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NOTCH PIPE TESTING

Notch pipe testing according to ISO 13479:1997 of the PE pipe material P502BL from Korea Petrochemical Ind. Co., Ltd.

Final report

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 P502BL 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 8.0 bar. All pipes have failed and the average failure time is presented in the table below.

Material	Bodycote code	Internal pressure	Average failure time
P502BL	2994	8.0 bar	7 097 h

The pipes were after failure evaluated in accordance with ISO 13479:1997. All failures were located to a notch.

The final results show that the PE pipe material P502BL, with the Bodycote Polymer internal code 2994, passed the requirement of 165 h at 80°C and 8.0 bar as required in ISO 13479:1997 for a PE 80 pipe material.

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Responsible for the report



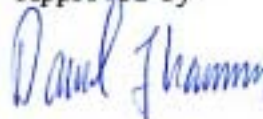
Mattias Svedberg

Reviewed by



Joakim Jansson

Approved by



Daniel Johansson

2003-10-15

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.

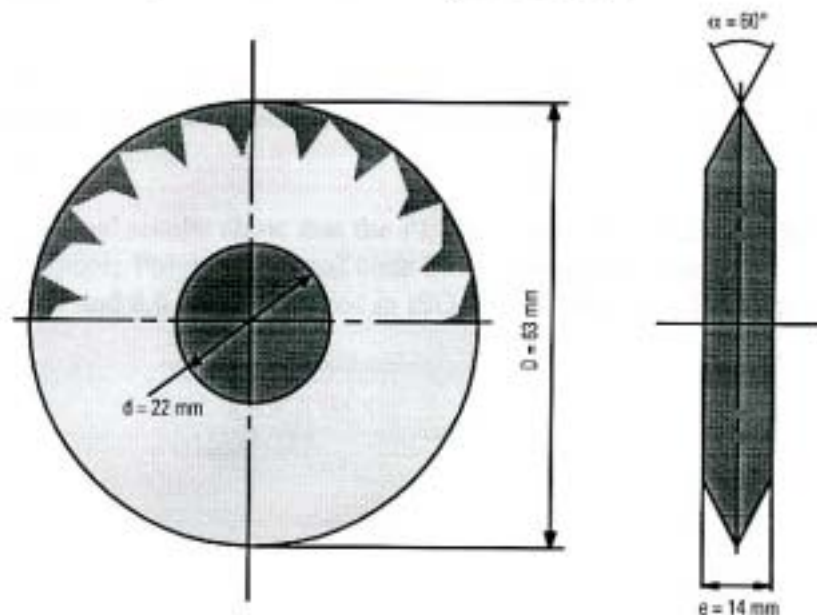


Figure 1
Dimensions for the V-cutter, Double equal angle cutters with plain bore and key drive

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.

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3 Results

The results are presented in Appendix B, Tables B.1-B.2. All three started pipe specimens have failed. The average failure time is presented in the table below.

Material	Bodycote code	Internal pressure	Average failure time
P502BL	2994	8.0 bar	7 097 h

All failures were located to a notch, see Table B.1. The pipes were after failure evaluated in accordance with ISO 13479:1997, see Table B.2 for further details.

The final results show that the PE pipe material P502BL, with the Bodycote Polymer internal code 2994, passed the requirement of 165 h at 80°C and 8.0 bar as required in ISO 13479:1997 for a PE 80 pipe material.

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Table A.1, Investigated pipe materials

P502BL (PE 80)		2994
Trade name:	P502BL	
Material:	PE	
Colour	Black	
Resin producer:	KPIC	
Pipe producer:	Anhui GUOTONG	
Pipe production date:	n/a	
Lot number:	n/a	
Pipe dimension:	110 x 10 mm	
Pipe marking:	"....." PE 80 "...." Dn110 Sdr11 GB 15558.1 M7 020814	
Consignor:	KPIC	
Arrival date at Bodycote:	2002-09-03	
Amount of pipes:	15 x 1.1 m	
Bodycote code:	2994	

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Table B.1

Notch pipe testing at 80°C of the PE pipe material P502BL from KPIC using water as the internal and external medium. Bodycote internal code is 2994.

Name of the laboratory:	Bodycote Polymer AB
Material:	P502BL (PE 80)
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:	Water/Water
Conditioning time:	24 h
Responsible for the testing:	Niklas Eriksson

Specimen ¹⁾	Temp °C	Start ²⁾	t ³⁾ mm	D ⁴⁾ mm	p ⁵⁾ bar	σ ⁶⁾ MPa	Failure time h	Failure mode	Remarks
2994-7	80	021017	10.66	110.25	8.04	-	8 608	Mixed	
2994-8	80	021017	10.54	110.25	8.04	-	6 081	Mixed	
2994-9	80	021017	10.52	110.25	8.04	-	6 601	Mixed	

1) Internal reference code at Bodycote

2) yymmdd

3) Average wall thickness

4) Mean outside diameter

5) Internal pressure

6) Circumferential stress (hoop stress)

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Table B.2

The table below shows the results from the post-test measurements on the notches for the investigated PE pipe material P502BL from KPIC. Bodycote internal code is 2994.

Pipe	Measured notch depth mm	Relative notch depth ² %	Ligament thickness mm
2994-7			
Notch 1	2.84	27	7.85
Notch 2	2.82	26	7.92
Notch 3	2.89	27	7.89
Notch 4	2.93	27	7.95
2994-8			
Notch 1	2.71	25	7.95
Notch 2	2.70	25	8.00
Notch 3	2.56	24	7.99
Notch 4	2.59	24	8.01
2994-9			
Notch 1	2.76	26	8.00
Notch 2	2.61	25	7.96
Notch 3	2.64	25	7.98
Notch 4	2.74	26	7.95

Notes

- *The bold text indicates in which notch the failure occurred.*
- *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 = $\frac{\text{notch depth}}{\text{wall thickness}}$