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For the attention of Mr Etienne DHEUR

Villeurbanne, 17th November, 2008

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Signature :

Test Report N° 2814127-2
Version : 01

TEST OF GLASSWOOL DUCT ACCORDING TO EN 13403
EROSION – AIRTIGHTNESS – RESISTANCE TO PRESSURE

EQUIPMENT ID: KNAUF INSULATION CLIMACOUSTIC 25 R 0,75
REFERENCE DOCUMENT(S): EN 13403
TESTS MADE BY: Dominique PUGNET
DATE: July 2008

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Version	Date	Nature of change	Modified pages
00	21/08/2008	First distributed	
01	17/11/2008	New reference of the glasswool duct	1,4,5,15

Each new version cancels and replaces the previous one.

CONTENTS

1. INTRODUCTION

The objective of the tests was to characterise one reference of glasswool duct according to EN 13403 July 2003 "Ventilation for buildings – Non-metallic ducts – Ductwork made from insulation ductboards". Tests were :

- Erosion and Emission of particles (§7.2 of EN 13403)
- Resistance against pressure (§7.3 of EN 13403)
- Air leakage factor and airtightness class (§4.3 of EN 13403, referred to §5.2 of prEN 1507)

The reference of the glasswool duct is KNAUF CLIMACOUSTIC 25 R 0,75.

Summary of the results is in part 2.

Detailed results of erosion and emission of particle tests are in APPENDIX 1 -.
Detailed results of resistance against pressure tests are in APPENDIX 2 -.
Detailed results of air leakage factor and airtightness class tests are in APPENDIX 3 -.

2. SUMMARY OF THE RESULTS

EROSION AND EMISSION OF PARTICLES TEST Air velocity = 18,8 m/s		
	Requirements	KNAUF INSULATION CLIMACOUSTIC 25 R 0,75
Particles > 0,5 µm	< 60 µg/m^3	0.036 µg/m^3
Particles > 5,0 µm	< 4,0 µg/m^3	0.020 µg/m^3

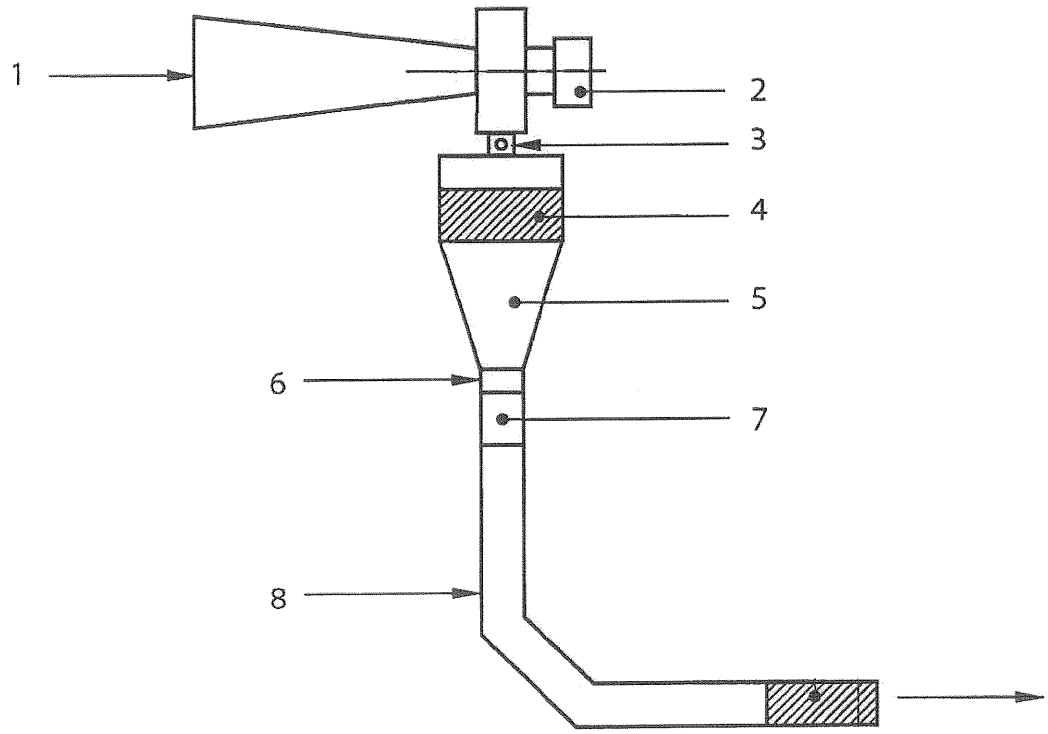
The material from the inside surface of the ductwork does not break away, nor flake off and does not show evidence of delamination or erosion.

RESISTANCE AGAINST PRESSURE TEST Pressure = 2000 Pa
KNAUF INSULATION CLIMACOUSTIC 25 R 0,75
The joining material remained intact. There is no evidence of other damage, which would cause the sample to become unusable.

AIRTIGHTNESS TEST		
	Pressure	KNAUF INSULATION CLIMACOUSTIC 25 R 0,75
Airtightness class	-756 Pa	C
Airtightness class	1005 Pa	C

APPENDIX 1 - Erosion and emission of particles

The samples are arranged in an L-shaped assembly. The entire assembly has similar cross-section (300 mm * 300 mm).



1 : Sucking box
2 : Sucking fan
3 : Control valve
4 : Absolute filters
5 : Blowing plenum
7 : Connexion duct
8 : Duct to be tested

Figure 1 : Construction for particle emission

Tests consisted in :

- Purge during 1 h, air velocity = 12 m/s,
- Stop during 15 min,
- Erosion test during 5 h, air velocity = 18,8 m/s.

The particle accounting is made with an optical laser counter with different channels given in Table 1. The counting is not done during the purge.

Channel	Range
1	0,2 – 0,3 µm
2	0,3 – 0,5 µm
3	0,5 – 0,7 µm
4	0,7 – 1,0 µm
5	1,0 – 2,0 µm
6	2,0 – 3,0 µm
7	3,0 – 5,0 µm
8	> 5 µm

Table 1 : Laser counter range

The extracted flow rate is of 28,3 l/min.

The average particle concentration is calculated from the extracted air volume and the measurement of the particle's mass using the following formula :

$$C = \frac{M}{Q_v t}$$

Where :

C is the particle concentration in µg/m^3,

M is the particles' mass in µg,

Q_v is the extraction flow rate in m^3/s.

The mass of particles is determined from the number of counted particles and the relative density of the glass (2500 kg/m^3).

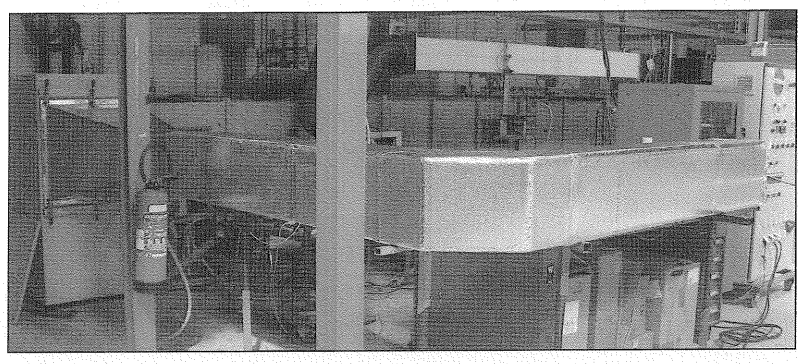


Figure 2 : View of the test facility

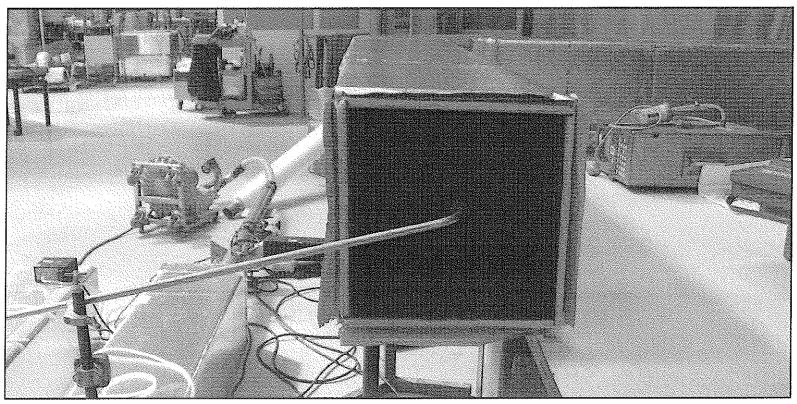


Figure 3 : Views of the installation

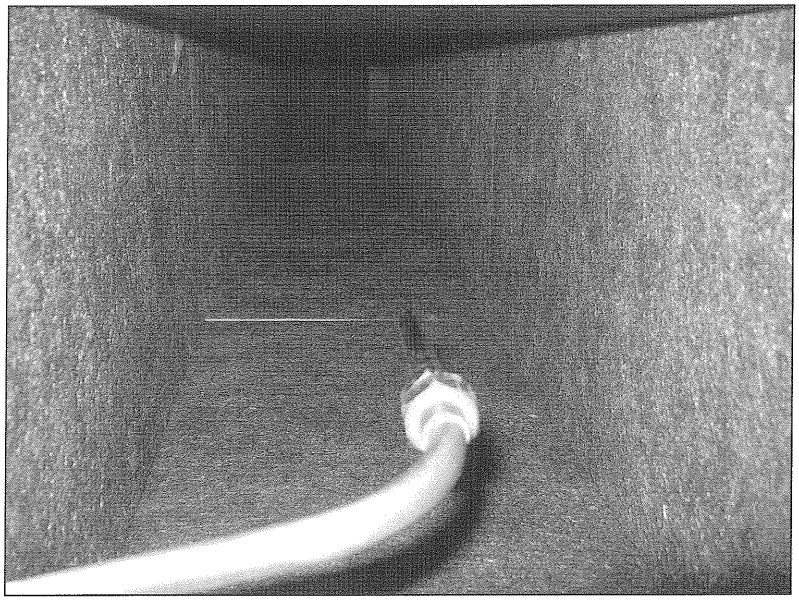


Figure 4 : View of the inside of the sample

Detailed results

Duration of extraction for the optical laser counter : 305 minutes

Extracted flow rate for the optical laser counter : 28,3 l/min = 0,0283 m^3/min

Extracted flow : 305 × 0,0283 = 8,63 m^3

Volume of a particle (diameter d) = $\frac{4}{3} \times \pi \times \left(\frac{d}{2}\right)^3$

Air velocity in the duct : 18,8 m/s

Air temperature : 23.6°C < T < 26.7°C

Range of particles diameter (µm)	Nb of counted particles	Nb of particles/m^3	Concentration µg/m3
0,2 - 0,3	38229	4429	9.06E-05
0,3 - 0,5	17159	1988	1.67E-04
0,5 - 0,7	3780	438	1.24E-04
0,7 - 1,0	3257	377	3.03E-04
1,0 - 2,0	3575	414	1.83E-03
2,0 - 3,0	1585	184	3.76E-03
3,0 - 5,0	1010	117	9.80E-03
> 5,0	1076	125	2.04E-02

Table 2 : Detailed results of the erosion test

	Requirements	Test results
Particles > 0,5 µm	< 60 µg/m^3	0.036 µg/m^3
Particles > 5,0 µm	< 4,0 µg/m^3	0.020 µg/m^3

Table 3 : Comparison with the requirements

The material from the inside surface of the ductwork does not break away, flake off and does not show evidence of delamination or erosion.

The requirements concerning the maximum particle concentration are fulfilled.

APPENDIX 2 - Resistance against pressure test

The pressure test determines the fitness for purpose of the ductboard assembly. A test sample is prepared like it can be seen in Figure 5 and Figure 6.

Two typical rectangular section ducts were constructed by KNAUF INSULATION company and assembled with a peripheral joint. The used internal section is 300 mm * 300 mm.

A pressure tap is sealed on the test sample and connected to a manometer.

An air supply tape is sealed on the test sample to supply specified air pressure.

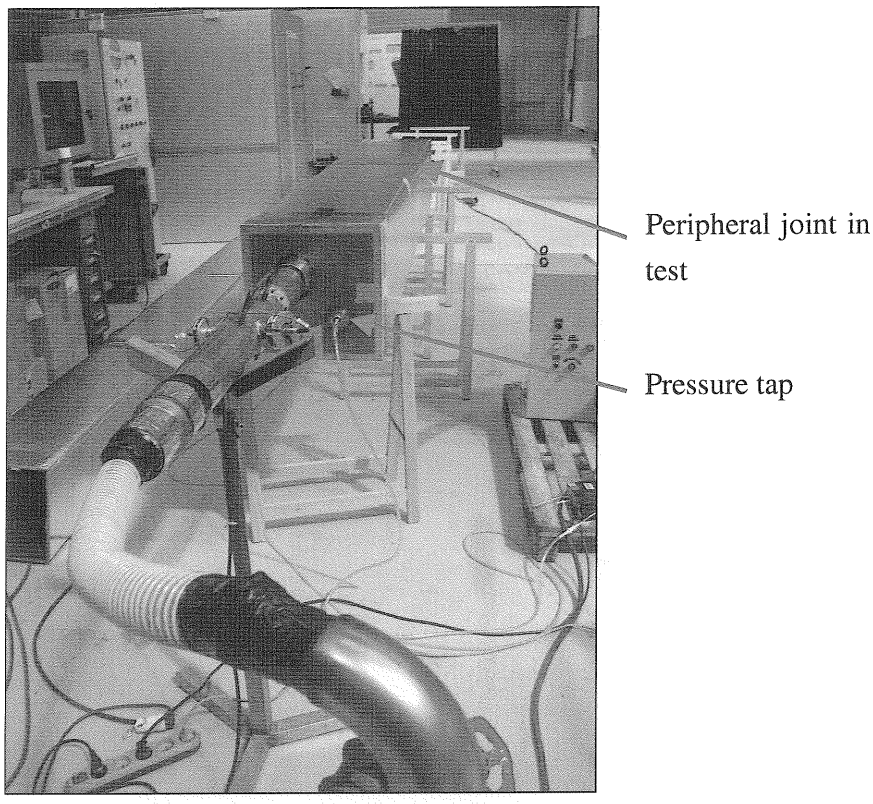


Figure 5 : View of the test facility

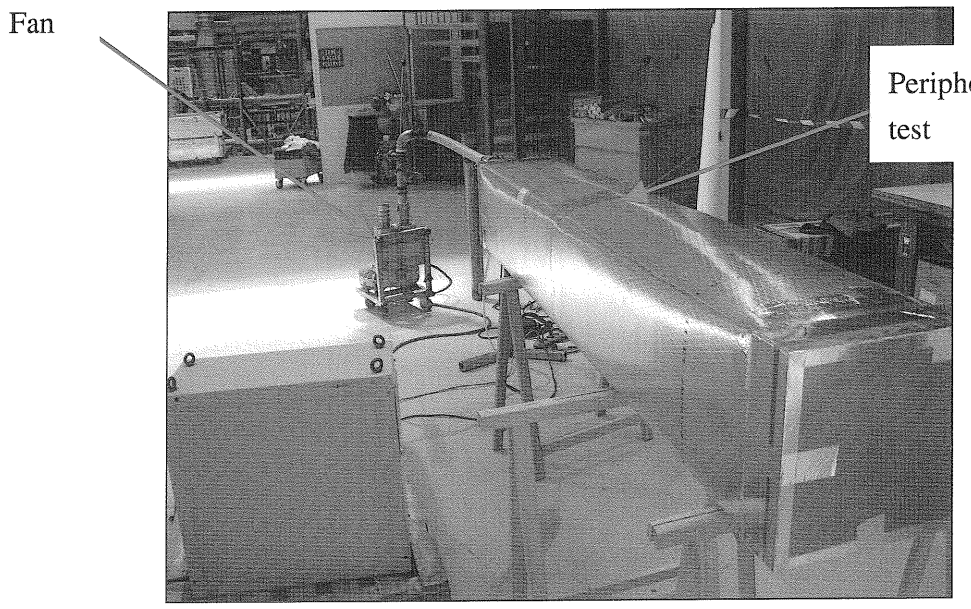
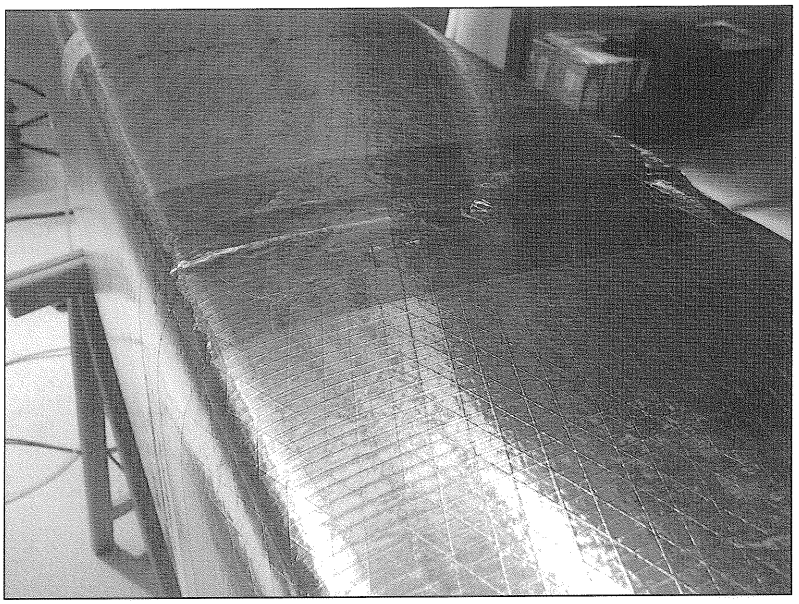


Figure 6 : View of the test facility

The manufacturer's rated pressure is 800 Pa.
This pressure is gradually reached in a time between 45 and 60 s, and is maintained during 1 min. It is then increased to 2000 Pa (2,5 times 800 Pa), and maintained during 1 h.

Detailed results



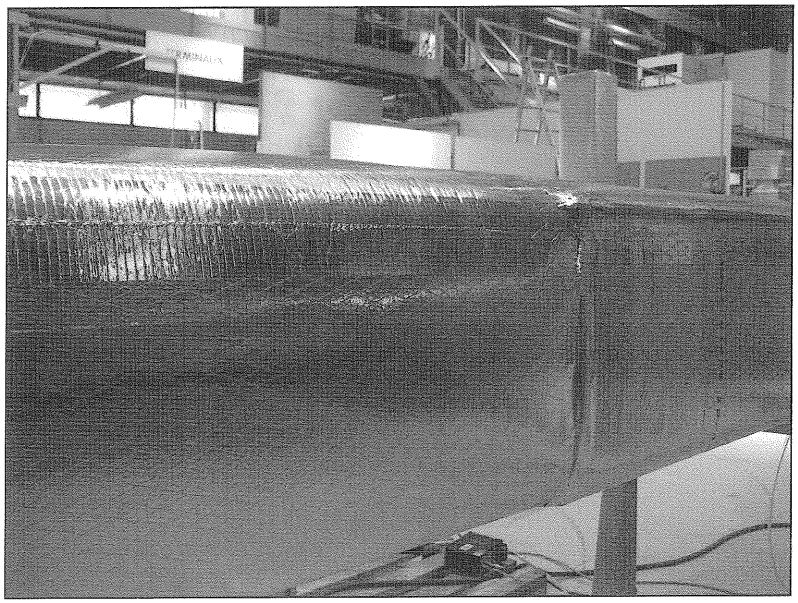


Figure 7 : Views of the sample after the pressure test

As it can be seen on Figure 7, the joining material remained intact. There is no evidence of other damage, which would cause the sample to become unusable.

APPENDIX 3 - Airtigntness test

Tests are made following NF EN 1507 July 2006 standard.

The test sample built by KNAUF INSULATION consists of 7 modules of 1,2 m of length and section of 300 mm × 300 mm.
For each sample :
Ductwork surface area (A) = 7 × 1,2 × 4 × 0,3 = 10,1 m²
Total joint length (L) = 6 × 4 × 0,3 + 7 × 1,2 = 15,6 m

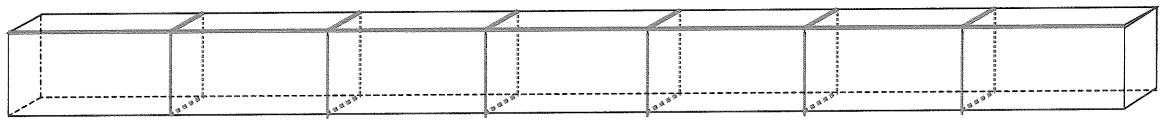


Figure 8 : Diagram of the samples

CETIAT closed the ends of each sample with metal sheets.

Table 4 shows the airtightness classification defined in the NF EN 1507 standard.

Air tightness class	Air leakage limit	Static gauge pressure limits (Pa)	
	$l.s^{-1}.m^{-2}$	Negative	Positive
A	$0,027.p_{test}^{0,65}$	-200	1000
B	$0,009.p_{test}^{0,65}$	-500	1000
C	$0,003.p_{test}^{0,65}$	-750	1000

Table 4 : Definition of the airtightness classes – NF EN 1507

The maximum negative pressure and positive pressure for the tests are defined by KNAUF INSULATION company :

- The maximum negative pressure is –750 Pa.
- The maximum positive pressure is 1000 Pa.

Detailed results

Atmospheric pressure: 99500 Pa

Air temperature: 22.6 to 23.2°C

Negative pressure

Pressure	Airflow rate	Airflow rate at 20°C and 101325 Pa		Leakage rate	
Pa	m3/h	m3/h	l/s	m3/h/m2	l/s/m2
-201	0.6	0.6	0.2	0.06	0.02
-306	0.9	0.9	0.2	0.09	0.02
-401	1.1	1.0	0.3	0.11	0.03
-503	1.2	1.2	0.3	0.12	0.03
-601	1.3	1.2	0.3	0.13	0.03
-756	2.2	2.1	0.6	0.22	0.06

Positive pressure

Pressure	Airflow rate	Airflow rate at 20°C and 101325 Pa		Leakage rate	
Pa	m3/h	m3/h	l/s	m3/h/m2	l/s/m2
203	0.2	0.2	0.0	0.02	0.00
401	0.4	0.4	0.1	0.04	0.01
602	0.7	0.7	0.2	0.07	0.02
806	0.9	0.9	0.2	0.09	0.02
1005	1.4	1.3	0.4	0.13	0.04

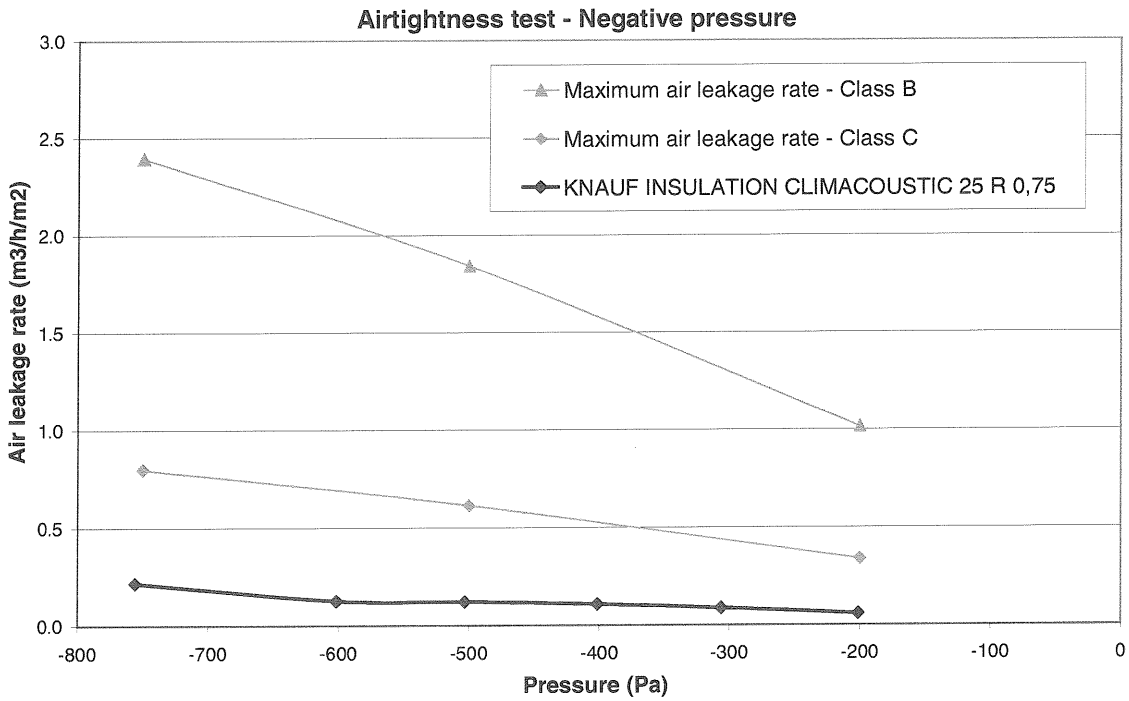


Figure 9 : Leakage flow rate according to the negative pressure

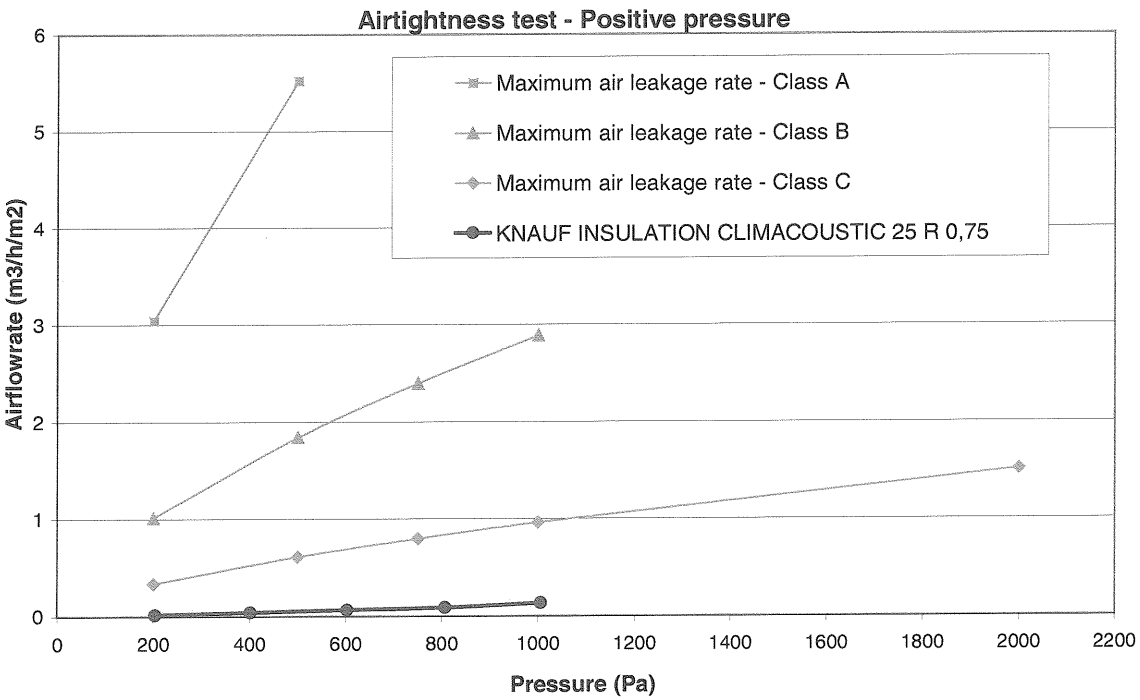


Figure 10 : Leakage flow rate according to the positive pressure

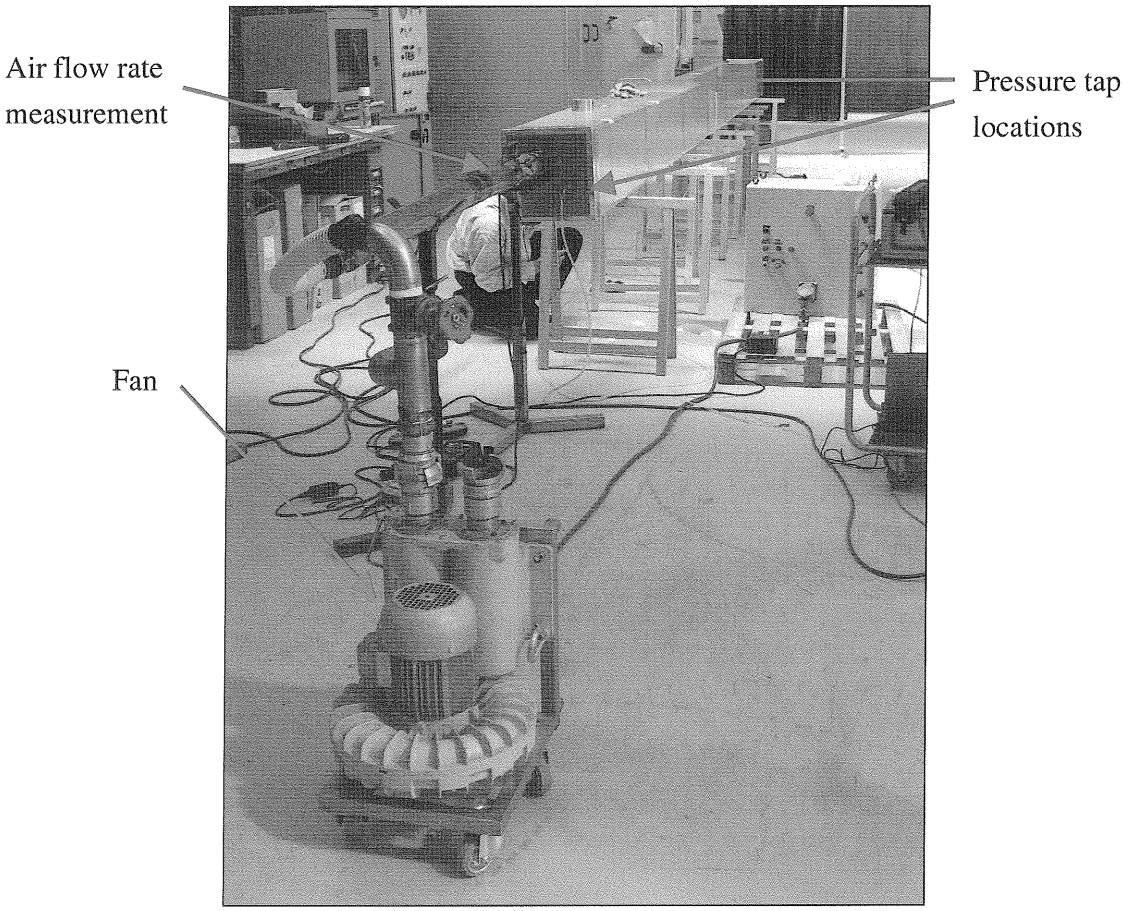


Figure 11 : View of the test facility