Assessment of ARDEX WPM 157 to: AS 4654.1:2012 Waterproofing membranes for external above-ground use Part 1: Materials

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The results reported herein relate only to the item(s) tested.

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Summary

Test Standard: Testing was conducted on a waterproofing membrane for external above-ground use with fully bonded membrane liquid exposed to assess its performance for: water vapour transmission; water absorption; acceptance of cycle movement; durability; abrasion resistance; bond strength and thickness. The external waterproofing membranes properties were tested in accordance to the Australian Standard AS4654.1:2012.

All methods were carried out according to Table 2.1 under fully bonded membrane liquid exposed against the performance criteria of Tables A1, A3 and A4.

Test results: The waterproofing membrane presented for testing complied with the performance criteria set in AS4654.1:2012 waterproofing membrane for external above-ground, exposed to both pedestrian traffic and non-trafficable. The following table shows the ARDEX WPM 157 performance as assessed from testing.

TABLE 1 SUMMARY OF TEST REQUIREMENTS AND TEST SPECIMEN RESULTS FOR AS4654.1:2012

TEST	METHOD	REQUIREMENTS	RESULT	STATUS
(a) Moisture Transmission Rate	ASTM E 96 Desiccant method for Determining Water Vapour Transmission (WVT)	Pass or fail results shall determine if material is a moisture suppressant coating.	WVT 7.79 g/m^2/24hrs Permeance 64.17 ng/Pa.s.m^2	Complied
(b) Acceptance of movement	AS AS4654.1 Appendix B for assessment of cyclic movement of membrane	Pass or fail criteria by observing any cracking, rupture holing or extending through the thickness for more than 1 mm in from the edge of the specimen.	Class III	Complied
(c) Abrasion resistance 2.3.2 Trafficable	AS 1580.403.2.1-2006 Paints and related materials	Pedestrian traffic only – abrasion depth less than 0.2 mm. Occasional service vehicle traffic – abrasion depth less than 0.1 mm. Regular vehicle traffic – abrasion depth less than 0.05 mm.	0.071mm	Occasional service vehicle traffic
(d) Durability **1. Control** **2. Water immersion** **3. Detergent immersion** **4. Heat ageing at 80°C** **5. Ultraviolet resistance** **6. Temperature resistance at -15°C to +85°C**	AS4654.1 Appendix A for assessment of membranes durability AS4654.2 temperature resistance section 2.4.2 (c)	Pass or fail criteria; compared to control samples: elongation at break shall be not less than 25 % for water and detergent immersion. Whereas, elongation at break shall be not less than 50 % for heat ageing samples.	1. Class III 2. Class III 3. Class III 4. Class III 5. Class III 6. Class III	Complied
(e) Bond strength to concrete and fibre-cement sheeting substrates	ASTM C794 Standard test method for adhesion-in-peel of elastomeric joint sealants	Test samples exposed to dry conditions, then tested for adhesion-in-peel strength.	105.02N with 100% adhesive failure loss for concrete. 2.07N with 100% substrate failure loss for fibre-cement sheeting.	Complied
(f) Membrane thickness	AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings.	The film thickness shall be measured at a minimum of five points and a maximum of 10 points, equally spaced across the strip	1.206mm	Complied

Note: The above is only a summary of the overall results and must be read in conjunction with the relevant sections of this report.

Introduction

CSIRO Services was engaged by Ardex Australia Pty Ltd to provide a private relabel report from existing CSIRO report 8319.3 assess a waterproofing membrane for compliance against the AS4654.1:2012 according to Tables 2.1 under fully bonded membrane sheet with compliance confirmed against the performance criteria of Tables A1, A3 and A4. The details for this assessment are listed in Table 3 below.

TABLE 2 DETAILS OF TEST SPECIMEN

CSIRO Agreement No.:	20200728.01
Applicant:	Ardex Australia Pty Ltd
PRODUCT DESCRIPTION:	ARDEX WPM 157

Note: CSIRO accepts no responsibility for the selection of specimens. The results in this report apply to the specimens tested and may not be applicable to other specimens of the same product.

This report details the performance, testing conditions and outcomes of the specimen assessed in accordance with waterproofing membrane system for exterior use - above ground level. Table 4 details the applicant's specified schedule of tests for the product.

TABLE 3 DETAILS OF THE SCHEDULE FOR TESTING OF THE SUBMITTED SPECIMEN

CSIRO Agreement No.:	20180402.01
TEST SCHEDULE:	AS4654.1 Clause A2, A4 Table A1, A3 & A4: a) Moisture vapour transmission rate - ASTM Designation E96/E96M – 16, 'Standard Test Methods for Water Vapour Transmission'; b) Acceptance of cyclic movement; Appendix B 'Assessment of resistance of waterproofing membranes to cyclic movement'; c) Abrasion resistance AS 1580.403.2.1-2006 Paints and related materials; d) Durability - Appendix A 'Assessment of durability of waterproofing membranes: Table A4 (a) Controls Table A4 (b) Water immersion Table A4 (c) Detergent immersion Table A1 & A4 (e) Heat aging at 80°C Table A1 & A4 (f) Ultraviolet resistance at 1000h of exposure (g) Temperature resistance at -15°C to +85°C e) Bond strength to concrete substrate - ASTM C794:2018 Standard test method for adhesion-in-peel of elastomeric joint sealants. f) Membrane thickness – AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings.

Test specimen description

The ARDEX WPM 157 is a one-component moisture curing membrane and has a polyurethane base. The nominal size of the membrane was 200 mm wide, 430 mm length and 2.0 mm thick.

The supplied specimen for assessment is shown below in Figures 1 and 2.

FIGURE 1 TOP FACE OF ARDEX WPM 157

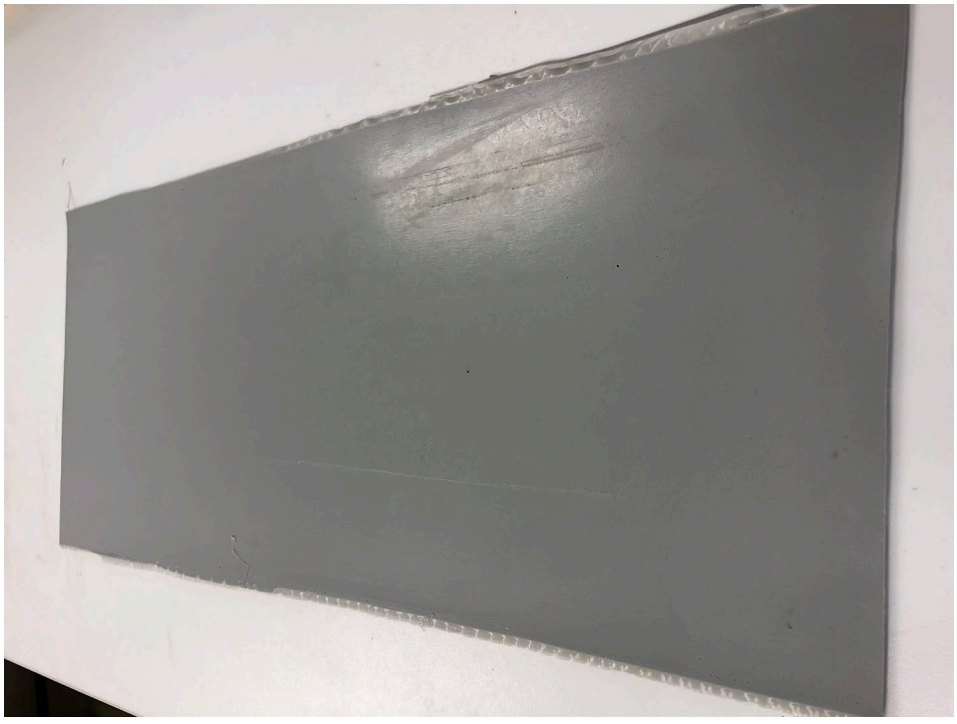


FIGURE 2 UNDERSIDE OF ARDEX WPM 157

Test Methodology

ASTM E96/E96M – 16 Water Vapour Transmission of materials

This Standard outlines the method for determining water vapour transmission (WVT) through the membrane using the desiccant and dummy sample method.

Four test samples were prepared by mechanical sealed using two neoprenes and a teflon gasket placed onto the open side of the test cups. The test cups contain dried desiccant with the trafficable side facing up were placed in a climate-controlled environment with periodic weighing so that the rate of water vapour movement through the membrane to the desiccant can be determined.

The exposed area (test dish face) for each of the cups was 0.002827 m^2. The test cups (all except the dummy sample, no desiccant) had a 6 mm gap between the desiccant and the underside of the membrane.

All test assemblies were kept in a Steridium environmental where chamber temperature humidity are maintained at a temperature of 23 ±2^oC and 50 ±5% relative humidity, for the 37 days duration. Measurements taken each afternoon (excluding weekends) over this period to determine the weight change and permeance of the membrane.

AS4654.1-2012 Appendix B Resistance to cyclic movement

This Standard outlines the method for determining resistance of membrane to cyclic movement set at 4mm extension.

A rectangular test sample of 65 mm x 25 mm x 1.22 mm was cut from the ARDEX WPM 157, then held in the test grips (70(w) x 45(l) x 20(t) mm), exposing a 25 x 2 mm central portion of the sample.

An Applied Test Systems Series 904 Vertical Sealant Tester was used for testing. The vertical sealant testing machine used software for cyclic movement control. The vertical testing machine was set to elongate the clamped test sample for the cycling is 4mm extension. Once the test piece reached full extension, it then returned to its original position, which completed one cycle of movement. The elongation and return was then repeated to complete a 50 cycle movement test, each cycle conducted over a nominal 2 hour period.

The test sample was inspected for signs of breakage, cracks and measurement for any necking. A reduction in width of more than 1 mm inwards from the edge of the test sample constitutes a failure.

AS 1580.403.2-2006 Paints and related materials – methods of test: Abrasion resistance

This Standard outlines the method for determining the abrasion resistance for trafficable of the exposed membrane when tested in accordance with AS 1580.403.2 using the H-22 wheel with 1000 cycles.

Two supplied square test panels of 100 mm x 100 mm x 3.05 mm plain low carbon steel with ARDEX WPM 157 coated on top. Samples were kept in a conditioning room maintained at a temperature of 23 ±2^oC and 60 ±5% relative humidity, for the minimum of 24h duration. After the completion of this exposure period of samples, a hole was drilled in the centre of each panel to enable it to be held securely in position on the Taber 5155 abrader. Each panel were wiped dry and then weighed (g) and recorded thickness (mm) before and after 1000 cycles, determining the mass loss and depth thickness.

AS 4654.1-2012 Appendix A Durability of membrane and Temperature Resistance

This Standard outlines the method for determining resistance of the membrane's durability after conditioning in various solutions over set periods, then assessed against an unconditioned material.

Testing of the ARDEX WPM 157 was in accordance with Appendix A4.2 Durability of membranes. As specified in A2.2.1 the membrane test samples were prepared in accordance with AS 1145.3-2001, Type 2, strip samples 10mm width with a 50mm gauge length. Test samples were exposed and conditioned to those requirements specified in Tables A1, A4 & Temperature Resistance of AS4654.1-2012.

In accordance with A4.2.2.2 Testing, a universal testing machine, fitted with a calibrated 5kN load cell, was used to record the elongation at break and tensile strength. The elongation at break of the immersed test samples were compared to the control test samples.

ASTM C794:2018 Standard test method for adhesion-in-peel of elastomeric joint sealants

This test method consists of preparing four strip test specimens of 25mm width and 250mm in length by embedding a wire mesh screen between two thin layers of the membrane being tested, on concrete and fibre-cement sheeting substrates. Single component solvent based polyurethane primer first apply on surface of both substrates per manufacturer's procedure, follow with the ARDEX WPM 157. For each coating, remix briefly before applying strips only 100mm in length on to the surface of concrete and fibre-cement sheeting substrates to ensure good initial bond. All test specimens were kept in a conditioning room maintained at a temperature of 23 ±2^{o}C and 60 ±5% relative humidity, for the 21 days duration. Then the specimens were placed in a tension-testing machine in such a way the test sample is peeled back from the substrate at 180° to the face of the sample. The exerted force was measured as well as the mode of failure of the membrane from both substrates at the test rate of 50mm/min for 1 minute.

AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings—Methods of test, Method 9: Determining thickness

This Standard sets out a mean to determine the thickness of polyethylene film. All three rectangular test strips of 290 mm x 50 mm was cut across middle width of the supplied sheets. The sheet thickness measured a three points, equally spaced across the strip. The specimens were tested in a conditioning room maintained at a temperature of 23 ±2^{o}C and 60 ±5% relative humidity.

Results

ATSM E96/E96M - 16 Water Vapour Transmission of materials

The periodic measurements of the membrane test samples were recorded as shown in Table 5, below.

Date of test: 29 July 2020 – 4 September 2020

TABLE 4 WATER VAPOUR TRANSMISSION TEST RESULTS

Product	Samples	Weight change	Water Vapour Transmission	Permeance
		G/t = g / s	(G/t)/A = g / m^2 24hr	WVT/S(R1-R2) = ng/Pa.s.m^2
ARDEX WPM 157	8319.2/66 8319.2/67 8319.2/68	2.3 x 10^{-7} 2.6 x 10^{-7} 2.8 x 10^{-7}	7.07 7.88 8.41	58.29 64.91 69.32
	Average	2.5 x 10^{-7}	**7.79**	**64.17**

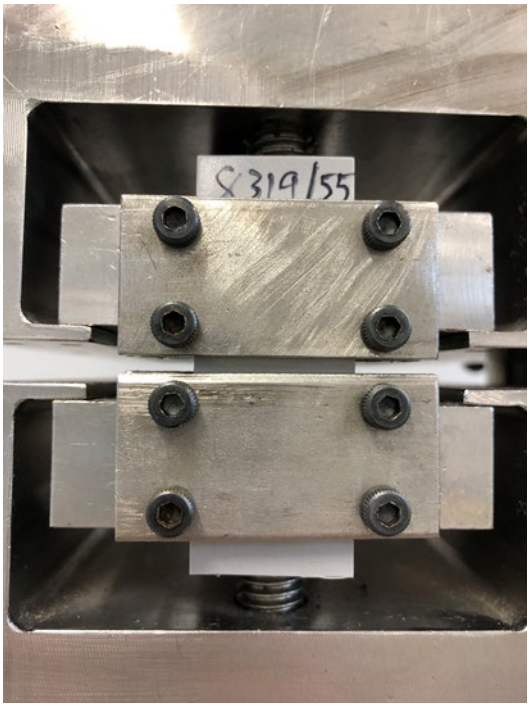
The performance criteria set out in AS4654.1 – 2012, Table A3 to record result, specifies a water vapour transmission rate shall determine if material is a moisture suppressant coating.

AS 4654.1:2012 Appendix B Resistance of waterproofing membranes to cyclic movement

The test result for cyclic movement of the waterproofing membrane test sample is shown in Table 7 below. The test sample completed 50 cycles for the nominal 2 hour period.

Date of test: 19 March 2020 – 23 March 2020

TABLE 5 TEST SAMPLE HOLING DURING CYCLIC MOVEMENT AND TEST RESULTS

Specimen:	ARDEX WPM 157
Test sample and elongation at break:	Test sample 65 (l) mm x 25 (w) mm x 1.22 (t) mm section; Maximum extension movement used for the cycling is 4 mm extension – Class III.
Clamped test sample of cyclic test:	 
Observation and measurement:	Observations: At test completion the specimen showed no signs of rupture holing or cracking.

The performance criteria set out in AS4654.1:2012, Table A3 and section B4, pass or fail criteria by observing any cracking, rupture or necking of more than 1 mm down from original width.

AS 1580.403.2.1-2006 Paints and related materials – methods of test: Abrasion resistance

The test results for abrasion resistance using abrader wheels H22 on the waterproofing membrane test sample are shown in Table 6 below. The test sample completed 1000 cycles.

Date of test: 08 July 2020

TABLE 6 ABRASION RESISTANCE TEST RESULTS

ARDEX WPM 157	Specimen No.: 8319.2/59 Thickness (mm)			Specimen No.: 8319.2/60 Thickness (mm)		
Test Point	Pre Taber	Post Taber	Loss	Pre Taber	Post Taber	Loss
1	2.306	2.231	0.075	2.270	2.168	0.102
2	2.291	2.214	0.077	2.260	2.166	0.094
3	2.243	2.207	0.036	2.253	2.164	0.089
4	2.262	2.227	0.035	2.282	2.187	0.095
5	2.267	2.240	0.027	2.262	2.166	0.096
6	2.254	2.185	0.069	2.251	2.165	0.086
7	2.234	2.205	0.029	2.234	2.146	0.088
8	2.268	2.230	0.038	2.250	2.153	0.097
Average			0.048			0.093
Mean loss	**0.071**					

The performance criteria set out in AS4654.1:2012 section 2.3.2 Trafficable.

Pedestrian traffic only – abrasion depth less than 0.2 mm

Occasional service vehicle traffic – abrasion depth less than 0.1 mm

Regular vehicle traffic – abrasion depth less than 0.05 mm.

AS 4654.1:2012 Appendix A Durability of membrane

The tensile strength and elongation at break were recorded for the control and immersed test samples. Criteria for pass or failure of the immersed test samples were then compared to the control samples. AS 4654.1:2012 Table A2 joint movement bond breaker was also referenced in Table 7, below.

Date of test: 01 April 2020; 03 April 2020, 24 April 2020, 01-11 May 2020, 18- 25 May 2020.

TABLE 7 DURABILITY TEST RESULTS

ARDEX WPM 157			Tensile Strength and Elongation		
Control samples	Break Force (N)	Thickness (mm)	Tensile strength (F/A) (MPa)	Elongation at break (mm) & (%)	Passed/Failed
8319.2/01	73.35	1.20	6.11	151.65 & 303	-
8319.2/02	80.18	1.30	6.12	156.79 & 314	-
8319.2/03	78.09	1.20	6.51	167.66 & 335	-
8319.2/04	79.04	1.20	6.59	162.66 & 325	-
8319.2/05	84.29	1.28	6.58	164.34 & 329	-
Average	79.0	1.24	6.40	160.62 & 321	-
Tensile Strength	79.0	1.24	6.40	160.62 & 321	-
Water Immersion	Average (N)		Average (MPa)	Average (mm) & (%)	-
7 day period	36.73	1.21	3.04	142.51 & 285	Passed*
28 day period	75.30	1.24	6.06	146.95 & 294	Passed*
56 day period	71.11	1.22	5.82	128.61 & 257	Passed*
Detergent Immersion	Average (N)		Average (MPa)	Average (mm) & (%)	-
7 day period	40.93	1.26	3.25	153.69 & 307	Passed*
28 day period	72.41	1.26	5.76	155.49 & 311	Passed*
56 day period	70.45	1.26	5.58	160.06 & 320	Passed*
Heat Ageing @ 80°C	Average (N)		Average (MPa)	Average (mm) & (%)	-
14 day period	79.40	1.24	6.40	119.04 & 238	Passed*
Ultraviolet resistance	Average (N)		Average (MPa)	Average (mm) & (%)	-
1000h of exposure	74.56	1.23	6.08	158.29 & 317	Passed*
Temperature Resistance	Average (N)		Average (MPa)	Average (mm) & (%)	
7 Days @-15°C	77.90	1.23	6.38	132.12 & 259	Passed*
7 Days @+85°C	79.86	1.26	6.44	138.99 & 283	Passed*
Table A4: Pass / Fail and Criteria compared with control samples			*Passed – Elongation at break was above the 25% limit; and all immersed samples were above the 25% criteria for elongation at break Control samples. Class I, II and III of Table A1. * Passed – Elongation at break for heat ageing at 80°C shall be not less than 50% of the results recorded for the controls.		
The performance criteria set out in AS 4654.1:2012, Table A4 specifies a comparison of the immersed test samples to the unconditioned (control) test samples shall be greater than 25% elongation at break.					

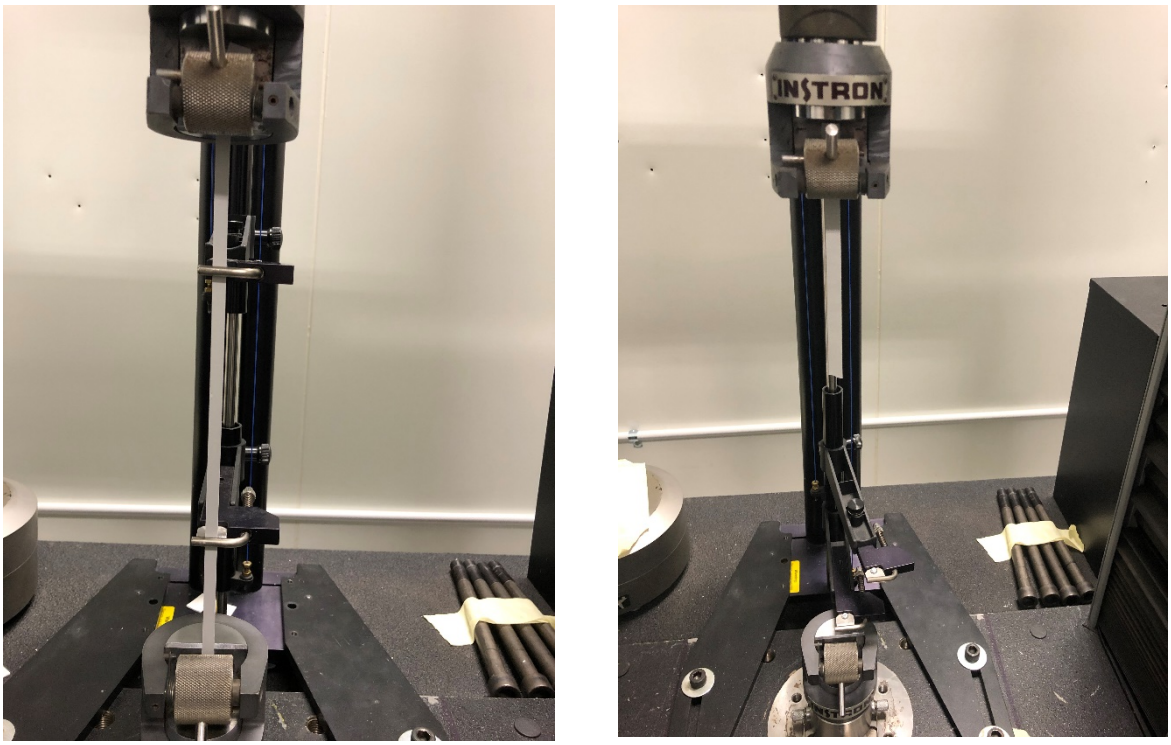


FIGURE 3 IMAGES OF TEST SAMPLE PERFORMING DURABILITY LOAD / ELONGATION TEST

ASTM C794:2018 Standard test method for adhesion-in-peel of elastomeric joint sealants

The measured dimensions of the test samples placed in the test rig stand are shown in Table 8, below.

Date of test: 3 July 2020 – 24 July 2020

TABLE 8 ADHESION-IN-PEEL STRENGTH TESTS RESULTS

Product	Samples	Length and Width of test samples	Concrete		Fibre-cement sheeting	
			Peel Adhesion strength in Dry condition	Adhesive Failure Loss	Peel Adhesion strength in Dry condition	Substrate Failure Loss
		mm	N	%	N	%
ARDEX WPM 157	8319.2/61 8319.2/62 8319.2/63 8319.2/64	25x250 25x250 25x250 25x250	47.02 139.12 109.55 124.40	100 100 100 100	13.50 77.53 44.11 23.67	100 100 100 100
			Average = 105.02 N	100%	Average = 2.07 N	100%

FIGURE 4 IMAGES OF TEST SAMPLE PERFORMING ADHESION-IN-PEEL

AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings—Methods of test, Method 9: Determining thickness

The sheet thickness measured a three points, equally spaced across the strip. The specimens tested in a conditioning room maintained at a temperature of 23 ±2ºC and 60 ±5% relative humidity are shown in Table 9, below.

Date of test: 19 May 2020

TABLE 9 DETERMINING THICKNESS TEST RESULTS

Product	Samples	Length and Width of test samples	Thickness
		mm	mm
ARDEX WPM 157	8319.2/56	290 x 50	1.185
	8319.2/56	290 x 50	1.199
	8319.2/56	290 x 50	1.194
	8319.2/57	290 x 50	1.200
	8319.2/57	290 x 50	1.200
	8319.2/57	290 x 50	1.216
	8319.2/58	290 x 50	1.213
	8319.2/58	290 x 50	1.225
	8319.2/58	290 x 50	1.220
		Average	1.206

Comments

The ARDEX WPM 157, as described herein, when subjected to the test methods of AS 4654.1:2012 the properties of (a) moisture vapour transmission, (b) water absorption, (c) cyclic movement (Class III), (d) durability, (e) Bond strength to concrete, fibre-cement sheeting substrate and (f) membrane thickness met the performance criteria to AS 4654.1:2012 Waterproofing membranes for external above-ground use Part 1: Materials

End of report