

MONROE BROTHERS LTD

Customer Sigmaphi
 Project JLab Q2-Q3 Quadrupole Pressure Relief
 Description Vessel Vent Path Vessel to the Relief Valve



Project Number SF / 12605
 Design Note 233 Issue 1

Version at 1 May 2016

msg_corner Fluid Helium
 Mass flow rate 9594.0 kg / hr
 2665.0 g / s
 Pressure 4.460 bar G
 5.473 bar A
 Vent temperature 6.88 K
 Superheat 0.00 K
 Gas temperature 6.88 K

Pressure drop
 Non Return Valve 21 mbar 33.1%
 Total 64 mbar 100.0%
 Convergence error - Absolute 0.00%
 Successful Convergence

Column insertion	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid	Valid
Start Position	010	020	030	040	050	060	070	080	090	100	110	120	120
Finish Position	020	030	040	050	060	070	080	090	100	110	120	120	120
Description	Entry Loss	010 to 020	020 to 030	030 to 040	NRV	050 to 060	060 to 070	070 to 080	080 to 090	090 to 100	100 to 110	110 to 120	Vent
Type													
Divertor Valve Kv					250								
Divertor Valve Cf					0.6								
Burst disc Sizing parameter													
Pressure	5.473	5.471	5.470	5.470	5.470	5.449	5.449	5.447	5.446	5.428	5.428	5.409	5.409 bar A
Temperature	6.880	6.879	6.879	6.879	6.879	6.873	6.873	6.899	6.899	6.951	6.968	7.022	7.048 K
Vapour density	71.181	71.158	71.157	71.157	71.157	70.978	70.976	70.054	70.047	67.987	67.436	65.458	kg / m³
Vapour viscosity	2.58E-06	2.58E-06	2.58E-06	2.58E-06	2.58E-06	2.58E-06	2.58E-06	2.57E-06	2.57E-06	2.55E-06	2.55E-06	2.53E-06	kg / m.s
Speed of sound	149.9	149.8	149.8	149.8	149.8	149.6	149.6	149.6	149.5	149.3	149.3	149.1	in²
Pipe nominal bore	4.000 n.b., sched 10S	4.000 n.b., sched 10S	4.000 n.b., sched 10S	4.000 n.b., sched 10S	180.00	4.000 n.b., sched 10S	3.000 n.b., sched 10S	3.000 n.b., sched 10S	3.000 n.b., sched 10S	3.000 n.b., sched 10S	3.000 n.b., sched 10S	3.000 n.b., sched 10S	3.000 n.b., sched 10S
Outside diameter	114.30	114.30	114.30	114.30	180.00	114.30	88.90	88.90	88.90	88.90	88.90	88.90	88.90
Wall	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05
Inside diameter	108.20	108.20	108.20	108.20	108.20	108.20	82.80	82.80	82.80	82.80	82.80	82.80	82.80
Length	0.0	127.0	0.0	0.0	100.0	576.0	79.4	720.7	172.0	50.8	172.0	76.2	mm
Flow area	9195.5	9195.5	9195.5	9195.5	9194.8	9195.5	5385.1	5385.1	5385.1	5385.1	5385.1	5385.1	mm²
Mass flow	2665.0	2665.0	2665.0	2665.0	2665.0	2665.0	2665.0	2665.0	2665.0	2665.0	2665.0	2665.0	g / s
Mass velocity	290	290	290	290	290	290	495	495	495	495	495	495	kg / m².s
Velocity	4.07	4.07	4.07	4.07	4.07	4.08	6.97	7.06	7.07	7.28	7.34	7.56	
Mach number	0.027	0.027	0.027	0.027	0.03	0.027	0.047	0.047	0.047	0.049	0.049	0.051	
Pipe Contraction (Node Inlet)	Geometry	Sudden						Sudden					
	Upstream diameter (Large)	Large						108.20					
	Node Diameter	108.20						82.80					
	Length												
	Angle												
	Diameter ratio	0.000						0.77					
	Resistance coefficient	0.464						0.12					
	Pressure loss	2.74						2.13					mbar
Pipe Friction Loss	Reynolds number	1.21E+07	1.21E+07	1.21E+07		1.22E+07	1.59E+07	1.59E+07	1.59E+07	1.61E+07	1.61E+07	1.62E+07	
	Friction coefficient	0.00535	0.00535	0.00535		0.00535	0.00500	0.00500	0.00500	0.00499	0.00499	0.00498	
	Pressure drop per unit length	0.29	0.29	0.29		0.29	1.04	1.06	1.06	1.09	1.09	1.13	
	Pressure drop	0.04	0.00	0.00		0.17	0.08	0.76	0.18	0.06	0.19	0.09	mbar per m
Pipe Enlargement (Node Outlet)	Node Diameter												mm
	Downstream diameter (Large)												mm
	Length												mm
	Angle												
	Coefficient												
	Pressure loss												mbar
Pipe Fitting (Node Outlet)	Fitting							Tee - As elbow		Tee - As elbow			
	Velocity head loss index							8		8			
	Velocity head loss							1.02		1.02			
	Pressure loss							17.83		18.52			

Enlargement & Fittings are mutually exclusive)

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Divertor Valve	Kv					250								
Reference 01-033.tif	Cf					0.6								
	Estimated Pressure drop					0.0211								bar
	Gf					10.6165								
	Pressure drop at choked conditions					1.668								bar
Maximum mass flow rate at choked conditions						15808								g / s
	Factor y					0.1688								
	Pressure drop factor					0.1681								
	Mass flow rate					2665.11								g / s
	Error in mass flow					0.004%								
	New estimate in pressure drop					0.021								bar
	Calculated pressure drop					21.12								mbar
	Damping (100% no convergence)					-200%								
	Next iteration					0.0211								bar
Heating	External Surface area	0	45604	0	0	56549	206832	22168	201290	48037	14188	48037	21282	mm³
	Heat Flux + contingency	0	0	0	0	0	0	38000	0	38000	38000	38000	38000	W / m²
	Heat Load	0.00	0.00	0.00	0.00	0.00	0.00	842.40	0.00	1825.42	539.14	1825.42	808.71	W
	Node outlet pressure	5.471	5.470	5.470	5.470	5.449	5.449	5.447	5.446	5.428	5.428	5.409	5.409	
	Inlet specific enthalpy	21.375	21.375	21.375	21.375	21.375	21.375	21.375	21.691	21.691	22.376	22.578	23.263	kJ / kg
	Specific enthalpy increment	0.000	0.000	0.000	0.000	0.000	0.000	0.316	0.000	0.685	0.202	0.685	0.303	kJ / kg
	Outlet specific enthalpy	21.375	21.375	21.375	21.375	21.375	21.375	21.691	21.691	22.376	22.578	23.263	23.566	kJ / kg
	Outlet temperature	6.879	6.879	6.879	6.879	6.873	6.873	6.899	6.899	6.951	6.968	7.022	7.048	K
	Temperature rise	-0.001	0.000	0.000	0.000	-0.006	0.000	0.025	0.000	0.052	0.017	0.054	0.026	K
Pressure Drop Summary	Inlet contraction	2.74							2.13					mbar
	Pipe friction		0.04					0.17	0.08	0.76	0.18	0.06	0.19	mbar
	Outlet enlarger													mbar
	Pipe Fitting									17.83		18.52		mbar
	Divertor valve					21.12								mbar
	Burst disc													mbar
	TOTAL	2.74	0.04	0.00	0.00	21.12	0.17	2.21	0.76	18.01	0.06	18.71	0.09	mbar
	Node outlet pressure	5.47	5.47	5.47	5.47	5.45	5.45	5.45	5.45	5.43	5.43	5.41	5.41	bar A
	Node outlet temperature	6.88	6.88	6.88	6.88	6.87	6.87	6.90	6.90	6.95	6.97	7.02	7.05	K