IBExU Institut für Sicherheitstechnik GmbH
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Test Report

IB-12-8-052

about the electrostatic properties of the BFM® material Seeflex 040E and its use in potentially explosive areas

(Translation)

Freiberg, 24 July 2012
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This document consists of: 6 pages text

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(Translation)

1 Order

1.1 Customer: BFM Global Ltd, Beach Haven 0749, Auckland, New Zealand

1.2 Supplier: IBExU Institut für Sicherheitstechnik GmbH, Freiberg, Germany

1.3 Delivery of the test sample: 31 May 2012

2 Test object, origination

In the scope of the Report IB-10-8-058 [1] BFM® connectors of 3 different flexible materials (Seeflex 040, Seeflex 400W and LM4) were examined for the BFM Global Ltd in Auckland (New Zealand) with regard to the electrostatic behaviour.

The following material sample was delivered for the examination which was carried out here:

- BFM® material Seeflex 040E (clear ether based thermoplastic polyurethane alloy): material sample of 16 cm x 17 cm, thickness = 1 mm

3 Execution of the tests and test results

3.1 Measuring conditions

The measuring was carried out in a conditioned room with the following parameters:

- Test temperature: 25 - 26 °C
- Relative humidity: 26 - 29 %
- Before the tests: storage of the material sample for at least 24 hours under the mentioned conditions

3.2 Surface resistance and volume resistivity

Test standards:	IEC 93:1993, IEC 167:1993
Measuring instrument:	Tera Ohm-Meter F-H12.020 of company Knick Elektronische Messgeräte GmbH & Co. KG (test instrument no.: 0209)

3.2.1 *Surface resistance*

Test electrode:	parallel electrodes according to IEC 167
Electrode length l:	10 cm
Electrode distance a:	1 cm

Measuring results at an instrument voltage of 500 V:

Surface resistance:	$2.0 \cdot 10^{11}\ \Omega$
Surface resistivity:	$2.0 \cdot 10^{12}\ \Omega$

3.2.2 *Volume resistivity*

Test electrode:	circular electrode
Electrode surface:	20 cm²

Volume resistivity at

Instrument voltage = 100 V:	$5.8 \cdot 10^{11}\ \Omega \cdot m$
Instrument voltage = 500 V:	$1.2 \cdot 10^{11}\ \Omega \cdot m$

3.3 Test with respect to the electrostatic charge / dangerous discharges

Test standard: EN 13463-1, Annex D: „Charging tests with non conductive materials“

Measuring instruments: Electrostatic voltmeter C 196 (former UdSSR), (test instrument no.: 0003)
Coulombmeter HMG 11/02 of company SCHNIER Elektrostatik GmbH (test instrument no.: 0462)

Test execution:

There are three different methods for charging:

- Charging with a DC high voltage power supply (U ≥ 30 kV)
- Rubbing with a pure polyamide cloth
- Rubbing with a cotton cloth

After each charging of the material sample, the charge from a typical discharge is measured. This is done by discharging the material sample by slowly approaching a spherical electrode until a discharge occurs.

Table 1: Results of the tests of a material sample (16 cm x 17 cm) Seeflex 040E

Methods for charging		Rubbing with a cotton cloth	Rubbing with a polyamide cloth	DC high voltage power supply
Charge Q in nC per individual test	Front side of the material sample	no measurable charges	no measurable charges	25, 27, 36, 37, 29, 26, 37, 32, 26, 30
	Rear side of the material sample	33, 35, 41, 51, 44, 41, 42, 41, 31, 32	27, 13, 13, < 5, < 5, 41, 15, 23, 11, 40	37, 47, 33, 56, 37, 29, 41, 43, 42, 37

4 Assessment of the measuring results

It was noticed with the determined surface resistance and the volume resistivity that Seeflex 040E is a non-conductive material [2, 3].

When rubbing with cotton cloth resp. polyamide cloth in the scope of the test for the electrostatic charge / dangerous discharges according to chapter 3.3 measurable discharges arose only on one side of the material sample although the surface resistance of the two sides was almost identical.

In accordance with the results in Table 1 and [1] the tested BFM® Material Seeflex 040E can be used without restrictions in all dust explosion hazardous areas (dust explosion hazardous zones are possible both inside and outside of the BFM® connector), if the mechanical design of the BFM® connector is as per [1].

Corresponding restrictions respectively limitations of the surfaces of the BFM® connectors are partly required at the presence of an outer gas explosion hazardous area of the zone 1 respectively 2 (see table 2; outer zone 0 is not considered because it is normally not present there). The limitations of the surfaces deduced from [4] were doubled since the BFM® connectors are surrounded from 2 sides with earthed metal [5].

Table 2: Maximum permissible dimensions of BFM® connectors of Seeflex 040E at an outer gas explosion hazardous zone

Zone outside	Zone inside and/or outside	Permissible surface of the BFM[1)] at Explosion Group		
		II A	II B	II C
1	20 or 21	no restrictions [4)]	not applicable [2)]	not applicable [2)]
	22	no restrictions [4)]	200 cm² [3)]	not applicable [2)]
2	20 or 21	no restrictions [4)]	200 cm² [3)]	not applicable [2)]
	22	no restrictions [4)]		

Notes:

[1)] Permissible surface of the BFM corresponds to the product of diameter x length of the BFM® connector

[2] BFM® connectors are not applicable since the surface criterion is already exceeded at the smallest available connector

[3] BFM® connectors are applicable for example at ∅ 100 mm and a length of max. 200 mm

[4] Restrictions of the surface of the BFM® connector are not required (see test results in table 1)

Literature:

[1] Test Report IB-10-8-058 about the electrostatical properties of the BFM® connectors Seeflex 040, Seeflex 400W and LM4 and their use in potentially explosive areas,
IBExU Institut für Sicherheitstechnik GmbH, Freiberg, 08 October 2010

[2] TRBS 2153: Technische Regeln für Betriebssicherheit - Vermeidung von Zündgefahren infolge elektrostatischer Aufladungen, Februar 2009

[3] Technical Report CLC/TR 50404: Electrostatics – Code of practice for the avoidance of hazards due to static electricity, June 2003

[4] EN 13463-1:2009: Non-electrical equipment intended for use in potentially explosive atmospheres – Part 1: Basic method and requirements

[5] U. v. Pidoll: Bewertung der Zündfähigkeit elektrostatischer Entladungen
VII Fachtagung: Maßnahmen des Brand- und Explosionsschutzes – Mittel zur Anlagen- und Arbeitssicherheit, Merseburg, 24.09.2003