

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

INBUREX Consulting

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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 × 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 × 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,

Möhnesee, 20 May 2015

Signatures

i.A. Ewa Müller Laboratory Technician

U REX

GMBH Manager Test Laboratory 59067 Hamm



Institute for applied physical-chemical Process- and Safety engineering



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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	surface resistance is the same surface of a mater arrangement and is com resistance across opposit expressed also in $[\Omega]$ or 60079-32-1 materials or at test conditions of 23 °	electrical resistance ial or object. It is de monly expressed in o te sides of a surface in [Ω m]. With regar objects can be class 2C and 30 % relative	e company ELTEX has been used. The between two electrodes contacting the pending on the geometry of the electrode ohms. The surface resistivity is the of unit length and width and is commonly d to the TRBS 2153 respectively IEC ified according to their surface resistance humidity as conductive ($\leq 10^{4}\Omega$), $10^{11}\Omega$) or non-conductive ($>10^{11}\Omega$).		
Remarks	The room temperature was 23 °C, the relative humidity 30 %rF.				
Results	ResultsTestSurface resistanceSurface resisti $[\Omega]$ $[\Omega m]$				
	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)



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

Test Report No.	TL/9075/14_0	DW01	Classification	Highly confi	dential
Sample	PKSR 2 mm S Polyester inne		Client	Filcoflex B.\	ν.
Sample No.	9075/1			NL – 5171P	W Kaatsheuvel
Test No.	TL9075DW01		Contact person	Mr. Werner	van Loon
				. It is depending	ectrodes contacting the on the geometry of the
	electrode arra Materials or o conditions of	bjects can be 23 °C and 50	% relative humi	ling to their volu dity as conduct	me resistivity at test i ve (<u><</u> 10 ⁴ Ωm),
Remarks	electrode arra Materials or o conditions of electrostatio	bjects can be 23 °C and 50 cally dissipat	classified accord % relative humi ive (10 ⁴ Ωm up	ling to their volu dity as conduct	me resistivity at test ive ($\leq 10^4 \Omega$ m), on conductive (> $10^9 \Omega$ n
	electrode arra Materials or o conditions of electrostatio	bjects can be 23 °C and 50 cally dissipat	classified accord % relative humi ive (10 ⁴ Ωm up 23 °C, the relat sistance	ding to their volu dity as conduct to 10^9 Ωm) or nc	me resistivity at test ive ($\leq 10^4 \Omega$ m), on conductive (> $10^9 \Omega$ n %rF.
Remarks Results	electrode arra Materials or o conditions of electrostatio	bjects can be 23 °C and 50 cally dissipat operature was Volume res	classified accord % relative humi ive (10 ⁴ Ωm up 23 °C, the relat sistance	ling to their volu dity as conduct to $10^9 \Omega$ m) or nc ive humidity 30 ^o Factor	me resistivity at test ive ($\leq 10^4 \Omega$ m), on conductive (> $10^9 \Omega$ n %rF. Volume resistivity
	electrode arra Materials or o conditions of electrostatio The room terr Test	bjects can be 23 °C and 50 cally dissipat perature was Volume res [Ω]	classified accord % relative humi ive $(10^{4}\Omega m up)$ 23 °C, the relat sistance 0^{12}	ing to their volu dity as conduct to 10 ⁹ Ωm) or nc ive humidity 30 Factor [m]	me resistivity at test ive ($\leq 10^4 \Omega$ m), on conductive (> $10^9 \Omega$ n %rF. Volume resistivity [Ω m]
Remarks Results	electrode arra Materials or o conditions of a electrostatio The room terr Test 1	bjects can be 23 °C and 50 cally dissipat operature was Volume res [Ω] 8.2*1	classified accord % relative humi ive ($10^4\Omega$ m up 23 °C, the relat sistance 0^{12} 0^{12}	ing to their volu dity as conduct to 10 ⁹ Ωm) or no ive humidity 30 ^o Factor [m] 1.43	me resistivity at test ive ($\leq 10^4 \Omega$ m), on conductive (> $10^9 \Omega$ n %rF. Volume resistivity [Ω m] 1.2*10 ¹³

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



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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	Principle of the 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
Remarks	The room temperature	was 23 °C, the relative	e humidity 30 %rF.
Results	Test	Determination of	of a propagating brush discharges
	1		sh discharges could be determined with scribed test procedure (see picture).
	2		sh discharges could be determined with the described test procedure.
			× ×



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

Test Report No.	TL/9075/14_DS01		Classification	Highly confiden	tial	
Sample	PKSR 2 mm Silicone Polyester inner ply		Client	Filcoflex B.V.		
Sample No.	9075/1			NL – 5171PW K	aatsheuvel	
Test No.	TL9075DW01		Contact person	Mr. Werner van	Loon	
Test Method	specimen. By the means of electrodes and stepwise ind The breakdown/ spark ove the current flow.	nt according to DIN EN 60243-1 Section 4.1 is applied to the of a high voltage source, a potential will be impressed on the increased until a breakdown or spark over takes place. Yer will be determined visually as well as by data logging of ated at 23 °C and 30 % relative humidity and then measured				
Results	Applied voltage		Obse	rvation		
	[kV]		n/ Spark over ed visibly	immediate i the curre		
		Yes	No	Yes	No	
	> 20		х		x	
		Breakdown	voltage > 20 kV	1		



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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 commonle expressed also in [Ω] or in [Ω m]. 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	TestSurface resistanceSurface resistivity2 $[\Omega]$ $[\Omega m]$					
	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} Ω 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)



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

Test Report No.	TL/9075/14_DW02	2 Classification	Highly confi	dential
Sample	PTFE 2120 Nature	FDA Client	Filcoflex B.V	'.
Sample No.	9075/2		NL – 5171P	W Kaatsheuvel
Test No.	TL9075DW02	Contact persor	Mr. Werner	van Loon
Test method	volume resistivity top and bottom sid electrode arranger Materials or object conditions of 23 °C	is the electrical resistar	the between two elect. It is depending expressed in ohms. ording to their volu midity as conduct	me resistivity at test i ve (< 10 ⁴ Ωm),
Remarks	The room tempera	ature was 23 °C, the re	lative humidity 30 °	%rF.
Results	Test V	olume 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	e classified as non cor	ductive.	

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



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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	Principle of the test m HV eached charged sample.	e-mails nietal.olate	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			
Remarks	The room temperature w	as 23 °C, the relative	humidity 30 %rF.			
Results	Test	Determination of	f a propagating brush discharges			
	1 Y		h discharges could be determined with cribed test procedure (see picture).			
	2 Y		h discharges could be determined with he described test procedure.			



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

Sample No. Test No.	9075/2		NL – 5171PW Kaatsheuvel
Sample No.	9075/2		NL – 5171PW Kaatsheuvel
Sample No.	9075/2		NL – 5171PW Kaatsheuvel
Sample	PTFE 2120 Naturel FDA	Client	Filcoflex B.V.
Test Report No.	TL/9075/14_DS02	Classification	Highly confidential

Test MethodThe 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 measure in this climate.				
Results	Applied voltage Observation [kV]				
	[(,,]		Breakdown/ Spark over noticed visibly		increase of ent flow
		Yes	No	Yes	No
	> 20		х		х
		Breakdown vo	oltage > 20 kV		