

Company Name -

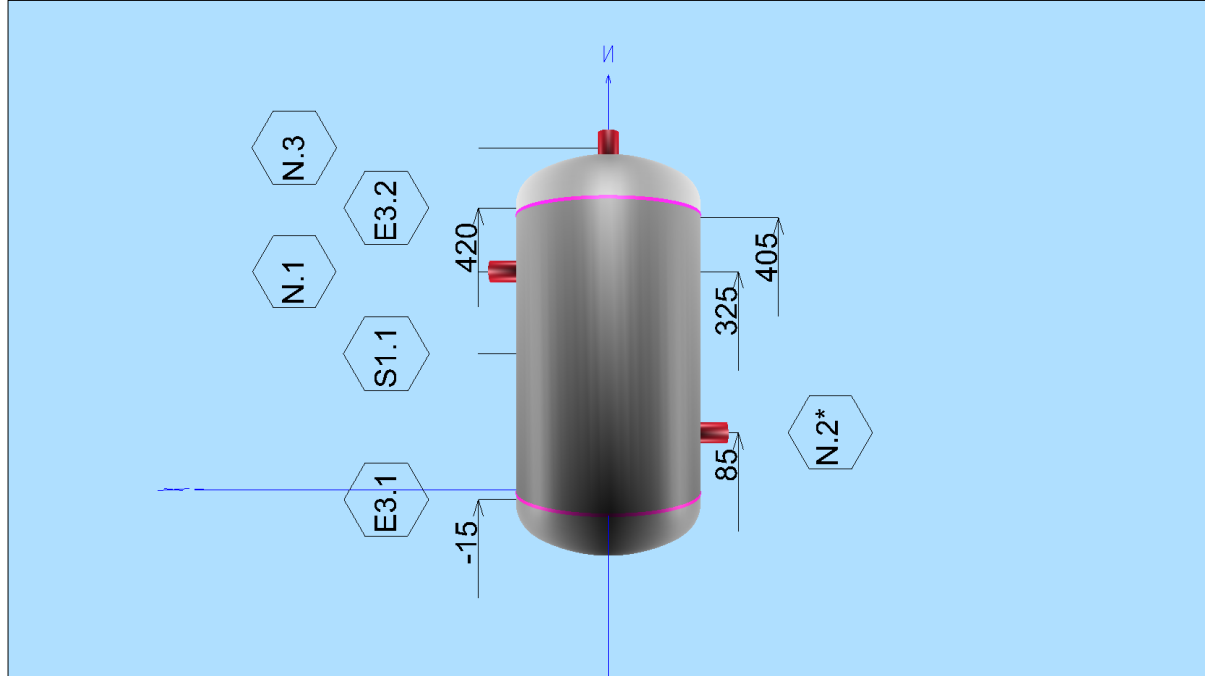
Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

(0) Drawing

3D View of Vessel (alter by using the Save User Specified View command)



Design Data & Process Information

Description	Units	Design Data
Process Card		General Design Data
Design Code & Specifications		EN13445 TG = 3b
Internal Design Pressure (MPa)	MPa	3.3
External Design Pressure (MPa)	MPa	
Hydrotest Pressure (MPa)	MPa	
Maximum Design Temperature (°C)	°C	130
Minimum Design Temperature (°C)	°C	-20
Operating Temperature (°C)	°C	
Corrosion Allowance (mm)	mm	0.5
Content of Vessel		
Specific Density of Oper.Liq		
Normal Liquid Level NLL (mm)	mm	

Utilization Chart

Utilization Chart

Company Name -

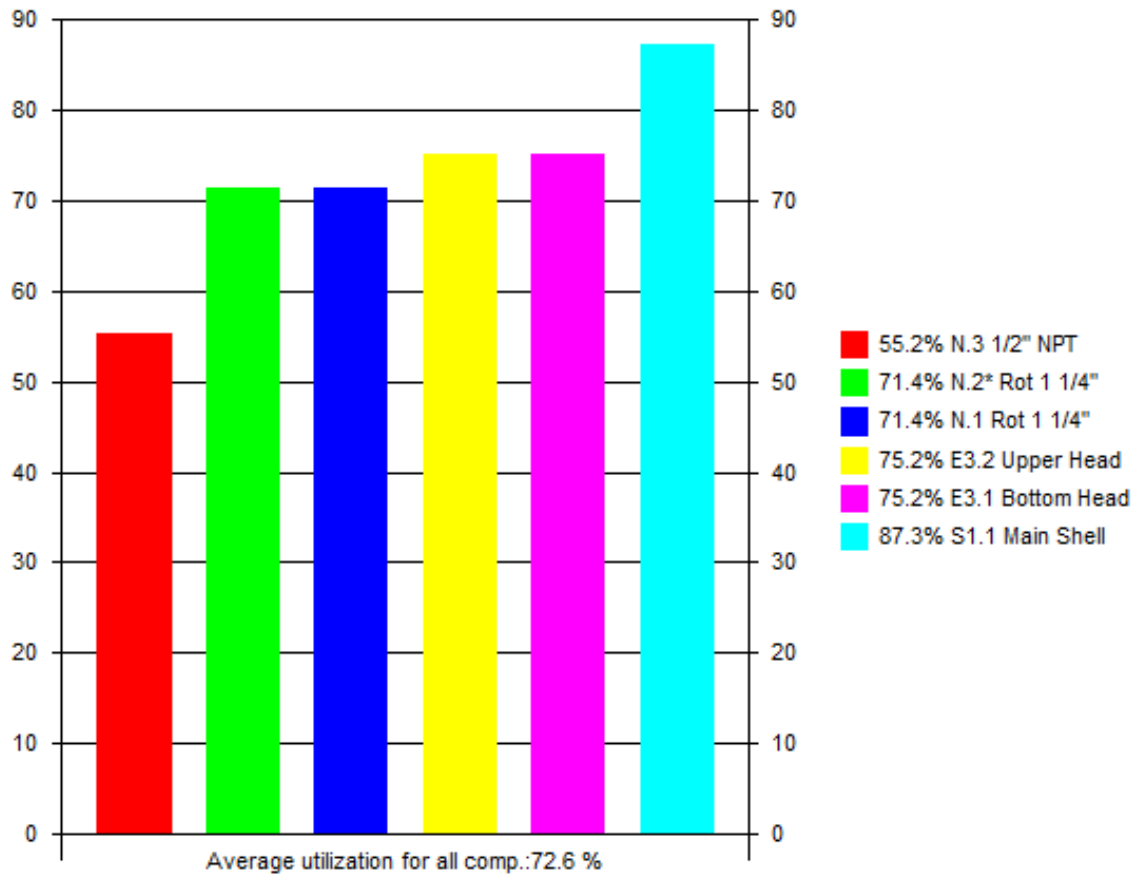
Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator :

Rev.:A

ONENTS UTILIZATION CHART - Client :GÜVEN SOGUTMA Vessel Tag No.:V8A.33B.30.A3.



Maximum Utilization of 87.3% for Component S1.1 Main Shell - VVD by Hexagon PPM, Ver:20.0

Welding Information

EN1708-1 Welding Requirements for Pressurized Components

NOTE: No welding information has been specified by the user.

Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 7.4.2 CYLINDRICAL SHELL

S1.1 Main Shell 24 Apr. 2023 09:27

INPUT DATA

COMPONENT ATTACHMENT/LOCATION

Distance from end of cylinder to ref. DATUM LINE....:mm 0.00 mm

GENERAL DESIGN DATA

PRESSURE LOADING: Design Component for Internal Pressure Only

PROCESS CARD:

General Design Data : Temp= 130°C, P=3.3000 MPa, c=0.5 mm, Pext=0.0000 MPa

SPECIFIC DENSITY OF OPERATING LIQUID.....:SG 0.00

LIQUID HEAD.....:LH 0.00 mm

SHELL DATA

CYLINDER FABRICATION: Welded Pipe

WELD JOINT COEFFICIENT: Testing Group 3 (z=0.85)

NEGATIVE TOLERANCE: Negative tolerance specified in mm

EN 10217-3:2019, 1.0565 P355NH welded tube, HT:N THK<=20mm 130'C

Rm=490 Rp=355 Rpt=292 f=194.67 f20=204.17 ftest=338.1 E=203868(N/mm²) ro=7.85

OUTSIDE DIAMETER OF SHELL.....:De 273.00 mm

LENGTH OF CYLINDRICAL PART OF SHELL.....:Lcyl 405.00 mm

NOMINAL WALL THICKNESS (uncorroded).....:en 4.0000 mm

NEGATIVE TOLERANCE/THINNING ALLOWANCE.....:th 0.3000 mm

Split shell into several shell courses and include welding information: NO

WELDING REQUIREMENTS TO EN 1708-1:2010

Comment(Optional):

Type of welded connection: Not Applicable

CALCULATION DATA

7.4.2 - CYLINDRICAL SHELLS UNDER INTERNAL PRESSURE

Required Minimum Shell Thickness Excl.Allow. emin :

$$\text{emin} = \text{De} * \text{P} / (2 * \text{f} * \text{z} + \text{P}) \quad (7.4-2)$$
$$= 273 * 3.3 / (2 * 194.67 * 0.85 + 3.3) = 2.6954 \text{ mm}$$

Required Minimum Shell Thickness Incl.Allow. :

$$\text{emina} = \text{emin} + \text{c} + \text{NegDev} = 2.7 + 0.5 + 0.3 = 3.4954 \text{ mm}$$

Analysis Thickness

$$\text{ea} = \text{en} - \text{c} - \text{NegDev} = 4 - 0.5 - 0.3 = 3.2000 \text{ mm}$$

»7.4.1 Cond.of Applicability $\text{emin}/\text{De} = 0.0099 \leq 0.16$ » OK«

Internal Pressure $\text{emina} = 3.5 \leq \text{en} = 4$ [mm]	87.3%	OK
--	-------	----

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :

Inside Diameter of Shell

$$\text{Di} = \text{De} - 2 * \text{ea} = 273 - 2 * 3.2 = 266.60 \text{ mm}$$

Mean Diameter of Shell

$$\text{Dm} = (\text{De} + \text{Di}) / 2 = (273 + 266.6) / 2 = 269.80 \text{ mm}$$

MAWP HOT & CORR. (Corroded condition at design temp.)

$$\text{MAWPHC} = 2 * \text{f} * \text{z} * \text{ea} / \text{Dm} = 2 * 194.67 * 0.85 * 3.2 / 269.8 = 3.9251 \text{ MPa}$$

MAWP NEW & COLD (Uncorroded condition at ambient temp.)

$$\text{MAWPNC} = 2 * \text{f20} * \text{z} * (\text{ea} + \text{c}) / \text{Dm}$$
$$= 2 * 204.17 * 0.85 * (3.2 + 0.5) / 269.8 = 4.7599 \text{ MPa}$$

MAX TEST PRESSURE (Uncorroded cond.at ambient temp.)

Ptmax = 2 * ftest * ztest * (ea + c) / Dm

$$= 2 * 338.1 * 1 * (3.2 + 0.5) / 269.8 = 9.2733 \text{ MPa}$$

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Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 7.4.2 CYLINDRICAL SHELL

S1.1 Main Shell 24 Apr. 2023 09:27

EN13445-5;10.2.3.3 REQUIRED MIN.HYDROSTATIC TEST PRESSURE:Ptmin

NEW AT AMBIENT TEMP. FOR TEST GROUPS 1, 2 and 3

$$Ptmin = 1.25 * Pd * f_{20} / f = 1.25 * 3.3 * 204.17 / 194.67 = 4.3263 \text{ MPa}$$

$$Ptmin = 1.43 * Pd = 1.43 * 3.3 = 4.7190 \text{ MPa}$$

Test Pressure Ptmin=4.72 <= Pmax=9.27[MPa]	50.8%	OK
--	-------	----

MAXIMUM DIAMETER OF UNREINFORCED OPENING IN SHELL

Inside Radius of Shell

$$ris = Di / 2 (9.5-3) = 266.6 / 2 = 133.30 \text{ mm}$$

Length of Shell Contributing to Reinforcement

$$Is = Sqr((2 * ris + ea) * ea) (9.5-2)$$

$$= Sqr((2 * 133.3 + 3.2) * 3.2) = 29.38 \text{ mm}$$

Maximum Diameter of Unreinforced Opening in Shell Checked to Rules in Section 9

$$dmax1 = MIN(0.5 * Di, (ea * Is * (f - 0.5 * P) / (P - ris * Is)) / (0.5 * ris + 0.5 * ea)) (9.5-7, 22, 23)$$

$$= MIN(0.5 * 266.6, (3.2 * 29.38 * (194.67 - 0.5 * 3.3) / (3.3 - 133.3 * 29.38)) / (0.5 * 133.3 + 0.5 * 3.2)) = 23.19 \text{ mm}$$

Maximum diameter of Opening Not Requiring Reinforcement Check

$$dmax2 = 0.15 * Sqr((2 * ris + ea) * ea) (9.5-18)$$

$$= 0.15 * Sqr((2 * 133.3 + 3.2) * 3.2) = 4.4074 \text{ mm}$$

Maximum Diameter of Unreinforced Opening

$$dmax = MAX(dmax1, dmax2) = MAX(23.19, 4.41) = 23.19 \text{ mm}$$

CALCULATION SUMMARY

7.4.2 - CYLINDRICAL SHELLS UNDER INTERNAL PRESSURE

Required Minimum Shell Thickness Excl.Allow. emin :

$$emin = De * P / (2 * f * z + P) (7.4-2)$$

$$= 273 * 3.3 / (2 * 194.67 * 0.85 + 3.3) = 2.6954 \text{ mm}$$

Required Minimum Shell Thickness Incl.Allow. :

$$emina = emin + c + NegDev = 2.7 + 0.5 + 0.3 = 3.4954 \text{ mm}$$

Internal Pressure emina=3.5 <= en=4[mm]	87.3%	OK
---	-------	----

MAX TEST PRESSURE (Uncorroded cond.at ambient temp.)

$$Ptmax = 2 * f_{test} * z_{test} * (ea + c) / Dm$$

$$= 2 * 338.1 * 1 * (3.2 + 0.5) / 269.8 = 9.2733 \text{ MPa}$$

EN13445-5;10.2.3.3 REQUIRED MIN.HYDROSTATIC TEST PRESSURE:Ptmin

NEW AT AMBIENT TEMP. FOR TEST GROUPS 1, 2 and 3

$$Ptmin = 1.25 * Pd * f_{20} / f = 1.25 * 3.3 * 204.17 / 194.67 = 4.3263 \text{ MPa}$$

$$Ptmin = 1.43 * Pd = 1.43 * 3.3 = 4.7190 \text{ MPa}$$

Test Pressure Ptmin=4.72 <= Pmax=9.27[MPa]	50.8%	OK
--	-------	----

MAXIMUM DIAMETER OF UNREINFORCED OPENING IN SHELL

Maximum Diameter of Unreinforced Opening

$$dmax = MAX(dmax1, dmax2) = MAX(23.19, 4.41) = 23.19 \text{ mm}$$

Volume:0.0226 m3 Weight:10.7 kg (SG= 7.85)

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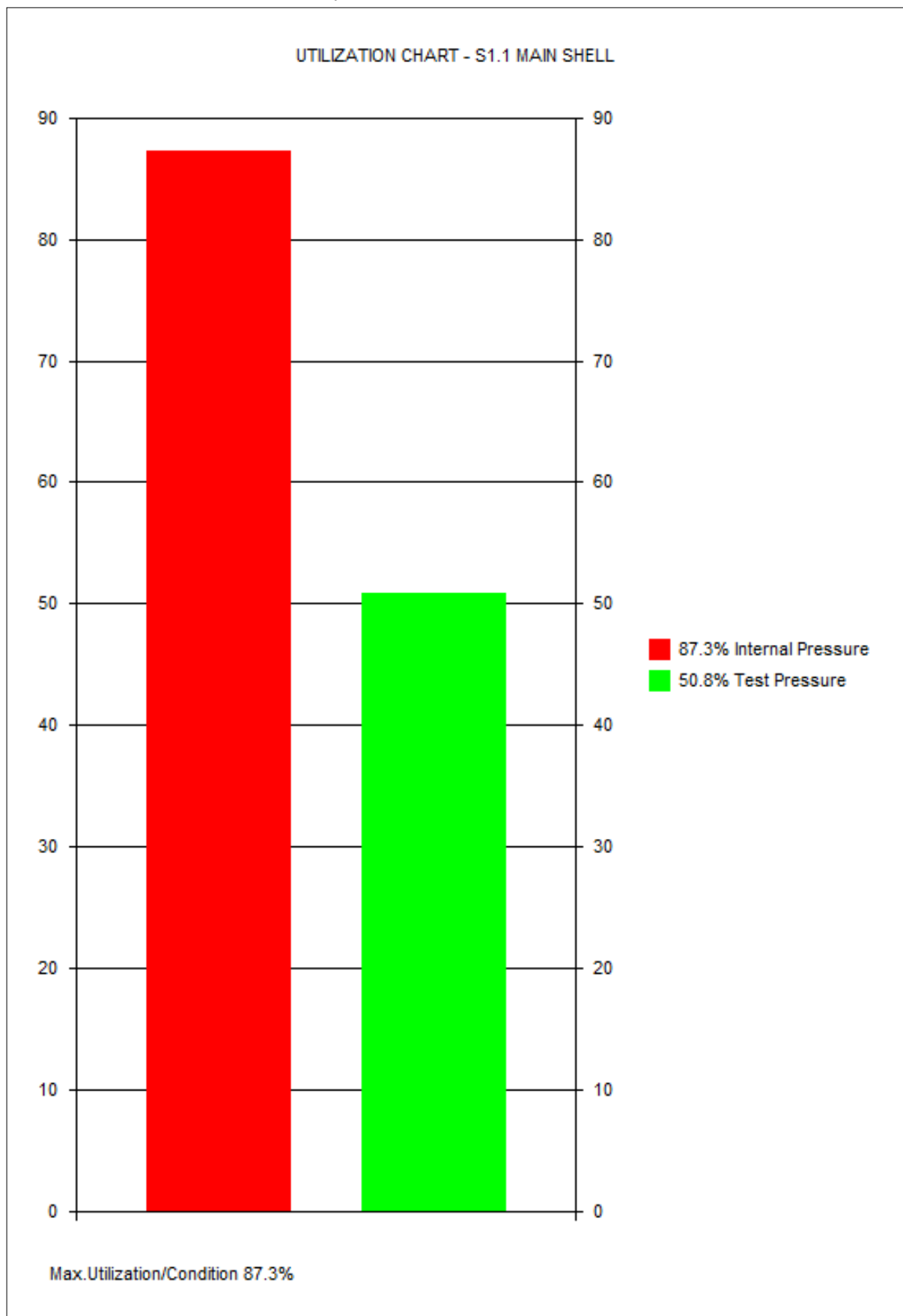
Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 7.4.2 CYLINDRICAL SHELL

S1.1 Main Shell

24 Apr. 2023 09:27



Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 7.5 DOMED ENDS

E3.1 Bottom Head 24 Apr. 2023 09:30 ConnID:S1.1

INPUT DATA

COMPONENT ATTACHMENT/LOCATION

Attachment: S1.1 Cylindrical Shell Main Shell
Location: Along z-axis zo= 0

GENERAL DESIGN DATA

PRESSURE LOADING: Design Component for Internal Pressure Only

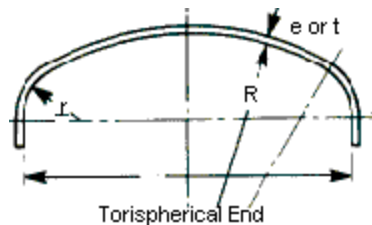
PROCESS CARD:

General Design Data : Temp= 130°C, P=3.3000 MPa, c=0.5 mm, Pext=0.0000 MPa

SPECIFIC DENSITY OF OPERATING LIQUID.....:SG 0.00

LIQUID HEAD.....:LH 0.00 mm

DIMENSIONS OF END



Type of Torispherical End: Dished End KORBOGEN DIN 28013-28014/SMS 482

WELD JOINT COEFFICIENT: Unwelded Component(z=1.0)

OUTSIDE DIAMETER OF CYLINDRICAL FLANGE OF END.....:De 273.00 mm

LENGTH OF CYLINDRICAL FLANGE OF END.....:Lcyl 15.00 mm

NEGATIVE TOLERANCE/THINNING ALLOWANCE.....:th 0.3000 mm

NOMINAL THICKNESS OF HEAD/END (uncorroded).....:en 4.0000 mm

Include calculation of forming during fabrication to EN13445-4 Section 9.: NO

MATERIAL DATA FOR END

EN 10028-2:2017, 1.0473 P355GH plate and strip, HT:N THK<=16mm 130'C

Rm=510 Rp=355 Rpt=308.6 f=205.73 f20=212.5 ftest=338.1 E=203868(N/mm2) ro=7.85

Material & Delivery Form: NOT Cold Spun Seamless Austenitic Stainless Steel

NOZZLES IN KNUCKLE REGION TO SECTION 7.7

Nozzles In Knuckle Region: NO

WELDING REQUIREMENTS TO EN 1708-1:2010

Comment(Optional):

Type of welded connection: Not Applicable

CALCULATION DATA

7.5.3 - TORISPHERICAL ENDS UNDER INTERNAL PRESSURE

7.5.3.2 Required Minimum End Thickness

Required Thickness of End to Limit Membrane Stress in Central Part

$$e_s = P * R / (2 * f * z - 0.5 * P) \quad (7.5-1)$$

$$= 3.3 * 218.4 / (2 * 205.73 * 1 - 0.5 * 3.3) = 1.7587 \text{ mm}$$

$$f_b = R_{pt} / 1.5 \quad (7.5-4) = 308.6 / 1.5 = 205.73 \text{ N/mm}^2$$

Required Thickness of Knuckle to Avoid Plastic Buckling

$$e_b = (0.75 * R + 0.2 * D_i) * ((P / (111 * f_b)) * (D_i / r)^{0.825})^{(0.667)} \quad (7.5-3)$$

$$= (0.75 * 218.4 + 0.2 * 266) * ((3.3 / (111 * 205.73)) * (266 / 42.042)^{0.825})^{(0.667)}$$

$$= 1.6443 \text{ mm}$$

7.5.3.5 Formulas for Calculation of Factor Beta

$$Y = \text{MIN}(e_{min} / R, 0.04) \quad (7.5-9) = \text{MIN}(2.21 / 218.4, 0.04) = 0.0101$$

$$Z = \text{LOG}(1 / Y) \quad (7.5-10) = \text{LOG}(1 / 0.0101) = 1.9953$$

$$X = r / D_i \quad (7.5-11) = 42.042 / 268.58 = 0.1565$$

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E3.1 Bottom Head 24 Apr. 2023 09:30 ConnID:S1.1

$$N = 1.006 - 1 / (6.2 + (90 * Y) ^ 4) \quad (7.5-12)$$

$$=1.006-1/(6.2+(90*0.0101)^4)= \quad 0.8608$$

$$\text{Beta01} = N * (-0.1833 * Z^3 + 1.0383 * Z^2 - 1.2943 * Z + 0.837) \quad (7.5-15)$$

$$=0.8608 * (-0.1833 * 2.^3 + 1.0383 * 2.^2 - 1.2943 * 2. + 0.837) = \quad 0.8023$$

$$\text{Beta02} = \text{MAX}(0.5, 0.95 * (0.56 - 1.94 * Y - 82.5 * Y ^ 2)) \quad (7.5-17)$$

$$=\text{MAX}(0.5, 0.95 * (0.56 - 1.94 * 0.0101 - 82.5 * 0.0101^2)) = \quad 0.5054$$

$$\text{beta} = 10 * ((0.2 - X) * \text{Beta01} + (X - 0.1) * \text{Beta02}) \quad (7.5-16)$$

$$=10 * ((0.2 - 0.1565) * 0.8023 + (0.1565 - 0.1) * 0.5054) = \quad 0.6344$$

Required Thickness of Knuckle to Avoid Axisymmetric Yielding

$$e_y = \text{beta} * P * (0.75 * R + 0.2 * D_i) / f \quad (7.5-2)$$

$$=0.6344 * 3.3 * (0.75 * 218.4 + 0.2 * 268.58) / 205.73 = \quad 2.2136 \text{ mm}$$

NOTE 3, since $e_y(2.2) > 0.005 * D_i(1.3)$ it is NOT necessary to calculate/consider eb.

Required Minimum End Thickness Excl.Allow. e_{min} :

$$e_{min} = e_{min} = 2.21 = \quad \underline{\underline{2.2136 \text{ mm}}}$$

Required Minimum End Thickness Incl.Allow. :

$$e_{minA} = e_{min} + c + t_h = 2.21 + 0.5 + 0.3 = \quad \underline{\underline{3.0100 \text{ mm}}}$$

Internal Pressure $e_{minA}=3.01 \leq e_n=4$[mm]	75.2%	OK
--	--------------	-----------

Analysis Thickness

$$e_a = e_n - c - t_h = 4 - 0.5 - 0.3 = \quad 3.2000 \text{ mm}$$

Inside Diameter of Shell

$$D_i = D_e - 2 * (e_n - c) = 273 - 2 * (4 - 0.5) = \quad 266.00 \text{ mm}$$

Mean Diameter of Shell

$$D_m = (D_e + D_i) / 2 = (273 + 266) / 2 = \quad 269.50 \text{ mm}$$

7.5.3.4 - Required Minimum Thickness of Straight Cylindrical Flange

$$L_{lim} = 0.2 * \text{SQRT}(D_i * e_{min}) = 0.2 * \text{SQRT}(266 * 2.21) = \quad 4.8531 \text{ mm}$$

Since $L_{cyl} > L_{lim}$, Required Thickness of Straight Cylindrical Flange to 7.4.2

Minimum Thickness of Straight Flange Excl. Allow.

$$e_{cyl} = P * D_i / (2 * f * z - P) \quad (7.4-1)$$

$$= 3.3 * 266 / (2 * 205.73 * 1 - 3.3) = \quad \underline{\underline{2.1506 \text{ mm}}}$$

Minimum Thickness of Straight Flange Incl.Corr. :

$$e_{cylA} = e_{cyl} + c = 2.15 + 0.5 = \quad \underline{\underline{2.6500 \text{ mm}}}$$

7.5.3.1 Conditions of Applicability - Torispherical Ends

»Geometry Check $r=42.042 \leq 0.2 * D_i=53.2$ [mm] « » OK«

»Geometry Check $r=42.042 \geq 0.06 * D_i=15.96$ [mm] « » OK«

»Geometry Check $r=42.042 \geq 2 * e$ [mm] « » OK«

»Geometry Check $e=2.21 \leq 0.08 * D_e=21.84$ [mm] « » OK«

»Geometry Check $e_a=3.2 \geq 0.001 * D_e=0.273$ [mm] « » OK«

»Geometry Check $R=218.4 \leq D_e=273$ [mm] « » OK«

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :NEW & COLD

$$P_s = 2 * f * z * e_a / (R + 0.5 * e_a) \quad (7.5-6)$$

$$= 2 * 212.5 * 1 * 3.7 / (217.9 + 0.5 * 3.7) = \quad 7.1559 \text{ MPa}$$

$$P_y = f * e_a / (\text{beta} * (0.75 * R + 0.2 * D_i)) \quad (7.5-7)$$

$$= 212.5 * 3.7 / (0.5925 * (0.75 * 217.9 + 0.2 * 266)) = \quad 6.1262 \text{ MPa}$$

$$P_b = 111 * f_b * (e_a / (0.75 * R + 0.2 * D_i)) ^ {1.5} * (r / D_i) ^ {0.825} \quad (7.5-8)$$

$$= 111 * 236.67 * (3.7 / (0.75 * 217.9 + 0.2 * 266)) ^ {1.5} * (42.042 / 266) ^ {0.825} = \quad 12.80 \text{ MPa}$$

$$P_{cyl} = 2 * e_a * f * z / (D_i + e_a)$$

$$= 2 * 3.7 * 212.5 * 1 / (266 + 3.7) = \quad 5.8306 \text{ MPa}$$

P_{max} (is the least of P_s , P_y , P_b and P_{cyl}) = P_{max}

$$= 5.83 = \quad \underline{\underline{5.8306 \text{ MPa}}}$$

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :HOT & CORR

$$P_s = 2 * f * z * e_a / (R + 0.5 * e_a) \quad (7.5-6)$$

$$= 2 * 205.73 * 1 * 3.2 / (218.4 + 0.5 * 3.2) = \quad 5.9849 \text{ MPa}$$

$$P_y = f * e_a / (\text{beta} * (0.75 * R + 0.2 * D_i)) \quad (7.5-7)$$

$$= 205.73 * 3.2 / (0.6009 * (0.75 * 218.4 + 0.2 * 266)) = \quad 5.0490 \text{ MPa}$$

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E3.1 Bottom Head 24 Apr. 2023 09:30 ConnID:S1.1

$$P_B = 111 * f_b * (e_a / (0.75 * R + 0.2 * D_i))^{1.5} * (r / D_i)^{0.825} \quad (7.5-8)$$
$$= 111 * 205.73 * (3.2 / (0.75 * 218.4 + 0.2 * 266))^{1.5} * (42.042 / 266)^{0.825} = 8.9264 \text{ MPa}$$
$$P_{cyl} = 2 * e_a * f * z / (D_i + e_a)$$
$$= 2 * 3.2 * 205.73 * 1 / (266 + 3.2) = 4.8911 \text{ MPa}$$

Pmax (is the least of Ps, Py, Pb and P_{cyl}) = Pmax
= 4.89 = 4.8911 MPa

MAX TEST PRESSURE (Uncorroded cond.at ambient temp.)

$$P_s = 2 * f * z * e_a / (R + 0.5 * e_a) \quad (7.5-6)$$
$$= 2 * 338.1 * 1 * 3.7 / (217.9 + 0.5 * 3.7) = 11.39 \text{ MPa}$$
$$P_y = f * e_a / (\beta * (0.75 * R + 0.2 * D_i)) \quad (7.5-7)$$
$$= 338.1 * 3.7 / (0.5925 * (0.75 * 217.9 + 0.2 * 266)) = 9.7471 \text{ MPa}$$
$$P_B = 111 * f_b * (e_a / (0.75 * R + 0.2 * D_i))^{1.5} * (r / D_i)^{0.825} \quad (7.5-8)$$
$$= 111 * 338.1 * (3.7 / (0.75 * 217.9 + 0.2 * 266))^{1.5} * (42.042 / 266)^{0.825} = 18.29 \text{ MPa}$$
$$P_{cyl} = 2 * e_a * f * z / (D_i + e_a)$$
$$= 2 * 3.7 * 338.1 * 1 / (266 + 3.7) = 9.2768 \text{ MPa}$$

Pmax (is the least of Ps, Py, Pb and P_{cyl}) = Pmax
= 9.28 = 9.2768 MPa

EN13445-5;10.2.3.3 REQUIRED MIN.HYDROSTATIC TEST PRESSURE:P_{tmin}

NEW AT AMBIENT TEMP. FOR TEST GROUPS 1, 2 and 3

$$P_{tmin} = 1.25 * P_d * f_{20} / f = 1.25 * 3.3 * 212.5 / 205.73 = 4.2607 \text{ MPa}$$

$$P_{tmin} = 1.43 * P_d = 1.43 * 3.3 = 4.7190 \text{ MPa}$$

Test Pressure P_{tmin}=4.72 <= P_{tmax}=9.28[MPa]

50.8%

OK

Maximum diameter of Opening Not Requiring Reinforcement Check , d_{max}

$$r_{is} = R \quad (9.5-4) = 218.4 = 218.40 \text{ mm}$$

Length of Shell Contributing to Reinforcement

$$I_s = \text{Sqr}((2 * r_{is} + e_a) * e_a) \quad (9.5-2)$$
$$= \text{Sqr}((2 * 218.4 + 3.2) * 3.2) = 37.52 \text{ mm}$$

Maximum Diameter of Unreinforced Opening in Shell Checked to Rules in Section 9

$$d_{max1} = \text{MIN}(0.5 * D_i, (e_a * I_s * (f - 0.5 * P) / P - r_{is} * I_s) / (0.5 * r_{is} + 0.5 * e_a)) \quad (9.5-7, 22, 23)$$
$$= \text{MIN}(0.5 * 266, (3.2 * 37.52 * (205.73 - 0.5 * 3.3) / 3.3 - 218.4 * 37.52) / (0.5 * 218.4 + 0.5 * 3.2)) = 0.00 \text{ mm}$$

Maximum diameter of Opening Not Requiring Reinforcement Check

$$d_{max2} = 0.15 * \text{Sqr}((2 * r_{is} + e_a) * e_a) \quad (9.5-18)$$
$$= 0.15 * \text{Sqr}((2 * 218.4 + 3.2) * 3.2) = 5.6285 \text{ mm}$$

Maximum Diameter of Unreinforced Opening

$$d_{max} = \text{MAX}(d_{max1}, d_{max2}) = \text{MAX}(0, 5.63) = 5.6285 \text{ mm}$$

CALCULATION SUMMARY

7.5.3 - TORISPHERICAL ENDS UNDER INTERNAL PRESSURE

7.5.3.2 Required Minimum End Thickness

Required Minimum End Thickness Excl.Allow. e_{min} :

$$e_{min} = e_{min} = 2.21 = 2.2136 \text{ mm}$$

Required Minimum End Thickness Incl.Allow. :

$$e_{minA} = e_{min} + c + th = 2.21 + 0.5 + 0.3 = 3.0100 \text{ mm}$$

Internal Pressure e_{minA}=3.01 <= e_n=4[mm]

75.2%

OK

Minimum Thickness of Straight Flange Incl.Corr. :

$$e_{cylA} = e_{cyl} + c = 2.15 + 0.5 = 2.6500 \text{ mm}$$

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :NEW & COLD

Pmax (is the least of Ps, Py, Pb and P_{cyl}) = Pmax
= 5.83 = 5.8306 MPa

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Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 7.5 DOMED ENDS

E3.1 Bottom Head 24 Apr. 2023 09:30 ConnID:S1.1

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :HOT & CORRPmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=4.89=4.8911 MPa**MAX TEST PRESSURE (Uncorroded cond.at ambient temp.)**Pmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=9.28=9.2768 MPa**EN13445-5;10.2.3.3 REQUIRED MIN.HYDROSTATIC TEST PRESSURE:Ptmin**

NEW AT AMBIENT TEMP. FOR TEST GROUPS 1, 2 and 3

Ptmin = 1.25 * Pd * f20 / f =1.25*3.3*212.5/205.73=

4.2607 MPa

Ptmin = 1.43 * Pd =1.43*3.3=

4.7190 MPa**Test Pressure Ptmin=4.72 <= Pmax=9.28[MPa]****50.8%****OK****Maximum diameter of Opening Not Requiring Reinforcement Check , dmax**

Maximum Diameter of Unreinforced Opening

dmax = MAX(dmax1, dmax2) =MAX(0,5.63)=

5.6285 mm

Volume:0.0033 m3 Weight:2.9 kg (SG= 7.85)

Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

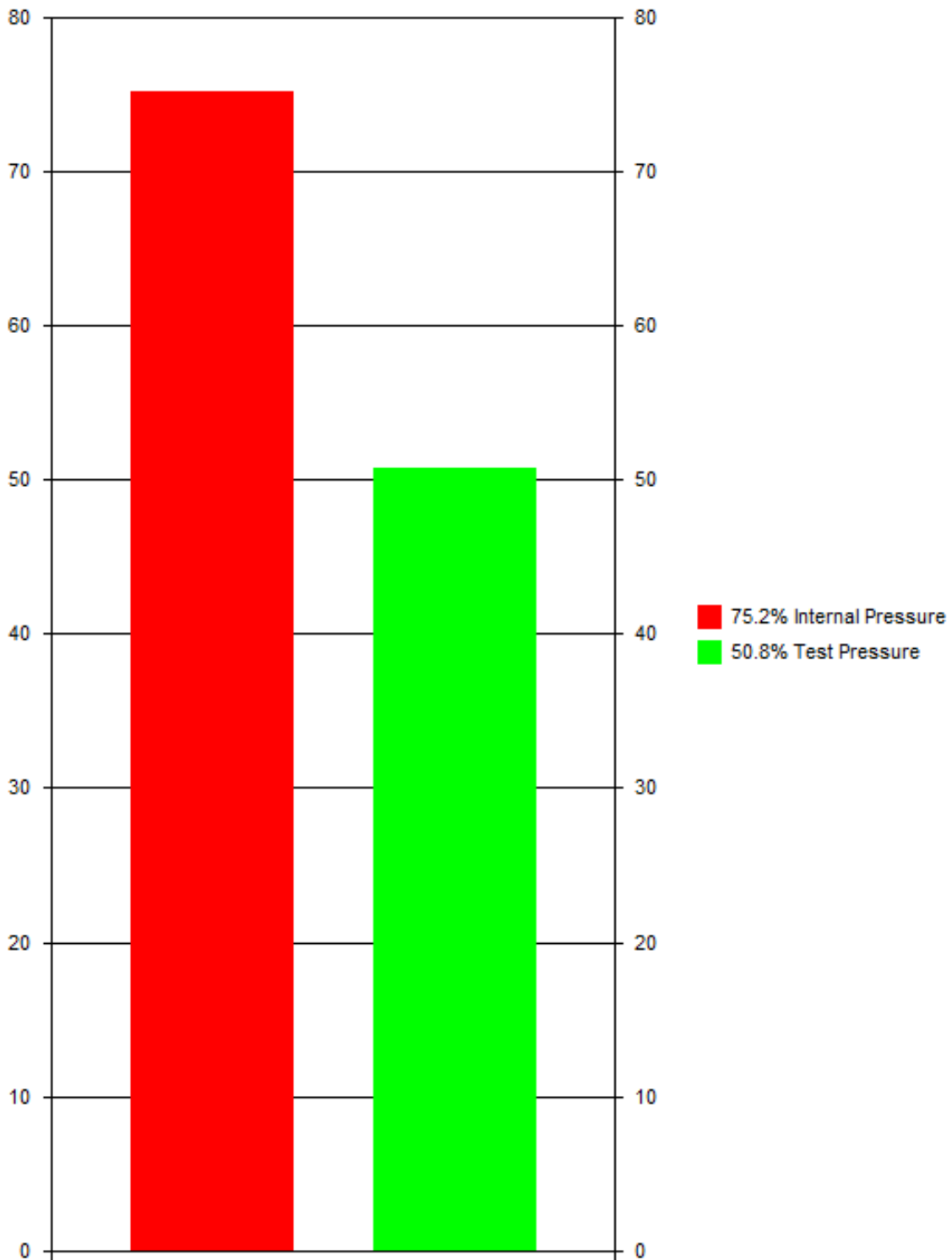
Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 7.5 DOMED ENDS

E3.1 Bottom Head

24 Apr. 2023 09:30 ConnID:S1.1

UTILIZATION CHART - E3.1 BOTTOM HEAD



Max.Utilization/Condition 75.2%

Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 7.5 DOMED ENDS

E3.2 Upper Head 24 Apr. 2023 09:30 ConnID:S1.1

INPUT DATA

COMPONENT ATTACHMENT/LOCATION

Attachment: S1.1 Cylindrical Shell Main Shell
Location: Along z-axis z1= 405

GENERAL DESIGN DATA

PRESSURE LOADING: Design Component for Internal Pressure Only

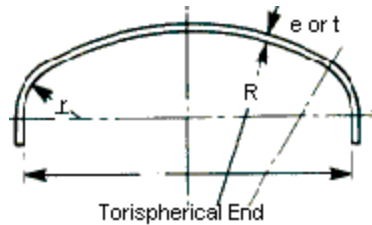
PROCESS CARD:

General Design Data : Temp= 130°C, P=3.3000 MPa, c=0.5 mm, Pext=0.0000 MPa

SPECIFIC DENSITY OF OPERATING LIQUID.....:SG 0.00

LIQUID HEAD.....:LH 0.00 mm

DIMENSIONS OF END



Type of Torispherical End: Dished End KORBOGEN DIN 28013-28014/SMS 482

WELD JOINT COEFFICIENT: Testing Group 3 (z=0.85)

OUTSIDE DIAMETER OF CYLINDRICAL FLANGE OF END.....:De 273.00 mm

LENGTH OF CYLINDRICAL FLANGE OF END.....:Lcyl 15.00 mm

NEGATIVE TOLERANCE/THINNING ALLOWANCE.....:th 0.3000 mm

NOMINAL THICKNESS OF HEAD/END (uncorroded).....:en 4.0000 mm

Include calculation of forming during fabrication to EN13445-4 Section 9.: NO

MATERIAL DATA FOR END

EN 10028-2:2017, 1.0473 P355GH plate and strip, HT:N THK<=16mm 130'C

Rm=510 Rp=355 Rpt=308.6 f=205.73 f20=212.5 ftest=338.1 E=203868(N/mm2) ro=7.85

Material & Delivery Form: NOT Cold Spun Seamless Austenitic Stainless Steel

NOZZLES IN KNUCKLE REGION TO SECTION 7.7

Nozzles In Knuckle Region: NO

WELDING REQUIREMENTS TO EN 1708-1:2010

Comment(Optional):

Type of welded connection: Not Applicable

CALCULATION DATA

7.5.3 - TORISPHERICAL ENDS UNDER INTERNAL PRESSURE

7.5.3.2 Required Minimum End Thickness

Required Thickness of End to Limit Membrane Stress in Central Part

$$e_s = P * R / (2 * f * z - 0.5 * P) \quad (7.5-1)$$

$$= 3.3 * 218.4 / (2 * 205.73 * 0.85 - 0.5 * 3.3) = 2.0705 \text{ mm}$$

$$f_b = R_{pt} / 1.5 \quad (7.5-4) = 308.6 / 1.5 = 205.73 \text{ N/mm}^2$$

Required Thickness of Knuckle to Avoid Plastic Buckling

$$e_b = (0.75 * R + 0.2 * D_i) * ((P / (111 * f_b)) * (D_i / r)^{0.825})^{(0.667)} \quad (7.5-3)$$

$$= (0.75 * 218.4 + 0.2 * 266) * ((3.3 / (111 * 205.73)) * (266 / 42.042)^{0.825})^{(0.667)}$$

$$= 1.6443 \text{ mm}$$

7.5.3.5 Formulas for Calculation of Factor Beta

$$Y = \text{MIN}(e_{min} / R, 0.04) \quad (7.5-9) = \text{MIN}(2.21 / 218.4, 0.04) = 0.0101$$

$$Z = \text{LOG}(1 / Y) \quad (7.5-10) = \text{LOG}(1 / 0.0101) = 1.9951$$

$$X = r / D_i \quad (7.5-11) = 42.042 / 268.58 = 0.1565$$

Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

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$$N = 1.006 - 1 / (6.2 + (90 * Y) ^ 4) \quad (7.5-12)$$

$$=1.006-1/(6.2+(90*0.0101)^4)= \quad 0.8608$$

$$\text{Beta01} = N * (-0.1833 * Z^3 + 1.0383 * Z^2 - 1.2943 * Z + 0.837) \quad (7.5-15)$$

$$=0.8608 * (-0.1833 * 2.^3 + 1.0383 * 2.^2 - 1.2943 * 2. + 0.837) = \quad 0.8022$$

$$\text{Beta02} = \text{MAX}(0.5, 0.95 * (0.56 - 1.94 * Y - 82.5 * Y ^ 2)) \quad (7.5-17)$$

$$=\text{MAX}(0.5, 0.95 * (0.56 - 1.94 * 0.0101 - 82.5 * 0.0101^2)) = \quad 0.5053$$

$$\text{beta} = 10 * ((0.2 - X) * \text{Beta01} + (X - 0.1) * \text{Beta02}) \quad (7.5-16)$$

$$=10 * ((0.2 - 0.1565) * 0.8022 + (0.1565 - 0.1) * 0.5053) = \quad 0.6344$$

Required Thickness of Knuckle to Avoid Axisymmetric Yielding

$$e_y = \text{beta} * P * (0.75 * R + 0.2 * D_i) / f \quad (7.5-2)$$

$$=0.6344 * 3.3 * (0.75 * 218.4 + 0.2 * 268.58) / 205.73 = \quad 2.2134 \text{ mm}$$

NOTE 3, since $e_y(2.2) > 0.005 * D_i(1.3)$ it is NOT necessary to calculate/consider eb.

Required Minimum End Thickness Excl.Allow. e_{min} :

$$e_{min} = e_{min} = 2.21 = \quad \underline{\underline{2.2134 \text{ mm}}}$$

Required Minimum End Thickness Incl.Allow. :

$$e_{minA} = e_{min} + c + t_h = 2.21 + 0.5 + 0.3 = \quad \underline{\underline{3.0100 \text{ mm}}}$$

Internal Pressure $e_{minA}=3.01 \leq e_n=4$[mm]	75.2%	OK
--	--------------	-----------

Analysis Thickness

$$e_a = e_n - c - t_h = 4 - 0.5 - 0.3 = \quad 3.2000 \text{ mm}$$

Inside Diameter of Shell

$$D_i = D_e - 2 * (e_n - c) = 273 - 2 * (4 - 0.5) = \quad 266.00 \text{ mm}$$

Mean Diameter of Shell

$$D_m = (D_e + D_i) / 2 = (273 + 266) / 2 = \quad 269.50 \text{ mm}$$

7.5.3.4 - Required Minimum Thickness of Straight Cylindrical Flange

$$L_{lim} = 0.2 * \text{SQRT}(D_i * e_{min}) = 0.2 * \text{SQRT}(266 * 2.21) = \quad 4.8529 \text{ mm}$$

Since $L_{cyl} > L_{lim}$, Required Thickness of Straight Cylindrical Flange to 7.4.2

Minimum Thickness of Straight Flange Excl. Allow.

$$e_{cyl} = P * D_i / (2 * f * z - P) \quad (7.4-1)$$

$$= 3.3 * 266 / (2 * 205.73 * 0.85 - 3.3) = \quad \underline{\underline{2.5338 \text{ mm}}}$$

Minimum Thickness of Straight Flange Incl.Corr. :

$$e_{cylA} = e_{cyl} + c = 2.53 + 0.5 = \quad \underline{\underline{3.0300 \text{ mm}}}$$

7.5.3.1 Conditions of Applicability - Torispherical Ends

»Geometry Check $r=42.042 \leq 0.2 * D_i=53.2$ [mm] « » OK«

»Geometry Check $r=42.042 \geq 0.06 * D_i=15.96$ [mm] « » OK«

»Geometry Check $r=42.042 \geq 2 * e$ [mm] « » OK«

»Geometry Check $e=2.21 \leq 0.08 * D_e=21.84$ [mm] « » OK«

»Geometry Check $e_a=3.2 \geq 0.001 * D_e=0.273$ [mm] « » OK«

»Geometry Check $R=218.4 \leq D_e=273$ [mm] « » OK«

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :NEW & COLD

$$P_s = 2 * f * z * e_a / (R + 0.5 * e_a) \quad (7.5-6)$$

$$= 2 * 212.5 * 0.85 * 3.7 / (217.9 + 0.5 * 3.7) = \quad 6.0825 \text{ MPa}$$

$$P_y = f * e_a / (\text{beta} * (0.75 * R + 0.2 * D_i)) \quad (7.5-7)$$

$$= 212.5 * 3.7 / (0.5925 * (0.75 * 217.9 + 0.2 * 266)) = \quad 6.1262 \text{ MPa}$$

$$P_b = 111 * f_b * (e_a / (0.75 * R + 0.2 * D_i)) ^ {1.5} * (r / D_i) ^ {0.825} \quad (7.5-8)$$

$$= 111 * 236.67 * (3.7 / (0.75 * 217.9 + 0.2 * 266)) ^ {1.5} * (42.042 / 266) ^ {0.825} = \quad 12.80 \text{ MPa}$$

$$P_{cyl} = 2 * e_a * f * z / (D_i + e_a)$$

$$= 2 * 3.7 * 212.5 * 0.85 / (266 + 3.7) = \quad 4.9560 \text{ MPa}$$

P_{max} (is the least of P_s , P_y , P_b and P_{cyl}) = P_{max}

$$= 4.96 = \quad \underline{\underline{4.9560 \text{ MPa}}}$$

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :HOT & CORR

$$P_s = 2 * f * z * e_a / (R + 0.5 * e_a) \quad (7.5-6)$$

$$= 2 * 205.73 * 0.85 * 3.2 / (218.4 + 0.5 * 3.2) = \quad 5.0871 \text{ MPa}$$

$$P_y = f * e_a / (\text{beta} * (0.75 * R + 0.2 * D_i)) \quad (7.5-7)$$

$$= 205.73 * 3.2 / (0.6009 * (0.75 * 218.4 + 0.2 * 266)) = \quad 5.0490 \text{ MPa}$$

Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

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$$P_b = 111 * f_b * (e_a / (0.75 * R + 0.2 * D_i))^{1.5} * (r / D_i)^{0.825} \quad (7.5-8)$$
$$= 111 * 205.73 * (3.2 / (0.75 * 218.4 + 0.2 * 266))^{1.5} * (42.042 / 266)^{0.825} = 8.9264 \text{ MPa}$$
$$P_{cyl} = 2 * e_a * f * z / (D_i + e_a)$$
$$= 2 * 3.2 * 205.73 * 0.85 / (266 + 3.2) = 4.1574 \text{ MPa}$$
$$P_{max} \text{ (is the least of } P_s, P_y, P_b \text{ and } P_{cyl}) = P_{max}$$
$$= 4.16 = \underline{\underline{4.1574 \text{ MPa}}}$$

MAX TEST PRESSURE (Uncorroded cond.at ambient temp.)

$$P_s = 2 * f * z * e_a / (R + 0.5 * e_a) \quad (7.5-6)$$
$$= 2 * 338.1 * 3.7 / (217.9 + 0.5 * 3.7) = 11.39 \text{ MPa}$$
$$P_y = f * e_a / (\beta * (0.75 * R + 0.2 * D_i)) \quad (7.5-7)$$
$$= 338.1 * 3.7 / (0.5925 * (0.75 * 217.9 + 0.2 * 266)) = 9.7471 \text{ MPa}$$
$$P_b = 111 * f_b * (e_a / (0.75 * R + 0.2 * D_i))^{1.5} * (r / D_i)^{0.825} \quad (7.5-8)$$
$$= 111 * 338.1 * (3.7 / (0.75 * 217.9 + 0.2 * 266))^{1.5} * (42.042 / 266)^{0.825} = 18.29 \text{ MPa}$$
$$P_{cyl} = 2 * e_a * f * z / (D_i + e_a)$$
$$= 2 * 3.7 * 338.1 * 1 / (266 + 3.7) = 9.2768 \text{ MPa}$$
$$P_{max} \text{ (is the least of } P_s, P_y, P_b \text{ and } P_{cyl}) = P_{max}$$
$$= 9.28 = \underline{\underline{9.2768 \text{ MPa}}}$$

EN13445-5;10.2.3.3 REQUIRED MIN.HYDROSTATIC TEST PRESSURE:P_{tmin}

NEW AT AMBIENT TEMP. FOR TEST GROUPS 1, 2 and 3

$$P_{tmin} = 1.25 * P_d * f_{20} / f = 1.25 * 3.3 * 212.5 / 205.73 = \underline{\underline{4.2607 \text{ MPa}}}$$

$$P_{tmin} = 1.43 * P_d = 1.43 * 3.3 = \underline{\underline{4.7190 \text{ MPa}}}$$

Test Pressure P_{tmin}=4.72 <= P_{tmax}=9.28[MPa]**50.8%****OK**

Maximum diameter of Opening Not Requiring Reinforcement Check , d_{max}

$$r_{is} = R \quad (9.5-4) = 218.4 = 218.40 \text{ mm}$$
$$\text{Length of Shell Contributing to Reinforcement}$$
$$I_s = \text{Sqr}((2 * r_{is} + e_a) * e_a) \quad (9.5-2)$$
$$= \text{Sqr}((2 * 218.4 + 3.2) * 3.2) = 37.52 \text{ mm}$$
$$\text{Maximum Diameter of Unreinforced Opening in Shell Checked to Rules in Section 9}$$
$$d_{max1} = \text{MIN}(0.5 * D_i, (e_a * I_s * (f - 0.5 * P) / P - r_{is} * I_s) / (0.5 * r_{is} + 0.5 * e_a)) \quad (9.5-7, 22, 23)$$
$$= \text{MIN}(0.5 * 266, (3.2 * 37.52 * (205.73 - 0.5 * 3.3) / 3.3 - 218.4 * 37.52) / (0.5 * 218.4 + 0.5 * 3.2)) = \underline{\underline{0.00 \text{ mm}}}$$
$$\text{Maximum diameter of Opening Not Requiring Reinforcement Check}$$
$$d_{max2} = 0.15 * \text{Sqr}((2 * r_{is} + e_a) * e_a) \quad (9.5-18)$$
$$= 0.15 * \text{Sqr}((2 * 218.4 + 3.2) * 3.2) = \underline{\underline{5.6285 \text{ mm}}}$$
$$\text{Maximum Diameter of Unreinforced Opening}$$
$$d_{max} = \text{MAX}(d_{max1}, d_{max2}) = \text{MAX}(0, 5.63) = \underline{\underline{5.6285 \text{ mm}}}$$

CALCULATION SUMMARY

7.5.3 - TORISPHERICAL ENDS UNDER INTERNAL PRESSURE

7.5.3.2 Required Minimum End Thickness

$$\text{Required Minimum End Thickness Excl.Allow. } e_{min} :$$
$$e_{min} = e_{min} = 2.21 = \underline{\underline{2.2134 \text{ mm}}}$$

$$\text{Required Minimum End Thickness Incl.Allow. } :$$
$$e_{minA} = e_{min} + c + t_h = 2.21 + 0.5 + 0.3 = \underline{\underline{3.0100 \text{ mm}}}$$

Internal Pressure e_{minA}=3.01 <= e_n=4[mm]**75.2%****OK**

$$\text{Minimum Thickness of Straight Flange Incl.Corr. } :$$
$$e_{cylA} = e_{cyl} + c = 2.53 + 0.5 = \underline{\underline{3.0300 \text{ mm}}}$$

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :NEW & COLD

$$P_{max} \text{ (is the least of } P_s, P_y, P_b \text{ and } P_{cyl}) = P_{max}$$
$$= 4.96 = \underline{\underline{4.9560 \text{ MPa}}}$$

Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

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MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :HOT & CORRPmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=4.16=

4.1574 MPa

MAX TEST PRESSURE (Uncorroded cond.at ambient temp.)Pmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=9.28=

9.2768 MPa

EN13445-5;10.2.3.3 REQUIRED MIN.HYDROSTATIC TEST PRESSURE:Ptmin

NEW AT AMBIENT TEMP. FOR TEST GROUPS 1, 2 and 3

Ptmin = 1.25 * Pd * f20 / f =1.25*3.3*212.5/205.73=

4.2607 MPa

Ptmin = 1.43 * Pd =1.43*3.3=

4.7190 MPa

Test Pressure Ptmin=4.72 <= Pmax=9.28[MPa]**50.8%****OK****Maximum diameter of Opening Not Requiring Reinforcement Check , dmax**

Maximum Diameter of Unreinforced Opening

dmax = MAX(dmax1, dmax2) =MAX(0,5.63)=

5.6285 mm

Volume:0.0033 m3 Weight:2.9 kg (SG= 7.85)

Company Name -

Client :GÜVEN SOGUTMA

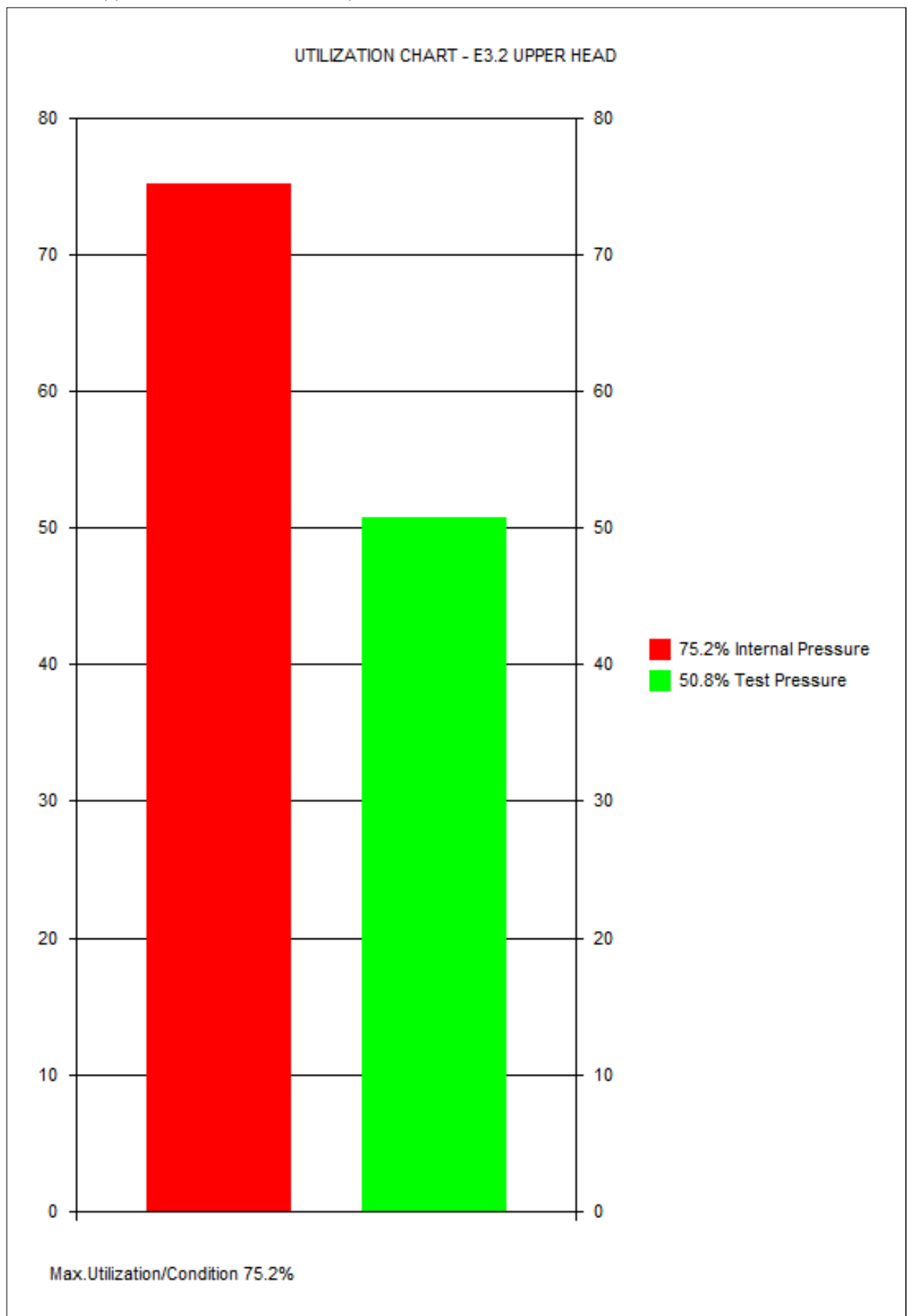
Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 7.5 DOMED ENDS

E3.2 Upper Head

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Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

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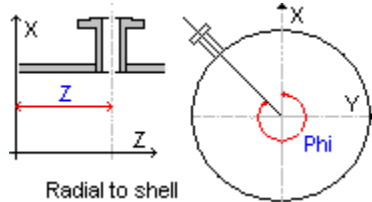
N.1 Rot 1 1/4" 24 Apr. 2023 09:34 ConnID:S1.1

INPUT DATA

COMPONENT ATTACHMENT/LOCATION

Attachment: S1.1 Cylindrical Shell Main Shell

Connect this nozzle to the nozzle neck of another nozzle: NO

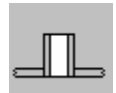


Orientation & Location of Nozzle: Radial to Shell

z-location of nozzle along axis of attachment.....:z 325.00 mm

Angle of Rotation of nozzle axis projected in the x-y plane:Phi 0.00 Degr.

GENERAL DESIGN DATA



Type of Opening: Nozzle Without Standard ASME or DIN/EN Flange Attachment

PRESSURE LOADING: Design Component for Internal Pressure Only

PROCESS CARD:

General Design Data : Temp= 130°C, P=3.3000 MPa, c=0.5 mm, Pext=0.0000 MPa

SPECIFIC DENSITY OF OPERATING LIQUID.....:SG 0.00

LIQUID HEAD.....:LH 0.00 mm

Apply a different corrosion allowance to nozzle neck than the shell thickness.: NO

Include Nozzle Load Calculation: NO

SHELL DATA (S1.1)

Shell Type: Cylindrical Shell

OUTSIDE DIAMETER OF SHELL.....:De 273.00 mm

NOMINAL WALL THICKNESS (uncorroded).....:en 4.0000 mm

NEGATIVE TOLERANCE/THINNING ALLOWANCE.....:th 0.3000 mm

EN 10217-3:2019, 1.0565 P355NH welded tube, HT:N THK<=20mm 130'C

Rm=490 Rp=355 Rpt=292 fs=194.67 f20=204.17 ftest=338.1 E=203868(N/mm2) ro=7.85

NOZZLE MATERIAL DATA



Delivery Form: Seamless Pipe

EN 10216-2:2013, 1.0345 P235GH seamless tube, HT:N THK<=16mm 130'C

Rm=360 Rp=235 Rpt=191.4 fb=127.6 f20=150 ftest=223.81 E=203868(N/mm2) ro=7.85

NOZZLE DIMENSIONAL DATA

Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 9.5 ISOLATED OPENINGS IN SHELLS

N.1 Rot 1 1/4"

24 Apr. 2023 09:34 ConnID:S1.1



Attachment: Set In Flush Nozzle

Shape of Nozzle/Opening: Circular

Application:

9.4.6.3 NOT a critical fatigue area, and calc.temp.is outside creep range.

OUTSIDE NOZZLE DIAMETER.....:deb 31.60 mm

NOMINAL NOZZLE THICKNESS (uncorroded).....:enb 6.8000 mm

Size of Flange and Nozzle:

Comment (Optional):

NEGATIVE TOLERANCE/THINNING ALLOWANCE.....: 12.50 %

NOZZLE STANDOUT MEASURED FROM VESSEL OD.....:ho 40.00 mm

WELDING DATA

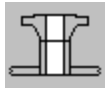
Nozzle/Pad to Shell Welding Area: Exclude Area of Nozzle to Shell Weld

Nozzle Weld Intersect: Nozzle Does NOT Intersect with a Welded Shell Seam

ANGLE PhiC(OBLIQUE IN TRANSVERSE.CROSS SECT.)Fig.9.5-2:PhiC 0.00 Degr.

ANGLE PhiL(OBLIQUE IN LONG.CROSS SECT.)Fig.9.5-1.....:PhiL 0.00 Degr.

DATA FOR REINFORCEMENT PAD



Type of Pad: No Pad

LIMITS OF REINFORCEMENT

Reduction of Limits of Reinforcement: No Reduction Required

WELDING REQUIREMENTS TO EN 1708-1:2010

Comment(Optional):

Type of welded connection: Not Applicable

CALCULATION DATA

PRELIMINARY CALCULATIONS

Shell Analysis Thickness eas

eas = en - c - th =4-0.5-0.3= 3.2000 mm

Nozzle Analysis Thickness eab

eab = enb - cn - NegDev =6.8-0.5-0.85= 5.4500 mm

Inside Radius of Curvature

ris = De / 2 - eas (9.5-3) =273/2-3.2= 133.30 mm

dib = deb - 2 * eab =31.6-2*5.45= 20.70 mm

Min.Nozzle Thk.Based on Internal Pressure ebp

ebp = P * deb / (2 * fb * z + P) =3.3*31.6/(2*127.6*1+3.3)= 0.4000 mm

Allowable Stresses

fob = Min(fs, fb) (9.5-8) =Min(194.67,127.6)= 127.60 N/mm²

GEOMETRIC LIMITATIONS

»Check Max.Diameter of Nozzle dib/(2*ris)=0.0776 <= 1.00=1[mm] «» OK«

Min.Nozzle Thk. ebp=0.4 <= eab=5.45[mm]

7.3%

OK

9.5.2.4.4 Nozzles normal to the shell, with or without reinforcement pads.

Calculation of Stress Loaded Areas Effective as Reinforcement

Company Name -

Client :GÜVEN SOGUTMA

Vessel Tag No.:V8A.33B.30.A3.A3.F4

Visual Vessel Design by Hexagon PPM,Ver:20.0 Operator : Rev.:A

EN13445:2014 Issue 5+A8:2019 - 9.5 ISOLATED OPENINGS IN SHELLS

N.1 Rot 1 1/4" 24 Apr. 2023 09:34 ConnID:S1.1

Area of Shell Afs

Limit of Reinforcement Along Shell

Iso = Sqr((2 * ris + eas) * eas)

=Sqr((2*133.3+3.2)*3.2)=

29.38 mm

Set In Nozzle

Afs = eas * Is (9.5-79) =3.2*29.38=

94.03 mm2

Area of Nozzle Afb

Limit of Reinforcement Along Nozzle (outside shell)

Ibo = MIN(Sqr((deb - eb) * eb), ho)

(9.5-76)

=MIN(Sqr((31.6-5.45)*5.45),40)=

11.94 mm

Set In Nozzle

Afb = eb * (Ibo + Ibi + eas) (9.5-78) =5.45*(11.94+0+3.2)=

82.50 mm2

Calculation of Pressure Loaded Areas

In the Nozzle Apb

Apb = 0.5 * dib * (Ibo + eas) (9.5-84) =0.5*20.7*(11.94+3.2)=

156.68 mm2

Cyl.Shell in the Longitudinal Section Aps

ApsL = ris * (Is + a) (9.5-94) =133.3*(29.38+15.8)=

6022.89 mm2

Cyl.Shell in the Transverse Cross Section Aps

ApsT = 0.5 * ris ^ 2 * (Is + a) / (0.5 * eas + ris)

(9.5-105)

=0.5*133.3^2*(29.38+15.84)/(0.5*3.2+133.3)=

2978.12 mm2

Aps = MAX(ApsL ApsT) =MAX(6022.89,2978.12)=

6022.89 mm2

9.5.2 Reinforcement Rules

Pressure Area Required pA(req.)

pAReqL = P * (ApsL + Apb + 0.5 * ApphiL)

(9.5-7)

=3.3*(6022.89+156.68+0.5*0)=

20.39 kN

pAReqT = P * (ApsT + Apb + 0.5 * Apphi)

(9.5-7)

=3.3*(2978.12+156.68+0.5*0)=

10.34 kN

pAReq = MAX(pAReqL, pAReqT) =MAX(20392.59,10344.85)=

20.39 kN

Pressure Area Available pA(aval.)

pAAval = (Afs+Afw)*fs+Afp*(fop-0.5*P)+Afb*(fob-0.5*P)

(9.5-7)

=(94.03+0)*(194.67-0.5*3.3)+0*(0-0.5*3.3)+82.5*(127.6-0.5*3.3)=

28.54 kN

Nozzle Reinforcement pAAval=28.54 >= pAReq=20.39[kN]

71.4%

OK

Maximum Allowable Pressure Pmax

Pmax = (Afs+Afw)*fs+Afb*fob/((ApsL+Apb)+0.5*(Afs+Afw+Afb+Afp))

(9.5-10)

=(94.03+0)*194.67+82.5*127.6/((6022.89+156.68)+0.5*(94.03+0+82.5+0))

= 4.5999 MPa

Max.Allowable Test Pressure Pmax

Ptmax = ==

9.0646 MPa

Weight of Nozzle: .1869kg

CALCULATION SUMMARY

Min.Nozzle Thk. ebp=0.4 <= eab=5.45[mm]

7.3%

OK

9.5.2.4.4 Nozzles normal to the shell, with or without reinforcement pads.

Limit of Reinforcement Along Shell

Iso = Sqr((2 * ris + eas) * eas)

=Sqr((2*133.3+3.2)*3.2)=

29.38 mm

Limit of Reinforcement Along Nozzle (outside shell)

Ibo = MIN(Sqr((deb - eb) * eb), ho)

(9.5-76)

8 N.1 Nozzle,Seamless Pipe Rot 1 1/4"

Umax= 71.4%

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Company Name -

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N.1 Rot 1 1/4" 24 Apr. 2023 09:34 ConnID:S1.1

$$=\text{MIN}(\text{Sqr}((31.6-5.45)*5.45),40)=$$

11.94 mm

Pressure Area Required pA(req.)

$$pA_{ReqL} = P * (A_{psL} + A_{pb} + 0.5 * A_{phiL})$$

(9.5-7)

$$=3.3*(6022.89+156.68+0.5*0)=$$

20.39 kN

$$pA_{ReqT} = P * (A_{psT} + A_{pb} + 0.5 * A_{phi})$$

(9.5-7)

$$=3.3*(2978.12+156.68+0.5*0)=$$

10.34 kN

$$pA_{Req} = \text{MAX}(pA_{ReqL}, pA_{ReqT}) = \text{MAX}(20392.59, 10344.85) =$$

20.39 kN

Pressure Area Available pA(aval.)

$$pA_{Aval} = (A_{fs}+A_{fw}) * (f_s-0.5*P) + A_{fp} * (f_{op}-0.5*P) + A_{fb} * (f_{ob}-0.5*P)$$

(9.5-7)

$$=(94.03+0)*(194.67-0.5*3.3)+0*(0-0.5*3.3)+82.5*(127.6-0.5*3.3)=$$

28.54 kN

Nozzle Reinforcement pAAval=28.54 >= pAReq=20.39[kN]**71.4%****OK****Maximum Allowable Pressure Pmax**

$$P_{max} = (A_{fs}+A_{fw}) * f_s + A_{fb} * f_{ob} / ((A_{psL}+A_{pb}) + 0.5 * (A_{fs}+A_{fw}+A_{fb}+A_{fp}))$$

(9.5-10)

$$=(94.03+0)*194.67+82.5*127.6 / ((6022.89+156.68)+0.5*(94.03+0+82.5+0))$$

$$= 4.5999 \text{ MPa}$$

Volume:0.00 m3 Weight:0.2 kg (SG= 7.85)

Company Name -

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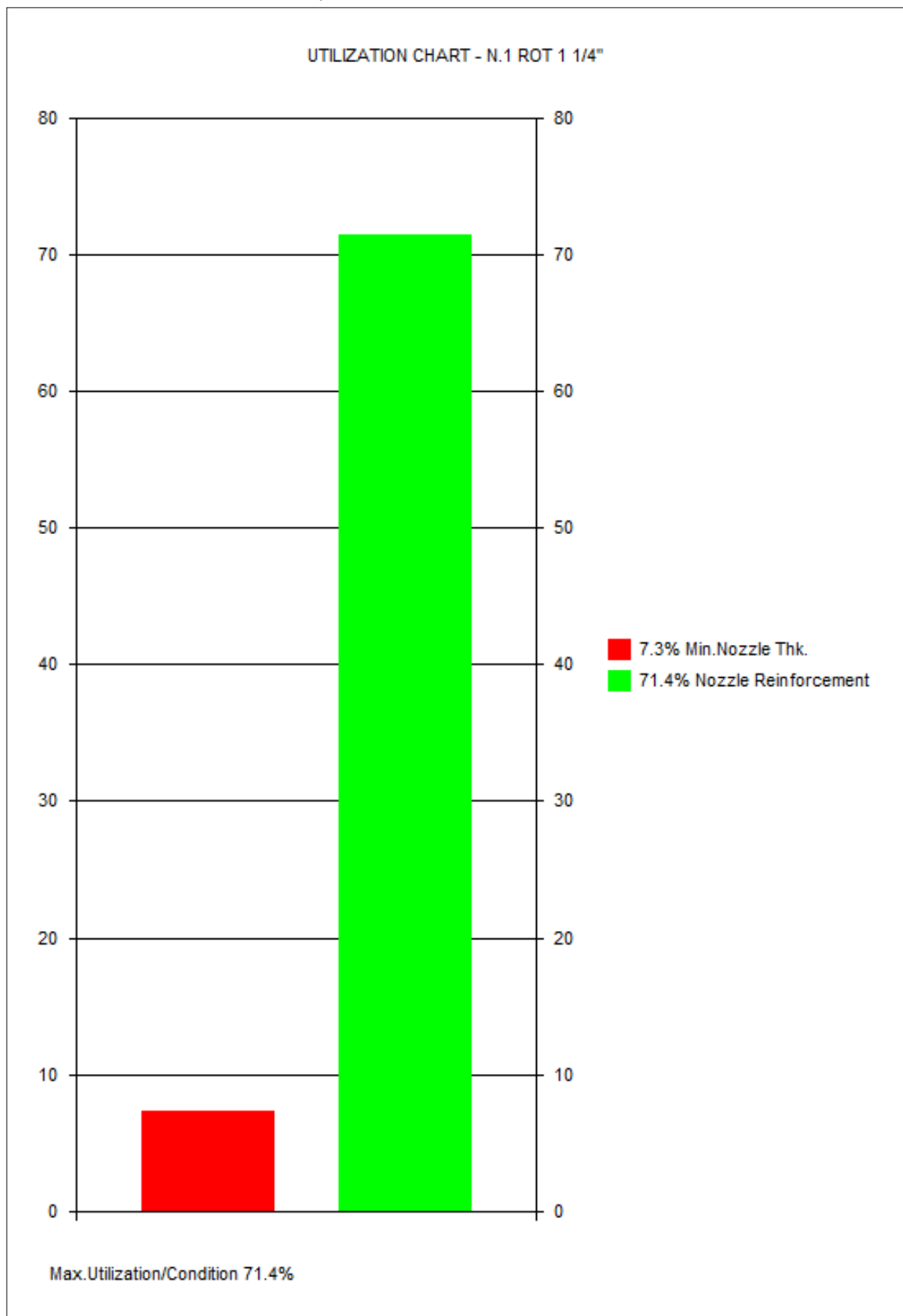
Vessel Tag No.:V8A.33B.30.A3.A3.F4

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N.1 Rot 1 1/4"

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Company Name -

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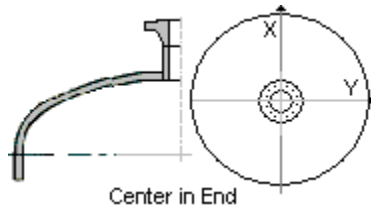
N.3 1/2" NPT

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INPUT DATA

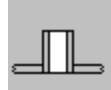
COMPONENT ATTACHMENT/LOCATION

Attachment: E3.2 Torispherical End Upper Head S1.1
Connect this nozzle to the nozzle neck of another nozzle: NO



Orientation & Location of Nozzle: Center in End

GENERAL DESIGN DATA



Type of Opening: Nozzle Without Standard ASME or DIN/EN Flange Attachment
PRESSURE LOADING: Design Component for Internal Pressure Only

PROCESS CARD:

General Design Data : Temp= 130°C, P=3.3000 MPa, c=0.5 mm, Pext=0.0000 MPa

SPECIFIC DENSITY OF OPERATING LIQUID.....:SG 0.00

LIQUID HEAD.....:LH 0.00 mm

Apply a different corrosion allowance to nozzle neck than the shell thickness.: NO

Include Nozzle Load Calculation: NO

SHELL DATA (E3.2)

Shell Type: Torispherical End

OUTSIDE DIAMETER OF SHELL.....:De 273.00 mm

NOMINAL WALL THICKNESS (uncorroded).....:en 4.0000 mm

NEGATIVE TOLERANCE/THINNING ALLOWANCE.....:th 0.3000 mm

INSIDE SPHERICAL RADIUS (corroded).....:R 218.40 mm

EN 10028-2:2017, 1.0473 P355GH plate and strip, HT:N THK<=16mm 130'C

Rm=510 Rp=355 Rpt=308.6 fs=205.73 f20=212.5 ftest=338.1 E=203868(N/mm2) ro=7.85

NOZZLE MATERIAL DATA



Delivery Form: Seamless Pipe

EN 10216-2:2013, 1.0345 P235GH seamless tube, HT:N THK<=16mm 130'C

Rm=360 Rp=235 Rpt=191.4 fb=127.6 f20=150 ftest=223.81 E=203868(N/mm2) ro=7.85

NOZZLE DIMENSIONAL DATA



Attachment: Set In Flush Nozzle

Shape of Nozzle/Opening: Circular

Application:

9.4.6.3 NOT a critical fatigue area, and calc.temp.is outside creep range.

OUTSIDE NOZZLE DIAMETER.....:deb 31.50 mm

NOMINAL NOZZLE THICKNESS (uncorroded).....:enb 7.0500 mm

Size of Flange and Nozzle:

Comment (Optional):

NEGATIVE TOLERANCE/THINNING ALLOWANCE.....: 12.50 %

NOZZLE STANDOUT MEASURED FROM VESSEL OD.....:ho 40.00 mm

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WELDING DATA

Nozzle/Pad to Shell Welding Area: Exclude Area of Nozzle to Shell Weld
Nozzle Weld Intersect: Nozzle Does NOT Intersect with a Welded Shell Seam
ANGLE BETWN.BRANCH AXIS AND A LINE NORMAL TO MAIN BODY:Phi 0.00 Degr.

DATA FOR REINFORCEMENT PAD



Type of Pad: No Pad

LIMITS OF REINFORCEMENT

Reduction of Limits of Reinforcement: No Reduction Required

WELDING REQUIREMENTS TO EN 1708-1:2010

Comment(Optional):

Type of welded connection: Not Applicable

CALCULATION DATA

PRELIMINARY CALCULATIONS

Shell Analysis Thickness eas 3.2000 mm
 $eas = en - c - th = 4 - 0.5 - 0.3 =$
Nozzle Analysis Thickness eab 5.6688 mm
 $eab = enb - cn - NegDev = 7.05 - 0.5 - 0.8813 =$
 $ris = R (9.5 - 4) = 218.4 =$ 218.40 mm
 $dib = deb - 2 * eab = 31.5 - 2 * 5.67 =$ 20.16 mm
Min.Nozzle Thk.Based on Internal Pressure ebp
 $ebp = P * deb / (2 * fb * z + P)$
 $= 3.3 * 31.5 / (2 * 127.6 * 1 + 3.3) =$ 0.4000 mm
Allowable Stresses
 $fob = Min(fs, fb) (9.5 - 8) = Min(205.73, 127.6) =$ 127.60 N/mm²

GEOMETRIC LIMITATIONS

»Check Max.Diameter of Nozzle $dib/De = 0.0739 \leq 0.60 = 0.6 [mm]$ (9.4.5.3)«» OK«

Min.Nozzle Thk. $ebp = 0.4 \leq eab = 5.67 [mm]$	7.0%	OK
--	------	----

»Location in End to Fig.9.5-4 $L = 120.75 \geq De/10 = 27.3 [mm]$ « » OK«

9.5.2.4.4 Nozzles normal to the shell, with or without reinforcement pads.

Calculation of Stress Loaded Areas Effective as Reinforcement

Area of Shell Afs

Limit of Reinforcement Along Shell
 $Iso = Sqr((2 * ris + eas) * eas)$
 $= Sqr((2 * 218.4 + 3.2) * 3.2) =$ 37.52 mm
Set In Nozzle
 $Afs = eas * Iso (9.5-79) = 3.2 * 37.52 =$ 120.07 mm²

Area of Nozzle Afb

Limit of Reinforcement Along Nozzle (outside shell)
 $Ibo = MIN(Sqr((deb - eb) * eb), ho)$ (9.5-76)
 $= MIN(Sqr((31.5 - 5.67) * 5.67), 40) =$ 12.10 mm
Set In Nozzle
 $Afb = eb * (Ibo + Ibi + eas) (9.5-78) = 5.67 * (12.1 + 0 + 3.2) =$ 86.74 mm²

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Calculation of Pressure Loaded Areas

In the Nozzle Apb

$$Apb = 0.5 * dib * (Ibo + eas) (9.5-84) = 0.5 * 20.16 * (12.1 + 3.2) = 154.25 \text{ mm}^2$$

Spherical Shell/End on any Section Aps

$$Aps = 0.5 * ris^2 * (Is + a) / (0.5 * eas + ris) (9.5-105) \\ = 0.5 * 218.4^2 * (37.52 + 15.76) / (0.5 * 3.2 + 218.4) = 5776.60 \text{ mm}^2$$

9.5.2 Reinforcement Rules

Pressure Area Required pA(req.)

$$pAReq = P * (Aps + Apb + 0.5 * Apphi) (9.5-7) \\ = 3.3 * (5776.6 + 154.25 + 0.5 * 0) = 19.57 \text{ kN}$$

Pressure Area Available pA(aval.)

$$pAAval = (Afs + Afw) * (fs - 0.5 * P) + Afp * (fop - 0.5 * P) + Afb * (fob - 0.5 * P) (9.5-7) \\ = (120.07 + 0) * (205.73 - 0.5 * 3.3) + 0 * (0 - 0.5 * 3.3) + 86.74 * (127.6 - 0.5 * 3.3) = 35.43 \text{ kN}$$

Nozzle Reinforcement pAAval=35.43 >= pAReq=19.57[kN]**55.2%****OK**

Maximum Allowable Pressure Pmax

$$Pmax = (Afs + Afw) * fs + Afb * fob / ((Aps + Apb + 0.5 * Apphi) + 0.5 * (Afs + Afw + Afb + Afp)) (9.5-10) \\ = (120.07 + 0) * 205.73 + 86.74 * 127.6 / ((5776.6 + 154.25 + 0.5 * 0) + 0.5 * (120.07 + 0 + 86.74 + 0)) = 5.9279 \text{ MPa}$$

Max.Allowable Test Pressure Ptmax

$$Ptmax = ==$$

11.26 MPa

Weight of Nozzle: .1895kg

CALCULATION SUMMARY

Min.Nozzle Thk. ebp=0.4 <= eab=5.67[mm]**7.0%****OK**

9.5.2.4.4 Nozzles normal to the shell, with or without reinforcement pads.

Limit of Reinforcement Along Shell

$$Iso = \text{Sqr}((2 * ris + eas) * eas) \\ = \text{Sqr}((2 * 218.4 + 3.2) * 3.2) = 37.52 \text{ mm}$$

Limit of Reinforcement Along Nozzle (outside shell)

$$Ibo = \text{MIN}(\text{Sqr}((deb - eb) * eb), ho) (9.5-76) \\ = \text{MIN}(\text{Sqr}((31.5 - 5.67) * 5.67), 40) = 12.10 \text{ mm}$$

Pressure Area Required pA(req.)

$$pAReq = P * (Aps + Apb + 0.5 * Apphi) (9.5-7) \\ = 3.3 * (5776.6 + 154.25 + 0.5 * 0) = 19.57 \text{ kN}$$

Pressure Area Available pA(aval.)

$$pAAval = (Afs + Afw) * (fs - 0.5 * P) + Afp * (fop - 0.5 * P) + Afb * (fob - 0.5 * P) (9.5-7) \\ = (120.07 + 0) * (205.73 - 0.5 * 3.3) + 0 * (0 - 0.5 * 3.3) + 86.74 * (127.6 - 0.5 * 3.3) = 35.43 \text{ kN}$$

Nozzle Reinforcement pAAval=35.43 >= pAReq=19.57[kN]**55.2%****OK**

Maximum Allowable Pressure Pmax

$$Pmax = (Afs + Afw) * fs + Afb * fob / ((Aps + Apb + 0.5 * Apphi) + 0.5 * (Afs + Afw + Afb + Afp)) (9.5-10) \\ = (120.07 + 0) * 205.73 + 86.74 * 127.6 / ((5776.6 + 154.25 + 0.5 * 0) + 0.5 * (120.07 + 0 + 86.74 + 0)) = 5.9279 \text{ MPa}$$

Company Name -

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Volume:0.00 m3 Weight:0.2 kg (SG= 7.85)

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