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Date: 2/11/2013

Report Physical Laboratory

Investigation number: 6451/1261 Requested by: Mr. Jos Baarda	Executed by : Ruud van Eekeren Date : 31-01-2013 Signed	Designated for:: Mr. Copy: Mr. Michel Aartsen Maarten Kruijer

Title :	Creep test on Pragma OD315 Bulgaria.
Description:	There has never been done a creep test on Pragma pipes from Bulgaria. The OD315 is the first diameter to test. Examined is: - Ringstiffness according to ISO 9969 and EN 13467-3 - Ringflexibility according to ISO 13968 and EN 13467-3 - Creep according to ISO 9967 - Dimensions, cross-section measurements and meter weight
Conclusion:	Ringstiffness reached an average force of 10.51 kN/m², so it's designated for the ringstiffness class of SN8. The ringflexibility test reached an average of 37% deflection without any cracks or delamination. A Creep ratio of 3,98 meets the requirements for PP pipes, which is ≤ 4, only just. Other, more comprehensive results, are stated in the table on page 2.

Date: ___/___/___ Signature Fylab:

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Pragma OD315 Bulgaria				
Test number				
Product			DN/OD315	EN 13476-3
Material			PP	
Date of test			19-12-12	
Weight per meter		[g/m]	4000	
Diameter outside		[mm]	315	
Diameter inside		[mm]	278,82	≥263
Profile height		[mm]	18,09	
Thickness T_we4		[mm]	2,76	≥1,90
Thickness T_ie5		[mm]	1,64	≥1,60
Pitch		[mm]	27,33	
Ring Stiffness	0°	[kN/m²]	10,39	
	120°	[kN/m²]	10,64	
	240°	[kN/m²]	10,49	
	avg.	[kN/m²]	**10,51**	SN8: > 8.0
Ring flexibilty	**0°**	[%]	35%	≥ 30.0%
		Failure after 30%	Force Decrease	
	120°	[%]	38%	≥ 30.0%
		Failure after 30%	Force Decrease	
	240°	[%]	38%	≥ 30.0%
		Failure after 30%	Force Decrease	
		Avg. Force @ 30% kN	5,15	
		Avg. Force max. kN	5,32	
Regression coefficient		R	0,9994	≥ 0.99
Creep ratio		γ_2	3,98	≤ 4

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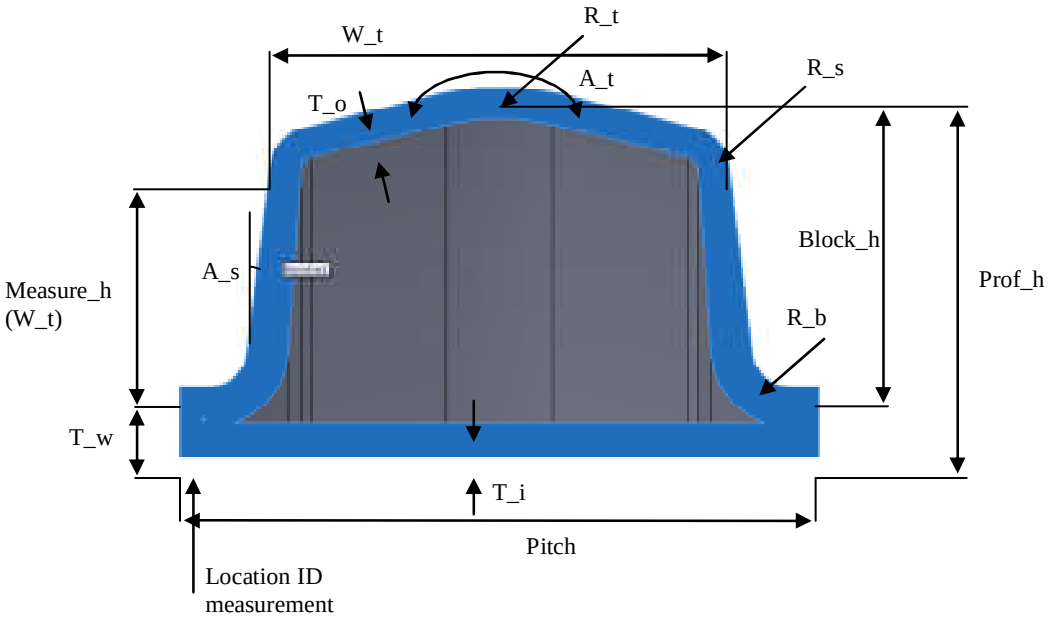
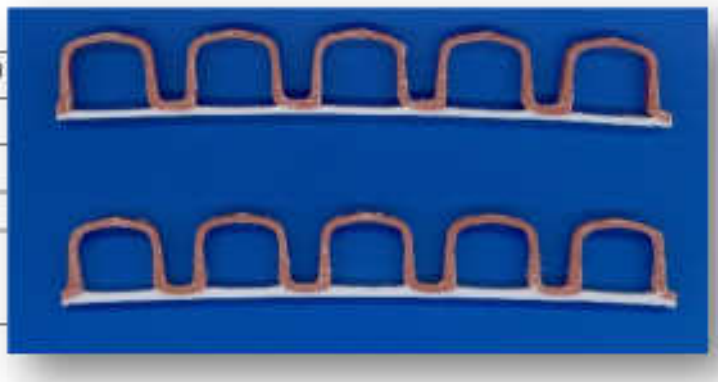
Size OD315		PLC	



Profile properties (min.3 measurements per item at 2 locations of the pipe, 0° and 90°)		0°	90°	Mean		
Profile height	Prof_h	18.25 mm	17.92 mm	18.09 mm		
Block height	Block_h	15.36 mm	15.16 mm	15.26 mm		
Pitch	Pitch	27.36 mm	27.29 mm	27.33 mm		
Width top	W_t	18.96 mm	19.01 mm	18.9 mm	Measure_h	10.81 mm
Thickness outer	T_o	1.40 mm	1.47 mm	1.44 mm		
Thickness inner	T_i	1.50 mm	1.77 mm	1.64 mm		
Radius top	R_t	-------	--------	-------		
Radius side	R_s	3.42 mm	3.72 mm	3.57 mm		
Radius bottom	R_b	1.99 mm	1.85 mm	1.92 mm		
Angle top	A_t	12.54°	13.85°	13.06°		
Angle side	A_s	6.36°	4.85°	5.6 1°		
Thickness	T_w	2.84 mm	2.67 mm	2.76mm		

Internal diameter	ID	278.82 mm
Outer diameter	OD	315 mm
Meter weight		4000 g/m

Remarks	



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Date: 2/11/2013

Creeptest ISO 9967

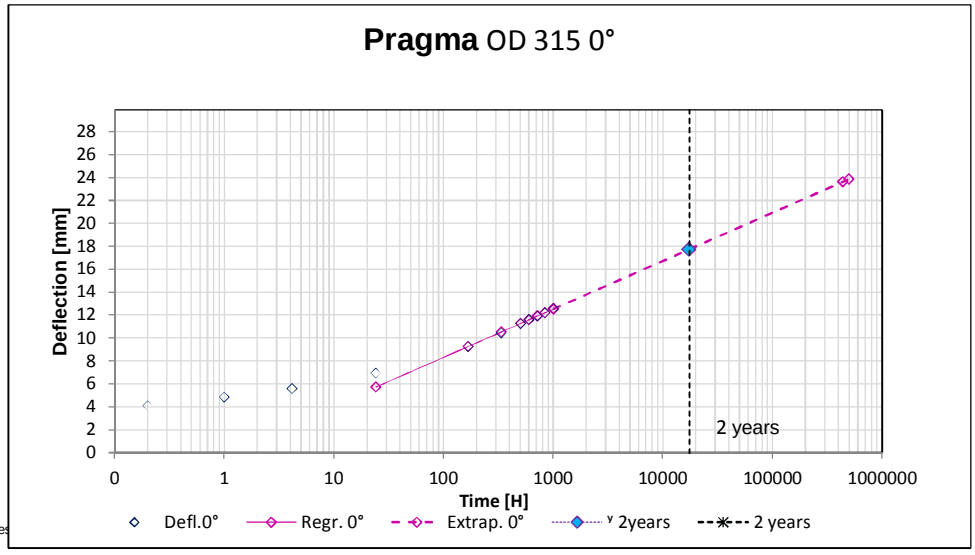
Position:	**0°**					Investigation nr.:	6451/1261
Product:	Bulgaria Pragma OD315			Material:	PP		
Diameter outside :		315,0	mm	Date of production:	2-nov-12		
Wall thickness averag		18,4	mm	Date of test start:	18-dec-12		
Diameter inside :		278,2	mm	Time of test start :	13:41		
Sample length :		297,5	mm	Age of sample:	**1104**	h	
Ring Stiffness :		10,5	kN/m²	Extrapolion time :	17250	h	
Initial E-modulus		-	N/mm²	Clock zero at pre-load:	0,716552	mm	
Load		222,4	N	Deflection @ t = 6':	4,192	mm	
Pre-load :		7	N		1,51	%	

Point nr.	Date [dd-mmm-yy]	Time hh:mm	Temp. [°C]	Test time [h]	Data [mm]	Deflection [mm]	Y_t calculated
1	18-dec-12	13:53	23,0	0,20	4,908	4,192	-2,943
2	18-dec-12	14:41	23,0	1,00	5,635	4,918	-0,002
3	18-dec-12	17:50	23,0	4,15	6,382	5,665	2,598
4	19-dec-12	13:50	23,0	24,15	7,744	7,028	5,815
5	25-dec-12	13:50	23,0	168,2	10,050	9,334	9,361
6	1-jan-13	13:50	23,0	336,2	11,223	10,507	10,626
7	8-jan-13	13:39	23,0	504,0	12,079	11,362	11,366
8	12-jan-13	13:39	23,0	600,0	12,418	11,702	11,684
9	17-jan-13	13:39	23,0	720,0	12,725	12,008	12,017
10	22-jan-13	13:39	23,0	840,0	12,997	12,280	12,299
11	29-jan-13	13:39	23,0	1008,0	13,363	12,647	12,632

		number of points	Yt = M * log(t) + B M	B	regr. Coëff. R^2	Deflection Y_2	regr. Coëff. R
		11	2,3798	4,8441	0,9580	14,943	0,978763
		10	2,6572	4,1599	0,9678	15,436	0,983774
		9	2,9913	3,2955	0,9760	15,989	0,98792
		8	3,4989	1,9358	0,9858	16,784	0,992859
		7	4,2910	-0,2523	0,9987	17,957	0,999374
		6	4,4309	-0,6496	0,9981	18,153	0,999026
		5	4,2066	-0,0022	0,9990	17,849	0,999517

Regression Y_t = 4,2066 *log(t) + -0,0022

		deflection mm	Creep ratio γ	Creep factor α	SN/γ kN/m²	Regr. Coëff.
	Y_2	17,85	**4,00**	0,25	2,63	0,99952
	Y_{50}	23,73	5,18	0,19	2,03	



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Creeptest ISO 9967

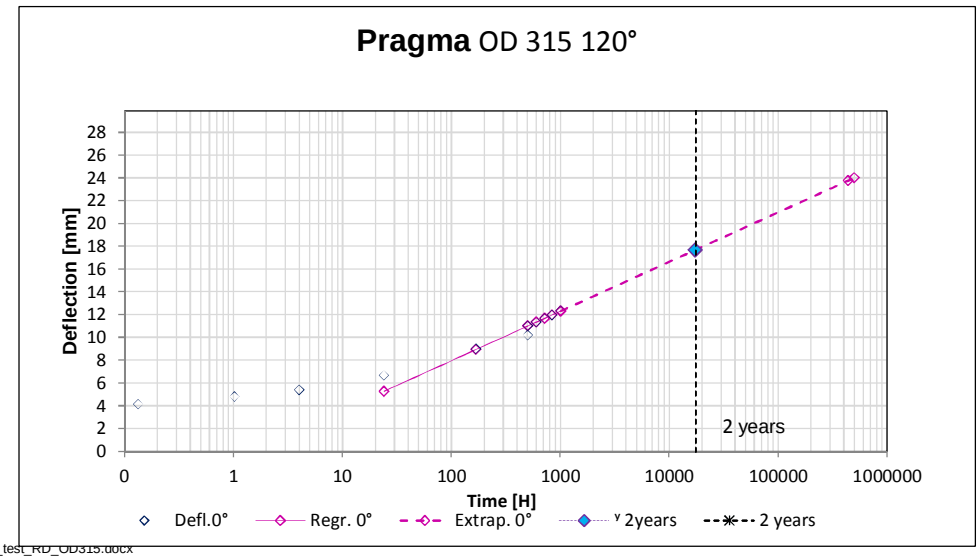
Position:	**120°**				Investigation nr.:	6451/1261	
Product:	Bulgaria Pragma OD315			Material:	PP		
Diameter outside :		315,0	mm	Date of production:	2-nov-12		
Wall thickness averag		18,3	mm	Date of test start:	18-dec-12		
Diameter inside :		278,4	mm	Time of test start :	14:49		
Sample length :		298,2	mm	Age of sample:	**1104**	h	
Ring Stiffness :		10,5	kN/m²	Extrapolion time :	17250	h	
Initial E-modulus		-	N/mm²	Clock zero at pre-load:	0,716552	mm	
Load		228,3	N	Deflection @ t = 6':	4,226	mm	
Pre-load :		7	N		1,52	%	

Point nr.	Date [dd-mmm-yy]	Time hh:mm	Temp. [°C]	Test time [h]	Data [mm]	Deflection [mm]	Y_t calculated
1	18-dec-12	14:57	23,0	0,13	5,601	4,226	-4,423
2	18-dec-12	15:50	23,0	1,02	6,267	4,893	-0,594
3	18-dec-12	18:50	23,0	4,02	6,382	5,490	1,996
4	19-dec-12	14:50	23,0	24,02	8,142	6,768	5,367
5	25-dec-12	14:50	23,0	168,0	10,469	9,094	9,034
6	1-jan-13	14:50	23,0	503,8	11,665	10,291	11,104
7	8-jan-13	14:39	23,0	503,8	12,479	11,105	11,104
8	12-jan-13	14:39	23,0	599,8	12,822	11,448	11,432
9	17-jan-13	14:39	23,0	719,8	13,132	11,758	11,776
10	22-jan-13	14:39	23,0	839,8	13,427	12,052	12,067
11	29-jan-13	14:39	23,0	1007,8	13,801	12,427	12,410

		number of points	Yt = M * log(t) + B M	B	regr. Coëff. R^2	Deflection Y_2	regr. Coëff. R
		11	2,2219	4,9478	0,9372	14,376	0,96811
		10	2,5737	4,0802	0,9556	15,002	0,977557
		9	2,9154	3,1879	0,9613	15,560	0,980473
		8	3,4458	1,7563	0,9609	16,379	0,98027
		7	4,3423	-0,7382	0,9256	17,689	0,962105
		6	5,7025	-4,6127	0,8552	19,586	0,924771
		5	4,3402	-0,6250	0,9990	17,793	0,9995

Regression Y_t = 4,3402 *log(t) + -0,6250

		deflection mm	Creep ratio γ	Creep factor α	SN/γ kN/m²	Regr. Coëff.
	Y_2	17,79	**3,96**	0,25	2,66	0,99950
	Y_{50}	23,86	5,17	0,19	2,03	



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Creeptest ISO 9967

Position:	**240°**				Investigation nr.:	6451/1261	
Product:	Bulgaria Pragma OD315			Material:	PP		
Diameter outside :		315,0	mm	Date of production:	2-nov-12		
Wall thickness averag		18,4	mm	Date of test start:	18-dec-12		
Diameter inside :		278,2	mm	Time of test start :	14:24		
Sample length :		298,0	mm	Age of sample:	**1104**	h	
Ring Stiffness :		10,5	kN/m²	Extrapolion time :	17250	h	
Initial E-modulus		-	N/mm²	Clock zero at pre-load:	0,716552	mm	
Load		222,7	N	Deflection @ t = 6':	4,406	mm	
Pre-load :		7	N		1,58	%	

Point nr.	Date [dd-mmm-yy]	Time hh:mm	Temp. [°C]	Test time [h]	Data [mm]	Deflection [mm]	Y_t calculated
1	18-dec-12	14:32	23,0	0,13	5,393	4,406	-4,195
2	18-dec-12	15:31	23,0	1,12	6,252	5,265	-0,069
3	18-dec-12	18:50	23,0	4,43	6,996	6,008	2,608
4	19-dec-12	14:50	23,0	24,43	8,369	7,382	5,922
5	25-dec-12	14:50	23,0	168,4	10,703	9,716	9,670
6	1-jan-13	14:50	23,0	336,4	11,907	10,919	11,013
7	8-jan-13	14:39	23,0	504,3	12,808	11,820	11,799
8	12-jan-13	14:39	23,0	600,3	13,152	12,164	12,137
9	17-jan-13	14:39	23,0	720,3	13,458	12,471	12,491
10	22-jan-13	14:39	23,0	840,3	13,767	12,780	12,790
11	29-jan-13	14:39	23,0	1008,3	14,160	13,173	13,144

		number of points	Yt = M * log(t) + B M	B	regr. Coëff. R^2	Deflection Y_2	regr. Coëff. R
		11	2,3837	5,2625	0,9486	15,378	0,973978
		10	2,7535	4,3591	0,9675	16,044	0,983616
		9	3,0949	3,4746	0,9754	16,608	0,987614
		8	3,6090	2,0966	0,9841	17,411	0,991993
		7	4,4703	-0,2831	0,9984	18,687	0,999211
		6	4,6519	-0,7991	0,9980	18,941	0,999011
		5	4,4385	-0,1827	0,9981	18,652	0,999011

Regression Y_t = 4,4703 *log(t) + -0,2831

		deflection mm	Creep ratio γ	Creep factor α	SN/γ kN/m²	Regr. Coëff.
	Y_2	18,69	**3,97**	0,25	2,65	0,99921
	Y_{50}	24,94	5,16	0,19	2,04