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Entwurf

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Erdöl- und Erdgasindustrie – Kompakte Flanschverbindungen mit IX Dichtungsring (ISO/DIS 27509:2019); Englische Fassung prEN ISO 27509:2019, nur auf CD-ROM

Petroleum and natural gas industries – Compact flanged connections with IX seal ring (ISO/DIS 27509:2019); English version prEN ISO 27509:2019, only on CD-ROM

Industries du pétrole et du gaz naturel – Raccordements à brides compactes avec bague d'étanchéité IX (ISO/DIS 27509:2019); Version anglaise prEN ISO 27509:2019, seulement en CD-ROM

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2019-08-23 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfs besonders zu vereinbaren.

Stellungnahmen werden erbeten

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- oder als Datei per E-Mail an noeg@din.de möglichst in Form einer Tabelle. Die Vorlage dieser Tabelle kann im Internet unter www.din.de/go/stellungnahmen-norm-entwuerfe oder für Stellungnahmen zu Norm-Entwürfen der DKE unter www.dke.de/stellungnahme abgerufen werden;
- oder in Papierform an den DIN-Normenausschuss Erdöl- und Erdgasgewinnung (NÖG), 10772 Berlin, Saatwinkler Damm 42/43, 13627 Berlin.

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 130 Seiten

DIN-Normenausschuss Erdöl- und Erdgasgewinnung (NÖG)

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Nationales Vorwort

Der Text von ISO/DIS 27509:2019 wurde vom Technischen Komitee ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“ der Internationalen Organisation für Normung (ISO) erarbeitet und als prEN ISO 27509:2019 durch das Technische Komitee CEN/TC 12 „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ übernommen, dessen Sekretariat von NEN (Niederlande) gehalten wird.

Für Deutschland hat hieran der Arbeitskreis NA 109-00-01-06 AK „Verfahrenstechnische Anlagen und Ausrüstungen“ im DIN-Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) mitgearbeitet.

Dieser Europäische Norm-Entwurf enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Originalfassung der ISO Norm.

Diese Norm 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. Die Angabe dieser Einheiten dient lediglich als Hilfe im amtlichen und geschäftlichen Verkehr (z. B. bei Einfuhr und Ausfuhr) mit solchen Staaten, die diese Einheiten anwenden.

Umrechnung:

Nicht-SI-Einheit	**SI-Einheit**	**Umrechnung**
°F	°C	°C = (5/9) (°F-32)
in (inch)	mm	1 in = 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 Dokumente wird im Folgenden auf die entsprechenden deutschen Dokumente hingewiesen:

ISO 898-2	siehe	DIN EN ISO 898-2
ISO 2768-1	siehe	DIN ISO 2768-1
ISO 4287	siehe	DIN EN ISO 4287
ISO 4288	siehe	DIN EN ISO 4288
ISO 5167-1	siehe	DIN EN ISO 5167-1
ISO 5167-2:2003	siehe	DIN EN ISO 5167-2:2004-01
ISO 9001	siehe	DIN EN ISO 9001
ISO 80000-1:2009	siehe	DIN EN ISO 80000-1:2013-08
ISO/TS 29001	siehe	DIN CEN ISO/TS 29001 (DIN SPEC 91241)

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Änderungen

Gegenüber DIN EN ISO 27509:2013-10 wurden folgende Änderungen vorgenommen:

a) normative Verweisungen aktualisiert;

b) Überarbeitung der Begriffe und Abkürzungen;

c) Unterabschnitt 7.2 überarbeitet;

d) Tabelle 32 erweitert;

e) Abschnitt 12 und Abschnitt 13 überarbeitet;

f) Anhang D umfassend überarbeitet;

g) redaktionelle Überarbeitung.

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Begriffe und Abkürzungen

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

3 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

— ISO Online Browsing Platform: verfügbar unter http://www.iso.org/obp

— IEC Electropedia: verfügbar unter http://www.electropedia.org/

3.1
Class
Druckklasse nach ASME in Übereinstimmung mit ASME B16.5 und ASME B16.34

3.2
Kompaktflanschverbindung
nicht abgedichtete, statische Schraubverbindung von Rohren mit zwei Flanschen, bei denen die Schraubenkräfte zwischen den Dichtflächen durch metallischen Kontakt übertragen werden

3.3
Dichtung (für nicht bewegte Bauteile)
Sperre, die den Durchgang von strömenden Medien (Fluiden) verhindert und alle Kräfte zwischen den Flanschen überträgt

3.4
Käufer
Person oder Organisation, die den Kauf der Rohrverbindung im Auftrag des Anwenders und/oder Betreibers oder zur eigenen Verwendung abwickelt

3.5
Dichtung (für bewegte Bauteile)
Bauteil, das eine Sperre für den Durchgang von strömenden Medien (Fluiden) bietet und keine signifikanten Kräfte zwischen den Flanschen überträgt

3.6
Lieferant
Person oder Organisation, die für die Lieferung der Rohrverbindung und ihre Übereinstimmung mit dem vorliegenden Dokument verantwortlich ist

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4 Symbole und Abkürzungen

4.1 Abkürzungen

BL Blindflansch (en: blind flange)

CFC Kompaktflanschverbindung (en: compact flanged connection)

CL Class (en: class)

DN Nenndurchmesser des Rohres (angegeben in Millimeter) [en: nominal pipe diameter]

ID Innendurchmesser (en: internal diameter)

IF Integralflansch (als Bestandteil eines anderen Ausrüstungselements oder Bauteils) [en: integral flange]

IX spezieller Dichtring aus Metall, der nach diesem Dokument angewendet wird

LB Steckscheiben (einschließlich PS und PB) [en: line blinds]

NPS Nennweite des Rohres (angegeben in Zoll) [en: nominal pipe size]

OD Außendurchmesser (en: outer diameter)

OS Orificeflanschzwischenstück (en: orifice spacer)

PB Paddelblindflanschzwischenstück (en: paddle blank)

PN Nenndruck (angegeben in bar) [en: nominal pressure]

PS Paddelflanschzwischenstück (en: paddle spacer)

PTFE Polytetrafluorethylen (en: polytetrafluoroethylene)

RI starre Kontaktfläche (en: rigid interface)

RT Reduzierflansch mit Gewinde (en: reducing threaded flange)

WN Anschweißende (en: weld neck)

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4.2 Symbole

A	Außendurchmesser des Ansatzes
A_{max}	maximaler Außendurchmesser zur Aufnahme von Standardwerkzeugen
A_{min}	kleinster Außendurchmesser des Ansatzes entsprechend der Auflistung in Tabelle 7 bis Tabelle 12
$Area_{015}$	aus t_{015} berechnete Querschnittsfläche des Ansatzes/Rohres
$Area_{eqv}$	aus Gleichung (B.5) berechnete Querschnittsfläche der Geometrie des Ansatzes bei einem Sonderflansch
A_b	Gesamtquerschnittsfläche der Verschraubung, bezogen auf die Fläche am Gewindekern
B	Bohrungsdurchmesser, wobei die Bohrung nicht größer als die maximale in diesem Dokument aufgeführte Bohrung sein sollte
B_{max}	maximaler aufgeführter Bohrungsdurchmesser
B_{min}	kleinster Bohrungsdurchmesser, für den die Flanschblattneigungen gelten
B1	kleinster Bohrungsdurchmesser für Blindflansch

ANMERKUNG B1 ist außerdem Anfangsdurchmesser für die Flanschblattneigung von Blindflanschen und Reduzierflanschen mit Gewinde.

BCD	Lochkreisdurchmesser
d_B	Schraubengröße (Nenndurchmesser der Schraube)
d_n	effektiver Kontaktdurchmesser der Stirnseite der Mutter (Mittelwert zwischen der Schlüsselweite und dem Durchmesser der Schraubenbohrung)
d_p	mittlerer Durchmesser des Ansatzendes = (A+B)/2
d_t	effektiver (mittlerer) Kontaktdurchmesser der Schraubengewinde
DA1	Innendurchmesser der Nut
DA3	Außendurchmesser der Nut
DG4	Dichtungsdurchmesser des Dichtrings (siehe Bild 13)
DW1	Innendurchmesser der Aussparung
DW2	Außendurchmesser der Aussparung
DW3	Außendurchmesser des Flansches
DW4	Außendurchmesser Flansch bis Kehlnaht des Ansatzes
e	radialer Abstand zwischen BCD und d_p

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e_B	(DW3+DW2)/4−BCD/2
e_p	(DW3+DW2)/4−(A+B)/4
E1	Tiefe der Nut
E2	Tiefe der Aussparung
F_A	aufgebrachte Axialkraft
F_{cB}	Gesamtkapazität von Schrauben zur Aufnahme plastischer Beanspruchungen (Fläche am Gewindekern × Anzahl der Schrauben × Dehngrenze)
F_f	axiale Tragfähigkeit des Flansches ohne Einwirkung von Abstützkräften
F_{fp}	axiale Tragfähigkeit des Flansches einschließlich Einwirkung von Abstützkräften
F_{End}	berechnete Kraft des Dichtungskörpers auf den Dichtringdurchmesser
F_P	geforderte Schraubenvorspannung
F_R	resultierende Kraft aus der äußeren Zugkraft F_A und dem äußeren Biegemoment M_A
f_y	Dehngrenze des Flanschwerkstoffes bei einer bestimmten Temperatur
f_{yb}	Dehngrenze des Schraubenwerkstoffes bei einer bestimmten Temperatur
HP1	Dicke von PB, PS und OS
HW3	Flanschdicke
HW5, HT5	Gesamtlänge
L	Durchmesser der Schraubenbohrung
L1, L2, L3	Tiefe der Schraubenbohrung
l	lichte Länge der Schraube zwischen mit Muttern eingeschraubten Gewinden
M_A	aufgebrachtes Biegemoment
n	Anzahl der Schrauben
Pt	Gewindesteigung der Schraube
p	Innendruck in N/mm^2
RA	Radius
RB	Radius
RC	Radius (höchster aufgeführter Wert)

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RV1	Radius Ansatz bis Flanschring bei festen Flanschen
T	auf die Schraube aufgebrachter Drehmoment
t	Rohrwanddicke
t_{min}	anwendbare Mindestdicke des Ansatzes, welche durch den Normrohr-Außendurchmesser A und den maximalen aufgeführten Bohrungsdurchmesser B_{max} festgelegt ist
t_{max}	maximale anwendbare Dicke des Ansatzes, welche durch A_{max} und den kleinsten aufgeführten Bohrungsdurchmesser festgelegt ist
t_{015}	Wanddicke, die die kleinstmögliche Flanschblattneigung (0,15°) ergibt
t_{eqv}	äquivalente Wandstärke berechnet aus $Area_{eqv}$ über HW5
W_f	Wölbmoment des Flansches
X	große Halbachse einer Ellipse
Y	kleine Halbachse einer Ellipse
αA2	Nutwinkel
αB1	Fasenwinkel des Flanschblattes
αB2	effektive Flanschblattneigung/Fasenwinkel der Rückseite
Δ	Anteil der ursprünglich aufgebrachten Vorspannung, der bei der Übertragung der Last der Schraube vom Spannwerkzeug auf die Mutter verloren geht
ψ	Nutzungsgrad des Flansches
μ_n	Reibungskoeffizient der Mutternauflagefläche
μ_t	Reibungskoeffizient der Schraubengewinde

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Nationaler Anhang NB
(informativ)

Literaturhinweise

DIN CEN ISO/TS 29001 (DIN SPEC 91241), *Erdöl-, petrochemische und Erdgasindustrie — Sektorspezifische Qualitätsmanagementsysteme — Anforderungen an Hersteller- und Serviceorganisationen*

DIN EN ISO 898-2, *Mechanische Eigenschaften von Verbindungselementen aus Kohlenstoffstahl und legiertem Stahl — Teil 2: Muttern mit festgelegten Festigkeitsklassen — Regelgewinde und Feingewinde*

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 5167-2:2004-01, *Durchflussmessung von Fluiden mit Drosselgeräten in voll durchströmten Leitungen mit Kreisquerschnitt — Teil 2: Blenden (ISO 5167-2:2003); Deutsche Fassung EN ISO 5167-2:2003*

DIN EN ISO 9001, *Qualitätsmanagementsysteme — Anforderungen*

DIN EN ISO 80000-1:2013-08, *Größen und Einheiten — Teil 1: Allgemeines (ISO 80000-1:2009 + Cor 1:2011); Deutsche Fassung EN ISO 80000-1:2013*

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

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Foreword

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

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

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

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 6, *Processing equipment and systems*.

This second edition cancels and replaces the first edition (ISO 27509:2012), which has been technically revised.

The main changes from the previous edition have been made to reduce risk of mistakes and quality issues, which have been the major cause to a limited use of the first edition of this document. The main changes are as follows:

— Annexes B and D (Annex E in previous edition) have become normative annexes, because they contain requirements.

— More stringent quality requirements regarding manufacture of products and assembly instructions have been introduced. These include:

  — ultrasonic testing of products according to new requirements in ASME VIII div. 2 (in Clause 7);

  — the importance of stringent requirements to material strength and machining strictly according to given tolerances for IX seal rings (in Clause 12);

  — new and better coating requirements for IX seal rings (in Clause 13 and Annex D);

  — requirements about quality assurance and control and conformance of products according to EN 10204.3.1 (in Clause 15);

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- excluding use of IX seal rings to assist alignment by transfer of significant shear load during assembly (in Annex D)
- more comprehensive and detailed guidelines on the evaluation of damages to products and the repair of such damages (in Annex D);
- more comprehensive requirements to qualification of bolt tensioning procedures (in Annex D).

— The elastoplastic deformation of flanges by first assembly has been better explained in 5.3 and in Annex D, in order to prevent unnecessary re-machining or rejection when flange bevel angles have changed.

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

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Introduction

This document, which is originally based on NORSOK L-005, 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 document.

This document has been developed for use in process piping systems, which are designed according to codes for pressure piping, e.g. ASME B31.3. See 5.7 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 document.

The main body of this document 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.

The normative annexes A, B, C and D cover the following topics:

— structural capacity equations for flange assemblies;

— how to apply the flanges to special geometries of valves and equipment nozzles;

— bolt dimensions and masses;

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

The informative annexes E, F and G cover the following topics:

— masses of all standard components;

— suitable dimensions of alternative metric bolting;

— additional information on bibliographical references.

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For the purposes of this document, the following verbal forms apply:

— "shall" indicates a requirement strictly to be followed in order to conform to this document 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 document;

— "can" is used for statements of possibility and capability, whether material, physical or casual.

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

1 Scope

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

This document is not applicable for external pressure.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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*

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

EN 1591-4, *Flanges and their joints — Part 4: Qualification of personnel competency in the assembly of the bolted connections of critical service pressurized systems*

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

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EN 10204, *Metallic products — Types of inspection documents*

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*

ASTM B568, *Standard Test Method for Measurement of Coating Thickness by X-Ray Spectrometry*

ASTM B571, *Standard Practice for Qualitative Adhesion Testing of Metallic Coatings*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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

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

3.1
class
ASME pressure class in accordance with ASME B16.5 and ASME B16.34

3. 2
compact flanged connection
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

3.3
gasket
barrier to prevent the passage of fluids, but which does transmit all loads between flanges

3. 4
purchaser
individual or organization that buys the pipe connection on behalf of the user and/or operator or for its own use

3. 5
seal
component providing a barrier to prevent the passage of fluids, transmitting no significant loads between the flanges

3.6
supplier
individual or organization that takes the responsibility for the supply of the pipe connection and its conformance with this document

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4 Abbreviations and symbols

4.1 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 this document
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 (expressed in bar)
PS	paddle spacer
PTFE	polytetrafluoroethylene
RI	rigid interface
RT	reducing threaded flange
WN	weld neck

4.2 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}
$Area_{eqv}$	cross-sectional area of a special flange neck geometry calculated from Formula (B.5)
A_b	total cross-sectional area of bolting, based on root area
B	bore diameter, where the bore should not exceed the maximum listed bore in this document

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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 (nominal bolt diameter)
d_n	effective contact diameter of nut face (average between width of cross flats and diameter of bolt hole)
d_p	average diameter of neck end = (A+B)/2
d_t	effective (mean) contact diameter of bolting threads
DA1	internal diameter of groove
DA3	outer diameter of groove
DG4	seal ring seal diameter (see Figure 13)
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
F_A	applied axial force
F_{cB}	bolt total plastic capacity (root area× number of bolts× 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_P	required bolt preload

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F_R	resulting force from external tension force F_A and external bending moment M_A
f_y	flange material yield strength at temperature
f_{yb}	bolt 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
l	clear bolt length between engaged threads with the nuts
M_A	applied bending moment
n	number of bolts
Pt	thread pitch of bolting
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	torque applied to the bolt
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}	maximum neck thickness that can be used which is defined by A_{max} and the minimum listed bore diameter
t_{015}	wall thickness giving the smallest possible face angle (0,15°)
t_{eqv}	equivalent wall thickness calculated from $Area_{eqv}$ over HW5
W_f	Warping moment capacity of flange
X	half major ellipse axis
Y	half minor ellipse axis
αA2	groove angle

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αB1	flange face bevel angle
αB2	effective face angle/rear face bevel angle
Δ	fraction of the initially applied pre-stress lost in transfer of bolt load from tension tool to the nut
ψ	flange utilization ratio
μ_n	coefficient of friction of nut bearing surface
μ_t	coefficient of friction of bolting threads

5 Design

5.1 General

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

a) They have been designed for face-to-face make-up for transfer of the bolt loading through the flange faces.

b) 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 8.2. 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.

c) 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.

d) They have been standardized to fit with commonly used standards by the valve industry (e.g. ASME B16.34, ISO 14313 and EN 12516 (all parts)), and other valve standards which make reference to these standards for pressure design.

e) CFCs shall comply with the applicable requirements in the piping or pressure vessel code agreed between the supplier and the purchaser.

The weakest part of flanged connections according to this document 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 7.3.

Supplier specific CFCs may refer to this document when additional requirements to the minimum requirements specified in this document are agreed between purchaser and supplier. The intension is to allow alternative and additional designs to the products in this document without compromising any of the listed items a), b) and e) in this subclause as well as the requirements of 8.1 and 8.3.

5.2 Design principles

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

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

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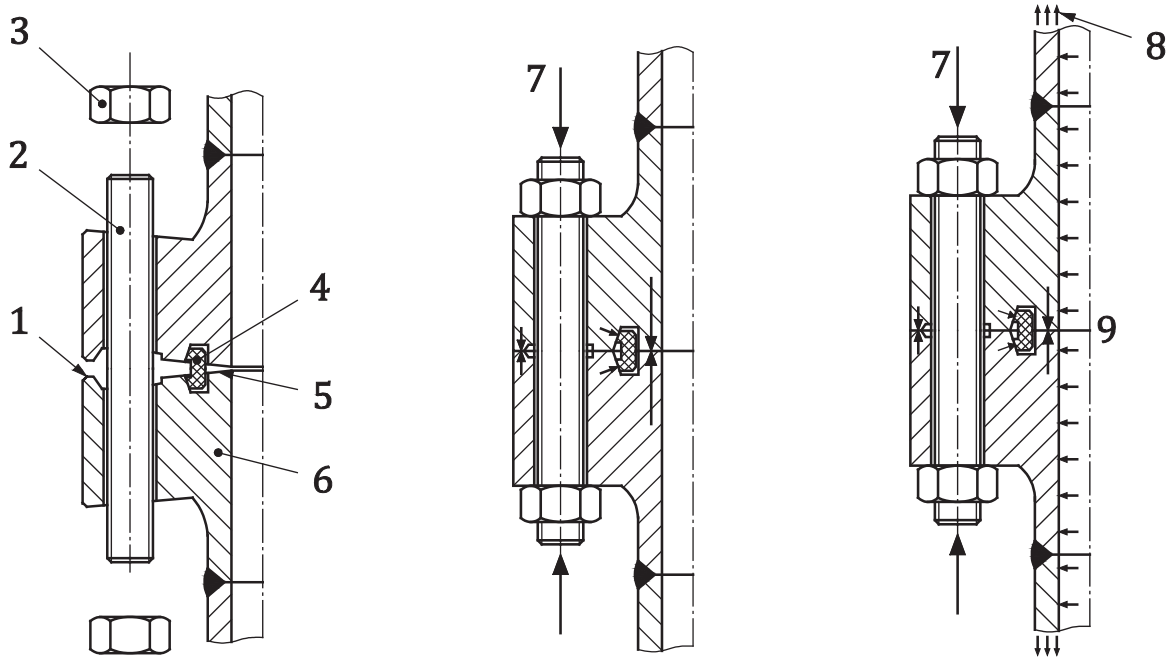
have been standardized for different and relevant adjoining pipe wall thicknesses for each welding neck flange of a given size and pressure class.

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.



a) Before assembly **b) Completed assembly** **c) Design loads**

Key

1 Wedge
2 Stud
3 Nut
4 IX seal ring
5 Heel
6 Weld neck flange
7 Bolt clamping force
8 Hydrostatic end force plus external loads
9 Fluid pressure

Figure 1 — Design principles of standard compact flange assemblies

The principle design of the flange face includes two independent seals, which are based on different principles, a force controlled heel seal, and a displacement controlled seal provided by the seal ring. The first seal is created by application of seal seating stress at the flange heel. However, an undamaged flange heel might 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.

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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.

5.3 Assembly requirements

In order to comply with the design principles as described in 5.2, it is mandatory to assemble the flanged connections to target bolt loads according to Table 1. See Annex D for detailed advice on how to assemble compact flanges.

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

The flange dimensions can be checked according to the tolerances in Table 28. Note that the flange gap at DW3 defined by angle αB2 can change after the first assembly. This is because the flange angles are standardized and can be changed by plastic deformation to a more optimal value through shake down to elastic conditions, by the first assembly. Such local plastic deformations have no influence on further flange functionality and shall not be a reason for flange face re-machining request or flange rejection. See Annex D for further guidance on evaluating flange dimensions in the field.

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

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

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5.4 Standard components

The types of flanges covered by this document 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

5.5 Units of measurements

In this document, 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.

5.6 Rounding

Except as otherwise required by this document, 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.

5.7 Compliance with piping design codes

Although not listed as a component standard in ASME B31.3, all components contained in this document fulfil the requirements for unlisted piping components in ASME B31.3. This is based on full compliance:

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 document.

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].

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d) Compact flanges according to this document was 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.

5.8 Compliance to this document

The manufacturer shall be responsible for complying with all of the applicable requirements of this document. 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.

6 Designation

6.1 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 document;

— 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

6.2 Designation of seal rings

The IX seal ring shall be designated as described below:

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— 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

7 Materials

7.1 General

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

7.2 Flange materials

Flanges covered by this document shall be made from base material product forms as listed in Table 2. The standardized bevel angle as described in 5.2 is applicable for steel and nickel alloys, which are covered in this document.

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 document is 205 MPa at room temperature. For flanges with HW3 > 150 mm, the minimum specified yield strength is 300 MPa.

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.

Materials shall be ultrasonically tested in accordance with ASME VIII div. 2. This requirement is applicable to all flange components made from forgings, forged bars and plates.

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 8.2. Examination and acceptance criteria shall be agreed between purchaser and manufacturer, but sealing surfaces shall satisfy requirements in 9.12.

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, and the indicated number "1") as well as in the crotch radius for the IF (see Figure 4, "RV1") manufactured in line with this document.

7.3 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.

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

Bolt nominal diameter, d_B	T_{des} **≤ 20 °C**	T_{des} **= 50 °C**	T_{des} **= 100 °C**	T_{des} **= 150 °C**	T_{des} **= 200 °C**	T_{des} **= 250 °C**
d ≤ 2 ½”	725 MPa	713 MPa	672 MPa	648 MPa	632 MPa	613 MPa
2 ½” < d ≤ 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. Nuts to ISO 898-2 should not be used in order to reduce the risk of nut thread stripping.

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. Hex nuts with a minimum height equal to one nominal bolt diameter shall be used. The choice of bolt thread standard can affect assembly and bolt preloading procedures. Annex D is based on imperial bolting dimensions, while Annex F 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 document, 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 5, 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.

Non-destructive examination of bolts and nuts shall be in accordance with ASME VIII div.2.

If super duplex bolting is used, the pre-loading method should be qualified to ensure that the average total residual pre-load is achieved. The procedure of Annex D.11 shall be followed. The particular requirement for super duplex bolting, is related to the possible high friction if torqued and the cold creep tendency of this material.

7.4 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.

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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
Carbon steel and low alloy 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 The hardness difference requirement between seal ring and seat/groove for RTJ and BX rings in ASME and API flange assemblies is not applicable for the deformation controlled IX seal ring in this document. This is because the force transmitted through the IX seal is much smaller than for the load controlled RTJ type gasket. In an ASME flanged connection, all bolt forces are used to energize the gasket by plastic deformation. In a compact flanged connection to this document, only in the order of 5 to 10 % of bolt pre-load is used to elastically deform the seal. Due to the low force transmitted there are no possible issues with local deformations/dents in the groove. In fact, the hardness of the seal ring material will normally be higher than the hardness of the groove surface of the flange.

NOTE 3 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 water.

NOTE 4 A lubricant is needed on the seal ring to groove contact face in order to obtain low friction and to prevent galling when the seal ring is sliding down the tapered groove during assembly. See also 13 for coating and colour coding.

8 Strength, pressure/temperature ratings and leak tightness

8.1 General

CFCs shall generally have a level of structural safety that is comparable to that of the connecting pipe. CFCs 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.

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8.2 Pressure/temperature ratings

Flanges covered by this document 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 [a]	
					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

[a] These values are applicable at room temperature, and are for information only.

Flanged connections covered by a class in this document will exceed the maximum rating of the corresponding ASME B16.5 class and material within the temperature range as defined by this document. 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 7.2 regarding cast flanges).

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.

8.3 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 document, should undergo a hydrostatic pressure test before installation in order to verify appropriate quality of welded pressure tappings; see 9.8.

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 × m^3/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.

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9 Dimensions of flanges

9.1 General

A summary of the DNs applicable to each rating class is given in Table 6.

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 CL1500[a]	Equal to CL1500[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	–	–	–	–	–	

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DN	NPS	CL 150	CL 300	CL 600	CL 900	CL 1500	CL 2500
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.							

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 D.6).

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

9.2 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 9.4 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.

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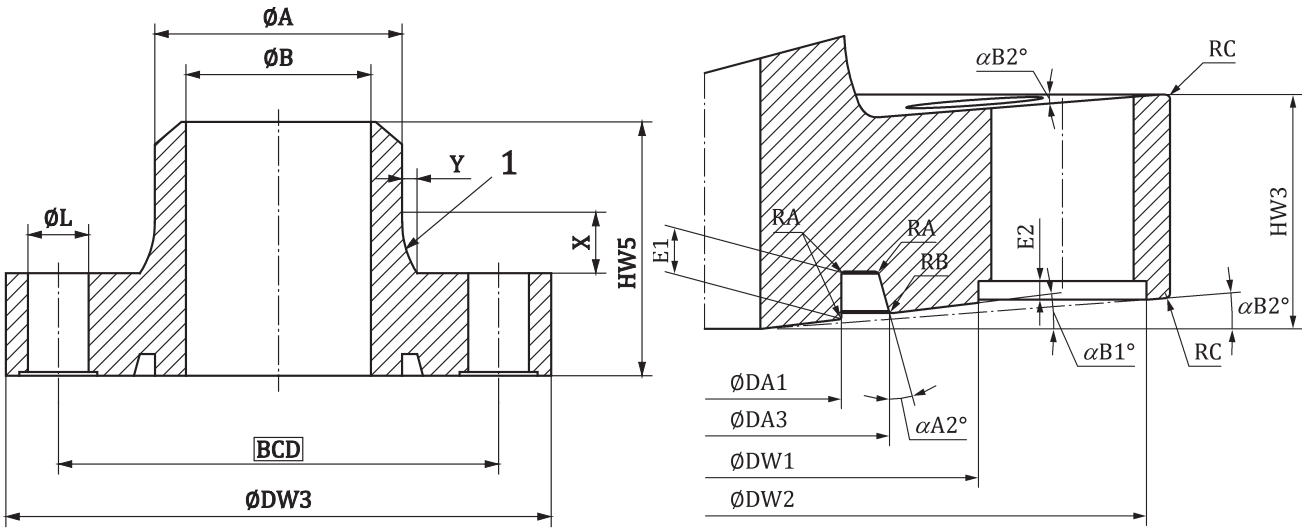

Key

1 Elliptical transition

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

Figure 2 — Nomenclatures for weld neck (WN) flanges

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
		mm	mm	mm	mm	mm	mm	mm	mm	mm	°	mm	mm	°	°	mm	mm	mm	mm	mm	mm	mm	mm		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	⅝

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DN	NPS	t mm	A mm	B mm	DW1 mm	DW2 mm	DW3 mm	BCD mm	DA1 mm	DA3 mm	αA2 °	E1 mm	E2 mm	αB1 °	αB2 °	HW3 mm	HW5 mm	X mm	Y mm	RA mm	RB mm	RC mm	L mm	n	d_B in
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	⅝
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	⅝
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	⅝
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	⅞
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	⅞
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	⅞
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	⅞
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	⅞
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	⅞
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	⅞

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	αA2 °	E1 mm	E2 mm	αB1 °	αB2 °	HW3 mm	HW5 mm	X mm	Y mm	RA mm	RB mm	RC 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

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DN	NPS	t mm	A mm	B mm	DW1 mm	DW2 mm	DW3 mm	BCD mm	DA1 mm	DA3 mm	αA2 °	E1 mm	E2 mm	αB1 °	αB2 °	HW3 mm	HW5 mm	X mm	Y mm	RA mm	RB mm	RC mm	L mm	n	d_B in
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	1⅛
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	1⅛
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	1⅜
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	1⅜
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	αA2 °	E1 mm	E2 mm	αB1 °	αB2 °	HW3 mm	HW5 mm	X mm	Y mm	RA mm	RB mm	RC 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

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DN	NPS	t mm	A mm	B mm	DW1 mm	DW2 mm	DW3 mm	BCD mm	DA1 mm	DA3 mm	αA2 °	E1 mm	E2 mm	αB1 °	αB2 °	HW3 mm	HW5 mm	X mm	Y mm	RA mm	RB mm	RC mm	L mm	n	d_B in
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	⅝
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	⅝
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	⅝
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	⅝
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	⅞
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	⅞
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	1 ⅛
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	1 ⅛
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	1 ⅜
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	1 ⅜
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	1 ⅝
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	1 ⅝
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	1¾
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	1¾

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DN	NPS	t mm	A mm	B mm	DW1 mm	DW2 mm	DW3 mm	BCD mm	DA1 mm	DA3 mm	αA2 °	E1 mm	E2 mm	αB1 °	αB2 °	HW3 mm	HW5 mm	X mm	Y mm	RA mm	RB mm	RC mm	L mm	n	d_B in
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	1 7/8
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	1 7/8
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	αA2 °	E1 mm	E2 mm	αB1 °	αB2 °	HW3 mm	HW5 mm	X mm	Y mm	RA mm	RB mm	RC 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	1⅛
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	1⅜
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	1⅝

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