



## Test Report

### Selected Measurements on K-Flex TITAN Supplied by K-Flex USA, LLC

Prepared For:

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Report: RD17821-R1

A handwritten signature in black ink, appearing to read 'Stuart Ruis', written over a horizontal line.

Stuart Ruis  
President

December 8, 2017

The test results in this report apply only to the specimens tested. The tests conform to the respective test methods except for the report requirements. The report includes summary data but a full complement of data is available upon request. This report shall not be reproduced, except in full, without written approval of R & D Services, Inc. This report must not be used by the client to claim product endorsement by R & D Services, Inc., IAS or any other organization.

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## Water Vapor Transmission Test Report

Test Number: RD172873WV

Date of Test: November 3 - 30, 2017

Specimen Number: 1726171017-12, 22

Date of Manufacture: Unknown

Description of Test Specimen: K-Flex TITAN; Elastomeric Tubular Insulation

Test Method: ASTM Test Method E 96/E96M – 16, “Standard Test Methods for Water Vapor Transmission of Materials” and EN 13469 “Determination of Water Vapor Transmission Properties of Preformed Pipe Insulation”

Report Prepared For: K-Flex USA, LLC / Mr. Biju Thomas

Water vapor transmission results were obtained using the desiccant method described in Section 11 of ASTM E96. The “perm” being reported was calculated using the method outlined in Section 13 of the standard. The specimens were prepared as described in Sections 6 and 7 in EN 13469. The ends of the tubular specimen were sealed with an aluminum foil and coated with microcrystalline wax (60 %) mixed with refined crystalline paraffin wax (40 %). The specimens were subjected to a conditioned space, and the mass of each specimen was tracked over the interval described below.

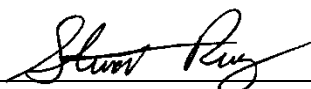
<b>Specimen Dimensions:</b>	Length (mm)	102.2
	Wall Thickness (mm)	27.8
	Outer Diameter (mm)	77.5

<b>Test Conditions:</b>	Temperature (°F)	71.5
	Relative Humidity (%)	49.7
	Test Duration (hr)	652

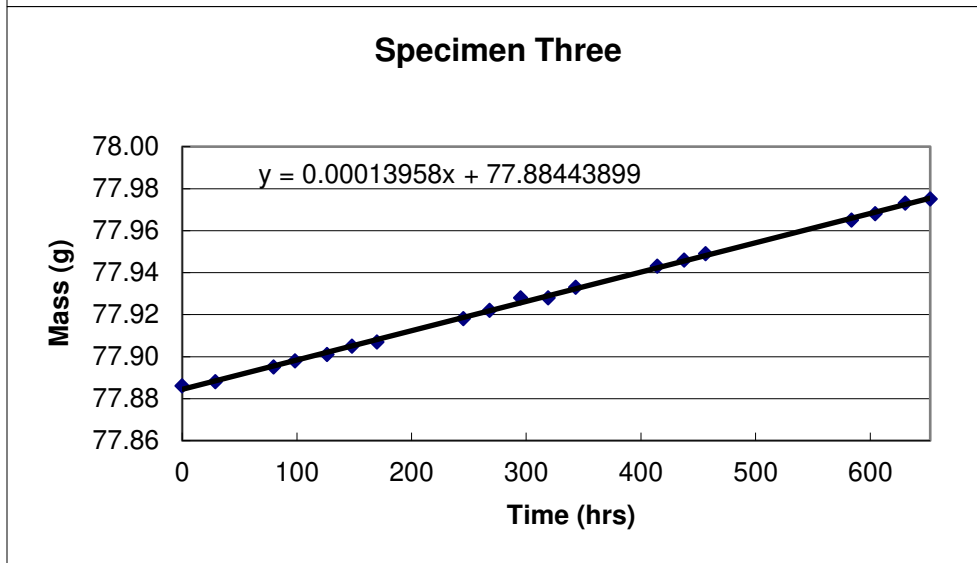
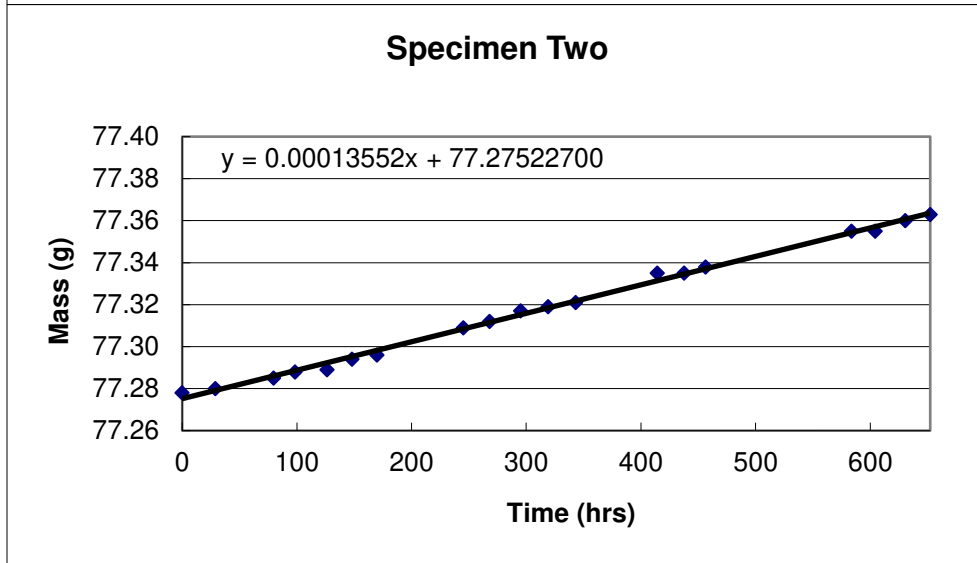
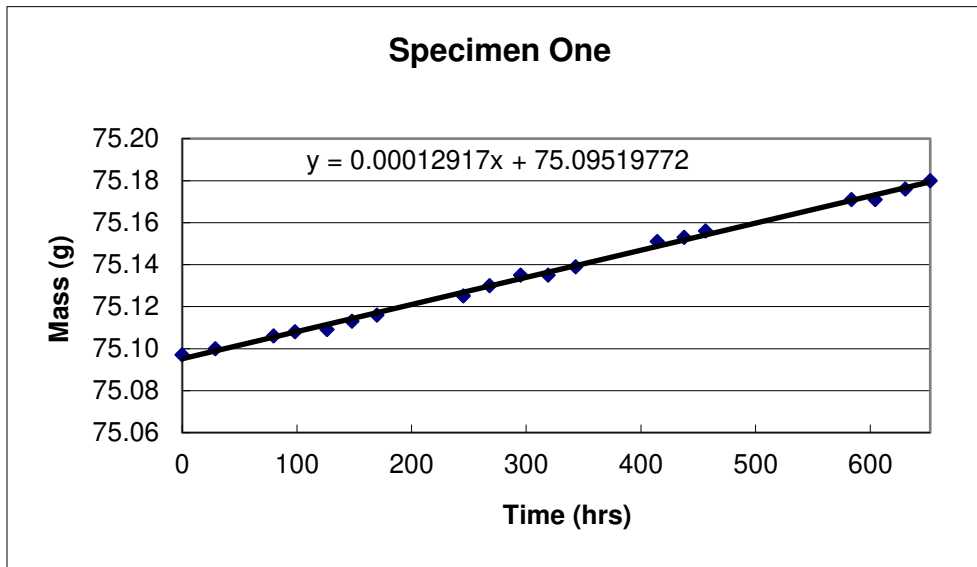
	<b>Specimen 1</b>	<b>Specimen 2</b>	<b>Specimen 3</b>	<b>Specimen 4</b>
<b>Test Results:</b>				
Mass Gain (g)	0.084	0.088	0.091	0.075
Specimen Area (ft <sup>2</sup> )	0.153	0.150	0.153	0.153
Water Vapor Transmission (gr/h·ft <sup>2</sup> )	0.013	0.014	0.014	0.012
Saturation Pressure (in. Hg)	0.777	0.777	0.777	0.777
Pressure Difference (in. Hg)	0.386	0.386	0.386	0.386
Permeance (perm, gr/ft <sup>2</sup> ·h·(in. Hg))	0.034	0.036	0.036	0.030
Thickness (in.)	1.09	1.09	1.09	1.09
Permeability (perm·in.)	0.037	0.040	0.040	0.033
Figure showing data is attached	yes	yes	yes	yes

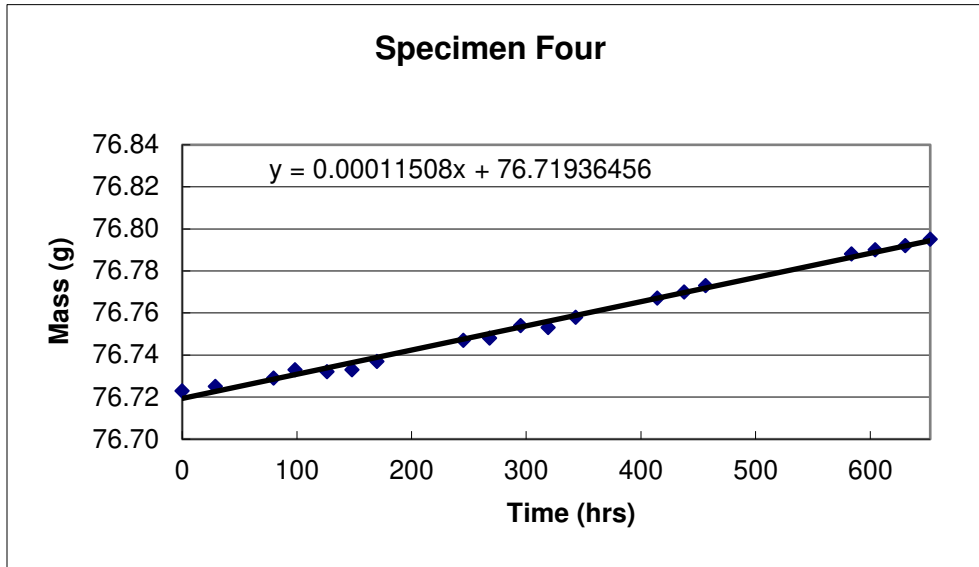
### Result:

The measured average permeance for the material was 0.034 perm under the conditions of the test. The measured average permeability for the material was 0.037 perm·in. under the conditions of the test.

  
 Reviewed By:

12/8/17  
 Date:







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## Water Absorption of Cellulosic Fiber Board Report

Test Number: RD172509WA-II

Date of Test: October 31, 2017

Specimen Number: 1726171017-12,22

Date of Manufacture: Unknown

Description of Test Specimen: K-Flex TITAN; Elastomeric Tubular Insulation

Test Method: ASTM C 209-15, "Standard Test Methods for Cellulosic Fiber Insulating Board" Section 14.

Report Prepared For: K-Flex USA, LLC / Mr. Biju Thomas

### Background

The amount of water absorbed by an elastomeric insulation due to submersion in water has been determined in accordance with ASTM C 209-15, "Standard Test Methods for Cellulosic Fiber Insulating Board" Section 14. Specimens of the insulation are submerged for two hours as specified in the standard. The specimens are dried according to the section 14.3 of the standard. The average weight gain of three specimens is measured and used to calculate the volume percent of water absorbed.

### Description of Test Specimens

The material used in this test was K-Flex TITAN supplied by K-Flex USA, LLC. Three tubular samples approximately 1 inch inner-diameter, 1 inch thick and 12 inches long were used.

### Test Results

	<b>Specimen 1</b>	<b>Specimen 2</b>	<b>Specimen 3</b>
<b>Length (mm)</b>	297.1	300.4	299.3
<b>Circumference (mm)</b>	244.8	246.0	243.3
<b>Wall Thickness (mm)</b>	26.1	27.2	27.3
<b>Volume (m<sup>3</sup>)</b>	0.00130	0.00130	0.00130
<b>Initial Mass (g)</b>	139.50	147.51	137.18
<b>Ending Mass (g)</b>	141.21	149.43	138.44
<b>Water Absorption (volume %)</b>	0.17	0.15	0.10

### Result:

**The average observed water absorption for the material tested was 0.14 Volume %.**

  
 Review: \_\_\_\_\_

12/8/17  
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## Test Report for Tensile Strength

Test Number: RD172511TS

Date of Test: November 1, 2017

Specimen Number: 1726171017-12,22

Date of Manufacture: Unknown

Description of Test Specimen: K-Flex TITAN; Elastomeric Tubular Insulation; Tested in machine direction (radial direction)

Test Method: ASTM D412-15a "Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers"

Report Prepared For: K-Flex USA, LLC / Mr. Biju Thomas

### Procedure

Five (5) 7 by 1 inch specimens were cut from material supplied by the client. The material was a tubular elastomeric foam rubber with a black facer. The facer was removed from the foam prior to testing. The thickness of the facer was measured for thickness, and then measured for tensile strength. A sample of the foam was also measured for tensile strength and found to be significantly less than the tensile strength of the facer. The specimens were fastened to mechanical vise grips and subjected to a constant rate of separation using until rupture of the specimen occurred. The specimens were conditioned at  $73.4 \pm 3.6$  °F and  $50 \pm 5\%$  relative humidity for 40 hours prior to testing. The test was also conducted under the same environmental conditions.

An initial grip separation of 3.0 inches was used, and the tensile load was applied at the rate of 20 inch per minute until failure occurred. These values were selected in accordance with ASTM D412-15a. The test was conducted using the INSTRON Universal Testing Instrument, Model Number 4400R, equipped with an electronic load cell and data acquisition system.

### Results

Specimen	Width (in)	Thickness (in)	Maximum Load (lbf)	Maximum Load/Width (lbf/in)	Maximum Tensile Strength (lbf/in <sup>2</sup> )/(MPa)	Elongation (%)
1	1.054	0.018	44.97	42.67	2366.8 / 16.32	318.0
2	1.107	0.018	47.22	42.66	2372.9 / 16.36	386.0
3	1.065	0.018	47.06	44.19	2451.0 / 16.90	320.3
4	1.065	0.018	54.74	51.40	2851.0 / 19.66	319.6
5	1.069	0.018	54.90	51.36	2859.4 / 19.71	243.1

AVERAGE MAXIMUM TENSILE STRENGTH				AVERAGE ELONGATION	
MPa	Std Dev	lbf/in <sup>2</sup>	Std Dev	(%)	Std Dev
17.8	1.8	2580.2	253.2	317.4	50.6

  
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## Test Report for Tensile Strength

Test Number: RD172510TS

Date of Test: November 1, 2017

Specimen Number: 1726171017-12,22

Date of Manufacture: Unknown

Description of Test Specimen: K-Flex TITAN; Elastomeric Tubular Insulation; Tested in cross-machine direction (length direction)

Test Method: ASTM D412-15a "Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers"

Report Prepared For: K-Flex USA, LLC / Mr. Biju Thomas

### Procedure

Five (5) 7 by 1 inch specimens were cut from material supplied by the client. The material was a tubular elastomeric foam rubber with a black facer. The facer was removed from the foam prior to testing. The thickness of the facer was measured for thickness, and then measured for tensile strength. A sample of the foam was also measured for tensile strength and found to be significantly less than the tensile strength of the facer. The specimens were fastened to mechanical vise grips and subjected to a constant rate of separation using until rupture of the specimen occurred. The specimens were conditioned at  $73.4 \pm 3.6$  °F and  $50 \pm 5\%$  relative humidity for 40 hours prior to testing. The test was also conducted under the same environmental conditions.

An initial grip separation of 3.0 inches was used, and the tensile load was applied at the rate of 20 inch per minute until failure occurred. These values were selected in accordance with ASTM D412-15a. The test was conducted using the INSTRON Universal Testing Instrument, Model Number 4400R, equipped with an electronic load cell and data acquisition system.

### Results

Specimen	Width (in)	Thickness (in)	Maximum Load (lbf)	Maximum Load/Width (lbf/in)	Maximum Tensile Strength (lbf/in <sup>2</sup> )/(MPa)	Elongation (%)
1	1.077	0.018	28.05	26.04	1445.9 / 9.97	146.9
2	1.049	0.018	28.16	26.84	1490.0 / 10.27	121.9
3	1.058	0.018	19.14	18.09	1007.4 / 6.95	230.7
4	1.054	0.018	21.02	19.94	1106.3 / 7.63	234.6
5	1.024	0.018	30.66	29.94	1666.3 / 11.49	146.0

AVERAGE MAXIMUM TENSILE STRENGTH				AVERAGE ELONGATION	
MPa	Std Dev	lbf/in <sup>2</sup>	Std Dev	(%)	Std Dev
9.3	1.9	1343.2	276.3	176.0	52.7

  
 Reviewed By: \_\_\_\_\_

12/8/17  
 Date: \_\_\_\_\_