LABORATORY REPORT

Client : Primasil Limited **RC19953**

Testing of FKM material ref. 9053B/005 (674641) to BS EN 549

Summary

A sample of FKM material was received from Primasil Limited. The material was tested to BS EN 549 as requested. The sample was found to meet the requirements for an H2/E1 grade material.

Materials and methods

A sample of FKM material ref. 9053B/005 (674641) was received from Primasil Limited 21st May 2010. The material was allocated the goods received number GR10/334.

The sample consisted of a moulded sheet of nominal dimensions 175 x 175mm, a hardness block of nominal dimensions 150 x 50mm and a set of 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 FKM 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 of dumb-bells was tested unaged. The second set was tested 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. A one inch square profile cutter and a hand-operated cutting press were used. 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. The compression set was also determined at a temperature of 0°C. The test duration for the elevated and low temperature studies was 168 and 72 hours respectively.

Resistance to gas

The FKM 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 was determined following immersion in pentane for a period of 72 hours at a temperature of 23°C. 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 weighed following drying and the change in mass was calculated.

Resistance to lubricant

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

Ozone resistance

The FKM material was tested for ozone resistance 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 the 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 test, test result and indicates if the material was found to meet the physical requirements for an H2/E1 grade material. The results sheet for each test is appended.

The FKM material ref. 9053B/005 (674641) was found to meet the requirements of BS EN549 listed for H2/E1 grade materials.

Table 1 FKM50– Results recorded on testing to BS EN 549

Sample ref. 9053B/005 (674641) Test	Method		Test Result	Specification	Pass/Fail
Tensiles unaged	ISO 37	Tensile Strength (MPa)	7.93	≥ 7	Pass
		Elongation at break (%)	300	≥ 125	Pass
Tensiles aged 168hr @ 175°C	ISO 37	Tensile Strength (MPa)	9.53	Max. Change -40%	Pass
		Elongation at break (%)	264	Max. Change -40%	Pass
Microhardness unaged	ISO 48	IRHD	51	45-60	Pass
Microhardness aged 168hr @ 175°C	ISO 48	IRHD	52	Max. Change +/- 10	Pass
Comp set 168hr @ 175°C	ISO 815	(%)	33	≤40	Pass
Comp set 72hr @ 0°C	ISO 815	(%)	23	≤40	Pass
Change in mass on immersion in pentane 73hr at 23°C	ISO 1817	(%)	+0.37	Max. Change +10% / -5%	Pass
Change in mass on drying for 168hr @ 40°C		(%)	+0.04	Max. Change +5% / -8%	Pass
Resistance to lubricant	ISO 1817				
Change in mass 168hr @ 100°C		(%)	+0.06	Max. Change +15% / -10%	Pass
Microhardness unaged	ISO 48	IRHD	52	45-60	Pass
Microhardness aged in oil no. 2, 168hr @ 100°C	ISO 48	IRHD	52	Max. Change +/- 10	Pass
Resistance to ozone 24hr, 20% str, 30°C, 50pphm ozone	ISO 1431-1 Method A		No Cracks	No Cracks	Pass

Charles Forge
for Rubber Consultants

22nd July 2010

Appendix

TO: MR.C.FORGE RC 19953

TENSILE PROPERTIES (MPa)

Reference:19953.05.01
Tested by: SM
Instron 5567

Test Lab Reference :22730
Date of test :4.06.10
Aged :UNAGED/23°C

Test pieces cut with grain

Tested to BS ISO 37: 2005

Sample ID	100%	200%	300%	400%	500%	T.S.	E.B.	Th. (mm)
674641	1.43	3.48	7.74	-------	-------	7.93	305	1.93
	1.44	3.66	8.12	-------	-------	8.70	312	1.95
	1.35	3.29	-------	-------	-------	7.00	293	1.94
	1.38	3.43	-------	-------	-------	7.20	292	1.95
	1.41	3.75	-------	-------	-------	6.68	266	1.94
	1.35	3.54	8.02	-------	-------	8.02	300	1.97

TO: MR C FORGE RC 19953

TENSILE PROPERTIES (MPa)

Reference: 19953.05.01
Tested by: GM
Instron 5567

Test Lab Reference : 22730A
Date of test : 02/07/10
Aged : 7DAYS/175°C

Test pieces cut with grain

Tested To: BS EN 549

Sample ID	100%	200%	300%	400%	500%	T.S.	E.B.	Th. (mm)
674641	1.83	6.27	-----	-----	-----	9.65	250	1.95
	1.70	5.59	-----	-----	-----	9.53	264	1.94
	1.65	5.30	-----	-----	-----	9.63	271	1.97
	1.71	5.53	-----	-----	-----	9.30	263	1.96
	1.79	6.10	-----	-----	-----	8.76	242	1.98
	1.67	5.32	-----	-----	-----	9.50	268	1.99

TO: MR C FORGE RC 19953

MICROHARDNESS

Reference : 19953.05.01
Tested by : GM
Test Temp (°C) : 23°C
Type of Surface : MOULDED
Sample Type : 1"SQUARE

Test Lab Reference : **22730B**
Date of test : 07.06.10
Aged : UNAGED/23°C
Tested to BS ISO 48: 2007

Sample Identification	No.	Reading 1 IRHD	Reading 2 IRHD	Reading 3 IRHD	MEDIAN IRHD
674641	1	52	52	51	52
	2	52	51	51	51
	3	51	51	51	51

TO: MR.C.FORGE RC 19953

MICROHARDNESS

Reference : 19953.05.01
Tested by : RB
Test Temp (°C) : 23
Type of Surface : Moulded
Sample Type : 1" Square

Test Lab Reference : **22730C**
Date of test : 02/07/2010
Aged : 7 Days/175°C
Tested to BS ISO 48: 2007

Sample Identification	No.	Reading 1 IRHD	Reading 2 IRHD	Reading 3 IRHD	MEDIAN IRHD
01 674641	1	52	52	53	52
	2	52	52	52	52
	3	52	52	53	52

TO:Mr C Forge RC 19953

COMPRESSION SET

Reference : 19953.05.01
Tested by : CZ
Lab Temp(°C): 23

Compression (%) = 25
Test Temp (°C) = 175
Test duration = 168 Hours
Recovery Time = 30 Minutes

Test Lab Reference : **22730**
Date of test : 24/06/2010
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 %
674641	33	33	33	33

TO:Mr C Forge RC 19953

COMPRESSION SET

Reference : 19953.05.01
Tested by : CDF
Lab Temp(°C): 23

Compression (%) = 25
Test Temp (°C) = 0
Test duration = 72 Hours
Recovery Time = 30 Minutes

Test Lab Reference : **22730A**
Date of test : 25/05/2010
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 %
674641	23	23	23	23

TO: Mr C Forge RC19953

% WEIGHT CHANGE

Reference : 19953.05.01
Tested by : CZ
Sample Type: 50mm x 20mm strips

Test Lab Reference : 22730
Date of test : 07/06/2010
AGED: Swell in Pentane for 72Hrs/23°C
Dry for 168Hrs/40°C, condition overnight
Tested to: EN 549

Sample Identification	No	WEIGHT(mg) Before swelling	WEIGHT(mg) After swelling	%WEIGHT CHANGE	WEIGHT(mg) After Drying	%WEIGHT CHANGE
674641	1	3871.9	3885.0	0.34	3873.6	0.04
	2	3851.3	3866.5	0.39	3852.6	0.03
	3	3934.6	3949.9	0.39	3936.0	0.04

TO: Mr C Forge RC 19953

% WEIGHT CHANGE

Reference : 19953.05.01
Tested by : CZ
Sample Type: 50mm X 20mm Strip

Test Lab Reference : **22730**
Date of test : 07/06/2010
AGED: 168Hrs/100°C in IRM902 OIL

Sample Identification	No	WEIGHT(mg) before ageing	WEIGHT(mg) After ageing	%WEIGHT CHANGE
674641	1	3872.7	3877.1	0.11
	2	3728.9	3730.4	0.04
	3	3676.0	3677.6	0.04

TO:MR C FORGE RC 19953

MICROHARDNESS

Reference : 19953.05.01
Tested by : GM
Test Temp (°C) : 23°C
Type of Surface : MOULDED
Sample Type : 50cmx20cm Strips

Test Lab Reference : **22730**
Date of test : 07.06.10
Aged : UNAGED/23°C
Tested to BS ISO 48: 2007

Sample Identification	No.	Reading 1 IRHD	Reading 2 IRHD	Reading 3 IRHD	MEDIAN IRHD
474641	1	52	53	53	53
	2	52	52	52	52
	3	51	51	51	51

TO:MR C Forge RC 19953

MICROHARDNESS

Reference : 19953.05.01
Tested by : CZ
Test Temp (°C) : 23
Type of Surface : Moulded
Sample Type : 50mm X 20mm Strip

Test Lab Reference : **22730A**
Date of test : 14/06/2010
Aged : 168Hrs/100°C in IRM902 Oil
Tested to BS ISO 48: 2007

Sample Identification	No.	Reading 1 IRHD	Reading 2 IRHD	Reading 3 IRHD	MEDIAN IRHD
674641	1	52	52	52	52
	2	51	52	52	52
	3	51	52	52	52