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CONFIDENTIAL TECHNICAL REPORT

RC 20137

Silicone ref. PR 410/35 (X4879/2)
Testing to BS EN 549

Client: Primasil Silicones Ltd

Issued by:

Charles Forge

Date: 16th November 2010

Summary

A sample of silicone material ref. PR 410/35 (X4879/2) was received from Primasil Silicones Ltd. The sample was tested to BS EN 549. It was found to meet the requirements for an H1/E1 grade material for use in manufacture of seals.

Materials and methods

A sample of silicone material ref. PR 410/35 (X4879/2) was received from Primasil Silicones Ltd 5th August 2010. The material was allocated the goods received number GR10/554.

The sample supplied consisted of a moulded sheet of nominal 300 x 300mm with integral hardness block and compression set buttons. The thickness of the sheet, hardness block and compression set buttons were a nominal 2, 6 and 6mm respectively.

Tensile testing

The tensile properties of the silicone material were determined in accordance with ISO 37. Type 2 tensile dumb-bells were cut from the 2mm thick sheet using a pneumatic cutting press. The dumb-bells were tested using an Instron 5567 materials testing system equipped with an advanced video-extensometer (AVE). The tensile properties were determined for two sets of six test pieces. One set was tested unaged and the second set following ageing for a period of 168 hours at a temperature of 175°C.

Microhardness

Three one inch square test pieces were cut from the 2mm thick sheet, using a 1" square profile cutter and a hand-operated cutting press. The hardness was measured in accordance with ISO 48, method M (Microtest), using a Wallace Cogenix Microhardness Tester. The material was tested both unaged and following ageing for a period of 168 hours at a temperature of 175°C.

Compression Set

The compression set properties of the material were determined in accordance with ISO 815. The material was tested for compression set at an elevated temperature of 175°C and a sub-ambient temperature of 0°C. The test duration for the elevated and low temperature studies were 168 and 72 hours respectively.

Resistance to gas

The silicone material was tested for resistance to gas in accordance with ISO 1817. Three test pieces. 20 X 50mm were cut from the 2mm thick sheet using an appropriate cutter and a hand-operated cutting press.

The change in mass, following immersion in pentane for a period of 72 hours at a temperature of 23°C, was determined. The test pieces were transferred to a drying oven for a period of 168

hours at a temperature of 40°C. The test pieces were removed from the oven, conditioned under standard laboratory conditions, and the change in mass recorded.

Resistance to lubricant

The silicone material was tested for resistance to swelling in standard oil no 2 in accordance with ISO 1817. Test pieces, 20 X 50mm, were cut from the 2mm thick sheet. The change in mass and the change in hardness were determined following immersion in the oil for a period of 168 hours at a temperature of 100°C. The hardness was measured in accordance with ISO 48, Method M (microtest).

Ozone resistance

The silicone material was subjected to ozone resistance testing in accordance with ISO 1431-1, Method A.

Three strips of width 10mm were cut from the 2mm thick sheet using a twin-blade parallel strip cutter and a hand-operated cutting press. Gauge marks were marked on the test piece prior to mounting in the test jig. The test piece was extended to 20% strain and clamped in place. The cut edges of the strip were coated with a thin film of molten paraffin wax. The test pieces were conditioned in darkness for a period of 72 hours under standard laboratory conditions; a temperature of 23 +/- 2°C and a relative humidity of 50 +/-5%.

The test strips were examined under X7 magnification, using a hand lens, prior to transfer to a Satra Hampden HTE-P3C6R ozone test cabinet. Ozone gas was generated within the test chamber on passing air over an ultra violet (UV) light source. The ozone concentration within the chamber was determined using an integral UV analyser.

The jigs were suspended within the test chamber. The test pieces were exposed to an ozone concentration of 50pphm at a temperature of 30°C for a period of 24 hours. The test pieces were removed from the cabinet, on completion of the study, and examined under X7 magnification.

Results

The test results are summarised in Table 1. The table lists the results recorded and indicates if the material was found to meet the physical requirements for an H1/E1 grade material. Results sheets listing the results recorded for each individual test are appended.

The silicone material ref. PR 410/35 (X4879/2) was found to meet the requirements for an H1/E1 grade material for use in manufacture of seals.

Table 1 Silicone PR 410/35 (X4879/2) – Results recorded on testing to BS EN 549

Sample ref. PR410/35 Silicone X4879/2 Test	Method		Test Result	Specification	Pass/Fail
Tensiles unaged	ISO 37	Tensile Strength (MPa)	10.9	≥ 5	Pass
		Elongation at break (%)	974	≥ 125	Pass
Tensiles aged 168hr @ 175°C	ISO 37	Tensile Strength (MPa)	10.3	Max. Change -40%	Pass
		Elongation at break (%)	824	Max. Change -40%	Pass
Microhardness unaged	ISO 48	IRHD	38	<45	Pass
Microhardness aged 168hr @ 175°C	ISO 48	IRHD	42	Max. Change +/- 10	Pass
Comp set 168hr @ 175°C	ISO 815	(%)	25	≤40	Pass
Comp set 72hr @ 0°C	ISO 815	(%)	8	≤40	Pass
Change in mass on immersion in pentane 72hr at 23°C	ISO 1817	(%)	+213	Not required	Not required
Change in mass on drying for 168hr @ 40°C		(%)	-3.05	Max. Change + / -5%	Pass
Resistance to lubricant	ISO 1817				
Change in mass 168hr @ 100°C		(%)	+6.1	Max. Change +10% / -1%	Pass
Microhardness unaged	ISO 48	IRHD	38	<45	Pass
Microhardness aged in oil no. 2, 168hr @ 100°C	ISO 48	IRHD	38	Max. Change +/- 15	Pass
Resistance to ozone 24hr, 20% str, 30°C, 50pphm ozo	ISO 1431-1 Method A		No cracks	No cracks	Pass

Charles Forge
for Rubber Consultants

16th November 2010

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Appendix

TO: MR.C.FORGE RC 20137

TENSILE PROPERTIES (MPa)

Reference:20137.05.01-02
Tested by: SM
Instron 5567

Test Lab Reference :22814
Date of test :13.08.10
See below
Aged :See below

Test pieces cut with grain

Tested to BS ISO 37: 2005

Sample ID	100%	200%	300%	400%	500%	T.S.	E.B.	Th. (mm)	CODE
02	0.61	1.00	1.51	2.18	3.02	11.09	954	2.19	
PR410/35	0.60	0.96	1.45	2.07	2.84	10.84	992	2.18	
X4879/2	0.60	0.99	1.53	2.22	3.10	10.54	919	2.15	
Unaged	0.60	0.97	1.48	2.14	2.97	11.23	971	2.13	
	0.60	0.97	1.45	2.08	2.86	10.86	976	2.14	
	0.58	0.93	1.40	1.97	2.69	10.91	1029	2.15	
Mean	**0.60**	**0.97**	**1.47**	**2.11**	**2.91**	**10.91**	**974**	**2.16**	
02	0.71	1.18	1.86	2.75	3.92	10.57	832	2.14	
PR410/35	0.73	1.21	1.90	2.81	3.98	10.83	836	2.12	
X4879/2	0.72	1.19	1.85	2.70	3.79	9.25	801	2.13	Slight flaw
Aged 168hr@175°C	0.74	1.25	1.96	2.90	4.14	10.64	807	2.12	
	0.70	1.14	1.77	2.61	3.69	10.05	841	2.12	Slight flaw
	0.72	1.20	1.87	2.74	3.88	10.41	829	2.16	
Mean	**0.72**	**1.20**	**1.87**	**2.75**	**3.90**	**10.29**	**824**	**2.13**	

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MICROHARDNESS

Reference : 20137.05.01-02
Tested by : RB
Test Temp (°C) : 23
Type of Surface : Moulded
Sample Type : 1" Squares

Test Lab Reference : **22814C**
Date of test : 13/08/2010
Aged : See below
Tested to BS ISO 48: 2007

Sample Identification	No.	Reading 1 IRHD	Reading 2 IRHD	Reading 3 IRHD	MEDIAN IRHD
PR410/35 X4879/2 Unaged/23°C	4	37	37	38	37
	5	38	38	38	38
	6	38	37	38	38
PR410/35 X4879/2 Aged 7 Days/175°C	4	42	42	42	42
	5	42	42	42	42
	6	42	42	41	42

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MICROHARDNESS

Swelling in IRM 902 oil for 168 hours at 100°C

Reference : 20137.05.01-02
Tested by : RB
Test Temp (°C) : 23
Type of Surface : Moulded
Sample Type : (50 x 20 x 2)mm pieces

Test Lab Reference : **22814A**
Date of test : 13/08/2010
Aged : See below
Tested to BS ISO 48: 2007

Sample Identification	No.	Reading 1 IRHD	Reading 2 IRHD	Reading 3 IRHD	MEDIAN IRHD
PR410/35 X4879/2 Unaged	4	38	38	37	38
	5	38	38	38	38
	6	39	38	39	39
PR410/35 X4879/2 Aged in IRM 902 oil 168hr@100°C	4	38	38	38	38
	5	39	38	39	39
	6	38	38	37	38

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COMPRESSION SET

Reference : 20137.05.01-02
Tested by : RB
Lab Temp(°C): 23

Compression (%) = 25
Test Temp (°C) = See below
Test duration = See below
Recovery Time = 30 Minutes

Test Lab Reference : **22814**
Date of test : 15/09/2010
Aged : Unaged/23°C
Tested to BS 903: A6: 1992
ISO 815: 1991
Silicone fluid lubricant used.
Micrometer foot diameter = 4 mm.
The test pieces were tested as a set.

The sample is a moulded cylindrical disc of diameter 13mm, thickness 6.3mm (Type B in standard) and it is not laminated. If the test-piece thickness is non-standard the achieved compression will be quoted.

	Compression Set %			
Sample Identification	Test Piece 1	Test Piece 2	Test Piece 3	MEDIAN %
PR410/35 X4879/2 7 days at 175°C	24	25	25	25
PR410/35 X4879/2 72hr at 0°C	8	7	8	8

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% WEIGHT CHANGE

Reference : 20137.05.01-02
Tested by : SM
Sample Type: (50 x 20 mm) pieces.

Test Lab Reference : **22814**
Date of test : 13.08.10
AGED: **Swollen for 72 hours @ 23°C in Pentane,weighed Dried for 168 Hours @ 40°C, conditioned for 16 hours, then re-weighed**

Sample Identification	No	WEIGHT(mg) before swelling	WEIGHT(mg) Immediately After swelling	%WEIGHT CHANGE	WEIGHT (mg) After drying for 168 hours/40°C	% WEIGHT CHANGE
02	4	2430.0	7589.4	212.32	2356.1	-3.04
PR 410/35	5	2452.4	7776.1	217.08	2377.4	-3.06
X4879/2	6	2477.2	7654.2	208.99	2401.5	-3.06

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% WEIGHT CHANGE

Reference : 20137.05.01-02
Tested by : CZ
Sample Type: 50mm x 20mm Strip

Test Lab Reference : **22814A**
Date of test : 17/08/2010
AGED: 168Hrs/100°C in IRM 902 Oil

Sample Identification	No	WEIGHT(mg) before ageing	WEIGHT(mg) After ageing	%WEIGHT CHANGE
Mix 02	4	2506.8	2657.5	6.01
PR 410/35	5	2432.0	2580.2	6.09
X4879/2	6	2378.8	2522.4	6.04

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OZONE TEST

Reference : 20137.05.01-02
Tested by : RB
Test Temperature (°C) : 30
Test Duration (hours) : 24
Strain (%) : 20
Ozone Concentration (pphm) : 50
Test Piece Type : Strip cut from moulded sheet

Test Lab Reference : **22814**
Date of test : 19/08/2010
Aged : Unaged/23°C
Tested to BS ISO 1431-1: 2004 Procedure A

Sample Identification	TIME	OBSERVATIONS
Mix 02 PR 410/35 X 4879/2	24 Hours	Test piece 1 - No cracks, no bloom Test piece 2 - No cracks, no bloom Test piece 3 - No cracks, no bloom

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