Qirion

Report functionality tests W&S RS350S Regulator

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Qirion

Colofon		
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	Distribution list	Wigersma & Sikkema B.V.

Contents

1 Project management

1.1 Reason

At the request of Wigersma & Sikkema B.V., Qirion EC performed a series of functional tests on an RS350S DN50 PN16 gas pressure regulator with a 22.5 mm insert in the Test Facility Gas (TFG) in Amsterdam on 16 and 17 March 2022. The regulator supplied has serial number 35000388 and has been tuned for distribution (not for delivery). This is based on the Test Program Pressure regulator V2022 supplied by grid operator Fluvius, which is included in the appendix.

1.2 Purpose

The purpose of these tests is to test the functional operation of this regulator at inlet pressures of 1 and 7 bar and outlet pressures of 100 and 21 mbar. This involves determining the control accuracy, response time, and inlet pressure sensitivity of the RS350S.

1.3 Approach and preconditions for testing

To obtain the desired inlet pressure of 1, 2, 5, and 7 bar, use is made of the modified Fisher 298 regulator, which is part of the inlet side of the test line. The regulator is provided with an electronic control pressure regulator, with which the setpoint and the slope (the speed with which this setpoint is approached) can be entered remotely.

The increase and decrease of capacity are regulated by remotely controlled valves, which are mounted on the outlet side of the test line. The position and slope can be specified. At present, it is possible to feed approximately 4,000-5,000 m^3 (n)/h of natural gas into the Amsterdam gas network via the TFG before the outlet pressure becomes too high. This may not exceed 120 mbar.

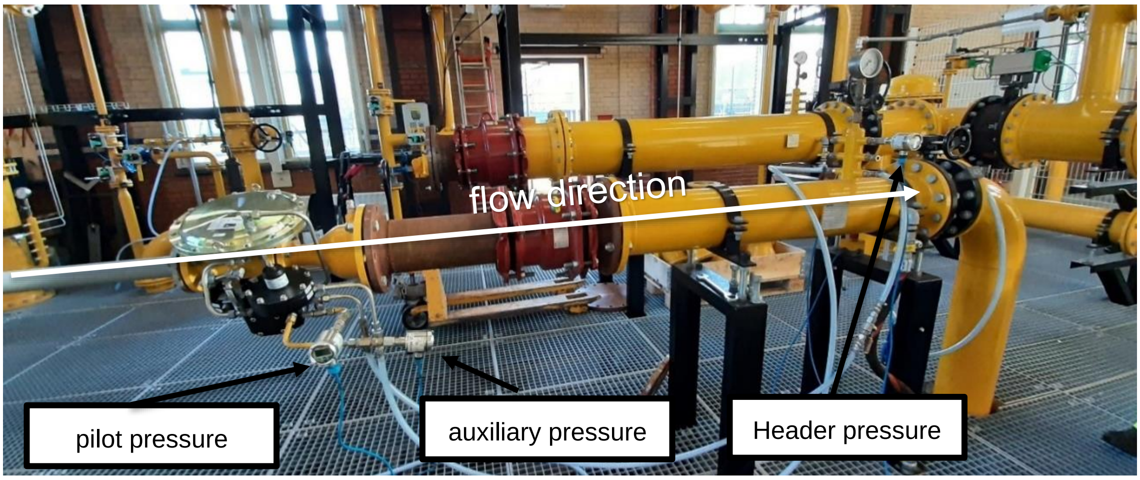
To carry out the 100 mbar tests, it is necessary to have priority over the Amsterdam gas network, which is operated at 100 mbar. By setting the setpoint of the controller approximately 10 mbar higher than the prevailing network pressure, sufficient test capacity becomes available. The setpoint used is set at 109 mbar(o). This value is set at an inlet pressure of 2.5 bar and a capacity of 5% of the maximum capacity.

To obtain the desired pressure of 21 mbar, an ejector system is used. Here, a gas stream of 8 bar is injected directly into the exhaust stream at high speed. This injection causes a pressure drop at the rear of the regulator under test. However, this injection is at the expense of the available test capacity. Section 2.4 gives a detailed description of the operation of the ejector.

2 Test setup

2.1 Installation configuration

For this test, use is made of the DN200 test line and both the small measuring line (Q_{max} ~1700 $m_{(n)}^3$ /h) and the large measuring line (Q_{max} ~8000 $m_{(n)}^3$ /h). At the front, the regulator is connected with a DN50 pipe. On the outlet side, the regulator is widened to DN150 and then to DN200, with the header at >5D from the last disturbing element. A P&ID of the entire setup is included in the appendix.



2.2 TFG pressure measurement locations

For this test, the pressure in the gas stream is measured at several points:

1. On the inlet side of the DN200 test line (Pu)
2. On the pilot (Pup and Pm) (optional)
3. On the header, at least 5D straight from the outlet side of the test controller, to which the measuring line to the pilot is connected (Pd)
4. On the outlet side of the TFG on behalf of the Liander gas network monitoring (Pd, net)

2.2.1 Pressure measuring point inlet side (Pu)

For measuring the inlet pressure (Pu), use is made of an ABB 216GS pressure sensor with a set range of 0-10 bar. The measurement values are read out digitally from the sensor itself.

2.2.2 Pressure measuring point pilot feeding pressure (Pup)

For measuring the pilot feeding pressure (Pup), use is made of an ABB 216GS pressure sensor with a set range of 0-400 mbar. The measurement values are read out digitally from the sensor itself. This measurement was done at the request of W&S for internal purposes and is therefore not included in this report.

2.2.3 Pressure measuring point pilot pressure (Pm)

An ABB 216GS pressure transducer with a set range of 0-400 mbar is used to measure the pilot pressure (Pm). The measurement values are read out digitally from the sensor itself. This measurement was carried out at the request of W&S for internal purposes and is therefore not included in this report.

2.2.4 Pressure measuring point header pressure (Pd)

An ABB 216GS pressure transducer with a set range of 0-400 mbar is used to measure the head pressure (Pd). The measurement values are read out digitally from the sensor itself.

2.2.5 Pressure measuring point grid pressure (Pd,net)

An ABB 216GS pressure transducer with a set range of 0-400 mbar is used to measure the grid pressure. The measurement values are read out digitally from the sensor itself. This measurement is used for Liander gas network monitoring and determines the maximum permitted capacity by the TFG test system.

2.3 TFG capacity control (Control valves 31 and 32)

For measuring and controlling the capacity demand, a Bronkhorst High Tech INFLOW mass flow meter (08) and (09) are used in combination with a Schubert & Salzer Ball-Sector control valves (31) and (32). The maximum capacity of the small capacity meter is 1,700$m_{(n)}^3$ /h and of the large one 8,000$m_{(n)}^3$ /h.

2.4 Ejector system for low pressure

As mentioned before, the TFG has a direct connection to the 100-mbar grid of Amsterdam. However, to be able to work with lower outlet pressures as well, the outlet pressure must be artificially lowered. This is done via an ejector, which is located just before the connection point with the Amsterdam gas network. From the inlet side, part of the gas, with a pressure of 8 bar, is led through a bypass to the ejector. By injecting this gas at high speed into the outlet side of the test lane, a Venturi effect is created.

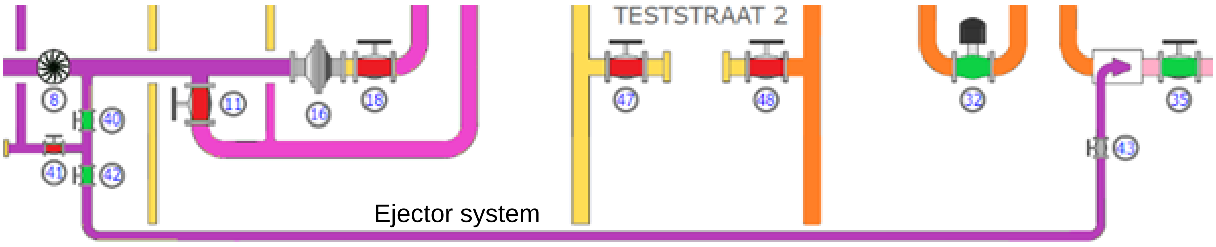


Figure 1 Detail of ejector system (purple line) with supply from inlet side and injection point on the outlet side

More or less gas can be injected through the ejector via the control valve (42). The higher the quantity of gas injected, the lower the negative pressure to be achieved. However, there are limitations to the use of the ejector. One of these limitations is that, since a relatively large amount of gas is required to create a low pressure, the available capacity of the Amsterdam gas network is already partly filled by the gas from the ejector. This causes the network pressure to increase, and less capacity remains to be led through the object to be tested. The injection of gas into the outlet side also causes an erratic pressure pattern. It is not as stable as in the regular tests with 100 mbar. This can also be seen in the graph below and the measurement data.

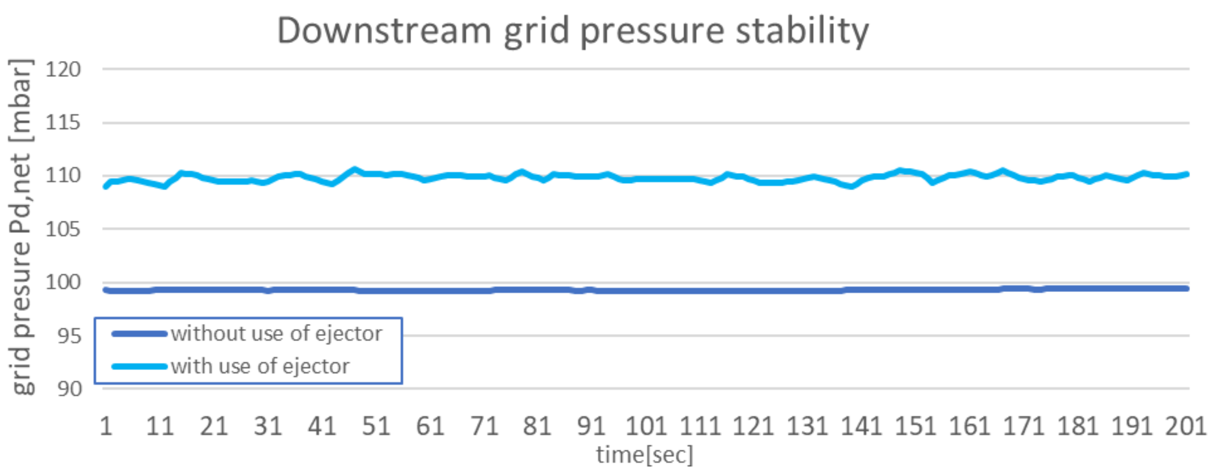


Figure 2 Difference in the stability of exhaust pressure towards the Amsterdam gas network with and without the use of the ejector system; with ejector, exhaust pressure becomes higher and more erratic in shape

3 Test results

3.1 Test 1: Determination control accuracy of the regulator

During this test, the control accuracy of the regulator was determined. The gas demand from the grid is increased with constant speed from 0 to Q_{max} using the TFG capacity control valve (31) or (32). Then the gas demand is reduced again with constant speed from Q_{max} to 0 with the same valve. During the measurement, the capacity is recorded with TFG reference meters (07) or (09), the inlet pressure with a pressure sensor (Pu), the head pressure with pressure sensor (Pd), and the net pressure with pressure sensor (Pd, net) are logged. Additionally, the pilot feeding pressure (Pup) and the pilot pressure (Pm) were also logged.

The test was carried out at a supply pressure of 1 bar and 7 bar, which is supplied and regulated by the TFG pressure regulator (16).

Reminder: To have priority over the regular low-pressure gas network of Amsterdam, which is operated at 100 mbar, the set outlet pressure of the regulator to be tested is set at approximately 109 mbar instead of the 100 mbar mentioned in the test program.

3.1.1 Control accuracy at P_u = 1 bar and P_d = 100 mbar

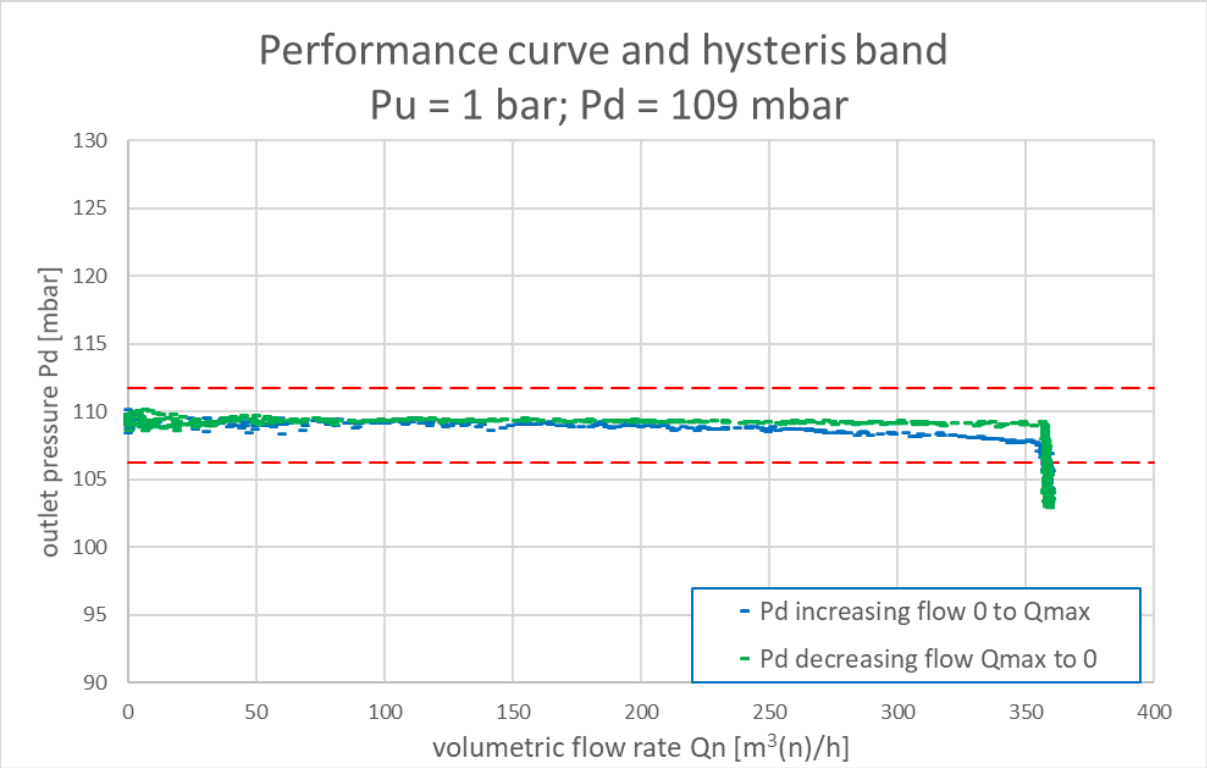


Figure 3 Control accuracy of the regulator at an inlet pressure of 1 bar and outlet pressure of 109 mbar

Capacity (Qn) [m^3 (n)/h]	Exhaust pressure (Pd) increasing [mbar]	Exhaust pressure (Pd) descending [mbar]
0	109,4	109,5
50	109,2	109,7
100	109,2	109,4
150	108,9	109,3
200	108,9	109,2
250	108,6	109,2
300	108,3	109,1
350	107,7	109,2

3.1.2 Control accuracy at P_u = 7 bar and P_d = 100 mbar

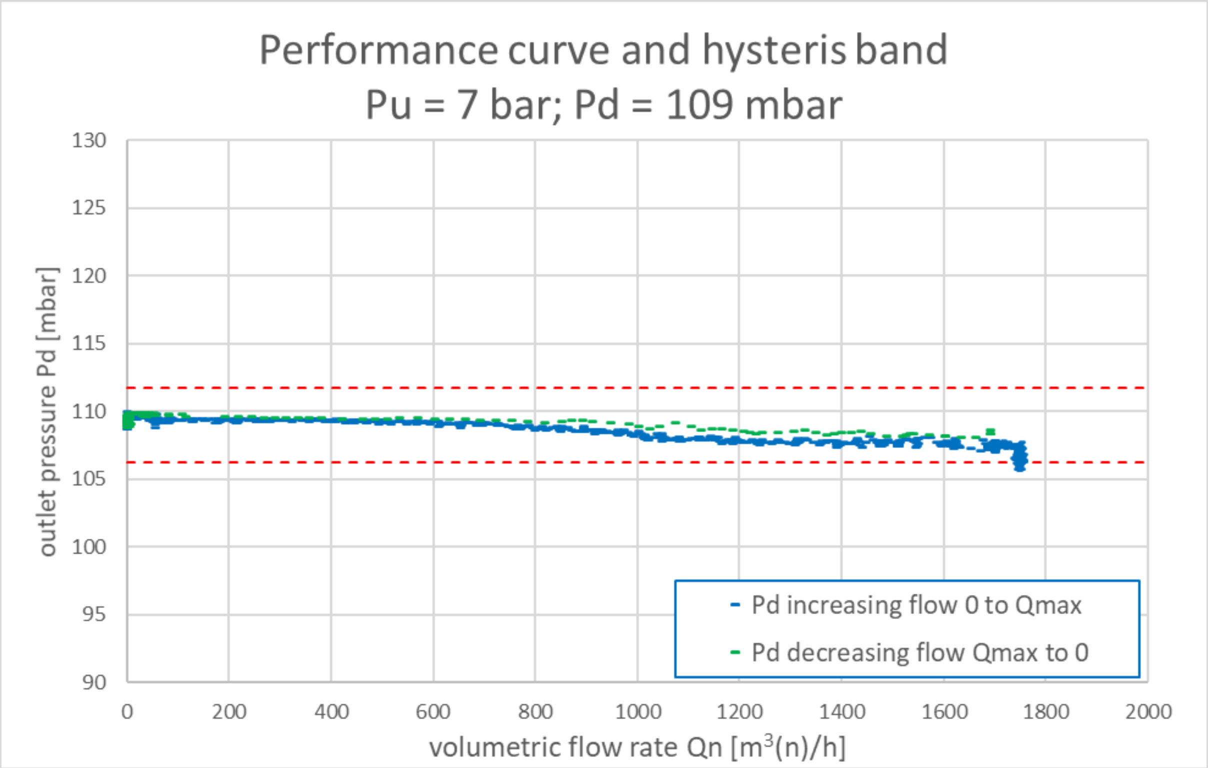


Figure 4 Control accuracy of the regulator at an inlet pressure of 7 bar and outlet pressure of 109 mbar

Capacity (Qn) [m^3 (n)/h]	Exhaust pressure (Pd) increasing [mbar]	Exhaust pressure (Pd) descending [mbar]
0	109,4	109,5
200	109,3	109,6
400	109,3	109,5
600	109,0	109,4
800	108,6	109,1
1000	108,4	108,9
1200	107,8	108,5
1400	107,6	108,4
1600	107,7	108,1

3.1.3 Control accuracy at P_u = 1 bar and P_d = 21 mbar

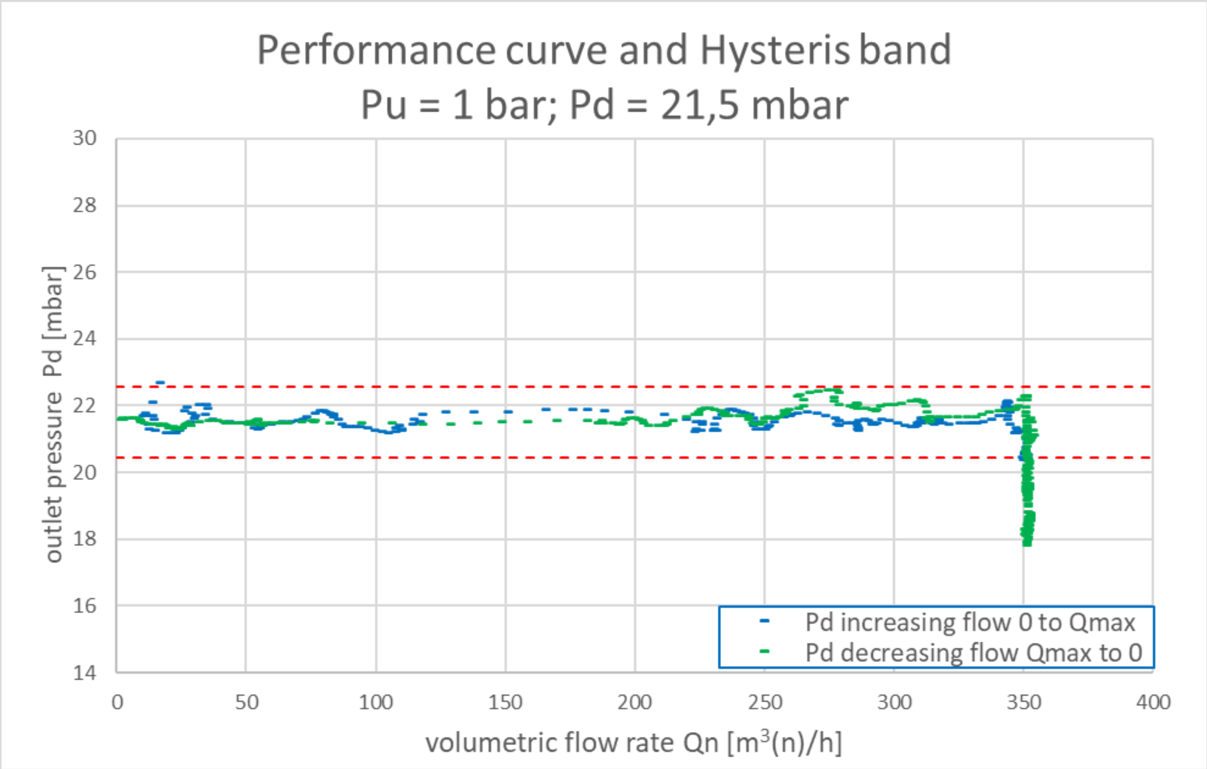


Figure 5 Control accuracy of the regulator at an inlet pressure of 1 bar and outlet pressure of 21 mbar*

Capacity [m³ (n)/h]	Exhaust pressure rising [mbar(o)]	Exhaust pressure descending [mbar(o)]
0	21,7	21,7
50	21,4	21,5
100	21,2	21,3
150	22,1	21,4
200	21,8	21,0
250	21,2	21,5
300	21,5	21,3
350	21,3	21,4

**) The erratic course of the graph is entirely due to fluctuations of the downstream grid. These fluctuations occur due to the injection of 8 bar gas to obtain the desired underpressure of 21 mbar.*

3.1.4 Control accuracy at P_u = 7 bar and P_d = 21 mbar

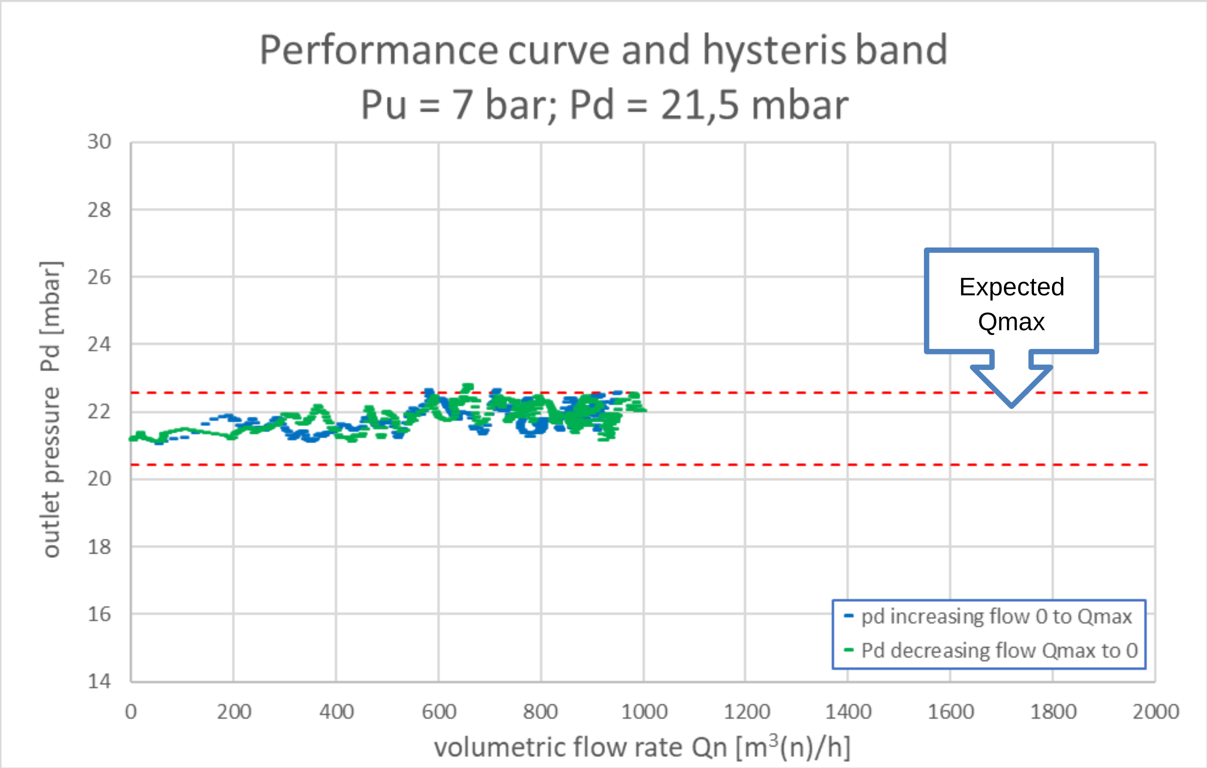


Figure 6 Control accuracy of the regulator at an inlet pressure of 7 bar and outlet pressure of 21 mbar

Capacity [m^3 (n)/h]	Exhaust pressure rising [mbar]	Exhaust pressure descending [mbar]
0	21,5	21,2
200	21,3	21,0
400	21,6	21,3
600	22,5	21,5
800	21,5	22,2
1000	22,4	22,2

Note on last test (7 bar - 21 mbar):

The capacity achieved is not the maximum capacity the regulator could deliver. At the time of testing, there was not enough capacity available in the grid to cover the entire control range at Pu = 21 mbar. This was due to the amount of gas needed to obtain the required under pressure for this test.

3.2 Test 2: Determination of the reaction speed of the regulator

This test looks at the reaction speed of the test regulator, and thus at the occurring closing pressure at the normal closing of a valve, which is specified as 10 sec, and the fast-closing of a valve, which is specified as < 2sec. The test is performed at both 1 bar and 7 bar and 20% of the maximum capacity of the regulator at these pressures. Per inlet/outlet pressure the test is performed three times.

Note: *For normal closure, the minimum closing time of the control valves is used, which is around 10 seconds for the small ones and around 16 seconds for the big ones. For fast closing, a DN400 safety valve is used, which is part of the test line. Here, closure takes place in less than 1 second. The volume between the controller and this safety valve is approximately 0.7 m3(n).*

Also shown in table form are the most important outlet pressures that occurred during the tests, namely the maximum pressure after closing and the minimum pressure after opening the valve.

3.2.1 Reaction speed at Pu = 1 bar and Pd = 100 mbar

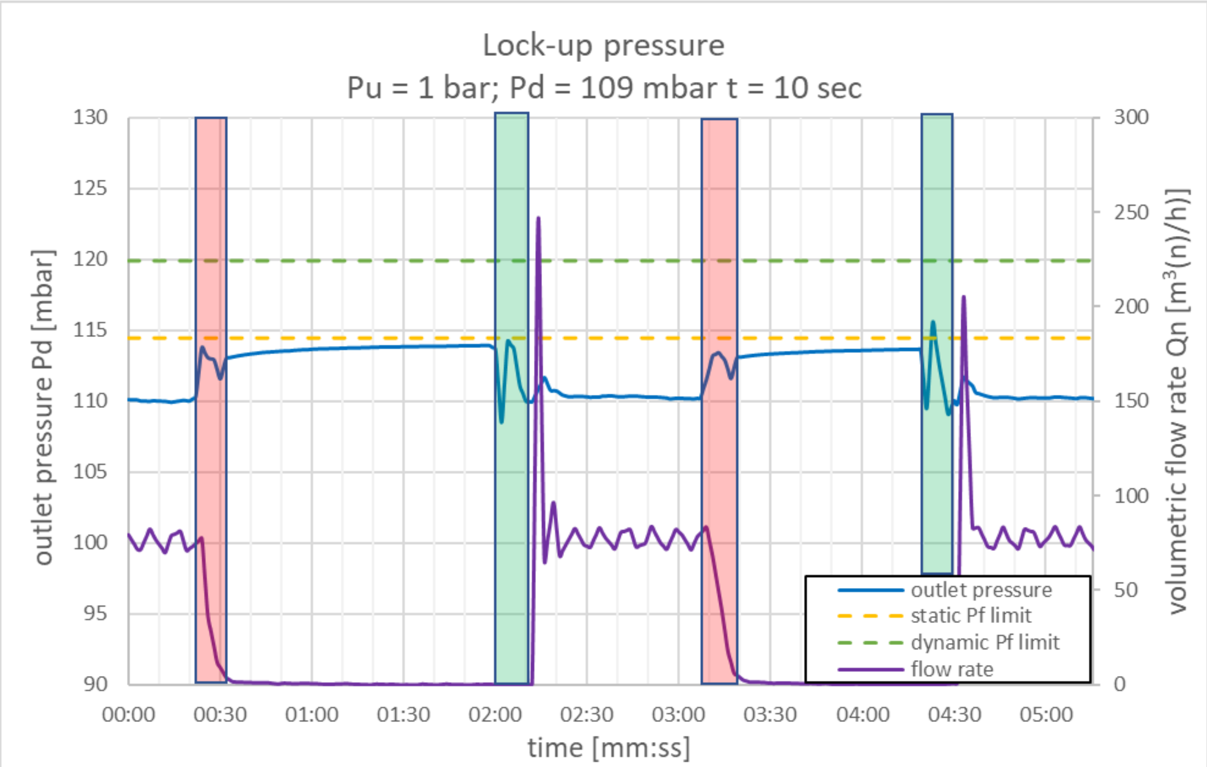


Figure 7 Reaction speed at normal closing (10 sec) Pu=1 bar; Pd = 109 mbar

Measurement	P_d for closing [mbar]	$P_{d,max}$ after closing [mbar]	$P_{d,min}$ after opening [mbar]
1	110,0	113,9	108,5
2	110,1	113,6	109.0

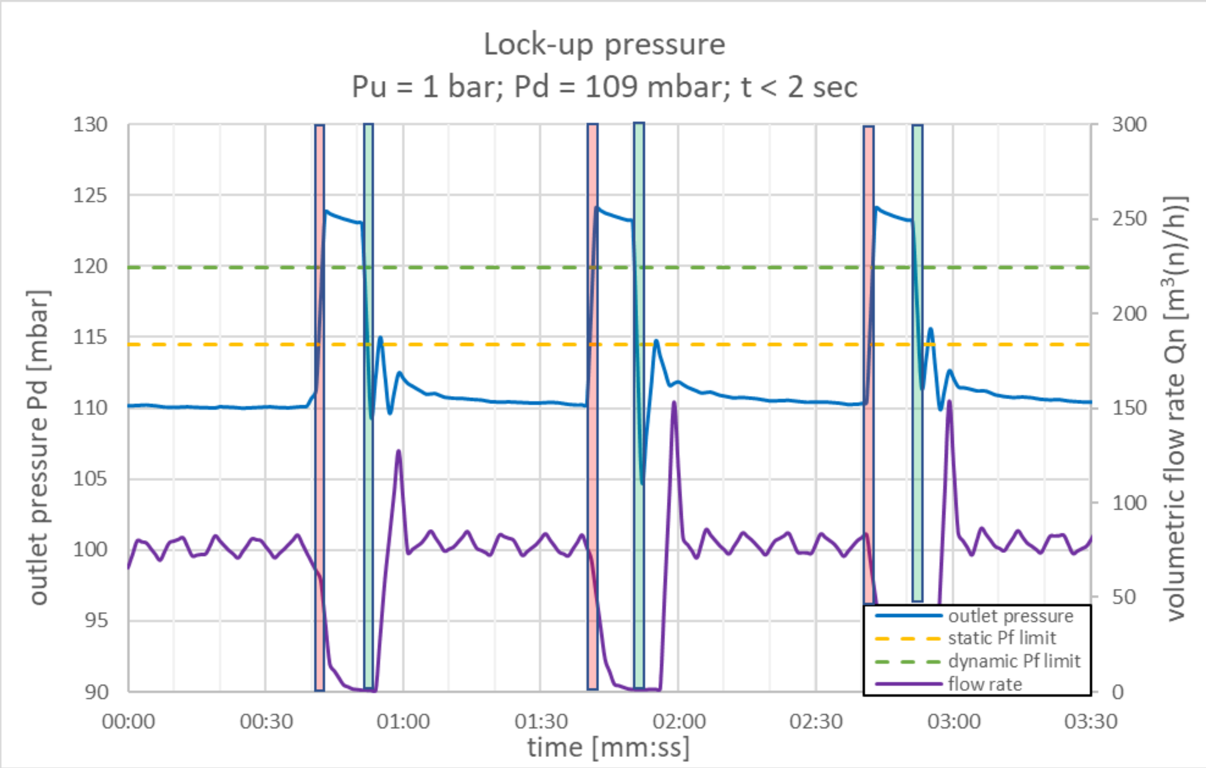


Figure 8 Reaction speed with fast closing (<2 sec) Pu = 1 bar; Pd = 109 mbar

Measurement	P_d for closing [mbar]	$P_{d,max}$ after closing [mbar]	$P_{d,min}$ after opening [mbar]
1	110,0	123,8	109,4
2	110,1	124,0	104,8
3	110,3	124,0	109,9

3.2.2 Reaction speed at Pu = 7 bar and Pd = 100 mbar

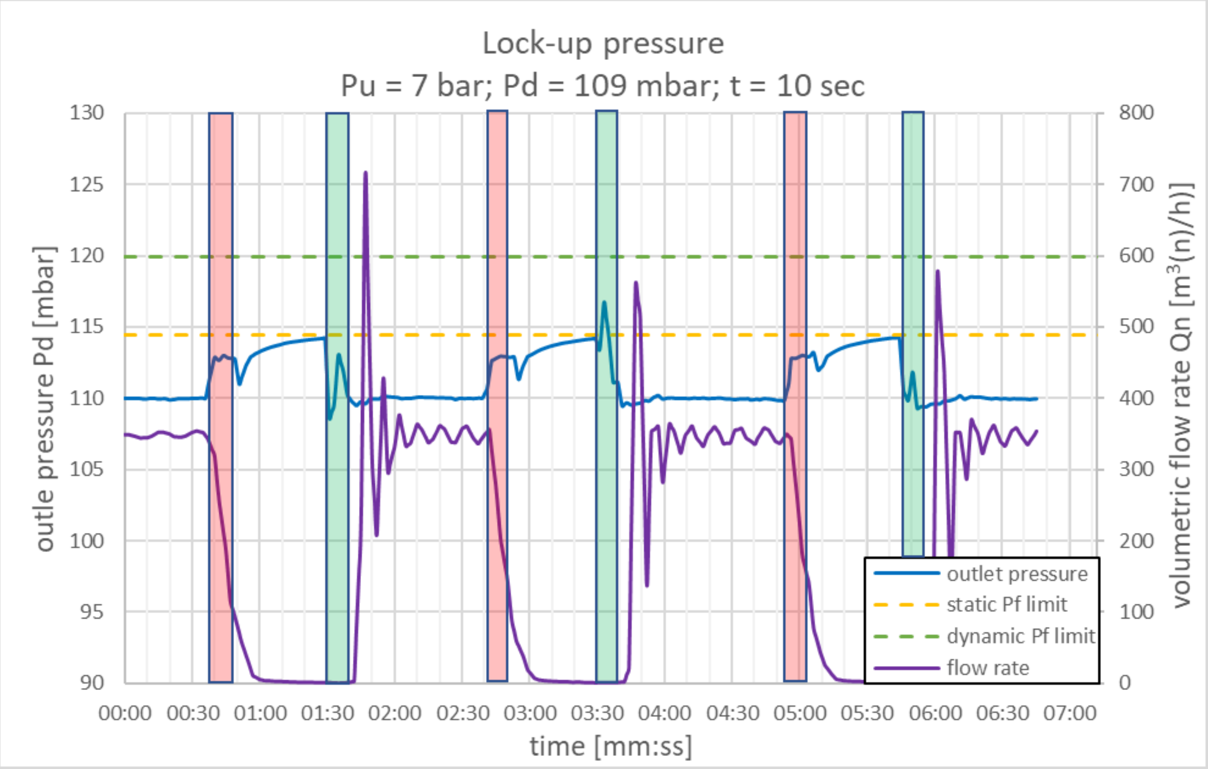


Figure 9 Reaction speed at normal closing (10 sec) Pu=7 bar; Pd = 110 mbar

Measurement	P_d for closing [mbar]	$P_{d,max}$ after closing [mbar]	$P_{d,min}$ after opening [mbar]
1	110,0	114,0	108,6
2	110,0	114,0	109,5
3	109,8	114,0	109,4

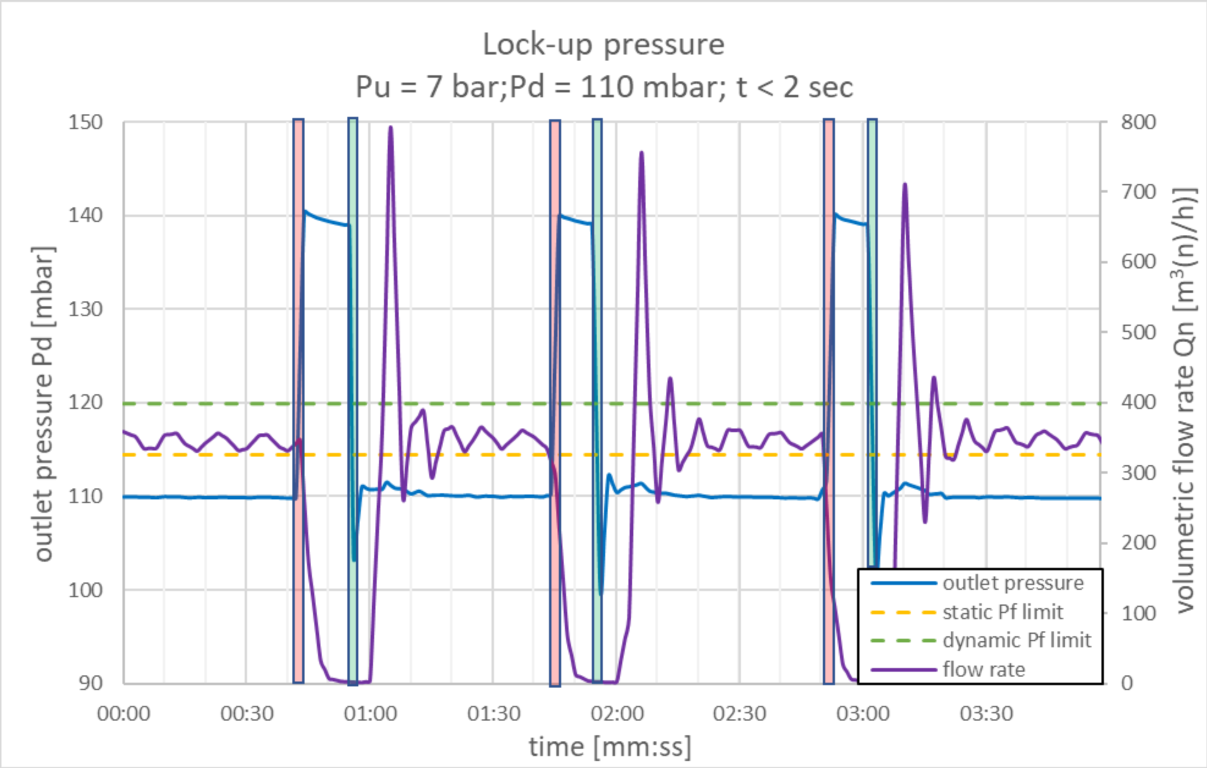


Figure 10 Reaction speed with fast closing (<2 sec) Pu = 7 bar; Pd = 110 mbar

Measurement	P_d for closing [mbar]	$P_{d,max}$ after closing [mbar]	$P_{d,min}$ after opening [mbar]
1	109,8	140,2	103,6
2	109,9	139,8	100,0
3	109,9	139,8	101,7

3.2.3 Reaction speed at Pu = 1 bar and Pd = 21 mbar

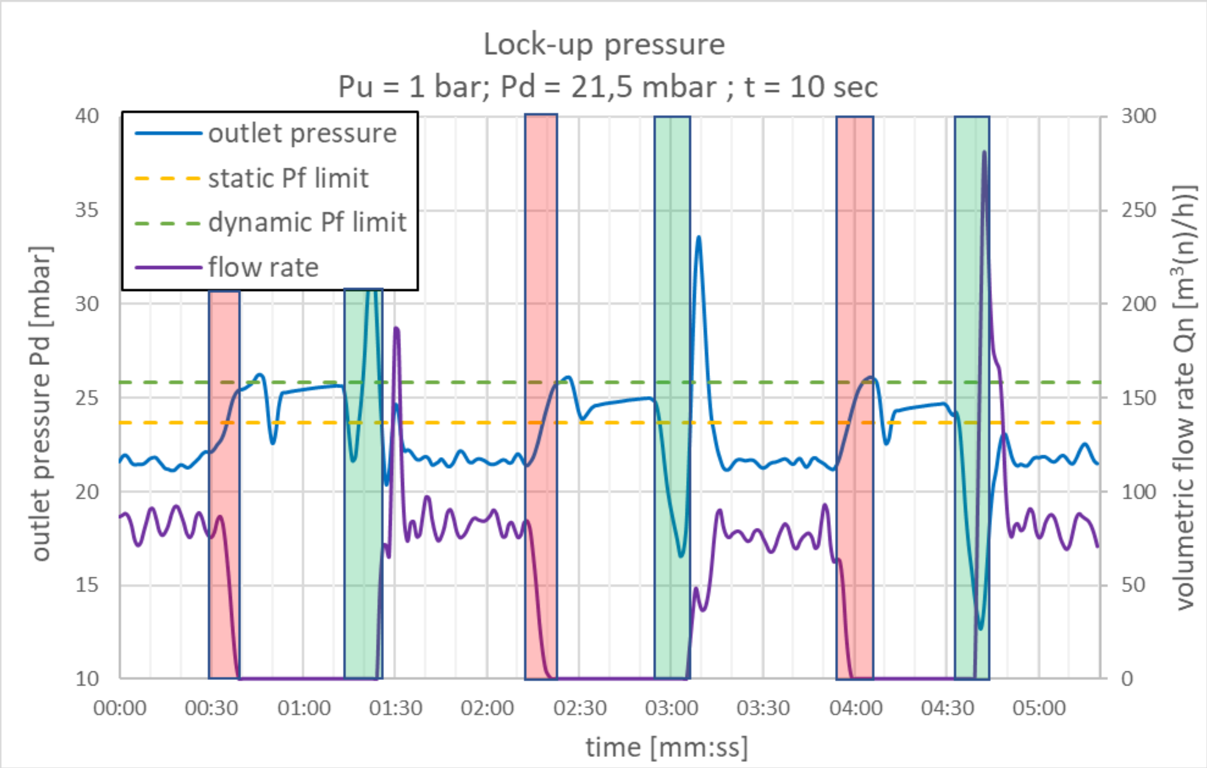


Figure 11 Reaction speed at normal closing (10 sec) Pu=1 bar; Pd = 21 mbar

Measurement	P_d for closing [mbar]	$P_{d,max}$ after closing [mbar]	$P_{d,min}$ after opening [mbar]
1	21,9	26,5	20,2
2	21,4	26,2	15,6
3	21,2	25,8	13,2

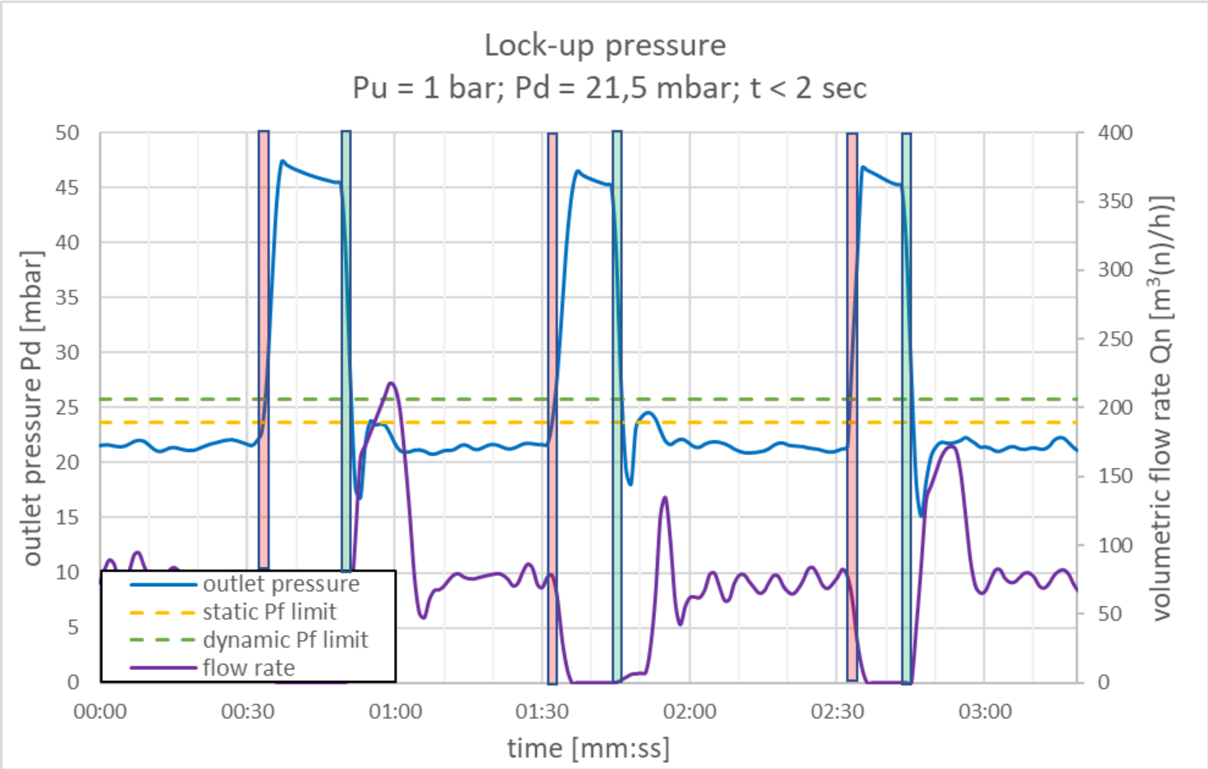


Figure 12 Reaction speed with fast closing (<2 sec) Pu = 1 bar; Pd = 21 mbar

Measurement	P_d for closing [mbar]	$P_{d,max}$ after closing [mbar]	$P_{d,min}$ after opening [mbar]
1	21,5	47,3	9,1
2	21,7	46,7	9,1
3	21,6	47,0	11,0

3.2.4 Reaction speed at Pu = 7 bar and Pd = 21 mbar

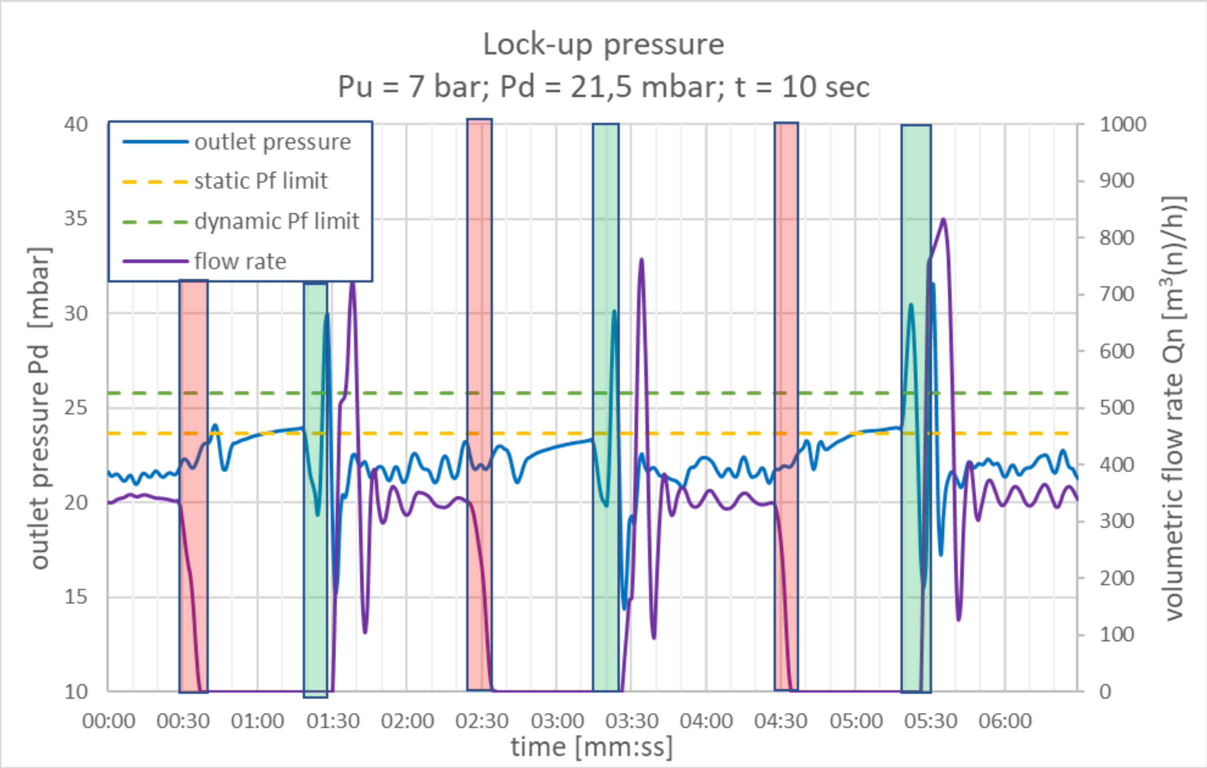


Figure 13 Reaction speed at normal closing (10 sec) Pu=7 bar; Pd = 21 mbar

Measurement	P_d for closing [mbar]	$P_{d,max}$ after closing [mbar]	$P_{d,min}$ after opening [mbar]
1	21,3	24,9	10,8
2	22,0	23,4	11,0
3	21,9	23,7	12,8

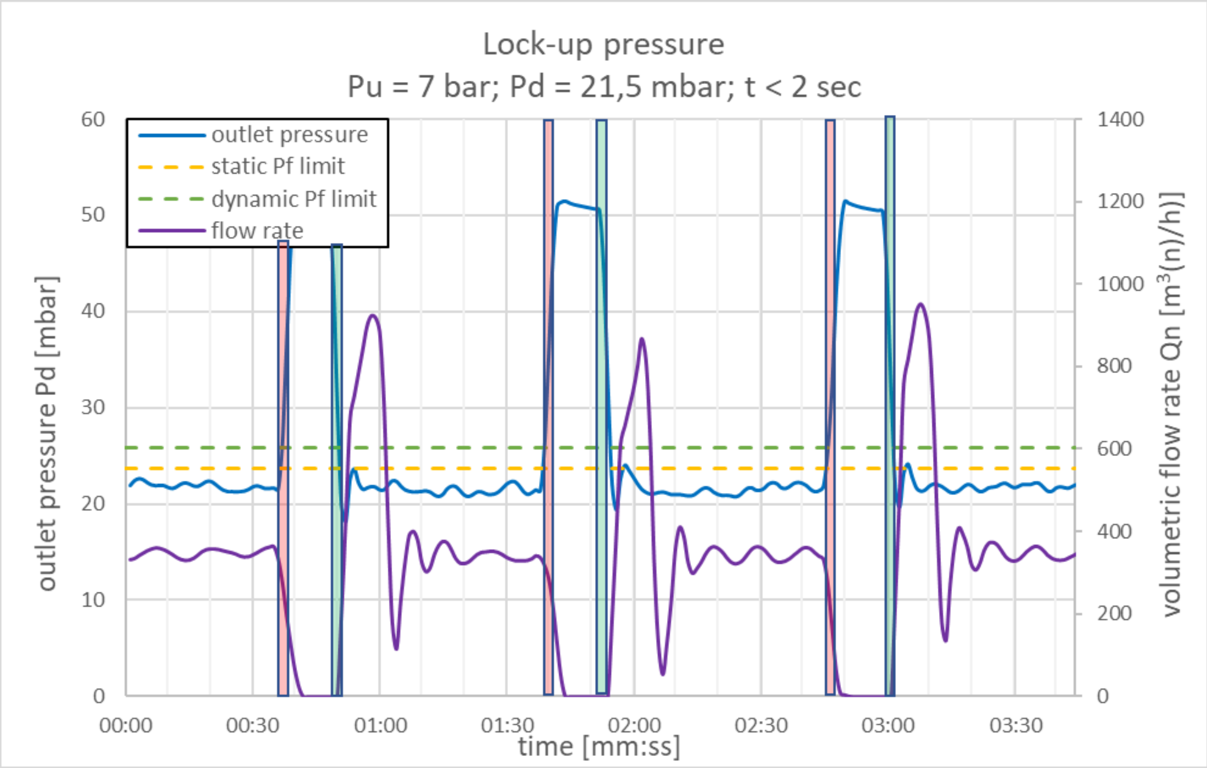


Figure 14 Reaction speed with fast closing (<2 sec) Pu = 7 bar; Pd = 21 mbar

Measurement	P_d for closing [mbar]	$P_{d,max}$ after closing [mbar]	$P_{d,min}$ after opening [mbar]
1	21,9	51,6	10,6
2	21,9	51,4	14,4
3	21,6	51,5	13,6

3.3 Test 3: Determination of inlet pressure sensitivity of the regulator

In this test, the sensitivity of the regulator was determined by changing supply pressure. The regulator was set at 50% Q_{max}, at a maximum upstream pressure of 7 bar, and then the inlet pressure was slowly reduced to 0 bar.

3.3.1 Inlet pressure sensitivity at an outlet pressure (Pd) of 100 mbar

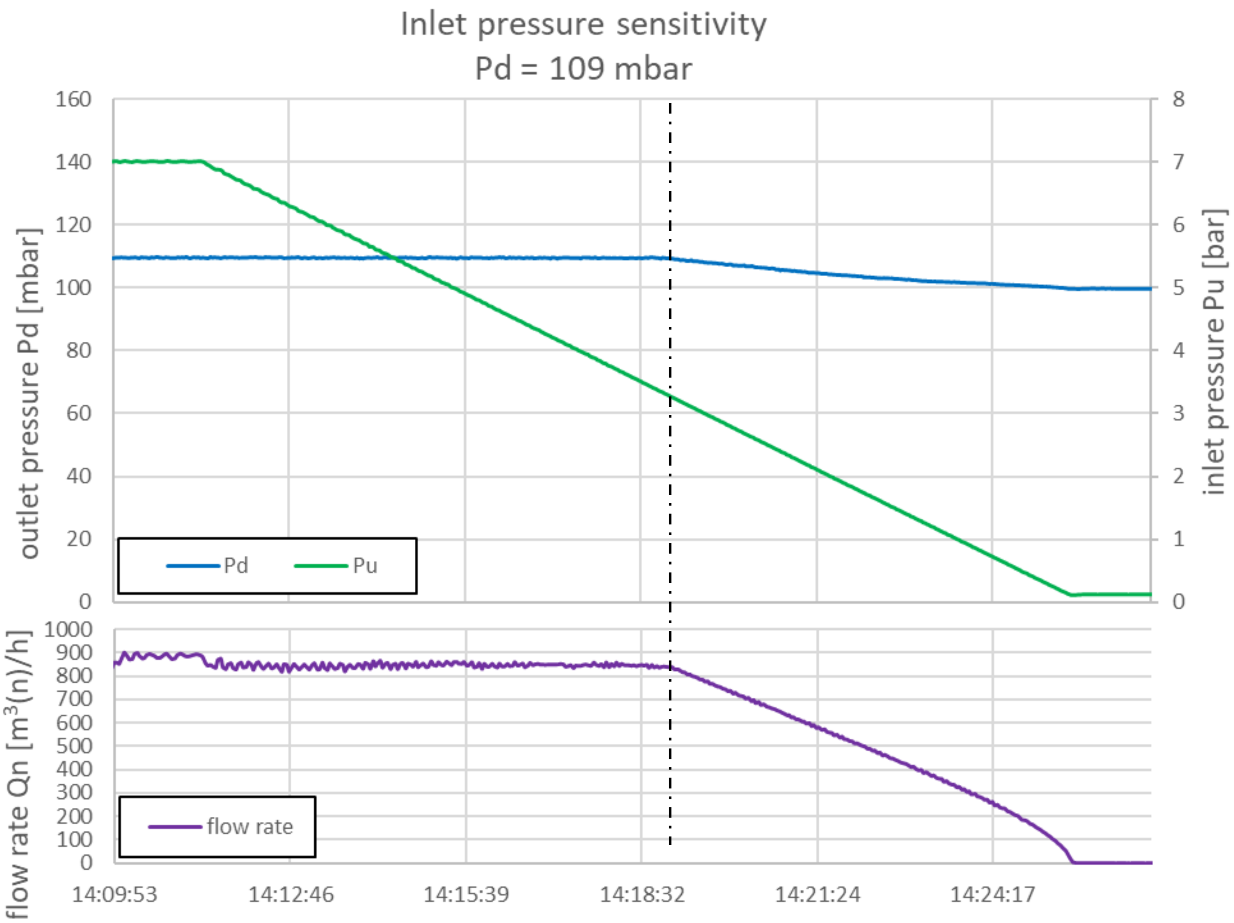


Figure 15 Inlet pressure sensitivity of the outlet pressure with decreasing inlet pressure (dotted line is fully open valve) Pd=109,6 bar

Inlet pressure Pu [bar]	Exhaust pressure Pd [mbar]	Capacity Qn [m^3 (n)/h]
7,0	109,6	890
6,5	109,6	842
6,0	109,6	827
5,5	109,5	840
5,0	109,5	861
4,5	109,5	845
4,0	109,5	845
3,5	109,4	847
3,0	108,0	778
2,5	106,2	668
2,0	104,3	559
1,5	102,9	444
1,0	101,7	327
0,5	100,8	190
0,123	99,7	0

3.3.2 Inlet pressure sensitivity at an outlet pressure (Pd) of 21 mbar

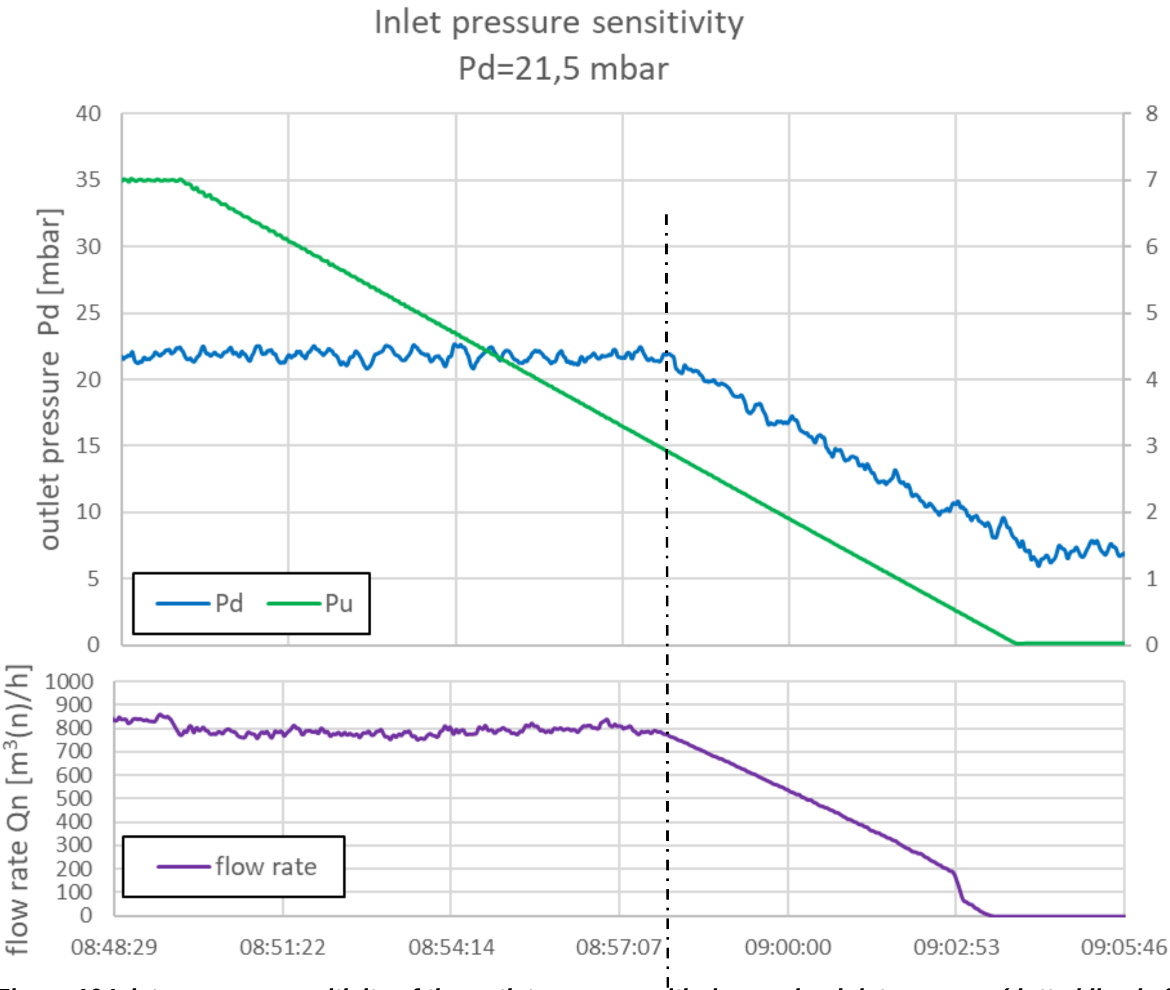


Figure 16 Inlet pressure sensitivity of the outlet pressure with decreasing inlet pressure (dotted line is fully open valve) Pd=21 bar

Inlet pressure Pu [bar]	Exhaust pressure Pd [mbar]	Capacity Qn [m³ (n)/h]
7,0	21,5	881
6,5	21.8	761
6,0	21,7	795
5,5	21,8	803
5,0	22,1	725
4,5	21,9	780
4,0	21,8	839
3,5	21,6	844
3,0	20,9	787
2,5	19,8	675
2,0	16,7	554
1,5	15,7	445
1,0	13,1	320
0,5	10,2	133
0,037	5,0	0

Note: Creating the required vacuum via our ejector is unfortunately accompanied by fluctuations in the vacuum. This translates into a more erratic pattern of both the ejector pressure and the capacity.

5. Conclusion

The following conclusions can be drawn from the measurement results found:

Control accuracy:
From the control accuracy tests at both an inlet pressure of 1 bar and 7 bar and outlet pressure of 21 and 100 (110) mbar, the measured outlet pressures over the entire control range[1)] fall within the specified accuracy class of 2.5% for outlet pressures >50 mbar and 5% for outlet pressures < 50 mbar.

1) *In the test of 7 bar inlet pressure and 21 mbar outlet pressure, it was unfortunately not possible to measure the entire range due to a shortage of capacity, but from the measured course of events it can be predicted with sufficient certainty that the accuracy class over the entire range will also remain within the limits*.

Response speed:
The reaction speed tests showed that with normal closing (about 10 seconds) the outlet pressure in the tests with 110 mbar falls within the set-closing pressure class of 5%. In the tests with an outlet pressure of 21 mbar, a small excess of the closing class of 10% was observed during the test with 1 bar of inlet pressure. The capriciousness of the outlet pressure due to our ejector for suppressing is most likely the cause of this. At an inlet pressure of 7 bar, the closing pressure did fall within the 10% limit.

The values found for fast closing were higher than the above-mentioned value. Considering the actual closing speed of <1 s and the limited capacity of the outlet net (approx. 0.7 m^3), these values are not unreasonable.

Intake pressure sensitivity:
The gradient found between an inlet pressure of 7 bar (start value) and full valve opening (approximately 3.5 bar) is 0.2% for the 110 mbar tests and 0.4% for the 21 mbar tests. This is within the specified gradient class of 0.5% and 1.0% respectively.

Annex

Appendix A - P&ID test setup

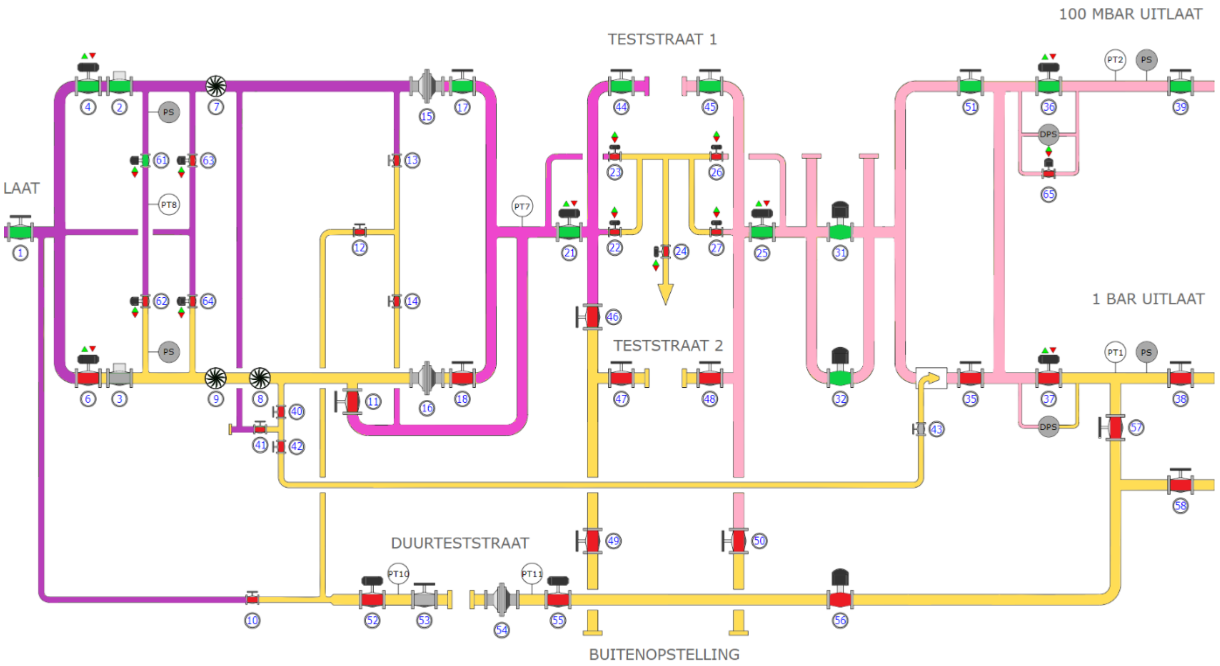


Figure 17 Flow diagram for 100 mbar tests

Purple: 8 bar; lilac: 1-7 bar; pink: 100 mbar; yellow: pressureless

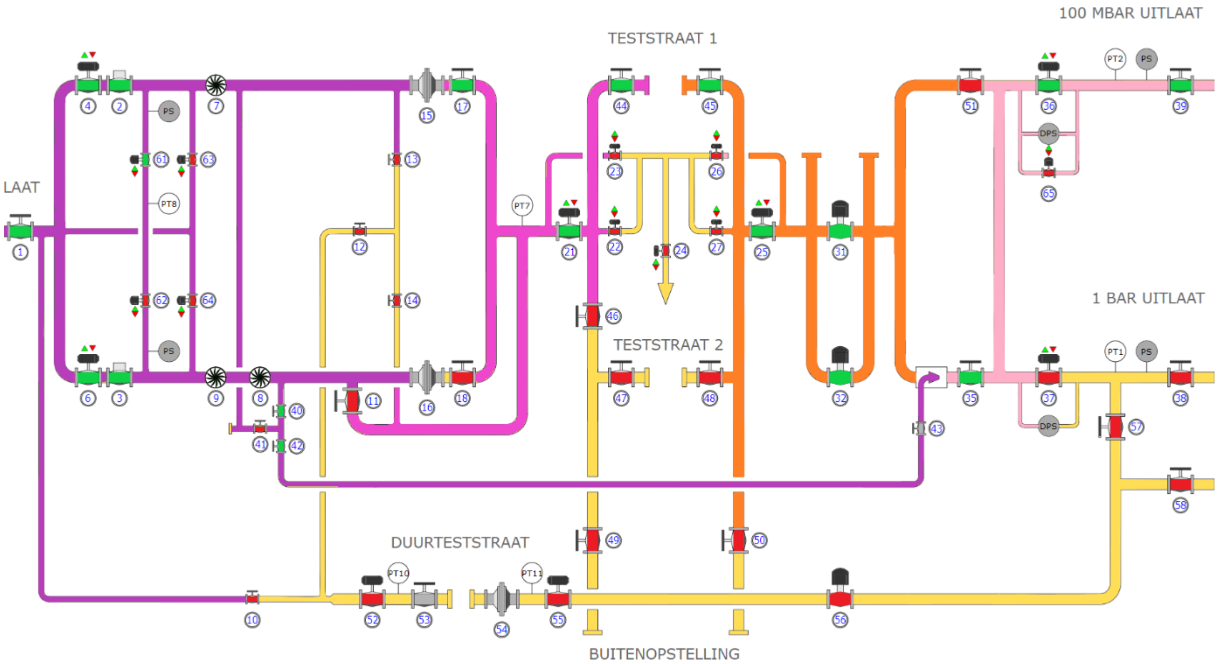


Figure 18 Flow chart for 21 mbar ejector tests

Purple: 8 bar; lilac: 1-7 bar; pink: 100 mbar; orange: 21 mbar; yellow: pressureless

Annex B - Calibration data of applied sensors

Sensor	type	range	Accuracy	Serial number	measurement value	Calibration date
PT08	ABB 261AS	0-10 bara	0,1%	6505006661	1 per sec	5-11-2020
PT07	ABB 261GS	0-10,000 mbarg	0,1%	6600101218	1 per sec	5-11-2020
TFG1LD	ABB 261GS	0-400 mbarg	0,1%	6600101220	1 per sec	21-11-2020
TFG1MD	ABB 261GS	0-2500 mbarg	0,1%	6600101223	1 per sec	22-11-2020
TFG2LD	ABB 261GS	0-400 mbarg	0,1%	6600118489	1 per sec	21-11-2020
TFG2MD	ABB 261GS	0-2500 mbarg	0,1%	6600118490	1 per sec	22-11-2020
TFG3LD	ABB 261GS	0-400 mbarg	0,1%	6600101219	1 per sec	21-11-2020
TFG4LD	ABB 261GS	0-400 mbarg	0,1%	6600101221	1 per sec	21-11-2020
TFG5HD	ABB 261GS	0-10 bar	0,1%	6600094485	1 per sec	21-11-2020
TFG6HD	ABB 261GS	0-10,000 mbarg	0,1%	6600101216	1 per sec	21-11-2020
PT02	ABB 261GS	0-400 mbarg	0,1%	6600101221	1 per sec	5-11-2020
FT07	Bronkhorst INFLOW	0-1300 Nm3/h	1.0% FS	M16200011B	1 per sec	16-3-2020
FT09	Bronkhorst INFLOW	0-8000 Nm3/h	1.0% FS	160181215203D1	1 per sec	26-4-2020

specification control valve and safety valve:

No.	Valve	Brand and type	Diameter	Closing time
25	Safety valve	Wouter Witzel butterfly valve, type EVFL	DN400	<1 second
31	Control valve	Schubert & Salzer Ball-Sector	DN150	±10 seconds
32	Control valve	Schubert & Salzer Ball-Sector	DN250	±16 seconds

Appendix C - Specifications W&S RS350S regulator

Default values	Pd ≥ 50 mbar	Pd < 50 mbar	
Accuracy class AC (EN 334)	2,5	5	%
Closing pressure class SG (EN 334)	5	10	%
Hysteresis	< 0,4	< 1	%
Closing pressure range class SZ	< 1	< 1	%
Exhaust pressure change with inlet pressure variation			
from 16 to 1.5 bar at Qmax	+ 0,5	+ 1	%
start time from zero consumption			
DN50	< 0,2	< 0,2	s
Open time of 0-100 % valve stroke:			
DN50	< 2	< 2	s
Closing time of 100-0 % valve stroke:			
DN50	< 1	< 1	s
Overshoot at flap of 100-0 % within lock time	< 10	< 20	%
Undershoot at valve stroke of 0-100 % within opening time	< 10	< 20	%
Gas velocity in exhaust flange	< 150	< 150	m/s
AG overpressure safety shut-off valve	2,5	10	%
AG vacuum safety shut-off valve	10	20	%

Appendix D - V2022 (Fluvius) pressure regulator test program

Testprogramma drukregelaar

Algemeen

Bedoeling van dit testprogramma is om een beeld te hebben van de performantie van de drukregelaar, onder verschillende omstandigheden.

Voor de drukregelaar zijn er 4 testprocedures:

- **Test 1: Regelnauwkeurigheid regelaar:** De regelnauwkeurigheid van de regelaar wordt getest bij de verschillende inlaatdrukken.
- **Test 2: Reactiesnelheid van de regelaar:** De reactiesnelheid van het snel sluiten en het snel openen van de regelaar wordt getest.
- **Test 3: Inlaatdrukgevoeligheid van de regelaar:** De voordrukgevoeligheid van de regelaar wordt getest.

Test 1: Regelnauwkeurigheid

Doel: De regelnauwkeurigheid van de drukregelaar testen bij verschillende inlaatdrukken.

Beschrijving:

Het instelpunt van de regelaar wordt ingesteld op 3 à 5% van het maximum debiet van de installatie en bij een inlaatdruk van 2,5 bar. Het maximum debiet van de installatie wordt in overleg bepaald of meegegeven.
De uitlaatdruk wordt ingesteld op 100 mbar, nadien worden de testen herhaald voor Puit 21mbar.
Bij een inlaatdruk van respectievelijk 7 en 1 bar wordt de evolutie van de uitlaatdruk nagegaan bij:

→ een verhoging van het debiet tot $Q_{max\ regelaar}$
→ en de verdere evolutie bij een afname van het debiet tot 0 nagegaan.

De bekomen hysteresis wordt weergegeven in een grafiek.

<table>
<tr><th>Test</th><th>Uitlaatdruk Puit</th><th>Inlaatdruk</th><th>Instelpunt</th><th>Gevraagd</th></tr>
<tr><td>1</td><td>100mbar</td><td>7bar</td><td rowspan="4">3 à 5% van het maximum debiet – bij een inlaatdruk van 2,5bar.</td><td rowspan="4">Evolutie uitlaatdruk bij verhoging van debiet naar $Q_{max\ regelaar}$ + evolutie uitlaatdruk bij afname debiet van $Q_{max\ regelaar}$ tot 0.</td></tr>
<tr><td>2</td><td></td><td>1bar</td></tr>
<tr><td>3</td><td>21mbar</td><td>7bar</td></tr>
<tr><td>4</td><td></td><td>1 bar</td></tr>
</table>

Weergave resultaten: Alle gegevens worden zowel in tabelvorm als op grafiek weergegeven.

Test 2: Reactiesnelheid

Doel: De reactiesnelheid van de regelaar testen. Zowel het snel sluiten als het snel openen worden getest.
Beschrijving:
Het instelpunt van de regelaar wordt ingesteld op 3 à 5% van het maximum debiet van de installatie en bij een inlaatdruk van 2,5 bar.
De inlaatdruk wordt ingesteld op 7 bar.
De uitlaatdruk wordt ingesteld op 100 mbar.

Wanneer het debiet 20% van het maximale debiet bedraagt, wordt de sluitdruk van de regelaar getest bij het sluiten van de uitlaatafsluiter in 10s. Na 10 seconden wordt de uitlaatafsluiter opnieuw in 10s geopend en wordt de uitlaatdruk van de regelaar nagegaan.

Nadien wordt de test opnieuw uitgevoerd bij een snelle sluiting en opening (<2s).

Vervolgens wordt de inlaatdruk geregeld op 1 bar en wordt de test herhaald.

De volledige test wordt herhaald bij een uitlaatdruk van 21mbar.

Test	Instelpunt	Inlaatdruk	Uitlaatdruk	Test
5	3 à 5% van het maximum debiet – bij een inlaatdruk van 2,5bar.	7bar	100mbar	• Debiet ↗ tot ±20% van Qmax • Sluiten uitlaatafsluiter in 10s • 10s wachten • Openen uitlaatafsluiter in 10s • **Controle uitlaatdruk regelaar** • Sluiten uitlaatafsluiter in <2s • 10s wachten • Openen uitlaatafsluiter in <2s • **Controle uitlaatdruk regelaar**
6			21mbar	Zie hierboven
7		1bar	100mbar	
8			21mbar	

<u>Weergave resultaten:</u> Alle gegevens worden zowel in tabelvorm als op grafiek weergegeven.

Test 3: Inlaatdrukgevoeligheid

Doel: de voordrukgevoeligheid van de drukregelaar testen.

<u>Beschrijving:</u>

Het instelpunt van de regelaar wordt ingesteld op 3 à 5% van het maximum debiet van de installatie en bij een inlaatdruk van 2,5 bar.

Het debiet wordt geregeld op 50% van het maximale debiet van de installatie.

De uitlaatdruk wordt ingesteld op 100 mbar.

De inlaatdruk wordt ingesteld op 7 bar.

De evolutie van de uitlaatdruk wordt nagegaan bij het langzaam laten dalen van de inlaatdruk tot 0 bar.

De volledige test wordt herhaald bij een uitlaatdruk van 21mbar.

Test	Instelpunt	Inlaatdruk	Uitlaatdruk	Test
9	3 à 5% van het maximum debiet – bij een inlaatdruk van 2,5bar.	7bar	100mbar	• Debiet ↗ tot ±50% van Qmax • Inlaatdruk ↘ 7bar naar 0bar • Evolutie Puit wordt gelogd.
10		7bar	21mbar	

<u>Weergave resultaten:</u> Alle gegevens worden zowel in tabelvorm als op grafiek weergegeven.