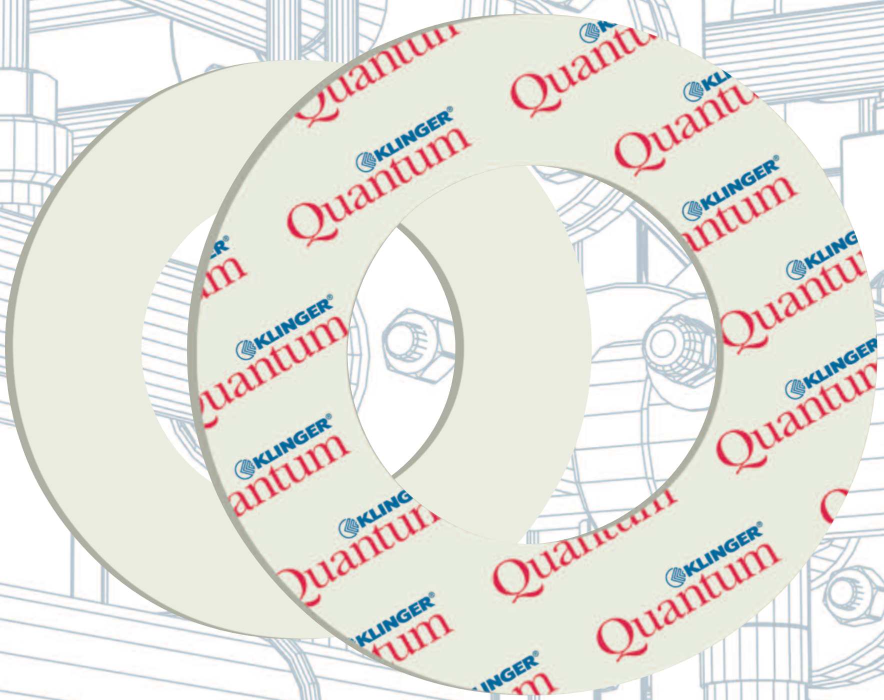
KLINGER®
trusted. worldwide.

KLINGER® Quantum

Right on top
A new era in gasket technology



KLINGER® Quantum
Unique gasket material with the highest flexibility at high temperatures, manufactured from a high quality fibre and filler compound bonded in a high temperature resistant HNBR-matrix.
Suitable for use in oils, water, steam, gases, salt solutions, fuels, alcohols, weak organic and inorganic acids, hydrocarbons, lubricants and refrigerants.

www.klinger.co.at

KLINGER®Quantum

A new era in gasket technology

Since the change-over to asbestos-free fibre gaskets, many users have been searching for a gasket material with the outstanding high-temperature properties of the asbestos-containing material KLINGERit.

As the leading manufacturer of static gasket materials, KLINGER was the pioneer in the development of asbestos-free fibre reinforced gaskets.

The best achieved so far was the market launch of KLINGER®top-sil-ML1, which, although it was a large step forward, did not reach the really challenging ultimate goal.

With the development of KLINGER®Quantum, Klinger is now heralding a new era in the world of gasket technology.

A Vision Becomes Reality

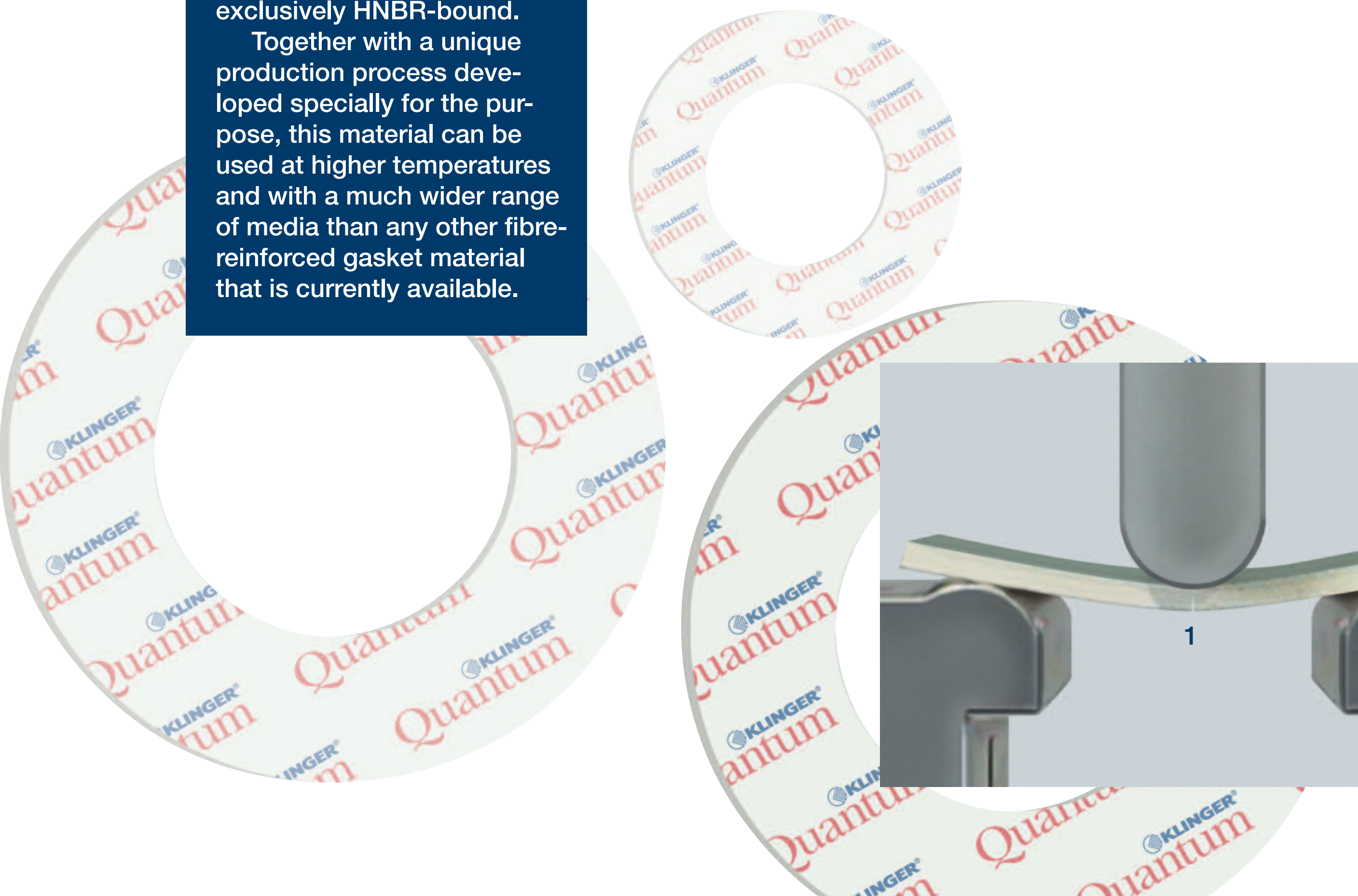
The idea of KLINGER®Quantum arose from the vision of developing an asbestos-free, fibre-reinforced gasket material that would behave in a similar, problem-free manner at high temperatures to the earlier KLINGERit. Moreover, this material would fulfil the contemporary, trend-setting requirements for tightness and environmental compatibility.

The first groundbreaking step in the development of an asbestos-free fibre gasket was the presentation and market launch of KLINGERSIL® in 1982. Since then, KLINGERSIL® materials have established themselves in the market and proven themselves a million times over. Many applications are today simply not conceivable without these materials.

Nonetheless, so far, fibre-reinforced materials generally have not been able to fulfil the expectations of many users with regard to flexibility at higher temperatures.

KLINGER®Quantum is the first fibre-reinforced gasket material in the world that is exclusively HNBR-bound.

Together with a unique production process developed specially for the purpose, this material can be used at higher temperatures and with a much wider range of media than any other fibre-reinforced gasket material that is currently available.



KLINGER®Quantum

A new era in gasket technology

Being a world-wide market leader, KLINGER was therefore continuously involved in finding a solution to this problem and in 2004, exactly 111 years after the invention of KLINGERit, presented the groundbreaking material KLINGER® top-sil-ML1.

The patented, futuristic multilayer concept resulted in an extension of service life at high temperatures.

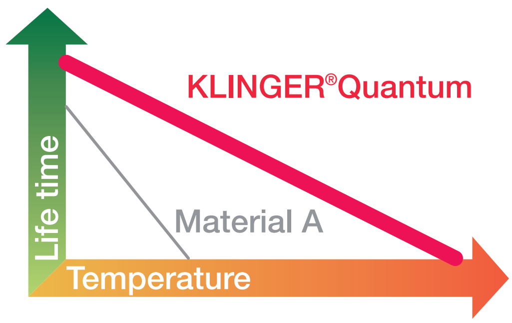
HNBR was used for the first time as the binding agent in fibre-reinforced gasket materials in combination with NBR.

From the experience gained in this development and a focused, consistent further development of the production process came the breakthrough: in 2009, KLINGER revolutionized the capability of fibre gaskets with the launch of the unique sealant material KLINGER® Quantum.

The Outstanding Properties

KLINGER®Quantum offers a formerly unknown level of flexibility for fibre-reinforced gasket materials at high continuous temperatures, with a simultaneously improved chemical resistance and a broader range of applications than all known fibre-reinforced gasket materials.

Of course, KLINGER®Quantum fulfils all the present-day requirements for tightness and safety.



Flexibility at High Temperatures

The 3-point bending test is often used as an evaluation method for the flexibility of fibre-reinforced gasket materials. Special tests on conditioned specimens provide an indication of the brittleness and hence of the aging behaviour of the elastomers used.

Before the test, the specimens are first conditioned and subsequently tested.

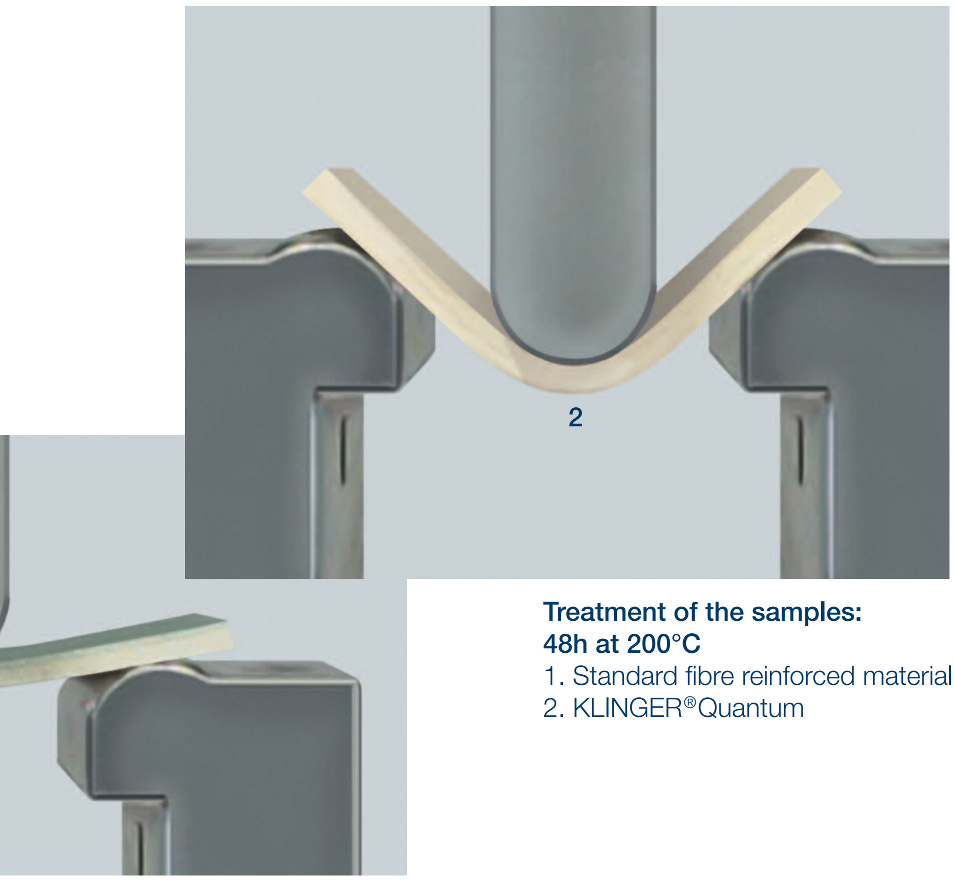
The results of the tests on these artificially aged test specimens provide information on the aging resistance of the different material concepts.

Particularly in steam applications, pressure shocks frequently occur, which result in damage to the gasket material. A more flexible gasket that can overcome extensive expansion without fracture is a decisive factor in obtaining a more reliable gasket joint.

In this test, KLINGER®Quantum shows its uniqueness and outstanding position as compared to all other available fibre-reinforced gasket materials. The flexibility of KLINGER®Quantum at higher temperatures is several times higher than that of traditional fibre-reinforced gasket materials.

All the negative aspects of flat gaskets such as embrittlement, crack formation and increased leakage can be reduced significantly by the use of KLINGER®Quantum.

The handling of the material is similar to that of the known fibre-reinforced materials and is therefore familiarly simple.



Treatment of the samples:
48h at 200°C

1. Standard fibre reinforced material
2. KLINGER®Quantum

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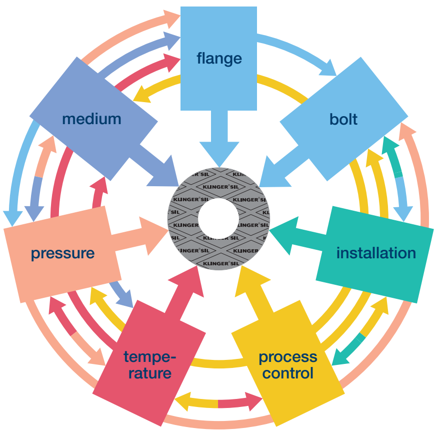
Flanged joint integrity

The many and varied demands made on gaskets

A common perception is that the suitability and tightness 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 picture below. It is always advisable to consider these factors when selecting a material for a given application.



A statement about the expected tightness of the flange connection is only possible if a qualified and defined installation of the gasket has been executed.

In facilities, for which limited emission requirements acc. to TA-Luft are specified, the guideline VDI 2290 for the evaluation of the technical tightness of flange connections has to be considered.

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.

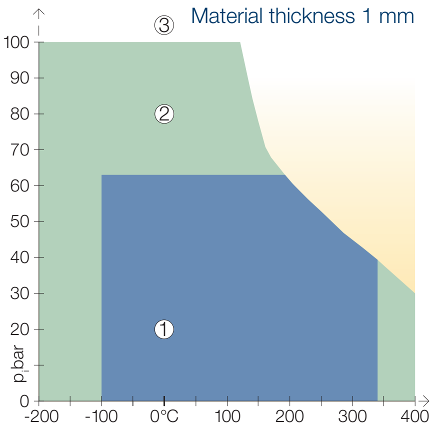
Areas of Application

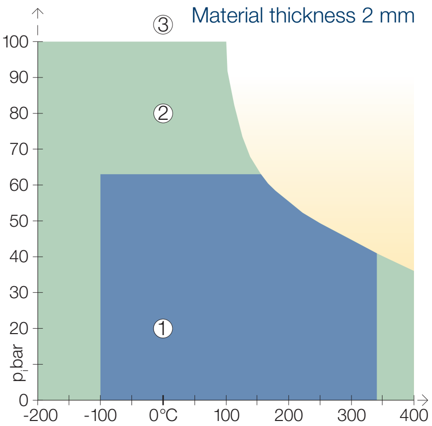
① In area one, the gasket material is normally suitable subject to chemical compatibility.

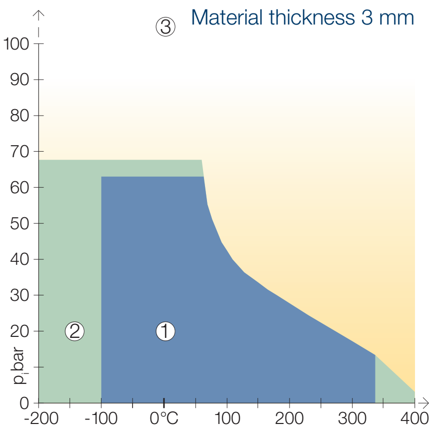
② In area two, the gasket materials may be suitable but a technical evaluation is recommended.

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.







As the maximum operating pressure and load bearing capability are both depending on the gasket thickness, KLINGER provides thickness related pT diagrams.

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Hot Compression Test / Bending Test according to ISO 178

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 hot compression test. This subjects the gasket to more severe conditions.

This test method is specified in DIN 28090-2:2014 in short-term test.

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

Temperatures up to 400°C are then applied and the additional thickness decrease is measured. This simulates the first start up phase.

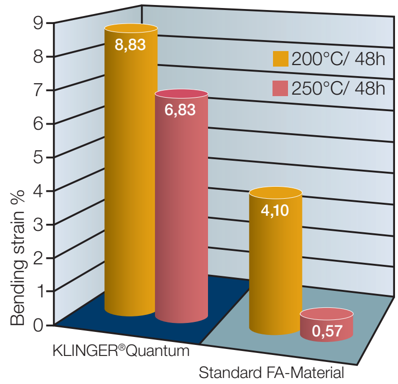
Bending Test according to ISO 178
To evaluate flexibility potentials of sealing materials the three point bending test is often used to assess the flexibility of compressed fibre materials.

In this test, the test specimen is deformed in the middle between the contact faces with a constant testing speed until it breaks, or until the deformation has reached a specified value.

For the flexibility test, specimens of a fibre-reinforced reference material and of KLINGER®Quantum were treated for 48h at 200°C and at 250°C.

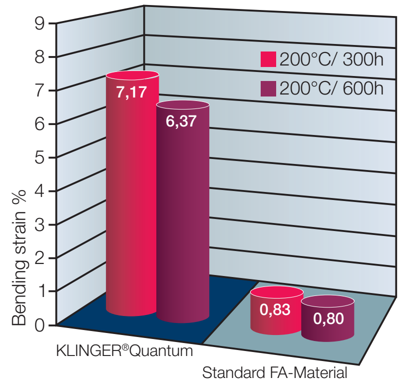
The results of the test on these artificially aged samples provide information on the aging resistance of the two different materials and underscore the high performance of KLINGER®Quantum.

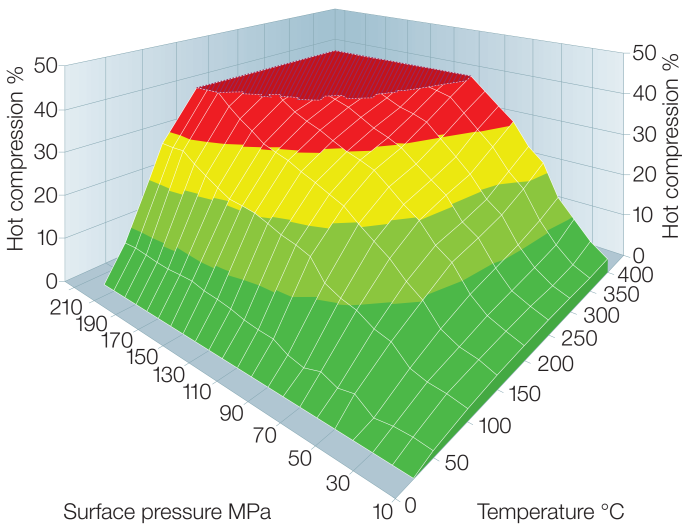
The unique behaviour of KLINGER®Quantum manifests itself even more impressively in long-term tests. For this purpose, a fibre-reinforced reference material, together with KLINGER®Quantum was again treated at a temperature of 200°C for 300 h and 600 h.



After 600 hours at a temperature of 200°C KLINGER®Quantum shows a flexibility that is 8 times higher than known fibre-reinforced gasket materials!

Particularly in steam applications, there are often strong pressure shocks that result in damage to the gasket material. A more flexible gasket that withstands greater expansions without rupture is thus a factor that contributes to a safer, more reliable gasket joint.





The diagram shows the additional thickness decrease at temperature.

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KLINGER® Quantum

Tightness of flange connections / Application and Installation instructions

Specific requirements on the tightness of flange connections
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.

In facilities, for which limited emission requirements acc. to TA-Luft or the compliance with tightness classes are required, often with increasing internal pressures high surface pressures have to be applied.

For such operating conditions the plant operator has to verify, that the required flange connections are also suitable to bear these demands without mechanical overloading.

Only gasket materials with a TA-Luft-certificate may be used. The required tightness and stress analysises acc. to EN 1591-1 (or comparable) have to be carried out with specific gasket factors acc. to EN 13555. The assembly of the gasket has to be executed solely by qualified assembly personnel (EN 1591-4:2013).

Only the controlled tightening of the bolts assures that the assembly bolt load is within the required narrow tolerances.

Tightness of flange connections in operating condition
The flange connection will remain tight as long as the surface pressure on the gasket in service is higher than the required minimum surface pressure for a certain tightness class L.

The higher the initial surface pressure of the gasket, the safer the required tightness in operating condition can be achieved.

The maximum permissible surface pressure of the gasket in operating condition may not be exceeded.

The sealing calculation program KLINGER®expert contains important information regarding the performance of KLINGER sealing materials.

Discontinuous operation
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® top-chem, KLINGER® Quantum).

In cyclic loading conditions we recommend a minimum surface stress of 30 MPa. In such cases the gasket thickness should be as thin as technically possible.
For safety and functional reasons never re-use gaskets.

The following guidelines are designed to ensure the optimum performance of a reliable flange connection.

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 a material for a given application please contact KLINGER Technical Department.

2. Media Resistance
Attention has to be paid on the fact that the media resistance of the gasket material is also given under operating conditions. In general, higher compressed gaskets show a better resistance to media influences than less compressed gaskets.

3. Gasket thickness – Gasket width
A generally binding rule to determine the required gasket thickness doesn't exist. The gasket chosen should be as thin as technically possible. In most cases, at small and medium nominal diameters, a thickness of 2 mm is sufficient. To ensure optimum performance a minimum thickness/width ratio of 1/5 is required (ideally 1/10).

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

KLINGER®Quantum

Application and Installation instructions

5. 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.

6. Gasket dimension

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

7. 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 about 0.10 to 0.14.

8. 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.

If certain tightness classes should be achieved in critical plants, the installation of the gasket has to be executed by qualified and competent assembly personnel (acc. to EN 1591-4), without exception.

9. Tightness of the flange connection

Basically the tightness depends on the applied surface pressure during installation, as well as on the remaining surface pressure in the operating condition.

Gaskets installed with high seating stresses exhibit a longer service life than gaskets installed with lower compressive stresses.

10. 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.

11. Low temperature area

KLINGER gaskets are also applicable at low temperatures without any problems. The assurance of the required surface pressure in the complete temperature range, is the precondition for the tightness of the flange connection.

12. Re-use

For safety and functional reasons never re-use gaskets.

KLINGER®expert
the powerful sealing calculation.

The powerful calculation program for the skilled personnel.
KLINGER®expert's data base contains standard flanges, bolt details and a comprehensive catalogue of media to help the user design joints, select materials and calculate installation values.
Free download.
App for Android and Apple also available.

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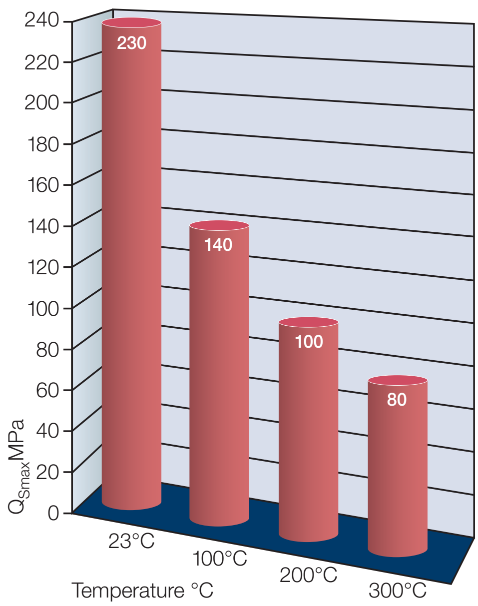
Gasket factors acc. to EN 13555

Maximum permissible surface pressure under operating condition Q_{Smax} acc. to EN 13555
The maximum surface pressure in operating condition is the maximum permissible surface pressure the gasket can be loaded at the specified temperatures.

To validate the test result of Q_{Smax}, P_{QR} values are provided. An evaluation of the tested gasket regarding unacceptable extrusion
in the bore or damage of the gasket is also required.

The diagram shows these values for the various temperature ratings.



Creep relaxation factor P_{QR} acc. to EN 13555
This factor considers the relaxation influence on the gasket load between the tightening of the bolts and the long-term effect of the service temperature.

P_{QR} values for stiffness 500 kN/mm, gasket thickness 2 mm				
Temperature	Gasket stress		P_{QR} at Q_{Smax}	Q_{Smax} (MPa)
	40 MPa	60 MPa		
23°C	0.93	0.94	0.98	230
100°C	0.83	0.89	0.76	140
200°C	0.82	0.84	0.76	100
300°C	0.72	0.72	0.67	80

Secant unloading modulus of the gasket E_G and gasket thickness e_G acc. to EN 13555

Secant unloading modulus of the gasket E_G (MPa) and gasket thickness e_G (mm)								
Gasket stress	Ambient temperature		Temperature 100°C		Temperature 200°C		Temperature 300°C	
MPa	E_G MPa	e_G mm	E_G MPa	e_G mm	E_G MPa	e_G mm	E_G MPa	e_G mm
1		1.94		1.97		1.93		1.94
20	2972	1.80	2118	1.77	4236	1.71	2850	1.73
30	3106	1.76	2558	1.74	4998	1.70	2732	1.72
40	3794	1.74	4781	1.72	4558	1.69	2418	1.71
50	5590	1.71	4649	1.71	6924	1.68	3161	1.70
60	6664	1.69	7069	1,70	5951	1.67	4983	1.68
80	7442	1.67	7365	1.66	5154	1.64	4549	1.61
100	9619	1.65	9164	1.58	6298	1.55		
120	9775	1.63	10067	1.47				
140	9550	1.62	8049	1.35				
160	10861	1.61						
180	14055	1.60						
200	15574	1.59						
220	15264	1.58						
230	13557	1.58						

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Gasket factors acc. to EN 13555

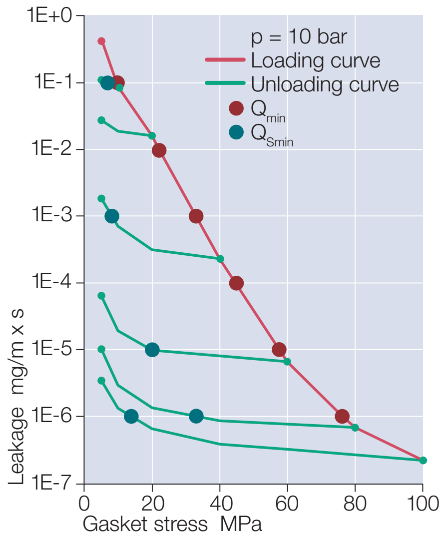
Minimum surface pressure $Q_{min(L)}$ acc. to EN13555 (Installation)
The minimum surface pressure during installation is the minimum required surface pressure, which has to be applied on the gasket surface during assembly at room temperature.
This is to assure that the gasket can adjust to the roughness of the flange surfaces, that internal leakage paths can be tightened and that the required tightness class L for the specified internal pressure will be achieved.

Minimum surface pressure $Q_{Smin(L)}$ acc. to EN13555 (Operating condition)
The minimum surface pressure in service is the minimum required surface pressure, which has to be applied on the gasket surface under operating conditions, i.e. after unloading during service, in order to keep the required tightness class L for the specified internal pressure.

Minimum stress to seal for tightness class L
$Q_{min(L)}$ at assembly/ $Q_{Smin(L)}$ after off-loading 10 bar

L mg/ s x m	$Q_{min(L)}$ MPa	$Q_{Smin(L)}$ MPa Q_A= 10 MPa	Q_A= 20 MPa	Q_A= 40 MPa	Q_A= 60 MPa	Q_A= 80 MPa	Q_A= 100 MPa
10^{-0}	5	5	5	5	5	5	5
10^{-1}	10	7	5	5	5	5	5
10^{-2}	22			5	5	5	5
10^{-3}	33			8	5	5	5
10^{-4}	45				5	5	5
10^{-5}	57				20	5	5
10^{-6}	76					33	14

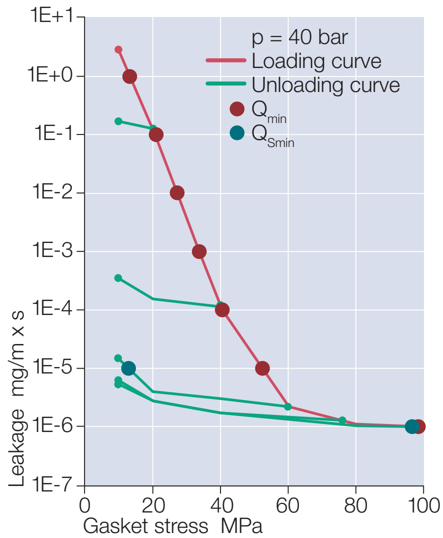
Q_A = Stress on the gasket during installation before unloading



Minimum stress to seal for tightness class L
$Q_{min(L)}$ at assembly/ $Q_{Smin(L)}$ after off-loading 40 bar

L mg/ s x m	$Q_{min(L)}$ MPa	$Q_{Smin(L)}$ MPa Q_A= 20 MPa	Q_A= 40 MPa	Q_A= 60 MPa	Q_A= 80 MPa	Q_A= 100 MPa
10^{-0}	13	10	10	10	10	10
10^{-1}	21		10	10	10	10
10^{-2}	27		10	10	10	10
10^{-3}	34		10	10	10	10
10^{-4}	40			10	10	10
10^{-5}	52			13	10	10
10^{-6}	96					98

Q_A = Stress on the gasket during installation before unloading



KLINGER® Quantum

Technical values

Unique gasket material with the highest flexibility at high temperatures, manufactured from a high quality fibre and filler compound bonded in a high temperature resistant HNBR-matrix.
Suitable for use in oils, water, steam, gases, salt solutions, fuels, alcohols, weak organic and inorganic acids, hydro-carbons, lubricants and refrigerants.

Dimensions of the standard sheets

Sizes:
1,000 x 1,500 mm,
2,000 x 1,500 mm
Thicknesses:
0.8 mm, 1.0 mm, 1.5 mm, 2.0 mm, 3.0 mm
Tolerances:
Thickness acc. DIN 28091-1, length ± 50 mm, width ± 50 mm.

Other thicknesses, sizes and tolerances on request.

Surfaces

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

Typical values for thickness 2.0 mm			
Compressibility ASTM F 36 J		%	10
Recovery ASTM F 36 J		%	50
Stress relaxation DIN 52913	50 MPa, 16 h/175°C	MPa	32
	50 MPa, 16 h/300°C	MPa	30
Stress relaxation BS 7531	40 MPa, 16 h/300°C	MPa	29
KLINGER cold/hot compression	thickness decrease at 23°C	%	10
50 MPa	thickness decrease at 300°C	%	14
	thickness decrease at 400°C	%	20
Tightness	DIN 28090-2	mg/s x m	0.02
Specific leakrate λ	VDI 2440	mbar x l/s x m	4.4E-08
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	1.7
Average surface resistance	ρ_O	Ω	7.7x10E12
Average specific volume resistance	ρ_D	Ω cm	4.7x10E12
Average dielectric strength	E_d	kV/mm	18.5
Average power factor	50 Hz	tan δ	0.064
Average dielectric coefficient	50 Hz	εr	6.8
Thermal conductivity	λ	W/mK	0.44
ASME-Code sealing factors	Leakage DIN 28090		
for gasket thickness 1.0 mm	tightness class 0.1 mg/s x m	MPa	y 15
			m 1.1
for gasket thickness 2.0 mm	tightness class 0.1 mg/s x m	MPa	y 15
			m 2.5
for gasket thickness 3.0 mm	tightness class 0.1 mg/s x m	MPa	y 15
			m 3.8
Classification acc. to BS 7531:2006	Grade AX		

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-tested
DIN-DVGW
TA-Luft (Clean air)
Fire-Safe acc. DIN EN ISO 10497

Certified according to DIN EN ISO 9001:2008

Subject to technical alterations.
Status: September 2015

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