INTERNATIONAL STANDARD

ISO 20421-1

First edition 2006-04-15

Cryogenic vessels — Large transportable vacuum-insulated vessels —

Part 1:

Design, fabrication, inspection and testing

Récipients cryogéniques — Récipients transportables isolés sous vide de grande contenance —

Partie 1: Conception, fabrication, inspection et essais



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below

This document is a preview denetated by this

© ISO 2006

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office Case postale 56 • CH-1211 Geneva 20 Tel. + 41 22 749 01 11 Fax + 41 22 749 09 47 E-mail copyright@iso.org Web www.iso.org

Published in Switzerland

Contents

Page

Scope	Foreword	_
2 Normativa references		
3 Terms and definitions 4 Symbols	•	
4 Symbols		
5 General requirements 5 6 Mechanical loads 5 6.1 General 5 6.2 Load during the pressure test 5 7 Chemical effects 5 8 Thermal conditions 9 9 Materials 9 9.1 Selection of materials 9 9.2 Inspection certificates 9 10 Design 11 10.1 Design options 11 10.2 Common design requirements 11 10.3 Design by calculation 11 11 Fabrication 41 11.1 General 44 11.2 Cutting 44 11.3 Cold forming 44 11.4 Hot forming 44 11.5 Mary 44 11.6 Welding 54 11.7 Non-welded joints 55 12.1 Quality plan 55 <t< td=""><td>3 Terms and definitions</td><td>3</td></t<>	3 Terms and definitions	3
5 General requirements 5 6 Mechanical loads 5 6.1 General 5 6.2 Load during the pressure test 5 7 Chemical effects 5 8 Thermal conditions 9 9 Materials 9 9.1 Selection of materials 9 9.2 Inspection certificates 9 10 Design 11 10.1 Design options 11 10.2 Common design requirements 11 10.3 Design by calculation 11 11 Fabrication 41 11.1 General 44 11.2 Cutting 44 11.3 Cold forming 44 11.4 Hot forming 44 11.5 Mary 44 11.6 Welding 54 11.7 Non-welded joints 55 12.1 Quality plan 55 <t< td=""><td>4 Symbols</td><td>6</td></t<>	4 Symbols	6
6.1 General	5 General requirements	
6.2 Load during the pressure test		
6.2 Load during the pressure test	6.1 General	8
10.1 Design options	6.2 Load during the pressure test	۶
10.1 Design options	7 Chemical effects	
10.1 Design options	8 Thermal conditions	c
10.1 Design options	O Meteriale	
10.1 Design options	9.1 Selection of materials	
10.1 Design options	9.2 Inspection certificates	Ç
11.2 Cutting 44 11.3 Cold forming 47 11.4 Hot forming 48 11.5 Manufacturing tolerances 48 11.6 Welding 52 11.7 Non-welded joints 55 12 Inspection and testing 55 12.1 Quality plan 55 12.2 Production control test plates 56 12.3 Non-destructive testing 56 12.4 Rectification 60 12.5 Pressure testing 60 13 Marking and labelling 60 14 Final acceptance test 61 15 Periodic inspection 61 4 Annex A (informative) Examples of tank plates 62 Annex B (normative) Additional requirements for 9 % Ni steel 74 Annex D (informative) Pressure strengthening of vessels from austenitic stainless steels 76 Annex E (informative) Specific weld details 83	10 Design	10
11.2 Cutting 44 11.3 Cold forming 47 11.4 Hot forming 48 11.5 Manufacturing tolerances 48 11.6 Welding 52 11.7 Non-welded joints 55 12 Inspection and testing 55 12.1 Quality plan 55 12.2 Production control test plates 56 12.3 Non-destructive testing 56 12.4 Rectification 60 12.5 Pressure testing 60 13 Marking and labelling 60 14 Final acceptance test 61 15 Periodic inspection 61 4 Annex A (informative) Examples of tank plates 62 Annex B (normative) Additional requirements for 9 % Ni steel 74 Annex D (informative) Pressure strengthening of vessels from austenitic stainless steels 76 Annex E (informative) Specific weld details 83	10.1 Design options	10
11.2 Cutting 44 11.3 Cold forming 47 11.4 Hot forming 48 11.5 Manufacturing tolerances 48 11.6 Welding 52 11.7 Non-welded joints 55 12 Inspection and testing 55 12.1 Quality plan 55 12.2 Production control test plates 56 12.3 Non-destructive testing 56 12.4 Rectification 60 12.5 Pressure testing 60 13 Marking and labelling 60 14 Final acceptance test 61 15 Periodic inspection 61 4 Annex A (informative) Examples of tank plates 62 Annex B (normative) Additional requirements for 9 % Ni steel 74 Annex D (informative) Pressure strengthening of vessels from austenitic stainless steels 76 Annex E (informative) Specific weld details 83	10.2 Common design requirements	10
11.2 Cutting 44 11.3 Cold forming 47 11.4 Hot forming 48 11.5 Manufacturing tolerances 48 11.6 Welding 52 11.7 Non-welded joints 55 12 Inspection and testing 55 12.1 Quality plan 55 12.2 Production control test plates 56 12.3 Non-destructive testing 56 12.4 Rectification 60 12.5 Pressure testing 60 13 Marking and labelling 60 14 Final acceptance test 61 15 Periodic inspection 61 4 Annex A (informative) Examples of tank plates 62 Annex B (normative) Additional requirements for 9 % Ni steel 74 Annex D (informative) Pressure strengthening of vessels from austenitic stainless steels 76 Annex E (informative) Specific weld details 83	10.3 Design by calculation	18
11.2 Cutting 44 11.3 Cold forming 47 11.4 Hot forming 48 11.5 Manufacturing tolerances 48 11.6 Welding 52 11.7 Non-welded joints 55 12 Inspection and testing 55 12.1 Quality plan 55 12.2 Production control test plates 56 12.3 Non-destructive testing 56 12.4 Rectification 60 12.5 Pressure testing 60 13 Marking and labelling 60 14 Final acceptance test 61 15 Periodic inspection 61 4 Annex A (informative) Examples of tank plates 62 Annex B (normative) Additional requirements for 9 % Ni steel 74 Annex D (informative) Pressure strengthening of vessels from austenitic stainless steels 76 Annex E (informative) Specific weld details 83	11 Fabrication	47
11.7 Non-welded joints	11.1 General 11.2 Cutting	4 <i>1</i>
11.7 Non-welded joints	11.3 Cold forming	47
11.7 Non-welded joints	11.4 Hot forming	49
11.7 Non-welded joints	11.5 Manufacturing tolerances	49
12.2 Production control test plates	11.7 Non-welded joints	5ŧ
12.2 Production control test plates	12 Inspection and testing	5!
12.2 Production control test plates	12.1 Quality plan	5
13 Marking and labelling	12.2 Production control test plates	56
13 Marking and labelling	12.3 Non-destructive testing	58
13 Marking and labelling	12.5 Pressure testing	6(
Annex A (informative) Examples of tank plates	13 Marking and labelling	61
Annex A (informative) Examples of tank plates	14 Final acceptance test	61
Annex A (informative) Examples of tank plates		
Annex B (normative) Elastic stress analysis	·	
Annex C (normative) Additional requirements for 9 % Ni steel	· , , , , , , , , , , , , , , , , , , ,	
Annex D (informative) Pressure strengthening of vessels from austenitic stainless steels	•	
Annex E (informative) Specific weld details		
· · · · · · · ·		
Alliex F (IIIIOIIIIalive) Outer-jacket relief devices	Annex F (informative) Outer-jacket relief devices	

Annex G (informative) Base materials	93
Annex H (normative) Components subject to external pressure (pressure on the convex surface) — Calculation	. 102
Annex I (normative) Design of openings in cylinders, spheres and cones — Calculation	. 113

this document is a preview denetated by EUS

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an y the nal Standa.

is drawn to the pos.
30 shall not be held resp.

421-1 was prepared by Technical.

.0421 consists of the following parts ander ...

um-insulated vessels:

Part 1: Design, fabrication, inspection and testing

Part 2: Operational requirements International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 20421-1 was prepared by Technical Committee ISO/TC 220, Cryogenic vessels.

ISO 20421 consists of the following part and are the general title Cryogenic vessels — Large transportable vacuum-insulated vessels:

© ISO 2006 - All rights reserved

Inis document is a preview denetated by EUS

Cryogenic vessels — Large transportable vacuum-insulated vessels —

Part 1:

Design, fabrication, inspection and testing

1 Scope

This part of ISO 20421 specifies requirements for the design, fabrication, inspection and testing of large transportable vacuum-insulated ryogenic vessels of more than 450 l volume, which are permanently (fixed tanks) or not permanently (demonstrable tanks and portable tanks) attached to a means of transport, for one or more modes of transport.

This part of ISO 20421 applies to large mansportable vacuum-insulated cryogenic vessels for fluids specified in 3.1 and does not apply to vessels designed for toxic fluids.

This part of ISO 20421 does not include the general vehicle requirements, e.g. running gear, brakes, lighting, etc., which are in accordance with the relevant standards/regulations.

This International Standard does not cover specific requirements for refillable liquid-hydrogen tanks that are primarily dedicated as fuel tanks in vehicles. For fuel canks used in land vehicles, see ISO 13985.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4126-2, Safety devices for protection against excessive pressure Part 2: Bursting disc safety devices

ISO 4136, Destructive tests on welds in metallic materials — Transverse tensile test

ISO 5173, Destructive tests on welds in metallic materials — Bend tests

ISO 9016, Destructive tests on welds in metallic materials — Impact tests — Test specimen location, notch orientation and examination

ISO 9606-1, Approval testing of welders — Fusion welding — Part 1: Steels

ISO 9606-2, Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys

ISO 9712, Non-destructive testing — Qualification and certification of personnel

ISO 10474, Steel and steel products — Inspection documents

ISO 14732, Welding personnel — Approval testing of welding operators for fusion welding and of resistance weld setters for fully mechanized and automatic welding of metallic materials

© ISO 2006 – All rights reserved

ISO 20421-1:2006(E)

ISO 15607, Specification and qualification of welding procedures for metallic materials — General rules

ISO 15613, Specification and approval of welding procedures for metallic materials — Qualification based on pre-production welding test

ISO 15614-1, Specification and qualification of welding procedures for metallic materials — Part 1: Welding procedure tests for the arc welding of steels

ISO 15614-2, Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure tests for the arc welding of aluminium and its alloys

ISO 15614-3, Specification and approval of welding procedures for metallic materials — Part 3: Welding procedure tests for the arc welding of aluminium and its alloys

ISO 17636, Non-destructive examination of welds — Radiographic testing of fusion-welded joints

ISO 20421-2, Cryogenic vessels — Large transportable vacuum-insulated vessels — Part 2: Operational requirements

ISO 21010, Cryogenic vessels — Gasimaterial compatibility

ISO 21011, Cryogenic vessels — Valves for cryogenic service

ISO 21013-1, Cryogenic vessels — Safety devices for protection against excessive pressure — Part 1: Reclosable pressure-relief valves

ISO 21028-1, Cryogenic vessels — Toughness requirements for materials at cryogenic temperature — Part 1: Temperatures below –80 degrees C

ISO 21028-2, Cryogenic vessels — Toughness requirements for materials at cryogenic temperature — Part 2: Temperatures between –80 degrees C and –20 degrees C.

ISO 23208, Cryogenic vessels — Cleanliness for cryogenic service

ASME VIII-2

EN 1708-1, Welding — Basic weld joint details in steel — Part 1: Pressurzed components

EN 10028-4, Flat products made of steels for pressure purposes — Part 4 Nickel alloy steels with specified low temperature properties

EN 10028-7, Flat products made of steels for pressure purposes — Part 7: Stainless Steels

EN 12300, Cryogenic vessels — Cleanliness for cryogenic service

EN 13068-3, Non-destructive testing — Radioscopic testing — Part 3: General principles of radioscopic testing of metallic materials by X- and gamma rays

EN 13445-3, Unfired pressure vessels — Part 3: Design

EN 13445-4, Unfired pressure vessels — Part 4: Fabrication

UN Recommendations on the transport of dangerous goods — Model regulations (12th revised edition)