

**AS 4087:2011**

(Incorporating Amendments up to and including No. 2)



**STANDARDS**  
Australia



# **Metallic flanges for waterworks purposes**



AS 4087:2011

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee WS-022, Valves for Water Supply Purposes. It was approved on behalf of the Council of Standards Australia on 15 March 2011 and on behalf of the Council of Standards New Zealand on 13 May 2011.

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- Australian Water Association
- Engineers Australia
- Institute of Instrumentation, Control & Automation Aust
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# **Metallic flanges for waterworks purposes**

Originated as AS 4087—1993.

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Revised and redesignated as AS/NZS 4087:2011.

Reissued incorporating Amendment No 2 (June 2023) as AS 4087:2011.

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## Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee WS-022, Valves for Water Supply Purposes, to supersede AS 4087—2004.

<sup>A2</sup>This Standard incorporates Amendment No. 1 (September 2012) and Amendment No. 2 (June 2023). The start and end of changes introduced by the Amendment are indicated in the text by tags including the Amendment number 1. <sup>A2</sup>

<sup>A2</sup>Amendment No. 2 to this document was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee WS-022, Valves for Water Supply Purposes. As a consequence of Amendment No. 2, which is published as an Australian-only amendment, this document will be redesignated from AS/NZS 4087 to AS 4087. <sup>A2</sup>

The objective of this Standard is to provide manufacturers with requirements for metallic flanges for waterworks purposes and installers of flanged components with guidance on the most appropriate jointing requirements to achieve a satisfactory long-term watertight joint.

The first flange Standard published in Australia was AS B52-1931, which was an endorsement of BS 10, the inch series flange British Standard, *Flanges and bolting for pipes valves and fittings*. Britain metricated in 1970 and adopted European (ISO) dimensions for flanges whilst Australia chose to continue with the same inch series flange dimensions. AS 2129, *Flanges for pipes, valves and fittings*, was published in 1978 to supersede AS B52 but incorporated 'soft metric' dimensions. The AS/NZS 4331 series, *Metallic flanges*, was published in 1995 as an endorsement of ISO hard metric flanges.

The most common AS 2129 flange tables used for waterworks purposes were Tables D, C, E, F and H with pressure ratings of 700, 1200, 1400, 2100 and 3500 kPa respectively. Table C flanges were subsequently re-rated to 1400 kPa in AS 2129—1991 to reflect industry experience.

AS 4087 was first published in 1993 to provide a dedicated flange Standard for waterworks purposes with a rationalized range of flanges. Table E was eliminated and flanges were designated by allowable operating pressure (AOP). The table below indicates bolting compatibility between AS 4087 and AS 2129 flanges.

Bolting compatibility	
<sup>A2</sup> AS 4087 <sup>A2</sup> Flange classification	AS 2129 Flange classification
PN 14	D, C
PN 16	D, C
PN 21	F, H
PN 35	F, H

The principal changes to this Edition are as follows:

- (a) Incorporation of previous amendments.
- (b) Requirements specified for non-circular flanges, including type tests based on ISO 2531, *Ductile iron pipes, fittings, accessories and their joints for water or gas applications*.
- (c) Inclusion of maximum allowable type test pressures, adopted from AS 2129, *Flanges for pipes, valves and fittings*.
- (d) Amendments to some flange hub dimensions to overcome bolt assembly impracticalities.

Statements expressed in mandatory terms in notes to figures are deemed to be requirements of this Standard.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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## Foreword

Limitations on the use of flanges specified in this Standard may be imposed by one or more of the following:

- (a) Material of construction.
- (b) Pressure class.
- (c) Configuration.
- (d) DN (nominal size).
- (e) Whether installed in buried or submerged or above-ground situations and for the last, the method of support (i.e. beam action).
- (f) Requirements of any relevant product Standard.

Where a pipeline component or appurtenance has an allowable operating pressure (AOP) that is different to an available flange pressure class for the relevant material, the next higher flange pressure class should be specified. For example a PN 10 grey cast iron butterfly valve should incorporate a [Figure B2](#) PN 14 flange and a PN 25 ductile iron fitting should incorporate a [Figure B6](#) PN 35 flange. Test pressures for the pipeline component or appurtenance should be as given in the pipeline component or appurtenance Standard.

The designer of a pipeline or pressure-retaining equipment should evaluate the possible conditions to which flanges will be exposed. The designer should determine whether flanges according to this Standard are suitable for the proposed application.

# Australian Standard®

## Metallic flanges for waterworks purposes

### Section 1 Scope and general

#### 1.1 Scope

This Standard specifies requirements for circular flanges manufactured from copper alloy, grey cast iron, ductile cast iron, or steel. The external shapes of flanges may alternatively be any other shape.

It covers nominal sizes with pressure ratings for PN 14, PN 16, PN 21 and PN 35 at operating temperatures not exceeding 80°C. The Standard also specifies requirements for jointing materials.

Flanges are suitable for use on pipes, pipe fittings, valves and other appurtenances that are primarily intended for the conveyance or storage of water or wastewater.

NOTE For applications outside the limits specified in this Standard the appropriate flange details may be determined from AS 2129 series, *Flanges for pipes, valves and fittings*, and AS/NZS 4331 series, *Metallic flanges*.

#### 1.2 Application

Flange dimensions shall be in accordance with [Appendix B](#).

NOTE 1 Guidelines for designers and installers on the selection of correct jointing requirements for flanges are detailed in [Appendix C](#).

NOTE 2 Guidelines for purchasers on information that should be supplied at the time of enquiry or order are detailed in [Appendix D](#).

#### 1.3 Normative references

The normative documents referenced in this Standard are listed in [Appendix A](#).

NOTE Documents referenced for informative purposes are listed in the [Bibliography](#).

#### 1.4 Definitions

For the purpose of this Standard, the definitions below apply.

##### 1.4.1

##### **allowable operating pressure**

##### **AOP**

the allowable internal pressure, excluding surge, that a component can safely withstand in service

##### 1.4.2

##### **allowable site test pressure**

##### **ASTP**

maximum pressure applied on site in a newly installed pipeline (includes a safety factor and allowances for surge)

##### 1.4.3

##### **coating**

a corrosion-inhibiting medium applied to the surface of a flange

##### 1.4.4

##### **DN (nominal size)**

an alphanumeric designation of size for components of a pipework system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number, which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

**1.4.5****flange contact surface**

that part of the flange face upon which the gasket is compressed

**1.4.6****flange face**

the reference plane that is perpendicular to the axis of the flange and coincident with the front of the flange (see [Figure 1.2](#) and [Appendix B](#))

**1.4.7****flange thickness**

the distance from either the back face of a flange or, if the boltholes are spot-faced, the spot facing to the flange face (see [Appendix B](#))

**1.4.8****fluid**

water, recycled water, sewage or wastewater at temperatures not exceeding 80°C

**1.4.9****integral flange**

a flange that is cast or forged as part of a pressure-containing component

**1.4.10****maximum allowable operating pressure****MAOP**

maximum internal pressure, including surge, that a component can safely withstand in service

**1.4.11****maximum allowable type test pressure****MATTP**

the maximum allowable hydrostatic pressure applied to a flange for the purposes of proof or type testing an associated appurtenance

**1.4.12****pressure class****PN**

a classification of flanges by PN number, based on the allowable operating pressure (AOP) expressed in megapascals ( $PN = 10 \times AOP$ )

**1.4.13****temperature**

the temperature of the fluid contained by the pressure-containing component to which the flange is attached

**1.5 Configuration****1.5.1 General**

Flange configuration is determined by—

- (a) the type, as specified in [Clause 1.5.2](#); and
- (b) the face, as specified in [Clause 1.5.3](#).

**1.5.2 Type**

The types of flanges shall be the following (see [Figure 1.1](#)):

- (a) Blank (steel and ductile iron).

- (b) Plate fixed by brazing or welding (copper alloy and steel).
- (c) Screw-on (ductile iron).
- (d) Integral—
  - (i) with neck (ductile iron); and
  - (ii) without neck (grey iron, copper alloy and steel).

NOTE For convenience, only the flat face variant of each type has been illustrated.

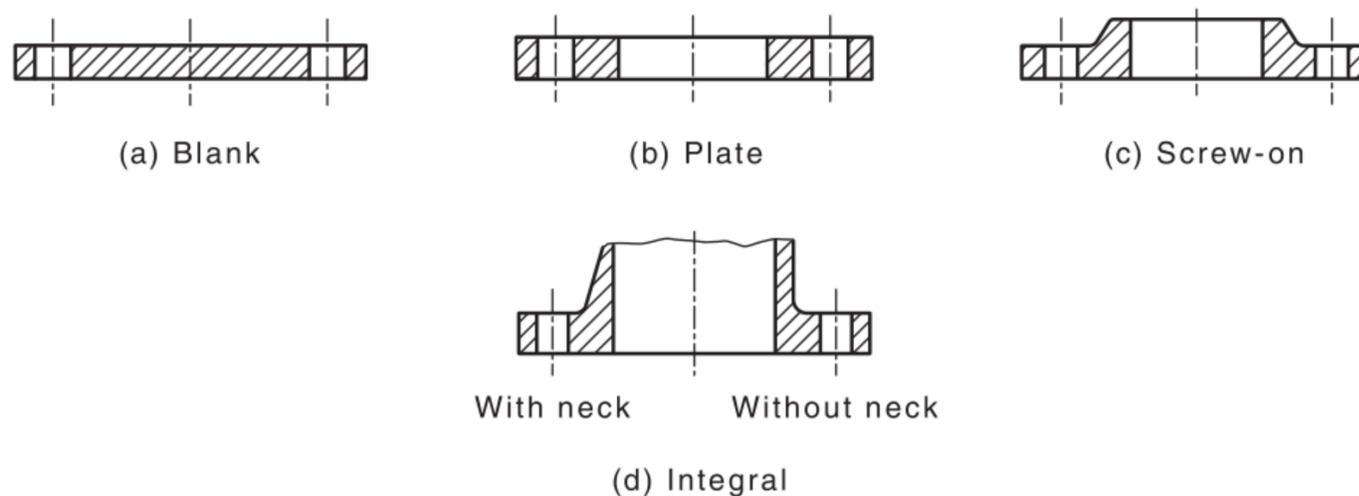


Figure 1.1 — Flange types

### 1.5.3 Flange face

Ⓐ Flanges shall be manufactured with a flat face, with or without an O-ring groove, or raised face, as given in Table 1.1. A flat-face O-ring groove flange shall only be mated with a flat-face flange. Ⓐ

Table 1.1 — Allowable flange face types

Material	Pressure class	Face type
Copper alloy	14	Flat
Grey cast iron	14	Flat
	21	Flat
	35	Flat
Ductile cast iron	16	Raised
	35	Raised
Steel	16	Flat, O-ring or raised
	21	Flat, O-ring or raised
	35	Flat, O-ring or raised

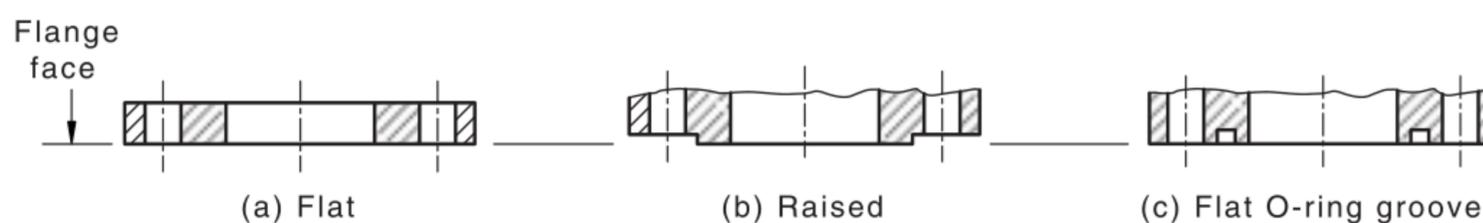


Figure 1.2 — Flange faces

## 1.6 Marking

Flanges (other than integral flanges) shall be permanently and legibly marked on the rim or on the back of the flange between the rim and the pitch circle diameter, with the following information:

- (a) The number of this Standard, i.e. AS 4087.
- (b) DN (nominal size).
- (c) Pressure class, PN.
- (d) Material (e.g. DI, steel).
- (e) Manufacturer's name or trademark.
- (f) Where thread sealants not complying with AS/NZS 4020 are used with screwed flanges, a warning statement 'Not for drinking water'.

Integral flanges need not be marked in accordance with this Standard if the product Standard specifies information to be marked on the product.

NOTE Manufacturers making a statement of compliance with this Australian/New Zealand Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

## Section 2 Classification and allowable pressures

The classification and allowable pressures for flanges shall be in accordance with [Table 2.1](#). The integrity of a flanged joint is dependent upon the correct selection of jointing materials and the correct method of assembly.

NOTE For guidelines on flange jointing, see [Appendix C](#).

The various types of flanges are not necessarily applicable to all Classifications and nominal sizes (see [Table 2.1](#) and [Appendix B](#)).

**Table 2.1 — Classification and allowable pressures**

Pressure Class PN	AOP kPa	MAOP kPa	ASTP kPa	MATTP, kPa		DN range (inclusive)			
				Copper alloy and steel	Grey cast iron and ductile cast iron	Copper alloy	Grey cast iron	Ductile cast iron	Steel
14	1 400	1 680	1 750	2 100	2 800	15 to 150	80 to 1 200	—	—
16	1 600	1 920	2 000	2 400	3 200	—	—	80 to 1 200	50 to 1 200
21	2 100	2 520	2 625	3 150	4 200	—	80 to 1 200	—	50 to 1 200
35	3 500	4 200	4 375	5 250	7 000	—	80 to 600	80 to 1 200	50 to 1 200

## Section 3 Materials

### 3.1 Flanges

Materials from which flanges are manufactured shall be free from defects that could affect the performance or function of the flanges at the allowable test pressures and service conditions.

Flange material grades shall be in accordance with [Table 3.1](#) and—

- (a) for an integral flange, be of the same type or grade as the parent article; or
- (b) for a non-integral flange, be compatible with the material of the parent article to which it is to be joined.

**Table 3.1 — Flange material grades**

Material	Standard	Material designation
Copper alloy	AS 1565	C83600, C90250, C90810, C92410
Ductile cast iron	AS 1831	ISO1083/JS/500-7/S ISO1083/JS/450-10/S ISO1083/JS/400-12/S ISO1083/JS/400-15/S
Grey cast iron	AS 1830	ISO185/JL/200 ISO185/JL/250
Steel	AS 2074 AS 3678 ASTMA240MAS2074	C3 250 304, 304L, 310, 316, 316L, 321 H3A, H3B, H3C, H5A, H5B, H5C, H6A, H6B, H6C
* Other grades of steel or alloy steel may be used subject to the yield stress being not less than 250 MPa		

### 3.2 Fasteners

Fasteners shall be in accordance with [Table 3.2](#). Alternative fasteners may be specified by the purchaser.

Where specified, galvanized coatings shall comply with AS 1214.

**Table 3.2 — Fasteners**

Component	Material			Dimensional	Mechanical	
	Composition	Standard	Grade	Standard	Standard	Property class
Bolts	Carbon steel	AS 2074	C1	AS 1111.1	AS 4291.1	4.6
				AS 1110.1		8.8
Stainless steel	ASTM A276	316	AS 1110.1	ISO 3506-1	A4-50	
					A4-70	
A4-80	Carbon steel	AS 2074	C1	AS 2528	AS 4291.1	8.8
					ISO 3506-1	A4-70
A4-80	Stainless steel	ASTM A276	316	AS 1112.1	AS 4291.2	5
					ISO 3506-2	8
Nuts	Carbon steel	AS 2074	C1	AS 1112.1	AS 4291.2	5
						8
Stainless steel	ASTMA564M	316	AS 1112.1	ISO 3506-2	A4-80	A4-80

**Table 3.2** (continued)

Component	Material			Dimensional	Mechanical	
	Composition	Standard	Grade	Standard	Standard	Property class
Washers	Carbon steel	AS 2074	C1	AS 1237.2	ISO 6507-1	100HV
	Stainless steel	ASTMA240M	316			200HV
<p>NOTE 1 Type A studbolts (see AS 2528) are preferred to bolts for application in high-pressure flanges (greater than PN 16) because of their inherent ease of insertion and removal from either side of a flange joint. This is of particular advantage where the shape of a valve body limits access.</p> <p>NOTE 2 Where galvanized bolting is used in buried or submerged situations, precautions should be taken to prevent corrosion.</p> <p>NOTE 3 Guidelines for the selection of appropriate fasteners is given in <a href="#">Appendix C</a>.</p>						

### 3.3 Flange gaskets

Flange gaskets shall comply with WSA 109.

### 3.4 O-rings for flanges

#### 3.4.1 General

O-rings shall comply with WSA 109 and [Clauses 3.4.2](#) to [3.4.5](#).

#### 3.4.2 Material

O-rings shall be made from material that is not adversely affected by the fluid or environmental conditions to which the O-ring will be subjected in service. The material shall comply with AS 1646.1 and either AS 1646.2 or AS 1646.3 with a nominal hardness of 40 IRHD.

#### 3.4.3 Method of manufacture

The material shall be either—

- (a) cut and glued from extruded cord; or
- (b) moulded integrally.

#### 3.4.4 Dimensions

The outside diameter of the O-ring shall be equal to the outside diameter of the O-ring groove minus 2 mm. The average diameter of the O-ring at any point shall be  $10 \pm 0.5$  mm.

#### 3.4.5 Assembly

An O-ring may be retained in its groove during assembly by the application of a non-injurious soft-setting material. Hard setting material shall not be used.

## Section 4 Manufacturing requirements, dimensions and tolerances

### 4.1 Dimensions and tolerances

#### 4.1.1 Thickness of flange

The dimensions for the thickness of flanges shall be as specified in [Appendix B](#) with a tolerance of  $+(3 + 0.05T)$ ,  $-0$  mm.

NOTE To achieve the surface requirements of [Clause 4.3](#) it may be necessary to machine the contact surface after the flange has been welded or brazed to the parent article. Such cases may necessitate a machining allowance in the original thickness.

#### 4.1.2 Outside diameter of flange

The dimensions for the outside diameter of flanges shall be as specified in [Appendix B](#) and, although a tolerance is not specified in this Standard, the minimum diameter shall provide sufficient bearing area for the nut or bolt head (see [Clause 4.3](#)).

NOTE Outside diameters in accordance with AS/NZS 4331 (all parts) are acceptable.

#### 4.1.3 O-ring groove

The dimensions for the O-ring groove shall be as specified in [Appendix B](#) with the following tolerances:

(a) X	$\pm 0.5$ mm.
(b) W	$\pm 0.5$ mm.
(c) r0	$\pm 0.1$ mm.
(d) r1	$\pm 0.2$ mm.

Dimensions and tolerances shall apply after the application of coatings.

#### 4.1.4 Height of raised face

The dimensions for the height of raised face shall be as specified in [Appendix B](#), with the following tolerances:

(a) 2 mm	$+1.0, -1.0$ mm.
(b) 3 mm	$+1.5, -2.0$ mm.
(c) 4 mm	$+2.0, -3.0$ mm.
(d) 5 mm	$+2.5, -4.0$ mm.

#### 4.1.5 Diameter of raised face

The dimensions for the diameter of raised face shall be as specified in [Appendix B](#), with the following tolerances:

(a) Flanges less than or equal to DN 100	$+2.0, -4.0$ mm.
(b) Flanges greater than DN 100 but less than or equal to DN 300	$+2.0, -4.5$ mm.
(c) Flanges greater than DN 300 but less than or equal to DN 600	$+2.0, -5.0$ mm.

- (d) Flanges greater than DN 600 but less than or equal to DN 1200 +2.0, -5.5 mm.

#### 4.1.6 Boltholes

The dimensions for the boltholes shall be as specified in [Appendix B](#), with the following tolerances:

- (a) The pitch circle diameter:
- (a) The pitch circle diameter
    - (i) M12 to M24 inclusive ±1.5 mm.
    - (ii) M27 and larger ±2.0 mm.
  - (b) The centre-to-centre spacing of adjacent boltholes:
    - (i) M12 to M24 inclusive ±0.75 mm.
    - (ii) M27 and larger ±1.0 mm.
  - (c) The diameter of boltholes +1.5, -0.5 mm.

Dimensions and tolerances shall apply after application of coatings.

Boltholes shall be—

- (i) drilled or cored and spaced equally around the pitch circle, which is concentric with the bore;
- (ii) parallel to the axis of the flange; and
- (iii) for integral flanges, located off the centre-lines and where there are two or more concentric flanges, they shall be aligned.

## 4.2 Contact surfaces

### 4.2.1 General

The contact surfaces for flange faces and O-ring grooves shall be machined or otherwise finished so that the flatness and squareness to the axis and the surface finish are appropriate to the type of gasket or O-ring used. Flange contact surfaces shall not be rougher than N10 ( $R_a = 12.5 \mu\text{m}$ ) and the annulus that makes contact with O-rings shall not be rougher than N8 ( $R_a = 3.2 \mu\text{m}$ ), in accordance with AS 2382.

### 4.2.2 Tolerance on flatness

The tolerance on flatness across the flange face shall be as follows:

- (a) Flanges of nominal size less than or equal to DN 250 ±0.2 mm.
- (b) Flanges of nominal size greater than DN 250 ±0.5 mm.

Dimensions and tolerances shall apply after the application of coatings.

## 4.3 Spot-facing and back-facing of flanges

### 4.3.1 Parallelism of bearing surfaces

The bearing surfaces on the flange for nuts and bolt heads shall be parallel to the flange face, with tolerances as follows:

- |  |                |
|--|----------------|
| (a) Copper alloy and steel flanges               | maximum of 1°. |
| (b) Grey cast iron and ductile cast iron flanges | maximum of 2°. |

#### 4.3.2 Diameter of spot-facing

The diameter of spot-facing shall be not less than the dimension across the corners of the appropriate nut plus 3 mm. Where spot-facing cuts into the fillet of a flange, the diameter shall not exceed the dimension across the corners of the nut by more than 5 mm.

#### 4.3.3 Back-facing

Where a flange is back-faced, the fillet may be reduced, provided it is not eliminated completely, so as to form a sharp corner at the junction of the flange and the hub.

#### 4.3.4 Thickness of flanges after spot-facing or back-facing

The thickness of a flange after spot-facing or back-facing shall be as specified in [Clause 4.1.1](#).

### 4.4 Preparation for the attachment of flanges

#### 4.4.1 Screw-on flanges

The threads of screw-on flanges shall extend to the flange end and shall be perpendicular to the flange face within  $\pm 0.3^\circ$ .

To facilitate engagement of the threaded joint and to protect the threads, the lead-in at the back of the flange shall be chamfered to an angle of approximately  $45^\circ$ . The chamfer shall—

- (a) be concentric with the thread;
- (b) have a major diameter approximately equal to the major diameter of the thread; and
- (c) be included in the measurement of the thread length.

NOTE The thread form and thread type for screw-on flanges are not specified in this Standard.

Thread sealing compounds in contact or likely to come in contact with drinking and recycled water shall comply with AS/NZS 4020 with an applied scaling factor of 0.01.

The threaded connections of screw-on flanges manufactured from ductile cast iron shall comply with the type test requirements of AS/NZS 2280.

#### 4.4.2 Plate flanges

##### 4.4.2.1 Plate flanges for welding

Steel plate flanges for welding shall have a 2 mm maximum radial clearance fit on the pipe, pipe fitting or pressure-retaining equipment.

Steel welding neck flanges shall be machined in the bore to match the internal diameter of the adjoining pipe, pipe fitting or pressure-retaining equipment.

The weld preparation shall comply with the type specified in the appropriate application Standard.

##### 4.4.2.2 Plate flanges for brazing

Copper alloy plate flanges for brazing shall be machined in the bore to have a clearance fit on the pipe, pipe fitting or pressure-retaining equipment. The clearance shall be appropriate to the brazing process,

parent material and the filler metal to be used, but the maximum radial clearance shall not exceed 0.1 mm.

## Section 5 Design

### 5.1 Circular flanges

Circular flanges designed in accordance with Sections 3 and 4 shall be deemed to meet the requirements of [Section 2](#).

### 5.2 Flanges with alternative external shape

#### 5.2.1 General

Flanges with alternative external shape shall meet the requirements of [Clause 4.1](#) except where varied in this Clause.

#### 5.2.2 Thickness

The thickness dimensions and tolerance as given in [Clause 4.1.1](#) shall be maintained at least—

- (a) within a circular area concentric with the bore with a minimum diameter equal to pitch circle diameter ( $P$ ) – hole diameter ( $V$ ), as shown in [Figure 5.1](#); and
- (b) within a circular area, concentric with each bolthole, with a minimum diameter of outside diameter ( $D$ ) – pitch circle diameter ( $P$ ), as shown in [Figure 5.1](#).

NOTE Thickness dimensions in areas outside those defined in Items (a) and (b) are not specified in this Standard.

#### 5.2.3 Performance requirements

For flanges with alternative external shape or reduced thickness as given in [Clause 5.2.2](#), each flange size and material type shall be type tested to demonstrate the strength and leak tightness of the flanged joint.

When the flanged joint is tested in accordance with [Appendix E](#), there shall be no leakage or permanent distortion of the flanges.

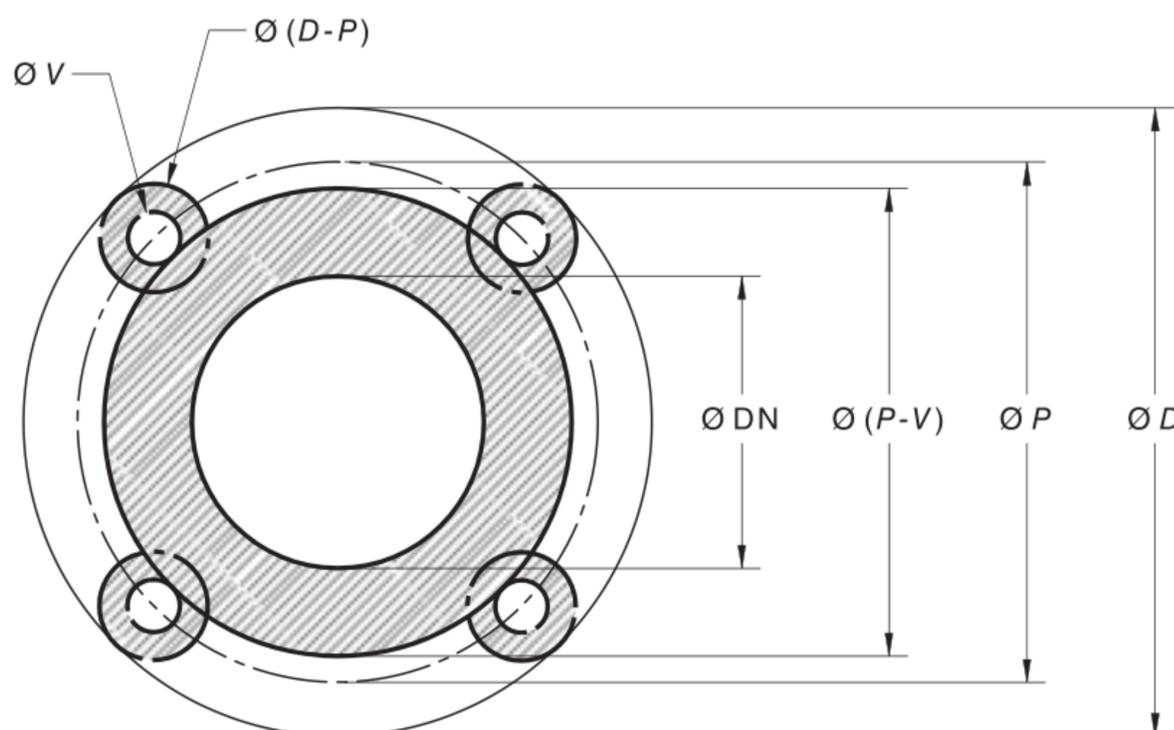


Figure 5.1 — Flange areas of defined thickness

## Appendix A (normative)

### Normative references

The following are the normative documents that are referenced in this Standard.

NOTE Documents referenced for information purposes are listed in the [Bibliography](#).

AS 1110.1, *ISO metric hexagon bolts and screws, Part 1: Product grades A and B—Bolts*

AS 1111.1, *ISO metric hexagon commercial bolts and screws, Part 1: Product grade C—Bolts*

AS 1112.1, *ISO metric hexagon nuts, Part 1: Style 1—Product grades A and B*

AS 1214, *Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)*

AS 1237.2, *Plain washers for metric bolts, screws and nuts for general purposes, Part 2: Tolerances*

AS 1565, *Copper and copper alloys—Ingots and castings*

AS 1646.1, *Elastomeric seals for waterworks purposes, Part 1: General requirements*

AS 1646.2, *Elastomeric seals for waterworks purposes, Part 2: Material requirements for pipe joint seals used in water and wastewater applications—Specifies by prescription formulation*

AS 1646.3, *Elastomeric seals for waterworks purposes, Part 3: Material requirements for pipe joints seals used in water and wastewater applications with the exception of natural rubber and polyisoprene compounds*

AS 1830, *Grey cast iron*

AS 1831, *Ductile cast iron*

AS 2074, *Cast steels*

AS 2382, *Surface roughness comparison specimens*

AS 2528, *Bolts, studbolts and nuts for flanges and other high and low temperature applications*

AS 3678, *Structural steel—Hot-rolled steel plates, floorplates and slabs*

AS 4291.1, *Mechanical properties of fasteners made of carbon steel and alloy steel, Part 1: Bolts, screws and studs*

AS/NZS 2280, *Ductile iron pressure pipes and fittings*

AS/NZS 4020, *Testing of products for use in contact with drinking water*

AS/NZS 4291.2, *Mechanical properties of fasteners, Part 2: Nuts with specified proof load values—Coarse thread*

ISO 185, *Grey cast irons—Classification*

ISO 887, *Plain washers for metric bolts, screws and nuts for general purposes—General plan*

ISO 1083, *Spheroidal graphite cast irons—Classification*

ISO 3506-1, *Mechanical properties of corrosion-resistant stainless-steel fasteners, Part 1: Bolts, screws and studs*

ISO 3506-2, *Mechanical properties of corrosion-resistant stainless-steel fasteners, Part 2: Nuts*

ISO 6507-1, *Metallic materials—Vickers hardness test, Part 1: Test method*

ASTM A240/A240M, *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications*

ASTM A276, *Standard Specification for Stainless Steel Bars and Shapes*

ASTM A564M, *Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes*

WSA 109, *Industry standard for flange gaskets and O-rings*

NOTE WSA 109 is available from the Water Services Association of Australia's website at <http://www.wsaa.asn.au>

## Appendix B (normative)

### Dimensions of flanges

#### B1 Scope

This Appendix specifies the dimensions of flanges for the following:

- (a) Flange types (see [Clause 1.5.2](#)).
- (b) Flange faces (see [Clause 1.5.3](#)).
- (c) Pressure classes (see [Clause 1.4.12](#)).
- (d) Materials (see [Section 3](#)).

#### B2 Dimensions

The dimensions of flanges are given in the following figures:

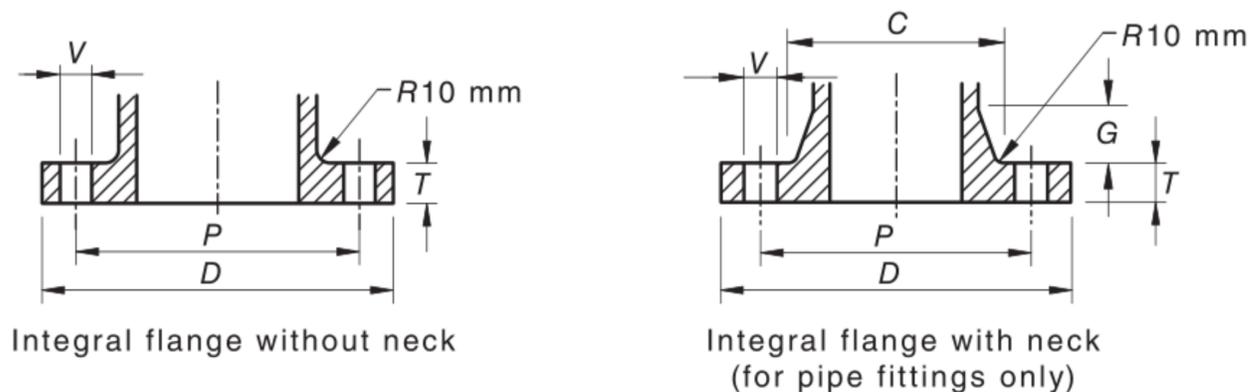
- (a) [Figure B1](#), copper alloy—PN 14.
- (b) [Figure B2](#), grey cast iron—PN 14.
- (c) [Figure B3](#), grey cast iron—PN 21.
- (d) [Figure B4](#), grey cast iron—PN 35.
- (e) [Figure B5](#), ductile cast iron—PN 16.
- (f) [Figure B6](#), ductile cast iron—PN 35.
- (g) [Figure B7](#) steel—PN 16.
- (h) [Figure B8](#), steel—PN 21.
- (i) [Figure B9](#), steel—PN 35.



DN	Outside diameter of flange (D) mm	Bolting details				Thickness of flange (T) mm
		Pitch circle diameter (P) mm	Number of holes (N)	Diameter of holes (V) mm	Fastener size and thread	
15	95	67	4	14	M12	6
20	100	73	4	14	M12	6
25	115	83	4	14	M12	8
32	120	87	4	14	M12	8
40	135	98	4	14	M12	10
50	150	114	4	18	M16	10
65	165	127	4	18	M16	11
80	185	146	4	18	M16	13
100	215	178	4	18	M16	22
150	280	235	8	18	M16	22

NOTE 1 For allowable flange face types, see Table 1.  
 NOTE 2 For guidelines on jointing, see [Appendix C](#).

**Figure B1 — Dimensions for copper alloy flanges—PN 14**



DN	Outside diameter of flange ( <i>D</i> ) mm	Bolting details				Thickness of flange ( <i>T</i> ) mm
		Pitch circle diameter ( <i>P</i> ) mm	Number of holes ( <i>N</i> )	Diameter of holes ( <i>V</i> ) mm	Fastener size and thread	
80	185	146	4	18	M16	19
100	215	178	4	18	M16	22
150	280	235	8	18	M16	22
200	335	292	8	18	M16	25
225	370	324	8	18	M16	25
250	405	356	8	22	M20	25
300	455	406	12	22	M20	29
350	525	470	12	26	M24	32
375	550	495	12	26	M24	32
400	580	521	12	26	N24	32
450	640	584	12	26	M24	35
500	705	641	16	26	M24	38
600	825	756	16	30	M27	41
700	910	845	20	30	M27	44
750	995	927	20	30	M30	48
800	1060	984	20	36	M33	48
900	1175	1092	24	36	M33	51
1000	1255	1175	24	36	M33	54
1200	1490	1410	32	36	M33	60

NOTE 1 For allowable flange face types, see Table 1.

NOTE 2 A flat-face flange greater than DN 500 should only be mated with—

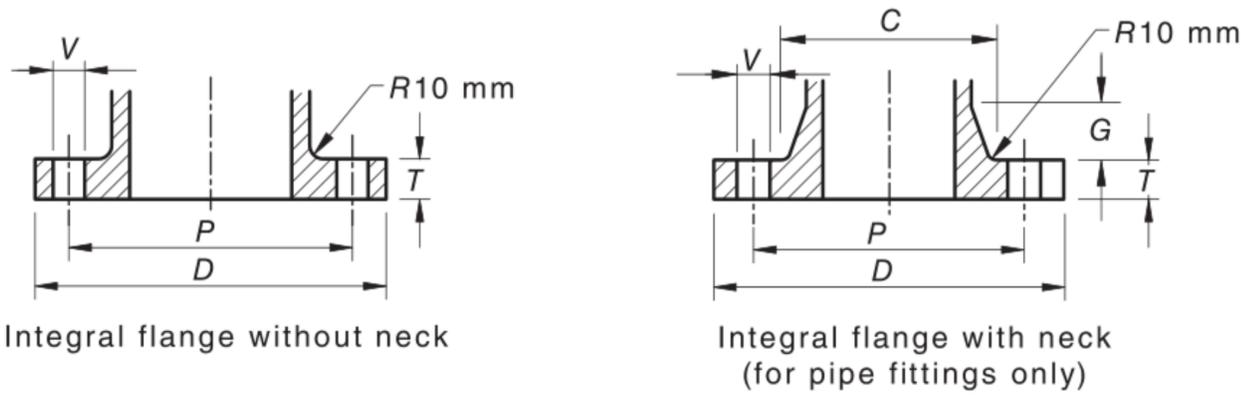
(a) flat-face flange with a narrow face gasket;

(b) a raised face flange; or

(c) a flat face O-ring groove steel flange.

NOTE 3 For guidelines on jointing, see [Appendix C](#).

**Figure B2 — Dimensions for grey cast iron flanges—PN 14**



DN	Outside diameter of flange (D) mm	Bolting details				Thickness of flange (T) mm
		Pitch circle diameter (P) mm	Number of holes (N)	Diameter of holes (V) mm	Fastener size and thread	
80	205	1665	8	18	M16	19
100	230	191	8	18	M16	22
150	305	260	12	22	M20	25
200	370	324	12	22	M20	29
225	405	356	12	26	M24	29
250	430	381	12	26	M24	32
300	490	438	16	26	M24	32
350	550	495	16	30	M27	35
375	580	521	16	30	M27	35
400	610	552	20	30	M27	35
450	675	610	20	33	M30	38
500	735	673	24	33	M30	41
600	850	781	24	36	M33	44
700	935	857	24	36	M33	48
750	1015	940	28	36	M33	51
800	1060	984	28	36	M33	52
900	1185	1105	32	39	M36	57
1000	1275	1194	36	39	M36	60
1200	1530	1441	40	42	M39	67

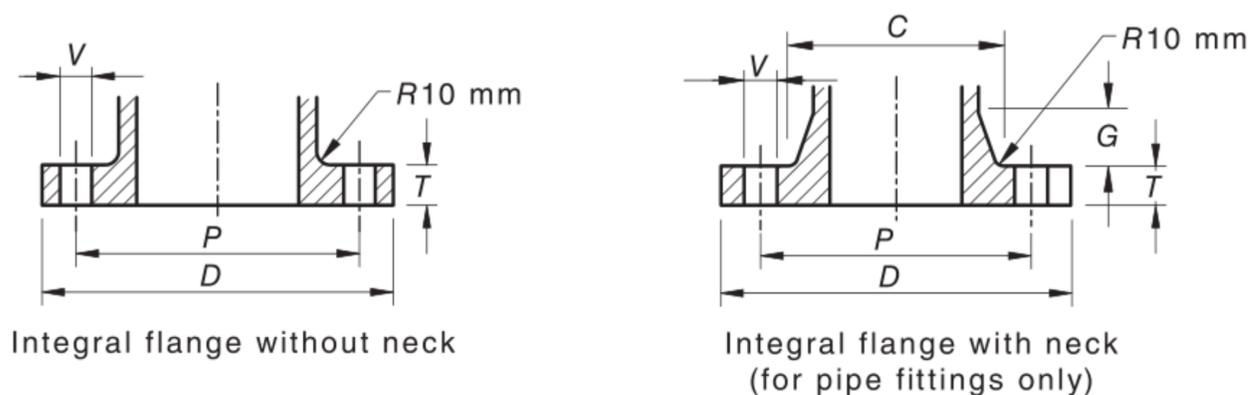
NOTE 1 For allowable flange face types, see Table 1.

NOTE 2 A flat-face flange should only be mated with—

- (a) flat-face flange with a narrow face gasket;
- (b) a raised-face flange; or
- (c) a flat-face O-ring groove steel flange.

NOTE 3 For guidelines on jointing, see [Appendix C](#).

**Figure B3 — Dimensions for grey cast iron flanges—PN 21**



DN	Outside diameter of flange ( <i>D</i> ) mm	Bolting details				Thickness of flange ( <i>T</i> ) mm
		Pitch circle diameter ( <i>P</i> ) mm	Number of holes ( <i>N</i> )	Diameter of holes ( <i>V</i> ) mm	Fastener size and thread	
80	205	165	8	18	M16	29
100	230	191	8	18	M16	32
150	305	260	12	22	M20	35
200	370	324	12	22	M20	41
225	405	356	12	26	M24	41
250	430	381	12	26	M24	41
300	490	438	16	26	M24	44
350	550	495	16	30	M27	48
375	580	521	16	30	M27	51
400	610	552	20	30	M27	51
450	675	610	20	33	M30	54
500	735	673	24	33	M30	57
600	850	781	24	36	M33	64

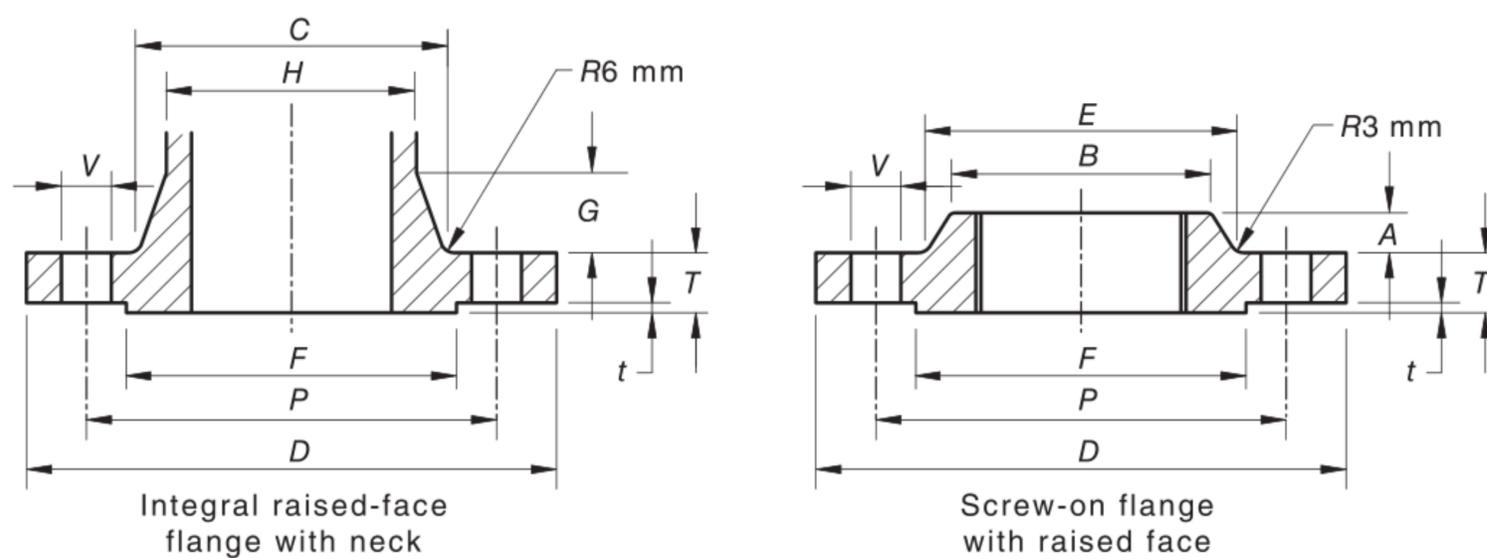
NOTE 1 For allowable flange face types, see Table 1.

NOTE 2 A flat-face flange should only be mated with—

- (a) flat-face flange with a narrow face gasket;
- (b) a raised-face flange; or
- (c) a flat-face O-ring groove steel flange.

NOTE 3 For guidelines on jointing, see [Appendix C](#).

**Figure B4 — Dimensions for grey cast iron flanges—PN 35**



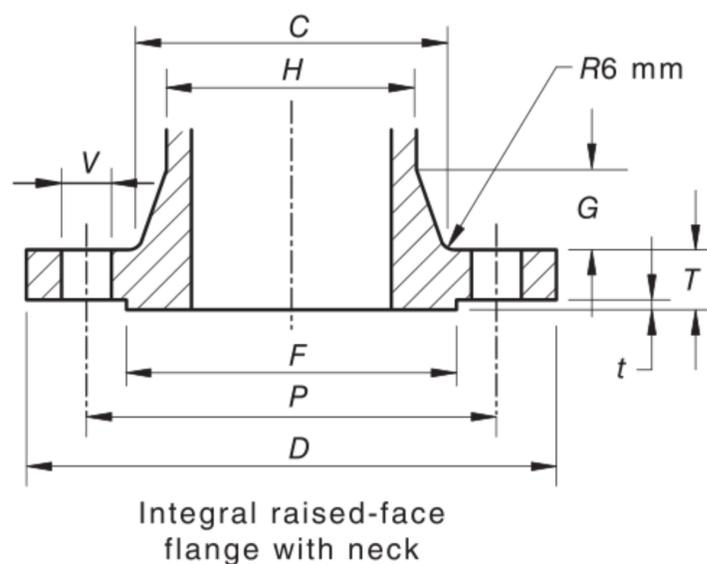
Height of raised face	
Nominal size DN	Dimension ( $t$ ) mm
$\leq 250$	3
$> 250 \leq 500$	4
$> 500$	5

**Figure B5 — Dimensions for ductile cast iron flanges—PN 16**

DN	Out-side-dia-meter-of-flange (D) mm	Dia-meter-of-raised-face (F) mm	Bolting details				Dimensions of neck for integral flange			Dimensions of boss for screw-on flange			Thickness of flange (T) mm
			Pitch circle diameter (P) mm	Number of holes (N)	Dia-meter-of-holes (V) mm	Fast-ener-size-and-thread	Diameter at large end (C) mm	Diameter at small end (H) mm	Minimum length (G) mm	Diameter at large end (E) mm	Diameter at small end (B) mm	Length (A) mm	
80	185	122	146	4	18	M16	106	100	8	110	108	18	18
100	215	154	178	4	18	M16	136	126	11	140	138	23	20
150	280	211	235	8	18	M16	188	181	11	194	192	24	23
200	335	268	292	8	18	M16	243	236	12	250	248	32	23
225	370	300	324	8	18	M16	275	263	19	279	277	33	24
250	405	328	356	8	22	M20	307	290	26	308	306	38	24
300	455	378	406	12	22	M20	354	349	28	360	358	32	30
350	525	438	470	12	26	M24	412	403	29	—	—	—	33
375	550	463	495	12	26	M24	439	430	30	446	444	42	33
400	580	489	521	12	26	M24	465	457	31	—	—	—	33
450	640	552	584	12	26	M24	528	511	33	530	528	45	33
500	705	609	641	16	26	M24	581	564	34	585	583	48	35
600	825	720	756	16	30	M27	689	671	38	693	691	48	42
700	910	809	845	20	30	M27	784	777	47	—	—	—	45
750	995	888	927	20	33	M30	855	830	53	858	856	50	47
800	1060	942	984	20	36	M33	912	885	55	—	—	—	48
900	1175	1050	1092	24	36	M33	1020	991	58	—	—	—	52
1000	1255	1133	1175	24	36	M33	1103	1098	63	—	—	—	56
1200	1490	1368	1410	32	36	M33	1338	1312	74	—	—	—	63

NOTE 1 For allowable flange face types, see Table 1.

NOTE 2 For guideline on jointing, see [Appendix C](#).



Height of raised face	
Nominal size DN	Dimension ( $t$ ) mm
$\leq 250$	3
$> 250 \leq 500$	4
$> 500$	5

**Figure B6 — Dimensions for ductile cast iron flanges—PN 35**

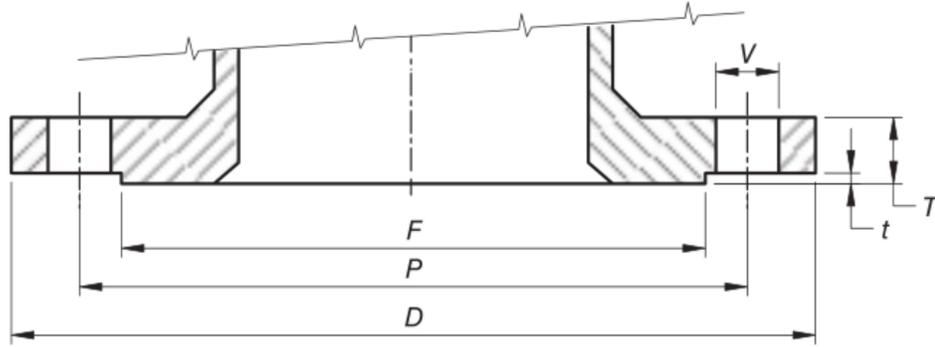
DN	Outside diameter of flange (D) mm	Diameter of raised face (F) mm	Bolting details				Dimensions of neck for integral flange			Dimensions of boss for screw-on flange			Thickness of flange (T) mm
			Pitch circle diameter (P) mm	Number of holes (N)	Diameter of holes (V) mm	Fastener size and thread	Diameter at large end (C) mm	Diameter at small end (H) mm	Minimum length (G) mm	Diameter at large end (E) mm	Diameter at small end (B) mm	Length (A) mm	
80	205	141	165	8	18	M16	110	100	11	110	108	18	22
100	230	167	191	8	18	M16	137	126	13	140	138	23	22
150	305	232	260	12	22	M20	198	181	20	194	192	24	27
200	370	296	324	12	22	M20	257	236	27	250	248	32	31
225	405	324	356	12	26	M24	290	263	33	279	277	33	34
250	430	349	381	12	26	M24	315	290	33	308	306	38	34
300	490	406	438	16	26	M24	376	349	38	360	358	32	38
350	550	459	495	16	30	M27	433	403	42	—	—	—	41
375	580	485	521	16	30	M27	459	430	42	446	444	42	42
400	610	516	552	20	30	M27	488	457	47	—	—	—	44
450	675	571	610	20	33	M30	542	511	48	530	528	45	46
500	735	634	673	24	33	M30	602	564	60	585	583	48	49
600	850	739	781	24	36	M33	710	671	66	693	691	48	54
700	935	815	857	24	36	M33	785	777	72	—	—	—	58
750	1015	898	940	28	36	M33	870	830	73	858	856	50	59
800	1060	942	984	28	36	M33	912	885	80	—	—	—	63
900	1185	1060	1105	32	39	M36	1028	991	88	—	—	—	68
1000	1275	1149	1194	36	39	M36	1117	1098	97	—	—	—	72
1200	1530	1385	1441	40	42	M39	1358	1312	114	—	—	—	82

NOTE 1 Only raised-face flanges shall be used.

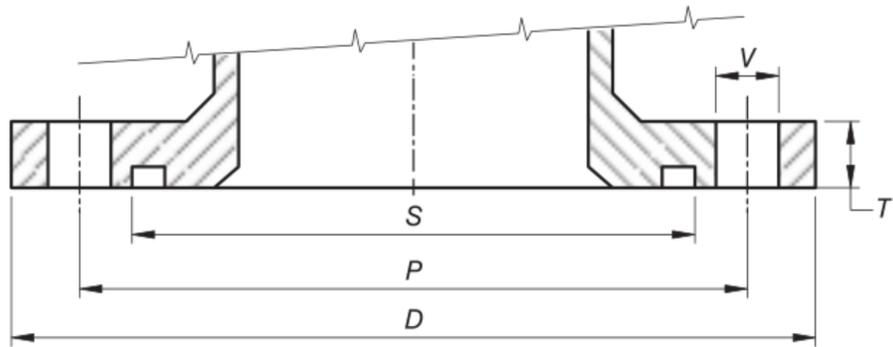
NOTE 2 For guideline on jointing, see [Appendix C](#).

A1

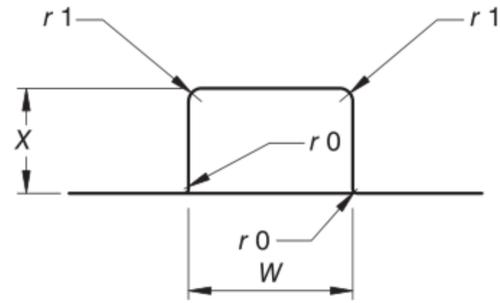
Dimensions in millimetres



(a) Raised-face flanges



(b) Flat-face and O-ring flanges



$X = 6.0 \pm 0.2$   
 $W = 15.0 \pm 0.5$   
 $r_0 = 0.5 \pm 0.1$   
 $r_1 = 1.00 \pm 0.2$

(c) O-ring groove detail

Height of raised face	
Nominal size DN	Dimension (t) mm
≤250	3
>250 ≤500	4
>500	5

DN	Outside diameter		Diameter of raised face (F) mm	Bolting details				Thickness of flange (T) mm
	Flange (D) mm	O-ring groove (S) mm		Pitch circle diameter (P) mm	Number of holes (N)	Diameter of holes (V) mm	Fastener size and thread	
50	150	—	90	114	4	18	M16	11
65	165	—	103	127	4	18	M16	11
80	185	—	122	146	4	18	M16	11
100	215	—	154	178	4	18	M16	13
150	280	—	211	235	8	18	M16	13
200	335	—	268	292	8	18	M16	19
225	370	—	300	324	8	18	M16	19
250	405	—	328	356	8	22	M20	19
300	455	370	378	406	12	22	M20	23
350	525	430	438	470	12	26	M24	30
375	550	455	463	495	12	26	M24	30
400	580	485	489	521	12	26	M24	30
450	640	545	552	584	12	26	M24	30

DN	Outside diameter		Diameter of raised face ( <i>F</i> ) mm	Bolting details				Thickness of flange ( <i>T</i> )  mm
	Flange	O-ring groove		Pitch circle diameter ( <i>P</i> ) mm	Number of holes ( <i>N</i> )	Diameter of holes ( <i>V</i> ) mm	Fastener size and thread	
	( <i>D</i> ) mm	( <i>S</i> ) mm						
500	705	605	609	641	16	26	M24	38
600	825	715	720	756	16	30	M27	48
700	910	800	809	845	20	30	M27	56
750	995	880	888	927	20	33	M30	56
800	1060	935	942	984	20	36	M33	56
900	1175	1045	1050	1092	24	36	M33	66
1000	1255	1125	1133	1175	24	36	M33	66
1200	1490	1360	1368	1410	32	36	M33	76

NOTE 1 A flat-face flange greater than DN 300 should only be mated with—

(a) a flat-face flange with a narrow face gasket;

(b) a raised-face flange; or

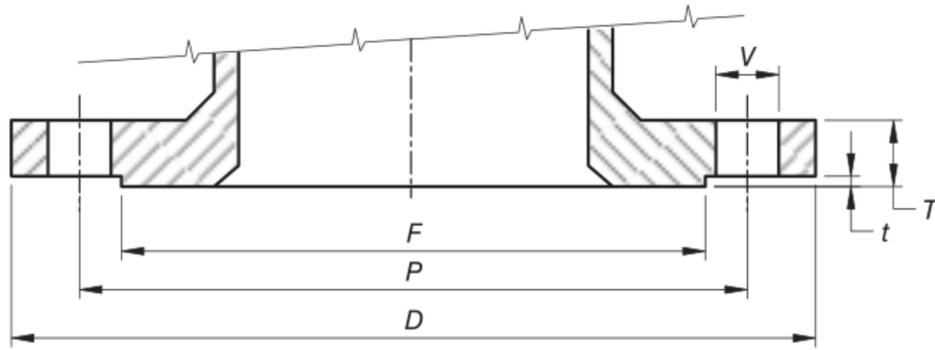
(c) a flat-face O-ring groove steel flange.

NOTE 2 For guidelines on jointing, see [Appendix C](#).

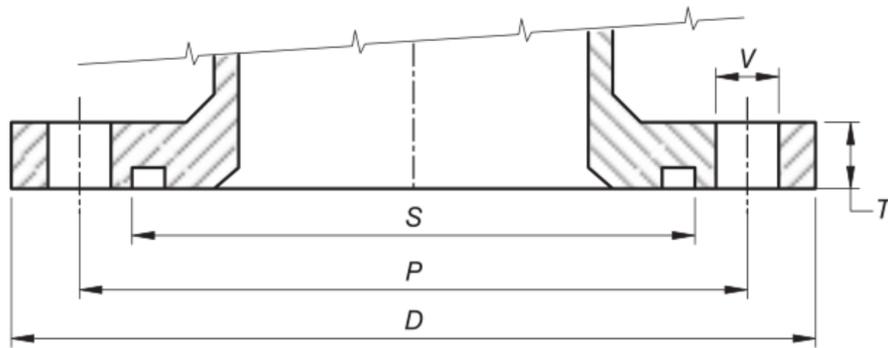
**Figure B7 — Dimensions for steel flanges—PN 16**



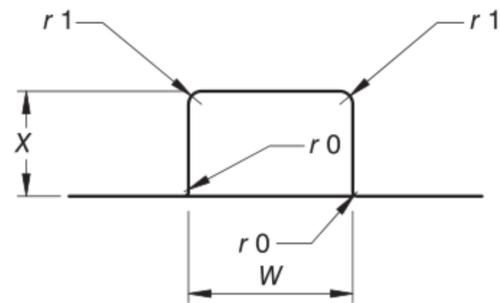
Dimensions in millimetres



(a) Raised-face flanges



(b) Flat-face and O-ring flanges



$X = 6.0 \pm 0.2$   
 $W = 15.0 \pm 0.5$   
 $r0 = 0.5 \pm 0.1$   
 $r1 = 1.00 \pm 0.2$

(c) O-ring groove detail

Height of raised face	
Nominal size DN	Dimension ( $t$ ) mm
$\leq 250$	3
$>250 \leq 500$	4
$>500$	5

DN	Outside diameter		Diameter of raised face	Bolting details				Thickness of flange
	Flange	O-ring groove		Pitch circle diameter	Number of holes	Diameter of holes	Fastener size and thread	
	( $D$ ) mm	( $S$ ) mm	( $F$ ) mm	( $P$ ) mm	( $N$ )	( $V$ ) mm		( $T$ ) mm
50	165	—	103	127	4	18	M16	15
65	185	—	122	146	8	18	M16	15
80	205	—	141	165	8	18	M16	15
100	230	—	167	191	8	18	M16	19
150	305	—	232	260	12	22	M20	24
200	370	—	296	324	12	22	M20	24
225	405	—	324	356	12	26	M24	30
250	430	—	349	381	12	26	M24	30
300	490	400	406	438	16	26	M24	30
350	550	455	459	495	16	30	M27	30
375	580	480	485	521	16	30	M27	38
400	610	510	516	552	20	30	M27	38
450	675	565	571	610	20	33	M30	38
500	735	630	634	673	24	33	M30	48
600	850	735	739	781	24	36	M33	58

DN	Outside diameter		Diameter of raised face ( <i>F</i> ) mm	Bolting details				Thickness of flange ( <i>T</i> ) mm
	Flange ( <i>D</i> ) mm	O-ring groove ( <i>S</i> ) mm		Pitch circle diameter ( <i>P</i> ) mm	Number of holes ( <i>N</i> )	Diameter of holes ( <i>V</i> ) mm	Fastener size and thread	
700	935	810	815	857	24	36	M33	58
750	1015	890	898	940	28	36	M33	58
800	1060	935	942	984	28	36	M33	68
900	1185	1055	1060	1105	32	39	M36	68
1000	1275	1145	1149	1194	36	39	M36	78
1200	1530	1385	1385	1441	40	42	M39	88

NOTE 1 A flat-face flange should only be mated with—

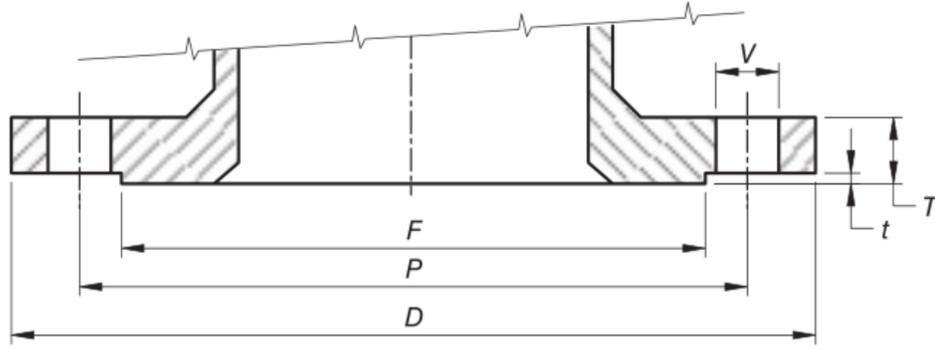
- (a) a flat-face flange with a narrow face gasket;
- (b) a raised-face flange; or
- (c) a flat-face O-ring groove steel flange.

NOTE 2 For guidelines on jointing, see [Appendix C](#).

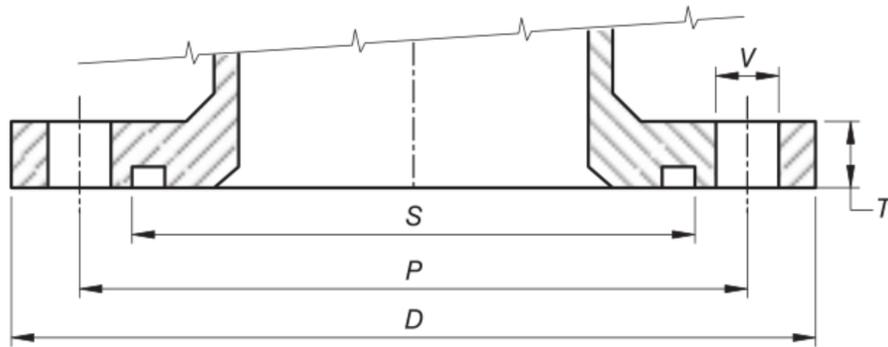
**Figure B8 — Dimensions for steel flanges—PN 21**



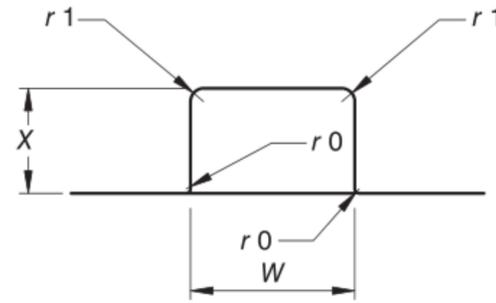
Dimensions in millimetres



(a) Raised-face flanges



(b) Flat-face and O-ring flanges



- $X = 6.0 \pm 0.2$
- $W = 15.0 \pm 0.5$
- $r0 = 0.5 \pm 0.1$
- $r1 = 1.00 \pm 0.2$

(c) O-ring groove detail

Height of raised face	
Nominal size DN	Dimension (t) mm
≤ 250	3
> 250 ≤ 500	4
> 500	5

DN	Outside diameter		Diameter of raised face	Bolting details				Thickness of flange
	Flange (D) mm	O-ring groove (S) mm		Pitch circle diameter (P) mm	Number of holes (N)	Diameter of holes (V) mm	Fastener size and thread	
50	165	—	103	127	4	18	M16	19
65	185	—	122	146	8	18	M16	19
80	205	—	141	165	8	18	M16	24
100	230	—	167	191	8	18	M16	24
150	305	—	232	260	12	22	M20	31
200	370	—	296	324	12	22	M20	31
225	405	—	324	356	12	26	M24	38
250	430	—	349	381	12	26	M24	38
300	490	400	406	438	16	26	M24	38
350	550	455	459	495	16	30	M27	48
375	580	480	485	521	16	30	M27	48
400	610	510	516	552	20	30	M27	48
450	675	565	571	610	20	33	M30	58

500	735	630	634	673	24	33	M30	58
600	850	735	739	781	24	36	M33	68
700	935	810	815	857	24	36	M33	78
750	1015	890	898	940	28	36	M33	78
800	1060	935	942	984	28	36	M33	84
900	1185	1055	1060	1105	32	39	M36	94
1000	1275	1145	1149	1194	36	39	M36	98
1200	1530	1385	1385	1441	40	42	M39	108

NOTE 1 A flat-face flange should only be mated with—

- (a) a flat-face flange with a narrow face gasket;
- (b) a raised-face flange; or
- (c) a flat-face O-ring groove steel flange.

NOTE 2 For guidelines on jointing, see Appendix C.

**Figure B9 — Dimensions for steel flanges—PN 35**

A2

## Appendix C (informative)

### Flange jointing guidelines

#### C1 Scope

This Appendix gives guidance for the selection of correct jointing requirements for flanges, including flange face type, gasket type and thickness, and minimum property class of bolts and stud bolts. Guidelines for assembly are given in WSA 109.

#### C2 Jointing guidelines

Jointing guidelines for flange assembly are given in [Table C1](#). The ability of a flanged joint to provide a watertight seal under allowable operating pressures and temperatures is dependent inter alia on the correct selection of jointing gaskets and fasteners and proper assembly of the flanged joint.

**Table C1 — Jointing guidelines for flange assembly**

Pressure class PN	Flange material	Flange face	Nominal size DN	Gasket type	Thickness mm	Minimum property class of bolts and stud bolts	
						Carbon steel	Grade 316 stainless steel
14	Copper alloy	Flat	Up to DN 150	Elastomeric	3	4.6	50
	Grey cast iron	Flat	Up to DN 500	Elastomeric	3	4.6	50
			>DN 500 to DN 1200	Compressed fibre (narrow face)	3	8.8	70
16	Ductile cast iron	Raised	Up to DN 750	Elastomeric	3	4.6	50
			>DN 750 to DN 1200	Compressed fibre	1.5	8.8	70
	Steel	Raised	Up to DN 600	Elastomeric	3	4.6	50
			>DN 600 to DN 1200	Compressed fibre	1.5	8.8	70
		Flat	Up to DN 300	Elastomeric	3	4.6	50
			>DN 300 to DN 600	Elastomeric (narrow face)	3	4.6	50
			>DN 600 to DN 1200	Compressed fibre (narrow face)	3	8.8	70
				O-ring	10 dia	4.6	50

**Table C1 (continued)**

Pressure class PN	Flange material	Flange face	Nominal size DN	Gasket type	Thickness mm	Minimum property class of bolts and stud bolts	
						Carbon steel	Grade 316 stainless steel
21	Grey cast iron	Flat	Up to DN 1200	Compressed fibre (narrow face)	3	8.8	70
	Steel	Raised	Up to DN 1200	Compressed fibre	1.5	8.8	70
		Flat		Compressed fibre (narrow face)	3	8.8	70
				O-rings	10 dia	8.8	70
35	Grey cast iron	Flat	Up to DN 600	Compressed fibre (narrow face)	3	8.8	70
	Ductile cast iron	Raised	Up to DN 1200	Compressed fibre	1.5	8.8	70
	Steel	Raised	Up to DN 1200	Compressed Fibre	1.5	8.8	70
		Flat		Compressed fibre (narrow face)	3	8.8	70
				O-ring	10 dia	8.8	70

NOTE The nominated property class for bolts and stud bolts has been selected to provide adequate tension to counteract the internal forces generated by the ASTP and to provide a minimum sealing stress of 4 MPa for elastomeric flange gaskets and 20 MPa for compressed fibre gaskets. Accepted practice is for bolts to operate at 60–65% of proof stress, but no lower than 30% and no higher than 80%. Where flange gaskets are used with smaller inside diameters or alternative material properties to those specified in WSA109, fasteners with higher property class values may be necessary.

## Appendix D (informative)

### Purchasing guidelines

#### D1 General

Australian and New Zealand Standards are intended to include the technical provisions necessary for the supply of products referred to in a particular Standard, but do not purport to comprise all the necessary provisions of a contract. In a number of cases, a purchaser is either asked to state the requirements or give a range of options, which are contractual matters to be agreed upon between the purchaser and manufacturer.

This Appendix contains advice and recommendations on the information to be supplied by the purchaser at the time of an enquiry or order and by a manufacturer after an order has been placed. Its aim is to avoid misunderstanding and to result in the purchaser receiving satisfactory products and services.

#### D2 Information to be supplied by the purchaser

The purchaser should provide the following information at the time of enquiry or order:

- (a) Material of manufacture (see [Section 3](#)).
- (b) Configuration (see [Clause 1.5](#)).
- (c) DN (see [Clause 1.4.4](#)) and—
  - (i) fitting that is to be joined to the flange; or
  - (ii) for integral flanges, where appropriate, the Australian Standard for the pipe, pipe fitting, valve or other equipment of which it will form part.
- (d) Pressure class (see [Clause 1.4.12](#)) or AOP (see [Table 2.1](#)).

#### D3 Information to be supplied by the manufacturer

Where requested, the manufacturer should supply the following information for screw-on flanges (see [Clause 4.4.1](#)):

- (a) Details of thread sealing compound.
- (b) Thread form and type.

## Appendix E (normative)

### Type test for flanges with alternative external shapes

#### E1 Scope

This Appendix specifies the methods for carrying out type tests on flanged joints where the flanges have an external shape other than circular and/or a reduced thickness (see [Clause 5.2](#)).

#### E2 Test assembly

The test assembly shall comprise pipes, valves or fittings with identical flanges, assembled so as to be leak-tight. Both ends of the test assembly shall be suitably blanked off.

The test assembly shall be placed on two supports such that the assembled flanged joint is positioned at midspan. The assembly may consist of a combination of pipes, valves or fittings, but only the tested joint at midspan shall be considered.

NOTE 1 Flange jointing should be in accordance with the manufacturer's guidelines or as given in [Appendix C](#).

NOTE 2 For a typical test assembly, see [Figure E1](#).

#### E3 Hydrostatic test

The test assembly shall be supported so that no bending moment is induced in the flange joint under test.

A pressure equal to MATTP (see [Table 2.1](#)) shall be applied for a minimum period of 10 min.

#### E4 Hydrostatic test with moment applied

A pressure of  $1.5 \times PN$  shall be applied. An external load ( $F$ ) shall be applied to the assembled flanged joint by means of a flat plate, in a direction perpendicular to the axis of the test assembly, so as to cause the bending moment given in [Table E1](#). The load  $F$  to be applied shall be determined from the following equation:

$$F = 4M_c / L - w / L \left( L^2 / 2 - 2a^2 \right) \quad \text{E4}$$

where

$F$  = external load to be applied, in kilonewtons

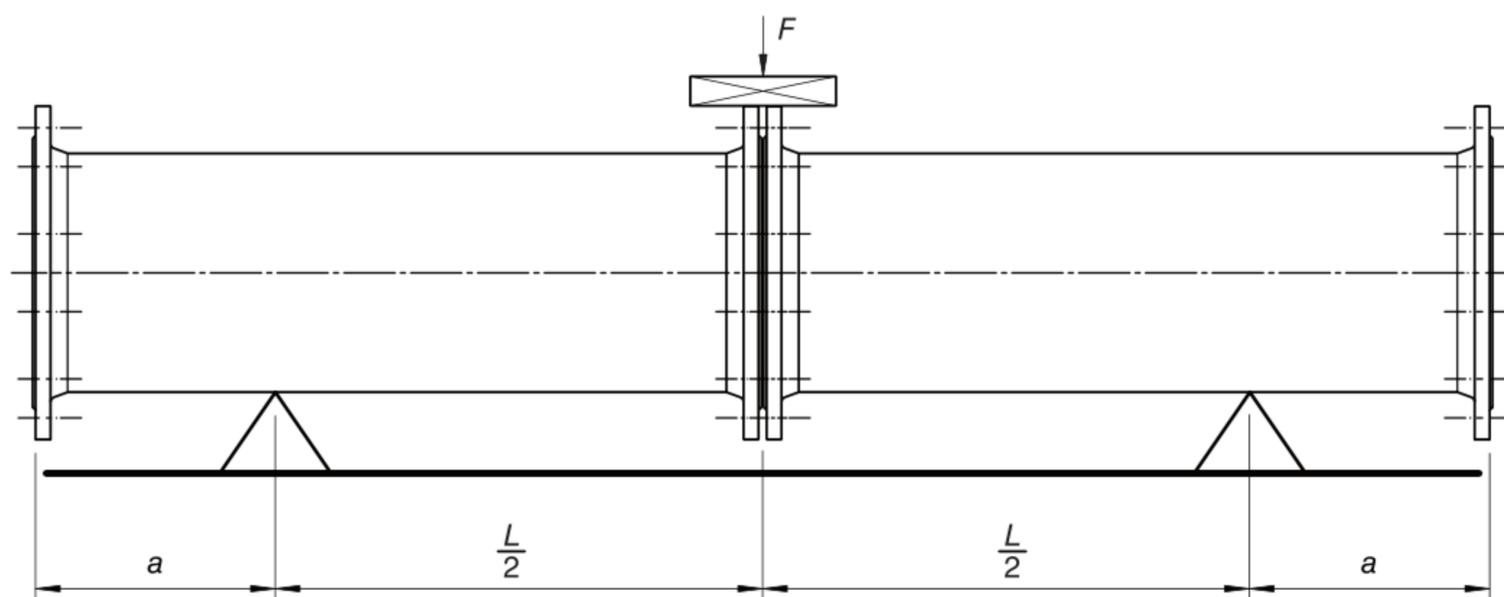
$M_c$  = midspan bending moment, given in [Table E1](#), in kilonewton metres

$L$  = distance between supports, in metres

$w$  = weight per metre of assembly filled with water, in kilonewtons per metre

$a$  = cantilever overhang, in metres

The pressure and applied force shall be maintained for a minimum period of 2 h.



**Figure E1 — Typical test assembly arrangement**

**Table E1 — Midspan bending moments for flange joint type test**

DN	Midspan bending moment ( $M_C$ ) kNm
50	0.6
65	0.8
80	1.0
100	1.7
150	3.1
200	4.7
225	5.8
250	6.8
300	9.4
350	12.6
375	13.3
450	18.2
500	22.0
600	30.1
700	46.3
750	46.3
900	139.2
1000	158.6
1200	213.7

## **Bibliography**

*AS/NZS 4331.1, Metallic flanges, Part 1: Steel flanges*

*AS/NZS 4331.2, Metallic flanges, Part 2: Cast iron flanges*

*AS/NZS 4331.3, Metallic flanges, Part 3: Copper alloy and composite flanges*

## Amendment control sheet

### AS 4087:2011

#### Amendment No. 1 (2012)

##### Revised text amendment

Summary: This amendment applies to [Figure B7](#).

Published on 10 September 2012.

#### Amendment No. 2 (2023)

##### Revised text amendment

Summary: This amendment applies to a Global change, the [Preface](#), [Clause 1.5.3](#) and [Figure B9](#).

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