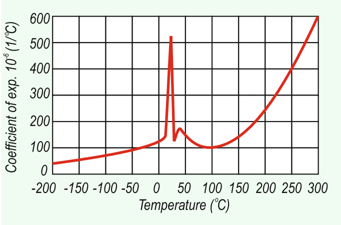
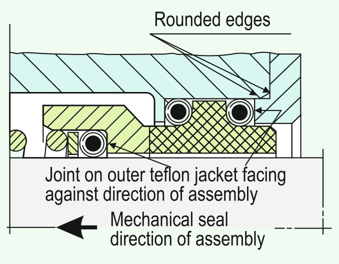
TTV O-rings

Double PTFE-encapsulated O-rings of the type used in SEALMATIC mechanical seals combine the elasticity of the core materials (synthetic rubber) with the chemical and thermal resistance of the PTFE. The material PTFE features good chemical and thermal resistance, but it also displays a high degree of rigidity, a low co-efficient of thermal conductivity, an unfavourable expansion characteristic (see graph) and a tendency to cold flow.





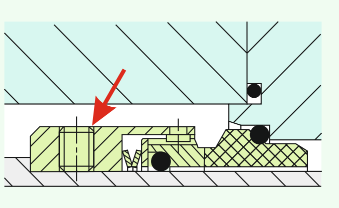
It is advisable, therefore, to avoid the use of **O-rings made of solid PTFE.**

The assembly position of double PTFE-en-capsulated elastomers is critical. Care must be taken to ensure that the joint on the outer jacket faces against the assembly direction, as otherwise there is a risk of the jacket opening and being pulled off.

Bending of the jacket must be avoided at all costs to prevent leaks. Slip TTV O-rings onto tubes for safe storage.

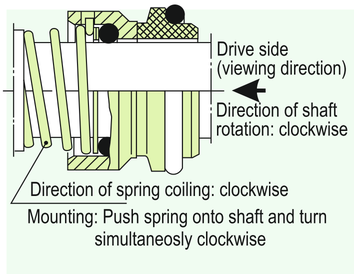
Screw locking

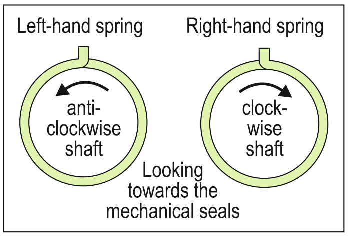
If no special provision is made for locking screw thread, use set screw with a suitable adhesive (e.g. Loctite®) after removing any grease.



Conical springs

When a conical spring is used for driving the seal (e.g. in standard types U200 and U300), the mechanical seal becomes **dependent on the direction of rotation.** Looking toward the sliding face of the rotating parts of the seal, shafts rotating in clockwise direction require right-hand springs and shafts rotating in anti-clockwise direction require left-hand springs. Mounting the conical spring is easier if you twist it onto the shaft with a screwing action in the same direction as the spring coiling. This screwing action will cause the spring to open. For brief reversals of the direction of rotation we recommend seal type "S30".





Pressure vessel regulations

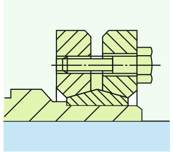
Requirements imposed by various international standards for Pressure Vessel Code on Group III pressure vessels (Section 8)

- International Pressure Vessel Code orders that pressure vessels be built and operated in accordance with the generally valid rules of engineering (such as the German AD Code, ASME etc).
- AD Bulletin W2 requires every pressure-bearing part made of austenitic steel to be accompanied by a material certificate EN 10204 3.1 B or 3.1C.
- The manufacturer must subject every pressure vessel to a pressure test.
- Every pressure vessels must be issued with a certificate confirming its correct production and pressure testing in accordance with the Pressure Vessel Code. This certificate is included with the delivery.

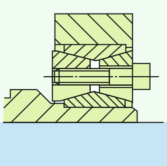
Types of drive

For a seal to function properly, the shaft torque must be transmitted uniformly to the shaft sleeve and/or rotating parts under all operating conditions. Depending on the seal design it is necessary to make allowance for centrifugal and axial forces and in some case to observe special installation instructions. Incorrect fitting can cause, for example, jamming and de-formation of the seal.

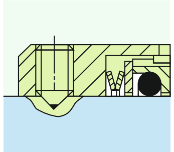
Typical arrangements



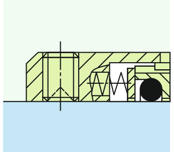
Shrink disk



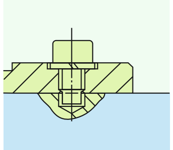
Clamping set



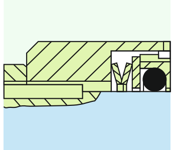
Set screw
with cone point



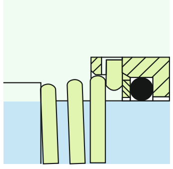
Set screw
with cup point



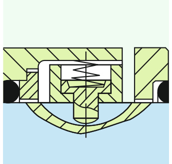
Allen set screw
with full dog point



Drive key



Conical spring



Spring loaded
drive pin

Shrink disk

The pressure necessary for the transmission of torque is generated through clamping force on lubricated conical surfaces. The shrink disk couplings can be released at any time by slackening the tensioning screws. All the parts involved are subjected to elastic deformation only, so the original clearance is restored once the screws are released.

Provided the conical surfaces are undamaged, the shrink disks can be retensioned any number of times (ensure correct lubrication). Shaft sleeves should not have a clearance diameter under the shrink disk and should make full contact with the shaft.

Viscosity ν

Conversion table*

The following conversion table shows the kinematic viscosity n in terms of conventional units of measurement at the same temperature.

ν mm²/s	°E	R.I sec	SU sec
1.0	1.00	-	-
1.5	1.06	-	-
2.0	1.12	30.4	32.6
2.5	1.17	31.5	34.4
3.0	1.22	32.7	36.0
3.5	1.26	34.0	37.6
4.0	1.31	35.3	39.1
4.5	1.35	36.6	40.8
5.0	1.39	38.0	42.4
5.5	1.44	39.3	44.0
6.0	1.48	40.6	45.6
6.5	1.52	42.0	47.2
7.0	1.57	43.3	48.8
7.5	1.61	45.7	50.4
8.0	1.65	46.1	52.1
8.5	1.70	47.5	53.8
9.0	1.74	49.0	55.5
9.5	1.79	50.4	57.2
10.0	1.83	51.9	58.9
11.0	1.93	54.9	62.4
11.5	1.98	56.4	64.2
12.0	2,02	58.0	66.0
12.5	2.07	59.6	67.9
13.0	2.12	61.2	69.8
13.5	2.17	62.9	71.7
14.0	2.22	64.5	73.6
14.5	2.27	66.2	75.7
15.0	2.33	67.8	77.4
15.5	2.38	69.5	79.3
16.0	2.43	71.2	81.3
16.5	2.49	72.9	83.3
17.0	2.54	74.6	85.3
17.5	2.59	76.3	87.4
18.0	2.65	78.1	89.4
18.5	2.71	79.8	91.5
19.0	2.76	81.6	93.6
19.5	2.82	83.4	95.7
20.0	2.88	85.2	97.8
25.0	3.47	103.9	119.3
30.0	4.08	123.5	141.3
35.0	4.71	143.4	163.7
40.0	5.35	163.5	186.3
50.0	6.65	203.9	232.1
60.0	7.95	244.3	278.3
70.0	9.26	284.7	324.4
80.0	10.58	325.1	370.8
90.0	11.89	365.6	417.1
100.0	13.20	406.0	463.5
150.0	19.80	609.0	695.2
200.0	26.40	812.0	926.9
250.0	33.00	1015.0	1158.7
300.0	39.60	1218.0	1390.4
350.0	46.20	1421.0	1622.1
400.0	52.80	1624.0	1853.9
500.0	66.00	2030.0	2317.4
600.0	79.20	2436.0	2781.0
700.0	92.40	2842.0	3244.5
800.0	105.60	3248.0	3708.0
900.0	118.80	3654.0	4171.5
1000.0	132.00	4060.0	4635.0

Conventional units of measurement:
°E = degrees Engler
R = Redwood Seconds I and II
SU= Saybolt Universal seconds
* according to Ubbelohde $mm^2/s \simeq cSt$

Circulation

For single seals it is generally advisable to install a circulation pipe from the discharge nozzle of the pump to the seal chamber. A pipe size G1/4 is normally sufficient. There should be a close fitting neck bush between the pump casing and the seal chamber.

Flushing

Flushing systems are installed in accordance with DIN ISO 5199, Appendix E, Plan No. 08a or API 610, Appendix D, Plan 32. A clean and mostly cold external medium is injected into the stuffing box in the area of the sliding faces via on orifice (throttle) into the medium to be sealed. Flushing is used either to lower the temperature or to prevent deposits forming in the area of the mechanical seal. Again it is recommended that a close fitting neck bush is employed.

Quench

Quench is the term commonly used in sealing engineering for an arrangement that applies a pressureless external medium (fluid, vapour, gas) to a mechanical seal's faces on the atmosphere side. A quench is used on the one hand when a single mechanical seal does not function at all or only within certain limits without auxiliary measures or when a double mechanical seal with pressurized buffer medium is unnecessary. When an integral stationary seat stop is fitted, the quench pressure should not exceed 1 bar. A quench performs at least one of the duties described below.

Fluid quench

- Absorption or removal of leakage by the quench medium Monitoring of the mechanical seal's leakage rate by periodic measurement of the level of the quench medium in the circulation vessel or thermosiphon vessel Lubrication and cooling of the standby mechanical seal
- Exclusion of air: For media which react with atmospheric oxygen the quenching medium stops the leakage making contact with the atmosphere
- Protection against dry running: For applications subject to brief, periods of vacuum and operation of pumps without pumping liquid (submersible pumps) the quenching medium prevents dry running of the mechanical seal
- Stabilization of the lubrication film: For operation under vacuum and/or sealing pressures close to the vapour pressure, the quenching medium stabilizes the lubrication film
- Cooling or heating of the outboard side of the mechanical seal.

Steam quench

- Heating: For media with a high melting point the vapour quench prevents the leakage from solidifying in that area of the mechanical seal critical for its proper functioning
- Exclusion of air
- Removal of leakage

Gas quench

- Icing protection: With operating temperatures <0 °C (cryogenic mechanical seals), the injection of nitrogen or dry air into the seal housing prevents the mechanical seal parts on the atmosphere side from icing up
- Exclusion of air
- Removal of leakage

Sealing the quench medium

- Outboard mini-gland – the preferred choice for steam, not so much for liquids
- Lip seals – the preferred choice for oils and water
- Mechanical seals – the preferred choice for all circulating quench fluids

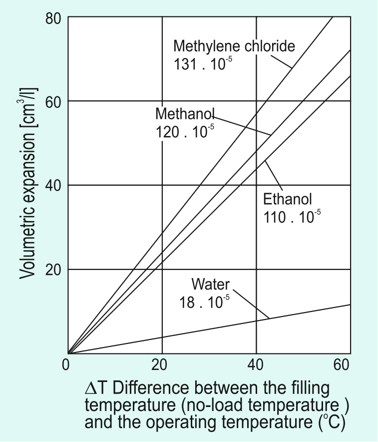
In some cases, for mechanical seals to function correctly the conditions in which they operate must be altered. This depends on the seal type, the duty conditions including environmental protection, and the type of equipment into which the seals are fitted.

A simple change to a single seal's operating conditions in a dead-end arrangement can be made, for instance, by adding a recirculation line from the pump discharge to the seal chamber (API Plan 1).

As operational demands increase, so too must the capabilities of the supply units to support the mechanical seal.
The following section contains the necessary information for the correct selection of supply systems and auxiliary equipment to ensure reliable operation of your mechanical seals.

Barrier medium

The barrier medium fulfills two functions -it dissipates the heat generated by the seal and it prevents the product from penetrating the sealing gap to any appreciable degree. Any liquid and any gas can be chosen as barrier medium, with due consideration to the corrosion resistance of the parts it comes into contact with and to its compatibility with the process medium and surroundings. The barrier medium must not contain any solids. It is particularly important that liquid barrier media do not tend to precipitate and that they have a high boiling point, a high specific thermal capacity and good thermal conductivity. Clean, demineralised water satisfies these requirements to a high degree.
Hydraulic oil is often used in buffer fluid units and water in closed barrier fluid circuits. To prevent damage to the TS and sealing system, due allowance must be made for the co-efficient of volumetric expansion of the barrier fluids used.



Volumetric expansion of various buffer media

Barrier systems

To guarantee the correct working of double mechanical seals, the barrier interspace (between the product side and the atmosphere side of the mechanical seal) must be completely filled with clean barrier medium.
Before starting up double mechanical seals it is vital, therefore, to ensure a sufficient rate of circulation of the barrier fluid The barrier fluid pressure should lie 10 % or at least 2....3 bar above the maximum pressure to be sealed. The flow rate must be controlled to ensure that the temperature of the barrier medium at the outlet lies below approximately 60 °C and that it does not exceed boiling point under any circumstances. The maximum acceptable inlet/outlet temperature differential is 15 K. The barrier fluid outlet lies at the highest point of the stuffing box for automatic venting of any vapour. In view of the basic conditions of operation, a barrier system must perform the following functions:

- Build-up pressure in the barrier interspace
- Compensation of leakage
- Circulation of the barrier medium
- Cooling of the barrier medium
- Cooling of the seal

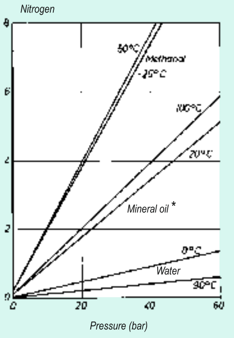
Barrier fluid systems for liquid-lubricated mechanical seals break down into two basic categories:

- **Open circuit**

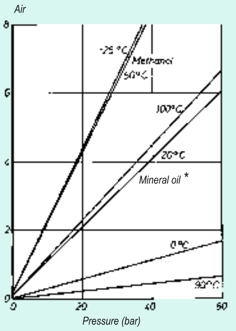
A circuit in which both the circulation and the pressurization take place through a single barrier fluid system.
After each circuit the barrier fluid is relieved and collected in a pressureless tank.

- **Closed circuit**

In this type of circuit all the components are kept under the same pressure. Pressure is applied by means of nitrogen or the process medium pressure or via a refill system. Pressure loss in the circuit must be taken into account when drawing up the design.



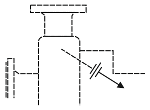
* viscositiy at 38 °C : 34.9 mm² /s



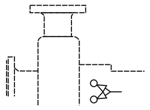
* viscositiy at 38 °C : 34.9 mm² /s

Circulation systems to API 682 / ISO 21049

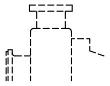
Clean pumping media



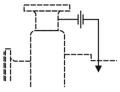
Plan 01
Internal circulation from the pump case to the seal.



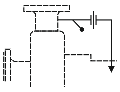
Plan 02
Dead end seal chamber with no circulation. Stuffing box cooling and a neck bush are necessary, unless otherwise specified.



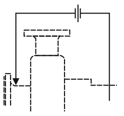
Plan 03
Circulation between the seal chamber and the pump created by the design of the seal chamber. (eg. taper bore)



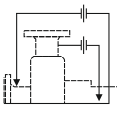
Plan 11
Circulation from the pump discharge, through an orifice to the seal.



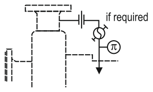
Plan 12
Circulation from the pump discharge, through a strainer and an orifice to the seal.



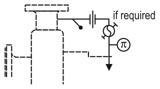
Plan 13
Circulation from the seal chamber, through an orifice and back to pump suction.



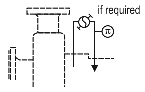
Plan 14
Circulation from pump discharge through orifice to seal chamber and through orifice back to pump suction. (Combination of Plan 11+13).



Plan 21
Circulation from the pump discharge, through an orifice and a cooler to the seal.

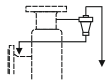


Plan 22
Circulation from the pump discharge, through a strainer, an orifice and a cooler to the seal.

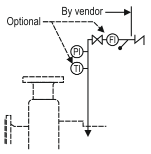


Plan 23
Circulation by means of a pumping ring from the seal, through a cooler and back to the seal.

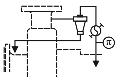
Contaminated and special pumping media



Plan 31
Circulation from the pump discharge through a cyclone separator.

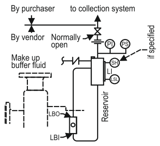


Plan 32
Injection of clean fluid into the seal chamber from an external source

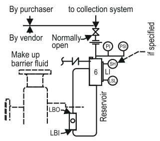


Plan 41
Circulation from the pump case through a cyclone separator, and clean fluid through a cooler to the seal.

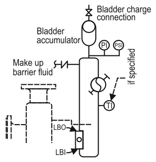
Buffer/barrier medium between seals



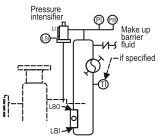
Plan 52
External fluid reservoir, pressureless, thermosiphon or forced circulation as required.



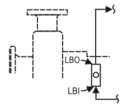
Plan 53A
Circulation with thermosiphon system, pressurized. Forced circulation by pumping ring or circulation pump.



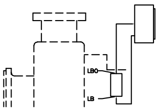
Plan 53B
Circulation with bladder accumulator and cooler, pressurized. Forced circulation by pumping ring or circulation pump.



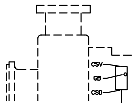
Plan 53C
Circulation with pressure booster and cooler. Pressurized by reference pressure of seal chamber. Forced circulation by pumping ring or circulation pump.



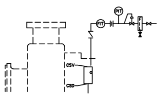
Plan 54
Circulation of clean fluid from an external system.



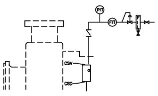
Plan 55
External source to provide a clean unpressurized buffer fluid to a dual unpressurized seal.



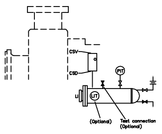
Plan 71
Tapped connections for purchaser's use. Typically this plan is used when the purchaser may use buffer gas in the future.



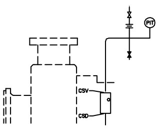
Plan 72
Externally supplied buffer gas for arrangement 2 seals. Buffer gas may be used alone to dilute seal leakage or in conjunction with Plan 75 or 76 to help sweep leakage into a closed collection system. Pressure of buffer gas is lower than process side pressure of inner seal.



Plan 74
Externally supplied barrier gas for arrangement 3 seals. Barrier gas is maintained at a pressure greater than a seal chamber pressure.

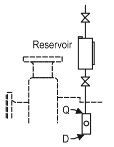


Plan 75
Containment seal chamber leakage collection system for condensing or mixed phase leakage on arrangement 2 seals. This plan is used when pumped fluid condenses at ambient temperature.

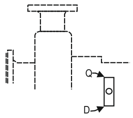


Plan 76
Containment seal chamber drain for non-condensing leakage on arrangement 2 seals. This plan is used if the pumped fluid does not condense at ambient temperature.

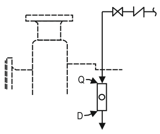
Plan for atmospheric side



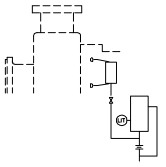
Plan 51
Dead-end quench (usually methanol)



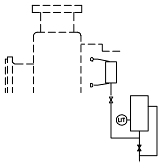
Plan 61
Tapped connections for the customer's use.



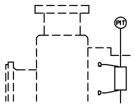
Plan 62
External fluid quench (steam, gas, water, etc.)



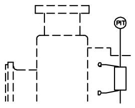
Plan 65A
Atmospheric leakage collection and detection for condensing leakage with failure detection by excess flow into system.



Plan 65B
Atmospheric leakage collection and detection for condensing leakage with failure detection by cumulative leakage into system.

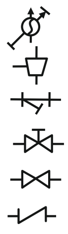


Plan 66A
External leakage detection arrangement with throttle bushings.



Plan 66B
External leakage detection arrangement with orifice plug.

Legend



	Cooler
	Cyclone separator
	Strainer
	Flow control valve
	Block valve
	Non return valve
	Orifice
D	Drain
F	Flush
FI	Flow indicator
LBI	Liquid buffer/barrier inlet
LBO	Liquid buffer/barrier outlet
LI	Level indicator
LSH	Level switch MAX
LSL	Level switch MIN
PI	Pressure indicator
PS	Pressure switch
PSL	Pressure switch MIN
TI	Temperature indicator
Q	Quench

Symbols

A	Area of sliding face
A_H	Area hydraulically loaded by medium pressure
b	Width of sliding face
c	Specific heat capacity
D	Outer diameter of sliding face
d	Inner diameter of sliding face
D_a	Outer diameter of bellows
d_H	Hydraulic diameter
D_i	Inner diameter of bellows
d_m	Mean diameter of sliding face
d_w	Diameter of shaft
f	Coefficient of friction
F_f	Spring force
h	Gap width
H	Delivery head of pumping screw
k	Balance ratio
k_1	Pressure gradient factor
n	Speed
p_1	Medium pressure
p_2	Atmosphere pressure
p_3	Buffer/Barrier fluid pressure
Δp	p_1-p_2; p_3-p_1; p_3-p_2
p_f	Spring pressure
p_G	Sliding pressure
p_r	Calculated load for the frictional force of the secondary seal
P_R	Power consumption of sliding faces
P_V	Turbulence loss through rotating parts
$\dot{V}$	Delivery rate
Q	Mechanical seal leakage rate
R_a	Mean roughness index (calculated)
t,T	Temperature of the medium to be sealed
ΔT	Rise in temperature of the medium to be sealed
t_3	Temperature of the buffer medium
v_g	Sliding velocity
η	Dynamic viscosity
χ	Load factor
ρ	Density
ν	Kinematic viscosity

Mechanical seals according to EN 12756 (code system)

For single mechanical seals there is a distinction drawn between standard (N) and short (K) types. For double mechanical seals (back-to-back) EN specifies the short type only.

Single seal

Designation

Description ☐ ☐ ☐ ☐ ☐ ☐ ☐

Position 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

N = standard type with l_{1N}
K = short type with l_{1k}
C = type C

U = no shaft step
B = with shaft step
C = 0

Nominal diameters **d_1** and **d_{10}** of the mechanical seal
Shaft/shaft sleeve diameters are always three-digit numbers
beneath the stationary seat for types U and B

Direction of rotation of the Mechanical Seal

Type N and K (is also the spring winding direction)	Type C
R = clockwise	
Looking from the stationary seat toward the seal face with the seal face rotating in clockwise direction	Looking from the drive side with the shaft rotating in clockwise direction
L = anti clockwise	
Looking from the stationary seat toward the seal face with the seal face rotating in anticlockwise direction	Looking from the drive side with the shaft rotating in anticlockwise direction

S = independent of direction of rotation

Spring type (state single spring or multiple springs in your order)

Pinned stationary seat
0 = no torsion lock, without anti-rotation pin
1 = with torsion lack, with anti-rotation pin
2 = for type C

Material (see inside end cover)

Position:
1. Seal face
2. Stationary seat
3. Secondary seals
4. Spring
5. Other metal parts (except seal cover and shaft sleeve)

Double seal

Designation

Description ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Position 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐

U = no shaft step
B = with shaft step
C = type C
} on product side

U = no shaft step
B = with shaft step
C = type C
} on atmosphere side

Nominal diameters **d_1** and **d_{10}** (always three-digit numbers)

Direction of rotation (see single seal)

Anti-rotation pin for stationary seat on the atmosphere and/or product side
0 = without anti-rotation pin
1 = with anti-rotation pin for stationary seat on atmosphere side
2 = with anti-rotation pin for stationary seat on product side
3 = with anti-rotation pin for stationary seal on the atmosphere and product sides
4 = for type C

Positive retention for stationary seat on the product side
0 = without
D = with
E = for type C

Material (see inside end cover)

Position:
1. Seal face inboard
2. Stationary seat inboard
3. Secondaryseals inboard
4. Spring
5. Other metal parts
6. Sliding face outboard
7. Stationary seat outboard
8. Secondaryseals outboard

Technical Information

Seal and Material Code to API 682/ISO 21049

Seal designations compliant with ISO 21049 1st Issue and API 682 3rd Edition

The seal description was redefined in ISO 21048, Annex D. Contrary to the earlier arrangement, no details such as the face and O-ring materials used are included in the designation. Such details are now to be found only in the seal data sheet.

The following rule applies for seal codes with four or more digits.

1st digit Seal Category
Here a C is used followed by the corresponding category number 1, 2 or 3 to which the seal belongs.

2nd digit Arrangement
Here an A is used followed by the number 1, 2 or 3 according to the seal arrangement applied.

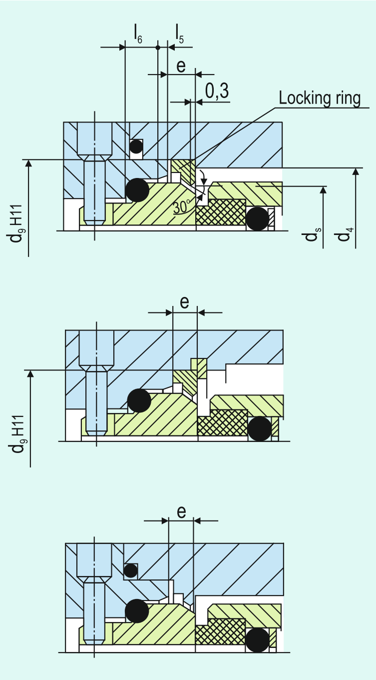
3rd digit Seal Type
Here the letter A, B or C is used according to the seal in question.

4th digit and other Supply System Plans
The cooling and/or flushing diagrams used are listed here one after the other without separating commas.

Example 1:
C1A1A11
Seal category 1
Seal arrangement 1 (single seal)
Seal type A (O-ring seal)
Product circulation according to Plan 11

Example 2:
C3A2B1152
Seal category 3
Seal arrangement 2 (double seal pressureless)
Seal type B (rotating metal bellows seal)
Product circulation according to Plan 11
Pressureless quench according to Plan 52

Seat locking*) to EN 12756



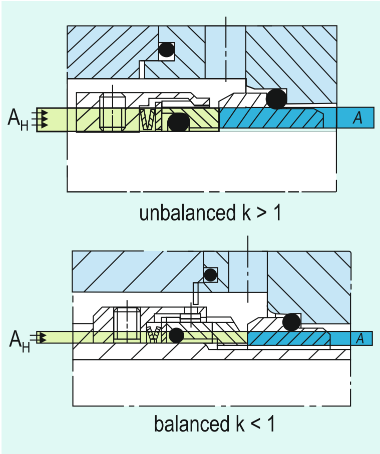
d_1	d_2	d_4		d_9		l_5	l_6	e	d_s
		U	B	U	B				
10	14	22	26	26	30	1.5	4	4	-
12	16	24	28	28	32	1.5	4	4	-
14	18	26	34	30	38	1.5	4	4	-
16	20	23	36	32	40	1.5	4	4	-
18	22	34	38	38	42	2.0	5	4	31.2
20	24	36	40	40	43	2.0	5	4	33.2
22	26	38	42	42	46	2.0	5	4	35.2
24	28	40	44	43	48	2.0	5	4	37.2
25	30	41	46	46	50	2.0	5	4	38.2
28	33	44	49	48	53	2.0	5	4	41.2
30	35	47	61	50	60	2.0	5	4	43.2
32	38	48	58	53	62	2.0	5	4	46.2
33	38	49	58	53	62	2.0	5	4	46.2
35	40	51	60	60	65	2.0	5	4	48.2
38	43	58	63	62	67	2.0	6	6	53.5
40	45	60	65	66	70	2.0	6	6	55.5
43	48	63	68	67	72	2.0	6	6	58.5
45	50	65	70	70	75	2.0	6	6	60.5
48	53	68	73	72	77	2.0	6	6	63.5
50	55	70	75	75	86	2.5	6	6	67.5
53	58	73	83	77	86	2.5	6	6	70.6
55	60	75	85	86	91	2.5	6	6	72.6
58	63	83	88	88	93	2.5	6	6	75.6
60	65	85	90	91	96	2.5	6	6	77.6
63	68	88	93	93	98	2.5	6	6	80.6
65	70	90	95	97	103	2.5	6	6	82.6
68	-	93	-	98	-	-	-	6	88.6
70	75	95	104	103	018	2.5	7	6	90.2
75	80	104	109	108	150	2.5	7	6	95.2
80	85	109	114	120	125	3.0	7	6	103.0
85	90	114	119	125	130	3.0	7	6	108.0
90	95	119	124	130	136	3.0	7	6	113.0
95	100	124	129	135	140	3.0	7	6	117.5
100	105	129	134	140	145	3.0	7	6	122.5

*) not applicable for seats made of carbon.

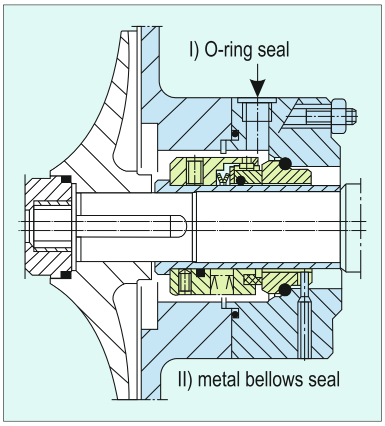
Balance ratio

The balance ratio is a non-dimensional factor of the mechanical seal and is defined as

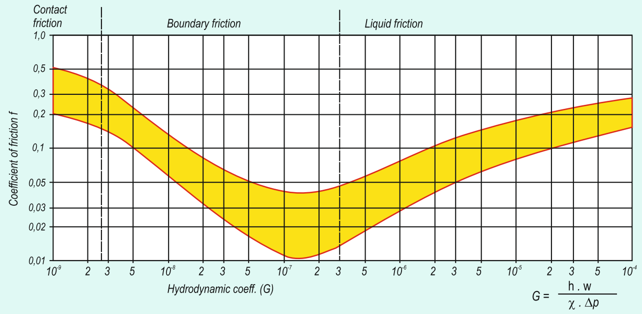
$$k = \frac{\text{hydraul. loaded area } A_H}{\text{area of sliding face } A}$$

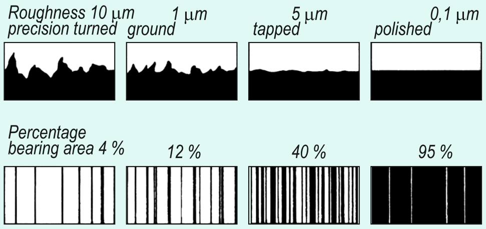


In practice k values are selected between 0.65 and 1.2. With a lower k value, the safety against thermal overload will increase, but the mechanical seal may also lift off more easily.



Unlike an O-ring seal, the hydraulic diameter of a bellows seal is not a fixed geometric value. It is conditional on the absolute level of the pressure to be sealed and on the direction of pressurization (internal or external pressure).





Degree of roughness in relation to the percentage bearing

Load factor χ

The balance ratio is just a non-dimensional factor used to assess a mechanical seal. A second one is the load factor χ.

$$\chi = k + \frac{p_f \pm p_r}{\Delta p}$$

The balance ratio and the load factor are practically identical when the pressure differentials to be sealed are large. The friction at the dynamic secondary seals p_r is usually disregarded in the calculation.

Sliding pressure p_g

The term "sliding pressure" is understood to be the surface pressure on the two sealing faces which remains after subtracting all those forces that act on the seal face and which are balanced by hydraulic pressures. The sliding pressure is conditional on the pressure differential to be sealed, the balance ratio, the pressure conditions inside the sealing gap i.e. gap between the seal faces (pressure gradient factor) and the spring pressure. The pressure gradient factor k_1 can assume values between 0 and 1, depending on the geometry of the two sealing faces. For sealing gap geometries which converge in leakage direction - V-gap for externally pressurized seals - the value of k_1 is > 0.5, while for sealing gap geometries which diverge in leakage direction - A-gap for externally pressurized seals - the value of $k_1 < 0.5$. For simplified calculations the value of k_1 is generally taken to be 0.5. Under unfavourable conditions the sliding pressure can become negative, causing the sealing faces to open resulting in excessive leakage.

$$p_g = \Delta p \cdot (k - k_1) + p_f$$

Coefficient of friction f

The coefficient of friction f is conditional on the materials that are in contact, the medium being sealed, the sliding velocity and the design-related conditions of contact between the sliding faces.

For general considerations and calculations, a coefficient of friction of between 0.05 and 0.08 can be applied as a good approximation. As can be seen in the graph, a lower value is obtained under improved conditions of lubrication, e.g. due to partial build-up of hydrodynamic pressure in the sealing gap. On the other hand, when a mechanical seal is run under purely hydrodynamic conditions of operation, the coefficient of friction will rise as the speed increases - similar to hydrodynamic bearings.

Gap width h

Seals with contacting faces

In contact seals with a theoretically parallel sealing gap, the distance between the two sealing faces is conditional on the roughness of the surfaces.

Numerous measurements taken in the laboratory and in practice with due allowance for external factors indicate that a mean gap width of less than 1 mm can be used as a basis for calculating the normal degree of leakage.

Seals with non-contacting faces

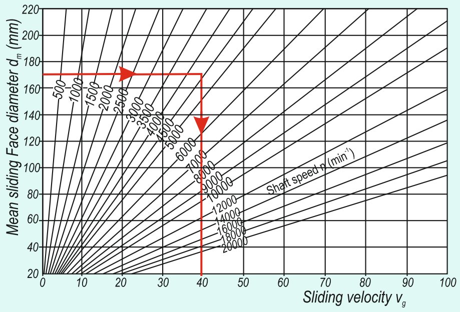
Hydrostatically or hydrodynamically balanced, non-contacting mechanical seals adjust automatically to a defined gap width during operation. The width of the gap depends mainly on the shape of the gap in radial as well as circumferential direction, on the operating conditions and on the medium.

Surface roughness

Microfinished sliding faces made of various materials display the following average, arithmetic mean roughness values (R_a):

Tungsten carbide. nickel-bonded	:	**0,01 µm**
Silicon carbide (SiC)	:	**0,04 µm**
Special cast Cr-steel	:	**0,15 µm**
Carbon graphite	:	**0,10 µm**
Aluminum oxide	:	**0,15 µm**
C-SiC-Si/C-SiC	:	**0,15 µm**

The lower the roughness value, the higher the percentage bearing area and hence the higher load capacity of a mechanical seal.



Example:
d_m = 170 mm
n = 4500 min^{-1}
v_g = 40 m/s

Sliding velocity v_g

The sliding velocity is usually quoted in relation to the mean sliding face diameter.

Cooling water requirements

When estimating the amount of cooling water required by heat exchangers it can be assumed that the temperature of the cooling water will increase by 5 K between the inlet and the outlet. This means that 1 l/min of cooling water dissipates 350 W.

Turbulence losses P_v

The turbulence-related consumption of power is not significant until the circumferential speed reaches 30 m/s. It must be given due consideration particularly with special seals.

Power consumption

The total power consumption of a mechanical seal is calculated from

- The power consumed by the sliding faces.
- The power consumption due to turbulence created by the rotating parts.

Heat transfer

The total power consumption of a mechanical seal has to be dissipated into the medium or the buffer fluid by means of appropriate measures in order to stop the seal from overheating. The necessary fluid flow rate for removal of the power losses is calculated by

$$\dot{V} = \frac{P_R + P_V}{\Delta T \cdot c \cdot \rho}$$

Under certain conditions of installation or operation heat may pass from the product to the sealing compartment and will need to be taken into account when calculating the circulation rate.

Example calculation:

P_R = 420 W (1 W = 1 J / s)
ΔT = 10 K
Fluid: Water;
c = 4200 J (kg · K)
ρ = 1 kg / dm^3

$$\dot{V} = \frac{420\,W \cdot kg \cdot K \cdot dm^3}{10\,K - 420\,Ws - 1\,kg}$$

= 0.01 l/s = 0.6 l/min

Technical Information

Prior to installation

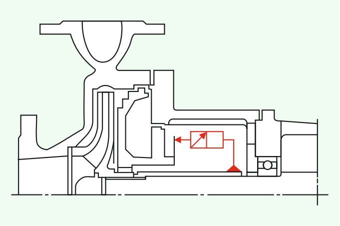
To fit a seal you will need its installation and operating instructions with the correct drawing. Before starting, check the dimensions, the maximum acceptable deviations and the geometrical tolerances of the machine.

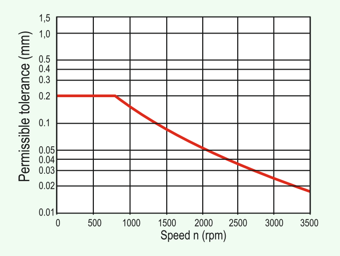
Edges and shoulders
All edges and shoulders onto or into which the mechanical seal is pushed during installation must be chamfered, deburred and rounded off to less than 30° x 2 mm.

Dimensional deviations
Acceptable deviations for dimensions having no tolerance specification:
ISO 2768
- Part 1, fine/medium for linear and angular dimensions
- Part 2, tolerance class K for general geometrical tolerances

Axial run-out

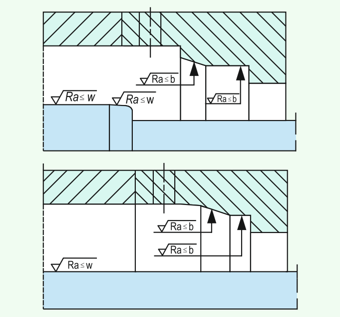
Mounting face
Axial run-out depends on the speed. Permissible values are indicated by the graph.





Surface finish

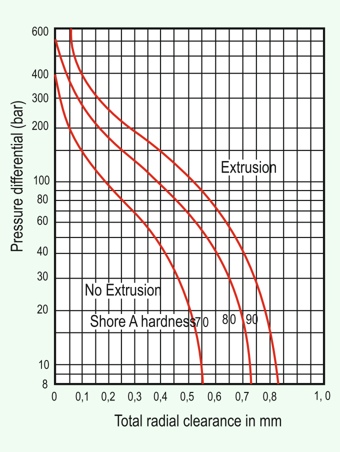
Finished surfaces according to EN12756



Mean roughness index	for secondary seal material R_a	
	b	w
Elastomers	2.5 µm	0.8 µm
Non-elastomers or optional use of elastomers and non-elastomers	1.6 µm	0.2 µm

Extrusion characteristics of elastomeric O-rings

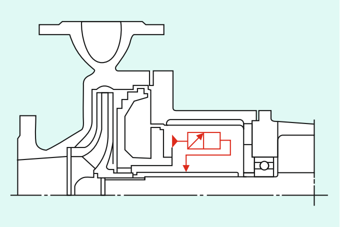
The extrusion resistance of elastomeric O-rings can be greatly enhanced by the use of support rings.

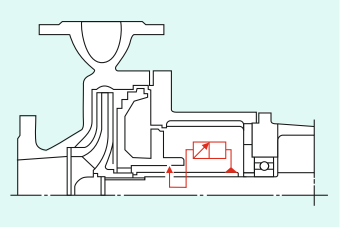


Concentricity tolerance

Shaft in accordance with ISO 5199
In the area of the mechanical seal the shaft concentricity tolerance must not exceed 50 µm for diameters < 50 mm, 50 µm- 80 µm for diameters between 50 and 100 mm, and 110 µm for diameters > 100 mm.

Seal chamber bore
For sliding velocities of v_g < 25 m/s the concentricity tolerance of the seal chamber in relation to the shaft should not exceed 0.2 mm, and when pumping screws are used it should not exceed 0.1 mm due to the effect of the pumping characteristic. If these values are exceeded please contact Sealmatic.



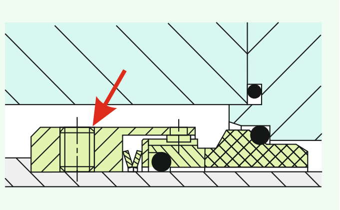


Mechanical Seal Installation

Absolute cleanliness and care are essential when fitting mechanical seals. Dirt and damage to sliding faces and O-rings jeopardize a seal's function. Any protective covering on the sliding faces must be removed without trace. Never put lubricant on the sliding faces - mount only in a completely dry, dust free and clean state. The accompanying installation instructions and the notes on the assembly drawings must be observed exactly.

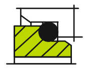
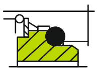
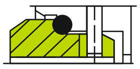
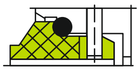
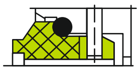
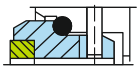
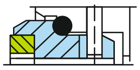
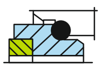
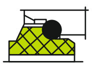
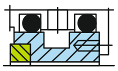
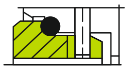
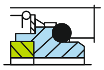
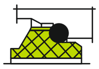
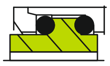
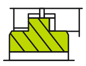
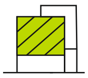
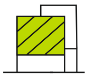
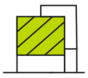
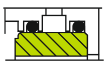
Fitting advice
To reduce the friction on O-rings when mounting seals on a shaft or when inserting seal cartridges in their housing, apply a thin coating of silicon grease or oil to the shaft or housing (N.B.: this does not apply to elastomer bellows seals). Never allow EP rubber O-rings to come into contact with mineral oil or grease. When inserting stationary seats, be careful to apply even pressure and use only water or alcohol to reduce O-ring friction.

Screw locking
If no special provision is made for locking screw threads, use set screws with a suitable adhesive (e.g. Loctite®) after removing any grease.



Venting
To prevent damage to the sliding faces from dry running, the buffer space must be carefully vented **after you have installed the seal.** This is particularly important for those types of buffer/barrier fluid systems that do not vent themselves or are partially self venting (double seal with buffer/barrier fluid systems).

Stationary Seats General Table

Seats				Types of Seals																					
Type	Seal Type	Version	Description/ materials	UG100	UG120	UG130	UG943	U300	U320	U370	U370G	U370GN	U320N	U700(F)	U740(F)	U740(F)-D	B120N	B170GN	B700(F)	B740(F)	B740(F)-D	BJ920	BJ970G	UFL800N	TB850
G4	U320		solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide	●	●	●	●		●	●	●	○	○	●	●	○	○	○	○	○	○	○	○	●	
G6	U320N4		solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide	●	●	●	●		○	●	○	●	●	●	●	○	○	○	○	○	○	○	○	●	
G7	U320S8		solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide	●	●	●	●		●	●	●	○	○	○	○	○									
G9 to DIN 24960	U320N		solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide	●	●	●	●		○	○	○	●	●	●	●	●	●	●	●	●	●	○	○	●	
	U700N		Carbon Resin/Antimony Impregnated	○	○	○		●		●	○	●		●	●	●									
	B700N		Carbon Resin/Antimony Impregnated														●	●	●	●	●				
	U377GN		Shrunk in Tungsten Carbide/ Silicon Carbide	●	●	●	●		○	○	○	●	●	●	●	●									
	U177GN		Shrunk in Tungsten Carbide/ Silicon Carbide														●	●	●	●	●				
G12	U377G		Shrunk in Tungsten Carbide/ Silicon Carbide	●	●	●	●		●	○	●	○	○	●	●	●									
G13	U300		solid Carbon Resin/Antimony Impregnated	●	●	●		●		●	●	○		●	●	●									
G15	B721G15 B740G15		Shrunk in Tungsten Carbide/ Silicon Carbide (cooled)														○	○	○	●	○				
G16	BJ920N		solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	○	
G18	U377GS8		Shrunk in Tungsten Carbide/ Silicon Carbide	●	●	●	●		●	○	●	○	○	●	●	●									
G30	U300N4		solid Carbon Resin/Antimony Impregnated	○	○	○		●		●	○	●		●	●	●									
G35	TB850		double-elastic mounted, solid Ceramic, Tungsten Carbide/ Silicon Carbide																						○
G42	TB850		Ceramic, Tungsten Carbide/ Silicon Carbide																						●
G50	UG943		solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide	○	○	○	●																		
G55	UG943		solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide	○	○	○	●																		
G60	UG100		solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide	●	●	●	○																		
G115	B750G115		solid Silicon Carbide/Tungsten Carbide (Cooled)														○	○	○	●	○				

● — Default

○ — Optional

Table of Materials

Face Materials (Item 1/2)

Synthetic Carbons

A	Carbon graphite antimony impregnated
B	Carbon graphite resin impregnated, approved for foodstuffs
B3	Carbon graphite resin impregnated
B4	Electrographite resin impregnated
B5	Carbon, resin bonded
C	Electrographite antimony impregnated

Metals

E	Cr-Steel
G	CrNiMo-Steel
S	Special cast CrMo-Steel

Carbides

U = Tungsten carbides

U1	Tungsten carbide, Co-binder
U2	Tungsten carbide, Ni-binder
U22	Tungsten carbide, Ni-binder (shrunk-in)
U3	Tungsten carbide, NiCrMo-binder
U37	Tungsten carbide, NiCrMo-binder (shrunk-in)
U7	Tungsten carbide, binder-free

Q = Silicon carbides

Q1	SiC, silicon carbide, sintered pressureless
Q12	SiC, silicon carbide, sintered pressureless (shrunk-in)
Q2	SiC-Si, reaction bonded
Q22	SiC-Si, reaction bonded(shrunk-in)
Q3	SiC-C-Si, carbon silicon impr.
Q32	SiC-C-Si, carbon silicon impr.
Q6	SiC-C, SiC, sintered pressureless with carbon
Q4	C-SiC, carbon surface silicated
Q19	SiC,DLC- coated
Q15	SiC,Diamond face

Standards followed:
EN 12756
ISO 1629

Metal Oxides (Ceramics)

V	Al-Oxide > 99%
V2	Al-Oxide > 96%
X	Steatite (Magnesia silicate)

Plastics

Y1	PTFE, glassfiber reinforced
Y2	PTFE, Carbon reinforced

Secondary Seal Components (Item 3)

Elastomers, not wrapped

B	Butyl rubber
E	Ethylene propylene rubber
K	Perfluorocarbon rubber
N	Chloroprene rubber
P	Nitrile-butadiene-rubber
S	Silicone rubber
V	Fluorocarbon rubber
X	Aflas
X4	HNBR

Elastomers, wrapped

M1	FKM, double PTFE wrapped
M2	EPDM, double PTFE wrapped
M3	VMQ, double PTFE wrapped
M4	CR, double PTFE wrapped
M5	FKM, FEP wrapped
M7	FKM, double PTFE wrapped/ PTFE solid

Differing Materials

U1	Perfluorocarbon rubber/PTFE

Non-Elastomers

G	Pure graphite
T	PTFE (Polytetrafluoroethylene)
T2	PTFE glass fiber reinforced
T3	PTFE carbon reinforced
T12	PTFE carbon-graphite reinforced

Spring and Construction Mat. (Item 4/5)

Spring Materials

G	1.4571	CrNiMo Steel
M	2.4610	Hastelloy® C-4 Nickel-base alloy
M5	2.4819	Hastelloy® C-276

Construction Materials

D	St	C steel
E	1.4122	Cr steel
F	1.4301	CrNi steel
F	1.4308	CrNi cast steel
F1	1.4313	Special cast CrNi steel
G	1.4401	CrNiMo steel
G	1.4404	CrNiMo steel
G	1.4571	CrNiMo steel
G	1.4581	CrNiMo cast steel
G1	1.4462	CrNiMo steel - Duplex
G1	1.4460	CrNiMo steel-Duplex
G4	1.4410	CrNiMo steel surperduplex
G4	1.4501	CrNiMoCu steel - Superduplex
G3	1.4539	NiCrMo steel

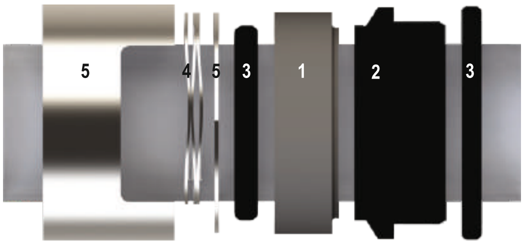
M = Nickel-base alloy

M	2.4610	Hastelloy® C-4
M1	2.4617	Hastelloy® B-2
M3	2.4660	Carpenter® 20 Cb3
M4	2.4375	Monel® alloy K500
M5	2.4819	Hastelloy® C-276
M6	2.4668	Inconel® 718

T = Other materials

T1	1.4505	CrNiMoCuNb steel
T2	3.7035	Pure Titanium
T3	2.4856	Inconel® 625
T4	1.3917	Carpenter® 42
T5	1.4876	Inconel® 800
T6	-	AM350

Material code designation example



Item	1	2	3	4	5
Material code	Seal face	Stat. face	Secondary Seals	Spring	Other parts
acc.to EN 12756	Q1	B	V	G	G

Example : Sealmatic U700N/d_1 Q1 B V G G