

Date _____ Calc. _____ Chkd. _____ Appr. _____

Software by SANT'AMBROGIO S.I. srl - Milano, Italy - EN Rev. 1.21-kEeB/aUs
WELDING NECK FLANGE POS.:4
According to EN 13445-3 Ed. 2002 up to issue 17 (Clause 11)

* CALCULATION TEMPERATURE $T = 60.0 \text{ }^{\circ}\text{C}$

* MATERIAL:

FLANGE (Rec.Nr 188) SA 350 LF2 PMA REQUIRED
SHELL (Rec.Nr 119) SA 516 Gr. 60 PMA REQUIRED
BOLTING (Rec.Nr 229) SA 320 L7 PMA REQUIRED; $\leq 63.5 \text{ mm}$
GASKET -1 -Tesneni

* NOMINAL DESIGN STRESSES: -Flange-----Hub-----Bolting-----

	MPa	MPa	MPa
OPERATING	158.250 (f)	140.750 (fH)	215.500 (fB)
ASSEMBLY	165.333 (fA)	147.333 (fH,A)	215.500 (fB,A)
TESTING	236.190 (ftest)	210.476 (fH,test)	323.250 (fB,test)

* GASKET PARAMETERS: $m = 2.75$ $y = 30.00 \text{ MPa}$

Design pressure	$P_d =$	0.900 MPa
Overpressure due to static head - Design	$P_h =$	0.000 MPa
Calculation pressure	$P = (P_d + P_h) =$	0.900 MPa
Test pressure	$P_t =$	1.510 MPa
Overpressure due to static head - Test	$P_{ht} =$	0.000 MPa
Calculation test pressure	$P_{test} = (P_t + P_{ht}) =$	1.510 MPa
Corrosion allowance	$c =$	3.0 mm
Flange outside diameter	$A =$	756.0 mm
Bolt circle	$C =$	708.0 mm
Gasket width	$w =$	20.0 mm
Mean gasket diameter	$G_{mean} =$	655.0 mm
Flange inside diameter (uncorroded)	$B =$	610.0 mm
Hub at large end	$g_1 =$	10.0 mm
Shell thickness	$g_0 =$	10.0 mm
Flange thickness	$e =$	49.0 mm
Hub length	$h =$	40.0 mm
Bolt number and type	$n =$	12 M20 x 2,50 (Iso)
Bolt outside diameter	$db =$	20.00 mm
Cross-sectional area of one bolt	$Ab =$	244.79 mm ²
Distance between adjacent bolts	$\Delta tab =$	185.35 mm

----- CALCULATED GASKET DIMENSIONS -----

Basic gasket seating width	$bo = w/2$	=	10.000 mm
Effective gasket seating width	$b = 2.52 * \text{SQR}(bo) [bo > 6.3]$	=	7.969 mm
Diameter of gasket load reaction	$G = G_{mean} + w - 2 * b$	=	659.062 mm

---- CHECK OF BOLTING AREA (adopted cross-sectional area: $AB = 2937.53 \text{ mm}^2$) ----

Operating: $Wop \geq 3.14/4 * G^2 * P + 2 * b * 3.14 * G * m * P$	=	388706.682 N
Assembly : $WA \geq 3.14 * G * b * y$	=	494740.877 N
Testing : $Wtest \geq 3.14/4 * G^2 * P_{test} + 2 * b * 3.14 * G * m * P_{test}$	=	652163.433 N

$ABop = Wop / fB$	=	1803.743 mm ²
$ABA = WA / fB,A$	=	2295.781 mm ²
$ABtest = Wtest / fB,test$	=	2017.520 mm ²

$AB \text{ (max.for gasket crush)} = 6.28 * y * G * w / fB,A$	=	11452.622 mm ²
---	---	---------------------------

Date _____ Calc. _____ Chkd. _____ Appr. _____

Software by SANT'AMBROGIO S.I. srl - Milano, Italy - EN Rev. 1.21-eBgB/aUs
WELDING NECK FLANGE POS.:4
According to EN 13445-3 Ed. 2002 up to issue 17 (Clause 11)

----- FLANGE LOADS, LEVER ARMS AND MOMENTS -----				
cF	= MAX[SQR(Deltab/(2*db+6*e/(m+0.5))),1]	=	1.192	
hD	= (C-B-c-g1)/2	=	42.5	mm
hT	= (2*C-B-2*c-G)/4	=	35.2	mm
hG	= (C-G)/2	=	24.5	mm
OPERATING:				
HD	= 3.14/4*(B+2*c)^2*P	=	268221.6	N
HG	= 2*3.14*b*G*m*P	=	81673.7	N
HT	= 3.14/4*G^2*P-HD	=	38811.4	N
Mop	= HD*hD+HT*hT+HG*hG	=	14765386.2	N*mm
M	= Mop*CF/(B+2*c)	=	28570.9	N
ASSEMBLY:				
W	= 0.5*(AB,min+AB)*fB,A	=	563889.1	N
MA	= W*hG	=	13797768.1	N*mm
M	= MA*CF/(B+2*c)	=	26698.6	N
TESTING:				
hD	= (C-B-g1)/2	=	44.0	mm
hT	= (2*C-B-G)/4	=	36.7	mm
HD	= 3.14/4*B^2*Ptest	=	441292.5	N
HG	= 2*3.14*b*G*m*Ptest	=	137030.2	N
HT	= 3.14/4*G^2*Ptest-HD	=	73840.7	N
Mtest	= HD*hD+HT*hT+HG*hG	=	25482353.1	N*mm
M	= Mtest*CF/B	=	49793.1	N
----- FLANGE FACTORS -----(operating / testing)				
K	=A/(B+2*c)	=	1.227 /	1.239
BetaU	=(K^2*(1+8.55246*LGT(K))-1)/1.36136/(K^2-1)/(K-1)	=	10.547 /	10.079
BetaT	=(K^2*(1+8.55246*LGT(K))-1)/(1.0472+1.9448*K^2)/(K-1)	=	1.828 /	1.823
BetaY	=(0.66845+5.7169*K^2*LGT(K)/(K^2-1))/(K-1)	=	9.598 /	9.172
(g1-c)/(g0-c)		=	1.000 /	1.000
h/SQR((B+2*c)(g0-c))		=	0.609 /	0.512
BetaF	= (figure 11.5-4)	=	0.909 /	0.909
BetaV	= (figure 11.5-5)	=	0.550 /	0.550
fi	= (figure 11.5-6)	=	1.000 /	1.000
I0	= sqr[(B+2*c)*(g0-c)]	=	65.666 /	78.102
Lambda	=(e*BetaF+I0)/(BetaT*I0)+e^3*BetaV/(BetaU*I0*go^2)	=	2.825 /	1.684
Note: Flange factors in testing conditions do not include corrosion allowance				
----- FLANGE STRESSES----- (MPa --- operating / assembly / testing)				
k*SigmaH	= k*fi*M/(Lambda*g1^2)	=	206.389 /	192.864 / 295.762
k*SigmaR	= k*(1.333*e*BetaF+I0)*M/(Lambda*e^2*I0)	=	8.020 /	7.494 / 21.682
k*SigmaTeta	= k*(BetaY*M/e^2-SigmaR*(K^2+1)/(K^2-1))	=	74.506 /	69.624 / 87.623
k*0.5*(SigmaH+SigmaR)		=	107.205 /	100.179 / 158.722
k*0.5*(SigmaH+SigmaTeta)		=	140.448 /	131.244 / 191.693
Stress Factor k		=	1.000 /	1.000 / 1.000
----- PRESSURES -----				
	1.43*Pd	=	1.287	MPa
FLANGE:	1.25*Pd*fA/f	=	1.175	MPa
BOLTS:	1.25*Pd*fB,A/fB	=	1.125	MPa
MAX DESIGN PRESSURE - BOLTS		=	1.47	MPa
MAX TEST PRESSURE - BOLTS		=	2.20	MPa
MAX DESIGN PRESSURE - FLANGE		=	1.02	MPa
MAX TEST PRESSURE - FLANGE		=	1.81	MPa
WEIGHTS: Gross=	152.4 Kg,	Net=	64.9 Kg,	Gross-Net= 87 Kg (57 %)