Addressee : *For the attention of Mr Hervé PRIGENT*

ANJOS VENTILATION
ROCHE BLANCHE
01230 TORCIEU

Villeurbanne, 05/04/2017

Person in charge: **Camille LEFEBVRE**
Function: Project Manager

Signature: Camille LEFEBVRE
Chargée d'affaires

Test Report N° 1660221-3
Version: 00

Characterization of a range of adjustable flow regulators according to the draft standard NF E 51-776-1

EQUIPMENT ID: Adjustable flow regulators for duct RDR Ø80 to Ø160
MANUFACTURER: ANJOS VENTILATION
REFERENCE DOCUMENT(S): pr NF E 51-776-1
TESTS MADE BY: Gilles COUDERC
DATE OF TESTS: Mai to August 2016

The signed final report cancels all the draft documents distributed before.

Each new version of the report cancels and replaces the previous one.

All canceled copies or duplicates of the report must be destroyed. We draw your attention on risks of mistakes encountered by using a canceled version.

Version	Date	Nature of change	Modified pages
00	05/04/2017	First edition	

CONTENTS

1. INTRODUCTION

ANJOS Ventilation asked CETIAT to characterize the airflow/pressure curves for adjustable flow regulators, installed in duct and named RDR.

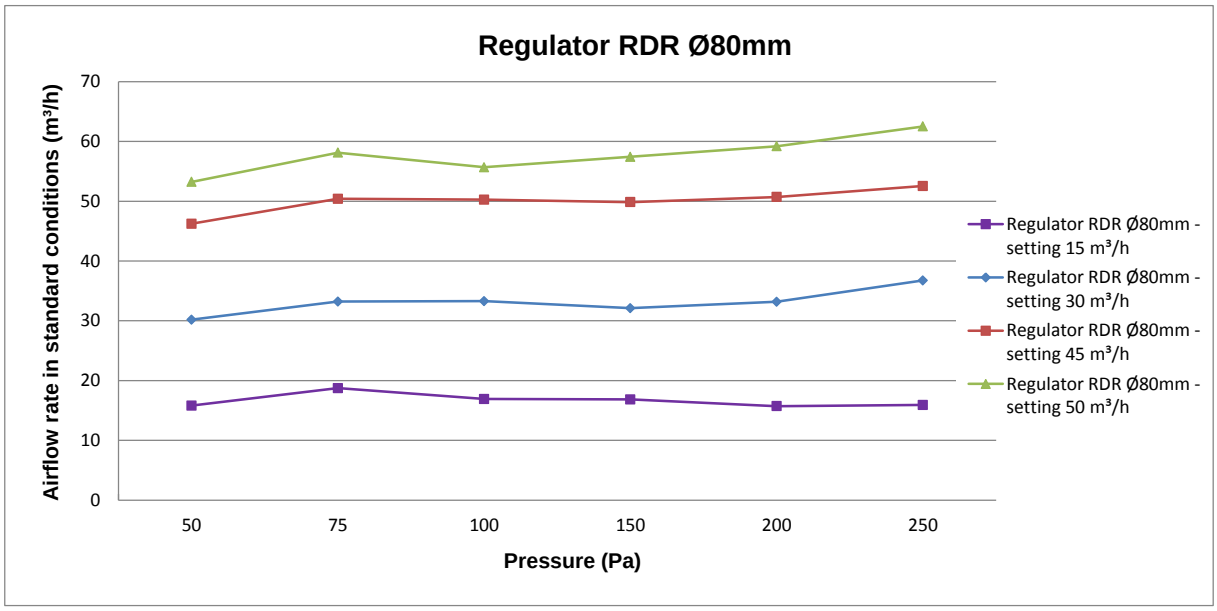
Four products are tested:

- RDR Ø80: regulator diameter 80 mm
- RDR Ø100: regulator diameter 100 mm
- RDR Ø125: regulator diameter 125 mm
- RDR Ø160: regulator diameter 160 mm

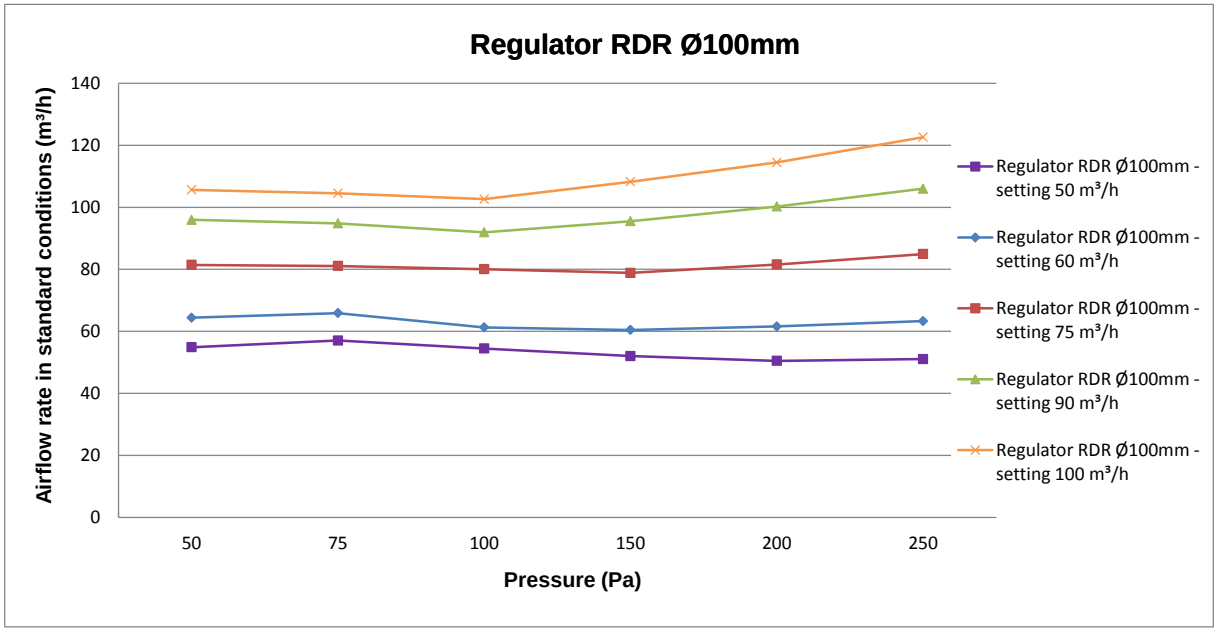
The tests are done according to the draft standard under fomal vote pr NF E 51-776-1 *" Ventilation des bâtiments - Appareils de régulation de débit d'air en conduits – Partie 1 : Essais".*

2. SUMMARY OF RESULTS

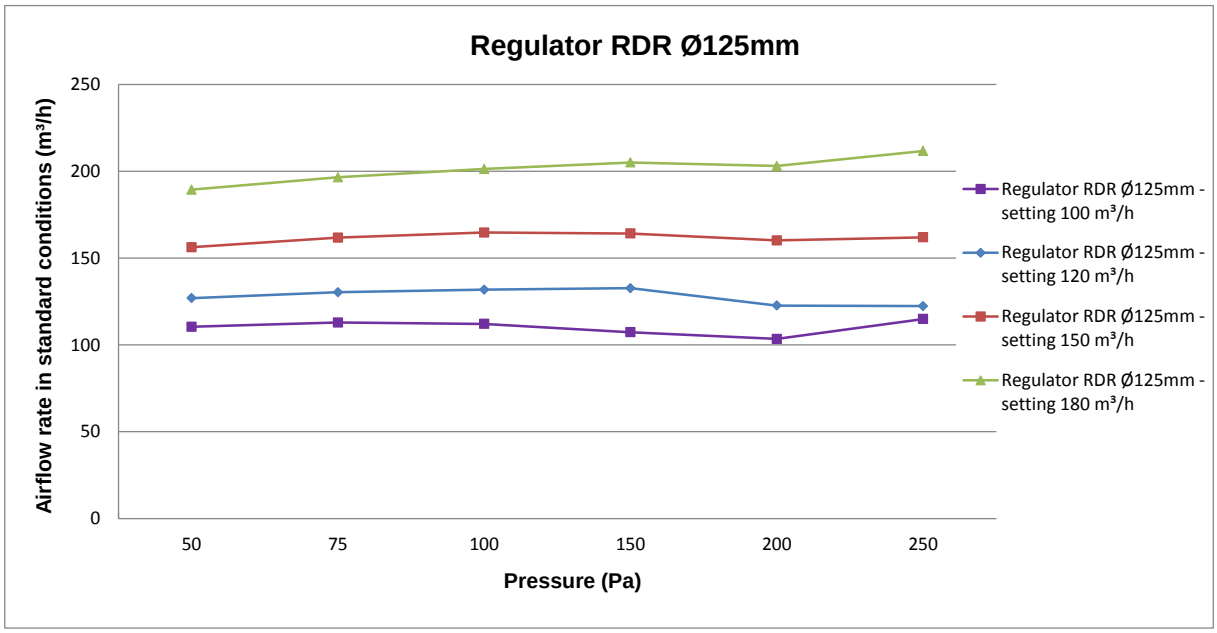
2.1. Regulator RDR Ø80



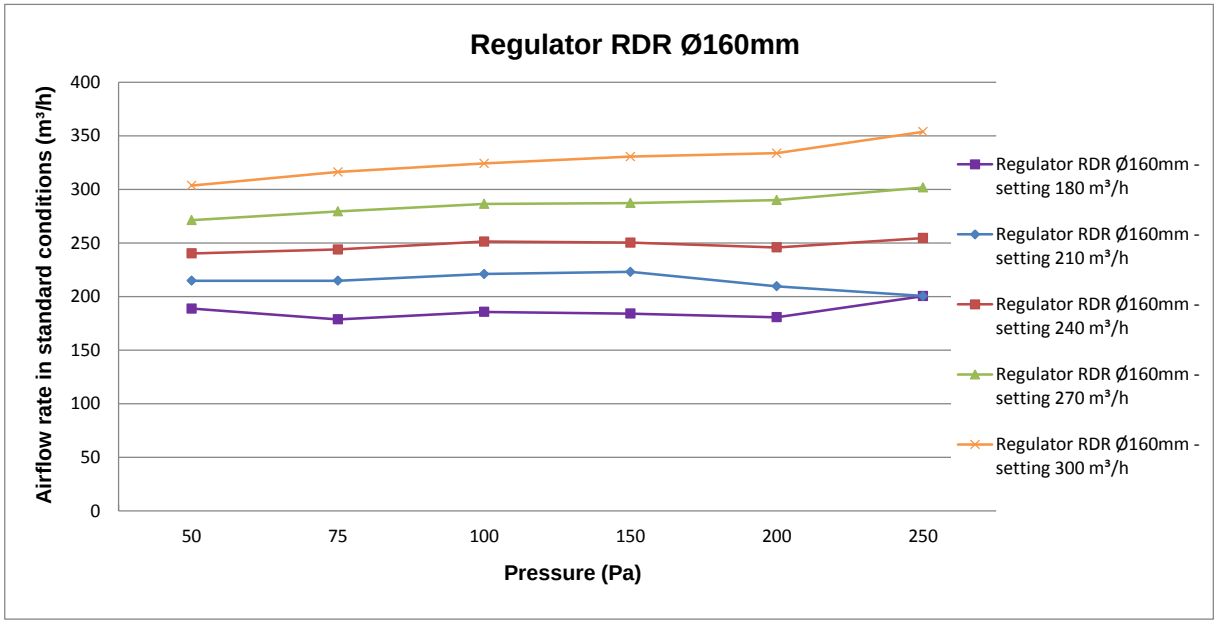
2.2. Regulator RDR Ø100



2.3. Regulator RDR Ø125

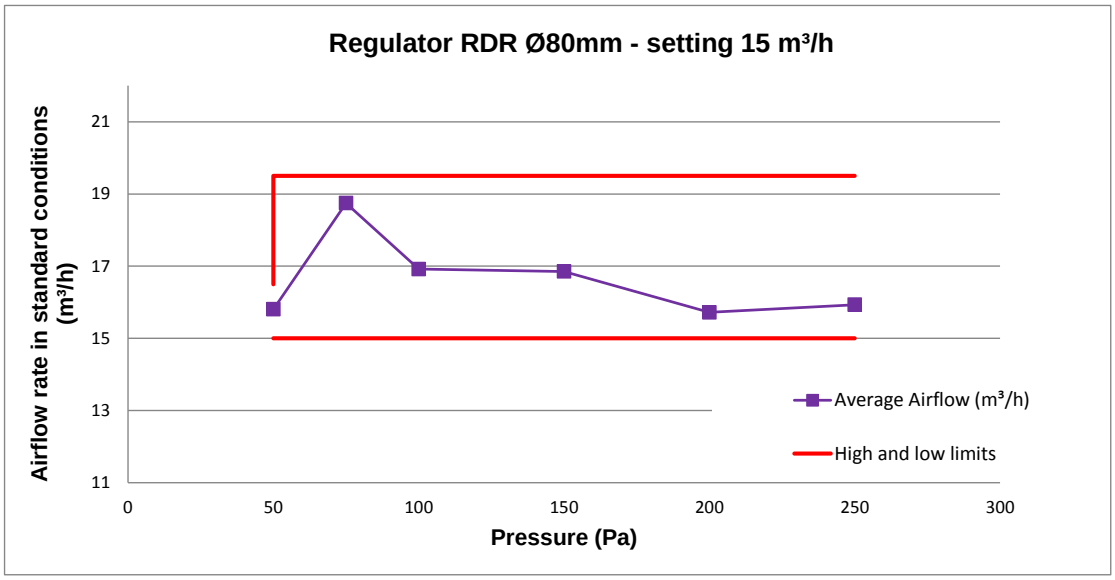


2.4. Regulator RDR Ø160



3. RESULTS RDR Ø80

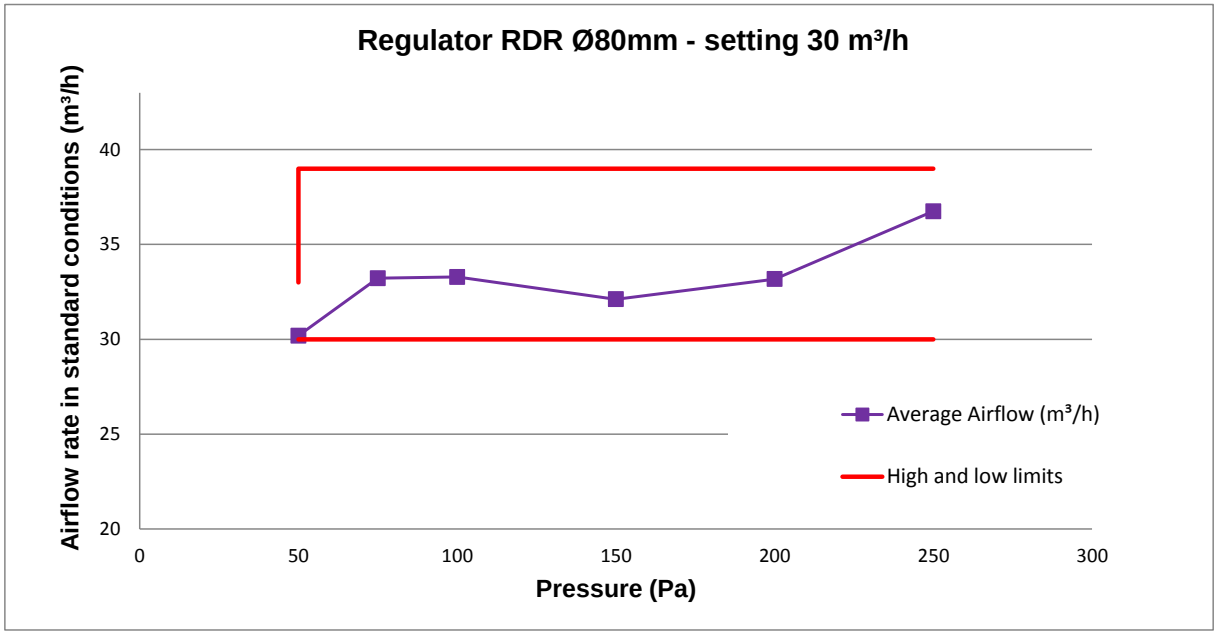
RDR Ø80 - Airflow 15 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	15.8
75	18.7
100	16.9
150	16.9
200	15.7
250	15.9

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	15.8
	75	19.6
	100	16.9
	150	16.8
	200	15.7
	250	15.9
Decrease	250	15.9
	200	15.7
	150	16.9
	100	16.9
	75	17.9
	50	15.8

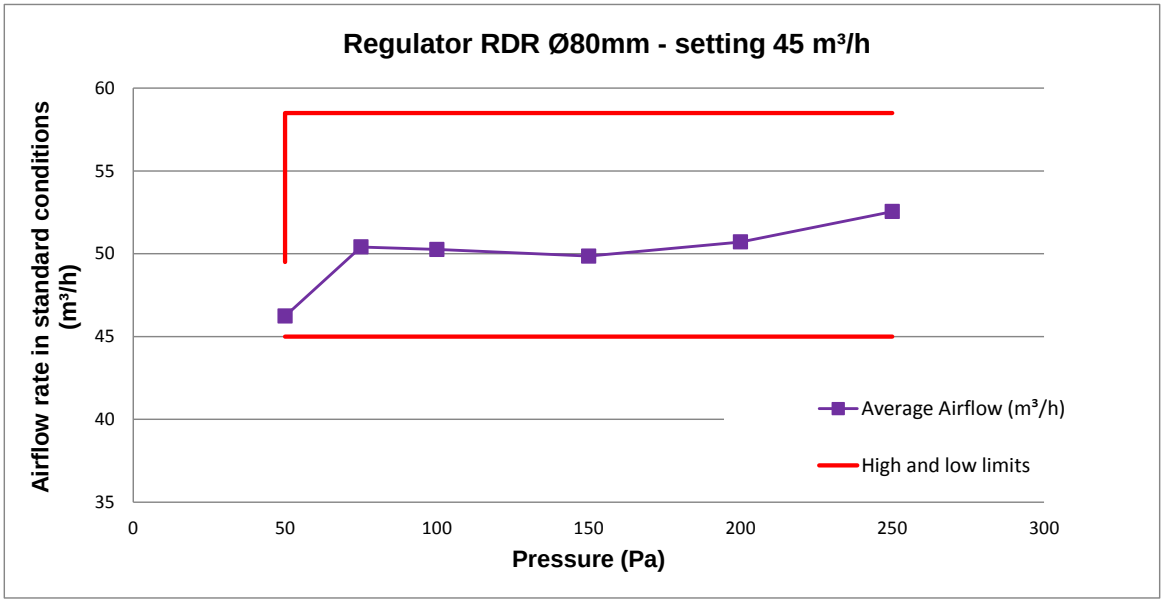
RDR Ø80 - Airflow 30 m³/h



Static pressure difference (Pa)	Average airflow rate in standard conditions (m³/h)
50	30.2
75	33.2
100	33.3
150	32.1
200	33.2
250	36.8

	Static pressure difference (Pa)	Airflow rate in standard conditions (m³/h)
Increase	50	30.4
	75	35.9
	100	34.9
	150	31.7
	200	32.9
	250	36.8
Decrease	250	36.7
	200	33.4
	150	32.5
	100	31.7
	75	30.5
	50	30.0

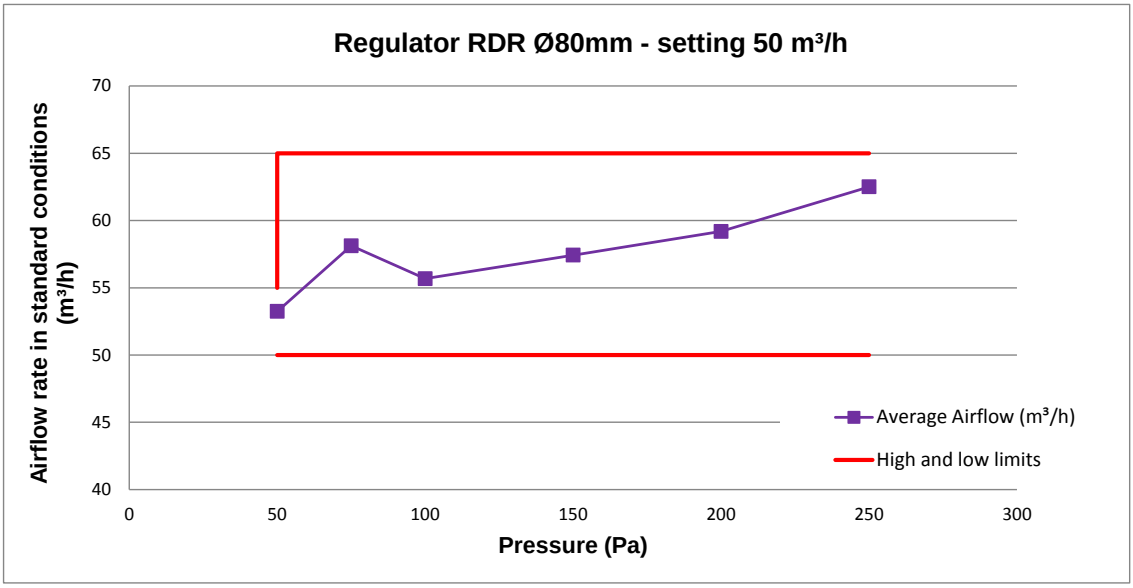
RDR Ø80 - Airflow 45 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	46.2
75	50.4
100	50.3
150	49.9
200	50.7
250	52.5

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	46.5
	75	53.6
	100	52.2
	150	49.9
	200	50.8
	250	52.6
Decrease	250	52.5
	200	50.7
	150	49.8
	100	48.3
	75	47.2
	50	45.9

RDR Ø80 - Airflow 50 m³/h

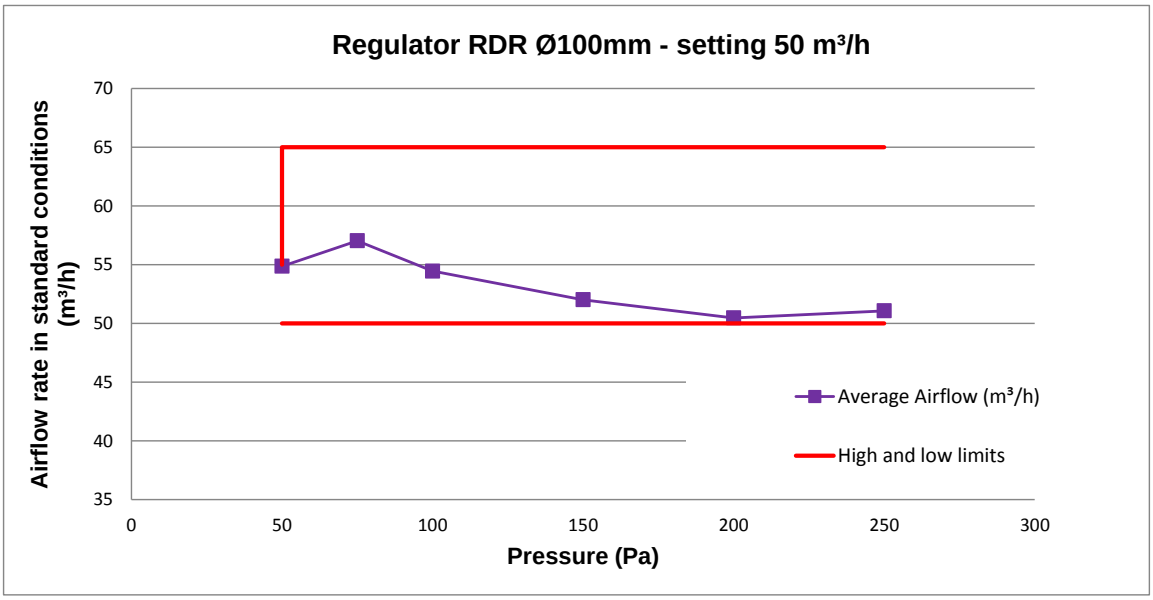


Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	53.2
75	58.1
100	55.7
150	57.4
200	59.2
250	62.5

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	54.0
	75	62.0
	100	56.2
	150	57.4
	200	59.2
	250	62.6
Decrease	250	62.5
	200	59.2
	150	57.5
	100	55.2
	75	54.2
	50	52.5

4. RESULTS RDR Ø100

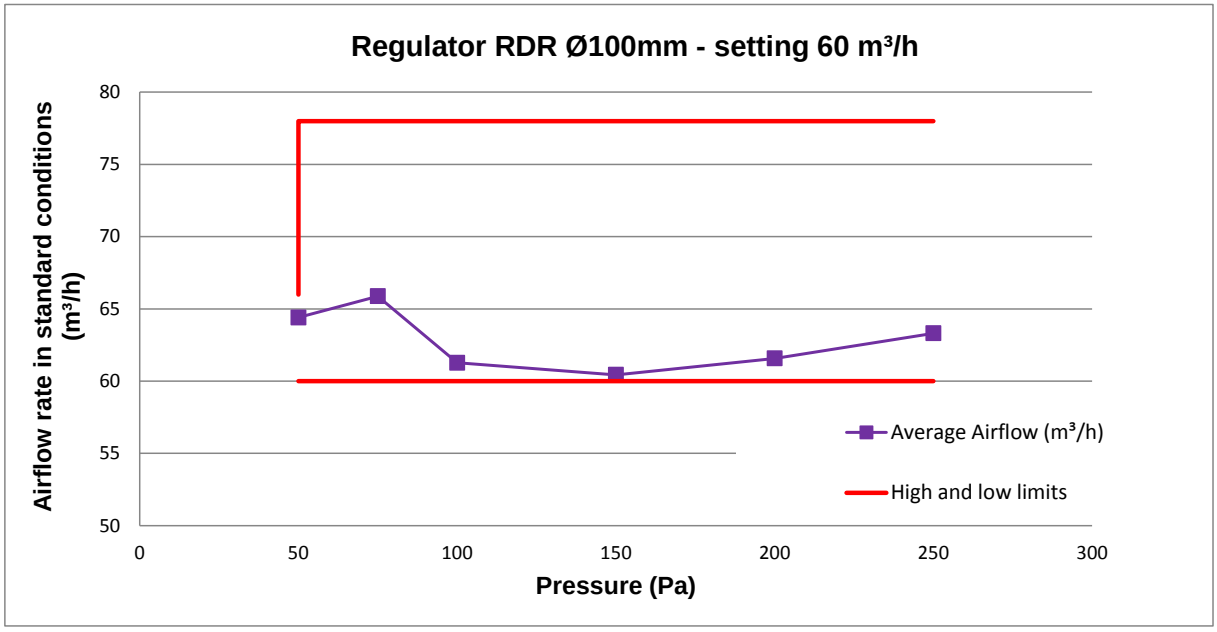
RDR Ø100 - Airflow 50 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	54.9
75	57.0
100	54.5
150	52.0
200	50.5
250	51.1

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	54.7
	75	60.6
	100	57.2
	150	54.5
	200	51.4
	250	51.4
Decrease	250	50.8
	200	49.5
	150	49.5
	100	51.7
	75	53.5
	50	55.1

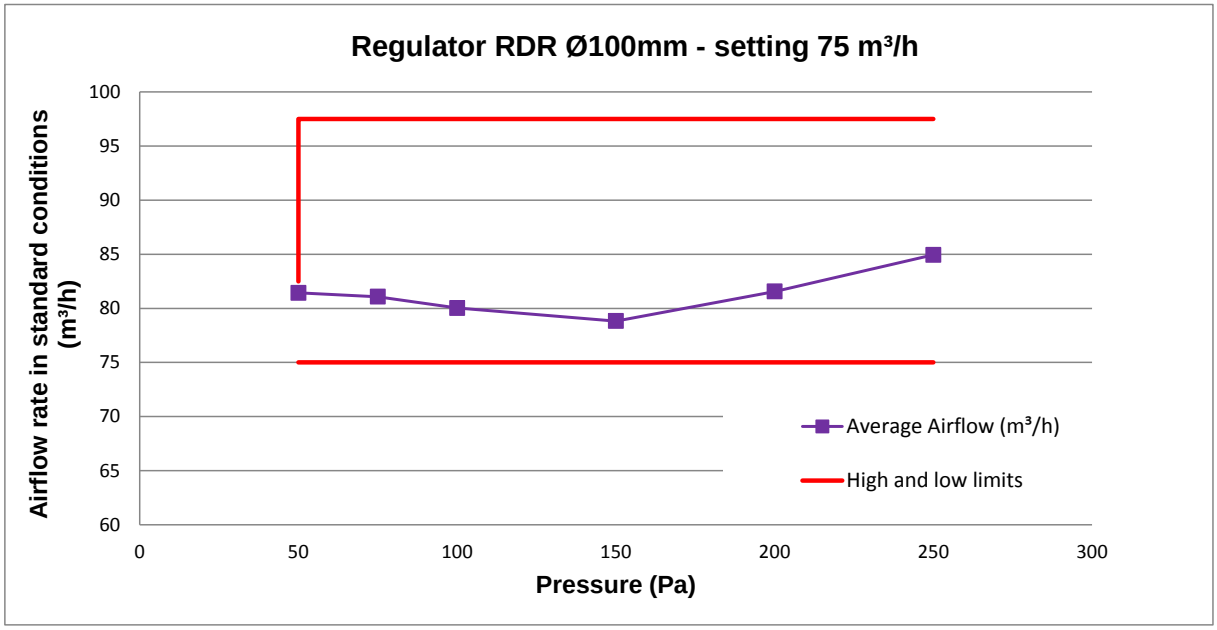
RDR Ø100 - Airflow 60 m³/h



Static pressure difference (Pa)	Average airflow rate in standard conditions (m³/h)
50	64.4
75	65.9
100	61.3
150	60.4
200	61.6
250	63.3

	Static pressure difference (Pa)	Airflow rate in standard conditions (m³/h)
Increase	50	64.4
	75	70.2
	100	61.7
	150	62.0
	200	62.6
	250	63.7
Decrease	250	63.0
	200	60.6
	150	58.9
	100	60.8
	75	61.5
	50	64.4

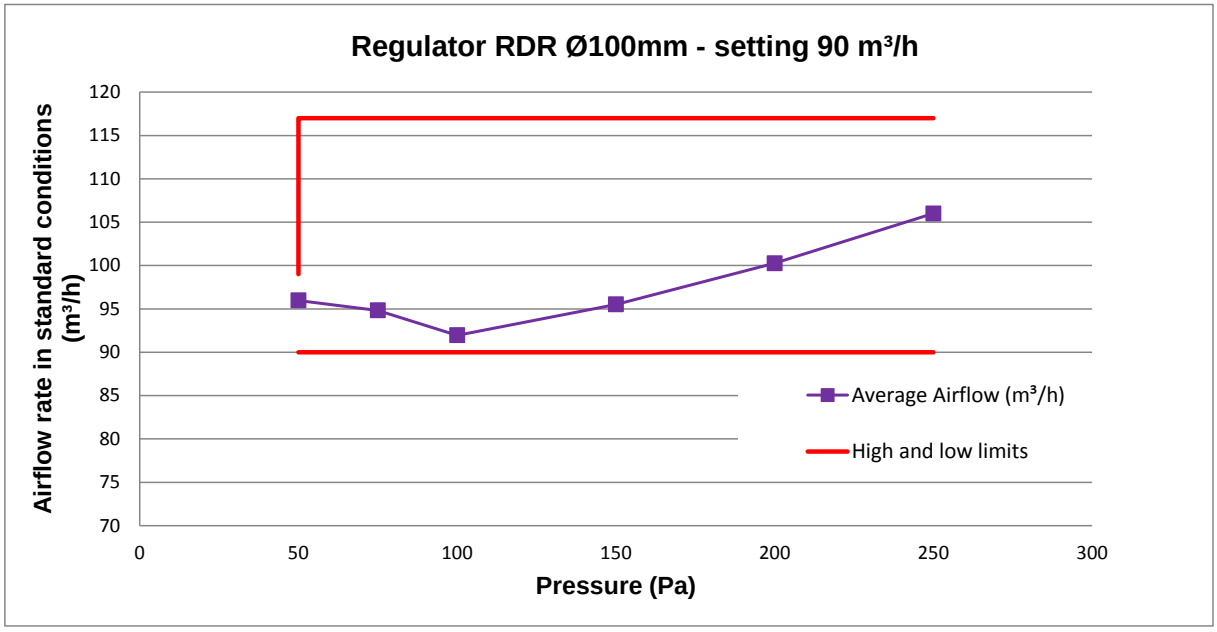
RDR Ø100 - Airflow 75 m³/h



Static pressure difference (Pa)	Average airflow rate in standard conditions (m³/h)
50	81.4
75	81.1
100	80.0
150	78.8
200	81.6
250	84.9

	Static pressure difference (Pa)	Airflow rate in standard conditions (m³/h)
Increase	50	82.6
	75	83.6
	100	82.7
	150	79.9
	200	82.3
	250	85.2
Decrease	250	84.7
	200	80.9
	150	77.7
	100	77.4
	75	78.6
	50	80.3

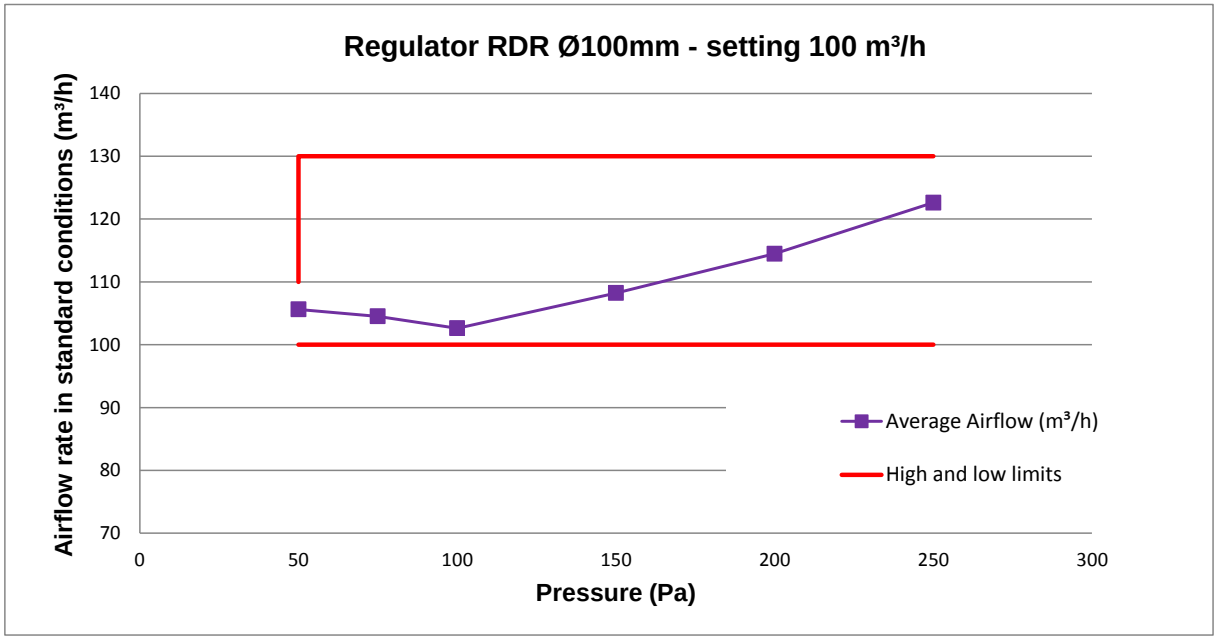
RDR Ø100 - Airflow 90 m³/h



Static pressure difference (Pa)	Average airflow rate in standard conditions (m³/h)
50	96.0
75	94.8
100	91.9
150	95.5
200	100.3
250	106.0

	Static pressure difference (Pa)	Airflow rate in standard conditions (m³/h)
Increase	50	98.3
	75	98.3
	100	94.2
	150	97.1
	200	101.5
	250	106.4
Decrease	250	105.6
	200	99.0
	150	94.0
	100	89.7
	75	91.4
	50	93.6

RDR Ø100 - Airflow 100 m³/h

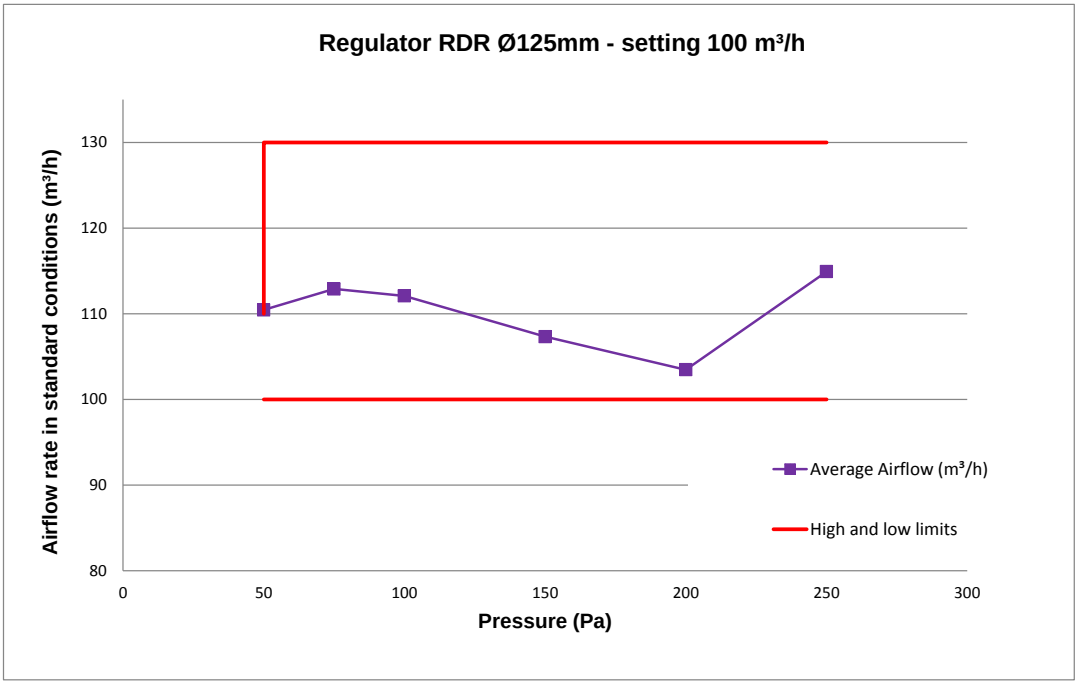


Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	105.6
75	104.5
100	102.6
150	108.2
200	114.5
250	122.6

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	109.2
	75	108.5
	100	105.1
	150	109.8
	200	115.1
	250	122.5
Decrease	250	122.7
	200	113.8
	150	106.7
	100	100.2
	75	100.5
	50	102.0

5. RESULTS RDR Ø125

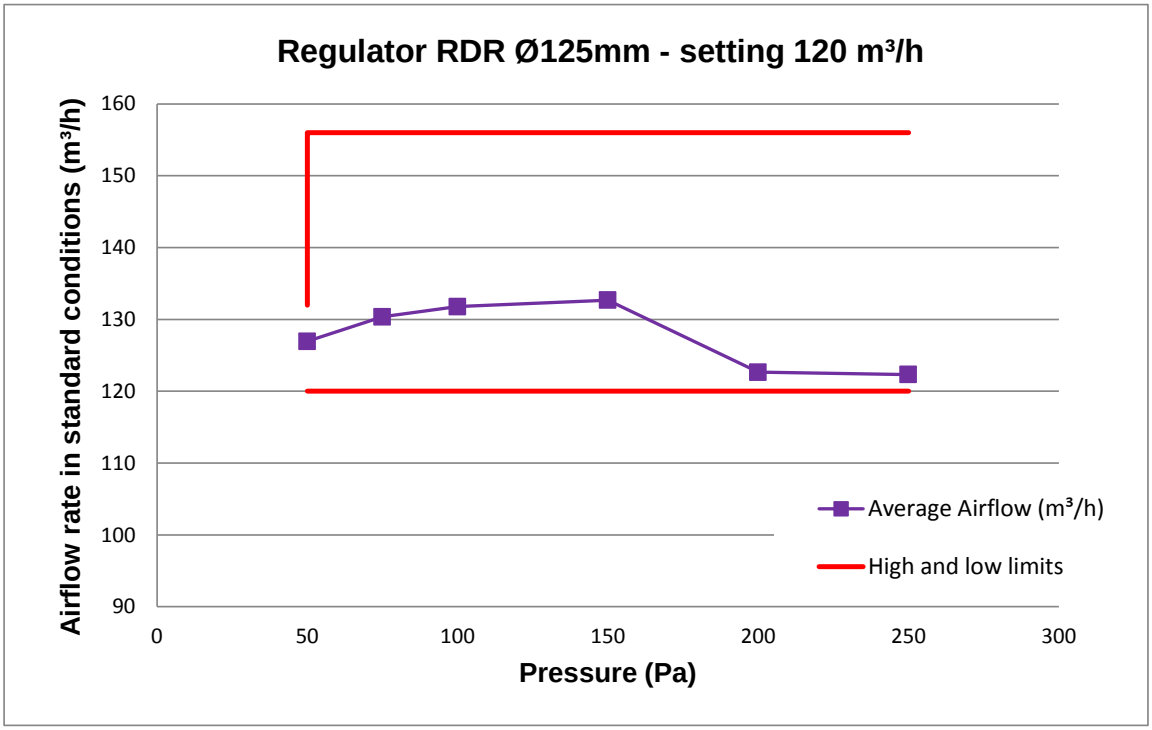
RDR Ø125 - Airflow 100 m³/h



Static pressure difference (Pa)	Average airflow rate in standard conditions (m³/h)
50	110.4
75	112.9
100	112.1
150	107.3
200	103.5
250	114.9

	Static pressure difference (Pa)	Airflow rate in standard conditions (m³/h)
Increase	50	111.7
	75	115.3
	100	114.5
	150	110.4
	200	103.2
	250	114.2
Decrease	250	115.6
	200	103.7
	150	104.2
	100	109.7
	75	110.5
	50	109.2

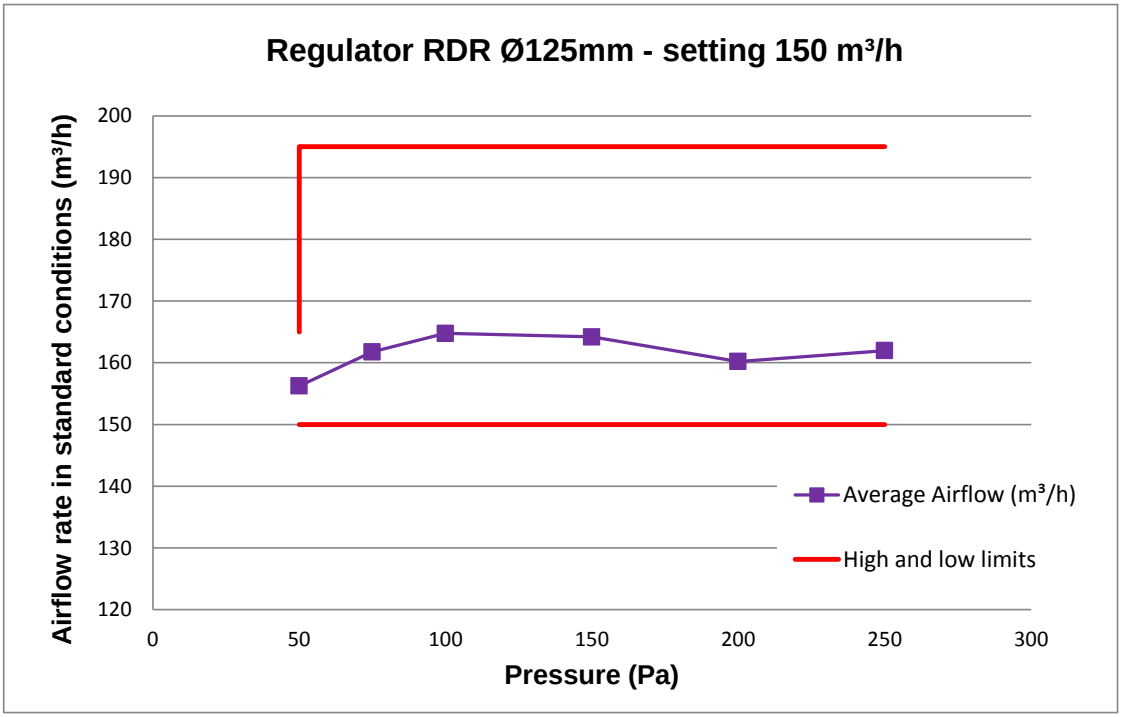
RDR Ø125 - Airflow 120 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	127.0
75	130.4
100	131.8
150	132.7
200	122.7
250	122.3

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	127.8
	75	132.4
	100	134.2
	150	134.1
	200	126.1
	250	123.2
Decrease	250	121.4
	200	119.2
	150	131.3
	100	129.3
	75	128.4
	50	126.1

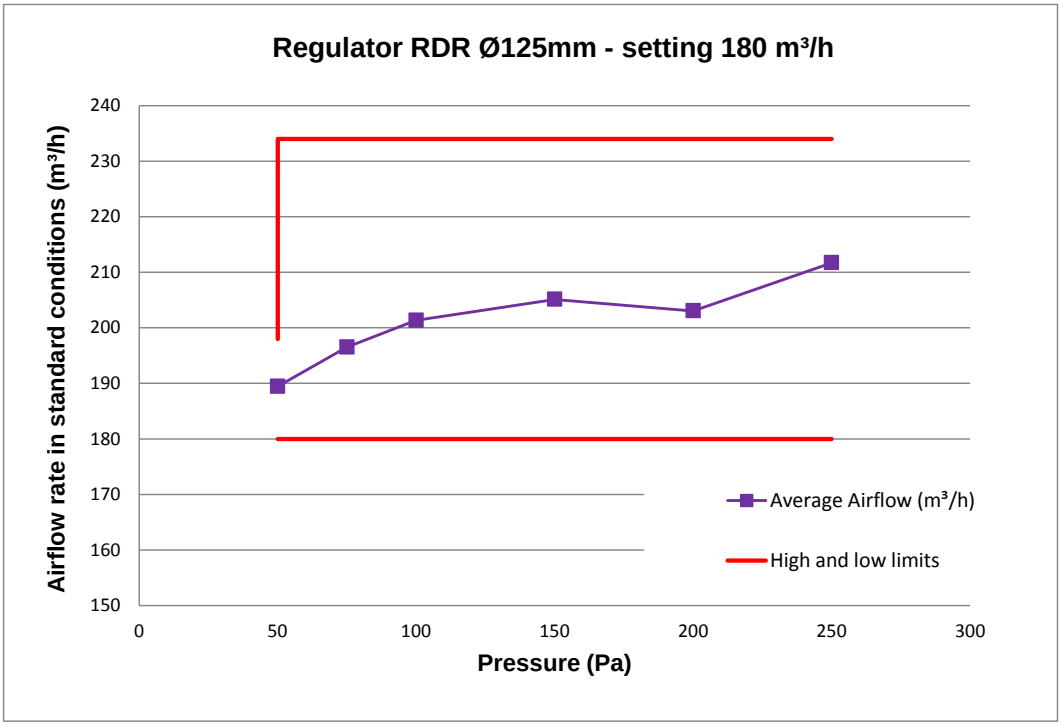
RDR Ø125 - Airflow 150 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	156.3
75	161.8
100	164.8
150	164.2
200	160.2
250	162.0

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	158.3
	75	164.0
	100	167.7
	150	168.5
	200	163.8
	250	163.2
Decrease	250	160.7
	200	156.6
	150	159.8
	100	161.8
	75	159.5
	50	154.2

RDR Ø125 - Airflow 180 m³/h

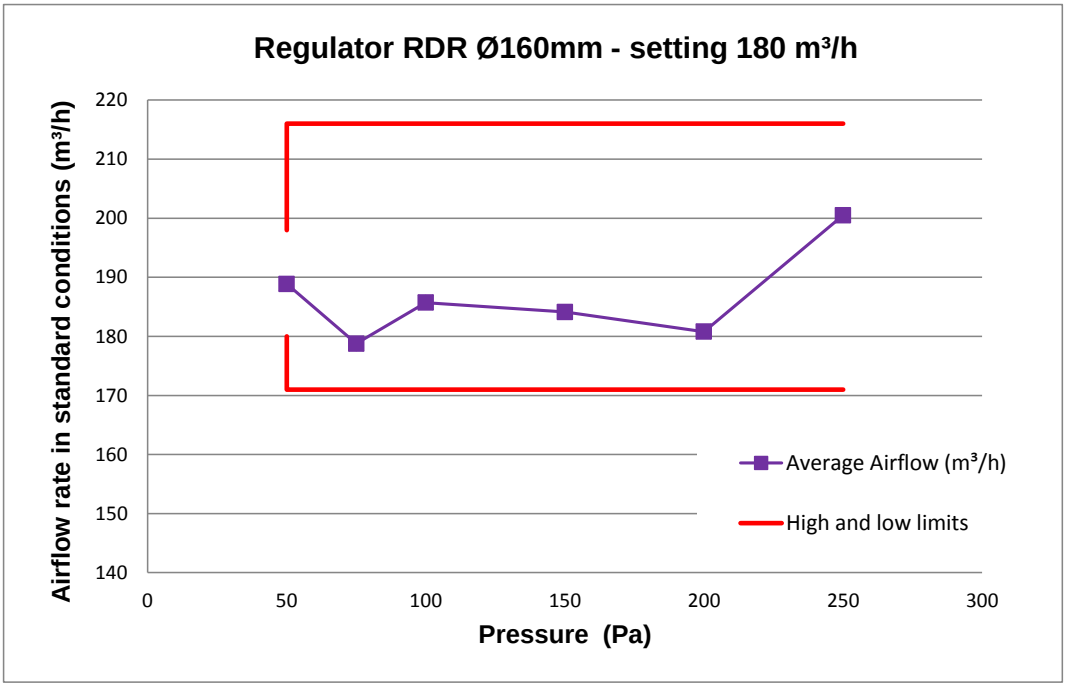


Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	189.4
75	196.5
100	201.3
150	205.1
200	203.0
250	211.7

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	191.3
	75	198.8
	100	204.4
	150	208.8
	200	206.9
	250	211.4
Decrease	250	212.0
	200	199.1
	150	201.4
	100	198.3
	75	194.2
	50	187.6

6. RESULTS RDR Ø160

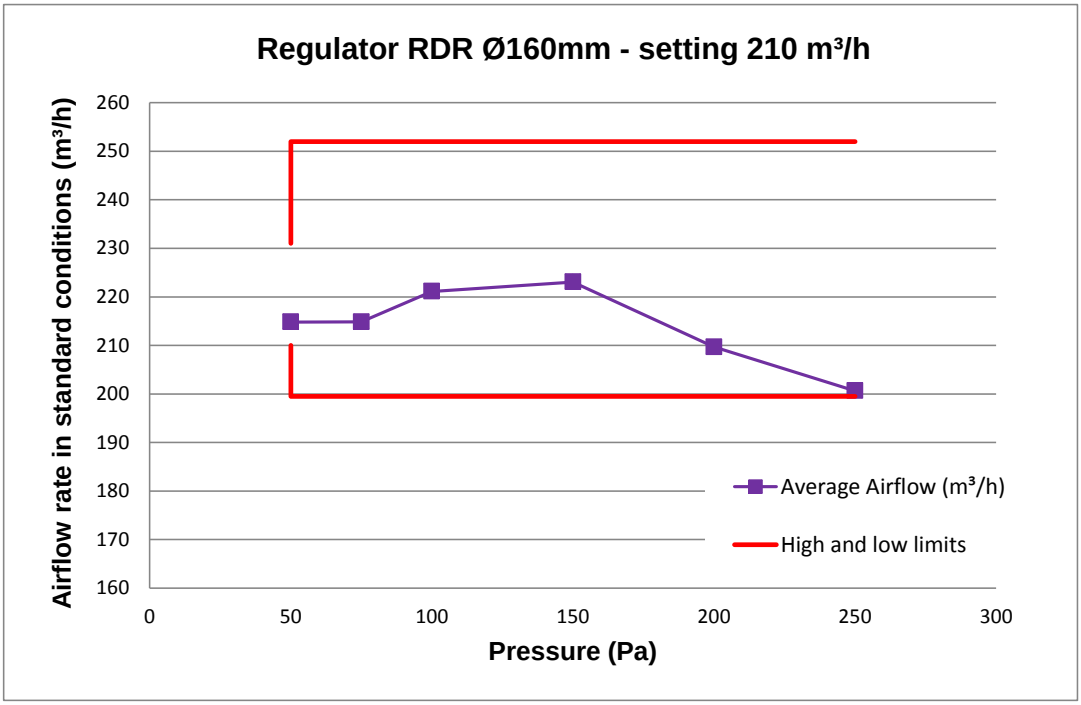
RDR Ø160 - Airflow 180 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	188.9
75	178.8
100	185.7
150	184.1
200	180.8
250	200.5

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	199.8
	75	182.5
	100	192.5
	150	189.5
	200	181.3
	250	200.7
Decrease	250	200.3
	200	180.3
	150	178.7
	100	179.0
	75	175.1
	50	177.9

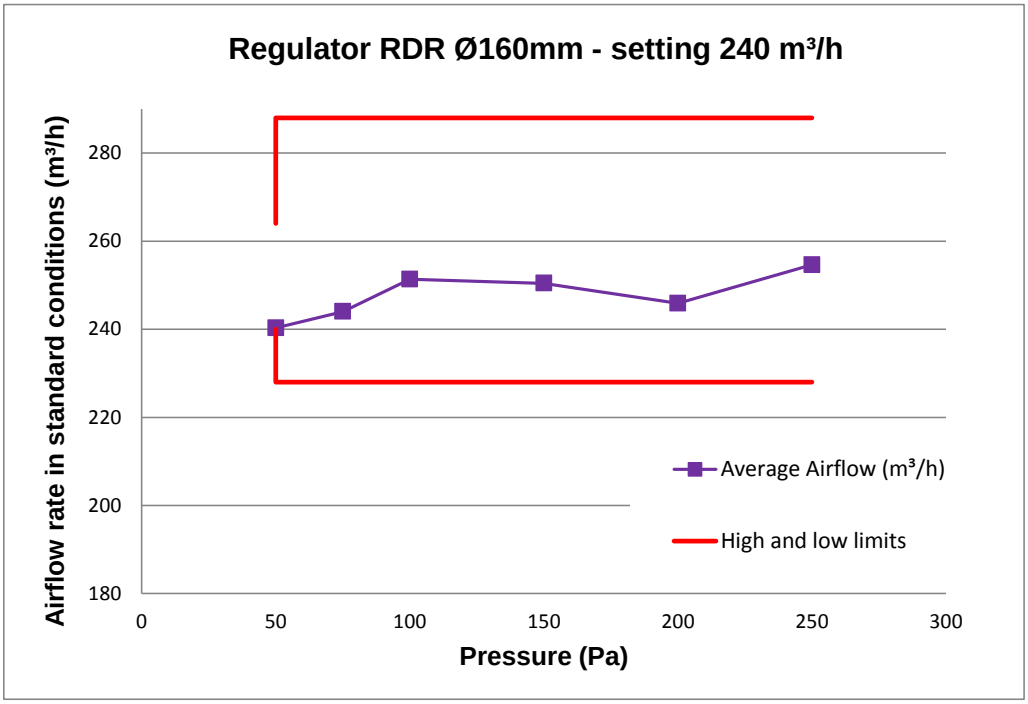
RDR Ø160 - Airflow 210 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	214.8
75	214.9
100	221.1
150	223.1
200	209.7
250	200.6

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	225.0
	75	222.8
	100	227.6
	150	230.1
	200	226.3
	250	200.7
Decrease	250	200.5
	200	193.0
	150	216.0
	100	214.7
	75	206.9
	50	204.6

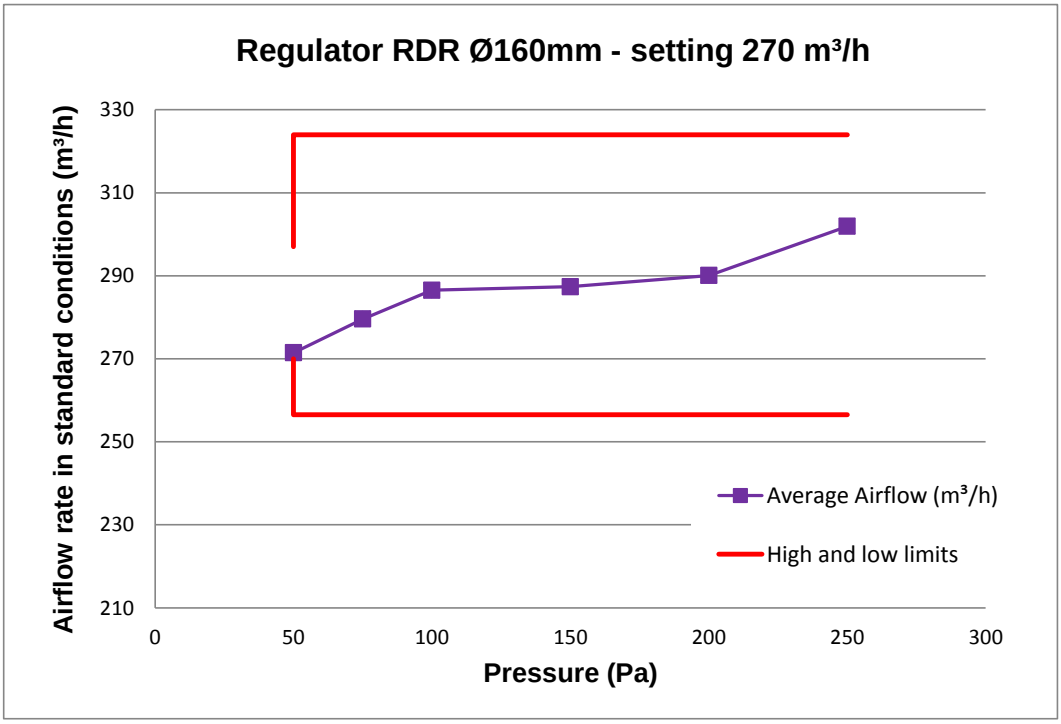
RDR Ø160 - Airflow 240 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	240.3
75	244.0
100	251.3
150	250.4
200	245.9
250	254.6

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	246.5
	75	251.5
	100	258.4
	150	263.7
	200	259.1
	250	256.6
Decrease	250	252.7
	200	232.6
	150	237.2
	100	244.3
	75	236.5
	50	234.0

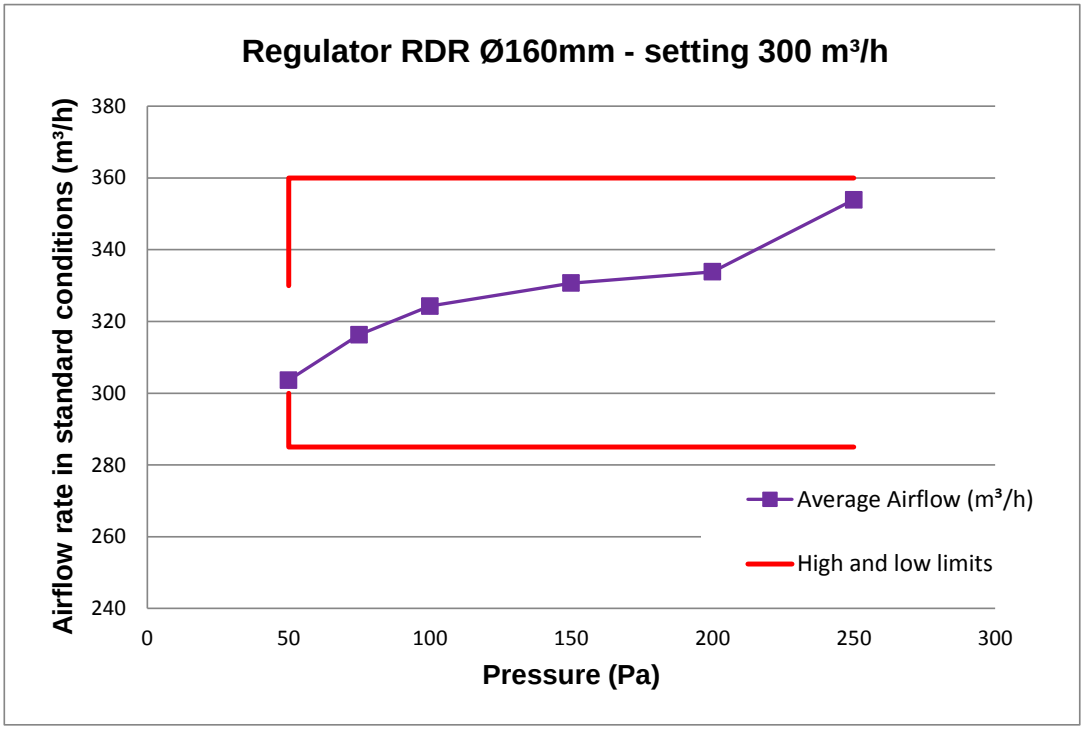
RDR Ø160 - Airflow 270 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	271.4
75	279.6
100	286.5
150	287.4
200	290.1
250	301.9

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	285.0
	75	288.7
	100	296.2
	150	299.6
	200	303.5
	250	302.4
Decrease	250	301.4
	200	276.7
	150	275.1
	100	276.8
	75	270.5
	50	257.8

RDR Ø160 - Airflow 300 m³/h



Static pressure difference (Pa)	*Average airflow rate in standard conditions (m³/h)*
50	303.6
75	316.3
100	324.3
150	330.7
200	333.8
250	353.9

	Static pressure difference (Pa)	*Airflow rate in standard conditions (m³/h)*
Increase	50	312.7
	75	322.6
	100	332.5
	150	345.3
	200	345.9
	250	354.5
Decrease	250	353.3
	200	321.8
	150	316.1
	100	316.1
	75	309.9
	50	294.5

APPENDIX 1 - TESTED PRODUCTS

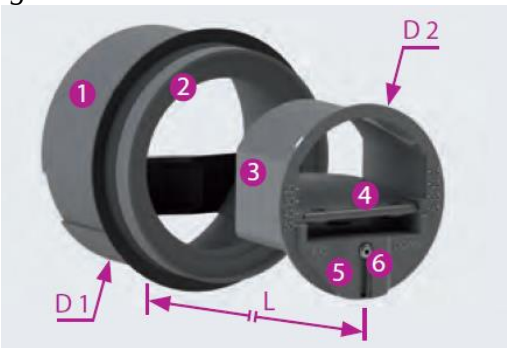
The products tested are adjustable flow regulators, installed in duct, named RDR. They work for pressure between 50 and 250 Pa.

Four products are tested:

- RDR Ø80: regulator diameter 80 mm
- RDR Ø100: regulator diameter 100 mm
- RDR Ø125: regulator diameter 125 mm
- RDR Ø160: regulator diameter 160 mm

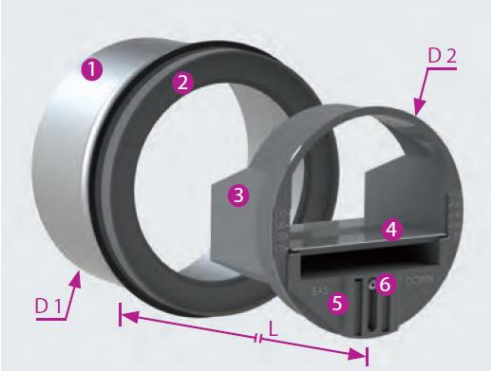
Each regulator has several settings of airflow.

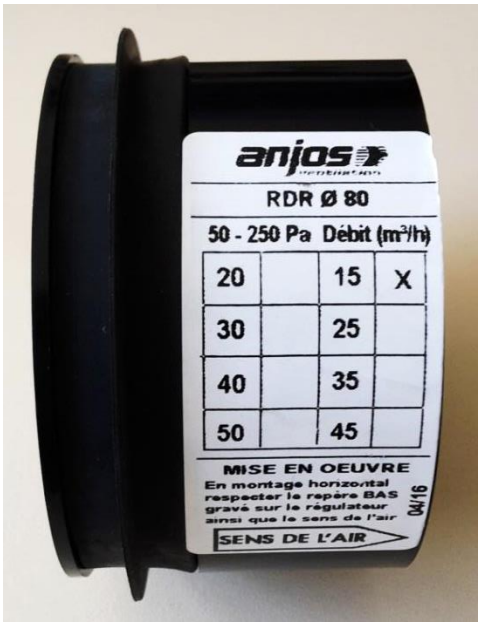
Regulators RDR Ø80 and Ø100:



1 Manchette avec joint d'étanchéité
2 Entretoise (selon débit)
3 Corps
4 Elément régulateur
5 Module de réglage du débit
6 Vis de blocage du module de réglage

Regulators RDR Ø125 and Ø160:





RDR Ø80

RDR Ø100

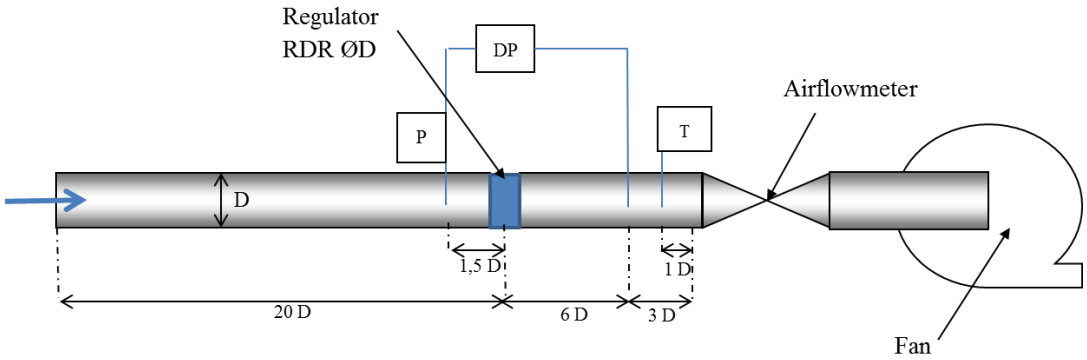
RDR Ø125

RDR Ø160

APPENDIX 2 - DESCRIPTION OF THE TESTS

According to ANJOS Ventilation's request, the tests are done according to the draft standard under fomal vote pr NF E 51-776-1 *" Ventilation des bâtiments - Appareils de régulation de débit d'air en conduits – Partie 1 : Essais".*

The tests are done in extraction configuration.
The test facility is the following:



We measure:

- The static pressure difference
- The pressure before the regulator
- The volumetric airflow
- The air temperature in the duct
- The ambient humidity
- The atmospheric pressure

All the measurements are corrected according to the calibration certificates.

The test facility ducts are airtighted and the leakages are controlled and limited as much as possible.

Before each test, the airflow is set on the product according to the ANJOS Ventilation guidelines.

The difference of pressure is set thanks to the fan. The levels of pressure difference set are: 50 Pa – 75 Pa – 100 Pa – 150 Pa – 200 Pa – 250 Pa. The tests are done in increasing pressure and in decreasing pressure.
The airflow is measured for each level of pressure.
Before measuring the values, a time of stabilization is respected.

The tests are done for each diameter and for the settings underlined in pink in the tables:

RDR	Marquage débit en m³/h
Ø 80	15
	20
	25
	30
	35
	40
	45
	50
Ø 100	50
	60
	70
	75
	80
	90
	100
Ø 125	100
	110
	120
	130
	140
	150
	160
	170
	180

RDR	Marquage débit en m³/h
Ø 160	180
	190
	200
	210
	220
	230
	240
	250
	260
	270
	280
	290
	300

Débits testés

The measured airflows are corrected in order to be given in the standard conditions:
The following formula is used:

$$Qv_{standard\_conditons} = Qv_{measured} \times \left(\frac{293.15}{273.15+T}\right)^{1-n} \times \left(\frac{Pa}{101325}\right)^{1-n} \times \left(\frac{(17.1+0.048\times T)\times 10^{-6}}{18.06\times 10^{-6}}\right)^{2n-1}$$

Formula equivalent to the formula:

$$Qv_{standard\_conditions} = Qv_{measured} \times \left(\frac{1.204}{Rho_{test}}\right)^{n-1} \times \left(\frac{(17.1+0.048\times T)\times 10^{-6}}{18.06\times 10^{-6}}\right)^{2n-1}$$

Rho_{test}: air density during test

n: coefficient equal to 0.5

The used formula is the formula validated by the European experts and will be implemented in the standards of the working groups WG2 and WG4, like the standard EN 13141-1. The draft standard under formal vote pr NF E 51-776-1 refers to the standard EN 13141-1.

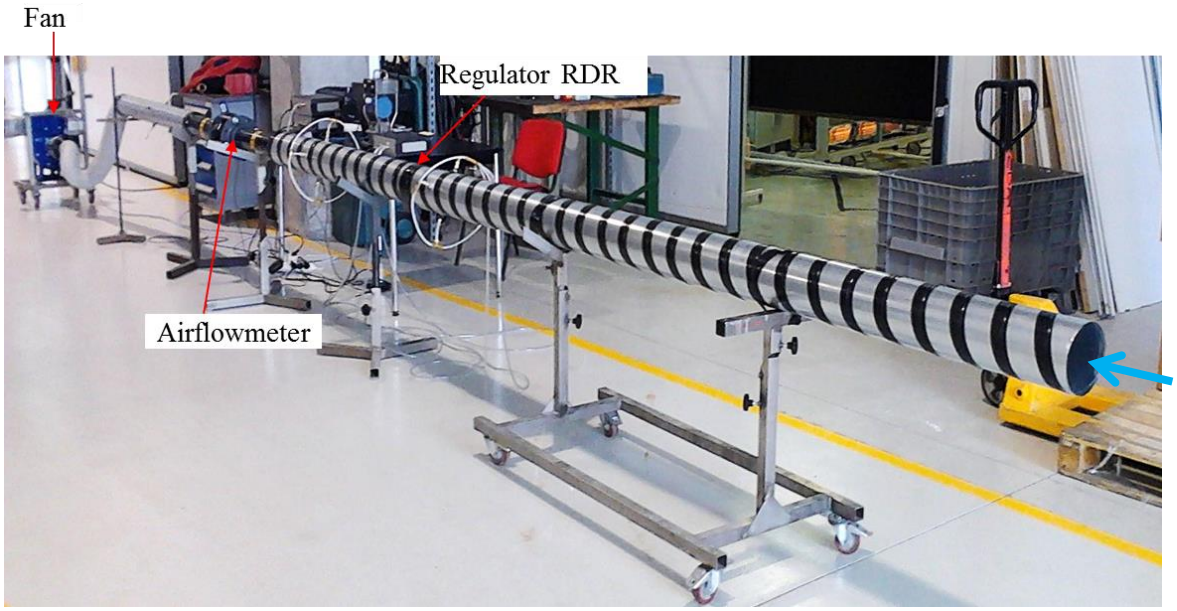
The average airflow is calculated at each pressure by doing the average of airflow in increasing pressure and airflow in decreasing pressure.

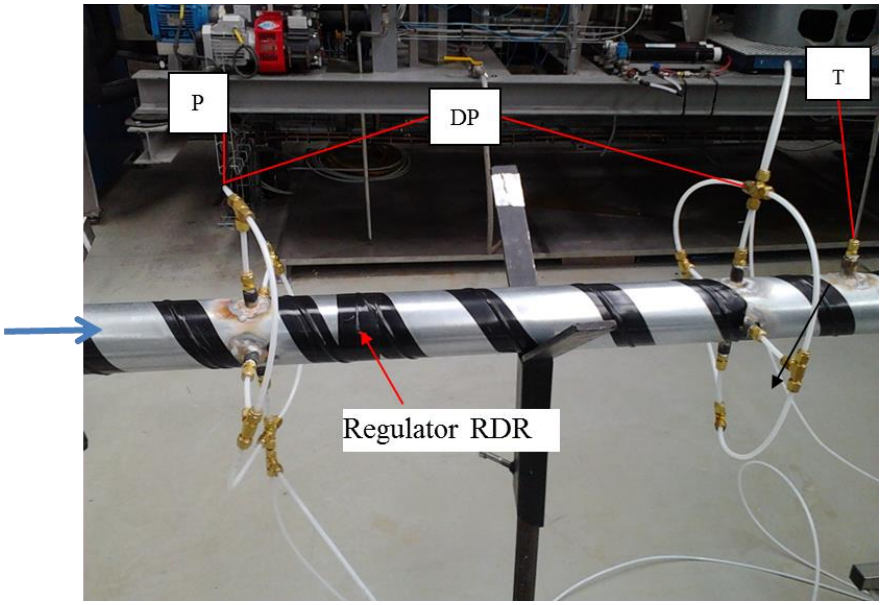
The airflow values are compared to the high and low limits fixed by the draft standard under formal vote, pr NF E 51-776-2:

Diamètre de raccordement de l'appareil de régulation de débit d'air passif ou actif	Exigences de valeur du débit volumique	
	sur toute la plage de fonctionnement	à p_{min}
inférieur ou égal à 125 mm	$q_{nominal} \leq q_{vmesuré} \leq q_{nominal}$ x 1,3	$q_{nominal} \leq q_{vmesuré} \leq q_{nominal}$ x 1,1
supérieur à 125 mm	$q_{nominal}$ x 0,95 $\leq q_{vmesuré} \leq q_{nominal}$ x 1,2	$q_{nominal} \leq q_{vmesuré} \leq q_{nominal}$ x 1,1

During some tests, the pressure is difficult to stabilize to the wanted level. In the cases, measurements are done of the 2 pressures surrounding the wanted value. A linear interpolation is done to obtain the airflow at the wanted pressure.
All measurements are in Appendixes.

During the tests, the air temperature is between 15 and 25°C and do not vary more than 2°C.

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Regulator RDR

APPENDIX 3 - DETAILED RESULTS RDR Ø80

Regulator RDR Ø80mm - setting 15 m³/h

	Atmospheric Pressure (Pa)	Temperature in duct (°C)	Dew point temperature (°C)	Density (kg/m³)	Pressure before Regulator (Pa)	**Static pressure difference (Pa)**	Airflow rate (m³/h)	**Airflow rate in standard conditions (m³/h)**
Increase	99562	23.1	1.0	1.17	1	**50**	16.1	**15.8**
	99526	22.8	0.6	1.17	2	**75**	19.8	**19.6**
	99514	22.8	0.6	1.17	2	**103**	17.2	**16.9**
	99496	22.8	0.6	1.17	1	**151**	17.0	**16.8**
	99480	22.8	0.7	1.17	1	**202**	15.9	**15.7**
	99471	22.7	1.0	1.17	1	**250**	16.2	**15.9**
Decrease	99463	22.6	0.7	1.17	1	**251**	16.2	**15.9**
	99457	22.5	0.8	1.17	1	**201**	16.0	**15.7**
	99446	22.5	0.8	1.17	1	**149**	17.2	**16.9**
	99440	22.4	0.9	1.17	2	**105**	17.2	**16.9**
	99435	22.3	0.2	1.17	1	**75**	18.2	**17.9**
	99424	22.2	0.6	1.17	1	**50**	16.0	**15.8**

Regulator RDR Ø80mm - setting 30 m³/h

	Atmospheric Pressure (Pa)	Temperature in duct (°C)	Dew point temperature (°C)	Density (kg/m³)	Pressure before Regulator (Pa)	**Static pressure difference (Pa)**	Airflow rate (m³/h)	**Airflow rate in standard conditions (m³/h)**
Increase	98976	20.5	2.9	1.17	4	**50**	30.8	**30.4**
	98966	20.6	3.0	1.17	5	**75**	36.4	**35.9**
	98968	20.8	3.1	1.17	5	**100**	35.4	**34.9**
	98974	20.8	3.1	1.17	4	**149**	32.2	**31.7**
	98968	20.8	3.1	1.17	11	**200**	33.4	**32.9**
	98966	20.8	3.2	1.17	13	**250**	37.3	**36.8**
Decrease	98958	21.2	3.4	1.17	13	**252**	37.3	**36.7**
	98961	21.2	3.6	1.17	11	**202**	33.9	**33.4**
	98965	21.2	3.6	1.17	9	**151**	33.0	**32.5**
	98961	21.2	3.8	1.17	4	**100**	32.1	**31.7**
	98962	21.2	3.9	1.17	4	**75**	31.0	**30.5**
	98958	21.2	4.0	1.17	3	**51**	30.5	**30.0**

Regulator RDR Ø80mm - setting 45 m³/h

	Atmospheric Pressure (Pa)	Temperature in duct (°C)	Dew point temperature (°C)	Density (kg/m³)	Pressure before Regulator (Pa)	**Static pressure difference (Pa)**	Airflow rate (m³/h)	**Airflow rate in standard conditions (m³/h)**
Increase	98960	21.6	4.2	1.17	9	**50**	47.3	**46.5**
	98957	21.6	4.3	1.17	11	**77**	54.5	**53.6**
	98942	21.5	4.4	1.17	11	**103**	53.1	**52.2**
	98933	21.6	4.4	1.17	10	**149**	50.7	**49.9**
	98928	21.6	4.4	1.17	10	**200**	51.6	**50.8**
	98931	21.7	4.6	1.17	11	**250**	53.5	**52.6**
Decrease	98917	21.7	4.3	1.17	11	**249**	53.3	**52.5**
	98905	21.8	4.3	1.16	10	**199**	51.5	**50.7**
	98898	21.9	4.3	1.16	10	**151**	50.7	**49.8**
	98900	22.0	4.3	1.16	9	**100**	49.1	**48.3**
	98887	22.0	4.3	1.16	9	**75**	48.0	**47.2**
	98882	22.0	4.1	1.16	8	**49**	46.7	**45.9**

Regulator RDR Ø80mm - setting 50 m³/h

	Atmospheric Pressure (Pa)	Temperature in duct (°C)	Dew point temperature (°C)	Density (kg/m³)	Pressure before Regulator (Pa)	**Static pressure difference (Pa)**	Airflow rate (m³/h)	**Airflow rate in standard conditions (m³/h)**
Increase	98869	22.0	4.1	1.16	11	**50**	54.9	**54.0**
	98857	22.1	4.2	1.16	15	**76**	63.1	**62.0**
	98847	22.2	4.2	1.16	12	**102**	57.2	**56.2**
	98846	22.6	4.2	1.16	13	**154**	58.4	**57.4**
	98840	22.4	4.2	1.16	14	**200**	60.3	**59.2**
	98838	22.4	4.3	1.16	15	**250**	63.7	**62.6**
Decrease	98843	22.2	4.5	1.16	15	**249**	63.6	**62.5**
	98861	22.3	4.2	1.16	14	**201**	60.2	**59.2**
	98886	22.3	4.4	1.16	13	**151**	58.5	**57.5**
	98883	22.2	4.4	1.16	12	**99**	56.1	**55.2**
	98893	22.1	4.6	1.16	11	**74**	55.2	**54.2**
	98890	22.0	5.0	1.16	11	**49**	53.4	**52.5**

APPENDIX 4 - DETAILED RESULTS RDR Ø100

Regulator RDR Ø100mm - setting 50 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	100050	21.3	9.5	1.18	3	**50**	55.3	**54.7**
	100046	21.3	9.5	1.18	5	**77**	61.2	**60.6**
	100049	21.4	9.5	1.18	4	**99**	57.8	**57.2**
	100049	21.6	9.7	1.18	3	**150**	55.1	**54.5**
	100049	21.8	9.5	1.18	3	**201**	52.0	**51.4**
	100045	22.0	9.1	1.18	3	**250**	52.0	**51.4**
Decrease	100040	22.2	9.2	1.18	2	**250**	51.4	**50.8**
	100040	22.3	9.3	1.17	2	**200**	50.1	**49.5**
	100044	22.4	9.2	1.17	2	**150**	50.1	**49.5**
	100032	22.5	9.1	1.17	2	**100**	52.4	**51.7**
	100026	22.7	9.1	1.17	3	**75**	54.2	**53.5**
	100013	22.8	8.9	1.17	3	**50**	55.8	**55.1**

Regulator RDR Ø100mm - setting 60 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	99791	24.4	7.5	1.16	4	**49**	65.5	**64.4**
	99795	24.4	7.5	1.16	5	**76**	71.4	**70.2**
	99791	24.4	7.5	1.16	3	**101**	62.7	**61.7**
	99787	24.5	7.6	1.16	3	**149**	63.0	**62.0**
	99782	24.6	7.6	1.16	3	**199**	63.7	**62.6**
	99780	24.6	7.6	1.16	4	**249**	64.8	**63.7**
Decrease	99774	24.6	7.7	1.16	4	**250**	64.0	**63.0**
	99774	24.5	7.8	1.16	3	**200**	61.6	**60.6**
	99771	24.5	7.8	1.16	3	**151**	59.9	**58.9**
	99765	24.5	7.9	1.16	3	**98**	61.9	**60.8**
	99772	24.6	7.8	1.16	3	**74**	62.6	**61.5**
	99778	24.6	7.8	1.16	4	**50**	65.5	**64.4**

Regulator RDR Ø100mm - setting 75 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	99867	21.3	11.1	1.18	9	**50**	83.5	**82.6**
	99862	21.1	11.1	1.18	10	**76**	84.5	**83.6**
	99860	21.1	11.1	1.18	9	**100**	83.7	**82.7**
	99856	21.1	11.2	1.18	9	**149**	80.8	**79.9**
	99849	21.0	11.2	1.18	9	**199**	83.2	**82.3**
	99841	21.0	11.2	1.18	10	**249**	86.2	**85.2**
Decrease	99829	21.0	11.2	1.18	10	**251**	85.7	**84.7**
	99830	21.0	11.2	1.18	9	**201**	81.8	**80.9**
	99827	21.1	11.3	1.18	8	**149**	78.6	**77.7**
	99827	21.1	11.3	1.18	8	**99**	78.3	**77.4**
	99817	21.2	11.3	1.18	8	**73**	79.5	**78.6**
	99810	21.3	11.3	1.18	9	**49**	81.2	**80.3**

Regulator RDR Ø100mm - setting 90 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	99788	21.5	11.4	1.17	14	**50**	99.6	**98.3**
	99789	21.7	11.4	1.17	14	**76**	99.5	**98.3**
	99783	21.8	11.5	1.17	13	**101**	95.4	**94.2**
	99767	21.9	11.5	1.17	14	**150**	98.4	**97.1**
	99751	22.1	11.6	1.17	15	**201**	102.9	**101.5**
	99742	22.2	11.6	1.17	17	**250**	107.9	**106.4**
Decrease	99725	22.4	11.6	1.17	17	**250**	107.2	**105.6**
	99719	22.6	11.6	1.17	14	**201**	100.5	**99.0**
	99704	22.8	11.7	1.17	13	**151**	95.4	**94.0**
	99693	22.9	11.7	1.17	11	**98**	91.1	**89.7**
	99683	23.0	11.7	1.17	12	**72**	92.8	**91.4**
	99677	23.1	11.7	1.17	12	**49**	95.1	**93.6**

Regulator RDR Ø100mm - setting 100 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	99645	23.4	11.8	1.16	17	**49**	111.0	**109.2**
	99630	23.5	11.7	1.16	17	**77**	110.3	**108.5**
	99617	23.4	11.7	1.16	16	**101**	106.8	**105.1**
	99610	23.4	11.6	1.16	17	**149**	111.6	**109.8**
	99601	23.5	11.6	1.16	19	**201**	117.1	**115.1**
	99592	23.5	11.6	1.16	22	**249**	124.6	**122.5**
Decrease	99584	23.3	11.4	1.16	22	**251**	124.8	**122.7**
	99574	23.4	11.3	1.16	19	**200**	115.8	**113.8**
	99559	23.4	11.2	1.16	16	**148**	108.5	**106.7**
	99548	23.4	11.1	1.16	14	**99**	101.9	**100.2**
	99534	23.4	10.9	1.16	14	**74**	102.3	**100.5**
	99520	23.5	10.9	1.16	14	**47**	103.8	**102.0**

APPENDIX 5 - DETAILED RESULTS RDR Ø125

Regulator RDR Ø125mm - setting 100 m³/h

	Atmospheric Pressure (Pa)	Temperature in duct (°C)	Dew point temperature (°C)	Density (kg/m³)	Pressure before Regulator (Pa)	**Static pressure difference (Pa)**	Airflow rate (m³/h)	**Airflow rate in standard conditions (m³/h)**
Increase	99410	21.3	5.2	1.17	9	**51**	113.2	**111.7**
	99412	21.1	5.1	1.17	9	**76**	116.8	**115.3**
	99417	21.0	4.8	1.17	9	**102**	116.0	**114.5**
	99420	20.9	4.8	1.17	8	**157**	111.8	**110.4**
	99425	21.3	5.0	1.17	7	**198**	104.6	**103.2**
	99432	21.8	5.3	1.17	9	**246**	115.8	**114.2**
Decrease	99438	21.9	5.1	1.17	9	**252**	117.3	**115.6**
	99434	21.9	4.9	1.17	7	**202**	105.2	**103.7**
	99435	21.9	4.7	1.17	7	**149**	105.7	**104.2**
	99446	21.6	4.1	1.17	8	**103**	111.1	**109.7**
	99448	21.5	4.4	1.17	8	**76**	112.0	**110.5**
	99449	21.4	3.9	1.17	8	**48**	110.7	**109.2**

Regulator RDR Ø125mm - setting 120 m³/h

	Atmospheric Pressure (Pa)	Temperature in duct (°C)	Dew point temperature (°C)	Density (kg/m³)	Pressure before Regulator (Pa)	**Static pressure difference (Pa)**	Airflow rate (m³/h)	**Airflow rate in standard conditions (m³/h)**
Increase	99471	21.1	3.1	1.17	11	**50**	129.4	**127.8**
	99475	21.1	3.1	1.17	2	**75**	134.0	**132.4**
	99479	21.0	3.1	1.17	13	**100**	135.9	**134.2**
	99481	20.9	3.1	1.18	12	**154**	135.7	**134.1**
	99479	20.8	4.0	1.18	11	**203**	127.6	**126.1**
	99479	20.7	4.8	1.18	10	**249**	124.7	**123.2**
Decrease	99485	21.5	4.7	1.17	10	**251**	123.0	**121.4**
	99486	21.4	4.4	1.17	9	**198**	120.7	**119.2**
	99484	21.3	4.2	1.17	12	**149**	133.0	**131.3**
	99485	21.3	4.0	1.17	11	**100**	131.0	**129.3**
	99482	21.3	4.4	1.17	11	**75**	130.0	**128.4**
	99480	21.3	4.6	1.17	11	**47**	127.8	**126.1**

Regulator RDR Ø125mm - setting 150 m³/h

	Atmospheric Pressure (Pa)	Temperature in duct (°C)	Dew point temperature (°C)	Density (kg/m³)	Pressure before Regulator (Pa)	**Static pressure difference (Pa)**	Airflow rate (m³/h)	**Airflow rate in standard conditions (m³/h)**
Increase	99420	22.5	2.5	1.17	16	**50**	160.7	**158.3**
	99420	22.4	2.2	1.17	18	**75**	166.5	**164.0**
	99423	22.3	2.0	1.17	18	**101**	170.2	**167.7**
	99418	22.3	1.8	1.17	19	**151**	171.0	**168.5**
	99414	22.4	2.1	1.17	17	**203**	166.2	**163.8**
	99413	22.1	2.2	1.17	17	**251**	165.6	**163.2**
Decrease	99406	22.2	1.2	1.17	17	**250**	163.0	**160.7**
	99396	22.4	1.3	1.17	16	**197**	159.0	**156.6**
	99382	22.4	1.4	1.17	16	**144**	162.2	**159.8**
	99380	22.4	1.2	1.17	17	**102**	164.3	**161.8**
	99382	22.3	1.3	1.17	16	**76**	161.9	**159.5**
	99377	22.5	1.3	1.17	16	**51**	156.6	**154.2**

Regulator RDR Ø125mm - setting 180 m³/h

	Atmospheric Pressure (Pa)	Temperature in duct (°C)	Dew point temperature (°C)	Density (kg/m³)	Pressure before Regulator (Pa)	**Static pressure difference (Pa)**	Airflow rate (m³/h)	**Airflow rate in standard conditions (m³/h)**
Increase	99361	22.6	1.3	1.17	24	**51**	194.3	**191.3**
	99355	22.6	1.1	1.17	26	**74**	201.9	**198.8**
	99347	22.5	0.9	1.17	27	**99**	207.6	**204.4**
	99336	22.6	0.8	1.17	29	**152**	212.1	**208.8**
	99328	22.7	0.8	1.17	28	**202**	210.2	**206.9**
	99321	22.8	0.7	1.17	29	**249**	214.8	**211.4**
Decrease	99320	22.9	0.7	1.17	29	**252**	215.4	**212.0**
	99318	22.9	0.7	1.17	26	**198**	202.3	**199.1**
	99307	22.9	0.6	1.17	27	**147**	204.7	**201.4**
	99307	22.9	0.5	1.17	26	**99**	201.5	**198.3**
	99307	22.8	0.4	1.17	25	**72**	197.3	**194.2**
	99303	22.9	0.4	1.17	23	**50**	190.6	**187.6**

APPENDIX 6 - DETAILED RESULTS RDR Ø160

Regulator RDR Ø160mm - setting 180 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	100000	24.5	14.0	1.16	10	**50**	203.3	**199.8**
	100000	24.5	14.0	1.16	9	**63**	176.8	**173.8**
	100000	24.7	14.0	1.16	10	**83**	191.9	**188.6**
	100000	24.7	14.0	1.16	10	**104**	195.8	**192.5**
	100000	24.6	14.0	1.16	10	**151**	192.8	**189.5**
	100000	24.7	14.0	1.16	9	**201**	184.4	**181.3**
	100000	24.6	14.0	1.16	11	**250**	204.2	**200.7**
Decrease	100000	24.6	14.0	1.16	11	**248**	203.7	**200.3**
	100000	24.7	14.0	1.16	9	**200**	183.5	**180.3**
	100000	24.7	14.0	1.16	9	**151**	181.9	**178.7**
	100000	24.7	14.0	1.16	9	**100**	182.1	**179.0**
	100000	24.7	14.0	1.16	9	**75**	178.2	**175.1**
	100000	24.7	14.0	1.16	8	**60**	176.5	**173.5**
	100000	24.7	14.2	1.16	9	**42**	184.9	**181.7**

Regulator RDR Ø160mm - setting 210 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	100000	24.6	15.0	1.16	15	**47**	238.4	234.2
	100000	24.6	15.0	1.16	11	**57**	207.9	204.3
	100000	24.7	15.0	1.16	14	**77**	226.8	222.8
	100000	24.7	15.1	1.16	14	**103**	231.6	227.6
	100000	24.7	15.0	1.16	15	**151**	234.2	230.1
	99900	24.7	15.0	1.16	14	**200**	230.5	226.3
	99900	24.8	15.0	1.16	11	**249**	204.4	200.7
Decrease	99900	24.8	15.0	1.16	11	**248**	204.2	200.5
	99900	24.7	15.1	1.16	10	**200**	196.5	193.0
	99900	24.8	15.1	1.16	13	**153**	220.0	216.0
	99900	24.8	15.0	1.16	13	**100**	218.6	214.7
	99900	24.8	15.1	1.16	12	**75**	210.7	206.9
	99900	24.8	15.1	1.16	11	**54**	207.0	203.2
	99900	24.8	15.1	1.16	12	**38**	212.8	209.0

Regulator RDR Ø160mm - setting 240 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	100000	24.8	14.0	1.16	18	**44**	262.0	257.5
	100000	24.8	14.0	1.16	15	**60**	233.7	229.7
	100000	24.8	14.0	1.16	18	**75**	256.0	251.5
	100000	24.7	14.0	1.16	18	**101**	263.0	258.4
	100000	24.7	14.0	1.16	19	**151**	268.3	263.7
	100000	24.7	14.0	1.16	18	**205**	263.7	259.1
	100000	24.8	14.0	1.16	18	**257**	261.1	256.6
Decrease	100000	24.8	14.0	1.16	18	**250**	257.2	252.7
	100000	24.8	14.0	1.16	15	**202**	236.7	232.6
	100000	24.8	14.0	1.16	16	**152**	241.4	237.2
	100000	24.8	14.0	1.16	17	**101**	248.6	244.3
	100000	24.8	14.0	1.16	16	**75**	240.7	236.5
	100000	24.8	14.0	1.16	16	**70**	238.6	234.4
	100000	24.8	14.0	1.16	15	**36**	237.9	233.8

Regulator RDR Ø160mm - setting 270 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	99900	24.9	14.0	1.16	23	**39**	293.1	287.8
	99900	24.9	14.0	1.16	22	**63**	287.1	281.9
	99900	24.9	14.0	1.16	23	**76**	294.0	288.7
	99900	24.9	14.0	1.16	24	**101**	301.7	296.2
	99900	24.9	13.8	1.16	25	**150**	305.2	299.6
	99900	24.9	13.8	1.16	25	**203**	309.1	303.5
	99900	24.9	13.8	1.16	25	**250**	307.9	302.4
Decrease	99900	24.9	13.9	1.16	25	**247**	307.0	301.4
	99900	24.9	13.9	1.16	21	**200**	281.8	276.7
	99900	24.9	13.8	1.16	20	**146**	280.1	275.1
	99900	25.0	13.8	1.16	21	**99**	282.0	276.8
	99900	25.0	13.8	1.16	20	**76**	275.5	270.5
	99900	25.0	13.8	1.16	18	**52**	262.3	257.5
	99900	25.0	13.8	1.16	19	**33**	265.8	260.9

Regulator RDR Ø160mm - setting 300 m³/h

	Atmospheric Pressure (Pa)	*Temperature in duct (°C)*	*Dew point temperature (°C)*	*Density (kg/m³)*	*Pressure before Regulator (Pa)*	***Static pressure difference (Pa)***	*Airflow rate (m³/h)*	***Airflow rate in standard conditions (m³/h)***
Increase	99900	24.4	14.1	1.16	27	**35**	320.4	314.9
	99900	24.4	14.1	1.16	27	**56**	317.4	311.9
	99900	24.4	14.1	1.16	28	**75**	328.3	322.6
	99900	24.6	14.1	1.16	30	**102**	338.5	332.5
	99900	24.5	14.1	1.16	32	**153**	351.4	345.3
	99900	24.6	14.1	1.16	33	**201**	352.1	345.9
	99900	24.7	14.1	1.16	33	**251**	360.9	354.5
Decrease	99900	24.7	14.1	1.16	33	**250**	359.8	353.3
	99900	24.7	14.1	1.16	28	**200**	327.6	321.8
	99900	24.7	14.0	1.16	26	**145**	321.8	316.1
	99900	24.7	14.1	1.16	27	**99**	321.8	316.1
	99900	24.7	14.1	1.16	25	**76**	315.6	309.9
	99900	24.7	14.1	1.16	23	**49**	299.8	294.5

APPENDIX 7 - MEASUREMENT UNCERTAINTIES

The measurement uncertainties are the following:

For RDR diameter 80, 100 and 125mm

		Instrument range	N° instrum	Maximum uncertainty
Uncertainty for airflow	Airflow measurement	10/200 m³/h	11869	2.8%
Uncertainty for pressure	DP from 200 to 250 Pa	-1500/1500 Pa	16209	3.0%
	DP from 50 to 150 Pa	-200/+200 Pa	16210	2.0%

For RDR diameter 160mm

		Instrument range	N° instrum	Maximum uncertainty
Uncertainty for airflow	Airflow measurement	25/650 m³/h	14991	1.9%
Uncertainty for pressure	DP from 200 to 250 Pa	0/2000 Pa	5775	0.9%
	DP from 50 to 150 Pa	0/200 Pa	14979	2.3%

The uncertainty is the maximum uncertainty on the measurements.