



TEST REPORT

on Testing a Nonmetallic Material for Reactivity with Oxygen

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Reference Number	16016329 E
Copy	1. copy of 2 copies
Customer	TEADIT Deutschland GmbH Schanzenstraße 35 51063 Köln Germany
Date of request	March 24, 2016
Receipt of signed contract	May 9, 2016
Reference	- - -
Test samples	Sealing material TEADIT NA1002, batch 2015100050; BAM Order-No.: 2.1/53 151
Receipt of samples	May 9, 2016
Test date	May 25 to July 20, 2016
Test location	BAM – Division 2.1 „Gases, Gas Plants“; building no. 41, room 120
Test procedure or requirement according to (in the current version at test time)	DIN EN 1797 und ISO 21010 “Cryogenic Vessels - Gas/Material Compatibility“; Annex of code of practice M 034-1 (BGI 617-1) “List of nonmetallic materials compatible with oxygen“, by German Social Accident Insurance Institution for the raw materials and chemical industry; TRGS 407 Technical Rules for Hazardous Substances “Tätigkeiten mit Gasen - Gefährdungsbeurteilung“ chapter 3 “Informationsermittlung und Gefährdungsbeurteilung“ and chapter 4 “Schutzmaßnahmen bei Tätigkeiten mit Gasen“

All pressures of this report are excess pressures.
This test report consists of page 1 to 4 and annex 1.

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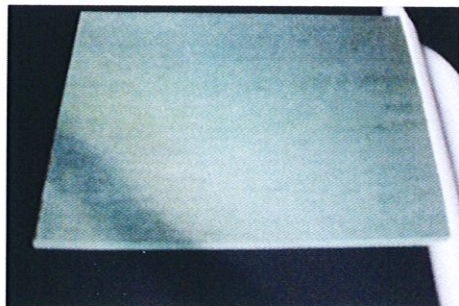
2015-06 / 2015-09-17



1 Documents and Test Samples

The following documents and samples were submitted to BAM:

- 1 Test application
„Testing and evaluating the nonmetallic material TEADIT NA1002, batch 2015100050, for gaseous oxygen service at temperatures up to 60 °C.
- 1 Safety Data Sheet TEADIT NA1002
(4 Seiten, Rev. 05/19112015)
- 8 Sheets of sealing Material TEADIT NA1002, batch 2015100050,
Dimension: 230 mm x 310 mm, Thickness 2,2 mm
Color of the packing material: Green



2 Applied Test Methods for Evaluating the Technical Safety

The product TEADIT NA1002 is a sealing material that shall be used for gaseous oxygen service at temperatures up to 60 °C. The following test method was applied:

2.1 Testing for Ignition Sensitivity to Gaseous Oxygen Impacts

Generally, this test method is required if rapid oxygen pressure changes on the material cannot be safely excluded in usage.

3 Preparation of Samples

Prior to testing, the material was cut into pieces of approximately 1 mm³ up to 2 mm³.

4 Tests

4.1 Ignition Sensitivity Testing to Gaseous Oxygen Impacts at 60 °C

The test method is described in annex 1. Based on the specified use conditions by the customer, the test was performed at 60 °C.

4.1.1 Assessment Criterion

According to DIN EN 1797 „Cryogenic Vessels - Gas/Material Compatibility“ and to ISO 21010 „Cryogenic Vessels - Gas/Material Compatibility“ the criterion for a reaction of the sample to gaseous oxygen impacts is a temperature rise of at least 20 °C.

4.1.2 Results

Sample Temperature t_a [°C]	Initial Oxygen Pressure p_i [bar]	Final Oxygen Pressure p_F [bar]	Reaction
60	1	80	Ignition on 1. impact
60	1	60	Ignition on 1. impact
60	1	40	Ignition on 1. impact
60	1	25	Ignition on 2. impact
60	1	20	no reaction*
60	1	20	no reaction*

* Within a series of five consecutive impacts

In two separate tests, each consisting of a series of five consecutive impacts, no reactions of the sample with oxygen could be observed at following conditions:

Sample Temperature t_a [°C]	Initial Oxygen Pressure p_i [bar]	Final Oxygen Pressure p_F [bar]
60	1	20

5 Summary and Evaluation

It is intended to use the product TEADIT NA1002 as a sealing material for gaseous oxygen service.

Ignition sensitivity testing of the material showed that no reactions could be detected at temperatures of 60 °C on final oxygen pressure of 20 bar.

Based on the test results, there are no objections with regard to technical safety, to use the sealing material TEADIT NA1002, batch 2015100050, for gaseous oxygen service at following operating conditions:

Maximum Temperature [°C]	Maximum Oxygen Pressure [bar]
60	20

This evaluation does not cover the use of the sealing material TEADIT NA1002, batch 2015100050, for liquid oxygen service. For this case, a particular test for reactivity with liquid oxygen needs to be carried out.

6 Comments

This safety evaluation considers the fact, that rapid oxygen pressure changes – so called oxygen pressure surges – cannot be safely excluded on the material in usage.

This evaluation is based exclusively on the results of the tested sample of a particular batch.

Products on the market that contain a reference to BAM testing shall be marked accordingly. It shall be evident that only a sample of a batch has been tested and evaluated for oxygen compatibility. The reference shall not produce a presumption of conformity that monitoring of the production on a regular basis is being performed by BAM.

The product may only be used for gaseous service. The maximum safe oxygen pressure of the product and its maximum use temperature as well as other restrictions in use shall be given.

**Bundesanstalt für Materialforschung und -prüfung (BAM)
12200 Berlin**

November 2, 2016

Division 2.1 "Gases, Gas Plants"

By order



Dipl.-Ing. Peter Hartwig

Distribution list: 1. copy: TEADIT Deutschland GmbH
2. copy: BAM - Division 2.1 "Gases, Gas Plants"



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 cm³ 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 t_a . After the tube and pipe are at test pressure p_I , the quick opening valve is opened and preheated oxygen of 60 °C and of pressure p_F 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_I to p_F 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 ratio p_F/p_I . 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 the test is repeated (up to four times) until a reaction takes place. This means, each test series consists of a maximum of five single 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_F/p_I , 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 .