BAM
Bundesanstalt für Materialforschung und -prüfung

Report

on Testing a nonmetallic material for Reactivity with Oxygen

Reference Number	2-337/2014 E
Copy	1. Copy of 2 Copies
Customer	Rich. Klinger Dichtungstechnik GmbH & Co. KG Am Kanal 8 - 10 2352 Gumpoldskirchen Austria
Order Date	February 3, 2014
Reference	Eb
Receipt of Order	February 10, 2014
Test Samples	Gasket material Klingersil® C-4430, batch 20963, for use in flanged connections in piping, valves and fittings or other components for gaseous oxygen service at pressures up to 130 bar and temperatures up to 60 °C; BAM Order-No.: 2.1/51 962
Receipt of Samples	February 7, 2014
Test Date	March 4 to 17, 2014
Test Location	BAM - Working Group "Safe Handling of Oxygen"; building no. 41, room no. 073 and no. 120
Test Procedure according to	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 2013; Rule BGR 500 "Betreiben von Arbeitsmitteln" part 2, chapter 2.32 "Betreiben von Sauerstoffanlagen", paragraph 3.17 "Lubricants and sealing materials", Edition: April 2008.

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 (6 pages, revision 01, date of issue: January 20, 2011)
15 Disks of gasket material Klingersil® C-4430, batch 20963
Diameter: 140 mm; Thickness: 2 mm
Color: one side green, other side grey

2 Test Methods

To evaluate the compatibility of the gasket material Klingersil® C-4430, batch 20963, for use as a gasket material in flanged connections in piping, valves and fittings or other components for gaseous oxygen service at pressures up to 130 bar and temperatures up to 60 °C, a flange test was carried out.

The flange test was carried out at a pressure of 130 bar and at a temperature of 80 °C as the gasket material should be used initially for gaseous oxygen service at temperatures greater than 60 °C. However, this idea was given up in the course of testing.

3 Results

3.1 Flange Test

The test method is described in annex 1.

Due to a small unevenness (≤ 0.5 mm) at the inner edge of one of the two flanges, two gaskets produced radial cracks. These gaskets burnt between the flanges - one extensively, the other partially. In both cases this resulted in leakages. It was figured out that the gasket material is extremely sensitive during assembly. After detecting and eliminating of the small unevenness and cleaning of the flanges, the test was continued.

Results:

Number of Tests	Oxygen Pressure [bar]	Temperature [°C]	Notes
1	130	80	Only those parts of the gasket burn that project into the pipe
2	130	80	same behavior as in test no. 1
3	130	80	same behavior as in test no. 1
4	130	80	same behavior as in test no. 1
5	130	80	same behavior as in test no. 1

In five tests at 130 bar oxygen pressure and 80 °C, only those parts of the gasket material Klingersil® C-4430, batch 20963, burn that project into the pipe; the fire is neither transmitted to the steel nor does the gasket burn between the flanges. The flange remains gas-tight.

4 Summary and Evaluation

It turned out that usage of the gasket material is extremely limited, if on assembling no attention is paid to clean and smooth flange faces.

Due to a small unevenness (≤ 0.5 mm) at the inner edge of one of the two flanges, two gaskets showed radial cracks. These gaskets burnt between the flanges - one extensively, the other partially. In both cases this resulted in leakages. It was figured out that the gasket material is extremely sensitive during assembly. After detecting and eliminating of the small unevenness and cleaning of the flanges, the test was continued.

This unfavorable behavior during assembly may restrict the practical use of the gasket. It is therefore recommended to present this fact in the installation instructions of the gasket.

On basis of the results of the flange testing and taking the restriction into account, that the clean flanges have no cracks, burrs, notches etc., there are no objections with regard to technical safety to use the gasket material Klingersil® C-4430, batch 20963, with a maximum thickness of 2 mm in flange connections made of copper, copper alloys or steel at following conditions:

Maximum Oxygen Pressure [bar]	Maximum Temperature [°C]
130	60

This applies to flat faced flanges, male/female flanges, and flanges with tongue and groove.

This evaluation does not cover the use of the gasket material Klingersil® C-4430, batch 20963, for liquid oxygen service. For this case, a particular test for reactivity with liquid oxygen needs to be carried out.

5 Comments

The test results refer exclusively to the tested batch of the gasket material Klingersil® C-4430, batch 20963.

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. 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, April 3rd, 2014

Division 2.1
"Gases, Gas Plants"

On behalf of

Dr. Thomas Kasch

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Annex 1

Testing of Gaskets for Flanges in Oxygen Steel Pipings

The test apparatus mainly consists of two DN 65 PN 160 steel pipes, each approximately 2 m in length, with corresponding standard flanges welded to each pipe.

Both pipes are sealed using the gasket to be tested. In case of a gasket disk its inner diameter is chosen in such a way that it projects into the pipe. If a gasket tape is under test, both ends of the tape are allowed to project into the pipe. The test apparatus is then pressurized with oxygen up to the desired test pressure. The flange is heated by heating sleeves to the test temperature, at least 50 K lower than the ignition temperature of the gasket. An electrical filament ignites that part of the gasket projecting into the pipe. If the gasket is electrically conductive, such as spiral seals or graphite foils, a nonconductive primer capsule of organic material (PTFE, rubber) is used which acts on the seal.

The gasket's behavior after ignition is important for its evaluation. If the seal burns with such a hot flame that the fire is transmitted to the steel of the flange (in most case the test apparatus is destroyed), the seal is considered unsuitable from the beginning. If only those parts of the seal burn that project into the pipe and the fire is not transmitted to the flanges and if the seal does not burn between the flanges there are no objections with regard to technical safety to use the seal under the conditions tested. Such a positive result is to confirm in four additional tests. If, however, the flanged connection becomes un-tight during a test, e. g., because of softening or burning of the seal, the test has to be continued at a lower temperature and oxygen pressure until a positive test result is reached in five tests, as mentioned above.