BAM
Bundesanstalt für Materialforschung und -prüfung

Report

on Testing of a Gasket Material for Gaseous Oxygen Service

Reference Number II-611/2009 E

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1 Application

Customer
Rich. Klinger Dichtungstechnik GmbH & Co. KG
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AUSTRIA

Order Date March 6, 2009

Receipt of Order March 10, 2009

Test Samples Gasket material KLINGER®Quantum for use in flanged connections in gaseous oxygen piping, in valves and fittings or other components for gaseous oxygen service at temperatures up to 90 °C and oxygen pressures up to 160 bar and for liquid oxygen service;
BAM-Order No. II.1/ 49 565

Receipt of Samples March 9, 2009

Test Date March 31, 2009 to July 9, 2009

Test Location BAM-Working Group "Safe Handling of Oxygen"; building no. 41, room no. 073

Test procedure according to
DIN EN 1797: 2002-02
„Cryogenic Vessels - Gas/Material Compatibility"
Annex of pamphlet M 034-1 (BGI 617-1)
„Liste der nichtmetallischen Materialien die von der Bundesanstalt für Materialforschung und –prüfung (BAM) zum Einsatz in Anlageteilen für Sauerstoff als geeignet befunden worden sind.",
to pamphlet M 034 „Sauerstoff" (BGI 617)
Berufsgenossenschaft der chemischen Industrie
Edition: October 2008;
according to chapter 3.17 „Gleitmittel und Dichtwerkstoffe" to rule BGR 500 „Betreiben von Arbeitsmitteln" part 2, chapter 2.32 „Betreiben von Sauerstoffanlagen", Edition: September 2008.

All pressures of this report are excess pressures.

This report consists of page 1 to 5 and annex 1 to 4.

TEST REPORT

2 Documents

The following documents and samples were submitted to BAM:

1 Application
1 Material information
14 Discs of KLINGER®Quantum
Diameter: 140 mm, thickness: 2 mm
colour: beige

3 Test Methods and Results

3.1 Autogenous Ignition Temperature (AIT)

The test method is described in annex 1.

Results:

Test No.	Initial oxygen pressure p_a [bar]	Final oxygen pressure p_e [bar]	AIT [°C]
1	121	166	133
2	121	164	125
3	121	162	120
4	121	162	122
5	121	161	118

In five tests with an initial oxygen pressure of p_a = 121 bar, an AIT of 124 °C was determined with a standard deviation of ± 6 °C. The final oxygen pressure p_e at ignition is approximately 163 bar.

3.2 Artificial Aging

The test method is described in annex 2.

Results:

Time [h]	Temperature [°C]	Oxygen Pressure [bar]	Mass Change [%]
100	90	160	+ 0,8

After aging of the gasket material KLINGER®Quantum at 90 °C and 160 bar oxygen pressure, the material was slightly brittle and the color was brownish. The test sample gained 0,8 % in mass.

3.2.1 AIT after Artificial Aging

The test method is described in annex 1.

Results:

Test No.	Initial oxygen pressure p_a [bar]	Final oxygen pressure p_e [bar]	AIT [°C]
1	121	175	155
2	121	176	156
3	121	173	147
4	121	173	147
5	121	180	165

In five tests with an initial oxygen pressure of p_a = 121 bar, an AIT of 154 °C was determined with a standard deviation of ± 7 °C for the aged gasket material. The final oxygen pressure p_e at ignition is approximately 175 bar.

This shows, that the AIT of the aged sample was slightly higher compared to the AIT of the non-aged sample.

3.3 Flange Test

The test method is described in annex 3.

Results:

Number of tests	Oxygen pressure [bar]	Temperature [°C]	Remarks
1	160	65	Only those parts of the gasket burn that project into the pipe.
2	160	65	Same behavior as in test no. 1.
3	160	65	Same behavior as in test no. 1.
4	160	65	Same behavior as in test no. 1.
5	160	65	Same behavior as in test no. 1.

At 160 bar oxygen pressure and 65 °C only those parts of the gasket material KLINGER®Quantum burn that project into the pipe; the fire is neither transmitted to the steel nor does the gasket burn between the flanges. The flange connection remained gas-tight.

3.4 Reactivity with Liquid Oxygen on Mechanical Impact

The test method is described in annex 4.

Results:

Test No.	Drop Height [m]	Impact Energy [Nm]	Reaction
1	0,67	500	Violent ignition on 1. impact
2	0,33	250	Violent ignition on 1. impact
3	0,17	125	Violent ignition on 1. impact

At drop heights of 0,67 m, 0,33 m, and 0,17m (impact energy 500 Nm, 250 Nm, and 125 Nm), violent reactions of the material KLINGER®Quantum with liquid oxygen could be detected in all tests.

4 Evaluation

The tests have shown that the autogenous ignition temperature of the flat gasket KLINGER®Quantum is (124 ± 6) °C at 163 bar oxygen pressure.

After aging at a temperature of 90 °C and an oxygen pressure of 160 bar, the material proved to be insufficient aging resistant. The discoloration and the increase in autogenous ignition temperature after aging up to 154 °C have no influence on the oxygen compatibility.

However, because of the slight brittleness of the material after aging KLINGER®Quantum can only be used for gaseous oxygen service, if dynamic stresses on flange connections can safely be excluded.

On basis of the above-mentioned criterion and the test results and the results of the flange testing, there are no objections with regard to technical safety to use the gasket KLINGER®Quantum in flange connections made of copper, copper alloys or steel at following conditions:

Maximum Temperature	Maximum Oxygen Pressure
65 °C	160 bar

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

According to the BAM-Standard "Testing for Reactivity with Liquid Oxygen on Mechanical Impact", described in annex 2, the gasket KLINGER®Quantum is not suitable for liquid oxygen service.

5 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.

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, July 31, 2009

Division II.1
"Gases, Gas Plants"

i.V. Tillack

Dr. Chr. Binder
Head of Working Group

Working Group
"Safe Handling of Oxygen"

Dipl.-Ing. K. Arlt
Engineer in Charge

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