Report No.: **R17 03 3198-A_ACT**

Subject: **Full Notch Creep Tests (FNCT) under ACT conditions on specimens from a multilayer pipe (Type 2, 3-layer according to PAS 1075) OD 160 x 9.5 mm (SDR 17) made from BorSafe™ HE3490-LS-H (Supervision audit 1/2017)**

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Date: 16.06.2017
Responsible for test: D. Cormann
Author: Dipl. Ing. (FH) J. Akopjan
Managing director: Dr.-Ing. J. Hessel

The test results in this report relate only to the items tested.
Further test specifications can be found in the documentation of testing.
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Digitally signed by Buzdugan Valeria
Date: 2021.08.05 23:16:17 EEST
Reason: MoldSign Signature
Location: Moldova

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1 Preliminary Remarks

The objective of the investigation is the determination of the resistance to slow crack growth of pipes using the Full Notch Creep Test (FNCT) under ACT-conditions according to PAS 1075 [1].

The FNCT represents an accelerated test method which allows the assessment of polymeric materials with respect to their stress-crack behaviour.

The pipe was sampled for retesting by MPA Darmstadt (MPA Darmstadt CERT Reg.-No. K1621 / 10.2015 / K1366 / 01.2013 / K1367 / 01.2013, K1622 / 10.2015 / K1464 / 09.2013, K1465 / 09.2013, Pipes for water distribution made of polyethylene with enhanced stress crack resistance (PE 100-RC) for alternative installation techniques, manufacturing group 14/15/16, type 1/2).

2 Basics of the Investigation

[1] PAS 1075 (2009-04) — Pipes made from Polyethylene for alternative installation techniques – Dimensions, technical requirements and testing, Beuth Verlag GmbH, Berlin, Germany

[2] R16 02 3051-G-P (22.07.2016) — Test certificate of raw material batch 20B11724 made from BorSafe™ HE 3490-LS-H, HESSEL Ingenieurtechnik GmbH, Roetgen, Germany

[3] EN 12814-3 (2014-07) — Testing of welded joints in thermoplastics semi-finished products — Part 3: Tensile creep test, Annex A: Resistance to slow crack growth, Beuth Verlag GmbH, Berlin, Germany

[4] PA ACT 2.1-9 (2013-09) — Accelerated Creep Test (ACT) - Accelerated test method to verify the creep rupture strength of polyolefins (validation included), internal instruction for testing of HESSEL Ingenieurtechnik GmbH, Roetgen, Germany

[5] DVS 2203-4 Supplement 2 (2016-09) — Testing of welded joints of thermoplastic panels and pipes – Tensile creep test for resistance to slow crack growth in the full notch creep test (FNCT), DVS Media GmbH, Düsseldorf, Germany

3 Test sample

A black multilayer pipe (Type 2, 3-layer according to PAS 1075 [1]) OD 160 x 9.5 mm (SDR 17) with 4 blue stripes on the outside was provided by Konti Hidroplast in Gevgelija, Republic of Macedonia and arrived at HESSEL Ingenieurtechnik on 24.02.2017. The pipe is characterised as described in table 1.

Sample	Layer	Resin	Batch	Colour	Certificate of Batchcontrol
A	outside	BorSafe™ HE3490-LS-H	20B11724	black	R16 02 3051-G-P [2]
	centre	BorSafe™ HE3494-LS-H	5160454	blue	R16 01 3098-B-P
	inside	BorSafe™ HE3490-LS-H	20B11724	black	R16 02 3051-G-P [2]

Table 1: Test Sample

4 Specimen Preparation and Testing Conditions

Specimens with parallel sides and square cross-sections (10 mm x 10 mm) were machined in axial direction from the pipe. Each specimen was notched perpendicular to the parallel sides in middle of the test specimen (figure 1).

The tensile creep rupture tests were performed on 3 notched specimens following EN 12814-3 Annex A [3] and the test instruction PA ACT 2.1-9 [4] using a solution of NM5[1] in demineralised water (2/100, w/w) at (90 ± 0.5) °C. The specimens were loaded by a constant tensile stress of (4.00 ± 0.02) N/mm² related to the remaining un-notched cross-sections (ligament-area). The creep rupture times were recorded.

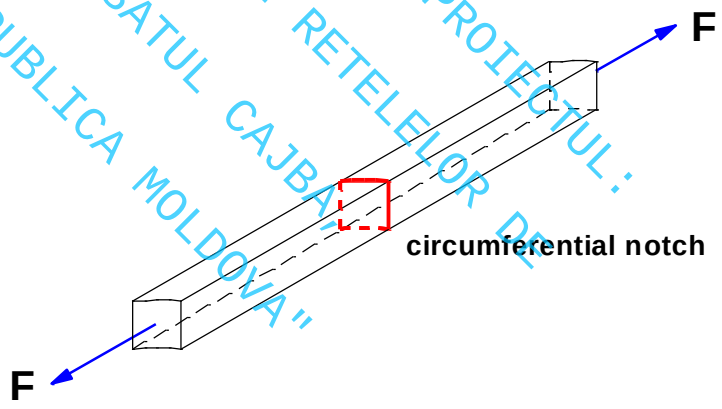

Figure 1: FNCT-specimen under constant load

1 Mixture of anionic and cationic detergents

5 Test Results

The results of the tested specimens are given in table 2. The creep rupture times were statistically evaluated according to DVS 2203-4 supplement sheet 2 [5].The fracture surfaces of the specimens after the tests are shown in figure 2.

Specimen-designation	Rupture time [h]	Geometric mean value [h]	Scattering-factor	Remark
A1	779.71	710.15	1.093 (9.3 %)	Percentage of brittle fracture surface related to the ligament-area > 30 %
A2	702.70			
A3	653.66			

Table 2: Results of tensile creep tests on notched specimens (ACT) in an aqueous solution of 2 % NM5 at 90 °C and 4 N/mm²

specimen A1 specimen A2 specimen A3

Figure 2: Top view of the fracture surfaces (one half of each specimen)

6 Conclusion

The tested specimens from a multilayer pipe (Type 2, 3-layer according to PAS 1075) OD 160 x 9.5 mm (SDR 17) made from BorSafe™ HE 3490-LS-H meet the requirement of 160 hours in the the Full Notch Creep Test under ACT conditions.

Report No.: **R17 03 3198-B_ACT**

Subject: **Full Notch Creep Tests (FNCT) under ACT conditions on specimens from a multilayer pipe (Type 2, 3-layer according to PAS 1075) OD 250 x 14.8 mm (SDR 17) made from BorSafe™ HE3490-LS-H (Supervision audit 1/2017)**

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Information regarding accreditation, certification, recognition as testing laboratory and further official recognition will be provided on written request.

Date: 16.06.2017
Responsible for test: D. Cormann
Author: Dipl. Ing. (FH) J. Akopjan
Managing director: Dr.-Ing. J. Hessel

The test results in this report relate only to the items tested.
Further test specifications can be found in the documentation of testing.

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1 Preliminary Remarks

The objective of the investigation is the determination of the resistance to slow crack growth of pipes using the Full Notch Creep Test (FNCT) under ACT-conditions according to PAS 1075 [1].

The FNCT represents an accelerated test method which allows the assessment of polymeric materials with respect to their stress-crack behaviour.

The pipes were sampled for retesting by MPA Darmstadt (MPA Darmstadt CERT Reg.-No. K1621 / 10.2015 / K1366 / 01.2013 / K1367 / 01.2013, K1622 / 10.2015 / K1464 / 09.2013, K1465 / 09.2013, Pipes for water distribution made of polyethylene with enhanced stress crack resistance (PE 100-RC) for alternative installation techniques, manufacturing group 14/15/16, type 1/2).

2 Basics of the Investigation

[1] PAS 1075 (2009-04) — Pipes made from Polyethylene for alternative installation techniques – Dimensions, technical requirements and testing, Beuth Verlag GmbH, Berlin, Germany

[2] R16 02 3051-G-P (22.07.2016) — Test certificate of raw material batch 20B11724 made from BorSafe™ HE 3490-LS-H, HESSEL Ingenieurtechnik GmbH, Roetgen, Germany

[3] EN 12814-3 (2014-07) — Testing of welded joints in thermoplastics semi-finished products — Part 3: Tensile creep test, Annex A: Resistance to slow crack growth, Beuth Verlag GmbH, Berlin, Germany

[4] PA ACT 2.1-9 (2013-09) — Accelerated Creep Test (ACT) - Accelerated test method to verify the creep rupture strength of polyolefins (validation included), internal instruction for testing of HESSEL Ingenieurtechnik GmbH, Roetgen, Germany

[5] DVS 2203-4 Supplement 2 (2016-09) — Testing of welded joints of thermoplastic panels and pipes – Tensile creep test for resistance to slow crack growth in the full notch creep test (FNCT), DVS Media GmbH, Düsseldorf, Germany

3 Test sample

Black multilayer pipe (Type 2, 3-layer according to PAS 1075 [1]) OD 250 x 14.8 mm (SDR 17) with 4 blue stripes on the outside was provided by Konti Hidroplast in Gevgelija, Republic of Macedonia and arrived at HESSEL Ingenieurtechnik on 24.02.2017. The pipe is characterised as described in table 1.

Sample	Layer	Resin	Batch	Colour	Certificate of Batchcontrol
B	outside	BorSafe™ HE3490-LS-H	20B11724	black	R16 02 3051-G-P [2]
	centre	BorSafe™ HE3494-LS-H	5160454	blue	R16 01 3098-B-P
	inside	BorSafe™ HE3490-LS-H	20B11724	black	R16 02 3051-G-P [2]

Table 1: Test Sample

4 Specimen Preparation and Testing Conditions

Specimens with parallel sides and square cross-sections (10 mm x 10 mm) were machined in axial direction from the inside wall of the pipe. Each specimen was notched perpendicular to the parallel sides in middle of the test specimen (figure 1).

The tensile creep rupture tests were performed on 3 notched specimens following EN 12814-3 Annex A [3] and the test instruction PA ACT 2.1-9 [4] using a solution of NM5[1] in demineralised water (2/100, w/w) at (90 ± 0.5) °C. The specimens were loaded by a constant tensile stress of (4.00 ± 0.02) N/mm² related to the remaining un-notched cross-sections (ligament-area). The creep rupture times were recorded.

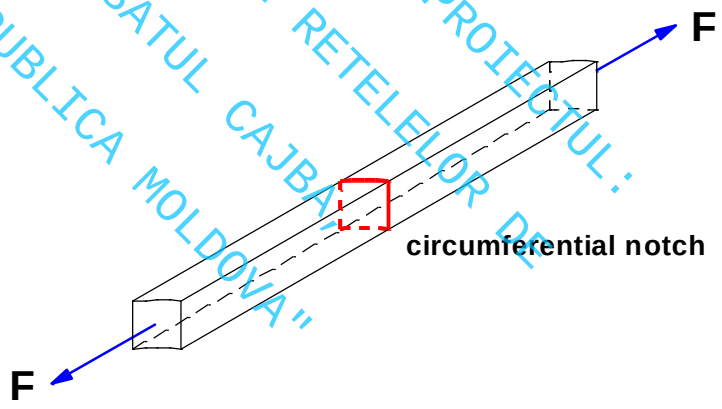


Figure 1: FNCT-specimen under constant load

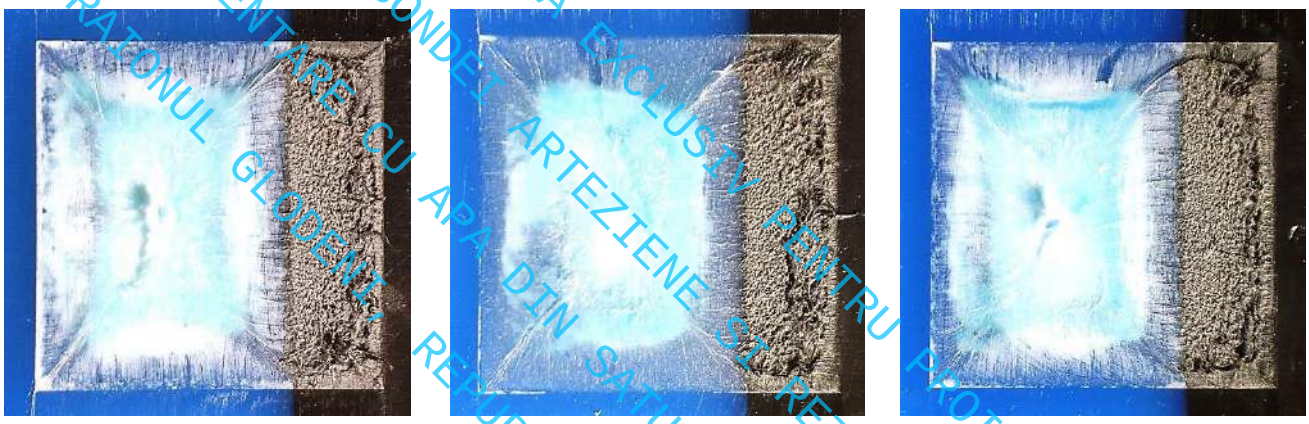
1 Mixture of anionic and cationic detergents

5 Test Results

The results of the tested specimens are given in table 2. The creep rupture times were statistically evaluated according to DVS 2203-4 supplement sheet 2 [5]. The fracture surfaces of the specimens after the tests are shown in figure 2.

Specimen-designation	Rupture time [h]	Geometric mean value [h]	Scattering-factor	Remark
B1	1352.51	1207.62	1.145 (14.5 %)	Percentage of brittle fracture surface related to the ligament-area > 30 %
B2	1252.95			
B3	1039.24			

Table 2: Results of tensile creep tests on notched specimens (ACT) in an aqueous solution of 2 % NM5 at 90 °C and 4 N/mm²



specimen B1 specimen B2 specimen B3

Figure 2: Top view of the fracture surfaces (one half of each specimen)

6 Conclusion

The tested specimens from a multilayer pipe (Type 2, 3-layer according to PAS 1075) OD 250 x 14.8 mm (SDR 17) made from BorSafe™ HE 3490-LS-H meet the requirement of 160 hours in the Full Notch Creep Test under ACT conditions.

Report No.: **R19 02 3618-B_Scratch**

Subject: **External Protective Layer Scratch Test according to Annex A6 of PAS 1075 on a Type 3 pipe OD 110 x 10 mm (SDR 11) made from BorSafe™ HE3490-LS-H (Type Test)**

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Date: 26.03.2019
Responsible for test: R. Cárdenas
Author: Dipl. Ing. (FH) J. Grieser
Managing director: Dr.-Ing. J. Hessel

The test results in this report relate only to the items tested.
Testing and evaluation of test results have been carried out in the period of time from 30.01.2019 (installation of samples) to 26.03.2019 (reporting).
Further test specifications can be found in the documentation of testing.

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1 Preliminary Remarks

The objective of the investigation is the determination of the scratch depth into the surface of a protective layer after a defined blade has scratched the Type 3 pipe under constant load and speed. The External Protective Layer Scratch Test is described in Annex A6 of PAS 1075 [1].

The pipes with an additional external protective layer (Type 3 according to PAS 1075) were sampled for the initial approval according to the certification program ZP 424 [2] by Dark Heisel from MPA Darmstadt (Report-no. K 18 …).

2 Basics of the Investigation

[1]	PAS 1075 (2009-04)	Pipes made from Polyethylene for alternative installation techniques – Dimensions, technical requirements and testing, Annex A 6: Description of the External Protective Layer Scratch Test, Beuth Verlag GmbH, Berlin, Germany
[2]	ZP-424 (16.08.2018)	Certification program ZP 424, Issue 5, Polyethylene pipes for alternative installation techniques based on PAS 1075:2009-04, Staatliche Materialprüfungsanstalt Darmstadt
[3]	ZP 14.23.39 (2017-05)	Certification scheme "Plastic pipe system (pressure pipes and fittings)", Edition: March 2015, Annex O: ZP 14.23.39 - Pressure pipes made from Polyethylene (PE) for alternative installation techniques – PE 100-RC, DIN CERTCO, Berlin, Germany
[4]	R18 02 3443-R-P (17.05.2018)	Test certificate of raw material batch 20B12873 made from BorSafe™ HE3490-LS-H, HESSEL Ingenieurtechnik GmbH, Roetgen, Germany
[5]	PA SMR 2.5-3 (2013-09)	External protective layer scratch test according to PAS 1075, Annex A6, internal instruction for testing of HESSEL Ingenieurtechnik GmbH, Roetgen, Germany

3 Test sample

Black plain solid wall pipes OD 110 x 10 mm (SDR 11) with an additional external protective layer (Type 3 according to PAS 1075) were provided by Konti Hidroplast in Gevgelija, Republic of North Macedonia and arrived at HESSEL Ingenieurtechnik on 14.01.2019. The pipes are characterised as described in table 1 and 2.

Sample	Layer[1)]	Raw material[1)]	Material batch[1)]	Colour	Measured wall-thickness [mm]	Number of pipes	Pipe Length [m]
3618-B	inside	BorSafe™ HE3490-LS-H	20B12873	black	10.44 … 11.04	8	1.2
	additional external	BorECO™ BA212E	63180238	blue	1.33 … 1.51		

Table 1: Test sample

The BorSafe batch 20B12873 was tested at HESSEL Ingenieurtechnik and meet the requirement of 400 hours in the Full Notch Creep Test (FNCT) under ACT conditions for PE 100-RC materials according to the DIN CERTCO certification scheme [3], proved by the test certificate R18 02 3443-R-P [4].

Sample	Signature
3618-B	= 2426/ 2427/ 2428/ 2429/ 2433 / 2438/ 2439/ 2456 = KONTI HIDROPLAST MACEDONIA DVGW TW DIN EN 12201-2 PN16 PE 100 RC T Y P E 3 PP PEELABLE LAYER SDR 11 ø110 X 10.0 GRAD B 1 0 1 8 0 6 3 4 3

Table 2: Signature on the outside surface of the pipe sample

4 Specimen Preparation and Testing Conditions

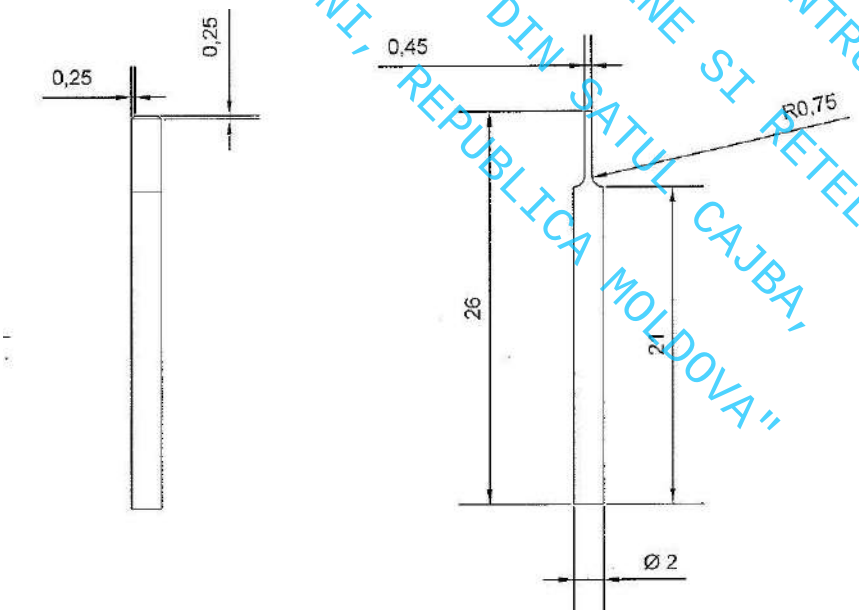

Figure 1: Blade geometry

1) Information according to the sample submission form of MPA Darmstadt

The cratch tests were performed according to Annex A6 of PAS 1075 and the test instruction PA SMR 2.5-3 [5] of HESSEL Ingenieurtechnik on 3 samples. The scratch depth of the blade (figure 1) into the surface of the external layer was measured at a distance of 600 mm from the starting point. The general test parameters are characterised as described in table 3 and 4.

Parameter	Value	Unit
Scratch speed	100	mm/min
Minimum scratch length	600	mm

Table 3: Test parameters

Pipe Diameter	Weight	Unit
32 - 90 mm	4	kg
110 – 160 mm	6	kg
> 180 mm	12	kg

Table 4: Load of the blade

5 Test Results

The applied load and the measured scratch depth of the blade into the protective layer at a distance of 600 mm from the starting point are given in table 5.

Sample No.	Load of the Blade [kg]	External protective layer thickness before testing [mm]	Residual thickness [mm]	Scratch depth of the blade [mm]	Scratch depth of the blade [%]
B.1	6	1,287	1,265	0,022	1,7
B.2	6	1,398	1,380	0,018	1,3
B.3	6	1,214	1,197	0,017	1,4
Mean value	6	1,300	1,281	0,019	1,5

Table 5: Results of the protective layer scratch tests

The measured thickness of the selected protective layers is between 1.21 and 1.40 mm, which is above the minimum requirement (≥ 0.8 mm) according to PAS 1075, Annex A6.

The measured scratch depth of the blade after the tests is between 1.3 % and 1.7 % of the original thickness of the external protective layer and does not exceed the requirement of 75% of the original thickness according to PAS 1075, Annex A6.

6 Conclusion

The tested Type 3 pipe OD 110 x 10 mm (SDR 11) made from BorSafe™ HE3490-LS-H met the requirements in the "External Protective Layer Scratch Test" according to Annex A6 of PAS 1075.

Report No.: **R19 02 3618-B2_ACT**

Subject: **Full Notch Creep Tests (FNCT) under ACT conditions on specimens from a pipe OD 110 x 10 mm (SDR 11) made from BorSafe™ HE3490-LS-H with an external protective PP-layer (Type 3 according to PAS 1075)**

(Type Test)

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Information regarding accreditation, certification, recognition as testing laboratory and further official recognition will be provided on written request.

Date: 25.03.2019
Responsible for test: R. Cárdenas
Author: Dipl. Ing. (FH) J. Grieser
Managing director: Dr.-Ing. J. Hessel

The test results in this report relate only to the items tested.
Testing and evaluation of test results have been carried out in the period of time from 05.02.2019 (installation of samples) to 25.03.2019 (reporting).
Further test specifications can be found in the documentation of testing.

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1 Preliminary Remarks

The objective of the investigation is the determination of the resistance to slow crack growth of pipes using the Full Notch Creep Test (FNCT) under ACT-conditions according to PAS 1075 [1].

The FNCT represents an accelerated test method which allows the assessment of polymeric materials with respect to their stress-crack behaviour.

The pipes with an additional external protective layer (Type 3 according to PAS 1075) were sampled for the initial approval according to the certification program ZP 424 [2] by Dark Heisel from MPA Darmstadt (Report-no. K 18 …).

2 Basics of the Investigation

[1] PAS 1075 (2009-04) — Pipes made from Polyethylene for alternative installation techniques – Dimensions, technical requirements and testing, Beuth Verlag GmbH, Berlin, Germany

[2] ZP-424 (16.08.2018) — Certification program ZP 424, Issue 5, Polyethylene pipes for alternative installation techniques based on PAS 1075:2009-04, Staatliche Materialprüfungsanstalt Darmstadt

[3] ZP 14.23.39 (2017-05) — Certification scheme "Plastic pipe system (pressure pipes and fittings)", Edition: March 2015, Annex O: ZP 14.23.39 - Pressure pipes made from Polyethylene (PE) for alternative installation techniques – PE 100-RC, DIN CERTCO, Berlin, Germany

[4] R18 02 3443-R-P (17.05.2018) — Test certificate of raw material batch 20B12873 made from BorSafe™ HE3490-LS-H, HESSEL Ingenieurtechnik GmbH, Roetgen, Germany

[5] EN 12814-3 (2014-07) — Testing of welded joints in thermoplastics semi-finished products — Part 3: Tensile creep test, Annex A: Resistance to slow crack growth, Beuth Verlag GmbH, Berlin, Germany

[6] DVS 2203-4 Supplement 2 2016-09 — Testing of welded joints of thermoplastic panels and pipes – Tensile creep test for resistance to slow crack growth in the full notch creep test (FNCT), DVS Media GmbH, Düsseldorf, Germany

[7] PA ACT 2.1-9 (2013-09) — Accelerated Creep Test (ACT) - Accelerated test method to verify the creep rupture strength of polyolefins (validation included), internal instruction for testing of HESSEL Ingenieurtechnik GmbH, Roetgen, Germany

3 Test sample

A black plain solid wall pipe OD 110 x 10 mm (SDR 11) with an additional external protective PP-layer (Type 3 according to PAS 1075) was provided by Konti Hidroplast in Gevgelija, Republic of North Macedonia and arrived at HESSEL Ingenieurtechnik on 14.01.2019. The pipe is characterised as described in table 1.

Sample	Layer[1)]	Raw material[1)]	Material batch[1)]	Colour	Measured wall-thickness [mm]	Number of pipes	Pipe Length [m]
3618-B2	inside	BorSafe™ HE3490-LS-H	20B12873	black	10.44 … 11.04	1	0.2
	additional external	BorECO™ BA212E	63180238	blue	1.33 … 1.51		

Table 1: Test sample

The BorSafe batch 20B12873 was tested at HESSEL Ingenieurtechnik and meet the requirement of 400 hours in FNCT under ACT conditions for PE 100-RC materials according to the DIN CERTCO certification scheme [3], proved by the test certificate R18 02 3443-R-P [4].

4 Specimen Preparation and Testing Conditions

Specimens with a width of 10 mm were machined from the pipe with parallel sides in axial direction. The thickness of the specimens corresponds to the thickness of the pipe at the sampling location (10.4 … 11.0 mm) without external protective layer which has been removed from the specimens before measuring. Each specimen was notched perpendicular to the parallel sides' in middle of the test specimen (figure 1). The tensile creep rupture tests were performed on 3 notched specimens following EN 12814-3 Annex A [5], supplement 2 [6] of the technical code DVS 2203 4 and the test instruction PA ACT 2.1-9 [7] using a solution of NM5[2)] in de-mineralised water (2/100, w/w) at (90 ± 0.5) °C. The specimens were loaded by a constant tensile stress of (4.00 ± 0.02) N/mm² related to the remaining un-notched cross-sections (ligament-area). The creep rupture times were recorded.

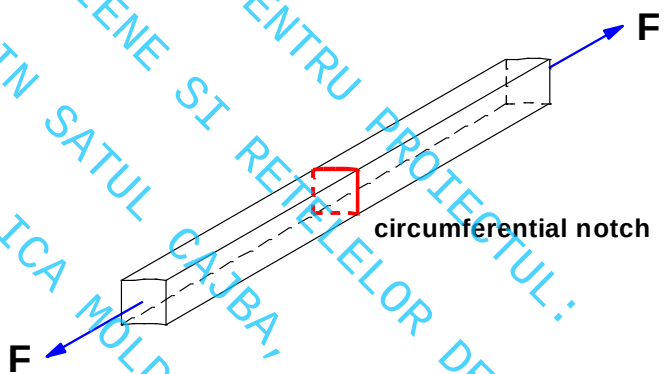

Figure 1: FNCT-specimen under constant load

1) Information according to the sample submission form of MPA Darmstadt
2) Mixture of anionic and cationic detergents

5 Test Results

The results of the tested specimens are given in table 2. The creep rupture times were statistically evaluated according to supplement 2 of the technical code DVS 2203-4 to calculate the geometric mean value and the scattering factor.

The geometric mean value of specimens in the Full Notch Creep Tests (FNCT) under ACT conditions is above the requirement of 195 hours in the pipe stress cracking test according to the certification scheme ZP 424 of MPA Darmstadt. The fracture surfaces of the tested specimens are shown in figure 2.

Specimen-designation	Rupture time [h]	Geometric mean value [h]	Scattering-factor	Remark
B2.1	589.10	615.59	1.0668 (6.7 %)	Percentage of brittle fracture surface related to the ligament-area > 30 %
B2.2	663.00			
B2.3	597.27			

Table 2: Results of tensile creep tests on notched specimens (ACT) in an aqueous solution of 2 % NM5 at 90 °C and 4 N/mm²

Specimen B2.1 Specimen B2.2 Specimen B2.3

Figure 2: Top view of the fracture surfaces (one half of each specimen)

6 Conclusion

The tested specimens from a pipe OD 110 x 10 mm (SDR 11) made from BorSafe™ HE3490-LS-H with an external protective PP-layer (Type 3 according to PAS 1075) meet the requirement of 195 hours in the pipe stress cracking test according to the certification scheme ZP 424 of MPA Darmstadt.

Report No.: **R19 02 3618-C_ACT**

Subject: **Full Notch Creep Tests (FNCT) under ACT conditions on specimens from a pipe OD 400 x 36.4 mm (SDR 11) made from BorSafe™ HE3490-LS-H with an external protective PP-layer (Type 3 according to PAS 1075)**

(Type Test)

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Information regarding accreditation, certification, recognition as testing laboratory and further official recognition will be provided on written request.

Date: 29.03.2019
Responsible for test: R. Cárdenas
Author: Dipl. Ing. (FH) J. Grieser
Managing director: Dr.-Ing. J. Hessel

The test results in this report relate only to the items tested.
Testing and evaluation of test results have been carried out in the period of time from 05.02.2019 (installation of samples) to 29.03.2019 (reporting).
Further test specifications can be found in the documentation of testing.

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1 Preliminary Remarks

The objective of the investigation is the determination of the resistance to slow crack growth of pipes using the Full Notch Creep Test (FNCT) under ACT-conditions according to PAS 1075 [1].

The FNCT represents an accelerated test method which allows the assessment of polymeric materials with respect to their stress-crack behaviour.

The pipe segment was sampled for the initial approval according to the certification program ZP 424 [2] by Dark Heisel from MPA Darmstadt (Report-no. K 18 …).

2 Basics of the Investigation

[1]	PAS 1075 (2009-04)	Pipes made from Polyethylene for alternative installation techniques – Dimensions, technical requirements and testing, Beuth Verlag GmbH, Berlin, Germany
[2]	ZP-424 (16.08.2018)	Certification program ZP 424, Issue 5, Polyethylene pipes for alternative installation techniques based on PAS 1075:2009-04, Staatliche Materialprüfungsanstalt Darmstadt
[3]	ZP 14.23.39 (2017-05)	Certification scheme “Plastic pipe system (pressure pipes and fittings)”, Edition: March 2015, Annex O: ZP 14.23.39 - Pressure pipes made from Polyethylene (PE) for alternative installation techniques – PE 100-RC, DIN CERTCO, Berlin, Germany
[4]	R18 02 3443-R-P (17.05.2018)	Test certificate of raw material batch 20B12873 made from BorSafe™ HE3490-LS-H, HESSEL Ingenieurtechnik GmbH, Roetgen, Germany
[5]	EN 12814-3 (2014-07)	Testing of welded joints in thermoplastics semi-finished products — Part 3: Tensile creep test, Annex A: Resistance to slow crack growth, Beuth Verlag GmbH, Berlin, Germany
[6]	DVS 2203-4 Supplement 2 2016-09	Testing of welded joints of thermoplastic panels and pipes – Tensile creep test for resistance to slow crack growth in the full notch creep test (FNCT), DVS Media GmbH, Düsseldorf, Germany
[7]	PA ACT 2.1-9 (2013-09)	Accelerated Creep Test (ACT) - Accelerated test method to verify the creep rupture strength of polyolefins (validation included), internal instruction for testing of HESSEL Ingenieurtechnik GmbH, Roetgen, Germany

3 Test sample

A segment from a black plain solid wall pipe OD 400 x 36.4 mm (SDR 11) was provided without the additional external protective layer[1)] by Konti Hidroplast in Gevgelija, Republic of North Macedonia and arrived at HESSEL Ingenieurtechnik on 14.01.2019. The segment is characterised as described in table 1.

Sample	Layer[2)]	Raw material[2)]	Material batch[2)]	Colour	Measured wall-thickness [mm]	Number of pipes	Segment dimensions [m]
3618-C	inside	BorSafe™ HE3490-LS-H	20B12873	black	38.5 … 39.3	1	0.25 x 0.25
	external	-[1)]	-[1)]	-[1)]	-[1)]		

Table 1: Test sample

The BorSafe batch 20B12873 was tested at HESSEL Ingenieurtechnik and meet the requirement of 400 hours in FNCT under ACT conditions for PE 100-RC materials according to the DIN CERTCO certification scheme [3], proved by the test certificate R18 02 3443-R-P [4].

4 Specimen Preparation and Testing Conditions

Specimens with a square cross section of 10 mm x 10 mm were machined from the inside of the pipe with parallel sides in axial direction. Each specimen was notched perpendicular to the parallel sides' in middle of the test specimen (figure 1).

The tensile creep rupture tests were performed on 3 notched specimens following EN 12814-3 Annex A [5], supplement 2 [6] of the technical code DVS 2203 4 and the test instruction PA ACT 2.1-9 [7] using a solution of NM5[3)] in de-mineralised water (2/100, w/w) at (90 ± 0.5) °C. The specimens were loaded by a constant tensile stress of (4.00 ± 0.02) N/mm² related to the remaining un-notched cross-sections (ligament-area). The creep rupture times were recorded.

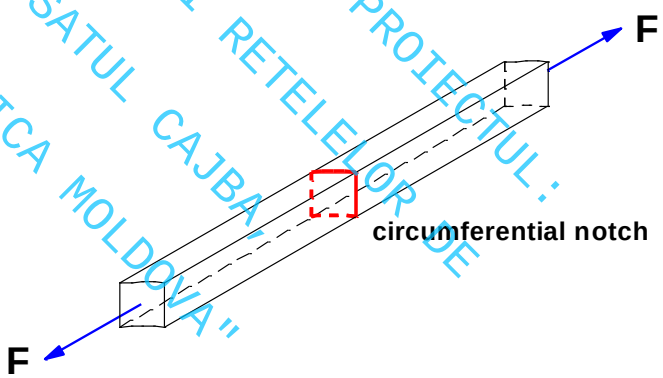


Figure 1: FNCT-specimen under constant load

1) The segment was produced as type 3 pipe with an external protective PP-layer, but shipped without the layer, because it fell off the pipe after cutting, according to the information given in the sample submission form of MPA Darmstadt.
2) Information according to the sample submission form of MPA Darmstadt.
3) Mixture of anionic and cationic detergents

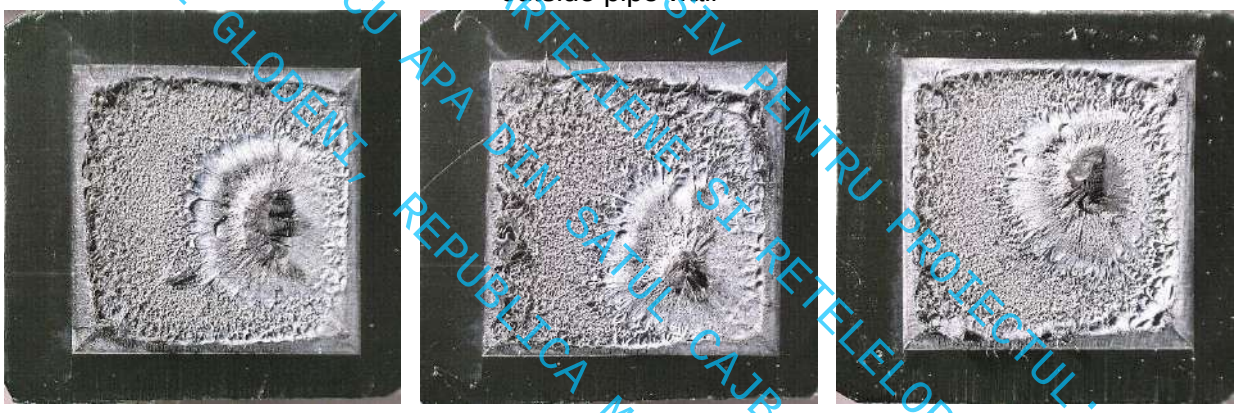
5 Test Results

The results of the tested specimens are given in table 2. The creep rupture times were statistically evaluated according to supplement 2 of the technical code DVS 2203-4 to calculate the geometric mean value and the scattering factor.

The geometric mean value of specimens in the Full Notch Creep Tests (FNCT) under ACT conditions is above the requirement of 195 hours in the pipe stress cracking test according to the certification scheme ZP 424 of MPA Darmstadt. The fracture surfaces of the tested specimens are shown in figure 2.

Specimen-designation	Rupture time [h]	Geometric mean value [h]	Scattering-factor	Remark
C1	1040.47	1121.63	1.0894 (8.9 %)	Percentage of brittle fracture surface related to the ligament-area > 30 %
C2	1231.22			
C3	1101.49			

Table 2: Results of tensile creep tests on notched specimens (ACT) in an aqueous solution of 2 % NM5 at 90 °C and 4 N/mm²



Specimen C1 Specimen C2 Specimen C3

Figure 2: Top view of the fracture surfaces (one half of each specimen)

6 Conclusion

The tested specimens from a pipe OD 400 x 36.4 mm (SDR 11) made from BorSafe™ HE3490-LS-H with an external protective PP-layer[1)] (Type 3 according to PAS 1075) meet the requirement of 195 hours in the pipe stress cracking test according to the certification scheme ZP 424 of MPA Darmstadt.

Report No.: **R19 02 3618-D_Scratch**

Subject: **External Protective Layer Scratch Test according to Annex A6 of PAS 1075 on a Type 3 pipe OD 315 x 18.7 mm (SDR 17) made from BorSafe™ HE3490-LS-H (Type Test)**

Client: **KONTI HIDROPLAST®**
Industriska bb

1480 Gevgelija
Republic of North Macedonia

HESSEL Ingenieurtechnik GmbH

Am Münsterwald 3
D-52159 Roetgen

Tel.: +49 2471 / 920 22- 0
Fax: +49 2471 / 920 2219
E-Mail: info@hessel-ingtech.de
Net: www.hessel-ingtech.de

Information regarding accreditation, certification, recognition as testing laboratory and further official recognition will be provided on written request.

Date: 26.03.2019
Responsible for test: R. Cárdenas
Author: Dipl. Ing. (FH) J. Grieser
Managing director: Dr.-Ing. J. Hessel

The test results in this report relate only to the items tested.
Testing and evaluation of test results have been carried out in the period of time from 29.01.2019 (installation of samples) to 26.03.2019 (reporting).
Further test specifications can be found in the documentation of testing.

Contents

1 Preliminary Remarks 3
2 Basics of the Investigation 3
3 Test sample 3
4 Specimen Preparation and Testing Conditions 4
5 Test Results 5
6 Conclusion 6

1 Preliminary Remarks

The objective of the investigation is the determination of the scratch depth into the surface of a protective layer after a defined blade has scratched the Type 3 pipe under constant load and speed. The External Protective Layer Scratch Test is described in Annex A6 of PAS 1075 [1].

The pipe with an additional external protective layer (Type 3 according to PAS 1075) was sampled for the initial approval according to the certification program ZP 424 [2] by Dark Heisel from MPA Darmstadt (Report-no. K 18 …).

2 Basics of the Investigation

[1]	PAS 1075 (2009-04)	Pipes made from Polyethylene for alternative installation techniques – Dimensions, technical requirements and testing, Annex A 6: Description of the External Protective Layer Scratch Test, Beuth Verlag GmbH, Berlin, Germany
[2]	ZP-424 (16.08.2018)	Certification program ZP 424, Issue 5, Polyethylene pipes for alternative installation techniques based on PAS 1075:2009-04, Staatliche Materialprüfungsanstalt Darmstadt
[3]	ZP 14.23.39 (2017-05)	Certification scheme “Plastic pipe system (pressure pipes and fittings)”, Edition: March 2015, Annex O: ZP 14.23.39 - Pressure pipes made from Polyethylene (PE) for alternative installation techniques – PE 100-RC, DIN CERTCO, Berlin, Germany
[4]	R18 02 3443-R-P (17.05.2018)	Test certificate of raw material batch 20B12873 made from BorSafe™ HE3490-LS-H, HESSEL Ingenieurtechnik GmbH, Roetgen, Germany
[5]	PA SMR 2.5-3 (2013-09)	External protective layer scratch test according to PAS 1075, Annex A6, internal instruction for testing of HESSEL Ingenieurtechnik GmbH, Roetgen, Germany

3 Test sample

A black plain solid wall pipe OD 315 x 18.7 mm (SDR 17) with an additional external protective layer (Type 3 according to PAS 1075) was provided by Konti Hidroplast in Gevgelija, Republic of North Macedonia and arrived at HESSEL Ingenieurtechnik on 14.01.2019. The pipe is characterised as described in table 1 and 2.

Sample	Layer[1)]	Raw material[1)]	Material batch[1)]	Colour	Measured wall-thickness [mm]	Number of pipes	Pipe Length [m]
3618-D	inside	BorSafe™ HE3490-LS-H	20B12873	black	19.24 … 19.48	1	1.2
	additional external	BorECO™ BA212E	63180619	blue	3.54 … 4.56		

Table 1: Test sample

The BorSafe batch 20B12873 was tested at HESSEL Ingenieurtechnik and meet the requirement of 400 hours in the Full Notch Creep Test (FNCT) under ACT conditions for PE 100-RC materials according to the DIN CERTCO certification scheme [3], proved by the test certificate R18 02 3443-R-P [4].

Sample	Signature
3618-D	= 1520 = KONTI HIDROPLAST MACEDONIA DVGW TW DIN EN 12201 2 PN10 PE 100 RC T Y P E 3 PP PEELABLE LAYER SDR 17 ø315 X 18.7 GRAD B 1 0 1 8 0 6 3 2 3

Table 2: Signature on the outside surface of the pipe sample

4 Specimen Preparation and Testing Conditions

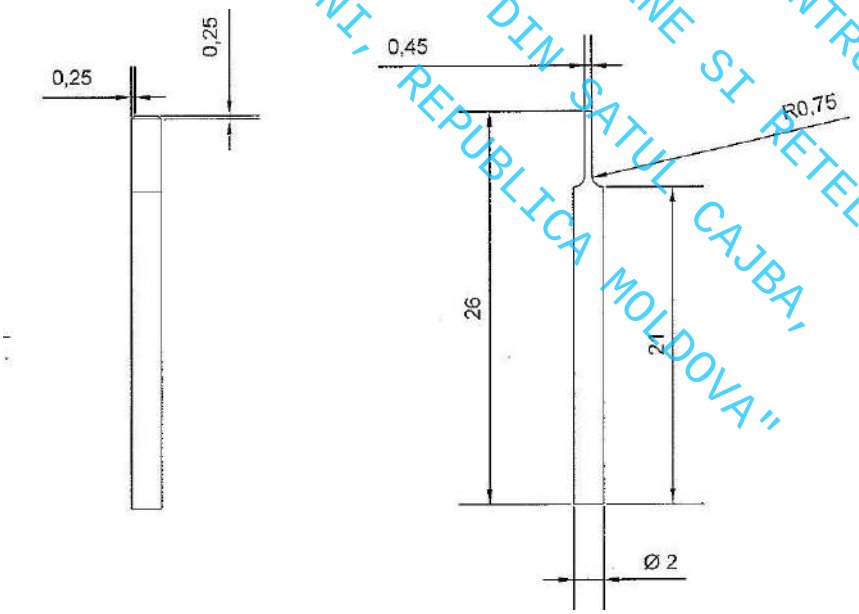


Figure 1: Blade geometry

1) Information according to the sample submission form of MPA Darmstadt

The cratch tests were performed according to Annex A6 of PAS 1075 and the test instruction PA SMR 2.5-3 [5] of HESSEL Ingenieurtechnik on 3 samples. The scratch depth of the blade (figure 1) into the surface of the external layer was measured at a distance of 600 mm from the starting point. The general test parameters are characterised as described in table 3 and 4.

Parameter	Value	Unit
Scratch speed	100	mm/min
Minimum scratch length	600	mm

Table 3: Test parameters

Pipe Diameter	Weight	Unit
32 - 90 mm	4	kg
110 – 160 mm	6	kg
> 180 mm	12	kg

Table 4: Load of the blade

5 Test Results

The applied load and the measured scratch depth of the blade into the protective layer at a distance of 600 mm from the starting point are given in table 5.

Sample No.	Load of the Blade [kg]	External protective layer thickness before testing [mm]	Residual thickness [mm]	Scratch depth of the blade [mm]	Scratch depth of the blade [%]
D.1	12	3.54	3.26	0.28	7.8
D.2	12	3.63	3.33	0.30	8.3
D.3	12	4.29	3.97	0.32	7.4
Mean value	12	3.82	3.52	0.30	7.8

Table 5: Results of the protective layer scratch tests

The measured thickness of the selected external protective layers is between 3.54 and 4.29 mm, which is above the minimum requirement (≥ 0.8 mm) according to PAS 1075, Annex A6.

The measured scratch depth of the blade after the tests is between 7.4 % and 8.3 % of the original thickness of the external protective layer and does not exceed the requirement of 75% of the original thickness according to PAS 1075, Annex A6.

6 Conclusion

The tested Type 3 pipe OD 315 x 18.7 mm (SDR 17) made from BorSafe™ HE3490-LS-H met the requirements in the "External Protective Layer Scratch Test" according to Annex A6 of PAS 1075.

Ф 8.5 02/10

Работен налог Бр. 19-6H04-000300

Нарачка 19-6H04-000300
Датум на РН 25.7.2019

Производ	**ПЕ100 РЦ /ПЕ100/ПЕ100 РЦ ЦРЕВО Ф250 ПН 10**		**Ф** 250.80
Вк. количина	**276.00**	**М**	**Smin** 14.80
Ред на производство	**ЦРНА-СИНО- ЦРНА**		**Smax** 15.60
	23x12m,9x1.2m		**Овалност** 2.50
Рок на производство	15.30	Час	
Ресурс	**Производна линија 4**		

Потребни материјали			**Потребна количина**	
1	ПЕ100 ХЕ3490 ЛСХ	BOREALIS HE 3490 LS-H	3036.0	КГ

ТЕХНОЛОШКА КАРТА ЗА ПРИТИСОЧНИ ЦРЕВА И ЦЕВКИ

Технолошка карта Бр. Ф 250 / BOREALIS HE 3490 LS-H

Производна линија Бр. 4

Материјал:		Боја (% мастербач)
Надворешен слој:	BOREALIS HE 3490 LS-H	/
Среден слој:	BOREALIS HE 3494 LS-H	/
Внатрешен слој:	BOREALIS HE 3490 LS-H	/
Линии:	BOREALIS HE 3494 LS-H	

Технолошки параметри:		Алат (mm):	
Шнека надворешно (rpm):	15 Hz	Трн	222
Шнека средно (rpm):	122	Чаура	270
Шнека внатрешно (rpm):	30		
Влеча (m/min):	0.3	Калибратор	259
Температура на шнека (°C):	200		
Температура на глава (°C):	200		
Вакум V1 (bar):	0.60		
Вакум V2 (bar):	5.00		
Ладење T1(°C):	20		
Ладење T2(°C):	18		

Печат: **KONTI HIDROPLAST POTABLE WATER DVGW DW8148 CO0245 TW DIN EN12201-2 PN10 PE100RC / PE100 / PE100RC TYPE2 SDR17 Ф250X14.8 GRAD B 07 19 04 300**

Изработил и одобрил:

KONTI HIDROPLAST®

ИЗВЕШТАЈ ОД КОНТРОЛА НА ПРОИЗВОДОТ И ПРОИЗВОДСТВО

Машина: Линија 4 | Работен налог: 19-6404-300 | Производство на: ф250 SDR17

Суровина: ПП; НАД. BOREALIS HE3490 LS-H Lot: 20B1341/1; СРЕ. BOREALIS HE3494 LS-H Lot: 578080802; ВНА. BOREALIS HE3490 LS-H Lot: 20B1341/1; ЛИН.

СМЕНА 1										СМЕНА 2										СМЕНА 3									
Дата	Реден Бр.	Должина (m)	Овалност (mm)	Контрола на почеток и крај Ø (mm)	Контрола на почеток и крај S (mm)	Штиклирај за извршена проверка: Проверка на боја	Проверка на маркирање	Надворешен изглед	Дата	Реден Бр.	Должина (m)	Овалност (mm)	Контрола на почеток и крај Ø (mm)	Контрола на почеток и крај S (mm)	Штиклирај за извршена проверка: Проверка на боја	Проверка на маркирање	Надворешен изглед	Дата	Реден Бр.	Должина (m)	Овалност (mm)	Контрола на почеток и крај Ø (mm)	Контрола на почеток и крај S (mm)	Штиклирај за извршена проверка: Проверка на боја	Проверка на маркирање	Надворешен изглед
26.7.2019	13	12	1,5	250,7	15,1 / 15,3	✓	✓	✓										25.7.2019	2	12	1,5	250,7	15,1 / 15,4	✓	✓	✓
	17	12	1,5	250,7	15,1 / 15,3	✓	✓	✓											4	12	1,5	250,7	15,1 / 15,4	✓	✓	✓
	20	12	1,5	250,7	15,2 / 15,4	✓	✓	✓											7	12	1,5	250,7	15,2 / 15,5	✓	✓	~
	22	12	1,5	250,7	15,2 / 15,4	✓	✓	✓											11	12	1,5	250,7	15,2 / 15,5	✓	~	✓
			11 x 12м																		12 x 12м							
			9 x 1,2м																									
Ширина на линија (mm)		Длабочина на лин. (mm)		Број на линии					Ширина на линија (mm)		Длабочина на лин. (mm)		Број на линии					Ширина на линија (mm)		Длабочина на лин. (mm)		Број на линии				

Мерењето е извршено со инструмент број:

АНАЛИЗА:

KONTI HIDRO PLAST

LABORATORY REPORT FOR QUALITY CONTROL OF RAW MATERIAL

TECHNICAL-TECHNOLOGICAL LABORATORY KONTI HIDROPLAST

MATERIAL:	**Borealis BorSafe HE3490-LS-H**	Nu. of entrance:	180829
Type of material:	HDPE 100-RC black	Date of entrance:	01.04.2019
Lot/batch:	**20B13411**	Quantity (kg):	23,375.00

Test nu.: 8703

MELT FLOW RATE (MFR)

Standard: EN ISO 1133-1;2011 Method A, Equipment 0024

Subject: raw material

CONDITION:

Temperature of extrusion (°C): ***190***

Mass weight (kg): ***5***

T_{ref} = 10 min. = 600 sec.

Cutt-off time - t (sec ***240***

CALCULATION:

m1(g): *0.1*

m2(g): *0.105*

m3(g): *0.1*

$$MFR = \frac{T_{ref}}{t} \cdot m_{sred}$$

MFR (g/10min)= ***0.254***

MFR certif. (g/10min)= ***0.24***

Difference (%): ***5.90***

MFR acc. EN12201 EN1555, method (190°C/5kg): 0.2<MFR<1.4 (g/10min)

Max allowed difference less than ±20%

Status MFR: Conform

DENSITY

STANDARD EN ISO 1183-1;2012, Equipment 00024

1) Density:	0.9573
2) Density:	0.9555
3) Density:	0.9566
Average (g/cm³):	**0.9564**

Density by certificate (g/cm³) 0.9599

Density acc. EN 12201 ≥0.930 (g/cm³)

Status density: Conform

Date:	Responsible for quality control
02.04.2019	Eng. Gordana Manoleva
	Laboratory | QC: Mech. Eng. Zafir Stardelev

KONTI HIDRO PLAST

LABORATORY REPORT FOR QUALITY CONTROL OF RAW MATERIAL

TECHNICAL-TECHNOLOGICAL LABORATORY KONTI HIDROPLAST

MATERIAL:	**Borealis BorSafe HE3490-LS-H**	Nu. of entrance:	180829
ype of material:	HDPE 100-RC black	Date of entrance:	01.04.2019
Lot/batch:	**20B13411**	Quantity (kg):	23,375.00

Test nu.: 8703

VOLATILE CONTENT

STANDARD EN 12099:1997, Equipment 00019

CONDITION:

Temperature of exemination: 105±2(°C)

Time: 65 min.

Masa before heating:	*25.004*
Mass after heating:	*24.999*
Result (mg/kg):	*199.97*

CALCULATION:

$$m_v = \frac{m_1 - m_2}{m_1} \times 10^6$$

REQUIREMENT: <350 mg/kg

Status volatile content: ***Conform***

HOMOGENITY

STANDARD GW 322 - A2, Equipment 00022

Inhomogenity:	*0.00*
Limit inhomogenity:	*0.02*

Result homogenity: ***Conform***

Test note

Date: 02.04.2019	Responsible for quality control Eng. Gordana Manoleva Laboratory | QC: Mech. Eng. Zafir Stardelev

BOREALIS

Inspection Certificate 3.1 EN 10204

Order number/date
2001293862/21.03.2019
Delivery no. / date
85321625/22.03.2019
Product
BorSafe HE3490-LS-H Bag
HD Polyethylene
Batch number
20B13411
Quantity
23.375 KG
Date
25.03.2019
Production date
06.03.2019
Contact person
Suzana Peric
Suzana.Peric@borealisgroup.com
Tel: 4373269815084
Fax: 4373269815825
Your reference
4
Shipping unit
VI2498AB,VI2361AB

KONTI HIDROPLAST
Ul. Industrijska 5
1480 GEVGELIJA/MACEDONIA
REPUBLIC OF NORTH MACEDONIA
Attn: Jelena Repac
E-mail: gordanam@konti-hidroplast.com.mk

Property	Reference test method	Unit	Value
Melt Flow Rate (190 /5.0Kg)	ISO 1133	g/10min	0,24
Density 23℃	ISO 1183-1/Method A	kg/m³	959,9
Oxidation Ind. Time (210℃)	ISO 11357-6	min	43,0
Total Moisture content	ISO 15512	ppm	10
Carbon Black content	ISO 6964	%	2,4
Dispersion	ISO 18553	Note	2,3
Appearance	ISO 18553		B

The actual method used, may differ from the mentioned reference method. The obtained results are equal to those of the reference method and are traceable via an established and documented correlation.

To the best of our knowledge, the information contained herein is accurate and reliable as of the date of production. However, the CoA does not release the customer from their liability to check that the delivered material is fit for purpose.

Quality Control Department, Anna Fritzon, Stenungsund Sweden)
For questions regarding the certificate, please contact your Borealis Sales Representative.

Borealis AG
Wagramerstrasse 17-19, A-1220 Vienna, Austria, Tel.:+ 43 1 22 400 300, Fax.: + 43 1 22 400 333

KONTI HIDRO PLAST

LABORATORY REPORT FOR QUALITY CONTROL OF RAW MATERIAL

TECHNICAL-TECHNOLOGICAL LABORATORY KONTI HIDROPLAST

MATERIAL: Borealis BorSafe HE3494-LS-H
Type of material: HDPE 100-RC blue
Lot/batch: 5180802

Nu. of entrance: 180830
Date of entrance: 01.04.2019
Quantity (kg): 11,000.00

Test nu.: 8596

MELT FLOW RATE (MFR)

Standard: EN ISO 1133-1;2011 Method A, Equipment 0024

Subject: raw material

CONDITION:

Temperature of extrusion (°C): 190
Mass weight (kg): 5

$T_{ref} = 10\,\text{min.} = 600\,\text{sec.}$

Cutt-off time - t (sec 240

CALCULATION:

m1(g): 0.099
m2(g): 0.098
m3(g): 0.099

$MFR = \frac{T_{ref}}{t} \cdot m_{sred}$

MFR acc. EN12201 EN1555, method (190°C/5kg): 0.2<MFR<1.4 (g/10min)

MFR (g/10min)= 0.247
MFR certif.(g/10min)= 0.26
Difference (%) 5.13
Max allowed difference less than ±20%

Status MFR: Conform

DENSITY

STANDARD EN ISO 1183-1;2012, Equipment 00024

1) Density: 0.9611
2) Density: 0.9541
3) Density: 0.9492
Average (g/cm³): 0.9548

Density by certificate (g/cm³) 0.9498

Density acc. EN 12201 ≥0.930 (g/cm³)

Status density: Conform

Date: 02.04.2019

Responsible for quality control
Eng. Gordana Manoleva
Laboratory | QC: Mech. Eng. Zafir Stardelev

KONTI HIDRO PLAST

LABORATORY REPORT FOR QUALITY CONTROL OF RAW MATERIAL

TECHNICAL-TECHNOLOGICAL LABORATORY KONTI HIDROPLAST

MATERIAL:	**Borealis BorSafe HE3494-LS-H**	Nu. of entrance:	180830
ype of material:	HDPE 100-RC blue	Date of entrance:	01.04.2019
Lot/batch:	**5180802**	Quantity (kg):	11,000.00

Test nu.: 8596

VOLATILE CONTENT

STANDARD EN 12099:1997, Equipment 00019

CONDITION:

Temperature of exemination: 105±2(°C)

Time: 65 min.

Masa before heating:	*25.0104*
Mass after heating:	*25.0079*
Result (mg/kg):	*99.96*

CALCULATION:

$$m_v = \frac{m_1 - m_2}{m_1} \times 10^6$$

REQUIREMENT: <350 mg/kg

Status volatile content: ***Conform***

HOMOGENITY

STANDARD GW 322 - A2, Equipment 00022

Inhomogenity:	*0.00*
Limit inhomogenity:	*0.02*

Result homogenity: ***Conform***

Test note

Date:	Responsible for quality control
02.04.2019	Eng. Gordana Manoleva
	Laboratory | QC: Mech. Eng. Zafir Stardelev

BOREALIS

Inspection Certificate 3.1 EN 10204

Order number/date
2001292779/15.03.2019

Delivery no. / date
85319321/21.03.2019
Product
BorSafe HE3494-LS-H Bag
HD Polyethylene
Batch number
5180802
Quantity
11.000 KG
Date
27.03.2019
Production date
17.11.2018
Contact person
Suzana Peric
Suzana.Peric@borealisgroup.com
Tel: 4373269815084
Fax: 4373269815825
Your reference
3
Shipping unit
PVN813/XXZ022

KONTI HIDROPLAST
Ul. Industrijska 5
1480 GEVGELIJA/MACEDONIA
REPUBLIC OF NORTH MACEDONIA
Attn: Jelena Repac

Property	Reference test method	Unit	Value
Melt Flow Rate (190 /5.0Kg)	ISO 1133	g/10min	0,26
Density 23°C	ISO 1183-1/Method A	kg/m³	949,8
Oxidation Ind. Time (210°C)	ISO11357-6	min	101
Total Moisture content	ISO 15512	ppm	10
Dispersion	ISO18553	Note	2,5

The actual method used, may differ from the mentioned reference method. The obtained results are equal to those of the reference method and are traceable via an established and documented correlation.
To the best of our knowledge, the information contained herein is accurate and reliable as of the date of production. However, the CoA does not release the customer from their liability to check that the delivered material is fit for purpose.

Quality Control Department, Marjo Taive, Porvoo (Finland)
For questions regarding the certificate, please contact your Borealis Sales Representative.

Borealis AG
Wagramerstrasse 17-19, A-1220 Vienna, Austria, Tel.:+43 1 22 400 300, Fax.: +43 1 22 400 333

KONTI HIDRO PLAST
GEVGELIJA
91480 ГЕВГЕЛИЈА ул. "ИНДУСТРИСКА" 66 тел. (034) 212-064

LABORATORY REPORT FOR PIPE TESTING

TECHNICAL LABORATORY OF KONTI HIDROPLAST

Test	PE 100 RC Type 2 DN/PN *250/10*	Work sheet
164900	**Production date** *26.07.2019*	19-6H04-000300

Appearance:	Black inside and outside, blue middle layer with blue stripes	**Standard**	EN 12201
Marking:	KONTI HIDROPLAST POTABLE WATER DVGW DW8148 CO0245 TW DIN EN12201-2 PN10 PE100 RC/PE100/PE100 RC TYPE2 SDR17 Ø250×14.8 GRAD B 07 19 04 300		

Raw materia Borealis HE3490-LS-H / HE3494-LS-H | **Mater. Lot:** 20B13411 / 5180802

DIMENSION AND TOLERANCE (mm)

de max: *251.5*	Thickness max: *16.4*	Ovality max: *5.0*	**Measurement instruments:** *1043/1014/1031*
de min: *250.0*	Thickness min: *14.8*		
de (mm) *250.65*	**e (mm)** *15.25/15.55*	**Ovality** *1.4*	***Status Conform***

MELT FLOW RATE

STANDARD EN ISO 1133:97 METHOD A, EQUIPMENT 00024

Test no. of MFR of raw material

MFR of raw material (g/10min) *0.254*

CONDITION: Subject: pipe

Temperature of extrusion,T (°C *190*

Load (kg): *5.0*

Cut off time (sec): *240*

Tref. = 10 min = 600 sek

CALCULATION:

$$MFR = \frac{T_{ref}}{t} \cdot m_{aver}$$

m1s:	*0.102*
m2s:	*0.100*
m3s:	*0.102*
m_aver.:	0.1013

RESULT

MFR pipe(g/10min) *0.253*

Difference (%): *0*

Limits and tolerance:

MFR acc. EN12201,method (190°C/5kg): 0.2<MFR<1.4 (g/10min) ; Max difference between pipe and raw material less than ±20%

Note_MFR:

MFR of middle blue layer from pipe is 0.255 g/10min => 3.2%.

Status : Comply

KONTI HIDRO PLAST
91480 ГЕВГЕЛИЈА ул. "ИНДУСТРИСКА" 66 тел. (034) 212-064

LABORATORY REPORT FOR PIPE TESTING

TECHNICAL LABORATORY OF KONTI HIDROPLAST

Test 164900	**PE 100 RC Type 2 DN/PN *250/10*** **Production date: *26.07.2019***	Work sheet 19-6H04-000300

Appearance	Black inside and outside, blue middle layer with blue stripes	**Standard**	EN 12201
Marking:	KONTI HIDROPLAST POTABLE WATER DVGW DW8148 C00245 TW DIN EN12201-2 PN10 PE100 RC/PE100/PE100 RC TYPE2 SDR17 Ø250×14.8 GRAD B 07 19 04 300		

Raw materia Borealis HE3490-LS-H / HE3494-LS-H | **Lot/batch:** 20B13411 / 5180802

STANDARD EN 12201, ISO 3126

HOMOGENITY

STANDARD GW 322-A2 , Lab. equipment 00021,00022

Inhomogenity:	0.00
Limit inhomogenity:	0.02

Status: *Comply*

LONGITUDINAL REVERSION OF PIPE

STANDARD ISO 2505-1/2, METHOD B EQUIPMENT 00018

LENGTHS

	Before heating L_0	After cooling L_1	R_l (%)
1.	100	98.61	1.39
2.	100	98.52	1.48
3.	100	98.47	1.53

Tolerance ± 3%

CALCULATION (%)

$$\Delta L = L_0 - L_1$$

$$R_l = \frac{\Delta L}{L_0} * 100$$

Time exposure to the test temperature (min): 120 **Date:** 05.08.2019

Test temperature (°C): 110

Status: *Conform*

KONTI HIDRO PLAST
91480 ГЕВГЕЛИЈА ул. "ИНДУСТРИСКА" 66 тел. (034) 212-064

LABORATORY REPORT FOR PIPE TESTING

TECHNICAL LABORATORY OF KONTI HIDROPLAST

Test	PE 100 RC Type 2 DN/PN *250/10*	Work sheet
164900	**Production date:** *26.07.2019*	19-6H04-000300

Appearance:	Black inside and outside, blue middle layer with blue stripes	**Standard**	EN 12201
Marking:	KONTI HIDROPLAST POTABLE WATER DVGW DW8148 CO0245 TW DIN EN12201-2 PN10 PE100 RC/PE100/PE100 RC TYPE2 SDR17 Ø250×14.8 GRAD B 07 19 04 300		

Raw materia Borealis HE3490-LS-H / HE3494-LS-H | **Lot/batch:** 20B13411 / 5180802

HYDROSTATIC STRENGTH

STANDARD EN ISO 1167-1/2, EQUIPMENT 00014/00015

Pressure test type, parameters, method and conditions		*Pressure test results*		
Grafic no:	164900	P (bar), +2% / -1%	7	L(mm) 912
Hoop stress, σ(MPa)	5.4	Tank T(°C), ± 1(°C)	80	*Pipe length shouldbe min 3×dn (min 250mm), for dn>315mm, L ≥ 2×dn.*
Tank T(°C), ± 1(°C)	80	Test time t(h)	180	
Test time min, t(h)	165	Pressure test environment:	Water in water	
Set time to achieve test pressure (sec):	30 sec	Time to achieve test pressur		
Type of end caps:	A	Type of failure (ductile/brittle):	-	
Number of test pieces:	1	Forced burst rupture after testing (ductile/brittle):	-	

Pressure test not

Status: Conform

FINAL STATEMENT:

Test results meet the Standard requirements.

Date	Responsible for quality control	Quality control, laboratory:
13.08.2019	Eng. Gordana Manoleva	Mech. Eng. Zafir Stardelev

Certificate for Calibration of MFI

Customer: KONTI & HIDRO PLAST

Certificate Number: 25659_1

Address: GEVGELIJA - MACEDONIA

Equipment
ID-Nr. 2354-1-3-15
MODEL: 400C1 SCITEQ No: 1406011

Calibration of:			GO	NO GO
Die	Primary Instrument:	Double ended Taperlock Plug Gauge. Serial Number. 1211001	☑	☐
Barrel	Primary Instrument:	Double ended Taperlock Plug Gauge. Serial Number. 054106	☑	☐
Temperature	Primary Instrument:	Hanna HI935005 Serial number: B0022653		

ISO 1133

Table 1 — Maximum allowable variation in temperature with distance and with time throughout the test

Test temperature, T °C	Maximum variation in test temperature [a]	
	with distance at between 10 mm and 75 mm above the die surface °C	with time at 10 mm above the die surface [b] °C
$125 \leqslant T < 250$	± 2,0	± 0,5 [c]
$250 \leqslant T < 300$	± 2,5	± 0,5
$300 \leqslant T$	± 3,0	± 1,0

[a] Variation is over the normal time of a test, typically less than 25 min, and can be verified during calibration of the equipment.

[b] When using a 4 mm length die (see 5.1.4), the readings should be made 14 mm above the die surface.

[c] A value of 0,2 °C is preferred since it gives better reproducibility. It is intended that the value of 0,2 °C will become a requirement at the next revision of this International Standard.

values before calibration

Setpoint	Display	Gauge	Deviation
190,0	190,0	190,1	0,07

values after calibration

Setpoint	Display	Gauge	Deviation
190,0	190,1	190,1	0,00

Temperature checked at 10 mm above the Die. (Acc. ISO 1133 5.1 and table 1): 189,8 °C
Temperature checked at 30 mm above the Die. (Acc. ISO 1133 5.1 and table 1): 190,1 °C
Temperature checked at 50 mm above the Die. (Acc. ISO 1133 5.1 and table 1): 190,3 °C
Temperature checked at 75 mm above the Die. (Acc. ISO 1133 5.1 and table 1): 190,3 °C

Name: Helder Queiros Title: Service Engineer Date: 29/03/2018 Signature:

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centro de apoio tecnológico à indústria metalomecânica

Certificate of Calibration

Metrology Laboratory - Temperature and Humidity

DATE OF ISSUE: 2018-03-02 **CERTIFICATE Nº** LMT20185002062/10

English Version

CUSTOMER

SEPI-HÉLDER QUEIRÓS, LDA
Rua do Comércio do Porto 126 - 4º Esq Frente,
4400-421 Vila Nova de Gaia

EQUIPMENT UNDER CALIBRATION

Type of equipment	Digital Thermometer
Reading Unit	
Manufacturer	HANNA INSTRUMENTS
Model	HI 935005
Serial number	B0022653
Reference	-----
Temperature Sensor	
Manufacturer	-----
Model	-----
Serial number	-----
Reference	B0022653-S
Equipment condition	In good condition of conservation
Reading unit resolution	0.1 ºC for every steps

ENVIRONMENTAL CONDITIONS

Local	CATIM Porto Temperature Laboratory
Calibration date	2018-03-01
Temperature	23 ºC (±3) ºC
Humidity	50 %hr (±10) %hr

CALIBRATION PROCESS

Calibration performed under internal procedures:
LMT P03.10, Rev. A4, 2016-06-09; LMT P03.02, Rev. A4 2004-02-26

STANDARD EQUIPMENT USED

SPRT 25 Ohm, reference number 04.50720, calibrated at I.P.Q.; SPRT 25 Ohm, reference number 09.50144, calibrated at I.P.Q.; Liquid bath HART SCIENTIFIC reference number 02.50583; Liquid bath JULABO reference number 10/501125; Furnace FLUKE 9100S, reference number 16.30.535, calibrated at CATIM and traceable to IPQ; Tinsley bridge Ambassador, reference number 85/04067/8, calibrated at CATIM and traceable to IPQ.

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor k=2, which provides a confidence level of approximately 95%. The uncertainty has been determined in accordance with EA-4/02

IPAC is signatory to the EA MLA for calibration, testing, certification and inspection scopes

Calibration Technician

(Aníbal Pinheiro)

Technical Supervisor

(Madalena Sarmento)

IPAC acreditação
M0003
Calibração

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Certificate of Calibration

Metrology Laboratory - Temperature and Humidity

DATE OF ISSUE: 2018-03-02 **CERTIFICATE Nº** LMT20185002062/10

Calibration Step	Standard Reading	Equipament Reading	Error	k´	v´ef	Uncertainty
1	-19.938 °C	-19.7 °C	0.2 °C	2.02	122	+/- 0.077 °C
2	0.027 °C	0.2 °C	0.2 °C	2.02	122	+/- 0.077 °C
3	99.979 °C	100.5 °C	0.5 °C	2.02	130	+/- 0.086 °C
4	199.960 °C	200 °C	0 °C	2.05	51	+/- 0.60 °C
5	299.677 °C	300 °C	0 °C	2.04	59	+/- 2.1 °C

Certificate for Calibration of Pressure

Customer:	KONTI & HIDRO PLAST	SCITEQ Technician:	Helder Queiros
Address:	GEVGELIJA - MACEDONIA	Calibration Date:	29/03/2018
		Certificate Number:	25659
		Model:	Sciteq Sub 5

Station No. 1-5

540

Primary Instrument: AMETEK-JOFRA Model CE PPC 140 bar. Serial N.: 509180-00681

Calibration Traceability: According to BNM, LNE, DTI accreditation no. 200 | Temp: 23 °C +/- 1 | Calibration uncertainty: 16mBar +/-

Station No.	1	Controler No.	15077532						
Transmitter No.	410874-033	Transmitter Offset before/after	-0,07 / -0,02		Class/type	0,3	Pressure Range (Bar)	0- 40,00	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
38,00	38,13	38,20	-0,07	*-0,175*	38,00	38,22	38,22	0,00	*0,000*

Station No.	2	Controler No.	15077532						
Transmitter No.	415197-001	Transmitter Offset before/after	-0,06 / +0,02		Class/type	0,3	Pressure Range (Bar)	0- 40,02	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
38,00	38,00	38,07	-0,07	*-0,175*	38,00	37,99	37,99	0,00	*0,000*

Station No.	3	Controler No.	15077532						
Transmitter No.	388574-035	Transmitter Offset before/after	-0,09 / +0,03		Class/type	0,3	Pressure Range (Bar)	0- 60,56	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
55,00	55,30	55,80	-0,50	*-0,826*	55,00	55,30	55,30	0,00	*0,000*

Station No.	4	Controler No.	15077532						
Transmitter No.	388574-049	Transmitter Offset before/after	-0,01 / -0,03		Class/type	0,3	Pressure Range (Bar)	0- 59,99	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
55,00	55,22	55,28	-0,06	*-0,100*	55,00	54,98	54,98	0,00	*0,000*

Station No.	5	Controler No.	15077532						
Transmitter No.	413254-008	Transmitter Offset before/after	-0,09 / -0,12		Class/type	0,3	Pressure Range (Bar)	0- 99,89	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
95,00	95,05	95,05	0,00	*0,000*	95,00	95,00	95,00	0,00	*0,000*

Name: Helder Queiros **Title:** Service engineer **Date:** 29/03/2018 **Signature:**

SCITEQ

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E-mail: service@sciteq.com Homepage: www.sciteq.com

Certificate for Calibration of Pressure

Customer: KONTI & HIDRO PLAST

Address: GEVGELIJA - MACEDONIA

Station No. 6-10

s40

SCITEQ Technician: Helder Queiros

Calibration Date: 29/03/2018
Certificate Number: 25659
Model: Sciteq Sub 5

Primary Instrument: AMETEK-JOFRA Model CE PPC 140 bar. Serial N.: 509180-00681

Calibration Traceability: According to BNM, LNE, DTI accreditation no. 200 **Temp:** 23 ºC +/- 1 **Calibration uncertainty:** 16mBar +/-

Station No.	6	Controler No.	15077532						
Transmitter No.	474902-009	Transmitter Offset before/after		-0,03 / +0,03	Class/type	0,3	Pressure Range (Bar)	0- 100,09	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
95,00	95,13	95,41	-0,28	*-0,280*	95,00	95,12	95,12	0,00	*0,000*

Station No.	7	Controler No.	15077532						
Transmitter No.	474902-006	Transmitter Offset before/after		+0,05 / -0,05	Class/type	0,3	Pressure Range (Bar)	0- 59,91	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
55,00	55,08	55,01	0,07	*0,117*	55,00	54,98	54,98	0,00	*0,000*

Station No.	8	Controler No.	15077532						
Transmitter No.	480346-23	Transmitter Offset before/after		-0,07 / +0,05	Class/type	0,3	Pressure Range (Bar)	0- 60,31	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
55,00	55,17	55,47	-0,30	*-0,497*	55,00	54,99	54,99	0,00	*0,000*

Station No.	9	Controler No.	15077532						
Transmitter No.	480346-002	Transmitter Offset before/after		-0,03 / +0,01	Class/type	0,3	Pressure Range (Bar)	0- 40,01	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
38,00	38,00	38,08	-0,08	*-0,200*	38,00	38,15	38,15	0,00	*0,000*

Station No.	10	Controler No.	15077532						
Transmitter No.	471692-017	Transmitter Offset before/after		+0,01 / 0,00	Class/type	0,3	Pressure Range (Bar)	0- 40,03	4-20 mA
values before calibration					*values after calibration*				
Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %	Setpoint	Display	Gauge	Deviation	Transmitter Full Scale Deviation %
0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	
38,00	38,09	38,13	-0,04	*-0,100*	38,00	37,98	37,98	0,00	*0,000*

Name: Helder Queiros **Title:** Service engineer **Date:** 29/03/2018 Signature:

SCITEQ

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Tel: +45 86 96 19 33 Fax: +45 86 96 24 75
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Calibration Certificate

LaborMet - METROLOGY LABORATORY - PRESSURE

English version

Date: 2018-02-26 **Certificate n.º: LMP20185002114/10**

CUSTOMER:

SEPI-SOLUÇÕES DE ENGENHARIA PARA PROCESSOS INDUSTRIAIS HÉLDER QUEIRÓS, LDA
Rua Macieirinha nº 5 -
4050-341 Porto

DESCRIPTION:

Equipment: Pressure Calibrator
Manufacture: AMETEK
Model: CE PPCE 140 BAR
Serial Number: 509180-00681
Equipment reference

Range of indication: 0 a 140 bar
Division: 0.01 bar
Resolution: 0.01 bar
Accuracy

MAIN EQUIPMENT USED:

STANDARDS	CATIM Nº	TRACEABLE
Calibrador RUSKA 7252 i	17.501464	FLUKE

CALIBRATION PROCESS:

The calibration was performed using LMP-P01 04 - RevA2:2013-05-31.

Three sets of measurements were made in the direction of increasing and decreasing pressure. The values presented in the results table are the average of all readings. The error of the equipment is calculated as the difference between the pressure of the equipment and the reference pressure (Error = P equipment - P standard) .

Pressure generated with Nitrogen. All measurements were performed in a controlled environment of (20±2)ºC and (50±10)% RH., at the Oporto facilities.

VISUAL INSPECTION

The equipment is in good condition.

"The reported expanded uncertainty is stated as the standard uncertainty multiplied by the coverage factor k = k´, which for a t-distribution with vef = v'ef effective degrees of freedom corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with EA-4/02 document"

IPAC is signatory to the EA MLA for calibration, testing, certification and inspection scopes.

Calibration date: 2018-02-26

Technician **Technical Responsible**

Daniel Pinto Pedro Castro

IPAC acreditação
M0003
Calibração

Rua dos Plátanos, 197
4100-414 Porto - Portugal

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Rua Cidade do Porto, Campus da Delphi - Edifício 4
4705-086 Braga - Portugal

Calibration Certificate

LaborMet - METROLOGY LABORATORY - PRESSURE

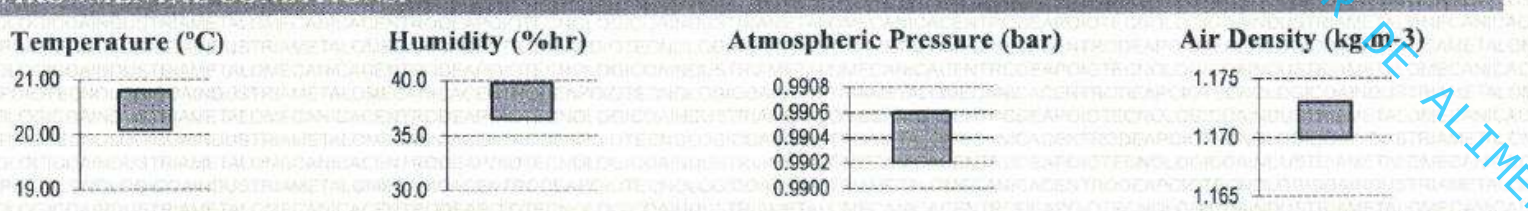
English version

RESULTS:

Equipment bar	Error bar	k'	V'_{ef}	Expanded Uncertainty bar	Error % F.S.
0.00	0.00	2.05	56	± 0.0061	0.0
10.00	-0.01	4.53	2	± 0.036	0.0
20.00	-0.02	2.87	4	± 0.018	0.0
30.00	-0.03	2.32	9	± 0.012	0.0
40.00	-0.05	2.23	12	± 0.012	0.0
50.00	-0.06	2.32	9	± 0.014	0.0
60.00	-0.07	2.10	26	± 0.016	-0.1
80.00	-0.11	2.02	106	± 0.013	-0.1
100.00	-0.13	2.02	138	± 0.016	-0.1
120.00	-0.14	2.02	104	±0.015	-0.1
140.00	-0.15	2.02	105	±0.015	-0.1

Maximum hysteresis error: 0.01 bar

ENVIRONMENTAL CONDITIONS:



OBSERVATIONS:

The equipment was calibrated with the display vertically.

It is considered the outlet pressure as the equipment reference .

The unit of pressure according to the International System of Units (SI) is the Pascal (1 bar = 100000 Pa).

Rua dos Plátanos, 197
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4705-086 Braga - Portugal

LIST-REGISTER OF CALIBRATED INSTRUMENTS AND EQUIPMENT _ 20.01.2020

Length measuring instruments

Ordinal number	Measuring instrument	Nu. of measuring instrument	Fabric designation	Measuring range	Date of calibration	Validity of the calibration	Institution for external calibration	Location of measuring instrument	*Status*	*Note*
1	Digital caliper „BETA“	020	C81029681	0-150mm/0.01mm	22.05.2015	22.05.2016	EUROMETING	Laboratory	*Unapproved*	*Not in use*
2	Mechanical caliper	2.86	027	0-300mm/0.05mm	10.03.2010	10.03.2011	EUROMETING	Production plant	*Not calibrated*	*Not in use*
3	Measurment tape X3017-0002	033	2001642	100-230/ 0.05mm	10.03.2010	10.03.2011	EUROMETING	Production plant	*Unapproved*	*Not in use*
4	Mechanical caliper „Mitutoyo“	025	10155595	0-200mm/0.05mm	22.05.2015	22.05.2016	EUROMETING	Production plant	*missing*	*Not in use*
5	Etalons	032	/	L (1.0mm ... 100.0mm)	13.06.2019	13.06.2020	EUROMETING	Laboratory	*Approved*	
6	Mechanical caliper - Depth measuring	029	290120021	0-300 /0.05mm	19.06.2019	18.06.2020	EUROMETING	Production plant /mech. department	*Approved*	
7	Mechanical caliper „Vis“	028	10401259	0-500mm/0.05mm	Renamed as #1007 by EUROMETING		EUROMETING	Mech. department/ Lab. or prod. line	Renamed as #1007 by EUROMETING	
8	Mechanical caliper	2.87	015	0-300mm/0.05mm	19.06.2019	19.06.2020	EUROMETING	Laboratory	*Approved*	
9	Mechanical caliper „KANON-Japan“	2.89	2.89	0-200mm/0.02mm	19.06.2019	11.06.2020	EUROMETING	Mech. department	*Approved*	
10	Mech. caliper „BETA“	031	05080730	0-150mm/0.05mm	16.05.2014	16.05.2015	EUROMETING	Injection moding deparment	*Unapproved*	*Not in use*
11	Digital caliper „BETA“	023	C810290466	0-150mm/0.01mm	17.04.2013	16.04.2014	EUROMETING	Production plant	-	*missing*
12	Digital caliper „HILKA“	0.24	76991500	0-150mm/0.01mm	11.04.2012	10.04.2013	EUROMETING	Production plant	*Unapproved*	*Not in use*
13	Digital caliper „KANON-Japan“	022	830379	0-150mm/0.01mm	15.04.2011	15.04.2012	EUROMETING	Production plant	*Unapproved*	*Not in use*
14	Mechanical micrometer „Kroeplin“ OD2050R	030	AA43H044	0-50mm/0.05mm	17.04.2013	16.04.2014	EUROMETING	Production line	*Unapproved*	*Not in use*

Length measuring instruments

Ordinal number	Measuring instrument	Nu. of measuring instrument	Fabric designation	Measuring range	Date of calibration	Validity of the calibration	Institution for external calibration	Location of measuring instrument	*Status*	*Note*
15	Measurment tape	0.27	228	0-3000 /1mm	15.04.2011	15.04.2012	EUROMETING	Production plant	*Unapproved*	*Not in use*
16	Digital micrometer „Kroeplin“	019	2.113	0-50 /0.01mm	02.03.2009	27.02.2010	EUROMETING	Production plant	*Unapproved*	*Not in use*
17	Measurment tape X3017-0003	021	2001593	200-330 /0.05mm	02.03.2009	27.02.2010	EUROMETING	Production plant	*Unapproved*	*Not in use*
18	Etalons	1027		Ø(20;25;32;40;50;63;75;90;110)	19.06.2019	13.06.2020	EUROMETING	Production plant	*Approved*	
19	Mechanical caliper „VERNIER“	034	D 00507	0-1000/0.02mm	19.06.2019	12.06.2020	EUROMETING	Production plant/ Mech. Department	*Approved*	
20	Digital caliper „BETA“1651 DG T/P	1005	C1011191705	0-150/0.01mm	09.06.2014	09.06.2015	EUROMETING	Laboratory	-	*Not in use*
21	Circumferential INOX tape ``Schwenk`` CJU950	1001	950E 9134	Ø 20- Ø 300 /0.1mm	10.06.2014	09.06.2015	EUROMETING	Laboratory	*Unapproved*	*Not in use*
22	Circumferential INOX tape ``Schwenk`` CJU2200	1002	2200 10401	Ø 300- Ø 700 /0.1mm	09.06.2014	09.06.2015	EUROMETING	Laboratory	*Not calibrated*	*Not in use*
23	Circumferential INOX tape ``Schwenk`` CJU3460	1003	3460E 8043	Ø 700-Ø 1100/ 0.1mm	19.06.2019	19.06.2020	EUROMETING	Laboratory	*Approved*	
24	Digital micrometer „Kroeplin“	1004	NW 03 L 041	0-60mm/0.02mm	20.05.2015	20.05.2016	EUROMETING	Production line 8	*Unapproved*	*Not in use*
25	Mechanical caliper „BETA“1650	1006	11080399	150mm/0.1mm	19.06.2019	17.06.2020	EUROMETING	Fitting production plant	*Approved*	
26	Mechanical caliper "VIS"	1007	10401259	0-500mm/0.05mm	19.06.2019	18.06.2020	EUROMETING	Laboratory	*Approved*	
27	Digital caliper „BETA“1651 DG T/P	1008	C01110180585	0-150mm/0.01mm	19.06.2019	20.06.2020	EUROMETING	Production plant	*Approved*	
28	Под. Клунесто мерило „BETA“1651 DG T/P	1009	C1011191858	0-150mm/0.01mm	16.05.2014	16.05.2015	EUROMETING	Production plant	-	*missing*
29	Mechanical caliper „BETA“1650	1010	0212-4514	150mm/0.02mm	17.04.2013	16.04.2014	EUROMETING	Maintenance	*Not calibrated*	*Not in use*
30	Mechanical micrometer „Kroeplin D2R20“	1011	DA05M094	0-20mm/0.01mm	10.06.2017		EUROMETING	Production plant	*Damage*	*Not in use*
31	Mechanical micrometer „Kroeplin OD2050R“	1012	AA21L101	0-50mm/0.05mm	June 2017	June 2018	EUROMETING	Production plant	*Damage*	*Not in use*
32	Mechanical micrometer „Kroeplin OD2050R“	1013	AA04L186	0-50mm/0.05mm	19.06.2019	18.06.2020	EUROMETING	Laboratory	*Approved*	

Length measuring instruments

Ordinal number	Measuring instrument	Nu. of measuring instrument	Fabric designation	Measuring range	Date of calibration	Validity of the calibration	Institution for external calibration	Location of measuring instrument	*Status*	*Note*
33	Circumferential INOX tape ``Schwenk`` CJU950	1014	950E 9316	Ø 20- Ø 300 /0.1mm	19.06.2019	19.06.2020	EUROMETING	Laboratory	*Approved*	
34	Circumferential INOX tape ``Schwenk`` CJU2200	1015	2200 10765	Ø 300- Ø 700 /0.1mm	19.06.2019	12.06.2020	EUROMETING	Laboratory	*Approved*	
35	Mechanical caliper „Kroeplin IP 65" TYPE D8R100	1017	AX10N009	0-100mm/0.1mm	19.06.2019	18.06.2020	EUROMETING	Laboratory	*Approved*	
36	Circumferential INOX tape ``Schwenk`` CJU950	1018	950E 10532	Ø 20- Ø 40 /0.1mm	15.05.2014	15.05.2015	EUROMETING	Laboratory	*Not calibrated*	*Not in use*
37	Circumferential INOX tape ``Schwenk`` CJU2200	1019	2200 12501	Ø 300- Ø 700 /0.1mm	15.05.2014	15.05.2015	EUROMETING	Laboratory	*Not Approved*	*Not in use*
38	Mechanical caliper "BETA 1650"	1022.1	S/N 11080083	0-150mm/0.05mm	17.04.2013	16.04.2014	EUROMETING	Mech. Department	-	*missing*
39	Mechanical caliper	1023/150	S/N 09251576	0-150mm/0.05mm	19.06.2019	17.06.2020	EUROMETING	Mech. Department	*Approved*	
40	Mechanical micrometer „Kroeplin OD2050R"	1020	AA16M103	0-50mm/0.05mm	20.05.2015	20.05.2016	EUROMETING	Laboratory	*Broken*	*Not in use*
41	Digital caliper ``MIB``	1022	GX 140700616	0-500/0.01mm	19.06.2019	12.06.2020	EUROMETING	Laboratory	*Approved*	
42	Digital caliper ``MIB``	1023/1000	GX 140400046	0-1000mm/0.01mm	19.06.2019	18.06.2020	EUROMETING	Laboratory	*Approved*	
43	Circumferential INOX tape ``MIB`` 161R-6	1024	07074075 457	Ø20-Ø2400mm/0.1mm	19.06.2019	12.06.2020	EUROMETING	Laboratory	*Approved*	
44	Mechanical caliper ``MIB``	1025	GX 131000398	0-300/0.05mm	19.06.2019	18.06.2020	EUROMETING	Mech. Department	*Approved*	
45	Mechanical caliper ``MIB``	1026	61001001150	0-150/0.05mm	19.06.2019	11.06.2020	EUROMETING	Mech. Department	*Approved*	
46	Digital caliper ``BETA 1651 DGT``	1030	C 1110181899	0-150/0.01mm	19.06.2019	17.06.2020	EUROMETING	Laboratory	*Approved*	
47	Digital caliper ``MIB``	1031	GX130900001	0-300/0.01mm	19.06.2019	18.06.2020	EUROMETING	Laboratory	*Approved*	

Length measuring instruments										
Ordinal number	**Measuring instrument**	**Nu. of measuring instrument**	**Fabric designation**	**Measuring range**	**Date of calibration**	**Validity of the calibration**	**Institution for external calibration**	**Location of measuring instrument**	***Status***	***Note***
48	Digital caliper ``Filetta``	1032	E 42305	0-150mm/0.01mm	June 2018	June 2019	EUROMETING	Production plant	*Not Approved*	*Not in use*
49	Mechanical caliper ``Filetta``	1033	/	0-150mm/0.05mm	19.06.2019	11.06.2020	EUROMETING	Production plant	*Approved*	
50	Mechanical caliper ``Mitotoyo``	1034	10069744	0-150mm/0.05mm	19.06.2019	11.06.2020	EUROMETING	Production plant	*Approved*	
51	Mechanical caliper ``MIB``	1035	/	0-150mm/0.05mm	19.06.2019	11.06.2020	EUROMETING	Production plant	*Approved*	
52	Etalons, Ø rings	1036	/	Ø(20; 20.3; 25.0; 25.0; 25.3; 32.0; 32.3; 40.0; 40.4; 50.0; 50.4; 63.0; 63.4)	19.06.2019	12.06.2020	EUROMETING	Laboratory	*Approved*	
53	Mechanical micrometer „Kroeplin D2R20“	1037	DA420135	0-20mm/0.01mm	01.06.2018	01.06.2019	EUROMETING	Laboratory	*Not Approved*	*Not in use*
54	Mechanical micrometer „Kroeplin D4R50“	1038	AA14P004	0-50mm/0.05mm	19.06.2019	12.06.2020	EUROMETING	Production line 6, 8, 26	*Approved*	
55	Mechanical caliper „MIB“	1039	/	0-150mm/0.05mm	June 2018		EUROMETING	Product. Line 20;21-24	*Not Approved*	*Not in use*
56	Mechanical caliper „Mitutoyo“	1040	14185884	0-150mm/0.05mm	19.06.2019	17.06.2020	EUROMETING	Mech. Department	*Comply*	
57	INZISE 1108-150	1041	0502181638	0-150mm/0.01mm	19.06.2019	17.06.2020	EUROMETING	Machines for small dimenrsions	*Comply*	
58	Mechanical micrometer „Kroeplin IP65 D4R50“	1042	AA21R031	0-50/0.05mm	July 2018			Laboratory	*Do not comply*	*Returned back to the seller*
0.36	Mechanical micrometer „Kroeplin IP65 D4R50“	1043	AA21R005	0-50/0.05mm	19.06.2019	18.06.2020		Laboratory	*Comply*	
60	Mechanical micrometer „Kroeplin IP65 D2R20“	1044	DA46Q042	0-20/0.01mm	19.06.2019	12.06.2020		Laboratory	*Comply*	
	Mechanical caliper (NO NAME)	1045	-	0-200/0.02mm	July 2019				*Not Approved*	*Not in use*
57	INZISE 1108-150	1046	1102181930	0-150mm/0.01mm	19.06.2019	20.06.2020		Kostadinov Bore	*Comply*	*Internal check*
57	ACCUD 111-006-12	1047	180921220	0-150mm/0.01mm	19.06.2019	17.06.2020		Eng. Goran Uzunov	*Comply*	*Internal check*
	Digital caliper ``BETA 1651 DGT``	1050	C 1810170688	0-150/0.01mm	19.06.2019	17.06.2020	EUROMETING	Polizoev	*Approved*	

Pressure measurment instruments

Ordinal number	Measuring instrument	Nu. of measuring instrument	Fabric designation	Measuring range	Date of calibration	Validity of the calibration	Institution for external calibration	Location of measuring instrument	*Status*	*Note*
1	pressure gauge-„Italmanometri“	2.20	179	0-60 bar/0.2bar	10.03.2010	10.03.2011	EUROMETING	Laboratory	*Not calibrated*	*Not in use*
2	pressure gauge-„Italmanometri“	2.21	178	0-60 bar/0.2bar	11.04.2012	10.04.2013	EUROMETING	Laboratory	*Not calibrated*	*Not in use*
3	pressure gauge-„Kindmen“	2.22	177	0-100 bar/0.2bar	11.04.2012	10.04.2013	EUROMETING	Laboratory	*Not calibrated*	*Not in use*
4	Digital manometar-„WIKA“	013	WIKA S # 4107133	0-40 bar/0,01bar	19.06.2019	13.06.2020	EUROMETING	Laboratory	*Comply*	

Temperature regulators

Ordinal number	Measuring instrument	Nu. of measuring instrument	Fabric designation	Measuring range	Date of calibration	Validity of the calibration	Institution for external calibration	Location of measuring instrument	*Status*	*Note*
1	Temperature regulator (China)	2.154	Pt 100	0-400°C/1°C	19.06.2019	13.06.2020	EUROMETING	Laboratory	*Approved*	
2	Temperature regulator (RKC)	2.24	K	0-400°C/1°C	19.06.2019	13.06.2020	EUROMETING	Laboratory	*Approved*	
3	Temperature thermometer-„MC“	2.24 A	MC	0-80°C/2°C	19.06.2019	13.06.2020	EUROMETING	Laboratory	*Approved*	
4	Temperature regulator (RKC)	2.23	Pt 100	0-400°C/1°C	10.03.2011	10.03.2012	EUROMETING	Laboratory	*Not calibrated*	*Not in use*
5	Temperature regulator (Eurotherm)	2.153	2216 e	0-350°C/ 0.1°C	19.06.2019	13.06.2020	EUROMETING	Laboratory	*Approved*	
6	Digital thermometer "TBT 08H"	2.25	2.25	-50 to 300°C /0.1°C	15.05.2014	15.05.2015	EUROMETING	Laboratory	*Not calibrated*	*Not in use*
7	Digital thermometer "Lae"	2.26		0 to 100°C /0.1°C	13.06.2019	13.06.2020	EUROMETING	Laboratory	*Approved*	
	Digital thermometer "Ridgid"	2.27		-50 to +800°C /0.1°C	19.06.2019	13.06.2020	EUROMETING	Laboratory	*Approved*	
	Analog "LSW"	2.28		-30 to + 50 °C / 1°C	19.06.2019	13.06.2020	EUROMETING	Laboratory	*Approved*	
8	Temperature regulator SCITEQ Pt100	1128	23504-1-3-15	0 to 450°C /0.1°C	25.01.2019	25.01.2020	SCITEQ	Laboratory	*Approved*	
9	Temperature regulator ENDA, water tank No.2, pressure station	1129	SN 141411309	1 to 200°C /0.1°C	19.06.2019	13.06.2020	EUROMETING	Laboratory	*Approved*	

Scales (weight measurment devices)

Ordinal number	Measuring instrument	Nu. of measuring instrument	Fabric designation	Measuring range	Date of calibration	Validity of the calibration	Institution for external calibration	Location of measuring instrument	*Status*	*Note*
1	Digital scale -KERN PLS 360-3	0025	072705	0-360 /0.001g	07.06.2018	07.06.2020	MAKMERA	Laboratory	*Approved*	
2	Digital scale- „ATHENA"MK-05-03-00073	0033	12285	030g-15kg/2g	07.06.2018	07.06.2020	MAKMERA	Laboratory	*Approved*	
3	Digital scale -60/D5 MK-05-03-00167	0738	100655	200g-60kg/10g	07.06.2018	07.06.2020	MAKMERA	Production plant	*Approved*	
4	Digital scale -30/D5 MK-05-03-00167	0737	100810	400g-60kg/5g	07.06.2018	07.06.2020	MAKMERA	Production plant	*Approved*	
5	Digital scale -Tehtnica	0023	EXACTA 610 EB	0-600g /0.01g	22.03.2010	22.03.2011	MAKMERA	Laboratory	*Not calibrated*	*Not in use*
6	Digital scale -30/D5 MK-05-03-00167	/	8999997	0-500kg/200g	07.06.2018	07.06.2020	MAKMERA	Production plant	*Approved*	

DYNAMOMETER

Ordinal number	Measuring instrument	Nu. of measuring instrument	Fabric designation Ser.no.	Measuring range	Date of calibration	Validity of the calibration	Institution for external calibration	Location of measuring instrument	*Status*	*Note*
1	Dynamometer ATORN 41570008	1016	7501	0-10 kN / 0.2kN	10.06.2013		Producer	Laboratory	*Do not comply*	*Not in use*

Laboratory equipment

Ordinal number	Measuring equipment	Nu. of measuring equipment	Fabric designation	Date of calibration	Location of measuring instrument	Institution for calibration	*Note*
1	Melt index extruder „SCITEQ“	0024	CFR 91/2	19.06.2019	Laboratory	EUROMETING	Temperature regulator 2.153; MFR scales, Not in use
2	Melt index extruder „SCITEQ“	1128	XNR-400C1	25.01.2019	Laboratory	SCITEQ every 2nd year	Temperature regulator 11.28
3	Microscope **"ZEISS"**	0022	STEMI DR 1663	/	Laboratory	/	Not subject to calibration
4	Microscope **"ZEISS" Stemi 508** with camera **Axiocam 208 color**	1856	STEMI 508	/	Laboratory	/	Not subject to calibration
5	Micro slice cutter	0021	HM 325	/	Laboratory	/	Not subject to calibration
6	Oven	0018	101-2A	19.06.2019	Laboratory	EUROMETING	Temperature regulator 2.154
7	Impact strenght equipment	0016	XJL-300	08.04.2019	Laboratory	Internal check	Conform
8	Machine for determination ring stiffness and tensile properties	0008	**Testometric** M500-50kN	07.11.2018	Laboratory	ЛАБОРАТОРИЈА КАЛАБСИ	Conform
9	Machine for determination ring stiffness, 2m	1214	WDT-W 50kN, 2013121	07.11.2018	Laboratory	ЛАБОРАТОРИЈА КАЛАБСИ	Conform
10	Machine for determination ring stiffness	1101	WDT-W 50kN, 2014660	07.11.2018	Laboratory	ЛАБОРАТОРИЈА КАЛАБСИ	Conform
11	Equipment for determination hardness of water	0012	ISO LAB	/	Laboratory	/	Not subject for calibration
12	Pressure station	017	XGY-B	/	/	/	Not in use
13	Pressure station	0014	SCITEQ SUB10	March 2018	Laboratory	SCITEQ every 2nd year	Conform
			SCITEQ SUB10	Every 3 months	Laboratory	Internal check	Conform
14	Temperature tank No.1 for pressure station	0015	XGY-400	19.06.2019	Laboratory	EUROMETING	Temperature regulator 2.24, Internally cheched
15	Temperature tank No.2 for pressure station	1129	ENDA	19.06.2019	Laboratory	EUROMETING	Temperature regulator 1129. Checks with # 2.26
16	Milling machine	0018	YLZ-150	/	Laboratory	/	Not subject to calibration
17	Watertightness	1120		/	Laboratory	/	Not subject to calibration

Date **20.01.2020**

Quality control

Mech. eng. Stardelev Zafir

QUALITY CONTROL PLAN FOR BRT AND PVT FOR PE100-RC WATER SUPPLY PIPE

Batch release test (BRT) acc.12201-7 Table 7

Characteristics	Reference to Part and clause	Minimum sampling frequency [a]	Number of test piece [1)]	Number of measurements per test piece
Appearance and colour (coils and straight lengths)	2-5.1/5.2	Every 4 h. If production of an item: > 4 h, every item	1	1
Geometrical (coils and straight lengths)	2-6	Continuously or every 4 h. If production of an item: > 4 h every item	1	1
Hidrostatic strength (80°C, 165 h)	2-7.2	Once per pipe batch per week [2)]	1	1
Melt mass-flow rate (MFR) [3)]	2-8.2	Not applicable , 100 % virgin material used	1	1
Elongation at break	2-8.2	Once per pipe batch	See note 4)	1
Oxidation induction time (thermal stability)	2-8.2	Not applicable	/	/
Marking	2-12.4	At start up and every 4 h.	1	1

1) The number of test pieces given in the table are the minimum. All test pieces shall pass the relevant tests .

2) Once per batch for size 3 and 4.

3) Tests to be carried out where reprocessed materials are used.

4) Number of test pieces are specified in ISO 6259-1. The test pieces are taken from the circumference of one pipe sample.

Process verification test (PVT) acc. EN 12201-7 Table 11

Characteristics	Reference to Part and clause	Minimum sampling frequency [a]	Number of test piece	Number of measurements per test piece
Hydrostatic strength (80 °C, ≥ 1 000 h)	3-7.3	Once per size group per year [1)]	3 [2)]	1
Oxidation induction time	3-8.2	Not applicable	/	/

1) Rotate sizes, SDR and compound each year.

2) One for size groups 3 and 4.

f.8.4.08

Date:
April 2020

Quality control manager
Eng. Gordana Manoleva

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ISO 9001:2008 No.01442/0
ISO 14001:2004 No.00211/0

QUALITY CONTROL PLAN FOR (TT) FOR PE100-RC WATER SUPPLY PIPE

Type test (TT) acc. EN 12201-7 Table 3

Characteristic	Reference to Part and clause of EN 12201	Sampling procedure	Number of test piece(s) [1]	Number of measurements per test piece
Appearance and colour	2-5.1/5.2	Two dimension per size group	1	1
Geometrical	2-6.1	Two dimension per size group	1	1
Hidrostatic strength (20°C, 100 h)	2-7.2	Two dimension per size group [2]	3	1
Hidrostatic strength (80°C, 1000 h)	2.72	Two dimension per size group [2]	3	1
Elongation at break	2-8.2	Two dimension per size group [3]	See note 3)	1
Oxidation induction time	2-8.2	Not applicable	/	/
Melt mass-flow rate (MFR)	2-8.2	Once per size group	3	1
Marking	2-12.4	Once per size	1	1
Fitness for purpose	For preperation of assemblies, tests and frequency see en 12201-5			

1) All te test piece(s) given in Table are the minimum. All test pieces shall pass the relevant tests.

2) If the product range covers more than one size group, samples shall comprise the smallest and largest diametars manufactured plus a sample from each intermediate size group. The succesful testing will validate all diametars within the range tested. Successful testing on the lowest SDR pipe will validate pipes with the same OD having a high SDR i.e. thinner wall thickness. Where a manufacturer extends his production beyond his approval then addiitional type testing shall be carried out.

3) The number of test pieces are specified in ISO 6259-1. The test pieces are taken from the circumference of one pipe sample.

f.8.4.08

Date:
14.09.2019

Quality control menager
Eng. Gordana Manoleva