Thin tube under uniform lateral external pressure
(critical external pressure when elastic buckling occurs)

	Aluminum 6061-T6	Aluminum 6061-T6	Stiffened Al. 6061-T6	Sandwich composite Nomex core [1]	Sandwich composite fuzzy carbon core	Sandwich composite Rohacell core	AlBeMet	Be - modified from CDF Run I
Modulus of elasticity (psi)	1.00E+07	1.00E+07	1.00E+07				2.80E+07	4.40E+07
Poisson's ratio	0.33	0.33	0.33				0.17	0.02
Elongation (%)	12	12	12				5	2.5
Wall thickness (in)	0.039	0.025	0.010	0.386	0.086	0.046	0.020	0.020
Radius (in)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Length (in)	170	170	170	170	170	170	170	170
Ciritcal ext. pressure (psi)	171.2	43.8	45.0	14349.8	348.0	93.5	57.7	91.7
Design safety factor	11.6	3.0	3.1	976.2	23.7		3.9	6.2
Density (lb/in^3)	0.098	0.098	0.098				0.076	0.067
Matl radiation length (cm)	8.9	8.9	8.9	Nomex 683; Al: 8.9; epoxy: 45	F. C: 1198; Al 8.9; epoxy: 44	Roh: 4186; Al 8.9; epoxy: 45	18.8	35.2
X/X0 (%)	**1.125**	**0.714**	**0.300**	**0.548**	**0.200**	**0.230**	**0.270**	**0.144**
Comments	This design is used in the most recent BTeV simulation		Max. press calculated using ASME BPVC (stiffening rings t=0.010", h=0.125")	(2 skins 0.006" thk alum; 0.374" thk core; 0.012" thk epoxy); [1]	(2 skins 0.003" thk alum; 0.080" thk core; ttl 0.002" thk epoxy); X/X0=0.143% for skins 0.002"	(2 skins 0.003" thk alum; 0.080" thk core; ttl 0.010" thk epoxy[incl epoxy within core])		
Pros	Ease in manufacturing, w/stand radiation	Ease in manufacturing, w/stand radiation; cost least	Very strong in terms of elastic stability	Very strong in terms of elastic stability	Low radiation length	Low radiation length	Low radiation length	Low radiation length
Cons			Welding of stiffeners to tube not feasible - epoxying might be an option; uncertain about toughness	Need more development work to see if can make w/ facings this thin or thinner, to understand joint integrity; cost unknown	Unknown core material; need much more development to understand joint integrity, permeability, elastic stability; cost unknown	Need more development to understand joint integrity, permeability; cost unknown	Expensive	Very Expensive
Total cost for 2 tubes	$246	$1,737	$4,001				No quote	$92,080
(Notes on cost)	for wall thickness 0.035"		(tube only, not incl stiffeners)				no data currently exists on AlBeMet tube under vacuum	Estimate of $300,000 for 2 tubes if made new

[1] Bowden, G., et al, "A Sandwich Structure Beam Pipe for Storage Rings," SLAC-PUB-3354, June, 1984.

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