Industrie Service

Mehr Sicherheit.
Mehr Wert.

Technical Report

IS-DDB-MAN-12-136

Fire-Safe-Test following DIN EN ISO 10497:2010-06, resp. API 607, fifth edition, 06.2005 at 1 gasket of the type "KLINGERSIL C-4430 plus"

Datum: 14.09.2012

Unsere Zeichen:
IS-DDB-MAN/Jo
Dokument: PB Fire-Safe_Klinger-Austria_EN-10497_Dichtung_Klingersil-C4430_E-12.docx

Das Dokument besteht aus 5 Seiten and 2 attachments.
Seite 1 von 5

Die auszugsweise Wiedergabe des Dokumentes und die Verwendung zu Werbezwecken bedürfen der schriftlichen Genehmigung der TÜV SÜD Industrie Service GmbH.

Die Prüfergebnisse beziehen sich ausschließlich auf die untersuchten Prüfgegenstände.

Applicant: Rich. Klinger Dichtungstechnik GmbH & Co.KG
Am Kanal 8-10

A – 2352 Gumpoldskirchen

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TÜV®

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1. Order

Company Rich. Klinger Dichtungstechnik GmbH & Co.KG applied at TÜV SÜD Industrie Service GmbH the accomplishment of a Fire-Safe-Test following DIN EN ISO 10497:2010-06 resp. API 607, fifth edition at 1 gasket of the type „KLINGERSIL C-4430 plus", which was clipped between 2 flanges (consecutively called "test system").

The test was done on the 07.08.2012 in Graben-Neudorf with presence of an authorised expert of TÜV SÜD Industrie Service GmbH.

2. Accomplishment of the test

The test assembly and the accomplishment were carried out following DIN EN ISO 10497 (see photos in the attachment). Simultaneously 2 other gaskets were tested flanged in series. Because of the compact test installation there was used only 1 thermocouple and one calorimeter cube per gasket (see photos).

3. Test result

The test results mentioned in the attachment show that the requirements following DIN EN ISO 10497 resp. API 607, fifth edition have been achieved by the gasket

KLINGERSIL C-4430 plus, DN 40, nominal pressure PN 40, thickness 1,5 mm.

The gasket was tightened with a torque of 100 Nm which is equal to a surface pressure of 38 N/mm^2.

4. Area of application

According to the testing of a gasket DN 40 simultaneously the requirements for gaskets of the same type are valid for nominal size DN 40 and below, DN 50, DN 65 and DN 80.

According to the testing of the gasket for a nominal pressure PN 40, gaskets of the same type for nominal pressures PN 40, PN 63 and PN 100 are also covered.

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Test protocol

1. Date of the test August 07, 2012

2. Location of the test KLINGER SCHÖNEBERG GmbH
Heidelberger Straße 3
76676 Graben-Neudorf

3. Test specifications DIN EN ISO 10497:2010-06 resp. API 607, fifth edition, 6.2005

4. Gasket manufacturer Rich. Klinger Dichtungstechnik GmbH & Co. KG
Am Kanal 8-10
A – 2352 Gumpoldskirchen

5. Tested gasket

Gasket KLINGERSIL C-4430 plus; DN 40, PN 40
Thickness 1,5 mm; Torque 100 Nm;
Surface pressure 38 N/mm^2
Limits of use: see data sheet as attachment

6. Test conditions

Test fluid:	Water
Test fuel:	Liquid gas acc. DIN 51622
Burn period:	30 minutes
Thermocouples:	The temperature of the flames after 2 minutes should be 750 °C; the average temperature at the flame area should be between 750 °C and 1000 °C and should not fall below 700 °C.
Calorimeter cubes:	The average temperature after 15 minutes should be 650 °C. This temperature should be held during the burn period and should not fall below 560 °C.
Test pressure:	
(Low-pressure)	2 bar
(High-pressure)	30 bar

7. Test procedure

7.1 Preliminary test: Tightness test of the gasket, which was clipped between 2 flanges with water (1,4 x PN)

Test pressure: 56 bar

Result: Test system was tight

7.2 Burn period

Temperatures of the Calorimetercubes

Temperature after 15 min	Average temperature after 15 min till end of the burn period
K2	K2
716	716

Temperatures of the thermocouples

Temperature after 2 min	Average temperature
T4	T4
954	863

7.3 Cooling-down period of the ball valve to 100°C

Test system 6 Min

7.4 Closing of the fuel supply and cooling down to 100 °C

Cooling down with air blast cooling and water.

7.5 External leakage during the burn period and the cooling-down period

max. permissible leakage during the burn period and cooling down period: 40 ml/min

determined leakage: Test system 0 ml

Result: passed

7.6 Operability

Increase the test pressure to high pressure, close the shut-off valve (Nr. 15) and open the test system against the upcoming pressure.

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Holding of the high test pressure and measuring of the outer leakage over a period of 5 minutes.

7.7 External leakage following operational test

max. permissible Leakage:		40 ml/min
determined Leakage:	Test system:	0 ml
Result:	passed	

7.8 Optical appearance of the gasket after completion of the Fire-Safe-test

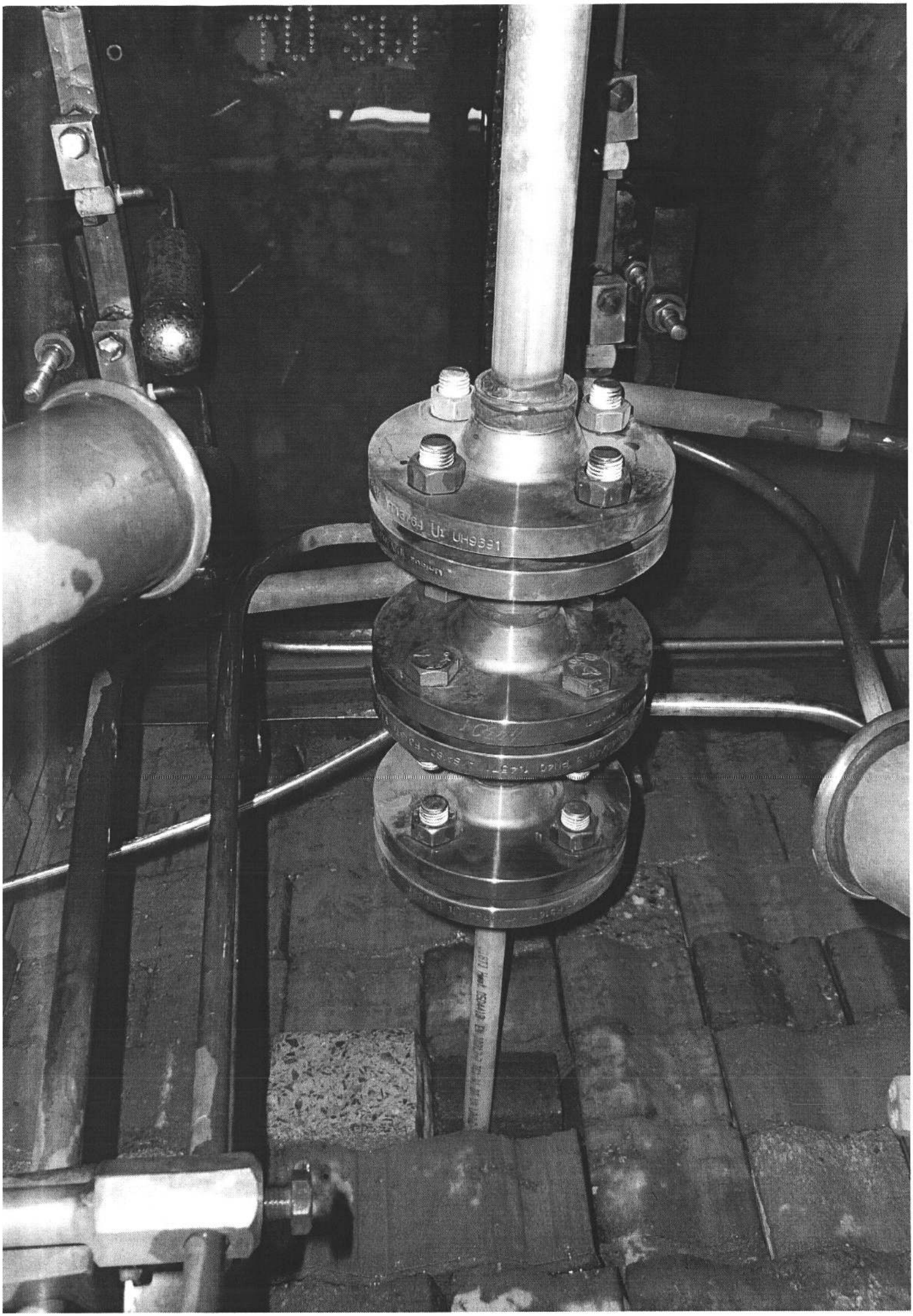
The gasket was in one piece, it was sticking a little on the flange surface and the colour had become darker.

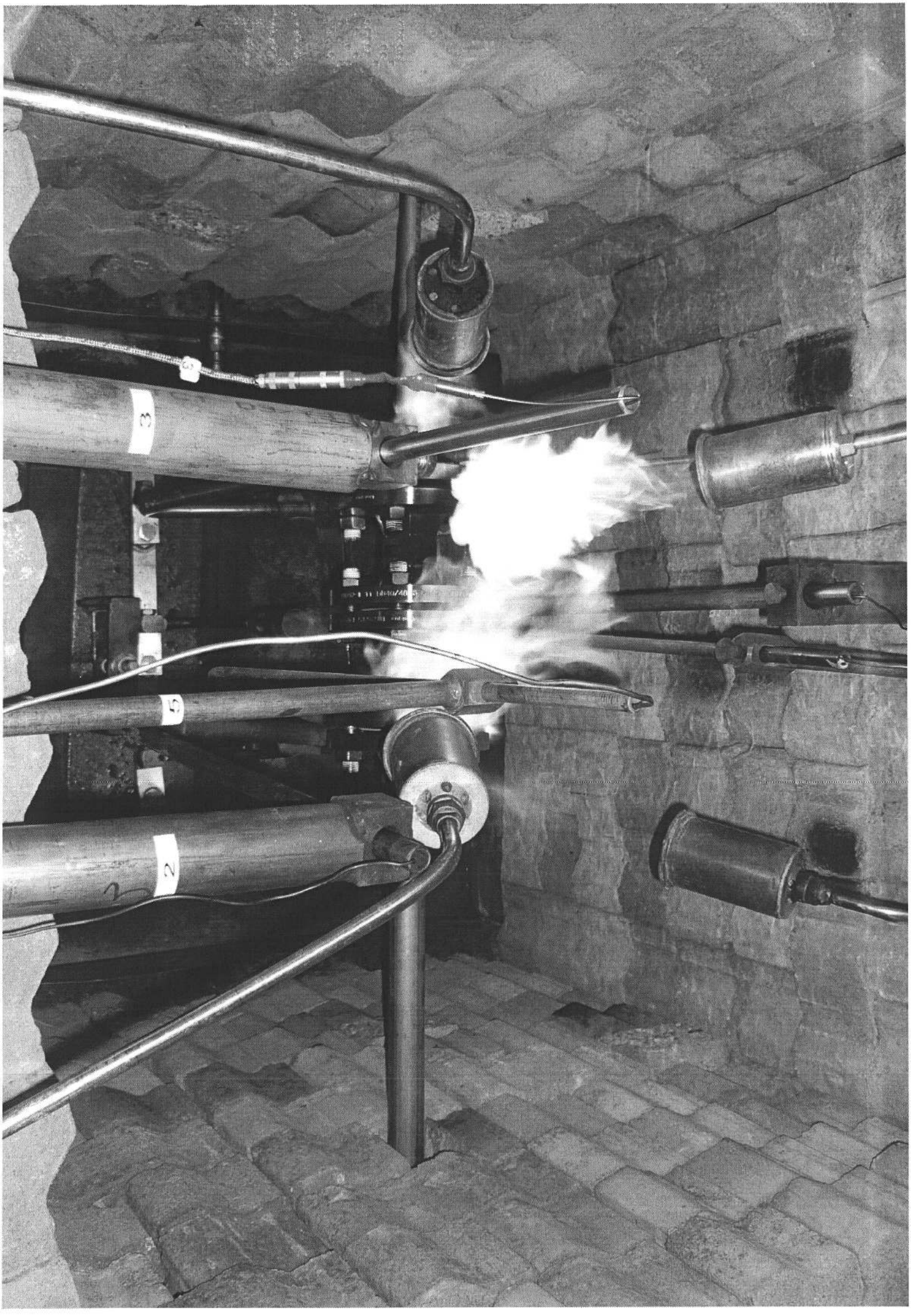
Mannheim, 14th September, 2012
IS-DDB-MAN/jo

TÜV SÜD Industrie Service GmbH
Abteilung Druckbehälter
The expert

Dipl.-Ing. John

Attachments: Photos
Data sheet



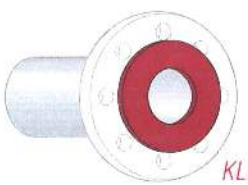


KLINGER®



KLINGERSIL® C-4430*plus*

Superior performance at high temperature applications

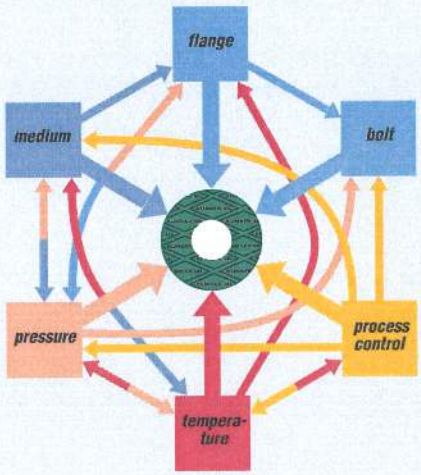


+ *Thermal stability*
+ *Life time*
+ *High temperature tightness*
+ *Safety*

KLINGER – The global leader in static sealing

The many, varied demands placed on gaskets

A common perception is that the suitability of a gasket for any given application depends upon the maximum temperature and pressure conditions. This is not the case.

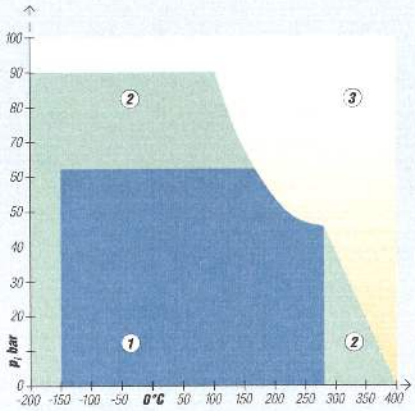


Maximum temperature and pressure values alone can not define a material's suitability for an application. These limits are dependent upon a multiplicity of factors as shown in the diagram opposite. It is always advisable to consider these factors when selecting a material for a given application.

Selecting gaskets with pT diagrams

The Klinger pT diagram provides guidelines for determining the suitability of a particular gasket material for a specific application based on the operating temperature and pressure only.

Additional stresses such as fluctuating load may significantly affect the suitability of a gasket in the application and must be considered separately. Always refer to the chemical resistance of the gasket to the fluid.



Areas of Application

① In area one, the gasket material is normally suitable subject to chemical compatibility.
② In area two, the gasket materials may be suitable but a technical evaluation is recommended.
③ In area three, do not install the gasket without a technical evaluation.

Always refer to the chemical resistance of the gasket to the fluid.

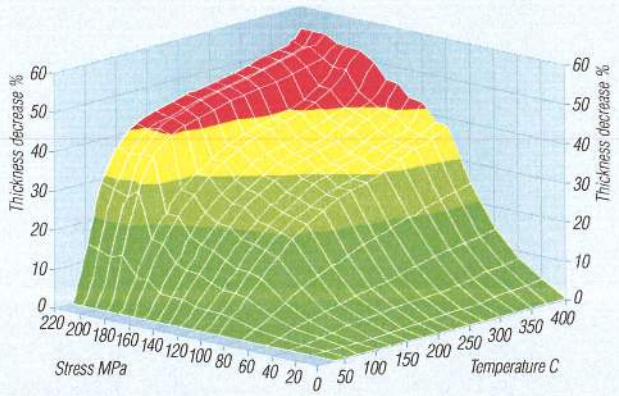
Klinger Hot and Cold Compression Test Method

The Klinger Hot Compression Test was developed by Klinger as a method to test the load bearing capabilities of gasket materials under hot and cold conditions.

In contrast to the BS 7531 and DIN 52913 tests, the Klinger Compression test maintains a constant gasket stress throughout the entire test. This subjects the gasket to more severe conditions.

The thickness decrease is measured at an ambient temperature of 23°C after applying the gasket load.
This simulates assembly.

Temperatures up to 300°C are then applied and the additional thickness decrease is measured. This simulates the first start up phase.



The diagram shows additional thickness decrease at temperature

KLINGERSIL® C-4430*plus*
Four PLUS on safety

+ Thermal stability

With the market launch of KLINGER® Quantum – the first fibre reinforced gasket material solely bounded with HNBR – KLINGER® has revolutionized the world of gaskets.

The R&D department of KLINGER® has taken the experiences which have been gained during the development of KLINGER® Quantum and applied them on KLINGERSIL® C-4430 – a fibre reinforced gasket material with highest stress relaxation. The result of the usage of the "Quantum technology" is a fibre reinforced gasket material with an extended profile of properties – ***KLINGERSIL® C-4430 plus****.*

With ***KLINGERSIL® C-4430 plus*** *the thermal stability of the material has been extended and due to the usage of the "Quantum technology" the maximum operating temperature could be increased. This has been obtained through technical-chemical methods which give the binder NBR a higher temperature resistance. The crosslinking of the elastomer had been modified insofar as it needs more energy to break them which would lead to a change in mechanical properties.*

A thermogravimetrical analysis which has been performed for ***KLINGERSIL® C-4430 plus*** *shows a onset of decomposition of the gasket material at approx. 400°C which is much higher as for standard fibre reinforced gasket materials.*

+ Life time

The life time or period of application of a gasket material nowadays is a very important economical and safety-relevant factor.

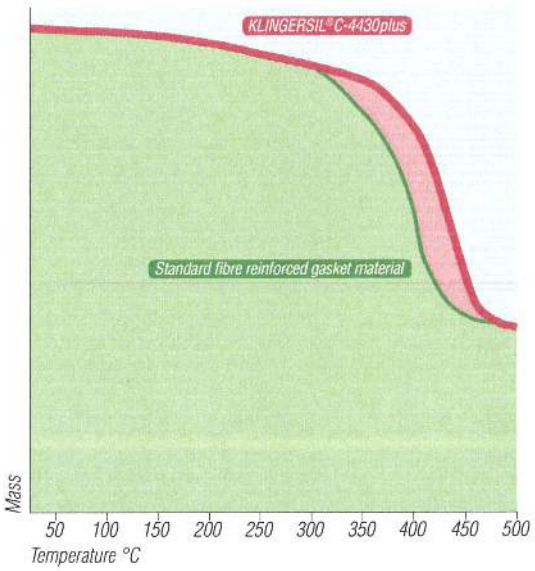
The optimum gasket material causes no unscheduled shutdowns in the plant and therefore also no further costs through maintenance, loss of production or stockkeeping.

Because of the "Quantum technology" which has been chosen for ***KLINGERSIL® C-4430 plus*** *the ageing of the gasket material has been prolongated and therefore a longer lifer time of the gasket material in the application has been achieved.*

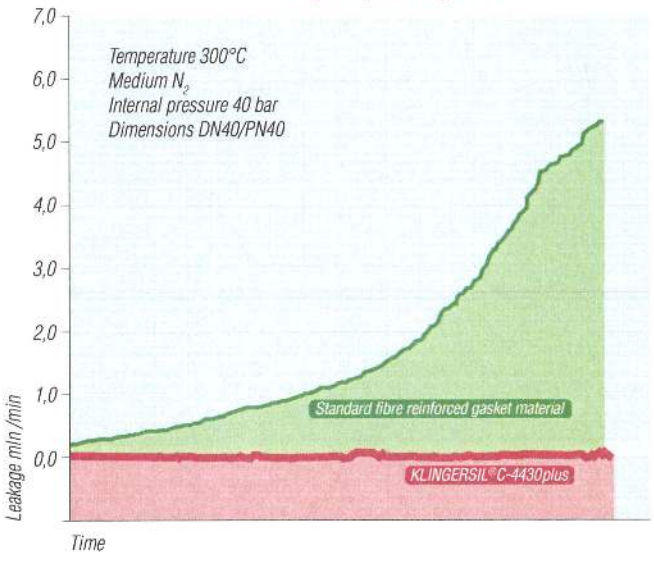
The reduced ageing is indicated over constant material properties at high temperatures and a longer time period. In the below diagram this is illustrated with a constant high tightness of ***KLINGERSIL® C-4430 plus*** *at a temperature of 300°C.*

Other commercial fibre reinforced gasket materials which are also based on NBR but do not use the "Quantum technology" show an increase in Leakage at the same test conditions because of an ongoing ageing.

Thermogravimetrical analysis



High temperature tightness



KLINGERSIL® C-4430*plus*
Four PLUS on safety

+ Safety

The most common gasket failures at the use of fibre reinforced gasket materials show up at discontinuous applications because of pressure- or temperature changes (ie. steam applications, planned shutdowns, vibrations in the pipeline, etc).

Every fibre reinforced gasket material is getting hard and brittle at higher temperatures over time.

The gasket therefor shows insufficient flexibility which would be necessary to bear possible additional stresses. This can lead to leakages or accidents and therefor higher costs for the plant operator.

Because of the above mentioned retarded ageing of ***KLINGERSIL® C-4430 plus*** *this material obtains a higher safety margin to absorb possible impacts of dynamic applications without losing the tightness feature.*

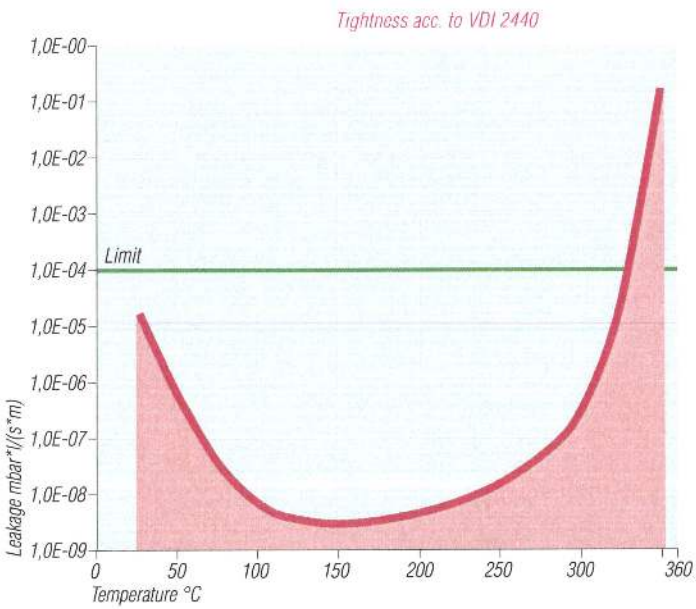
+ High temperature tightness

A important criteria for a optimum gasket material is of course a high tightness at installation but moreover a continuous tightness at operating temperature. The growing requirements of many varied guidelines on the tightness of fibre reinforced gasket material demands a consideration of this matter when developing a new gasket material.

The VDI 2440 for example defines as tightness criteria for a high grade gasket a maximum permissible leakage of 1.0 x 10-4 mbar x l / s x m with an internal test pressure of 1 bar helium.

The test is performed on a gasket which is installed in a flange which has to be conditioned at the maximum operating temperature before the test. If this test is performed on several unused gaskets at different temperatures the below shown diagram results for ***KLINGERSIL®C-4430 plus****.*

The determined graph for ***KLINGERSIL®C-4430 plus*** *shows a behaviour over the whole recommended temperature range which is by far higher than required.*



Important points to be observed

With heightened awareness of safety and environmental issues, reducing leaks from flanged assemblies has become a major priority for industry. It is therefore important for companies who use gaskets to choose the correct material for the job and install and maintain it correctly to ensure optimum performance.

A flanged joint will remain tight as long as the surface pressure in service is higher than the minimum surface pressure required to achieve the necessary levels of tightness but is lower than the maximum permissible surface pressure. But increasingly high demands on the tightness requirements for flanged joints (e.g. Tightness class L 0.1 in accordance with DIN 28090) necessitate the application of high loads on the gasket material in order to meet these stringent requirements.

If the gasket is to be subjected to non-static loading and stress fluctuations due to temperature and pressure cycling, it is advisable to select a gasket material which is less prone to embrittlement with increasing temperatures (e.g. KLINGER® graphite laminate, KLINGER® Quantum, KLINGER® top-chem or KLINGER® top-sil).

In cyclic loading conditions we recommend a minimum surface stress of 30 MPa and that the gasket should be as thin as is practicable.

For safety reasons never re-use gaskets.

KLINGERSIL® C-4430*plus*
Installation instructions

The following guidelines are designed to ensure the optimum performance of our gasket materials:

1. Choosing the gasket

There are many factors which must be taken into account when choosing a gasket material for a given application including temperature, pressure and chemical compatibility. Please refer to the information given in our brochure or, for advice to our software program KLINGER®expert. If you have any questions regarding the suitability of material for a given application please contact Klinger Technical Department.

2. Gasket thickness

The gasket should be as thin as technically practical. To ensure optimum performance a minimum thickness/width ratio of 1/5 is required (ideally 1/10).

3. Flange condition

Ensure all remains of old gasket materials are removed and the flanges are clean, in good condition and parallel.

4. Gasket compounds

Ensure all gaskets are installed in a dry state, the use of gasket compounds is not recommended as this has a detrimental effect on the stability and load bearing characteristics of the material. In its uncompressed form the gasket can absorb liquid, and this may lead to failure of the gasket in service. To aid gasket removal Klinger materials are furnished with a non sticking finish.

In difficult installation conditions, seperating agents such as dry sprays based on molybdenum sulphide or PTFE e.g. KLINGER®flon spray, may be used, but only in minimal quantities. Make sure that the solvents and propellants are completely evaporated.

5. Gasket Dimensions

Ensure gasket dimensions are correct. The gasket should not intrude into the bore of the pipework and should be installed centrally.

6. Bolting

Wire brush stud/bolts and nuts (if necessary) to remove any dirt on the threads. Ensure that the nuts can run freely down the thread before use.

Apply lubricant to the bolt and to the nut threads as well as to the face of the nut to reduce friction when tightening. We recommend the use of a bolt lubricant which ensures a friction coefficient of between 0.10 to 0.14.

7. Joint Assembly

It is recommended that the bolts are tightened using a controlled method such as torque or tension, this will lead to greater accuracy and consistency than using conventional methods of tightening. If using a torque wrench, ensure that it is accurately calibrated.

For torque settings please refer to the KLINGER®expert or contact our Technical Department which will be happy to assist you.

Carefully fit the gasket into position taking care not to damage the gasket surface.

When torquing, tighten bolts in three stages to the required torque as follows:

Finger tighten nuts. Carry out tightening, making at least three complete diagonal tightening sequences i.e. 30%, 60% and 100% of final torque value. Continue with one final pass – torquing the bolts/studs in a clockwise sequence.

8. Retightening

Provided that the above guidelines are followed retightening of the gasket after joint assembly should not be necessary.

If retightening is considered necessary, then this should only be performed at ambient temperature before or during the first start-up phase of the pipeline or plant. Retightening of compressed fibre gaskets at higher operating temperatures and longer operating times may lead to a failure of the gasket connection and possible blow out.

9. Re-use

For safety reasons never re-use a gasket.

KLINGER EXPERT®

Powerful sealing calculation with online help on CD-ROM



KLINGERSIL® C-4430*plus* Technical data



Uses

High pressure gasket for universal applications. Suitable for use with water and steam at higher temperatures as well as to oils, gases, salt solutions, fuels, alcohols, moderate organic and inorganic acids, hydrocarbons, lubricants and refrigerants. Premium material grade with outstanding stress retention.

Typical values			
Compressibility ASTM F 36 J		%	9
Recovery ASTM F 36 J		%	50
Stress relaxation DIN 52913	50 MPa, 16h/ 175°C	MPa	39
	50 MPa, 16h/ 300°C	MPa	35
Stress relaxation BS 7531	40 MPa, 16h/ 300°C	MPa	31
Klinger cold/hot compression	thickness decrease at 23°C	%	8
50 MPa	thickness decrease at 300°C	%	11
	thickness decrease at 400°C	%	14
Tightness according DIN 3535/6	DIN 28090-1	mg/s x m	< 0.1
Tightness class L	VDI 2440		0.1
Specific leakrate λ	VDI 2440	mbar x l/s x m	2.9E-06
Thickness increase after fluid	oil IRM 903: 5 h/150 °C	%	3
immersion ASTM F 146	fuel B: 5 h/23 °C	%	5
Density		g/cm³	1.75
Average surface resistance	R_{OA}	Ω	4.1x10E13
Average specific volume resistance	ρ_D	Ω cm	4.5x10E12
Average dielectric strength		kV/mm	21.3
Average power factor	1 kHz, ca.2 mm thickness	tan δ	0.02
Average dielectric coefficient	1 kHz, ca.2 mm thickness	εr	6.4
Thermal conductivity		W/mK	0.42
ASME-Code sealing factors			
for gasket thickness 2.0 mm	tightness class 0.1 mg/s x m	MPa y	25
		m	5

Dimensions of the standard sheets

Sizes:
1000 x 1500 mm, 2000 x 1500 mm.
Thicknesses:
0.5 mm, 1.0 mm, 1.5 mm, 2.0 mm, 3.0 mm;
other thicknesses and sizes on request.
Tolerances:
thickness ± 10%, length ± 50 mm, width ± 50 mm.

Surfaces

KLINGERSIL® gasket materials are generally furnished with surfaces of low adhesion.

Function and durability

The performance and service life of KLINGER gaskets depend in large measure on proper storage and fitting, factors beyond the manufactor's control. We can, however, vouch for the excellent quality of our products.

With this in mind, please also observe our installation instructions.

Tests and approvals

BAM approval in accordance with UVV 28 (in preparation).
DIN-DVGW permit (in preparation).
DVGW W 270 (in preparation).
KTW.
WRc.
Fire Safe according to ISO 10497 (in preparation).
TA Luft (Clean air) approval.

Subject to technical alterations.
Issue: May 2012

Certified according to DIN EN ISO 9001:2008

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