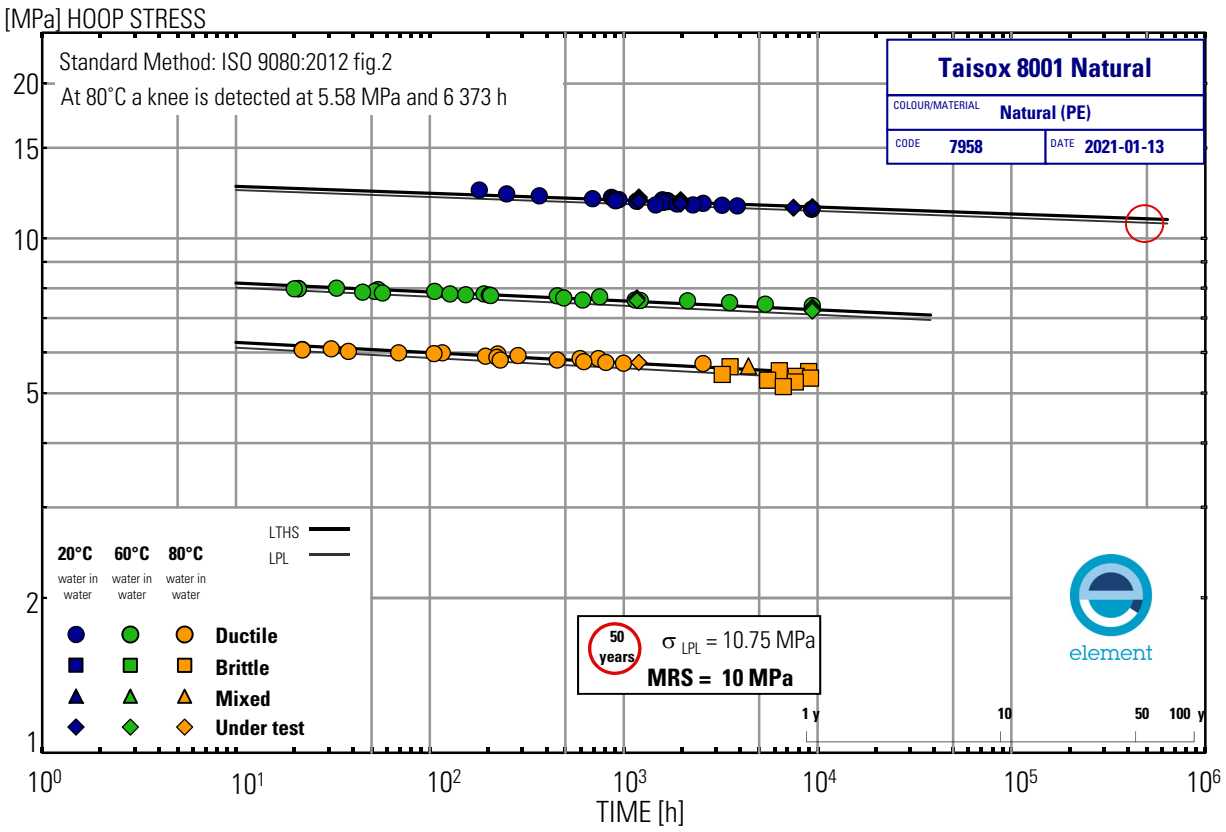
ELEMENT TEST REPORT P-21-07-v1

DETERMINATION OF THE LONG-TERM HYDROSTATIC STRENGTH

ISO 9080:2012-evaluation of the natural PE pipe grade Taisox 8001 Natural from Formosa Plastics Corporation



Element Materials Technology
Plastic Pipes
Studsvik 3, SE-611 99 TYSTBERGA, Sweden
T: +46 13 16 90 00
E: info.nykoping@element.com

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Handled by
Mattias Svedberg

Formosa Plastics Corporation
Technical Department, Polyolefin Division

No.1, Formosa Industrial Complex, Mailiao Village,
Yunlin County
63681
Taiwan

DETERMINATION OF THE LONG-TERM HYDROSTATIC STRENGTH ISO 9080:2012-evaluation of the natural PE pipe grade Taisox 8001 Natural from Formosa Plastics Corporation

ABSTRACT

The aim of this project was to determine the long term hydrostatic strength of the natural PE pipe grade Taisox 8001 Natural according to ISO 9080 and then MRS-classify it according to ISO 12162. The ISO 9080-evaluation of the pipe grade gives the following 50 years-strength values at 20°C.

ISO 9080 STRENGTH VALUES			
T	**TIME**	σ_{LPL}	σ_{LTHS}
20°C	50 yrs	10.75 MPa	10.94 MPa

By its LPL value of 10.75 MPa at 20°C and 50 years the natural PE pipe grade Taisox 8001 Natural has a minimum required strength (MRS) classification of 10 MPa and is thereby designated PE 100 according to ISO 12162:2009.

At 80°C a knee was detected, only using burst samples, at 5.58 MPa and 6 373 h. The ISO 9080-evaluation is performed according to 5.1.5 figure 2 in ISO 9080 when having a knee only at the highest temperature. This means that the t_{max} at 80°C equals the time of the knee detection.

Please observe that this report only covers the ISO 9080-evaluation following MRS classification and material designation. Additional requirements for PE 100 pipe compounds are given in the relevant product standards.

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APPENDICES

Written by

Mattias Hagman
JUNIOR PROJECT MANAGER

Reviewed by

Jarno Hassinen
OPERATIONS MANAGER

Approved by

Mattias Svedberg
SENIOR PROJECT MANAGER

1 EVALUATED PIPE GRADE

A short presentation of the evaluated pipe grade is presented below and detailed information is given in Appendix B.

EVALUATED PIPE GRADE	
TRADE NAME	Taisox 8001 Natural
COLOUR	Natural
MATERIAL	PE
NOMINAL DIMENSION	32 x 3 mm
ELEMENT CODE	7958
NO OF SAMPLES TESTED	120

2 EXPERIMENTAL PROCEDURE

The hydrostatic pressure testing is performed at Element according to ISO 1167:2006. The pressure testing at 20, 60 and 80°C is performed using deionised water on the inside and on the outside of the pipe specimens. The accuracy for temperature[1] and pressure[1] is better than ±1°C and +2/-1% respectively. The measurements of the wall thickness[1] are accurate within ±0.02 mm and the diameter[1] within ±0.1 mm.

3 RESULTS FROM THE HYDROSTATIC PRESSURE TESTING

The results obtained from the hydrostatic pressure testing are presented in Appendix B and shown in Appendix C. The table gives a summary of the observations.

SUMMARY OF THE RESULTS FROM THE HYDROSTATIC PRESSURE TESTING						
T	**TOTAL**	**BURST**	**ON TEST**	**STOPPED**	**LONGEST TIME TO BURST**	**LONGEST TEST TIME**
20°C	46	22	24	0	9 329 h	9 404 h
60°C	36	26	10	0	9 396 h	9 403 h
80°C	38	32	6	0	9 202 h	9 402 h

[1] The expanded uncertainty of measurement has been calculated as the standard uncertainty of measurement multiplied by the coverage factor K=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA Publication EA-4/02 and is documented at ELEMENT.

4 ISO 9080-EVALUATION

The ISO 9080-evaluation consists of multiple linear regression analysis (MLR) on the stress rupture data obtained at the different test temperatures. The MLR is performed using the latest version of the software Pipeson Analyzer from Pipeson.

The ISO 9080 also includes extrapolation factors that determine to what times we can extrapolate at each temperature.

4.1 General model for the regression analysis according to ISO 9080

The general 4-parameter model used in ISO 9080 is the following:

$$Log(t) = C_1 + C_2 \cdot \frac{1}{T} + C_3 \cdot Log(\sigma) + C_4 \cdot \frac{Log(\sigma)}{T} + e$$

where

C_1 *to* C_4	*parameters used in this model*	
t	*time to failure*	*[h]*
T	*Temperature*	*[K]*
σ	*Hoop stress*	*[MPa]*
e	*error variable*	*Laplace-Gaussian distribution, with zero mean and constant variance (the errors are assumed to be independent)*

The 4-parameter model shall be reduced to a 3-parameter model if the probability level of C_3 is greater than 0.05. i.e. $C_3 = 0$.

5 RESULTS FROM THE ISO 9080 EVALUATION

The diagram in Appendix C.2 shows the observations and lines for σ_{LPL} and σ_{LTHS} for the selected analysis.

5.1 Comments on selecting the data set for ISO 9080

- Data points equal to and below 66 h at 20°C were excluded from the analysis in accordance with paragraph 4.2.3 in ISO 9080.
- The software detected a knee at 60°C. However, as the knee detection is caused by on test samples, it is disregarded and all data designated to type A.
- At 80°C a knee was detected, only using burst samples, at 5.58 MPa and 6 373 h. The ISO 9080-evaluation is performed according to 5.1.5 figure 2 in ISO 9080 when having a knee only at the highest temperature. This means that the t_{max} at 80°C equals the time of the knee detection.

5.2 Distribution of stress rupture data

The table below presents the distribution of observations for the data set that was used in the ISO 9080-evaluation.

DISTRIBUTION OF THE STRESS RUPTURE DATA INCLUDED IN THE ISO 9080 EVALUATION							
T	**TOTAL**	**BURST**	**ONGOING**	**STOPPED**	**>7 000 h**	**>9 000 h**	**EXCLUDED**[2)]
20°C	30	21	9	0	4	3	0
60°C	30	24	6	0	4	4	0
80°C	30	29	1	0	4	1	8
Requirement[1)]	*30*	-	-	-	*4*	*1*	-

1) Indicate the required number of observations according to ISO 9080.

2) Number of pipe samples included in the distribution analysis, but not in the regression analysis.

5.3 Regression analysis model

Different analyses were performed adding pipes that still were in progress and using the 3 or 4-parameter models.

The 4-parameter model was finally chosen, as the probability level for C_3 was ≤0.05. The table below presents the regression coefficients and the standard error values for the selected analysis.

REGRESSION COEFFICIENTS FOR THE SELECTED MODEL				
FIRST BRANCH	**C_1**	**C_2**	**C_3**	**C_4**
VALUE	-164.143	72 530.852	68.217	-41 900.854
STANDARD ERROR	9.022	3 670.137	5.967	2 560.144

5.4 Extrapolation time limits

The tables below show the maximum test times and the maximum extrapolation time limits for the different test temperatures.

MAXIMUM TEST TIMES		
T_t[1)]	**t_{max}**[2)]	
20°C	7 509 h	0.86 yrs
60°C	8 407 h	0.96 yrs
80°C	6 373 h[3)]	0.73 yrs

1) T_t is the test temperature

2) The maximum test time, t_{max}, is the logarithmic average of the 5 longest observations.

3) The ISO 9080-evaluation is performed according to 5.1.5 figure 2 in ISO 9080 when having a knee only at the highest temperature. This means that the t_{max} at 80°C equals the time of the knee detection.

MAXIMUM EXTRAPOLATION TIME LIMITS		
T_s[1)]	**EXTRAPOLATION TIME LIMIT, t_e**[2)]**, AT T_s**	
20°C	637 286 h	72.8 yrs
60°C	38 237 h	4.36 yrs
80°C	6 373 h	0.73 yrs

1) T_s is the service temperature (the extrapolated temperature)

2) The extrapolation time limit, t_e, is calculated from the relation: $t_e = t_{max} \cdot k_e$, k_e is the extrapolation time factor and is a function of the difference in extrapolated temperature, T_s, and the test temperature, T_t.

5.5 Extrapolated strength values

The selected model gives the following extrapolated strength values corresponding to 50 years at 20°C and to the extrapolation time limits at the test temperatures.

EXTRAPOLATED STRENGTH VALUES						
TIME	σ_{LTHS} [MPa]			σ_{LPL}[MPa]		
	20°C	60°C	80°C	20°C	60°C	80°C
10 h	12.623	8.192	6.279	12.417	8.022	6.131
100 h	12.240	7.870	5.999	12.047	7.711	5.859
1 000 h	11.869	7.562	5.731	11.683	7.406	5.595
10 000 h	11.509	7.265	-	11.323	7.110	-
100 000 h	11.159	-	-	10.970	-	-
50 yrs	10.941	-	-	10.747	-	-
100 yrs	-	-	-	-	-	-

EXTRAPOLATED STRENGTH VALUES AT t_e				
T	t_e	t_e	σ_{LTHS}	σ_{LPL}
20°C	637 286 h	72.8 yrs	10.886 MPa	10.690 MPa
60°C	38 237 h	4.36 yrs	7.098 MPa	6.941 MPa
80°C	6 373 h	0.73 yrs	5.524 MPa	5.388 MPa

5.6 Classification and designation according to ISO 12162

By its LPL value of 10.75 MPa at 20°C and 50 years the natural PE pipe grade Taisox 8001 Natural has a minimum required strength (MRS) classification of 10 MPa and is thereby designated PE 100 according to ISO 12162:2009.

At 80°C a knee was detected, only using burst samples, at 5.58 MPa and 6 373 h. The ISO 9080-evaluation is performed according to 5.1.5 figure 2 in ISO 9080 when having a knee only at the highest temperature. This means that the t_{max} at 80°C equals the time of the knee detection.

Please observe that this report only covers the ISO 9080-evaluation following MRS classification and material designation. Additional requirements for PE 100 pipe compounds are given in the relevant product standards.

6 ADDITIONAL COMMENTS

The delivered pipes showed good visual appearance and no unusual behaviour were observed during the hydrostatic pressure testing.

The results are only valid for the samples with the Element code 7958.

7 VERSION HISTORY

The latest version replaces any preceding version of the report.

VERSION	DATE	CHANGES
v1	2021-01-15	-

8 REFERRED DOCUMENTS

DOCUMENT	VERSION	TITLE
EA-4/16	2003	EA guidelines on the expression of uncertainty in quantitative testing
ISO 1167	2006	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids – Determination of the resistance to internal pressure
ISO 9080	2012	Plastics piping and ducting systems –Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation
ISO 12162	2009	Thermoplastics materials for pipes and fittings for pressure applications – Classification, designation and design coefficient
ISO/IEC 17025	2018	General requirements for the competence of testing and calibration laboratories
Pipeson Analyzer®	3.2.6	ISO 9080 evaluation software from Pipeson AB, SE-11152 Stockholm, Sweden

CLIENT INFO

Client	Formosa Plastics Corporation
Department	Technical Department, Polyolefin Division
Street address	No.1, Formosa Industrial Complex, Mailiao Village, Yunlin County
Postal code	63681
Country	Taiwan
Contact person	Mr. Yiying Hsieh
Phone	+886-5-681-183
Fax	+886-5-681-1122
E-mail	ishield21@fpc.com.tw
Web	n/a

MATERIAL INFO

Element code	7958
Trade name	Taisox 8001 Natural
Material	PE
Colour	Natural
Nominal dimension	32 x 3 mm
Arrival date at Element	2019-10-15
Amount	180 x 350 mm
Consignor	Formosa Plastics Corporation
Condition of material at arrival	Good visual appearance
Marking	No commercial marking
Resin producer	Formosa Plastics Corporation
Resin production site	Linyuan County, Kaohsiung City, Taiwan
Resin production batch no	n/a
Resin production date	n/a
Pipe producer	Formosa Plastics Corporation
Pipe production site	Mailiao Plant, Yulin County, Taiwan
Pipe production batch no	n/a
Pipe production date	n/a
Method of manufacturing	Extrusion

TEST INFO

Test laboratory	Element Materials Technology, ISO/IEC 17025 Swedac accreditation no. 0067
Responsible	Nataliya Taunley - Technical Supervisor
Test method	ISO 1167:2006
Length (total/free)	350/310 mm for samples fitted with brass fittings and 350/250 mm for PVDF
Fittings	Brass fittings and type A
Internal medium	Water
External medium	Water
Conditioning time	3 h
Situation on	2021-01-13

TABLE REMARKS

Code	Element internal code
T	Test temperature
Start date	Date when the sample was started
Reg date	Date when the sample was stopped or registered as failure.
e_{min}	Minimum wall thickness
d_{em}	Mean outside diameter
p	Internal pressure
σ	Circumferential stress (hoop stress)
->	The sample is under test

PIPE REMARKS

1 At temperatures ≤ 40 °C, failure times up to 1 000 h may be neglected, provided that the number of remaining observations conforms to 4.2.1. In that case, all points under the selected time and temperature shall be discarded.

2 The failure occurred closer than 0.1 x l_0 from an end cap, where l_0 is the free length of the pipe, and may therefore be discarded according to ISO 1167-1 clause 10.4. The sample will be included in the ISO 9080 to fulfill the distribution requirements.

The sample is included in the ISO 9080 evaluation as data type A

The sample is included in the ISO 9080 evaluation as data type B

TEST INTERRUPTIONS

SAMPLE	DATE	TEST TIME	RESTARTED AFTER	STATUS

HYDROSTATIC PRESSURE TESTING

Code	T	Start date	Reg date	d_{em}	e_{min}	p	σ	Burst time	Burst mode	Test time	Remark
	[°C]	[yymmdd]	[yymmdd]	[mm]	[mm]	[bar]	[MPa]	[h]		[h]	
7958-34	20	191104	191107	32.07	3.19	28.34	12.83	66	Ductile		*1*
7958-7	20	191104	191112	32.05	3.12	26.77	12.41	180	Ductile		
7958-24	20	191104	191115	32.06	3.17	26.77	12.20	249	Ductile		
7958-10	20	191104	191120	32.05	3.16	26.48	12.10	367	Ductile		
7958-13	20	191104	191210	32.06	3.14	26.09	12.01	865	Ductile		
7958-147	20	201124		32.06	3.14	26.09	12.01	->		*>1 197*	
7958-11	20	191218	200124	32.08	3.16	26.09	11.94	887	Ductile		
7958-79	20	201124	201223	32.08	3.16	26.09	11.94	691	Ductile		
7958-100	20	191104	191213	32.08	3.17	26.09	11.90	905	Ductile		
7958-128	20	201124		32.07	3.17	26.09	11.89	->		*>1 197*	
7958-43	20	201124	210104	32.06	3.17	26.09	11.89	944	Ductile		
7958-96	20	201023	201229	32.08	3.11	25.50	11.88	1 585	Ductile		
7958-20	20	201023		32.07	3.11	25.50	11.87	->		*>1 965*	
7958-164	20	191218	200227	32.09	3.12	25.50	11.84	1 684	Ductile		
7958-123	20	201124	210102	32.08	3.11	25.40	11.83	907	Ductile		
7958-158	20	201124		32.06	3.12	25.50	11.82	->		*>1 197*	
7958-15	20	191104	191223	32.08	3.19	26.09	11.81	1 165	Ductile		
7958-66	20	201124		32.07	3.13	25.50	11.79	->		*>1 197*	
7958-122	20	201023	210102	32.08	3.12	25.40	11.79	1 698	Ductile		
7958-38	20	191218	200224	32.08	3.13	25.40	11.75	1 599	Ductile		
7958-63	20	201023		32.08	3.13	25.40	11.75	->		*>1 965*	
7958-71	20	201124		32.08	3.13	25.40	11.75	->		*>1 197*	
7958-6	20	191218	200406	32.06	3.15	25.50	11.70	2 572	Ductile		
7958-29	20	201023		32.07	3.11	25.11	11.69	->		*>1 965*	
7958-12	20	191218	200306	32.07	3.15	25.40	11.66	1 884	Ductile		
7958-84	20	201023		32.07	3.12	25.11	11.65	->		*>1 965*	
7958-95	20	191104	200207	32.05	3.16	25.40	11.61	2 277	Ductile		
7958-53	20	201023	201223	32.07	3.13	25.11	11.61	1 463	Ductile		
7958-59	20	200306	200720	32.06	3.13	25.11	11.60	3 218	Ductile		
7958-98	20	201023		32.06	3.13	25.11	11.60	->		*>1 965*	
7958-107	20	200306	200814	32.06	3.14	25.11	11.56	3 853	Ductile		
7958-108	20	201023		32.08	3.11	24.81	11.56	->		*>1 965*	

HYDROSTATIC PRESSURE TESTING

Code	T	Start date	Reg date	d_{em}	e_{min}	p	σ	Burst time	Burst mode	Test time	Remark
	[°C]	[yymmdd]	[yymmdd]	[mm]	[mm]	[bar]	[MPa]	[h]		[h]	
7958-118	20	201023		32.06	3.11	24.81	11.55	->		*>1 965*	
7958-33	20	191218		32.07	3.12	24.81	11.51	->		*>9 404*	
7958-87	20	201023		32.07	3.12	24.81	11.51	->		*>1 965*	
7958-51	20	200306		32.07	3.13	24.81	11.47	->		*>7 508*	
7958-134	20	191218		32.09	3.14	24.81	11.44	->		*>9 404*	
7958-16	20	191218	210111	32.07	3.15	24.81	11.39	9 329	Ductile		
7958-31	20	200306		32.07	3.15	24.81	11.39	->		*>7 508*	
7958-52	20	200306		32.08	3.13	24.52	11.34	->		*>7 508*	
7958-14	20	191218		32.07	3.14	24.52	11.30	->		*>9 404*	
7958-73	20	200306		32.08	3.12	24.22	11.24	->		*>7 508*	
7958-27	20	191218		32.08	3.13	24.22	11.20	->		*>9 404*	
7958-141	20	200306		32.06	3.14	24.22	11.15	->		*>7 508*	
7958-74	20	200306		32.08	3.16	24.22	11.09	->		*>7 508*	
7958-42	20	200306		32.08	3.12	23.73	11.01	->		*>7 508*	

HYDROSTATIC PRESSURE TESTING

Code	T	Start date	Reg date	d_{em}	e_{min}	p	σ	Burst time	Burst mode	Test time	Remark
	[°C]	[yymmdd]	[yymmdd]	[mm]	[mm]	[bar]	[MPa]	[h]		[h]	
7958-85	60	191104	191105	32.09	3.12	17.65	8.20	4.6	Ductile		
7958-177	60	191104	191105	32.07	3.09	17.26	8.09	9.3	Ductile		
7958-112	60	191104	191106	32.06	3.09	17.06	8.00	33	Ductile		
7958-176	60	201216	201217	32.09	3.13	17.26	7.99	21	Ductile		
7958-26	60	191104	191105	32.07	3.13	17.26	7.98	21	Ductile		
7958-77	60	201216	201217	32.08	3.13	17.26	7.98	20	Ductile		
7958-162	60	201216	201218	32.08	3.11	17.06	7.95	54	Ductile		
7958-3	60	191104	191107	32.06	3.13	17.06	7.89	52	Ductile		
7958-75	60	201216	201221	32.07	3.13	17.06	7.89	106	Ductile		
7958-60	60	201216	201218	32.07	3.14	17.06	7.86	45	Ductile		
7958-55	60	201216	201221	32.06	3.15	17.06	7.83	57	Ductile		
7958-23	60	191104	191111	32.07	3.13	16.87	7.80	127	Ductile		
7958-78	60	201216	201226	32.07	3.13	16.87	7.80	190	Ductile		
7958-61	60	201216	201223	32.08	3.14	16.87	7.77	153	Ductile		
7958-120	60	201125	201204	32.06	3.11	16.67	7.76	203	Ductile		
7958-1	60	191104	191113	32.06	3.15	16.87	7.74	206	Ductile		
7958-131	60	201125	201214	32.06	3.12	16.67	7.73	454	Ductile		
7958-99	60	201125	201229	32.06	3.13	16.67	7.70	751	Ductile		
7958-119	60	191104	191125	32.07	3.18	16.87	7.66	491	Ductile		
7958-45	60	201125		32.08	3.15	16.67	7.66	->		*>1 170*	
7958-49	60	201125		32.07	3.16	16.67	7.63	->		*>1 170*	
7958-25	60	191218	200113	32.07	3.14	16.48	7.59	614	Ductile		
7958-57	60	201125	210112	32.08	3.14	16.48	7.59	1 146	Ductile		
7958-62	60	201125		32.08	3.15	16.48	7.57	->		*>1 170*	
7958-149	60	191104	191225	32.09	3.10	16.18	7.57	1 219	Ductile		
7958-5	60	191218	200316	32.07	3.15	16.48	7.56	2 133	Ductile		
7958-116	60	201125		32.08	3.11	16.18	7.54	->		*>1 170*	
7958-76	60	191104	200330	32.06	3.12	16.18	7.50	3 516	Ductile		
7958-47	60	191218	200730	32.07	3.14	16.18	7.45	5 375	Ductile		
7958-22	60	191218	210113	32.06	3.16	16.18	7.40	9 396	Ductile		
7958-30	60	191218		32.07	3.13	15.89	7.35	->		*>9 403*	
7958-17	60	191218		32.06	3.15	15.89	7.29	->		*>9 403*	

HYDROSTATIC PRESSURE TESTING

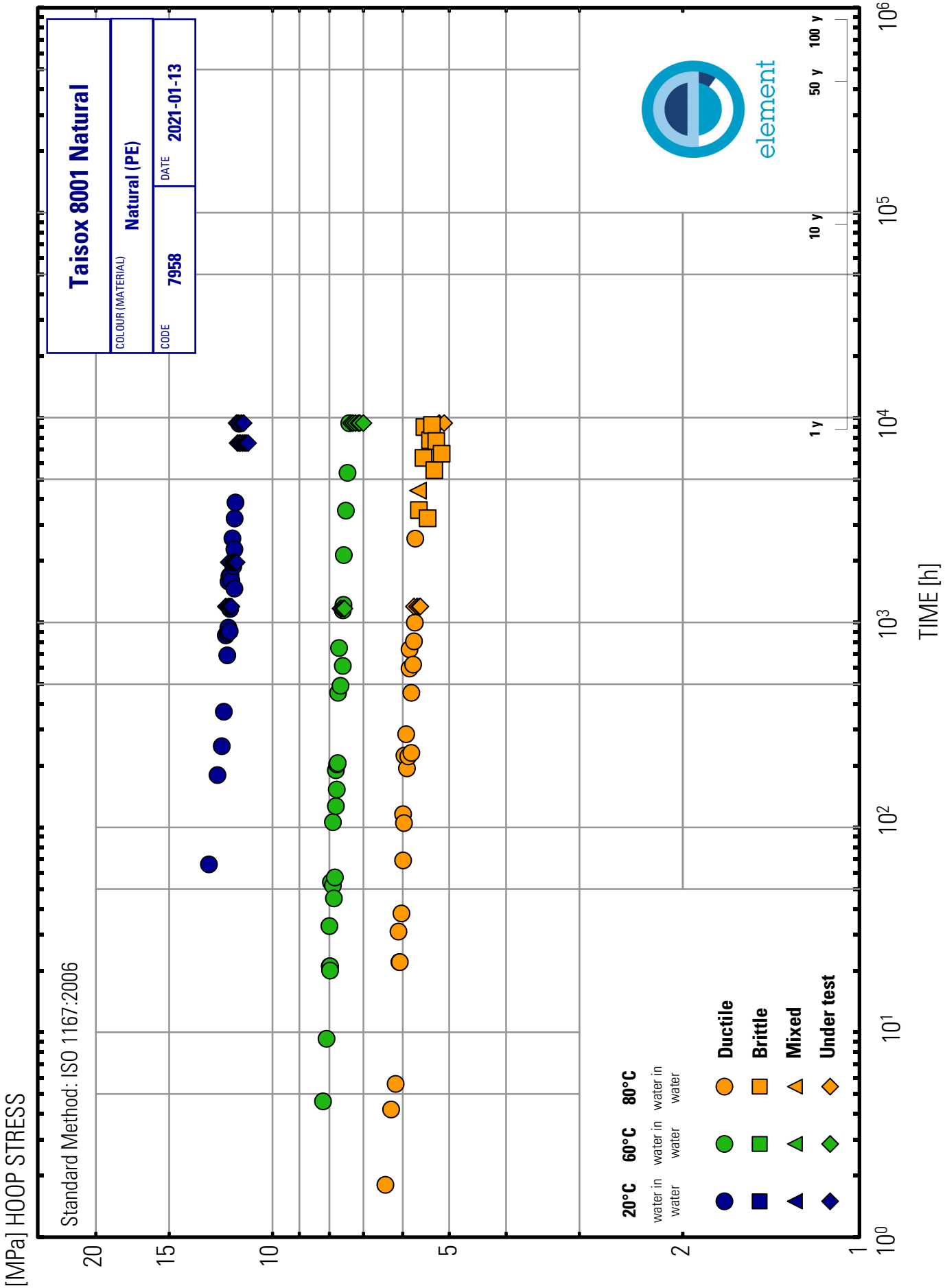
Code	T	Start date	Reg date	d_{em}	e_{min}	p	σ	Burst time	Burst mode	Test time	Remark
	[°C]	[yymmdd]	[yymmdd]	[mm]	[mm]	[bar]	[MPa]	[h]		[h]	
7958-173	60	191218		32.08	3.18	15.89	7.22	->		*>9 403*	
7958-21	60	191218		32.08	3.14	15.50	7.14	->		*>9 403*	
7958-41	60	191218		32.07	3.12	15.30	7.10	->		*>9 403*	
7958-91	60	191218		32.06	3.12	15.10	7.00	->		*>9 403*	

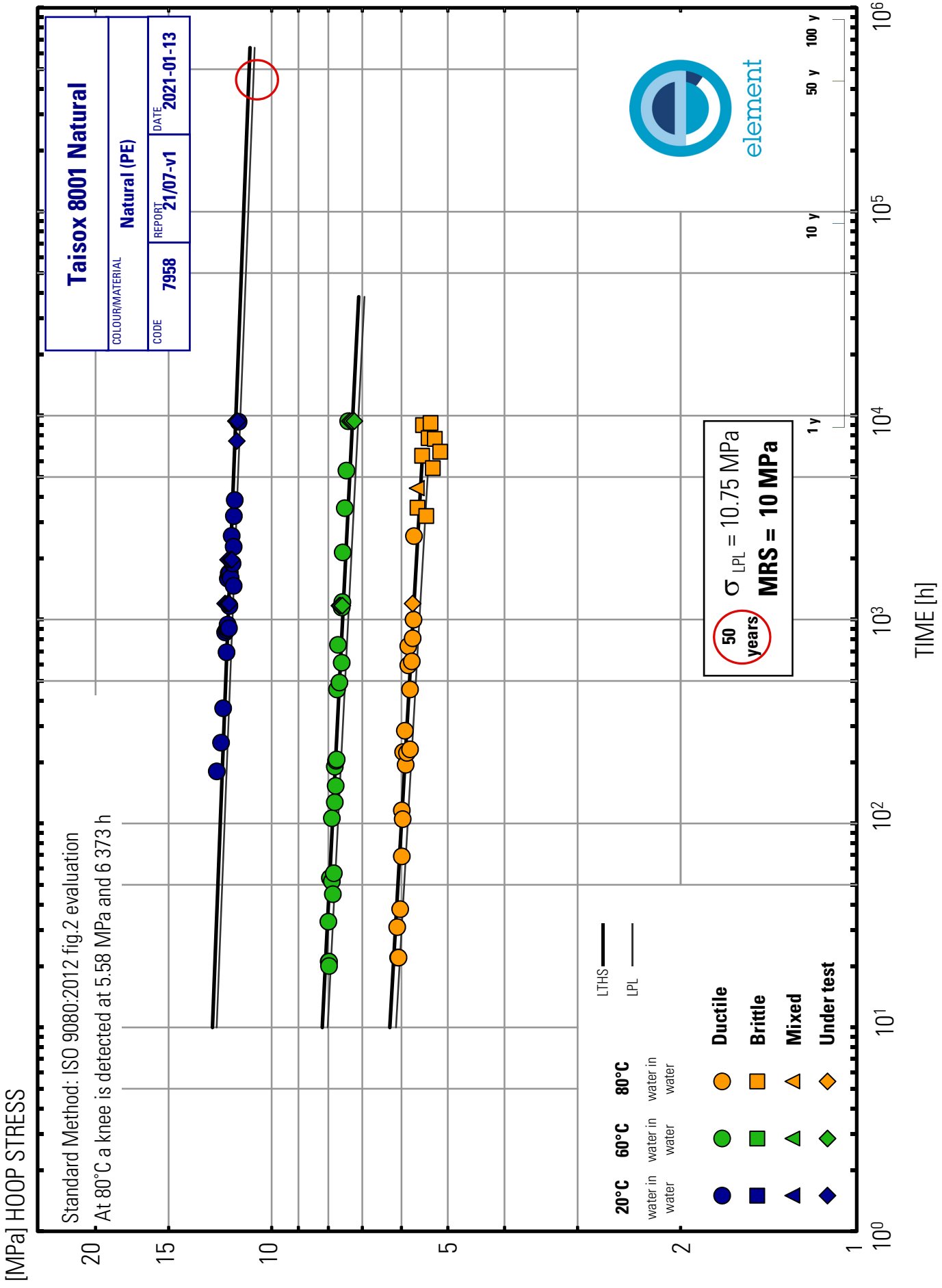
HYDROSTATIC PRESSURE TESTING

Code	T	Start date	Reg date	d_{em}	e_{min}	p	σ	Burst time	Burst mode	Test time	Remark
	[°C]	[yymmdd]	[yymmdd]	[mm]	[mm]	[bar]	[MPa]	[h]		[h]	
7958-168	80	191104	191105	32.08	3.18	14.12	6.42	1.8	Ductile		
7958-104	80	191104	191105	32.08	3.10	13.44	6.28	4.2	Ductile		
7958-50	80	191104	191105	32.08	3.11	13.24	6.17	5.6	Ductile		
7958-67	80	201217	201221	32.08	3.14	13.24	6.10	31	Ductile		
7958-56	80	201217	201221	32.06	3.15	13.24	6.08	22	Ductile		
7958-19	80	191104	191105	32.05	3.15	13.24	6.07	22	Ductile		
7958-80	80	201217	201221	32.07	3.13	13.04	6.03	38	Ductile		
7958-18	80	191218	191223	32.07	3.15	13.04	5.99	116	Ductile		
7958-58	80	201217	201221	32.07	3.15	13.04	5.99	69	Ductile		
7958-86	80	201217	201222	32.06	3.16	13.04	5.97	105	Ductile		
7958-28	80	191104	191114	32.08	3.12	12.85	5.96	224	Ductile		
7958-68	80	201217	201229	32.08	3.14	12.85	5.92	285	Ductile		
7958-64	80	201217	201226	32.07	3.15	12.85	5.90	194	Ductile		
7958-69	80	201217	201229	32.08	3.14	12.75	5.87	222	Ductile		
7958-113	80	191104	191205	32.09	3.16	12.75	5.84	740	Ductile		
7958-157	80	201124	201221	32.07	3.11	12.55	5.84	596	Ductile		
7958-32	80	191218	191230	32.07	3.13	12.55	5.80	231	Ductile		
7958-65	80	201124	201214	32.07	3.13	12.55	5.80	454	Ductile		
7958-40	80	201124	201221	32.06	3.15	12.55	5.76	623	Ductile		
7958-8	80	191104	191209	32.07	3.16	12.55	5.74	809	Ductile		
7958-54	80	201124		32.06	3.16	12.55	5.74	->		*>1 197*	
7958-169	80	201124	210105	32.08	3.17	12.55	5.72	998	Ductile		
7958-44	80	191218	200403	32.08	3.13	12.36	5.71	2 567	Ductile		
7958-36	80	201124		32.07	3.15	12.36	5.67	->		*>1 197*	
7958-35	80	191218	200622	32.08	3.16	12.36	5.65	4 403	Mixed		
7958-9	80	191104	200331	32.05	3.17	12.36	5.63	3 539	Brittle		*2*
7958-154	80	201124		32.08	3.11	12.06	5.62	->		*>1 197*	
7958-180	80	201124		32.07	3.12	12.06	5.60	->		*>1 197*	
7958-83	80	191218	200908	32.08	3.11	11.87	5.53	6 357	Brittle		*2*
7958-2	80	191104	201113	32.07	3.12	11.87	5.51	8 997	Brittle		*2*
7958-39	80	191218	200504	32.08	3.13	11.77	5.44	3 223	Brittle		
7958-4	80	191104	200923	32.06	3.11	11.57	5.39	7 759	Brittle		

HYDROSTATIC PRESSURE TESTING

Code	T	Start date	Reg date	d_{em}	e_{min}	p	σ	Burst time	Burst mode	Test time	Remark
	[°C]	[yymmdd]	[yymmdd]	[mm]	[mm]	[bar]	[MPa]	[h]		[h]	
7958-37	80	191218	210105	32.06	3.13	11.57	5.35	9 202	Brittle		*2*
7958-72	80	191218	200805	32.08	3.16	11.57	5.30	5 534	Brittle		
7958-46	80	191218	201103	32.08	3.13	11.38	5.26	7 692	Brittle		
7958-97	80	191218		32.06	3.11	11.18	5.20	->		*>9 402*	
7958-48	80	191218	200921	32.07	3.14	11.18	5.15	6 661	Brittle		
7958-70	80	191218		32.07	3.17	11.18	5.10	->		*>9 402*	


Taisox 8001 Natural
COLOUR (MATERIAL)
Natural (PE)
CODE
7958
DATE
2021-01-13
element
[MPa] HOOP STRESS
Standard Method: ISO 1167:2006
TIME [h]
1 y
10 y
50 y
100 y
20°C water in water
60°C water in water
80°C water in water
Ductile
Brittle
Mixed
Under test


Taisox 8001 Natural
COLOUR/MATERIAL
Natural (PE)
CODE
7958
REPORT
21/07-v1
DATE
2021-01-13
element
[MPa] HOOP STRESS
TIME [h]
Standard Method: ISO 9080:2012 fig.2 evaluation
At 80°C a knee is detected at 5.58 MPa and 6 373 h
20
15
10
5
2
1
10^0
10^1
10^2
10^3
10^4
10^5
10^6
1 y
10 y
50 y
100 y
LTHS
LPL
20°C water in water
60°C water in water
80°C water in water
Ductile
Brittle
Mixed
Under test
50 years
σ LPL = 10.75 MPa
MRS = 10 MPa

ELEMENT/P-21-07-v1

DETERMINATION OF THE LONG-TERM HYDROSTATIC STRENGTH
ISO 9080:2012-evaluation of the natural PE pipe grade Taisox 8001
Natural from Formosa Plastics Corporation

Element Materials Technology
Plastic Pipes
Studsvik 3, SE-611 99 TYSTBERGA · Sweden
Phone +46 13 16 90 00   Fax +46 13 16 90 20, +46 155 26 31 25
www.polymer.element.com · info.nykoping@element.com