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Translation of BAM Report

about the test of nonmetallic materials
for reactivity with oxygen

Reference Number	2-927/2014
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Customer	Teadit Deutschland GmbH Schanzenstrasse 35 51063 Cologne Germany
Oder Date	April 09, 2014
Reference	Florian Werner
Receipt of Order	April 11, 2014
Test Samples	Braided packing type **2236** for testing for reactivity with gaseous oxygen at 60°C;
Receipt of Samples	March 27, 2014
Test Date	April 23 up to May 09, 2014
Test Location	BAM – Laboratory II. 13; Building no.41, room no. 120
Test Procedure	DIN EN 1797:2002-02
According to	"Cryogenic Vessels – Gas/Material Compatibility" ISO 21010: 2004-07 Annex of supporting document to code of practice M 034e "Oxygen"(BGI 617-1) "List of nonmetallic materials" According to rule BGR 500 "Betreiben von Arbeitsmittel" part 2, Chapter 2.32 "Betreiben von Sauerstoffanlagen", Chapter 3.17 „Gleitmittel und Dichtwerkstoffe" Edition: April 2008

All pressures in this report are excess pressures (gage pressures). This test report consist of page 1 to 3 and annex 1.

1. Documents and Test Samples

The following documents and samples were submitted to BAM:

1 test application
1 Product information of 2236, Graphite yarn with an Inconel net reinforced and impregnated with lubricant and corrosion inhibitor (Rev2013344)
1 Security data sheet 2236
2 test sample: braided packing type 2236, Dimension: 5x5 mm in 800 mm length
Color: Black

2. Test Methods

A determination of the autogenous ignition temperature (Annex 1) was not necessary as the material is not for use at temperature greater than 60°C.

2.1. Ignition Sensitivity to Gaseous Oxygen Impacts

The Test method is described in annex 1.

Results:

Sample temperature t_a [°C]	Oxygen pressure p_a [bar]	Oxygen pressure p_e [bar]	Reaction on impact
60	1	50	no reaction*
60	1	60	no reaction*
60	1	80	no reaction*
60	1	90	no reaction*
60	1	100	no reaction*
60	1	120	no reaction*
60	1	150	ignition on 1. impact
60	1	140	ignition on 1. impact
60	1	130	no reaction*
60	1	130	no reaction*

* within a series of five consecutive impacts

3. Evaluation

There are no objections with regards to use the braided packing (yarn) 2236 in valves and fittings or other components for gaseous oxygen service at following operation conditions:

Maximum temperature	Maximum oxygen pressure
60 °C	130 bar

This evaluation does not cover the use of the braided packing 2236 for liquid oxygen service. For this application, a particular test for reactivity with liquid oxygen needs to be carried out.

Comments

The test results refer exclusively to the tested material.

Products that have been tested by us, and which are on the market, shall be marked according to our evaluation in the BAM test report. A label on a product saying that a BAM test has been performed and (or) citing our reference number, only, is not tolerable. The use of the product and its safe operating conditions must also be given.

Annex 1

Testing for Ignition Sensitivity to Gaseous Oxygen Impacts

Approximately 0.2 g to 0.5 g of the pasty or divided solid sample is placed into a heatable steel tube, 15 cm^3 in volume. In case of liquids to be tested, ceramic fibre, soaked with the sample, is used. The sample tube is connected by a 750 mm long pipe (internal diameter 14 mm) and a pneumatically operated quick opening valve to a high-pressure oxygen accumulator.

A heater allows to set the sample tube to the test temperature ta. After the tube and pipe are at test pressure p_a, the quick opening valve is opened and preheated oxygen 60 °C and of pressure p_e flows abruptly into the pipe and tube. In this way, the oxygen in the tube and in the pipe is almost adiabatically compressed from pressure p_a to p_e and heated. If there is a reaction of the sample with oxygen, indicated by a steep temperature rise in the tube, further tests with a new sample are performed at a lower pressure ration p_e/p_a. If, however, no reaction of the sample with oxygen can be detected after a waiting period of 30 seconds, the tube is de-pressurized and test is repeated (up to four times) until a reaction takes places. This means, each test series consists of a maximum of five singe tests with the same material under the same conditions. If no reaction can be observed, even after the fifth single test of a test series, testing is continued with new samples at greater pressure ratios p_e/p_a, until finally that pressure ratio is determined, at which no reaction can be observed within a test series of five single tests. If the repetition of that test series with a new sample shows the same result, the test can be finished or continued at a different test temperature t_a.