# DIN EN ISO 21013-3:2016-12 (E)

## Cryogenic vessels - Pressure-relief accessories for cryogenic service - Part 3: Sizing and capacity determination (ISO 21013-3:2016 )

## Contents

Page


**European foreword** ... **4**

**Foreword** ... **5**

**1 Scope** ... **6**

**2 Normative references** ... **6**

**3 Symbols** ... **7**

**4 Calculation of the total quantity of heat transferred per unit time from the hot wall (outer jacket) to the cold wall (inner vessel)** ... **11**

4.1 General ... 11

4.2 Under conditions other than fire ... 11

4.2.1 Vacuum-insulated vessels under normal vacuum ... 11

4.2.2 Pressure build-up device ... 12

4.2.3 Vacuum-insulated vessels in the case of loss of vacuum and non-vacuum insulated vessels ... 12

4.2.4 Supports and piping ... 14

4.3 Under fire conditions ... 14

4.3.1 Insulation system remains fully or partially in place during fire conditions ... 14

4.3.2 Insulation system does not remain in place during fire conditions ... 15

4.4 Air or Nitrogen condensation ... 15

4.4.1 General ... 15

4.4.2 Loss of vacuum with air and nitrogen ... 15

4.4.3 Fire with loss of vacuum with air or nitrogen ... 16

4.5 Heat transfer per unit time (watts) ... 17

4.5.1 General ... 17

4.5.2 Normal operation ... 17

4.5.3 Pressure build up regulator fully open ... 17

4.5.4 Loss of vacuum condition ... 17

4.5.5 Fire condition with loss of vacuum, vacuum jacket, and insulation fully or partially in place ... 18

4.5.6 Fire condition with loss of vacuum, insulation not in place ... 18

4.5.7 Total heat transfer rate ... 18

**5 Calculation of the mass flow to be relieved by pressure relief devices** ... **18**

5.1 Relieving pressure, ***P***, less than the critical pressure ... 18

5.2 Relieving pressure, ***P***, equal to or greater than the critical pressure ... 19

5.3 Example ... 19

**6 Piping for pressure relief devices** ... **20**

6.1 Pressure drop ... 20

6.1.1 General ... 20

6.1.2 Relief valves ... 20

6.1.3 Bursting discs ... 20

6.2 Back pressure consideration ... 21

6.3 Heat transfer ... 21

**7 Sizing of pressure relief devices** ..... **22**
7.1 General ..... 22
7.2 Sizing of pressure relief valves ..... 22
7.2.1 Discharge capacity ..... 22
7.2.2 Determination of critical vs. subcritical flow for gases ..... 23
7.2.3 Critical flow ..... 23
7.2.4 Subcritical flow ..... 24
7.2.5 Recommended analysis method ..... 25
7.2.6 Example ..... 27
7.3 Sizing of bursting discs ..... 31
7.3.1 Discharge capacity ..... 31
7.3.2 Determination of critical vs. subcritical flow for gases ..... 32
7.3.3 Critical flow ..... 32
7.3.4 Subcritical flow ..... 32
7.3.5 Recommended analysis method ..... 33
7.3.6 Example ..... 36
**Annex A** (informative) **Cryostats** ..... **39**
**Annex ZA** (informative) **Relationship between this European Standard and the Essential Requirements of EU Directive (2014/68/UE — Pressure Equipment Directive)** ..... **40**
**Bibliography** ..... **41**