ASME B31J-2017, Table 1-1 Flexibility and Stress Intensification Factors
(Including Proposal Errata 11-9-2017)

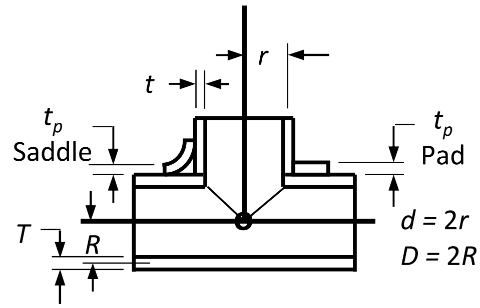
Supplier:	Description:	Appr.	Date	Rev.
				0
				1
				2

Sketch 2.2 Reinforced Fabricated Tee

When t_p > 1.5T, Use t_p = 1.5T

[Notes (1), (7)]

Flexibility factors and SIF's shall not be less than 1.0



Units of measure: U.S. Customary

Run matching pipe: NPS 10 (DN 250) -- 10S, thk = 0.165 in.(4.19 mm) D_{nps} = 10 (DN 250)

Run outside diameter of matching pipe: D_o = 10.75 in.

Run nominal wall thickness of matching pipe (or average T if available): T = 0.165 in.

Run mean radius of pipe = (D_o - T) / 2 R = 5.293 in.

Run mean diameter of matching pipe = 2R D = 10.585 in.

General Note (b): D/T = 64.2 OK. D/ T is less or equal to 100.

Branch matching pipe: NPS 6 (DN 150) -- 10S, thk = 0.134 in.(3.4 mm) d_{nps} = 6 (DN 150)

Branch outside diameter of matching pipe: d_o = 6.625 in.

Note (1): d_o/D_o is > 0.5, thus SIFs apply at centerlines intersection point.

Branch nominal wall thickness of matching pipe: t = 0.134 in.

Branch mean radius of pipe = (d_o - t) / 2 r = 3.246 in.

Branch mean diameter of matching pipe = 2r d = 6.491 in.

General Note (b): d/t = 48.4 OK. d/ t is less or equal to 100.

Thickness of pad or saddle: input t_p = 0.365 in.

When (input t_p) > 1.5T, use t_p = 1.5T. t_p = 0.248 in.

Note (7): A rigid element can only be considered adjacent when less than $0.1D^{1.4}/T^{0.4}$ from branch:

Is there a rigid component adjacent to Leg 1 within 5.59 in. of the branch? ☐ FALSE

Is there a rigid component adjacent to Leg 2 within 5.59 in. of the branch? ☐ FALSE

Number of flanges or rigid component attached to run pipe end (Input 0, 1, or 2) N_c = 0

Note (7) The flexibility and stress intensification factors apply only if the following conditions are satisfied:

(a) Branch pipe axis is within 5 deg of run surface unless noted as β below		☑	TRUE
(b) $R/T \le 50$	R/T = 32.1		TRUE
(c) $d/D \le 1$	d/D = 0.6		TRUE
(d) $r/t \le 50$	r/t = 24.2		TRUE
(e) Are T and D maintained at least (2D) =	21.2 in. each side of branch centerline?	☑	TRUE

Continue below. Note (7) conditions (a), (b), (c), (d), and (e) are satisfied.

Note (7): Factor c from Table 1-3, Flanged End Correction Coefficients:

multiplier for flexibility factor k_{ib}, $= 1 - 0.032 N_c^{1.345}(D/T)^{0.431}(d/D)^{0.903}$ = c_{ib} = 1.000

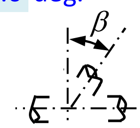
multiplier for flexibility factor k_{ob} $= 1 - 0.07 N_c^{0.61}(D/T)^{0.44}(d/D)^{0.339}$ = c_{ob} = 1.000

multiplier for flexibility factor k_{tb} $= 1 - 0.003 N_c^{3.962}(D/T)^{0.548}(d/D)^{0.693}$ = c_{tb} = 1.000

Note (7): Multiplier for SIF i_{ob} = larger of $[1.07(t/T) - 1.08(t/T)^2 + 0.026]$ * $(D/T)^{0.34}$, or 1.0 when $t/T \le 0.85$, $d/D < 1$, and $D/T \ge 25$ = F_1 = 1.000

Note (7): Branch pipe axis is β deg. from normal to the run pipe surface: β = 0.0 deg.

If β is > 5 deg. and ≤ 45 deg., then D/T must be < 50 and d/D must be ≤ 0.6.



Beta = 0 deg., D/T = 64.2 and d/D = 0.61, therefore: **Continue below.**

Flexibility Factors:

Run in-plane, $k_{ir} = 0.21[R/(T+0.5t_p)]^{0.97} (t/T)^{-0.65} (d/D)^{6.2}$	k_{ir} =	1.00	0.19
Run out-of-plane, $k_{or} = 1.0$	k_{or} =	1.00	
Run torsional, $k_{tr} = 0.12[R/(T+0.5t_p)]^{1.39} (t/T)^{-0.74} (d/D)^{8.5}$	k_{tr} =	1.00	0.12
Branch in-plane, $k_{ib} = [1.29(d/D) - 2.73(d/D)^2 + 1.62(d/D)^3] [R/(T+0.5t_p)]^{1.2}$ x $(t/T)^{0.56}(d/D)^{0.33} (c_{ib})$ =	k_{ib} =	3.43	3.43
Branch in-plane, $k_{ob} = [0.84(d/D) - 1.27(d/D)^2 + 0.5(d/D)^3] [R/(T+0.5t_p)]^{1.69}$ x $(t/T)^{0.68}(d/D)^{0.21} (c_{ob})$ =	k_{ob} =	16.33	16.33
Branch in-plane, $k_{tb} = 1.1 [R/(T+0.5t_p)]^{0.5}(d/D)^{5.42} (c_{tb})$	k_{tb} =	1.00	0.33

Stress Intensification Factors (SIFs):

Note (1): d_o/D_o is > 0.5, thus SIFs apply at centerlines intersection point.

Note (7): If $i_{ir} < i_{or}$, then use $i_{ir} = i_{or}$

Run SIF in-plane, $i_{ir} = [R/(T+0.5t_p)]^{0.45} (d/D)^{0.54} (t/T)^{-0.34} \ge 1.5$	i_{ir} =	3.05	3.05
Run SIF out-of-plane, $i_{or} = [1.29(d/D) - 2.87(d/D)^2 + 2.39(d/D)^3] (t/T)^{-0.25}$ x $[R/(T+0.5t_p)]^{0.35}$ =	i_{or} =	1.00	0.77
Run SIF torsional, $i_{tr} = 0.36[R/(T+0.5t_p)]^{2/3} (t/T)^{-0.6} (d/D)^{1.4}$	i_{tr} =	1.43	1.43
Branch SIF in-plane, $i_{ib} = [3.33(d/D) - 5.49(d/D)^2 + 2.94(d/D)^3]$ x $(TR^{2/3})(T+0.5t_p)^{-5/3} (t/T)^{0.3}$ =	i_{ib} =	2.45	2.45
Note (7): If $i_{ob} < i_{ib}$, then use $i_{ob} = i_{ib}$.			
Branch SIF out-of-plane, $i_{ob} = [2.86(d/D) + 2.4(d/D)^2 - 4.34(d/D)^3]$ * $(TR^{2/3})$ x $(T+0.5t_p)^{-5/3}(t/T)^{0.3} (F_1)$ When $t/T < 0.85$, use $t/T = 0.85$	i_{ob} =	6.26	6.26
Branch SIF torsional, $i_{tb} = 0.642(d/D)^2 (TR^{2/3})(T+0.5t_p)^{-5/3} (t/T)^{0.3}$	i_{tb} =	1.00	0.90

Run inside diameter of matching pipe = $D_i = D_o - 2T$ =	D_i =	10.420 in.
Branch inside diameter of matching pipe = $d_i = d_o - 2t$ =	d_i =	6.357 in.
Note (7): Section modulus of run pipe = $Z_r = (\pi/32) [(D_o^4 - D_i^4)/D_o]$	Z_r =	14.3 in.^3
Note (7): Section modulus of branch pipe = $Z_b = (\pi/32) [(d_o^4 - d_i^4)/d_o]$	Z_b =	4.3 in.^3
Table 1-2: Moment of inertia of run pipe = $I_r = \pi/64 (D_o^4 - D_i^4)$	I_r =	76.9 in.^4
Table 1-2: Moment of inertia of branch pipe = $I_r = \pi/64 (d_o^4 - d_i^4)$	I_b =	14.4 in.^4

General Note *(d)*: For all components of Sketches 2.1 through 2.6, the directional sustained stress or moment multiplier can be conservatively taken as the smaller of (1) and either (2) or (3) below:

(1) 0.75 times the applicable SIF

(2) (t/T) x the square root of the applicable SIF when $t/T > 1$ is $t/T > 1$? No

(3) the square root of the applicable SIF when $t / T \leq 1$ is $t/T \leq 1$? Yes

So, apply the stress and moment multiplier using the smaller result from either *(1)* or *(3)*

	(1)	*(2)*	*(3)*	Multiplier
Run SIF in-plane, iir multiplier = smaller of either (1) or (3):	2.29	N/A	1.75	**1.75**
Run SIF out-of-plane, ior multiplier = smaller of either (1) or (3):	1.00	N/A	1.00	**1.00**
Run torsional SIF, itr multiplier = smaller of either (1) or (3):	1.07	N/A	1.20	**1.07**
Branch SIF in-plane, iib multiplier = smaller of either (1) or (3):	1.83	N/A	1.56	**1.56**
Branch SIF out-of-plane, iob multiplier = smaller of (1) or (3):	4.70	N/A	2.50	**2.50**
Branch torsional SIF, itb multiplier = smaller of either (1) or (3):	1.00	N/A	1.00	**1.00**