

### Report Physical Laboratory

Investigation number:  6634/1343	Executed  by : Mr. R. Van Eekeren / Mr. J.Baarda	Designated for: :  Mr. S. Staynov
Requested by:  Mr. S. Staynov	Date : 29-08-2013  Signed	Copy: Mr. Michel Aartsen Mr. M. Kruijjer

Title : **Creep ratio PP pragma ID600 SN 8 from Pipelife Bulgaria**

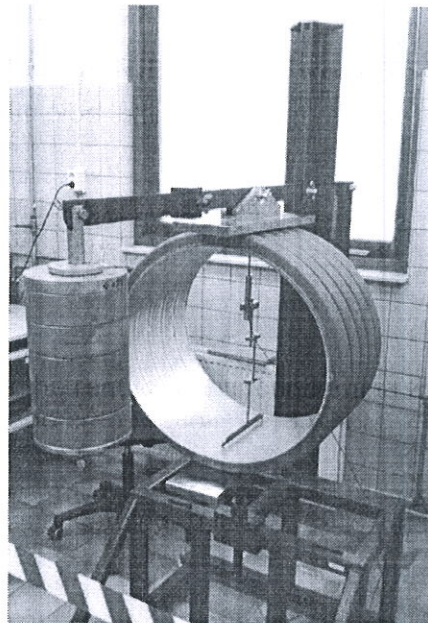
Description: To find out if this pipe fulfils important mechanical properties like creep and ring stiffness.

Material: PP Outer layer: 350HM by Ineos  
 PP Inner Layer 433NA by Ineos

Production Date 30-05-2013

Summary: **Creep Results**  
 The Pipe meets the requirements concerning the Creep ratio according to ISO 9967. The average creep ratio is **3.13** where a maximum of 4 is allowed.

**Ring stiffness**  
 The ring stiffness according to ISO 9969 is **11.11 kN/m<sup>2</sup>**



## Results Creep according to ISO 9967

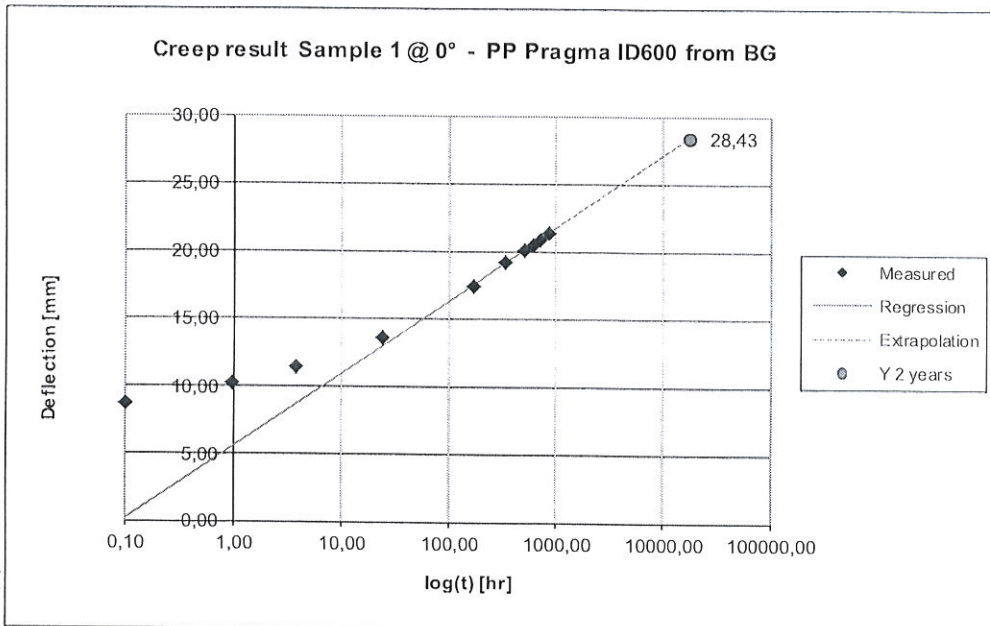
Position 0°			Investigation nr.: 6634/1343	
Manufacturer	PP Pragma ID600 from BG		Recipe	Inner 433NA outer 350HM by Ineos
Diameter OD :	688,0	mm	Product date	30-5-2013
Wall thickness avg. :	43,7	mm	Start date :	16-7-2013
Diameter ID :	600,7	mm	Start time :	9:04
Sample length :	353,5	mm	Age at start	1128 h
Stiffness (SN)	11,1	kN/m <sup>2</sup>	Extrapol.time :	17520 h
			Klock zero point.:	1,9104 mm
Load	1660,4	N	Deflection t = 6':	8,740234 mm
Pre-load	60,8	N	Deflection t = 6':	1,46 %

Point nr.	Date	Time	Temp. °C	Test time hr	Gauge value mm	Deflection mm	Yt calculated
1	16-07-13	9:10	22	0,10	10,651	8,740	0,236
2	16-07-13	10:01	22	0,96	12,146	10,236	5,514
3	16-07-13	12:54	22	3,84	13,376	11,465	8,752
4	17-07-13	8:53	22	23,82	15,506	13,596	13,016
5	23-07-13	8:53	22	167,8	19,339	17,429	17,575
6	30-07-13	8:53	22	335,8	21,100	19,189	19,194
7	6-08-13	8:53	22	503,8	22,079	20,169	20,142
8	10-08-13	9:30	22	600,4	22,455	20,544	20,551
9	14-08-13	9:30	22	696,4	22,781	20,871	20,898
10	20-08-13	9:30	22	840,4	23,245	21,335	21,336
11	27-08-13	9:30	22	1008,4	23,685	21,774	21,762

Regr. Points	Amount Yt = Mlog(t) + B		regr. coef R <sup>2</sup>	Deflection Yt
	M	B		
11	3,47843	10,54279	0,9616	25,304
10	3,97817	9,32847	0,9789	26,210
9	4,40296	8,23013	0,9860	26,914
8	5,05922	6,47520	0,9974	27,944
7	5,54536	5,13349	0,9994	28,665
6	<b>5,37647</b>	<b>5,61284</b>	<b>0,9996</b>	<b>28,428</b>
5	5,34794	5,69516	0,9990	28,389

Regression line Yt= 5,37647 \*log(t) + 5,61284

Deflection mm	Creep factor α	Creep ratio γ	SN/γ kN/m <sup>2</sup>
2 Years	28,43	0,32	3,12
			3,56



**Position 120°**

Investigation nr.: 6634/1343

Manufacturer:	PP Pragma ID600 from BG	Recipe	Inner 433NA outer 350HM by Ineos
Diameter OD :	688,0 mm	Product date	30-05-13
Wall thickness avg. :	43,6 mm	Start date :	16-07-13
Diameter ID :	600,8 mm	Start time :	9:31
Sample length :	354,0 mm	Age at start	1128 h
Stiffness (SN)	11,1 kN/m <sup>2</sup>	Extrapol.time :	17520 h
		Klock zero point.:	1,898193 mm
Load	1687,2 N	Deflection t = 6':	8,731079 mm
Pre-load	60,89 N	Deflection t = 6':	1,45 %

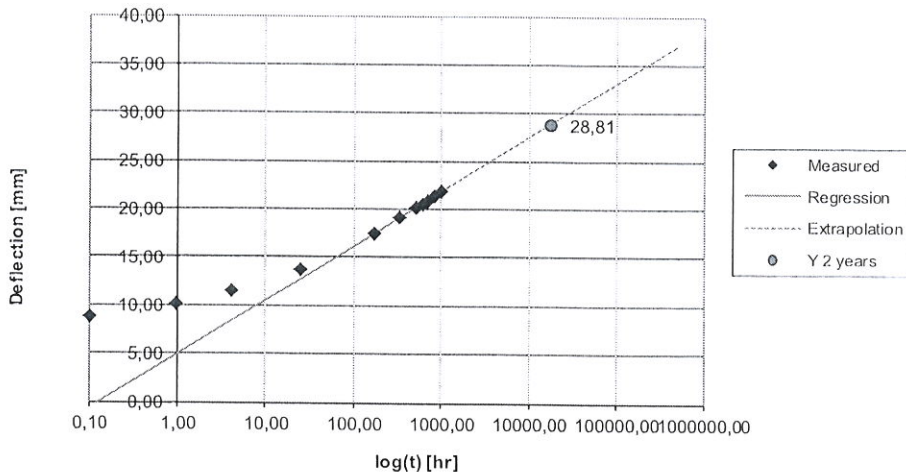
Point nr.	Date	Time	Temp. °C	Test time hr	Gauge value mm	Deflection mm	Yt calculated
1	16-07-13	9:37	22	0,10	10,629	8,731	-0,663
2	16-07-13	10:29	22	0,96	12,109	10,211	4,848
3	16-07-13	13:39	22	4,12	13,461	11,563	8,417
4	17-07-13	9:53	22	24,36	15,540	13,641	12,753
5	23-07-13	9:53	22	168,4	19,348	17,450	17,473
6	30-07-13	9:53	22	336,4	21,097	19,199	19,162
7	06-08-13	9:53	22	504,4	22,076	20,178	20,151
8	10-08-13	9:30	22	600,0	22,464	20,566	20,575
9	14-08-13	9:30	22	696,0	22,803	20,905	20,938
10	20-08-13	9:30	22	840,0	23,291	21,393	21,397
11	27-08-13	9:30	22	1008,0	23,746	21,848	21,842

Amount	Yt = Mlog(t) + B		regr. coef	Deflection
Regr. Points	M	B	R <sup>2</sup>	Yt
11	3,49145	10,53654	0,9610	25,353
10	3,99995	9,30077	0,9785	26,275
9	4,43977	8,16440	0,9858	27,005
8	5,09611	6,40808	0,9970	28,034
<b>7</b>	<b>5,62144</b>	<b>4,95805</b>	<b>0,9997</b>	<b>28,813</b>
6	5,53092	5,21495	0,9995	28,686
5	5,57784	5,07959	0,9990	28,749

Regression line Yt= 5,62144 \*log(t) + 4,95805

	Deflection mm	Creep factor α	Creep ratio γ	SN/γ kN/m <sup>2</sup>
2 Years	28,81	0,32	3,16	3,51

Creep result Sample 2 @ 120° - PP Pragma ID600 from B G



**Position 240°**

Investigation nr.: 6634/1343

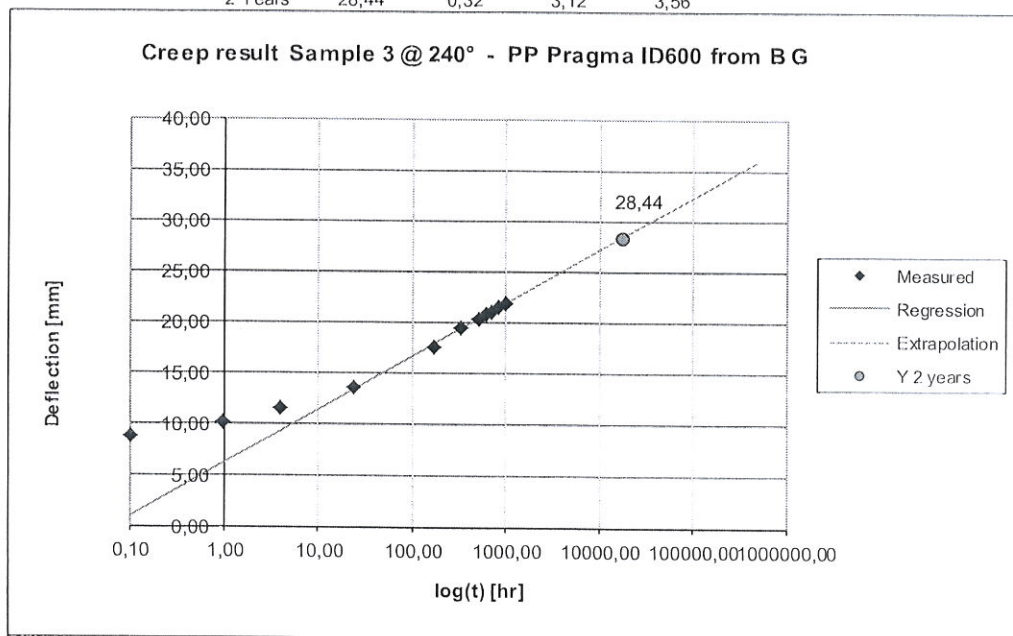
Manufacturer:	PP Pragma ID600 from BG	Recipe	Inner 433NA outer 350HM by Ineos
Diameter OD :	688,0 mm	Product date	30-05-13
Wall thickness avg. :	43,7 mm	Start date :	16-07-13
Diameter ID :	600,7 mm	Start time :	9:55
Sample length :	355,6 mm	Age at start	1128 h
Stiffness (SN)	11,1 kN/m <sup>2</sup>	Extrapol.time :	17520 h
		Klock zero point.:	1,681518 mm
Load	1660,4 N	Deflection t = 6':	8,731079 mm
Pre-load	61,16 N	Deflection t = 6':	1,45 %

Point nr.	Date	Time	Temp. °C	Test time hr	Gauge value mm	Deflection mm	Yt calculated
1	16-07-13	10:01	22	0,10	10,413	8,731	1,051
2	16-07-13	10:53	22	0,96	11,935	10,254	6,181
3	16-07-13	13:53	22	3,96	13,293	11,612	9,398
4	17-07-13	9:53	22	23,96	15,396	13,715	13,481
5	23-07-13	9:53	22	168,0	19,336	17,654	17,898
6	30-07-13	9:53	22	336,0	21,136	19,455	19,471
7	06-08-13	9:53	22	504,0	22,104	20,422	20,390
8	10-08-13	9:30	22	599,6	22,473	20,792	20,785
9	14-08-13	9:30	22	695,6	22,784	21,103	21,122
10	20-08-13	9:30	22	839,6	23,221	21,539	21,548
11	27-08-13	9:30	22	1007,6	23,648	21,967	21,962

Amount	Yt = Mlog(t) + B		regr. coef	Deflection
Regr. Points	M	B	R <sup>2</sup>	Yt
11	3,54419	10,59068	0,9630	25,631
10	4,04929	9,36347	0,9802	26,547
9	4,47113	8,27318	0,9867	27,247
8	5,12515	6,52387	0,9981	28,273
7	5,50534	5,47464	0,9985	28,837
<b>6</b>	<b>5,22344</b>	<b>6,27467</b>	<b>0,9996</b>	<b>28,441</b>
5	5,13310	6,53527	0,9993	28,318

Regression line Yt= 5,22344 \*log(t) + 6,27467

	Deflection mm	Creep factor α	Creep ratio γ	SN <sub>γ</sub> kN/m <sup>2</sup>
2 Years	28,44	0,32	3,12	3,56



## Results Ring Stiffness according to ISO 9969

Order number : 66341343      Test Temperature: 22,6 °C  
 Product : Pragma ID600 Bulgarije      Tested by : RVE  
 Product date : Juni 2013      Note :  
 Recipe : PP

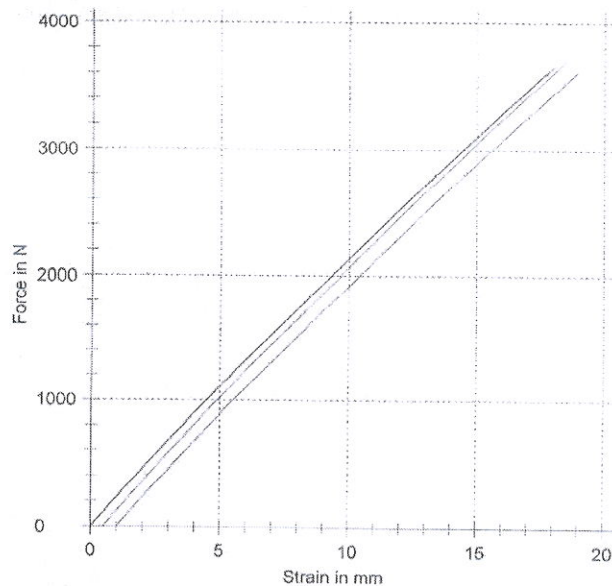
### Parameter Table:

Test speed: 20 mm/min      Pre-load: 53,21 N

### Results:

Pos. °	ID mm	OD mm	Length mm	Defl. %	Defl. mm	F-Fmax N	SN kN/m <sup>2</sup>
0	600,5	688	354,1	3,0	18,02	3655,17	11,09
120	600,7	688	351,6	3,0	18,02	3699,09	11,30
240	600,2	688	354,8	3,0	18,01	3618,32	10,96

### Series graph:

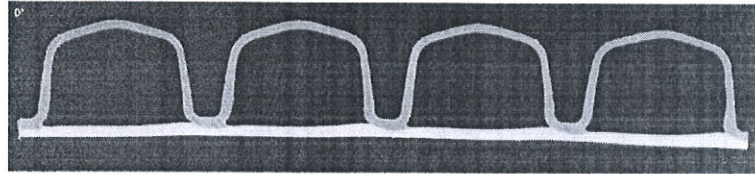


### Statistics:

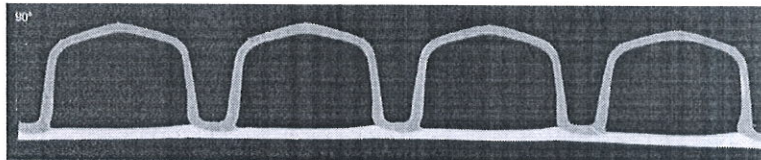
Sub-series #1	ID mm	OD mm	Length mm	Defl. %	Defl. mm	F-Fmax N	SN kN/m <sup>2</sup>
n = 3							
x	600,5	688	353,5	3,0	18,01	3657,53	11,11

### Dimensions

0°

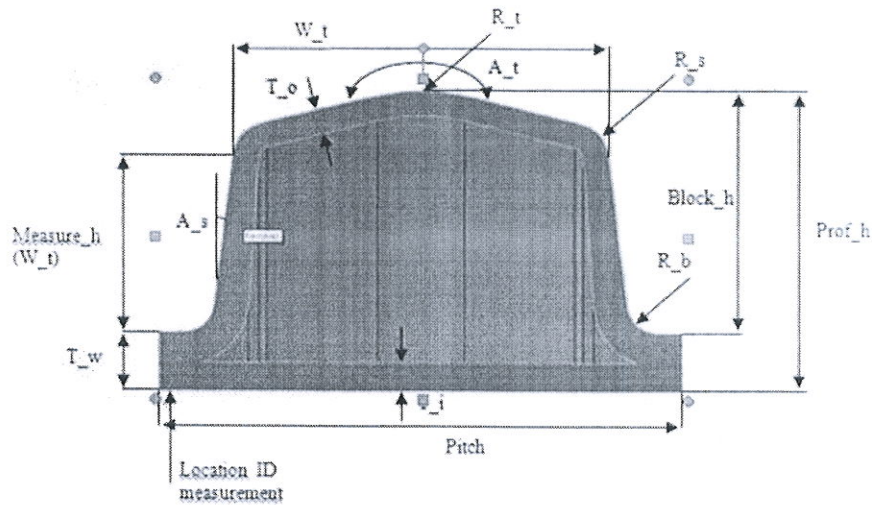


90°



PP Pragma

Size	ID600	Prod.date:	30-5-2013	Pipelife Bulgaria
------	-------	------------	-----------	-------------------



Profile properties (min. 3 measurements per item at 2 locations of the pipe 0° and 90°)					
				0°	90°
Profile height	Prof_h	[mm]		44,85	43,85
Block height	Block_h	[mm]		37,71	37,58
Pitch	Pitch	[mm]		70,57	70,65
Width Top	W_t	[mm]		52,3	52,83
Thickness Outer	T_o	[mm]		2,71	2,75
Thickness inner	T_i	[mm]		3,65	3,31
Radius Top	R_t	[mm]		17,73	18,46
Radius Side	R_s	[mm]		3,43	2,55
Radius Bottom	R_b	[mm]		3,06	2,86
Angle Top	A_t	[°]		16,54	16,11
Angle Side	A_s	[°]		8,39	8,25
Thickness	T_w	[mm]		5,56	5,75
	Measure_n	[mm]		26,06	26,37
Internal Diameter	ID	[mm]		600,5	
Outer Diameter	OD	[mm]		668	
Meter Weight		[kg/m]		16,345	
Remarks					