REPORT

Issued by an Accredited Testing Laboratory

Contact person RISE
Viktor Emanuelsson
Division Materials and Production
+46 10 516 53 23
viktor.emanuelsson@ri.se

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Tesa A/S
Att: Lenda Mathiassen
Klintehöj Vaenge 12
DK-3460 BIRKERÖD
Danmark

Testing of tape

(2 appendices)

Commission

Type testing of the tape tesa 60077 according to SP-method 1380 version 3.
Before type testing the dimensional stability of the tape was tested according to SP-method 5138. SP-method 5138 is not decisive for the outcome of the type test but used as a screening test which can indicate if the tape might face problems during the long ageing test included in SP-method 1380.

Test samples

The tape is a 50 mm wide tape called tesa 60077. Samples of the tape of two different colours, green and white, arrived at RISE 2020-04-29. The green version of the tape was used for the testing.

Experimental procedure

Dimensional stability according to SP-method 5138 (not accredited method)

Two pieces of the air and vapour barrier with dimensions 75±1 cm x 20±1 cm was jointed together by using a tape piece of a length of 70±1 cm. In total four samples were made; two where the air and vapour barrier had been cut along the production direction and two where the air and vapour barrier had been cut orthogonally to the production direction. Directly after sample preparation lines were drawn along the two shorter sides of each sample so that the lines crossed the ends of the tape and the distances between the lines were measured at four locations: two on the tape and two on the air and vapour barrier. After that, the samples were conditioned at 23 ± 2°C and 50 ± 5 % RH for at least 24 hours.

After conditioning all the samples were measured again whereafter they were exposed for seven days in a heating cabinet. During the first day of the exposure the temperature was linearly raised from room temperature to 65± 3 °C during 24 hours, where after the temperature was constant at 65± 3 °C for five days. During the last day of the exposure the temperature was linearly decreased to room temperature during 24 hours. After the exposure, the samples were conditioned again at 23 ± 2°C and 50 ± 5 % RH for at least 24 hours before the samples were studied, and the dimensional changes were measured again.

The dimensional change of the tape not attached on an air and vapour barrier was also measured. Two tape samples of an approximate length of 70 cm were cut from the tape roll and the length of each sample was measured directly after the removal. The reinforcement strings were removed whereafter the adhesive was covered with talcum. The tapes were positioned with the adhesive facing upwards on a glass plate with talcum on it and exposed to

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65± 3 °C for 24 hours. After exposure, the samples were conditioned for at least 24 hours before the length of each tape sample was measured again.

Type testing according to SP-method 1380 Edition 3 (accredited method)
The testing of the tapes was performed according to SP-method 1380, edition 3. The splices were made according to chapter 5.3.3 in SP-method 1380, edition 3.

Material composition (analysis with FTIR)
IR-spectrums were collected between 4000 and 400 cm^{-1} according to SP-Method 1468 by using an FTIR equipment with an ATR accessory. Spectrums were collected on the carrier, the adhesive and on the reinforcement strings. Two spectrums were collected on each part of the tape. After the collection ATR correction and automatic base line correction was performed on each spectrum. All spectrums can be found in Appendix 1.

Heat ageing
The ageing was conducted at 90 °C for 24 weeks according to SP-method 1380 version 3. The samples were conditioned for at least 24 h at 23°C and 50 %RH before the ageing and before each testing was started after the ageing.

Tensile testing on film
Performed according to SP-method 1380 edition 3 (before and after ageing).

Shear resistance
Performed according to SP-method 1380 edition 3 (before and after ageing).

Water vapour transmission resistance
Performed according to SP method 1380 edition 3 (before and after ageing).

Result

Dimensional stability according to SP-method 5138
Performed by Viktor Emanuelsson.
Requirements: No sources of leakage (channels between the tape and the barrier) are allowed, and the length of the tape must not change more than 0.5% on the air and vapour barrier.
Result: No channels could be found at the visual control of the samples after the exposure. The measured change in length of the tape on the air and vapour barrier is approximately 2%, which is higher than the requirement in SP-method 5138. For results see Table 1 and 2 below. As no channels could be found the tape was considered ok for further testing, as there are no requirements regarding tape shrinkage in SP-method 1380 version 3 or CR031.

Table 1. Dimensional stability of joints.

	After short conditioning							After exposure						
	Part	Before	After	Change		Average		After	Change		Average		Total change	Channels
Direction and sample nr.		(cm)	(cm)	(cm)	(%)	(cm)	(%)	(cm)	(cm)	(%)	(cm)	(%)		Yes/No
Along 1	Film	67.60	67.55	-0.05	-0.1%			67.30	-0.30	-0.4%				
		67.40	67.40	0.00	0.0%	**0.0**	**0.0%**	67.10	-0.30	-0.4%	**-0.3**	**-0.4%**		
	Tape	67.40	67.20	-0.20	-0.3%			66.40	-1.00	-1.5%				
		67.35	67.20	-0.15	-0.2%	**-0.2**	**-0.3%**	66.35	-1.00	-1.5%	**-1.0**	**-1.5%**		**No**
Along 2	Film	67.30	67.30	0.00	0.0%			66.95	-0.35	-0.5%				
		67.40	67.40	0.00	0.0%	**0.0**	**0.0%**	67.00	-0.40	-0.6%	**-0.4**	**-0.6%**	**-0.5%**	
	Tape	67.25	67.15	-0.10	-0.1%			66.30	-0.95	-1.4%				
		67.30	67.15	-0.15	-0.2%	**-0.1**	**-0.2%**	66.35	-0.95	-1.4%	**-1.0**	**-1.4%**	**-1.4%**	**No**
Orthogonally 1	Film	67.70	67.70	0.00	0.0%			67.80	0.10	0.1%				
		67.35	67.35	0.00	0.0%	**0.0**	**0.0%**	67.40	0.05	0.1%	**0.1**	**0.1%**		
	Tape	67.45	67.30	-0.15	-0.2%			66.65	-0.80	-1.2%				
		67.40	67.30	-0.10	-0.1%	**-0.1**	**-0.2%**	66.65	-0.75	-1.1%	**-0.8**	**-1.1%**		**No**
Orthogonally 2	Film	67.65	67.65	0.00	0.0%			67.75	0.10	0.1%				
		68.00	67.95	-0.05	-0.1%	**0.0**	**0.0%**	68.05	0.05	0.1%	**0.1**	**0.1%**	**0.1%**	
	Tape	67.70	67.60	-0.10	-0.1%			66.90	-0.80	-1.2%				
		67.75	67.60	-0.15	-0.2%	**-0.1**	**-0.2%**	66.95	-0.80	-1.2%	**-0.8**	**-1.2%**	**-1.2%**	**No**

Table 2. Dimensional stability of tape.

Sample		Before	After	Difference		Average		Total difference
		cm	%	cm	%	cm	%	%
1	1	68.10	66.75	-1.35	-2.0%			
	2	68.15	66.80	-1.35	-2.0%	**-1.4**	**-2.0%**	
2	1	67.80	66.45	-1.35	-2.0%			
	2	67.85	66.55	-1.30	-1.9%	**-1.3**	**-2.0%**	**-2.0%**

Type testing according to SP-method 1380 Edition 3

Material composition

Performed by Viktor Emanuelsson.

Collected spectrums are presented in Attachment 1. Each spectrum will hereafter be referred to as a reference spectrum.

Shear resistance

Performed by Peter Widén.

Requirement: the shear resistance must not be lower than 500 N/m before and after ageing.

Result: Approved, see Table 3 and 4 for results.

Table 3. Shear resistance before aging

Sample	Shear resistance (N/m)	Breaking mode
1	1141	Adhesion 50% cohesion 50%
2	1156	Adhesion 50% cohesion 50%
3	1074	Adhesion 50% cohesion 50%
4	1052	Adhesion 50% cohesion 50%
5	1129	Adhesion 50% cohesion 50%
Average	**1110**	
Standard deviation	**45**	

Table 4. Shear resistance after aging

Sample	Shear resistance (N/m)	Breaking mode
1	1226	Adhesion 100%
2	1204	Adhesion 100%
3	1255	Adhesion 100%
4	1172	Adhesion 100%
5	1282	Adhesion 100%
Average	**1228**	
Standard deviation	**43**	

Elongation at break before and after ageing

Performed by Peter Widén.

Requirement: the elongation at break for the aged material must not be lower than 50% of the elongation at break for the unaged material.

Result: Approved, see Table 5 for results.

Table 5. Elongation at break

Sample	Before aging (%)	After aging (%)
1	614	743
2	696	788
3	754	761
4	736	775
5	840	688
Average	**728**	**751**
Standard deviation	**83**	**39**
Change of elongation		**3%**

Water vapour transmission resistance on splice before and after ageing.
Performed by Peter Widén.
Requirement: The water vapour transmission resistance on the splice before and after ageing must not be lower than $1.5 \cdot 10^6$ s/m.
Result: Approved. For results see Table 6 and 7. The results are presented according to SP CR 128 Attachment 1 as a water vapour transmission resistance for the produced splice instead of g- and µ-values.

Table 6. Water vapour transmission resistance on splice before ageing.

Sample	***Water vapour transmission resistance*** Z_p **[Pa·m²·s/kg]**	***Water vapour transmission resistance*** Z_v **[s/m]**	**Equivalent air column at 1013.25 hPa** s_d **[m]**
1	$7.1 \cdot 10^{11}$	$5.2 \cdot 10^6$	138.5
2	$6.6 \cdot 10^{11}$	$4.8 \cdot 10^6$	128.8
3	$6.6 \cdot 10^{11}$	$4.8 \cdot 10^6$	129.1
4	$6.6 \cdot 10^{11}$	4.8•107	128.9
Average	$\mathbf{6.7 \cdot 10^{11}}$	$\mathbf{4.9 \cdot 10^6}$	**131**
Standard deviation	$\mathbf{2.5 \cdot 10^{10}}$	$\mathbf{1.8 \cdot 10^5}$	**4.8**

Table 7. Water vapour transmission resistance on splice after ageing.

Sample	***Water vapour transmission resistance*** Z_p **[Pa·m²·s/kg]**	***Water vapour transmission resistance*** Z_v **[s/m]**	**Equivalent air column at 1013.25 hPa** s_d **[m]**
1	$4.7 \cdot 10^{11}$	$4.4 \cdot 10^6$	91.3
2	$5.2 \cdot 10^{11}$	$3.8 \cdot 10^6$	100.7
3	$4.6 \cdot 10^{11}$	$3.4 \cdot 10^6$	90.7
4	$5.8 \cdot 10^{11}$	$4.2 \cdot 10^6$	112.3
Average	$\mathbf{5.1 \cdot 10^{11}}$	$\mathbf{3.1 \cdot 10^6}$	**99**
Standard deviation	$\mathbf{5.2 \cdot 10^{10}}$	$\mathbf{3.8 \cdot 10^5}$	**10.1**

Conclusions

The results of the tape tesa 60077 fulfils the requirements in SP method 1380, edition 3.

The change in length of the tape when tested according to SP-method 5138 was higher than the requirement in that method, but no channels had formed between the tape and the film. As there is no requirement on tape shrinkage in CR031 yet that result is however not a hindrance of a possible certification of the tape.

The results presented in this report are only related to the test samples.

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Signed by: Viktor Emanuelsson
Reason: I am the author of this document
Date & Time: 2021-03-29 10:42:54 +02:00

Viktor Emanuelsson

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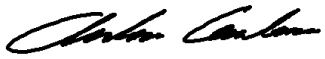


Signed by: Christian Carlsson
Reason: I have reviewed this document
Date & Time: 2021-03-29 10:33:13 +02:00

Christian Carlsson

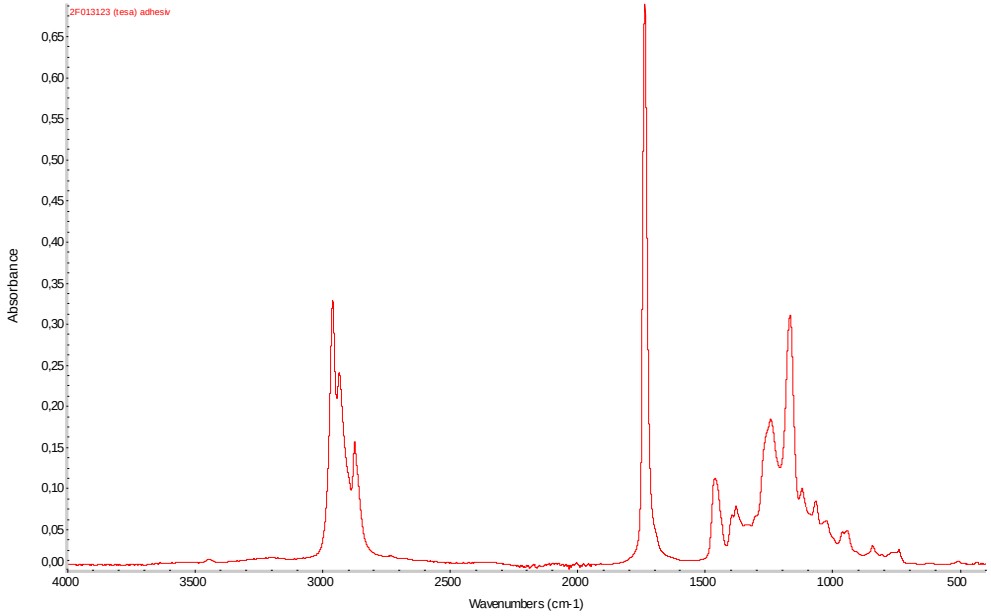
Appendices

1. FTIR-spectrums
    a. Adhesive
    b. Carrier
    c. Reinforcement strings
2. Uncertainty of measurement

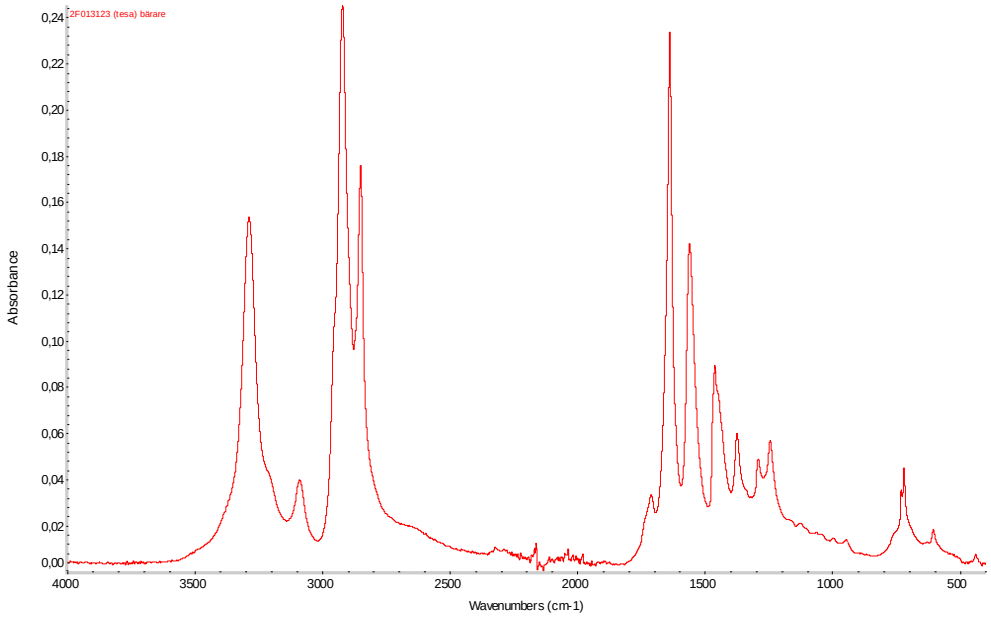
Appendix 1

FTIR results

Adhesive

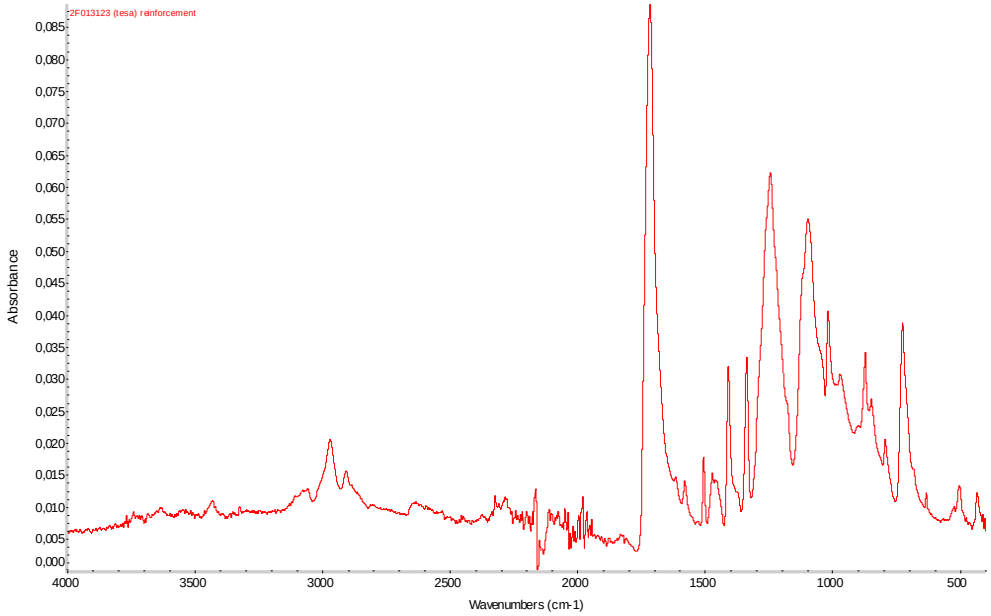


Carrier



Appendix 1

Reinforcement strings



Appendix 2

Uncertainty of measurement

SP-method 1380: Elongation at break	± 2.1 %	1) 2)
SP-method 1380: Shear resistance	± 3.5 %	1)
EN 1931: Water vapour resistance	± 10 %	1)

The reported uncertainty is an expanded uncertainty (U), based on a standard uncertainty multiplied by a coverage factor, k=2, which provides a level of confidence of approximately 95%.

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1) The uncertainty of measurement applies for a single measurements value.
The spread in results due to variations in sample characteristics is not accounted for in the given uncertainty of measurement.

2) Uncertainty in percent of measurement value.