Report

Air permeability Homebox

Contract number: 18-G-0160
Reference: EA/SK

Air permeability measurements Homebox

Contract number	:	18-G-0160
Version	:	01
Status	:	Final
Date	:	9 August 2018
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Tested object	:	Homebox

Colophon

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1 Contract

1.1 Introduction

On 13 July 2018 Mr R. Pennings of TRIM Trading B.V. commissioned Kiwa BDA Dak- en Geveladvies B.V. to carry out air permeability measurements of the Homebox, The Insulated Postbox.
This contract was awarded following the tender submitted by Kiwa BDA Dak- en Geveladvies B.V. on 6 July 2018.

1.2 Objective of the contract

The objective of the contract is to determine the air permeability performance of the Homebox.

1.3 Method

The measurements were carried out on 27 July 2018 by Mr E. van Ameijde of Kiwa BDA Dak- en Geveladvies. Mr E. van Ameijde also carried out the interpretation of the measurement data and drew up the corresponding report.

This report contains the findings, measurement data, the analysis thereof and the corresponding conclusions.

2 Conclusions

Table 1

Part	$Q_{v;10}$-value
Homebox	0,00006665 $dm^3.s^{-1}$

3 Information and notifications

3.1 Project data

The Homebox is an insulated letterbox provided with two flaps with slit sealings. This principle ensures that a stationary air chamber is created with an insulating effect. In addition, the outer lid is insulated with a high-quality insulation material. The outer lid is made of brushed aluminium (stainless steel look) and the box construction is made of ABS polymers. The inner lid is available in the colours grey (RAL 7074), cream (RAL 9001) and white (RAL 9010).

3.1 Weather data

During the test the following weather data were measured:
− air pressure outside   :   1010,2 hPa
− temperature inside   :   21,3 °C

3.2 Measuring equipment

The following equipment was used to perform the tests:
− blower door fan 1   Retrotec 300   No: 00001955
− digital manometer 1   Retrotec DM32   SN: 402995

4   Measurement

4.1   Test box

Prior to the measurement the Homebox was mounted in a test cabinet. To determine the air loss of the test box and its connections with the test equipment, first a baseline measurement must be carried out. The Homebox was taped up airtight on the test box, and then the measurement was carried out. After performing the measurement, the Homebox was released from the airtight connection to the cabinet. The measurement was performed again. The difference between the two measurements is the air loss of the Homebox.

4.2   Measurement method

The air permeability was determined in accordance with EN-ISO 9972:2015 - Thermal performance of buildings - Determination of air permeability of buildings – Fan pressurization method. A pressure difference between both sides of the Homebox was accomplished by using a calibrated blower door fan. The test cabinet was depressurised in a pre-set cycle according to the standard. After this, the process was reversed by creating overpressure in the cabinet.

The following measurements were taken:
− Measurement 01 - Depressurized measurement, Homebox taped airtight.
− Measurement 02 - Depressurized measurement, Homebox not taped.
− Measurement 03 - Pressurized measurement, Homebox taped airtight.
− Measurement 04 - Pressurized measurement, Homebox not taped.

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5 Measurement results

The measurement results have been added to this report as Annex 2 (Depressurized measurement data) and Annex 3 (pressurized measurement data).

5.1 $q_{v;10}$-value

The $q_{v;10}$ value is the air volume flow which is calculated from the pressure/volume flow characteristic at a pressure difference of 10Pa. The data from annexes 2 and 3 were used for the calculation below.

Depressurized
The $q_{v;10}$ is: 0,0060778 $dm^3.s^{-1}$ – 0,0060056 $dm^3.s^{-1}$ = 0,0000722 $dm^3.s^{-1}$

Pressurized
The $q_{v;10}$ is: 0,0057139 $dm^3.s^{-1}$ – 0,0056528 $dm^3.s^{-1}$ = 0,0000611 $dm^3.s^{-1}$

Average
The $q_{v;10}$ value is the average between the depressurized and pressurized measurement and equals: 0,00006665 $dm^3.s^{-1}$

ANNEX 1
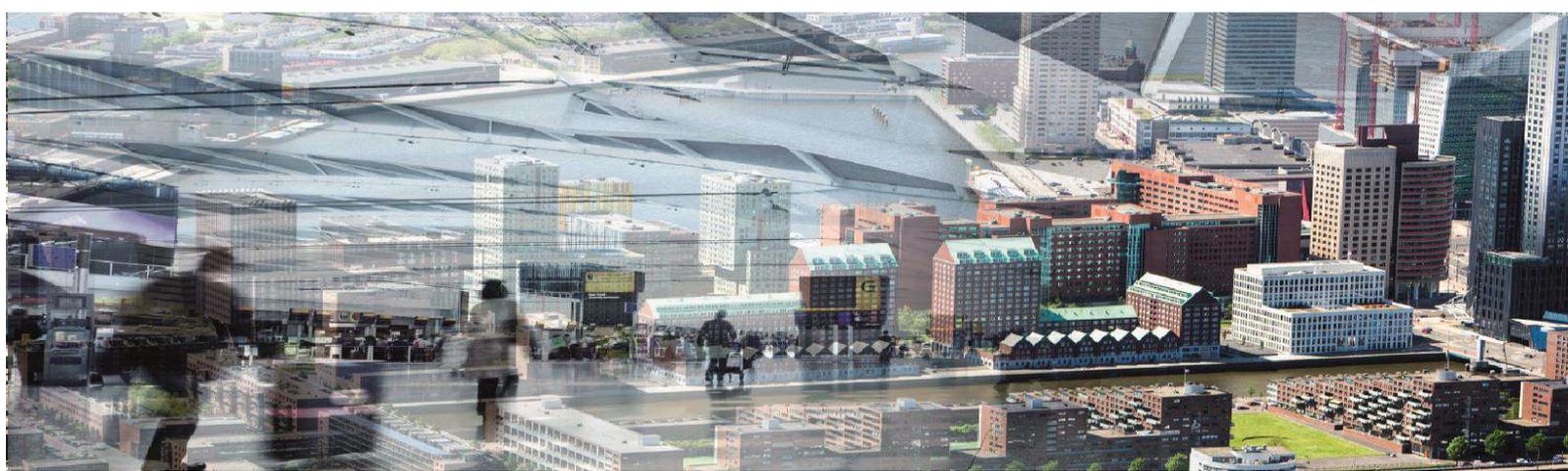
Photo 1

Photo 2

Photo 3

ANNEX 2
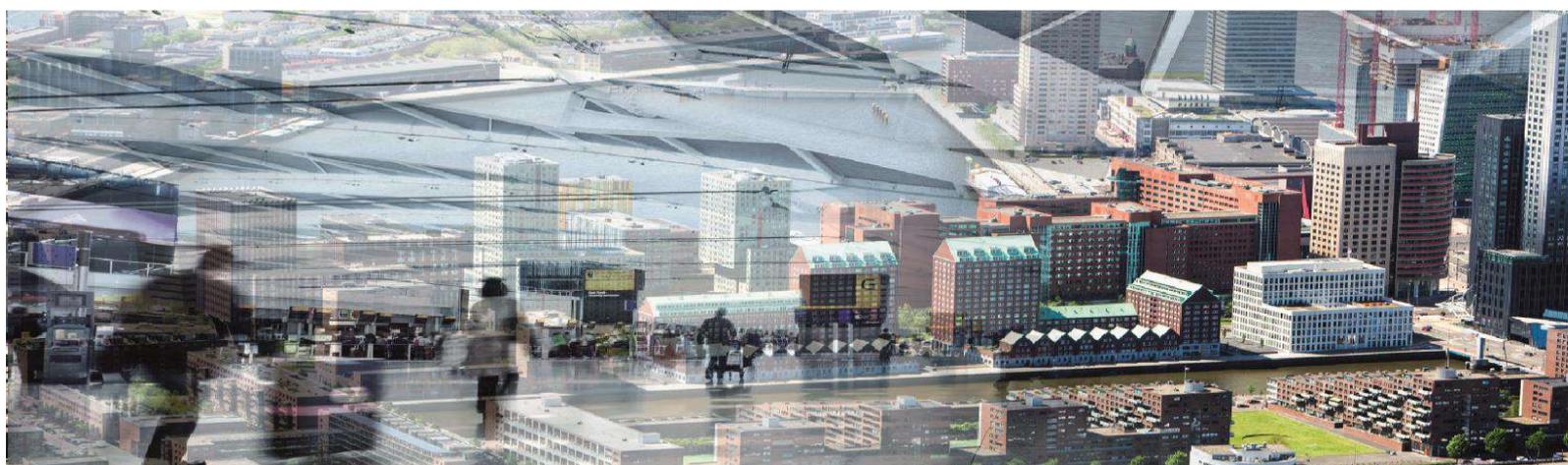
Air Leakage Test Data

Depressurized Data Set – Equipment and test cabinet

Operator Location:	Inside the building	
Initial Temperature:	indoors: 21 C	
Final Temperature:	indoors: 21 C	

Depressurize Test Analysis				
Correlation, r [%]:	99,954			

	Mean	95% confidence limits		Uncertainty
		Lower	Upper	
Slope, n:	0,662	0,64637	0,67666	
Air leakage coefficient, C_{env} [L/s/Pa^n]:	0,0013106	0,001236	0,001389	
Air leakage coefficient, C_L [L/s/Pa^n]:	0,0013090	0,001233	0,001389	
Air flow at 50 Pa, Q_{50} [L/s]	0,017411	0,01730	0,01752	+/-0,6%
Air flow at 10 Pa, Qv_{10} [L/s]	0,0060056	0,005858	0,006156	+/-2,5%
Effective leakage area at 10 Pa, A_L [cm²]	0,01473	0,01437	0,01510	+/-2,5%
Equivalent leakage area at 10 Pa, A_L [cm²]	0,02415	0,02356	0,02475	+/-2,5%

Measured pressure [Pa]	-20,2	-30,1	-34,9	-40,1	-45,0	-50,1	-55,2	-60,0	-69,9	-79,9	-90,2
Total Flow, Vr [L/s]	0,00940299	0,0125428	0,0138200	0,0151953	0,0164315	0,0175382	0,0186904	0,0197012	0,0216653	0,0236282	0,0255238
Corrected Flow, Venv [L/s]	0,0093984	0,012537	0,013813	0,015188	0,016424	0,017530	0,018681	0,019692	0,021655	0,023617	0,025511
Error [%]	-1,9%	0,7%	0,5%	0,8%	1,0%	0,5%	0,3%	0,2%	-0,4%	-0,6%	-0,9%

Flow vs Induced Pressure (Depressurized set)

Depressurized Data Set – Equipment, test cabinet and Homebox

Operator Location:	Inside the building	
Initial Temperature:	indoors: 21 C	
Final Temperature:	indoors: 21 C	

Depressurize Test Analysis				
Correlation, r [%]:	99,958			
	Mean	95% confidence limits		Uncertainty
		Lower	Upper	
Slope, n:	0,662	0,64767	0,67647	
Air leakage coefficient, C_{env} [L/s/Pa^n]:	0,0013247	0,001253	0,001400	
Air leakage coefficient, C_L [L/s/Pa^n]:	0,0013231	0,001250	0,001400	
Air flow at 50 Pa, Q_{50} [L/s]	0,017636	0,01753	0,01774	+/-0,6%
Air flow at 10 Pa, Qv_{10} [L/s]	0,0060778	0,005936	0,006222	+/-2,3%
Effective leakage area at 10 Pa, A_L [cm²]	0,01491	0,01456	0,01526	+/-2,3%
Equivalent leakage area at 10 Pa, A_L [cm²]	0,02444	0,02387	0,02502	+/-2,3%

Measured pressure [Pa]	-20,1	-30,2	-34,9	-40,1	-45,2	-49,9	-54,8	-59,8	-70,4	-80,3	-90,1
Total Flow, Vr [L/s]	0,00948861	0,0127141	0,0140017	0,0153795	0,0166647	0,0177155	0,0188463	0,0199642	0,0220992	0,0239967	0,0258343
Corrected Flow, Venv [L/s]	0,0094840	0,012708	0,013995	0,015372	0,016657	0,017707	0,018837	0,019954	0,022088	0,023985	0,025822
Error [%]	-1,8%	0,6%	0,5%	0,8%	0,9%	0,4%	0,4%	0,3%	-0,3%	-0,7%	-1,0%

Flow vs Induced Pressure (Depressurized set)
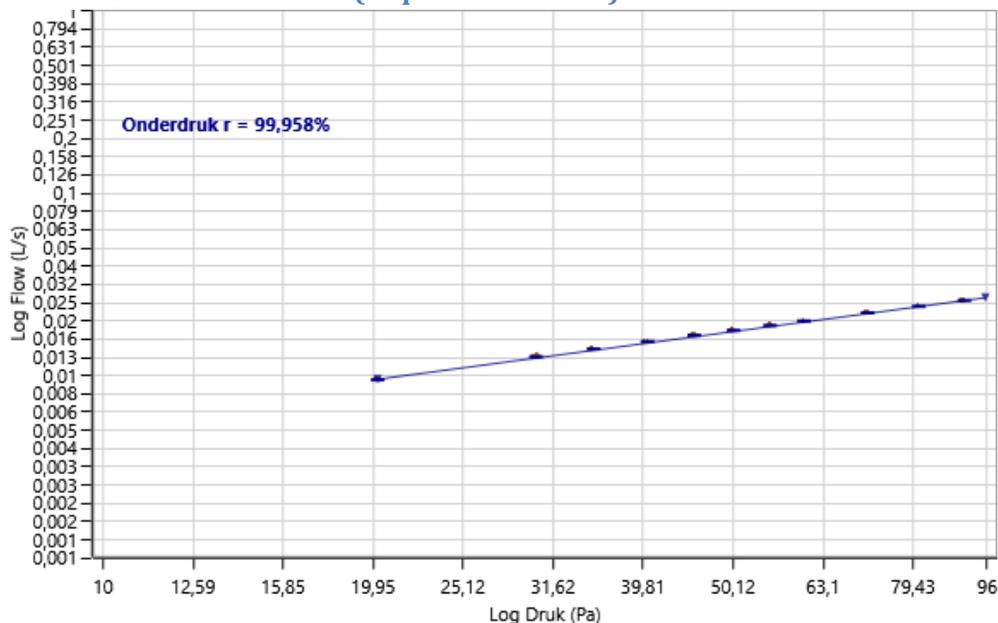
Onderdruk r = 99,958%

Test Equipment

	Fan	Fan serial	Fan location	Gauge	Gauge serial	Gauge Calibration
#1	Retrotec 300	00001955		DM32	402995	

Fan Calibration Certificate Retrotec 350:

Retrotec 350 Fan last calibrated: (ventilator kalibratie - B1) . Published Flow Equation Parameters, Round B1 CFM							
Range	n	K	K1	K2	K3	K4	MF
102	0,59	10,7	0	0,4	0	1	100
74	0,5045	7,077	0	0,25	0	1	15
47	0,5	3,241	0	0,1	0	1	10
29	0,502	1,19	0	0,2	0	1	20
18	0,499	0,457	0	0,25	0	1	25
11	0,48	0,208	0	0,25	0	1	25
7	0,5	0,0718	0	0,11	0	1	25
3	0,485	0,0216	0	0,3	0	1	25
2	0,53	0,0065	0	0,3	0	1	25
1	0,593	0,002044	0	0,3	0	1	40

Fan Pressure (FP) is the measured fan pressure when using a self-referenced fan or when Room Pressure is negative. If using a fan which is not self-referenced, and Room Pressure is positive, Fan Pressure is calculated by subtracting the measured Room Pressure from the Absolute Value of the Fan Pressure.

If PrA>0 and fan is not self-referencing: FP = |PrB|-PrA
If PrA<0 or fan is self-referencing: FP = PrB

Flow calculations are not valid if Fan Pressure is less than either MF or (K2 x |CR|).

Flow in CFM using the above coefficients is calculated as follows for standard Ranges:

$$flow = (FP - CR \times K1)^n \ \times \ (K + K3 \times FP) \times K4$$

FP = fan pressure,   CR = corrected room pressure

ANNEX 3
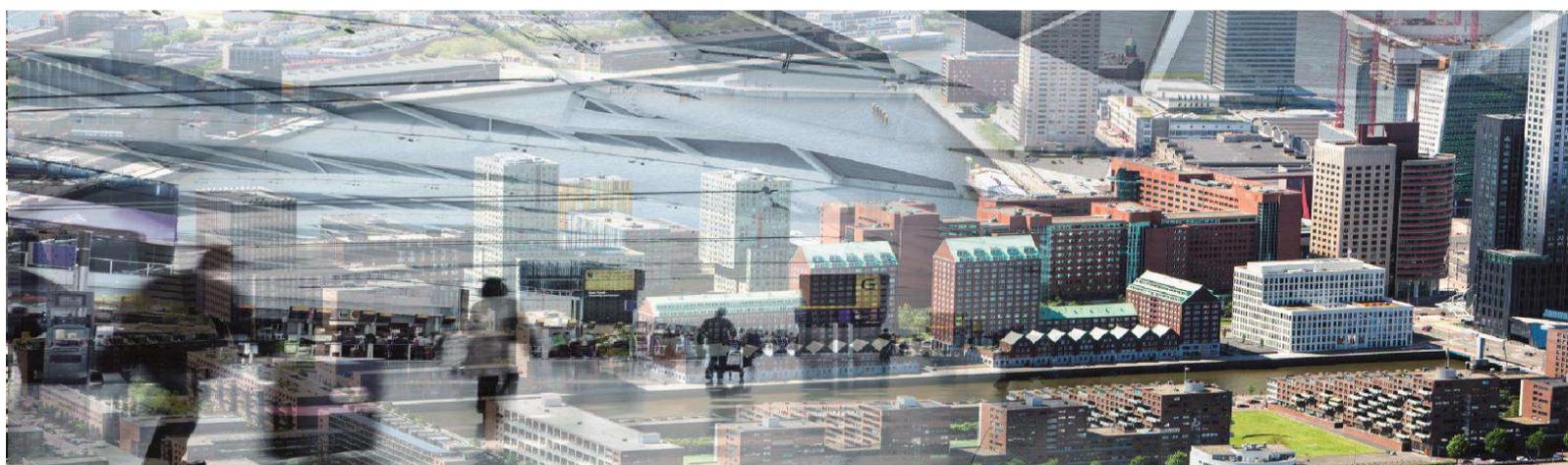
Air Leakage Test Data

Pressurized Data Set – Equipment and test cabinet

Operator Location:	Inside the building	
Initiële temperatuur:	indoors: 21 C	
Finale temperatuur:	indoors: 21 C	

Pressurize Test Analysis				
Correlation, r [%]:	99,979			

	Mean	95% confidence limits		Uncertainty
		Lower	Upper	
Slope, n:	0,638	0,62842	0,64805	
Air leakage coefficient, C_{env} [L/s/Pa^n]:	0,0013019	0,001253	0,001353	
Air leakage coefficient, C_L [L/s/Pa^n]:	0,0013003	0,001253	0,001350	
Air flow at 50 Pa, Q_{50} [L/s]	0,015789	0,01572	0,01586	+/-0,4%
Air flow at 10 Pa, Qv_{10} [L/s]	0,0056528	0,005564	0,005744	+/-1,6%
Effective leakage area at 10 Pa, A_L [cm²]	0,01387	0,01365	0,01409	+/-1,6%
Equivalent leakage area at 10 Pa, A_L [cm²]	0,02274	0,02238	0,02311	+/-1,6%

Measured pressure [Pa]	20,1	30,0	35,0	39,8	44,9	49,8	55,2	60,1	69,8	80,0	89,9
Total Flow, Vr [L/s]	0,00874581	0,0114036	0,0126344	0,0137601	0,0148885	0,0158497	0,0169116	0,0177892	0,0195247	0,0212754	0,0228300
Corrected Flow, Venv [L/s]	0,0087416	0,011398	0,012628	0,013753	0,014881	0,015842	0,016903	0,017781	0,019515	0,021265	0,022819
Error [%]	-1,1%	0,0%	0,3%	0,6%	0,8%	0,4%	0,4%	0,0%	-0,3%	-0,4%	-0,8%

Flow vs Induced Pressure (Pressurized set)
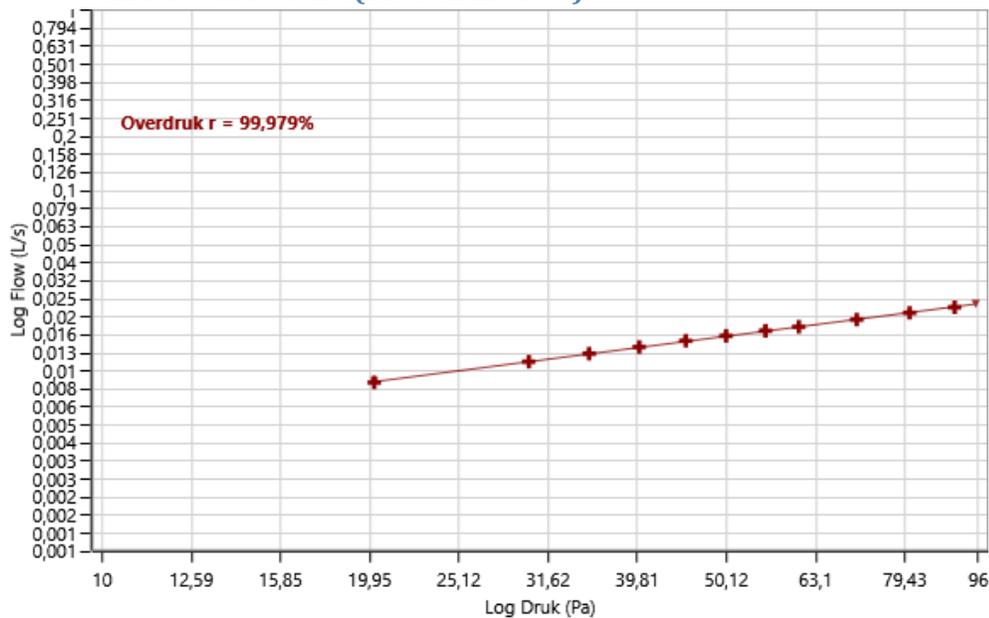
Pressurized Data Set – Equipment, test cabinet and Homebox

Operator Location:	Binnen	
Initiële temperatuur:	binnen: 21 C	
Finale temperatuur:	binnen: 21 C	

Pressurize Test Analysis				
Correlation, r [%]:	99,979			
	Mean	95% confidence limits		Uncertainty
		Lower	Upper	
Slope, n:	0,646	0,63586	0,65594	
Air leakage coefficient, C_{env} [L/s/Pa^n]:	0,0012927	0,001244	0,001344	
Air leakage coefficient, C_L [L/s/Pa^n]:	0,0012911	0,001242	0,001342	
Air flow at 50 Pa, Q_{50} [L/s]	0,016156	0,01609	0,01622	+/-0,4%
Air flow at 10 Pa, Qv_{10} [L/s]	0,0057139	0,005622	0,005808	+/-1,6%
Effective leakage area at 10 Pa, A_L [cm²]	0,01402	0,01379	0,01425	+/-1,7%
Equivalent leakage area at 10 Pa, A_L [cm²]	0,02298	0,02261	0,02336	+/-1,6%

Measured pressure [Pa]	20,0	29,9	34,8	39,8	45,1	50,0	55,2	60,1	70,2	79,7	89,9
Total Flow, Vr [L/s]	0,00887741	0,0116417	0,0128855	0,0140184	0,0152011	0,0162236	0,0173051	0,0181201	0,0200427	0,0216642	0,0237860
Corrected Flow, Venv [L/s]	0,0088731	0,011636	0,012879	0,014012	0,015194	0,016216	0,017297	0,018111	0,020033	0,021654	0,023774
Error [%]	-0,9%	0,3%	0,6%	0,3%	0,4%	0,3%	0,3%	-0,6%	-0,5%	-0,9%	0,6%

Flow vs Induced Pressure (Pressurized set)
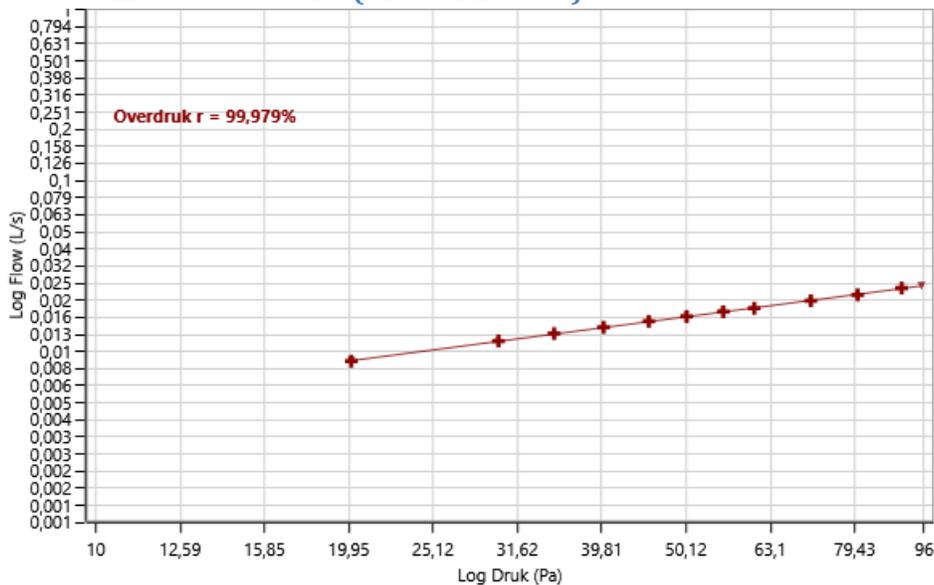
Test Equipment

	Fan	Fan serial	Fan location	Gauge	Gauge serial	Gauge Calibration
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Fan Calibration Certificate Retrotec 350:

Retrotec 350 00001955   Fan last calibrated: (ventilator kalibratie - B1) .   Published Flow Equation Parameters, Round B1 CFM

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FP = fan pressure,   CR = corrected room pressure