BRITISH STANDARD

BS EN 1591-2:2008

Flanges and their joints — Design rules for gasketed circular flange connections

Part 2: Gasket parameters

ICS 23.040.60

British Standards

National foreword

This British Standard is the UK implementation of EN 1591-2:2008. It supersedes DD ENV 1591-2:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PSE/15, Flanges.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 1591-2:2008) 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of an identical text or by endorsement, at the latest by December 2008, and conflicting national standards shall be withdrawn at the latest by December 2008.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes ENV 1591-2:2001.

EN 1591 *"Flanges and their joints — Design rules for gasketed flange connections"* consists of the following three parts:

— *Part 1: Calculation method*

— *Part 2: Gasket parameters*

— *Part 3: Calculation method for metal to metal contact type flanged joint (CEN/TS)*

The data values given in this European Standard were all determined by the test methods given in EN 13555. The data given was obtained during the PERL Project[1)] during which the test methods of EN 13555 were assessed for practicability & repeatability by the test laboratories at MPA & CETIM,(see footnotes 2 & 3 of Table A.1). The materials selected for evaluation during that project were those suggested by the organisations taking part in the PERL project. The materials tested in that project, and therefore the data given in this document, must be seen as just a selection of the total range of commercial gasket offerings that are available from the various gasket manufacturers and distributors. The data presented in this document is intended to assist engineers using EN 1591-1 during their preliminary calculations. Other public sources of reliable data are given in Annex B. In all cases it is expected that engineers will obtain from the manufacturer of their choice the data for the gasket intended to be used in the application in hand. The website of the European Sealing Association, www.europeansealing.com, contains links to their members throughout Europe.

The importance of using the data for the exact style, make and thickness of gasket intended to be used can be seen from the dispersion of the results between gasket makes within a style and thickness in this document.

NOTE The objective for the Publication of this version of EN 1591-2 is to present and make available during the standardization work of CEN/TC 54/TC 74/TC 267/TC 69/TC 269/JWG tables of values (results of tests) more reliable than those specified in the experimental standard ENV 1591-2:2001. This EN 1591-2 is therefore dedicated to be amended somehow in accordance with the revision in progress carried out by the Joint Working Group on EN 1591-1.

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

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1) PERL, *Pressure Equipment, Reduction of Leak rate: Gasket parameters measurement, RTD Project in the Framework of the "Competitive & Sustainable Growth" Programme*

1 Scope

This European Standard details generic gasket parameters for use in EN 1591-1 during preliminary calculations during which the type of gasket to be used in an application is to be decided. Once the gasket type has been decided the parameters for gaskets of that type from the different potential commercial suppliers should be used in further calculations as within a gasket type there will be differences depending upon the supplier.

WARNING — For the final calculations using the method given in EN 1591-1 the reader is directed to obtain gasket parameters for the selected generic type of gasket from the intended gasket manufacturer. This is because the data for a generic gasket type will vary between manufacturers. This variation can be seen in the tables of data which are embodied in 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 1591-1:2001, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 1: Calculation method*

EN 13555:2004, *Flanges and their joints — Gasket parameters and test procedures relevant to the design rules for gasketed circular flange connections*

3 Symbols and definitions

For the purposes of this document, the symbols and definitions given in EN 1591-1:2001 and EN 13555:2004 apply.

4 Typical gasket parameters for various gasket styles

4.1 General

It shall be noted that the data given in the following tables is only intended to be used in preliminary calculations using EN 1591-1. The data was obtained using the test methods given in EN 13555 during the testing of a selection of a few of the many styles and makes of commercial gasket that are on offer in Europe. For final calculations the user of EN 1591-1 shall contact the gasket supplier of choice and obtain the data for the style and thickness of the gasket intended to be used.

A group of end users has derived a pre-calculation method of use of EN 1591-1 that allows gasket selection without any further calculation. This is outlined in Annex C.

EN 13555 permits the testing of gaskets sized for either DN40/PN40 or NPS 4 CLASS 300 flanges. All the data values given in this document were obtained from DN40/PN 40 gaskets.

It should be noted that the rules of EN 13555 regarding Q_{Smax} have been adhered to in that where no collapse was found during the Q_{Smax} test then the value of Q_{Smax} is taken to be that of the surface pressure, Q_{i} , used during the P_{QR} test with the highest surface pressure tabulated.

The data in the following sets of tables is presented in three gasket parameter groupings, $Q_{\mathrm{min[L]}}$ and $Q_{\mathrm{Smin[L]}}$ in the 4.2 set of tables followed by Q_{Smax} and P_{QR} in the 4.3 set and then E_{G} in the 4.4 set to allow easy appreciation of how the parameter varies with gasket type. A brief explanation of the parameters in the grouping is given at the start of each set. For more information about the gasket parameters or test methods EN 13555 should be consulted.

Data generated in accordance with EN 13555 should be used together with EN 1591-1 to ensure that a flanged joint is as safe and as tight as required results. It will never be possible for the gasket parameters to be tabulated at all values of the controlling parameters so results at the next "worse" values of those controlling parameters should be used to ensure that the result is conservative.

The various parameters that are obtained from gaskets by the tests detailed in EN 13555 are inter-related in complex ways and the guidance given below is in some respects simplistic in view of those inter-relationships. If further guidance is required it is recommended that the favoured suppliers or manufacturers should be consulted as they will be able to provide all the necessary guidance that is required to aid the selection of an optimised solution for any sealing application.

$Q_{Smin[L]}$ is influenced by Q_A, the higher the level of Q_A achieved on assembly the better.

Q_A will be limited by either the maximum bolt load available, the maximum flange loading that can be permitted or the maximum gasket loading, Q_{Smax}, that can be withstood.

High values of Q_{Smax} are desirable. Where a value of Q_{Smax} is not tabulated at the temperature and gasket thickness of interest then the value for Q_{Smax} at the next higher values should be used.

For secure achievement of a given level of tightness, L, the lower the values of $Q_{min[L]}$ and $Q_{Smin[L]}$ the better. Where data is tabulated for more than one helium pressure then interpolation to deduce a value for the pressure of interest is permitted. Where data is not available for the thickness of interest then data for the next higher available thickness should be used.

Low values of $Q_{min[L]}$ and $Q_{Smin[L]}$ are desirable. A low difference between the $Q_{Smin[L]}$ values for successive values of L is also desirable as this indicates a low sensitivity to off-loading in service.

Within a gasket type, high values of P_{QR} are desirable. Where a P_{QR} value is not tabulated at exactly the required level of temperature, stiffness and surface pressure then the value of P_{QR} at the next level above those required should be used.

Low values of E_G are desirable. Where a value of E_G is not tabulated at exactly the required level of temperature, surface pressure and thickness then the value of E_G at the next level above those required should be used.

The data in the following sets of tables was generated as the test methods of EN 13555 were evolving. As a consequence the data for some tested gaskets does not in all respects comply with the rules subsequently derived and given in EN 13555. An instance of this is given by P_{QR} in the 4.3 set of tables as values are only given for a stiffness of 500 kN/mm whereas the standard calls for P_{QR} values for a range of stiffness to be determined.

The notes at the end of the 4.3 set of tables of Q_{Smax} and P_{QR} give important guidance in the use of the data in that set of tables.

For relation between the gasket types and the codes used in the tables see Annex A.

4.2 $Q_{min[L]}$, $Q_{Smin[L]}$

$Q_{min[L]}$ is the 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.

$Q_{Smin[L]}$ is the 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. In the case of the data in Tables 2 to 15 then only values at ambient temperature are given.

L is defined in terms of specific leakage rates in Table 1. Additional better tightness classes are introduced as required by continuing the series.

Table 1 — Tightness classes

Tightness Class	Specific Leakage Rate mg/(sm)
$L_{1,0}$	≤ 1,0
$L_{0,1}$	≤ 0,1
$L_{0,01}$	≤ 0,01

For the Tables 2 to 15 the following marking applies:

$Q_{min[L]}$ or $Q_{Smin[L]}$ values for 40 bar without underlining;

$Q_{min[L]}$ or $Q_{Smin[L]}$ figures for 10 bar are marked by a dashed line;

$Q_{min[L]}$ or $Q_{Smin[L]}$ figures for 80 bar are underlined;

$Q_{min[L]}$ or $Q_{Smin[L]}$ figures for 160 bar are double underlined .

Table 2 — Graphite filled spiral wound gasket with outer ring

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium, plus some data for other pressures, at ambient temperature.
Code 3-3-100-1, 4,5 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160
		-- / Material code	$Q_{Smin[L]}$ MPa					
10^1	-	-	-	-	-	-	-	-
10^0	10 30 35	3-3-100-1	-	10 10	10 10	10 10	10 10	10 10 11
10^{-1}	49 37 57	3-3-100-1	-	-	10 43	10 11	10 10	10 10 12
10^{-2}	63 62 71	3-3-100-1	-	-	-	19 25	10 17	10 10 15
10^{-3}	74 80 87	3-3-100-1	-	-	-	80	28 32	10 19 28
10^{-4}	98 126 104	3-3-100-1	-	-	-	-	-	24 71 40
10^{-5}	-	-	-	-	-	-	-	-
10^{-7}	-	-	-	-	-	-	-	-
10^{-8}	-	-	-	-	-	-	-	-
10^{-9}	-	-	-	-	-	-	-	-

Table 3 — Graphite filled spiral wound gasket with outer and inner ring

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.
Code 3-4-104-1, 4,5 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160	320
		--	$Q_{Smin[L]}$ MPa						
		Material code							
10^{1}	-	-	-	-	-	-	-	-	
10^{0}	10 10 10	3-4-104-1	10	10	10	10	10	10 - 10	10 10
10^{-1}	16 32 20	3-4-104-1	-	10	10	10	10	10 - 10	10 10
10^{-2}	25 48 45	3-4-104-1	-	10	10	10	10	10 - 10	10 10
10^{-3}	42 81 83	3-4-104-1	-	-	16	18	17	10 - 31	10 15
10^{-4}	81 143 159	3-4-104-1	-	-	-	-	62	35 - 157	26 51
10^{-5}	181 281	3-4-104-1	-	-	-	-	-	-	83 198
10^{-6}	314	3-4-104-1	-	-	-	-	-	-	298
10^{-7}	-	-	-	-	-	-	-	-	
10^{-8}	-	-	-	-	-	-	-	-	

Table 4 — Low stress, graphite filled, spiral wound gasket with outer and inner rings

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.
Code 3-5-102-1, 4,5 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160	320
		-	$Q_{Smin[L]}$ MPa						
		Material code							
10^{1}	-	-	-	-	-	-	-	-	-
10^{0}	10 - 10	-	-	-	-	10 -	-	-	- 10
10^{-1}	10 10 12	3-5-102-1	10	10	10	10 10	10	10	10 10
10^{-2}	10 19 33	3-5-102-1	10	10	10	10 10	10	10	10 10
10^{-3}	2970 174	3-5-102-1	-	-	-	10 20	10	14	26 168
10^{-4}	140 231	3-5-102-1	-	-	-	-	-	82	88 230
10^{-5}	154 290	3-5-102-1	-	-	-	-	-	101	123 288
10^{-6}	167	3-5-102-1	-	-	-	-	-	-	157
10^{-7}	180	3-5-102-1	-	-	-	-	-	-	192
10^{-8}	194	3-5-102-1	-	-	-	-	-	-	258

Table 5 — PTFE filled spiral wound gasket with outer and inner rings

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.
Code G03, 5,1 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	**60**	**120**	**180**	**240**	**300**	**480**
		-- / **Material code**	$Q_{Smin[L]}$ MPa					
10^{1}	-	-	-	-	-	-	-	-
10^{0}	-	-	-	-	-	-	-	-
10^{-1}	30 58	G03	30	30	30	30	30	30 30
10^{-2}	39 74	G03	-	30	30	30	30	30 30
10^{-3}	52 90	G03	-	30	30	30	30	30 30
10^{-4}	69 105	G03	-	43	30	30	30	30 30
10^{-5}	101 125	G03	-	-	30	30	30	30 30
10^{-6}	149 166	G03	-	-	97	47	48	35 34
10^{-7}	353 428	G03	-	-	-	-	-	132 372
10^{-8}	-	-	-	-	-	-	-	-

Table 6 — Corrugated metal core with graphite facing

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.

Code 7-01-104-1, 3,2 mm

Code K04, 2,3 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160	320
		-- / Material code	$Q_{Smin[L]}$ MPa						
10^1	-	-	-	-	-	-	-	-	-
10^0	-	-	-	-	-	-	-	-	-
10^{-1}	10	7-01-104-1	10	10	10	10	10	10	10
	10	K04	-	-	-	-	-	-	-
10^{-2}	11	7-01-104-1	10	10	10	10	10	10	17
	11	K04	10	10	10	10	10	10	-
10^{-3}	17 10 20	7-01-104-1	10	10	10	10	10	10 - 10	24 10
	10 22	K04	10	10	10	10	10	10 10	-
10^{-4}	21 75 30	7-01-104-1	-	33	13	17	27	24 - 20	32 10
	14 28	K04	-	10	10	10	10	11 10	10
10^{-5}	45 104 40	7-01-104-1	-		18	27	46	36 - 28	37 33
	41 35	K04	-	25	10	10	10	20 10	
10^{-6}	52 165 95	7-01-104-1	-	-	32	36	66	68 - 35	116 74
	84 68	K04	-	-	-	10	10	10	-
10^{-7}	57 295 152	7-01-104-1	-	-	-	73	86	159 - 95	165 243
	100 80	K04	-	-	-	-	44	10	-
10^{-8}	306	7-01-104-1	-	-	-	-	-	-	305

Table 7 — Metal jacketed gasket with graphite filler

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.

Code 6-4-103-1, 3,2 mm

No sealing data for H02

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160	320
		-- / Material code	$Q_{Smin[L]}$ MPa						
10^1	34	6-4-103-1	-	10	10	10	10	10	10 20
10^0	55 63 120	6-4-103-1	-	-	26	23	21	10	10 20
10^{-1}	96 187	6-4-103-1	-	-	-	-	-	56	14 20
10^{-2}	171 287	6-4-103-1	-	-	-	-	-	-	35 40
10^{-3}	253	6-4-103-1	-	-	-	-	-	-	133
10^{-4}	-	-	-	-	-	-	-	-	-
10^{-5}	-	-	-	-	-	-	-	-	-
10^{-6}	-	-	-	-	-	-	-	-	-
10^{-7}	-	-	-	-	-	-	-	-	-
10^{-8}	-	-	-	-	-	-	-	-	-

Table 8 — Graphite covered metal jacketed gasket with graphite filler and outer ring

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.

Code 5-5-103-1, 4,5 mm

Code H01, 4,8 mm

L **mg/(sm)**	$\boldsymbol{Q_{min[L]}}$ **MPa**	$\boldsymbol{Q_A}$ **MPa**	**20**	**40**	**60**	**80**	**100**	**160**	**320**
		--	$\boldsymbol{Q_{Smin[L]}}$ **MPa**						
		Material code							
10^{1}	-	-	-	-	-	-	-	-	-
10^{0}	-	-	-	-	-	-	-	-	-
10^{-1}	- 13 28	5-5-103-1	10	10	10	10	10	10 - 20	10 10
10^{-2}	14 32 73	5-5-103-1	10	10	10	10	10	10 - 32	10 10
10^{-3}	10	H01	10	10	10	10	10	10	-
	60 69	5-5-103-1	-	-	-	33	25	24	22 34
10^{-4}	10 15	H01	10	10	10	10	10	10	-
	218	5-5-103-1	-	-	-	-	-	-	131
10^{-5}	14 23	H01	-	10	10	10	10	10	-
10^{-6}	20 33	H01	-	15	10	10	10	10 10	-
10^{-7}	31 60	H01	-	-	-	38	32	14 28	-
10^{-8}	50 -	-	-	-	-	-	-	127 -	-

Table 9 — Graphite sheet with multiple thin metal insertions

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.

Code A01, 2,1 mm

L **mg/(sm)**	$Q_{min[L]}$ **MPa**	Q_A **MPa**	**20**	**40**	**60**	**80**	**100**	**160**
		-- / **Material code**	$Q_{Smin[L]}$ **MPa**					
10^{1}	-	-	-	-	-	-	-	-
10^{0}	-	-	-	-	-	-	-	-
10^{-1}	10	A01	10	10	10	10	10	10
10^{-2}	10 30	A01	-	10	10	10	10	10
10^{-3}	38 72	A01	-	-	-	37	17	10
10^{-4}	83 120	A01	-	-	-	-	-	10 38
10^{-5}	123 157	A01	-	-	-	-	-	52 150
10^{-6}	-	-	-	-	-	-	-	-
10^{-7}	-	-	-	-	-	-	-	-
10^{-8}	-	-	-	-	-	-	-	-

Table 10 — Graphite sheet with tanged stainless steel core

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.

Code 1-5-101-1, 2 mm

Code E02, 2,1 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160
		-- / Material code	$Q_{Smin[L]}$ MPa					
10^1	-	-	-	-	-	-	-	-
10^0	10	1-5-101-1	10	10	10	10	10	10
10^{-1}	10 10	E02	10	10	10	10	10	10
	10 15 27	1-5-101-1	10	10	10	10	10	10 10
10^{-2}	28 47	E02	-	-	11	10	10	10
	23 41 60	1-5-101-1	-	-	10	10	10	10 10
10^{-3}	62 88	E02	-	-	-	-	36	10
	49 84 96	1-5-101-1	-	-	-	-	39	10 12
10^{-4}	94 122	E02	-	-	-	-	-	10 29
	93 139	1-5-101-1	-	-	-	-	-	16 95
10^{-5}	124 149	E02	-	-	-	-	-	33 117
	135 200	1-5-101-1	-	-	-	-	-	130 -
10^{-6}	151 -	-	-	-	-	-	-	125 -
10^{-7}	-	-	-	-	-	-	-	-
10^{-8}	-	-	-	-	-	-	-	

Table 11 — Serrated metal core (Kammprofile) with graphite facing

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.
Code 2-5-104-1, 4 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160	320
		--	$Q_{Smin[L]}$ MPa						
		Material code							
10^{1}	- - 29	2-5-104-1	-	-	-	-	-	- - 10	-
10^{0}	- 10 37	2-5-104-1	- 10	- 10	- 10	- 10	- 10	- 10 10	- 10
10^{-1}	10 33 50	2-5-104-1	10	10 30	10 17	10 14	10 10	10 10 23	10 10
10^{-2}	12 45 62	2-5-104-1	12	16	18 32	14 24	13 23	17 10 43	10 20
10^{-3}	28 53 69	2-5-104-1	-	27	29 46	22 35	20 33	24 32 62	18 30
10^{-4}	47 60 76	2-5-104-1	-	-	46	31 50	31 46	34 42 82	32 55
10^{-5}	59 71 101	2-5-104-1	-	-	-	46 66	43 70	48 59 101	77 97
10^{-6}	71 83 126	2-5-104-1	-	-	-	64	73 86	73 76 121	123 125
10^{-7}	111 110 138	2-5-104-1	-	-	-	-	-	108 149 141	170 154
10^{-8}	138 - 160	2-5-104-1	-	-	-	-	-	139 - 160	255
10^{-9}	308	2-5-104-1	-	-	-	-	-	-	316
10^{-10}	-	-	-	-	-	-	-	-	-

Table 12 — Modified PTFE

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.
Code 1-10-102-1, 2 mm
Code 1-10-100-1, 2 mm

Code G02, 2,0 mm
Code D01, 2,0 mm
Code A02, 2,0 mm
Code K02, 2,0 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160
		--	$Q_{Smin[L]}$ MPa					
		Material code						
10^1	-	-	-	-	-	-	-	-
10^0	10 -	1-10-102-1	10 10	10 10	10 10	10 10	-	-
	10	1-10-100-1	10	10	10	10		
10^{-1}	12 12 19	1-10-102-1	10 10	10 10	10 10	10 10 10	-	-
	10 10	1-10-100-1	10	10	10	10 10	-	-
	10 10	G02	10	10	10	10	10	10
	10	D01	10	10	10	10	10	10
	10	A02	10	10	10	10	10	10
10^{-2}	17 16 26	1-10-102-1	11 10	10 10	10 10	10 10 10	-	-
	10 12 22	1-10-100-1	10 10	10 10	10 10	10 10 10	-	-
	11 25	G02	-	10	10	10	10	10
	10 25	D01	-	10	10	10	10	10
	11	A02	-	10	10	10	10	10
10^{-3}	26 21 33	1-10-102-1	-	10 10	10 10	10 10 10	-	-
	12 17 30	1-10-100-1	10 10	10 10	10 10	10 10 10	-	-
	27 52	G02	-	-	33	13	10	10
	22 30	D01	-	10	10	10	10	10
	10 15	A02	10	10	10	10	10	10
	10 -	K02						

Table 12 *(continued)*

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160
		--	$Q_{Smin[L]}$ MPa					
		Material code						
10^{-4}	38 31 39	1-10-102-1	-	17 10	10 10	10 10 10	-	-
	17 42 37	1-10-100-1	10 -	10	10 10	10 10 10	-	-
	58 83	G02	-	-	-	-	27	10
	31 36	D01	-	15	10	10	10	10
	12 20	A02	14	10	10	10	10	10
	13 10	K02	10	10	10	10	10	10 10
10^{-5}	62 41	1-10-102-1	-	-	11	43 10	-	-
	50 -	1-10-100-1	-	-	25 -	10 -	-	-
	94 160	G02						10 -
	40 54	D01	-	-	33	16	10 10	10
	20 58	A02	-	-	50	10 11	10	10
	17 27	K02	-	16	13	11	10	13 10
10^{-6}	67	1-10-102-1	-	-	-	64	-	-
	40 92	K02	-	-	-	-	83	31 65
10^{-7}	-	-	-	-	-	-	-	-
10^{-8}	-	-	-	-	-	-	-	-

Table 13 — Non-asbestos, fibre based sheet

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature,

Code 1-9-101-1, 2 mm
Code G01, 2 mm
Code E01, 2,1 mm
Code D02, 1,9 mm
Code B01, 2 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160
		--	$Q_{Smin[L]}$ MPa					
		Material code						
10^1	10	1-9-101-1	10	10	10	10	10	10
10^0	12 10	1-9-101-1	10 10	10 10	10 10	10 10	10 10	10 10
10^{-1}	10 10	G01	10	10	10	10	10	10
	10 10	E01	10	10	10	10	10	10
	10 10	D02	10	10	10	10	10	10
	10 10	B01	10	10	10	10	10	10
	10 20 22	1-9-101-1	- 10	10 10	10 10	10 10	10 10	10 10
10^{-2}	22 24	G01	-	10	10	10	10	10
	12 48	E01	-	-	15	10	10	10
	40 64	D02	-	-	-	14	10	10
	15 25	B01	-	10	10	10	10	10
	16 35 43	1-9-101-1	-	10 10	10 10	10 10	10 10	10 10
10^{-3}	40 54	G01	-	-	19	10	10	10
	56 86	E01	-	-	-	-	22	10
	77 92	D02	-	-	-	-	34	10 13
	32 42	B01	-	-	10	10	10	10
	33 57 69	1-9-101-1	-	-	20	19 15	10 10	10 10

Table 13 *(continued)*

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160
		--	$Q_{Smin[L]}$ MPa					
		Material code						
10^{-4}	66 68	G01	-	-	-	19	10	10 10
	84 108	E01	-	-	-	-	-	10 15
	100 111	D02	-	-	-	-	-	17 32
	47 54	B01	-	-	19	10	10	10
	60 81 95	1-9-101-1	-	-	-	40	33 38	17 19
10^{-5}	100 83	G01	-	-	-	-	29	12 14
	107 130	E01	-	-	-	-	-	18 39
	116 134	D02	-	-	-	-	-	44 111
	60 75	B01	-	-	-	34	20	10 19
	85 112 130	1-9-101-1	-	-	-	-	-	33 37
10^{-6}	130 111	G01	-	-	-	-	-	79 108
	129 -	E01						52 -
	144 -	D02						140 -
	98 113	B01						92 109
	108 151	1-9-101-1	-	-	-	-	-	125
10^{-7}	-	-	-	-	-	-	-	-
10^{-8}	-	-	-	-	-	-	-	-

Table 14 — Proprietary type of graphite faced Kammprofile with secondary metal to metal seal

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.
Code F01, 4,1 mm

L mg/(sm)	$Q_{min[L]}$ MPa	Q_A MPa	20	40	60	80	100	160	320
		--	$Q_{Smin[L]}$ MPa						
		Material code							
10^{1}	-	-	-	-	-	-	-	-	-
10^{0}	-	-	-	-	-	-	-	-	-
10^{-1}	-	-	-	-	-	-	-	-	-
10^{-2}	-	-	-	-	-	-	-	-	-
10^{-3}	-	-	-	-	-	-	-	-	-
10^{-4}	-	-	-	-	-	-	-	-	-
10^{-5}	-	-	-	-	-	-	-	-	-
10^{-6}	-	-	-	-	-	-	-	-	-
10^{-7}	34	F01	-	-	34	-	-	-	-
10^{-8}	41	F01	-	-	34	-	-	-	-
10^{-9}	47	F01	-	-	34	-	-	-	-
10^{-10}	54	F01	-	-	45	-	-	-	-
10^{-11}	61	F01	-	-	-	-	-	-	-

Table 15 — Proprietary PTFE/graphite gasket with metal eyelet

$Q_{min[L]}$, $Q_{Smin[L]}$ for 40 bar of helium , plus some data for other pressures, at ambient temperature.
Code K01, 1,9 mm

L **mg/(sm)**	**$Q_{min[L]}$ MPa**	**Q_A MPa**	**20**	**40**	**60**	**80**	**100**	**160**
		--	**$Q_{Smin[L]}$ MPa**					
		Material code						
10^{1}	-	-	-	-	-	-	-	-
10^{0}	-	-	-	-	-	-	-	-
10^{-1}	-	-	-	-	-	-	-	-
10^{-2}	-	-	-	-	-	-	-	-
10^{-3}	-	-	-	-	-	-	-	-
10^{-4}	10 10	K01	10	10	10	10	10	10
10^{-5}	14 15	K01	-	-	37	22	19	10 12
10^{-6}	28 107	K01	-	-	-	-	-	18 56
10^{-7}	106	K01	-	-	-	-	-	83
10^{-8}	-	-	-	-	-	-	-	-

4.3 Q_{smax} and P_{QR}

Q_{smax} is the maximum surface pressure that may be imposed on the gasket at the indicated temperature without collapse or compressive failure of the gasket. P_{QR} is 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.

Table 16 — Q_{smax} and P_{QR} (EN 13555 based data)

Temperature °C	Q_{Smax}	P_{QR} (Q_i) for connection stiffness, Q_i in MPa, of 500 kN/mm	Material code, initial gasket thickness
Non-asbestos fibre based sheet			
Ambient	120	1,0 (120)	G01, 2,0 mm
	120	1,0 (120)	E01, 2,1mm
	120	1,0 (120)	D02, 1,9 mm
	120	1,0 (120)	B01, 2,0 mm
	150	0,98 (150)	1-9-101-1, 2 mm
175	120	0,9 (120)	G01, 2,0 mm
	120	0,8 (120)	E01, 2,1 mm
	80	0,7 (80)	D02, 1,9 mm
	80	0,8 (80)	B01, 2,0 mm
200	60	0,81 (60)	1-9-101-1, 2 mm
250	120	0,9 (120)	G01, 2,0 mm
	100	0,8 (100)	E01, 2,1 mm
	80	0,5 (80)	D02, 1,9 mm
	80	0,6 (80)	B01, 2,0 mm
	50	0,77 (50)	1-9-101-1, 2 mm
Modified PTFE sheet			
Ambient	60	0,9 (60)	1-10-102-1, 2 mm
	50	0,84 (50)	1-10-100-1, 2 mm
	120	1,0 (120)	G02, 2,0 mm
	80	0,9 (80)	D01, 2,0 mm
	120	0,9 (120)	A02, 2,0 mm
	40	0,9 (40)	K02, 2,0 mm
150	120	1,0 (120)	G02, 2,0 mm
	40	0,6 (40)	D01, 2,0 mm
	120	0,6 (120)	A02, 2,0 mm
	40	0,5 (40)	K02, 2,0 mm

Table 16 (*continued*)

Temperature °C	Q_{smax}	P_{QR} (Q_i) for connection stiffness, Q_i in MPa, of 500 kN/mm	Material code, initial gasket thickness
175	60	0,5 (60)	1-10-102-1, 2 mm
	40	0,41 (40)	1-10-100-1, 2 mm
225	60	0,42 (60)	1-10-102-1, 2 mm
	25	0,36 (25)	1-10-100-1, 2 mm
	120	0,8 (120)	G02, 2,0 mm
	40	0,4 (40)	D01, 2,0 mm
	120	0,5 (120)	A02, 2,0 mm
	40	0,4 (40)	K02, 2,0 mm
Serrated metal core [Kammprofile] with graphite facing			
Ambient	600	1,00 (600)	2-5-104-1, 4 mm
	328	1,0 (328)	F01, 4,1 mm
300	450	0,94 (450)	2-5-104-1, 4 mm
	328	0,98 (328)	F01, 4,1 mm
450	400	0,80 (400)	2-5-104-1, 4 mm
	328	0,96 (328)	F01, 4,1 mm
Graphite sheet with tanged stainless steel core			
Ambient	200	1,0 (200)	E02, 2,1 mm
	200	1,0 (200)	1-5-101-1, 2 mm
300	120	1,0 (120)	E02, 2,1 mm
	140	0,78 (140)	1-5-101-1, 2 mm
400	120	1,0 (120)	E02, 2,1 mm
450	120	0,62 (120)	1-5-101-1, 2 mm

Table 16 (*continued*)

Temperature **°C**	Q_{smax}	P_{QR} (Q_i) **for connection stiffness,** Q_i **in MPa, of 500 kN/mm**	**Material code, initial gasket thickness**
Graphite sheet with multiple thin metal insertions			
Ambient	120	1,0 (120)	A01, 2,1 mm
300	120	1,0 (120)	A01, 2,1 mm
400	120	0,98 (120)	A01, 2,1 mm
Graphite covered metal jacketed with graphite filler and outer ring			
Ambient	120	1,0 (120)	H01, 4,8 mm
	400	0,98 (400)	5-5-103-1, 4,5 mm
300	120	1,0 (120)	H01, 4,8 mm
400	120	1,0 (120)	H01, 4,8 mm
Metal jacketed with graphite filler			
Ambient	400	1,0 (400)	6-4-103-1, 3,2 mm
	120	1,0 (120)	H02, 3,6 mm
300	400	0,93 (400)	6-4-103-1, 3,2 mm
	120	1,0 (120)	H02, 3,6 mm
400	120	1,0 (120)	H02, 3,6 mm
450	400	0,87 (400)	6-4-103-1, 3,2 mm

Table 16 (*continued*)

Temperature °C	Q_{smax}	P_{QR} (Q_i) for connection stiffness, Q_i in MPa, of 500 kN/mm	Material code, initial gasket thickness
Corrugated metal core with graphite facing			
Ambient	400	1,00 (400)	7-01-104-1, 3,2 mm
	120	0,9 (120)	K04, 2,3 mm
300	200	0,72 (200)	7-01-104-1, 3,2 mm
	120	0,5 (120)	K04, 2,3 mm
400	120	0,4 (120)	K04, 2,3 mm
450	180	0,52 (180)	7-01-104-1, 3,2 mm
PTFE filled spiral wound gasket with both inner and outer rings			
Ambient	360	0,98 (360)	G03, 5,1 mm
150	360	0,98 (360)	G03, 5,1 mm
225	360	0,99 (360)	G03, 5,1 mm
Low Stress , graphite filled, spiral wound gasket with both inner & outer rings			
Ambient	297	0,99 (297)	3-5-102-1, 4,5 mm
Graphite filled spiral wound gasket with outer ring only			
Ambient	125	0,99 (125)	3-3-100-1, 4,5 mm
Graphite filled spiral wound gasket with both inner and outer rings			
Ambient	311	1,00 (311)	3-4-104-1, 4,5 mm
300	250	0,94 (250)	3-4-104-1, 4,5 mm
450	220	0,92 (220)	3-4-104-1, 4,5 mm
Proprietary PTFE / Graphite gasket with metal eyelet			
Ambient	120	1,0 (120)	K01, 1,9 mm
300	120	0,9 (120)	K01, 1,9 mm

NOTES

The user shall take great care over the use of the Q_{Smax} values tabulated above as the thickness of the gasket, the land width of the gasket, the surface finish of the flanges and other factors all influence greatly the value of Q_{smax} in service.

In some instances in the above the Q_{Smax} value was set by the gasket supplier at a more conservative level than that indicated by the test method given in EN 13555.

There are two differing philosophies governing the use of spiral wound gaskets. For PN designated flanges metal to metal contact between the flange faces and the outer guide ring of a spiral is not permitted whereas, for Class designated flanges, the standard practice is to load the gasket until contact is made. The Q_{Smax} values consequently reflect this difference.

4.4 E_G

E_G is the unloading modulus determined from the thickness recovery of the gasket between the initial surface pressure and unloading to a third of this initial surface pressure.

Table 17 — Graphite filled spiral wound gasket with outer ring

Temperature	**Ambient**	**300 °C**	**450 °C**
Material code	**3-3-100-1**	**3-3-100-1**	**3-3-100-1**
Gasket stress MPa	**4,5 mm**	**4,5 mm**	**4,5 mm**
2,5	-	-	-
5	-	-	-
10	-	-	-
20	1854	2904	2299
30	1975	-	-
40	2158	3359	4094
50	2563	-	-
60	2892	4694	6081
80	3643	6874	7835
100	4714	10291	9943
120	6147	15117	11529
140	-	-	-
160	-	-	-
180	-	-	-
240	-	-	-
260	-	-	-
300	-	-	-
340	-	-	-
380	-	-	-
400	-	-	-
440	-	-	-
490	-	-	-
550	-	-	-
600	-	-	-
650	-	-	-

Table 18 — Graphite filled spiral wound gasket with inner and outer rings

Temperature	**Ambient**	**300 °C**	**450 °C**
Material code	**3-4-104-1**	**3-4-104-1**	**3-4-104-1**
Gasket stress MPa	**4,5 mm**	**4,5 mm**	**4,5 mm**
2,5	-	-	-
5	-	-	-
10	-	-	-
20	1233	1423	1489
30	1620	-	-
40	1916	2790	3013
50	2316	3997	-
60	2719	4203	4739
80	3372	4291	6156
100	3987	5205	7428
120	4793	6111	8525
140	5808	6972	9297
160	7024	7938	10206
180	8520	9661	10968
240	15577	11638	-
260	-	-	-
300	30036	-	-
340	-	-	-
380	-	-	-
400	-	-	-
440	-	-	-
490	-	-	-
550	-	-	-
600	-	-	-
650	-	-	-

Table 19 — Low stress, graphite filled, spiral wound gasket with inner and outer rings

Temperature	**Ambient**	**200 °C**	**300 °C**	**450 °C**
Material code	**3-5-102-1**	**3-5-102-1**	**3-5-102-1**	**3-5-102-1**
Gasket stress MPa	**4,5 mm**	**4,5 mm**	**4,5 mm**	**4,5 mm**
2,5	-	-	-	
5	-	-	-	
10	-	-	-	
20	725	843	942	850
30	996	-	-	-
40	1207	1809	1988	2259
50	1703	-	-	-
60	2268	4211	3776	3840
80	-	8537	6992	4945
100	-	-	-	-
120	-	-	-	-
140	-	-	-	-
160	-	-	-	-
180	-	-	-	-
240	-	-	-	-
260	-	-	-	-
300	-	-	-	-
340	-	-	-	-
380	-	-	-	-
400	-	-	-	-
440	-	-	-	-
490	-	-	-	
550	-	-	-	
600	-	-	-	
650	-	-	-	

Table 20 — PTFE filled spiral wound gasket with inner and outer rings

Temperature	Ambient	150 °C	225 °C
Material code	G03	G03	G03
Gasket stress MPa	5,1 mm	5,1 mm	5,1 mm
2,5	-	-	-
5	-	-	-
10	-	-	-
20	-	-	-
30	-	-	-
40	-	-	-
50	-	-	-
60	2989	3232	2415
80	3742	3507	2694
100	-	-	-
120	4723	3933	3241
140	5324	4980	4363
160	-	-	-
180	5241	5479	5221
240	6519	6751	6597
260	-	-	-
300	7566	10077	8521
340	10518	13690	11485
380	-	-	-
400	14394	19892	15054
440	17000	28614	18352
490	25742	34196	25922
550	-	-	-
600	-	-	-
650	-	-	-

Table 21 — Corrugated metal core with graphite facing

Temperature	Ambient	Ambient	300 °C	300 °C	400 °C	450 °C
Material code	7-01-104-1	K04	K04	7-01-104-1	K04	7-01-104-1
Gasket stress MPa	3,2 mm	2,3 mm eyelets	2,3 mm eyelets	3,2 mm	2,3 mm eyelets	3,2 mm
2,5	-	-	113	-	62	-
5	-	-	178	-	186	-
10	-	-	622	-	533	-
20	1498	50	1027	3559	3446	2933
30	1822	193	3548	-	2494	-
40	2134	618	2323	4518	2474	4903
50	2221	1326	2327	-	3179	-
60	1968	1632	2632	4823	4698	5113
80	2824	2403	4646	6942	2393	5530
100	3968	2741	2666	7662	2338	5528
120	5185	2807	3088	7821	3331	5394
140	6804	2606	-	7812	-	5302
160	8046	3127	-	7388	-	5061
180	9489	4002	-	7292	-	4968
240	-	-	-	-	-	-

Table 22 — Metal jacketed with graphite filler

Temperature	Ambient	Ambient	300 °C	300 °C	400 °C	450 °C
Material code	6-4-103-1	H02	6-4-103-1	H02	H02	6-4-103-1
Gasket stress MPa	3,2 mm	3,6 mm	3,2 mm	3,6 mm	3,6 mm	3,2 mm
2,5	-	-	-	-	-	-
5	-	-	-	-	-	-
10	-	-	-	-	-	-
20	696	709	1004	798	796	1033
30	1126	1120	-	1050	1070	-
40	1718	1344	2120	1531	1372	2434
50	2435	1902	-	1952	2647	-
60	3334	2424	3402	2509	2519	3845
80	5787	3171	4521	3613	3379	5021
100	9029	3495	5405	3621	4099	5977
120	13855	5158	6296	4866	5487	6513
140	19811	5876	7048	4975	5282	7108
160	28779	5525	7886	6288	5607	7252
180	40961	5965	8547	6618	6302	7682
240	-	-	10584	-	-	8677
260	-	-	-	-	-	-
300	-	-	12474	-	-	9610
340	-	-	-	-	-	-
380	-	-	-	-	-	-
400	-	-	17061	-	-	11381
440	-	-	-	-	-	-
490	-	-	-	-	-	-
550	-	-	-	-	-	-
600	-	-	-	-	-	-
650	-	-	-	-	-	-

Table 23 — Graphite sheet with multiple thin metal insertions

Temperature	Ambient	300 °C	400 °C
Material code	A01	A01	A01
Gasket stress MPa	2,1 mm	2,1 mm	2,1 mm
2,5	-	-	-
5	-	-	-
10	-	-	-
20	352	371	438
30	679	526	793
40	1041	734	958
50	1117	1177	1121
60	1424	1287	1912
80	1496	1588	2803
100	1803	2107	2057
120	1904	3371	2498
140	2340	2853	2948
160	2371	2722	3334
180	2272	3567	3145
240	-	-	-
260	-	-	-
300	-	-	-
340	-	-	-
380	-	-	-
400	-	-	-
440	-	-	-
490	-	-	-
550	-	-	-
600	-	-	-
650	-	-	-

Table 24 — Graphite sheet with tanged stainless steel core

Temperature	Ambient	Ambient	200 °C	300 °C	300 °C	400 °C	450 °C
Material code	**E02**	**1-5-101-1**	**1-5-101-1**	**E02**	**1-5-101-1**	**E02**	**1-5-101-1**
Gasket stress MPa	**2,1 mm**	**2 mm**	**2 mm**	**2,1 mm**	**2 mm**	**2,1 mm**	**2 mm**
2,5	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
20	411	198	591	499	416	484	943
30	700	397	-	866	-	849	-
40	1019	675	1579	1023	1396	1097	2482
50	1248	1043	-	1594	-	1250	-
60	1438	1536	2493	1363	2423	1708	3833
80	2240	2804	3437	2424	3828	2829	4706
100	2411	4738	4258	2404	5542	1943	4799
120	2372	7083	4871	3198	5968	3337	-
140	2783	10447	-	3397	-	3389	-
160	3235	13992	-	3380	-	3057	-
180	3081	-	-	4246	-	3148	-
240	-	-	-	-	-	-	-
260	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-
340	-	-	-	-	-	-	-
380	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-
440	-	-	-	-	-	-	-
490	-	-	-	-	-	-	-
550	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-
650	-	-	-	-	-	-	-

Table 25 — Serrated metal core [Kammprofile] with graphite facing

Temperature	Ambient	300 °C	450 °C
Material code	2-5-104-1	2-5-104-1	2-5-104-1
Gasket stress MPa	4 mm	4 mm	4 mm
2,5	-	-	-
5	-	-	-
10	-	-	-
20	3273	13379	12923
30	3598	-	-
40	4369	19157	20649
50	5722	-	-
60	7391	30932	58406
80	12085	52885	73918
100	16774	-	68786
120	22854	-	141110
140	32441	-	-
160	35528	-	-
180	38537	-	-
240	-	-	-
260	45757	-	-
300	-	-	-
340	45542	-	-
380	-	-	-
400	44702	-	-
440	-	-	-
490	-	-	-
550	-	-	-
600	-	-	-
650	-	-	-

Table 26 — Modified PTFE

Temperature	Ambient						150 °C			
Material code	**1-10-102-1**	**1-10-100-1**	**G02**	**D01**	**A02**	**K02**	**G02**	**D01**	**A02**	**K02**
Gasket stress MPa	**2 mm**	**2 mm**	**2,0 mm**	**2,0 mm**	**2,0 mm**	**2,0 mm**	**2,0 mm**	**2,0 mm**	**2,0 mm**	**2,0 mm**
2,5	-	-	-	-	-	23	-	-	-	27
5	-	-	-	-	-	74	-	-	-	72
10	-	-	-	-	-	219	-	-	-	230
20	1924	2170	2704	402	2175	434	1981	510	2023	511
30	2587	2986	3283	-	-	658	2833	-		893
40	3894	8625	3125	883	2552	750	4491	1092	2161	810
50	6378	-	4286	-	-	883	4276	-		999
60	9750	-	3880	1345	3577	1124	4982	1313	2257	1357
80	-	-	4413	1889	5753	1378	3663	2538	2764	912
100	-	-	4779	2055	4057	1671	4074	1224	2739	1497
120	-	-	4684	1663	3942	2051	4422	1212	2404	968
140	-	-	5081	1333	4420	2034	4536	808	2596	-
160	-	-	5205	1145	4022	1394	5629	617	2376	-
180	-	-	5410	1357	3063	1629	5450	499	2847	-
240	-	-	-	-	-	-	-	-	-	-
260	-	-	-	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-	-	-	-
340	-	-	-	-	-	-	-	-	-	-
380	-	-	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-	-	-
440	-	-	-	-	-	-	-	-	-	-
490	-	-	-	-	-	-	-	-	-	-
550	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-
650	-	-	-	-	-	-	-	-	-	-

Table 26 (*continued*)

Temperature	175 °C		225 °C					
Material code	1-10-102-1	1-10-100-1	1-10-102-1	1-10-100-1	G02	D01	A02	K02
Gasket stress MPa	2 mm	2 mm	2 mm	2 mm	2,0 mm	2,0 mm	2,0 mm	2,0 mm
2,5	-	-	-	-	-	-	-	36
5	-	-	-	-	-	-	-	76
10	-	-	-	-	-	-	-	207
20	1164	826	1263	614	1874	579	1291	520
30	-	-	1569	-	2166	-	-	564
40	1682	1254	2178	809	3215	553	1458	1296
50	-	-	2553	-	3551	-	-	677
60	2217	1335	3170	864	3613	1127	2243	930
80	-	-	-	-	4035	990	1764	1930
100	-	-	-	-	3953	923	1861	-
120	-	-	-	-	4174	779	2850	-
140	-	-	-	-	4533	699	1777	-
160	-	-	-	-	3797	762	1533	-
180	-	-	-	-	3656	603	1595	-
240	-	-	-	-	-	-	-	-
260	-	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-	-
340	-	-	-	-	-	-	-	-
380	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-
440	-	-	-	-	-	-	-	-
490	-	-	-	-	-	-	-	-
550	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-
650	-	-	-	-	-	-	-	-

Table 27 — Non-Asbestos fibre based sheet

Temperature	Ambient					175 °C				200 °C
Material code	G01	E01	D02	B01	1-9-101-1	G01	E01	D02	B01	1-9-101-1
Gasket stress MPa	2,0 mm	2,1 mm	1,9 mm	2,0 mm	2 mm	2,0 mm	2,1 mm	1,9 mm	2,0 mm	2 mm
2,5	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
20	1773	1357	727	1512	979	1931	1095	900	1847	4898
30	2079	-	1280	-	1414	2442	-	1184	-	-
40	1963	1802	1712	2006	2153	2152	1874	1401	1911	4990
50	2917	-	1759	-	2972	2496	-	1805	-	-
60	3318	2175	1940	2668	4182	3164	2320	2235	3218	6023
80	4026	2904	2619	3290	8412	4253	2603	1936	3342	-
100	4843	3537	3252	3997	15159	4114	3901	2326	2909	-
120	5402	4124	2799	4296	26392	3350	4230	2049	3503	-
140	5044	4526	3193	4578	40379	4611	1871	2099	3405	-
160	4507	4362	3459	5187	-	4106	1933	2299	2960	-
180	4394	4258	3776	4529	-	3876	2037	2145	2946	-
240	-	-	-	-	-	-	-	-	-	-
260	-	-	-	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-	-	-	-
340	-	-	-	-	-	-	-	-	-	-
380	-	-	-	-	-	-	-	-	-	-
400	-	-	-	-	-	-	-	-	-	-
440	-	-	-	-	-	-	-	-	-	-
490	-	-	-	-	-	-	-	-	-	-
550	-	-	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-	-	-
650	-	-	-	-	-	-	-	-	-	-

Table 27 (*continued*)

Temperature	250 °C				
Material code	G01	E01	D02	B01	1-9-101-1
Gasket stress MPa	2,0 mm	2,1 mm	1,9 mm	2,0 mm	2 mm
2,5	-	-	-	-	-
5	-	-	-	-	-
10	-	-	-	-	-
20	2259	2096	1140	2575	3731
30	3522	-	1402	-	-
40	3339	2082	1471	2063	4159
50	2814	-	2041	-	-
60	2950	3165	2046	3392	4024
80	4929	3592	2100	2967	-
100	4514	3657	3189	3417	-
120	4029	2588	2605	2903	-
140	4331	1834	2145	2848	-
160	5231	2120	2174	3006	-
180	5467	2276	2348	3001	-
240	-	-	-	-	-
260	-	-	-	-	-
300	-	-	-	-	-
340	-	-	-	-	-
380	-	-	-	-	-
400	-	-	-	-	-
440	-	-	-	-	-
490	-	-	-	-	-
550	-	-	-	-	-
600	-	-	-	-	-
650	-	-	-	-	-

Table 28 — Proprietary type of graphite faced kammprofile with secondary metal to metal seal

Temperature	Ambient	300 °C	400 °C
Material code	F01	F01	F01
Gasket stress MPa	4,1 mm	4,1 mm	4,1 mm
2,5	-	-	-
5	-	-	-
10	-	-	-
20	-	-	-
30	-	-	-
40	-	-	-
50	8921	13616	8922
60	-	-	-
80	10323	10805	17190
100	10719	13262	19056
120	-	-	-
140	11961	12189	14765
160	15795	22923	16863
180	-	-	-
240	16347	14635	17365
260	16257	17406	13680
300	-	-	-
340	15561	18733	13144
380	18900	18326	15805
400	-	-	-
440	20856	19654	16729
490	17100	19558	19335
550	16577	17079	15245
600	18265	17000	16314
650	17258	18220	15615

Table 29 — Graphite covered metal jacketed with graphite filler and outer ring

Temperature	Ambient	Ambient	300 °C	300 °C	400 °C	450 °C
Material code	H01	5-5-103-1	H01	5-5-103-1	H01	5-5-103-1
Gasket stress MPa	4,8 mm	4,5 mm	4,8 mm	4,5 mm	4,8 mm	4,5 mm
2,5	-	-	-	-	-	-
5	-	-	-	-	-	-
10	-	-	-	-	-	-
20	659	534	823	680	825	253
30	1029	963	1708	-	1345	-
40	1778	1243	2175	1637	3107	758
50	2595	1629	3525	-	5080	-
60	3124	2038	4442	3002	5082	1625
80	5409	3395	9476	5831	4918	2763
100	9487	5381	9837	11047	10608	4563
120	11419	-	-	-	20040	-
140	16002	-	-	-	30099	-
160	17889	-	-	-	25893	-
180	24030	-	-	-	28125	-
240	-	-	-	-	-	-
260	-	-	-	-	-	-
300	-	-	-	-	-	-
340	-	-	-	-	-	-
380	-	-	-	-	-	-
400	-	-	-	-	-	-
440	-	-	-	-	-	-
490	-	-	-	-	-	-
550	-	-	-	-	-	-
600	-	-	-	-	-	-
650	-	-	-	-	-	-

Table 30 — Proprietary PTFE/Graphite gasket with metal eyelet

Temperature	**Ambient**	**300 °C**	**400 °C**
Material code	**K01**	**K01**	**K01**
Gasket stress MPa	**1,9 mm**	**1,9 mm**	**1,9 mm**
2,5	-	-	-
5	-	-	-
10	-	-	-
20	532	544	471
30	752	670	1091
40	1101	960	848
50	1148	1124	1398
60	1681	1788	1586
80	1828	1750	1692
100	2451	2723	2202
120	3403	2420	3487
140	3717	1651	1203
160	3169	1749	1530
180	3345	2264	1718
240	-	-	-
260	-	-	-
300	-	-	-
340	-	-	-
380	-	-	-
400	-	-	-
440	-	-	-
490	-	-	-
550	-	-	-
600	-	-	-
650	-	-	-

Annex A
(informative)

Relation between the gasket types and the codes used in the tables

Table A.1 — Relation between the gasket types and the different codes

Description	Gasket type		Materials				
	Form	Design	Structure	Extra rings	Reinforcement or filler	Facing	CETIM
E sheet	Sheet	generic	PTFE, modified		none	—	1-10-10
			..		..	—	1-10-10
			..		silicon carbide	—	
			..		expanded graphite	—	
			..		glass fibre	—	
	Sheet	proprietary	PTFE, modified	PTFE inner eyelet	PTFE, expanded	PTFE, expanded	
TFE / Graphite gasket with metal eyelet				metal eyelet	PTFE / Graphite	PTFE / Graphite	
d with graphite filler	Jacketed	generic	metal jacket		graphite	—	6-4-103
			..		..	—	
ered metal jacketed with graphite filler &			..		..	graphite	5-5-103
			..		..	..	
l core [kammprofile] with graphite facing	Serrated (kammprofil)	generic	metal		—	graphite	2-5-104
pe of graphite faced kammprofile with tal to metal seal	Serrated (kammprofil)	proprietary	metal		—	graphite, metal to metal seal	
	Corrugated	proprietary	metal	stainless steel eyelets		..	
t with tanged stainless steel core	Sheet	generic	graphite		tanged stainless steel	—	
			..		..	—	1-5-101

Table A.1 *(continued)*

Description	Gasket type	Materials	Code				
	Form	Design	Structure	Extra rings	Reinforcement or filler	Facing	CETIM
, fibre based sheet		generic	non-asbestos, "it" calendered		none	—	
			..		..	—	
			..		..	—	1-9-10
		generic	non-asbestos, "it" calendered, reduced binder content		—	—	
	Sheet	proprietary	non-asbestos, non-woven fabric, impregnated		—	—	
t with multiple thin metal insertions	Sheet	proprietary	graphite		multiple thin metal insertions	—	
piral wound gasket with both outer and	Spiral-wound	generic	metallic winding	inner, outer	PTFE	—	
spiral wound gasket with outer and inner			..	..	graphite	—	3-4-10
spiral wound gasket with outer ring		generic	metallic winding, outer ring	outer	graphite	—	3-3-10
raphite filled spiral wound gasket with r rings		generic	metallic winding, low stress	inner, outer	graphite	—	3-5-10

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Annex B
(informative)

Public sources of reliable data

An online database of EN 13555 data can be accessed at www.gasketdata.org. This database was set up by Fachhochschule Münster and only accepts data known to be obtained strictly within the requirements of EN 13555 and subject to random verification checks.

Annex C
(informative)

Outline of a pre-calculation method of gasket selection

A group of end users appreciated that using EN 1591-1 for the calculation of their flanges would mean that a large number of calculations would be carried out in a continuing manner and they were naturally eager to find a way in which the need for repetitious calculation could be avoided.

They appreciated that for sites where only flanges to a given standard were used and where sealing to a single given level was required across the whole site that by undertaking a series of pre-calculations that the gaskets could then be selected, without the need for further calculation, by ensuring that only gaskets with parameters within certain limits were used.

Accordingly, they found for Flange Type 11 in the latest version of EN 1092-1 that a leakage rate of 0,1 mg/(s·m) or lower would be achieved if a gasket having :

— $Q_{\text{min}[0,1]}$ of 25 MPa (EN 1514-1 gasket) or 50 MPa (EN 1514-2 gasket) or less,

— Q_{Smax} of 100 MPa (EN 1514-1 gasket) or 300 MPa (EN 1514-2 gasket) or more,

— E_{G} of E_{G} = 20 MPa·Q_{I} + 8 000 MPa (EN 1514-1 gasket) or E_{G} = 20 MPa·Q_{I} + 10 000 MPa (EN 1514-2 gasket) or less,

— P_{QR} such that the following equation is fulfilled: $Q_{\text{Smin}[L]}/Q_{\text{A}} \le P_{\text{QR}}$,

— and $Q_{\text{Smin}[0,1]}$ of 6,6 MPa or less.

NOTE 1 As in EN 13555, values below 10 MPa for $Q_{\text{Smin}[L]}$ and $Q_{\text{min}[L]}$ are not measured, and one can extrapolate down to $Q_{\text{Smin}[0,1]}$ of 6,6 MPa.

NOTE 2 This method could be applied directly to any gaskets specified in the EN 1514 series of standards. Also, if the necessary background work was repeated, it could also be applied to the EN 12560 series or any other dimensional standard.

Bibliography

[1] www.europeansealing.com (on-line reference)

[2] www.gasketdata.org (on-line reference)

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