ISO 21009-1:2008-09 (E)

Cryogenic vessels - Static vacuum-insulated vessels - Part 1: Design, fabrication, inspection and tests

Contents

Page

Foreword v

1 Scope 1

2 Normative references 1

3 Terms and definitions 2

4 Symbols 5

5 General requirements 7

6 Mechanical loads 7
6.1 General 7
6.2 Load during the pressure test 7

7 Chemical effects 8

8 Thermal conditions 8

9 Material 8
9.1 Selection of materials 8
9.2 Inspection certificate 9
9.3 Materials for outer jackets and service equipment 9

10 Design 9
10.1 Design options 9
10.2 Common design requirements 9
10.3 Design by calculation 16
11 Fabrication 43
11.1 General 43
11.2 Cutting 43
11.3 Cold forming 47
11.4 Hot forming 49
11.5 Manufacturing tolerances 50
11.6 Welding 53
11.7 Non-welded permanent joints 54
12 Inspection and testing 54
12.1 Quality plan 54
12.2 Production control test plates 56
12.3 Non-destructive testing 57
12.4 Rectification 60
12.5 Pressure testing 60
13 Marking and labelling 61
14 Final assessment 62
15 Periodic inspection 62

Annex A (normative) Elastic stress analysis 63

Annex B (normative) Additional requirements for 9 % Ni steel 72

Annex C (normative) Pressure strengthening of vessels from austenitic stainless steels 74

Annex D (informative) Pressure limiting systems 85

Annex E (normative) Further use of the material cold properties to resist pressure loads 86

Annex F (informative) Specific weld details 90

Annex G (normative) Additional requirements for flammable fluids 94

Annex H (informative) Relief devices 95

Annex I (normative) Outer jacket relief devices 96

Annex J (informative) Increased material property for austenitic stainless steel 97

Annex K (normative) Base materials 98

Annex L (normative) Cylindrical shells subject to external pressure (pressure on the convex surface) -- Calculation 107

Annex M (normative) Design of openings in cylinders, spheres and cones -- Calculation 112

Annex N (normative) Design of ends for internal pressure 122

Bibliography 124