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ICS 23.040.60

Einsprüche bis 2011-04-30

Entwurf

**Erdöl- und Erdgasindustrie –
Kompakte Flanschverbindungen mit IX Dichtungsring
(ISO/DIS 27509:2011);
Englische Fassung prEN ISO 27509:2011, nur auf CD-ROM**

Petroleum and natural gas industries –
Compact flanged connections with IX seal ring (ISO/DIS 27509:2011);
English version prEN ISO 27509:2011, only on CD-ROM

Industries du pétrole et du gaz naturel –
Raccordements à brides compactes avec bague d'étanchéité IX (ISO/DIS 27509:2011);
Version anglaise prEN ISO 27509:2011, seulement en CD-ROM

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Gesamtumfang 113 Seiten

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Normenausschuss Rohrleitungen und Dampfkesselanlagen (NARD) im DIN

Nationales Vorwort

Dieses Dokument (prEN ISO 27509:2011) wurde vom Technischen Komitee ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“, SC 6/ Working Group WG 5 „Piping systems“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 12 „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ (Sekretariat: AFNOR, Frankreich) erarbeitet.

Für Deutschland hat hieran der Arbeitsausschuss NA 109-00-01 AA „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie — Spiegelausschuss zu CEN/TC 12“ im Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) des DIN Deutsches Institut für Normung e. V. mitgearbeitet.

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Dieses Dokument enthält neben den gesetzlichen Einheiten auch die Einheiten „°F“, „in (inch)“, „NPS“ und „psi (psig)“ die in Deutschland nicht zugelassen sind. Es wird ausdrücklich darauf hingewiesen, dass die Anwendung dieser Einheiten im nationalen amtlichen und geschäftlichen Verkehr aufgrund des Gesetzes über Einheiten im Messwesen nicht zulässig ist.

Umrechnung:

Nicht-SI-Einheit	SI-Einheit	Umrechnung	
°F	°C	°C	= (5/9) (°F-32)
in (inch)	mm	1 inch	= 25,4 mm
NPS	DN	1 NPS	= DN 25
psi (psig)	kPa	1 psi	= 6,894 757 kPa

Für die in diesem Dokument zitierten Internationalen Normen wird im Folgenden auf die entsprechenden Deutschen Normen hingewiesen:

ISO 2768-1	siehe DIN ISO 2768-1
ISO 4200	siehe DIN 2460, DIN EN 10224, DIN EN 10311
ISO 4287	siehe DIN EN ISO 4287
ISO 4288	siehe DIN EN ISO 4288
ISO 5167-1	siehe DIN EN ISO 5167-1
ISO 5167-2	siehe DIN EN ISO 5167-2
ISO 14313	siehe DIN EN 13942

Nationaler Anhang NA (informativ)

Begriffe und Abkürzungen

Die Benennung der folgenden Begriffe und Abkürzungen ist identisch mit der Benennung in der englischen Fassung.

3 Begriffe und Abkürzungen

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe und Abkürzungen:

3.1 Begriffe

3.1.1

können/kann

Verbform zur Bezeichnung materieller, physikalischer oder nicht voraussehbarer Möglichkeiten und Fähigkeiten

3.1.2

Class

CL

Druckklasse nach ASME (siehe ASME B16.5 und ASME B16.34)

3.1.3

Kompaktflanschverbindung

CFC

nicht abgedichtete, statische Schraubverbindung von Rohren mit zwei Flanschen, bei denen die Schraubenkräfte zwischen den Dichtflächen durch metallischen Kontakt übertragen werden

3.1.4

Dichtung (für nicht bewegte Bauteile)

Sperre, die den Durchgang von strömenden Medien (Fluiden) verhindert und alle Kräfte zwischen den Flanschen überträgt

ANMERKUNG Siehe EN 1591-1, Bild 3.

3.1.5

dürfen, darf

Verbform zur Bezeichnung einer Vorgehensweise, die im Rahmen dieser Internationalen Norm zulässig ist

3.1.6

Käufer

Person oder Organisation, die den Kauf der Rohrverbindung im Auftrag eines Anwenders und/oder Betreibers oder zur eigenen Verwendung abwickelt

3.1.7

Dichtung (für bewegte Bauteile)

Bauteil, das eine Sperre für den Durchgang von strömenden Medien (Fluiden) bietet und keine signifikanten Kräfte zwischen den Flanschen überträgt

3.1.8**müssen/muss**

Verbform zur Bezeichnung von Anforderungen, die unbedingt einzuhalten sind, um Übereinstimmung mit dieser Internationalen Norm zu erreichen und von denen Abweichungen nur unter Zustimmung aller betroffenen Parteien zulässig sind

3.1.9**sollten/sollte**

Verbform, die darauf hinweist, dass von mehreren Möglichkeiten eine als besonders geeignet empfohlen wird, ohne andere Möglichkeiten zu erwähnen oder auszuschließen oder dass eine bestimmte, nicht unbedingt erforderliche Vorgehensweise zu bevorzugen ist

3.1.10**Lieferant**

Person oder Organisation, die für die Lieferung der Rohrverbindung und ihrer Übereinstimmung mit der vorliegenden Internationalen Norm verantwortlich ist

3.2 Abkürzungen

API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BL	Blindflansch
CFC	Kompaktflanschverbindung; Compact-Flanschverbindung
CL	Klasse
DN	Nenndurchmesser des Rohres (mm)
EN	Europäische Norm
ID	Innendurchmesser
IF	Integralflansch (als Bestandteil eines anderen Ausrüstungselements oder Bauteils)
ISO	International Organisation für Normung
IX	spezieller Dichtring aus Metall, der nach Abschnitt 4 angewendet wird
LB	Steckscheiben (einschließlich PS und PB)
NPS	Nennweite des Rohres (Zoll)
OD	Außendurchmesser
OS	Orificeflanschzwischenstück
PB	Paddelblindflanschzwischenstück
PN	Nenndruck (bar)
PS	Paddelflanschzwischenstück
PTFE	Polytetrafluorethylen (Teflon®)
RI	starre Kontaktfläche
RT	Reduzierflansch mit Gewinde
WN	Anschweißende

Nationaler Anhang NB (informativ)

Literaturhinweise

DIN 2460, *Stahlrohre und Formstücke für Wasserleitungen*

DIN EN 10224, *Rohre und Fittings aus unlegiertem Stahl für den Transport von Wasser und anderen wässrigen Flüssigkeiten — Technische Lieferbedingungen*

DIN EN 10311, *Verbindungen für Stahlrohre und Fittings für den Transport von Wasser und anderen wässrigen Flüssigkeiten*

DIN EN 13942, *Erdöl- und Erdgasindustrie — Rohrleitungstransportsysteme — Rohrleitungsarmaturen*

DIN EN ISO 4287, *Geometrische Produktspezifikation (GPS) — Oberflächenbeschaffenheit: Tastschnittverfahren — Benennungen, Definitionen und Kenngrößen der Oberflächenbeschaffenheit*

DIN EN ISO 4288, *Geometrische Produktspezifikation (GPS) — Oberflächenbeschaffenheit: Tastschnittverfahren — Regeln und Verfahren für die Beurteilung der Oberflächenbeschaffenheit*

DIN EN ISO 5167-1, *Durchflussmessung von Fluiden mit Drosselgeräten in voll durchströmten Leitungen mit Kreisquerschnitt — Teil 1: Allgemeine Grundlagen und Anforderungen*

DIN EN ISO 5167-2, *Durchflussmessung von Fluiden mit Drosselgeräten in voll durchströmten Leitungen mit Kreisquerschnitt — Teil 2: Blenden*

DIN ISO 2768-1, *Allgemeintoleranzen — Toleranzen für Längen- und Winkelmaße ohne einzelne Toleranzeintragung*

— Leerseite —

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English Version

**Petroleum and natural gas industries —
Compact flanged connections with IX seal ring
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Industries du pétrole et du gaz naturel —
Raccordements à brides compactes avec bague
d'étanchéité IX
(ISO/DIS 27509:2011)

Erdöl- und Erdgasindustrie —
Kompakte Flanschverbindungen mit IX Dichtungsring
(ISO/DIS 27509:2011)

This draft European Standard is submitted to CEN members for parallel enquiry. It has been drawn up by the Technical Committee CEN/TC 12.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (prEN ISO 27509:2011) 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.

This document is currently submitted to the parallel Enquiry.

Endorsement notice

The text of ISO/DIS 27509:2011 has been approved by CEN as a prEN ISO 27509:2011 without any modification.

Introduction

This International Standard, which is based on NORSOK L-005, is developed to provide a standard for compact flanged connections (CFCs) which is an alternative to conventional flanges as specified in ASME standards, European Standards and International Standards, with reduced weight and smaller overall dimensions. In addition leak tightness reliability is increased by its inherent design features and make up procedures. The CFC may also be an alternative to other types of clamp and hub type mechanical connectors.

The use of load carrying sealing elements, traditionally referred to as "gaskets", will normally violate the fundamental requirements 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.

Informative annexes cover the following topics:

- weights of all standard components;
- structural capacity equations for flange assemblies;
- layout considerations when designing piping systems with compact flanges;
- how to apply the flanges to special geometries of valves and equipment nozzles;

installation and assembly instructions, and guidelines on how to repair damage and irregularities on sealing surfaces.

1 Scope

This International Standard specifies detailed manufacturing requirements for circular steel and nickel alloys 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 CL 2500 (PN 420) for nominal sizes from DN 15 (NPS ½) to DN 600 (NPS 24).

NOTE 1 NPS is in accordance with ASME B36.10M and ASME B36.19M.

Flanges included in this International Standard are 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 petroleum, petrochemical and natural gas industries.

This International Standard covers the temperature range from -196 °C to +250 °C.

NOTE 2 For systems operating at temperatures above +250 °C the effects of differential thermal expansion and bolt relaxation may affect the functionality of the joint.

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.

ASME B16.5, *Pipe Flanges and Flanged Fittings*

ASME B16.20, *Metallic Gaskets For Pipe Flanges: Ring Joint Spiral Wound And Jacketed*

ASME B16.25, *Butt welding ends*

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

ASME B18.2.2, *Square and Hex Nuts (Inch Series)*

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

ASME B31.3, *Process Piping*

ASME B36.10M, *Welded and Seamless Wrought Steel Pipe*

ASME B36.19M, *Stainless Steel Pipe*

ASME VIII, Div. 2:2004, *Boiler and Pressure Vessel Code – Alternative Rules*

ASTM A193, *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-temperature Service*

ASTM A320, *Standard Specification for Allow-Steel and Stainless Steel Bolting for Low-Temperature Service*

EN 1092-1:2001, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 1: Steel flanges*

EN 1779:1999, *Non-destructive testing — Leak testing - Criteria for method and technique selection*

EN 13480 (all parts), *Metallic industrial piping -*

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

ISO 4200, *Plain end steel tubes, welded and seamless. General tables of dimensions and masses per unit length*

ISO 4287, *Geometrical product specification (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 4288, *Geometric Product Specification (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, *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*

3 Terms, definitions and abbreviations

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

3.1 Terms and definitions

3.1.1

can

verbal form used for statements of possibility and capability, whether material, physical or casual

3.1.2

class

CL

ASME pressure class (see ASME B16.5 and ASME B16.34)

3.1.3

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

3.1.4

gasket

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

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

3.1.5

may

verbal form used to indicate a course of action permissible within the limits of this International Standard

3.1.6

purchaser

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

3.1.7

seal

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

3.1.8

shall

verbal form used to indicate requirements 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

3.1.9

should

verbal form used to indicate 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

3.1.10

supplier

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

3.2 Abbreviations

API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BL	blind flange
CFC	compact flanged connection
CL	class
DN	nominal pipe diameter (mm)
EN	European Standard
ID	internal diameter
IF	integral flange (as part of some other equipment or component)
ISO	International Organisation for Standardisation
IX	special metallic seal ring applied in Clause 4
LB	line blinds (including PS and PB)
NPS	nominal pipe size (in)

OD	outer diameter
OS	orifice spacer
PB	paddle blank
PN	nominal pressure (bar)
PS	paddle spacer
PTFE	polytetrafluoroethylene (Teflon®)
RI	rigid interface
RT	reducing threaded flange
WN	weld neck

4 Design

4.1 General

This subclause specifies the minimum design requirements CFCs shall fulfil in order to be compliant with this International Standard.

CFCs shall be

- designed for face-to-face make-up for transfer of the bolt loading through the flange faces,
- designed so that a static mode is maintained in the bolted joint up to a specified static mode pressure defined by the purchaser. Static mode is maintained as long as the difference between maximum and minimum nominal load sustained by the bolts in the joint does not exceed 5 % of the minimum guaranteed load, which would produce a permanent elongation of 2% after relaxation, when measured from zero to static mode pressure at room temperature, and at minimum required bolt preload. The static mode pressure shall be equal to or greater than the hydrostatic test pressure.
- standardised 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.
- standardised to fit with commonly used standards by the valve industry (e.g. ASME B16.34, ISO 14313 and EN 12516-series), and other valve standards, which make reference to these standards for pressure design.
- weakest part of flanged connections according to this International Standard regarding fatigue failure will always be located somewhere in the transition from flange to pipe or flange to nozzle neck of an equipment or valve. The bolted joint itself will never be subjected to fatigue load if considerations to cycling temperatures are taken when selecting bolt material, see 6.2.

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 standardised 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, see 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 1,8 times the flange 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. This pressure will also represent the static mode pressure. 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.

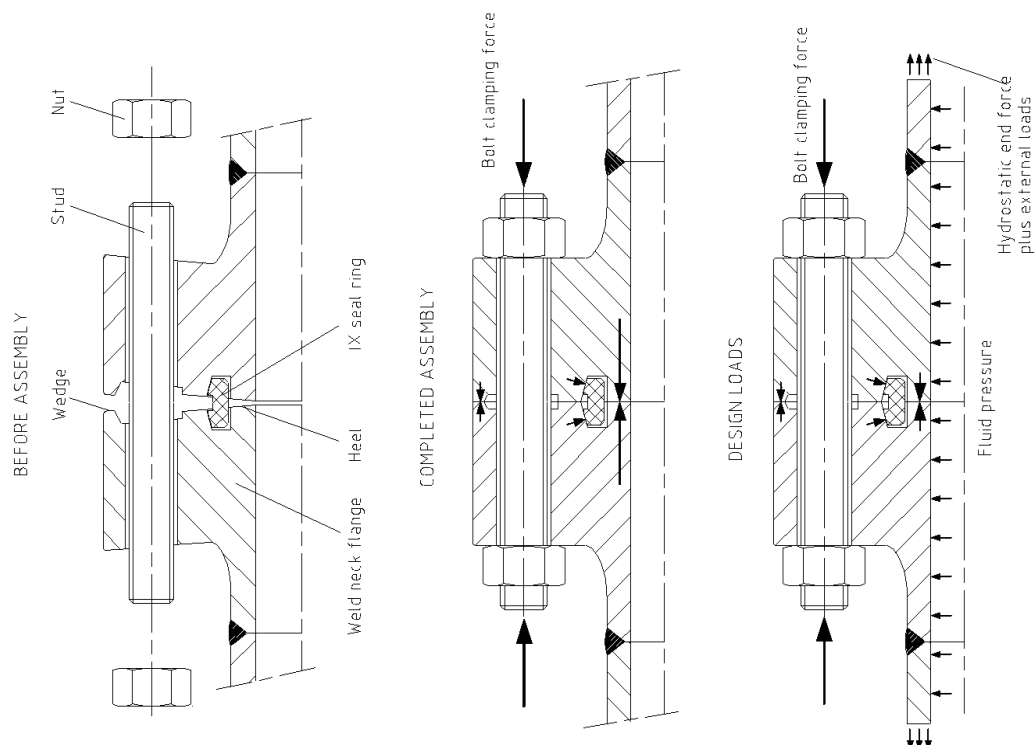


Figure 1 — Design principles of standard compact flange assemblies

4.3 Single seal option

The main function of the heel surfaces together with the convex bevel of the flange faces is to provide sufficient compression between heel surfaces after assembly so that separation will never occur within allowable load limits. This provides constant static sealing conditions for the IX seal ring independent of load variations in the piping.

To verify quality of the seal ring performance after assembly through pressure testing of the piping, and for the reason explained above, the purchaser may specify that the heel seal shall be punctured by a radial groove from the bore to the ring groove. Surface finish of the heel surface can then be reduced to 6,3 μm , ref. Table 27, and scratches and dents on the heel surface may not be repaired. However, high spots shall be removed.

4.4 Assembly requirements

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

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
1/2-UNC	44
5/8-UNC	71
3/4-UNC	106
7/8-UNC	147
1-UNC	193
1 1/8-8UN	255
1 1/4-8UN	325
1 3/8-8UN	405
1 1/2-8UN	492
1 5/8-8UN	589
1 3/4-8UN	693
1 7/8-8UN	807
2-8UN	929
2 1/4-8UN	1199
2 1/2-8UN	1503
2 3/4-8UN	1667
3-8UN	2004
3 1/4-8UN	2373
3 1/2-8UN	2773
3 3/4-8UN	3204
4-8UN	3666

4.5 Standard components

The types of flanges 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

4.6 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.

4.7 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 31-0:1992, Annex B, Rule A.

4.8 Compliance to this International Standard

This product standard is in accordance with ASME VIII Div.2:2004, Appendix 4 and Appendix 6, and has been developed for use in process piping, see ASME B31.3 and EN 13480 (all parts). Additional requirements may be relevant for other applications, e.g. in subsea installations and pipeline risers for the oil and gas industry.

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

In line with EN 1092-1, the following shall designate the flanges in accordance with this International Standard:

- flange type abbreviation according to Table 2;
- number of this International Standard;
- the letter 'S' added if option 'single seal' to Clause 4.3 has been specified.
- 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 with single seal, nominal size DN 200 and with material ASTM A516 grade 70 (low temperature carbon steel):

BL/ISO 27509/S/DN200/CL2500/A516gr70

EXAMPLE 3 Designation of a RT flange in CL900, nominal size DN 25, threaded outlet not specified (DN 15 NPT is default, see A.8), and with material ASTM A182F316 (stainless steel):

RT/ISO 27509/DN25/CL900/DN15NPT/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 standard.

6.2 Flange materials

Flanges covered by this International Standard shall be made from raw material products as listed in Table 2. The standardised 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. For lower strength materials, the flange size, the bolt pre-tension force and flange face angle shall be determined based on the actual design requirements.

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 8. Standards for examination and acceptance criteria shall be those referenced in the applied Piping Design Code.

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	$T_{des} \leq 20\text{ °C}$	$T_{des} = 50\text{ °C}$	$T_{des} = 100\text{ °C}$	$T_{des} = 150\text{ °C}$	$T_{des} = 200\text{ °C}$	$T_{des} = 250\text{ °C}$
$d \leq 2\frac{1}{2}"$	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 Annex F 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. Thread tolerances shall be considered in the nut strength evaluation.

Imperial or metric standard bolts threaded at both ends or full length may be used. Heavy hex nuts shall be used. The choice of bolt thread standard may affect assembly and bolt preloading procedures. Annex F is based on imperial bolting dimensions, while Annex H 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. Care shall be taken by selecting an appropriate bolt material for the above effects. Within the temperature limits of this standard, it is acceptable to use low alloy bolting in austenitic flange materials. In such applications, washers shall be applied under the nuts in order to avoid indenting the nut into the flange with the result of loss of pre-load.

Washers shall be in same or equivalent grade of material as the nuts.

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 used 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 Annex F. 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.

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
(Fine grained) carbon steel	-50 °C to +250 °C	Carbon steel or low alloy steels, e.g. CS360LT or AISI 4140
Stainless steel	-50 °C to +250 °C	22Cr Duplex
Stainless steel	-50 °C to +250 °C	17/4-PH
Austenitic stainless steel and nickel alloys	-196 °C to +250 °C	Nickel alloys such as Alloy 625 or similar
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 may 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 §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

Pressure class		Class abbreviation	Nominal pressure		ASME pressure rating ceiling values	
					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	155,2
Class	1500	CL 1500	PN	260	3 750	258,6
Class	2500	CL 2500	PN	420	6 250	431,0

Flanged connections covered by a class in this International Standard will exceed the maximum rating of the corresponding ASME B16.5 class within the temperature range as defined by this International Standard. This corresponds to a utilization factor 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 tapings, see clause 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 (Pa·m³/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	•	Equal to CL 2500	Equal to CL 2500	Equal to CL 2500	•
20	¾		•				•
25	1		•				•
40	1 ½		•				•
50	2		•	Equal to CL1500	Equal to CL1500	•	•
65	2 ½		•			•	•
80	3		•	Equal to CL 900	•	•	•
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	•	•	•	•	•	

NOTE "Equal to CL xxxx" means that the dimensions are equal for the referred pressure class, the flange shall then be marked with the higher pressure class, see 9.4.

8.2 Symbols

A = outside diameter of neck

Amax = the maximum outer diameter to accommodate standard tools

Amin	=	minimum neck outer diameter listed in Table 7 to Table 12
Area015	=	the cross section area of the neck/pipe calculated from t015.
Areaeqv	=	the cross section area of a special flange neck geometry calculated from teqv
B	=	bore diameter, the bore should not exceed the maximum listed bore in this International Standard
Bmax	=	maximum listed bore diameter
Bmin	=	the minimum bore diameter for which the face angles are valid
B1	=	minimum bore diameter for flange to be blinded. Also start diameter for blind and reducing threaded flange face angle
Da1	=	ID of groove
Da3	=	OD of groove
dB	=	bolt size
BCD	=	bolt circle diameter
DW1	=	inner recess diameter
DW2	=	outer recess diameter
DW3	=	outside diameter of flange
DW4	=	flange to neck fillet OD
E1	=	depth of groove
E2	=	depth of recess
E3	=	depth of recess for gasket
HP1	=	thickness of PB, PS and OS
HW3	=	flange thickness
HW5, HT5	=	overall length
L	=	bolt hole diameter
L1,L2,L3	=	bolt hole depths
nB	=	number of bolts
R1	=	radius
R2	=	radius
R3	=	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_{015} = the wall thickness giving the smallest possible face angle ($0,15^\circ$)

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

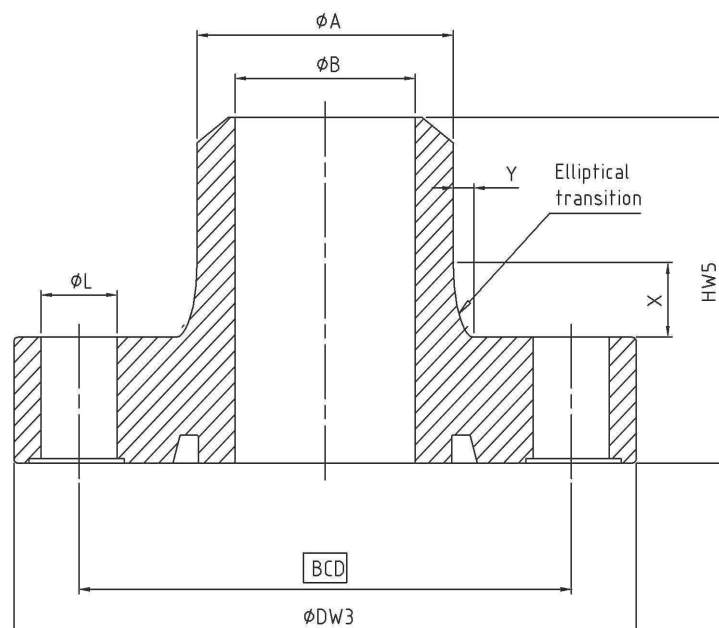
$\alpha B2$ = effective face angle/rear face bevel angle

8.3 Weld neck (WN) dimensions

The minimum outside diameter of the WN of 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 8.5 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.



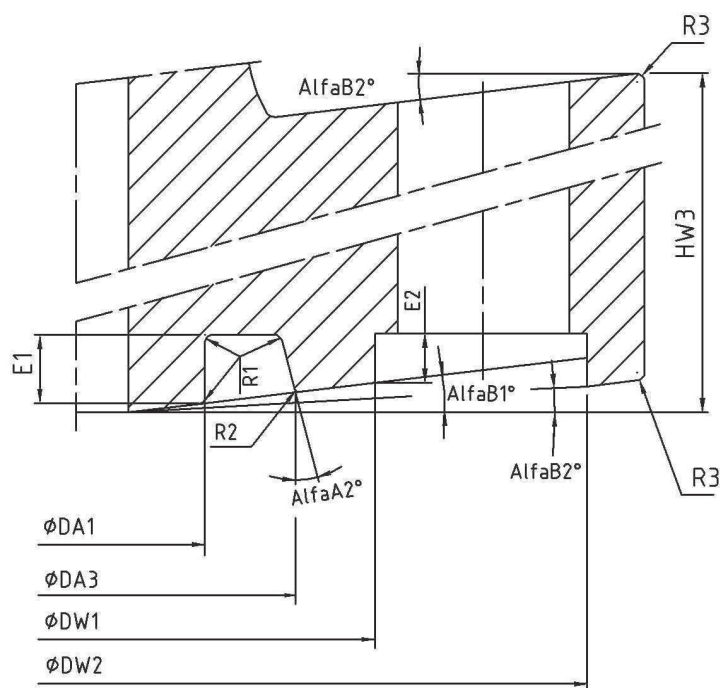


Figure 2 — Nomenclatures for weld neck (WN) flanges

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

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

DN	NPS	t mm	A mm	B mm	DW1 mm	DW2 mm	DW3 mm	BCD mm	DA1 mm	DA3 mm	●A2 °	E1 mm	E2 mm	●B1 °	●B2 °	HW3 mm	HW5 mm	X mm	Y mm	R1 mm	R2 mm	R3 mm	L mm	n	d _B in
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 mm	A mm	B mm	Dw1 mm	Dw2 mm	Dw3 mm	BCD mm	DA1 mm	DA3 mm	●A2 °	E1 mm	E2 mm	●B1 °	●B2 °	Hw3 mm	Hw5 mm	X mm	Y mm	R1 mm	R2 mm	R3 mm	L mm	n	d _b in
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	⅝
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	⅝
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	⅝
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	⅝
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	⅞
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	⅞
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	1⅞
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	1⅞
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	1¼
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	1¼
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	1¼
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	1¼
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	1⅞
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	1⅞
1150	46	12.70-25.0	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	12.70-25.0	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 mm	A mm	B mm	Dw1 mm	Dw2 mm	Dw3 mm	BCD mm	DA1 mm	DA3 mm	$\alpha A2$ °	E1 mm	E2 mm	$\alpha B1$ °	$\alpha B2$ °	Hw3 mm	Hw5 mm	X mm	Y mm	R1 mm	R2 mm	R3 mm	L mm	n	d _b in
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	0.61	0.40	53.0	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	0.68	0.45	60.0	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	64.0	113.0	20.7	5.9	0.8	1.4	1.5	25.0	24	¾
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	73.0	122.0	23.2	6.6	0.9	1.5	2.0	29.0	24	1
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	80.0	131.0	25.7	7.3	1.0	1.6	2.0	32.0	24	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	86.0	139.0	28.1	8.0	1.0	1.7	2.0	32.0	28	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	94.0	149.0	30.6	8.7	1.1	1.8	2.0	35.0	24	1¼
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	100.0	158.0	33.0	9.4	1.1	1.9	3.0	35.0	28	1¼
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	105.0	166.0	35.5	10.1	1.1	1.9	3.0	35.0	32	1¼
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	112.0	176.0	37.9	10.8	1.2	2.0	3.0	38.0	32	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	118.0	185.0	40.4	11.5	1.3	2.1	3.0	38.0	36	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	126.0	195.0	42.8	12.2	1.3	2.2	3.0	42.0	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	133.0	205.0	45.3	12.9	1.3	2.2	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	145.0	214.0	47.3	13.5	1.4	2.3	3.0	45.0	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	147.0	223.0	49.0	14.0	1.4	2.3	3.0	49.0	32	1¼
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	153.0	232.0	50.8	14.5	1.4	2.4	3.0	49.0	36	1¼
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	165.0	241.0	52.5	15.0	1.5	2.5	3.0	52.0	32	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	170.0	249.0	54.3	15.5	1.5	2.5	3.0	52.0	36	1½
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	174.0	262.0	56.0	16.0	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	189.0	270.0	57.8	16.5	1.6	2.6	3.0	55.0	36	2

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

DN	NPS	t mm	A mm	B mm	Dw1 mm	Dw2 mm	Dw3 mm	BCD Mm	DA1 mm	DA3 mm	$\alpha A2$ °	E1 mm	E2 mm	$\alpha B1$ °	$\alpha B2$ °	Hw3 mm	Hw5 mm	X mm	Y mm	R1 mm	R2 mm	R3 mm	L mm	n	d _b in
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	⅝
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	⅝
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	⅝
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	⅞
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	1⅞
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	1¼
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	1⅞
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	1⅞
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	1¾
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	1¾
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	1⅞
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	2¼
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	2¼
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 mm	A mm	B mm	Dw1 mm	Dw2 mm	Dw3 mm	BCD mm	DA1 mm	DA3 mm	$\alpha A2$ °	E1 mm	E2 mm	$\alpha B1$ °	$\alpha B2$ °	Hw3 mm	Hw5 mm	X mm	Y mm	R1 mm	R2 mm	R3 mm	L mm	n	d _b in
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	⅝
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	⅞
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	1⅝
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	1⅞
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	2½
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	2½
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	2¾
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	3½
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	3½
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 mm	A mm	B mm	Dw1 mm	Dw2 mm	Dw3 mm	BCD mm	DA1 mm	DA3 mm	$\alpha A2$ °	E1 mm	E2 mm	$\alpha B1$ °	$\alpha B2$ °	Hw3 mm	Hw5 mm	X mm	Y mm	R1 mm	R2 mm	R3 mm	L mm	n	d _b In
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	⅝
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	⅞
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	1⅝
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	1⅝
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	1¾
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	1⅞
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