REPORT

issued by an Accredited Testing Laboratory

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Testing of PEX-pipe with protection pipe from Meltex

The revision concerns correcting the unit for the TOC-value in the hygienic tests.

Object

Pipe made from cross-linked polyethylene, PEX, with a protective pipe.

Date of delivery

2017-12-29

Supplier

Meltex Finland, Article number: 2013018 and 2015515

Dimension and marking

The following pipes were bought by RISE from the open market and were delivered to RISE Pipecenter in Gothenburg.

Dimension	Marking
Ø 15x2.5 mm	MO59 PEXGOL PE-Xa 15x2,5 D1 DIN 16892/3 EN ISO 15875 class 2-10 bar tmax 95°C No. 142401 14.12.17
Blue protection pipe	MC NW 23/28 KIWA KOMO K11 488 119833 0678

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TEST PROCEDURES

The following mechanical and hygienic testing has been performed.

Mechanical testing

All of the mechanical tests except the exchangeability has been performed by RISE Pipe Center in Gothenburg. The exchangeability test has been performed by RISE in Borås.

Characteristics	Method standard	Accreditation EN ISO 17025
Geometrical characteristics and ovality	EN ISO 3126	Yes
Hydrostatic pressure test	ISO 1167	Yes
Elongation at break	ISO 6259-1, ISO 6259-3	Yes
Longitudinal reversion	EN ISO 2505	Yes
Cross-linking level	EN 579	Yes
Flexibility*	Measuring of force required to bend the pipe	No
Necking at tensile*	Measuring of necking force CSTB 3597, version 2007	No
Burst testing	ASTM D1599	No
Exchangeability *	Nordtest NT VVS 129 (6.4.13 and 6.4.14)	Yes

* Detailed test description below.

Hygienic testing

RISE has anonymized the pipes and sent samples to *Hygiene-Institut des Ruhrgebiets* in Germany for accredited Hygien tests according to the table below and the KTW Guideline, issue date 2016-03-07.

Evaluated property	Standards and guidelines	Comment
Colour	SOP 14.5, 2008-11	Tests were performed at both 23 and 60 °C for 31 days.
Turbidity	SOP 14.5, 2008-11	
Tendency to foam formation	SOP 14.5, 2008-11	
Threshold odour number (TON)	DIN EN 1622, 2006-10	
Threshold flavour number (TFC)	DIN EN 1622, 2006-10	
Total organic carbon (TOC)	DIN EN 1484, 1997-08	
2,5-Dimethyl-3-hexyne-2,5-diol CAS 142-30-3	Hygien institute In-house method (GC-MS)*	

*These results are not accredited.

Flexibility

The main steps in the procedure were as following and the purpose was to evaluate the force needed to bend the pipe during pipe installation:

1. Cutting out a sample of pipe having a length of 1570 ± 3 mm.
2. Condition at ambient temperature 23± 2 °C.
3. Bending the pipe into a ring along the pre-curvature.
4. Insertion of the pipe ring into a tensile tester.
5. Pre-testing, compress the pipe ring to force 5 N at speed 50 mm/minute.
6. Reset load and position measurement.
7. Testing, compress the pipe 100 mm at 200 mm/minute and record the final force.

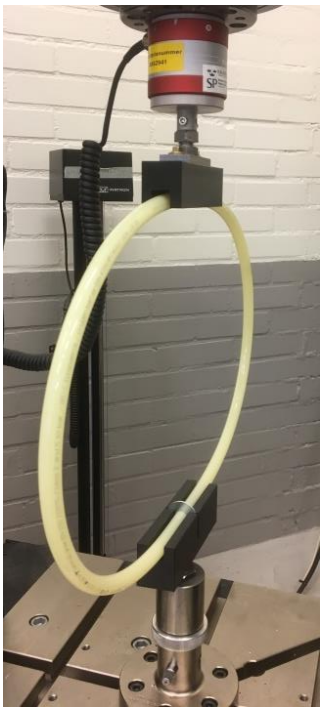

Figure 1 Generic picture of flexibility testing.

Necking at tensile

The test pieces for this tests are whole pipes approximately 10-12 cm long.
The testing speed is chosen according to test procedure according to CSTB 3597 Version 2007 clause 8. The main steps in the test procedure are as following:

1. Mount one test piece in a tensile testing machine.
2. Measure the force while the pipe is elongated, 100 mm/min.
3. Record the force at necking of the pipe, i.e the yield point of the material.

Burst testing

The burst testing are performed at 80 ± 2 °C in a water bath. The pressure was ramped during 60 seconds according to the table below. The aim was to find in which test case the pipe failed and record the pressure at failure. What constitutes a failure are described in ASTM D1599-99 clause 5. Five samples were used for each test case.

Test case	Nominal outside diameter mm	Nominal minimum wall thickness mm	Hoop stress at 60 seconds MPa	Pressure at 60 seconds bar	Rate of loading bar/s
1	15	2.4	5.25	20.00	0.33
2	15	2.4	7.88	30.00	0.50
3	15	2.4	10.5	40.00	0.67

TEST RESULTS

Measurement uncertainty

Reported uncertainty corresponds to an approximate 95 % confidence interval around the measured value. The interval has been calculated in accordance with EA-4/16 (EA guidelines on the expression of uncertainty in quantitative testing), which is normally accomplished by quadratic addition of the actual standard uncertainties and multiplication of the resulting combined standard uncertainty by the coverage factor k=2. The results apply only to the tested objects.

Geometrical characteristics

Test no	Mean outside diameter mm	Out of roundness mm	Wall thickness min. mm	Wall thickness max. mm
Ø 15x2.5 mm				
1	15.2	0.2	2.55	2.65
2	15.2	0.2	2.55	2.60
3	15.2	0.2	2.55	2.65

Test method: *EN ISO 3126:2005*
The measurements were performed at 23 ± 2 °C with equipment with the following accuracy
Wall thickness: *0.01 mm*
Diameter: *0.1 mm*
Length: *0.1 mm*
Date of test: *2018-02-01*

Resistance to internal pressure

The results from hydrostatic pressure testing are associated with a big uncertainty of the method. The actual temperature, pressure and wall thickness have a very significant effect on the rupture time. The uncertainty originating from the geometrical measurement is especially big for pipes with a small wall thickness. To decrease the statistical uncertainty of the time to rupture at the specified hoop stress, a wider testing with several more samples needs to be performed.

Test no	Hoop stress MPa	Test temp. °C	Test pressure MPa	Time to rupture h	Requirement h
Ø 15x2.5 mm					
1	4.7	95	1.893	>400	>22
2	4.7	95	1.893	>400	>22
3	4.7	95	1.893	>400	>22

The tests were interrupted without any failures. The tested pipes have fulfilled the requirement regarding time to rupture in EN ISO 15875-2:2003.

Pressure test method: *EN ISO 1167-1:2006, End caps of type A*
Dimension measurement method: *EN ISO 3126:2005*
The test conditions parameters were:
Free length between the end caps: *400 mm*
Conditioning time: *1 h*
Internal/External medium: *Water/water*
Time to achieve the pressure: *<5 minutes*
Test temperature: *± 0.3 °C*
Test pressure: *± 0.7 %*
Date of test: *2018-02-02 –03-09*

Elongation at break

Test no	Test piece	Testing speed mm/minute	Stress at yield MPa	Results %
Ø 15x2.5 mm				
1	Cutted Type 2	100	19.7	462
2		100	19.1	428
3		100	19.1	437
4		100	19.7	446
Average			19.4	443

Test method: *ISO 6259-1:2015*
Test piece chosen according to: *ISO 6259-3:1997 and ISO 6259-3:2015*
Test temperature: *23 ± 2 °C*
The calculated uncertainty at determination of elongation at break is <10 %-units
Date of test *2018-01-25*

Longitudinal reversion

The tests were performed in air and only in two points due to the pipe curvature.

Test no	Testing time	Length variation			Longitudinal reversion
	minutes	before mm	after mm	difference mm	%
Ø 15x2.5 mm					
1	60	98.6	97.3	-1.3	1.3
2	60	98.1	96.9	-1.2	1.2
3	60	97.8	96.7	-1.1	1.1
Average					1.2

No bubbles or cracks were observed after the test.

Test method: *EN ISO 2505:2005*
Test temperature: *120 ± 1 °C*
The calculated uncertainty for longitudinal reversion is <0.2 %-units.
Date of test: *2018-02-02*

Degree of crosslinking

Dimension	Sample no	Measured crosslinking %
Ø 15x2.5 mm	1	73
	2	77
	Average	75

Test method: *EN 579:1993*
Weighting uncertainty: *0.1 mg*
Date of test: *2018-02-21*

Flexibility

Test no	Test piece	Testing speed mm/minute	Force at end of test N
Ø 15x2.5 mm			
1	See figure 1	200	28.3
2		200	28.0
3		200	27.9
Average			28.1

Test method: *See test procedures, page 3*
Test temperature: *23 ± 2 °C*
The calculated uncertainty for the force measurement is <1%
Date of test *2018-03-07*

Necking at tensile,

The stress at necking are calculated from nominal pipe dimensions.

Test no	Test piece	Testing speed mm/minute	Necking force N	Stress at necking MPa
Ø 15x2.5 mm				
1	10-12 cm pipe	100	1811	18.5
2		100	1787	18.2
3		100	1795	18.3
Average			1798	18.3

Test method: *See test procedures, page 3*
Test temperature: *23 ± 2 °C*
The calculated uncertainty for the force measurement is <1%
Date of test *2018-01-25*

Burst testing

The hoop stress is calculated from nominal pipe dimensions.

Test no	Critical test case	Rate of loading bar/s	Max pressure before burst bar	Max hoop stress before burst MPa
Ø 15x2.5 mm				
1	Case 3	0.67	30.2	7.55
2		0.67	31.8	7.95
3		0.67	32.1	8.03
4		0.67	32.2	8.05
5		0.67	31.9	7.98
Average			31.6	7.91

Test method: *ASTM D1599-99, see test procedures, page 4*
Test temperature: *81 ± 1 °C*
Conditioning time: *1 h*
Internal/External medium: *Water/water*
The calculated uncertainty for the burst pressure measurement is <5%
Date of test *March 2018*

Exchangeability

The following additional products were used in addition to the PEX-pipe and protection pipe:

Product	Reference number
Roth quickbox	RSK 187 67 71

Installation method: *Byggforsk Vannskadekontoret Rör-i-rör-systemer Lommehåndbok, utgåva 2, daterad 2006*
Lubrication: No

Result: No leakage in the subsequent leakage test.

Test method: *Nordtest NT VVS 129 clause 6.4.13 and 6.4.14*
Test set up: *Figure 6 in NT VVS 129*
Test temperature: *23 ± 2 °C*
Date of test *January 2018*

Hygienic testing

The following results were reported to RISE by *Hygene-Institut des Ruhrgebiets* 2018-03-29. The reference number for the report was *K-296510-18-Ä-Ko*, and report date: 2018-03-28.

Parameter	Method	Cold water test (23 °C)		Warm water test (60 °C)	
		10 days	31 days	10 days	31 days
Colour	SOP 14.5, 2008-11	Colourless	Colourless	Colourless	Colourless
Turbidity	SOP 14.5, 2008-11	Clear	Clear	Clear	Clear
Tendency to foam formation	SOP 14.5, 2008-11	None	None	None	None
Threshold odour number (23°C)	DIN EN 1622, 2006-10	25	16	25	3
Threshold flavour number (23°C)	DIN EN 1622, 2006-10	-	-	-	3
Total organic carbon (TOC) [Ctap mg/l]	DIN EN 1484, 1997-08	0.90	0.77	1.5	<0.05
2,5-Dimethyl-3-hexyne-2,5-diol CAS 142-30-3 [Ctap µg/l]	Hygien institute In-house method (GC-MS)	<0.2	<0.2	<0.6	<0.6

Date of test *2018-01-16 – 2018-02-21*

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