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FINAL TEST REPORT

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Result: **PASS** Report Date: 31-Aug-2021

Customer Name:	ABN Pipe Systems S.L.U.
Tested To:	ASTM F2389 (ASTM F2023)-2019 (2015) – per NSF/ANSI 14
Description:	25 mm x 3.2 mm PP Pipe (monowall made from inner layer) | ABN INSTAL CT-FASER-RD
Test Type:	Qualification
Trade Designation:	Borealis RA 7050 | ABN INSTAL CT-FASER-RD
Job Number:	J-00357023
Project Number:	W0580068
Project Manager:	Javier Marin

Testing was conducted at Element Sweden.

Thank you for having your product tested by NSF International.

Please contact your Project Manager if you have any questions or concerns pertaining to this report.

Report Authorization: _____

Ata Ciechanowski, P.E.
Senior Principal Engineer, Engineering Laboratory

Authority: _____

Paul Anderson – Director, Laboratory Operations

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Test Method:

Chlorine Resistance Testing was performed in accordance with ASTM F2389 *Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems* using the method in ASTM F2023 *Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water,* and NSF 14 for *Dependent transfer listing and minor formulation changes.*

Test Details:

Specimens were tested as 15″ lengths with PFA fittings on both pipe ends.

Specimens were exposed to continuous flowing chlorinated Reverse Osmosis water (via sodium hypochlorite) and tested in a vertical position under conditions as detailed below in Tables 1 and 2.

Table 1: Primary Test Variables and Control Limits

Parameter	Nominal at Element Sweden	Control Limits
pH	6.80	± 0.2
Free Chlorine (mg/L)	4.30	± 0.2
Nominal ORP (mV)	≥825	Average
Fluid Temperature (°C)*	115°C	± 1
Air Temperature (°C)*	115°C	± 2.5
Water Pressure (psig)	See Table 2	± 3
Flow Rate (dm^3/h)	≥40	Average

*The Fluid and Air Temperatures are controlled at the same set-point. No measurable temperature drop across the test specimens was observed on the samples used in the data analysis calculation.

Results:

Testing of five specimens was originally initiated. Three specimens at 115 °C/70 psig and two specimens at 115 °C/40 psig were tested. Three samples exhibited brittle failures. Two samples exhibited significant erosion on the wall thickness which resulted in ductile/mixed mode failures. Table 2 provides a summary of the test details of the specimens.

The failed specimens were observed to have moderate degradation with extensive micro-cracking and radial cracking on the inner surface. Failure was due to a loss of fluid at a brittle slit perforation or a ductile failure as a result of erosion on the wall thickness. The failures appear to be typical of chlorine induced oxidative failures.

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Table 2: Test Results and Protocol Predictions

Specimen ID	Job Number/ Sample Number	Temp (°C)	Pressure (psig)	Stress (psi)	Test Time (hr)	Status	95% LPL (hr)
1	J-00357023-3	115	70	217	3159	Brittle Failure	2959
2	J-00357023-4	115	70	217	3349	Ductile Failure	2958
3	J-00357023-5	115	70	219	3325	Mixed Mode Failure	2957
4	J-00357023-1	115	40	124	3773	Brittle Failure	3059
5	J-00357023-2	115	40	124	3845	Brittle Failure	3059

Data Analysis:

Specimens were tested at two test conditions. The samples used in the data analysis were three specimens were tested at 115 °C/70 psig and two specimens were tested at 115 °C/40 psig. Table 3 provides a summary of the specimen's test times with the 95% LPL (Lower Predictive Limit) predicted by the Protocol data set.

The data set of the original five specimens was analyzed according to ASTM F2023. The data set was compared to the NSF Chlorine Resistance data set for the Borealis RA 7050. The results are summarized in Table 3.

Table 3: Summary of Data Analysis

ASTM F2023 Criteria	Minimum	Test Result
Data points shall exceed the LPL for that condition	5 (All)	5

Discussion:

The data set meets the requirements of NSF 14:

- All of the data points are above the LPL.

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Conclusions:

When tested in accordance with ASTM F2389 *Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems* using the method in ASTM F2023 *Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water,* and NSF 14 for *Dependent transfer listing and minor formulation changes,* the pipe's extrapolated time-to-failure meets the CL-TD classification.

***Unless otherwise indicated, method uncertainties are not applied in any determinations of conformity. Testing utilizes the requested sections of any referenced standards, which may not be the entire standard.

***Date of Laboratory Activity:** 22-Oct-2020 to 2-Sep-21

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