YOUR 360° SEALING PARTNER

Joint Integrity Management

JOINT INTEGRITY MANAGEMENT | CHEMICAL RESISTANCE | ANSI VS DIN | LIST OF PRODUCT TESTING | STANDARD CROSS REFERENCE TABLE FOR MAIN ALLOYS

CF®

Enviromental sustainability

Main norms and reference standards

One of the main CF values is sustainability. This includes the sustainable and future-oriented development of materials and sealing systems that allow the implementation of and compliance with ever increasing requirements for the reduction of harmful emissions.

Our R&D and Engineering management be provided with the most advanced technologies, benefit specific training and support programs by international partners, Zulu Joint Integrity www.zulujointintegrity.co.uk is one of these, for the purpose to promote knowledge, exchange of information and experience and define procedures for obtaining the expected results.

The main European reference standard on the reduction of environmental impacts and industrial emissions.

IPPC DIRECTIVE 96/61/CE - 2010/75/EU

IPPC stands for Integrated Pollution Prevention and Control or integrated control and prevention of pollution.

This approach was introduced with the Directive 96/61/EC of 24 November 1996, also known as the IPPC Directive". The IPPC Directive provides for a new approach to reducing the environmental impacts of industrial emissions, through the gradual application a set of technical solutions (plant engineering, management and control put in place to avoid or, if it is possible, to reduce emissions of pollutants into the air, in water and soil, including waste measures.

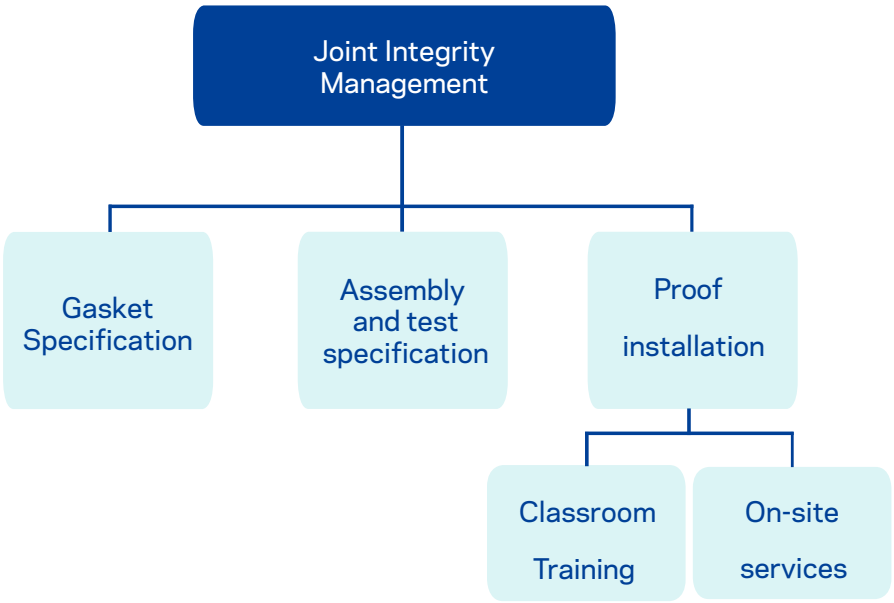
The IPPC Directive introduced important innovative aspects in the assessment of components which, as an integral part of a company's production process, interact with the environment:

- adoption of an integrated approach in evaluation environmental aspects without compromising the economic development of the sector;
- emission limit value based BAT (Best available techniques), which design activities and operational procedures" in such a way as to prevent - or where that is not possible - reduce harmful emissions and negative effects on the environment.

Joint Integrity Management

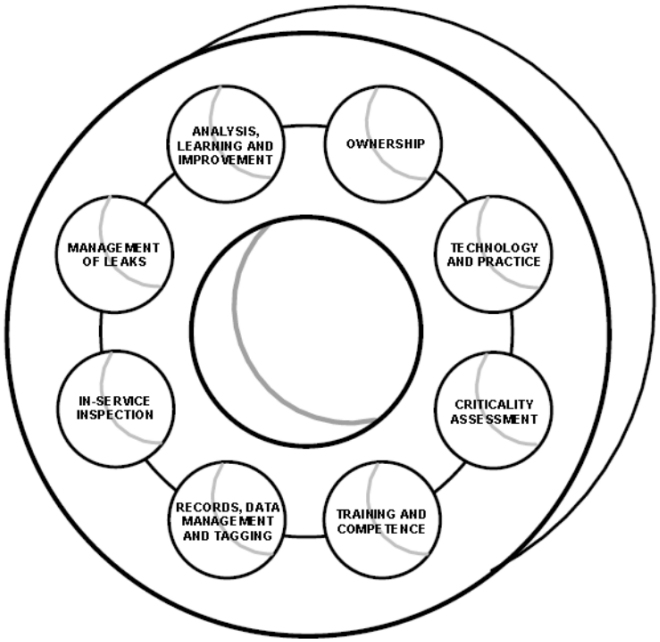
A global approach

CF services allow our customers to planning efficient and controlled processes to become environmentally and economically sustainable and avoid accidents affecting plants or people. CF is a qualified development consultant, the production, installation and maintenance of sealing systems for industrial applications



JOINT INTEGRITY PROCESS

1. Establish the specifications of the gaskets, the type of bolts, the lubrication and the tightening procedure and the bolt torque value based on the permissible leakage rate with regard to the fluid to be contained.
2. Develop procedures for field personnel who perform tightening by specifying the procedures for selecting, installing and tightening flanged couplings.
3. Select only specialized, competent and trained personnel on the specifications, see point 1).
4. Verify and activate a control system to verify that the described procedures are applied (TAG control method).
5. Make the verification of the couplings traceable for the purpose of acquiring information usable also in the future (eg critical couplings).



Costumer is followed by a 3 steps program:

1. Gasket specification
2. Assembly and test specification
3. Proof installation

Gasket Specification

The requirements for sealing connections and the restrtiction of harmful emissions have been increasing steadily over the past years.

National and European regulatory requirements, like the Pressure Equipment Directive, demand a significantly more detailed depth of verification due to stricter environmental requirements [e.g. TA luft, VDI 2200/2440, 2290 for Germany].

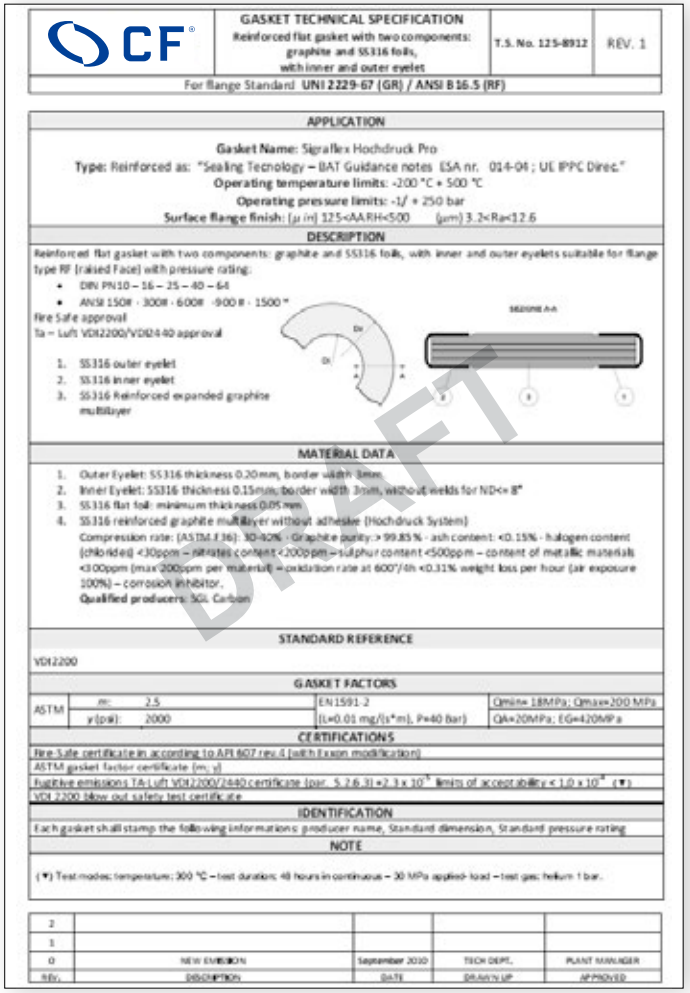
Gasket parameters are key components in the calculation of flanged connections.

The European standard DIN EN 13555 and its ASME section VIII div 1 app. -2 and PVRC METHOD in the United States specifies the distinctive parameters of gaskets and materials for seals and provide test procedures for establish the values of these parameters to be included in the calculations according to ASME or EN1591.

The aim of the calculations using the algorithm of DIN EN 1591-1 or ASME is the definition of the minimum value and maximum clamping value to be applied to the flanged joint when the seal has been selected and verified stability for the flange itself.

The calculation specifies the required tightening torque, this value is mandatory and independent of whether the gasket has a standard or custom design.

CF offers customers analytical procedures and studies in accordance with ASME and DIN EN 1591-1 for the calculation of flange connections and pipe classes.



CF®

GASKET TECHNICAL SPECIFICATION
Reinforced flat gasket with two components: graphite and SS316 foils, with inner and outer eyelet

T.S. No. 125-8912 | REV. 1

For flange Standard UNI 2229-67 (GR) / ANSI B 16.5 (RF)

APPLICATION

Gasket Name: Sigraflex Hochdruck Pro
Type: Reinforced as: "Sealing Tecnology – BAT Guidance notes ESA nr. 014-04 ; UE IPPC Direc."
Operating temperature limits: -200 °C ÷ 500 °C
Operating pressure limits: -1/ ÷ 250 bar
Surface flange finish: (µ in) 125<AA.RH<500 (µm) 3.2<Ra<12.6

DESCRIPTION

Reinforced flat gasket with two components: graphite and SS316 foils, with inner and outer eyelets suitable for flange type RF (raised Face) with pressure rating:

- DIN PN10 – 16 – 25 – 40 – 64
- ANSI 150# - 300# - 600# -900# - 1500 #

Fire Safe approval
Ta – Luft VDI2200/VDI2440 approval

1. SS316 outer eyelet
2. SS316 inner eyelet
3. SS316 Reinforced expanded graphite multilayer

MATERIAL DATA

1. Outer Eyelet: SS316 thickness 0.20 mm, border width 3mm
2. Inner Eyelet: SS316 thickness 0.15 mm, border width 3mm, without welds for ND<= 8"
3. SS316 flat foil: minimum thickness 0.05 mm
4. SS316 reinforced graphite multilayer without adhesive (Hochdruck System)

Compression rate: (ASTM F36): 30-60% - Graphite purity: > 99.85 % - ash content: <0.15% - halogen content (chlorides) <30ppm – nitrates content <200ppm – sulphur content <500ppm – content of metallic materials <300ppm (max 200ppm per material) – oxidation rate at 600°/4h <0.31% weight loss per hour (air exposure 100%) – corrosion inhibitor.
Qualified producers: SGL Carbon

DRAFT

STANDARD REFERENCE

VDI2200

GASKET FACTORS

ASTM	m: 2.5	EN 1591-2	Qmin= 18MPa; Qmax=200 MPa	
	y(psi): 2000	(L=0.01 mg/(s*m), P=40 bar)	QA=20MPa; EG=420MPa	

CERTIFICATIONS

Fire Safe certificate in according to API 607 rev.4 (with Fusion modification)
ASTM gasket factor certificate (m; y)
Fugitive emissions TA-Luft VDI2200/2440 certificate (par. 5.2.6.3) $\leq 2.3 \times 10^{-5}$ limits of acceptability $< 1.0 \times 10^{-4}$ (▼)
VDI 2200 blow out safety test certificate

IDENTIFICATION

Each gasket shall stamp the following information: producer name, Standard dimension, Standard pressure rating

NOTE

(▼) Test modes: temperature: 300 °C – test duration: 48 hours in continuous – 30 MPa applied load – test gas: helium 1 bar.

rev.	DESCRIPTION	DATE	DRAWN UP	APPROVED
2				
1				
0	NEW EMISSION	September 2010	TECH DEPT.	PLANT MANAGER

Chemical resistance chart

Resistant ●
Partially resistant ◐
Not resistant ○
No Data

	VITON	CF1100	CF2000	CF2001G	UNIVERSAL PRO	HOCHDRUCK PRO	SIGRAFLEX MF	CF3000	CF3024	CF3070	CF3090	ASI304	ASI316L	ASI321	ALLOY 600	MONEL 400	TITANIO	HASTELLOY C-276
Alkalis																		
Ammonia solution	○	●	●	◐	◐	◐	●	●	●	●	●	○	◐	○	●	◐		●
Caustic potassium solution			●	●	●	●	●		●			●	●	●				
Potassium hydroxide	○	●	◐	◐	◐	◐	◐	●	●	○	●	●	●	●	●	●		●
Sodium hydroxide	◐	◐	◐	◐	◐	◐	●	●	●	○	●	○	●		●	●		●
Caustic sodium solution			●	●	●	●	●		●			●	●	●				
Aqueous salt solutions																		
Borates		●	●	●	●	●	●		●									
Bromides		●	●	◐	◐	◐	◐		●			○	○	○				
Chlorides			●	●	●	●	●		●									
Chromates 20% concentration			○	○	○	○	○		●			○	○	○				
Fluorides			●	●	●	●	●		●									
Iodides			●	●	●	●	●		●									
Carbonates			●	●	●	●	●		●									
Nitrates			◐	◐	◐	◐	●		●									
Nitrites			●	●	●	●	●		●									
Phosphates			●	●	●	●	●		●			●	●	●				
Sulphates			●	●	●	●	●		●									
Acids																		
Boric acid	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Bromic acid		●	●	◐	◐	◐	◐		●			○	○	○		◐		
Chlorosulfonic acid up to 20%		●	●	●	●	●	●		●									
Hydrofluoric acid		○	●	◐	◐	◐	◐		●			○		○	○	◐		●
Nitrohydrochloric acid (aqua regia)	◐	○	○	○	○	○	○	●	●	●	●	◐	◐	◐				
Mixed acid (nitric acid + sulfuric acid)			○	○	○	○	○		●									
Oleum	◐	◐	○	○	○	○	○	○	●	●	●	◐	●	◐		○		
Perchloric acid	●	◐	◐	◐	◐	◐	◐	●	●	●	●	◐	◐	◐				
Phosphoric acid	●	●	●	●	●	●	●	●	●			◐	●	◐	●	◐		●
Nitric acid up to 20%	◐	◐	◐	◐	◐	◐	◐	●	●	●	●	◐	◐	◐	○	○		●
Nitric acid 20% - 65%	◐	◐	◐	◐	◐	◐	◐	●	●	●	●	◐	◐	◐	○	○		●
Hydrochloric acid	●	◐	●	○	○	○	○	●	●	●	●	○	○	○	○	◐		●
Sulphuric acid up to 70%	◐	◐	◐	◐	◐	◐	◐	●	●	●	●	○	○	○	○	○		
Sulphuric acid 70% - 100%	◐	◐	◐	◐	◐	◐	◐	◐	●	●	●	○	○	○	○	○		
Sulphurous acid	○	●	●	◐	◐	◐	◐	●	●	●	●	○	○	○	○	○	●	●

Resistant ●
Partially resistant ◐
Not resistant ○
No Data

	VITON	CF1100	CF2000	CF2001G	UNIVERSAL PRO	HOCHDRUCK PRO	SIGRAFLEX MF	CF3000	CF3024	CF3070	CF3090	ASI304	ASI316L	ASI321	ALLOY 600	MONEL 400	TITANIO	HASTELLOY C-276
Oxidizing molten salts																		
Potassium chlorate	◐		○	○	○	○			●			●	●	●			●	
Potassium nitrate	●		○	○	○	○	○	●	●	●	●	●	●	●	●	●	●	●
Sodium peroxide	◐		○	○	○	○	●	●	●	●	●	●	●	●		●		●
Non-oxidizing molten salts																		
Borics, sodium, potassium			●	●	●	●	●		●			●	●	●				
Calcium chloride	●		●	●	●	●	●	●	●	●	●	●	●	●			●	●
Potassium hydrosulphide			●	●	●	●	●		●									
Gases / vapours																		
Ammonia	○	●	●	●	●	●	●	●	●	●	●	◐	◐	◐	●	●		●
Bromine	●	●	○	○	○	○	○	●	●	●	●		○					●
Hydrogen bromide		●	●	●	●	●	●	●	●	●	●	◐	◐	◐		◐		
Chlorine	◐	●	●	○	○	○	○	●	●	●	●	◐	◐	◐	◐	◐		◐
Chlorine dioxide	●	○	○	○	○	○	○	●	●	●	●	○	○	○			◐	
Hydrogen chloride		●	●	●	●	●	●		●			○	○	○				
Fluorine	◐	○	○	○	○	○	○	○	◐	○	○	●	●	●	●	●		●
Hydrogen fluoride	○	○	●	●	●	●	●	○	◐	○	○	○	○	○	○	○		
Carbon oxide	●	●	●	●	●	●	●	●	●	●	●	●	●					
Carbon dioxide	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●	●
Air	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Oxygen	●	●	◐	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Sulphur dioxid	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●	◐	●	●
Sulphur trioxide	●	◐	○	○	○	○	○	●	●	●	●	◐	◐	◐		◐		
Sulphur hexafluoride	◐	●	●	◐	◐	◐	◐		●			○	○	○				
Hydrogen sulphide	○	●	●	●	●	●	●	●	●	●	●	●	●	●		◐	●	●
Nitrogen	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Nitrogen dioxide (dry)	○	●	◐	◐	◐	◐	◐		●			○	○	○				
Nitrogen oxides (dry)		●	◐	◐	◐	◐	◐		●			○	○	○				
Water steam	◐	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Other inorganic media																		
Bleaching liquor	●	◐	●	◐	◐	◐	◐		●			○	○	○	○	◐	●	◐
Hydrazine	○	●	●	●	●	●	●	●	●	●	●	●	●	●		◐		
Sulphur		●	●	●	●	●	●	●	●	●	●	●	●	●		◐		●
Hydrogen peroxide 85%	◐	◐	○	○	○	○	●	●	●	●	●	●	●	●	●	●		●

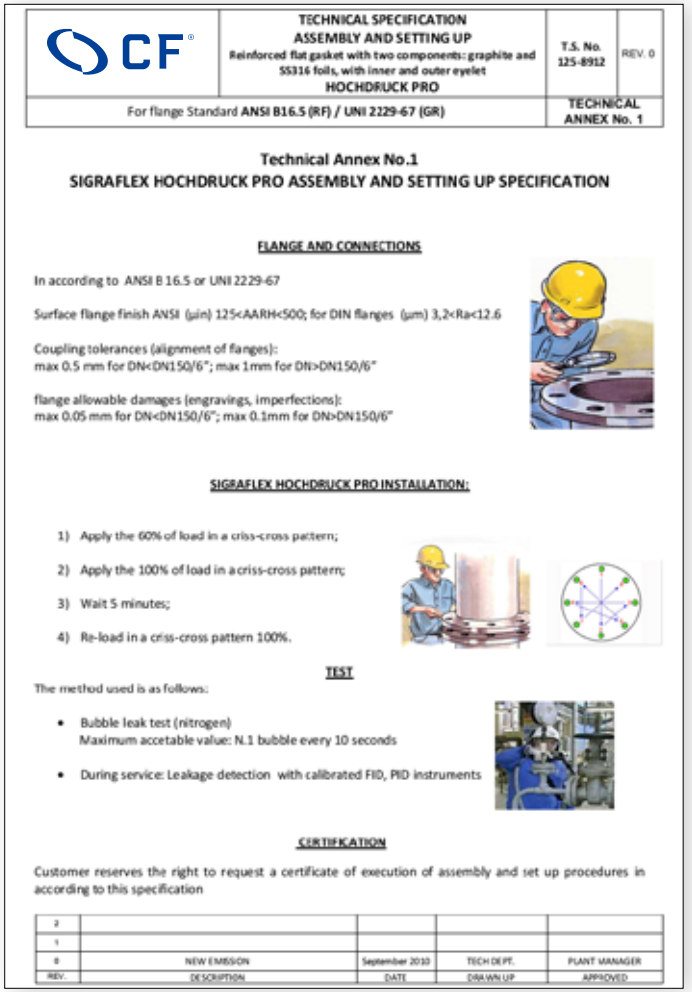
● Resistant
◐ Partially resistant
○ Not resistant
No Data

	VITON	CF1100	CF2000	CF2001G	UNIVERSAL PRO	HOCHDRUCK PRO	SIGRAFLEX MF	CF3000	CF3024	CF3070	CF3090	ASI304	ASI316L	ASI321	ALLOY 600	MONEL 400	TITANIO	HASTELLOY C-276
Water																		
Water	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Alcohols																		
Methanol	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Ethanol	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Glycol	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Isopropyl alcohol	●	●	●	◐	◐	◐	●	●	●	●	●	○	◐	○				
Aldehydes																		
Formaldehyde	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●
Acetaldehyde		●	●	●	●	●	●		●									
Benzaldehyde	○	●	●	●	●	●	●		●			●	●	●				
Ethers																		
Ethyl-methyl ether		●	●	●	●	●	●		●			●	●	●	●	●		●
Diethyl ether	○	●	●	●	●	●	●		●			●	●	●				
Dioxane	○	●	●	●	●	●	●	●	●	●	●	●	●	●				
Biphenyl ether		●	●	●	●	●	●		●									
Esters																		
Ethyl acrylic ester		●	●	●	●	●	●		●			●	●	●				
Ethyl butyl ester			●	●	●	●	●		●			●	●	●				
Amyl acetoacetics ester			●	●	●	●	●		●			●	●	●				
Ketones																		
Ethyl methyl ketone		●	●	●	●	●	●		●			●	●	●				
Dimethyl ketone		●	●	●	●	●	●		●			●	●	●	●	●		●
Methyl isobutyl ketone		●	●	●	●	●	●		●			●	●	●				
Hydrocarbons																		
Ethylene	●	●	●	●	●	●	●	●	●	●	●	○	◐	○				
Propylene	●	●	●	●	●	●	●	●	●	●	●	●	●	●				
Propane	●	●	●	●	●	●	●	●	●	●	●	●	●	●				
Benzene	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Isooctate	●	●	●	●	●	●	●	●	●	●	●							
Styrene	◐	●	●	●	●	●	●	●	●	●	●	◐	◐	◐				
Xylene	◐	●	●	●	●	●	●	●	●	●	●	●	●	●			●	●
Halogenated hydrocarbons																		
Chloroform	◐	●	●	●	●	●	●	●	●	●	●	●	●	●			●	
Tetrachloromethane (carbon tetrachloride)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

	VITON	CF1100	CF2000	CF2001G	UNIVERSAL PRO	HOCHDRUCK PRO	SIGRAFLEX MF	CF3000	CF3024	CF3070	CF3090	ASI304	ASI316L	ASI321	ALLOY 600	MONEL 400	TITANIO	HASTELLOY C-276
Freons	◐	●	●	●	●	●	●		●			●	●	●	●	●		●
Chlorobenzene	●	●	●	●	●	●	●	●	●	●	●							●
Organic acid																		
Acrylic acid	○	●	●	●	●	●	●	●		●	●	●	●	●				
Formic acid	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Phenylacetic acid			●	●	●	●	●		●									
Acetic acid	◐	◐	●	●	●	●	●	●	●	●	●	○	◐		●	●	●	●
Hexachlorinephenylacetic acid		●	●	●	●	●	●		●									
Maleic acid		●	●	●	●	●	●		●			●	●	●				
Chlorineacetic acid	○	●	●	●	●	●	●	●	●	●	●	◐	◐	◐			●	
Phthalic acid	◐	●	●	●	●	●	●	●	●	●	●						●	
Stearic acid	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	◐		●
Sulphonic acid			●	●	●	●	●		●									
Trichloroacetic acid	○	◐	●	●	●	●	●	●	●	●	●							
Tartaric acid	◐		●	●	●	●	●	●	●	●	●						●	
Amines																		
Aniline	◐	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Dimethyloamine		●	●	●	●	●	●		●									
Trimethyloamine		●	●	●	●	●	●		●									
Other organic compounds																		
Acrylonitrile	○	●	●	●	●	●	●	●	●	●	●	●	●	●				
Dimethylosulpoxide		●	●	●	●	●	●		●									
Epichlorohydrin		●	●	◐	◐	◐	◐		●			○	○	○				
Mercpatans	○	●	●	●	●	●	●		●			●	●	●				
Nitrobenzene	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Phenol		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Carbon disulphide	◐	●	●	●	●	●	●	●	●	●	●	●	●			●		
Technical mixtures																		
Petrol	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Hydraulic oil	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Paraffin oil		●	●	●	●	●	●	●	●	●	●	●	●	●		●		●
Dissolvent for paints		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Engine oil		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Transformer oil	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Oils - heat carriers		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●

Assembly and test specification

In the past, the importance of implementing a procedure selection and installation to get a connection tighted flange was often underestimated because the level of acceptable leakage. Since when guidelines EN1591/4 or ASME PCC1 have become a standard, implementing an installation, technically, has become mandatory, just as the the calculation checks mentioned above.
These standards describe the basic knowledge, the qualifications and skills needed by the personnel involved to perform operational tasks on flanged connections for critical uses.
A qualified installation ensures the leakage allowable class which will be obtained during the test pressure: for this CF products are always accompanied from the assembly and testing specifications.



TECHNICAL SPECIFICATION
ASSEMBLY AND SETTING UP
Reinforced flat gasket with two components: graphite and SS316 foils, with inner and outer eyelet
HOCHDRUCK PRO

T.S. No. 125-8912 | REV. 0

For flange Standard ANSI B16.5 (RF) / UNI 2229-67 (GR) | TECHNICAL ANNEX No. 1

Technical Annex No.1
SIGRAFLEX HOCHDRUCK PRO ASSEMBLY AND SETTING UP SPECIFICATION

FLANGE AND CONNECTIONS

In according to ANSI B 16.5 or UNI 2229-67

Surface flange finish ANSI (µin) 125<AARH<500; for DIN flanges (µm) 3,2<Ra<12.6

Coupling tolerances (alignment of flanges):
max 0.5 mm for DN<DN150/6"; max 1mm for DN>DN150/6"

flange allowable damages (engravings, imperfections):
max 0.05 mm for DN<DN150/6"; max 0.1mm for DN>DN150/6"

SIGRAFLEX HOCHDRUCK PRO INSTALLATION:

1) Apply the 60% of load in a criss-cross pattern;
2) Apply the 100% of load in a criss-cross pattern;
3) Wait 5 minutes;
4) Re-load in a criss-cross pattern 100%.

TEST

The method used is as follows:

- Bubble leak test (nitrogen)
  Maximum accetable value: N.1 bubble every 10 seconds
- During service: Leakage detection with calibrated FID, PID instruments

CERTIFICATION

Customer reserves the right to request a certificate of execution of assembly and set up procedures in according to this specification

REV.	DESCRIPTION	DATE	DRAWN UP	APPROVED
2				
1				
0	NEW EMISSION	September 2010	TECH DEPT.	PLANT MANAGER

Proof installation

The complete Joint Integrity process does not stop at the selection of the gasket or at how it is to be installed or at how the pressure test is to be carried out. It must also ensure that throughout the service life condition of the flanged joint, the safety and fugitive emissions required are matched.
The integrated Joint Integrity Management system allows CF to offer a package of services and solutions ensuring the verification, of the operator of the installation and tightness of flanged connections and compliance with environmental regulations in the long term service.
The main activities carried out by CF for the implementation of a Joint Integrity Management process are:

CLASSROOM TRAINING

1. Training for personnel involved directly or contractors with related theoretical and practical examination and issue of certificate of qualification in accordance with en 1591-4
2. Maintaining the qualifications of the staff involved as point 1)

ON-SITE SERVICES

3. Implementation of a Joint Integrity procedures in the field, tagging process, status of connections
4. Shut down service: quality service and Joint Integrity Management, interface with the client, contractors as third part company granting of the result
5. Verification and validation in the field all activities are carried out
6. Implementation, traceability, data record system and statistics for the identification of critical issues in progress.

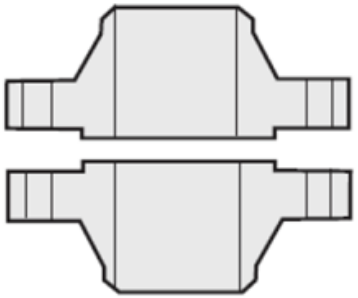
TRAINING RIG

LICENSE

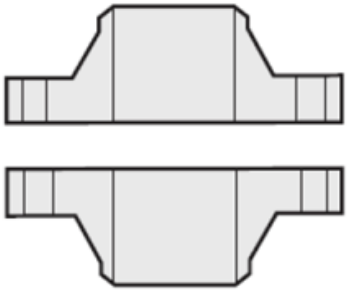
TAGGING

ON-SITE

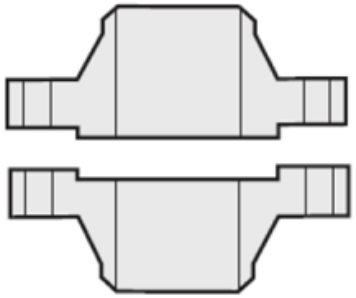
Joint integrity on flanges



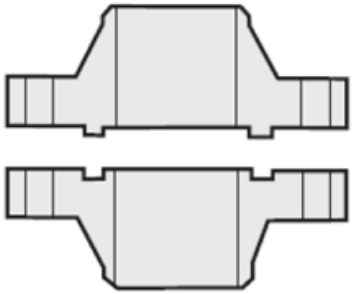
Raised face



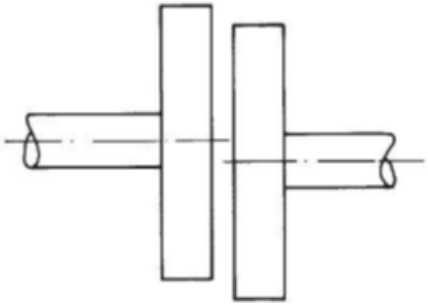
Flat face



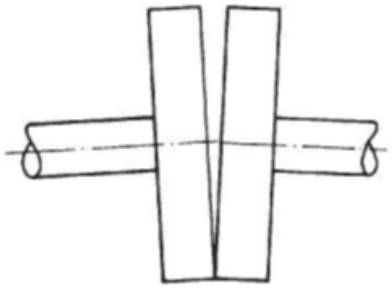
Male & Female



Tongue & Groove

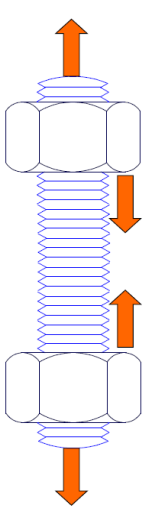


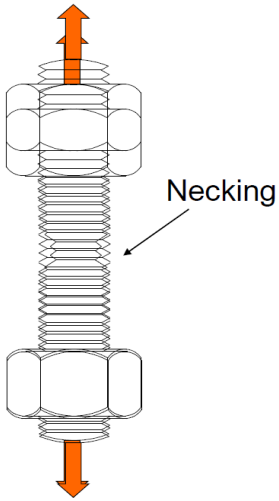
Parallel Misalignment

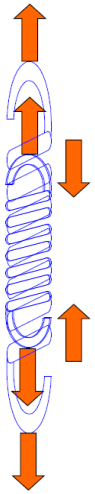


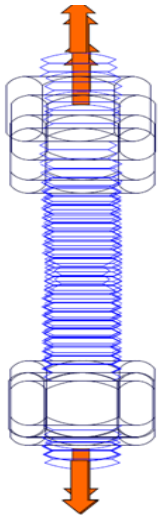
Angular Misalignment

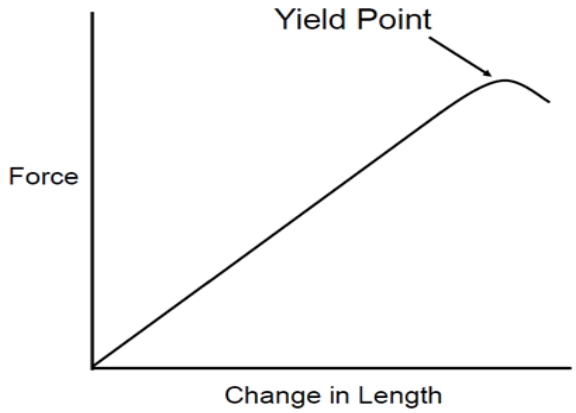
Joint integrity on bolts and nuts



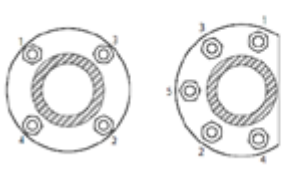




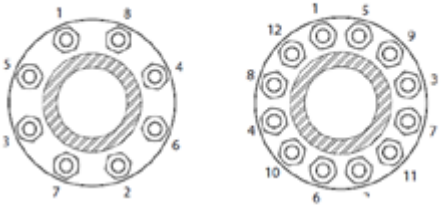




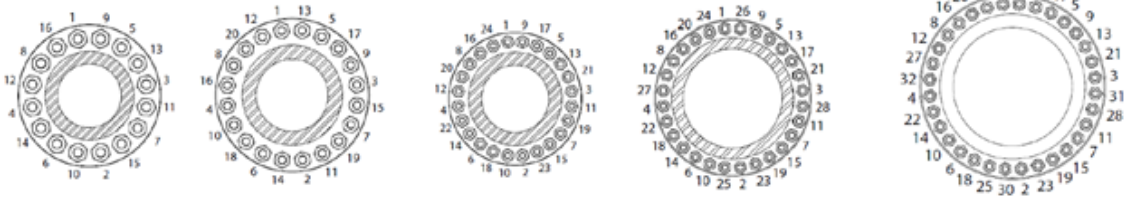
4 BOLTS **5 BOLTS** **6 BOLTS**

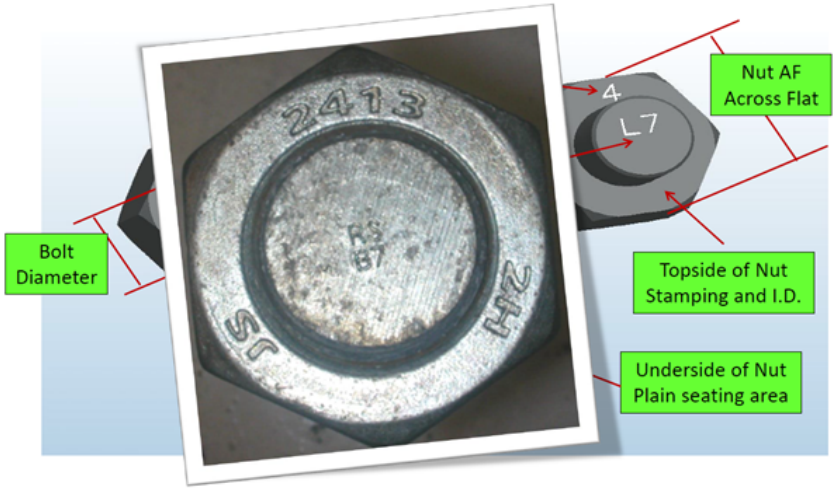


8 BOLTS **12 BOLTS**



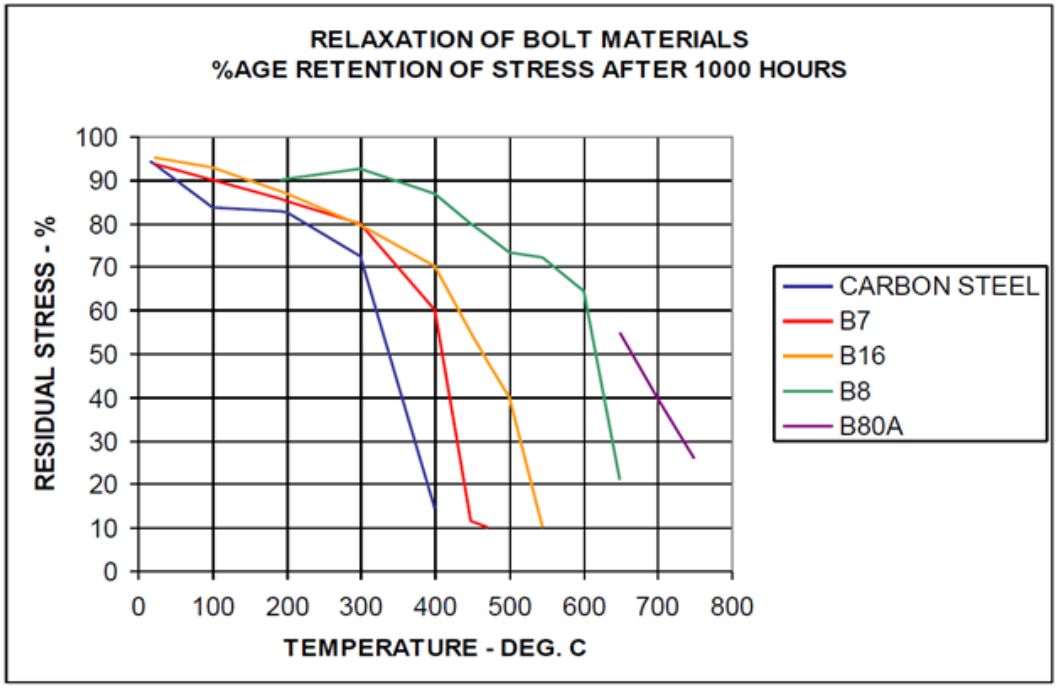
16 BOLTS **20 BOLTS** **24 BOLTS** **28 BOLTS** **32 BOLTS**

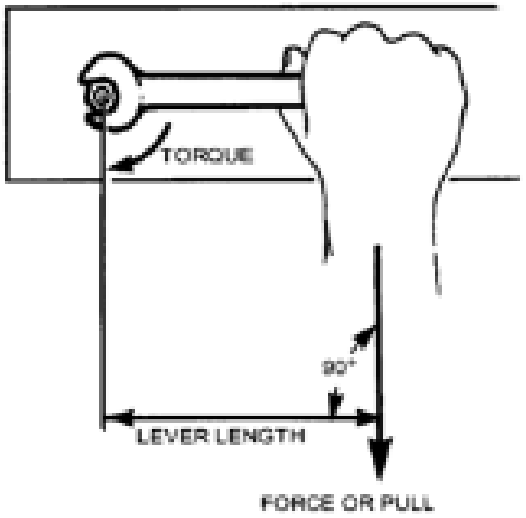


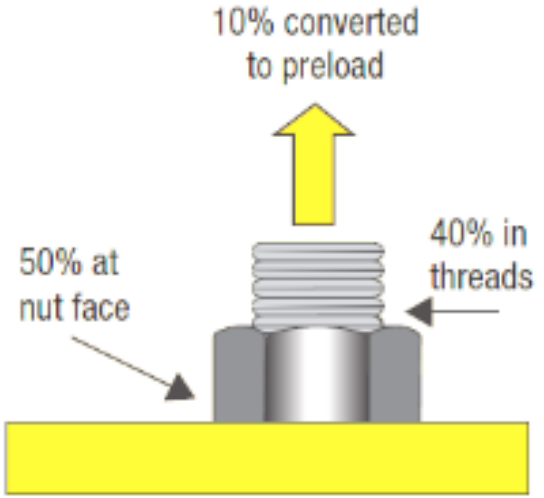


Bolt installation

Young's Modulus (lbf / in$^{2)}$	Material	Grade	Temperature Range (^{0}C)	Yield Strength (lbf /in^2)
	Carbon Steel	SAE J429-1	-20 to 300	36,000
30 x 10^6	Low Alloy Cr – Mo Cr – Mo - V	 ASTM A193 B7 ASTM A193 B16	 -20 to 400 -20 to 520	 105,000 105,000
29.7 x 10^6	Stainless Steel 304SS	ASTM A320 B8	-200 to 575	30,000
32.5 x 10^6	Nimonic	BS4882 B80A	-250 to 750	90,000







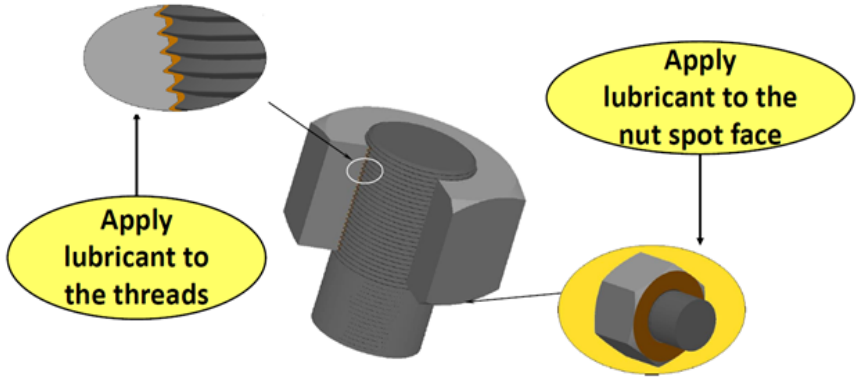
Frictional Losses (dry steel bolt)

Bolt lubrification & washers

Coefficient of friction values (by manufactured)

LUBRICANT	C.o.F (μ)
API BUI 5A2	0.12
Anti seize	0.09
Beldamite ASC	0.13
Berutex FH-34	0.16
Berutex FH-35	0.16
Biral BASC	0.11
Castrol Nucleol S202	0.08
Chesterton Nickel Anti Seize (paste)	0.14
Copaslip	0.12
Coppercrest	0.14
Copper Ease	0.14
Coppergrease	0.11
Copperslip	0.09
CP Ironsides Q221285	0.12
DAG 156	0.15
DAG 580 (Dry Lubricant)	0.16
Easyrun 100	0.08
Fel-Pro C-102	0.16
Fordec Copper Anti seize	0.15
Gleitmo 165	0.1
HP anti seize	0.15
Maxol LFCP 5006	0.2
Molykote Cu-7439	0.15
Molykote G-Rapid	0.08
Molykote HSC	0.11
Molykote P37 paste	0.12
Molykote Q5-7405	0.04
Molykote Ti 1200	0.12
Molykote 1000	0.11

LUBRICANT	C.o.F (μ)
Molykote 7443	0.13
Never seez Std grade(NS160)	0.18
Never seez Spl grade(NS165)	0.18
Nickeleez	0.12
OKS 235	0.11
OKS 240	0.12
OKS 250	0.08
Omega 99	0.13
Omega 99N	0.09
Omega 95	0.12
PBC	0.13
PBC/D Lead Free	0.12
Rocol ASP	0.1
Rocol J166	0.15
Rocol 797	0.16
Spherol Castrol	0.13
Swanlube	0.12
Thread Eze	0.18
Triflow	0.1
Walkers Anti seize No 203	0.15
WCF Anti seize	0.15
503	0.06
504	0.09
505	0.1
506	0.11
507	0.1
516	0.18
785 - Parting lub	0.17



WASHERS MAINTENANCE

Selections for proof bolted flange connections

Joint integrity on the bolt selection

1. **COSTRUCTION CODE (ASME CODE OR EN CODE)**
   - flanges and bolts (type, dimensions, material)
   - gasket (type, dimensions, characteristics)

   (GASKET FACTORS TO BE USED: ASME CODE m,Y; EN CODE Qmin, Qmax, EG, PQR)

2. **TIGHTNESS CLASS**

   For the chosen construction and materials
   - tightness class to be met

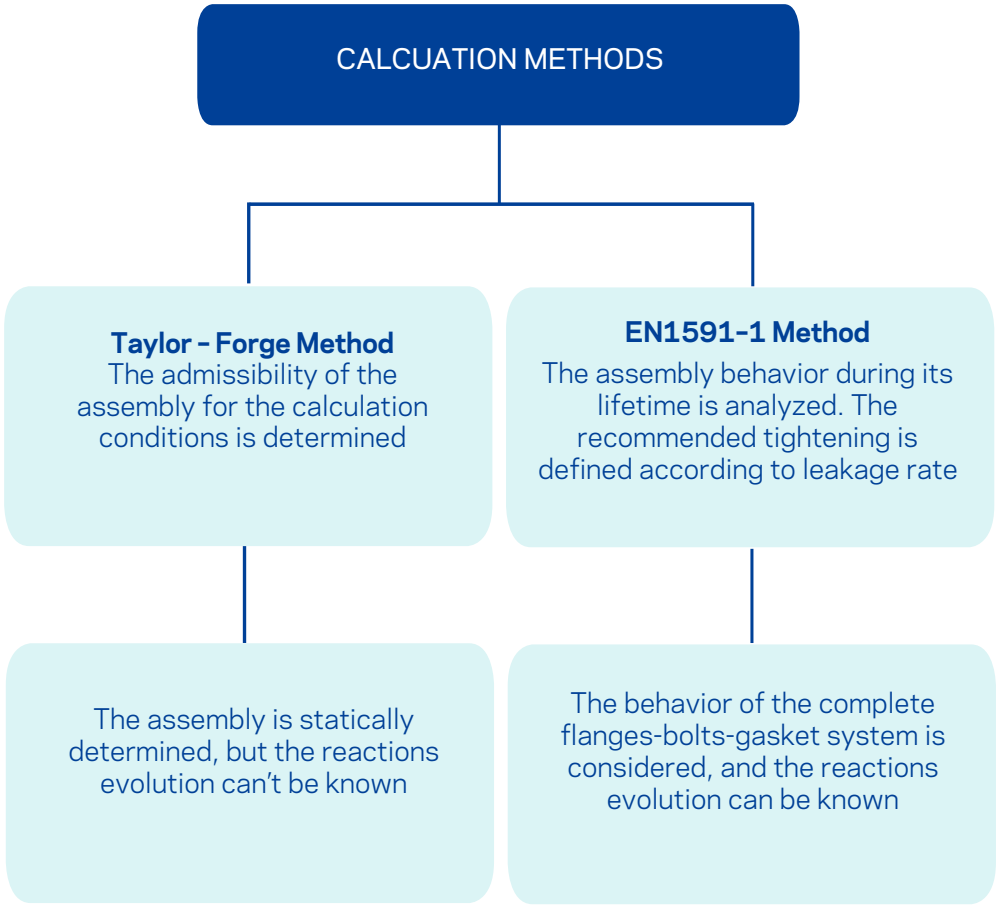
   (TO BE SELECTED BY THE END USER, DEPENDING ON MEDIA AND SERVICE)

3. **PROOF INSTALLATION**

   Qualified and controlled mounting of the bolted flange connection (ASME PCC-1; VDI2290; EN1591/4)

Procedure Comparison

Calculation methods for gasketed circular flange connections



ANSI vs DIN

ANSI

ASME Section VIII div.1 app.2
(pressure vessel and Boiler Code)

Taylor – Forge Method (1943) Theoretical constants: m; y (asbestos)

1° evolution Taylor – Forge Method

ASTM F586 (1979- REV.01 1989) MEASURED constants: m; y for all materials (leakage VS. different gasket compression)

M, Y STILL ON FORCE

2° evolution PVRC Method not used yet

ROOT TEST (1993)

MEASURED constants: Gb, a, Gs for all materials (Tightness parameter Tp VS. different gasket compression)

WIDELY USED

Refinery and Petrolchemical worldwide

ASME Section VIII div.1 app.2
(pressure vessel and Boiler Code)

Taylor – Forge Method (1943) Theoretical constants: m; y (asbestos)

M, Y STILL ON FORCE

DIN

AD MERKBLATT/DIN2505 (1990) (D)

1 °evolution EN13445 (EU)

EN 13445-3 ANNEX G/ EN1591 Method (2001) MEASURED constants: EN 13555 (2014) Qmin, Qmax, EG, PQR

FOR OTHER EU COUNTRIES
EN 13445-2 OR ANNEX G/ EN1591 Method IS OPENED

WIDELY USED

Chemical & Pharmaceutical

EN 13445-3 ANNEX G/ EN1591 Method (2001)
MEASURED constants: EN 13555 (2014) Qmin, Qmax, EG, PQR
FOR OTHER EU COUNTRIES
EN 13445-2 OR ANNEX G/ EN1591 Method IS OPENED

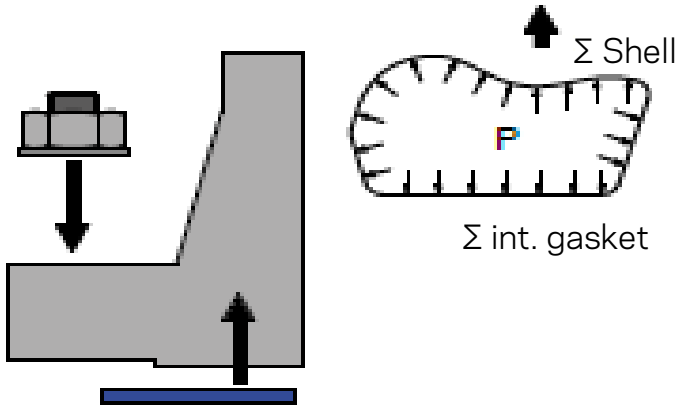
EN13555 ON FORCE

Taylor - Forge Method

The admissibility of the assembly is determined by the flange stress values (Pic. 1), by the bolt (Pic. 2) and by the gasket pressure value (m;Y) (Pic. 3)

The evolution of the reaction can't be known

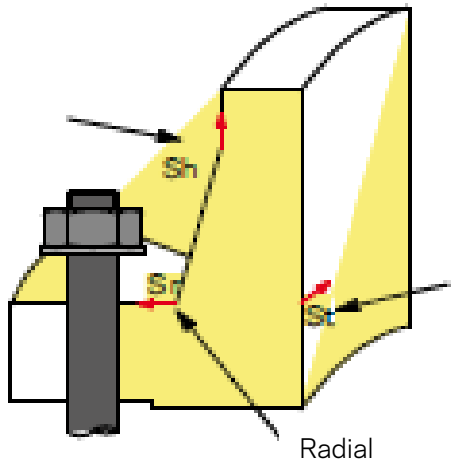
The applied force by the bolts remains constant at all steps of service



Pic.1

The load imposed on the gasket is the required one to provide seating

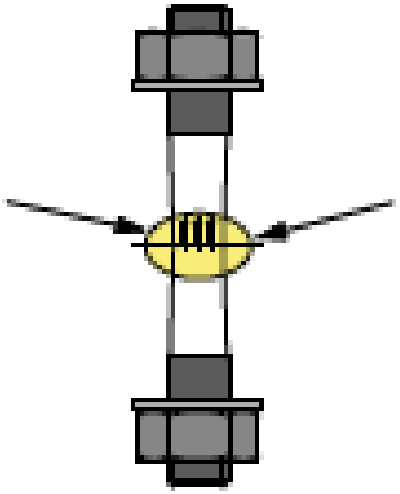
Longitudinal hub stress



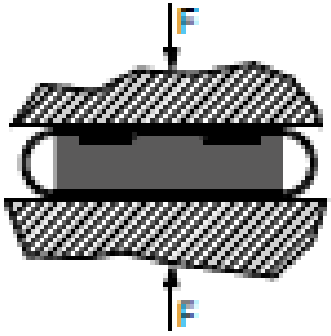
Tangential stress

Radial stress

Pic.2



Pic.3



EU Directive and German legislation

IPPC 96/61/EC Directive and German legislation Air Act VDI2990

EU DIRECTIVE IPPC 96/61/EC

The EU has set of common rules for permitting and controlling industrial production and waste process in the IPPC Directive of 1996. New and existing installations required to meet the IPPC Directive by 30.10.2007:

IPPC Directive is based on several principles:

1. **INTEGRATED APPROACH** - Whole environmental performance of the plant e.g. emissions to air, land, noise, accidents must be taken in account
2. **BAST AVAILABLE TECHNIQUES (BAT)** - Permit emissions limit values must be based on BAT Reference Documents (BREF'S)

GERMAN LEGISLATION AIR ACT VDI2990

TA-LUFT (oct 2002)

Technical guidance for Air Pollution Prevention
General administrative regulation to the emission control law

VDI2440 (lab test) (nov 2000)

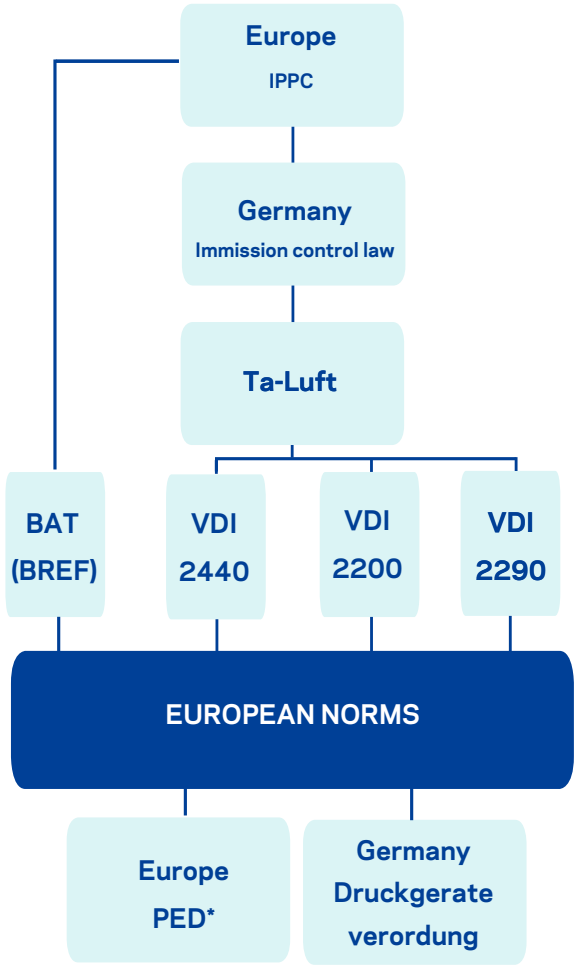
Guideline Emission reduction in mineral oil refinieries
Surface pressure of 30 MPA, test pressure difference 1 bar in Helium leakage less than 10-4 mbar*l/s*m

VDI2200 (june 2007)

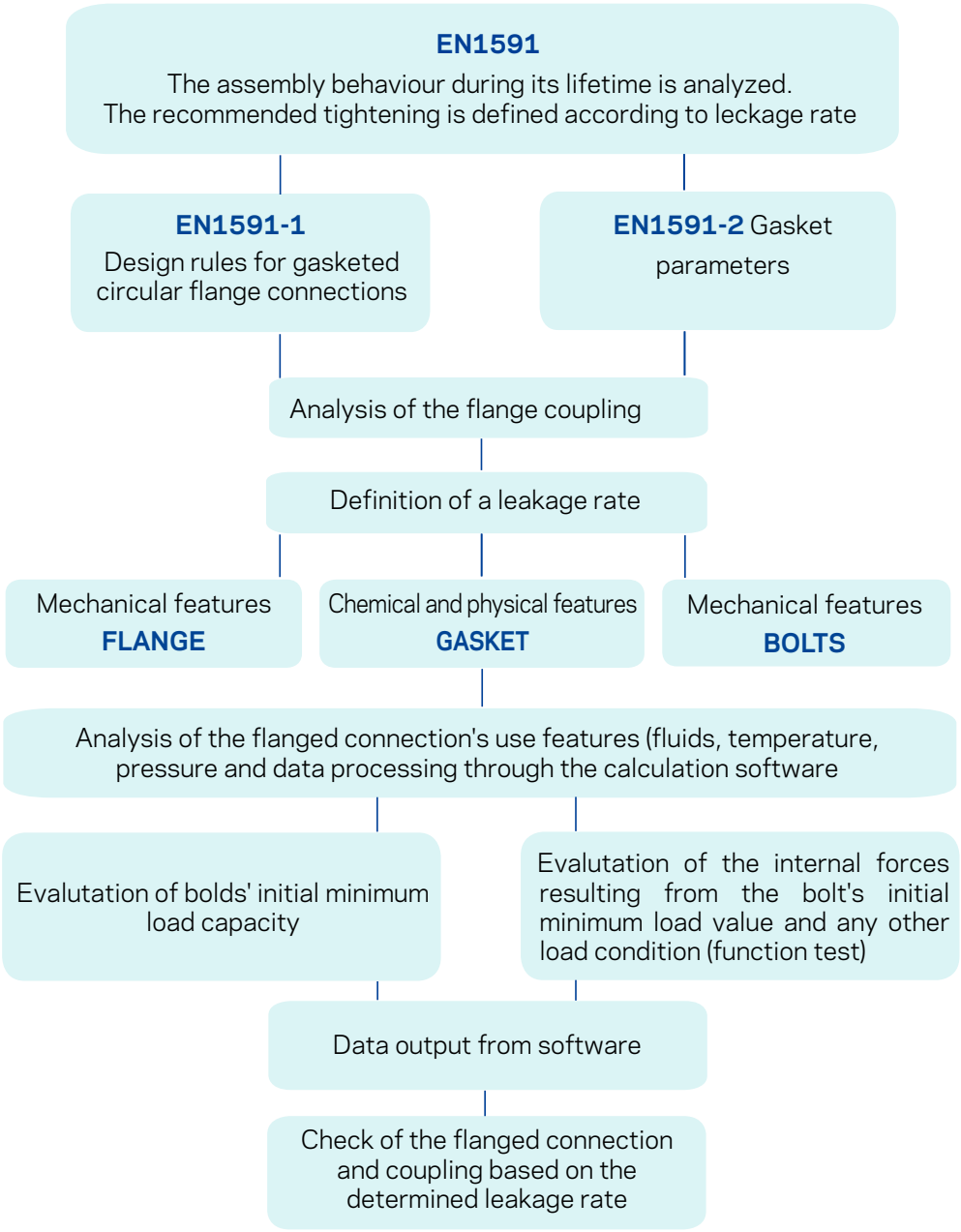
Detailed description of VDI2440 test and selection, calculation, design and assembly of bolted flange connection

VDI2290 (june 2012)

1. Controlled assembly
2. Recommended bolt torque
3. Qualified, accredited, trained and skilled personnel (EN1591-4) (2013)
4. Inspection of assembly quality
5. Clear instructions for assembly
6. Main scope: to increase plant and process safety



THE ASSEMBLY BEHAVIOUR



CF R-ADVISORS PRELIMINARY NOTES OF STATIC CONNECTIONS

Regulation EN1591

Flanges and their joints – Design rules for gasketed circular flange connections (07/01/2003) - is the European reference law on the specific topic.
It is divided into two sections:

- **EN1591 - 1** Calculation method
- **EN1591 - 2** Gasket parameters

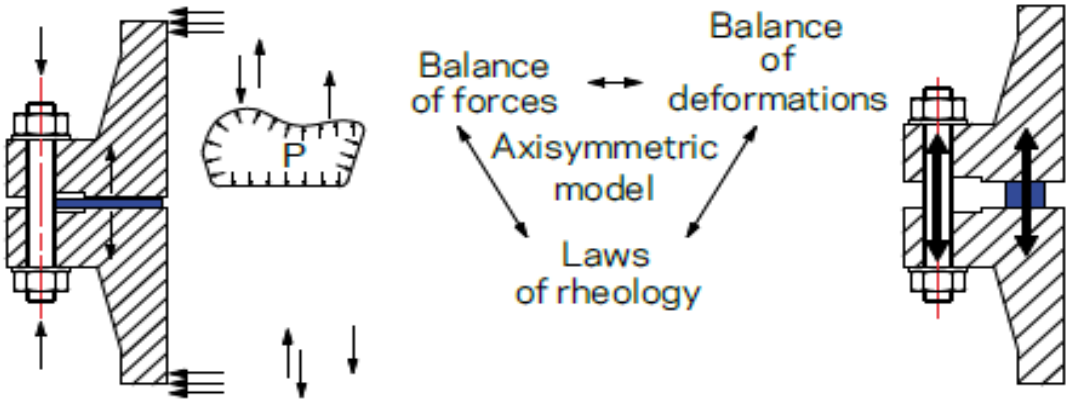
EN1591 sets leakage rates and mechanical resistance criteria for flanged connections.
The behavior of the complete flanges-gasket-bolt system is considered both in assembly and working conditions. The calculation is based on the elastic analysis of the load/deformation relationships among every part of the flanged junction, corrected by the possible plastic behavior of the gasket.

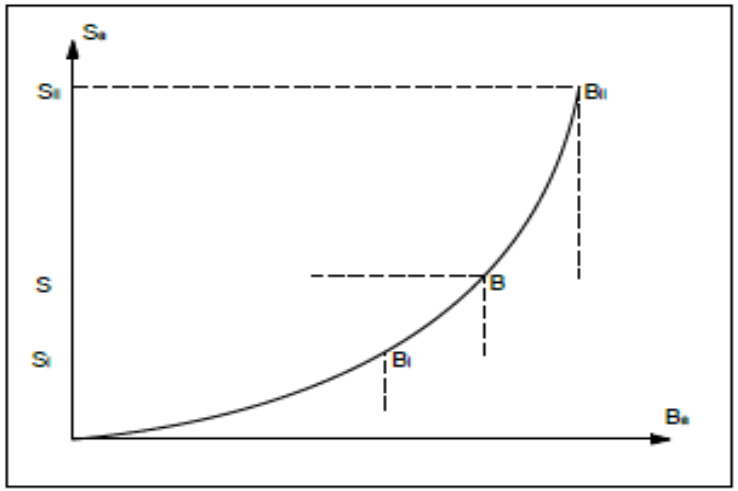
EN1591 PARAMETERS

- Fluid pressure
- Mechanical resistance of the material of flanges, bolts and gaskets
- Bolt load stress
- Possible dispersion due to the flange assembly process
- Change of gasket stress due to deformation of the components
- Influence of piping tensions
- Effect of axial forces and external bending moments
- Effects of temperature difference between bolts and the flange ring

EN1591 Method

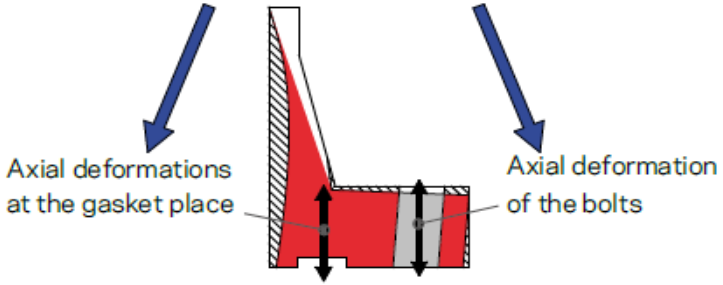
The behavior of the assembly is determined by the leak-tightness values, based on the deformation of the flange during its lifetime (Pic. 1), of bolts (Pic. 2) and the deformations of the gasket in both tightening and operative conditions (Qmin (L), Qmax, QA, EG) (Pic. 3)





Deformation balance between

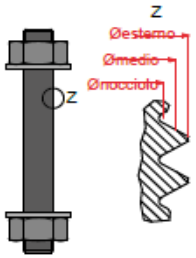
Pic. 1



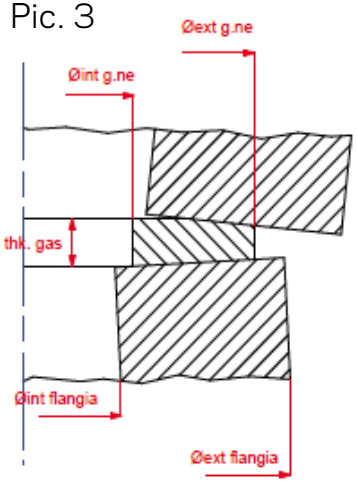
Pic. 2

The bolt are tested in secrions

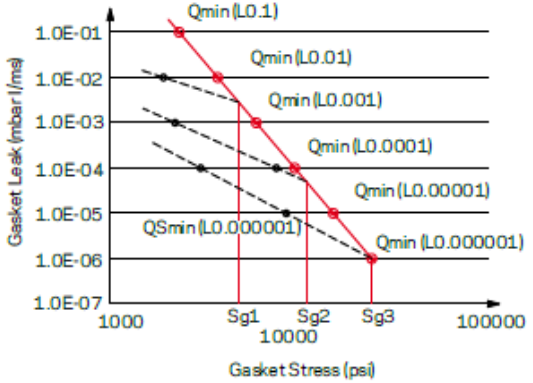
Torsion phenomenon at tightening is considered



Pic. 3



CEN Constants definition - Leak vs Sg Idealized Graph For 3 Loading and unloading cycles



RESISTANCE CRITERIA

Gasket → Limitation of the compression

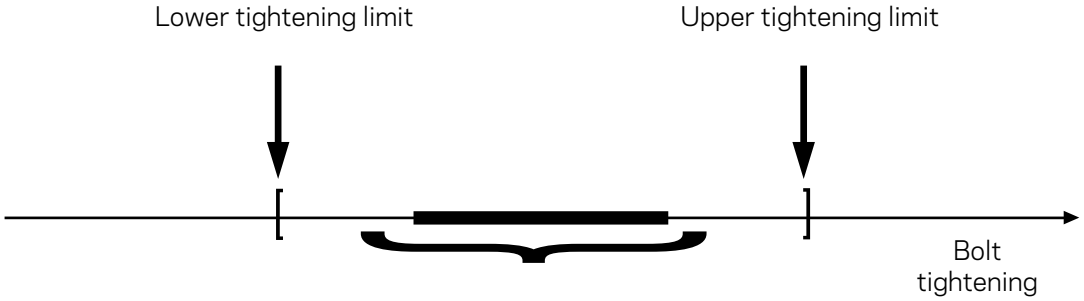
Bolts → Limitation of the traction

Flanges → Limitation of the rotation

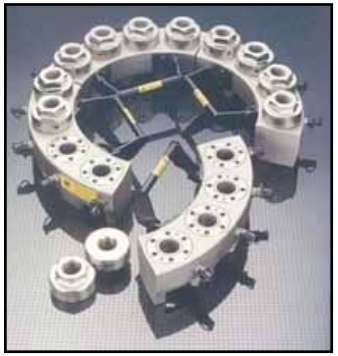
Seating Criteria
Leak-thightness Criteria
} Lower tightening limit

Bolt strength criteria
Gasket strength criteria
Flange strength criteria
} Upper tightening limit

TIGHTENING RECOMMENDATION



TIGHTENING DEVICE SCATTER


ADVANTAGES OF THE CF R-ADVISORS CALCULATION METHOD ACCORDING TO EN1591

The method stated so far evaluates the degree of fugitive emissions per pollutant based on the fixed leakage rate (L). The CF monitoring plan avails itself of the calculation outputs coming from EN1591. This calculation method represents a valid alternative option, where possible, to other means of plant validation, such as:

- Specific tests
- EN1591 standard procedure
- Usage of normalized flanged couplings

Norms overview

Pipeline Construction

GUIDELINES, LAWS, DIRECTIVES			
Pressure Equipment Directive	RL 97/23/EC RL 97/23/EC	Pressure Equipment Directive [14. Ordinance regarding the Product Safety Law [ProdSG]]	DruckgeräteV
SHEET METAL & WELDING PARTS			
Steel welding pieces for vessels [gen. requirements, ferritic and martensenic steels, nickel-steels, Fk steels, martensitic, austenisic, duplex steels	DIN EN 10222-1 bis -5	Flat products made of steels for pressure purposes	DIN EN 10028-1 bis -6
SHEET METAL & WELDING PARTS			
Oil and gas industry - steel pipes for pipeline transport systems	DIN EN ISO 3183	Pipes for flammable media - requirement class C	DIN EN 10208-3
FLANGES AND THEIR CONNECTIONS			
Round flanges in acc. w. PN		Round flanges for pipes, valves, form pieces, and accessory parts by class design	
▪ in steel	DIN EN 1092-1	▪ Steel flanges, NPS ½ to 24	DIN EN 1759-1
▪ in cast iron	DIN EN 1092-2	▪ Copper alloy flanges	DIN EN 1759-3
▪ in copper alloy	DIN EN 1092-3	▪ Aluminium alloy flanges	DIN EN 1759-4
▪ in aluminium alloys	DIN EN 1092-4		
Gaskets for flanges with PN designation		Gaskets for flanges with class designation	
▪ Non-metallic gaskets with or without inserts	DIN EN 1514-1	▪ Non-metallic gaskets with or without inserts	DIN EN 1759-1
▪ Spiral wound gaskets	DIN EN 1514-2	▪ Spiral wound gaskets	DIN EN 12560-2
▪ Non-metallic gaskets with PTFE layer	DIN EN 1514-3	▪ Non-metallic gaskets with PTFE layer	DIN EN 12560-3
▪ Metallic gaskets, with corrugated flat, or notched profile	DIN EN 1514-4	▪ In metal with corrugated, flat or grooved profile	DIN EN 12560-3
▪ Kammprofile serrated gaskets	DIN EN 1514-6	▪ RTJ gaskets	DIN EN 12560-5
▪ Metal enveloped gaskets with layer	DIN EN 1514-7	▪ Kammprofile serrated gaskets	DIN EN 12560-6
▪ O-rings with layer	DIN EN 1514-8	▪ Metal enveloped gaskets DIN EN 12560-7 with layer	DIN EN 12560-7
Bolts & nuts		Quality assurance testing and verification of gaskets in accordance with the standard sires EN 1514 and 12560	DIN EN 14772
▪ Selection of bolts and nuts	DIN EN 1515-1		
▪ Classification of bolts materials by PN	DIN EN 1514-2		
▪ Classification of bolts materials by class	DIN EN 1514-3		
▪ Selection for implementation within the scope of DGRL	DIN EN 1514-4		
Rules for the design of flange connections with round flanges and gaskets		Sealing parameters and testing procedure fir the applicationof the rules for the design of round flanges and gaskets	DIN EN 13555
▪ Calculation methods	DIN EN 1591-1		
▪ Background information	DIN EN 1591-1 suppl. 1		
▪ Sealing parameters	DIN EN 1591-2		
▪ Calculation parameters in the force shunt	DIN CEN/TS 1591-3		
▪ Qualification of personne for the installation of bolted connections with regards to pressure value	DIN EN 1591-4		
▪ Calculation method for flange connections with full surface contact	DIN CEN/TS 1591-5		

Regulations & Requirements

BAM oxygen	European Pressure Equipment Directive VdTÜV leaflet "Gasket 100" For installers and operators of oval sealing covers. VdTÜV component test sheets reflect the results of type tests/component tests of specific components with safety require-ments
BAM EO/PO	The Federal Institute for Materials Research and Testing [BAM] tests gaskets for flange connections in ethylene and propylenoxide applications. BAM test reports only verify the material suitability of the specific batch submitted to BAM for testing. The report is neither a certificate nor an approval.
DVGW	German Gas and Water Association [DVGW] certifies sealing materials for the German gas supply industry.
EC 1935/2004	Regulation by the European Parliament regarding materials and items intended for coming into direct contact with foods and to rescind directives 80/590/EEC and 89/109/EEC.
FDA	Fulfills food law requirements with regards to materials in direct contact with food set out by the U.S. Food and Drug Administration [FDA].
Fire Safe Test	The "Fire Safe Test for Valves" verifies, whether shut-off devices function and seal reliably in case of advanced or initial fires. The tests are defined in various industry standards for valves, e.g. API 607, BS 6755-2, EN ISO 10497. The requirements of this standard are tightness of the performance components for a time span representative for the time needed to extinguish most fires. From this results: „Maintaining seal properties under temperature influences of 650 °C during 30 minutes."
Germanischer Lloyd [GL]	Germanischer Lloyd certifies sealing materials for shipbuilding.
KTW	Guideline for the hygienic assessment of organic materials in direct contact with drinking water in accordance with KTW re-commendations [plastics used in drinking water systems] of the Federal Environmental Agency [UBA].
LNG/LPG	Liquefied natural gas [LNG] and liquefied petroleum gas [LPG] applications on ships, terminals and storage tanks.
SVGW	The Swiss Association for the Gas and Water sector [SVGW] tests and certifies sealing materials for the Swiss gas supply industry.
TA Luft 2002	High quality seals following the technical guidelines for maintaining clean air [Clean Air Act] in accordance with the provisions of the VDI standard 2440/2200.

ABBREVIATIONS: DIN Deutsches Institut für Normung | EN European standard | ISO International Organization for Standardization

Norms and standards

FLANGES, FLANGE CONNECTIONS & CONNECTION ELEMENTS

DIN EN 1092*	Flanges and their joints Round flanges for pipes, valves, form parts, and accessory parts, with PN designations
Part 1:	Steel flanges
Part 2:	Cast iron flanges
Part 3:	Copper alloy flanges
Part 4:	Aluminium alloy flanges

[*] EN 1092 replaces the norms set out in the DIN EN series 25ff. and 26ff

DIN EN 1591	Flanges and their joints Rules for the design of flange connections with round flanges and gaskets
Part 1:	Calculation
Part 2:	Seal Parameters
CEN/TS Part 3:	Calculation method for flange connections with gaskets in the force shunt
Part 4:	Competence qualification of personnel for the installation of bolted connections in pressurised systems in critical applications
CEN/TR Part 5:	Calculation method for connections with full-contact seals
DIN EN 1759	Flanges and their joints Round flanges for pipes, valves, form parts, and accessory parts, with PN designations
Part 1:	Steel flanges
Part 2:	Cast iron flanges
Part 3:	Copper alloy flanges
Part 4:	Aluminium alloy flanges
DIN EN ISO 4014	Hexagonal bolts with shaft Product classes A and B
DIN 2510	Bolt connections with reduced shaft
Part 1:	Overview, area of application and installation examples
Part 2:	Metric threads with large clearance, nominal and limit dimensions
Part 3:	Threaded bolts
Part 4:	Stud bolts
Part 5:	Hex nuts
Part 6:	Capped nuts
Part 7:	Extension sleeves
Part 8:	Tapped holes for stud bolts
DIN 28030	Flange connections Rules for the design of flange connections with round flanges and gaskets
DIN EN 1591	Flanges and their joints for apparatus and vessels
DIN 28031	Welding flanges for non-pressurised apparatus and vessels made of non-alloy and non-corroding steel
DIN 28032	Welding flanges for pressurised vessels and apparatus made of non-alloy steel
DIN 28034	Welding neck flanges for pressurised vessels and apparatus made of non-alloy steel
DIN 28036	Welding flanges for pressurised vessels and apparatus made of non-corroding steel
DIN 28038	Welding flanges with cylindrical lug for pressurised vessels and apparatus made of non-corroding steel

GASKETS AND SEALING MATERIALS

DIN EN 1514*	Flanges and their connections Dimensions for gasket seals with PN designation
Part 1:	Non-metallic gaskets, with or without inserts
Part 2:	Spiral wound gaskets for steel flanges
Part 3:	Non-metallic gaskets with PTFE layer
Part 4:	Metallic gaskets with serrated, flat, or grooved profile for steel flanges
Part 6:	Kammprofile serrated gaskets for steel flanges
Part 7:	Metal enveloped gaskets with layer for steel flanges
Part 8:	Rubber O-rings for groove flanges

[*] DIN EN 1514 replaces the norms set out in the DIN EN series 2690, 2691, and 2692

DIN EN 12560	Flanges and their connections Flange seals with class designation
Part 1:	Non-metallic gaskets, with or without inserts
Part 2:	Spiral wound gaskets for steel flanges
Part 3:	Non-metallic gaskets with PTFE layer
Part 4:	Metallic gaskets with serrated, flat, or grooved profile for steel flanges
Part 5:	RTJ gaskets for steel flanges
Part 6:	Kammprofile serrated gaskets for steel flanges
Part 7:	Metal enveloped gaskets with layer for steel flanges
DIN 2696	Flange connections with lens gasket
DIN 28040	Non-metallic gaskets for vessels and apparatus
DIN 3535	Gaskets for gas supply
Part 5:	Sealing materials made of rubber, cork, and synthetic fibers for gas valves and gas apparatuses; safety-relevant requirements, testing
Part 6:	Non-metallic gasket materials based on fibers, graphite, or polytetrafluorethylene [PTFE] for gas valves, apparatuses, and pipes
DIN 28091	Technical delivery conditions for gasket sheets
Part 1:	General specifications for sealing materials
Part 2:	Requirements and testing of fiber-based materials [FA]
Part 3:	Requirements and testing of PTFE-based materials [TF]
Part 4:	Requirements and testing of expanded graphite-based materials [GR]

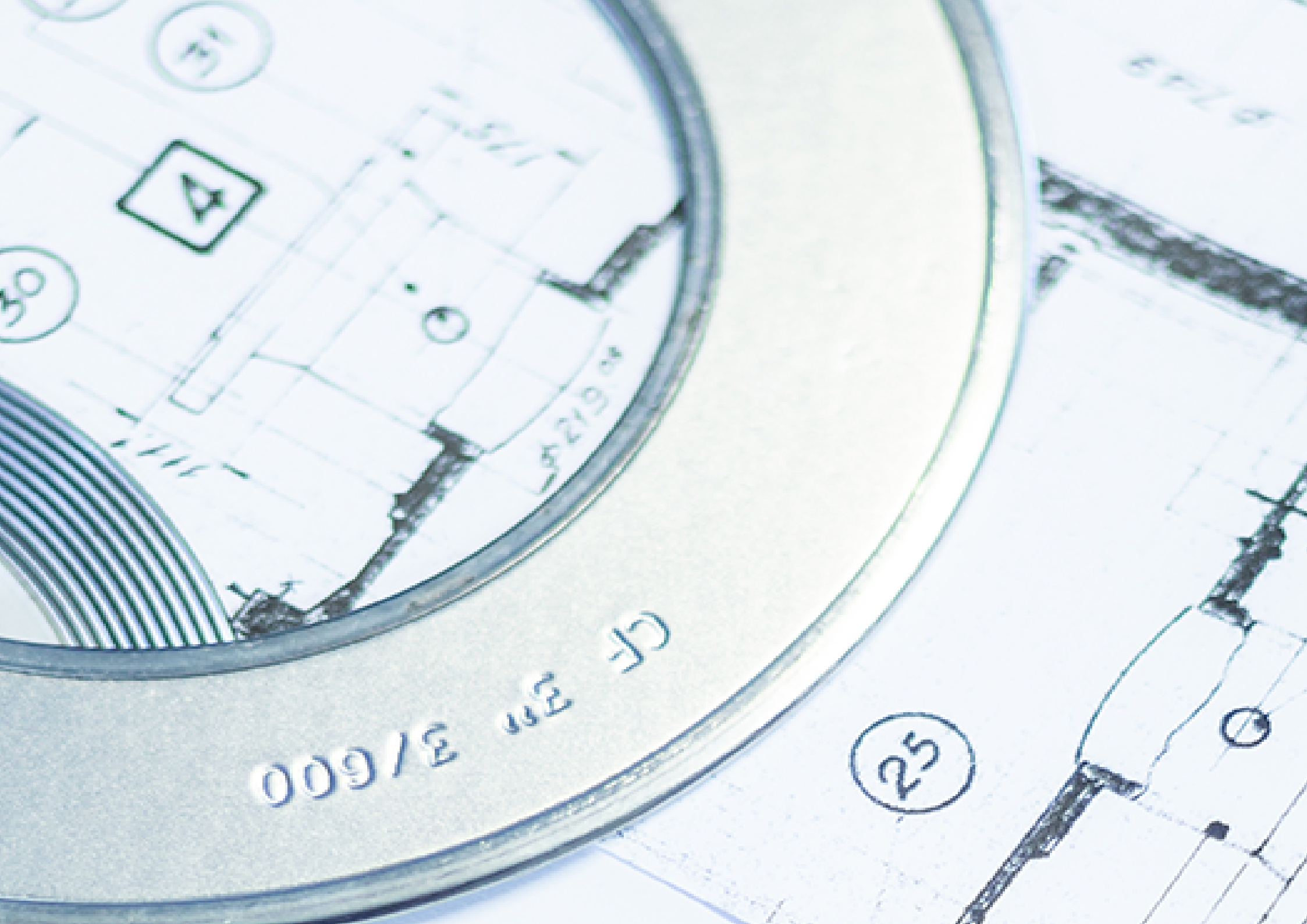
TEST PROCEDURE

DIN EN 13555	Flanges and their joints Rules for the design of flange connections with round flanges and gaskets
DIN 28090	Static gaskets for flange connections
Part 1:	Sealing parameters ant testing procedures
Part 2:	Seals in the form of gasket sheets Custom testing procedures for quality assurance
Part 3:	Seals in the form of gasket sheets testing procedures to determine chemical reliability
ISO 15848	Industrial valves Measuring, testing, and qualification procedures for fugitive emissions
Part 1:	Classification system and qualification procedure for the type testing of valves
Part 2:	Ongoing approval inspections of the valves during production
ISO 10497	Valve inspection fire safety requirements for type testing

MISCELLANEOUS

ISO 15156	Oil and gas industry materials for use in environments with H_2S content in in oil and gas production
Part 1:	General selection criteria for the selection of materials with appropriate crack resistance
Part 2:	Crack-resistant, non-alloy and low-alloy steels and cast iron
Part 3:	High-alloy steels [CRAs] and other alloys

ABBREVIATIONS: DIN Deutsches Institut für Normung | EN European standard | ISO International Organization for Standardization



Norms and standards

FLANGES, FLANGE CONNECTIONS & CONNECTION ELEMENTS			
ASME B 16.5	Flanges and flanged valves NPS 1/2 through NPS 24, Metric/Inch standard	ISO 7005	Metallic flanges
		Part 1:	Steel flanges
		Part 2:	Cast iron flanges
		Part 3:	Copper alloy and composite flanges
ASME B 16.47	Large diameter steel flanges NPS 26 through NPS 60, Metric/Inch standard	AWWA C207-01	Steel pipe flanges for waterworks service - sizes 4 in. through 144 in. [100 mm through 3,600 mm]
BS 10	Flanges and bolts for pipes, valves, and connection pieces		
BS 3063	Dimensions for "inside bolt circle" and "full face" gaskets or pipe flanges in accordance with BS 10 and BS 2035, and "full face" gaskets for flanges to BS 1770		

GASKETS AND SEALING MATERIALS			
ASME B 16.20	Metallic gaskets for pipe flanges: Ring joint, spiral Wound and jacketed, camprofile	ASME B 16.21	Non-metallic gaskets for pipe flanges

TEST PROCEDURE			
API STD 607	Fire test for quarter-turn Valves & valves equipped with non-metallic seats	BS 6755-2	Testing of valves
		Part 2:	Specification for fire type testing requirements
API STD 622	Type testing of process valve packing for fugitive emissions		

MISCELLANEOUS			
ASME B 16.48	Line blanks	NACE MR0175	Petroleum and natural gas industries Materials for use in H2S-containing environments in oil and gas production
NACE MR0103	Material requirements Materials resistant to sulphide stress Cracking in corrosive petroleum refining environments	Part 1:	General principles for selection of cracking-resistant materials

ABBREVIATIONS: ASME American Society of Mechanical Engineers | API American Petroleum Institute · BS British Standards ISO International Organization for Standardization | NACE National Association of Corrosion Engineers | AWWA American WaterWorks Association

Regulations & Requirements

AD Requirements Pressure vessel work group	
Series A:	Equipment, setup, identification
Series B:	Calculation
Series G	Basic principles
Series HP:	Manufacturing and testing
Series N:	Pressure vessels made of non-metallic materials
Series S:	Exceptions
Series W:	Metallic materials
Series Z:	Guides
API SPEC 6A	Specification for wellhead and Christmas tree equipment
EC 1935	Directive [EG] No. 1935/2004 of the European Parliament and Council, dated October 27, 2004 on materials and items designated for use in direct contact with food
KTA 3201.1	Primary circuit components of light water reactors
Part 1:	Materials and product forms
Part 2:	Design, construction, and calculation
KTA 3211.1	Pressure and activity-retaining system components outside the primary circuit
Part 1:	Materials
Part 2:	Design, construction, and calculation

PAS 1050	Instructions for the implementation of TA Luft [Clean Air Act] in the chemical- and pharmaceutical industry
Part 1:	General requirements
Part 2:	Flanges and gaskets
TA Luft	First general administrative specification with regards to the Federal Pollution Control Act
VDI 2200	Technically tight flange connections Selection, design, construction, and installation of bolted flange connections
VDI 2440	Emission reduction Oil refineries
VDI 2290	Emission reduction Parameters for technically tight flange connections
97/23/EG	European Pressure Equipment Directive VdTÜV leaflet “Gasket 100” For installers and operators of oval sealing covers. VdTÜV component test sheets reflect the results of type tests/component tests of specific components with safety require-ments

Gasket Factors

CF SERIES	CF CODE	MATERIAL	m	y (Psi)	y (MPa)	y (N/mm^2)
Revoseal	JP-2	STAINLESS STEEL	3,75	7975	14	14
	JG 2	STAINLESS STEEL	3,75	7975	14	14
	REVOLUTION	STAINLESS STEEL	5	6525	45	45
	VARIO	STAINLESS STEEL	3,75	7975	14	14
	ECO+	STAINLESS STEEL	8,5	11310	78	78
Flat Gasket	CF 1000	ASB FREE	2,5	2500	17,24	17,24
	CF 1100	ASB FREE	2,5	2500	17,24	17,24
	CF1100 Gr.X	ASB FREE	2,5	2500	17,24	17,24
	CF 1200	ASB FREE	2,5	2500	17,24	17,24
	CF 2001G	REINF GRAPH	2,5	2500	17,24	17,24
	CF 2002G	REINF GRAPH	3	4000	27,58	27,58
	CF 2000	EXP GRAPH	2	800	5,51	5,51
	SIGRAFLEX MF	MF	2,5	1000	6,89	6,89
	VITON	RUBBER	1,2	220	1,5	1,5
	NBR	RUBBER	0	200	1,37	1,37
	SONDERTYP	SONDERTYP	2,5	2000	13,79	13,79
	HOCHDRUCK PRO	REINF GRAPH	2,5	2000	13,79	13,79
	CF 3000	PTFE VIRGIN	3,5	6500	44,8	44,8
	CF3024	PTFE EXPANDED	2	2800	19,3	19,3
	CF 3031	PTFE GLASS	2,5	2500	17,24	44,8
	CF 3070	PTFE GLASS	2,5	2500	17,24	17,24
	CF 3080	PTFE BARIUM	2,5	2500	17,24	17,24
	CF 3090	PTFE SILICA	2,5	2500	17,24	17,24
Spiral Wound Gasket	CF 4000	SWG	3	10000	68,96	68,96
Metal Jacketed Gasket	CF5000 INOX	MJG FLAT	3,75	9000	62	62
	CF5000 RAME	MJG FLAT	3,3	6500	44,8	44,8
	CF5000 SOFT IRON	MJG FLAT	3,75	7600	52,4	52,4
	CF5035 INOX	MJG ENERG	3,5	6500	44,8	44,8
Camprofile	CF6000	CAMPROFILE	2	2500	17,24	17,24
Ring Joint	CF 7000 SOFT IRON	RTJ	5,5	18000	124	124
	CF 7000 F5	RTJ	6	21800	150	150
	CF 7000 INOX	RTJ	6,5	26000	179	179
Insulation Kit	VCS	INS KIT	0	8265	57	57

List of product testing

	CERTIFICATE	VDI 2440	BLOW OUT	FIRE SAFE API 607	FIRE SAFE API 6FB	FIRE SAFE BS6755	BAM	DVGW	FDA	WRAS	PUBLIC HEALT OFFICE	KTW	WRC	TUV
Revoseal	Revolution	X	X	X					X (ptfe)					
	JP-2	X	X	X					X (ptfe)					
	JP-1	X	X	X					X (ptfe)					
	JG-2	X	X	X					X (ptfe)					
	JG-1	X	X	X					X (ptfe)					
	Vario	X	X	X					X (ptfe)					
	Eco+	X	X	X					X (ptfe)					
Series 1000	1000									X				
	CF1100 Gr.X	X			X		X	X						
	1100						X	X		X	X			
	1200													
	1300													
Series 2000	2000													
	2001G			X			X	X						
	2002G	X		X			X	X						X
	HOCHDRUCK PRO	X	X	X			X	X						
	SIGRAFLEX MF	X	X	X		X	X	X	X					
	UNIVERSAL PRO	X	X	X			X	X						
Series 3000	CF3000								X					
	CF3024	X	X				X	X	X				X	X
	CF3031													
	CF3033	X												
	CF3051						X		X					
	CF3055													
	CF3070	X	X				X		X					
	CF3083													
	CF3090	X	X				X	X	X					
	CF3500	X					X	X	X					
	CF3504	X					X		X					
Series 4000	CF4000				X									
	CF4000 spring	X												X
Series 5000	CF5000													
	CF5033	X												
	CF5035				X									X
Series 6000	CF6000	X		X										
Series 7000	CF7000													
Elastomer gaskets	EPDM	X												X
	NEOPRENE	X												X

VDI2440: norms for fugitive emissions reduction (TA - Luft)

BLOW OUT: norm blow out resistance

FIRE SAFE API 607 REV 04 WITH EXXON MODIFICTION: fire resistanceaccording to API

FIRE SAFE API 6FB: fire resistance according to API

FIRE SAFE BS6755 REV 02: fire resistance according to British Standard

BAM: German standard for use on oxygen and explosive atmospheres

DVGW: use on gas lines and/or drinking water

FDA: American food law (no contamination)

WRAS: English standard for use on drinking water

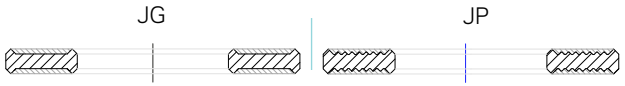
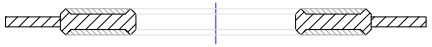
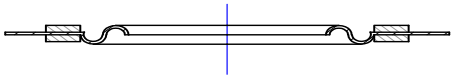
KTW: German law for food use

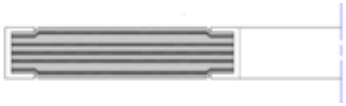
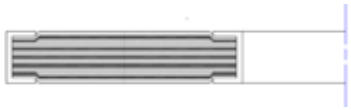
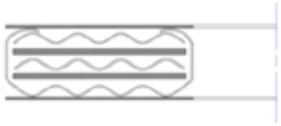
WRC: English law for food use

TUV: independent body for certification and inspection and control of materials

Surface finish flange

Gasket comparison table

CF SERVICE CODE	TYPICAL CROSS SECTION	TYPE OF GASKET	SURFACE ROUGHNESS	
			µm	µinch
New Technology				
CF Service code revoseal		JP/JG	3,2-12,5	125-500
CF Service code revoseal		REVOLUTION	3,2-12,5	125-500
CF Service code revoseal		VARIO	3,2-12,5	125-500
CF Service code revoseal		ECO+	3,2-12,5	125-500
Flat gasket – Non Asbestos				
CF1100		Flat asbestos free	6,3-12,5	250-500
Flat gasket - Graphite				
CF2001G		Reinf graph with No.1 tanged insert. Thk.2mm	3,2-12,5	125-500
CF2002G		Reinf graph with No.2 tanged insert. Thk.3mm	3,2-12,5	125-500

CF SERVICE CODE	TYPICAL CROSS SECTION	TYPE OF GASKET	SURFACE ROUGHNESS	
			µm	µinch
Sigraflex Hochdruck Pro		Multilayer reinf graph	3,2-12,5	125-500
Sigraflex MF		Multilayer reinf graph	3,2-12,5	125-500
Spiralwound gasket				
CF4000		Spiral Wound gasket	3,2-6,3	125-250
Metaljacketed gasket				
CF5000		Metal Jacketed gasket	3,2-6,3	125-250
CF5035		Metal Jacketed gasket	3,2-6,3	125-250
Camprofile				
CF6000		Camprofile	3,2-6,3	125-250
Ring joint				
CF7000		Ring Joint	1,6	63

Standars cross-reference table for main alloys

			USA		Germany	Europe EN 10088/3		USA ASTM			
Tipo Lega	Materiale	Nome Commerciale	UNS	ASTM	Werkst Nr.	Nome	Nr.	Barra	Tubo	Bobina	Lamiera
Nickel	Nickel 200	Nickel 200	N02200		2.4660			B160	B163/B730	B162	B162
Nickel	Nickel 201	Nickel 201	N02201		2.4068			B160	B163/B730	B162	B162
Nickel Alloy	Alloy 400	Monel 400	N04400		2.436			B164	B163/B730	B127	B127
Nickel Alloy	Alloy 600	Inconel 600	N06600		2.4816			B166	B163/B516	B168	B168
Nickel Alloy	Alloy 601	Inconel 601	N06601		2.4851			B166	B163	B168	B168
Nickel Alloy	Alloy 625	Inconel 625	N06625		2.4856			B446	B444/B704	B443	B443
Nickel Alloy	Alloy 718	Inconel 718	N07718		2.4668			B637	B626	B670	B670
Nickel Alloy	Alloy 800	Incoloy 800	N08800		1.4876			B408	B163/B515	B409	B409
Nickel Alloy	Alloy 800H	Incoloy 800H	N08810		1.4958			B408	B163/B515	B409	B409
Nickel Alloy	Alloy 800HT	Incoloy 800HT	N08811		1.4959			B408	B163/B515	B409	B409
Nickel Alloy	Alloy 825	Incoloy 825	N08825		2.4858			B425	B163/B704	B424	B424
Nickel Alloy	Alloy C276	Hastelloy C-276	N10276		2.4819			B574	B622/B626	B575	B575
Nickel Alloy	Alloy C4	Hastelloy C-4	N06455		2.4610			B574	B622/B626	B575	B575
Nickel Alloy	Alloy C22	Hastelloy C-22	N6022		2.4602			B574	B622/B626	B575	B575
Nickel Alloy	Alloy B2/B3/B4	Hastelloy B2/B3/B4	N10665		2.4617			B335	B622/B626	B333	B333
Nickel Alloy	Alloy 59	Alloy 59	N06059		2.4605			B574	B622/B626	B575	B575
Nickel Alloy	Alloy C2000	Alloy C2000	N06200					B574	B622/B626	B575	B575
Nickel Alloy	CuNi 70/30	Cupronickel 70/30	C71500		2.0882				SB111		SB171
Nickel Alloy	CuNi 90/10	Cupronickel 90/10	C70600								

			USA		Germany	Europe EN 10088/3		USA ASTM			
Tipo Lega	Materiale	Nome Commerciale	UNS	ASTM	Werkst Nr.	Nome	Nr.	Barra	Tubo	Bobina	Lamiera
Legati		F5		A182 F5/4-6 Cr½Mo	1.7362	12CrMo20	1.7362				
Titanio	Titanio Gr.1		R50250		3.7025			B348	B338	B265	B265
Titanio	Titanio Gr.2		R50400		3.7035			B348	B338	B265	B265
Titanio	Titanio Gr.3		R50550		3.7055			B348			B265
Titanio	Titanio Gr.4		R50700		3.7065			B348		B265	B265
Titanio	Titanio Gr.5		R56400		3.7165			B348			
Titanio	Titanio Gr.7		R52400		3.7235			B348	B338	B265	B265
Titanio	Titanio Gr.9		R56320					B348	B338	B265	
Duplex	Duplex	SAF2205	S31803	ASTM F51	1.4462			A276	A789	A240	A240
Duplex	Duplex	SAF2205	S32205		1.4462			A276	A789	A240	A240
Duplex	Super Duplex	SAF2507	S32750	A182 F53	1.4410			A479	A789	A240	A240
Duplex	Super Duplex	Ferralium, SAF2507	S32760	A182 F55	1.4501	X2CrNiMoCuWN25.7.4	1.4501	A479	A789	A240	A240
Duplex	Duplex			A182 F11		12CrMo5					
Duplex	Duplex			A182 F12	1.7335	14CrMo3					
Duplex	254 SMO/6Mo	354	S31254	A182 F44	1.4547	X1CrNiMoCuN20-18-7	1.4547	A479/A276	A269	A240	A240
	Alloy 904/L	TP904L	N08904		1.4539			B649	B673	A240	B625
Inox	AISI304L	TP304L	S30403	304L	1.4307	X 2 CrNi 18-09	1.4307	A479/A276	A269	A240	A240
Inox	AISI304H	TP304H		304H	1.4301	X 5 Cr Ni 1810	1.4301				
Inox	AISI316L	TP316L	S31603	316L	1.4404	X 2 CrNiMo 17-12-2	1.4404	A479/A276	A269	A240	A240
Inox	AISI316Ti	TP316Ti	S31635	316Ti	1.4571	X 6 CrNiMoTi 17-12-2	1.4571				
Inox	AISI317L	TP317L	S31703	317L	1.4438	X 2 CrNiMo 18-15-4	1.4438	A479/A276	A269	A240	A240
Inox	AISI321	TP321	S32100	321	1.4541	X 6 CrNiTi 18-10	1.4541	A479/A276	A269	A240	A240
Inox	AISI347	TP347	S34700	347	1.4550	X 6 CrNiNb 18-10	1.4550	A479/A276	A269	A240	A240
Inox	AISI410	TP410	S41000	410	1.4006	X12Cr13	1.4006				
Inox	AISI420	TP420	S42000	420	1.4021	X20Cr13	1.4021				
Inox	AISI430	TP430	S43000	430	1.4016	X6Cr17	1.4016				
Acc. Carbonio	Carbon steel	Carbon steel		CS	1.0333						