



**UN/ECE Technical Service No. E8/C and E27/J**

**TECHNICAL REPORT  
No. 120095 – 21 – TAC**

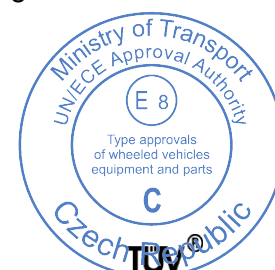
Test according to Regulation ECE No. 110.04

**I. Specific components of motor vehicles using compressed natural gas (CNG) in their propulsion system**

ECE No. 110.00 – date of entry into force: 2000-12-28  
including all amendments up to and including  
ECE No. 110.04, supplement 1 – date of entry into force: 2020-09-25

Objectives: Document for issue of approval certificate

- 0. Specific component** Pressure regulator with automatic valve
- I. Technical data**
- 0.1. Make (trade name of manufacturer): Rail
- 0.2. Type: TYRION
- 0.2.1. Variants: Outlet pressure from 2 to 8 bar
- 0.3. Means of identification of type: Manufacturer's label
- 0.3.1. Location of that marking: On the body of regulator
- 0.4. Class of component: 2
- 0.4.1. Additional symbol: "C"
- 0.5. Name and address of manufacturer: RAIL S.r.l.  
Via A. Grandi, 16  
42030 Vezzano sul Crostolo, Reggio Emilia,  
Italy
- 0.8. Address of assembly plant: See item 0.5.
- 0.9. Location of the approval mark: On the body of the pressure regulator



Technical Report No.:  
Regulation:  
Manufacturer:  
Type:

**TÜV SÜD Czech s.r.o.**  
120095 – 21 – TAC  
ECE No. 110.04  
RAIL S.R.L  
Tyrion



Czech

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## II. Test report

### 1. Test conditions

- 1.1. Test sample: Pressure regulator type TYRION
- 1.1.1. Technical data from the manufacturer: Working Pressure 26MPa  
Temperature range -40°C ÷ 120°C
- 1.2. Test procedures used: See the attachments
- 1.3. Measuring and test equipment: See the attachments
- 1.4. Worst case evaluation: The variants with max and low output pressure was tested
- 1.5. Testing conditions: See the attachments
- 1.6. Test track or site: See the attachments

### 2. Test results

The technical data and the test results are indicated in attachment to this Technical Report.

3. Specimen submitted to test on: 2020-11-10

4. Date of test: 2020-11-10 ÷ 2020-12-21



Technical Report No.: 120095 – 21 – TAC  
Regulation: ECE No. 110.04  
Manufacturer: RAIL S.R.L  
Type: Tyrion



Czech

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- III. **Manufacturer's information folder** Information document for the approval  
15 pages total of 2020-12-21
- IV. **Other documentation**  
No other documentation
- V. **Attachments**  
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The results presented above relate to the tested items only and to the sample as provided by the customer.

Measuring and test equipment and test site meet the requirements of the applicable legislation. This report shall never be reproduced incomplete and without a written permission of the testing laboratory. TÜV SÜD Czech confidentiality degree: confidential

VI. **Final assessment**

The described vehicle sample  
**complies**  
with the requirements of ECE Regulation No. 110.04  
for issue of approval certificate

This technical report consists of pages No. 1 to 3 and 12 pages of attachments.

Václav Baloun

Report author

Officially recognized expert

Prague, 2021-01-08

End of the technical report





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## Test Report

### PRESSURE REGULATOR

Tested and examined to: Annex 4D, Annex 4A - para. 2. and 4., Annex 4C, ECE Regulation 110

<b>Mark:</b>	RAIL
<b>Type:</b>	TYRION with: Automatic valve (class 0) Pressure relief valve (class 2/3) Filter (class 0)
<b>Manufacturer:</b>	RAIL S.r.l. Via A. Grandi, 16 42030 Vezzano sul Crostolo Reggio Emilia - Italy
<b>Samples:</b>	2 – MOD. 2 bar - No.: 1, 2 3 – MOD. 8 bar - No.: 3, 4, 5
<b>Date of the tests:</b>	20.11. 2020 - 21.12. 2020

<b>Classification of component:</b>	Class 0	Class 2	Class 3
<b>Classification pressure:</b>	26,000 kPa	200 kPa	800 kPa
<b>Pressure relief valve:</b>	370 kPa (class 2), 1,200 kPa (class 3)		
<b>Design temperatures:</b>	- 40°C to + 120°C		

#### General design rules:

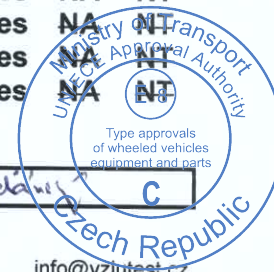
		Results		
Annex 4A, para. 2.3.	It must have the electrical system isolated from the body. Isolation resistance shall be >10 MΩ.	yes	NA	NT
Annex 4A, para. 2.4.	The valve shall be in „closed“ position when its power is switched off.	yes	NA	NT
Annex 4D, para. 2.2.	The materials constituting the regulator which are in contact with the heat exchange medium of the regulator when operating, shall be compatible with that fluid.	yes	NA	NT

#### Applicable test procedures according to Annex 5:

		Results		
5A. Overpressure test		yes	NA	NT
5B. External leakage test		yes	NA	NT
5C. Internal leakage test		yes	NA	NT
5D. CNG compatibility test		yes	NA	NT
5E. Corrosion resistance test		yes	NA	NT
5F. Resistance to dry-heat		yes	NA	NT
5G. Ozone ageing		yes	NA	NT
5H. Temperature cycle test		yes	NA	NT
5L. Durability test (Annex 4D, para. 2.4.; Annex 4A, para.: 2.2.3.)		yes	NA	NT
5N. Vibration resistance test		yes	NA	NT
5O. Operating temperatures		yes	NA	NT
5Q. Compatibility with heat exchange fluid		yes	NA	NT

Note: NA = not applicable, NT = not tested

<b>Date:</b> 21.12.2020	<b>Worked up by:</b> Žďánský	<b>Signature:</b>	<b>C</b>
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### Testing and measuring equipment

Testing equipment Reg. no. 7 – Freezer NZ 350/75  
 Testing equipment Reg. no. 13 – The source of hydraulic pressure with armoured housing  
 Testing equipment Reg. no. 24 – Furnace HS 122/1  
 Testing equipment Reg. no. 30 – Climatic chamber CSR – 70/500 CTS  
 Testing equipment Reg. no. 33 – High pressure compressor Astra 160/E  
 Testing equipment Reg. no. 34 – Hydro-pneumatic multiplier  
 Testing equipment Reg. no. 36 – High pressure test pump PI 1300  
 LDS vibration systém V850-440HBT 600  
 Corrosion chamber Erichsen-Corrotherm 610  
 Analytical balance KERN 770, Inv. No. 8946  
 Semi-laboratory balance Meopta, Inv. No. 321008  
 Universal oven drying Memmert, type ULP 600, Serial No.: g600.0150  
 Climatic chamber WK 111 with the ozone generator ANSEROS

Pressure gauge 0 - 60 MPa, accuracy 1.0, (serial no. 197705)  
 Pressure gauge 0 - 40 MPa, accuracy 1.6, (serial no. 237902MC)  
 Pressure gauge 0 - 40 MPa, accuracy 2.5, (serial no. 205312)  
 Pressure gauge 0 - 10 MPa, accuracy 1.0, (serial no. SM 419173)  
 Pressure gauge 0 - 4 MPa, accuracy 2.5, (serial no. RJ 734355)  
 Pressure gauge 0 - 1 MPa, accuracy 2.5, (serial no. OJ 156384)  
 Pressure gauge 0 - 600 kPa, accuracy 2.5, (serial no. LL 864736)  
 Pressure gauge 0 - 250 kPa, accuracy 2.5, (serial no. MB 190304)

### Annex 4A, para. 2.3.: Isolation resistance

	Requirement	Samples			
		1	2	3	4
Isolation resistance	> 10 MΩ	> 500 MΩ	> 500 MΩ	> 500 MΩ	> 500 MΩ

### Annex 5A: Overpressure test

Test pressure 39,000 kPa (class 0) during 3 minutes

	Requirement	Samples			
		1	2	3	4
Rupture	no	no	no	no	no
Permanent distortion	no	no	no	no	no

	Requirement	Samples			
		5			
Rupture	no	no			
Permanent distortion	no	no			

Test pressure 820 kPa (class 2) – No. 2 and 2,400 kPa (class 3) – No. 5 during 3 minutes

	Requirement	Samples			
		2	5		
Rupture	no	no	no		
Permanent distortion	no	no	no		

**Date:** 21.12.2020 **Worked up by:** Žďánský **Signature:**

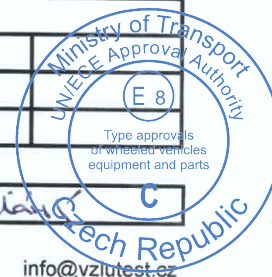
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**Annex 5B: External leakage test**

Test pressure 0 to 39,000 kPa (class 0) during 3 minutes

	Temperature	Requirement	Samples			
			1	2	3	4
External leakage	+ 20°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h
	- 40°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h
	+ 120°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

	Temperature	Requirement	Samples			
			5			
External leakage	+ 20°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h			
	- 40°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h			
	+ 120°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h			

Test pressure 0 to 820 kPa (class 2) – No. 2 and 0 to 2,400 kPa (class 3) – No. 5 during 3 minutes

	Temperature	Requirement	Samples			
			2	5		
External leakage	+ 20°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h		
	- 40°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h		
	+ 120°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h		

**Annex 5B, para. 5: High temperature test**

Test pressure 26,000 kPa (class 0), 200 kPa (class 2) – No.: 1, 2 and 800 kPa (class 3) – No.: 3, 4, 5 during 3 minutes by + 120°C (8 hours of tempering)

	Requirement	Samples			
		1	2	3	4
Leakage	≤ 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

	Requirement	Samples			
		5			
Leakage	≤ 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h			

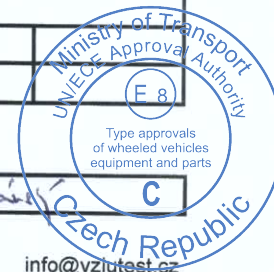
**Annex 5B, para. 6: Low temperature test**

Test pressure 26,000 kPa (class 0), 200 kPa (class 2) – No.: 1, 2 and 800 kPa (class 3) – No.: 3, 4, 5 during 3 minutes by - 40°C (8 hours of tempering)

	Requirement	Samples			
		1	2	3	4
Leakage	≤ 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

	Requirement	Samples			
		5			
Leakage	≤ 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h			

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**Annex 5C: Internal leakage test**

Seat leakage test of pressure relief valve (Annex 5C, para. 2.)

Test pressure 0 to 350 kPa (class 2) during 3 minutes

		Samples			
	Requirement	1			
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h			

Seat leakage test of pressure relief valve (Annex 5C, para. 2.)

Test pressure 0 to 1,200 kPa (class 3) during 3 minutes

		Samples			
	Requirement	3	4		
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h		

Seat leakage test of automatic valve (Annex 5C, para. 2.)

Test pressure 0 to 39,000 kPa (class 0) during 3 minutes

		Samples			
	Requirement	1	2	3	4
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

		Samples			
	Requirement	5			
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h			



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**Annex 5D: CNG compatibility test**

Samples:

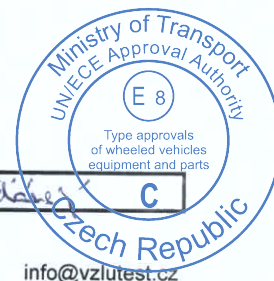
- 1 - O-ring 5.0 x 2.0 FPM ED 90 Sh - position 2
- 2 - Diaphragm - position 10
- 3 - O-ring 12.42 x 1.78 HNBR 70 Sh - position 12
- 4 - O-ring 41.0 x 1.78 V2N - position 15
- 5 - O-ring 15.0 x 1.8 FPM ED 90 Sh - position 16
- 6 - O-ring 7.5 x 1.5 VITON 80 Sh - position 21
- 7 - Seat sealing of pressure relief valve 5.2 x 2.7- position 25
- 8 - O-ring 10.82 x 1.78 FPM ED 90 Sh - position 29
- 9 - Seat sealing of automatic valve 5.5 x 2.2 - position 32
- 10 - O-ring 3.5 x 1.0 FKM GLT 85 Sh - position 34

	Requirement	Samples			
		1	2	3	4
Maximum change in volume	< 20 %	+ 2.67 %	+ 8.63 %	+ 7.53 %	+ 1.28 %
Change of mass after air tempering	≥ - 5 %	+ 0.05 %	- 4.83 %	- 2.25 %	+ 0.03 %

	Requirement	Samples			
		5	6	7	8
Maximum change in volume	< 20 %	+ 2.06 %	- 0.39 %	+ 1.71 %	+ 1.89 %
Change of mass after air tempering	≥ - 5 %	+ 0.03 %	- 0.04 %	- 0.03 %	+ 0.03 %

	Requirement	Samples			
		9	10		
Maximum change in volume	< 20 %	+ 4.42 %	+ 6.51 %		
Change of mass after air tempering	≥ - 5 %	- 0.07 %	- 0.05 %		

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**Annex 5E: Corrosion resistance test**

Salt spray (144 hours) according to ISO 15500-2 - Sample No.: 5

Immersion in Ammonia (24 hours) according to ISO 15500-2 - Sample No.: 2

	Requirement	Samples	
Cracking	no	2	no

Overpressure test (Annex 5A) after Corrosion resistance test

Test pressure 39,000 kPa (class 0) during 3 minutes

	Requirement	Samples	
Rupture	no	2	5
Permanent distortion	no	no	no

Test pressure 820 kPa (class 2) – No. 2 and 2,400 kPa (class 3) – No. 5 during 3 minutes

	Requirement	Samples	
Rupture	no	2	5
Permanent distortion	no	no	no

External leakage test (Annex 5B) after Corrosion resistance test

Test pressure 0 to 39,000 kPa (class 0) during 3 minutes

	Temperature	Requirement	Samples	
External leakage	+ 20°C	< 15 cm <sup>3</sup> /h	5	0 cm <sup>3</sup> /h
	- 40°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h
	+ 120°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

Test pressure 0 to 820 kPa (class 2) – No. 2 and 0 to 2,400 kPa (class 3) – No. 5 during 3 minutes

	Temperature	Requirement	Samples	
External leakage	+ 20°C	< 15 cm <sup>3</sup> /h	2	5
	- 40°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h
	+ 120°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

High temperature test (Annex 5B, para. 5) after Corrosion resistance test

Test pressure 26,000 kPa (class 0), 200 kPa (class 2) – No.: 2 and 800 kPa (class 3) – No.: 5 during 3 minutes by + 120°C (8 hours of tempering)

	Requirement	Samples	
Leakage	≤ 15 cm <sup>3</sup> /h	2	5
		0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

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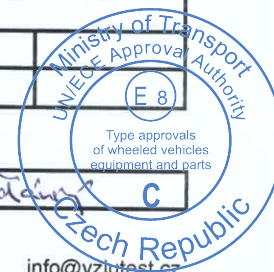
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Low temperature test (Annex 5B, para. 6) after Corrosion resistance test  
 Test pressure 26,000 kPa (class 0), 200 kPa (class 2) – No.: 2 and 800 kPa (class 3) – No.: 5  
 during 3 minutes by – 40°C (8 hours of tempering)

	Requirement	Samples			
		2	5		
Leakage	≤ 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h		

Seat leakage test of automatic valve (Annex 5C, para. 2.) after Corrosion resistance test  
 Test pressure 0 to 39,000 kPa (class 0) during 3 minutes

	Requirement	Samples			
		2	5		
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h		

**Annex 5F: Resistance to dry-heat**

Samples:

- 1 - O-ring 5.0 x 2.0 FPM ED 90 Sh - position 2
- 2 - O-ring 12.42 x 1.78 HNBR 70 Sh - position 12
- 3 - O-ring 41.0 x 1.78 V2N - position 15
- 4 - O-ring 15.0 x 1.8 FPM ED 90 Sh - position 16
- 5 - O-ring 7.5 x 1.5 VITON 80 Sh - position 21
- 6 - O-ring 10.82 x 1.78 FPM ED 90 Sh - position 29
- 7 - O-ring 3.5 x 1.0 FKM GLT 85 Sh - position 34

	Requirement	Samples			
		1	2	3	4
Allowable change in tensile strength	≤ + 25 %	+ 1.19 %	- 1.96 %	- 8.33 %	- 2.04 %
Allowable change in ultimate elongation	≤ + 10 % ≥ - 30 %	- 2.33 %	- 16.42 %	+ 2.12 %	+ 2.22 %

	Requirement	Samples			
		5	6	7	
Allowable change in tensile strength	≤ + 25 %	- 1.47 %	+ 2.86 %	- 4.17 %	
Allowable change in ultimate elongation	≤ + 10 % ≥ - 30 %	+ 2.04 %	- 1.79 %	+ 4.76 %	



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**Annex 5G: Ozone ageing**

Samples:

- 1 - O-ring 5.0 x 2.0 FPM ED 90 Sh - position 2
- 2 - Diaphragm - position 10
- 3 - O-ring 12.42 x 1.78 HNBR 70 Sh - position 12
- 4 - O-ring 41.0 x 1.78 V2N - position 15
- 5 - O-ring 15.0 x 1.8 FPM ED 90 Sh - position 16
- 6 - O-ring 7.5 x 1.5 VITON 80 Sh - position 21
- 7 - O-ring 10.82 x 1.78 FPM ED 90 Sh - position 29
- 8 - O-ring 3.5 x 1.0 FKM GLT 85 Sh - position 34

	Requirement	Samples			
		1	2	3	4
Cracking of test piece	no	no	no	no	no

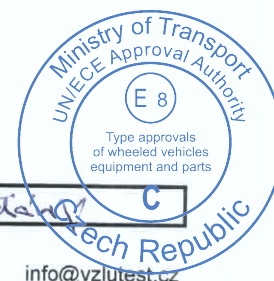
	Requirement	Samples			
		5	6	7	8
Cracking of test piece	no	no	no	no	no

**Annex 5Q: Compatibility with heat exchange fluids of non-metallic parts**

Samples:

- 1 - O-ring 41.0 x 1.78 V2N - position 15
- 2 - O-ring 7.5 x 1.5 VITON 80 Sh - position 21

	Requirement	Samples			
		1	2		
Maximum change in volume	< 20 %	+ 2.06 %	+ 2.99 %		
Change of mass after air tempering	≥ - 5 %	+ 1.21 %	+ 0.67 %		
Allowable change in tensile strength	≥ - 25 %	- 2.17 %	- 1.52 %		
Allowable change in ultimate elongation	≤ + 10 % ≥ - 30 %	+ 4.24 %	+ 2.08 %		



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**Annex 5L: Durability test (Annex 4D, para. 2.4.)**

Sample No.: 3

Total number of cycles: 50,000 cycles

Rate: 6 cycles/minute

Testing medium: air

		Samples	
	Requirement	3	
Damage	no	no	
Malfunction	no	no	

## a) Room temperature cycling

47,500 cycles at temperature + 20°C and at the pressure 20,000 kPa

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Temperature	Requirement	3
External leakage	+ 20°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

## b) Room temperature cycling

500 cycles at temperature + 20°C and at the pressure from 20,000 kPa to 10,000 kPa

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Temperature	Requirement	3
External leakage	+ 20°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

## c) High temperature cycling

500 cycles at temperature + 120°C and at the pressure 20,000 kPa

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Temperature	Requirement	3
External leakage	+ 120°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

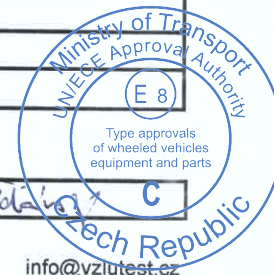
## d) High temperature cycling

500 cycles at temperature + 120°C and at the pressure from 20,000 kPa to 10,000 kPa

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Temperature	Requirement	3
External leakage	+ 120°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h



<b>Date:</b> 21.12.2020	<b>Worked up by:</b> Žďánský	<b>Signature:</b> <i>Zola</i>
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e) Low temperature cycling

500 cycles at temperature – 40°C and at the pressure 10,000 kPa

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Temperature	Requirement	3
External leakage	– 40°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

f) Low temperature cycling

500 cycles at temperature – 40°C and at the pressure from 10,000 kPa to 5,000 kPa

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Temperature	Requirement	3
External leakage	– 40°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

Seat leakage test of pressure relief valve (Annex 5C, para. 2.) after Durability test

Test pressure 0 to 1,200 kPa (class 3) during 3 minutes

		Samples	
	Requirement	3	
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	

Seat leakage test of automatic valve (Annex 5C, para. 2.) after Durability test

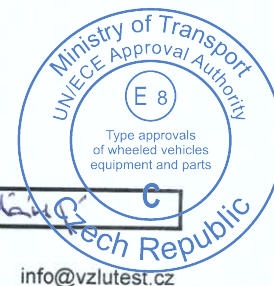
Test pressure 0 to 39,000 kPa (class 0) during 3 minutes

		Samples	
	Requirement	3	
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 800 kPa (class 3) during 3 minutes

		Samples	
	Temperature	Requirement	3
External leakage	+ 20°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h
	– 20°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h
	+ 120°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h



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**Annex 5L: Durability test (Annex 4A, para.: 2.2.3.)**

Sample No.: 1

Total number of cycles: 50,000 cycles

Rate: 6 cycles/minute

Testing medium: dry air

		Samples	
	Requirement	1	
Damage	no	no	
Malfunction	no	no	

a) Room temperature cycling

48,000 cycles at temperature + 20°C and at the pressure from 20,000 kPa to 10,000 kPa

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Temperature	Requirement	1
External leakage	+ 20°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

b) High temperature cycling

1,000 cycles at temperature + 120°C and at the pressure from 20,000 kPa to 10,000 kPa

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Temperature	Requirement	1
External leakage	+ 120°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

c) Low temperature cycling

1,000 cycles at temperature – 40°C and at the pressure from 20,000 kPa to 10,000 kPa

External leakage test (Annex 5B) after Durability test

Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Temperature	Requirement	1
External leakage	– 40°C	< 15 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h

Seat leakage test of automatic valve (Annex 5C, para. 2.) after Durability test

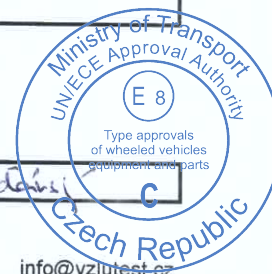
Test pressure 0 to 39,000 kPa during 3 minutes

		Samples	
	Requirement	1	
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	

Date: 21.12.2020

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Signature:





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**Annex 5N: Vibration resistance test**

Sample No.: 4  
Amplitude: 1,5 mm

Frequency: 17 Hz  
Total test time: 6 hours

	Requirement	Samples	
		4	
Damage	no	no	
Malfunction	no	no	

Seat leakage test of pressure relief valve (Annex 5C, para. 2.) after Vibration resistance test  
Test pressure 0 to 1,200 kPa (class 3) during 3 minutes

	Requirement	Samples	
		4	
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	

Seat leakage test of automatic valve (Annex 5C, para. 2.) after Vibration resistance test  
Test pressure 0 to 39,000 kPa (class 0) during 3 minutes

	Requirement	Samples	
		4	
Leakage	0 cm <sup>3</sup> /h	0 cm <sup>3</sup> /h	

Presented results are only applicable to samples, which have been tested.  
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**The test results and examinations according to ECE Regulation No. 110 were handed over to the TÜV SÜD Czech s.r.o., Novodvorská 994/138, 142 21 Praha 4. This Institute has authorised the VZLU TEST to carry out approval tests under the Contract of Agreement.**



Jindřich Žďánský  
Head of Hydraulics Testing Laboratory

Prague, 21 December 2020

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Director of VZLU TEST, a.s.

\*\*\*END OF TEST REPORT \*\*\*

Date: 21.12.2020	Worked up by: Žďánský	Signature: <i>J. Žďánský</i>
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