

Date: 2/11/2013

Report Physical Laboratory		
Investigation number: 6451/1261	Executed by : Ruud van Eekeren Date : 31-01-2013 Signed	Designated for: Mr. Copy: Mr. Michel Aartsen Maarten Kruijer
Requested by: Mr. Jos Baarda		
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: <ul style="list-style-type: none"> - 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/m ² , 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.		

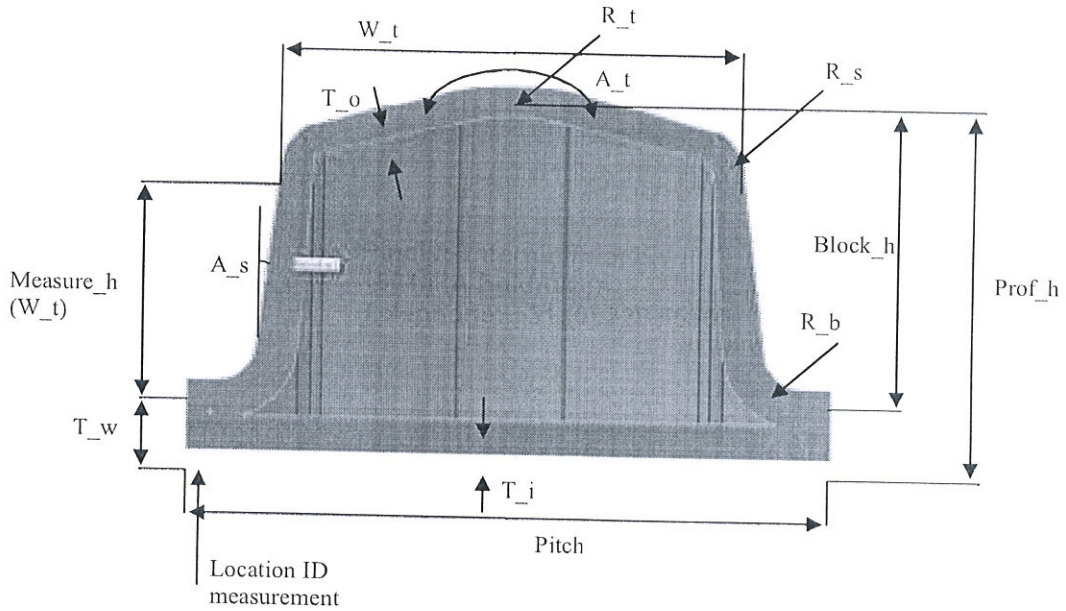
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Pragma OD315 Bulgaria			
Test number			
Product		DN/OD315	EN 13476-3
Material		PP	
Date of test		19-12-12	
Weight per meter	[g/m]	4000	
Diameter outside	[mm]	315	
Diameter inside	[mm]	278,82	≥263
Profile height	[mm]	18,09	
Thickness T _{w e4}	[mm]	2,76	≥1,90
Thickness T _{i e5}	[mm]	1,64	≥1,60
Pitch	[mm]	27,33	
Ring	0°	[kN/m ²]	10,39
	120°	[kN/m ²]	10,64
	240°	[kN/m ²]	10,49
	avg.	[kN/m ²]	10,51
Stiffness	0°	[%]	35%
		Failure after 30%	Force Decrease
	120°	[%]	38%
		Failure after 30%	Force Decrease
	240°	[%]	38%
		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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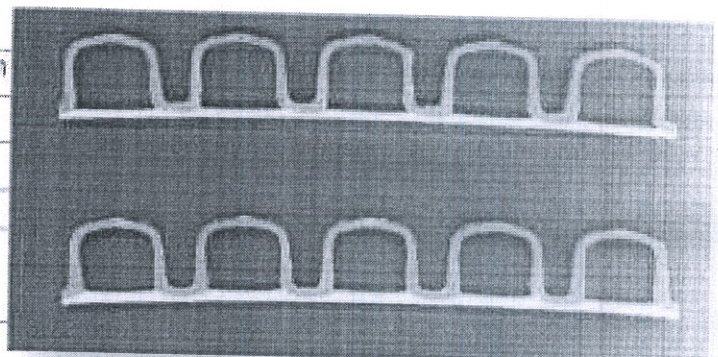
Size OD315		PLC	
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		0°	90°	Mean		
Profile properties (min.3 measurements per item at 2 locations of the pipe, 0° and 90°)						
Profile height	Prof_h	18.25 mm	17.92 mm	18.09 mm		
Block height	Block_h	15.36 mm	15.16 mm	15.26 mm		
Pitch	Pitch	27.36 mm	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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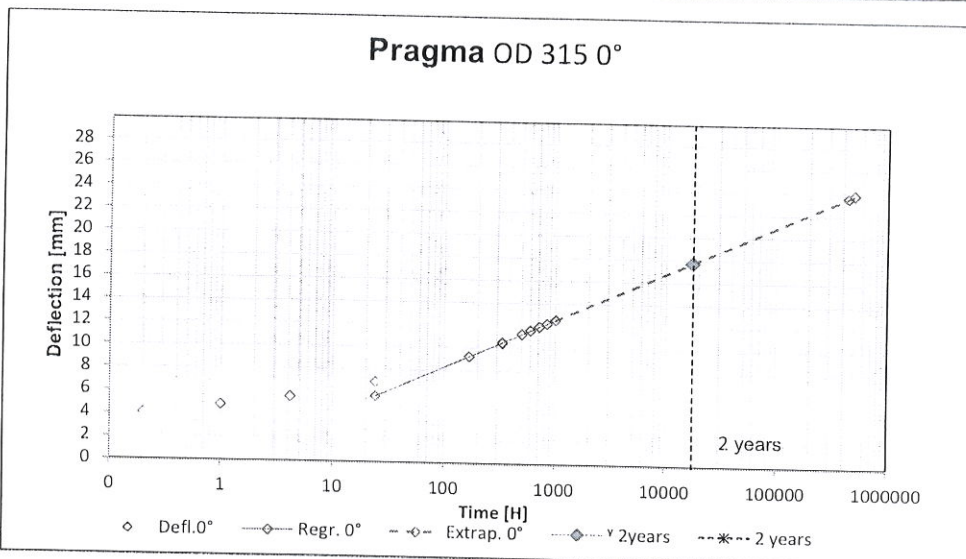
Position: 0°		Creep test ISO 9967	
Product: Bulgaria Pragma OD315		Investigation nr.: 6451/1261	
Diameter outside :	315,0 mm	Material:	PP
Wall thickness averag :	18,4 mm	Date of production:	2-nov-12
Diameter inside :	278,2 mm	Date of test start:	18-dec-12
Sample length :	297,5 mm	Time of test start :	13:41
Ring Stiffness :	10,5 kN/m ²	Age of sample:	1104 h
Initial E-modulus	- N/mm ²	Extrapolation time :	17250 h
Load	222,4 N	Clock zero at pre-load:	0,716552 mm
Pre-load :	7 N	Deflection @ t = 6':	4,192 mm
			1,51 %

Point nr.	Date [dd-mm-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	Y _t = M * log(t) + B	regr. Coëff. R ²	Deflection Y ₂	regr. Coëff. R
	M B			
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/m ²	Regr. Coëff.
Y ₂	17,85	4,00	0,25	2,63	0,99952
Y ₅₀	23,73	5,18	0,19	2,03	



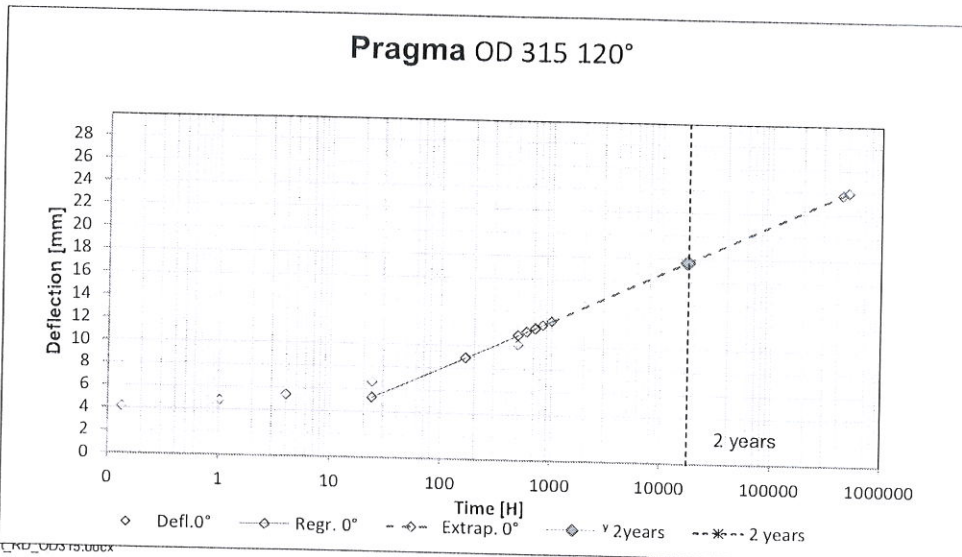
Position: 120°		Creep test ISO 9967	
Product: Bulgaria Pragma OD315		Material: PP	
Diameter outside :	315,0 mm	Date of production:	2-nov-12
Wall thickness average :	18,3 mm	Date of test start:	18-dec-12
Diameter inside :	278,4 mm	Time of test start :	14:49
Sample length :	298,2 mm	Age of sample:	1104 h
Ring Stiffness :	10,5 kN/m ²	Extrapolation time :	17250 h
Initial E-modulus	- N/mm ²	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-mm-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	Y _t = M * log(t) + 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/m ²	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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Position: 240°		Creep test ISO 9967	
Product: Bulgaria Pragma OD315		Material: PP	
Diameter outside :	315,0 mm	Date of production:	2-nov-12
Wall thickness average :	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/m ²	Extrapolation time :	17250 h
Initial E-modulus	- N/mm ²	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-mm-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	Y _t = M * log(t) + 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/m ²	Regr. Coëff.
Y ₂	18,69	3,97	0,25	2,65	0,99921
Y ₅₀	24,94	5,16	0,19	2,04	

