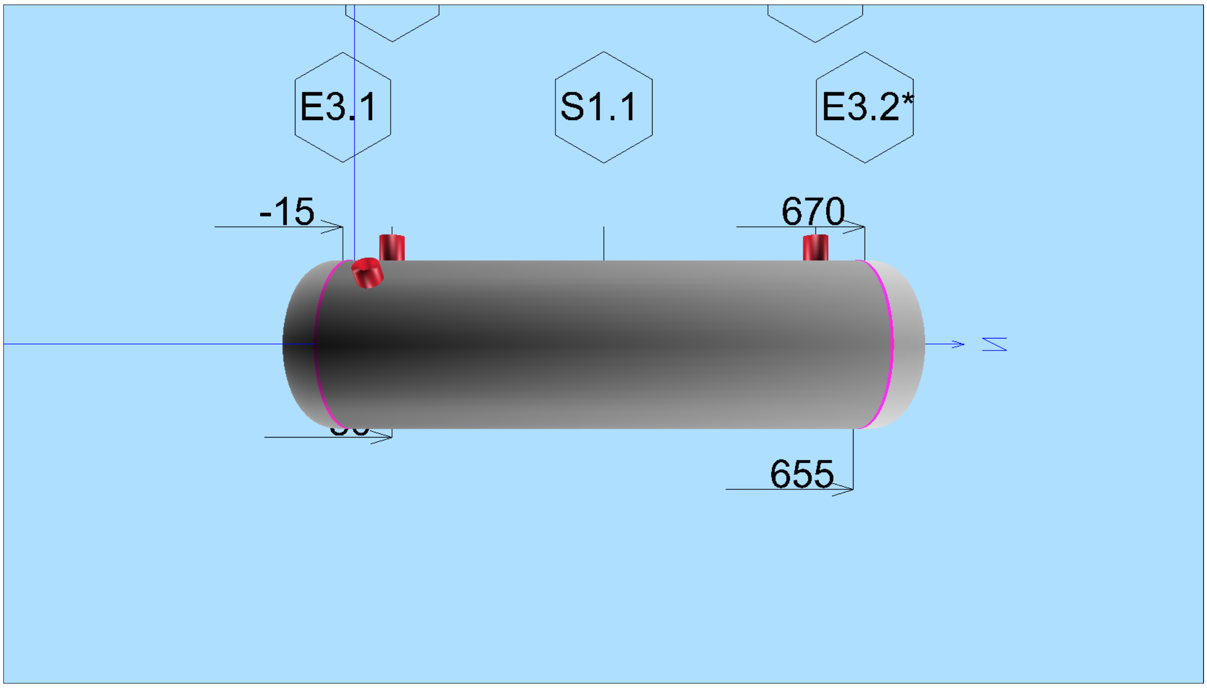
(0) Drawing

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

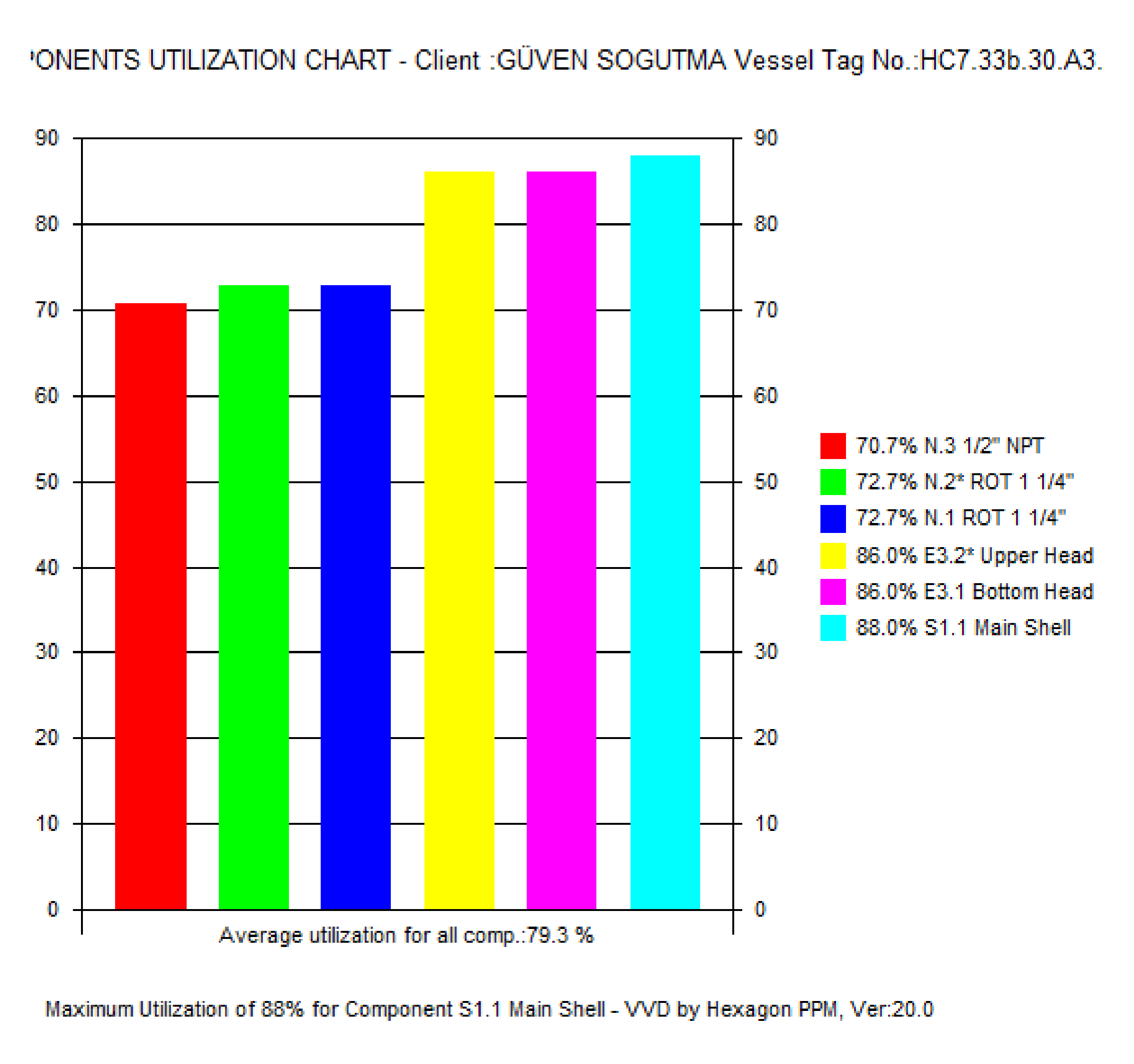


Design Data & Process Information

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



Welding Information

```
EN1708-1 Welding Requirements for Pressurized Components
NOTE: No welding information has been specified by the user.
```

INPUT DATA

COMPONENT ATTACHMENT/LOCATION

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        107.30 mm
```

SHELL DATA

```
CYLINDER FABRICATION: Welded Pipe
WELD JOINT COEFFICIENT: Testing Group  2   (z=1.0)
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        219.00 mm
LENGTH OF CYLINDRICAL PART OF SHELL.................:Lcyl      655.00 mm
NOMINAL WALL THICKNESS (uncorroded).................:en        3.0000 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 :
emin = De * P / (2 * f * z + P)                                (7.4-2)
=219*3.3/(2*194.67*1+3.3)=                             1.8406 mm

Required Minimum Shell Thickness Incl.Allow. :
emina = emin + c + NegDev =1.84+0.5+0.3=                 2.6406 mm

Analysis Thickness
ea = en - c - NegDev =3-0.5-0.3=                         2.2000 mm
```

»7.4.1 Cond.of Applicabilty emin/De=0.0084 <= 0.16« » OK«

Internal Pressure emina=2.64 <= en=3[mm]	88.0%	OK

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :

```
Inside Diameter of Shell
Di = De - 2 * ea =219-2*2.2=                             214.60 mm
Mean Diameter of Shell
Dm = (De + Di) / 2 =(219+214.6)/2=                       216.80 mm
MAWP HOT & CORR. (Corroded condition at design temp.)
MAWPHC = 2 * f * z * ea / Dm =2*194.67*1*2.2/216.8=      3.9509 MPa

MAWP NEW & COLD (Uncorroded condition at ambient temp.)
MAWPNC = 2 * f20 * z * (ea + c) / Dm
=2*204.17*1*(2.2+0.5)/216.8=                           5.0854 MPa
```

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

```
Ptmax = 2 * ftest * ztest * (ea + c) / Dm
=2*338.1*1*(2.2+0.5)/216.8=                            8.4213 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*204.17/194.67=         4.3263 MPa
Ptmin = 1.43 * Pd =1.43*3.3=                                 4.7190 MPa
```

Test Pressure Ptmin=4.72 <= Ptmax=8.42[MPa]	56.0%	OK

MAXIMUM DIAMETER OF UNREINFORCED OPENING IN SHELL

```
Inside Radius of Shell
ris = Di / 2 (9.5-3) =214.6/2=                               107.30 mm
Length of Shell Contributing to Reinforcement
Is = Sqr(( 2 * ris + ea) * ea)                                     (9.5-2)
=Sqr((2*107.3+2.2)*2.2)=                                    21.84 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*214.6,(2.2*21.84*(194.67-0.5*3.3)/3.3-107.3*21.84)/(0.5*107.3+0.5*
2.2))=                                                       =   8.5283 mm
Maximum diameter of Opening Not Requiring Reinforcement Check
dmax2 = 0.15 * Sqr(( 2 * ris + ea) * ea)                           (9.5-18)
=0.15*Sqr((2*107.3+2.2)*2.2)=                               3.2759 mm
Maximum Diameter of Unreinforced Opening
dmax = MAX( dmax1, dmax2) =MAX(8.53,3.28)=                   8.5283 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)
=219*3.3/(2*194.67*1+3.3)=                                  1.8406 mm
Required Minimum Shell Thickness Incl.Allow. :
emina = emin + c + NegDev =1.84+0.5+0.3=                     2.6406 mm
```

Internal Pressure emina=2.64 <= en=3[mm]	88.0%	OK

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

```
Ptmax = 2 * ftest * ztest * (ea + c) / Dm
=2*338.1*1*(2.2+0.5)/216.8=                                 8.4213 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*204.17/194.67=         4.3263 MPa
Ptmin = 1.43 * Pd =1.43*3.3=                                 4.7190 MPa
```

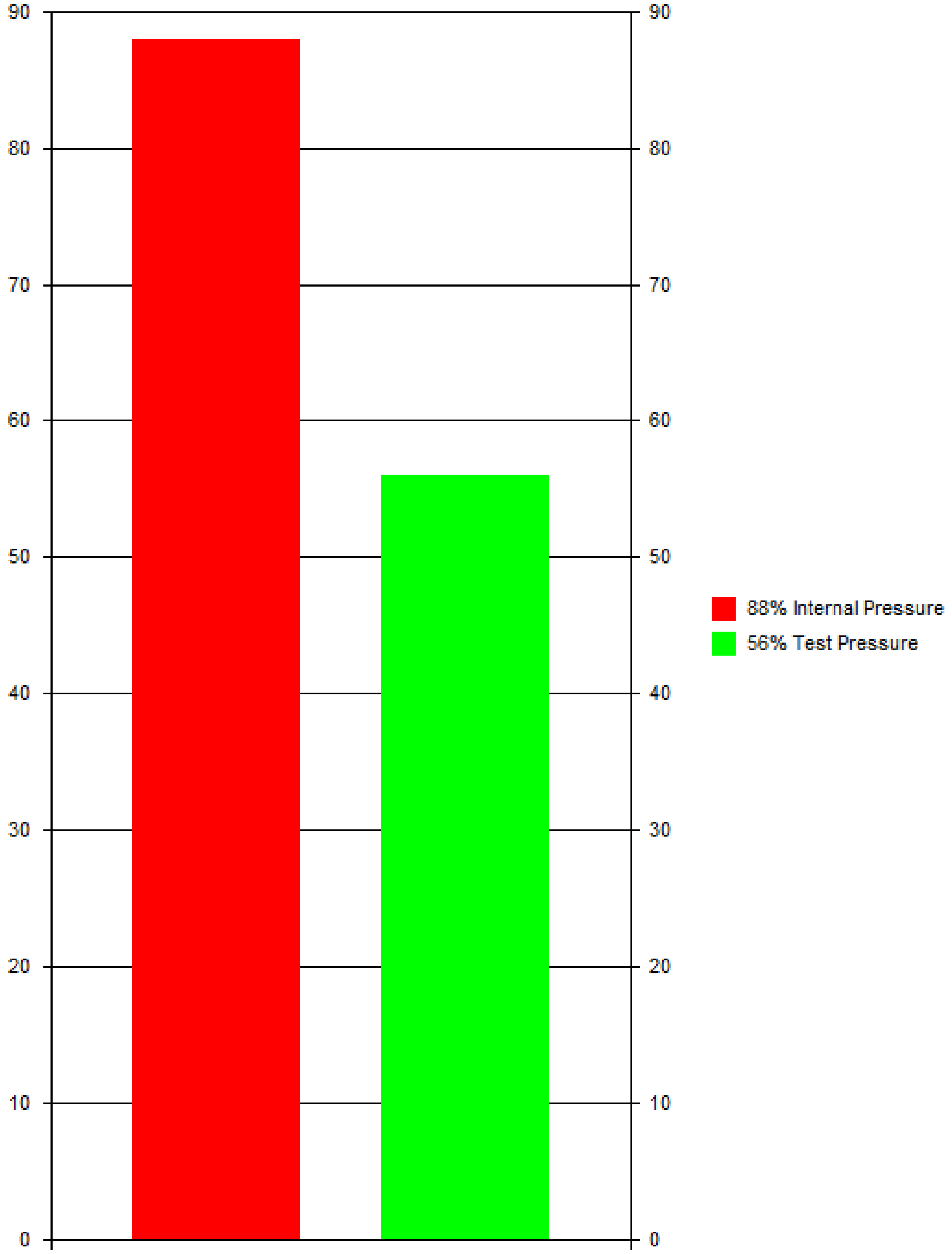
Test Pressure Ptmin=4.72 <= Ptmax=8.42[MPa]	56.0%	OK

MAXIMUM DIAMETER OF UNREINFORCED OPENING IN SHELL

```
Maximum Diameter of Unreinforced Opening
dmax = MAX( dmax1, dmax2) =MAX(8.53,3.28)=                   8.5283 mm
```

Volume:0.0237 m3 Weight:10.5 kg (SG= 7.85)

UTILIZATION CHART - S1.1 MAIN SHELL



Max.Utilization/Condition 88%

INPUT DATA

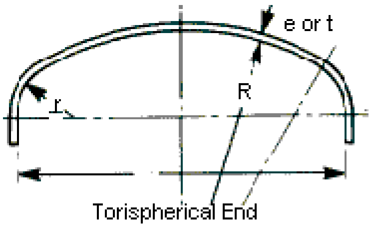
COMPONENT ATTACHMENT/LOCATION

```
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        107.00 mm
```

DIMENSIONS OF END




```
Type of Torispherical End: Dished End KORBBOGEN DIN 28013-28014/SMS 482
WELD JOINT COEFFICIENT: Unwelded Component(z=1.0)
OUTSIDE DIAMETER OF CYLINDRICAL FLANGE OF END.......:De         219.00 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         3.0000 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
es = P * R / (2 * f * z - 0.5 * P)                                 (7.5-1)
=3.3*175.2/(2*205.73*1-0.5*3.3)=                       1.4108 mm

fb = Rpt / 1.5 (7.5-4) =308.6/1.5=                       205.73 N/mm2
Required Thickness of Knuckle to Avoid Plastic Buckling
eb = (0.75*R+0.2*Di)*((P/(111*fb)*(Di/r)^0.825)^(0.667)            (7.5-3)
=(0.75*175.2+0.2*214)*((3.3/(111*205.73)*(214/33.726)^0.825)^(0.667)
=   1.3221 mm

7.5.3.5 Formulas for Calculation of Factor Beta
Y = MIN( emin / R, 0.04) (7.5-9) =MIN(1.77/175.2,0.04)=      0.0101
Z = LOG( 1 / Y) (7.5-10) =LOG(1/0.0101)=                     1.9953
X = r / Di (7.5-11) =33.726/215.46=                          0.1565
```

```
N = 1.006 - 1 / (6.2 + (90 * Y) ^ 4)                           (7.5-12)
=1.006-1/(6.2+(90*0.0101)^4)=                          0.8608
Beta01 = N*(-0.1833*Z^3+1.0383*Z^2-1.2943*Z+0.837)              (7.5-15)
=0.8608*(-0.1833*2.^3+1.0383*2.^2-1.2943*2.+0.837)=    0.8023
Beta02 = MAX( 0.5, 0.95 * (0.56 - 1.94 * Y - 82.5 * Y ^ 2))     (7.5-17)
=MAX(0.5,0.95*(0.56-1.94*0.0101-82.5*0.0101^2))=       0.5054
beta = 10 * ((0.2 - X) * Beta01 + (X - 0.1) * Beta02)           (7.5-16)
=10*((0.2-0.1565)*0.8023+(0.1565-0.1)*0.5054)=         0.6344
Required Thickness of Knuckle to Avoid Axisymmetric Yielding
ey = beta * P * (0.75 * R + 0.2 * Di) / f                       (7.5-2)
=0.6344*3.3*(0.75*175.2+0.2*215.46)/205.73=            1.7758 mm
```

NOTE 3, since ey(1.8) > 0.005*Di(1.1) it is NOT necessary to calculate/consider eb.

```
Required Minimum End Thickness Excl.Allow. emin :
emin = emin =1.78=                                        1.7758 mm

Required Minimum End Thickness Incl.Allow. :
emina = emin + c + th =1.78+0.5+0.3=                      2.5800 mm
```

Internal Pressure emina=2.58 <= en=3[mm]	86.0%	OK

```
Analysis Thickness
ea = en - c - th =3-0.5-0.3=                              2.2000 mm
Inside Diameter of Shell
Di = De - 2 * (en - c) =219-2*(3-0.5)=                    214.00 mm
Mean Diameter of Shell
Dm = (De + Di) / 2 =(219+214)/2=                          216.50 mm
```

7.5.3.4 - Required Minimum Thickness of Straight Cylindrical Flange

```
Llim = 0.2 * SQR( Di * emin) =0.2*SQR(214*1.78)=          3.8988 mm
Since Lcyl > Llim, Required Thickness of Straight Cylindrical Flange to 7.4.2
Minimum Thickness of Straight Flange Excl. Allow.
ecyl = P * Di / (2 * f * z - P)                                 (7.4-1)
=3.3*214/(2*205.73*1-3.3)=                             1.7302 mm

Minimum Thickness of Straight Flange Incl.Corr. :
ecyla = ecyl + c =1.73+0.5=                               2.2300 mm
```

7.5.3.1 Conditions of Applicability - Torispherical Ends

»Geometry Check r=33.726 <= 0.2 * Di=42.8[mm] « » OK«
»Geometry Check r=33.726 >= 0.06 * Di=12.84[mm] « » OK«
»Geometry Check r=33.726 >= 2*e[mm] « » OK«
»Geometry Check e=1.78 <= 0.08*De=17.52[mm] « » OK«
»Geometry Check ea=2.2 >= 0.001*De=0.219[mm] « » OK«
»Geometry Check R=175.2 <= De=219[mm] « » OK«

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :NEW & COLD

```
Ps = 2 * f * z * ea / (R + 0.5 * ea)                            (7.5-6)
=2*212.5*1*2.7/(174.7+0.5*2.7)=                        6.5180 MPa
Py = f * ea / ( beta * ( 0.75 * R + 0.2 * Di))                  (7.5-7)
=212.5*2.7/(0.599*(0.75*174.7+0.2*214))=               5.5106 MPa
PB = 111*fb*(ea/(0.75*R+0.2*Di))^1.5*(r/Di)^0.825               (7.5-8)
=111*236.67*(2.7/(0.75*174.7+0.2*214))^1.5*(33.726/214)^0.825=     11.07 MPa
Pcyl = 2 * ea * f * z / (Di + ea)
=2*2.7*212.5*1/(214+2.7)=                              5.2953 MPa
Pmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=5.3=                                                  5.2953 MPa
```

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :HOT & CORR

```
Ps = 2 * f * z * ea / (R + 0.5 * ea)                            (7.5-6)
=2*205.73*1*2.2/(175.2+0.5*2.2)=                       5.1345 MPa
Py = f * ea / ( beta * ( 0.75 * R + 0.2 * Di))                  (7.5-7)
=205.73*2.2/(0.6118*(0.75*175.2+0.2*214))=             4.2465 MPa
```

```
PB = 111*fb*(ea/(0.75*R+0.2*Di))^1.5*(r/Di)^0.825                (7.5-8)
=111*205.73*(2.2/(0.75*175.2+0.2*214))^1.5*(33.726/214)^0.825=   7.0578 MPa
Pcyl = 2 * ea * f * z / (Di + ea)
=2*2.2*205.73*1/(214+2.2)=                                 4.1869 MPa
Pmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=4.19=                                                     4.1869 MPa
```

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

```
Ps = 2 * f * z * ea / (R + 0.5 * ea)                               (7.5-6)
=2*338.1*1*2.7/(174.7+0.5*2.7)=                             10.37 MPa
Py = f * ea / ( beta * ( 0.75 * R + 0.2 * Di))                     (7.5-7)
=338.1*2.7/(0.599*(0.75*174.7+0.2*214))=                   8.7678 MPa
PB = 111*fb*(ea/(0.75*R+0.2*Di))^1.5*(r/Di)^0.825                  (7.5-8)
=111*338.1*(2.7/(0.75*174.7+0.2*214))^1.5*(33.726/214)^0.825=    15.82 MPa
Pcyl = 2 * ea * f * z / (Di + ea)
=2*2.7*338.1*1/(214+2.7)=                                  8.4252 MPa
Pmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=8.43=                                                     8.4252 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 <= Ptmax=8.43[MPa]	56.0%	OK

Maximum diameter of Opening Not Requiring Reinforcement Check , dmax

```
ris = R (9.5-4) =175.2=                                      175.20 mm
Length of Shell Contributing to Reinforcement
Is = Sqr(( 2 * ris + ea) * ea)                                     (9.5-2)
=Sqr((2*175.2+2.2)*2.2)=                                    27.85 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*214,(2.2*27.85*(205.73-0.5*3.3)/3.3-175.2*27.85)/(0.5*175.2+0.5*2.
2))=                                                        =      0.00 mm

Maximum diameter of Opening Not Requiring Reinforcement Check
dmax2 = 0.15 * Sqr(( 2 * ris + ea) * ea)                           (9.5-18)
=0.15*Sqr((2*175.2+2.2)*2.2)=                              4.1778 mm

Maximum Diameter of Unreinforced Opening
dmax = MAX( dmax1, dmax2) =MAX(0,4.18)=                      4.1778 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. emin :
emin = emin =1.78=                                           1.7758 mm

Required Minimum End Thickness Incl.Allow. :
emina = emin + c + th =1.78+0.5+0.3=                         2.5800 mm
```

Internal Pressure emina=2.58 <= en=3[mm]	86.0%	OK

```
Minimum Thickness of Straight Flange Incl.Corr. :
ecyla = ecyl + c =1.73+0.5=                                  2.2300 mm
```

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :NEW & COLD

```
Pmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=5.3=                                                      5.2953 MPa
```

MAXIMUM ALLOWABLE WORKING PRESSURE MAWP :HOT & CORR

```
Pmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=4.19=                                                    4.1869 MPa
```

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

```
Pmax (is the least of Ps, Py, Pb and Pcyl) = Pmax
=8.43=                                                    8.4252 MPa
```

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

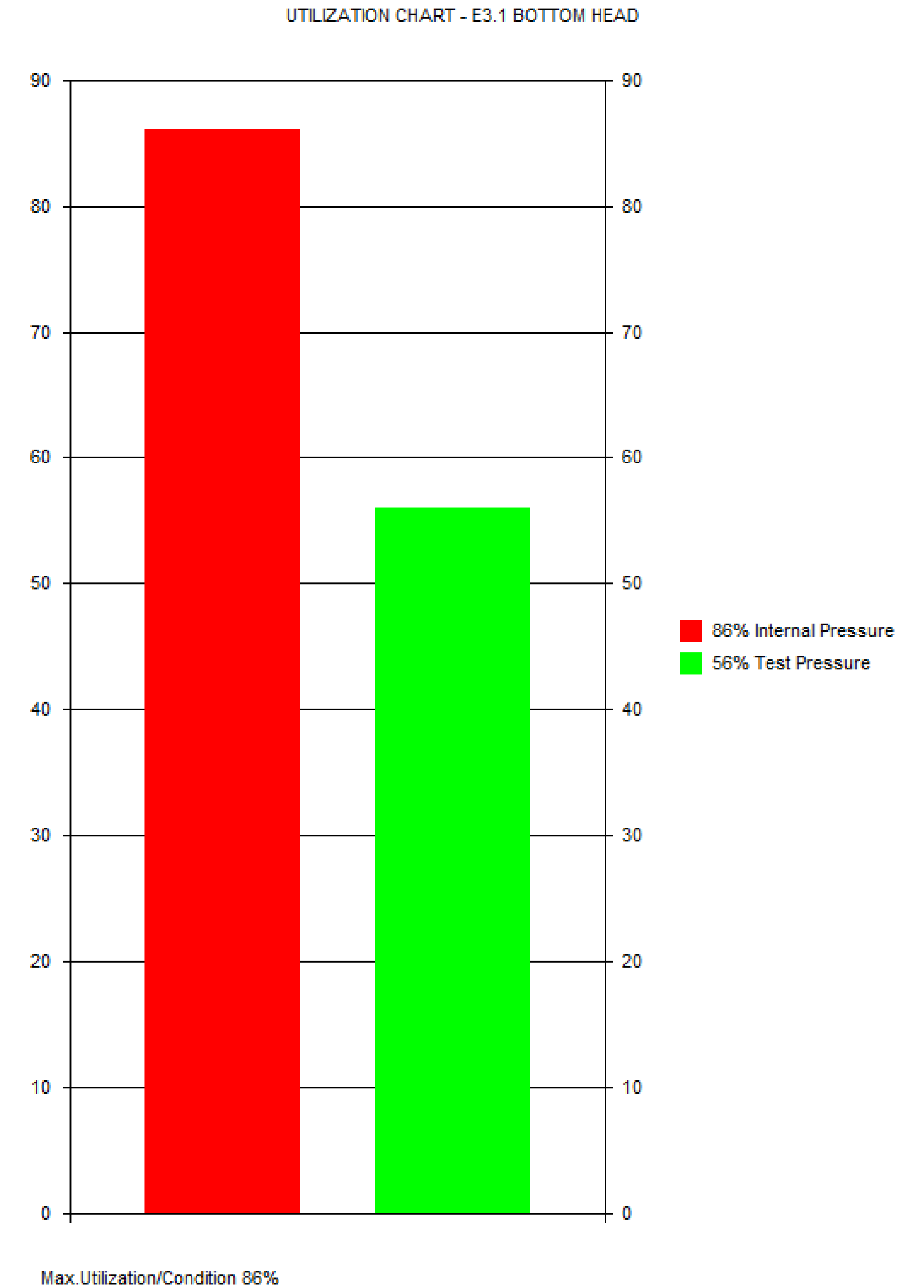
```
NEW AT AMBIENT TEMP. FOR TEST GROUPS 1, 2 and 3
Ptmin = 1.25 * Pd * f20 / f =1.25*3.3*212.5/205.73=         4.2607 MPa
Ptmin = 1.43 * Pd =1.43*3.3=                                4.7190 MPa
```

Test Pressure Ptmin=4.72 <= Ptmax=8.43[MPa]	56.0%	OK

Maximum diameter of Opening Not Requiring Reinforcement Check , dmax

```
Maximum Diameter of Unreinforced Opening
dmax = MAX( dmax1, dmax2) =MAX(0,4.18)=                     4.1778 mm
```

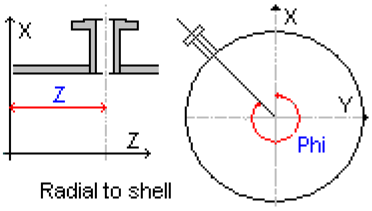
Volume:0.0018 m3 Weight:1.5 kg (SG= 7.85)


UTILIZATION CHART - E3.1 BOTTOM HEAD
90
80
70
60
50
40
30
20
10
0
86% Internal Pressure
56% Test Pressure
Max.Utilization/Condition 86%

INPUT DATA

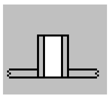
COMPONENT ATTACHMENT/LOCATION

```
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 attacment........:z          50.00 mm
Angle of Rotation of nozzle axis projected in the x-y plane:Phi     0.00 Degr.
```

GENERAL DESIGN DATA

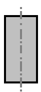


```
Type of Opening: Nozzle Without Standard ASME or DIN/EN Flange Attachment
PRESSURE LOADING: Design Component for Internal Pressure Only
PROCESS CARD:
General Design Data : Temp= 130°C, P=3.3000 MPa, c=0.5 mm, Pext=0.0000 MPa
SPECIFIC DENSITY OF OPERATING LIQUID................:SG          0.00
LIQUID 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        219.00 mm
NOMINAL WALL THICKNESS (uncorroded).................:en        3.0000 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
```

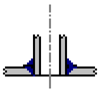
NOZZLE MATERIAL DATA



```
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

EN13445:2014 Issue 5+A8:2019 - 9.5 ISOLATED OPENINGS IN SHELLS
N.1 ROT 1 1/4" 28 May 2023 11:31 ConnID:S1.1

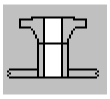


```
Attachment: Set In Flush Nozzle
Shape of Nozzle/Opening: Circular
Application:
9.4.6.3 NOT a critical fatigue area, and calc.temp.is outside creep range.
OUTSIDE NOZZLE DIAMETER.............................:deb        31.60 mm
NOMINAL NOZZLE THICKNESS (uncorroded)...............:enb       6.8000 mm
Size of Flange and Nozzle:
Comment (Optional):
NEGATIVE TOLERANCE/THINNING ALLOWANCE...............:          12.50 %
NOZZLE STANDOUT MEASURED FROM VESSEL OD.............:ho        32.00 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 =3-0.5-0.3=                                 2.2000 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) =219/2-2.2=                        107.30 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)=0.0965 <= 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

Area of Shell Afs

```
Limit of Reinforcement Along Shell
Iso = Sqr(( 2 * ris + eas) * eas)
=Sqr((2*107.3+2.2)*2.2)=                               21.84 mm
Set In Nozzle
Afs = eas * Is (9.5-79) =2.2*21.84=                     48.05 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,)32)=                        11.94 mm
Set In Nozzle
Afb = eb * (Ibo + Ibi + eas) (9.5-78) =5.45*(11.94+0+2.2)=  77.05 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+2.2)=  146.33 mm2

Cyl.Shell in the Longitudinal Section Aps
ApsL = ris * (Is + a) (9.5-94) =107.3*(21.84+15.8)=     4038.71 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*107.3^2*(21.84+15.86)/(0.5*2.2+107.3)=          2001.86 mm2

Aps = MAX( ApsL ApsT) =MAX(4038.71,2001.86)=            4038.71 mm2
```

9.5.2 Reinforcement Rules

Pressure Area Required pA(req.)

```
pAReqL = P * (ApsL + Apb + 0.5 * ApphiL)                       (9.5-7)
=3.3*(4038.71+146.33+0.5*0)=                            13.81 kN

pAReqT = P * (ApsT + Apb + 0.5 * Apphi)                        (9.5-7)
=3.3*(2001.86+146.33+0.5*0)=                          7.0890 kN

pAReq = MAX( pAReqL, pAReqT) =MAX(13810.63,7089.03)=      13.81 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)
=(48.05+0)*(194.67-0.5*3.3)+0*(0-0.5*3.3)+77.05*(127.6-0.5*3.3)=    18.98 kN
```

Nozzle Reinforcement pAAval=18.98 >= pAReq=13.81[kN]	72.7%	OK

Maximum Allowable Pressure Pmax

```
Pmax = (Afs+Afw)*fs+Afb*fob/((ApsL+Apb)+0.5*(Afs+Afw+Afb+Afp))     (9.5-10)
=(48.05+0)*194.67+77.05*127.6/((4038.71+146.33)+0.5*(48.05+0+77.05+0))
=   4.5167 MPa
```

Max.Allowable Test Pressure Ptmax

```
Ptmax =   ==                                            9.1068 MPa

Weight of Nozzle: .1505kg
```

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*107.3+2.2)*2.2)=                               21.84 mm
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,)32)=                              11.94 mm
```

Pressure Area Required pA(req.)

```
pAReqL = P * (ApsL + Apb + 0.5 * ApphiL)                            (9.5-7)
=3.3*(4038.71+146.33+0.5*0)=                                 13.81 kN

pAReqT = P * (ApsT + Apb + 0.5 * Apphi)                             (9.5-7)
=3.3*(2001.86+146.33+0.5*0)=                                7.0890 kN

pAReq = MAX( pAReqL, pAReqT) =MAX(13810.63,7089.03)=           13.81 kN
```

Pressure Area Available pA(aval.)

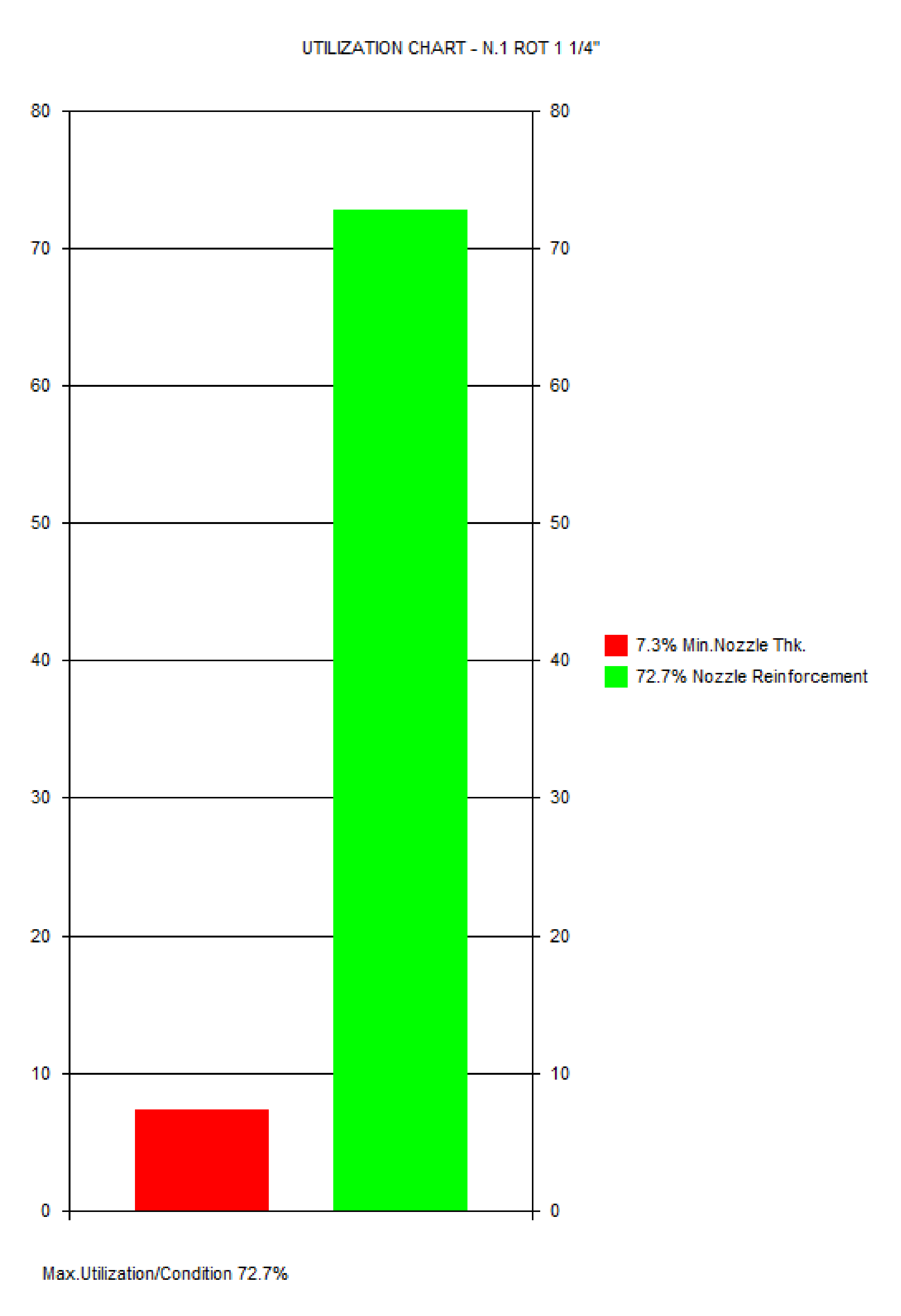
```
pAAval = (Afs+Afw)*(fs-0.5*P)+Afp*(fop-0.5*P)+Afb*(fob-0.5*P)      (9.5-7)
=(48.05+0)*(194.67-0.5*3.3)+0*(0-0.5*3.3)+77.05*(127.6-0.5*3.3)=    18.98 kN
```

Nozzle Reinforcement pAAval=18.98 >= pAReq=13.81[kN]	72.7%	OK

Maximum Allowable Pressure Pmax

```
Pmax = (Afs+Afw)*fs+Afb*fob/((ApsL+Apb)+0.5*(Afs+Afw+Afb+Afp))     (9.5-10)
=(48.05+0)*194.67+77.05*127.6/((4038.71+146.33)+0.5*(48.05+0+77.05+0))
=   4.5167 MPa
```

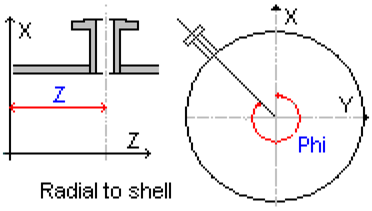
Volume:0.00 m3 Weight:0.2 kg (SG= 7.85)


UTILIZATION CHART - N.1 ROT 1 1/4"
80
70
60
50
40
30
20
10
0
7.3% Min.Nozzle Thk.
72.7% Nozzle Reinforcement
Max.Utilization/Condition 72.7%

INPUT DATA

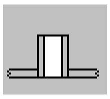
COMPONENT ATTACHMENT/LOCATION

```
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 attacment........:z          50.00 mm
Angle of Rotation of nozzle axis projected in the x-y plane:Phi    45.00 Degr.
```

GENERAL DESIGN DATA

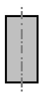


```
Type of Opening: Nozzle Without Standard ASME or DIN/EN Flange Attachment
PRESSURE LOADING: Design Component for Internal Pressure Only
PROCESS CARD:
General Design Data : Temp= 130°C, P=3.3000 MPa, c=0.5 mm, Pext=0.0000 MPa
SPECIFIC DENSITY OF OPERATING LIQUID................:SG          0.00
LIQUID 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        219.00 mm
NOMINAL WALL THICKNESS (uncorroded).................:en        3.0000 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
```

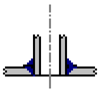
NOZZLE MATERIAL DATA



```
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

EN13445:2014 Issue 5+A8:2019 - 9.5 ISOLATED OPENINGS IN SHELLS
N.3 1/2" NPT 28 May 2023 12:33 ConnID:S1.1

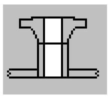


```
Attachment: Set In Flush Nozzle
Shape of Nozzle/Opening: Circular
Application:
9.4.6.3 NOT a critical fatigue area, and calc.temp.is outside creep range.
OUTSIDE NOZZLE DIAMETER..............................:deb        31.50 mm
NOMINAL NOZZLE THICKNESS (uncorroded)................:enb       7.0500 mm
Size of Flange and Nozzle:
Comment (Optional):
NEGATIVE TOLERANCE/THINNING ALLOWANCE................:           12.50 %
NOZZLE STANDOUT MEASURED FROM VESSEL OD..............:ho         20.00 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 =3-0.5-0.3=                                2.2000 mm
Nozzle Analysis Thickness eab
eab = enb - cn - NegDev =7.05-0.5-0.8813=                    5.6688 mm
Inside Radius of Curvature
ris = De / 2 - eas (9.5-3) =219/2-2.2=                       107.30 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(194.67,127.6)=               127.60 N/mm2
```

GEOMETRIC LIMITATIONS

»Check Max.Diameter of Nozzle dib/(2*ris)=0.094 <= 1.00=1[mm] «» OK«

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.

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*107.3+2.2)*2.2)=                                    21.84 mm
Set In Nozzle
Afs = eas * Is (9.5-79) =2.2*21.84=                           48.05 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,)20)=                             12.10 mm
Set In Nozzle
Afb = eb * (Ibo + Ibi + eas) (9.5-78) =5.67*(12.1+0+2.2)=     81.07 mm2
```

Calculation of Pressure Loaded Areas

```
In the Nozzle Apb
Apb = 0.5 * dib * (Ibo + eas) (9.5-84) =0.5*20.16*(12.1+2.2)=   144.17 mm2

Cyl.Shell in the Longitudinal Section Aps
ApsL = ris * (Is + a) (9.5-94) =107.3*(21.84+15.75)=        4033.34 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*107.3^2*(21.84+15.81)/(0.5*2.2+107.3)=               1999.18 mm2

Aps = MAX( ApsL ApsT) =MAX(4033.34,1999.18)=                4033.34 mm2
```

9.5.2 Reinforcement Rules

Pressure Area Required pA(req.)

```
pAReqL = P * (ApsL + Apb + 0.5 * ApphiL)                          (9.5-7)
=3.3*(4033.34+144.17+0.5*0)=                                13.79 kN

pAReqT = P * (ApsT + Apb + 0.5 * Apphi)                           (9.5-7)
=3.3*(1999.18+144.17+0.5*0)=                              7.0731 kN

pAReq = MAX( pAReqL, pAReqT) =MAX(13785.8,7073.05)=           13.79 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)
=(48.05+0)*(194.67-0.5*3.3)+0*(0-0.5*3.3)+81.07*(127.6-0.5*3.3)=   19.48 kN
```

Nozzle Reinforcement pAAval=19.48 >= pAReq=13.79[kN]	70.7%	OK

Maximum Allowable Pressure Pmax

```
Pmax = (Afs+Afw)*fs+Afb*fob/((ApsL+Apb)+0.5*(Afs+Afw+Afb+Afp))     (9.5-10)
=(48.05+0)*194.67+81.07*127.6/((4033.34+144.17)+0.5*(48.05+0+81.07+0))
=   4.6434 MPa
```

Max.Allowable Test Pressure Ptmax

```
Ptmax =   ==                                                  9.3342 MPa

Weight of Nozzle: .1028kg
```

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 = Sqr(( 2 * ris + eas) * eas)
=Sqr((2*107.3+2.2)*2.2)=                                    21.84 mm
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,)20)=                                   12.10 mm
```

Pressure Area Required pA(req.)

```
pAReqL = P * (ApsL + Apb + 0.5 * ApphiL)                                 (9.5-7)
=3.3*(4033.34+144.17+0.5*0)=                                      13.79 kN

pAReqT = P * (ApsT + Apb + 0.5 * Apphi)                                  (9.5-7)
=3.3*(1999.18+144.17+0.5*0)=                                     7.0731 kN

pAReq = MAX( pAReqL, pAReqT) =MAX(13785.8,7073.05)=                 13.79 kN
```

Pressure Area Available pA(aval.)

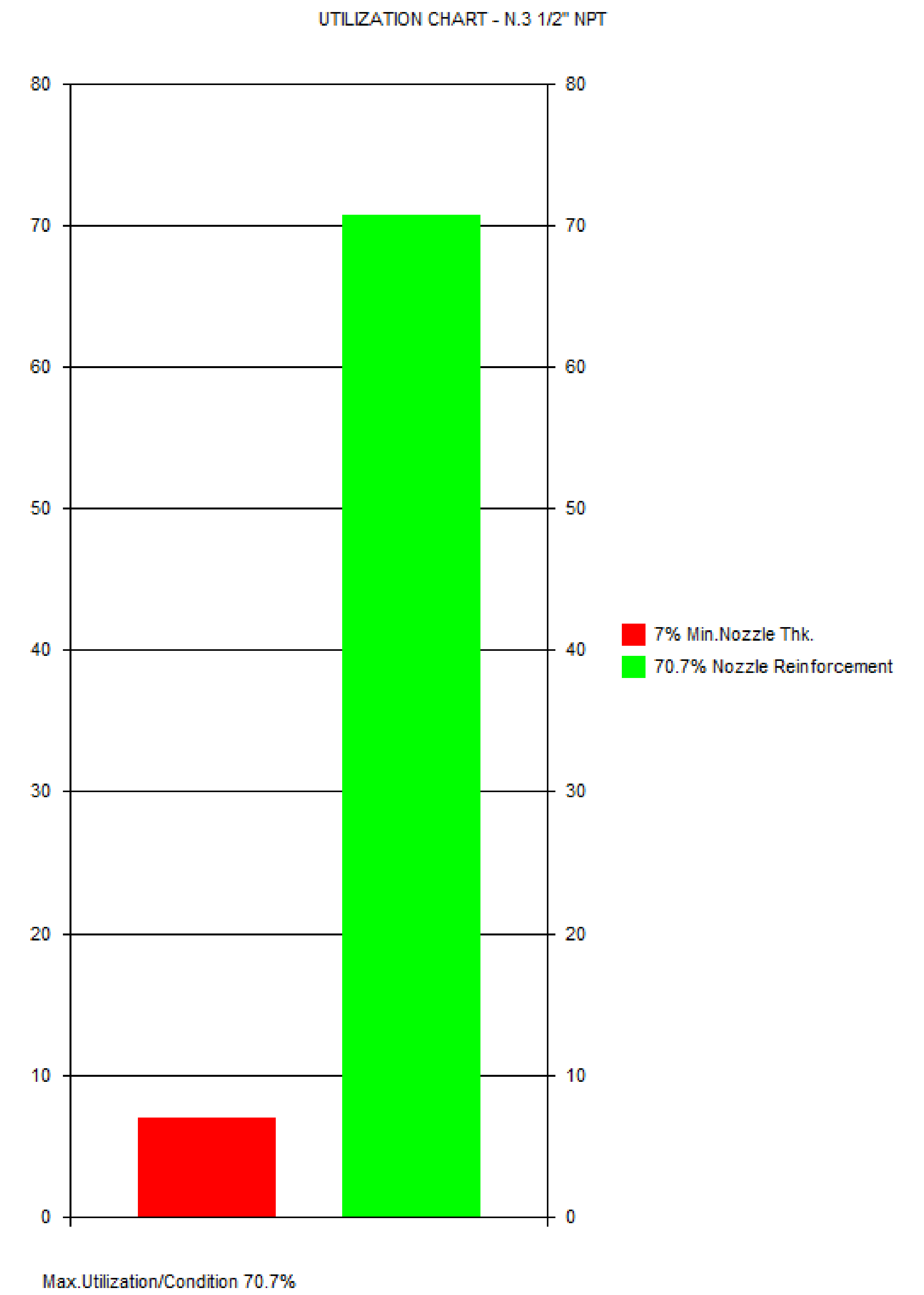
```
pAAval = (Afs+Afw)*(fs-0.5*P)+Afp*(fop-0.5*P)+Afb*(fob-0.5*P)      (9.5-7)
=(48.05+0)*(194.67-0.5*3.3)+0*(0-0.5*3.3)+81.07*(127.6-0.5*3.3)=     19.48 kN
```

Nozzle Reinforcement pAAval=19.48 >= pAReq=13.79[kN]	70.7%	OK

Maximum Allowable Pressure Pmax

```
Pmax = (Afs+Afw)*fs+Afb*fob/((ApsL+Apb)+0.5*(Afs+Afw+Afb+Afp))     (9.5-10)
=(48.05+0)*194.67+81.07*127.6/((4033.34+144.17)+0.5*(48.05+0+81.07+0))
=   4.6434 MPa
```

Volume:0.00 m3   Weight:0.1 kg (SG= 7.85)


UTILIZATION CHART - N.3 1/2" NPT
80
70
60
50
40
30
20
10
0
7% Min.Nozzle Thk.
70.7% Nozzle Reinforcement
Max.Utilization/Condition 70.7%