

Contents		Page
Foreword		v
1	Scope	1
2	Normative references	1
3	Symbols	2
4	Calculation of the total quantity of heat transferred per unit time from the hot wall (outer jacket) to the cold wall (inner vessel)	6
4.1	General	6
4.2	Under conditions other than fire	6
4.2.1	Vacuum-insulated vessels under normal vacuum	6
4.2.2	Pressure build-up device	7
4.2.3	Vacuum-insulated vessels in the case of loss of vacuum and non-vacuum insulated vessels	7
4.2.4	Supports and piping	9
4.3	Under fire conditions	9
4.3.1	Insulation system remains fully or partially in place during fire conditions	9
4.3.2	Insulation system does not remain in place during fire conditions	10
4.4	Air or Nitrogen condensation	10
4.4.1	General	10
4.4.2	Loss of vacuum with air and nitrogen	10
4.4.3	Fire with loss of vacuum with air or nitrogen	11
4.5	Heat transfer per unit time (watts)	12
4.5.1	General	12
4.5.2	Normal operation	12
4.5.3	Pressure build up regulator fully open	12
4.5.4	Loss of vacuum condition	12
4.5.5	Fire condition with loss of vacuum, vacuum jacket, and insulation fully or partially in place	13
4.5.6	Fire condition with loss of vacuum, insulation not in place	13
4.5.7	Total heat transfer rate	13
5	Calculation of the mass flow to be relieved by pressure relief devices	13
5.1	Relieving pressure, P , less than the critical pressure	13
5.2	Relieving pressure, P , equal to or greater than the critical pressure	14
5.3	Example	14
6	Piping for pressure relief devices	15
6.1	Pressure drop	15
6.1.1	General	15
6.1.2	Relief valves	15
6.1.3	Bursting discs	15
6.2	Back pressure consideration	16
6.3	Heat transfer	16
7	Sizing of pressure relief devices	17
7.1	General	17
7.2	Sizing of pressure relief valves	17
7.2.1	Discharge capacity	17
7.2.2	Determination of critical vs. subcritical flow for gases	18
7.2.3	Critical flow	18
7.2.4	Subcritical flow	19
7.2.5	Recommended analysis method	20
7.2.6	Example	22
7.3	Sizing of bursting discs	26
7.3.1	Discharge capacity	26

7.3.2	Determination of critical vs. subcritical flow for gases	27
7.3.3	Critical flow	27
7.3.4	Subcritical flow	27
7.3.5	Recommended analysis method	28
7.3.6	Example	31
Annex A (informative) Cryostats		34
Bibliography		35