



## Report

on Testing a Lubricant for Reactivity with Oxygen

<b>Reference Number</b>	2-1529/2014 E
<b>Copy</b>	1. Copy of 2 Copies
<b>Customer</b>	DuPont de Nemours International Sàrl European Technical Center 146 Route du Nant d'Avril 1217 Meyrin Switzerland
<b>Order Date</b>	June 18, 2014
<b>Reference</b>	- - -
<b>Receipt of Order</b>	June 24, 2014
<b>Test Samples</b>	Krytox <sup>®</sup> GPL 226 Grease, batch LOT-G5489, for use as a lubricant in piping, valves and fittings or other components for gaseous oxygen service at temperatures up to 60 °C; BAM Order-No.: 2.1/52 165
<b>Receipt of Samples</b>	June 24, 2014
<b>Test Date</b>	August 12, 2014
<b>Test Location</b>	BAM - Working Group "Safe Handling of Oxygen"; building no. 41, room no. 120
<b>Test Procedure according to</b>	DIN EN 1797: 2002-02 „Cryogenic Vessels - Gas/Material Compatibility“ ISO 21010: 2004-07 „Cryogenic Vessels - Gas/Material Compatibility“ Annex of pamphlet M 034-1 (BGI 617-1) "List of nonmetallic materials compatible with oxygen by BAM Federal Institute for Material Research and Testing.", by German Social Accident Insurance Institution for the raw materials and chemical industry, Edition: March 2014; TRGS 407 Technical Rules for Hazardous Substances "Tätigkeiten mit Gasen - Gefährdungsbeurteilung" chapter 3 "Informationsermittlung und Gefährdungsbeurteilung" and chapter 4 "Schutzmaßnahmen bei Tätigkeiten mit Gasen" Edition: June 2013.

All pressures of this report are excess pressures.  
This test report consists of page 1 to 3 and annex 1.

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In case a German version of the test report is available, exclusively the German version is binding.

**TEST REPORT**

## 1 Documents and Test Samples

The following documents and samples were submitted to BAM:

- 1 Test application
- 1 Safety Data Sheet  
(12 pages, version 3.4, date of issue: April 18, 2013)
- 100 g paste-like Krytox<sup>®</sup> GPL 226 Grease, batch LOT-G5489  
Color: white

## 2 Test Methods

To evaluate the compatibility of Krytox<sup>®</sup> GPL 226 Grease, batch LOT-G5489, for use as a lubricant in piping, valves and fittings or other components for gaseous oxygen service at temperatures up to 60 °C, ignition sensitivity testing to gaseous oxygen impacts at 60 °C was carried out.

A determination of the autogenous ignition temperature (AIT) in high pressure oxygen was not necessary as the lubricant Krytox<sup>®</sup> GPL 226 Grease, batch LOT-G5489, is not for use at temperatures greater than 60 °C.

## 3 Results

### 3.1 Ignition Sensitivity to Gaseous Oxygen Impacts

The test method is described in annex 1.

Results:

Sample Temperature $t_a$ [°C]	Initial Oxygen Pressure $p_i$ [bar]	Final Oxygen Pressure $p_f$ [bar]	Reaction
60	1	250	ignition on 1. impact
60	1	200	ignition on 1. impact
60	1	150	ignition on 1. impact
60	1	100	ignition on 1. impact
60	1	50	no reaction*
60	1	60	no reaction*
60	1	80	no reaction*
60	1	90	no reaction*
60	1	90	ignition on 1. impact
60	1	80	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 Krytox<sup>®</sup> GPL 226 Grease, batch LOT-G5489, with oxygen could be detected at a final oxygen pressure  $p_F$  of 80 bar and at a temperature of 60 °C.

#### 4 Summary and Evaluation

According to DIN EN 1797: 2002-02 „Cryogenic Vessels - Gas/Material Compatibility“ and to ISO 21010: 2004-07 „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.

On basis of the above-mentioned criterion and the test results, there are no objections with regard to technical safety, to use Krytox<sup>®</sup> GPL 226 Grease, batch LOT-G5489, as a lubricant in piping, valves and fittings, or other components for gaseous oxygen service at following operating conditions:

Maximum Temperature [°C]	Maximum Oxygen Pressure [bar]
60	80

This evaluation does not cover the use of the lubricant Krytox<sup>®</sup> GPL 226 Grease, batch LOT-G5489, for liquid oxygen service. For this case, a particular test for reactivity with liquid oxygen needs to be carried out.

#### 5 Comments

This evaluation is based exclusively on the test results of batch LOT-G5489 of Krytox<sup>®</sup> GPL 226 Grease.

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.

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

**BAM Federal Institute for Materials Research and Testing  
12200 Berlin, August 22, 2014**

**Division 2.1  
"Gases, Gas Plants"**

On behalf of



Dr. Thomas Kasch

Distribution list: 1. Copy: DuPont de Nemours International Sàrl  
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## **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<sup>3</sup> 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  $p_a$ , the quick opening valve is opened and preheated oxygen of 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 ratio  $p_e/p_a$ . 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 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  $p_e/p_a$ , 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  $t_a$ .