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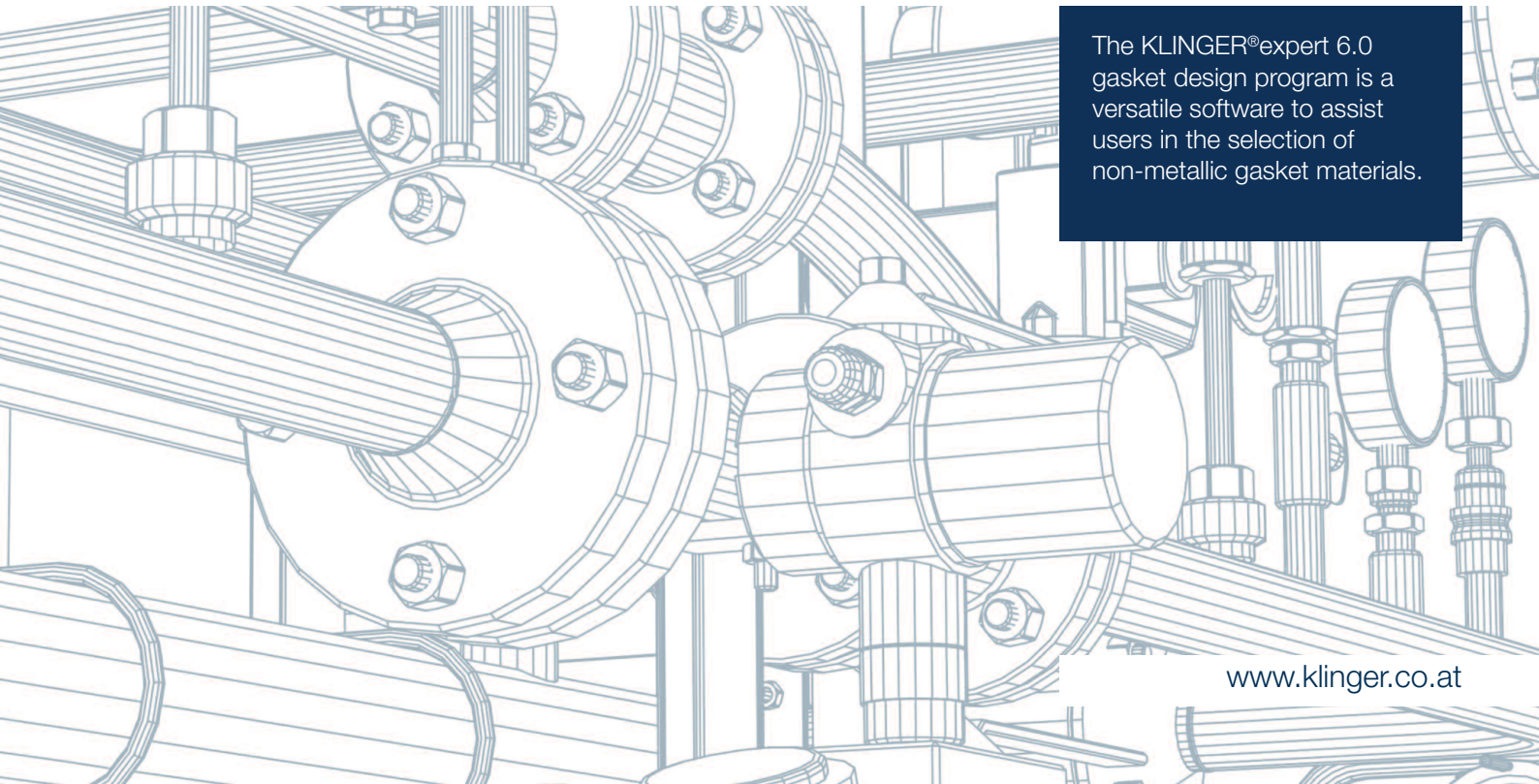
KLINGER® expert 6.0

The Powerful Sealing Calculation



The KLINGER®expert 6.0 gasket design program is a versatile software to assist users in the selection of non-metallic gasket materials.

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KLINGER®expert 6.0

Powerful Sealing Calculation

The KLINGER®expert 6.0 gasket design program is a versatile software to assist users in the selection of non-metallic gasket materials.

The program uses industry standards which contain all information for the selection of a suitable gasket material.

KLINGER®expert 6.0 offers a lot of functions, e.g.:

- **Identifcation of the best gasket material for specific applications**
- **Design of gasket assemblies**
- **Checks of chemical and temperature suitability**
- **Calculation of bolt torque requirements**
- **Graphic illustration of the scatter of various bolting-up methods**
- **Selection of required product approvals and certifcates**

1.0 Starting of the program

After starting the program an information appears. If this note is confirmed with „Accept" a new window will open in which the following possibilities can be chosen:

1.1 File

Open
opens an existing calculation file

Save
saves the current calculation

1.2 Preferences

Here you can change the default values (i.e. language).

Language
The currently used language can be altered by selecting it via the pulldown menu.

Measuring units
The requested units (SI- or US-standard) can be chosen.

Standard values
Enables a selection of the preferred or most common start-up requirements such as bolt quality, bolt utilisation and gasket thickness.

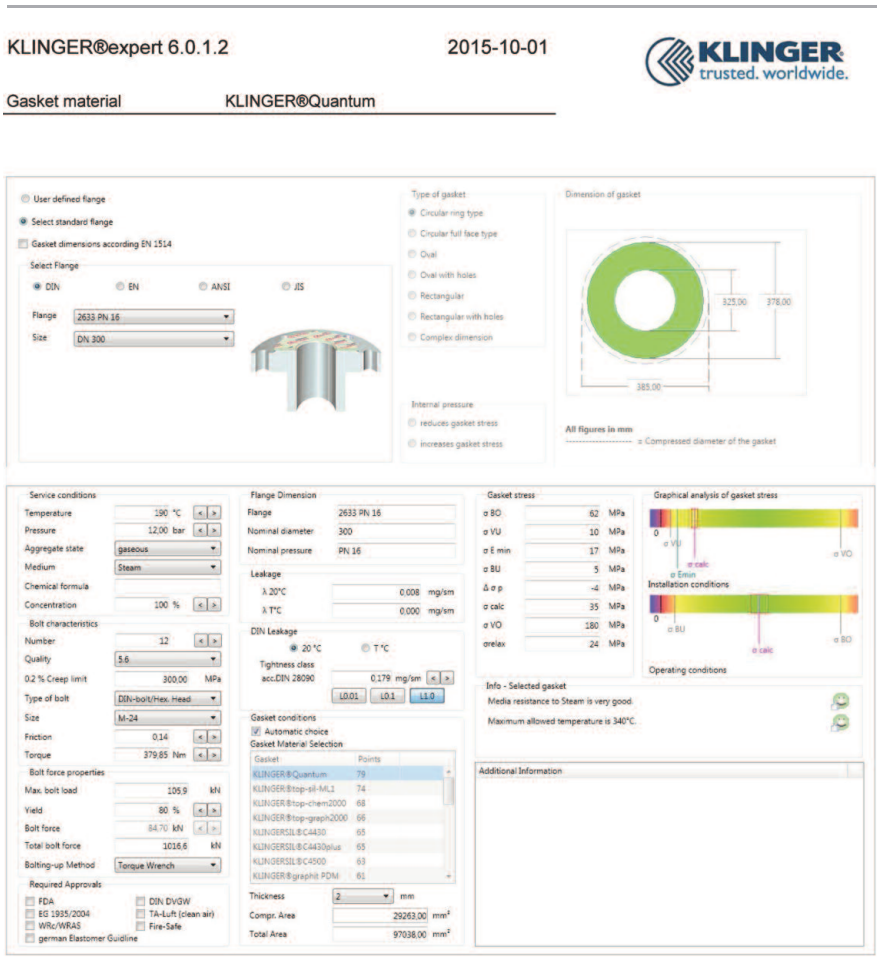
1.3 Print-out of the calculation

Prints the current gasket calculation.

The calculation results as well as some additional information concerning the gasket materials and the flange connection will be printed. There is also the possibility to print an additional user-defined comment.

1.4 Reset calculation

Resets all input values (e.g. flange dimension, temperature, pressure etc.) of the current gasket calculation.



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Flange selection

2.0 Flange selection

Flanges

KLINGER®expert 6.0 contains a wide range of standard flanges acc. to DIN, EN, JIS and ANSI standards.

KLINGER®expert 6.0 can also be used to calculate user-defined flanges.

Gasket geometry – Gasket dimensions

When using standard flanges the gasket dimensions are fixed. The drawing shows the inner and outer diameters of the gasket and also includes the dimensions of the raised face area where applicable.

At user-defined flanges the type of gasket has to be chosen. The first six options require the dimensions of the gasket, like inner and outer diameter, bolt hole size and length and width for rectangular gaskets.

The final option „Complex dimension“ requires the area of the gasket to be entered for more complex shapes.

The calculation implies an even allocation of the bolts.

The required areas are:

stressed gasket area:

Area of the gasket which will be subjected to compressive load.

total area:

The total area is defined by the outer shape of the gasket.

The type of pressure loading can be selected under the point „internal pressure”.

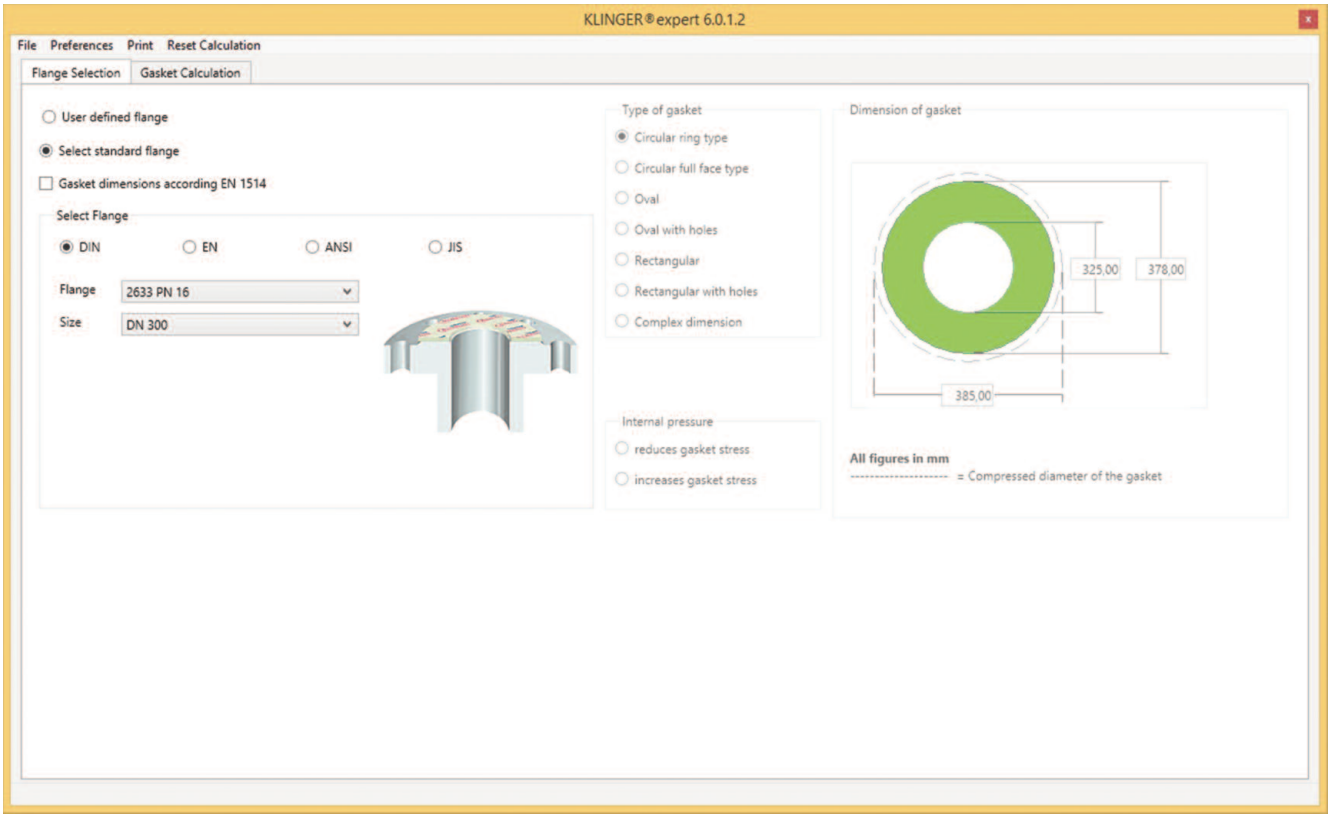
Internal pressure:

reduces gasket stress:

This is the most common type of application. The internal pressure has the effect of reducing the gasket stress.

increases gasket stress:

The option is sometimes required for boiler man hole joints for which the lid of the flange is on the inside of the vessel. Therefore the internal pressure increases the gasket stress.



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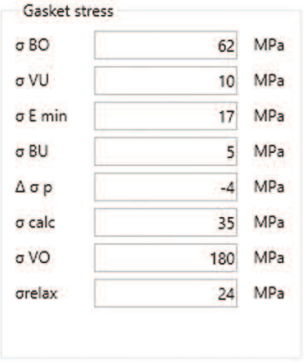
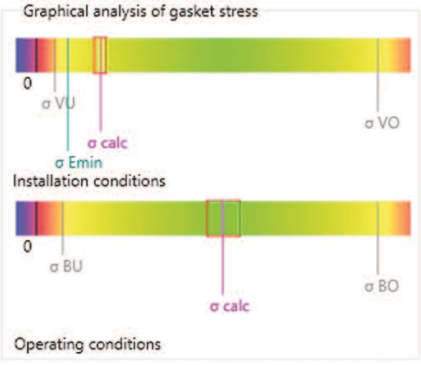
Calculation results

3.0 Gasket calculation – The analysis screen

The analysis screen is split into a number of areas:

3.1 Service conditions
3.2 Bolt characteristics
3.3 Bolt force properties
3.4 Bolting-up method
3.5 Required approvals
3.6 Flange dimensions
3.7 Tightness
3.8 Tightness acc. to DIN
3.9 Gasket conditions
3.10 Gasket material selection
3.11 Gasket stress
3.12 Info – selected gasket





3.1 Service conditions

The application temperature and pressure have to be put into the respective fields.

The aggregate state can be selected from the option box.

The medium can be chosen from the drop-down list. The specification of the medium is the same for both standard and non-standard flanges.

In many cases the chemical formula is shown automatically.

The concentration of the medium has also to be entered.

3.2 Bolt characteristics

This area displays information concerning the bolts of the flange:

Number, size and type of bolt
The number and size of the bolts is given when using standard flanges.

The type of bolt has to be selected.

For user-defined flanges the number, type and size of bolts have to be chosen first.

Bolt quality
A wide range of bolt materials are available for selection.

0,2% Creep limit
The stress applied to the bolt material to attain a permanent deformation of 0,2 %.

This value depends on the selected material and cannot be edited. This value is used in the calculation of the percentage of bolt yield.

Friction
The friction coefficient is preset with the value 0,14. It can be changed if necessary.

The lower the value the higher the amount of energy transferred into stretching the bolt and not „wasted" by friction in the thread.

Torque
The level of torque currently calculated.

3.3 Bolt force properties

The maximum bolt load is calculated depending on the bolt material.

The maximum bolt load is reduced due to the selected bolt yield.

The total bolt force is the sum of the single bolt loads.

3.4 Bolting-up method

The applied bolting-up method can also be selected in KLINGER® expert 6.0.

There are 4 bolting-up methods available:

Wrench
uncontrolled tightening by hand

Torque wrench
with measuring of the torque

Hydraulic tensioner
measuring of the hydraulic pressure

Wrench
measuring of turn of nut

If one of the bolting-up methods is selected, then the scatter of the selected bolting-up method will be shown in the graphical analysis of the gasket stress.

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Calculation results

3.5 Required approvals and certificates

In this area of the analysis screen the required approvals and certificates can be selected (not mandatory) for the current calculation.

Only gasket materials with the necessary approvals will be suggested.

3.6 Flange dimensions

Here you find information regarding the selected flange. For standard flanges nominal pressure and diameter are indicated.

For user-defined flanges a remark „user-defined flange" is shown.

It is always possible to change to the window „flange selection". There the currently selected gasket dimensions are stated.

3.7 Tightness

This value indicates the effective tightness for the reference medium nitrogen, based on the effective surface pressure.

That means, under the given application details (bolt forces, internal pressure, gasket dimensions, temperature) the flange connection would show a corresponding tightness against the reference medium nitrogen.

The tightness is calculated at room temperature (λ20) and the operating temperature (λT).

3.8 Tightness acc. to DIN

The tightness is calculated in accordance with DIN 28090 and the currently selected tightness class (L= 0,01; L= 0,1; L=1,0).

KLINGER®expert 6.0 automatically defines a tightness class based on the selected medium. The value is calculated for a gasket dimension 90 x 50 mm with the current internal pressure, material and thickness.

3.9 Gasket conditions

Gasket areas

Here the stressed gasket area and the total area are indicated.

Gasket thickness

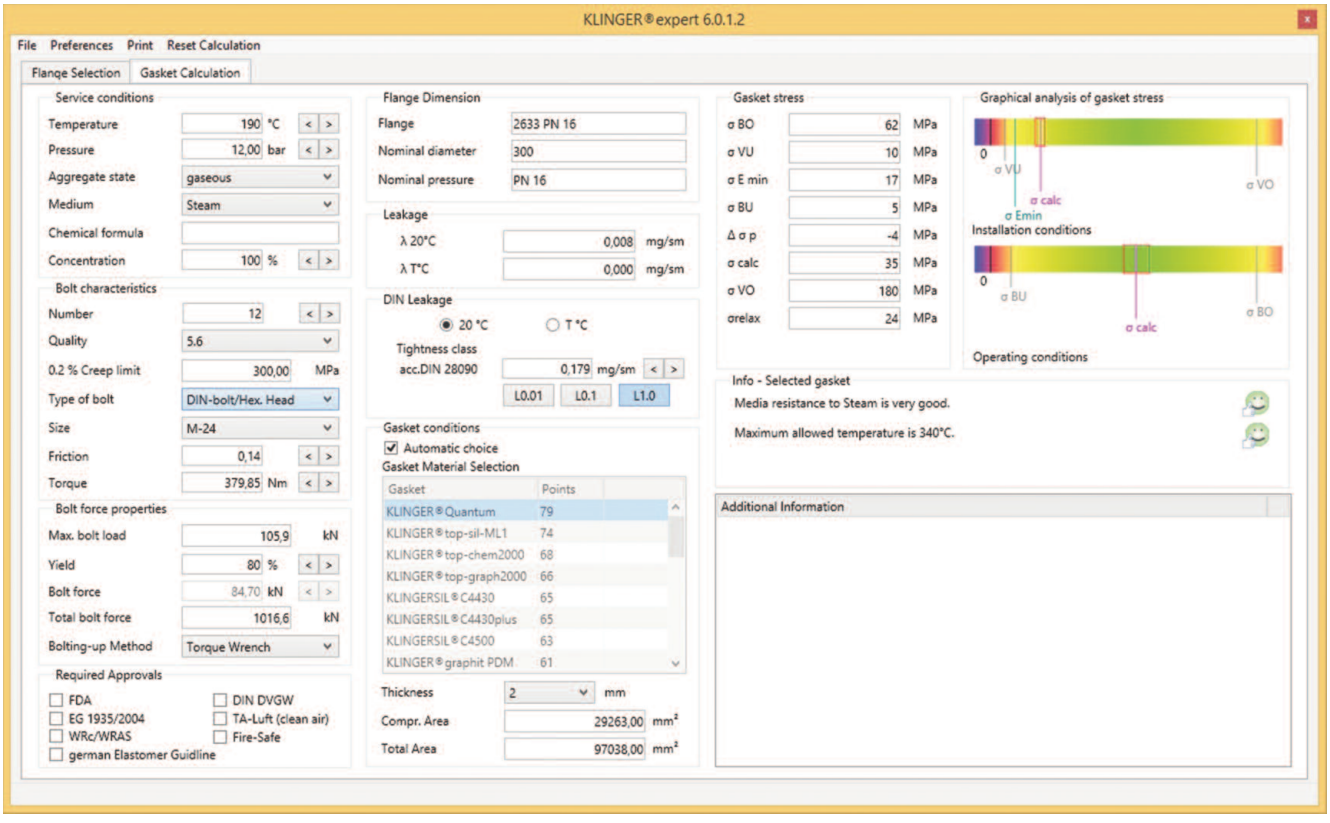
The thickness of the gasket material has to be chosen for the calculation.

3.10 Gasket material selection

The automatically selected as well as all other gasket materials are indicated regarding their suitability for the calculated application.

Every material is evaluated using a point system based on the characteristics of the single gasket materials.

KLINGER®expert 6.0 automatically selects the material with the highest score.



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Calculation results

3.11 Gasket stress

The primary information for checking the assembly is calculated and displayed.
The definitions of the terms are the following:

Maximum surface pressure under operating conditions σ_{BO}

The maximum permissible surface stress, given in N/mm², refers to the gasket material and the stated operating conditions. This value may not be exceeded by the calculated surface pressure.

The maximum stress capability of a gasket is depending on a number of factors such as temperature, material, thickness and with graphite materials in particular the width to thickness ratio.

A damage of the gasket material is possible when the material is subjected to a load higher than its maximum.

Maximum surface pressure under installing conditions σ_{VO}

σ_{VO} amounts to the value of σ_{BO} at room temperature. It is always equal to or larger than σ_{BO} and therefore does not represent an additional restrictive limitation in the calculation of the gasket.

Minimum surface pressure under operating conditions $\sigma_{BU/L}$

The minimum surface pressure $\sigma_{BU/L}$ is the surface pressure which must be applied on the effective gasket area in the operating condition to achieve the desired tightness class with the given medium, internal pressure and temperature. The actual surface pressure may not fall below this value in any case.

The higher the initial surface stress the higher the ensurance to achieve the required tightness under operating conditions.

Minimum surface pressure under installing conditions $\sigma_{VU/L}$

At least this surface stress must be reached on the sealing area through the bolt forces during assembly to guarantee the tightness requirements selected under the defined operating conditions.

Due to further variables not covered by calculation, one has to ensure that the actual installation stress lies above $\sigma_{VU/L}$. This applies especially for lower $\sigma_{VU/L}$ values (<10 N/mm²).

$\sigma_{VU/L}$ is a material specific index and does not yet take account of a possible higher necessary minimum installation surface pressure which will be required because of the relief of the gasket through the internal pressure (cf. σ_{Emin}).

Minimum installing surface pressure σ_{Emin}

The minimum installing surface pressure σ_{Emin} is the surface pressure which should be reached with the installation of the gasket.
It ensures that adequate pressure/adaption of the gasket material is achieved (cf. $\sigma_{VU/L}$), and that possible dynamic changes of the surface pressure through the internal operating pressure are taken into account (cf. $\Delta\sigma_p$).

This surface pressure should be reached by the effective pressure in view of the necessary tightness.
If this is not the case, meaning that the expected tightness is less than desired, the installation surface pressure can nevertheless still be adequate under certain circumstances.

Take account of the „Tightness acc. to DIN".

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Calculation results

Internal pressure loaded/relieved $\Delta\sigma_p$

This value represents the maximum possible arithmetical reduction or raise of the gasket stress as the result of the operating pressure during operation by this value.

The inner pressure can raise (+) or lower (-) the surface pressure during operation.

Additional reduction of the installation surface stress through the actual operating conditions, e.g. decrease of the bolt forces due to temperature cannot be covered by the calculation and therefore not be taken into consideration in this software.

The impact of the relaxation of the gasket under temperature and in consequence the reduction of the initial surface pressure is taken into account and indicated as σ_{relax}.

Calculated surface stress σ_{calc}

The surface stress indicated is determined by the calculation. It depends on the entire bolt load which is made available and on the stressed gasket area.

The compressive load due to the bolts must be sufficient to compress the material and also counteract the release of load due to the internal pressure. The torque of the bolts must be selected to ensure the calculated gasket stress σ_{calc} is higher than σ_{Emin} and lower than σ_{BO}.

Typically the bolts should be torqued to equate to a utilisation figure of 60 – 80% (DIN), ensuring the bolt operates within its elastic region and will not be over-stressed.

Equal surface stress is required over the whole gasket. Using inner pressure loaded gaskets, the calculated surface stress is determined by the bolt forces and the inner pressure too.

This value is an approximate value, because there are some not considerable parameters which have an effect on it. Also we presume that the bolts will be tighten up after applying the inner pressure.

You should pay attention that the bolts will not be overloaded, when decreasing the inner pressure.

Remaining surface stress σ_{relax}

This surface stress considers the relaxation (settling properties) of the gasket material under long-term impact of stress and temperature.

Therefore not the calculated surface pressure σ_{calc} but the surface pressure reduced by the relaxation σ_{relax} is applied on the gasket.

σ_{relax} values are determined for temperatures ranging from 25°C to 300°C, gasket thicknesses from 0,8 mm to 3 mm and surface pressures from 5 MPa to σ_{BO}.

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Rich. Klinger Dichtungstechnik GmbH & Co KG
Am Kanal 8-10
A-2352 Gumpoldskirchen, Austria
Phone +43 (0) 2252/62599-137
Fax +43 (0) 2252/62599-296
e-mail: marketing@klinger.co.at

http://www.klinger.co.at