

BS EN ISO 27509:2012

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Petroleum and natural gas industries — Compact flanged connections with IX seal ring

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The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by ISO corrigendum August 2013 is indicated in the text by AC1 AC1.

The UK participation in its preparation was entrusted to Technical Committee EPL/501, Electronic assembly technology & Printed Electronics.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2013

ISBN 978 0 580 84112 5

ICS 23.040.60

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2013.

Amendments/corrigenda issued since publication

Date	Text affected
31 August 2013	Implementation of ISO corrigendum August 2013

English Version

Petroleum and natural gas industries - Compact flanged
connections with IX seal ring (ISO 27509:2012)

Industries du pétrole et du gaz naturel - Raccordements à
brides compactes avec bague d'étanchéité IX (ISO
27509:2012)

Erdöl- und Erdgasindustrie - Kompakte
Flanschverbindungen mit IX Dichtungsring (ISO
27509:2012)

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Foreword

This document (EN ISO 27509:2012) has been prepared by Technical Committee ISO/TC 67 “Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries” in collaboration with Technical Committee CEN/TC 12 “Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries” the secretariat of which is held by AFNOR.

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Introduction

This International Standard, which is based on NORSOK L-005^[36], has been developed to provide a standard for compact flanged connections (CFCs) that constitutes an alternative to conventional flanges as specified in ASME standards, European Standards and other International Standards, with reduced mass and smaller overall dimensions, as well as increased reliability in leak tightness by means of its inherent design features and make up procedures. CFCs can also provide an alternative to other types of clamp and hub type mechanical connectors.

The use of load carrying sealing elements, traditionally referred to as "gaskets", does not comply with the fundamental requirements of this International Standard.

This International Standard has been developed for use in process piping systems, which are designed according to codes for pressure piping, e.g. ASME B31.3. See 4.7 for more details.

The flange designs have been selected to achieve a minimum safety factor of 2,0 when subjected to a design pressure equal to ASME B16.5 pressure temperature ratings within the temperature limits of this International Standard.

The main body of this International Standard contains all necessary information on how to manufacture and supply flange and seal ring materials, such as

- flange dimensions and material requirements;
- seal ring dimensions and material requirements;
- bolting dimensions and material requirements;
- requirements to tolerances and surface finish;
- requirements to designation and marking of finished products.

Normative annexes A and D cover the following topics:

- structural capacity equations for flange assemblies;
- bolt dimensions and masses.

Informative annexes B, C, E, F and G cover the following topics:

- how to apply the flanges to special geometries of valves and equipment nozzles;
- quality management;
- installation and assembly instructions, and guidelines on how to repair damage and irregularities on sealing surfaces;
- masses of all standard components;
- suitable dimensions of alternative metric bolting.

For the purposes of this International Standard, the following verbal forms apply:

- "shall" indicates a requirement strictly to be followed in order to conform to this International Standard and from which no deviation is permitted, unless accepted by all involved parties;
- "should" indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required;
- "may" indicates a course of action permissible within the limits of this International Standard;
- "can" is used for statements of possibility and capability, whether material, physical or casual.

Petroleum and natural gas industries — Compact flanged connections with IX seal ring

1 Scope

This International Standard specifies detailed manufacturing requirements for circular steel and nickel alloy compact flanged connections and associated seal rings, for designated pressures and temperatures in class designations CL 150 (PN 20) to CL 1500 (PN 260) for nominal sizes from DN 15 (NPS ½) to DN 1200 (NPS 48), and for CL 2500 (PN 420) for nominal sizes from DN 15 (NPS ½) to DN 600 (NPS 24).

NOTE NPS is in accordance with ASME B36.10M and ASME B36.19M.

This International Standard is applicable to welding neck flanges, blind flanges, paddle spacers and spacer blinds (paddle blanks), valve/equipment integral flanges, orifice spacers, reducing threaded flanges and rigid interfaces for use in process piping for the petroleum, petrochemical and natural gas industries.

This International Standard is applicable within a temperature range from –196 °C to +250 °C.

This International standard is not applicable for external pressure.

2 Normative references

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

ISO 2768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 4288, *Geometric Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 1: General principles and requirements*

ISO 5167-2:2003, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 2: Orifice plates*

ISO 14313, *Petroleum and natural gas industries — Pipeline transportation systems — Pipeline valves*

ISO 80000-1:2009, *Quantities and units — Part 1: General*

ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard*

ASME B16.34, *Valves — Flanged, Threaded and Welding End*

ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*

ASME B31.3, *Process Piping*

EN 1092-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1779, *Non-destructive testing — Leak testing — Criteria for method and technique selection*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

3.1.1

class

CL

ASME pressure class in accordance with ASME B16.5 and ASME B16.34

3.1.2

compact flanged connection

CFC

non-gasketed bolted static pipe connection including two flanges and where the bolt loads are transferred through metal to metal contact between the flange faces

3.1.3

gasket

barrier to prevent the passage of fluids, but which does transmit all loads between flanges

EXAMPLE As shown in EN 1591-1:2001, Figure 3.

3.1.4

purchaser

individual or organization that buys the pipe connection on behalf of the user and/or operator or for its own use

3.1.5

seal

component providing a barrier to prevent the passage of fluids, transmitting no significant loads between the flanges

3.1.6

supplier

individual or organization that takes the responsibility for the supply of the pipe connection and its conformance with this International Standard

3.2 Symbols

A outside diameter of neck

$A_{\max}$ maximum outer diameter to accommodate standard tools

$A_{\min}$ minimum neck outer diameter listed in Table 7 to Table 12

$Area_{015}$ cross-sectional area of the neck/pipe calculated from t_{015}

$Area_{\text{eqv}}$ cross-sectional area of a special flange neck geometry calculated from t_{eqv}

B bore diameter, where the bore should not exceed the maximum listed bore in this International Standard

$B_{\max}$ maximum listed bore diameter

$B_{\min}$	minimum bore diameter for which the face angles are valid
B1	minimum bore diameter for flange to be blinded
NOTE	B1 is also the start diameter for blind and reducing threaded flange face angles.
BCD	bolt circle diameter
d_B	bolt size
d_p	average diameter of neck end = $(A+B)/2$
DA1	internal diameter of groove
DA3	outer diameter of groove
DG4	seal ring seal diameter
DW1	inner recess diameter
DW2	outer recess diameter
DW3	outside diameter of flange
DW4	flange to neck fillet outer diameter
e	radial distance between BCD and d_p
e_B	$(DW3 + DW2)/4 - BCD/2$
e_p	$(DW3 + DW2)/4 - (A+B)/4$
E1	depth of groove
E2	depth of recess
E3	depth of recess for gasket
F_A	applied axial force
F_{cB}	bolt total plastic capacity (root area $\times$ number of bolts $\times$ yield strength)
F_f	flange axial load capacity without effect of bolt prying
F_{fp}	flange axial load capacity including the effect of bolt prying
F_{end}	end cap force calculated to seal ring seal diameter
F_R	resulting force from external tension force F_A and external bending moment M_A
f_y	flange material yield strength at temperature
HP1	thickness of PB, PS and OS
HW3	flange thickness
HW5, HT5	overall length
L	bolt hole diameter
L1,L2,L3	bolt hole depths
M_A	applied bending moment
n	number of bolts
p	internal pressure in N/mm^2

RA	radius
RB	radius
RC	radius (maximum value tabulated)
RV1	neck to flange ring radius on integral flanges
t	pipe wall thickness
$t_{\min}$	minimum neck thickness that can be used which is defined by the standard pipe outer diameter, A, and maximum listed bore diameter, $B_{\max}$.
$t_{\max}$	the maximum neck thickness that can be used which is defined by $A_{\max}$ and the minimum listed bore diameter
$t_{0.15}$	the wall thickness giving the smallest possible face angle (0,15°)
t_{eqv}	the wall thickness calculated from a special flange neck geometry
X	half major ellipse axis
Y	half minor ellipse axis
$\alpha A2$	groove angle
$\alpha B1$	flange face bevel angle
$\alpha B2$	effective face angle/rear face bevel angle
ψ	flange utilization ratio

3.3 Abbreviated terms

BL	blind flange
CFC	compact flanged connection
CL	class
DN	nominal pipe diameter (expressed in millimetres)
ID	internal diameter
IF	integral flange (as part of some other equipment or component)
IX	special metallic seal ring applied in Clause 4
LB	line blinds (including PS and PB)
NPS	nominal pipe size (expressed in inches)
OD	outer diameter
OS	orifice spacer
PB	paddle blank
PN	nominal pressure (bar)
PS	paddle spacer
PTFE	polytetrafluoroethylene
RI	rigid interface

RT	reducing threaded flange
WN	weld neck

4 Design

4.1 General

In order to be compliant with this International Standard, CFCs fulfil the minimum design requirements outlined below.

- They have been designed for face-to-face make-up for transfer of the bolt loading through the flange faces.
- They have been designed so that a static mode is maintained in the bolted joint up to 1,5 times the specified pressure/temperature rating, see 7.2. Static mode is maintained as long as the difference between maximum and minimum nominal stress sustained by the bolts in the joint does not exceed 5 % of the minimum values specified in Table 3.
- They have been standardized to cover as a minimum the same pressure temperature class designations and sizes as can be found in ASME B16.5 with equal or better performance.
- They have been standardized to fit with commonly used standards by the valve industry (e.g. ASME B16.34, ISO 14313 and the EN 12516 series of parts), and other valve standards which make reference to these standards for pressure design.
- The weakest part of flanged connections according to this International Standard regarding fatigue failure is always located somewhere in the transition from flange to pipe or flange to nozzle neck of an equipment or valve. The bolted joint itself is never subjected to fatigue load if considerations to cycling temperatures are taken when selecting bolt material, see 6.3.

4.2 Design principles

Figure 1 shows the design principles of compact flanges and its seal system according to this International Standard.

The flange face includes a slightly convex bevel with the highest point, called the heel, adjacent to the bore and a small outer wedge around the outer diameter of the flange. The assembly is made up by tightening/tensioning the flange bolting which pulls the two connector halves together. The bevel angles have been standardized for different and relevant adjoining pipe wall thicknesses for each welding neck flange of a given size and pressure class.

For the IX seal ring, axial forces are exerted on the taper of the metal seal ring and translated into a radial sealing force. Furthermore with increased pre-load, the bevel is closed and face to face contact is achieved at the outer wedge while most of the bolt pre-load is transferred as compressive forces between the flange faces at the heel, as illustrated in Figure 1. The arrows in the figure indicate the applied forces/pressure and the contact forces after make-up and during normal operation.

The principle design of the flange face includes two independent seals. The first seal is created by application of seal seating stress at the flange heel. However, an undamaged flange heel may not seal at any extreme load condition, but the heel contact will be maintained for pressure values up to 1,5 times the flange pressure rating at room temperature for any combination of WN flange and a corresponding pipe within given limits of pipe wall thicknesses in tables of dimensions. This requirement is only applicable when the WN thickness fulfils the code requirement for minimum pipe wall thickness for the actual material. The main seal is the IX seal ring. The seal ring force is provided by the elastic stored energy in the stressed seal ring. Any heel leakage will give internal pressure acting on the seal ring inside intensifying the sealing action.

The design aims at preventing exposure to oxygen and other corrosive agents in the way that adjoining flanges remain in contact along their outer circumference for all allowable load levels. Thus, this prevents corrosion of the flange faces, the stressed length of the bolts and the seal ring.

The back face of the flange in the made-up position is parallel to the flange face in order to prevent bending of the bolts in the assembled condition.

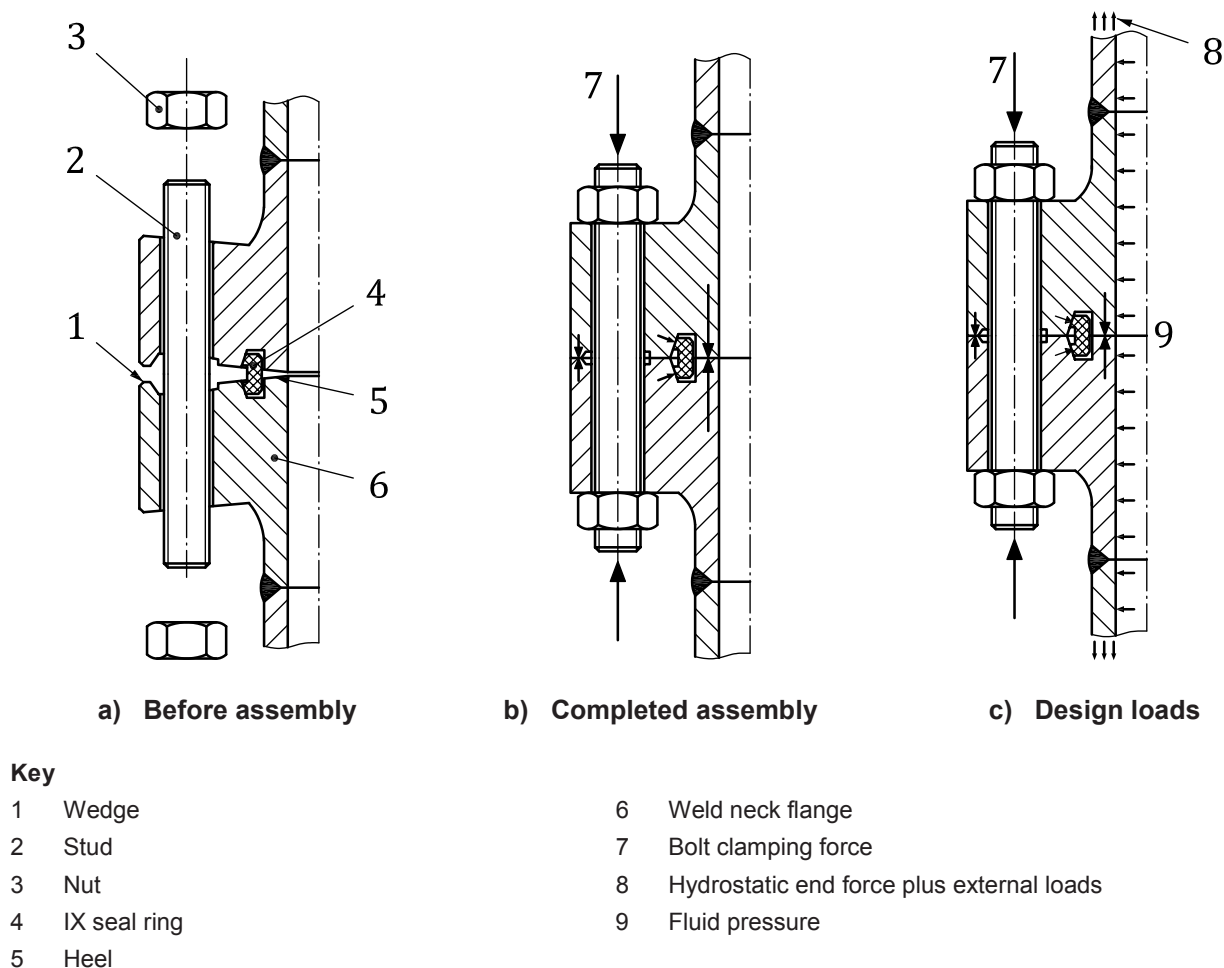


Figure 1 — Design principles of standard compact flange assemblies

4.3 Assembly requirements

In order to comply with the design principles as described in 4.2 it is mandatory to assemble the flanged connections to target bolt loads according to Table 1 below. For detailed advice on how to assemble compact flanges, see Annex E.

NOTE Compact flange IX seal rings require sufficient flexibility to enable seal ring size entrance and removal. The required spacing needs to be considered during piping design and layout to ensure necessary flexibility in the piping systems.

Table 1 — Target residual preload for bolt materials used to assemble compact flanges to this International Standard

Stud bolt size in	Target residual preload kN
½-UNC	44
⅝-UNC	71
¾-UNC	106
⅞-UNC	147
1-UNC	193
1 ⅛-8UN	255
1 ¼-8UN	325
1 ⅜-8UN	405
1 ½-8UN	492
1 ⅝-8UN	589
1 ¾-8UN	693
1 ⅞-8UN	807
2-8UN	929
2 ¼-8UN	1199
2 ½-8UN	1503
2 ¾-8UN	1667
3-8UN	2004
3 ¼-8UN	2373
3 ½-8UN	2773
3 ¾-8UN	3204
4-8UN	3666

4.4 Standard components

The types of flanges covered by this International Standard are given in Table 2.

Table 2 — Types of flanges and accepted raw material forms for manufacture

Type	Description	Raw material product forms
WN	Weld neck flange	Forged to shape
BL	Blind flange	Plate or forged to shape
IF	Integral flange as part of some other equipment or component	Forging, forged bar (maximum DN 50) or casting
RI	Rigid interface as part of some other equipment or component	Plate, forging or casting
PB	Paddle blank	Plate or forged to shape
PS	Paddle spacer	Plate or forged to shape
OS	Orifice spacer	Plate or forged to shape
RT	Reducing threaded flange	Plate or forged to shape

4.5 Units of measurements

In this International Standard, data are expressed in both SI units and USC units. For a specific order item, unless otherwise stated, only one system of units shall be used, without combining data expressed in the other system.

For data expressed in SI units, a comma is used as the decimal separator and a space is used as the thousands separator. For data expressed in USC units, a dot (on the line) is used as the decimal separator and a comma is used as the thousands separator.

4.6 Rounding

Except as otherwise required by this International Standard, to determine conformance with the specified requirements, observed or calculated values shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding method of ISO 80000-1:2009, Annex B, Rule A.

4.7 Compliance with piping design codes

Although not listed as a component standard in ASME B31.3, all components contained in this International Standard fulfil the requirements for unlisted piping components in paragraph 302.2.3 in ASME B31.3. This is based on full compliance with paragraph 304.7.2 (a), (b), (c) and (d):

- a) The service experience requirement is fulfilled because this type of CFC has been widely used in the North Sea since 1990. The service experience covers the complete size range covered by this International Standard.
- b) The experimental stress analysis requirements is fulfilled since a number of tests on strain gauged test specimens have been run over the years. Reference is made to References [40] to [43], [50], [51] and [52].
- c) The proof test requirements are fulfilled since a number of pressure tests have been performed over the years. In addition to tests referenced under (b), reference is made to References [38], [44] and [45].
- d) Compact flanged connections to this International Standard were originally developed and designed using the design by analysis method to pre 2007 issue of ASME VIII div.2, appendix 4 and appendix 6. Specific requirements may apply to components designed by analysis, depending on the applied piping design code. Such requirements normally include impact testing at a defined temperature relative to the minimum design temperature and a specified extent of non-destructive testing.

4.8 Compliance to this International Standard

The manufacturer shall be responsible for complying with all of the applicable requirements of this International Standard. It shall be permissible for the purchaser to make any investigation necessary in order to be assured of compliance by the manufacturer and to reject any material that does not comply.

5 Designation

5.1 Designation of flanges

The following shall designate the flanges in accordance with EN 1092-1:

- flange type abbreviation according to Table 2;
- number of this International Standard;
- nominal flange size (DN);

- pressure class designation;
- pipe dimensions:
 - for standard pipes, the wall thickness in mm to one decimal accuracy;
 - for non-standard pipes, the pipe bore and wall thickness.
- material designation.

The designation elements shall be separated by a slash. The number of characters is not fixed.

Examples of designation are given below:

EXAMPLE 1 Designation of WN flange in CL 600, nominal size DN 250 with pipe schedule 40S, i.e. 9,3 mm wall thickness and material ASTM A182F51 (duplex):

WN/ISO 27509/DN250/CL600/9.3/A182F51

EXAMPLE 2 For designation of a BL flange in CL 2500, nominal size DN 200 and with material ASTM A516 Grade 70 (low temperature carbon steel):

BL/ISO 27509/DN200/CL2500/A516Grade70

EXAMPLE 3 Designation of an RT flange in CL900, nominal size DN 25, threaded outlet specified (0,5 inch NPT is default, see 8.9), and with material ASTM A182F316 (stainless steel):

RT/ISO 27509/DN25/CL900/0,5"NPT/A182F316

5.2 Designation of seal rings

The IX seal ring shall be designated as described below:

- number of this International Standard;
- type - and ring size - IX and the appropriate DN;
- material designation.

The designation elements shall be separated by "/" (slash). The number of characters is not fixed.

EXAMPLE Designation of an IX seal ring for DN 250 and material ASTM A182F51 (Duplex):

ISO 27509/IX250/A182F51

6 Materials

6.1 General

Criteria for the selection of materials suitable for a particular fluid service are not part of this International Standard.

6.2 Flange materials

Flanges covered by this International Standard shall be made from base material product forms as listed in Table 2. The standardized bevel angle as described in 4.2 is applicable for steel and nickel alloys, which are covered in this International Standard.

It is assumed that the flange material has a Young's modulus in the range 190 000 MPa to 210 000 MPa at room temperature. Minimum specified yield strength for flanges to this International Standard is 205 MPa at room temperature.

The elliptical transition between flange ring and flange neck of WN flanges, and the corresponding crotch transition of IF flanges shall be subject to 100 % surface examination irrespective of flange material. Examination method and acceptance criteria shall be according to standards referenced in the applied Piping Design Code.

Cast flanges shall be non-destructive tested to comply with casting factor used in calculations to determine performance. In general cast flanges used as IF should be examined by 100 % surface and volumetric control in order to obtain a casting factor of 1,0, and thus obtaining the minimum pressure and temperature ratings stated in Clause 7. Examination and acceptance criteria shall be agreed between purchaser and manufacturer, but sealing surfaces shall satisfy requirements in 8.12.

Test samples for certification testing required by the material standard, shall be taken from the flange ring transverse to the dominant grain flow direction, or alternatively in both axial (weld neck) and tangential (flange ring) direction relative to internal bore.

No repair welding is accepted in the elliptical transition for the WN flange (see Figure 2) as well as in the crotch radius for the IF (see Figure 4) manufactured in line with this International Standard.

6.3 Bolting materials

The minimum bolt yield strength at temperature shall be in accordance with Table 3. Linear interpolation can be used to calculate minimum yield strength for intermediate temperatures.

Table 3 — Minimum bolt yield strength as function of maximum design temperature, T_{des}

Bolt nominal diameter, d_B	$T_{des} \leq 20\text{ °C}$	$T_{des} = 50\text{ °C}$	$T_{des} = 100\text{ °C}$	$T_{des} = 150\text{ °C}$	$T_{des} = 200\text{ °C}$	$T_{des} = 250\text{ °C}$
$d \leq 2\frac{1}{2}"$	725 MPa	713 MPa	672 MPa	648 MPa	632 MPa	613 MPa
$2\frac{1}{2}" < d \leq 4"$	655 MPa	645 MPa	607 MPa	586 MPa	569 MPa	555 MPa

Bolt pre-load requirements described in Table 1 are based upon these requirements and so are the flange face angles and groove dimensional details.

Nuts shall have sufficient strength to carry 100 % of the bolt capacity defined by the specified minimum yield strength as listed above, and the thread stress area, see NOTE. Thread tolerances shall be considered in the nut strength evaluation.

NOTE Nuts to ISO 898-2 should not be used in order to reduce the risk of nut thread stripping.

Imperial or metric standard bolts threaded at both ends or full length may be used. Hex nuts with a minimum height equal to one nominal bolt diameter shall be used. The choice of bolt thread standard may affect assembly and bolt preloading procedures. Annex E is based on imperial bolting dimensions, while Annex G describes which metric bolts to choose for replacing the listed imperial bolts.

The effects of differential thermal expansion and bolt relaxation could affect the functionality of the joint up to loss of preload. Care shall be taken by selecting an appropriate bolt material for the above effects. Within the maximum temperature limits of this International Standard, it is acceptable to use low alloy steel bolting in combination with austenitic stainless steel flange materials. In such applications, washers shall be applied under the nuts in order to avoid indenting the nut into the flange which would cause loss of pre-load.

Washers shall be in same or equivalent grade of material as the nuts and should be through hardened.

Relaxation is not regarded to be of any importance for this flange standard since the maximum design temperature is 250 °C. A margin of 5 % points was used on bolt pre-load when documenting the flange standard to the functionality requirements in Clause 4, meaning the FEAs were performed with 70 % bolt yield as pre-load over the 75 % specified as target residual pre-load in Table 1. The 5 % point reduction was applied to account for uncertainties in pre-loading procedures and any long term relaxation.

6.4 Seal ring materials

Typical minimum yield stress and ultimate tensile stress for the seal ring material shall at maximum design temperature be 300 MPa and 360 MPa, respectively, in order to allow for reasonably elastic spring-back.

The user is responsible for selecting a seal ring material which is suitable for the service medium and the design temperature conditions.

There is no requirement for Charpy impact testing of seal ring materials.

Seal rings shall be made of forged or worked material. For in service use, Table 4 gives a guideline for seal ring selection and temperature limitations.

Table 4 — Seal ring selection

Flange material	Service temperature	Seal ring material	
			Typical manufacturing standard
(Fine grained) carbon steel	-50 °C to +250 °C	Carbon steel or low alloy steels, e.g. CS360LT or AISI 4140	ASTM A788 or equivalent
Stainless steel	-50 °C to +250 °C	22Cr Duplex	ASTM A182 or equivalent
Stainless steel	-50 °C to +250 °C	17/4-PH	ASTM A705 or equivalent
Austenitic stainless steel and nickel alloys	-196 °C to +250 °C	Nickel alloys such as Alloy 625 or similar	ASTM B564 or equivalent
NOTE 1 For testing purposes at ambient temperature, a carbon steel ring can be used for all flange materials.			
NOTE 2 Listed seal ring materials might be less resistant to corrosion than the stainless steel of the flanges, and this is justified by the low probability of corrosion due to the stressed contact between heel areas of the mating flanges, and due to the seal at the outer circumference of the flanges preventing ingress of moisture and water.			
NOTE 3 See Clause 12 for coating and colour coding.			

7 Strength, pressure/temperature ratings and leak tightness

7.1 General

CFCs according to this standard have a level of structural safety that is comparable to that of the connecting pipe. CFCs in general shall be designed against the following possible modes of failure, as appropriate:

- gross plastic deformation (excessive yielding);
- leak tightness;
- fatigue failure.

Furthermore, considerations shall be given to maximum and minimum assembly bolt preload and possible loss of bolt preload during operation due to combination of minimum assembly bolt load, pressure, external loads and thermal effects. Minimum assembly bolt load shall be determined based on assessment of accuracy of bolt preload method, short-term and long-term bolt relaxation.

Stresses resulting from bolt pre-loading shall be regarded as displacement stresses as defined in paragraph 319.2.3 of ASME B31.3, during testing and operation.

7.2 Pressure/temperature ratings

Flanges covered by this International Standard have been designated as one of the given classes in Table 5.

Table 5 — Pressure class designation and ASME rating ceiling values at room temperature to ASME B16.5, Table A-1 and Table A-2

Pressure class		Class abbreviation	Nominal pressure		ASME pressure rating ceiling values, see NOTE	
					psig	barg
Class	150	CL 150	PN	20	290	20,0
Class	300	CL 300	PN	50	750	51,7
Class	600	CL 600	PN	110	1 500	103,4
Class	900	CL 900	PN	150	2 250	155,1
Class	1500	CL 1500	PN	260	3 750	258,6
Class	2500	CL 2500	PN	420	6 250	430,9
NOTE These values are applicable at room temperature, and are for information only.						

Flanged connections covered by a class in this International Standard will exceed the maximum rating of the corresponding ASME B16.5 class and material within the temperature range as defined by this International Standard. This corresponds to a utilization ratio of 0,5 according to Annex A, which gives a method for determining the external load capacity for flanged connections.

For integral cast flanges also some design codes use the concept of “casting factors”. The yield strength should in such cases be multiplied by the relevant casting factor before used in the capacity equations (see 6.1).

Nominal design stress for bolts shall be determined by the same rule as used for nominal design stress of flanges and shells, e.g. same safety factor on yield stress. Bolt materials shall be selected with due consideration to creep and relaxation.

7.3 Pressure testing and leak tightness

Flanges are generally not required to be pressure tested until they are part of a piping system or pressure equipment, which shall be tested according to design codes and regulations for such pressure equipment and piping. However, orifice spacers contained in this standard, should undergo a hydrostatic pressure test before installation in order to verify appropriate quality of welded pressure tappings; see 8.8.

Flanged connections and flanged fittings may be subjected to system hydrostatic tests at a pressure of 1.5 times the 38 °C (100 °F) rating rounded off to the next higher 1 bar (25 psi) increment. Testing at any higher pressure is the responsibility of the user, taking into account the requirements of the applicable code or regulation.

The maximum leakage for correctly assembled connections may be specified by the supplier according to EN 1779, and shall be expressed as leakage rate in units of gas throughput ($\text{Pa} \times \text{m}^3/\text{s}$) for a specific gas, i.e. helium at room temperature and at max working pressure conditions. The circumferential length for this leakage shall also be specified. It is the responsibility of the supplier to verify that this leakage is not exceeded for the specified design conditions.

Default testing method shall be according to EN 1779. The purchaser may specify other test methods.

8 Dimensions of flanges

8.1 General

A summary of the DN's applicable to each rating class is given in Table 6.

All bolt holes shall be equally spaced on the bolt circle diameter. Bolt holes on integral flanges shall straddle the horizontal or vertical lines (see Figure F.6).

Dimensions for all flange types according to this International Standard can be found in Table 7 to Table 27. Dimensional tolerances can be found in Table 28.

Table 6 — Overview of sizes and rating class (CL)

DN	NPS	CL 150	CL 300	CL 600	CL 900	CL 1500	CL 2500
15	½	Equal to CL 300 ^a	—	Equal to CL 2500 ^a	Equal to CL 2500 ^a	Equal to CL 2500 ^a	—
20	¾		—				—
25	1		—				—
40	1 ½		—				—
50	2		—	Equal to CL 1500 ^a	Equal to CL 1500 ^a	—	—
65	2 ½		—			—	—
80	3		—	Equal to CL 900 ^a	—	—	—
100	4		—		—	—	—
125	5		—		—	—	—
150	6		—	—	—	—	—
200	8	—	—	—	—	—	—
250	10	—	—	—	—	—	—
300	12	—	—	—	—	—	—
350	14	—	—	—	—	—	—
400	16	—	—	—	—	—	—
450	18	—	—	—	—	—	—
500	20	—	—	—	—	—	—
550	22	—	—	—	—	—	—
600	24	—	—	—	—	—	—
650	26	—	—	—	—	—	—
700	28	—	—	—	—	—	—
750	30	—	—	—	—	—	—
800	32	—	—	—	—	—	—
850	34	—	—	—	—	—	—
900	36	—	—	—	—	—	—
950	38	—	—	—	—	—	—
1000	40	—	—	—	—	—	—
1050	42	—	—	—	—	—	—
1100	44	—	—	—	—	—	—
1150	46	—	—	—	—	—	—
1200	48	—	—	—	—	—	—

A dash (—) indicates that there is an individual design for this size and class.

^a "Equal to CL xxxx" means that overall dimensions are equal for the referenced pressure classes. However, flange face bevel angles may be different.

8.2 Weld neck (WN) dimensions

The minimum outside diameter of the WN flange is equal to the nominal outside diameter of the pipe. The maximum bore is equal to the specified nominal bore. This assures that the minimum WN thickness is equal to or larger than the wall thickness of the connected pipe.

Details for the weld preparation for WN flanges are given in ASME B16.25. Other welding end preparations can be agreed between supplier and purchaser.

Dimensions of WN flanges are defined in Figure 2. Given variations of wall thickness of connected pipe (t) in Table 7 to Table 12 are according to standard wall thicknesses in ASME B36.10M, ASME B36.19M and ISO 4200. WN flanges are neither designed for welding to rigid equipment nor to wall thicknesses above the pipe wall thickness range given in the tables below. Dimensions of IF according to 8.4 should then be used, or WN flanges to a higher pressure class could be used. It is recommended to consider a lower pressure class WN flange if the selected pipe wall thickness is below the range specified for the original pressure class in Table 7 to Table 12.

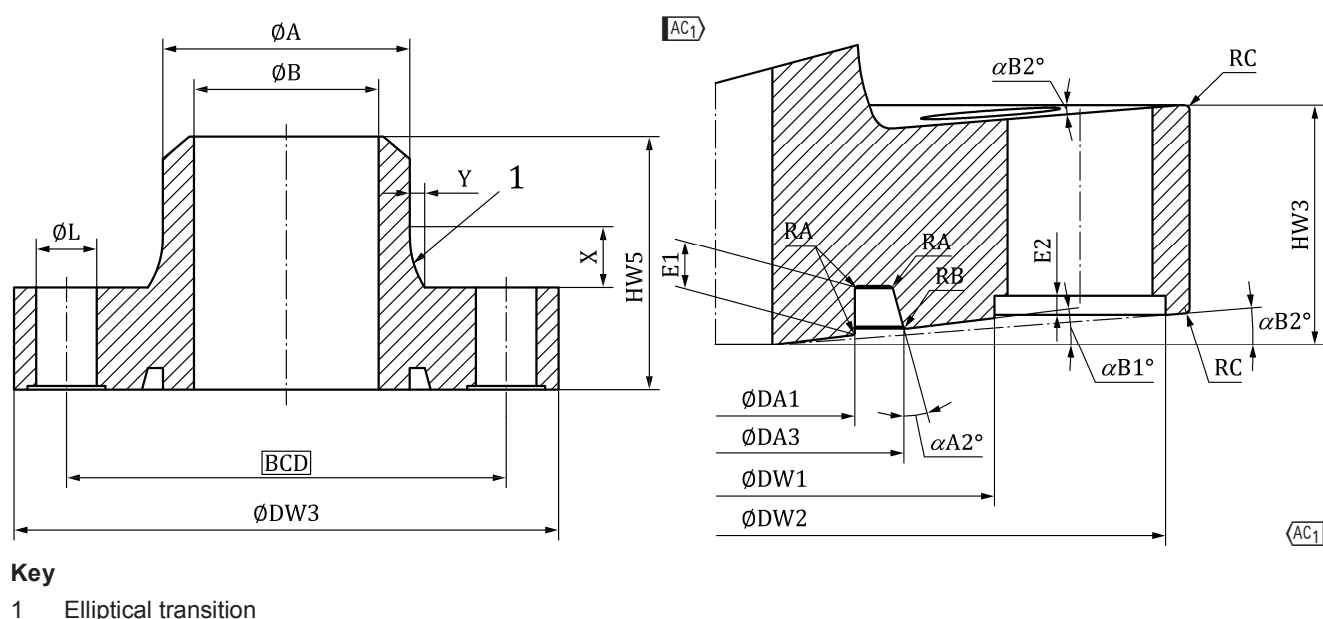


Figure 2 — Nomenclatures for weld neck (WN) flanges

NOTE The back face of the flange is a tangential transition to the elliptical shape of the neck.

Table 7 — Dimensions of CL 150 weld neck (WN) flanges

DN	NPS	t	A	B	DW1	DW2	DW3	BCD	DA1	DA3	αA2	E1	E2	αB1	αB2	HW3	HW5	X	Y	RA	RB	RC	L	n	d _B
15	½	2,11-4,78	21,3	17,1-11,7	49,1	87,0	93,0	67,3	20,8	30,88	15,2	5,30	1,0	0,27	0,18	15,0	40,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
20	¾	2,11-5,56	26,7	22,5-15,6	54,4	92,0	98,0	72,7	25,8	35,88	15,2	5,30	1,0	0,30	0,20	15,0	40,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
25	1	2,77-6,35	33,4	27,9-20,7	61,2	99,0	105,0	79,4	32,8	42,87	15,2	5,30	1,0	0,32	0,22	15,0	40,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
40	1½	2,77-5,08	48,3	42,8-38,1	76,0	114,0	120,0	94,3	47,8	58,88	15,3	5,58	1,0	0,41	0,27	15,0	41,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
50	2	2,77-5,54	60,3	54,8-49,2	88,1	126,0	132,0	106,3	59,8	71,88	15,3	6,19	1,0	0,45	0,30	15,0	42,0	10,5	3,0	0,4	0,6	1,0	15,0	4	½
65	2½	3,05-5,16	73,0	66,9-62,7	100,8	139,0	145,0	119,0	72,8	85,86	15,3	6,79	1,0	0,41	0,27	16,0	43,0	10,5	3,0	0,4	0,6	1,0	15,0	4	½
80	3	3,05-5,49	88,9	82,8-77,9	116,7	155,0	161,0	134,9	87,8	101,96	15,6	7,42	1,0	0,88	0,59	18,0	46,0	10,5	3,0	0,4	0,7	1,0	15,0	8	½
100	4	3,05-6,02	114,3	108,2-102,3	141,7	180,0	186,0	160,3	113,8	129,91	15,4	8,40	1,0	0,59	0,40	22,0	51,0	10,5	3,0	0,5	0,8	1,0	15,0	8	½
125	5	3,40-6,55	141,3	134,5-128,2	168,7	207,0	213,0	187,3	139,8	157,90	15,5	9,27	1,0	0,76	0,50	25,0	55,0	10,5	3,0	0,5	0,9	1,0	15,0	12	½
150	6	3,40-7,11	168,3	161,5-154,1	195,7	234,0	240,0	214,3	167,7	187,86	15,4	10,12	1,0	0,62	0,41	28,0	60,0	10,5	3,0	0,6	1,0	1,0	15,0	12	½
200	8	3,76-6,35	219,1	211,6-206,4	249,4	288,0	294,0	268,1	217,7	239,91	15,6	11,48	1,0	0,94	0,63	26,0	53,0	10,5	3,0	0,7	1,1	1,5	15,0	12	½
250	10	4,19-6,35	273,1	264,7-260,4	310,6	349,0	355,0	329,3	271,7	299,92	15,6	12,90	1,0	0,93	0,62	32,0	60,0	10,5	3,0	0,8	1,3	1,5	15,0	16	½
300	12	4,57-6,35	323,9	314,8-311,2	358,1	397,0	403,0	376,7	321,7	348,95	15,7	13,97	1,0	1,01	0,67	35,0	64,0	10,5	3,0	0,8	1,4	1,5	15,0	20	½
350	14	4,78-7,92	355,6	346,0-339,8	392,3	431,0	437,0	411,5	353,7	381,89	15,6	14,63	1,0	0,85	0,57	38,0	67,0	10,5	3,0	0,8	1,4	1,5	15,0	20	½
400	16	4,78-7,92	406,4	396,8-390,6	451,2	497,0	505,0	473,4	405,7	436,06	15,8	15,63	1,0	1,20	0,80	42,0	73,0	10,5	3,0	0,9	1,5	2,0	18,0	20	¾
450	18	4,78-7,92	457,2	447,6-441,4	498,7	545,0	552,0	520,9	455,7	487,97	15,7	16,54	1,0	1,01	0,67	46,0	77,0	10,5	3,0	1,0	1,6	2,0	18,0	20	¾
500	20	5,54-9,53	508,0	496,9-488,9	552,5	599,0	606,0	574,7	507,7	540,99	15,7	17,63	1,0	1,02	0,68	50,0	82,0	10,5	3,0	1,0	1,7	2,0	18,0	24	¾
550	22	5,54-9,53	558,8	547,7-539,7	606,9	653,0	661,0	629,1	557,7	593,03	15,7	18,45	1,0	1,08	0,72	54,0	87,0	10,5	3,0	1,1	1,8	2,0	18,0	28	¾
600	24	6,35-9,53	609,6	596,9-590,5	666,3	722,0	730,0	693,0	607,7	644,13	15,8	19,23	1,0	1,19	0,79	59,0	93,0	10,5	3,0	1,1	1,9	3,0	22,0	24	¾
650	26	7,92-9,53	660,4	644,6-641,3	720,2	776,0	784,0	746,8	659,5	696,97	15,7	20,00	1,0	1,00	0,67	64,0	98,0	10,5	3,0	1,1	1,9	3,0	22,0	24	¾
700	28	7,92-9,53	711,2	695,4-692,1	774,5	830,0	839,0	801,2	709,5	749,04	15,7	20,92	1,0	1,08	0,72	68,0	103,0	10,5	3,0	1,2	2,0	3,0	22,0	28	¾
750	30	7,92-12,70	762,0	746,2-736,6	828,9	884,0	893,0	855,5	761,5	802,05	15,7	21,65	1,0	1,08	0,72	72,0	108,0	10,9	3,1	1,3	2,1	3,0	22,0	32	¾
800	32	7,92-12,70	812,8	797,0-787,4	881,3	937,0	945,0	908,0	811,5	853,02	15,7	22,32	1,0	1,03	0,69	76,0	113,0	11,3	3,2	1,3	2,2	3,0	22,0	36	¾
850	34	7,92-12,70	863,6	847,8-838,2	933,9	989,0	998,0	960,5	861,5	904,16	15,8	22,97	1,0	1,18	0,79	79,0	118,0	11,8	3,4	1,3	2,2	3,0	22,0	40	¾
900	36	7,92-12,70	914,4	898,6-889,0	986,1	1050,0	1059,0	1016,6	913,5	958,16	15,8	23,82	1,0	1,15	0,77	84,0	123,0	12,3	3,5	1,4	2,3	3,0	25,0	32	¾
950	38	9,53-12,70	965,2	946,1-939,8	1041,2	1105,0	1114,0	1071,6	963,5	1009,22	15,8	24,44	1,0	1,20	0,80	88,0	128,0	12,7	3,6	1,4	2,3	3,0	25,0	36	¾
1000	40	9,53-12,70	1016,0	996,9-990,6	1098,7	1162,0	1172,0	1129,2	1015,5	1062,30	15,8	25,06	1,0	1,26	0,84	92,0	133,0	13,2	3,8	1,4	2,4	3,0	25,0	40	¾
1050	42	9,53-12,70	1066,8	1047,7-1041,4	1145,8	1209,0	1219,0	1176,2	1065,5	1113,36	15,9	25,65	1,0	1,31	0,87	95,0	137,0	13,8	3,9	1,5	2,5	3,0	25,0	44	¾
1100	44	9,53-12,70	1117,6	1098,5-1092,2	1197,8	1261,0	1271,0	1228,3	1115,5	1164,28	15,8	26,42	1,0	1,22	0,81	99,0	141,0	14,2	4,1	1,5	2,5	3,0	25,0	44	¾
1150	46	9,53-12,70	1168,4	1149,3-1143,0	1249,9	1313,0	1323,0	1280,3	1167,5	1217,35	15,9	27,00	1,0	1,28	0,85	102,0	146,0	14,7	4,2	1,6	2,6	3,0	25,0	48	¾
1200	48	9,53-12,70	1219,2	1200,1-1193,8	1302,4	1366,0	1376,0	1332,9	1217,5	1268,39	15,9	27,54	1,0	1,30	0,87	106,0	150,0	15,2	4,3	1,6	2,6	3,0	25,0	52	¾

Table 8 — Dimensions of CL 300 weld neck (WN) flanges

DN	NPS	t	A	B	DW1	DW2	DW3	BCD	DA1	DA3	αA2	E1	E2	αB1	αB2	HW3	HW5	X	Y	RA	RB	RC	L	n	d ₆
15	½	2,11-4,78	21,3	17,1-11,7	49,1	87,0	93,0	67,3	20,8	30,88	15,2	5,30	1,0	0,27	0,18	15,0	40,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
20	¾	2,11-5,56	26,7	22,5-15,6	54,4	92,0	98,0	72,7	25,8	35,88	15,2	5,30	1,0	0,30	0,20	15,0	40,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
25	1	2,77-6,35	33,4	27,9-20,7	61,2	99,0	105,0	79,4	32,8	42,87	15,2	5,30	1,0	0,32	0,22	15,0	40,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
40	1½	2,77-5,08	48,3	42,8-38,1	76,0	114,0	120,0	94,3	47,8	58,88	15,3	5,58	1,0	0,41	0,27	15,0	41,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
50	2	2,77-5,54	60,3	54,8-49,2	88,1	126,0	132,0	106,3	59,8	71,88	15,3	6,19	1,0	0,45	0,30	15,0	42,0	10,5	3,0	0,4	0,6	1,0	15,0	4	½
65	2½	3,05-5,16	73,0	66,9-62,7	100,8	139,0	145,0	119,0	72,8	85,86	15,3	6,79	1,0	0,41	0,27	16,0	43,0	10,5	3,0	0,4	0,6	1,0	15,0	4	½
80	3	3,05-5,49	88,9	82,8-77,9	116,7	155,0	161,0	134,9	87,8	101,96	15,6	7,42	1,0	0,88	0,59	18,0	46,0	10,5	3,0	0,4	0,7	1,0	15,0	8	½
100	4	3,05-6,02	114,3	108,2-102,3	141,7	180,0	186,0	160,3	113,8	129,91	15,4	8,40	1,0	0,59	0,40	22,0	51,0	10,5	3,0	0,5	0,8	1,0	15,0	8	½
125	5	3,40-6,55	141,3	134,5-128,2	168,7	207,0	213,0	187,3	139,8	157,90	15,5	9,27	1,0	0,76	0,50	25,0	55,0	10,5	3,0	0,5	0,9	1,0	15,0	12	½
150	6	3,40-7,11	168,3	161,5-154,1	195,7	234,0	240,0	214,3	167,7	187,86	15,4	10,12	1,0	0,62	0,41	28,0	60,0	10,5	3,0	0,6	1,0	1,0	15,0	12	½
200	8	3,76-8,18	219,1	211,6-202,7	252,9	299,0	306,0	274,6	217,7	239,89	15,4	11,48	1,0	0,66	0,44	35,0	69,0	10,5	3,0	0,7	1,1	1,5	18,0	12	¾
250	10	4,19-9,27	273,1	264,7-254,6	307,8	353,0	361,0	329,4	271,7	299,97	15,5	12,90	1,0	0,80	0,54	42,0	78,0	10,5	3,0	0,8	1,3	1,5	18,0	20	¾
300	12	4,57-10,31	323,9	314,8-303,3	361,6	407,0	415,0	383,2	321,7	348,91	15,4	13,97	1,0	0,67	0,45	47,0	85,0	11,4	3,3	0,8	1,4	1,5	18,0	20	¾
350	14	4,78-11,13	355,6	346,0-333,3	395,8	442,0	450,0	418,0	353,7	381,94	15,5	14,63	1,0	0,74	0,49	50,0	90,0	12,3	3,5	0,8	1,4	1,5	18,0	24	¾
400	16	4,78-12,70	406,4	396,8-381,0	455,8	511,0	519,0	482,4	405,7	436,04	15,6	15,63	1,0	0,84	0,56	58,0	100,0	13,5	3,9	0,9	1,5	2,0	22,0	24	¾
450	18	6,35-14,27	457,2	444,5-428,7	503,3	559,0	567,0	529,9	455,7	488,03	15,5	16,54	1,0	0,81	0,54	63,0	107,0	14,7	4,2	1,0	1,6	2,0	22,0	28	¾
500	20	6,35-15,09	508,0	495,3-477,8	558,1	621,0	631,0	587,7	507,7	541,04	15,5	17,63	1,0	0,81	0,54	69,0	116,0	16,0	4,6	1,0	1,7	2,0	25,0	24	¾
550	22	9,53-22,23	558,8	539,7-514,3	612,5	675,0	685,0	642,1	557,7	593,00	15,5	18,45	1,0	0,75	0,50	74,0	121,0	17,3	4,9	1,1	1,8	2,0	25,0	28	¾
600	24	9,53-17,48	609,6	590,5-574,6	668,3	740,0	750,0	702,0	607,7	644,18	15,6	19,23	1,5	0,91	0,61	81,0	128,0	18,4	5,3	1,1	1,9	3,0	29,0	28	1
650	26	7,92-16,00	660,4	644,6-628,4	722,2	794,0	804,0	755,8	659,5	697,22	15,7	20,00	1,5	0,99	0,66	86,0	134,0	19,7	5,6	1,1	1,9	3,0	29,0	32	1
700	28	7,92-15,88	711,2	695,4-679,4	776,5	848,0	859,0	810,2	709,5	749,16	15,6	20,92	1,5	0,92	0,61	91,0	140,0	21,0	6,0	1,2	2,0	3,0	29,0	32	1
750	30	7,92-17,50	762,0	746,2-727,0	837,9	917,0	928,0	874,5	761,5	802,35	15,7	21,65	1,5	1,06	0,71	98,0	147,0	22,2	6,3	1,3	2,1	3,0	32,0	32	1½
800	32	9,53-17,48	812,8	793,7-777,8	890,3	969,0	981,0	927,0	811,5	853,26	15,6	22,32	1,5	0,97	0,64	103,0	152,0	23,5	6,7	1,3	2,2	3,0	32,0	32	1½
850	34	9,53-20,00	863,6	844,5-823,6	945,9	1032,0	1045,0	985,5	861,5	904,45	15,7	22,97	1,5	1,09	0,72	109,0	159,0	24,7	7,1	1,3	2,2	3,0	35,0	32	1½
900	36	9,53-22,20	914,4	895,3-870,0	997,1	1084,0	1097,0	1037,6	913,5	958,34	15,7	23,82	1,5	0,99	0,66	114,0	164,0	25,9	7,4	1,4	2,3	3,0	35,0	32	1½
950	38	12,70-20,00	965,2	939,8-925,2	1052,2	1139,0	1152,0	1092,6	963,5	1009,45	15,7	24,44	1,5	1,05	0,70	119,0	170,0	27,2	7,8	1,4	2,3	3,0	35,0	36	1½
1000	40	12,70-22,20	1016,0	990,6-971,6	1109,7	1196,0	1210,0	1150,2	1015,5	1062,48	15,7	25,06	1,5	1,05	0,70	126,0	177,0	28,5	8,1	1,4	2,4	3,0	35,0	40	1½
1050	42	12,70-22,20	1066,8	1041,4-1022,4	1162,8	1257,0	1271,0	1206,2	1065,5	1113,57	15,7	25,65	1,5	1,09	0,73	131,0	184,0	29,6	8,5	1,5	2,5	3,0	38,0	36	1¾
1100	44	12,70-25,00	1117,6	1092,2-1067,6	1214,8	1309,0	1323,0	1258,3	1115,5	1164,66	15,8	26,42	1,5	1,14	0,76	135,0	190,0	30,9	8,8	1,5	2,5	3,0	38,0	40	1¾
1150	46	12,70-25,00	1168,4	1143,0-1118,4	1266,9	1370,0	1385,0	1314,3	1167,5	1217,68	15,7	27,00	1,5	1,12	0,74	142,0	198,0	32,2	9,2	1,6	2,6	3,0	42,0	36	1½
1200	48	12,70-25,00	1219,2	1193,8-1169,2	1319,4	1422,0	1437,0	1366,9	1217,5	1268,63	15,7	27,54	1,5	1,08	0,72	146,0	204,0	33,5	9,6	1,6	2,6	3,0	42,0	36	1½

Table 9 — Dimensions of CL 600 weld neck (WN) flanges

DN	NPS	t	A	B	DW1	DW2	DW3	BCD	DA1	DA3	αA2	E1	E2	αB1	αB2	HW3	HW5	X	Y	RA	RB	RC	L	n	d _B
15	½	2,77-4,78	21,3	15,8-11,7	49,1	87,0	93,0	67,3	20,8	30,86	15,1	5,30	1,0	0,15	0,10	20,0	51,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
20	¾	2,87-5,56	26,7	21,0-15,6	54,4	92,0	98,0	72,7	25,8	35,86	15,1	5,30	1,0	0,15	0,10	20,0	53,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
25	1	2,77-6,35	33,4	27,9-20,7	61,2	99,0	105,0	79,4	32,8	42,85	15,1	5,30	1,0	0,15	0,10	20,0	56,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
40	1½	2,77-7,14	48,3	42,8-34,0	77,1	115,0	121,0	95,3	47,8	58,88	15,2	5,58	1,0	0,29	0,19	23,0	64,0	12,4	3,5	0,3	0,5	1,0	15,0	8	½
50	2	2,77-8,74	60,3	54,8-42,8	91,7	130,0	136,0	110,0	59,8	71,89	15,2	6,19	1,0	0,33	0,22	23,0	60,0	10,5	3,0	0,4	0,6	1,0	15,0	8	½
65	2½	3,05-7,01	73,0	66,9-59,0	104,8	143,0	149,0	123,1	72,8	85,92	15,3	6,79	1,0	0,44	0,29	26,0	66,0	12,0	3,4	0,4	0,6	1,0	15,0	12	½
80	3	3,05-7,62	88,9	82,8-73,7	116,7	155,0	161,0	134,9	87,8	101,93	15,4	7,42	1,0	0,53	0,35	25,0	61,0	10,5	3,0	0,4	0,7	1,0	15,0	12	½
100	4	3,05-8,56	114,3	108,2-97,2	150,0	196,0	203,0	171,7	113,8	129,97	15,4	8,40	1,0	0,59	0,39	31,0	70,0	11,7	3,3	0,5	0,8	1,0	18,0	12	¾
125	5	3,40-9,53	141,3	134,5-122,2	177,0	223,0	230,0	198,6	139,8	157,88	15,3	9,27	1,0	0,48	0,32	35,0	78,0	13,7	3,9	0,5	0,9	1,0	18,0	12	¾
150	6	7,11-10,97	168,3	154,1-146,4	205,2	251,0	258,0	226,8	167,7	187,85	15,3	10,12	1,0	0,46	0,31	36,0	75,0	11,7	3,3	0,6	1,0	1,0	18,0	12	¾
200	8	6,35-12,70	219,1	206,4-193,7	258,7	304,0	312,0	280,4	217,7	239,92	15,4	11,48	1,0	0,60	0,40	43,0	87,0	14,1	4,0	0,7	1,1	1,5	18,0	20	¾
250	10	6,35-15,09	273,1	260,4-242,9	318,7	374,0	382,0	344,8	271,7	299,95	15,4	12,90	1,0	0,68	0,45	60,0	102,0	16,7	4,8	0,8	1,3	1,5	22,0	20	¾
300	12	8,38-17,48	323,9	307,1-288,9	378,0	441,0	450,0	407,7	321,7	349,01	15,5	13,97	1,0	0,72	0,48	64,0	108,0	19,1	5,5	0,8	1,4	1,5	25,0	20	¾
350	14	7,92-19,05	355,6	339,8-317,5	409,5	472,0	482,0	439,2	353,7	382,05	15,5	14,63	1,0	0,72	0,48	73,0	122,0	23,2	6,6	0,9	1,5	2,0	29,0	24	1
400	16	9,53-21,44	406,4	387,3-363,5	465,4	537,0	547,0	499,0	405,7	436,09	15,5	15,63	1,5	0,72	0,48	80,0	131,0	25,7	7,3	1,0	1,6	2,0	32,0	24	1½
450	18	9,53-23,83	457,2	438,1-409,5	523,4	602,0	614,0	560,1	455,7	488,19	15,5	16,54	1,5	0,81	0,54	86,0	139,0	28,1	8,0	1,0	1,7	2,0	32,0	28	1½
500	20	12,70-26,19	508,0	482,6-455,6	574,0	653,0	664,0	610,6	507,7	541,20	15,5	17,63	1,5	0,81	0,54	94,0	149,0	30,6	8,7	1,1	1,8	2,0	35,0	24	1½
550	22	12,70-28,58	558,8	533,4-501,6	631,1	717,0	730,0	670,7	557,7	593,17	15,5	18,45	1,5	0,75	0,50	100,0	158,0	33,0	9,4	1,1	1,9	3,0	35,0	28	1½
600	24	12,70-30,96	609,6	584,2-547,7	685,9	772,0	785,0	725,6	607,7	644,23	15,5	19,23	1,5	0,79	0,52	105,0	166,0	35,5	10,1	1,1	1,9	3,0	35,0	32	1½
650	26	14,2-28,00	660,4	632,0-604,4	736,0	822,0	835,0	775,6	659,5	697,27	15,6	20,00	1,5	0,85	0,57	112,0	176,0	37,9	10,8	1,2	2,0	3,0	38,0	32	1½
700	28	15,88-28,00	711,2	679,4-655,2	792,5	886,0	900,0	835,2	709,5	749,42	15,6	20,92	1,5	0,95	0,63	118,0	185,0	40,4	11,5	1,3	2,1	3,0	38,0	36	1½
750	30	15,88-30,00	762,0	730,2-702,0	847,1	940,0	955,0	889,8	761,5	802,49	15,7	21,65	1,5	0,98	0,65	126,0	195,0	42,8	12,2	1,3	2,2	3,0	42,0	32	1½
800	32	17,48-30,00	812,8	777,8-752,8	899,0	1001,0	1016,0	945,7	811,5	853,46	15,6	22,32	1,5	0,92	0,62	133,0	205,0	45,3	12,9	1,3	2,2	3,0	45,0	32	1½
850	34	17,48-32,00	863,6	828,6-799,6	954,3	1064,0	1081,0	1004,8	861,5	904,61	15,7	22,97	1,5	1,00	0,67	145,0	214,0	47,3	13,5	1,4	2,3	3,0	45,0	32	1½
900	36	19,05-36,00	914,4	876,3-842,4	1007,9	1118,0	1134,0	1058,4	913,5	958,39	15,5	23,82	1,5	0,81	0,54	147,0	223,0	49,0	14,0	1,4	2,3	3,0	49,0	32	1½
950	38	20,00-36,00	965,2	925,2-893,2	1060,5	1179,0	1196,0	1115,0	963,5	1009,62	15,6	24,44	1,5	0,95	0,64	153,0	232,0	50,8	14,5	1,4	2,4	3,0	49,0	36	1½
1000	40	20,00-40,00	1016,0	976,0-936,0	1115,1	1234,0	1251,0	1169,6	1015,5	1062,71	15,7	25,06	1,5	0,99	0,66	165,0	241,0	52,5	15,0	1,5	2,5	3,0	52,0	32	1½
1050	42	22,20-40,00	1066,8	1022,4-986,8	1167,7	1294,0	1312,0	1225,2	1065,5	1113,56	15,6	25,65	1,5	0,86	0,57	170,0	249,0	54,3	15,5	1,5	2,5	3,0	52,0	36	1½
1100	44	22,20-45,00	1117,6	1073,2-1027,6	1221,0	1347,0	1365,0	1278,5	1115,5	1164,67	15,6	26,42	1,5	0,91	0,60	174,0	262,0	56,0	16,0	1,6	2,6	3,0	55,0	36	2
1150	46	22,20-45,00	1168,4	1124,0-1078,4	1285,4	1419,0	1438,0	1345,9	1167,5	1217,95	15,7	27,00	2,0	1,05	0,70	189,0	270,0	57,8	16,5	1,6	2,6	3,0	55,0	36	2
1200	48	25,0-45,00	1219,2	1169,2-1129,2	1337,0	1470,0	1490,0	1397,4	1217,5	1268,69	15,6	27,54	2,0	0,86	0,57										

Table 10 — Dimensions of CL 900 weld neck (WN) flanges

DN	NPS	t	A	B	DW1	DW2	DW3	BCD	DA1	DA3	αA2	E1	E2	αB1	αB2	HW3	HW5	X	Y	RA	RB	RC	L	n	d ₆
15	½	2,77-4,78	21,3	15,8-11,7	49,1	87,0	93,0	67,3	20,8	30,86	15,1	5,30	1,0	0,15	0,10	20,0	51,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
20	¾	2,87-5,56	26,7	21,0-15,6	54,4	92,0	98,0	72,7	25,8	35,86	15,1	5,30	1,0	0,15	0,10	20,0	53,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
25	1	3,38-6,35	33,4	26,6-20,7	61,2	99,0	105,0	79,4	32,8	42,85	15,1	5,30	1,0	0,15	0,10	20,0	56,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
40	1½	2,77-7,14	48,3	42,8-34,0	77,1	115,0	121,0	95,3	47,8	58,88	15,2	5,58	1,0	0,29	0,19	23,0	64,0	12,4	3,5	0,3	0,5	1,0	15,0	8	½
50	2	2,77-8,74	60,3	54,8-42,8	91,7	130,0	136,0	110,0	59,8	71,89	15,2	6,19	1,0	0,33	0,22	23,0	60,0	10,5	3,0	0,4	0,6	1,0	15,0	8	½
65	2½	3,05-9,53	73,0	66,9-53,9	104,8	143,0	149,0	123,1	72,8	85,91	15,3	6,79	1,0	0,41	0,28	26,0	66,0	12,0	3,4	0,4	0,6	1,0	15,0	12	½
80	3	3,05-11,13	88,9	82,8-66,6	116,7	155,0	161,0	134,9	87,8	101,91	15,3	7,42	1,0	0,48	0,32	25,0	61,0	10,5	3,0	0,4	0,7	1,0	15,0	12	½
100	4	3,05-11,13	114,3	108,2-92,0	150,0	196,0	203,0	171,7	113,8	129,96	15,4	8,40	1,0	0,56	0,37	31,0	70,0	11,7	3,3	0,5	0,8	1,0	18,0	12	¾
125	5	6,55-12,70	141,3	128,2-115,9	177,0	223,0	230,0	198,6	139,8	157,86	15,3	9,27	1,0	0,43	0,29	35,0	78,0	13,7	3,9	0,5	0,9	1,0	18,0	12	¾
150	6	7,11-14,27	168,3	154,1-139,8	210,0	256,0	263,0	231,6	167,7	187,88	15,3	10,12	1,0	0,47	0,31	40,0	87,0	15,5	4,4	0,6	1,0	1,0	18,0	16	¾
200	8	6,35-18,26	219,1	206,4-182,6	267,2	322,0	330,0	293,2	217,7	239,96	15,4	11,48	1,0	0,58	0,39	50,0	98,0	19,1	5,5	0,7	1,1	1,5	22,0	20	¾
250	10	7,80-21,44	273,1	257,5-230,2	325,8	388,0	397,0	354,8	271,7	299,97	15,4	12,90	1,0	0,56	0,38	60,0	110,0	23,1	6,6	0,8	1,3	1,5	25,0	20	¾
300	12	8,38-25,4	323,9	307,1-273,1	380,3	452,0	462,0	413,9	321,7	349,00	15,4	13,97	1,5	0,58	0,39	68,0	119,0	26,7	7,6	0,8	1,4	1,5	29,0	20	1
350	14	9,53-27,79	355,6	336,5-300,0	415,6	487,0	497,0	449,3	353,7	382,03	15,4	14,63	1,5	0,61	0,41	73,0	127,0	28,9	8,3	0,8	1,4	1,5	29,0	24	1
400	16	12,70-30,96	406,4	381,0-344,5	477,2	556,0	567,0	513,8	405,7	436,09	15,4	15,63	1,5	0,65	0,43	82,0	140,0	32,6	9,3	0,9	1,5	2,0	32,0	24	1½
450	18	11,13-29,36	457,2	434,9-398,5	534,3	620,0	633,0	574,0	455,7	488,21	15,5	16,54	1,5	0,74	0,49	90,0	153,0	36,3	10,4	1,0	1,6	2,0	35,0	24	1½
500	20	12,70-32,54	508,0	482,6-442,9	592,9	686,0	700,0	635,5	507,7	541,27	15,5	17,63	1,5	0,76	0,51	99,0	166,0	39,9	11,4	1,0	1,7	2,0	38,0	24	1½
550	22	22,23-34,93	558,8	514,3-488,9	647,0	749,0	764,0	693,6	557,7	593,28	15,5	18,45	1,5	0,75	0,50	107,0	179,0	43,5	12,4	1,1	1,8	2,0	42,0	24	1½
600	24	14,27-38,89	609,6	581,1-531,8	704,6	814,0	830,0	754,2	607,7	644,42	15,5	19,23	1,5	0,82	0,55	115,0	191,0	47,1	13,5	1,1	1,9	3,0	45,0	24	1½
650	26	20,00-36,0	660,4	620,4-588,4	759,2	877,0	894,0	812,8	659,5	697,44	15,6	20,00	1,5	0,84	0,56	124,0	204,0	50,8	14,5	1,1	1,9	3,0	49,0	24	1½
700	28	22,20-40,00	711,2	666,8-631,2	812,8	931,0	948,0	866,4	709,5	749,20	15,4	20,92	1,5	0,62	0,41	141,0	214,0	52,5	15,0	1,2	2,0	3,0	49,0	24	1½
750	30	17,50-45,00	762,0	727,0-672,0	870,2	995,0	1014,0	926,9	761,5	802,29	15,4	21,65	1,5	0,66	0,44	149,0	227,0	56,0	16,0	1,3	2,1	3,0	52,0	24	1½
800	32	25,00-45,00	812,8	762,8-722,8	928,8	1061,0	1081,0	988,4	811,5	853,35	15,5	22,32	2,0	0,68	0,45	157,0	239,0	59,5	17,0	1,3	2,2	3,0	55,0	24	2
850	34	25,00-50,00	863,6	813,6-763,6	989,0	1139,0	1160,0	1057,1	861,5	904,71	15,6	22,97	2,0	0,89	0,60	158,0	254,0	63,0	18,0	1,3	2,2	3,0	62,0	24	2½
900	36	22,20-50,00	914,4	870,0-814,4	1042,7	1193,0	1214,0	1110,7	913,5	958,50	15,5	23,82	2,0	0,72	0,48	176,0	265,0	64,8	18,5	1,4	2,3	3,0	62,0	24	2½
950	38	30,00-55,00	965,2	905,2-855,2	1102,8	1267,0	1291,0	1176,8	963,5	1009,85	15,6	24,44	2,0	0,92	0,61	174,0	279,0	66,5	19,0	1,4	2,3	3,0	68,0	24	2½
1000	40	30,00-55,00	1016,0	956,0-906,0	1155,9	1320,0	1344,0	1230,0	1015,5	1062,64	15,5	25,06	2,0	0,77	0,51	190,0	290,0	68,3	19,5	1,4	2,4	3,0	68,0	24	2½
1050	42	25,00-60,00	1066,8	1016,8-946,8	1208,1	1372,0	1396,0	1282,1	1065,5	1113,93	15,6	25,65	2,0	0,90	0,60	192,0	300,0	70,0	20,0	1,5	2,5	3,0	68,0	28	2½
1100	44	32,00-60,00	1117,6	1053,6-997,6	1262,7	1427,0	1451,0	1336,8	1115,5	1164,64	15,5	26,42	2,0	0,72	0,48	211,0	310,0	71,8	20,5	1,5	2,5	3,0	68,0	28	2½
1150	46	36,00-65,00	1168,4	1096,4-1038,4	1321,3	1501,0	1527,0	1401,9	1167,5	1217,69	15,5	27,00	2,0	0,73	0,49	219,0	324,0	73,5	21,0	1,6	2,6	3,0	74,0	28	2¾
1200	48	36,00-65,00	1219,2	1147,2-1089,2	1394,4	1590,0	1618,0	1482,0	1217,5	1269,20	15,6	27,54	2,5	0,95	0,63	218,0	342,0	75,3	21,5	1,6	2,6	3,0	81,0	28	3

Table 11 — Dimensions of CL 1500 weld neck (WN) flanges

DN	NPS	t	A	B	DW1	DW2	DW3	BCD	DA1	DA3	αA2	E1	E2	αB1	αB2	HW3	HW5	X	Y	RA	RB	RC	L	n	d _B
15	½	2,77-7,47	21,3	15,8-6,4	49,1	87,0	93,0	67,3	20,8	30,86	15,1	5,30	1,0	0,15	0,10	20,0	51,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
20	¾	2,87-7,82	26,7	21,0-11,1	54,4	92,0	98,0	72,7	25,8	35,86	15,1	5,30	1,0	0,15	0,10	20,0	53,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
25	1	3,38-9,09	33,4	26,6-15,2	61,2	99,0	105,0	79,4	32,8	42,85	15,1	5,30	1,0	0,15	0,10	20,0	56,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
40	1½	3,68-10,15	48,3	40,9-28,0	77,1	115,0	121,0	95,3	47,8	58,89	15,2	5,58	1,0	0,30	0,20	23,0	64,0	12,4	3,5	0,3	0,5	1,0	15,0	8	½
50	2	3,91-11,07	60,3	52,5-38,2	91,7	130,0	136,0	110,0	59,8	71,88	15,2	6,19	1,0	0,30	0,20	23,0	60,0	10,5	3,0	0,4	0,6	1,0	15,0	8	½
65	2½	5,16-14,02	73,0	62,7-45,0	104,8	143,0	149,0	123,1	72,8	85,92	15,3	6,79	1,0	0,45	0,30	26,0	66,0	12,0	3,4	0,4	0,6	1,0	15,0	12	½
80	3	5,49-15,24	88,9	77,9-58,4	126,7	172,0	180,0	148,3	87,8	101,93	15,3	7,42	1,0	0,45	0,30	30,0	73,0	13,8	3,9	0,4	0,7	1,0	18,0	12	¾
100	4	6,02-17,12	114,3	102,3-80,1	161,0	216,0	224,0	187,0	113,8	129,96	15,3	8,40	1,0	0,49	0,33	37,0	86,0	16,8	4,8	0,5	0,8	1,0	22,0	12	¾
125	5	9,53-19,05	141,3	122,2-103,2	189,6	252,0	261,0	218,6	139,8	157,93	15,3	9,27	1,0	0,49	0,33	43,0	92,0	19,8	5,7	0,5	0,9	1,0	25,0	12	¾
150	6	10,97-21,95	168,3	146,4-124,4	225,7	297,0	307,0	258,8	167,7	187,94	15,3	10,12	1,5	0,49	0,33	50,0	101,0	23,0	6,6	0,6	1,0	1,0	29,0	12	1
200	8	12,70-25,00	219,1	193,7-169,1	284,4	355,0	365,0	317,4	217,7	239,96	15,3	11,48	1,5	0,49	0,33	60,0	115,0	28,9	8,3	0,7	1,1	1,5	29,0	16	1
250	10	12,70-28,58	273,1	247,7-215,9	354,6	440,0	453,0	393,6	271,7	300,06	15,4	12,90	1,5	0,55	0,37	75,0	136,0	35,1	10,0	0,8	1,3	1,5	35,0	16	1¼
300	12	14,27-33,32	323,9	295,4-257,3	409,3	495,0	508,0	449,0	321,7	349,10	15,4	13,97	1,5	0,58	0,38	83,0	151,0	41,1	11,7	0,8	1,4	1,5	35,0	20	1¼
350	14	19,05-35,71	355,6	317,5-284,2	450,4	544,0	558,0	493,1	353,7	382,15	15,4	14,63	1,5	0,62	0,41	89,0	162,0	44,7	12,8	0,8	1,4	1,5	38,0	20	1½
400	16	21,44-40,49	406,4	363,5-325,4	508,6	611,0	626,0	555,2	405,7	436,12	15,4	15,63	1,5	0,53	0,35	105,0	180,0	50,6	14,5	0,9	1,5	2,0	42,0	20	1½
450	18	23,83-45,24	457,2	409,5-366,7	568,6	687,0	704,0	622,3	455,7	488,31	15,5	16,54	1,5	0,68	0,45	111,0	198,0	56,5	16,1	1,0	1,6	2,0	49,0	20	1¾
500	20	26,19-50,01	508,0	455,6-408,0	634,1	759,0	778,0	690,7	507,7	541,29	15,4	17,63	1,5	0,61	0,41	126,0	217,0	62,4	17,8	1,0	1,7	2,0	52,0	20	1¾
550	22	34,93-53,98	558,8	488,9-450,8	698,3	831,0	850,0	757,9	557,7	593,24	15,4	18,45	2,0	0,53	0,36	142,0	234,0	68,3	19,5	1,1	1,8	2,0	55,0	20	2
600	24	30,96-59,54	609,6	547,7-490,5	762,1	911,0	933,0	829,3	607,7	644,50	15,5	19,23	2,0	0,69	0,46	146,0	253,0	74,2	21,2	1,1	1,9	3,0	62,0	20	2¼
650	26	32,00-60,00	660,4	596,4-540,4	819,7	969,0	990,0	887,0	659,5	697,20	15,3	20,00	2,0	0,49	0,33	172,0	269,0	75,2	21,5	1,1	1,9	3,0	62,0	20	2¼
700	28	36,00-60,00	711,2	639,2-591,2	879,9	1029,0	1051,0	947,2	709,5	749,32	15,4	20,92	2,0	0,54	0,36	182,0	285,0	78,8	22,5	1,2	2,0	3,0	62,0	24	2¼
750	30	36,00-65,00	762,0	690,0-632,0	943,5	1108,0	1132,0	1017,5	761,5	802,59	15,4	21,65	2,0	0,67	0,44	186,0	304,0	82,3	23,5	1,3	2,1	3,0	68,0	24	2¼
800	32	40,00-70,00	812,8	732,8-672,8	966,8	1131,0	1155,0	1040,8	811,5	853,32	15,3	22,32	2,0	0,52	0,35	202,0	311,0	85,8	24,5	1,3	2,2	3,0	68,0	24	2¼
850	34	40,00-75,00	863,6	783,6-713,6	1026,4	1206,0	1232,0	1107,1	861,5	904,35	15,3	22,97	2,0	0,51	0,34	214,0	328,0	89,3	25,5	1,3	2,2	3,0	74,0	24	2¼
900	36	45,00-80,00	914,4	824,4-754,4	1096,6	1308,0	1339,0	1191,3	913,5	958,50	15,4	23,82	2,5	0,57	0,38	222,0	352,0	92,8	26,5	1,4	2,3	3,0	88,0	20	3¼
950	38	50,00-80,00	965,2	865,2-805,2	1156,9	1383,0	1416,0	1257,5	963,5	1009,72	15,4	24,44	2,5	0,66	0,44	226,0	369,0	96,3	27,5	1,4	2,3	3,0	94,0	20	3¼
1000	40	50,00-85,00	1016,0	916,0-846,0	1210,4	1422,0	1452,0	1305,0	1015,5	1062,52	15,4	25,06	2,5	0,54	0,36	250,0	382,0	99,8	28,5	1,4	2,4	3,0	88,0	24	3¼
1050	42	50,00-90,00	1066,8	966,8-886,8	1271,9	1514,0	1549,0	1379,5	1065,5	1113,65	15,4	25,65	2,5	0,58	0,39	257,0	402,0	103,3	29,5	1,5	2,5	3,0	101,0	20	3¾
1100	44	55,00-95,00	1117,6	1007,6-927,6	1323,6	1550,0	1583,0	1424,2	1115,5	1164,52	15,3	26,42	2,5	0,51	0,34	275,0	413,0	106,8	30,5	1,5	2,5	3,0	94,0	24	3¾
1150	46	60,00-110,0	1168,4	1048,4-948,4	1388,9	1631,0	1666,0	1496,5	1167,5	1217,65	15,4	27,00	2,5	0,56	0,37	281,0	433,0	110,3	31,5	1,6	2,6	3,0	101,0	24	3¾
1200	48	60,00-115,0	1219,2	1099,2-989,2	1437,0	1679,0	1714,0	1544,7	1217,5	1268,44	15,3	27,54	2,5	0,47	0,31	303,0	445,0	110,3	31,5	1,6	2,6	3,0	101,0	24	3¾

Table 12 — Dimensions of CL 2500 weld neck (WN) flanges

DN	NPS	t	A	B	DW1	DW2	DW3	BCD	DA1	DA3	αA2	E1	E2	αB1	αB2	HW3	HW5	X	Y	RA	RB	RC	L	n	d _B
15	½	2,77-7,47	21,3	15,8-6,4	49,1	87,0	93,0	67,3	20,8	30,86	15,1	5,30	1,0	0,15	0,10	20,0	51,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
20	¾	2,87-7,82	26,7	21,0-11,1	54,4	92,0	98,0	72,7	25,8	35,86	15,1	5,30	1,0	0,15	0,10	20,0	53,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
25	1	3,38-9,09	33,4	26,6-15,2	61,2	99,0	105,0	79,4	32,8	42,85	15,1	5,30	1,0	0,15	0,10	20,0	56,0	10,5	3,0	0,3	0,5	1,0	15,0	4	½
40	1½	3,68-12,50	48,3	40,9-23,3	77,1	115,0	121,0	95,3	47,8	58,87	15,2	5,58	1,0	0,25	0,17	23,0	64,0	12,4	3,5	0,3	0,5	1,0	15,0	8	½
50	2	3,91-14,20	60,3	52,5-31,9	94,9	140,0	147,0	116,2	59,8	71,89	15,2	6,19	1,0	0,31	0,21	27,0	72,0	14,7	4,2	0,4	0,6	1,0	18,0	8	¾
65	2½	7,01-16,00	73,0	59,0-41,0	115,9	170,0	179,0	141,6	72,8	85,91	15,2	6,79	1,0	0,33	0,22	32,0	81,0	17,0	4,9	0,4	0,6	1,0	22,0	8	¾
80	3	5,49-17,50	88,9	77,9-53,9	137,3	199,0	209,0	166,3	87,8	101,94	15,3	7,42	1,0	0,40	0,27	36,0	85,0	20,0	5,7	0,4	0,7	1,0	25,0	8	¾
100	4	8,56-22,20	114,3	97,2-69,9	167,3	238,0	248,0	200,4	113,8	129,93	15,2	8,40	1,5	0,34	0,23	44,0	95,0	24,6	7,0	0,5	0,8	1,0	29,0	8	1
125	5	15,88-25,0	141,3	109,5-91,3	197,2	268,0	278,0	230,2	139,8	157,91	15,3	9,27	1,5	0,39	0,26	50,0	106,0	29,6	8,5	0,5	0,9	1,0	29,0	12	1
150	6	10,97-30,0	168,3	146,4-108,3	232,7	311,0	322,0	268,8	167,7	187,94	15,3	10,12	1,5	0,41	0,28	58,0	120,0	34,5	9,9	0,6	1,0	1,0	32,0	12	1½
200	8	15,09-36,0	219,1	188,9-147,1	301,6	394,0	408,0	343,7	217,7	239,99	15,3	11,48	1,5	0,44	0,29	72,0	145,0	44,0	12,6	0,7	1,1	1,5	38,0	12	1½
250	10	15,09-45,0	273,1	242,9-183,1	368,4	470,0	485,0	415,0	271,7	300,08	15,3	12,90	1,5	0,49	0,33	88,0	172,0	53,9	15,4	0,8	1,3	1,5	42,0	16	1½
300	12	17,48-55,0	323,9	288,9-213,9	429,6	548,0	564,0	483,2	321,7	349,17	15,4	13,97	1,5	0,55	0,37	99,0	195,0	63,4	18,1	0,8	1,4	1,5	49,0	16	1½
350	14	19,05-55,0	355,6	317,5-245,6	474,6	600,0	618,0	531,2	353,7	382,22	15,4	14,63	1,5	0,56	0,37	108,0	211,0	69,2	19,8	0,8	1,4	1,5	52,0	16	1½
400	16	21,44-65,0	406,4	363,5-276,4	547,8	697,0	718,0	615,1	405,7	436,37	15,4	15,63	2,0	0,62	0,41	125,0	238,0	78,5	22,4	0,9	1,5	2,0	62,0	16	2¼
450	18	23,88-70,0	457,2	409,4-317,2	609,0	758,0	780,0	676,3	455,7	488,28	15,4	16,54	2,0	0,53	0,36	136,0	260,0	88,0	25,1	1,0	1,6	2,0	62,0	16	2¼
500	20	26,19-80,0	508,0	455,6-348,0	661,8	825,0	849,0	735,0	507,7	541,35	15,4	17,63	2,0	0,56	0,37	147,0	282,0	97,3	27,8	1,0	1,7	2,0	68,0	16	2½
550	22	53,98-85,0	558,8	450,8-388,8	735,0	930,0	958,0	821,8	557,7	593,39	15,4	18,45	2,5	0,54	0,36	163,0	310,0	106,8	30,5	1,1	1,8	2,0	81,0	16	3
600	24	52,37-95,0	609,6	504,9-419,6	797,4	1008,0	1039,0	891,3	607,7	644,47	15,4	19,23	2,5	0,56	0,38	176,0	334,0	116,1	33,2	1,1	1,9	3,0	88,0	16	3¼

8.3 Blind flange (BL) dimensions

Dimensions specific to the blind flanges are given in this clause and are defined in Figure 3 and Table 13 and Table 14. The diameter B1 for blind flanges is the diameter of flat and no sealing surface without bevel face angle. All other dimensions are found in Table 7 to Table 12 for the WN flanges.

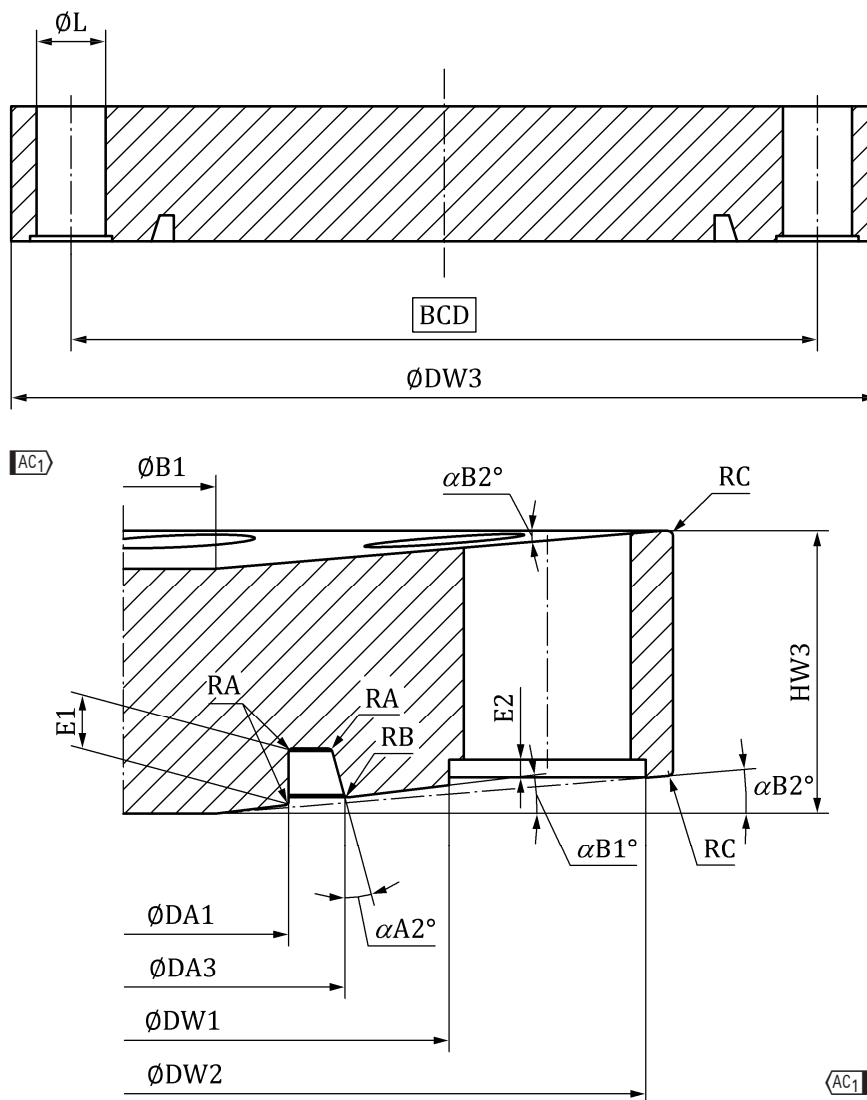


Figure 3 — Nomenclatures for blind flanges (BLs)

Table 13 — Dimensions for CL 150, CL 300 and CL 600 blind flanges (BLs)

		CL 150					CL 300					CL 600				
DN	NPS	B ₁ mm	DA3 mm	αA2 °	αB1 °	αB2 °	B ₁ mm	DA3 mm	αA2 °	αB1 °	αB2 °	B ₁ mm	DA3 mm	αA2 °	αB1 °	αB2 °
15	½	9,0	30,87	15,2	0,27	0,18	9,0	30,87	15,2	0,27	0,18	2,0	30,85	15,1	0,15	0,10
20	¾	13,0	35,87	15,2	0,27	0,18	14,0	35,87	15,2	0,27	0,18	3,0	35,85	15,1	0,15	0,10
25	1	19,0	42,87	15,2	0,27	0,18	19,0	42,87	15,2	0,27	0,18	7,0	42,85	15,1	0,15	0,10
40	1½	31,0	58,85	15,2	0,28	0,18	31,0	58,85	15,2	0,28	0,18	14,0	58,86	15,1	0,20	0,13
50	2	41,0	71,84	15,2	0,27	0,18	41,0	71,84	15,2	0,27	0,18	27,0	71,85	15,1	0,22	0,14
65	2½	49,0	85,83	15,2	0,22	0,15	49,0	85,83	15,2	0,22	0,15	36,0	85,86	15,2	0,25	0,16
80	3	63,0	101,87	15,3	0,44	0,30	63,0	101,87	15,3	0,44	0,30	53,0	101,85	15,2	0,27	0,18
100	4	83,0	129,82	15,2	0,25	0,16	83,0	129,82	15,2	0,25	0,16	71,0	129,85	15,2	0,28	0,18
125	5	104,0	157,76	15,2	0,28	0,19	104,0	157,76	15,2	0,28	0,19	90,0	157,76	15,1	0,20	0,13
150	6	126,0	187,70	15,1	0,15	0,10	126,0	187,72	15,1	0,20	0,13	117,0	187,74	15,1	0,19	0,12
200	8	173,0	239,70	15,2	0,27	0,18	167,0	239,70	15,1	0,20	0,13	155,0	239,72	15,1	0,21	0,14
250	10	218,0	299,66	15,2	0,23	0,15	209,0	299,68	15,1	0,21	0,14	196,0	299,70	15,1	0,20	0,13
300	12	260,0	348,63	15,2	0,22	0,15	250,0	348,63	15,1	0,16	0,11	233,0	348,69	15,2	0,22	0,15
350	14	287,0	381,59	15,1	0,18	0,12	275,0	381,61	15,1	0,17	0,11	257,0	381,68	15,2	0,22	0,15
400	16	328,0	435,60	15,2	0,25	0,17	315,0	435,61	15,1	0,20	0,13	294,0	435,66	15,1	0,22	0,14
450	18	371,0	487,53	15,1	0,19	0,12	355,0	487,56	15,1	0,18	0,12	332,0	487,66	15,2	0,24	0,16
500	20	413,0	540,50	15,1	0,18	0,12	396,0	540,53	15,1	0,17	0,11	369,0	540,62	15,2	0,23	0,15
550	22	456,0	592,47	15,1	0,18	0,12	437,0	592,50	15,1	0,17	0,11	406,0	592,58	15,1	0,21	0,14
600	24	496,0	643,46	15,1	0,21	0,14	478,0	643,50	15,1	0,19	0,13	445,0	643,56	15,1	0,21	0,14
650	26	539,0	696,35	15,1	0,17	0,11	517,0	696,42	15,1	0,19	0,13	483,0	696,48	15,1	0,21	0,14
700	28	581,0	748,32	15,1	0,17	0,12	558,0	748,36	15,1	0,17	0,11	520,0	748,49	15,2	0,23	0,15
750	30	624,0	801,29	15,1	0,17	0,12	598,0	801,37	15,1	0,20	0,13	558,0	801,46	15,2	0,23	0,15
800	32	665,0	852,26	15,1	0,17	0,11	639,0	852,32	15,1	0,17	0,12	595,0	852,42	15,1	0,21	0,14
850	34	707,0	903,23	15,1	0,18	0,12	678,0	903,33	15,1	0,20	0,13	634,0	903,43	15,2	0,23	0,15
900	36	750,0	957,19	15,1	0,17	0,11	719,0	957,26	15,1	0,18	0,12	672,0	957,33	15,1	0,18	0,12
950	38	792,0	1008,17	15,1	0,17	0,12	760,0	1008,24	15,1	0,18	0,12	709,0	1008,36	15,1	0,21	0,14
1000	40	835,0	1061,14	15,1	0,18	0,12	801,0	1061,21	15,1	0,18	0,12	746,0	1061,34	15,2	0,22	0,15
1050	42	876,0	1112,10	15,1	0,17	0,12	840,0	1112,20	15,1	0,19	0,12	784,0	1112,27	15,1	0,19	0,12
1100	44	918,0	1163,05	15,1	0,16	0,10	881,0	1163,18	15,1	0,19	0,13	823,0	1163,26	15,1	0,20	0,13
1150	46	961,0	1216,02	15,1	0,16	0,10	921,0	1216,14	15,1	0,19	0,12	860,0	1216,30	15,2	0,23	0,15
1200	48	1003,0	1266,99	15,1	0,16	0,10	962,0	1267,09	15,1	0,17	0,12	898,0	1267,19	15,1	0,18	0,12

Table 14 — Dimensions for CL 900, CL 1500 and CL 2500 blind flanges (BLs)

DN	NPS	CL 900					CL 1500					CL 2500				
		B ₁ mm	DA3 mm	αA2 °	αB1 °	αB2 °	B ₁ mm	DA3 mm	αA2 °	αB1 °	αB2 °	B ₁ mm	DA3 mm	αA2 °	αB1 °	αB2 °
15	½	2,0	30,85	15,1	0,15	0,10	2,0	30,85	15,1	0,15	0,10	2,0	30,85	15,1	0,15	0,10
20	¾	3,0	35,85	15,1	0,15	0,10	3,0	35,85	15,1	0,15	0,10	3,0	35,85	15,1	0,15	0,10
25	1	7,0	42,85	15,1	0,15	0,10	7,0	42,85	15,1	0,15	0,10	7,0	42,85	15,1	0,15	0,10
40	1½	14,0	58,86	15,1	0,20	0,13	14,0	58,86	15,1	0,20	0,13	14,0	58,86	15,1	0,20	0,13
50	2	27,0	71,85	15,1	0,22	0,14	27,0	71,85	15,1	0,22	0,14	19,0	71,87	15,2	0,24	0,16
65	2½	36,0	85,86	15,2	0,25	0,16	36,0	85,86	15,2	0,25	0,16	26,0	85,88	15,2	0,26	0,17
80	3	53,0	101,85	15,2	0,27	0,18	44,0	101,88	15,2	0,31	0,21	32,0	101,90	15,2	0,29	0,20
100	4	71,0	129,85	15,2	0,28	0,18	60,0	129,88	15,2	0,30	0,20	43,0	129,88	15,2	0,24	0,16
125	5	90,0	157,76	15,1	0,20	0,13	77,0	157,83	15,2	0,29	0,19	56,0	157,84	15,2	0,28	0,18
150	6	109,0	187,75	15,1	0,20	0,13	92,0	187,82	15,2	0,28	0,19	68,0	187,84	15,2	0,26	0,17
200	8	143,0	239,76	15,2	0,24	0,16	122,0	239,80	15,2	0,25	0,17	90,0	239,85	15,2	0,27	0,18
250	10	180,0	299,72	15,1	0,21	0,14	155,0	299,81	15,2	0,26	0,18	114,0	299,87	15,2	0,29	0,19
300	12	216,0	348,71	15,1	0,21	0,14	185,0	348,79	15,2	0,26	0,17	138,0	348,91	15,2	0,32	0,21
350	14	238,0	381,70	15,1	0,22	0,14	204,0	381,81	15,2	0,29	0,19	151,0	381,91	15,2	0,32	0,21
400	16	274,0	435,69	15,2	0,23	0,15	235,0	435,76	15,2	0,23	0,15	175,0	435,99	15,2	0,36	0,24
450	18	308,0	487,69	15,2	0,24	0,16	265,0	487,83	15,2	0,31	0,21	197,0	487,90	15,2	0,29	0,20
500	20	343,0	540,68	15,2	0,25	0,16	294,0	540,79	15,2	0,27	0,18	219,0	540,91	15,2	0,30	0,20
550	22	379,0	592,67	15,2	0,25	0,17	325,0	592,75	15,2	0,24	0,16	243,0	593,00	15,2	0,34	0,23
600	24	413,0	643,67	15,2	0,26	0,17	355,0	643,85	15,2	0,31	0,21	265,0	644,03	15,2	0,35	0,23
650	26	449,0	696,60	15,2	0,26	0,17	386,0	696,62	15,1	0,20	0,13					
700	28	485,0	748,48	15,1	0,18	0,12	417,0	748,63	15,1	0,21	0,14					
750	30	519,0	801,47	15,1	0,19	0,13	445,0	801,72	15,2	0,27	0,18					
800	32	554,0	852,47	15,1	0,20	0,13	476,0	852,56	15,1	0,19	0,13					
850	34	590,0	903,58	15,2	0,28	0,18	507,0	903,54	15,1	0,19	0,13					
900	36	626,0	957,44	15,1	0,20	0,13	537,0	957,61	15,2	0,23	0,15					
950	38	660,0	1008,56	15,2	0,28	0,19	568,0	1008,68	15,2	0,26	0,18					
1000	40	695,0	1061,44	15,2	0,22	0,15	597,0	1061,53	15,1	0,20	0,13					
1050	42	731,0	1112,48	15,2	0,25	0,17	627,0	1112,57	15,2	0,22	0,15					
1100	44	765,0	1163,35	15,1	0,20	0,13	658,0	1163,47	15,1	0,19	0,13					
1150	46	801,0	1216,36	15,1	0,21	0,14	689,0	1216,54	15,1	0,22	0,14					
1200	48	836,0	1267,51	15,2	0,28	0,19	719,0	1267,40	15,1	0,17	0,12					

8.4 Integral flange (IF) dimensions

Dimensions specific to the integral flanges are given in this clause and are defined in Figure 4 and Table 15 to Table 20. All other dimensions are found in Table 7 to Table 12 for the WN flanges. Dimensions for valves shall comply with requirements in ASME B16.34 and ISO 14313. The face angles for the integral flanges are based on the stiffness of flange ring and flange neck as outlined from requirements of ASME B16.34 and ISO 14313. For each flange size, two face angles are listed. One for the minimum neck thickness that can be used, $t_{\min}$, and the other angle is valid for the maximum neck thickness that can be used, $t_{\max}$.

For all integral flanges the face dimensions shall be interpolated between their listed values at maximum and minimum neck thickness. Calculating methods and examples are included in Annex B. The minimum value for flange face angle α_{B1} is set to $0,15^\circ$. Any calculation resulting in smaller angles than $0,15^\circ$ shall select angles and dimension corresponding to $0,15^\circ$.

For all use of the integral flange design it is an imperative requirement that the external transition between the flange ring and the neck has a smooth curvature, with no rapid diametrical steps, notches or other imperfections. The radius 'RV1' tabulated in Table 15 to Table 20 shall be adhered to. This is to prevent local high stress areas at the transition.

Some types of equipment and valves may use an internal nozzle at flange ends, e.g. a corrosion resistant nozzle at inlet of a pressure safety valve. It is then recommended to design this inlet nozzle and the supporting body flange as a rigid construction with no flange angle ($\alpha_{B1} = 0^\circ$, $\alpha_{B2} = 0^\circ$). The thickness of the inlet nozzle and the supporting body flange shall then be minimum $2,5 \times HW3$. The nozzle flange shall have the same external diameter, DW3, as the mating WN flange, or an external forged ring shall provide full closure at the external diameter, DW3, in order to provide a maximum bending moment capacity, and to protect bolting from environmental corrosion etc.

Dimensions and angles in Table 15 to Table 20 and Annex B might not cover equipment body designs with special flange configuration, e.g. funnel-shaped flange neck design differing considerably from a cylindrical design as specified in this standard. It is the equipment supplier's responsibility to verify that their design is in accordance with the general requirements described in this International Standard.

Standard bore diameter within a pressure class may be used if accepted by the purchaser. The standard bore should be selected within the given bore range for the actual size and pressure class. Smaller bore diameters may be accepted if the flange face angle is adjusted according to the actual flange warping stiffness. The flange functionality will not be affected by a bore diameter step at the mating faces between an integral flange and another flange component to this International Standard. However, other functional requirements such as effect on flow patterns, and pigging requirements may require small and tapered step changes at the mating faces.

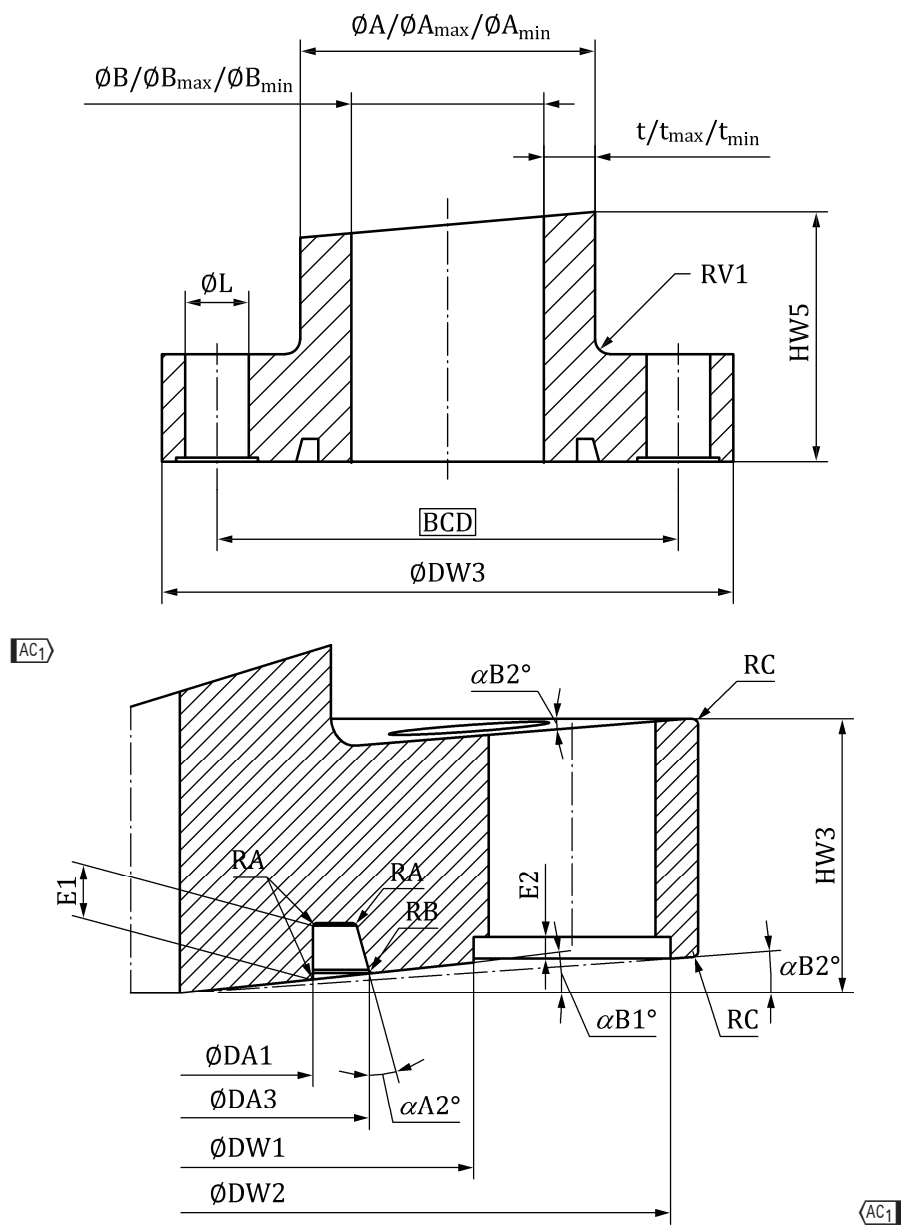


Figure 4 — Nomenclatures for integral flanges

Table 15 — Dimensions for CL 150 integral flanges (IFs)

CL 150									
NPS	DN	t _{min} /t _{max} mm	A _{min} A _{max} mm	B _{max} B _{min} mm	DA3 mm	αA2 °	αB1 °	αB2 °	Rv1 mm
½	15	2,11	21,3	17,1	30,88	15,2	0,30	0,20	3,0
½	15	5,15	22,0	11,7	30,87	15,2	0,24	0,16	3,0
¾	20	2,11	26,7	22,5	35,88	15,2	0,32	0,21	3,0
¾	20	7,70	31,0	15,6	35,86	15,2	0,22	0,15	3,0
1	25	2,77	33,4	27,9	42,88	15,2	0,34	0,23	3,0
1	25	9,15	39,0	20,7	42,85	15,1	0,21	0,14	3,0
1½	40	2,77	48,3	42,8	58,88	15,3	0,42	0,28	3,0
1½	40	6,95	52,0	38,1	58,86	15,2	0,30	0,20	3,0
2	50	2,77	60,3	54,8	71,88	15,3	0,45	0,30	3,0
2	50	8,90	67,0	49,2	71,84	15,2	0,25	0,17	3,0
2½	65	3,05	73,0	66,9	85,86	15,3	0,40	0,27	4,0
2½	65	8,65	80,0	62,7	85,83	15,2	0,23	0,15	4,0
3	80	3,05	88,9	82,8	101,96	15,6	0,90	0,60	4,0
3	80	8,05	94,0	77,9	101,90	15,4	0,58	0,39	4,0
4	100	3,05	114,3	108,2	129,90	15,4	0,59	0,39	4,0
4	100	9,85	122,0	102,3	129,84	15,2	0,35	0,23	4,0
5	125	3,40	141,3	134,5	157,90	15,5	0,75	0,50	4,0
5	125	10,40	149,0	128,2	157,82	15,3	0,46	0,31	4,0
6	150	3,40	168,3	161,5	187,86	15,4	0,61	0,41	4,0
6	150	11,95	178,0	154,1	187,77	15,2	0,35	0,23	4,0
8	200	3,76	219,1	211,6	239,89	15,6	0,90	0,60	4,0
8	200	12,80	232,0	206,4	239,74	15,3	0,38	0,25	4,0
10	250	4,19	273,1	264,7	299,88	15,6	0,82	0,55	6,0
10	250	16,30	293,0	260,4	299,69	15,2	0,30	0,20	6,0
12	300	4,57	323,9	314,8	348,91	15,6	0,91	0,60	6,0
12	300	14,40	340,0	311,2	348,70	15,3	0,40	0,27	6,0
14	350	4,78	355,6	346,0	381,86	15,5	0,78	0,52	6,0
14	350	17,60	375,0	339,8	381,64	15,2	0,28	0,19	6,0
16	400	4,78	406,4	396,8	435,99	15,7	1,07	0,71	6,0
16	400	19,70	430,0	390,6	435,65	15,2	0,37	0,24	6,0
18	450	4,78	457,2	447,6	487,92	15,6	0,91	0,60	6,0
18	450	18,30	478,0	441,4	487,64	15,3	0,38	0,25	6,0
20	500	5,54	508,0	496,9	540,93	15,6	0,93	0,62	6,0
20	500	21,55	532,0	488,9	540,59	15,2	0,34	0,22	6,0
22	550	5,54	558,8	547,7	592,95	15,6	0,95	0,63	6,0
22	550	23,15	586,0	539,7	592,56	15,2	0,33	0,22	6,0
24	600	6,35	609,6	596,9	644,02	15,7	1,03	0,69	6,0
24	600	25,25	641,0	590,5	643,57	15,3	0,37	0,25	6,0
26	650	7,92	660,4	644,6	696,85	15,6	0,84	0,56	6,0
26	650	26,85	695,0	641,3	696,46	15,2	0,31	0,21	6,0
28	700	7,92	711,2	695,4	748,89	15,6	0,89	0,59	6,0
28	700	28,45	749,0	692,1	748,44	15,2	0,31	0,21	6,0
30	750	7,92	762,0	746,2	801,92	15,6	0,92	0,61	6,0
30	750	33,70	804,0	736,6	801,37	15,2	0,27	0,18	6,0
32	800	7,92	812,8	797,0	852,95	15,6	0,95	0,63	6,0
32	800	34,30	856,0	787,4	852,36	15,2	0,28	0,19	6,0
34	850	7,92	863,6	847,8	903,98	15,7	1,00	0,66	6,0
34	850	35,40	909,0	838,2	903,34	15,2	0,29	0,19	6,0
36	900	7,92	914,4	898,6	958,01	15,7	1,00	0,67	6,0
36	900	33,00	955,0	889,0	957,38	15,2	0,36	0,24	6,0
38	950	9,53	965,2	946,1	1009,02	15,7	1,01	0,67	6,0
38	950	35,10	1010,0	939,8	1008,35	15,2	0,36	0,24	6,0
40	1000	9,53	1016,0	996,9	1062,06	15,7	1,03	0,69	6,0
40	1000	38,20	1067,0	990,6	1061,30	15,2	0,33	0,22	6,0
42	1050	9,53	1066,8	1047,7	1113,11	15,7	1,09	0,72	6,0
42	1050	36,30	1114,0	1041,4	1112,33	15,3	0,38	0,25	6,0
44	1100	9,53	1117,6	1098,5	1164,03	15,7	1,01	0,67	8,0
44	1100	36,90	1166,0	1092,2	1163,28	15,2	0,36	0,24	8,0
46	1150	9,53	1168,4	1149,3	1217,08	15,7	1,05	0,70	8,0
46	1150	37,50	1218,0	1143,0	1216,27	15,3	0,37	0,25	8,0
48	1200	9,53	1219,2	1200,1	1268,10	15,7	1,06	0,71	8,0
48	1200	38,60	1271,0	1193,8	1267,26	15,3	0,37	0,25	8,0