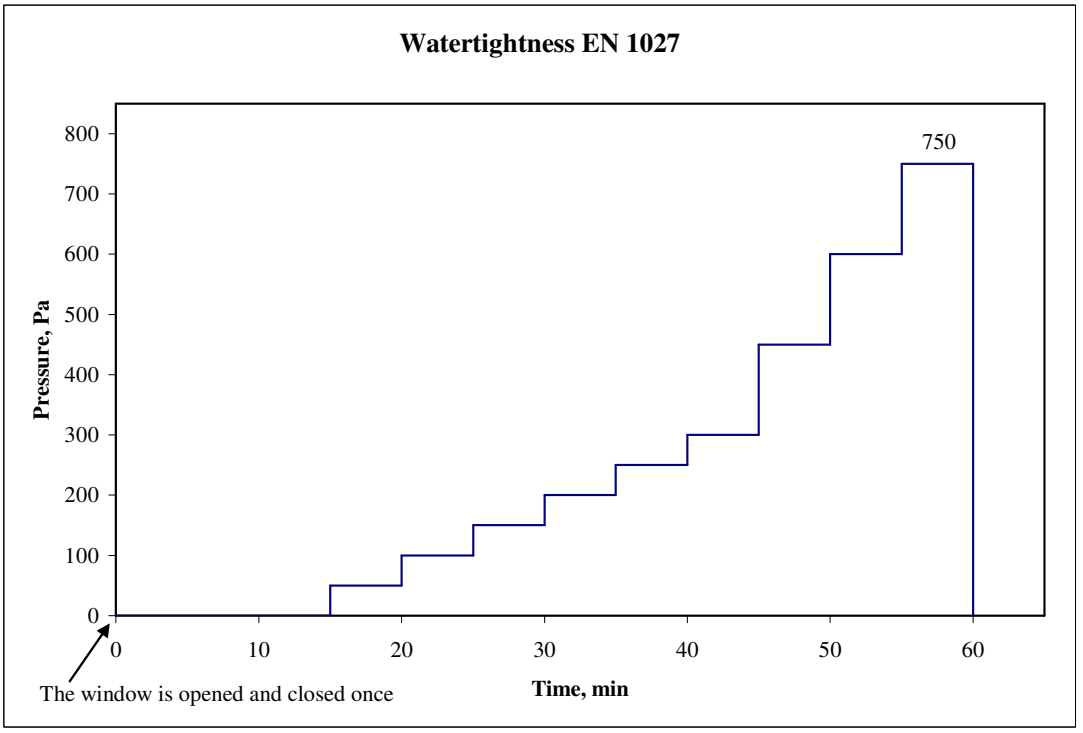
Rating in accordance with EN-ISO 717-1 **R_w (C; C_{tr}) = 35 (-2 ; -5) dB**

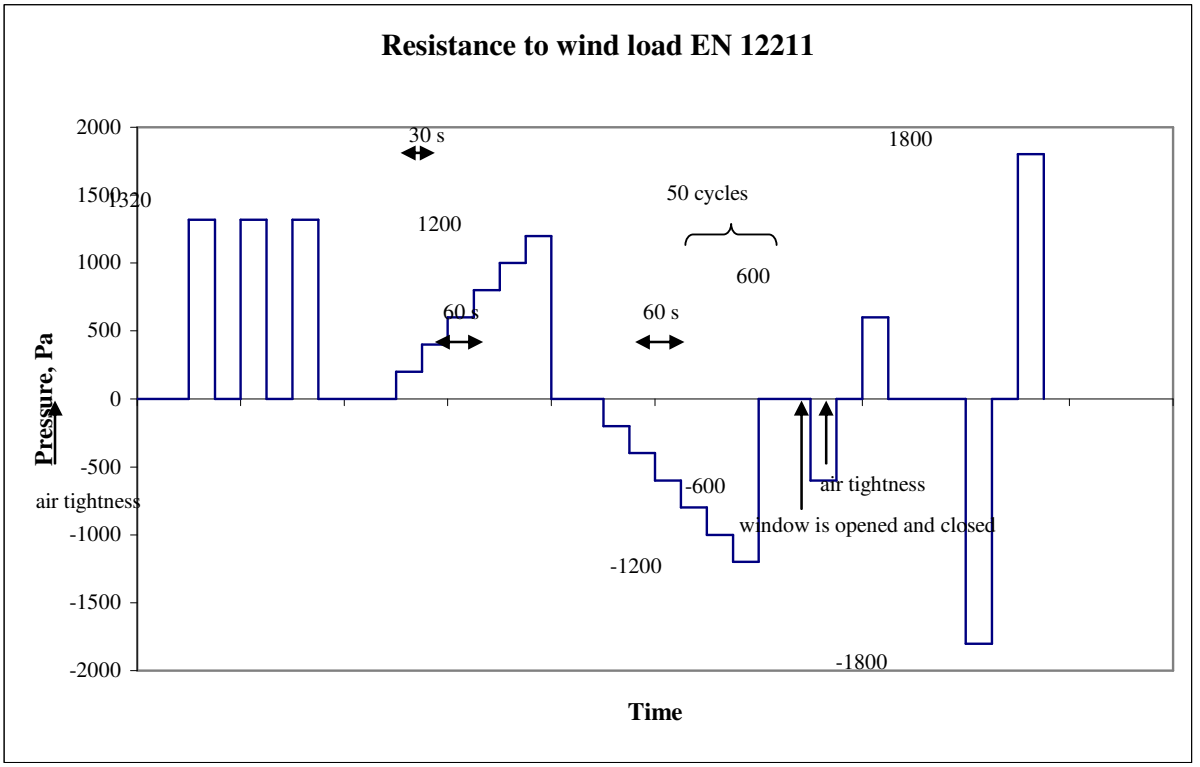
($C_{50\text{-}3150}$; Ctr $_{50\text{-}3150}$) = (-2 ; -9) dB

($C_{50\text{-}5000}$; Ctr $_{50\text{-}5000}$) = (-2 ; -9) dB

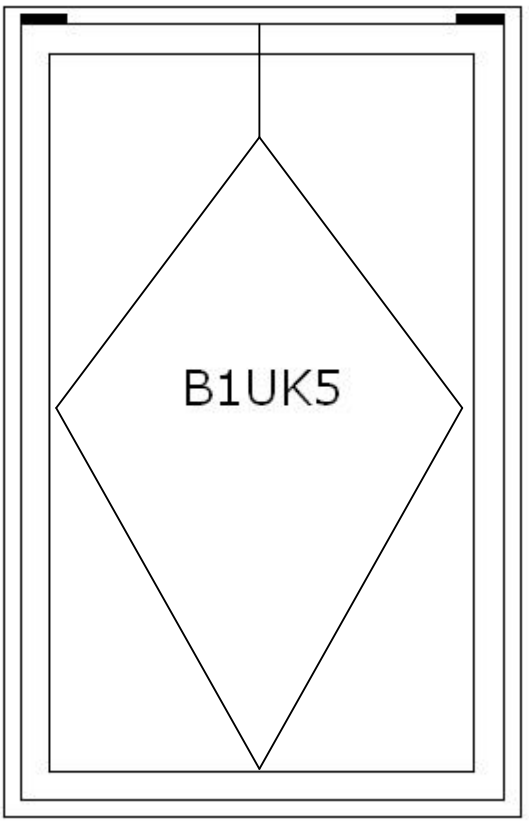
($C_{100\text{-}5000}$; Ctr $_{100\text{-}5000}$) = (-1 ; -5) dB







DRAWINGS OF WINDOW



Lock (L) and hinge (H) locations /B1UK5 (figure from inside)
Hardware: Maico