

**Project summary****Project : Flådestation Frederikshavn, Tanklag**

ID No.:

References

European Standard	EN 13480-3
Standard title	Metallic industrial piping
Standard edition	Issue 1
Standard dated	2002-08-05
ICS number	ICS 23.040.01
Program version	Version 1.0
Program build	Build 057 15-02-2009
Program development	Danish Exergy Technology - DXT

Nomenclature, equation numbers and figure numbers are made with direct reference to the English printed version of this European Standard.

Component type	Component name	Component ID	Mat. code	Mat. grade	Status
Cylindrical shell	OD273 X 6,3		EN10216-2	P235GH	OK
Nozzle No. 1	NOZZLE DN250/DN50		EN10216-2	P235GH	OK
Elbow 90°	ELBOW 90		EN10216-2	P235GH	OK
Tee	TEE DN250/DN250		EN10216-2	P235GH	OK
Tee	TEE DN250/DN200		EN10216-2	P235GH	OK
Reducer	REDUCER DN250/DN200		EN10216-2	P235GH	OK

**Project Flådestation Frederikshavn, Tanklag****Component : OD273 X 6,3****ID No.:****Global data**

Shell type	--	Cylindrical
Nominal diameter	mm	250
Product PSxDN	bar mm	6250
Piping class according to EN13480-1 Table4.1-1	--	1
Pipe volume	liter	0
Weight of pipe including content (W)	kg	0
Weight of fluid (WF)	kg	0

Operation data

Medium	--	Fuel gas-MARINEDIESEL
Fluid state	--	Liquid
Fluid group	--	2
Maximum operation pressure	barg	25,0
Maximum operation temperature	°C	40,0
Number of full load cycles	No	500
Component lifetime	hours	200000
Lifetime monitor system provided Yes/No	--	No

Design data for internal pressure

Maximum allowable internal pressure (PSmax)	barg	25,0
Design pressure (Pd)	barg	25,0
Calculation pressure (Pc)	barg	25,0
Minimum allowable temperature (TSmin)	°C	0,0
Maximum allowable temperature (TSmax)	°C	50,0
Calculation temperature (tc)	°C	50,0

Design data for external pressure

Maximum allowable external pressure (PSmax)	barg	0,0
Design pressure (Pd)	barg	0,0
Calculation pressure (Pc)	barg	0,0
Minimum allowable temperature (TSmin)	°C	20,0
Maximum allowable temperature (TSmax)	°C	20,0
Calculation temperature (tc)	°C	20,0

Test conditions

Testing group	--	--
Testing method	--	hydrostatic
Extent of NDT for governing welded joints	%	--
Test temperature	°C	20,0
Design stress at test conditions	N/mm ²	223,3
Design stress ratio at test pressure calculation (fa/ft)	--	1,06
Test pressure according to EN13480-5 (9.3.2-2)	barg	33,2
Test pressure according to EN13480-5 (9.3.2-3)	barg	35,8
Test pressure	barg	35,8
Maximum allowable internal test pressure	barg	46,0
		35,8

Assembly conditions

Assembly pressure (PA)	barg	0,0
Assembly temperature (TA)	°C	20,0
Design stress at assembly conditions	N/mm ²	--



EN13480 ver 1.0

CALCULATION OF CYLINDRICAL SHELL ACCORDING TO EN13480-3

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Project Flådestation Frederikshavn, Tanklag**Component : OD273 X 6,3****ID No.:****Shell under internal pressure**

Material code	--	EN10216-2
Material designation	--	P235GH
Material number	--	1.0345
Minimum tensile stress at 20°C (Rm)	N/mm ²	360,0
Minimum tensile stress at design temperature (Rmt)	N/mm ²	0,0
Minimum 0,2% proof stress at design temperature (Rp02)	N/mm ²	221,1
Minimum 1,0% proof stress at design temperature (Rp10)	N/mm ²	0,0
Creep rupture 200000 h at design temperature (RmT200)	N/mm ²	0,0
Elasticity module at design temperature (E) *1,0E-03	N/mm ²	209,7
Elongation after rupture	%	0,0
Dimensioning stress	--	Rp02
Safety factor (S)	--	1,50
Design stress (f)	N/mm ²	147,4
Thickness tolerance code	--	EN10216-2
Thickness class	--	None
Minus tolerance on ordered nominal wall thickness (C1p)	%	20,0
Minus tolerance on ordered nominal wall thickness (C1)	mm	1,26
Allowance for possible thinning during manufacturing process (C2)	mm	0,00
Allowance for metal wastage (C0)	mm	1,00
Outside shell diameter (Do)	mm	273,0
Ordered nominal wall thickness of shell (eord)	mm	6,3
Actual wall thickness of shell excl allowance (ea)	mm	4,0
Internal diameter (Di)	mm	264,9
Mean diameter (Dm)	mm	269,0
Weld or joint efficiency (z)	--	1,00
Minimum wall thickness with efficiency = 1,0 excl allowance	mm	2,295
Minimum wall thickness with efficiency = 1,0 incl allowance	mm	4,555
Minimum wall thickness with actual efficiency excl. allowance (e) (eq 6.1-1)	mm	2,295
Minimum wall thickness with actual efficiency incl allowance (e+C0+C1+C2)	mm	4,555
Max allowable pressure with actual efficiency (Pmax)	barg	44,2
Allowable efficiency (Za)	--	0,565
Max allowable internal pressure at test conditions	barg	67,1
Notional pressure (Pr)	barg	45,0

**Project : Flådestation Frederikshavn, Tanklag****Component : NOZZLE DN250/DN50****ID No.:**

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Nozzle number	:	1
Nozzle type	--	Set on
Nozzle radial angle (Psi1)	deg	0,0
Nozzle axial angle (Psi2)	deg	0,0
Material code	--	EN10216-2
Material grade	--	P235GH TC2
Material number	--	1.0345
Minimum tensile stress at 20°C (Rm)	N/mm ²	360,0
Minimum tensile stress at design temperature (Rmt)	N/mm ²	0,0
Minimum 0,2% proof stress at design temperature (Rp02)	N/mm ²	221,1
Minimum 1,0% proof stress at design temperature (Rp10)	N/mm ²	0,0
Dimensioning stress	--	Rp02
Safety factor	--	1,50
Design stress (fb)	N/mm ²	147,4
Calculation stress (fob)	N/mm ²	147,4
Thickness tolerance code	--	EN10216-2
Thickness class	--	NA
Minus tolerance on ordered wall thickness (C1p)	%	12,5
Minus tolerance on ordered wall thickness (C1)	mm	0,66
Allowance for metal wastage (C0)	mm	1,00
Ordered nominal outside diameter of nozzle (db)	mm	60,30
Ordered nominal wall thickness of nozzle (eord,b)	mm	5,30
Length of nozzle extending outside shell (lb)	mm	14,36
Length of nozzle extending inside shell (lbi)	mm	0,00
Nominal thickness of reinforcing plate (epn)	mm	0,00
Nominal width of reinforcing plate (lp)	mm	0,00
Distance between opening and shell discontinuity (X) (Figure 8.3.2-1)	mm	--
Nozzle welding coefficient factor (z)	mm	1,00
Inside diameter of nozzle excl allowance (dib)	mm	53,02
Effective wall thickness of nozzle (eb)	mm	3,64
Analysis thickness of nozzle (eab)	mm	3,64
Effective length of compensation shell (ls) (eq 8.4.1-2)	mm	32,96
Effective length of external projection (l'b) (eq 8.4.3-1)	mm	14,36
Effective length of inner projection (l'bi) (eq 8.4.3-2)	mm	0,00
Effective thickness of reinforcing plate (eapl) (eq 8.4.3-5)	mm	0,00
Effective width of reinforcing plate (lpl) (eq 8.4.3-4)	mm	0,00
Minimum distance between opening and shell discontinuity (Xmin) . (eq 8.3.2-1)	mm	12,12
Pressure area in shell (Aps) (Figure 8.4.3-1)	mm ²	8360,0
Pressure area in branch (Apb) (Figure 8.4.3-1)	mm ²	487,8
Pressure area total (Ap) (Figure 8.4.3-1)	mm ²	8847,8
Stress area shell (Afs) (Figure 8.4.3-1)	mm ²	147,9
Stress area nozzle (Afb) (Figure 8.4.3-1)	mm ²	52,3
Stress area reinforcing plate (Afp) (Figure 8.4.3-2)	mm ²	0,0
Load capacity shell (eq 8.4.3-3)	N	21615
Load capacity nozzle (eq 8.4.3-3)	N	7641
Load capacity reinforcing pad (eq 8.4.3-3)	N	0
TOTAL LOAD CAPACITY (eq 8.4.3-3)	N	29256
TOTAL LOAD (eq 8.4.3-3)	N	22120
Max allowable pressure at design temperature (Pmax)	barg	33,0

**Project : Flådestation Frederikshavn, Tanklag****Component : ELBOW 90****ID No.:**

Fitting number	:	1
Fitting Code	--	DIN2605
Fitting type	--	Elbow 90°
Nominal diameter	--	DN250
Design / Bauart	--	Bauart 3
Wall thickness series	--	Series 3
Calculation pressure (pc)	barg	25,0
Calculation temperature (tc)	°C	50,0
Material code	--	EN10216-2
Material grade	--	P235GH TC2
Material number	--	1.0345
Minimum tensile stress at 20°C (Rm)	N/mm ²	360,0
Minimum proof stress at design temperature (Rp02)	N/mm ²	221,1
Creep rupture stress 100.000 h (RmT100)	N/mm ²	0,0
Creep rupture stress 200.000 h (RmT200)	N/mm ²	0,0
Dimensioning stress	--	Rp02
Safety factor	--	1,50
Allowable stress (f)	N/mm ²	147,4
Outside diameter (da)	mm	273,0
Nominal wall thickness (S)	mm	6,3
Bending radius (r)	mm	381,0
Bending radius(b)	mm	518,0
Dimension (e)	mm	158,0
.....	mm	--
Efficiency / Ausnutzungsgrad	%	78,0
Minus tolerance on ordered wall thickness (C1p)	%	12,5
Minus tolerance on ordered wall thickness (C1)	mm	0,79
Allowance for metal wastage (C2)	mm	1,00
Required thickness for straight tube excl. allowance (e) (eq 6.1-1)	mm	2,30
Required thickness for fitting excl. allowance	mm	2,94
Actual thickness of fitting excl. allowance	mm	4,51
Required thickness for fitting incl. allowance	mm	4,72
Max allowable operation pressure	barg	38,6
Max allowable test pressure	barg	58,5

**Project : Flådestation Frederikshavn, Tanklag****Component : TEE DN250/DN250****ID No.:**

Fitting number	:	2
Fitting Code	--	DIN2615
Fitting type	--	Tee
Nominal diameter	--	DN250
Design / Bauart	--	DN250/DN250
Wall thickness series	--	Series 4
Calculation pressure (pc)	barg	25,0
Calculation temperature (tc)	°C	50,0
Material code	--	EN10216-2
Material grade	--	P235GH TC2
Material number	--	1.0345
Minimum tensile stress at 20°C (Rm)	N/mm ²	360,0
Minimum proof stress at design temperature (Rp02)	N/mm ²	221,1
Creep rupture stress 100.000 h (RmT100)	N/mm ²	0,0
Creep rupture stress 200.000 h (RmT200)	N/mm ²	0,0
Dimensioning stress	--	Rp02
Safety factor	--	1,50
Allowable stress (f)	N/mm ²	147,4
Outside diameter large end (d1)	mm	273,0
Nominal wall thickness large end (S1)	mm	8,8
Outside diameter small end (d2)	mm	273,0
Nominal wall thickness small end	mm	8,8
Dimension (a)	mm	216,0
Dimension (b)	mm	216,0
Efficiency / Ausnutzungsgrad	%	41,0
Minus tolerance on ordered wall thickness (C1p)	%	12,5
Minus tolerance on ordered wall thickness (C1)	mm	1,10
Allowance for metal wastage (C2)	mm	1,00
Required thickness for straight tube excl. allowance (e) (eq 6.1-1)	mm	2,30
Required thickness for fitting excl. allowance	mm	5,53
Actual thickness of fitting excl. allowance	mm	6,70
Required thickness for fitting incl. allowance	mm	7,63
Max allowable operation pressure	barg	30,4
Max allowable test pressure	barg	46,0

**Project : Flådestation Frederikshavn, Tanklag****Component : TEE DN250/DN200****ID No.:**

Fitting number	:	3
Fitting Code	--	DIN2615
Fitting type	--	Tee
Nominal diameter	--	DN250
Design / Bauart	--	DN250/DN200
Wall thickness series	--	Series 4
Calculation pressure (pc)	barg	25,0
Calculation temperature (tc)	°C	50,0
Material code	--	EN10216-2
Material grade	--	P235GH TC2
Material number	--	1.0345
Minimum tensile stress at 20°C (Rm)	N/mm ²	360,0
Minimum proof stress at design temperature (Rp02)	N/mm ²	221,1
Creep rupture stress 100.000 h (RmT100)	N/mm ²	0,0
Creep rupture stress 200.000 h (RmT200)	N/mm ²	0,0
Dimensioning stress	--	Rp02
Safety factor	--	1,50
Allowable stress (f)	N/mm ²	147,4
Outside diameter large end (d1)	mm	273,0
Nominal wall thickness large end (S1)	mm	8,8
Outside diameter small end (d2)	mm	219,1
Nominal wall thickness small end	mm	8,0
Dimension (a)	mm	216,0
Dimension (b)	mm	203,0
Efficiency / Ausnutzungsgrad	%	44,0
Minus tolerance on ordered wall thickness (C1p)	%	12,5
Minus tolerance on ordered wall thickness (C1)	mm	1,10
Allowance for metal wastage (C2)	mm	1,00
Required thickness for straight tube excl. allowance (e) (eq 6.1-1)	mm	2,30
Required thickness for fitting excl. allowance	mm	5,16
Actual thickness of fitting excl. allowance	mm	6,70
Required thickness for fitting incl. allowance	mm	7,26
Max allowable operation pressure	barg	32,6
Max allowable test pressure	barg	49,4

**Project : Flådestation Frederikshavn, Tanklag****Component : REDUCER DN250/DN200****ID No.:**

Fitting number	:	4
Fitting Code	--	DIN2616
Fitting type	--	Reducer
Nominal diameter	--	DN250
Design / Bauart	--	DN250/DN200
Wall thickness series	--	Series 3
Calculation pressure (pc)	barg	25,0
Calculation temperature (tc)	°C	50,0
Material code	--	EN10216-2
Material grade	--	P235GH TC2
Material number	--	1.0345
Minimum tensile stress at 20°C (Rm)	N/mm ²	360,0
Minimum proof stress at design temperature (Rp02)	N/mm ²	221,1
Creep rupture stress 100.000 h (RmT100)	N/mm ²	0,0
Creep rupture stress 200.000 h (RmT200)	N/mm ²	0,0
Dimensioning stress	--	Rp02
Safety factor	--	1,50
Allowable stress (f)	N/mm ²	147,4
Outside diameter large end (d1)	mm	273,0
Nominal wall thickness large end (S1)	mm	6,3
Outside diameter small end (d2)	mm	219,1
Nominal wall thickness small end	mm	6,3
Transition angle (alpha)	mm	28,0
Transition Length (L1)	mm	178,0
Efficiency / Ausnutzungsgrad	%	94,0
Minus tolerance on ordered wall thickness (C1p)	%	12,5
Minus tolerance on ordered wall thickness (C1)	mm	0,79
Allowance for metal wastage (C2)	mm	1,00
Required thickness for straight tube excl. allowance (e) (eq 6.1-1)	mm	2,30
Required thickness for fitting excl. allowance	mm	2,44
Actual thickness of fitting excl. allowance	mm	4,51
Required thickness for fitting incl. allowance	mm	4,23
Max allowable operation pressure	barg	46,5
Max allowable test pressure	barg	70,5