



Customer Sigmaphi
 Project JLab Dipole Pressure Relief
 Description Helium Vessel Exit Relief Pipe Reservoir to the Burst Disc

Project Number SF / 12605
 Design Note 211 Issue 2

| Fluid Helium | | | | | | | | | | | | | | | | Total Calculated | | Pressure Drop | | 1.559 | | bar A | | | | |
|-------------------------------|-----------------------------------|---------------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------|----------|------------|--------|------------------|-------|---------------|------------|---------|--|----------------------|-----|------|--|--|
| Mass flow rate | 17896 g / s | 64427 kg / hr | | | | | | | | | | | | | | | | | | | | | | | | |
| Pressure | 5.570 bar G | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 6.583 bar A | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vent temperature | 6.940 K | | | | | | | | | | | | | | | | | | | | | | | | | |
| Superheat | 0.000 K | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gas temperature | 6.940 K | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Entry Loss | | | | NRV | | | | Tee As Elbow | | | | Tee As Run | | | | Elbow LR | | | | Burst Expansion Disc | | | | |
| Pressure | 6.583 | 6.483 | 6.482 | 5.823 | 5.819 | 5.819 | 5.815 | 5.576 | 5.575 | 5.493 | 5.492 | 5.426 | 5.424 | 5.282 | 5.024 | 6.660 | | | | | | | | | | |
| Temperature | 6.940 | 6.921 | 6.923 | 6.789 | 6.795 | 6.800 | 6.804 | 6.749 | 6.753 | 6.743 | 6.747 | 6.742 | 6.755 | 6.734 | 6.660 | | | | | | | | | | | |
| Vapour density | 87.319 | 86.572 | 86.508 | 81.303 | 81.009 | 80.814 | 80.594 | 78.513 | 78.347 | 77.226 | 77.061 | 75.989 | 75.458 | 73.498 | | | | | kg / m³ | | | | | | | |
| Vapour viscosity | 2.86E-06 | 2.85E-06 | 2.84E-06 | 2.72E-06 | 2.72E-06 | 2.72E-06 | 2.71E-06 | 2.67E-06 | 2.66E-06 | 2.64E-06 | 2.64E-06 | 2.62E-06 | ##### | 2.58E-06 | | | | | kg / m.s | | | | | | | |
| Speed of sound | 163.9 | 162.7 | 162.6 | 154.6 | 154.5 | 154.4 | 154.3 | 151.4 | 151.3 | 150.3 | 150.2 | 149.3 | | | | | m / s | | | | | | | | | |
| Burst Disc MNFA | | | | | | | | | | | | | | | 12.7 | | | | | | | | in² | | | |
| | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | | | | | 4.000 | | | | | | |
| | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | n.b., | | | | | n.b., | | | | | | |
| | sched | sched | sched | sched | sched | sched | sched | sched | sched | sched | sched | sched | sched | sched | sched | | | | | sched | | | | | | |
| Pipe nominal bore | 10S | 10S | 10S | 10S | 10S | 10S | 10S | 10S | 10S | 10S | 10S | 10S | 10S | 10S | 10S | | | | | 10S | | | | | | |
| Outside diameter | 114.30 | 114.30 | 180.00 | 114.30 | 114.30 | 114.30 | 114.30 | 114.30 | 114.30 | 114.30 | 114.30 | 114.30 | 200.00 | 114.30 | 114.30 | | | | | mm | | | | | | |
| 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 | 3.05 | | | | | mm | | | | | | |
| Inside diameter | 108.20 | 108.20 | 108.20 | 108.20 | 108.20 | 108.20 | 108.20 | 108.20 | 108.20 | 108.20 | 108.20 | 108.20 | 102.14 | 108.20 | 108.20 | | | | | mm | | | | | | |
| Length | 0.0 | 127.0 | 100.0 | 576.0 | 88.9 | 433.4 | 200.0 | 76.2 | 200.0 | 76.2 | 240.0 | 247.7 | 200.0 | 0.0 | | | | | mm | | | | | | | |
| Flow area | 9195.5 | 9195.5 | 9195.5 | 9195.5 | 9195.5 | 9195.5 | 9195.5 | 9195.5 | 9195.5 | 9195.5 | 9195.5 | 9195.5 | 8193.5 | 9195.5 | | | | | mm² | | | | | | | |
| Parallel paths | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 1 | | | | | | | |
| Single path mass flow rate | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | 17896.4 | | | | | g / s | | | | | | | |
| Mass velocity | 1946 | 1946 | 1946 | 1946 | 1946 | 1946 | 1946 | 1946 | 1946 | 1946 | 1946 | 1946 | 2184 | 1946 | | | | | kg / m².s | | | | | | | |
| Velocity | 22.29 | 22.48 | 22.50 | 23.94 | 24.02 | 24.08 | 24.15 | 24.79 | 24.84 | 25.20 | 25.26 | 25.61 | 26.48 | 26.48 | | | | | m / s | | | | | | | |
| Mach number | 0.136 | 0.138 | 0.138 | 0.155 | 0.156 | 0.156 | 0.157 | 0.164 | 0.164 | 0.168 | 0.168 | 0.172 | 0.180 | | | | | | | | | | | | | |
| Reynolds number | 7.40E+07 | | 7.74E+07 | | 7.75E+07 | | 7.75E+07 | | 7.90E+07 | | 7.96E+07 | | 8.02E+07 | | | | | | | | | | | | | |
| Friction coefficient | 0.00341 | | 0.00337 | | 0.00337 | | 0.00337 | | 0.00335 | | 0.00335 | | 0.00334 | | | | | | | | | | | | | |
| Pressure drop per unit length | 8.89 | | 7.25 | | 7.28 | | 7.29 | | 7.47 | | 7.58 | | 7.69 | | | | | | mbar per m | | | | | | | |
| Pressure drop | 0.87 | | 4.18 | | 0.65 | | 3.16 | | 0.57 | | 0.58 | | 1.90 | | | | | | mbar | | | | | | | |
| Sudden contraction | Large ID | Large | | | | | | | | | | | | | | | | | | | | mm | | | | |
| | Small ID | 108.20 | | | | | | | | | | | | | | | | | | | | mm | | | | |
| | Diameter ratio | 0.000 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Resistance coefficient | 0.464 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Pressure loss | 100.70 | | | | | | | | | | | | | | | | | | | | mbar | | | | |
| 90° elbow | Resistance coefficient | | | | | | | | | | | | | | | 0.27 | | | | | | | | | | |
| | Pressure loss | | | | | | | | | | | | | | | 66.36 | | | | | | mbar | | | | |
| 45° standard elbow | Resistance coefficient | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Pressure loss | | | | | | | | | | | | | | | | | | | | | mbar | | | | |
| Tee | Resistance coefficient | | | | | | | | | | | | | | | 1.02 | | 0.34 | | | | | | | | |
| | Pressure loss | | | | | | | | | | | | | | | 239.69 | | 82.19 | | | | mbar | | | | |
| Burst disc | Resistance coefficient | | | | | | | | | | | | | | | | | 0.45 | | | | | | | | |
| | Pressure loss | | | | | | | | | | | | | | | | | 142.25 | | | | mbar | | | | |
| Sudden Expansion | Small ID | | | | | | | | | | | | | | | | | 108.20 | | | | mm | | | | |
| | Large ID | | | | | | | | | | | | | | | | | Large | | | | mm | | | | |
| | Pressure loss | | | | | | | | | | | | | | | | | 257.7 | | | | mbar | | | | |
| Valve | Valve Kv | 270 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Valve Cf | 0.8 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum Subcritical pressure drop | 2074.1 | | | | | | | | | | | | | | | | | | | | mbar | | | | |
| | Calculated pressure drop | 658.2 | | | | | | | | | | | | | | | | | | | | mbar | | | | |
| | Pressure drop | 658.2 | | | | | | | | | | | | | | | | | | | | mbar | | | | |
| Heating | External Surface area | 0 | 45604 | 56549 | 206832 | 31923 | 155623 | 71817 | 27362 | 71817 | 27362 | 86180 | 88927 | 125664 | 0 | | | | | mm² | | | | | | |
| | Heat Flux + contingency | 7000 | 7000 | 7000 | 7000 | 33000 | 7000 | 7000 | 33000 | 33000 | 33000 | 33000 | 33000 | 33000 | 33000 | | | | | W / m² | | | | | | |
| | Heat Load | 0.00 | 319.23 | 395.84 | 1447.83 | 1053.44 | 1089.36 | 502.72 | 902.95 | 2369.95 | 902.95 | 2843.95 | 2934.60 | 4146.90 | 0.00 | | | | | W | | | | | | |
| | Node outlet pressure | 6.483 | 6.482 | 5.823 | 5.819 | 5.819 | 5.815 | 5.576 | 5.575 | 5.493 | 5.492 | 5.426 | 5.424 | 5.282 | 5.024 | | | | | bar A | | | | | | |
| | Inlet specific enthalpy | 18.791 | 18.791 | 18.809 | 18.831 | 18.912 | 18.971 | 19.032 | 19.060 | 19.110 | 19.243 | 19.293 | 19.452 | 19.616 | 19.848 | | | | | kJ / kg | | | | | | |
| | Specific enthalpy increment | 0.000 | 0.018 | 0.022 | 0.081 | 0.059 | 0.061 | 0.028 | 0.050 | 0.132 | 0.050 | 0.159 | 0.164 | 0.232 | 0.000 | | | | | kJ / kg | | | | | | |
| | Outlet specific enthalpy | 18.791 | 18.809 | 18.831 | 18.912 | 18.971 | 19.032 | 19.060 | 19.110 | 19.243 | 19.293 | 19.452 | 19.616 | 19.848 | 19.848 | | | | | kJ / kg | | | | | | |
| | Outlet temperature | 6.921 | 6.923 | 6.789 | 6.795 | 6.800 | 6.804 | 6.749 | 6.753 | 6.743 | 6.747 | 6.742 | 6.755 | 6.734 | 6.660 | | | | | K | | | | | | |
| | Temperature rise | -0.019 | 0.001 | -0.134 | 0.006 | 0.005 | 0.004 | -0.055 | 0.004 | -0.010 | 0.004 | -0.005 | 0.013 | -0.021 | -0.075 | | | | | K | | | | | | |
| Total pressure drop | Pipe friction | | | | | | | | | | | | | | | 0.57 | | 0.58 | | 1.90 | | | | mbar | | |
| | Sudden contraction | 100.70 | | | | | | | | | | | | | | | | | | | | mbar | | | | |
| | Tee thru Run | | | | | | | | | | | | | | | 239.69 | | 82.19 | | | | mbar | | | | |
| | Burst disc | | | | | | | | | | | | | | | | | | | 142.25 | | | | | | |
| | Sudden expansion | | | | | | | | | | | | | | | | | | | 257.68 | | mbar | | | | |
| | Valve | 658.19 | | | | | | | | | | | | | | | | | | | | | | | | |
| | TOTAL | 100.70 | 0.87 | 658.19 | 4.18 | 0.65 | 3.16 | 239.69 | 0.57 | 82.19 | 0.58 | 66.36 | 1.90 | 142.25 | 257.68 | | | | | mbar | | | | | | |
| | Node outlet pressure | 6.48 | 6.48 | 5.82 | 5.82 | 5.82 | 5.82 | 5.58 | 5.58 | 5.49 | 5.49 | 5.43 | 5.42 | 5.28 | 5.02 | | | | | bar A | | | | | | |
| | Node outlet temperature | 6.92 | 6.92 | 6.79 | 6.79 | 6.80 | 6.80 | 6.75 | 6.75 | 6.74 | 6.75 | 6.74 | 6.75 | 6.73 | 6.66 | | | | | K | | | | | | |