



# KLINGER® expert 6.0

The Powerful Sealing Calculation





Powerful Sealing Calculation

The KLINGER<sup>®</sup>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<sup>®</sup> expert 6.0 offers a lot of functions, e.g.:

- Identification 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.

	expert 6.0.	1.2		2015-10-01	KLINGER trusted. worldwide				
Sasket materia	al	KLINGER®Q	uantum		-	0			
User defined fange Select standard fange Oli Gastet dimensions acc Select Flange DN Flange <u>2633 RN 1</u> Size <u>DN 200</u>	ording EN 1514	• ANSI • 25		e of gasket houter og type linder ful føre type vikil an wirkt holtes estangulær viki holtes omgler dimension mal pressure ekones gasket trives	Dimension of gasie		1300 77500		
Sanira condition-		Flance Dimension		Garbat stress		Granhical analysis of	nashat straes		
Service conditions	190 °C	Flange Dimension	2633 PN 16	Gasket stress o 80	62 MPa	Graphical analysis of	gasket stréss		
Service conditions Temperature Pressure	190 °C [-	Flange Dimension	2633 PN 16 300	Gasket stress a 80 a VU	62 MPa	Graphical analysis of	gøsket stress		
Service conditions Temperature Pressure Aggregate state	190 °C 12,00 bar gaseous	Flange Dimension Flange Flange Nominal diameter Nominal pressure	2633 PN 16 300 PN 16	Gasket stress a 80 a VU a Emin	62 MPa 10 MPa 17 MPa	Graphical analysis of	gasket stress		
Service conditions Temperature Pressure Aggregate state Medium	190 °C 12,00 bar gaseous Steam	Flange Dimension Flange Flange Flange Nominal diameter Nominal pressure Lackore	2633 PN 16 300 PN 16	Casket stress o 80 o VU o 8 min o 8U	62 MPa 10 MPa 17 MPa 5 MPa	Graphical analysis of	gasket stress		
Service conditions Temperature Pressure Aggregate state Medium Chemical formula	190 °C ( 1200 bar ( gaseous Steam	Flange Dimension Flange Nominal diameter Nominal pressure Leakage 3.000	2633 PN 16 300 PN 16	Casket stress o 80 o VU o Emin o 8U mo/em & o p	62 MPa 10 MPa 17 MPa 5 MPa -4 MPa	Graphical analysis of 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	gasket stress		
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Service conditions Temperature Pressure Aggregate state Medium Concentration Bolt characteristics	190 °C - 12,00 bar - gaseous Steam 100 % -	Flange Dimension Flange (a) Rominal diameter Nominal pressure Leakage (a) XD/C (c) AATC	2633 PN 16 300 PN 16 0.008 0.000	Gasket stress           σ 80           σ VU           σ Emin           σ 80           mg/sm         Δ σ p           mg/sm         σ calc           σ VO	62 MPa 10 MPa 17 MPa 5 MPa -4 MPa 35 MPa 180 MPa	Graphical analysis of 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	gasket stress		
Service conditions Temperature Pressure Aggregate state Medium Chemical formula Concentration Bolt characteristics Number	190 % ( 1200 bar ( gaseous Steam 100 % ( 12 ()	Flange Dimension     Fange     Fange     Nominal diameter     Nominal pressure     Leakage     A20°C     A1°C     DN Leskage     a.20°C	2633 PN 16 300 PN 16 0.008 0.000	Casket stress           σ 80           σ VU           σ 80           σ 80           g 80	62 MPs 10 MPs 17 MPs 5 MPs -4 MPs 35 MPs 180 MPs 24 MPs	Graphical analysis of 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	gasket stress		
Service conditions Temperature Pressure Apgregate state Medium Chemical formula Concertration Bolt characteristics Number Quality	130 °C ( 1200 bar ( gaseous Steam 100 % ( 12 ( 56	Flange Dimension Flange Rominal diameter Nominal presure Lealage A 30°C A 7°C T DIV Lealage 20°C T Sphness dats	2633 PN 16 300 PN 16 0.000 0.000	Cester stress a 80 a VU a 8 min a 80 a 80 a 80 mg/sm å a p mg/sm a calc a VO orelas	62 MPa 10 MPa 17 MPa 5 MPa 4 MPa 35 MPa 180 MPa 24 MPa	Graphical analysis of	gasket stress		
Service conditions Temperature Pessure Aggregate state Medium Concentration Bolt characteritics Number Quality Q2 % Creep limit	130 °C ( 1200 bar ( gaseous Steam 100 % ( 12 () 56 300,00	Flange Dimension Flange Nominal jeresure Leatage 1.30°C Call TC Call Classage Tghness class MPs. accDN 2000	2633 PN 16 300 PN 16 0.000 © T °C 0.279 mp1m	Casket these         α 80.           α 80.         α 80.           α 80.         α 80.           α 80.         α 80.           mg/tim         Δ α α.           mg/tim         α α.           α V0.         α relax           mg/tim         Δ α.           α V0.         α relax	62 MPa 10 MPa 17 MPa 4 MPa 4 MPa 180 MPa 24 MPa asset	Graphical analysis of or VI analogous or VI analogous Environmentations or VI analogous Installation conditions	gariet stries e case		
Service conditions Temperature Pressure Aggregate state Medium Concentration Bolt characteristics Number Quality Q2% Creep limit Type of bolt	150 °C ( 12,00 bar ( gateous Steam 100 % ( 12 () 56 300,00 DIN-bott/Hex. Head	Flange Dimension     Flange     Fange     Forminal pressure     Leatage     A20°C     A1°C     ONL Leatage     Con     Co	2633 PN 15 300 PN 16 0.000 © T *C 0.179 mg/sm	Casket stress a 80. a 90. a 80. a 9. a 80. a 9. a 80. a 9. a 80. a 9. a 80. a 9. a 80. a 9. a 9.	62 MPa 10 MPa 17 MPa 3 MPa 4 MPa 35 MPa 180 MPa 24 MPa sket to Steam is very good	Graphical analysis of	gariet stress		
Service conditions Temperature Pressure Aggregate state Medium Chemice formula Concernizes Diol characteristics Number Quality Quality Quality Quality Quality Size	190 °C g 190 °C g 100 % g 100 % g 100 % g 12 g 56 300.00 DIN-bot/Hex Heed M-24	Flange Dimension           Flange Dimension           Range           Nominal pressure           Leakage           λ 20°C           λ 1°C           DN Leakage           Call           ODI Leakage           Call           ODI Leakage           Call           Construction           Caster conditions	2653 PN 15 300 PN 18 0.008 0 T *C 0.179 mg/sm L001_U01_u	Casiet stress o 80 o VU o 80 o 90 o 9	62 MPa 10 MPa 17 MPa 5 MPa 4 MPa 35 MPa 180 MPa 180 MPa 24 MPa sist to Steen is very good d temperature is J40°C.	Graphical analysis of	garlet shess		
Service conditions Temporature Pressure Aggregate state Medium Chemical Romala Concertration Bolt characteristics Number Quality Q2 % Cheep limit Type of bolt Sice Fraction	190 °C ( gasaous Steam 100 % ( 56 300,00 DR-bott/Hoc Head M-24 0.14 ( 2	Flange Dimension     Flange     Fange     Normal diameter     Normal diameter     Normal pressure     Leslage     X.20°C     X.10°C     X.10°C     Cold Leslage     Cold Le	2633 PN 16 300 PN 18 0.000 0 T *C 0.179 mg/sm 1001 L01 L01 L cs	Cisket stress a 80, a 60, a 70, a 80, a 90, a 90,	62 MPa 10 MPa 17 MPa 5 MPa 4 MPa 180 MPa 24 MPa 24 MPa asket to Steem is very good d temperature is 340°C.	Graphical analysis of	genient stress		
Service conditions Temperature Pressure Aggregate table Medium Chemicki formula Chemicki formula Concentration Bolt claracteristics Number Quality Quality Quality Quality Quality Quality Git Claracteristics Number Fonction Torque	130 °C ( 12,00 bar ( gaseous Steam 100 % ( 56 300,00 DRN-bot/Hes. Head M-24 379,85 Nm ( 101 ( 102 ( 103 ( 1)	Flange Dimension     Fange     Fange     Fange     Kominal joessure     Lestage     X20°C     X1°C     Div Lestage     @ 20 °C     Tghmess deas     Me     secEl 20290     Gaset constores     Gaset Materal Sec     Sant	2933 PN 15 300 PN 15 0.000 0.000 0.179 mg/sm L001_01_01_0 st ccion	Casket stress a 80. a 90. a 90. a 80. a 80. a 80. a 80. a 80. a 80. a 90. a 90.	62 MPa 10 MPa 17 MPa 5 MPa 4 MPa 25 MPa 180 MPa 24 MPa stat to Steam is very good d temperature is 340°C.	Graphical analysis of	gasiet strèss		
Service conditions Temperature Pressure Aggregate state Medium Chemicin formula Concentrations Bolt characteristics Number Quality Qua	130 °C / 1200 bar / geseous Steam 100 % / 12 / 36 300.00 D(N-bott/Hex. Head M-24 0.14 / 379,65 Nm /	Flange Dimension     Flange     Fange     Formal diameter     Nominal diameter     Seale     Se	2633 PN 15 300 PN 16 0000 0 T °C 0.179 mg/sm 1001 401 4 con con con 77	Castet stress e 80. e VU e min e 80. e	62         MPa           10         MPa           17         MPa           3         MPa           35         MPa           35         MPa           26         MPa           24         MPa           35         MPa           24         MPa           35         MPa           24         MPa           35         MPa           36         MPa           37         MPa           38         MPa           39         MPa           300         MPa	Graphical analysis of	general stress		
Service conditions Temperature Pressure Aggregate state Medium Chemical formula Concertration Bolt characteristics Number Quality QUAIty QUAIty QUAIty QUAIty QUAIty QUAIty QUAIty QUAIty QUAIty QUAIty QUAIty Chemical formula Chemical formula Size Fraction Torque Bolt force properties Max bolt load	130 °C ( 1220 bar ( 388000) 58800 100 % ( 100 % ( 100 % ( 120 %) 120 % ( 100 % ( 100 %) 100 % ( 100 %) 100 % ( 100 %)	Flange Dimension     Flange     Fange     Normal disanter     Normal disanter     Normal pressure     Leskage     A 20°C     A 10°C     A 10°C     CIN Leskage     CIN Le	2633 PN 15 300 PN 16 0.000 0 T *C 0.179 mg/sm 0.001 401 4 ce ce Points Points NLI 74	Casket stress = 80, = 60, = 60, = 60, = 60, = 60, = 80, = 80,	62 MPa 10 MPa 17 MPa 5 MPa 4 MPa 35 MPa 180 MPa 24 MPa asket to Steam is very good of temperature is 340°C	Graphical analysis of or the second	genint stress		
Service conditions Temperature Pressure Aggregate state Medium Chenkis formula Concentration Both characteristics Number Quality Q2 % Creep limit Type of both Size Both forces properties Both forces properties Mara both tool	130 °C ( 12,00 bar ( gateoux) Steam 100 % ( 12 () 56 300,00 DIN-bott/fex. Head M-24 105,9	Flange Dimension     Flange     Fange     Fange     Normal diameter     Normal pressure     Lestage     3.20°C     D.T°C     D.T°C     Tophoses cleas     could clease conditions     Gaster conditions     Gaster conditions     Gaster     KINGER PQ-anto     KINGER Pg-anto	2633 PN 16 300 PN 16 0000 0 T °C 0.278 mg/sm 0.001 0.17 0.17 0.17 0.17 0.17 0.17 0.17 0.000 0.17 0.0000 0.00000 0.0000	Casket stress a 50. a VU a VU a VU a E mn a 8U a σ p mg/sm c case a VO a relax to fo - Salected gr Media resistance Maimum allove	62         MPa           10         MPa           17         MPa           5         MPa           35         MPa           180         MPa           24         MPa           stat         MPa           180         MPa           35         MPa           180         MPa           24         MPa           stat         to Steam is very good           difference is 340°C.         300	Graphical analysis of	gasiet stress		
Service conditions Temperature Pressure Apgregate state Medium Chemical formula Concentration Bolt diversetting Quality Bolt diverse properties Marc bolt Torque Bolt force properties Marc bolt bad Vield Bolt force Totals bolt force	130 °C ( 12,00 bar ( gatesout) Steam 100 % ( 3.6 3.0 DIN-bott/Hex.Head M-24 0.14 379.65 Nm ( 105.9 105.9 105.9 105.9	Flange Dimension     Flange     Fange     Fange     Forminal pressure     Forminal pressure     Sorr     S	2933 PN 15 200 PN 15 0.000 0.000 0.179 mg/am L001 L01 L01 L01 ct ct ct n 70 L017 mg/am L002 L01 L01 0.179 mg/am	Casiet stress     o 80     o VU     o E min     o 8U     o P     mg/km     o calc     or V0     oreles     Macinum allowe     Macinum allowe	62 MPa 10 MPa 17 MPa 5 MPa 4 MPa 180 MPa 24 MPa 24 MPa asket to Steem is very good d temperature is 340°C.	Graphical analysis of	gasient stries		
Sencie conditions Temperature Pressure Appregate state Medium Chemical formula Concernitation Bolt dinaucteritation Quality Quality Quality Quality Quality Quality Quality Quality Quality Quality Quality Quality Quality Size Friction force Bolt force Bolt force Bolt force	130 °C 2 122.0 bar 2 gaseoux Steam 100 % 2 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6	Flange Dimension     Fange     Rommal Gamete     Nommal Gamete     Searce     Sear	2853 PN 15 300 PN 16 0.008 0.000 0.176 mg/am 0.002 L0.3 L cec Physical Control	Casket stress     σ 80,     σ V0     σ v     σ v0     σ v     σ v     σ v     σ v     σ v     σ v     σ v     σ v     σ v     σ v     σ v     σ v     σ v     σ     σ v     σ	62     MPa       10     MPa       17     MPa       4     MPa       35     MPa       260     MPa       24     MPa       skatt     to Steam is very good       ditemperature is 340°C.	Graphical analysis of	geriet stress		
Service conditions Temporature Pressure Aggregate table Medium Chemical formula Concertration Bott characteristics Number Concertration Bott characteristics Number Quality Quality Quality Quality Quality Quality Quality Quality Dis Creap Joint Bott force Deporting Bott force Total bott force Bott force Bott force Deput Method	130 °C ( 1200 bar ( 3team) 100 % ( 12 ( 3-6) 300.00 DRN-b01/Hex. Head M-24 0.14 ( 379.65 Nm ( 105.9 80.55 ( 34.70 N ( 101.66) Torque Wrench	Flange Dimension     Flange     Fange     Normal diameter	2633 PN 15 300 PN 16 0.000 T °C 0.179 mg/sm 1001 L01 L0 101 101 101 101 101 101 101 1	Casket stress a 80, a VU a VU a BU BU a BU a VO a etak a VO a etak a VO a etak a VO a etak b for - Selected g Media restance Maximum allowe	62 MPa 10 MPa 17 MPa 5 MPa 4 MPa 180 MPa 24 MPa 24 MPa asket to Steam is very good d temperature is 140°C	Graphical analysis of	geniet stress		



#### Flange selection

#### 2.0 Flange selection Flanges

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

KLINGER<sup>®</sup>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:

ket stress.

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

#### 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.

Preferences Print Res lange Selection Gasket C User defined flange Select standard flange	set Calculation Calculation			
Outright Selection Gasket C     User defined flange     Select standard flange	Calculation			
User defined flange Select standard flange				
Gasket dimensions acco Select Flange	ording EN 1514	281 ()	Type of gasket  Circular ring type  Circular full face type  Val  Val  Val  Val  Val  Circular tubl face type  Val  Val  Val  Val  Val  Val  Val  Va	Dimension of gasket
520 mm	25/14/51 - 5.511-89-5		O Rectangular	325,00 378,00
Flange 2633 PN 16	6 *		Rectangular with holes	
			Internal pressure reduces gasket stress increases gasket stress	All figures in mm 



#### 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

σBO	62 M	/Pa
σVU	10 M	/Pa
σ E min	17 N	/Pa
σBU	5 1	/Pa
Δσρ	-4 N	IPa
σ calc	35 M	/Pa
σVO	180 M	/Pa
orelax	24 N	/IPa



#### 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<sup>®</sup> 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.



#### 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 ( $\lambda$ 20) and the operating temperature ( $\lambda$ T).

#### 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<sup>®</sup>expert 6.0 automatically selects the material with the highest score.

				1000 C 100						
Preferences Print I	Reset Calculation									
ange Selection Gaske	et Calculation									
Service conditions		_	Flange Dimension	-		Gasket stress			Graphical analysis of gasket stress	
Temperature	190 °C	< >	Flange	2633 PN 16		σΒΟ	62	MPa		
Pressure	12,00 bar	< >	Nominal diameter	300		σVU	10	MPa	0	
Aggregate state	gaseous	*	Nominal pressure	PN 16		σ E min	17	MPa	0,00	σV
Medium	Steam	×.	Leakage			σBU	5 MPa	MPa	o calc	
Chemical formula			λ 20°C	0.00	8 mg/sm	Δσρ	-4	MPa	Installation conditions	
Concentration	100 %	< >	λ T°C	0.00	ma/sm	σ calc	35	MPa		
Bolt characteristics			DINLeshare	0,00		σVO	180	MPa	0 g BU	
Number	12	< >	a 20 °C	0.7.0		orelax	24	MPa		σΒ
Quality	5.6	¥	20 °C     Tightness class     acc.DIN 28090     0,179 mg/sm < >						o caic	
0.2 % Creep limit	300,00	MPa				Operating conditions				
Type of bolt	DIN-bolt/Hex. Head	~	L0.01 L0.1 L1.0			Media resistance to Steam is very good.				
Size	M-24	~	Gasket conditions			Maximum allow	ad temperature	ir 240°C		
Friction	0.14	< >	Automatic choice		Maximum allow	eu temperature	15 340 C.		2	
Torque	379.85 Nm	< >	Gasket Material Selec	ction						
Bolt force properties		handens!	KLINGER & Quantum	Points	2	Additional Informa	tion			
Max. bolt load	105.9	kN	KLINGER® top-sil-M	L1 74						
Vield	80 %	6 3	KLINGER * top-chem	2000 68						
Bolt force	84.70 KN		KLINGER® top-grap	h2000 66						
Total bolt force	1016.6	kN	KLINGERSIL®C4430	65 ph/c 65						
Bolting-up Method	Torque Wrench		KLINGERSIL®C4500	63						
Basicad Association	rorque wrench	×1	KLINGER® graphit P	DM 61						
Required Approvals		Thickness	2 ¥ mm							
EG 1935/2004	TA-Luft (cle	an air)	Compr. Area	29263	.00 mm <sup>2</sup>					
WRc/WRAS	Fire-Safe		Total Area	97038	00 mm <sup>2</sup>					



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 $\sigma_{BO}$

The maximum permissible surface stress, given in N/mm<sup>2</sup>, 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 $\sigma_{\text{VO}}$

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

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

The minimum surface pressure  $\sigma_{\text{BU/L}}$  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  $\sigma_{\text{VU/L}}$ . This applies especially for lower  $\sigma_{\text{VU/L}}$  values (<10 N/mm<sup>2</sup>).

 $\sigma_{VU/L}$  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.  $\sigma_{Emin}$ ).

### $\begin{array}{l} \mbox{Minimum installing surface} \\ \mbox{pressure } \sigma_{\mbox{Emin}} \end{array}$

The minimum installing surface pressure  $\sigma_{\text{Emin}}$  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.  $\sigma_{\text{VU/L}}$ ), and that possible dynamic changes of the surface pressure through the internal operating pressure are taken into account (cf.  $\Delta \sigma_{\text{p}}$ ).

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".



#### 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  $\sigma_{relax}$ .

### Calculated surface stress $\sigma_{calc}$

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  $\sigma_{calc}$  is higher than  $\sigma_{Emin}$  and lower than  $\sigma_{BO}$ .

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 $\sigma_{\rm relax}$

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  $\sigma_{calc}$  but the surface pressure reduced by the relaxation  $\sigma_{relax}$  is applied on the gasket.

 $\sigma_{\text{relax}}$  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  $\sigma_{\text{BO}}$ .





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