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Mehr Wert.**

# Technical Report

## IS-DDB-MAN-12-135

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

Datum: 14.09.2012

Unsere Zeichen:  
IS-DDB-MAN/Jo  
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Das Dokument besteht aus  
5 Seiten und 2 attachments.  
Seite 1 von 5

**Applicant:** Rich. Klinger Dichtungstechnik GmbH & Co.KG  
Am Kanal 8-10  
  
A – 2352 Gumpoldskirchen

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.

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68167 Mannheim  
Deutschland



## 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“, 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**, 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<sup>2</sup>.

## 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.



## Test protocol

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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; DN 40, PN 40  
Thickness 1,5 mm; Torque 100 Nm;  
Surface pressure 38 N/mm<sup>2</sup>  
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
687	685

Temperatures of the thermocouples

Temperature after 2 min	Average temperature
T4	T4
950	867

### 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

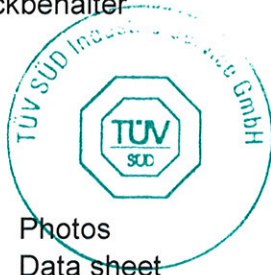
The printing on the gasket was still readable. The gasket was in one piece and the colour became darker.

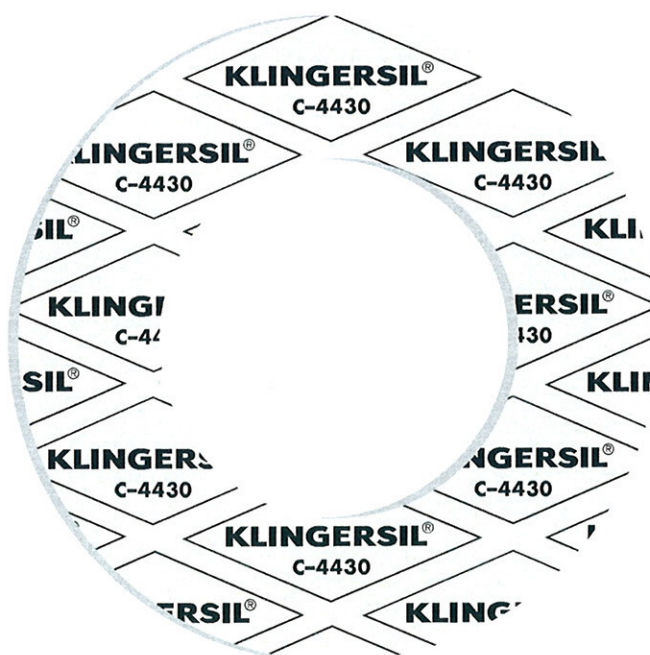
Mannheim, 14<sup>th</sup> September, 2012  
IS-DDB-MAN/Jo

TÜV SÜD Industrie Service GmbH  
Abteilung Druckbehälter  
The expert

Dipl.-Ing. John

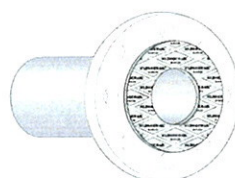
Attachments: Photos  
Data sheet





# KLINGERSIL® C-4430

A Universal Material  
with outstanding  
stress retention and  
resistance to  
hot water and steam



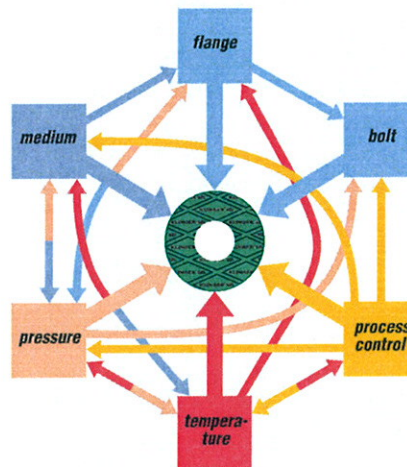
KLINGERSIL® C-4430  
*Optimum combination of synthetic fibres  
bonded with NBR.  
Resistant to water and steam  
at higher temperatures as well as to oils, gases,  
salt solutions, fuels, alcohols, moderate  
organic and inorganic acids, hydrocarbons,  
lubricants and refrigerants.*

*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.

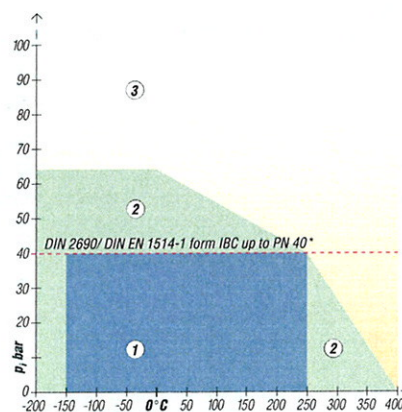


Maximum temperature and pressure values alone can not define a material's suitability for an application. These limits are dependent upon a multiplicity of factors as shown in the diagram opposite. It is always advisable to consider these factors when selecting a material for a given application.

### 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.



\*Gaskets according to DIN 2690 are only standardised up to PN 40 and gasket thickness 2 mm.

### 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.

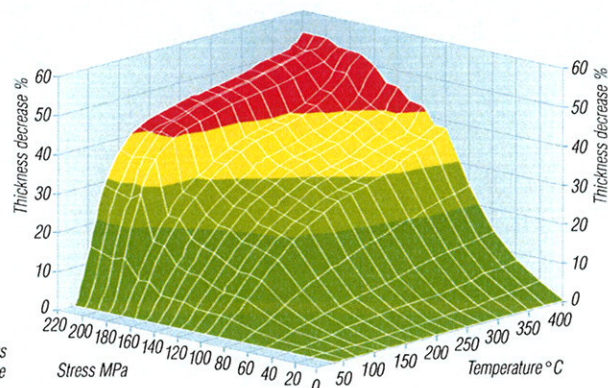
### Klinger Hot and Cold Compression Test Method

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.

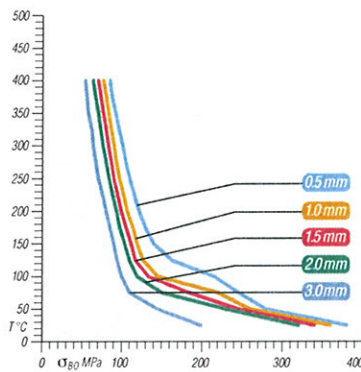


The diagram shows additional thickness decrease at temperature



## Maximum permissible surface pressure $\sigma_{B0}$ under operating conditions acc. DIN 28090 – 1

The maximum surface pressure under operating conditions is the maximum allowable surface pressure on the effective gasket area under service conditions that can be applied to the gasket before unacceptable relaxation of the flanged joint occurs and/or the gaskets are destroyed.



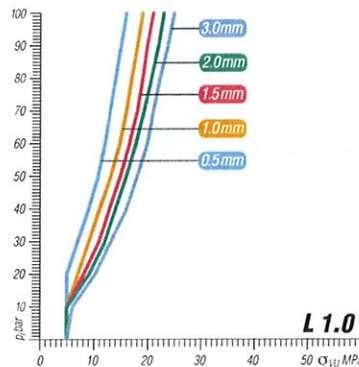
The diagram above shows this values for different gasket thicknesses.

## Min. surface pressure $\sigma_{VU}$ for tightness classes $L = 1.0$ , $L = 0.1$ and $L = 0.01$ in accordance to DIN 28090

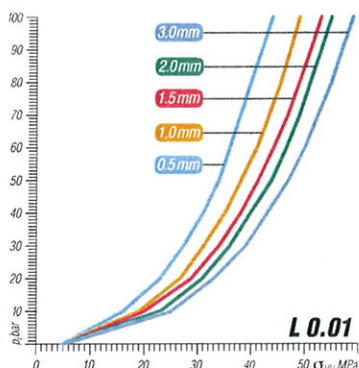
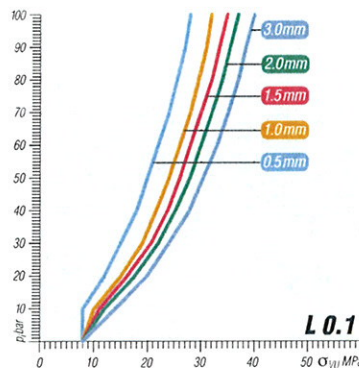
The minimum surface pressure is the minimum surface pressure that should be applied to the gasket to achieve the necessary tightness requirements.

The value must be sufficient to compress the material into the flange imperfections, reduce the materials porosity and also counteract the release of load due to the internal pressure.

The diagrams below show the minimum gasket stress required to achieve the relevant tightness classes as a function of thickness.

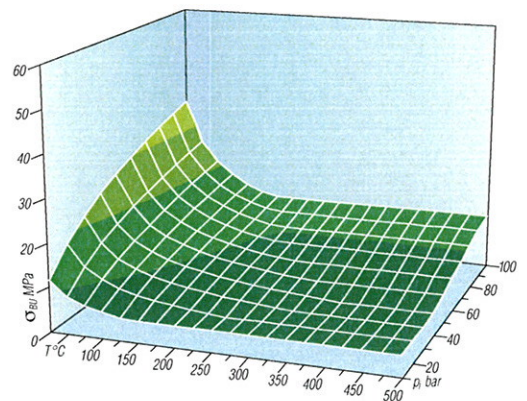


Tightness class  $L = 0.1$  allows a maximum leakage of 0.1 mg nitrogen per second per meter of gasket length (mg/s x m)



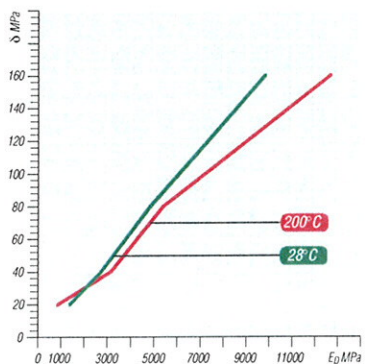
## Minimum surface pressure $\sigma_{BU}$ for tightness class $L = 0.1$

The three dimensional diagram below describes the behaviour of 2 mm gasket material with respect to the minimum surface pressure to achieve a tightness class of  $L = 0.1$  under a wide range of temperatures and internal pressures. It clearly shows that the minimum surface pressure decreases at elevated temperatures – the gasket will seal at lower loads under these conditions.



## Modulus of elasticity $E_D$ in accordance to DIN 28090

This diagram outlines the modulus of elasticity compared to the surface load. The curves describe the behaviour at ambient temperature and at 200°C.



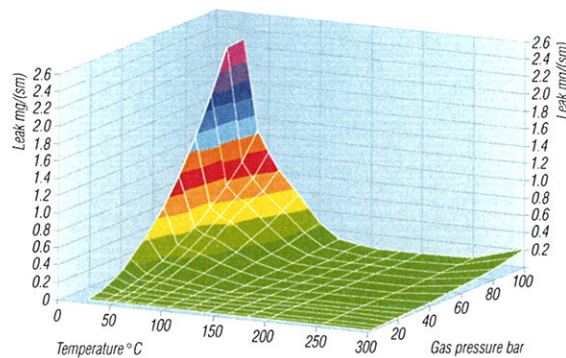


### High temperature tightness

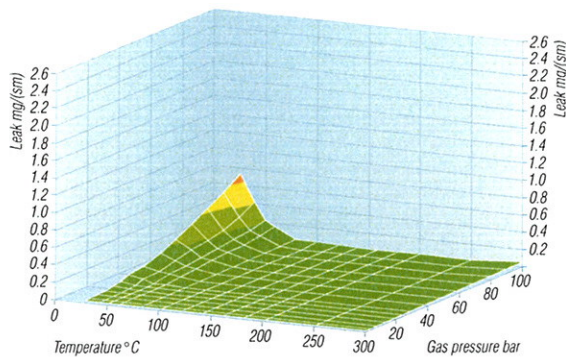
High temperature tightness is measured by means of the Klinger Hot Compression test under defined constant gasket load and temperature with increasing internal pressures using nitrogen as test fluid.

Stabilisation time for each reading is two hours and a new test specimen is used for every gasket load and temperature.

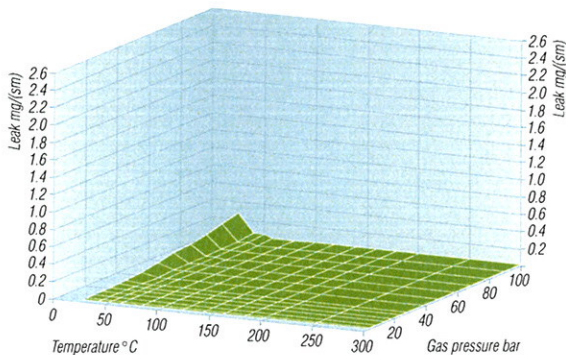
The tightness is analysed with a massflow meter. The pressure is controlled by pressure controller.



**Gasket load  
15 MPa**



**Gasket load  
25 MPa**



**Gasket load  
35 MPa**

### 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. KLINGERgraphite laminate, KLINGERtop-chem or KLINGERtop-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.



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, separating agents such as dry sprays based on molybdenum sulphide or PTFE e.g. KLINGERflon 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

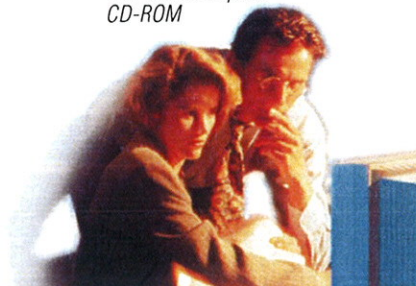
Provided that the above guidelines are followed retightening of the gasket after joint assembly should not be necessary.

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





### ■ 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.

### ■ 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  $\pm 10\%$ , length  $\pm 50$  mm,  
width  $\pm 50$  mm.

### ■ Surfaces

KLINGERSIL® gasket materials are generally furnished with surfaces of low adhesion. On request, graphite facings and other surface finishes on one or both sides are also available.

### ■ Function and durability

The performance and service life of KLINGER gaskets depend in large measure on proper storage and fitting, factors beyond the manufacturer'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

Fire safe according to BS 5146.  
BAM approval in accordance with UVV 28, oxygen( VGB 62)  
tested up to 100 bar and 85°C.  
Approved for gas supply in accordance with DIN 3535/6.  
DIN - DVGW permit NG 5123AN0418.  
SVGW permit, KTW recommended.  
Lab. National d'Essais 9030144.  
WRc approval. Germanischer Lloyd.  
Meets the technical requirements of BS 7531:2006 Grade AX.  
TA Luft (Clean air) approval,  
tested in accordance with VDI 2440 at 250°C.

### Typical values

Compressibility ASTM F 36 J		%	9
Recovery ASTM F 36 J	min	%	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 50 MPa	thickness decrease at 23°C	%	8
	thickness decrease at 300°C	%	11
Tightness according DIN 3535/6		mg/s x m	< 0.1
Tightness class L	DIN 28090-1		0.1
Specific leakrate $\lambda$	VDI 2440	mbar x l/s x m	2,13E-05
Cold compression	DIN 28091-2	%	6 - 10
Cold recovery	DIN 28091-2	%	2 - 4
Hot compression	DIN 28091-2	%	7
Hot recovery	DIN 28091-2	%	1
Spring back R	DIN 28091-2	mm	0.019
Thickness increase after fluid immersion ASTM F 146	oil JRM 903: 5 h/150 °C	%	3
	fuel B: 5 h/23 °C	%	5
Density		g/cm³	1.75
Average surface resistance	$R_{0A}$	$\Omega$	4.1x10E13
Average specific volume resistance	$\rho_D$	$\Omega$ cm	4.5x10E12
Average dielectric strength		kV/mm	21.3
Average power factor	1 kHz, ca.2 mm thickness	$\tan \delta$	0.02
Average dielectric coefficient	1 kHz, ca.2 mm thickness	$\epsilon_r$	6.4
Thermal conductivity		W/mK	0.42
<b>ASME-Code sealing factors</b>			
for gasket thickness 2,0 mm	tightness class 0.1 mg/s x m	MPa	y 25
		m	5

 **KLINGER**  
**EXPERT®**  
Powerful sealing calculation with  
online help on CD-ROM

**Certified according to  
DIN EN ISO 9001:2000**

Subject to technical alterations.  
Issue: December 2007

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http://www.klinger.co.at