SLOVENSKI STANDARD
SIST EN 13555:2005

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Prirobnice in prirobnični spoji - Parametri tesnil in preskusni postopki, potrebni za načrtovanje okroglih prirobičnih spojev s tesnili

Flanges and their joints - Gasket parameters and test procedures relevant to the design rules for gasketed circular flange connections

Flansche und ihre Verbindungen - Dichtungskennwerte und Prüfverfahren für die Anwendung der Regeln für die Auslegung von Flanschverbindungen mit runden Flanschen und Dichtungen

Brides et leurs assemblages - Parametres de joints et modes opératoires d'essai relatifs aux regles de calcul des assemblages a brides circulaires avec joint

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Contents

Foreword

This document (EN 13555:2004) has been prepared by Technical Committee CEN/TC 74 "Flanges and their joints", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2005, and conflicting national standards shall be withdrawn at the latest by June 2005.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This document provides the test procedures to allow the generation of the gasket parameters to enable the design equations established in EN 1591-1 to be employed. The same test procedures may be used for "Type Testing" of gaskets and gasket materials. These procedures are not for routine quality control purposes.

1 Scope

This document specifies the design parameters of gaskets and gasket materials required by EN 1591-1 and provides the test procedures for establishing the values of these parameters for inclusion in ENV 1591-2.

The testing procedures given might be applicable to gaskets of other shapes and dimensions but this shall be indicated in the report.

Gaskets which are wholly based upon elastomers, or based upon elastomer with the inclusion of particulate fillers or particulate reinforcement, are beyond the scope of this document.

2 Normative references

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

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

EN 1514-1, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 1: Non-metallic flat gaskets with or without inserts*

EN 1514-2, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 2: Spiral wound gaskets for use with steel flanges*

EN 1514-3, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 3: Non-metallic PTFE envelope gaskets*

EN 1514-4, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 4: Corrugated, flat or grooved metallic and filled metallic gaskets for use with steel flanges*

EN 1514-6, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 6: Covered serrated metal gaskets for use with steel flanges*

EN 1514-7, *Flanges and their joints — Gaskets for PN-designated flanges — Part 7: Covered metal jacketed gaskets for use with steel flanges*

EN 1591-1, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 1: Calculation method*

ENV 1591-2, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 2: Gasket parameters*

EN 1759-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, Class designated — Part 1: Steel flanges, NPS ½ to 24*

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

EN 12560-1, *Flanges and their joints — Gaskets for Class-designated flanges — Part 1: Non-metallic flat gaskets with or without inserts*

EN 12560-2, *Flanges and their joints — Gaskets for Class-designated flanges — Part 2: Spiral wound gaskets for use with steel flanges*

EN 12560-3, *Flanges and their joints — Gaskets for Class-designated flanges — Part 3: Non-metallic PTFE envelope gaskets*

EN 12560-4, *Flanges and their joints — Gaskets for Class-designated flanges — Part 4: Corrugated, flat or grooved metallic and filled metallic gaskets for use with steel flanges*

EN 12560-5, *Flanges and their joints — Gaskets for Class-designated flanges — Part 5: Metallic ring joint gaskets for use with steel flanges*

EN 12560-6, *Flanges and their joints — Gaskets for Class-designated flanges — Part 6: Covered serrated metal gaskets for use with steel flanges*

EN 12560-7, *Flanges and their joints — Gaskets for Class designated flanges - Part 7: Covered metal jacketed gaskets for use with steel flanges*

EN ISO 4287, *Geometrical products specification (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters (ISO 4287:1997)*

ISO 554, *Standard atmospheres for conditioning and/or testing — Specifications*

3 Notations

For the purposes of this document, the following notations apply.

Where units are applicable, they are shown in brackets. Where units are not applicable, no indication is given.

α_G	the axial coefficient of thermal expansion of gasket	[K^{-1}]
e_G	gasket or sealing element thickness	[mm]
Δe_G	change in gasket or sealing element thickness	[mm]
A_G	area of gasket subjected to surface pressure	[mm^2]
d	internal diameter of gasket	[mm]
d_s	internal diameter of area of gasket subjected to surface pressure	[mm]
D	external diameter of gasket	[mm]
D_s	external diameter of area of gasket subjected to surface pressure	[mm]
E_G	the secant unloading modulus of the gasket	[MPa]
L_N	leakage rate class — subscript N indicates the maximum specific leakage rate for that leakage rate class	[mg s^{-1} m^{-1}]
P_{QR}	ratio of gasket surface pressures after & before relaxation	—
Q	surface pressure	[MPa]
Q_A	gasket surface pressure at assembly	[MPa]
$Q_{min\ (L)}$	the minimum level of surface pressure required for leakage rate class L on assembly	[MPa]
$Q_{smin\ (L)}$	the minimum level of surface pressure required for leakage rate class L after off-loading	[MPa]
Q_{smax}	the maximum surface pressure than can be safely imposed upon the gasket at the service temperature without damage	[MPa]

Concordance with EN 1591-1 and ENV 1591-2:

Q_A, the gasket surface pressure at assembly is the gasket stress at the load situation 0 and is defined by Q_0 in EN 1591-1 and ENV 1591-2.

Q_{smax}, the maximum surface pressure that can be safely imposed upon the gasket at the indicated temperature without damage is the $Q_{max,ref}$ defined in ENV 1591-2.

$Q_{smin\ (L)}$ corresponds the Q_I defined in EN 1591-1 and in ENV 1591-2.

4 List of gasket parameters

The gasket parameters relevant to the calculation procedures for the design of bolted flange connections as given in ENV 1591-2 are shown in Table 1 together with the test procedures applicable for determining the value of the parameter in each case.

Table 1 — Gasket parameters and test procedures

Gasket parameter	Definition Clause	Test procedure(s) Clause
Q_{smax}	5.1	8.4
$Q_{min\ (L)}$	5.2	8.7
$Q_{smin\ (L)}$	5.4	8.7 and 8.8
P_{QR}	5.5	8.6
E_G	5.6	8.5
α_G	5.7	8.9

5 Definitions

5.1
Gasket parameter Q_{smax}
maximum gasket surface pressure that may be imposed on the gasket at the indicated temperatures without collapse or compressive failure of the gasket

5.2
Gasket parameter $Q_{min\ (L)}$
minimum gasket surface pressure on assembly required at ambient temperature in order to seat the gasket into the flange facing roughness and close the internal leakage channels so that the tightness class is to the required level L for the internal test pressure

5.3
Tightness class L_N
tightness classes are defined in Table 2 in terms of specific leak rates. Additional, better tightness classes can be introduced as required by continuing the series

Table 2 — Tightness classes

Tightness classes	$L_{1,0}$	$L_{0,1}$	$L_{0,01}$
Specific leak rates [mg s^{-1} m^{-1}]	≤ 1,0	≤ 0,1	≤ 0,01

The specific leak rate shall be obtained by dividing the measured leak rate by the arithmetic mean of the inner and outer gasket peripheries subjected to surface pressure from the flange facings, $\pi/2\ (D_S + d_S)$.

5.4
Gasket parameter $Q_{smin\,(L)}$
minimum gasket surface pressure required under the service pressure conditions, (i.e.) after off loading and at the service temperature, so that the required tightness class L is maintained for the internal test pressure

5.5
Gasket parameter P_{QR}
a factor to allow for the effect on the imposed load of the relaxation of the gasket between the completion of bolt up and after long term experience of the service temperature

5.6
Gasket parameters E_G
the unloading moduli determined from the thickness recovery of the gasket between the initial compression surface pressure and unloading to a third of this initial surface pressure

5.7
Gasket parameter axial coefficient of thermal expansion α_G
the coefficient of thermal expansion of the gasket under the service conditions of temperature and gasket surface pressure in the axial direction

5.8
Area of the gasket subjected to surface pressure, A_G
the area subjected to surface pressure by the flange facings is calculated from:

$$A_G = \frac{\pi}{4}\left(D_s^{\,2} - d_s^{\,2}\right) \qquad (2)$$

Where the contact area between the test platen and the gasket is fixed by raised faces as part of the design of the test platens, or the gasket overlaps the contact area of the test platens, then the stressed area is calculated from the above with D_s being whichever is the smaller of the outside diameter of the gasket, D, the outside diameter of the platen contact region, or, where used, the outside diameter of the raised face and with d_s replaced by whichever is the greater of the inside diameter of the gasket, d, the inside diameter of the platen contact area or, where used, the inside diameter of the raised face

5.9
Ambient Temperature
the ambient laboratory temperature during the testing detailed in this document shall be (23 ± 5) °C as recommended in ISO 554 but the temperature of the test platens at the start of all tests shall be (23 ± 2) °C

5.10
Test Temperatures
when testing is carried out at elevated temperature it is recommended, for reasons of uniformity, that the test temperature be selected from those shown below

Recommended Elevated Temperature

T [°C]	50	100	125	150	175	200	225	250	275	300	350	400	450	500	550	600
T [K]	323	373	398	423	448	473	498	523	548	573	623	673	723	773	823	873

In all cases the rate of increase of temperature shall be 2 °C per minute.

6 Test equipment

6.1 Design

Schematics of test rigs for compression, compression creep, and leakage measurement are shown in informative Annexes A to D. Annex A is a generalised schematic with the other figures providing further detail for specific aspects of the tests.

6.2 Test platens

The test platens, and heater assembly where appropriate, shall be sufficiently rigid so that any load imposed on the gasket can be withstood and so that there is no platen deformation which results in gasket surface pressure variation. This rigidity aspect can also be important when gasket elastic recovery is being investigated.

The dimensions of the test platen raised faces shall be as given in EN 1092-1 for a DN 40 / PN 40 gasket and EN 1759-1 for an NPS 4 CLASS 300 gasket. Figures B.1 and C.1 show the dimensions in the former case.

6.3 Surface finish of test platens

The surface finish of the test platens shall conform to the following:

3,2 µm < R_a < 6,3 µm

Exceptions to this range are acceptable where the gasket is intended for use with a surface finish outside of this range. In this case the surface finish used must be recorded.

This surface finish can be achieved by lathe turning with the following parameters:

— Helical pitch: 0,3 mm;

— Tool radius: 0,8 mm;

— Depth: 0,015 mm.

The recommended R_a values shall be checked before each test. Local errors shall not exceed twice the value of R_a (see EN ISO 4287).

Before each test, the freedom from debris from the previous test and from scratch and impact damage to the surface finish of the platens shall be checked visually.

Experience has indicated that during hot compression tests, such as the Q_{smax} test, the use of stainless steel foils or shims of thickness of 0,05 mm thickness between the test gasket and the platens protects the flange surface finish because platen cleaning, with the inherent probability of damaging the platen surface finish, is eliminated. If there is any effect from the use of such foils it will be conservative.

Where foils are used the fact of their use shall be included in the test report issued. Foils shall not be re-used and shall not be used in sealing tests

6.4 Measurement of gasket thickness

For those procedures where the gasket thickness has to be monitored during the test there shall be either three displacement transducers at 120° spacing around the circumference of the platens or one displacement transducer placed on the central line.

However, for a leak test, the use of an axial transducer is not recommended as it introduces a sealing complication to the rig design.

6.5 Loading

Any loading means may be used that allows the gasket to be loaded and unloaded at a required and consistent rate. The rate of loading and unloading to be used is fixed as:

0,5 MPa/s for all types of gasket except for PTFE based gaskets when 0,1 MPa/s shall be used.

The loading shall be recorded as a function of time.

6.6 Temperature

The rate of increase of temperature in all elevated temperature tests shall be 2 °C per minute

6.7 Leakage Measurement

EN 1779 gives the limits that can be achieved by various method of leakage measurement. The information given in that document shall be taken into account when selecting a measurement system.

For modern, high performance, sealing materials and gasket styles, the most appropriate method of measurement is very likely to be mass spectrometery.

7 Test specimens

7.1 Number of specimens

At least two specimens for each type of test shall be tested, in order to check the repeatability of the results.

7.2 Procurement and identification of specimens

The gaskets to be tested shall be selected at random from production gaskets or shall be cut from sheet representative of normal production. In both cases some basic checks shall be made in order to ensure that the gaskets or sheet are acceptable by the normal quality assurance criteria before the tests to this document are carried out. The results of these checks shall be recorded.

In all cases, full traceability to production shall be maintained.

7.3 Pre-conditioning of the specimen gaskets

For every gasket type where the sealing element is not solid metal the gasket shall be conditioned as indicated below before any of the tests of this document are carried out.

The test gasket shall be held for at least 48 hours in air with a relative humidity of (50 ± 6) % at ambient temperature.

7.4 Dimensions of test gaskets

The test gasket dimensions shall be either of those specified in Table 3:

Table 3 — Test gasket dimensions

Flange description	Raised face dimensions according to	Gasket dimensions according to
DN 40/PN 40	EN 1092-1	EN 1514-1 to 7 (according to the type of gasket)
NPS 4 CLASS 300	EN 1759-1	EN 12560-1 to 7 (according to the type of gasket)

Where the intended service is in tongue and groove flanges, the test gasket size is specified in EN 1092-1 or in EN 1759-1, and the test shall be carried out with test platens which have a tongue and groove configuration.

Tolerance of the platens for tongue and groove configurations shall be as given below:

— Negative tolerance for tongue width,

— Positive tolerance for groove width.

If this mode of testing is used it shall be clearly stated in the report.