

# Tæthedsprøvning

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In Compliance with ISO9972:2015 – Europe

# Tæthedskompagniet

Fortrykprøvning - Trykprøvning - Energimærkning




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Building Address:	Testvej 99, 0000 Testby
Performed for:	Test KUNDE
Performed by:	Konsulent NAVN
Test date:	2020-01-03
Associated Test file:	Testvej 99, 0000 Testby
Report Number:	100XX
Unique Property ID Number:	

## Summary

 <b>FanTestic</b>	version: <b>5.11.46</b>	licensed to: <b>Tæthedskompagniet</b>
Test date: <b>2020-01-03</b>	By: <b>Konsulent NAVN</b>	
Customer:	<b>Test KUNDE</b>	
Building Lot Number:		
Building address:	<b>Testvej 99, 0000 Testby</b>	

<b>Building and Test Information</b>	
Test file name:	<b>Testvej 99, 0000 Testby</b>
Building volume [m <sup>3</sup> ]:	<b>0</b>
Envelope Area [m <sup>2</sup> ]:	<b>0</b>
Floor Area [m <sup>2</sup> ]:	<b>186,8</b>
Building Height (from ground to top) [m]:	<b>0</b>
Altitude [m]:	<b>0</b>
Accuracy of volume measurements:	<b>0%</b>
Accuracy of envelope area measurements:	<b>0%</b>
Accuracy of floor area measurements:	<b>0%</b>
Number of building storeys:	<b>1</b>

<b>Resultater</b>	
Air changes at 50 Pa, $n_{50}$ [/h]	
Air flow at 50 Pa, [L/s]	<b>66,500</b>
Air flow at 10 Pa, [L/s]	<b>24,320</b>
Specific leakage rate (envelope) at 50 Pa, [L/s/m <sup>2</sup> ]	
Specific leakage rate (floor) at 50 Pa, [L/s/m <sup>2</sup> ]	<b>0,356</b>
Effective leakage area at 50 Pa, [cm <sup>2</sup> ]	<b>72,95</b>
Specific effective leakage area (envelope) at 50 Pa, [cm <sup>2</sup> /m <sup>2</sup> ]:	
Specific effective leakage area (floor) at 50 Pa, [cm <sup>2</sup> /m <sup>2</sup> ]:	<b>0,391</b>

## Building Information

### Building Measurements

Altitude above sea level [m]:	0
Building Volume [m <sup>3</sup> ]:	0
Volume Measurement Accuracy:	0%
Envelope Area (A <sub>E</sub> ) [m <sup>2</sup> ]:	0
Envelope Area Measurement Accuracy:	0%
Floor Area (A <sub>F</sub> ) [m <sup>2</sup> ]:	186,8
Floor Area Measurement Accuracy:	0%
Building Height (from ground to top) [m]:	0
Building number of storeys:	1

### Heating/Ventilation System

Ventilationsanlæg er standset forud for testen og alle ventiler dækket til med tape, emhætte er lukket med tape og tomrør ved teknik er lukket i ende med tape.

### Pictures



### Test Method

Testen er udført iht. alle gældende forskrifter, herunder gældende bygningsreglement og DS/EN 13829/DS/EN ISO 9972.

Der er foretaget forskelsmåling på tryk ude og inde, disse overholder stillede krav.

Der er målt vindhastighed og temperatur, barometerstand er iht. standard.

Korrelationkoefficient og eksponenten overholder de i DS/EN 13829/DS/EN ISO 9972 stillede krav.

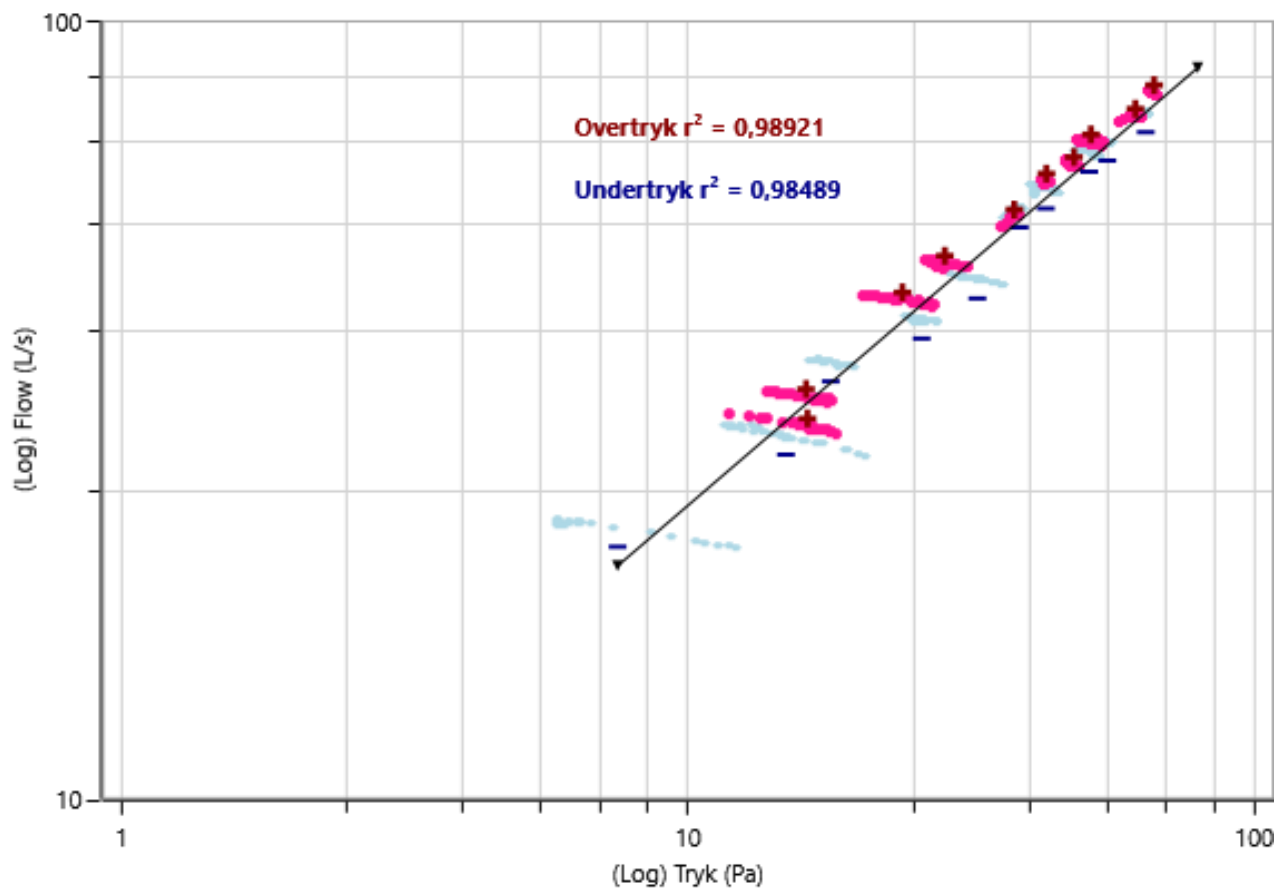
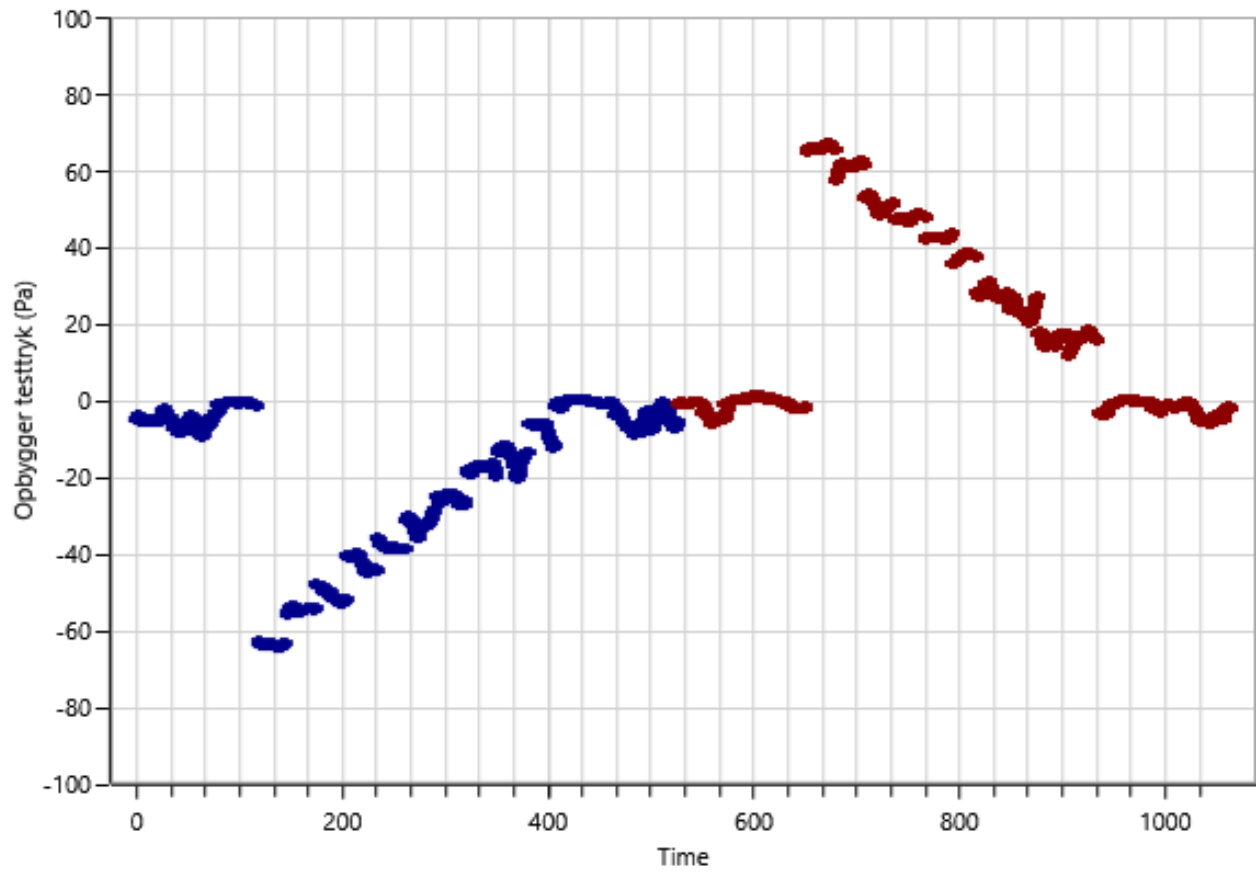
Resultatet af trykprøven er et gennemsnit af over- og undertryk.

Alt udstyr til udførelse af trykprøven er kalibreret iht. stillede krav.

## Discussion of Results

### Kombinerede testdata (Average Values)

	Resultater	95% konfidens interval		Usikkerhed pga. vind
Air flow at 50 Pa, [L/s]	66,500	63,790	69,330	+/-4,2%
Air changes at 50 Pa, $n_{50}$ [/h]				
Specific leakage rate (envelope) at 50 Pa, [L/s/m <sup>2</sup> ]				
Specific leakage rate (floor) at 50 Pa, [L/s/m <sup>2</sup> ]	0,356	0,341	0,371	+/-4,2%
Effective leakage area at 50 Pa, [cm <sup>2</sup> ]	72,95	70,00	76,05	+/-4,3%
Specific effective leakage area (envelope) at 50 Pa, [cm <sup>2</sup> /m <sup>2</sup> ]				
Specific effective leakage area (floor) at 50 Pa, [cm <sup>2</sup> /m <sup>2</sup> ]	0,391	0,374	0,407	



## Tæthedstest - Data Appendix -

### Undertryk Data Set

Test Dataset Date: 2020-01-03  
 Start time: 12:18:00  
 Finish Time: 12:34:51

Environmental Conditions		
Wind speed:	2: Let brise	from the
Operator Location:	Indendørs the building	
Greatest Baseline Pressure Point	-8,17 Pa	
Initial Bias Pressure:	-4,02 Pa	
Final Bias Pressure:	-2,87 Pa	
Average Bias Pressure:	-3,44 Pa	
Initial Temperature:	indoors: 22 C	outdoors: 6 C
Final Temperature:	indoors: 22 C	outdoors: 6 C
Barometric Pressure	101,3 kPa	from Standard temperatur og tryk

Undertryk Test Analysis				
Correlation, r [%]:	98,489			
Coefficient of Determination, r <sup>2</sup>	0,98489			
	Mean	95% confidence limits		Uncertainty
		Lower	Upper	
Slope, n:	0,595	0,53530	0,65556	
Air leakage coefficient, C <sub>env</sub> [L/s/Pa <sup>n</sup> ]:	6,0228	4,899	7,405	
Air leakage coefficient, C <sub>L</sub> [L/s/Pa <sup>n</sup> ]:	6,1438	4,997	7,554	
Air flow at 50 Pa, [L/s]	63,103	60,01	66,36	+/-5,0%
Air changes at 50 Pa, n <sub>50</sub> [/h]				
Specific leakage rate (envelope) at 50 Pa, [L/s/m <sup>2</sup> ]				
Specific leakage rate (floor) at 50 Pa, [L/s/m <sup>2</sup> ]	0,3378	0,3208	0,3548	+/-5,0%
Effective leakage area at 50 Pa, [cm <sup>2</sup> ]	69,24	65,85	72,82	+/-5,2%
Specific effective leakage area (envelope) at 50 Pa, [cm <sup>2</sup> /m <sup>2</sup> ]				
Specific effective leakage area (floor) at 50 Pa, [cm <sup>2</sup> /m <sup>2</sup> ]	0,371	0,352	0,389	+/-5,0%

Measured pressure [Pa]		-67,2	-58,0	-54,1	-45,9	-41,6	-35,6	-29,1	-21,2	-18,2	-10,9
Induced Pressure [Pa]		-63,7	-54,5	-50,7	-42,5	-38,2	-32,1	-25,6	-17,7	-14,8	-7,4
#1, Range B1	Fan Pressure [Pa]	123,4	106,0	99,8	81,3	72,9					
	Flow [L/s]	76,13	70,00	67,75	60,74	57,44					
	q <sub>m</sub> [L/s]	76,22	70,08	67,83	60,81	57,51					
	q <sub>env</sub> [L/s]	72,09	66,28	64,16	57,51	54,39					
#1, Range B74	Fan Pressure [Pa]						186,9	151,3	120,4	83,7	50,1
	Flow [L/s]						46,59	41,37	36,45	29,35	22,36
	q <sub>m</sub> [L/s]						46,64	41,42	36,49	29,38	22,38
	q <sub>env</sub> [L/s]						44,11	39,17	34,51	27,79	21,17
Total Flow, q <sub>r</sub> [L/s]		76,1301	69,9964	67,7503	60,7373	57,4386	46,5852	41,3691	36,4476	29,3484	22,3569
Measured Flow, q <sub>m</sub> [L/s]		76,2224	70,0813	67,8324	60,8110	57,5083	46,6417	41,4192	36,4918	29,3840	22,3840
Flow through envelope, q <sub>env</sub> [L/s]		72,090	66,282	64,155	57,514	54,391	44,113	39,174	34,514	27,791	21,171
Error [%]		0,9%	1,8%	2,9%	2,5%	3,3%	-7,2%	-5,7%	3,5%	-7,1%	6,4%

10 induced pressures each taken for 30 of the required 30 seconds.

12 baseline pressures each taken for 10 of required 10 seconds.

Average Baseline, ΔP: -3,44 Pa

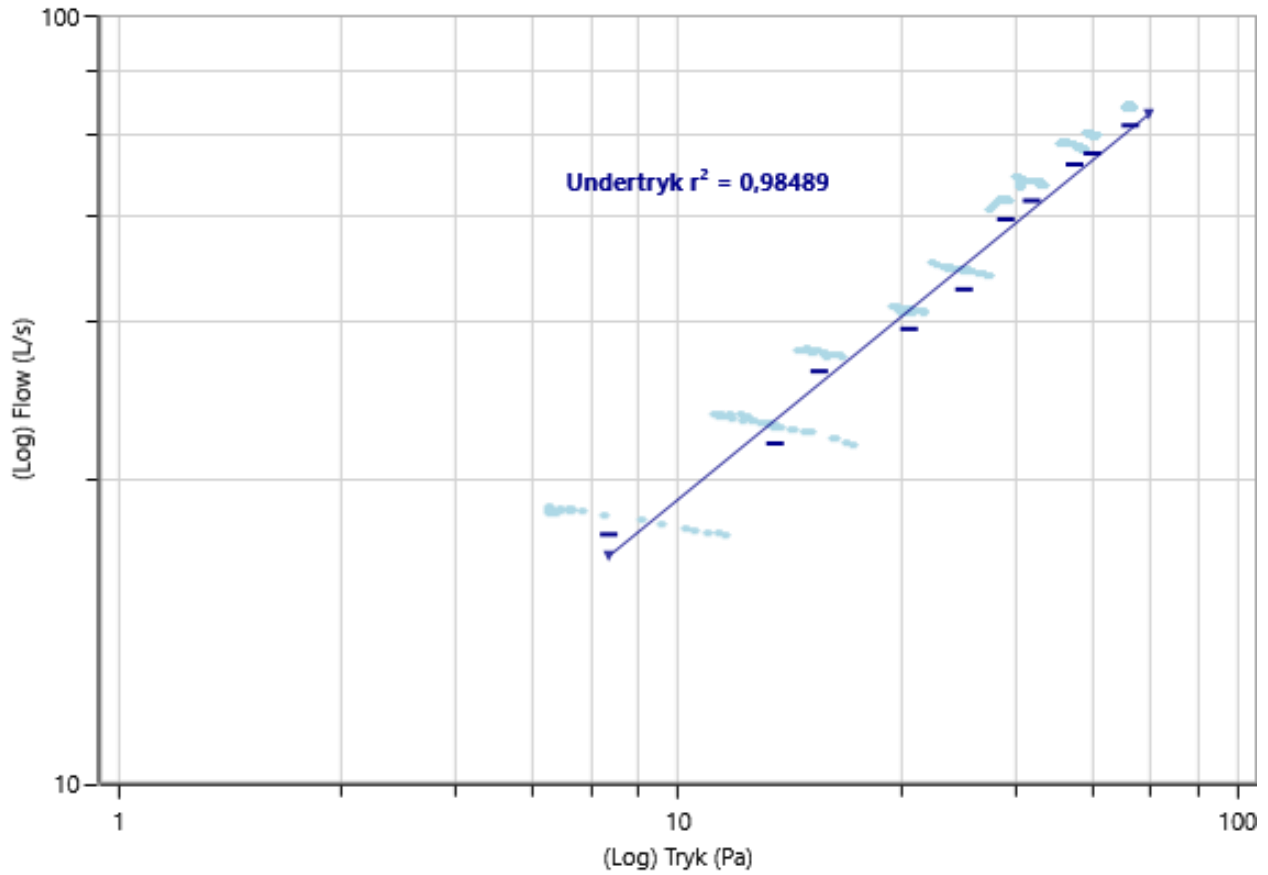
Greatest Baseline Pressure Point: -8,17 Pa

Static Pressure Averages:			
Average Baseline [Pa]	$\Delta P$ -3,44		
initial [Pa]	$\Delta P01$ -4,02	$\Delta P01$ -4,02	$\Delta P01$ + 0,00
final [Pa]	$\Delta P02$ -2,87	$\Delta P02$ -3,47	$\Delta P02$ + 0,16

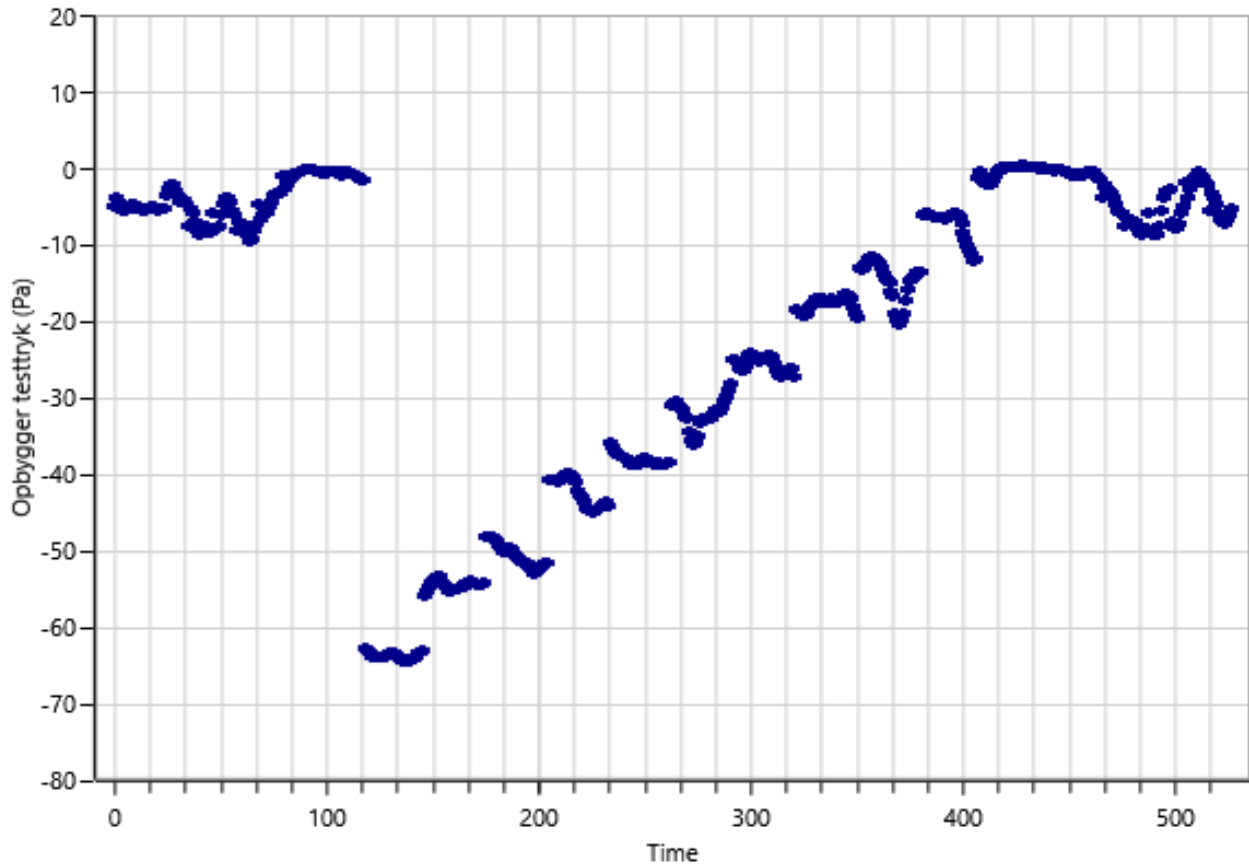
Baseline, initial [Pa]	-4,98	-5,37	-5,40	-3,52	-7,47	-5,82	-8,17	-4,75	-1,08	-0,19	-0,52	-0,93
Baseline, final [Pa]	-1,34	0,13	0,18	-0,07	-0,58	-0,85	-3,97	-7,50	-5,96	-6,95	-1,81	-5,72



### Induced Pressure vs. Flow (Undertryk Set)



### Building Gauge Pressure (Undertryk Set)



## Overtryk Data Set

Test Dataset Date: 2020-01-03  
 Start time: 12:42:45  
 Finish Time: 12:57:07

Environmental Conditions		
Wind speed:	2: Let brise	from the
Operator Location:	Indendørs the building	
Greatest Baseline Pressure Point:	-5,16 Pa	
Initial Bias Pressure:	-0,93 Pa	
Final Bias Pressure:	-1,96 Pa	
Average Bias Pressure:	-1,44 Pa	
Initial Temperature:	indoors: 22 C	outdoors: 6 C
Final Temperature:	indoors: 22 C	outdoors: 6 C
Barometric Pressure:	101,3 kPa	from Standard temperatur og tryk

Overtryk Test Analysis				
Correlation, r [%]:	98,921			
Coefficient of Determination, r <sup>2</sup>	0,98921			
	Mean	95% confidence limits		Uncertainty
		Lower	Upper	
Slope, n:	0,653	0,59730	0,70846	
Air leakage coefficient, C <sub>env</sub> [L/s/Pa <sup>n</sup> ]:	5,4476	4,463	6,649	
Air leakage coefficient, C <sub>L</sub> [L/s/Pa <sup>n</sup> ]:	5,4352	4,453	6,634	
Air flow at 50 Pa, [L/s]	69,894	67,57	72,30	+/-3,4%
Air changes at 50 Pa, n <sub>50</sub> [/h]				
Specific leakage rate (envelope) at 50 Pa, [L/s/m <sup>2</sup> ]				
Specific leakage rate (floor) at 50 Pa, [L/s/m <sup>2</sup> ]	0,3742	0,3615	0,3868	+/-3,4%
Effective leakage area at 50 Pa, [cm <sup>2</sup> ]	76,70	74,15	79,33	+/-3,4%
Specific effective leakage area (envelope) at 50 Pa, [cm <sup>2</sup> /m <sup>2</sup> ]				
Specific effective leakage area (floor) at 50 Pa, [cm <sup>2</sup> /m <sup>2</sup> ]	0,411	0,397	0,424	+/-3,4%

Measured pressure [Pa]		64,5	59,7	49,6	46,2	41,1	35,9	26,7	22,3	14,6	14,7
Induced Pressure [Pa]		65,9	61,1	51,0	47,6	42,6	37,3	28,2	23,7	16,0	16,1
#1, Range B1	Fan Pressure [Pa]	201,6	180,6	154,9	139,3	126,0	104,9				
	Flow [L/s]	80,73	75,29	69,79	65,26	62,15	55,89				
	q <sub>m</sub> [L/s]	78,60	73,31	67,95	63,55	60,51	54,42				
	q <sub>env</sub> [L/s]	83,11	77,51	71,85	67,19	63,98	57,54				
#1, Range B74	Fan Pressure [Pa]							224,1	185,0	114,1	100,9
	Flow [L/s]							48,76	43,75	32,88	30,14
	q <sub>m</sub> [L/s]							47,48	42,60	32,02	29,35
	q <sub>env</sub> [L/s]							50,20	45,04	33,85	31,03
Total Flow, q <sub>r</sub> [L/s]		80,72 68	75,29 23	69,78 68	65,26 48	62,14 63	55,89 06	48,76 20	43,75 18	32,88 11	30,13 89
Measured Flow, q <sub>m</sub> [L/s]		78,60 34	73,31 19	67,95 12	63,54 81	60,51 17	54,42 05	47,47 94	42,60 10	32,01 62	29,34 61
Flow through envelope, q <sub>env</sub> [L/s]		83,10 9	77,51 4	71,84 6	67,19 0	63,98 0	57,54 0	50,20 1	45,04 3	33,85 1	31,02 8
Error [%]		-1,0%	-2,9%	1,2%	-1,0%	1,5%	-0,6%	4,3%	4,7%	1,6%	-7,2%

10 induced pressures each taken for 30 of the required 30 seconds.

12 baseline pressures each taken for 10 of required 10 seconds.

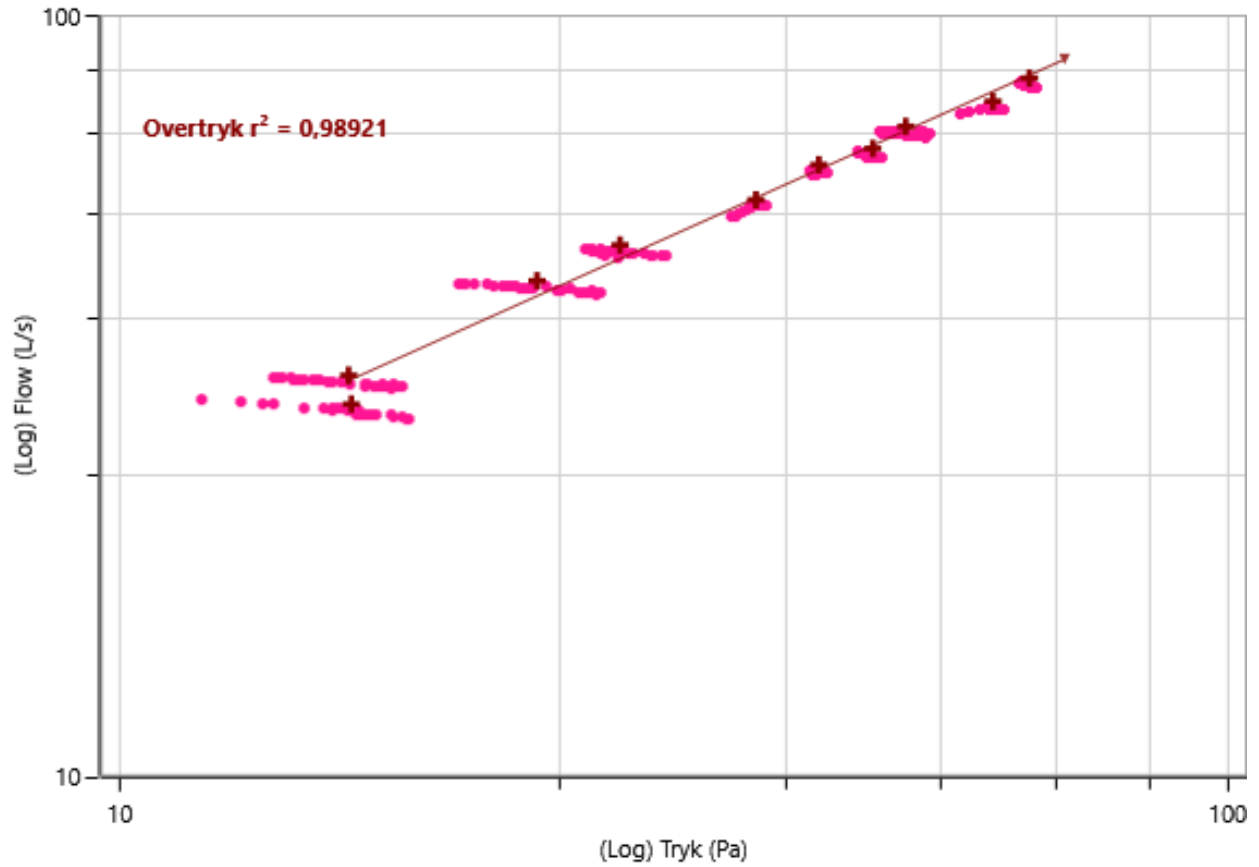
Average Baseline, ΔP: -1,44 Pa

Greatest Initial Baseline Pressure: -5,16 Pa

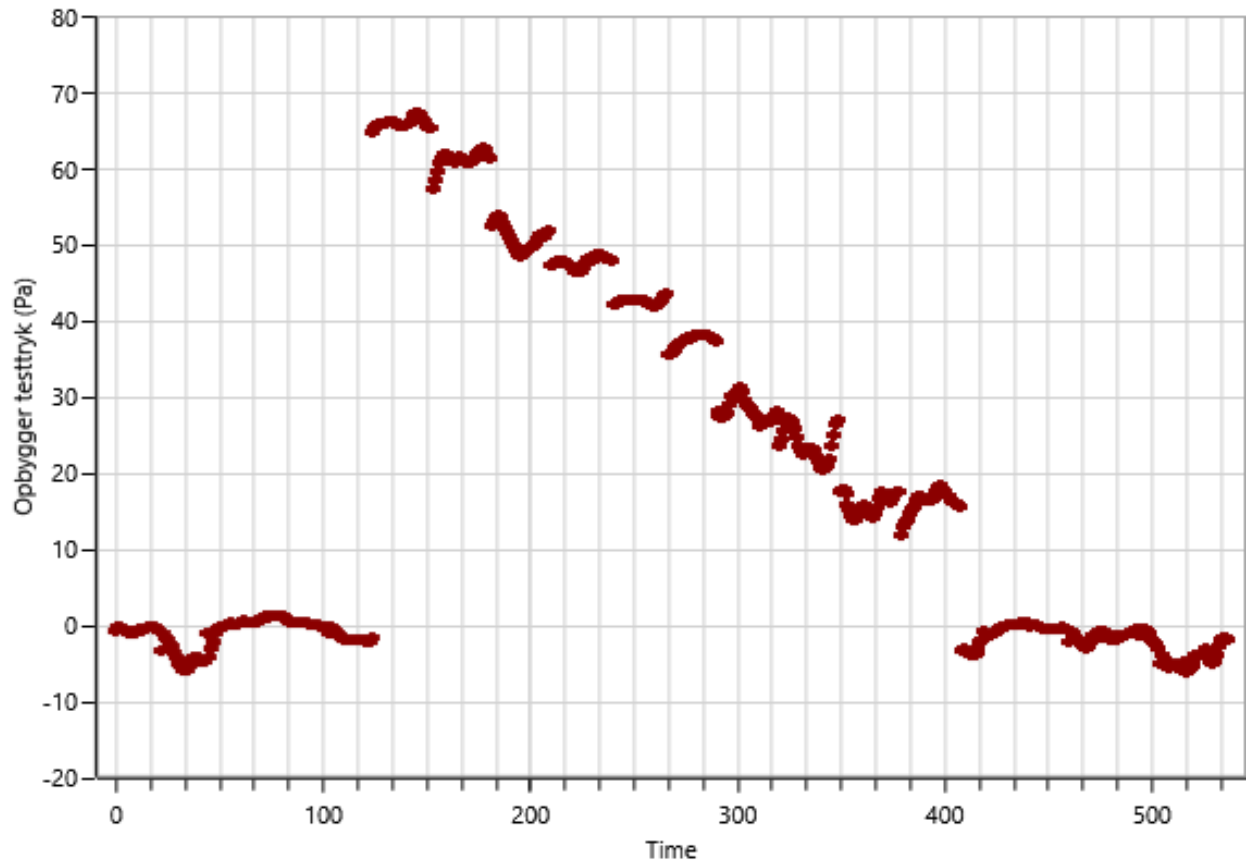
Static Pressure Averages:			
Average [Pa]	$\Delta P$ -1,44		
initial [Pa]	$\Delta P01$ -0,93	$\Delta P01$ -1,68	$\Delta P01$ + 0,57
final [Pa]	$\Delta P02$ -1,96	$\Delta P02$ -2,16	$\Delta P02$ + 0,21

Baseline, initial [Pa]	-	-	-	-	-	0,24	0,61	1,02	0,39	-0,03	-1,15	-1,92
	0,72	0,37	3,42	4,71	1,11							
Baseline, final [Pa]	-	-	0,21	-	-	-	-	-	-	-5,16	-4,66	-3,19
	3,25	0,76		0,15	0,39	2,09	1,41	1,26	1,39			

### Induced Pressure vs. Flow (Overtryk Set)



### Building Gauge Pressure (Overtryk Set)



## Test Equipment

The following test equipment was used in the performance of the air leakage tests.

	Fan	Fan serial	Fan location	Gauge	Gauge serial	Gauge Calibration
#1	Retrotec 5000		Garagedør	DM32	403289	

### Fan Calibration Certificate Retrotec 5000:

Retrotec 5000 Fan last calibrated: Febr. 2017 (Ventilator kalibrering - B1). Published Flow Equation Parameters, Round B1. CFM								
Range	n	K	K1	K2	K3	K4	MF	
Open	0,498	548	0	0,3	0	1	10	
A	0,502	287	0	0,4	0	1	20	
B8	0,54	113,25	0	0,7	0	1	40	
Polynomial Range	g	f	a	b	c	d	K2	MF
B4	29	-0,19	0,000007943	-0,00864	4,9	206	0,8	40
B2	30	0,1	0,00000088	-0,0029	2,15	90	1	50
B1	30	0	0,0000005	-0,00128	1,02	54	1	60
B74	25	0,15	0,000000796	-0,00095	0,59	18	0,8	35
B47	25	0,09	0,000000269	-0,0003591	0,2435	12,05	1	50
B29	25	-0,02	0,000000111	-0,000149	0,092	4,4	0,6	50

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  $(K2 \times |CR|)$ .

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

Flow in CFM using the above polynomial coefficients is calculated as follows:

$$flow = (a \times FP^3) + (b \times FP^2) + (c \times FP) + d + ((g - CR) \times f)$$