



Introduction

The development of DuO as a new concept for a high value, bituminous waterproofing membrane dates back to 1989. The first substantial DuO roofs were installed in 1990.

In 2000, after DuO had been launched as a revolutionary new roof membrane concept for over 10 years, Soprema nv (*previously known as De Boer nv*) decided to do an objective, international investigation of the quality of this waterproofing membrane. This happened in coordination with SGS and BBRI (Belgian Building research Institute) and evaluated samples from roofs in Western & Northern Europe and Asia.

In 2005, another DuO durability test was performed and test roofs from other countries were added to the list. (Netherlands, Sweden, Japan and Singapore)

In 2011, Soprema nv instructed SGS and BBRI to test the ageing DuO membranes again and two more roofs located in Germany and New Zealand were added.

This document provides you a conclusion of the general test results and a summary of the results of the DuO membrane installed on the roof of the Panasonic Semiconductor Asia Pte. Ltd. premises at 22 Ang Mo Kio Industrial park 2 in Singapore in the year 2000.

Location DuO Roof : Singapore

PANASONIC SEMICONDUCTOR ASIA Pte. Ltd. – SINGAPORE

Roof area	: 1600 m ²
Height	: 12 m
Wind zone	: III (Industrial area)
Installation year	: 2000
Built-up	: Concrete roof + insulation + existing covering + cement roof floor + primer + DuO HT 4 Green/ F C180
installation method	: Torch-on application
Construction	: renovation
Roof system	: 1 layer

GENERAL CONCLUSION OF ALL THE TEST RESULTS:

- The samples indicate that there is no significant reduction regarding tensile strength and elongation of the DuO membrane.
- The nail tear resistance of DuO is high for the new membrane. Test results show that the resistance does not deteriorate.
- The tests indicate that the tear resistance of DuO does not diminish through time.
- Maximum allowed shrinkage according to the norm is 0.3%. The test results of the older DuO membranes clearly score below that maximum allowance for new membranes.. This indicates that DuO is a very stable waterproofing membrane.
- The cold flexibility of DuO stays within the norm for artificially aged membranes. In some cases it even stays within the norm for new membranes. The results show us that the cold flexibility of DuO stays very good.
- The flow resistance of DuO stays within the norm for new and artificially aged membranes. Results of membranes installed in tropical climates show high temperature resistance of 155°C after ageing.
- The shear resistance of the DuO joint connection is still within the norms that are stipulated for new membranes.

DESCRIPTION OF TESTS:

Resistance to tearing (Rivestyrke) – Laboratory TUM (Germany)

The butterfly tests are related to the tear resistance of a waterproofing system. This test is also used to determine the tear initiation and tear propagation.

Dimensional stability – Laboratory SP (Sweden)

This test method checks the free shrinkage in longitudinal direction. The minimum result as declared by the manufacturer corresponds to good practice.

Flexibility at low temperature – Laboratory BDA (The Netherlands)

This test method determines the flexibility of the membrane at low temperature.

Flow resistance at elevated temperature – Laboratory Soprema nv (Belgium)

This test method determines the flow resistance (melting) of the membrane.

The minimum demanded result as declared by the manufacturer is more stringent compared to good practice.

Shear resistance of the joint - Laboratory BDA (The Netherlands)

This test method determines the shear resistance of the joint connection between two waterproofing membranes.

RESISTANCE TO TEARING (NAIL SHANK)

- LAB TUM



RESISTANCE TO TEARING (BUTTERFLY TEST)

- LAB TUM



RESISTANCE TO TEARING (RIVET/RYK)

- LAB TUM



SHEAR RESISTANCE OF THE JOINT

- LAB BDA



THICKNESS OF LAYERS



FLOW RESISTANCE AT ELEVATED TEMPERATURE

- LAB SUPREMA NV



DIMENSIONAL STABILITY - LAB SP

- LAB BDA



FLEXIBILITY AT LOW TEMPERATURE - LAB BDA



TENSILE STRENGTH & ELONGATION

- LAB BDA



observations during visual inspection :

- The general impression of the roof is still good.
- The work on the roof has been done skillfully and with a lot of care. No remarks.
- The roof has not been periodically maintained. Moss could be observed and vegetation blocks the drain pipes. Also, white and rust-coloured marks could be observed on the roof.
- Blistering was observed in four lanes. As the joints were still well sealed, further investigation is needed to determine the cause of this blistering.
- The samples were taken from different areas of the roof. Afterwards, the incisions were made water-tight again in a professional manner.

TESTS	specification	OFFICIAL LABORATORY VALUES - 2005		OFFICIAL LABORATORY VALUES - 2010	
		LONGITUDINAL	TRANSVERSAL	LONGITUDINAL	TRANSVERSAL
TENSILE STRENGTH <i>test method (UEA/c - 1984 and EN 12311-1)</i>	880N ± 20%	732N	665N	715N	610N
ELONGATION <i>test method (UEA/c - 1984 and EN 12311-1)</i>	60 ± 15%abs	39	39	34	35
RESISTANCE TO TEARING (NAIL SHANK) <i>test method (EN 12310-1)</i>	>250N	355N	355N	292N	306N
RESISTANCE TO TEARING (BUTTERFLY TEST) <i>test method (DIN 53515 and ISO 34-1 Method B)</i>	>110N	125N	120N	136N	122N
RESISTANCE TO TEARING (NAIL SHANK) <i>test method (DIN 53515 and ISO 34-1 Method B)</i>	>50N	75N	85N	122N	137N
DIMENSIONAL STABILITY <i>test method (SP 2187 and EN 1107-1 Method B)</i>	<0,30%	-0,11%		-0,22%	

specification	OFFICIAL LABORATORY VALUES - 2005	
	LONGITUDINAL	TRANSVERSAL
SHEAR RESISTANCE OF THE JOINT <i>test method (UEA/c - 1982 and EN 12317-1)</i>	682N	723N

new	after aging 6 months at 70°C		OFFICIAL LABORATORY VALUES - 2005		OFFICIAL LABORATORY VALUES - 2010	
	TOT. MEM-BRANE	TOP COATING	TOT. MEMBRANE	TOP COATING	TOT. MEMBRANE	TOP COATING
TOT. MEM-BRANE	>100°C	>140°C	115	155	100	155

new	after aging 6 months at 70°C		OFFICIAL LABORATORY VALUES - 2005		OFFICIAL LABORATORY VALUES - 2010	
	L & T topcoating	L & T undercoating	L topcoating	L undercoating	L topcoating	L undercoating
L & T topcoating	-15°C	-20°C	-32	-32	-16	-20
L & T undercoating	-5°C	-5°C	-32	-32	-14	-16

Final conclusion:

The laboratory tests of existing DuO roof samples show that the results can still be compared to the characteristics that are declared for new membranes.

Very intact samples were taken from some roofs where DuO was installed as a single layer by means of mechanical fastening. These samples show a significantly minor ageing compared to 5 years ago or even to new membranes.

The results also show that DuO keeps its achievements in different types of climates in Western Europe, Northern Europe and Asia.

This durability report also took a sample in Oceania and the results after 10 years show a bright future for the expected serviceability of DuO in this region.

We can conclude that the DuO membranes, installed on roofs in different continents and as a part of different roof concepts, still performs very well after an extra 5 years of natural ageing.

Taking into account that the oldest roofs are currently more than 20 years old, we can state today that, with a correct roof and roof detail maintenance, the previous expected lifetime can be extended by 5 years, meaning that a lifetime expectancy of 25 to 35 years is achievable.