
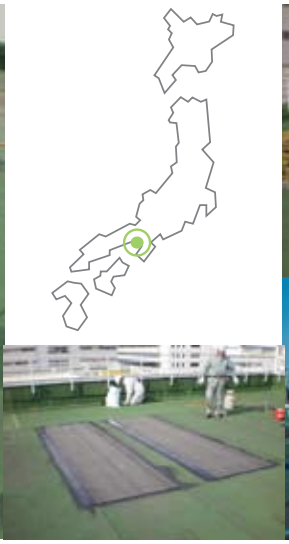

Introduction

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 form 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 Mitsubishi Electric Co. in Amagasaki - Japan in 2000..

Location DuO roof : Japan

MITSUBISHI ELECTRIC CO. – AMAGASAKI – JAPAN

Roof area	:	2730 m^2
Height	:	24 m
Wind zone	:	III (industrial area)
Installation year	:	2000
Built-up	:	concrete + primer + PUR insulation + vapour pressure distribution layer + DuO 4 mm T/F + coloured coating
installation method	:	DuO top layer flame-torched (on vapour pressure distribution layer underneath)
Construction	:	newly built
Roof system	:	2 layers (perforated basesheet and DuO cap sheet)

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.

observations during visual inspection :

- The general impression of the roof is still very good.
- The work on the roof has been done skilfully and with a lot of care. No remarks.
- The roof has been periodically maintained. There are no remarks, here either.
- The samples were taken from different areas of the roof. Afterwards, the incisions were made water-tight again in a professional manner.

TESTS		OFFICIAL LABORATORY VALUES - 2005		OFFICIAL LABORATORY VALUES - 2010	
	specification	LONGITUDINAL	TRANSVERSAL	LONGITUDINAL	TRANSVERSAL
TENSILE STRENGTH *test method (UEAtc – 1984 and EN 12311-1)*	**880N ± 20%**	779N	773N	885N	770N
ELONGATION *test method (UEAtc – 1984 and EN 12311-1)*	**60 ± 15%abs**	44	47	43	43
RESISTANCE TO TEARING (NAIL SHANK) *test method (EN 12310-1)*	**>250N**	310N	340N	304N	359N
RESISTANCE TO TEARING (BUTTERFLY TEST) *test method (DIN 53515 and ISO 34-1 Method B)*	**>110N**	130N	120N	152N	150N
RESISTANCE TO TEARING (NAIL SHANK) *test method (DIN 53515 and ISO 34-1 Method B)*	**>50N**	105N	90N	104N	154N
DIMENSIONAL STABILITY *test method (SP 2187 and EN 1107-1 Method B)*	**<0,30%**	-0,07%		-0,15%	

	specification		
SHEAR RESISTANCE OF THE JOINT *test method (UEAtc – 1982 and EN 12317-1)*	**>500N**	763N	848N

					OFFICIAL LABORATORY VALUES - 2005		OFFICIAL LABORATORY VALUES - 2010	
	new		after aging 6 months at 70°C					
FLOW RESISTANCE AT ELEVATED TEMPERATURE *test method (UEAtc - 1984 and EN 1110)*	TOT. MEMBRANE	TOP COATING	TOT. MEMBRANE	TOP COATING	TOT. MEMBRANE	TOP COATING	TOT. MEMBRANE	TOP COATING
	>100°C	**>140°C**	**>100°C**	**>150°C**	115	155	120	155

	new		after aging 6 months at 70°C		OFFICIAL LABORATORY VALUES - 2005				OFFICIAL LABORATORY VALUES - 2010			
FLEXIBILITY AT LOW TEMPERATURE *test method (UEAtc - 1982 and EN 1109)*	L & T topcoating	L & T undercoating	L & T topcoating	L & T undercoating	L topcoating	L undercoating	T topcoating	T undercoating	L topcoating	L undercoating	T topcoating	T undercoating
	-15°C	-20°C	-5°C	-5°C	-22	-24	-22	-24	-18	-22	-24	-24

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 membrane, 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 to lifetime expectancy of 25 to 35 years.