Flange connections acc. to EN13445-3 Annex G (May 2002)

Names and symbols are as defined in EN 13445-3 Annex G (May 2002)
KF = 1 Integral flange KF=2 Flat closure(KS=0) KF=3 Loose flange
KS = 1 Cylindrical or Conical shell KS=2 Spherical shell
KG = 1 Flat gasket
2 Metal gasket, curved surfaces, simple touching (Input rfG)
3 Ring joint metal gasket, octogonal (Input bGV, dGv needed)
4 Metal gasket, curved surfaces, double touching (Input rfG)

Nomination: Cover 1

F l a n g e geometry (see figures 4 to 10):			side 1	side 2
Type of flange	KF	=	1	1
Type of connected shell	KS	=	2	1
tan(Inclination of shell)	tan(phiS)	=	2.2180	0.0000
Axial thickness of flange at dGe	eFt	/mm =	40.00	46.00
Equivalent axial thickn. of flange	eF	/mm =	38.00	43.57
Ax. thickn. rad. loaded by press.	eP	/mm =	38.00	43.57
Equiv. axial thickn. loose flange	eL	/mm =	0.00	0.00
Flange thickness at weak section	eX	/mm =	0.00	0.00
Diameter at weak section	dX	/mm =	0.00	0.00
Inside diameter of flange	d0	/mm =	592.00	592.00
Average diameter of hub, thin end	d1	/mm =	598.30	601.00
Average diameter of hub, thick end	d2	/mm =	598.30	626.00
Bolt circle diameter	d3	/mm =	770.00	770.00
Outside diameter of flange	d4	/mm =	845.00	845.00
Diameter of bolt hole	d5	/mm =	30.00	30.00
Inside diameter of loose flange	d6	/mm =	0.00	0.00
Min. diameter of force transfer	d7min	/mm =	0.00	0.00
Outside diameter stub or collar	d8	/mm =	0.00	0.00
Diameter of central hole (KF=2)	d9	/mm =	0.00	0.00
Wall thickness inside d0 (KF=2)	e0	/mm =	0.00	0.00
Min. wall thickn. thin end of hub	e1;es	/mm =	6.30	9.00
Wall thickness at thick end of hub	e2	/mm =	6.30	34.00
Length of hub	lH	/mm =	0.00	59.00
Number of bolt holes in flange	NB	=	20	20

B o l t s geometry (see figure 2):			
Number of bolts	nB	=	20
Nominal diameter	dB0	/mm =	29.00
Effective diameter	dBe	/mm =	24.19
Diameter of waisted stud	dBs	/mm =	24.19
Length of clamp	lB	/mm =	88.00
Length of waist	lS	/mm =	0.00
G a s k e t geometry (see figure 3):			
Type of gasket	KG	=	1
Touching diameter (KG=2)	dG0	/mm =	0.00
Inside diameter	dG1	/mm =	620.00
Outside diameter	dG2	/mm =	685.00
Axial thickness	eG	/mm =	2.00
r2*cos(phiG)	rFG	/mm =	0.00
Set value of bGe	bGv	/mm =	0.00
Set value of dGe	dGv	/mm =	0.00

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Flange connections according to EN 13445-3 Annex G (May 2002)

Nomination: Cover 1

Materials input data :				(Explanations see page 4)
Load case:	Assembly	Test	Oper. 1	
Flange material side 1 :				C22.8 DIN 17243
Material of shell side 1 :				St35.8 I
TF /°C =	20.0	20.0	220.0	
fF /MPa =	228.0	228.0	118.0	
EF /MPa =	211000.0	211000.0	194000.0	
alfF *K =	0.0000111	0.0000111	0.0000123	
TS /°C =	20.0	20.0	220.0	
fS /MPa =	223.8	223.8	118.0	
TL /°C =	0.0	0.0	0.0	
fL /MPa =	0.0	0.0	0.0	
EL /MPa =	0.0	0.0	0.0	
alfL *K =	0.0000000	0.0000000	0.0000000	
Flange material side 2 :				C22.8 DIN 17243
Material of shell side 2 :				St35.8 I
TF /°C =	20.0	20.0	220.0	
fF /MPa =	228.0	228.0	118.0	
EF /MPa =	211000.0	211000.0	194000.0	
alfF *K =	0.0000111	0.0000111	0.0000123	
TS /°C =	20.0	20.0	220.0	
fS /MPa =	223.8	223.8	118.0	
TL /°C =	0.0	0.0	0.0	
fL /MPa =	0.0	0.0	0.0	
EL /MPa =	0.0	0.0	0.0	
alfL *K =	0.0000000	0.0000000	0.0000000	
Bolts material :				5.6 DIN 267 Teil 13
TB /°C =	20.0	20.0	220.0	
fB /MPa =	285.7	285.7	153.3	
EB /MPa =	212000.0	212000.0	197600.0	
alfB *K =	0.0000119	0.0000119	0.0000131	
A >= 10%				
Gasket material :				PTFE
TG /°C =	20.0	20.0	220.0	
Qmax/MPa =	50.0	50.0	20.0	
E0 /MPa =	600.0	600.0	400.0	
alfG *K =	0.0000000	0.0000000	0.0000000	
K1 =	20.0	20.0	20.0	
Qmi, m =	10.00	1.30	1.30	
gC =	1.00	0.90	0.50	
Load conditions :				
Number of load cases:	3			
P /MPa =	0.000	2.000	1.200	
FR /N =	0	0	0	
VarP =	0.000	0.000	0.000	
VarFR =	0.000	0.000	0.000	

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	Design Rules for Flange Connections	Page 3 of 4

Flange connections according to EN 13445-3 Annex G (May 2002)

Nomination: Cover 1

Assemblage and control data :			
Min. load ratio of bolts	PhiBmin =	0.300	
Scatter values of bolting up	eps1+ eps1- =	0.100	0.100
Friction coefficient of bolts	mue n mue t =	0.200	0.200
Number of reassemblies during service	NR =	10	

Results :

Load conditions:			
Load case:	Assembly	Test	Oper. 1
P /MPa =	0.000	2.000	1.200
FR /N =	0	0	0
FQ /N =	0	714209	428526
FG /N =	954991	58936	281027
FB /N =	954991	773145	709552
delU/mm =	0.0000	0.0000	0.0197
Load ratios:			
PhiB =	0.432	0.294	0.503
PhiG =	0.158	0.010	0.116
PhiF1 =	0.602	0.653	0.990
PhiL1 =	0.000	0.000	0.000
PhiF2 =	0.221	0.268	0.420
PhiL2 =	0.000	0.000	0.000
Inclination angles /rad:			
TheF1 =	0.01736	0.01593	0.01525
TheL1 =	0.00000	0.00000	0.00000
TheF2 =	0.00260	0.00366	0.00312
TheL2 =	0.00000	0.00000	0.00000
Compliances /(mm*10**-6/N):			
YQI =	1.23385	1.23385	1.34118
YRI =	0.91887	0.91887	0.99860
YGI =	1.07586	1.08280	1.24765
Diameters of force transfer (Loose flanges):			
d7_1 /mm =	0.00	0.00	0.00
d7_2 /mm =	0.00	0.00	0.00
Forces:			
FGmin/N =	226676	58936	35361

F u r t h e r r e s u l t s :				
Effective gasket width	bGe /mm =	10.70		
Effective diameter of gasket	dGe /mm =	674.30		
Details for assembly of bolts:				
Scatter values total bolt force	eps+ eps- =	0.042	0.042	
Nominal bolt force	FBOnom /N =	954991		
Bolt assembly torque	Mt /Nm =	334.0		
Bolt elongation at assemblage	d_lB /mm =	0.041		

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Flange connections according to EN 13445-3 Annex G (May 2002)

Explanations for page 2 (Material data)

TF	=	temperature	flange/stub/collar
fF	=	nominal design stress	flange/stub/collar
EF	=	modulus of elasticity	flange/stub/collar
alfF	=	thermal expansion coefficient	flange/stub/collar
TS	=	temperature	shell
fS	=	nominal design stress	shell
TL	=	temperature	loose flange
fL	=	nominal design stress	loose flange
EL	=	modulus of elasticity	loose flange
alfL	=	thermal expansion coefficient	loose flange
TB	=	temperature	bolts
fB	=	nominal design stress	bolts
EB	=	modulus of elasticity	bolts
alfB	=	thermal expansion coefficient	bolts

TG	=	temperature	gasket
Qmax	=	maximum allowable compressive stress	gasket
E0	=	modulus of elasticity	gasket
alfG	=	thermal expansion coefficient	gasket
K1	=	rate of change modulus of elasticity	gasket
Qmin	=	minimum required compr. stress	gasket
m	=	m-factor, m=Q/P	gasket
gC	=	creep factor	gasket

Explanations for loading values

P	=	calculation pressure, internal pressure positive
FR	=	additional axial force (includes external bending moment)
VarP	=	auxiliary value for estimation of allowable pressure
VarFR	=	auxiliary value for estimation of allowable axial force

Explanations for resulting variables

Forces:

FQ	=	axial force of calculation pressure
FG	=	gasket force
FB	=	total bolt force of all bolts
FGmin	=	minimum gasket force

Expansion:

delU	=	overall thermal expansion

Load ratios:

PhiB	=	for bolts	
PhiG	=	for gasket	
PhiF1/2	=	for flange/stub/collar side 1/2	
PhiL1/2	=	for loose flange side 1/2	for KF=3 (loose flange)
PhiL1/2	=	for section X side 1/2	for KF=2 (flat closure)

F u r t h e r r e s u l t s :			
Required bolt force	FB0req /N	=	878409
Lowest gasket force	FGdelt /N	=	878409
Required gasket force	FG0req /N	=	878409
Design gasket force	FG0des /N	=	878409

Date :	Name:	Chckd.:	Appr.: