



Design Conditions:

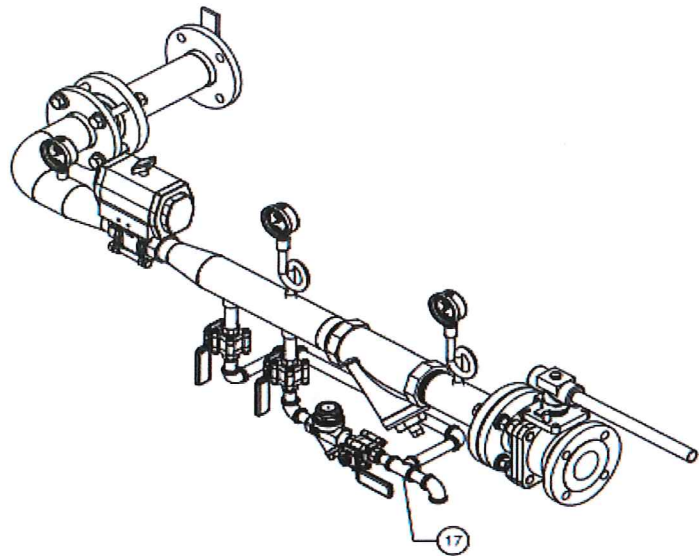
Code: **ASME B31.3**
Year: **2018**
Addenda: -
MAWP Internal: **50** psi
MAWP External: **0** psi
Max. Temperature: **300** °F
MDMT: **50** °F
MDMT Pressure: **50** psi
Corrosion Allowance: **0** in
Hydrostatic Test: **75** psi
Impact Testing: **None**
Impact Exemption: **323.2.2**
Radiography: **5%**

Conclusion:

The Steam Fitting has been analyzed to ASME B31.3, 2018 edition rules and is found acceptable.

ASME B31.3 Piping Calculations

Cust: **Caloris Engineering LLC**
File: **15912c-1 R0**
Desc: **Steam Fitting**
Dwg: **M877-8469**
Date: **August 17, 2020**



Author: **Farid Sarihi, EIT**
Reviewer: **Jakub Luszczki, C.E.T.**

Engineering Notes

Notes:

301 Loads Considered:

(301.2) Design Pressure: **Yes**
 (301.3) Design Temperature: **Yes**
 (301.4) Ambient Effects: **No**
 (301.5) Dynamic Effects: **No**
 (301.6) Weight Effects: **No**
 (301.7) Thermal Expansion Effects: **No**
 (301.8) Support Effects: **No**
 (301.9) Reduced Ductility Effects: **No**
 (301.10) Cyclic Effects: **No**
 (301.11) Air Condensation Effects: **No**

Revisions:

[illegible]

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8	1.5" Pipe - Items 5, 6	16	Socket Weld Sizing

Steam Fitting Vessel

Design Pressure:

50 P [psi] - design pressure

0 mpa [psi] - external operation pressure

Hydro Test: ASME B31.3 345.4.2

Test Pressure = 1.5 * mDp * MR-sH

= 1.5 * 50 * 1 - 0

mTp = 75

Material Properties: ASME B31.3 Table A-1

300 Temp [°F] - design temperature

Material	Application	Ambient Strength	Design Strength	Strength Ratio	Min °F	Max °F	Index
A182 F304 Forging & Fitting - S30400 []		20000	20000	1	-425	1500	1
A312 TP304 Pipe - S30400 []		20000	20000	1	-425	1500	2
A403 WP304 Forging & Fitting - S30400 []		20000	20000	1	-425	1500	3
							4
							5
							6
							7
							8
							9
							10
							11
							12
							13

Min Ratio (MR) = 1.000

Item 1, 3 - Flange Description

Flange Inputs:

SA 182 Gr. F304 Material

150 Class - pressure class

50.0 P_[psi] - design pressure300 Temp_[°F] - design temperature

Geometry Constraints and Data:

Comp = Vlookup(Material, FlangeMatChart, 3)

composition

18Cr-8Ni

Table = Vlookup(Material, FlangeMatChart, 2)

pressure table

Table 221

TM_[°F] = Vlookup(Material, FlangeMatChart, 5)

max temperature

1500

TM ≥ Temp

1500 ≥ 300

Acceptable

Pressure Rating:

Pclass_[psi] = PVElookup(Table, "Int1Dlin", Class, Temp)

rated pressure

205

Pclass ≥ P

205 ≥ 50

Acceptable

Weld Inputs:

2.5 Size - nominal flange size

0.120 tn_[in] - nominal pipe wall thickness0.000 Corr_[in] - internal corrosion allowanceHub_[in] = PVELOOKUP("B16.5_Class"&Class, "Lookup", "HubSO", Size)

0.310

Socket Weld: VIII-1 Fig UW-21, B31.1 Fig 127.4.4(B), B31.3 Fig 328.5.2B

F1sw_[in] = Min(1.4*tn, Hub)

minimum outer fillet

MIN(1.4*0.12, 0.31) = 0.168

Slip On Weld: VIII-1 Fig UW-21, B31.1 Fig 127.4.4(B), B31.3 Fig 328.5.2B

F1so_[in] = Min(1.4*tn, Hub)

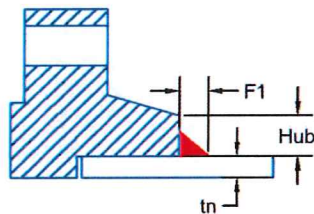
minimum outer fillet

MIN(1.4*0.12, 0.31) = 0.168

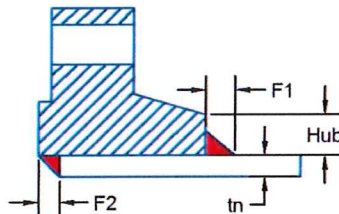
F2so_[in] = Min(tn, 0.25+Corr/0.7)

minimum inner fillet

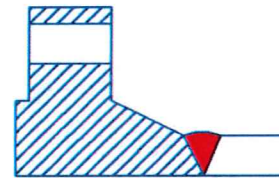
MIN(0.12, 0.25+0/0.7) = 0.120



Socket Weld



Slip On Weld



Weld Neck Weld

2.5" Pipe - Item 2 Description

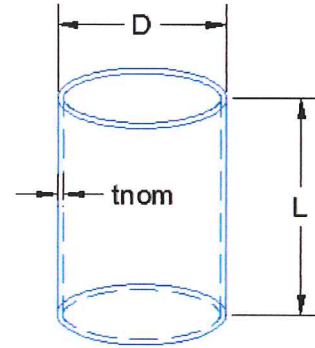
Dimensions:

2.875 $D_{[in]}$ - outside diameter
0.120 t_{nom} - nominal thickness
0.000 $h_{[in]}$ - thread allowance B1.20.2
12.500% $UT_{[%]}$ - undertolerance allowance
0.000 $Ca_{[in]}$ - corrosion allowance
0.000 $Ma_{[in]}$ - mechanical allowance

Material and Conditions:

300 $Temp_{[°F]}$ - design temperature
A312 TP304 **Pipe - S30400** **[]** **Material**

20,000 $S_{[psi]}$ - allowable stress level
1.00 E - longitudinal efficiency (circ. stress)
1.00 W - weld joint reduction factor
50.0 $P_{[psi]}$ - design pressure



Variables:

$ci_{[in]} = Ma + Ca$ $0 + 0 = 0.0000$
 $co_{[in]} = h$ $0 = 0.0000$
 $c_{[in]} = ci + co$ $0 + 0 = 0.0000$
 $T_{[in]} = t_{nom} * (1 - UT)$ $0.12 * (1 - 0.125) = 0.1050$
 $d_{[in]} = D - 2 * T$ $2.875 - 2 * 0.105 = 2.6650$
 $Y1$ = From Table 304.1.1 $= 0.40$
 $Y2 = (d + 2 * c) / (D + d + 2 * c)$ $(2.665 + 2 * 0) / (2.875 + 2.665 + 2 * 0) = 0.4810$

Interior Pressure: B31.3-304.1.2

$t1_{[in]} = P * D / (2 * (S * E * W + P * Y1))$ $50 * 2.875 / (2 * (20000 * 1 * 1 + 50 * 0.4)) = 0.0036$
 $t2_{[in]} = P * D / (2 * (S * E * W + P * Y2))$ $50 * 2.875 / (2 * (20000 * 1 * 1 + 50 * 0.481)) = 0.0036$
 $t_{[in]} = \text{if}(t1 >= D/6, t2, t1)$ $\text{IF}(0.0036 >= 2.875/6, 0.0036, 0.0036) = 0.0036$
 $SR_{[]}$ = $\text{if}(t1 >= D/6, S2/S, S1/S)$ $\text{IF}(0.0036 >= 2.875/6, 6660/20000, 6665/20000) = 0.033$
 $tm_{[in]} = t + c$ $0.0036 + 0 = 0.0036$
 $0.105 >= 0.0036$ **Acceptable**

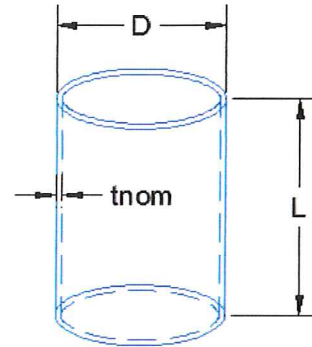
2.5" Fittings - Items 4, 5 Description

Dimensions:

2.875 $D_{[in]}$ - outside diameter
0.120 $tnom_{[in]}$ - nominal thickness
0.000 $h_{[in]}$ - thread allowance B1.20.2
12.500% $UT_{[%]}$ - undertolerance allowance
0.000 $Ca_{[in]}$ - corrosion allowance
0.000 $Ma_{[in]}$ - mechanical allowance

Material and Conditions:

300 $Temp_{[°F]}$ - design temperature
A403 WP304 Forging & Fitting - S30400 $[\]$ Material
20,000 $S_{[psi]}$ - allowable stress level
1.00 E - longitudinal efficiency (circ. stress)
1.00 W - weld joint reduction factor
50.0 $P_{[psi]}$ - design pressure



Variables:

$ci_{[in]} = Ma + Ca$ $0 + 0 = 0.0000$
 $co_{[in]} = h$ $0 = 0.0000$
 $c_{[in]} = ci + co$ $0 + 0 = 0.0000$
 $T_{[in]} = tnom * (1 - UT)$ $0.12 * (1 - 0.125) = 0.1050$
 $d_{[in]} = D - 2 * T$ $2.875 - 2 * 0.105 = 2.6650$
 $Y1$ = From Table 304.1.1 $= 0.40$
 $Y2 = (d + 2 * c) / (D + d + 2 * c)$ $(2.665 + 2 * 0) / (2.875 + 2.665 + 2 * 0) = 0.4810$

Interior Pressure: B31.3-304.1.2

$t1_{[in]} = P * D / (2 * (S * E * W + P * Y1))$ $50 * 2.875 / (2 * (20000 * 1 * 1 + 50 * 0.4)) = 0.0036$
 $t2_{[in]} = P * D / (2 * (S * E * W + P * Y2))$ $50 * 2.875 / (2 * (20000 * 1 * 1 + 50 * 0.481)) = 0.0036$
 $t_{[in]} = \text{if}(t1 >= D/6, t2, t1)$ $\text{IF}(0.0036 >= 2.875/6, 0.0036, 0.0036) = 0.0036$
 $SR_{[\]} = \text{if}(t1 >= D/6, S2/S, S1/S)$ $\text{IF}(0.0036 >= 2.875/6, 660/20000, 665/20000) = 0.033$
 $tm_{[in]} = t + c$ $0.0036 + 0 = 0.0036$
 $T >= tm$ $0.105 >= 0.0036$ **Acceptable**

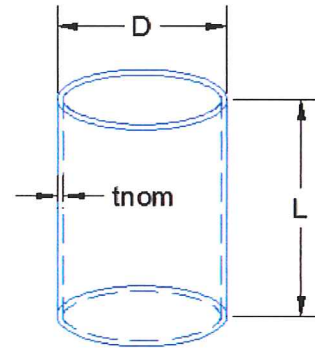
1.5" Pipe - Item 6 Description

Dimensions:

1.900 $D_{[in]}$ - outside diameter
0.109 $tnom_{[in]}$ - nominal thickness
0.000 $h_{[in]}$ - thread allowance B1.20.2
12.500% $UT_{[%]}$ - undertolerance allowance
0.000 $Ca_{[in]}$ - corrosion allowance
0.000 $Ma_{[in]}$ - mechanical allowance

Material and Conditions:

300 $Temp_{[°F]}$ - design temperature
A312 TP304 **Pipe - S30400** **[]** **Material**
20,000 $S_{[psi]}$ - allowable stress level
1.00 E - longitudinal efficiency (circ. stress)
1.00 W - weld joint reduction factor
50.0 $P_{[psi]}$ - design pressure



Variables:

$ci_{[in]} = Ma + Ca$ $0 + 0 = 0.0000$
 $co_{[in]} = h$ $0 = 0.0000$
 $c_{[in]} = ci + co$ $0 + 0 = 0.0000$
 $T_{[in]} = tnom * (1 - UT)$ $0.109 * (1 - 0.125) = 0.0954$
 $d_{[in]} = D - 2 * T$ $1.9 - 2 * 0.0954 = 1.7093$
 $Y1$ = From Table 304.1.1 $= 0.40$
 $Y2 = (d + 2 * c) / (D + d + 2 * c)$ $(1.7093 + 2 * 0) / (1.9 + 1.7093 + 2 * 0) = 0.4736$

Interior Pressure: B31.3-304.1.2

$t1_{[in]} = P * D / (2 * (S * E * W + P * Y1))$ $50 * 1.9 / (2 * (20000 * 1 * 1 + 50 * 0.4)) = 0.0024$
 $t2_{[in]} = P * D / (2 * (S * E * W + P * Y2))$ $50 * 1.9 / (2 * (20000 * 1 * 1 + 50 * 0.4736)) = 0.0024$
 $t_{[in]} = \text{if}(t1 >= D/6, t2, t1)$ $\text{IF}(0.0024 >= 1.9/6, 0.0024, 0.0024) = 0.0024$
 $SR_{[]} = \text{if}(t1 >= D/6, S2/S, S1/S)$ $\text{IF}(0.0024 >= 1.9/6, 474/20000, 478/20000) = 0.024$
 $tm_{[in]} = t + c$ $0.0024 + 0 = 0.0024$
 $T >= tm$ $0.0954 >= 0.0024$ **Acceptable**

Item 7 - Branch on item 2 Description

B31.3 Code? - select

a Nozzle_Design? - select

Conditions:

300 Temp [°F] - design temperature

50.0 P [psi] - Pressure

Header/Run:

A312 TP304 Pipe - S30400 [] Material-Header

AusteniticSteel GroupH - material group

20,000 Sh [psi] - allowable stress

1.00 Eh - longitudinal efficiency

1.00 Wh

12.50% UTh [%] - undertolerance allowance

0.0000 ch [in] - corrosion or mechanical allowance, B31.3

2.8750 Dh [in] - outside diameter, B31.3

0.1200 tnh [in] - nominal thickness

Branch:

A182 F304 Forging & Fitting - S30400 [] Material-Branch

AusteniticSteel GroupB - material group

20,000 Sb [psi] - allowable branch stress

1.00 Eb - longitudinal efficiency

1.00 Wb

0.00% UTb [%] - undertolerance allowance

0.0000 cb [in] - corrosion or mechanical allowance, B31.3

1.3800 Db [in] - branch outside diameter, B31.3

0.1050 tnb [in] - nominal thickness

0.1875 Leg41 [in] - branch fillet weld size

90 β [°] - angle between header and branch, B31.3

Weld Size Checks:

Throat41 [in] = 0.7*Leg41

tc [in] = Min(0.25, 0.7*tnb)

Throat41 >= tc

β >= 45

0.7*0.1875 = 0.1313

MIN(0.25, 0.7*0.105) = 0.0735

0.1313 >= 0.0735 Acceptable

90 >= 45 Acceptable

Header Interior Pressure Rating: 304.1.2 for B31.3

Th [in] = tnh*(1-UTh) available thickness

th [in] = P*Dh/(2*(Sh*Eh*Wh+P*Yh))

Th >= th + ch

0.12*(1-0.125) = 0.1050

50*2.875/(2*(20000*1*1+50*0.4)) = 0.0036

0.105 >= 0.0036 + 0 Acceptable

Branch Interior Pressure Rating: 304.1.2 for B31.3

Tb [in] = tnb*(1-UTb) available thickness

tb [in] = P*Db/(2*(Sb*Eb*Wb+P*Yb))

Tb >= tb + cb

0.105*(1-0) = 0.1050

50*1.38/(2*(20000*1*1+50*0.4)) = 0.0017

0.105 >= 0.0017 + 0 Acceptable

Dimensions:

d1 [in] = (Db-2*(Tb-cb))/sin(radians(β)) run direction hole size in branch, B31.3

(1.38-2*(0.105-0))/SIN(RADIANS(90)) = 1.1700

d2 [in] = (Tb-cb)+(Th-ch)+d1/2 "Half Width" of reinforcement zone, B31.3

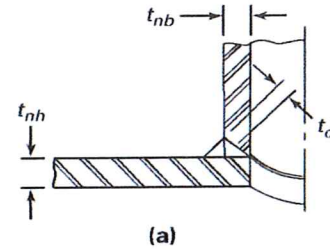
(0.105-0)+(0.105-0)+1.17/2 = 0.7950

d2Use [in] = Min(Dh, Max(d1, d2)) "Half Width" of reinforcement zone, B31.3

MIN(2.875, MAX(1.17, 0.795)) = 1.1700

L4 [in] = Min(2.5*(Tb-ch), 2.5*(Th-ch)) branch reinforcement length limit

MIN(2.5*(0.105-0), 2.5*(0.105-0)) = 0.2625



1 **Available Material Inside Code Limits:** This material is allowed to be used

2 $\text{Leg41i}_{[in]} = \text{if}(L4 \geq \text{Leg41}, \text{Leg41}, L4)$ Leg41 if inside limits IF(0.2625 >= 0.1875, 0.1875, 0.2625) = **0.1875**

3 **Area Replacement:** 304.3.3 for B31.3

4 $A1_{[in^2]} = t_h * d1 * (2 * \sin(\text{radians}(\beta)))$ required area $0.0036 * 1.17 * (2 * \sin(\text{RADIANS}(90))) =$ **0.0042**

5

6 $A2_{[in^2]} = (2 * d2_{Use} - d1) * (T_h - t_h - c_h)$ pipe $(2 * 1.17 - 1.17) * (0.105 - 0.0036 - 0) =$ **0.1186**

7

8 $A3_{[in^2]} = 2 * L4 * (T_b - t_b - c_b) / \sin(\text{radians}(\beta)) * \min(S_b / S_h, 1)$ branch $(2 * 1.17 - 1.17) * (0.105 - 0.0036 - 0) =$ **0.1186**

9 $2 * 0.2625 * (0.105 - 0.0017 - 0) / \sin(\text{RADIANS}(90)) * \min(20000 / 20000, 1) =$ **0.0542**

10 $A41_{[in^2]} = (\text{Leg41i}^2) * \min(S_b / S_h, 1)$ weld 41, part of A4 $(0.1875^2) * \min(20000 / 20000, 1) =$ **0.0352**

11

12 **Available** $_{[in^2]} = A2 + A3 + A41$ $0.1186 + 0.0542 + 0.0352 =$ **0.2080**

13 **Available** $\geq A1$ $0.208 \geq 0.0042$ **Acceptable**

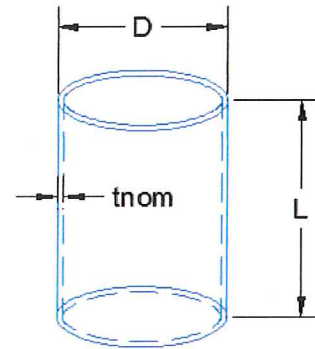
2.5" Pipe - Items 10, 11 Description

Dimensions:

2.875 $D_{[in]}$ - outside diameter
0.203 $tnom_{[in]}$ - nominal thickness
0.100 $h_{[in]}$ - thread allowance B1.20.2
12.500% $UT_{[%]}$ - undertolerance allowance
0.000 $Ca_{[in]}$ - corrosion allowance
0.000 $Ma_{[in]}$ - mechanical allowance

Material and Conditions:

300 $Temp_{[°F]}$ - design temperature
A312 TP304 **Pipe - S30400** **[]** **Material**
20,000 $S_{[psi]}$ - allowable stress level
1.00 E - longitudinal efficiency (circ. stress)
1.00 W - weld joint reduction factor
50.0 $P_{[psi]}$ - design pressure



Variables:

$ci_{[in]} = Ma + Ca$ $0 + 0 = 0.0000$
 $co_{[in]} = h$ $0.1 = 0.1000$
 $c_{[in]} = ci + co$ $0 + 0.1 = 0.1000$
 $T_{[in]} = tnom * (1 - UT)$ $0.203 * (1 - 0.125) = 0.1776$
 $d_{[in]} = D - 2 * T$ $2.875 - 2 * 0.1776 = 2.5198$
 $Y1$ = From Table 304.1.1 $= 0.40$
 $Y2 = (d + 2 * c) / (D + d + 2 * c)$ $(2.5198 + 2 * 0.1) / (2.875 + 2.5198 + 2 * 0.1) = 0.4861$

Interior Pressure: B31.3-304.1.2

$t1_{[in]} = P * D / (2 * (S * E * W + P * Y1))$ $50 * 2.875 / (2 * (20000 * 1 * 1 + 50 * 0.4)) = 0.0036$
 $t2_{[in]} = P * D / (2 * (S * E * W + P * Y2))$ $50 * 2.875 / (2 * (20000 * 1 * 1 + 50 * 0.4861)) = 0.0036$
 $t_{[in]} = \text{if}(t1 >= D/6, t2, t1)$ $\text{IF}(0.0036 >= 2.875/6, 0.0036, 0.0036) = 0.0036$
 $SR_{[]}$ = $\text{if}(t1 >= D/6, S2/S, S1/S)$ $\text{IF}(0.0036 >= 2.875/6, 902/20000, 906/20000) = 0.045$
 $tm_{[in]} = t + c$ $0.0036 + 0.1 = 0.1036$
 $T >= tm$ $0.1776 >= 0.1036$ **Acceptable**

Item 12 - Branch on item 2 Description

B31.3 Code? - select

a Nozzle_Design? - select

Conditions:

300 Temp [°F] - design temperature

50.0 P [psi] - Pressure

Header/Run:

A312 TP304 Pipe - S30400 [] Material-Header

AusteniticSteel GroupH - material group

20,000 Sh [psi] - allowable stress

1.00 Eh - longitudinal efficiency

1.00 Wh

12.50% UTh [%] - undertolerance allowance

0.0000 ch [in] - corrosion or mechanical allowance, B31.3

2.8750 Dh [in] - outside diameter, B31.3

0.1200 tnh [in] - nominal thickness

Branch:

A182 F304 Forging & Fitting - S30400 [] Material-Branch

AusteniticSteel GroupB - material group

20,000 Sb [psi] - allowable branch stress

1.00 Eb - longitudinal efficiency

1.00 Wb

0.00% UTb [%] - undertolerance allowance

0.0000 cb [in] - corrosion or mechanical allowance, B31.3

1.8800 Db [in] - branch outside diameter, B31.3

0.1400 tnb [in] - nominal thickness

0.1875 Leg41 [in] - branch fillet weld size

90 β [°] - angle between header and branch, B31.3

Weld Size Checks:

Throat41 [in] = 0.7*Leg41

tc [in] = Min(0.25, 0.7*tnb)

Throat41 >= tc

β >= 45

0.7*0.1875 = 0.1313

MIN(0.25, 0.7*0.14) = 0.0980

0.1313 >= 0.098 Acceptable

90 >= 45 Acceptable

Header Interior Pressure Rating: 304.1.2 for B31.3

Th [in] = tnh*(1-UTh) available thickness

th [in] = P*Dh/(2*(Sh*Eh*Wh+P*Yh))

Th >= th + ch

0.12*(1-0.125) = 0.1050

50*2.875/(2*(20000*1*1+50*0.4)) = 0.0036

0.105 >= 0.0036 + 0 Acceptable

Branch Interior Pressure Rating: 304.1.2 for B31.3

Tb [in] = tnb*(1-UTb) available thickness

tb [in] = P*Db/(2*(Sb*Eb*Wb+P*Yb))

Tb >= tb + cb

0.14*(1-0) = 0.1400

50*1.88/(2*(20000*1*1+50*0.4)) = 0.0023

0.14 >= 0.0023 + 0 Acceptable

Dimensions:

d1 [in] = (Db-2*(Tb-cb))/sin(radians(β)) run direction hole size in branch, B31.3

(1.88-2*(0.14-0))/SIN(RADIANS(90)) = 1.6000

d2 [in] = (Tb-cb)+(Th-ch)+d1/2 "Half Width" of reinforcement zone, B31.3

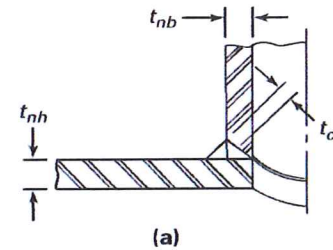
(0.14-0)+(0.105-0)+1.6/2 = 1.0450

d2Use [in] = Min(Dh, Max(d1, d2)) "Half Width" of reinforcement zone, B31.3

MIN(2.875, MAX(1.6, 1.045)) = 1.6000

L4 [in] = Min(2.5*(Tb-ch), 2.5*(Th-ch)) branch reinforcement length limit

MIN(2.5*(0.14-0), 2.5*(0.105-0)) = 0.2625



1 **Available Material Inside Code Limits:** This material is allowed to be used

2 $\text{Leg41i}_{[in]} = \text{if}(L4 \geq \text{Leg41}, \text{Leg41}, L4)$ Leg41 if inside limits IF(0.2625 >= 0.1875, 0.1875, 0.2625) = **0.1875**

3 **Area Replacement:** 304.3.3 for B31.3

4 $A1_{[in^2]} = t_h * d1 * (2 - \sin(\text{radians}(\beta)))$ required area $0.0036 * 1.6 * (2 - \sin(\text{RADIANS}(90))) =$ **0.0057**

5 $A2_{[in^2]} = (2 * d2_{Use} - d1) * (T_h - t_h - c_h)$ pipe $(2 * 1.6 - 1.6) * (0.105 - 0.0036 - 0) =$ **0.1623**

6 $A3_{[in^2]} = 2 * L4 * (T_b - t_b - c_b) / \sin(\text{radians}(\beta)) * \min(S_b / S_h, 1)$ branch $2 * 0.2625 * (0.14 - 0.0023 - 0) / \sin(\text{RADIANS}(90)) * \min(20000 / 20000, 1) =$ **0.0723**

7 $A41_{[in^2]} = (\text{Leg41i}^2) * \min(S_b / S_h, 1)$ weld 41, part of A4 $(0.1875^2) * \min(20000 / 20000, 1) =$ **0.0352**

8 **Available** $_{[in^2]} = A2 + A3 + A41$ $0.1623 + 0.0723 + 0.0352 =$ **0.2697**

9 **Available** $\geq A1$ $0.2697 \geq 0.0057$ **Acceptable**

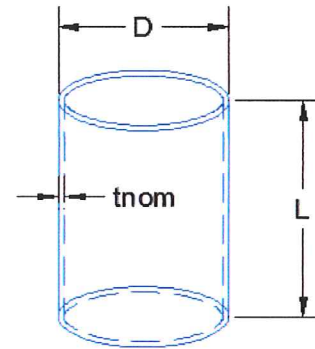
0.5" Pipe - Items 13,14,15,18 Description

Dimensions:

0.840 $D_{[in]}$ - outside diameter
0.109 $t_{nom [in]}$ - nominal thickness
0.057 $h_{[in]}$ - thread allowance B1.20.2
12.500% $UT_{[%]}$ - undertolerance allowance
0.000 $Ca_{[in]}$ - corrosion allowance
0.000 $Ma_{[in]}$ - mechanical allowance

Material and Conditions:

300 $Temp_{[°F]}$ - design temperature
A312 TP304 **Pipe - S30400** **[]** Material
20,000 $S_{[psi]}$ - allowable stress level
1.00 E - longitudinal efficiency (circ. stress)
1.00 W - weld joint reduction factor
50.0 $P_{[psi]}$ - design pressure



Variables:

$ci_{[in]} = Ma + Ca$ $0+0 = 0.0000$
 $co_{[in]} = h$ $0.057 = 0.0571$
 $c_{[in]} = ci + co$ $0+0.0571 = 0.0571$
 $T_{[in]} = t_{nom} * (1 - UT)$ $0.109 * (1 - 0.125) = 0.0954$
 $d_{[in]} = D - 2 * T$ $0.84 - 2 * 0.0954 = 0.6493$
 $Y1$ = From Table 304.1.1 $= 0.40$
 $Y2 = (d + 2 * c) / (D + d + 2 * c)$ $(0.6493 + 2 * 0.0571) / (0.84 + 0.6493 + 2 * 0.0571) = 0.4762$

Interior Pressure: B31.3-304.1.2

$t1_{[in]} = P * D / (2 * (S * E * W + P * Y1))$ $50 * 0.84 / (2 * (20000 * 1 * 1 + 50 * 0.4)) = 0.0010$
 $t2_{[in]} = P * D / (2 * (S * E * W + P * Y2))$ $50 * 0.84 / (2 * (20000 * 1 * 1 + 50 * 0.4762)) = 0.0010$
 $t_{[in]} = \text{if}(t1 >= D/6, t2, t1)$ $\text{IF}(0.001 >= 0.84/6, 0.001, 0.001) = 0.0010$
 $SR_{[]} = \text{if}(t1 >= D/6, S2/S, S1/S)$ $\text{IF}(0.001 >= 0.84/6, 525/20000, 529/20000) = 0.026$
 $tm_{[in]} = t + c$ $0.001 + 0.0571 = 0.0582$
 $0.0954 >= 0.0582$ **Acceptable**

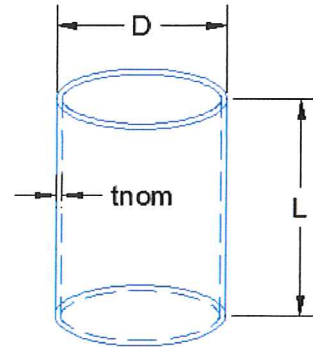
0.5" Fittings - Items 16, 17 Description

Dimensions:

0.840 $D_{[in]}$ - outside diameter
0.147 $t_{nom [in]}$ - nominal thickness
0.000 $h_{[in]}$ - thread allowance B1.20.2
0.000% $UT_{[%]}$ - undertolerance allowance
0.000 $Ca_{[in]}$ - corrosion allowance
0.020 $Ma_{[in]}$ - mechanical allowance

Material and Conditions:

300 $Temp_{[F]}$ - design temperature
A403 WP304 Forging & Fitting - S30400 [] Material
20,000 $S_{[psi]}$ - allowable stress level
1.00 E - longitudinal efficiency (circ. stress)
1.00 W - weld joint reduction factor
50.0 $P_{[psi]}$ - design pressure



Variables:

$ci_{[in]} = Ma + Ca$ $0.02 + 0 = 0.0200$
 $co_{[in]} = h$ $0 = 0.0000$
 $c_{[in]} = ci + co$ $0.02 + 0 = 0.0200$
 $T_{[in]} = t_{nom} * (1 - UT)$ $0.147 * (1 - 0) = 0.1470$
 $d_{[in]} = D - 2 * T$ $0.84 - 2 * 0.147 = 0.5460$
 $Y1 = \text{From Table 304.1.1}$ $= 0.40$
 $Y2 = (d + 2 * c) / (D + d + 2 * c)$ $(0.546 + 2 * 0.02) / (0.84 + 0.546 + 2 * 0.02) = 0.4109$

Interior Pressure: B31.3-304.1.2

$t1_{[in]} = P * D / (2 * (S * E * W + P * Y1))$ $50 * 0.84 / (2 * (20000 * 1 * 1 + 50 * 0.4)) = 0.0010$
 $t2_{[in]} = P * D / (2 * (S * E * W + P * Y2))$ $50 * 0.84 / (2 * (20000 * 1 * 1 + 50 * 0.4109)) = 0.0010$
 $t_{[in]} = \text{if}(t1 >= D/6, t2, t1)$ $\text{IF}(0.001 >= 0.84/6, 0.001, 0.001) = 0.0010$
 $SR_{ij} = \text{if}(t1 >= D/6, S2/S, S1/S)$ $\text{IF}(0.001 >= 0.84/6, 145/20000, 145/20000) = 0.007$
 $tm_{[in]} = t + c$ $0.001 + 0.02 = 0.0210$
 $T >= tm$ $0.147 >= 0.021$ **Acceptable**

Fig. 328.5.2C

Item Description	Socket Wall	T_w	Weld Size	$1.09T_w$	Min. Weld	Check
Item 16 - Elbow	0.184	0.109	0.188	0.119	0.119	Acceptable
Item 17 - Tee	0.184	0.109	0.188	0.119	0.119	Acceptable

Fig. 328.5.2C Minimum Welding Dimensions for Socket Welding Components Other Than Flanges

