Wilhelm-Jost-Institut

Institute for applied physical-chemical Process- and Safety engineering

Research- and Test Laboratory of the INBUREX Consulting GmbH

Test Report

Determination of the safety characteristics

of different products

for Filcoflex B.V.

NL – 5171PW Kaatsheuvel

Project-No. TL/9075/14

Möhnesee, 20 May 2015

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Safety characteristics of PKSR 2 mm Silicone Polyester inner ply

Test No.	Test Methode	Test Result
TL9075OW01	Surface resistance	1,9 x 10^9 Ω
TL9075DW01	Volume resistance	1*10^{13} Ωm
TL9075PBD01	possible generation of propagation brush discharges	Yes, propagating brush discharges could be determined with respect to the described test procedure.
TL9075DS01	Breakdown voltage	> 20 kV

Safety characteristics of PTFE 2120 Naturel FDA

Test No.	Test Methode	Test Result
TL9075OW02	Surface resistance	1,8 x 10^{10} Ω
TL9075DW02	Volume resistance	> 3*10^{13} Ωm
TL9075PBD02	possible generation of propagation brush discharges	Yes, propagating brush discharges could be determined with respect to the described test procedure.
TL9075DS02	Breakdown voltage	> 20 kV

Place, Date Möhnesee, 20 May 2015

Signatures

i.A. Ewa Müller
Laboratory Technician

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i.V. Dipl.-Ing. Martin Gosewinkel
Manager Test Laboratory

Determination of the Surface resistance and surface resistivity according to IEC 60093/EN 1149

Test Report No.	TL/9075/14/10_OW01	**Classification**	Highly confidential
Sample	PKSR 2 mm Silicone Polyester inner ply	**Client**	Filcoflex B.V.
Sample No.	9075/1		NL – 5171PW Kaatsheuvel
Test No.	TL9075OW01	**Contact person**	Werner van Loon

Test method

As measuring tool a Teraohm-Meter from the company ELTEX has been used. The surface resistance is the electrical resistance between two electrodes contacting the same surface of a material or object. It is depending on the geometry of the electrode arrangement and is commonly expressed in ohms. The surface resistivity is the resistance across opposite sides of a surface of unit length and width and is commonly expressed also in [Ω] or in [Ωm]. With regard to the TRBS 2153 respectively IEC 60079-32-1 materials or objects can be classified according to their surface resistance at test conditions of 23 °C and 30 % relative humidity as **conductive** ($\leq 10^4\Omega$), **electrostatically dissipative** ($10^4\Omega$ up to $10^{11}\Omega$) or **non-conductive** ($>10^{11}\Omega$).

Remarks

The room temperature was 23 °C, the relative humidity 30 %rF.

Results

Test	Surface resistance [Ω]	Surface resistivity[1] [Ωm]
1	$2.2*10^9$	$4.4*10^{10}$
2	$1.9*10^9$	$3.8*10^{10}$
3	$1.9*10^9$	$3.8*10^{10}$

The sample can be classified as **non conductive**.

(Median value: $1{,}9*10^9\ \Omega$, at a measuring voltage of 100 V)

[1] Surface resistivity = surface resistance x geometry factor (here: 19.8 according to geometry of the used electrode arrangement)

Determination of the volume resistance and volume resistivity according to IEC 60093/EN 1149-1

Test Report No.	TL/9075/14_DW01	**Classification**	Highly confidential
Sample	PKSR 2 mm Silicone Polyester inner ply	**Client**	Filcoflex B.V.
Sample No.	9075/1		NL – 5171PW Kaatsheuvel
Test No.	TL9075DW01	**Contact person**	Mr. Werner van Loon

Test method

As measuring tool a Teraohm-Meter from the company ELTEX has been used. The volume resistivity is the electrical resistance between two electrodes contacting the top and bottom side of a material or object. It is depending on the geometry of the electrode arrangement and is commonly expressed in ohms.
Materials or objects can be classified according to their volume resistivity at test conditions of 23 °C and 50 % relative humidity as **conductive** ($\leq 10^4\ \Omega$m), **electrostatically dissipative** ($10^4\Omega$m up to $10^9\Omega$m) or **non conductive** ($>10^9\Omega$m).

Remarks

The room temperature was 23 °C, the relative humidity 30 %rF.

Results

Test	Volume resistance [Ω]	Factor [m]	Volume resistivity [Ωm]
1	$8.2*10^{12}$	1.43	$1.2*10^{13}$
2	$7.0*10^{12}$	1.43	$1.0*10^{13}$
3	$7.8*10^{12}$	1.43	$1.1*10^{13}$

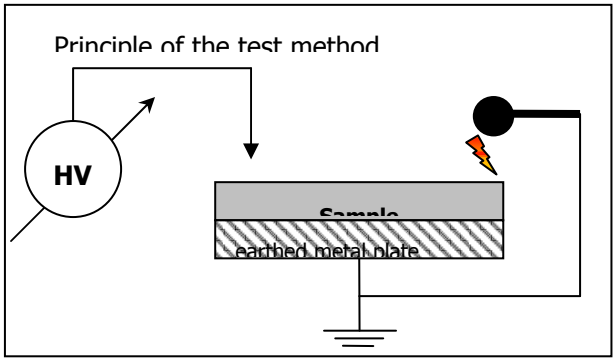
The sample can be classified as **non conductive**.

(Median value: $1*10^{13}\ \Omega$m at a measuring voltage of 100 V, Test 3)

Determination of the possible generation of propagation brush discharges

Test Report No.	TL/9075/14_PBD01	**Classification**	Highly confidential
Sample	PKSR 2 mm Silicone Polyester inner ply	**Client**	Filcoflex B.V.
Sample No.	9075/1		NL – 5171PW Kaatsheuvel
Test No.	TL9075PBD01	**Contact person**	Mr. Werner van Loon

Test method



The sample is located on an earthed metal plate.

It was charged by means of a high voltage source (electrostatic gun, U = 40 kV) for about 60 sec.

Then it was tried to initiate a propagating brush discharge by decreasing the distance between an earthed metal sphere and the charged sample.

Remarks The room temperature was 23 °C, the relative humidity 30 %rF.

Results

Test	Determination of a propagating brush discharges
1	Yes, propagating brush discharges could be determined with respect to the described test procedure (see picture).
2	Yes, propagating brush discharges could be determined with respect to the described test procedure.

Determination of the breakdown voltage according to DIN EN 60243-1+2

Test Report No.	TL/9075/14_DS01	**Classification**	Highly confidential
Sample	PKSR 2 mm Silicone Polyester inner ply	**Client**	Filcoflex B.V.
Sample No.	9075/1		NL – 5171PW Kaatsheuvel
Test No.	TL9075DW01	**Contact person**	Mr. Werner van Loon

Test Method

The electrode arrangement according to DIN EN 60243-1 Section 4.1 is applied to the specimen. By the means of a high voltage source, a potential will be impressed on the electrodes and stepwise increased until a breakdown or spark over takes place.

The breakdown/ spark over will be determined visually as well as by data logging of the current flow.

Remarks

The samples were acclimated at 23 °C and 30 % relative humidity and then measured in this climate.

Results

Applied voltage [kV]	**Observation**			
	Breakdown/ Spark over noticed visibly		**immediate increase of the current flow**	
	Yes	**No**	**Yes**	**No**
> 20		x		x
Breakdown voltage > 20 kV				

Determination of the Surface resistance and surface resistivity according to IEC 60093/EN 1149

Test Report No.	TL/9075/14/10_OW02	**Classification**	Highly confidential
Sample	PTFE 2120 Naturel FDA	**Client**	Filcoflex B.V.
Sample No.	9075/2		NL – 5171PW Kaatsheuvel
Test No.	TL9075OW02	**Contact person**	Werner van Loon

Test method

As measuring tool a Teraohm-Meter from the company ELTEX has been used. The surface resistance is the electrical resistance between two electrodes contacting the same surface of a material or object. It is depending on the geometry of the electrode arrangement and is commonly expressed in ohms. The surface resistivity is the resistance across opposite sides of a surface of unit length and width and is commonly expressed also in [Ω] or in [Ωm]. With regard to the TRBS 2153 respectively IEC 60079-32-1 materials or objects can be classified according to their surface resistance at test conditions of 23 °C and 30 % relative humidity as **conductive** ($\leq 10^4\Omega$), **electrostatically dissipative** ($10^4\Omega$ up to $10^{11}\Omega$) or **non-conductive** ($>10^{11}\Omega$).

Remarks

The room temperature was 23 °C, the relative humidity 30 %rF.

Results

Test	Surface resistance [Ω]	Surface resistivity[2] [Ωm]
1	$1.8*10^{10}$	$3.6*10^{11}$
2	$1.8*10^{10}$	$3.6*10^{11}$
3	$1.8*10^{10}$	$3.6*10^{11}$

The sample can be classified as **non conductive**.

(Median value: $1,8*10^{10}\ \Omega$ at a measuring voltage of 100 V, Test 3)

[2] Surface resistivity = surface resistance x geometry factor (here: 19.8 according to geometry of the used electrode arrangement)

Determination of the volume resistance and volume resistivity according to IEC 60093/EN 1149-1

Test Report No.	TL/9075/14_DW02	**Classification**	Highly confidential
Sample	PTFE 2120 Naturel FDA	**Client**	Filcoflex B.V.
Sample No.	9075/2		NL – 5171PW Kaatsheuvel
Test No.	TL9075DW02	**Contact person**	Mr. Werner van Loon

Test method

As measuring tool a Teraohm-Meter from the company ELTEX has been used. The volume resistivity is the electrical resistance between two electrodes contacting the top and bottom side of a material or object. It is depending on the geometry of the electrode arrangement and is commonly expressed in ohms.
Materials or objects can be classified according to their volume resistivity at test conditions of 23 °C and 50 % relative humidity as **conductive** (< $10^4\Omega$m), **electrostatically dissipative** ($10^4\Omega$m up to $10^9\Omega$m) or **non-conductive** (>$10^9\Omega$m).

Remarks

The room temperature was 23 °C, the relative humidity 30 %rF.

Results

Test	Volume resistance [Ω]	Factor [m]	Volume resistivity [Ωm]
1	> $2*10^{13}$	1.43	> $3*10^{13}$
2	> $2*10^{13}$	1.43	> $3*10^{13}$
3	> $2*10^{13}$	1.43	> $3*10^{13}$

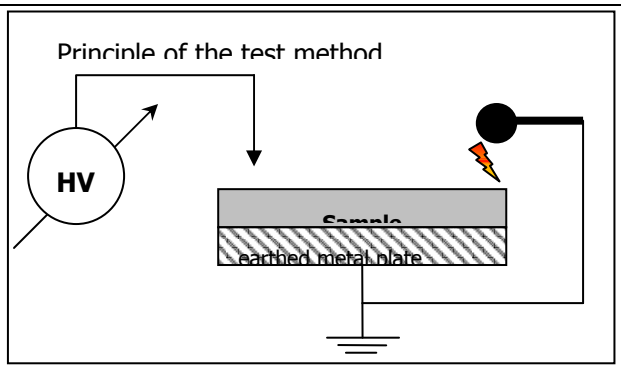
The sample can be classified as **non conductive**.

(Median value: > $3*10^{13}$ Ωm at a measuring voltage of 100 V, Test 3)

Determination of the possible generation of propagation brush discharges

Test Report No.	TL/9075/14_PBD02	**Classification**	Highly confidential
Sample	PTFE 2120 Naturel FDA	**Client**	Filcoflex B.V.
Sample No.	9075/2		NL – 5171PW Kaatsheuvel
Test No.	TL9075PBD02	**Contact person**	Mr. Werner van Loon

Test method



The sample is located on an earthed metal plate.

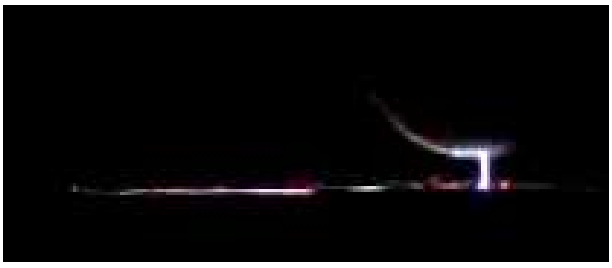
It was charged by means of a high voltage source (electrostatic gun, U = 40 kV) for about 60 sec.

Then it was tried to initiate a propagating brush discharge by decreasing the distance between an earthed metal sphere and the charged sample.

Remarks The room temperature was 23 °C, the relative humidity 30 %rF.

Results

Test	Determination of a propagating brush discharges
1	Yes, propagating brush discharges could be determined with respect to the described test procedure (see picture).
2	Yes, propagating brush discharges could be determined with respect to the described test procedure.



Determination of the breakdown voltage according to DIN EN 60243-1+2

Test Report No.	TL/9075/14_DS02	**Classification**	Highly confidential
Sample	PTFE 2120 Naturel FDA	**Client**	Filcoflex B.V.
Sample No.	9075/2		NL – 5171PW Kaatsheuvel
Test No.	TL9075DS02	**Contact person**	Mr. Werner van Loon

Test Method

The electrode arrangement according to DIN EN 60243-1 Section 4.1 is applied to the specimen. By the means of a high voltage source, a potential will be impressed on the electrodes and stepwise increased until a breakdown or spark over takes place.

The breakdown/ spark over will be determined visually as well as by data logging of the current flow.

Remarks

The samples were acclimated at 23 °C and 30 % relative humidity and then measured in this climate.

Results

Applied voltage [kV]	**Observation**			
	Breakdown/ Spark over noticed visibly		**immediate increase of the current flow**	
	Yes	**No**	**Yes**	**No**
> 20		x		x
Breakdown voltage > 20 kV				