



Calculation note — thermowell
ASME PTC 19.3 TW-2016

Project : Examples / Section 8-1
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Calculated 2026-10-09 08:18 UTC
WellFreq engine 0.2.0

Pass All four criteria of para. 7-1 were evaluated.

Acceptance criteria para. 7-1		
✓	Dimensional scope Section 4 Within the limits of the Code	
✓	Frequency limit para. 6-8 $r = 0.3579$, limit $r < 0.4$ (6-8.3 step 4)	×1.12
✓	Dynamic stress — support plane para. 6-12.3 $S_{o,max} = 2.41$ MPa, limit 19.43 MPa	×8.08
✓	Static stress — support plane para. 6-12.2 von Mises = 1.32 MPa, limit 204.8 MPa	×155.51
✓	External pressure para. 6-13 rating $P_r = 64.74$ MPa (shank 64.74, tip 549.05 MPa)	

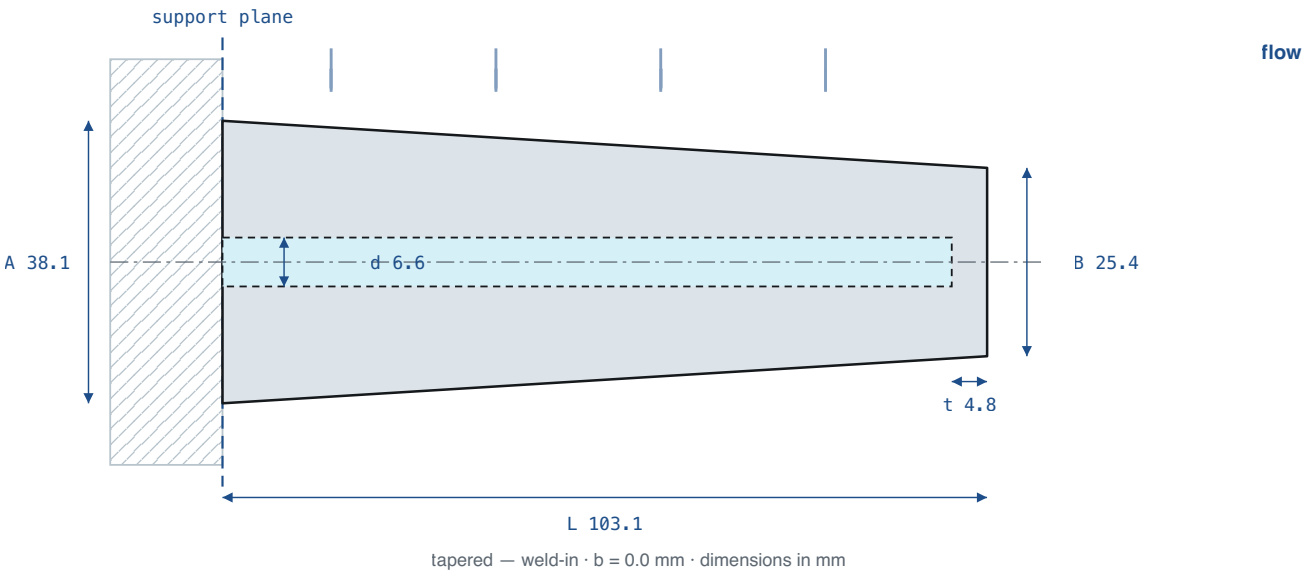
Process conditions

Temperature	232.2 °C
External pressure	16.203 bar g
Velocity	89.916 m/s
Density	7.993 kg/m³
Dynamic viscosity	1.710e-05 Pa·s

Material

Designation	ASTM A105
Modulus E at service T	189.61 GPa
Allowable stress S	136.52 MPa
Density	7 861 kg/m³
Fatigue class	A — as-welded or threaded

Geometry Section 4



To scale. tapered shank, weld-in mounting. Dimensions in millimetres.

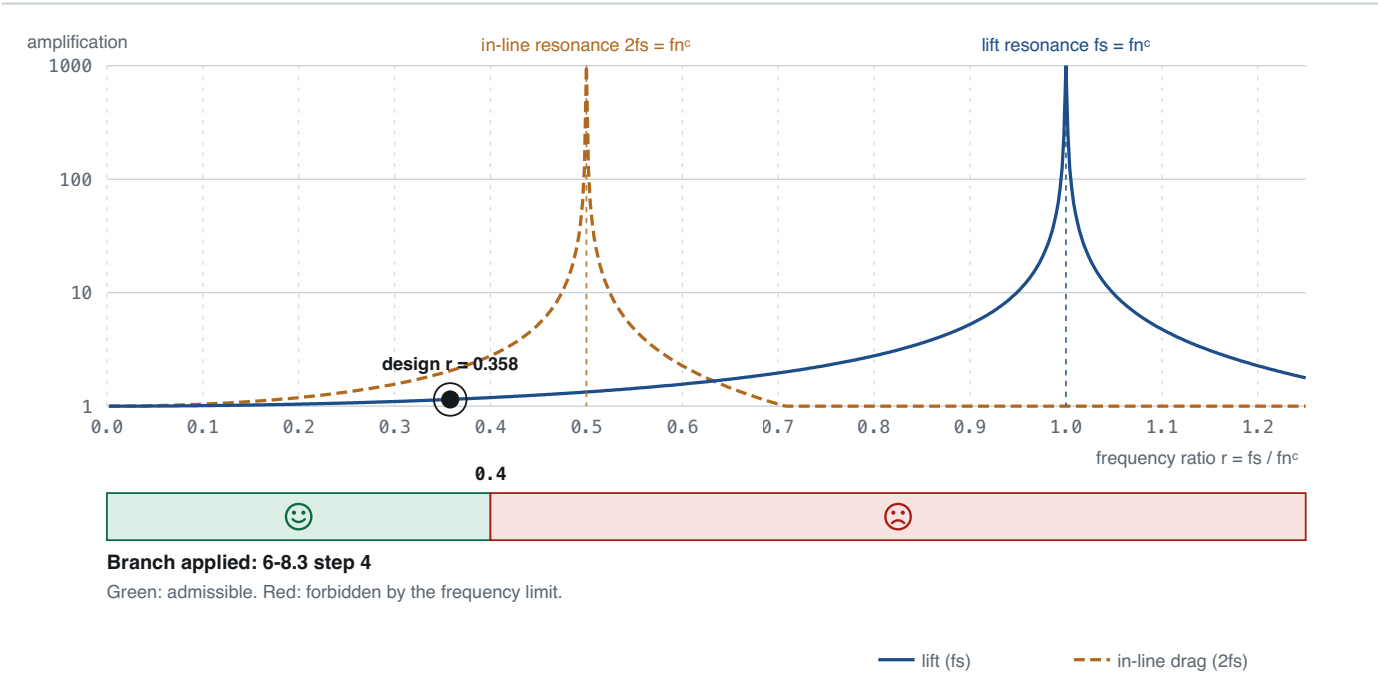
Flow para. 6-4

Reynolds on B	1.068e+06
Strouhal number	0.2200
Shedding frequency fs	778.80 Hz
C_D / C_d / C_l	1,4 / 0,1 / 1,0

Natural frequency para. 6-5 and 6-6

Average diameter Da	31.75 mm
fa — eq. (6-5-1)	2 095.1 Hz
Hf — eq. (6-5-2)	1.3519
Ha,f — eq. (6-5-4)	0.9995
Ha,s — eq. (6-5-5)	0.9922
fn — eq. (6-5-6)	2 808.9 Hz
Hc — para. 6-6	0.7746
fn° installed	2 175.8 Hz
Scruton number	4.5252

Amplitude response and frequency limit para. 6-8 and 6-9



Damping $\zeta = 0.0005$, amplification capped at $1/(2\zeta) = 1\,000$. The black dot marks the design condition.

Velocity exciting in-line resonance V_IR	125.60 m/s	
Cyclic stress at V_IR	402.9 MPa	
Fatigue limit F_T·F_E·Sf	19.43 MPa	
Withstands in-line resonance	exceeded	limit applied r < 0.4

Stresses para. 6-10 to 6-12

Quantity	support plane
Geometric parameter G — eq. (6-10-3)	29.05
Stress concentration Kt — eq. (6-12-4)	2.200
Steady drag S_D (MPa)	1.314
Oscillating lift S_L (MPa)	1.076
Oscillating drag S_d (MPa)	0.193
Radial pressure S_r (MPa)	1.620
Tangential pressure S_t (MPa)	1.721
Axial pressure S_a (MPa)	1.670
S_max = S_D + S_a (MPa)	2.984
von Mises (MPa)	1.317
Limit 1.5·S (MPa)	204.8
S_o,max — eq. (6-12-3) (MPa)	2.406
Fatigue limit (MPa)	19.43

Safety factors

Criterion	Factor	Verdict
Fatigue safety — support plane	8.08	pass
Static stress safety — support plane	155.51	pass
External pressure safety	39.95	pass
Frequency ratio r / limit	0.3579 / 0.4	pass

Each factor is the ratio of the allowable limit to the value reached. A factor below 1 means the limit is exceeded.

External pressure para. 6-13

P_c — shank, eq. (6-13-1)	64.74 MPa	
P_t — tip, eq. (6-13-2)	549.05 MPa	
Rating retained P_r	64.74 MPa	pass
Operating pressure	1.620 MPa	

Calculation assumptions

Damping ζ	5.000e-04	para. 6-8.2
Environmental factor F_E	1.000	eq. (6-12-5)
Sensor density ps	2 707 kg/m³	para. 6-5.3 step 5
Strouhal number	variable correlation	eq. (6-4-2)
Catalogue rating mode	no	para. 9-2
Root fillet b	0.00 mm	para. 6-6 and 6-7

Observations

Warning 6-8.3 step 4 The cyclic stress at in-line resonance exceeds the fatigue limit, so the frequency limit drops to $r < 0.4$. The para. 6-8.5 allowance for transient passage remains possible under six cumulative conditions, including a gaseous process fluid and fewer than $1e11$ accumulated cycles.

Produced by WellFreq 0.2.0 to ASME PTC 19.3 TW-2016. Specification of the thermowell, of its installation and of the full range of operating conditions is the responsibility of the system designer (para. 3-2 and 9-1). Compatibility of the material with the process fluid, impurities included, remains the responsibility of the end user. This note does not replace review by a qualified engineer.