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Title: BS EN ISO 24201 Petroleum, petrochemical and natural gas industries — Bulk material for offshore projects — Tertiary outfitting structures

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex **(e.g. 3.1)**	Paragraph/Figure/ Table/Note	**Type of comment**	**Commend (justification for change) by the MB**	**Proposed change by the MB**	**Secretariat observations on each comment submitted**
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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ISO/DIS 24201

ISO/TC **67**

Secretariat: **NEN**

Voting begins on:
2022-08-23

Voting terminates on:
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Industries du pétrole, de la pétrochimie et du gaz naturel — Matériels en vrac de site de forage pour les projets en mer— Structures d'équipements tertiaires

ICS: 75.180.10

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Full document details: 22/30454110 DC

Contents

Page

Foreword ..... **vii**
Introduction ..... **viii**
1 Scope **1**
2 Normative references **1**
3 Terms, definitions and abbreviated terms **2**
3.1 Terms and definition 2
3.2 Abbreviated terms 2
4 Requirements and specifications clause for steel outfitting **4**
4.1 General 4
4.2 Handrails 4
4.2.1 General requirements 5
4.2.2 End of handrails 6
4.2.3 Removable type handrails 7
4.2.4 Alternative dimension and thickness of handrail 10
4.2.5 Structural requirements 11
4.2.6 Tests of handrails 11
4.3 Safety gate 11
4.3.1 Structural requirements 13
4.3.2 Tests of handrails 13
4.4 Stairs 13
4.4.1 General requirements 14
4.4.2 Stair width and headroom clearances 14
4.4.3 Nosing 16
4.4.4 Treads and landings 16
4.4.5 Structural requirements 18
4.4.6 Tests of stairs 18
4.5 Spiral stairs 18
4.5.1 General requirements 19
4.5.2 Sizes of stairs 19
4.5.3 Nosing 22
4.5.4 Treads and landings 22
4.6 Vertical ladders 23
4.6.1 General requirements 25
4.6.2 Stiles (stringer) 28
4.6.3 Rungs 29
4.6.4 Spacing between the ladder and any permanent obstruction 29
4.6.5 Fall protection device 30
4.6.6 Structure requirements 31
4.6.7 Tests of vertical ladders 31
4.7 Grating 31
4.7.1 General requirements 32
4.7.2 Grating openings 33
4.7.3 Penetrations 34
4.7.4 Tests of gratings 35
4.8 Manhole 35
4.9 Connection method 38
4.9.1 Selection connection method for steel outfitting 38
4.9.2 Self-loosening prevention 39
4.9.3 Nuts fastening 39
4.9.4 Height of nut 40
4.9.5 Grating fastener 41
4.9.6 Bolt location and direction 41
4.9.7 Allowable capacity 42

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AVA Documents Document Sharing Hub
Full document details: 22/30454110 DC

5 Requirements and specifications clause for aluminium outfitting 42
5.1 General 42
5.2 Handrails 43
5.2.1 General requirements 44
5.2.2 Shape of rails and fasteners 45
5.2.3 End of handrails 46
5.2.4 Removable type handrails 48
5.2.5 Handrails on stairs 49
5.2.6 Structural requirements 53
5.2.7 Tests of handrails 53
5.3 Safety gate 54
5.3.1 Structural requirements 55
5.3.2 Tests of handrails 55
5.4 Stairs 55
5.4.1 General requirements 57
5.4.2 Stair width and headroom clearances 57
5.4.3 Nosing 57
5.4.4 Treads and landings 58
5.4.5 Structural requirements 61
5.4.6 Tests of stairs 61
5.5 Vertical ladders 61
5.5.1 General requirements 63
5.5.2 Stiles (stringer) 66
5.5.3 Rungs 67
5.5.4 Spacing between the ladder and any permanent obstruction 67
5.5.5 Fall protection device 68
5.5.6 Structure requirements 69
5.5.7 Tests of vertical ladders 69
5.6 Grating 69
5.6.1 General requirements 69
5.6.2 Grating openings 70
5.6.3 Penetrations 70
5.6.4 Tests of gratings 71

6 Material requirement for carbon steel tertiary outfitting structure 72
6.1 General 72
6.2 References 72
6.3 Material designation for tertiary structure 72
6.4 Manufacturing 73
6.5 Test and inspection 73
6.5.1 Chemical composition 73
6.5.2 Mechanical test 73
6.5.3 Specification of dimensional tolerance 75
6.5.4 Inspection and repair 75
6.6 Identification 75
6.7 Material table and MDS 75
6.8 Material certificate 76

7 Material requirement for aluminium tertiary outfitting structure 77
7.1 General 77
7.2 Material designation for tertiary structure 77
7.3 Manufacturing 77
7.4 Test and inspection 77
7.4.1 Chemical composition 77
7.4.2 Mechanical test 78
7.4.3 Specification of dimensional tolerance 79
7.4.4 Inspection and repair 79
7.5 Identification 79
7.6 Material table and MDS 79

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Documents
Document Sharing Hub
Full document details: 22/30454110 DC

7.7 Material certificate 80

8 Welding requirements 81
8.1 General 81
8.2 Welder qualification 81
8.3 Welding consumables / filler material 81
8.4 Welding procedures 81
8.5 Qualification of welding procedures 82
8.5.1 General requirements 82
8.5.2 Assembly of test pieces, examination and tests 82
8.5.3 Testing 84
8.5.4 Re-testing 86
8.5.5 Approval range 86
8.5.6 Welding procedure qualification record (WPQR) 92

9 Quality control and Inspection 92
9.1 Qualification requirement of inspector 92
9.1.1 Basis for qualification 92
9.1.2 Term of effectiveness 92
9.1.3 Associate inspector 92
9.1.4 Eye examination 93
9.1.5 Verification authority 93
9.2 Inspector responsibility 93
9.3 Items to be furnished to the inspector 93
9.4 Qualification of NDT inspector 93
9.5 Execution methods for the extent of inspection 93
9.6 Extent of inspection per method 93
9.7 Acceptance limitation 94
9.7.1 VT and MT acceptance criteria for structural steel welds 94
9.7.2 UT acceptance criteria for structural steel welds 96
9.8 Welding inspection report 97
9.9 Visual inspection in procurement 97
9.9.1 General 97
9.9.2 Checklist 98
9.9.3 Inspection volumes 98
9.10 Visual inspection after installation 98
9.10.1 General 98
9.10.2 Checklist 98
9.10.3 Inspection point 99

10 Test procedure 101
10.1 General 101
10.2 Handrails 101
10.2.1 General requirement 101
10.2.2 Test preparation 101
10.2.3 Test condition 102
10.2.4 Test sequence 103
10.2.5 Failure criteria 104
10.3 Stairs 104
10.3.1 General requirement 104
10.3.2 Test preparation 104
10.3.3 Test condition 105
10.3.4 Test sequence 106
10.3.5 Failure criteria 106
10.4 Vertical ladder 106
10.4.1 General requirement 106
10.4.2 Test preparation 106
10.4.3 Test condition 107
10.4.4 Test sequence 109
10.4.5 Failure criteria 109

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AVA Documents Document Sharing Hub
Full document details: 22/30454110 DC

10.5 Grating 110
10.5.1 General requirement 110
10.5.2 Test preparation 110
10.5.3 Test condition 111
10.5.4 Test sequence 112
10.5.5 Failure criteria 113
Annex A (informative) **Quality Control Plan (QCP) for steel outfitting of tertiary item** **114**
Annex B (informative) **Practical drawings of steel outfitting items for fabrication** **123**
Annex C (informative) **Manhole code components design details** **124**
Annex D (informative) **Practical drawings of manhole for fabrication** **127**
Annex E (informative) **Practical drawings of aluminium outfitting items for fabrication** **133**
Annex F (normative) **MDS for structural steel / tertiary outfitting structural** **134**
Annex G (normative) **MDS for structural Aluminium / tertiary outfitting structural** **141**
Annex H (informative) **Recommended welding procedure specification (WPS)** **144**
Annex I (informative) **Test report** **146**
Bibliography **151**

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Documents
Document Sharing Hub
Full document details: 22/30454110 DC

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, Materials, equipment and offshore structures for petroleum and natural gas industries.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The purpose of this document for tertiary structure items is to provide a uniform reference when tertiary structure is designed and constructed in offshore oil & gas projects. This document aims to reduce the number and variations in requirements to the minimum necessary to reflect a common and global best practice based upon existing standards and regulations. In addition, standard inventory for shapes and dimensions referred to as specifications are proposed in this document.

The main benefits of more standardized tertiary items are expected to be reduced delivery time, more streamlined and efficient engineering, and construction as well as improved cross use of tertiary items between projects. A risk-based approach has been used when defining the proposed requirements and recommendations. The underpinning factors for determining the proposed conditions are to provide an acceptable safety level for people in combination with cost efficient solutions for implementing the requirements.

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Petroleum, petrochemical and natural gas industries — Bulk material for offshore projects — Tertiary outfitting structures

1 Scope

This document covers topside systems for fixed or floating offshore projects not covered by class requirements. This document is also applicable for hull systems and onshore projects provided that there is no cost increase in its application. This document is not to be considered or confused with class rules from classification societies. For verification of compliance with class rules, it is best to use the respective class rules from class societies.

This document was developed based on major international standards to comply with requirements of shelf regulations of UK, US, Norway and Australia. Overall the requirements outlined in this document will meet most of the specified regulatory requirements. Exemptions where requirements in common standards for tertiary items applied in offshore oil & gas projects are not met in this document are clearly stated.

This document provides requirements to dimensions of the items but does not include requirements to clearances with other structures. Material selection is limited to references with more detailed information to be found in this document, material requirement in clauses 6 and 7.

The following tertiary outfitting designs for equipment items are covered in this document:

— handrails;

— safety gate;

— stairs;

— spiral stairs;

— vertical ladder;

— grating;

— manhole;

— connection method.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 10474:2013, *Steel and steel products — Inspection documents*

ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways*

ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

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3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms and definition

3.1.1
as-rolled
AR
rolling at high temperature followed by air cooling

Note 1 to entry: The rolling finishing temperature and reduction are typically in the austenite recrystallization region and above the normalizing temperature but, possibly are not able to be accurately controlled resulting in variable grain sizes and, hence, variable mechanical properties.

3.1.2
normalizing rolling
NR
a controlled rolling procedure where the final rolling temperature is controlled within the same temperature range as for conventional furnace normalizing

Note 1 to entry: Normalizing rolling is typically followed by air cooling. The primary grain control and refining mechanism is the recrystallization of austenite following each rolling pass in the normalizing temperature range.

3.1.3
thermo-mechanically controlled process
TM (TMCP)
a rolling procedure in which both rolling temperatures and reduction ratios and, when used, accelerated cooling conditions (AcC) are controlled

Note 1 to entry: It is characterized by high deformation ratios per rolling pass in the austenite non-recrystallization range close to the Ar3 temperature; perhaps involves rolling in the austenite-ferrite dual phase temperature region below Ar3. After the final pass, either air cooling or accelerated cooling, excluding quenching, is used. The primary grain size and microstructural control if the fine grained structure is obtained when the highly deformed austenite is transformed into typically ferrite, pearlite, bainite etc. during cooling.

3.1.4
normalizing
N
a separate heat treatment after rolling involving automatizing and air cooling to produce a fine-grained ferrite-pearlite microstructure

3.1.5
quenching and tempering, quenching (Q)
QT
a heat treatment process in which the steel is heated to an appropriate temperature above Ac3, followed by cooling at a rate sufficient for the formation of typically a martensitic or bainite microstructure.

Note 1 to entry: Quenched steels are typically hard and brittle. Tempering (T) is reheating of the steel to a temperature below Ac1. Tempering improves the ductility and toughness of quenched materials through microstructural changes, but reduces the hardness and strength. Furthermore, the quenching process results in material internal stress which is to some extent released/reduced by the subsequent tempering.

3.2 Abbreviated terms

ANSI American National Standards Institute

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API	American Petroleum Institute
AS	Australian Standard
ASSM	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
BS	British Standards
Ceq. (CEV)	Carbon equivalent
CS	Carbon equivalent
DC	Design Class
EN	European standards
ERW	Electric Resistance Welded
HSE	Health, Safety & Environment
IOSS	Integrated Offshore Standard Specification
ISO	International Standards Organization
JIS	Japanese Industrial Standards
MDS	Material Data Sheet
NDT	Non-Destructive Testing
NMA	Norwegian Maritime Authority
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NORSOK	Norsk Sokkels Konkuranseposisjon
LC	Load Case
OSHA	Occupational Safety and Health Administration
Pcm	Parameter of weld crack susceptibility of base metal
PSA	Petroleum Safety Authority Norway
QCP	Manufacturer's quality control plan
SMYS	Specified Minimum Yield Strength
SQL	Steel Quality Level
SUS	Steel Use Stainless
ULS	Ultimate Limit State
USCG	United States Coast Guard

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4 Requirements and specifications clause for steel outfitting

4.1 General

This document has been developed in the three layers' requirements, specifications and practical drawings as shown in Figure 1 considering operational safety and construction efficiency. The requirements were developed based on major international standards and regulations applied for aluminium tertiary items in offshore oil & gas projects.

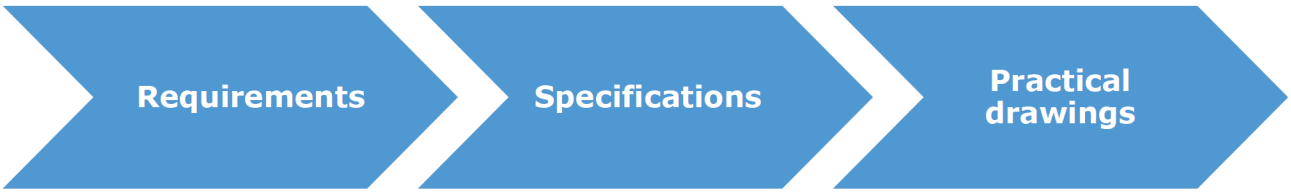


Figure 1 — Three layers

The specifications were developed based on requirements and industrial practice. The specified dimensions (specifications) provided in this document are based on either centre-to-centre (e.g. central axis from one rail to next rail) or centre-to-platform edge (e.g. central axis in rail to floor, wall or ceiling) as per industry practice.

The material grades for tertiary items shall be selected MDS number CS301 to CS308 in Annex F.

The practical drawings for fabrication were developed based on the specifications and fabricator's practice. These drawings can be used during the construction phase eliminating the need to develop shop drawings from scratch. The practical drawings are given enclosed in Annex B.

4.2 Handrails

The specifications and requirements for handrails are summarised in Table 1 — Specification and requirements for handrails.

Table 1 — Specification and requirements for handrails

Parameter	Specification	Requirement(s)	Comments and limitations
Height (a)	— 1 100 mm (centre-to-platform distance)	— Min. 1 100 mm	
Height on stair (b)	— 1 000 mm (centre-to-platform distance)	— Min. 1 000 mm	Not in compliance with ANSI: Min. 34" – max. 38" (863-965 mm)
Vertical opening (c)	— Max. 380 mm (centre-to-centre distance) — Max. 230 mm for lowest course (centre-to-edge distance)	— Max. 380 mm — Max. 230 mm for lowest course	
Intermediate knee rail	— Two (2) knee rails	— Min. 2 knee rails	

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Table 1 *(continued)*

Parameter	Specification	Requirement(s)	Comments and limitations
Diameter and thickness (d)	— 48 mm / 4 mm (top rail) — 34 mm / 4 mm (knee rails) — 48 mm / 6 mm (vertical stanchion)	— Min. 25 – max. 50 mm	Only partly in compliance with ANSI: 1,25" – 2" (32 – 51 mm)
Distance between vertical stanchions (e)	— Max. 1 500 mm (centre-to-centre distance)	— Max. 1 500 mm	
Height of toe-plate (f)	— 100 mm	— Min. 100 mm	
Thickness of toe plate (g)	— 8 mm	— 6 – 10 mm	
Vertical opening (gap) between toe plate and floor level (h)	— Max. 10 mm	— Max. 10 mm	Not in compliance with ANSI: Max. 0,25" (6 mm)
Horizontal opening (gap) between toe plates (i)	— Max. 10 mm	— Continuous type (or max. 10 mm)	NORSOK does not allow any horizontal gap
Radius of rounding (j)	— 150 R	— 150 R	
Length of end segment from vertical stanchion (k)	— 350 mm	— Max. 600 mm	
Space between two segments (m)	— Rounding type — 52 mm (space) — 100 mm (centre-to-centre distance)	— 50 - 120 mm (no rounding) — 50 – 80 mm (rounding)	
Sharp edges	— Not allowed	— Not allowed	
Material	— Tubular type		

4.2.1 General requirements

The specification for typical handrails on floor or platforms is presented in Figure 2. The diameter of top rail and intermediate knee rails are defined based upon specifications for Electric Resistance Welded (ERW) pipes in IOSS S201-4, Structural material Part 4: Tubulars for special, primary and secondary structural, for structural steel materials.

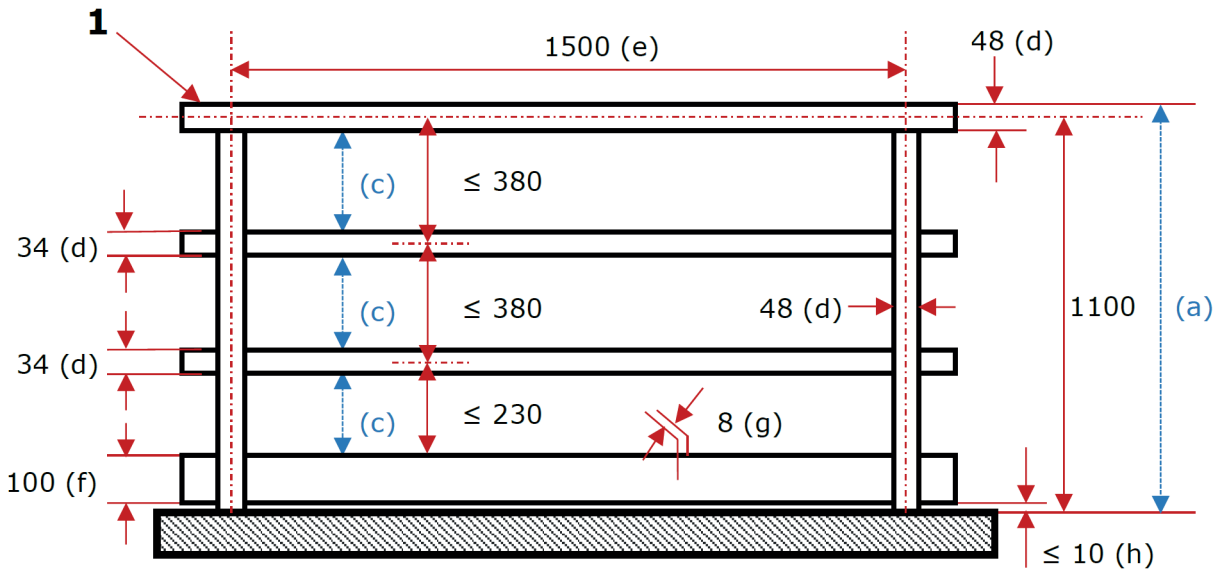
Top rails of major egress routes shall be continuous. Although continuous type is preferred also for other areas, dis-continuous type can be applied if required to ensure structural integrity, maintainability and ease of construction.

All pipe ends shall be sealed.

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Dimension in millimeters



Key

1 tubular type

Figure 2 — Specifications for handrails

All handrails at deck corner edges shall be inter-connected.

The toe plate shall be provided at the bottom of handrails. If the end of the toe plate can be shaken or vibrated due to a long length without fixture, appropriated fastening method shall be provided.

4.2.2 End of handrails

Sharp edges at the end of handrails shall be avoided to prevent any injury for workers. The specification for rounded end of handrails is shown in Figure 3.

The end extension of the handrail should not be more than 600 mm to prevent occupational safety hazards. For interrupted handrails, the space between the two segments shall be 50 to 80 mm to prevent hand trap hazards. The centre-to-centre distance specification between the two segments is 100 mm when the diameter specification of vertical stanchion is 48 mm.

In principle, continuous toe plate on the handrail is recommended. When the toe plate can be locally bended because of long length, it typically results in large vertical openings (gaps) between the toe plate and platform. In such cases, interrupted toe plates can be applied provided that the horizontal opening (gap) between two toe plates on the interrupted handrails does not exceed 10 mm.

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Dimension in millimeters

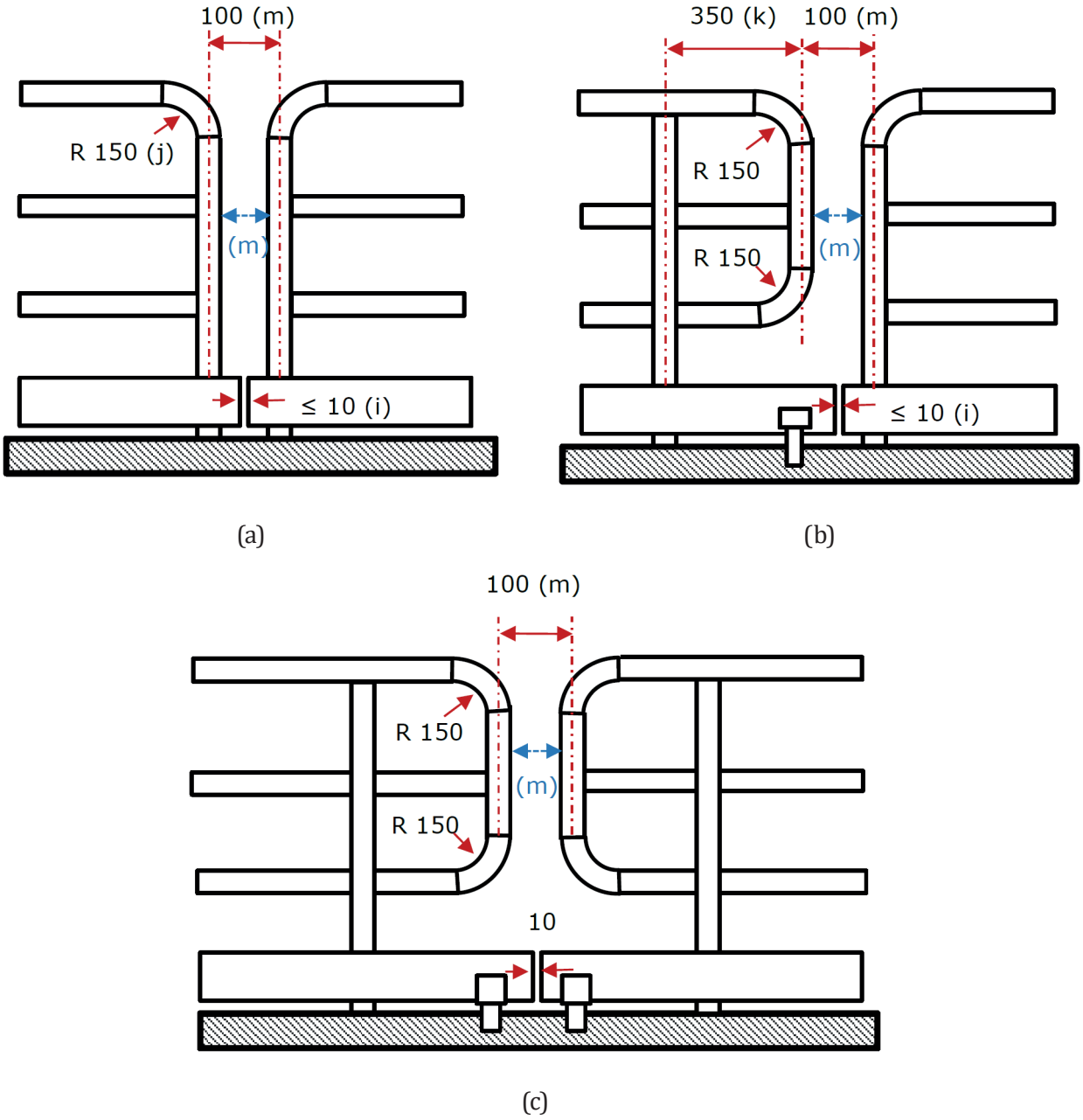


Figure 3 — Specification for rounded end of handrails

4.2.3 Removable type handrails

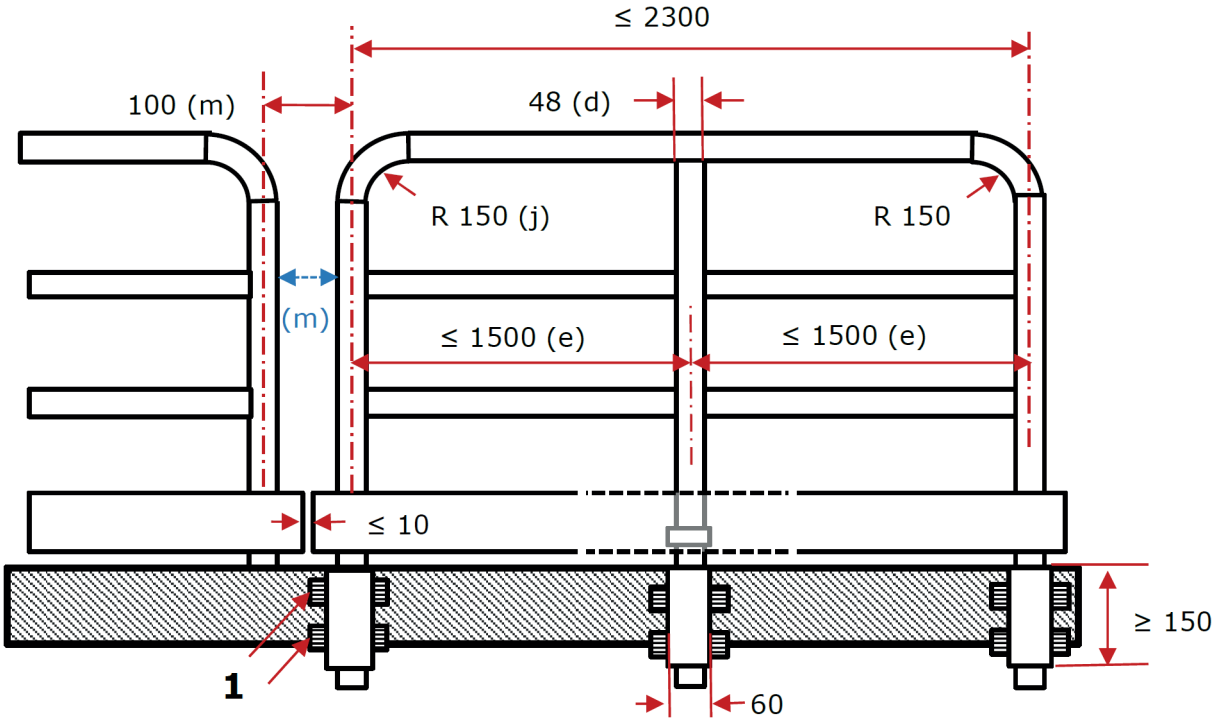
The dimension of removal type handrail should be equally designed with adjoined fixed handrails as shown in Figure 4. The opening (gap) between toe plates shall be less than 10 mm. The removal type handrails shall be fastened by minimum two bolts for each vertical stanchion. When frequent removal is required and there are no safety concerns, one bolt may be allowed.

The length of the removable type handrail shall not exceed 2 300 mm and the weight shall not exceed 50 Kg.

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Dimension in millimeters



Key

1 bolting (min. two bolts)

Figure 4 — Specification for removable type handrails Handrails on stairs

The specification of handrails on stairs are shown in Figure 5 and Figure 6. Any jointed and bended top rails shall be rounded. The vertical stanchions on the departure and arrival platform should not exceed 350 mm from the end of the stairs.

Handrails and guardrails shall be parallel to the pitch line of the stair flights and shall be level at open landings. The handrail shall be continuous from the top to the bottom of the stairway and shall be terminated in a safe manner at both ends.

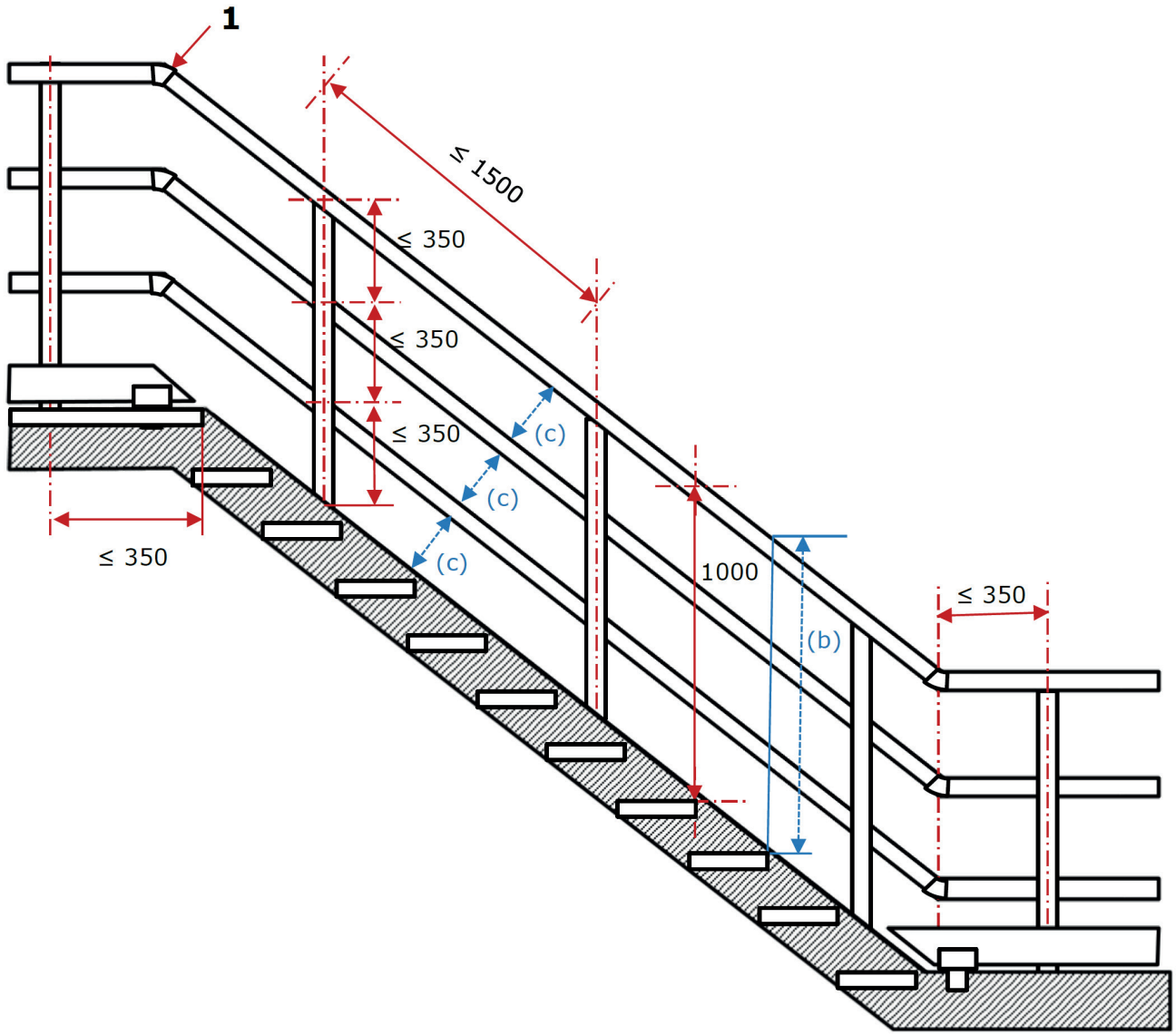
Handrails on flights that are 180° to each other shall have a minimum of 100 mm clear distance between rails or between rails and supporting structures, to avoid the possibility of catching hands and fingers.

Handrails shall not cause hindrance or injury to personnel. Sharp corners, rough edges, welds with burrs, etc., are not acceptable. Bolts, nuts and screws shall have a user-friendly design, which will not catch fingers or any part of a body in motion.

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Dimension in millimetres



Key

1 round type

Figure 5 — Specification for handrails on stairs (type 1)

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Dimension in millimeters

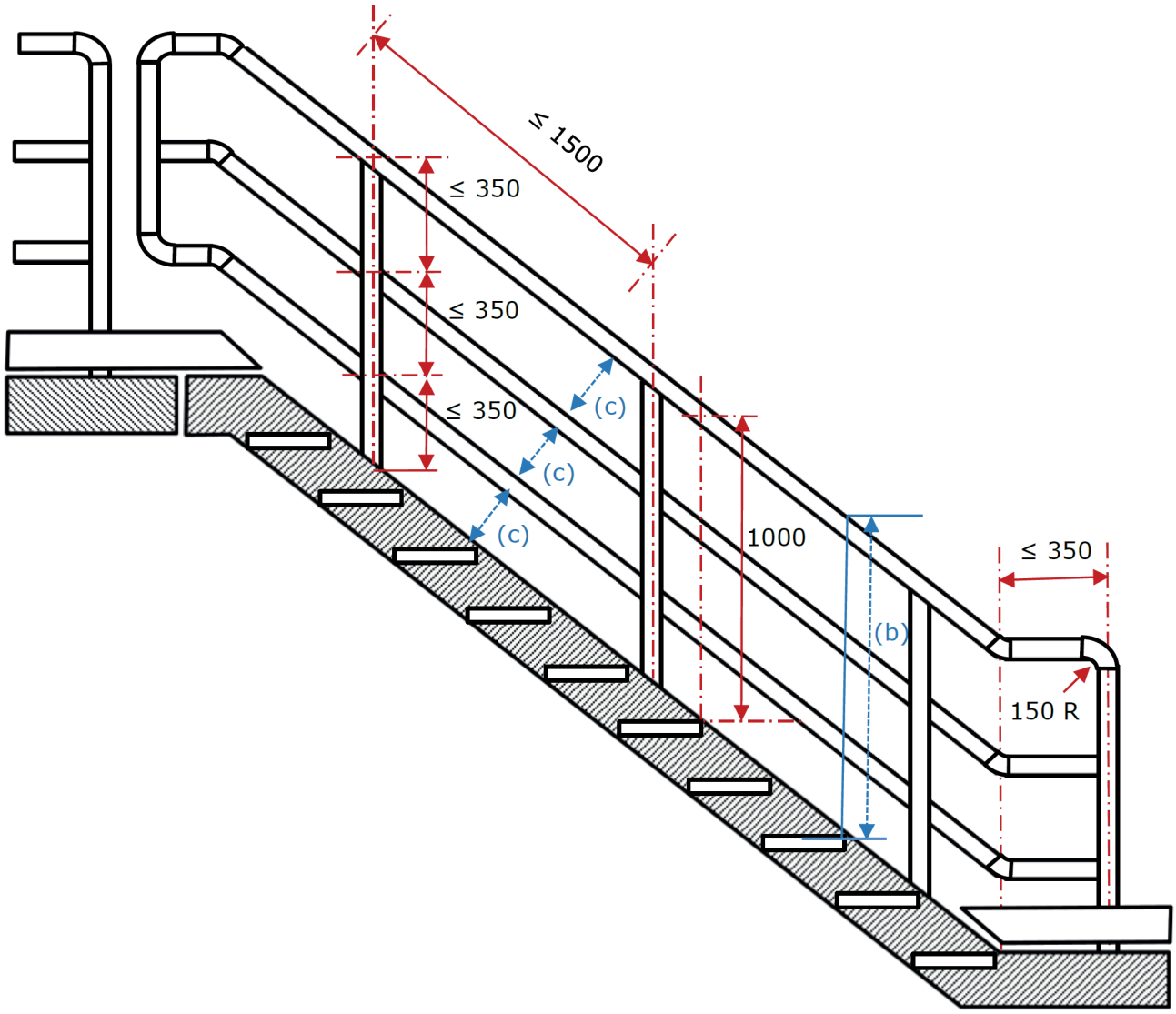


Figure 6 — Specification for disconnected handrails on stairs (type 2)

4.2.4 Alternative dimension and thickness of handrail

In special cases, different sizes may allow to be used in an area. The size of the handrail can be changed if the following conditions are satisfied.

— Any dimensions of handrail shall be within range of the requirement.

— The strength of the handrail shall meet the structural requirements according to test procedure.

Example of alternative sizes of handrail is described in Table E-1. The results were analyzed based on the condition, three stanchions with top- and mid-rails, and the load case (1,5 kN) on the center stanchion.

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Table 2 — Example of alternative size of handrail

Stanchions		**Top rail**		**Mid rail**		**Distance between stanchions** (mm)					
Diameter (mm)	Thickness (mm)	Diameter (mm)	Thickness (mm)	Diameter (mm)	Thickness (mm)	1 000	1 100	1 200	1 300	1 400	1 500
48	6	48	4	34	4	Y	Y	Y	Y	Y	Y
48	6	48	4	27	3	Y	Y	Y	Y	Y	N
48	6	48	4	27	3	Y	Y	Y	N	N	N
48	6	34	4	27	3	Y	N	N	N	N	N
48	4	48	4	34	4	Y	N	N	N	N	N
Where Y is applicable N is not applicable											

4.2.5 Structural requirements

The aluminium handrails and guardrails shall be designed for the following ultimate limit state (ULS) actions:

— a horizontal line action of 1,5 kN/m acting on the handrail;

— a point action of 1,0 kN acting in worst location and worst direction (horizontal or vertical). The point action does not act together with the horizontal line action;

— actions from possible attachments shall be established for each case; and

— actions on guardrails and flexible barriers in areas with cargo handling should be determined with due attention to relevant operational conditions.

A load factor of 1,3 shall be applied to the above ULS actions.

4.2.6 Tests of handrails

The test shall comply with the requirement of test procedure as described in section 10.

4.3 Safety gate

The specification and requirements for safety gate are summarized in Table 3.

Table 3 — Specification and requirements for safety gate

Parameter	**Specification**	**Requirement(s)**	**Comments and limitations**
Height (a)	— 1 100 mm (centre-to-centre distance)	— Min. 1 100 mm	Equal height with handrail
Horizontal clearance (b)	— 750 mm (centre-to-centre distance)	— Max. 800 mm	
Clear opening (c)	— 650 mm	— Min. 650 mm	
Gate width (d)	— 550 mm (centre-to-centre distance)	— Min. 550 mm	
Diameter	— 48 mm (top rail) — 33 mm (knee rails)	— Min.25 – max. 50 mm	
Hinge type (e)	— Self-closing by spring or gravity type hinge	— Self-closing by spring or gravity type hinge	

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Table 3 *(continued)*

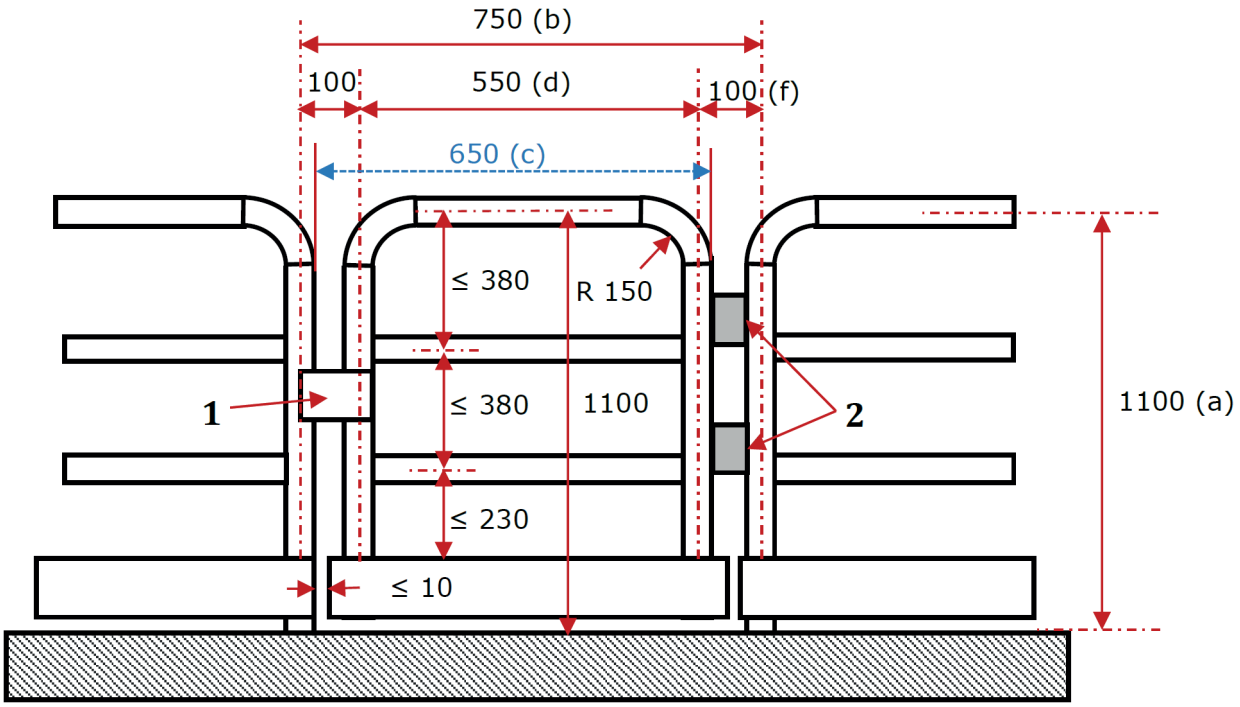
Parameter	Specification	Requirement(s)	Comments and limitations
Space between safety gate and adjoined segment (f)	— Rounding type — 52 mm (space) — 100 mm (centre-to-centre distance)	— 50 – 80 mm (rounding)	
Firm stopper (g)	— Firm stopper on middle of the gate.	— Firm stopper on middle of the gate.	
Opening direction	— Easy open onto the platform or floor	— Easy open onto the platform or floor	

The height of safety gate should be the same to adjoined guide-/handrails. The clear opening between vertical stanchion and hinge of the safety gate shall be no less than 650 mm as shown in Figure 7. The space between handrail and safety gate shall be 50 to 80 mm as per the requirements between two segments for handrails. The opening (gap) between toe plate on safety gate and adjoined handrail shall be less than 10 mm.

The safety gate shall be self-closed by spring or gravity force. The gate shall be easily opened onto the platform or floor. A firm stopper shall be provided at the side of the gate to prevent users falling through the opening.

This self-closing gate shall be installed at the top of vertical and inclined ladders to prevent a falling hazard.

Dimension in millimeters



Key

1 firm stopper (g)

2 spring/gravity (e)

Figure 7 — Specification of safety gate

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4.3.1 Structural requirements

The structural requirements shall comply with the requirement of handrails as described in section 4.2.5.

4.3.2 Tests of handrails

The test shall comply with the requirement of test procedure as described in section 10.

4.4 Stairs

The specification and requirements for stairs are summarized in Table 4. The specification and requirements are to be applied to all stairs on an installation except stairs providing means of access to machinery or equipment skids. Stairs in infrequently accessed areas such as inside a ballast tank is not covered in this document.

Table 4 — Specification and requirements for stairs

Parameter	Specification	Requirement(s)	Comments and limitations
Stairway slopes (α)	— 38°	— 30°- 40°	
Width (w)	— Normal access: 1 000 mm — Secondary stairs: 800 mm — Primary stairs: 1 200 mm — ≥ 50 persons: 1 500 mm — Stairs on access route between helideck and heli-admin: 1 500 mm	— Normal access: min. 1 000 mm — Secondary stairs: min. 800 mm — Primary stairs: min. 1 200 mm — ≥ 50 persons: min. 1 500 mm — Stairs on access route between helideck and heli-admin: min. 1 500 mm	Access width in machinery area can upon agreement be min. 600 mm. Min. 1 100 mm if stretcher (length x width = 2 200 mm x 650 mm) handling is required and/or for escape ways.
Head height (a)	— Min. 2 300 mm	— Min. 2 300 mm	
Clearance (b)	— Min 1 900 mm	— Min 1 900 mm	Absolute minimum clear distance between any obstacle and the pitch line.
Step overlap (r) **(Nosing)**	— Min. 10 mm — Nonslip finish	— Min. 10 mm — Nonslip finish	Not in compliance with NORSOK: Min. 20 mm
Climbing - height per flight (H)	— Max. 3 000 mm for multi flight — Max. 4 000 mm for single flight	— Max. 3 000 mm for multi flight — Max. 4 000 mm for single flight	
Number of rises	— Max. 16 for multi flight — Max. 22 for single flight	— Max. 16 for multi flight — Max. 22 for single flight	
Rise height (h)	— Max 190 mm	— Max 190 mm	

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Table 4 *(continued)*

Parameter	Specification	Requirement(s)	Comments and limitations
Going(g) and rise(h)	— 600 ≤ g + 2 h ≤ 660 mm	— 600 ≤ g + 2 h ≤ 660 mm	In the case where it is not possible to maintain the height of the rise between the level of departure and the first step, it may be reduced by a maximum of 15 %.
Toe plate on tread (c)	— 50 mm	— Min 50 mm	Back covers are recommended to be fitted for stairways inside of the living quarters.
Toe plate on landing (d)	— 100 mm	— Min 100 mm	
Uppermost step	— The uppermost step shall be level with the landing.	— The uppermost step shall be level with the landing.	
Length of landing area	— Min. 800 mm, Stair width ≤ landing length (depth) — Min. 1 500 mm if stretcher handling is required and/or for escape ways.	— Min. 800 mm, Stair width ≤ landing length (depth) — Min. 1 500 mm if stretcher handling is required and/or for escape ways.	Sufficient landing length shall be ensured in the main access way and escape way for standard stretcher (length x width = 2 200 mm x 650 mm) handling and safe escape. Stairway landings shall be sized to ensure at the minimum clearance is not impacted in way of doors that may open into the landing.

4.4.1 General requirements

The handrails on stairs shall comply with requirements of handrails in section 4.2.

To limit the lateral buckling and displacements, the small cross bracings between the stringers shall be provided on hinged stairways, stairs in the splash zone and when the height between two flights exceeds 2 000 mm.

4.4.2 Stair width and headroom clearances

The width of stairs should be designed based on purpose and personnel traffic as shown in Figure 8. For normal access, the width of stairs should be minimum 1 000 mm and for secondary access, the width should be minimum 800 mm. In the case of areas with low access frequency and no specific requirements for material handling such as an unmanned machinery area, the width can be reduced based on project agreement, but the width shall not be less than 600 mm.

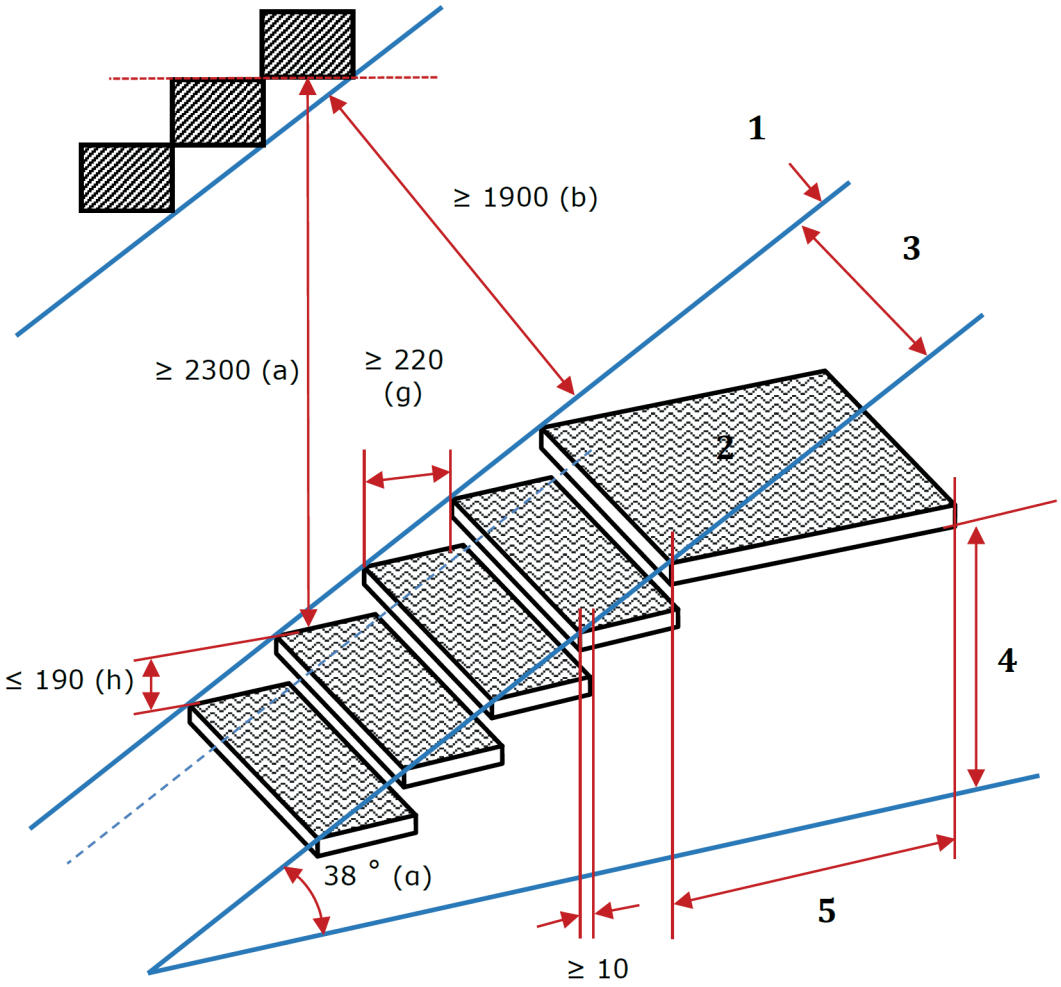
If standard stretcher (length x width = 2 200 mm x 650 mm) handling is required on the stairs, the width shall be minimum 1 100 mm. When bigger stretchers are used, the minimum width shall be assessed.

For stairs used for escape and primary access, the width shall be minimum 1 200 mm. Stairs designed for through traffic of more than 50 persons in escape situations shall have a minimum net width of 1 500 mm. The minimum width shall be measured between the inside of handrails.

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Head height from tread to any obstacle shall not be less than 2 300 mm and absolute minimum clear distance between any obstacle and the pitch line, measured at an angle of 90° from the pitch line shall not be less than 1 900 mm.

Dimension in millimetres



Key

1 pitch line
2 landing depth ≥ width of stair
3 ≥ 1 000 (normal access)
≥ 800 (secondary stairs)
≥ 1 200 (primary stairs)
≥ 1 500 (≥ 50 persons)
4 ≤ 3 000(multi flight)
≤ 4 000 (single)
5 ≥ 1 000(normal access)
≥ 800 (secondary stairs)
≥ 1 200 (primary stairs)
≥ 1 500 (≥ 50persons)

Figure 8 — Recommended overall dimension for stairs

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4.4.3 Nosing

All nosing shall have a non-slip surface such as anti-slip panel, with secure and permanent fixing on top of the flooring material, unless the selected material itself has a built-in nosing. The nosing shall be flush with the stair tread surface.

Internal stairs shall have nosing that allow efficient cleaning. The nosing should be painted with yellow color when the stairs are used as primary escape and main access way. Additionally, a photo luminescent stairway marking is recommended to the nosing of the stairs on primary escape routes.

4.4.4 Treads and landings

Each stairway shall have a landing at the top and bottom of every flight. There shall be an intermediate landing when two or more flights converge between deck levels. The depth, h, of the landing shall not be less than the width, g, of the stair.

Treads shall be evenly spaced. The maximum allowable deviation of the rise dimension in a single flight of stairs is +/-5 mm, including the first and last riser of every flight. Where it is not possible, the rise of the first step in the flight, may be reduced by maximum of 15 % (see Figure 9).

Treads shall withstand a foot load of 2 000 N (200 kg) on an area of 100 mm x 100 mm at any position without permanent deflection.

Dimension in millimetres

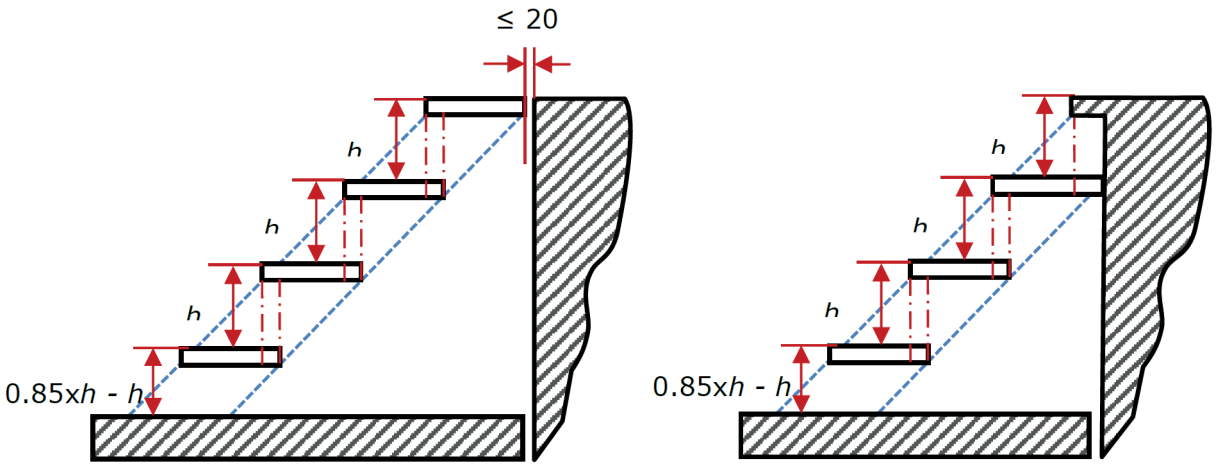


Figure 9 — Specification for height of rises and positioning of the uppermost step

All treads shall have a toe plate of minimum 50 mm height. All landings shall have a toe plate of minimum 100 mm height. Openings between toe plate and decks or gratings shall not exceed 10 mm (see Figure 10).

The overlap of the steps shall be more than 10 mm and shall apply equally to landings and floors.

The following formula is applicable for determining the stair proportion:

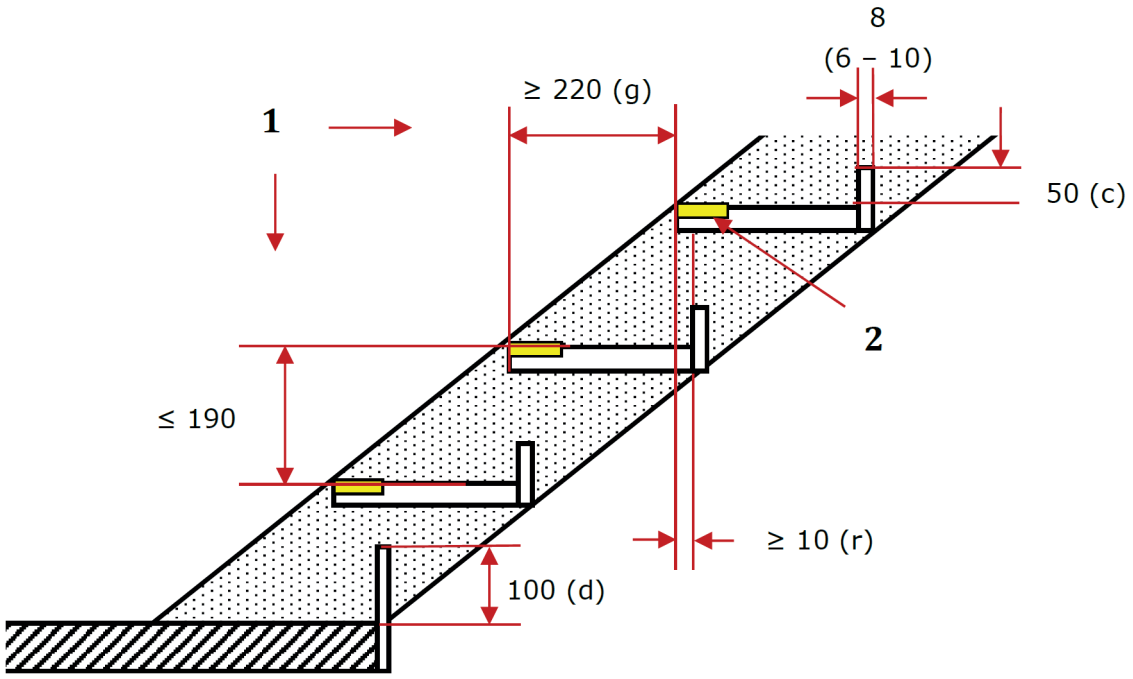
600 mm ≤ going (g) + 2 × rise (h) ≤ 660 mm

The maximum rise shall not exceed 190 mm and the going shall not be less than 240 mm. For special case, however, where the slope is between 38 and 40 degree, the minimum going is 220 mm due to the maximum height of rise.

The minimum rise height is 160 mm and first step (the lowest step) may be reduced by a maximum of 15 % of equal riser height.

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Dimension in millimetres



Key

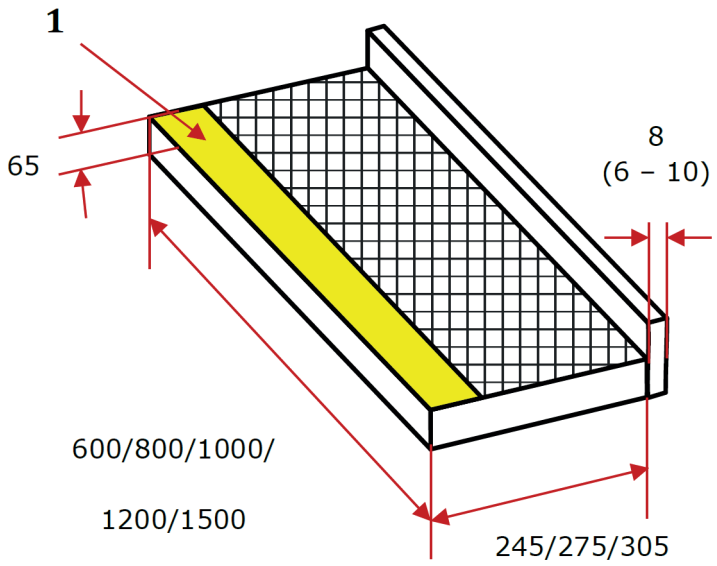
1 rise and going: 600 ≤ g+2 h ≤ 660 Pitch line

2 non-slop nosing (yellow marking or photoluminescence on primary escape way and main access way)

Figure 10 — Specification for riser and going for stairs

Figure 11 shows the specification for treads. The width specification is 600, 800, 1 000, 1 200 mm and the going specification is 245, 275, 305 mm.

Dimension in millimeters



Key

1 non-slip nosing including yellow marking or photoluminescence on primary escape way and main access way

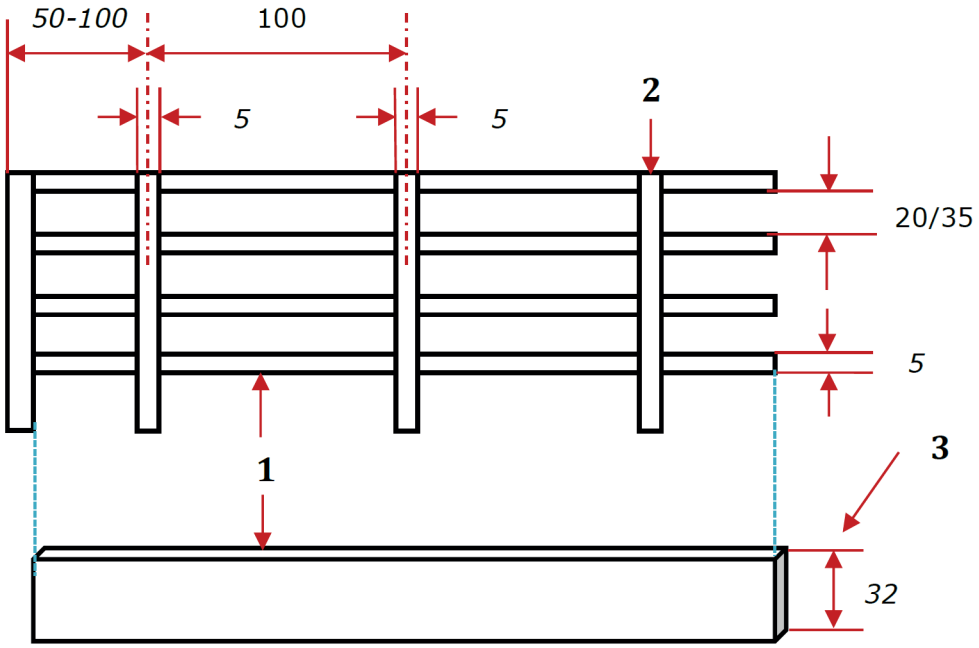
Figure 11 — Specification for riser and going for stairs

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Figure 12 shows the specification for treads grating. The thickness specification of cross and bearing bar is 5T. The depth specification of the bearing bar is 32 mm. Other dimensions shall comply with the requirements of grating in this document.

Dimension in millimeters



Key

1 bearing bar
2 cross bar
3 depth

Figure 12 — Specification for riser and going for stairs

4.4.5 Structural requirements

Treads shall withstand a foot load of 2 000 N (200 kg) on an area of 100 mm x 100 mm at any position without permanent deflection.

4.4.6 Tests of stairs

The test shall comply with the requirement of test procedure as described in section 10.

4.5 Spiral stairs

The specification and requirements for spiral stairs are summarized in Table 5. The specification and requirements are to be applied to all spiral stairs on an installation except stairs providing means of access to machinery or equipment skids.

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Table 5 — Specification and requirements for spiral stairs

Parameter	Specification	Requirement(s)	Comments and limitations
Width	— Normal access: 1 000 mm — Primary stairs: 1 200 mm — ≥ 50 persons: 1 500 mm	— Normal access: min. 1 000 mm — Primary stairs: min. 1 200 mm — ≥ 50 persons: min. 1 500 mm	Min. 1 000 mm if stretcher (length x width = 2 200 mm x 650 mm) handling is required and/or for escape ways.
Head height	— Min. 2 300 mm	— Min. 2 300 mm	
Step overlap (Nosing)	— Min. 10 mm — Nonslip finish	— Min. 10 mm — Nonslip finish	
Number of rises	— Max. 16 for multi flight — Max. 22 for single flight	— Max. 16 for multi flight — Max. 22 for single flight	
Rise height	— Max 190 mm	— Max 190 mm	
Going(g) and rise(h)	— 480 ≤ g + 2 h ≤ 800 mm	— 480 ≤ g + 2 h ≤ 800 mm	In the case where it is not possible to maintain the height of the rise between the level of departure and the first step, it may be reduced by a maximum of 15 %.
Toe plate on tread	— 50 mm	— Min 50 mm	Back covers are recommended to be fitted for stairways inside of the living quarters.
Toe plate on landing	— 100 mm	— Min 100 mm	
Uppermost step	— The uppermost step shall be level with the landing.	— The uppermost step shall be level with the landing.	
Angle for landing	— Landing at platform levels angle: 90° — Intermediate or rest landings angle: 45°	— Landing at platform levels angle ≥ 90° — Intermediate or rest landings angle ≥ 45°	Angle at the geometric centre on plan

4.5.1 General requirements

The handrails on spiral stairs shall comply with the requirements of handrails as outlined in section 6.2.

Inner and outer handrail shall be provided.

4.5.2 Sizes of stairs

In principle, two stair categories are specified as described in Table 6.

The outside diameter should be determined considering clear access widths, distance between the handrail and any obstruction as well as diameter of centre support column.

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Table 6 — Sizes of stairs

Stair category	Minimum outside diameter (mm)	Rise, h (mm)	Going, g (mm)			2 h + g (mm)		Clear width (mm)
			Minimum Inner going, g_i	Minimum centre going, g_c	Minimum outer going, g_o	Min.	Max.	Min.
Type 1	2 500	160-190	150	250	450	480	800	1 000
Type 2	2 900	160-190	150	250	450	480	800	1 200

The minimum clear width of a stairway shall be measured between the inside of inner and outer handrails.

The rise and going should be determined based on following formula:

480 mm ≤ going (g) + 2 × rise (h) ≤ 800 mm

The maximum rise shall not exceed 190 mm and the maximum number of risers in a single flight should be 16, except where it is not practicable to fit in intermediate landings at 16 riser intervals. In such cases the number of risers may be increased to 22.

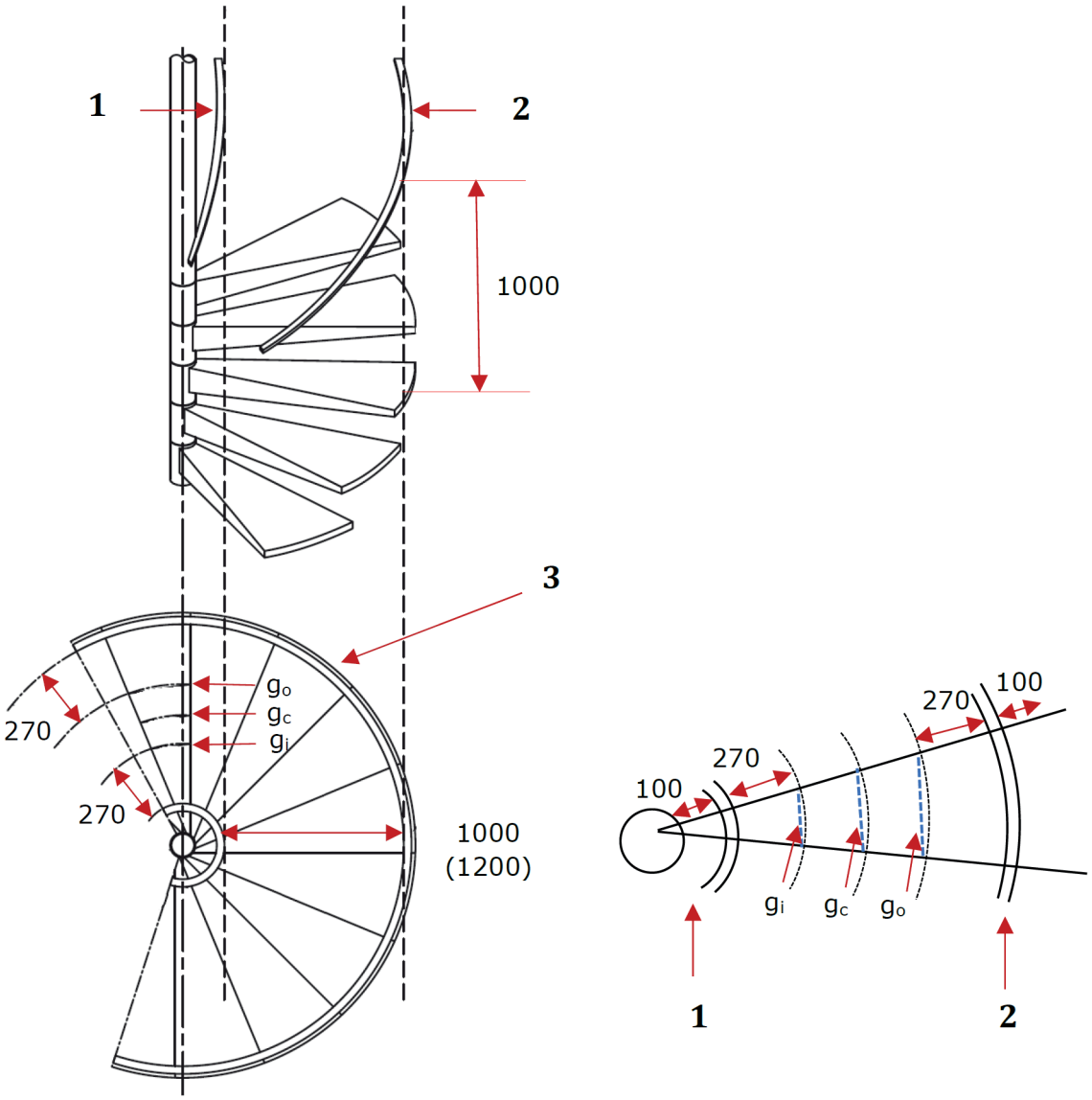
The inner going, which is the minimum going, should be measured at a point 270 mm horizontally from the inner handrail or from the column face where no inner handrail is fitted (see Figure 13).

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Dimension in millimeters



Key

1 inner handrail
2 outer handrail
3 gi: inner going
gc: centre going
go: outer going

Figure 13 — Measurement of clear width and goings

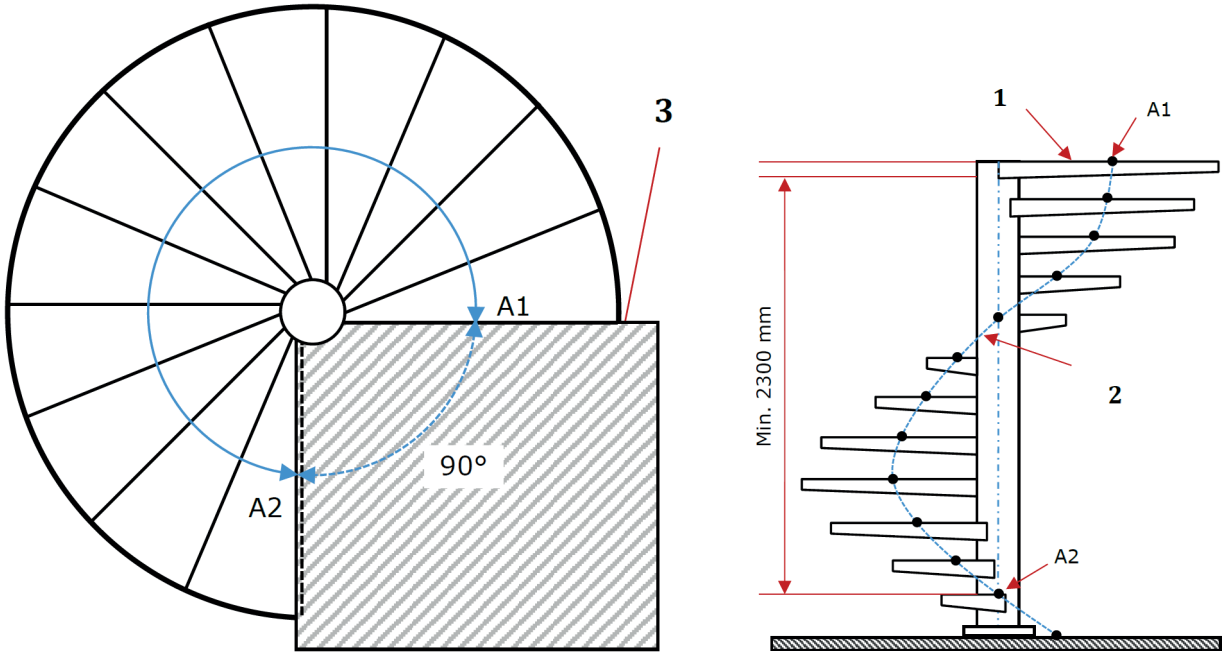
The centre going should be measured at the central point of the clear width. The outer going, which is the maximum going, should be measured at a point 270 mm horizontally from the outer handrail or string, whichever is the least radius.

The clear headroom should not be less than 2 300 mm, but it may be reduced to 2 100 mm wherever this is not practicable, e.g. at a distance 150 mm or less from the inner handrail across the tread (see Figure 14).

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Landings at platform levels should subtend an angle of not less than 90° at the geometric centre on plan. Intermediate or rest landings should have a plan area of not less than two consecutive treads or subtend an angle of 45° at the geometric centre on plan, whichever is the greater.



(a) Plan (b) Elevation

Key

1 landing
2 pitch line
3 landing at platform level

Figure 14 — Clear headroom

4.5.3 Nosing

All nosings shall have a non-slip surface such as anti-slip panel, with secure and permanent fixing on top of the flooring material, unless the selected material itself has a built-in nosing and anti-slip panel can be used as an alternative. The nosings shall be flush with the stair tread surface.

4.5.4 Treads and landings

Each stairway shall have a landing at the top and bottom of every flight. There shall be an intermediate or rest landing when two or more flights converge between deck levels.

Treads shall be evenly spaced. The maximum allowable deviation of the rise dimension in a single flight of stairs is +/-5 mm, including the first and last riser of every flight. Where it is not possible, the rise of the first step in the flight, may be reduced by maximum of 15 % of equal riser height.

Treads shall withstand a foot load of 2 000 N (200 kg) on an area of 100 mm x 100 mm at any position without permanent deflection.

All treads shall have a toe plate of minimum 50 mm height. All landings shall have a toe plate of minimum 100 mm height. Openings between toe plate and decks or gratings shall not exceed 10 mm.

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4.6 Vertical ladders

The specification and requirements for vertical ladders are summarized in Table 7.

Table 7 — Specification and requirements for vertical ladders

Parameters	Specification	Requirement(s)	Comments and limitations
Spacing between successive rungs (a)	— 300/290/280 mm (centre-to-centre distance)	— 225 – 300 mm	
Spacing between the lowest rung and the departure area (b)	— 100 – 400 mm (centre-to-floor distance)	— 100 – 400 mm	Recommendation is 225 - 300 mm
Width of ladder (c)	— 450 mm (centre-to-centre distance)	— 410 – 600 mm	
Rung shape	— Diamond type	— Diamond type	
Dimension (or diameter) of rungs	— 22 mm	— 22 – 50 mm	
Cross-section profile of stiles (stringer) (dimension or diameter)	— Flat bar — Width: 65 mm — Thickness: 12 mm — Pipe as length ≤ 3 000 mm without intermediate support — Diameter: 48,3 mm — Thickness: 3,7 mm — Pipe as 3 000 mm < length ≤ 5 000 mm without intermediate support — Diameter: 89,1 mm — Thickness: 5,5 mm — Pipe as 5 000 mm < length ≤ 10 000 mm with one intermediate support — Diameter: 89,1 mm — Thickness: 5,5 mm	— Flat bar with max. 80 mm width and min. 10 mm thickness — Pipe with min. 48 mm diameter and min. 3,7 thickness when length is less than 3 000 mm — Pipe with min. 89 mm diameter and min. 5,5 thickness when length is larger than 3 000 mm	Length without intermediate support is less than 3 000 mm for flat bar type Length without intermediate support is less than 5 000 mm for pipe type
Location of the lowest part of safety cage (d)	— 2 300 mm	— 2 200 – 2 500 mm	Not in compliance with ANSI: min. 7- max. 8' (2 133 – 2 438 mm); AS: min. 2 000 - max. 2 200 mm
Clear distance within safety cage hoop (e)	— 650 – 800 mm	— 650 – 800 mm	Not in compliance with AS: min. width 700 mm, min. depth 750 mm

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Table 7 *(continued)*

Parameters	Specification	Requirement(s)	Comments and limitations
Clear distance within the lowest part of safety cage hoop (f)	— 715 – 880 mm (max. 110 % of (e))	— 715 – 880 mm (max. 110 % of (e))	
Horizontal distance from the surrounding structure (safety cage) to centerline of ladder (g)	— 325 – 400 mm	— 325 – 400 mm	
Vertical distance between two hoops of safety cage (h)	— 1 500 mm (centre-to-centre distance)	— Max. 1 500 mm	
Distance between two uprights of safety cage (i)	— 300 mm (centre-to-centre distance)	— Max. 300 mm	Not in compliance with AS: max. 150 mm when vertical opening is 2 000 mm
Opening area of safety cage (j)	— Max. 0,40 m^2	— Max. 0,40 m^2	
Extension from arrival area (k)	— Safety cage: min. 1 100 mm (height of handrail) — Ladder for side access: — min. 5 rungs — Min. 1 400 mm (280 mm x 5)	— Safety cage: min. 1 100 mm (height of handrail) — Ladder for side access: — min. 5 rungs — Min. 1 400 mm (280 mm x 5)	Extension is measured from arrival. Extension of ladder is required when no good handholds are provided
Space between the ladder and any permanent obstruction **(measured from the front of the rungs) (m)**	— in front of the ladder: min. 650 mm min. 600 mm in case of a discontinuous obstacle — behind the front side of the rungs: min. 200 mm min. 150 mm in case of a discontinuous obstacle	— in front of the ladder: min. 650 mm min. 600 mm in case of a discontinuous obstacle — behind the front side of the rungs: min. 200 mm min. 150 mm in case of a discontinuous obstacle	
Toe clearance space between the walk-through ladder and any permanent obstruction **(measured from behind of the rungs) (n)**	— Min 150 mm — Min. 75 mm in case of a discontinuous obstacle — Upper rung : 60-75 mm	— Min 150 mm — Min. 75 mm in case of a discontinuous obstacle — Upper rung : 60-75 mm	Walk through ladders
Distance between the side access ladder stile and landing platform in the case of side access (p)	— 150 – 250 mm	— 150 – 250 mm	Side access ladder

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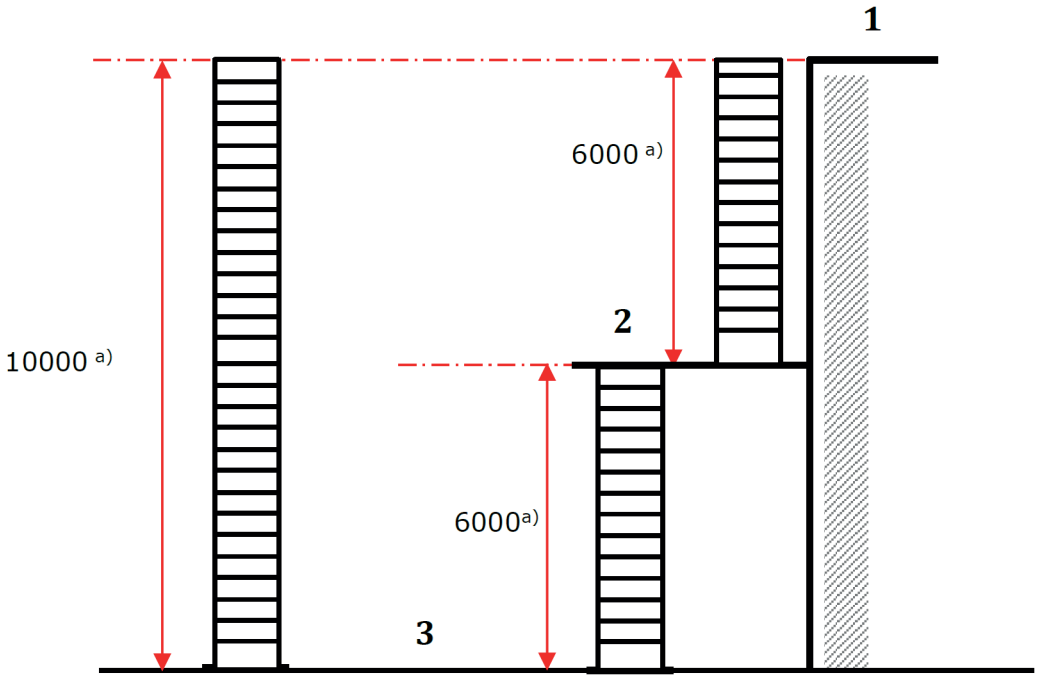
Table 7 *(continued)*

Parameters	Specification	Requirement(s)	Comments and limitations
Number of fixing support for flat bar type stile	— Min. 2 (< 3 m) — Min.one additional support for every 3 m (> 3 m)	— Min. 2 (< 3 m) — Min.one additional support for every 3 m (> 3 m)	Ladder stile with flat bar and pipe type only
Ladder height without rest platform (single flight)	— Max. 10 000 mm	— Max. 10 000 mm	Not in compliance with AS: Max. 6 000
Ladder height with staggered flights	— Max. 6 000 mm	— Max. 6 000 mm	

4.6.1 General requirements

Ladder height without intermediate platform or rest platform shall not be exceed 10 000 mm for single flight and with staggered flights shall not be exceed 6 000 mm (see Figure 15)

Dimension in millimeters



Key

1 arrival area
2 intermediate platform or rest platform
3 departure area
a) Maximum.

Figure 15 — Height of flights and location of platforms

Figure 16 shows the specification for side access type vertical ladders. Figure 17 shows the specification for walk-through type vertical ladders. For safe access, the side access type is recommended. The recommendation is not applicable to vertical ladders within tanks and void spaces.

The spacing between successive rungs shall be between 225 mm and 300 mm. The spacing specification of 300, 290, 280 mm provides flexibility due to different lengths of the vertical ladder (see Figure 16).

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The vertical ladder shall provide a safe access without any slipping hazard prevented by the shape of the rungs. Circular rungs are more prone to slipping and are consequently not allowed.

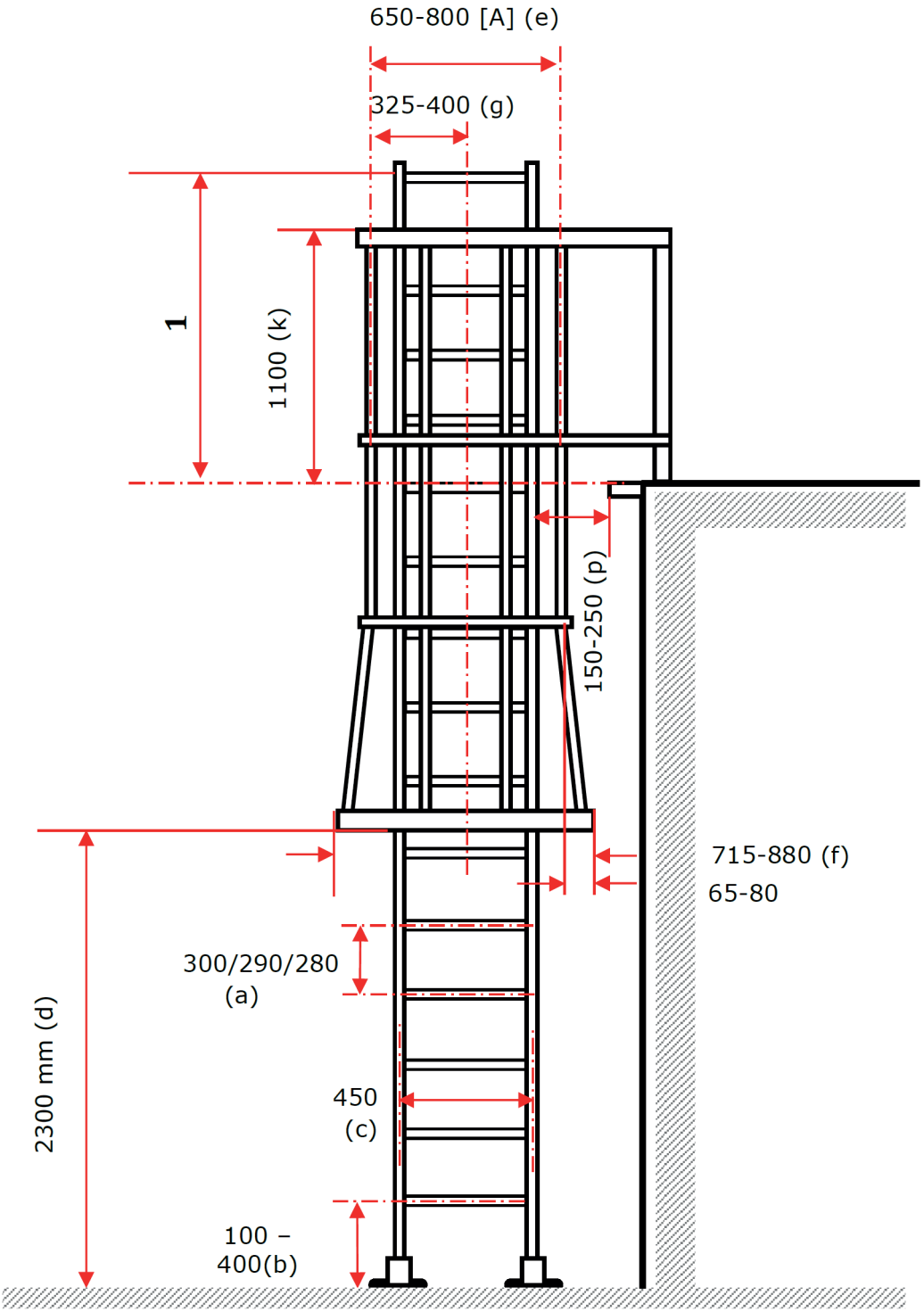
For side access type, the ladder shall be extended at least 5 rungs and be minimum 1 400 mm height for safe access.

The rung of the ladder closest to the upper departure level shall be flush with the deck surface.

At the top of vertical ladders, self-closing gates shall be installed. The width between the stiles (stringer) at the top of the step-through ladder shall be the same width as the width of the safety gate.

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Dimension in millimeters



Key

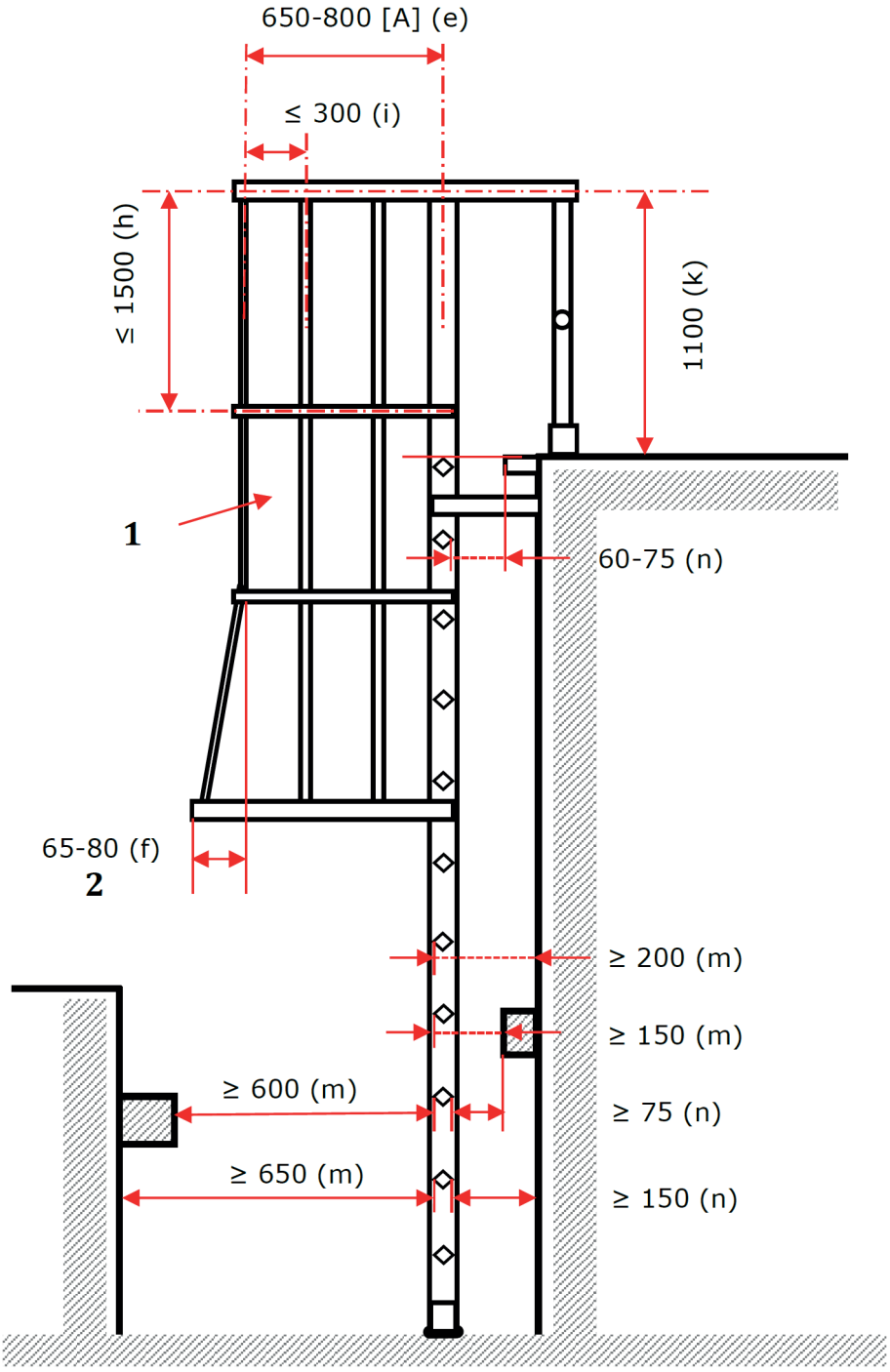
1 five (5) rungs (k): (300/290/280 × 5)

Figure 16 — Specification for vertical ladders (side access ladder)

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Dimension in millimeters



Key

1 opening space (j)

2 max. 10 % of [A]

Figure 17 — Specification for vertical ladders (walk through ladders)

4.6.2 Stiles (stringer)

The stiles shall be fixed at platform of departure area and upper level of arrival landing platform.

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Intermediate support shall be provided when the height is under following conditions.

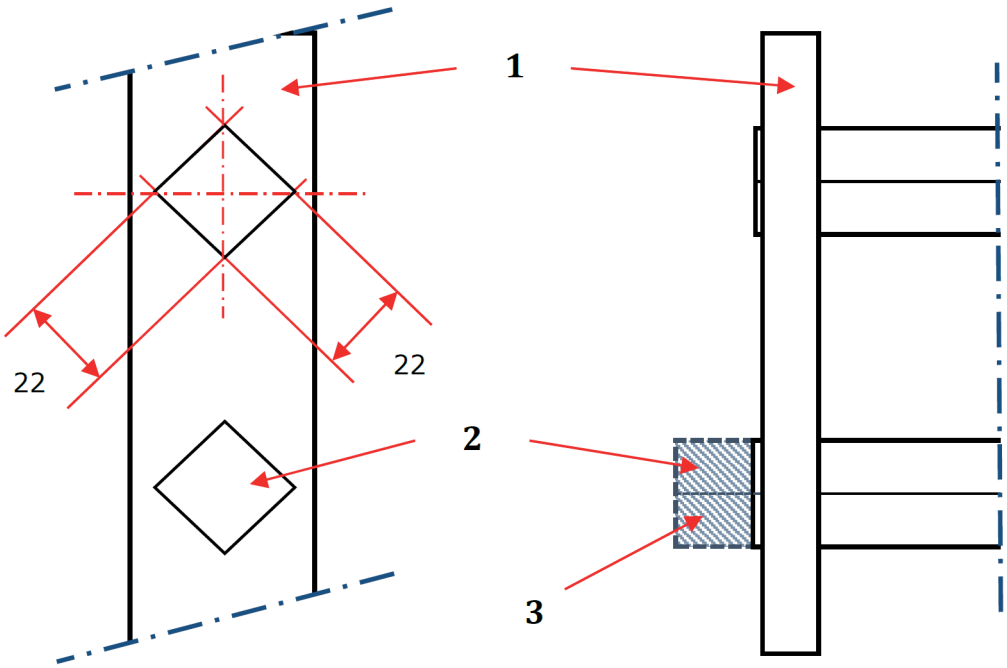
— When height > 3 000 mm with flat bar type stiles, minimum one intermediate support shall be provided for every 3 000 mm.

— When height > 5 000 mm with pipe type stiles, minimum one intermediate support shall be provided for every 5 000 mm.

4.6.3 Rungs

The shape specification is diamond type square as shown in Figure 18. Rung dimension specification is 22 mm for each side. The rungs shall be positioned in centre of the stile. The rung shall not extend after the penetration of the stile. Both sides of the stiles shall be continuously welded without any sharp edges.

Dimension in millimeters



Key

1 stile (stringer)
2 rung
3 penetrated part of rung shall be removed and continuously welded

Figure 18 — Specification for position, shape and penetration of rungs

4.6.4 Spacing between the ladder and any permanent obstruction

The space between the ladder and any permanent obstruction or obstacle shall be as follows.

a) Measured from the front of the rungs:

1) In front of the ladder: minimum 650 mm or, where obstacles such as pipes or trays cross, 600 mm.

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2) Behind the ladder: minimum 200 mm or where obstacles such as pipes or trays cross, 150 mm.

b) Measured from behind of the rungs:

1) Behind the ladder: Minimum 75 mm, except the upper rung, which shall be between 60 mm and 75 mm for walk through ladders.

For side access ladder, the space between stiles and end of arrival area shall be between 150 mm and 250 mm to prevent tripping and falling hazard.

4.6.5 Fall protection device

When a safety cage is arranged, the distance between two hoops (vertical opening) shall not exceed 1 500 mm and the distance between two uprights (horizontal opening) shall not exceed 300 mm. The opening space of the safety cage shall not exceed 0,4 m2 to prevent falling hazard.

The clear distances within the hoop of the safety cage shall be between 650 and 800 mm (see Figure 18). The distances should be decided based on average body size of operators. For easy access, clearing distance for the lowest part of safety cage hoop is recommended to be expanded to maximum 10 % of the clearing distances to other part of the safety cage hoop (see Figure 17).

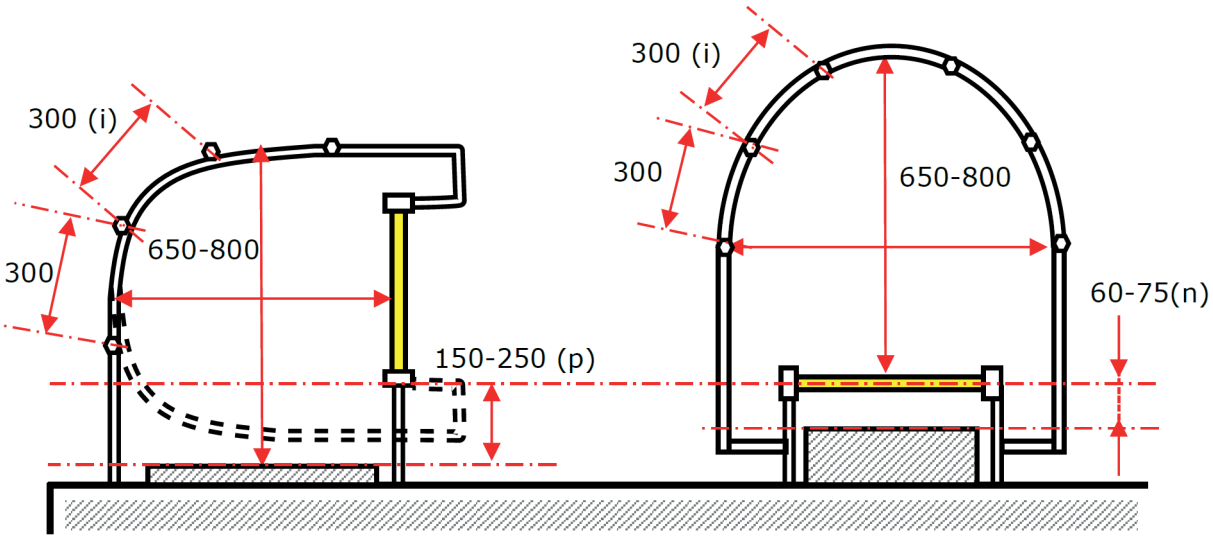
The height of the lowest part of safety cage hoop shall be between 2 200 mm and 2 500 mm. The recommended height is 2 300 mm.

The safety cage shall be extended at least same height as handrail from the arrival area.

If the horizontal distance from the fixed ladder, equipped with the safety case, to the guard-rail of an elevated departure area is more than 1 500 mm, the gaps inside the guardrail shall be closed in the area left and right of the axis of the safety cage of 1 500 mm.

Two types of fall protection meshed structure are specified (see Figure 20). The types can be chosen by designer and/or operators to suit the situation of areas. The fall protection meshed structure shall comply with the requirement of ISO 14122-4.

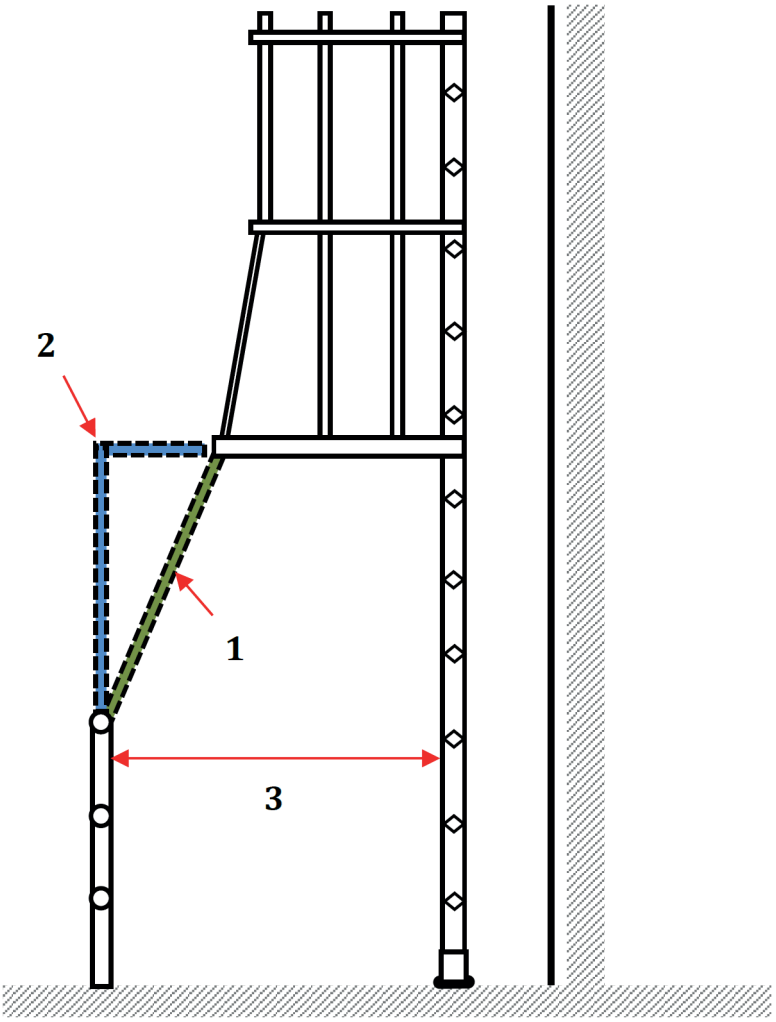
Dimension in millimeters



(a) side access type (b) walk-through type

Figure 19 — Specification for shape of safety cage

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Key

1 fall protection meshed structure (Type A)
2 fall protection meshed structure (Type B)
3 when ≤ 1 500 mm

Figure 20 — Specification for protection bar

4.6.6 Structure requirements

The general structure requirements shall comply with the requirement of ISO 14122-4.

4.6.7 Tests of vertical ladders

The test shall comply with the requirement of test procedure as described in clause 10.

4.7 Grating

The specification and requirements for gratings are shown in **Table 8**.

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Table 8 — Specification and requirements for gratings

Parameter	Specification	Requirement(s)	Comments and limitations
Opening diameter (Ball dropping test)	— 20 mm (above places where personnel can be present) — 35 mm (other areas where people normally should not be present)	— Max. 20 mm (above places where personnel can be present) — Max. 35 mm (other areas where people normally should not be present)	Not compliant with NMA: Max. 15 mm
Bearing bar spacing (a)	— 20 mm (above places where personnel can be present) — 35 mm (other areas where people normally should not be present)	— Max. 20 mm (above places where personnel can be present) — Max. 35 mm (other areas where people normally should not be present)	Centre-to-centre distance
Cross bar spacing (b)	— 100 mm — 50-100 mm for leftmost and rightmost of cross bar.	— 100 mm — 50-100 mm for leftmost and rightmost of cross bar	Centre-to-centre distance
Surface finish	— Non-slip: ex. punched type, Serrated type or equivalent — 3 mm depth — Radius: R 3,5 — Pitch: 12,5 mm	— Non-slip: ex. punched type, Serrated type or equivalent	
Height of toe plate for cut out by penetration of obstruction	— 100 mm — Min. 50 mm (under obstruction)	— Min. 100 mm — Min. 50 mm (under obstruction)	
Thickness of toe plate	— 8 mm	— 6 – 10 mm	
Opening between obstruction and grating	— Max. 50 mm	— Max. 50 mm	

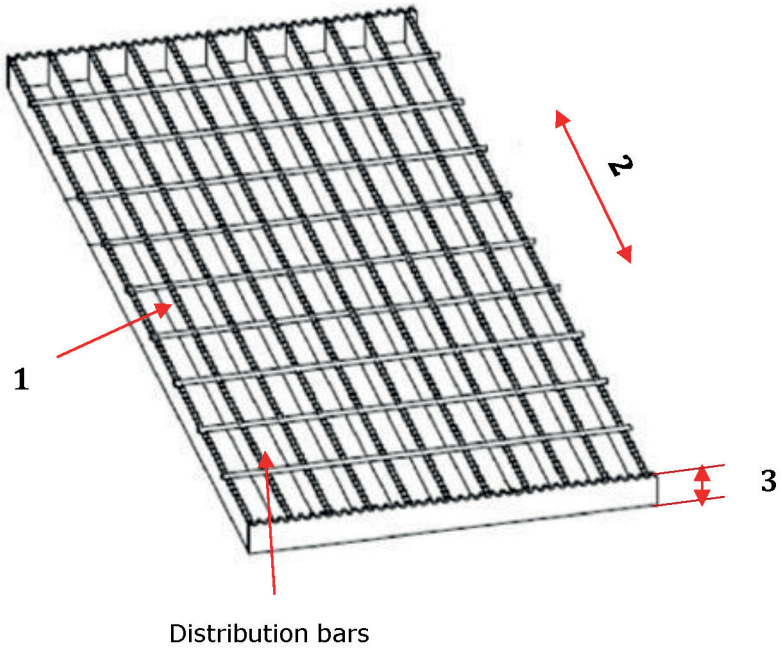
4.7.1 General requirements

The main function of gratings is to provide safe access and to prevent dropped objects. The requirements for grating apply to access ways for personnel and may not apply for grating to be used in areas for material handling and laydown.

Edges of grating shall be banded with same thickness as a bearing bar.

The surface of the grating should be non-slip type such as punched, serrated or equivalent to prevent slipping hazard as shown in Figure 22.

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Key

1 serrated load bearing bars
2 span (direction of load bearing bars)
3 bering/binding bar depth

Figure 21 — Grating components definition

Dimension in millimeters

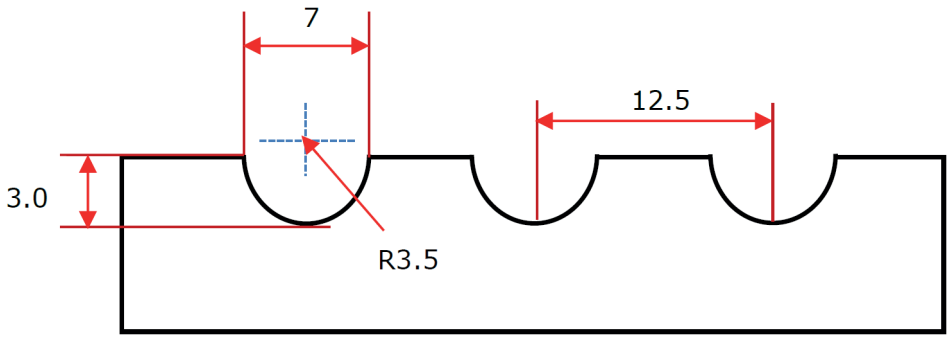


Figure 22 — Surface finish specification for gratings

4.7.2 Grating openings

The grating on the floorings above a place where people are working, as opposed to occasional passage shall not allow a ball with a diameter of 20 mm to pass through. The grating in other areas shall not allow a ball with a diameter of 35 mm to pass through.

The spacing between bearing bars should be 20 mm or 35 mm and space between cross bar should be 100 mm to fulfil the ball dropping test. The space between cross bars in leftmost and rightmost can be between 50 mm and 100 mm (see Figure 23).

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Dimension in millimeters

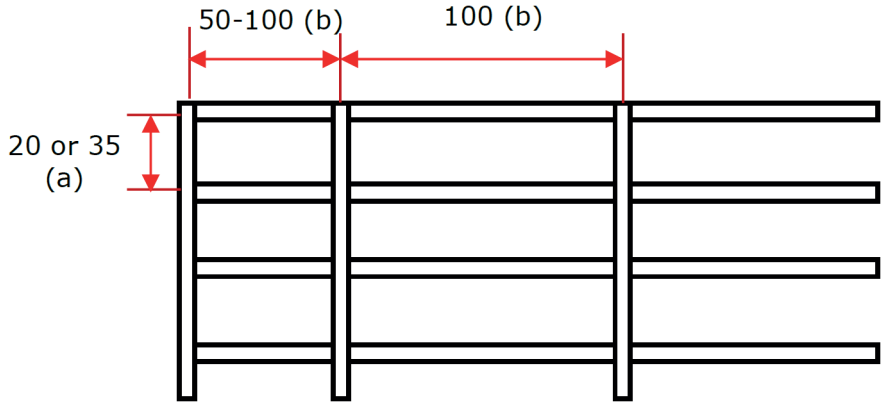


Figure 23 — Specification for gratings

4.7.3 Penetrations

If pipe penetrates though the grating, a toe-plate with 100 mm height shall be provided around the pipe. If, because of an obstruction (see Figure 24), there is in sufficient space for a full height toe-plate, the height of the toe-plate can be locally reduced to a minimum of 50 mm.

Dimension in millimeters

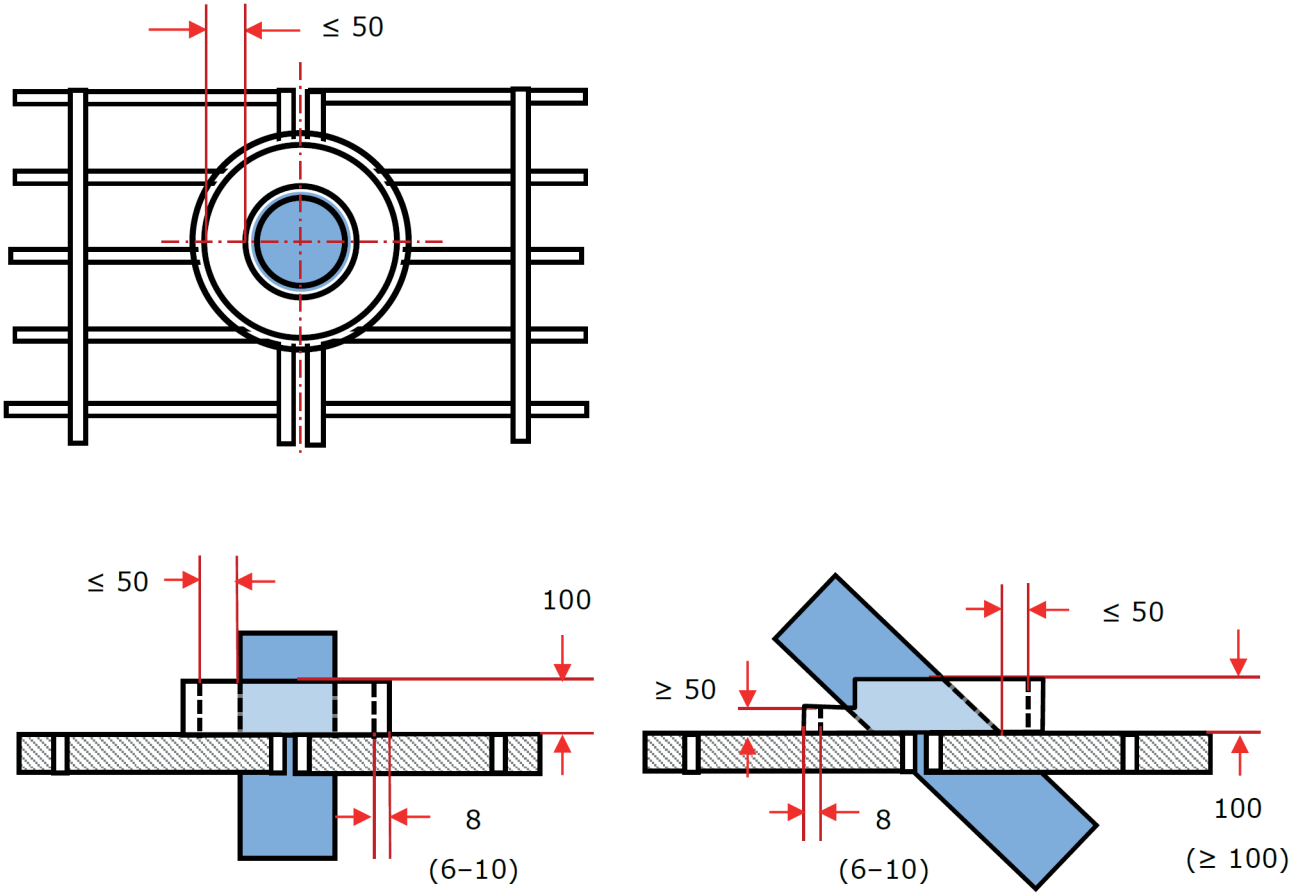


Figure 24 — Specification for penetration for gratings

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4.7.4 Tests of gratings

The test shall comply with the requirement of test procedure as described in section 10.

4.8 Manhole

In the offshore industry, a manhole has various design options, material specifications and dimensions. A code system for the design of manholes is frequently used. This document recommends using design options, material specifications and dimensions for man holes through a unified code system as shown in Figure 25.

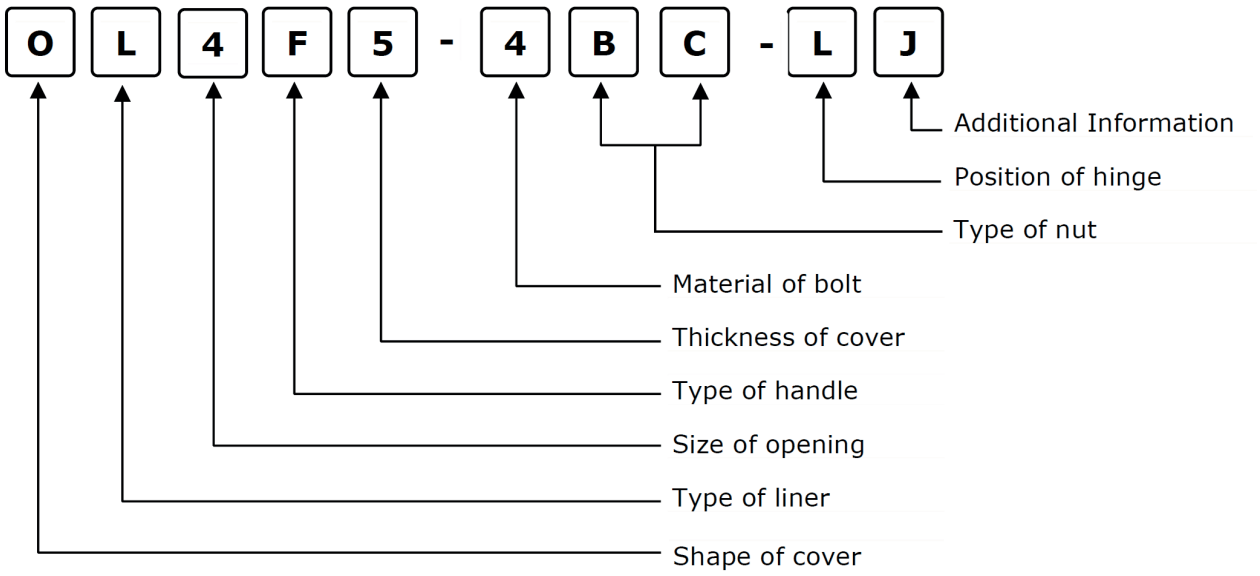


Figure 25 — Unified code specification for manhole

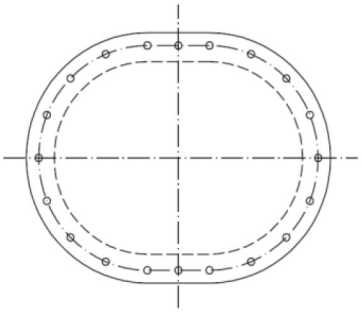
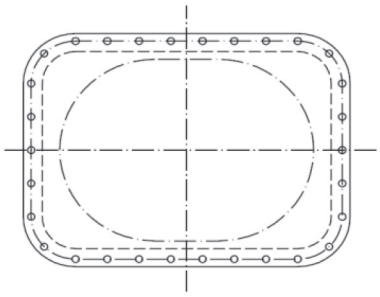
Manhole code components are described in Table 9 and design details are given in Annex C.

The typical drawing example is given in Annex D as practical drawings.

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Table 9 — Code details

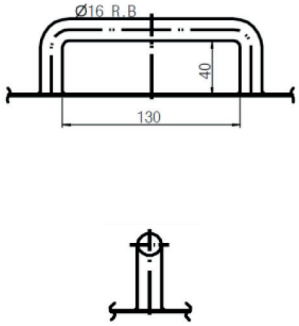
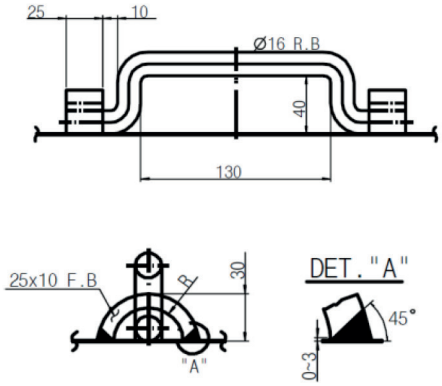
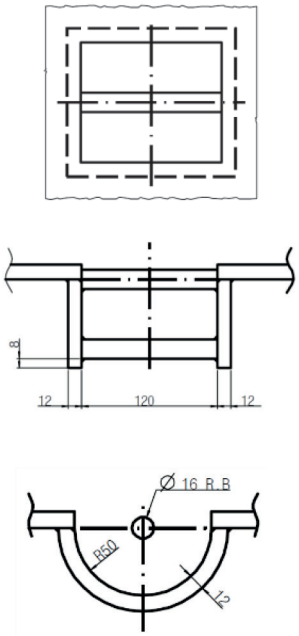
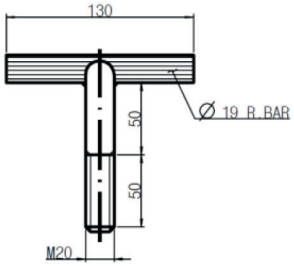
Part	Code	Description	Shape	Comment
Shape of cover	**O**	Oval		
	S	Square		
Type of liner	**L**	Liner		
	C	Coaming		
	F	Flush		
	R	Recess		
Size of opening	**4**	400 x 600		
	5	500 x 700		
	6	600 x 800		
	S	Special size		

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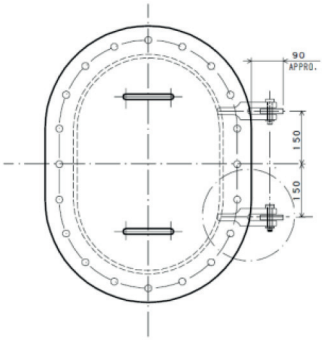
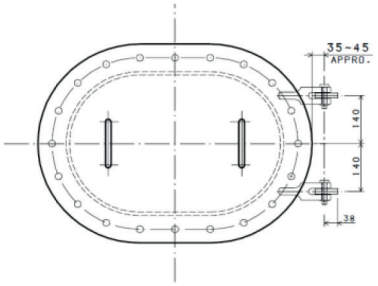
Table 9 *(continued)*

Part	Code	Description	Shape	Comment
Type of handle	**F**	Fixed		
	H	Hinged		Foldable type
	R	Recessed		
	T	T-bolt		
	N	Non-handle		

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Table 9 *(continued)*

Part	Code	Description	Shape	Comment
Thickness of cover	**2**	12,0		Recommended
	5	15,0		
	8	18,0		
Material of bolt	**4**	SUS304		
	6	SUS316		Recommended
Type of nut	**BC**	Brass Cap		
	BH	Brass Hexagon		
	SC	SUS Cap		
	SH	SUS Hexagon		
	SH6	SUS Hexagon		SUS316
Position of hinge	**L**	Long axis		
	S	Short axis		
Additional Information	**N**	No additional information		
	J	Jack up bolt		
	W	washer		
	G	Gas tight cover		
	P	Special packing		

4.9 Connection method

The connection method for steel outfitting shall consider self-loosening prevention, suitable fastening and maintainability.

4.9.1 Selection connection method for steel outfitting

Bolt and nut as fastening method should be used with specification for bolt and nuts in Table 10.

Mechanical properties of bolt, nut and washers shall be complied with ISO 898 parts 1, 2, 3.

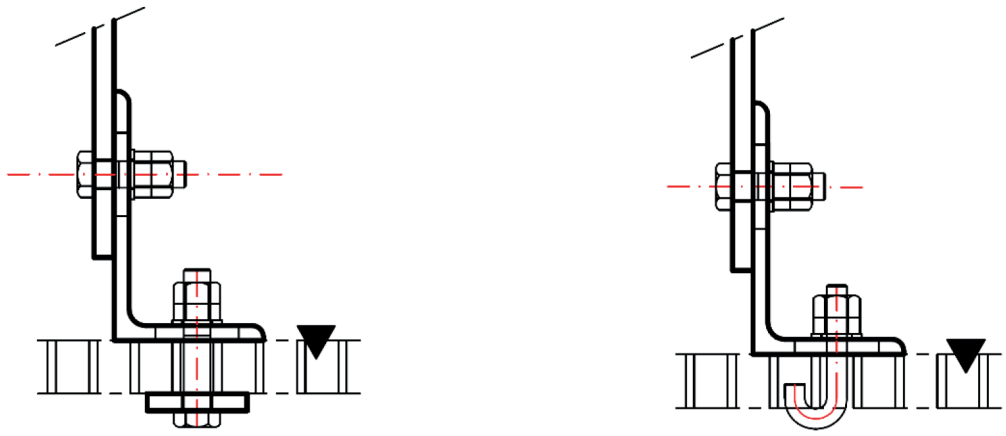
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Table 10 — Specification for bolt and nuts

Item	Bolt type	Thread diam-eter	Nut and Washer
Handrail	Normal hexagon head bolt	M12	Two nuts One plain washer
Removal hand-rail	Normal hexagon head bolt	M12	Two nuts One plain washer
Clamp	Normal hexagon head bolt	M12	One nut [1)] One plain washer
Ladder	Normal hexagon head bolt	M16	Two nuts One plain washer
	J-bolt	M12	Two nut One plain washer
Note [1)] Two nuts are recommended if there is vibration or the frequency of removal is low.			

Normal hexagon head bolt and J bolt can be used for fastening between bottom of ladder and grating. The curvature radius of the J bolt head shall consider the spacing between the bearing bars to ensure a tight fit. (see Figure 26)



a) Normal hexagon head bolt b) J bolt on grating

Figure 26 — Bolt fasting between ladder and grating

4.9.2 Self-loosening prevention

Double nut system (regular and thin nuts) should be used to prevent self-loosening where vibration occurs. The reason why the double nut system is effective in resisting self-loosening is due to the way the threads are jammed together. Since the bolt thread is in contact with the top flank of the small nut and the bottom flank of the top nut, relative thread movement is not possible.

Thin nuts used as jam nuts shall be assembled together with a regular nut or a high nut. In assemblies with jam nut, the thin nut is first tightened against the assembled parts and then the regular or high nut is tightened against the thin nut (see Figure 27).

4.9.3 Nuts fastening

The nuts should be fastened for preventing self-loosening according to following steps.

a) The thin nut should be placed on the bolt first.

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