

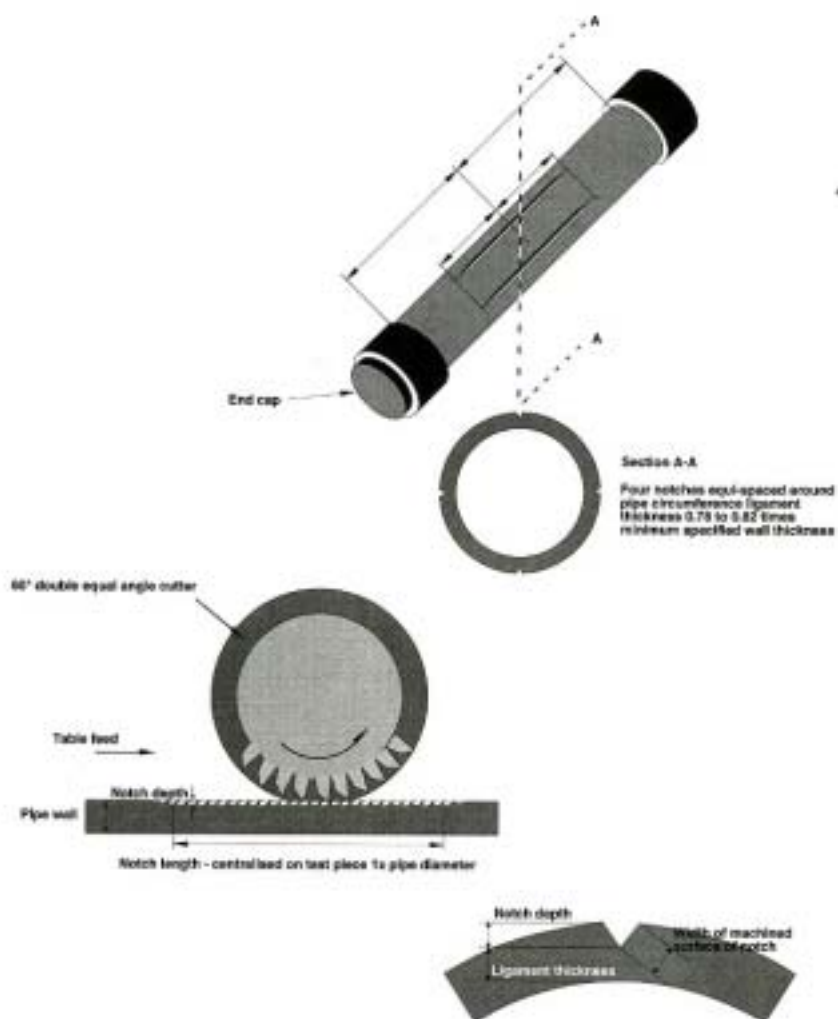
Bodycote Report

NOTCH PIPE TESTING

Notch pipe testing according to ISO 13479:1997 of the PE pipe material P600BL from Korea Petrochemical Ind. Co., Ltd.

Final report

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Summary

A notch pipe testing program has been performed on behalf of Korea Petrochemical Ind. Co., Ltd. (herein KPIC). 3 pipe specimens, 110 x 10 mm, of the PE pipe material P600BL from KPIC were notched and pressure tested according to the standard ISO 13479:1997, Test method for slow crack growth on notched pipes (notch test).

The testing conditions were 80°C water/water and 9.2 bar. All pipes have been terminated and the average test time is presented in the table below.

Material	Bodycote code	Internal pressure	Average test time
P600BL	2862	9.2 bar	12 912 h

The pipes were after termination evaluated in accordance with ISO 13479:1997.

The final results show that the black PE pipe material, with the Bodycote Polymer internal code 2994, passed the requirement of 165 h at 80°C and 9.2 bar as required in ISO 13479:1997 for a PE 100 pipe material.

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2003-10-21


List of contents

	Page	
1	Investigated pipe material	3
2	Experimental procedure	3
3	Results	4

Appendices

A	Investigated pipe material, Table A.1
B	Hydrostatic pressure testing, Table B.1
B	Measurement information, Table B.2

Responsible for the report



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Reviewed by



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Daniel Johansson

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1 Investigated pipe material

The characteristics and code of the investigated material is presented in Appendix A, Table A.1.

2 Experimental procedure

All tests have been performed at Bodycote Polymer AB. The pipes were notched according to ISO 13479:1997. The cutter is a V-cutter conforming to ISO 6108, for dimensions see Figure 1 below.

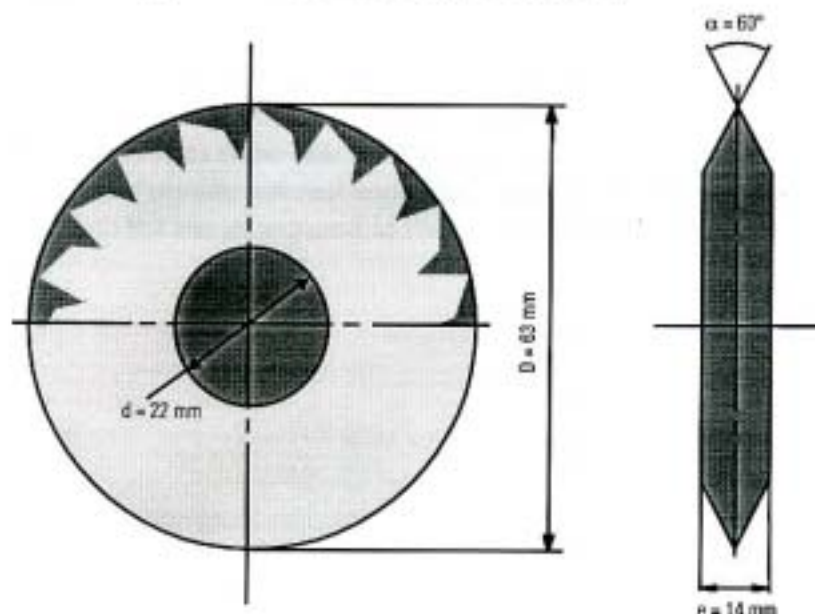


Figure 1
Dimensions for the V-cutter, Double equal angle cutters with plain bore and key drive

The notch cutter has 20 teeth and is rotating at 765 rpm with a transverse speed of 158 mm/min giving a cutting rate¹ of 0.010 ± 0.002 [(mm/rev)/tooth]. The accuracy of the notch length¹ is better than ± 1 mm and the measurement of the machined notch surface¹ is accurate within ± 0.1 mm.

The pressure testing is carried out with water filled pipes, the outer environment being water at 80°C. The water used is tap water. The pipes were fitted with Wipex brass fittings. The accuracy for the temperature¹ and the pressure¹ are better than ± 1 °C and $\pm 2\%$, respectively. The measurements of the wall thickness¹ are accurate within ± 0.02 mm and the diameters¹ within ± 0.1 mm.

The general testing conditions follow ISO 1167:1996.

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 Bodycote Polymer AB.

2003-10-21

3 Results

The results are presented in Appendix B, Tables B.1-B.2. The three started pipe specimens of the PE pipe material P600BL have been terminated. The average test time is presented in the table below.

Material	Bodycote code	Internal pressure	Average test time
P600BL	2862	9.2 bar	12 912 h

The pipes were after termination evaluated in accordance with ISO 13479:1997, see Table B.2 for further details.

The final results show that the PE pipe material P600BL, with the Bodycote Polymer internal code 2862, passed the requirement of 165 h at 80°C and 9.2 bar as required in ISO 13479:1997 for a PE 100 pipe material.

2003-10-21

Table A.1, Investigated pipe materials

P600BL	2862
Trade name:	P600BL
Material:	PE
Colour	Black
Resin producer:	KPIC
Pipe producer:	n/a
Pipe production date:	n/a
Lot number:	n/a
Pipe dimension:	110 x 10 mm
Pipe marking:	=0000= PEH50 110x10.0 PN10 SDR11 KWH-PIPE =0004=
Consignor:	KPIC
Arrival date at Bodycote:	2002-04-04
Amount of pipes:	26 x 1.2 m
Bodycote code:	2862

2003-10-21

Table B.1

Notch pipe testing at 80°C of the PE pipe material P600BL from KPIC using water as the internal and external medium. Bodycote internal code is 2862.

Name of the laboratory:	Bodycote Polymer AB
Material:	P600BL (PE 100)
Test method:	ISO 13479:1997(E)
Nominal dimension:	110 x 10 mm
Pipe length (total/free):	570/440 mm
Fittings:	Wipex brass fittings
Internal medium/External medium:	Tap water/Tap water
Conditioning time:	24 h
Responsible for the testing:	Björn Carlsson

Specimen ¹⁾ (internal code)	Temp °C	Start	t ²⁾ mm	D ³⁾ mm	p ⁴⁾ bar	σ ⁵⁾ MPa	Failure time h	Failure mode	Remarks
2862-2	80	020430	-	110.70	9.22	-	-	-	6) 12 912 h
2862-3	80	020430	-	110.70	9.22	-	-	-	6) 12 912 h
2862-4	80	020430	-	110.70	9.22	-	-	-	6) 12 912 h

1) Internal reference code at Bodycote

2) Average wall thickness

3) Mean outside diameter

4) Internal pressure

5) Circumferential stress (hoop stress)

6) The pipe was terminated after an e-mail from Mr Ha on October 20, 2003

2003-10-21

Table B.2

The table below shows the results from the post-test measurements on the notches for the investigated PE pipe material P600BL from KPIC. Bodycote internal code is 2862.

Pipe	Measured notch depth mm	Relative notch depth ² %	Ligament thickness mm
2862-2			
Notch 1	2.55	24	8.12
Notch 2	2.59	24	8.10
Notch 3	2.25	22	8.05
Notch 4	2.18	21	8.09
2862-3			
Notch 1	2.41	23	7.98
Notch 2	2.16	21	8.07
Notch 3	2.57	24	8.00
Notch 4	2.70	25	8.01
2862-4			
Notch 1	2.18	21	8.04
Notch 2	2.29	22	7.99
Notch 3	2.65	25	8.04
Notch 4	2.49	24	8.10

Notes

- *The ligament thickness should be within 7.8 and 8.2 mm for a 110 x 10 mm pipe. The given value refers to the ligament thickness at the notch.*
- *Complete documentation of the notch measurements is stored at Bodycote Polymer AB.*

² Relative notch depth = $\frac{\text{notch depth}}{\text{wall thickness}}$