**Calculation sheet for safety valves and bursting disks for bath cooled cryostats**

Part 1 - The minimum cross section of flow

Design case - Loss of insulation vacuum

(MERIT MAGNET VESSEL)

**Step 1 Parameters of the Cryogen**

Cryogen - Helium = He; Stickstoff = N2 | N2

Isentropy exponent $\kappa$ = 1.41

Evaporation enthalpy at $T_S$; 1,01325bar h = 199.1 J/g

**Step 2 Determination of the mass flow to be extracted**

Completely vacuum insulated : A=50900

One face not vacuum insulated : A=44300

Surface wetted by cryogen $A_{Cryogen}$ = 4.43E+05 cm²

Specific heat flux* q = 0.1 W/cm²

* The proposed value is assuming a superinsulated He dewar and a superinsulated LN2 vessel [1,2].

Evaporating mass flow m = 222.50 g/s

**Step 3 Determination of the flow parameters for the blow-off case**

Absolute counter pressure $p_a$ = 1.01325 bar

Limit of subcritical - supercritical flow p = 1.92 bar

Absolute pressure in vessel $p_d$ = 3 bar

Outflow function $\psi$ = 0.485

Temperature of cryogen when leaving vessel T = 150 K

Density of the discharging cryogen $\rho$ = 6.74 kg/m³

**Step 4 Determination of the minimum cross ection of the flow**

Outflow coefficient $\alpha_w$ = 0.5 **

** The proposed value is only valid for full stroke safety valves (see data sheet of valve)

**Minimum cross section of flow:**

**$A_0$ = 456 mm²**

**$d_0$ = 24 mm**

[1] AD-Merkblatt A1and A2, VdTÜV (1995/1998).
[2] W. Lehmann, G. Zahn "Safety aspects for LHe cryostats and LHe transport containers" ICEC 7 (1978) 569-579.
[3] H. Frey, R. Haefer: Tieftemperaturtechnologie, VDI-Verlag (1981).