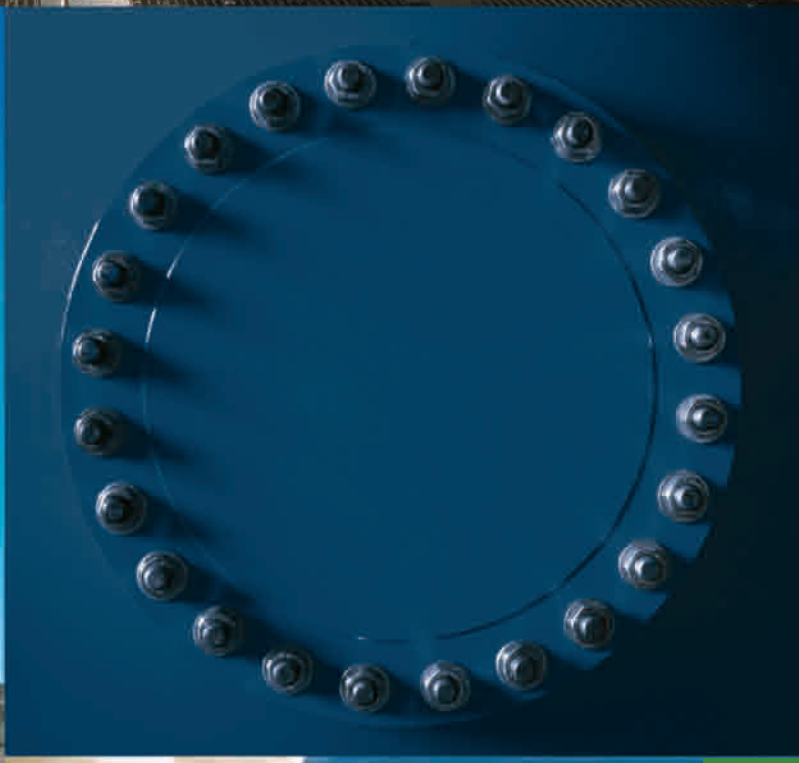
HTMS

High Tech Metal Seals



Edition 2010 - English

Content

The Company

History

HTMS is a private owned company, founded in 1999 by a group of sealing specialist with currently a combined experience of more than 100 years. The plant is located in Mechelen, Belgium.

High Tech Metal Seals, short HTMS designs and manufactures elastic or resilient metal seals.

- Metal O Rings
- Spring Energised Metal O Rings
- Metal-C-Rings
- Spring Energised Metal C Rings
- Metal Oysterseal®
- Metal Commaseal®

HTMS, Resilient Metal Seals are used in a wide variety of applications where normal seals cannot handle extremes of temperature, pressure, medium or combinations there off.

Internal C-Ring with DSO from 6,48

Markets

HTMS specialises in metallic seals, serving all markets, including Aerospace, Nuclear, Automotive, Industrial, Medical and others.

Clean room environment CLASS 5 as per ISO-14644 (MIL100 as per IEST-STD-CC1246D)

Quality

HTMS is dedicated to produce resilient metal seals under the most stringent quality procedures. The company is also ISO9001 certified. The quality system has been audited according to EN9100 by Safran/Snecma

- Computer controlled welding equipment
- 100% LP test on O Ring seal welds
- X-ray of weld area on request
- Helium leak test equipment, with electronic data logging
- Seating load and spring back measurement equipment
- Heat treatment

EURO-QUALITY SYSTEM ISO 9001

EURO-QUALITY SYSTEM EN 9100

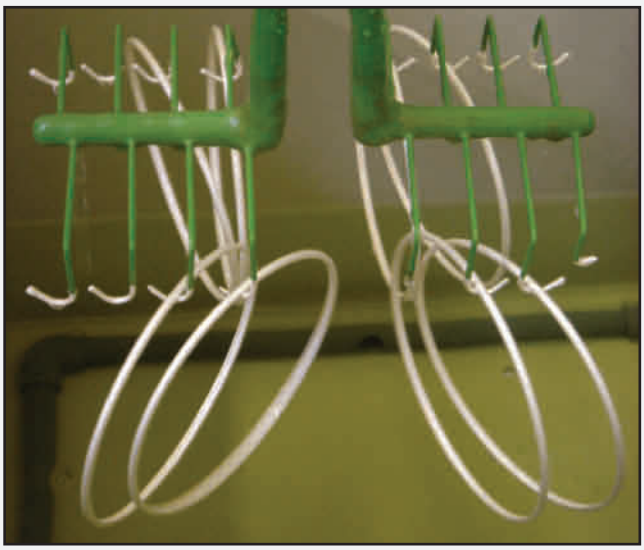
Expertise

- More than 100 years of experience
- In house testing
- R&D new products
- Close co-operation with universities

Flexibility

- Short delivery times
- Rush production procedure
- Dedicated staff
- Quick response time

testing equipment



In house plating facility

Introduction

Function of a Resilient Metal Seal

The sealing performance of resilient Metal Seals is based on a the relative high specific contact load at the sealing line generated by the compression of the seal to a certain groove depth and a certain resiliency or spring back of the elastic metal seal.

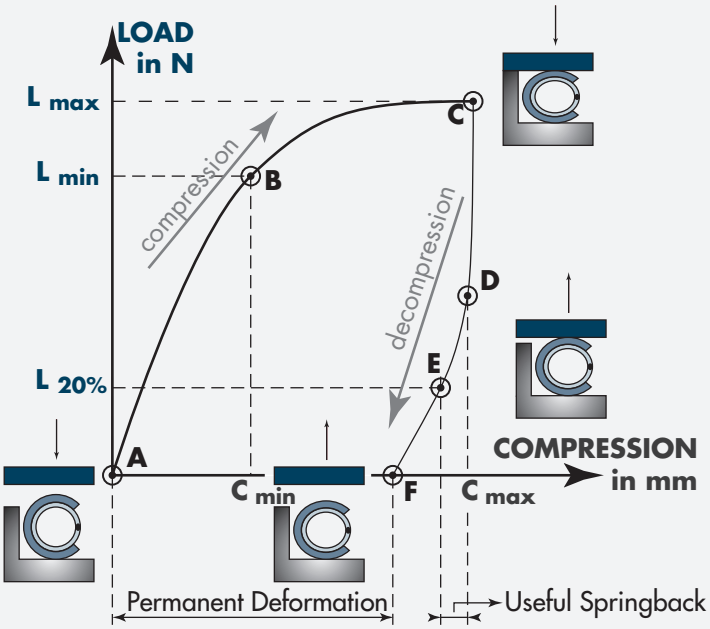
Typically resilient metal seals are compressed 20%. As an example a 3,18 mm FH (free height) seal is compressed to approximately 2,5 mm.

In the figure compression starts at point A.

Point B illustrates the maximum groove depth. At this point the seating load already passed 90% of its maximum.

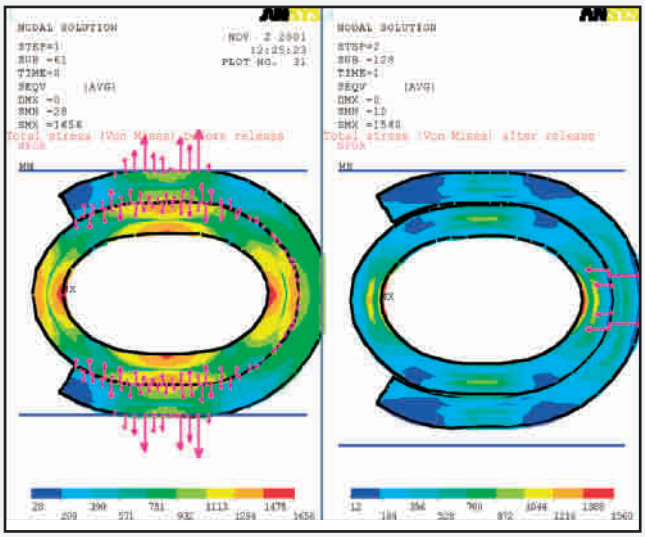
Point C illustrates the minimum groove depth, or the point where the seating load reaches its maximum. Reducing the groove depth even more and thus increasing the compression ratio can lead to seal failure.

Point D: At this point the seals' resilience overcomes the remaining (decompression) load, this resilience is called springback.



Point E: Springback of the seal at 20% of the maximum load (Lmax) is the useful springback.

Point F: Springback of the seal at zero load is total springback = elastic recovery of the seal.



Engineering

Development and Engineering of new products is conducted in close cooperation with universities.
In house testing equipment facilitates real hardware testing and comparison with FEA results.
The Oysterseal® in this catalogue is one of the results of this bespoken cooperation.

General Information

High Performance Seals for extreme service conditions. HTMS resilient Metal Seals are designed and produced to provide the required tightness, when subjected to extremes of temperatures, pressure and media.
HTMS metal seals are produced from stainless steel or high temperature alloy tubing, strip and wire.

Sealing Concept

The sealing performance of resilient Metal Seals is based on a the relative high specific contact load at the sealing line and a certain resiliency or spring back of the elastic metal seal.

The seating load and the corresponding sealing line width, are a function of the selected seal type, cross section, material, material thickness and the alloy properties itself.

Depending on the required tightness and the media to be sealed, a specific seating load will be required. Plating or coating with soft, ductile material will provide better sealing by filling up groove imperfections. The seating load will make the ductile layer to flow and fill up the groove surface irregularities.

Resilient Metal Seals require a controlled compression. Typically these seals are installed in a machined groove, or the compression is limited by a so called retainer plate.

General Properties

- Sizes: Diameters from 5 mm to 7 meter
- Cross section from 0,8 mm to 12,5 mm
- Temperature: Cryogenic to +750°C
- Pressure: From ultra high vacuum to +500 MPa.
- Available in circular, race track, oval and other shapes.
- Excellent resistance to corrosion and radiation.
- Maintains elasticity or spring back over an extended service life
- Does not suffer from explosive decompression
- Capable of reaching tightness better than 10^{-9} mbar.l/s
- Radiation resistant

Material Selection

The application parameters determine which material should be used. Temperature and media are important aspects in selecting the material. HTMS offers materials such as 321 stainless steel, Inconel® and other high temperature alloys.

Exceptions and particular cases

Resilient Metal seals often have to perform under extreme service conditions. Standard solutions as found in this catalogue may not always suffice this requirements.

HTMS can alter the standard design and materials to optimize seal performance for a given application.

With high accuracy and backed by FEA in cooperation with the University, HTMS can adjust the seals cross section, wall thickness, selected alloys, to name a few, in order to adapt seal performance to the variables in service.

Plating - Coating

In house platings or coatings are applied to improve the sealing performance of metal seals. Depending on the required tightness, the selected seal, the media to be sealed and the condition of the mating surface, a softer or harder plating or coating shall be chosen. When temperature allows, either PTFE coating or soft silver should be applied.
The soft layer, flows at seal compression into the mating surface irregularities and creates hereby the best seal performance possible.
PTFE coating can achieve leak rates around 10^{-6} mbar.l/s, measured with the vacuum method.
Metal type plating, like silver, indium, and tin to name a few, can achieve leak rates better than 10^{-9} mbar.l/s up to 10^{-12} mbar.l/s.

Heat Treatment

HTMS recommends to heat treat all non spring energised Metal C Rings. High performance HTMS metal seals will perform better in the heat treated condition.

Heat treatment of super alloys such as Inconel X750, Inconel 718, Haynes 214, will increase the yield strength of the material. This influences directly the seal performances, because of increasing seating load and a better spring back.
The increased seating load will press the soft plating better into the surface irregularities, thereby creating a better seal.
The higher spring back means that the intimate contact between the seal and the mating surface is maintained longer in case of flange deflection.

Such flange deflection can be a result of high temperatures, high pressures and/or a combination thereof.

Heat treatment is mostly not required for Spring Energised C Rings and Metal O Rings. However some demanding applications in Oil and Gas evironment do require heat treatment to prevent material embrittlement. (Heat treatment according to Nace)

Annealing and heat treatment also improves the seal's resistance against fatigue under cyclic loads. Structural integrity will be maintained for an extended period of time. HTMS offers age hardening, annealing and solution and precipitation heat treatment.

Metal O-Rings and and some Spring Energized C-Rings made from austenitic stainless steels, are not precipitation hardenable. These seals can only be supplied in the work hardened condition.
For demanding applications and for temperatures above 400°C, HTMS advises to use high alloy steels only.

Heat Treatment Code Table

Material Code		HT-1	HT-2	HT-3	HT-4	HT-5	HT-6	HT-7	HT-8
1	Nickel alloy X-750	X	X		X				
2	Nickel alloy 718	X	X		X	X			
3	321 SS	X							
4	Nickel alloy 600	X		X					
5	304 SS	X							
6	304 SS, high tensile	X							
7	316 SS	X							
8	Hastelloy	X							
9	302 SS	X							
A	ELGILLOY	X							X
B	HAYNES 214	X						X	
C	ALUMINIUM 1050	X		X					
D	ALLOY 625	X					X		
E	NIMONIC 90	X							
F	HASTELLOY C-276	X				X			
G	HAYNES 188	X							

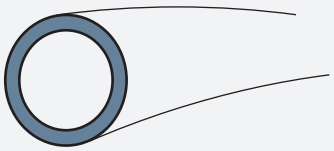
HT-1	Work Hardened
HT-2	Age Hardened, short cycle
HT-3	Annealing
HT-4	Solution and Precipitation Heat treatment
HT-5	Nace Heat treatment, Hardness max 40 HRC, Alloy 718
HT-6	Nace Solution Annealing
HT-7	Stress Relief
HT-8	Age Hardened, Hardness max for NACE 62 HRC

Heat Treatment Codes for Jacket and Spring materials

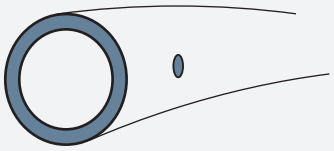
Seal Overview

Metal O-Ring for Internal Pressure Page 12
Metal O Ring for External Pressure Page 14

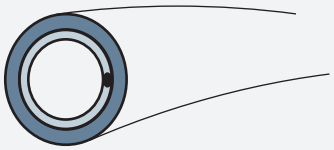
Non-vented rings (OI & OE) are designed for lower pressure ranges. The perfectly closed O Ring design avoids ingress of the media into the seal.
Moderate load, Moderate pressure capability



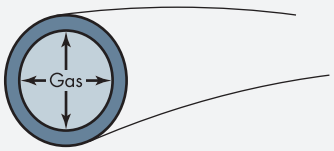
Internally (OVI) or externally (OVE) vented O Rings are designed for higher pressure. Besides the own seating load the seal is also energised by the system pressure.



Spring-energised metal O Ring for Internal pressure (OSI) and (OSE) for external pressure are designed for extreme low leakage at moderate pressures.

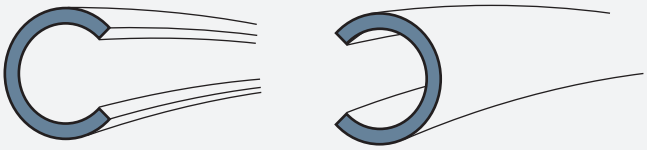


Gas filled metal O Ring for high temperature and moderate pressure applications. OGI for internal pressure and OGE for external pressure.



Metal C-Ring for Internal Pressure Page 16
Metal C Ring for External Pressure Page 18

Metal C-Ring for Internal Pressure (CI) and External Pressure (CE) are designed for high pressure (system pressure energised). They require low bolting load and have good spring back.

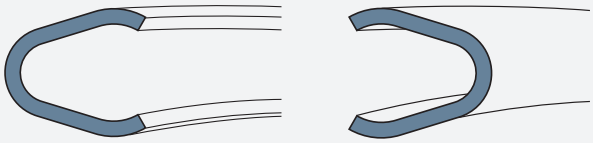


Spring Energised C Ring for Internal Pressure Page 20
Spring Energised C Ring for External Pressure Page 22

Metal CS-Ring for Internal Pressure (CSI) and External Pressure (CSE) are designed for high pressure and excellent tightness performance (system pressure energised). They require high bolting load and have good spring back.

Oysterseal®, Metal V Ring for Internal Pressure Page 24
Oysterseal®, Metal V Ring for External Pressure Page 26

The Oysterseal® is designed for maximum spring back, and as a consequence is a low load seal. Because of the low load it will only obtain a good tightness with very soft plating or coatings.

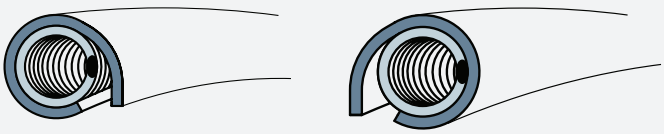


Metal C Ring for Axial Pressure Page 28

The radial C Ring for axial pressure is designed to seal shaft to bore. Close tolerances on both shaft and bore are required.

Metal Commaseal® for Axial Pressure and ID Dynamic Page 30
Metal Commaseal® for Axial Pressure and OD Dynamic Page 32

Commaseals® are designed for slow dynamic applications on ID or OD.

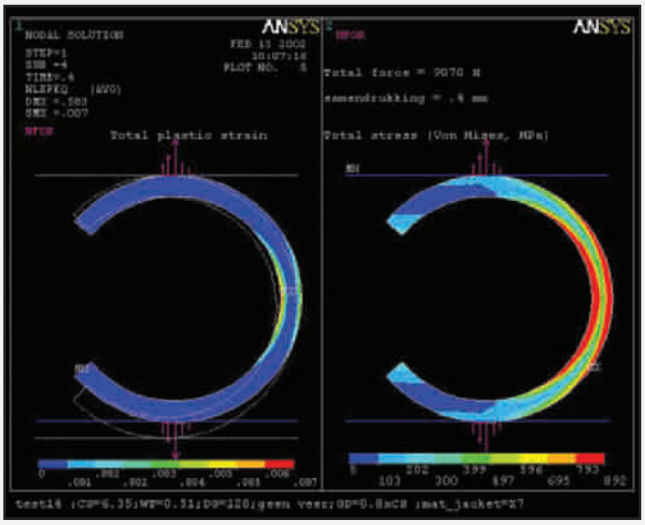


Seal Selection Guide

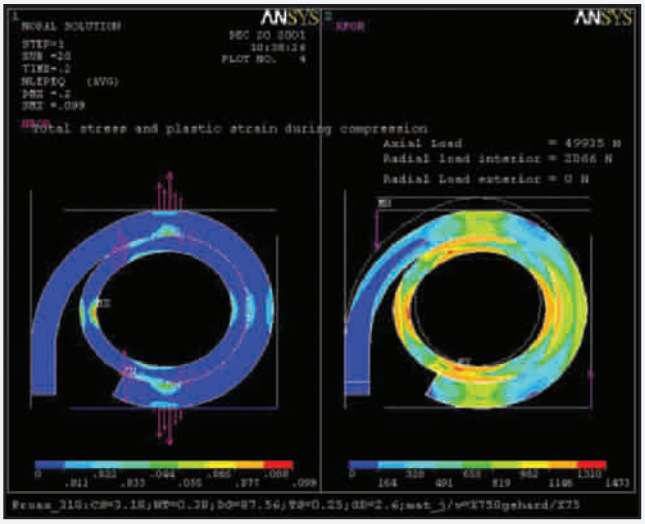
Load and Spring back

The selection of the most suitable seal for extreme service conditions is often a delicate trade off between load and spring back of the seal. The compression load or seating load has a direct relation with the obtainable tightness where as the spring back of the seal determines how well this tightness is maintained with varying temperatures and pressures.

For a given seal cross section and seal type it is generally true that with maximum load the spring back is lowest. And of course that seal with minimum load will generate the highest spring back.



C-Seal



Commaseal®

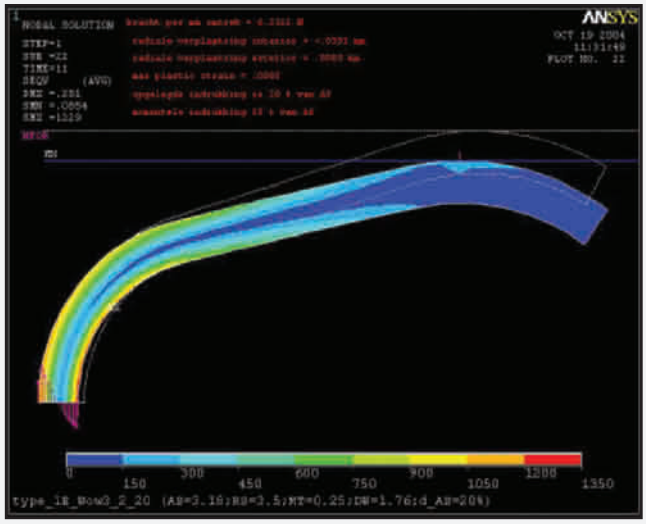
Looking at a Metal O Ring made from stainless steel, one with a thin wall and the other with a thick wall, the one with the thin wall will require lower load to be compressed to groove depth than the one with the thick wall, where the spring back of the latter will be lower than the one with the thin wall.

Again looking at the same cross section Metal O Ring, a seal made from Inconel X750 or Inconel 718 will have a higher load and higher spring back than a similar wall thickness Metal O Ring made from stainless steel.

Going over to Metal C Rings, there is a certain similarity with spring back and seating load. The big difference is that Metal C Rings compared with the same cross section Metal O Rings, typically generate a lower load, and thus a better spring back than Metal O Rings.

To overcome the low load of Metal C Rings, the spring energised Metal C Ring was developed. This seal, generates a relative high and uniform seating load with a relative high spring back.

The Oysterseal® or Metal V Ring, by its shape and material selection generates a high spring back, but gives only a moderate seating load.



Oysterseal®

Compression or Seating Load

The compression or seating load is expressed in N/mm seal circumference. The higher the load, the better the sealing performance will be. Soft plating requires lower load then harder plating.

Rough surface finish of the sealing faces require a higher load to obtain similar seal performance.

Non plated seals typically require extreme high loads to obtain technical tightness. It will be difficult, regardless the applied load to obtain a high tightness with un plated seals.

Tightness, Plating

Depending on the required tightness, medium to be sealed and temperature, a different plating or coating may be selected.

For tightness better than 10^{-9} mbar.l/s a soft plating is always required. Indium and Tin are soft platings. PTFE is a soft coating too, but the obtainable tightness is limited to 10^{-6} mbar.l/s., because of the own porosity of PTFE.

Silver, Gold and Copper are medium soft and require a higher load seal to obtain tightness ranges of 10^{-9} mbar.l/s. Silver is the most common used plating. Nickel plating, being the hardest plating requires a high load seal selection.

Flange rotation or lift off

Big diameters and high temperatures play a decisive role in the selection of a metal seal. Flange rotation or lift off occurs under high pressure. The higher the pressure and the bigger the flange diameters, subjected to this pressure, the bolds will be subjected to a quite high stress and strain, resulting in flange rotation or lift off.

For such service conditions the biggest possible cross section for the given diameter should be selected, in order to have the best possible springback characteristics.

Summarizing

The groove surface finish for any selected seal should be equal or better then Ra = 1,8. For tightness equal or better than 10^{-9} mbar.l/s, a surface finish better than Ra = 0,8 should be applied.

Always select the biggest possible cross section for a given diameter.

Selected the softest plating allowed for the application.

If bold load permits, choose the highest seal load available when medium soft plating such as silver, gold or copper is selected.

For temperatures above 350°C it is advised to use Inconel as base materials.

For pressures above 35 MPa it is advised to use C Ring type seals or vented O Rings, both with or without spring energising, depending on the required tightness.

For high temperature applications and when an O Ring type seal is required a gas filled seal may be the better option.

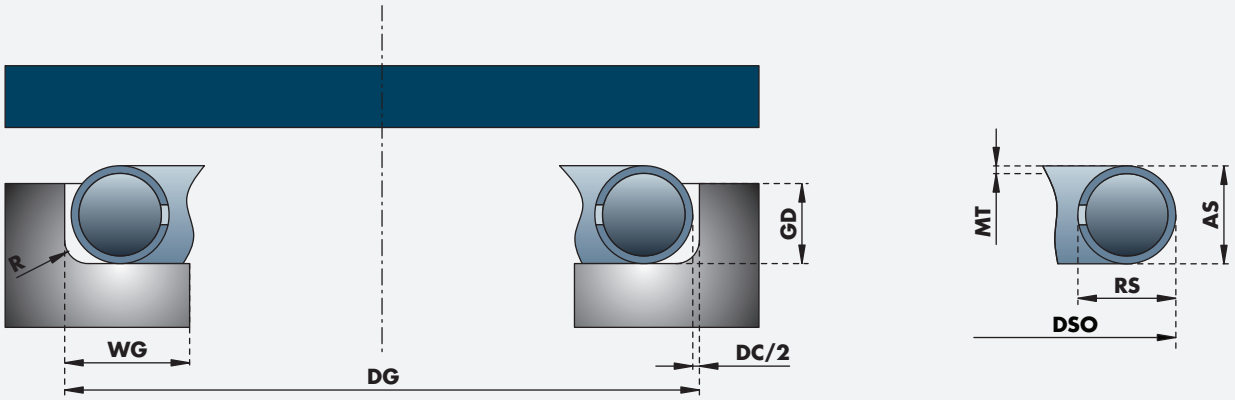
Tailor made leaktest

Metal O Rings - Internal Pressure:

OI OVI OSI OGI

Seal dimension					Groove dimensions				Load	SB
AS			MT	DC	DG	GD	WG	R		
Axial section	Tolerance on AS (cross section)	Material code	Material thickness	Diame-trical clearance	Diameter Groove (range)	Groove Depth (min/max)	Width Groove (min)	Radius (max)	N/mm Circum-ference *	Spring Back in mm
0,89	+0,08 / -0,03	M	0,15	0,20	6,35-25	0,64-0,69	1,40	0,25	140	0,03
1,19	+0,08 / -0,03	H	0,20	0,25	10-50	0,94-1,02	1,78	0,30	100	0,03
1,57	+0,08 -0,03	M	0,25	0,28	12-200	1,14-1,27	2,29	0,38	140	0,05
		H	0,36						200	0,04
2,39	+0,08 -0,03	M	0,25	0,33	25-200	1,88-2,01	3,18	0,51	100	0,05
		H	0,46						200	0,04
3,18	+0,08 -0,03	M	0,25	0,43	50-400	2,54-2,67	4,06	0,76	60	0,08
		H	0,51						180	0,05
3,96	+ 0,10	M	0,41	0,61	75-650	3,18-3,30	5,08	1,27	90	0,10
		H	0,51						135	0,08
4,78	+ 0,13	M	0,51	0,71	100-800	3,84-3,99	6,35	1,27	95	0,14
		H	0,64						200	0,10
6,35	+ 0,13	M	0,64	0,76	200-1200	5,05-5,28	8,89	1,52	100	0,20
		H	0,81						250	0,15
9,53	+ 0,13	M	0,97	1,02	300-2000	8,26-8,51	12,7	1,52	150	0,25
		H	1,24						300	0,20
12,7	+ 0,15	M	1,27	1,27	800-3000	11,05-11,43	16,51	1,52	200	0,30
		H	1,65						350	0,20

* Load and spring back figures are based on Inconel X750 in the age hardened condition. 321 stainless steel will only generate 1/3 of the given Inconel figures. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.



example

OI-007735-3.18M-3/0-1-S50

Seal Type

OI: Internal pressure, no venting
OVI: Internal pressure, O Ring vented, system pressure energised
OSI: Internal pressure, O Ring spring energised, as off section 3,96
OGI: Internal pressure, O Ring gas filled

Cross Section

Select the proper cross section or axial section (AS) in the table, then select the material code "L, M or H" based on the desired wall thickness.

Seal Diameter (DSO)

007735 = 77,35 mm, for groove diameter 77,88
The seal diameter is always the outside diameter without plating.
The diameter is calculated as follows:
Nominal outside groove diameter, DG, minus clearance or DC (in the table on the left page) minus 2 times the maximum plating or coating thickness.
or
DSO = DG - DC - (Plating thickness X 2)
See also figure on the left page, below
DSO = 77,88 - 0,43 - 2X 0,05 = 77,35 mm

Material

The first digit designates the O ring material, the second the spring material, in case an OSE type is selected.

Available Materials & Codes			
Jacket		**Spring**	
Code	**Material**	**Code**	**Material**
1	Alloy X-750	0	None
3	321 SS	1	Alloy X-750 *
4	Alloy 600	2	Alloy 718
		9	302 SS
(*) X-750 will become obsolete Other materials on special request			

Treatment

1: Work hardened

See Tab on the last page →

Plating

Plating Code "S"
= Silver Plating
Plating Thickness "50"
= 30 to 50 Microns

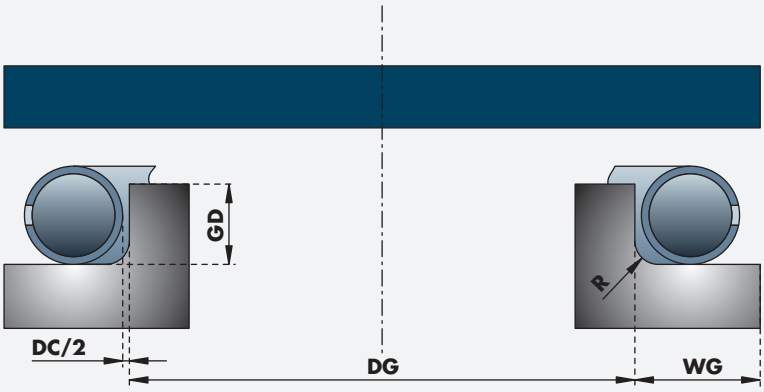
See Tab on the last page →

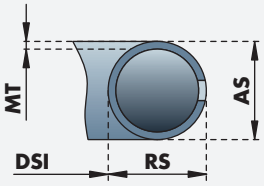
Metal O Rings - External Pressure:

OE OVE OSE OGE

Seal dimension					Groove dimensions				Load	SB
AS			MT	DC	DG	GD	WG	R		
Axial section	Tolerance on AS (cross section)	Material code	Material thickness	Diame-trical clearance	Diameter Groove (range)	Groove Depth (min/max)	Width Groove (min)	Radius (max)	N/mm Circum-ference *	Spring Back in mm
0,89	+0,08 / -0,03	M	0,15	0,20	6,35-25	0,64-0,69	1,40	0,25	140	0,03
1,19	+0,08 / -0,03	H	0,20	0,25	10-50	0,94-1,02	1,78	0,30	100	0,03
1,57	+0,08 -0,03	M	0,25	0,28	12-200	1,14-1,27	2,29	0,38	140	0,05
		H	0,36						200	0,04
2,39	+0,08 -0,03	M	0,25	0,33	25-200	1,88-2,01	3,18	0,51	100	0,05
		H	0,46						200	0,04
3,18	+0,08 -0,03	M	0,25	0,43	50-400	2,54-2,67	4,06	0,76	60	0,08
		H	0,51						180	0,05
3,96	+ 0,10	M	0,41	0,61	75-650	3,18-3,30	5,08	1,27	90	0,10
		H	0,51						135	0,08
4,78	+ 0,13	M	0,51	0,71	100-800	3,84-3,99	6,35	1,27	95	0,14
		H	0,64						200	0,10
6,35	+ 0,13	M	0,64	0,76	200-1200	5,05-5,28	8,89	1,52	100	0,20
		H	0,81						250	0,15
9,53	+ 0,13	M	0,97	1,02	300-2000	8,26-8,51	12,7	1,52	150	0,25
		H	1,24						300	0,20
12,7	+ 0,15	M	1,27	1,27	800-3000	11,05-11,43	16,51	1,52	200	0,30
		H	1,65						350	0,20

* Load and spring back figures are based on Inconel X750 in the age hardened condition. 321 stainless steel will only generate 1/3 of the given Inconel figures. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.





example

OE-006609-2.39M-3/0-1-N50

Seal Type

OE: External pressure, no venting
OVE: External pressure, O Ring vented, system pressure energised
OSE: External pressure, O Ring spring energised as off section 3,96
OGE: External pressure, O Ring gas filled

Cross Section

Select the proper cross section or axial section (AS) in the table, then select the material code "L, M or H" based on the desired wall thickness.

Seal Diameter (DSI)

006609 = 66,09 mm, for groove ID = 65,66
The seal diameter is always the inside diameter without plating.
The diameter is calculated as follows:
Nominal outside groove diameter, DG, plus clearance or DC (in the table on the left page) plus 2 times the maximum plating or coating thickness.
or
DSI = DG + DC + (Plating thickness X 2)
See also figure on the left page, below
DSI = 65,66 + 0,33 + 2X 0,05 = 66,09 mm

Treatment

1: Work hardened

See Tab on the last page →

Plating

Plating Code "N"
= Nickel Plating
Plating Thickness "50"
= 30 to 50 Microns

See Tab on the last page →

Material

The first digit designates the O ring material, the second the spring material, in case an OSE type is selected.

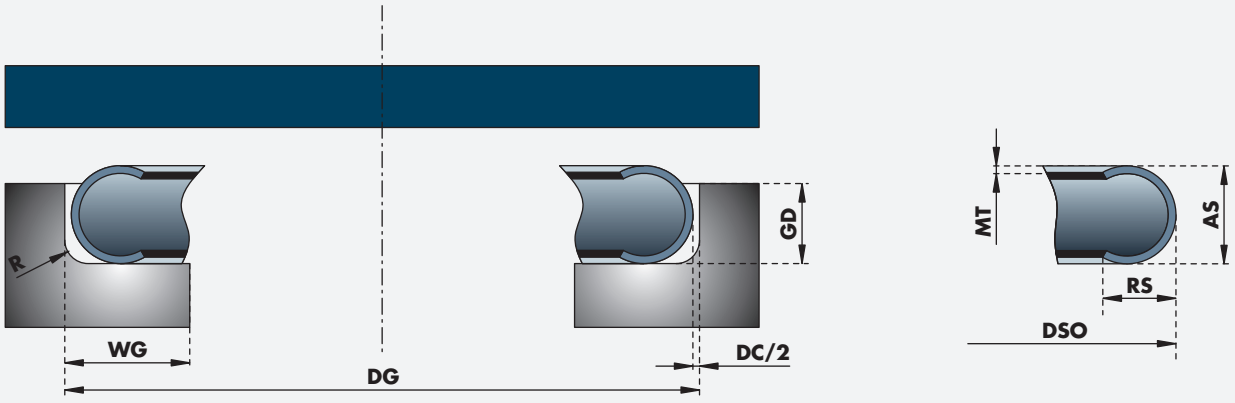
Available Materials & Codes			
Jacket		**Spring**	
Code	**Material**	**Code**	**Material**
1	Alloy X-750	0	None
3	321 SS	1	Alloy X-750 *
4	Alloy 600	2	Alloy 718
		9	302 SS
(*) X-750 will become obsolete Other materials on special request			

Metal C Rings - Internal Pressure:

CI

Seal dimension						Groove dimensions				Load	SB
AS		RS		MT	DC	DG	GD	WG	R		
Axial section	Tolerance on AS (cross section)	Radial section	Material code	Material thickness	Diame-trical clearance	Diameter Groove (range)	Groove Depth (min/max)	Width Groove (min)	Radius (max)	N/mm Circum-ference *	Spring Back in mm
0,79	+/-0,05	0,71	M	0,12	0,05	6 - 25	0,64-0,69	1,02	0,25	30	0,04
			H	0,18						50	0,03
1,19	+/-0,05	0,96	M	0,12	0,07	8 - 50	0,94-1,02	1,40	0,30	20	0,05
			H	0,20						35	0,04
1,57	+/-0,05	1,26	M	0,15	0,10	10-200	1,27-1,37	1,91	0,38	10	0,08
			H	0,25						40	0,06
2,39	+/-0,05	1,91	M	0,25	0,15	13-400	1,91-2,01	2,67	0,51	35	0,10
			H	0,38						65	0,08
2,79	+/-0,05	2,25	M	0,38	0,15	20-500	2.23-2,31	3,10	0,55	30	0,12
3,18	+/-0,08	2,54	M	0,38	0,20	30-600	2,54-2,67	3,43	0,76	45	0,15
			H	0,51						100	0,13
3,96	+/-0,08	3,17	M	0,41	0,25	45-750	3,18-3,30	4,32	1,27	40	0,20
			H	0,61						110	0,17
4,78	+/-0,10	3,82	M	0,51	0,30	75-900	3,84-3,99	5,08	1,27	65	0,22
			H	0,76						150	0,18
5,60	+/-0,10	4,50	M	0,51	0,30	75-1000	4,48-4,65	5,90	1,27	55	0,22
6,35	+/-0,10	5,08	M	0,64	0,40	100-1200	5,08-5,28	6,60	1,52	75	0,30
			H	0,97						160	0,27
7,90	+/-0,10	6,32	M	0,64	0,50	100-1500	6,32-6,58	8,22	1,52	65	0,30
9,53	+/-0,10	7,62	M	0,97	0,60	300-2000	7,62-8,03	9,65	1,52	120	0,40
			H	1,27						250	0,32
12,70	+/-0,13	10,16	M	1,27	0,80	600-3000	10,16-10,67	12,70	1,52	150	0,55
			H	1,65						250	0,48

* Load and spring back figures are based on Inconel X750 in the age hardened condition. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.



example

CI-009947-3.96M-2/0-2-SN50

Seal Type

CI: Internal pressure, system pressure energised

Cross Section

Select the proper cross section or axial section (AS) in the table, then select the material code "M or H" based on the desired wall thickness.

Treatment

2: Age hardened

See Tab on the last page →

Seal Diameter (DSO)

009947 = 99,47 mm, for groove OD = 99,82
The seal diameter is always the outside diameter without plating.
The diameter is calculated as follows:
Nominal outside groove diameter, DG, minus clearance or DC (in the table on the left page) minus 2 times the maximum plating or coating thickness.
or
DSO = DG - DC - (Plating thickness X 2)
See also figure on the left page, below
DSO = 99,82 - 0,25 - 2X 0,05 = 99,47 mm

Plating

Plating Code "SN"
= Tin Plating
Plating Thickness "50"
= 30 to 50 Microns

See Tab on the last page →

Material

The first digit designates the C ring material, the second is always "0" in case of a C Ring

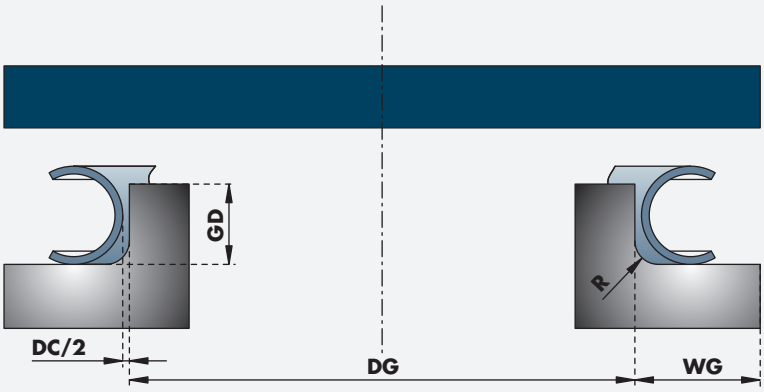
Available Materials & Codes			
Jacket		**Spring**	
Code	**Material**	**Code**	**Material**
1	Alloy X-750 *	0	-
2	Alloy 718	0	-
5	304 SS	0	-
(*) X-750 will become obsolete Other materials on special request			

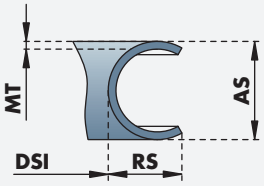
Metal C Rings - External Pressure:

CE

Seal dimension						Groove dimensions				Load	SB
AS		RS		MT	DC	DG	GD	WG	R		
Axial section	Tolerance on AS (cross section)	Radial section	Material code	Material thickness	Diame-trical clearance	Diameter Groove (range)	Groove Depth (min/max)	Width Groove (min)	Radius (max)	N/mm Circum-ference *	Spring Back in mm
0,79	+/-0,05	0,71	M	0,12	0,05	6 - 25	0,64-0,69	1,02	0,25	30	0,04
			H	0,18						50	0,03
1,19	+/-0,05	0,96	M	0,12	0,07	8 - 50	0,94-1,02	1,40	0,30	20	0,05
			H	0,20						35	0,04
1,57	+/-0,05	1,26	M	0,15	0,10	10-200	1,27-1,37	1,91	0,38	10	0,08
			H	0,25						40	0,06
2,39	+/-0,05	1,91	M	0,25	0,15	13-400	1,91-2,01	2,67	0,51	35	0,10
			H	0,38						65	0,08
2,79	+/-0,05	2,25	M	0,38	0,15	20-500	2.23-2,31	3,10	0,55	30	0,12
3,18	+/-0,08	2,54	M	0,38	0,20	30-600	2,54-2,67	3,43	0,76	45	0,15
			H	0,51						100	0,13
3,96	+/-0,08	3,17	M	0,41	0,25	45-750	3,18-3,30	4,32	1,27	40	0,20
			H	0,61						110	0,17
4,78	+/-0,10	3,82	M	0,51	0,30	75-900	3,84-3,99	5,08	1,27	65	0,22
			H	0,76						150	0,18
5,60	+/-0,10	4,50	M	0,51	0,30	75-1000	4,48-4,65	5,90	1,27	55	0,22
6,35	+/-0,10	5,08	M	0,64	0,40	100-1200	5,08-5,28	6,60	1,52	75	0,30
			H	0,97						160	0,27
7,90	+/-0,10	6,32	M	0,64	0,50	100-1500	6,32-6,58	8,22	1,52	65	0,30
9,53	+/-0,10	7,62	M	0,97	0,60	300-2000	7,62-8,03	9,65	1,52	120	0,40
			H	1,27						250	0,32
12,70	+/-0,13	10,16	M	1,27	0,80	600-3000	10,16-10,67	12,70	1,52	150	0,55
			H	1,65						250	0,48

* Load and spring back figures are based on Inconel X750 in the age hardened condition. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.





example

CE-056677-6.35M-2/0-2-IN50

Seal Type

CE: External pressure, system pressure energised

Cross Section

Select the proper cross section or axial section (AS) in the table, then select the material code "M or H" based on the desired wall thickness.

Treatment

2: Age hardened

See Tab on the last page →

Seal Diameter (DSI)

056677 = 566,77 mm, for groove OD = 566,27
The seal diameter is always the inside diameter without plating.
The diameter is calculated as follows:
Nominal outside groove diameter, DG, plus clearance or DC (in the table on the left page) plus 2 times the maximum plating or coating thickness.
or
DSI = DG + DC + (Plating thickness X 2)
See also figure on the left page, below
DSI = 566,27 + 0,40 + 2X 0,05 = 566,77mm

Plating

Plating Code "IN"
= Indium Plating
Plating Thickness "50"
= 30 to 50 Microns

See Tab on the last page →

Material

The first digit designates the C ring material, the second is always "0" in case of a C Ring

Available Materials & Codes			
Jacket		Spring	
Code	Material	Code	Material
1	Alloy X-750 *	0	-
2	Alloy 718	0	-
5	304 SS	0	-
(*) X-750 will become obsolete Other materials on special request			

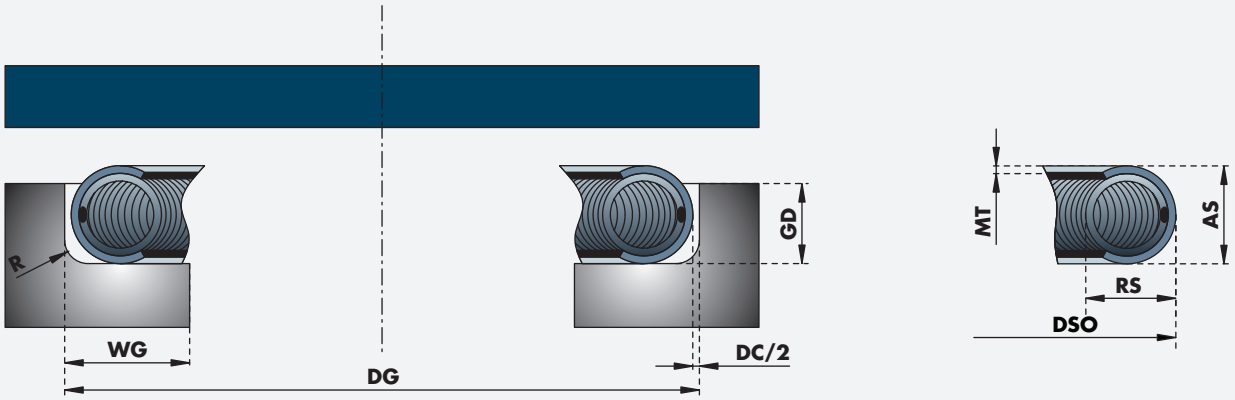
Metal CS Rings - Internal Pressure - Spring Energised:

CSI

Seal dimension						Groove dimensions				Load	SB
AS		RS		MT	DC	DG	GD	WG	R	M-Spring	
Axial section	Tolerance on AS (cross section)	Radial section	Material code Spring Load	Material thickness Jacket	Diame-trical clearance	Diameter Groove (range)	Groove Depth (min/max)	Width Groove (min)	Radius (max)	N/mm Circum-ference *	Spring Back in mm
1,57	+/-0,05	1,52	M/H	0,15	0,15	20-280	1,27-1,32	2,05	0,35	200	0,10
2,00	+/-0,05	1,85	M/H	0,25	0,20	20-300	1,60-1,68	2,50	0,40	180	0,12
2,39	+/-0,05	2,24	M/H	0,25	0,20	25-400	1,91-2,01	3,10	0,50	160	0,15
2,79	+/-0,05	2,64	M/H	0,38	0,25	25-500	2,23-2,34	3,60	0,50	200	0,18
3,18	+/-0,08	2,90	M/H	0,38	0,30	25-600	2,54-2,67	4,10	0,75	160	0,20
3,96	+/-0,08	3,60	M/H	0,41	0,41	32-750	3,18-3,30	5,10	1,20	210	0,25
4,78	+/-0,10	4,49	M/H	0,51	0,46	75-900	3,84-3,99	6,20	1,20	250	0,28
5,60	+/-0,10	5,19	M/H	0,51	0,48	75-1000	4,48-4,70	7,30	1,20	200	0,30
6,35	+/-0,10	5,81	M/H	0,64	0,51	100-1800	5,08-5,28	8,30	1,50	340	0,36
7,90	+/-0,10	7,25	M/H	0,64	0,70	150-3000	6,32-6,58	10,40	1,50	300	0,40
9,53	+/-0,10	8,66	M/H	0,97	0,75	300-3000	7,62-8,03	12,40	1,50	430	0,43
12,70	+/-0,13	11,53	M/H	1,27	1,00	600-7600	10,16-10,67	16,50	1,50	500	0,56

* Load and spring back figures are based on Inconel /Inconel Jacket and spring. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.

Load figures only valid for "M" (medium duty) spring



CSI-024563-4.78M-2/2-1-S50

Seal Type

CSI: Internal pressure, spring energised

Cross Section

Select the proper cross section or axial section (AS) in the table, then select the material code "M or H" based on the desired spring load.

Treatment

1: Work hardened

See Tab on the last page →

Seal Diameter (DSO)

024563 = 245,63 mm, for groove OD = 246,19
The seal diameter is always the outside diameter without plating.
The diameter is calculated as follows:
Nominal outside groove diameter, DG, minus clearance or DC (in the table on the left page) minus 2 times the maximum plating or coating thickness.
or
DSO = DG - DC - (Plating thickness X 2)
See also figure on the left page, below
DSO = 246,19- 0,46 - 2X 0,05 = 245,63 mm

Plating

Plating Code "S"
= Silver Plating
Plating Thickness "50"
= 30 to 50 Microns

See Tab on the last page →

Material

The first digit designates the C Ring material, the second specifies the spring material.

Available Materials & Codes			
Jacket		**Spring**	
Code	**Material**	**Code**	**Material**
1	Alloy X-750 *	1	Alloy X-750 *
2	Alloy 718	2	Alloy 718
5	304 SS	9	302 SS
-	-	A	Elgiloy
-	-	E	Nimonic
(*) X-750 will become obsolete Other materials on special request			

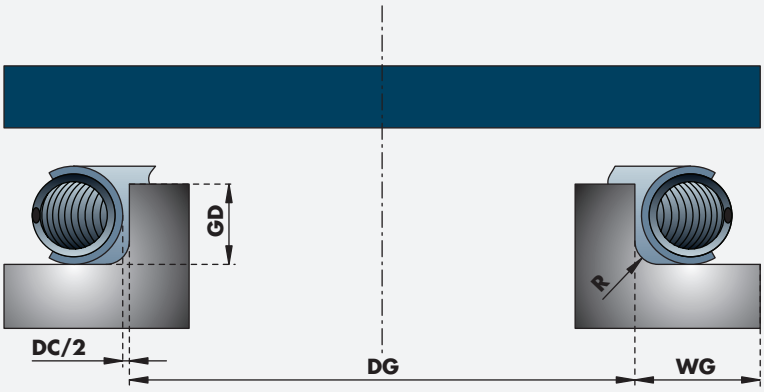
Metal CS Rings - External Pressure - Spring Energised:

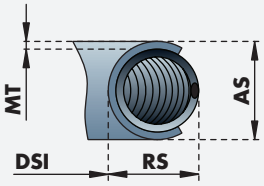
CSE

Seal dimension						Groove dimensions				Load	SB
AS		RS		MT	DC	DG	GD	WG	R	M-Spring	
Axial section	Tolerance on AS (cross section)	Radial section	Material code Spring Load	Material thickness Jacket	Diame-trical clearance	Diameter Groove (range)	Groove Depth (min/max)	Width Groove (min)	Radius (max)	N/mm Circum-ference *	Spring Back in mm
1,57	+/-0,05	1,52	M/H	0,15	0,15	20-280	1,27-1,32	2,05	0,35	200	0,10
2,00	+/-0,05	1,85	M/H	0,25	0,20	20-300	1,60-1,68	2,50	0,40	180	0,12
2,39	+/-0,05	2,24	M/H	0,25	0,20	25-400	1,91-2,01	3,10	0,50	160	0,15
2,79	+/-0,05	2,64	M/H	0,38	0,25	25-500	2,23-2,34	3,60	0,50	200	0,18
3,18	+/-0,08	2,90	M/H	0,38	0,30	25-600	2,54-2,67	4,10	0,75	160	0,20
3,96	+/-0,08	3,60	M/H	0,41	0,41	32-750	3,18-3,30	5,10	1,20	210	0,25
4,78	+/-0,10	4,49	M/H	0,51	0,46	75-900	3,84-3,99	6,20	1,20	250	0,28
5,60	+/-0,10	5,19	M/H	0,51	0,48	75-1000	4,48-4,70	7,30	1,20	200	0,30
6,35	+/-0,10	5,81	M/H	0,64	0,51	100-1800	5,08-5,28	8,30	1,50	340	0,36
7,90	+/-0,10	7,25	M/H	0,64	0,70	150-3000	6,32-6,58	10,40	1,50	300	0,40
9,53	+/-0,10	8,66	M/H	0,97	0,75	300-3000	7,62-8,03	12,40	1,50	430	0,43
12,70	+/-0,13	11,53	M/H	1,27	1,00	600-7600	10,16-10,67	16,50	1,50	500	0,56

* Load and spring back figures are based on Inconel /Inconel Jacket and spring. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.

Load figures only valid for "M" (medium duty) spring





example

CSE-033534-3.96H-2/2-1-N50

Seal Type

CSE: External pressure, spring energised

Cross Section

Select the proper cross section or axial section (AS) in the table, then select the material code "M or H" based on the desired spring load.

Seal Diameter (DSI)

033534 = 335,34 mm, for groove ID = 334,83
The seal diameter is always the inside diameter without plating.
The diameter is calculated as follows:
Nominal inside groove diameter, DG, plus clearance or DC (in the table on the left page) plus 2 times the maximum plating or coating thickness.
or
DSI = DG + DC + (Plating thickness X 2)
See also figure on the left page, below
DSI = 334,83 + 0,41 + 2X 0,05 = 335,34 mm

Treatment

1: Work hardened

See Tab on the last page →

Plating

Plating Code "N"
= Nickel Plating
Plating Thickness "50"
= 30 to 50 Microns

See Tab on the last page →

Material

The first digit designates the C Ring material, the second specifies the spring material.

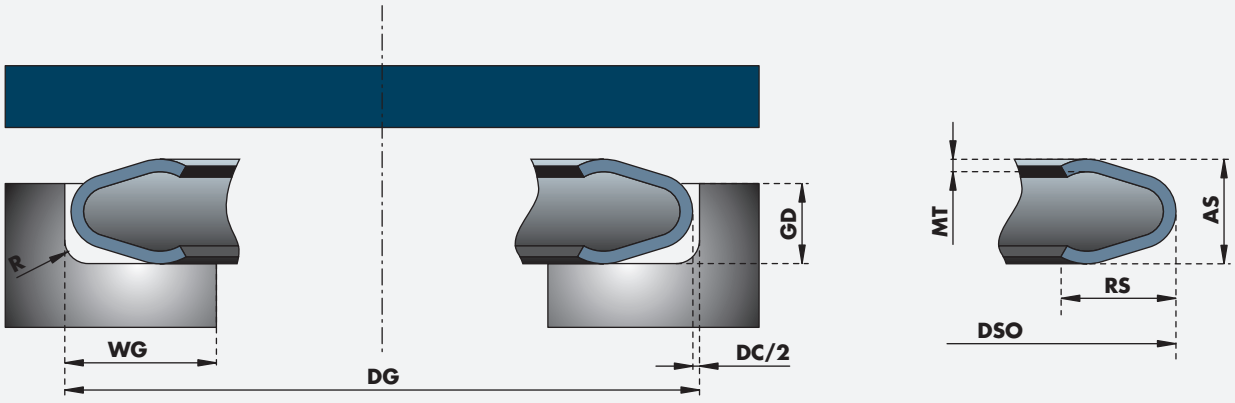
Available Materials & Codes			
Jacket		Spring	
Code	Material	Code	Material
1	Alloy X-750 *	1	Alloy X-750 *
2	Alloy 718	2	Alloy 718
5	304 SS	9	302 SS
-	-	A	Elgiloy
-	-	E	Nimonic
(*) X-750 will become obsolete Other materials on special request			

Oysterseal® - Internal Pressure:

YI

Seal dimension						Groove dimensions				Load	SB
AS		RS		MT	DC	DG	GD	WG	R		
Axial section	Tolerance on AS (cross section)	Radial section	Material code	Material thickness	Diame-trical clearance	Diameter Groove (range)	Groove Depth (min/max)	Width Groove (min)	Radius (max)	N/mm Circum-ference *	Spring Back in mm
2,39	+/-0,05	2,63	M	0,25	0,14	50-400	1,91-2,01	3,10	0,50	12	0,38
3,18	+/-0,08	3,50	M	0,38	0,19	65-600	2,54-2,67	4,10	0,75	9	0,51
3,96	+/-0,08	4,36	M	0,41	0,24	75-750	3,18-3,30	5,10	1,20	11	0,63
4,78	+/-0,10	5,26	M	0,51	0,29	90-900	3,84-3,99	6,20	1,20	11	0,76
5,60	+/-0,10	6,16	M	0,51	0,34	105-1000	4,48-4,70	7,30	1,20	8	0,90
6,35	+/-0,10	6,99	M	0,64	0,38	150-1800	5,08-5,28	8,30	1,50	13	1,02
9,53	+/-0,10	10,49	M	0,97	0,57	300-3000	7,62-8,03	12,40	1,50	15	1,52
12,70	+/-0,13	13,98	M	1,27	0,76	600-7600	10,16-10,67	16,50	1,50	20	2,03

* Load and spring back figures are based on Inconel 718 in the heat treated condition. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.



example

YI-005633-3.18M-1/0-1-S30

Seal Type

YI: Internal pressure

Cross Section

Select the proper cross section or axial section (AS) with the corresponding wall thickness.

Treatment

1: Work hardened

See Tab on the last page →

Seal Diameter (DSO)

005633 = 56,33 mm, for groove OD = 56,58
The seal diameter is always the outside diameter without plating.
The diameter is calculated as follows:
Nominal outside groove diameter, DG, minus clearance or DC (in the table on the left page) minus 2 times the maximum plating or coating thickness.
or
DSO = DG - DC - (Plating thickness X 2)
See also figure on the left page, below
DSO = 56,58 - 0,19 - 2X 0,03 = 56,33 mm

Plating

Plating Code "S"
= Silver Plating
Plating Thickness "30"
= 10 to 30 Microns

See Tab on the last page →

Material

The first digit designates the Oysterseal® seal material, the second is always a "0" in case of an Oysterseal®.

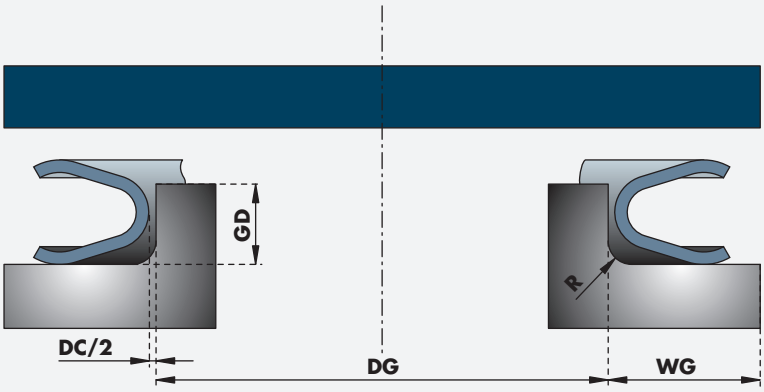
Available Materials & Codes			
Jacket		Spring	
Code	Material	Code	Material
1	Alloy X-750 *	0	-
2	Alloy 718	0	-
B	Haynes 214	0	-
(*) X-750 will become obsolete Other materials on special request			

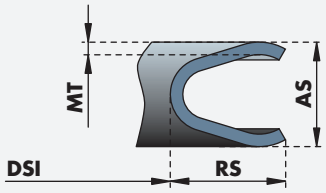
Oysterseal® - External Pressure:

YE

Seal dimension						Groove dimensions				Load	SB
AS		RS		MT	DC	DG	GD	WG	R		
Axial section	Tolerance on AS (cross section)	Radial section	Material code	Material thickness	Diame-trical clearance	Diameter Groove (range)	Groove Depth (min/max)	Width Groove (min)	Radius (max)	N/mm Circum-ference *	Spring Back in mm
2,39	+/-0,05	2,63	M	0,25	0,14	30-400	1,91-2,01	3,10	0,50	12	0,38
3,18	+/-0,08	3,50	M	0,30	0,19	45-600	2,54-2,67	4,10	0,75	9	0,51
3,96	+/-0,08	4,36	M	0,41	0,24	65-750	3,18-3,30	5,10	1,20	11	0,63
4,78	+/-0,10	5,26	M	0,51	0,29	70-900	3,84-3,99	6,20	1,20	11	0,76
5,60	+/-0,10	6,16	M	0,51	0,34	80-1000	4,48-4,70	7,30	1,20	8	0,90
6,35	+/-0,10	6,99	M	0,64	0,38	120-1800	5,08-5,28	8,30	1,50	13	1,02
9,53	+/-0,10	10,49	M	0,97	0,57	300-3000	7,62-8,03	12,40	1,50	15	1,52
12,70	+/-0,13	13,98	M	1,27	0,76	600-7600	10,16-10,67	16,50	1,50	20	2,03

* Load and spring back figures are based on Inconel 718 in the heat treated condition. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.





example

YE-016622-4.78M-1/0-1-C30

Seal Type

YE: External pressure

Cross Section

Select the proper cross section or axial section (AS) with the corresponding wall thickness.

Treatment

1: Work hardened

See Tab on the last page →

Seal Diameter (DSI)

016622 = 166,22 mm, for groove ID = 165,87
The seal diameter is always the inside diameter without plating.
The diameter is calculated as follows:
Nominal inside groove diameter, DG, plus clearance or DC (in the table on the left page) plus 2 times the maximum plating or coating thickness.
or
DSI = DG + DC + (Plating thickness X 2)
See also figure on the left page, below
DSI = 165,87 + 0,29 + 2X 0,03 = 166,22 mm

Plating

Plating Code "C"
= Copper Plating
Plating Thickness "30"
= 10 to 30 Microns

See Tab on the last page →

Material

The first digit designates the Oysterseal® material, the second is always a "0" in case of an Oysterseal®.

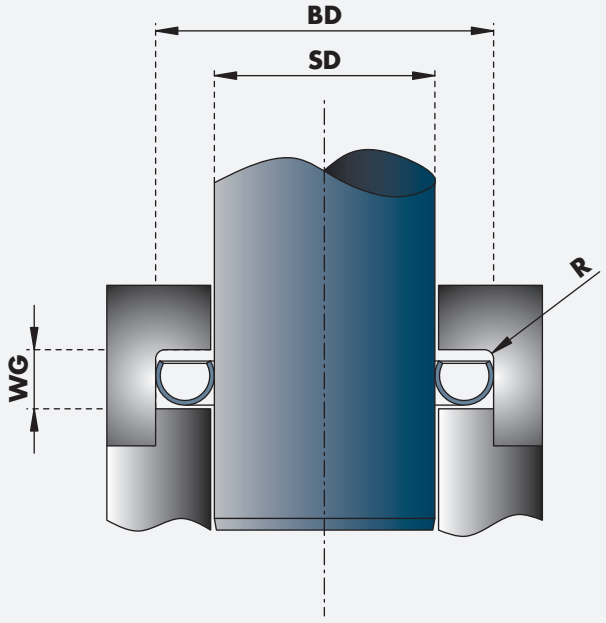
Available Materials & Codes			
Jacket		Spring	
Code	Material	Code	Material
1	Alloy X-750 *	0	-
2	Alloy 718	0	-
B	Haynes 214	0	-
(*) X-750 will become obsolete Other materials on special request			

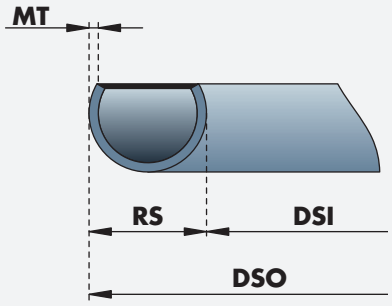
Metal C Rings - Axial Pressure:

CA

Groove Dimensions							Seal dimensions					
	BD		SD		WG	R		RS	MT	DSO	DSI	
Bore Diameter (range)	Bore Diameter	Tol. on BD	Shaft/Rod Diameter	Tol. on SD	Width Groove (min)	Radius (max)	Material code	Radial Section	Material	Diameter Seal Outside	Diameter Seal Inside	Tol. on DSO and DSI
12,70-38,00	SD+3.12	+0,03	BD -3.12	-0.03	1,3	0,38	1.57M	1,64	0,15	BD +0.08	DSO -3.28	+/- 0.03
38,01-45,00	SD+3.07	+0,03	BD -3.07	-0,03	1,3	0,38	1.57M	1,64	0,15	BD +0.10	DSO -3.28	+/- 0.03
30,00-38,00	SD+4.70	+0,03	BD -4.70	-0,03	1,98	0,51	2.39M	2,42	0,25	BD +0.08	DSO -4.85	+/- 0.03
38,01-85,00	SD+4.65	+0,03	BD -4.65	-0,03	1,98	0,51	2.39M	2,42	0,25	BD +0.10	DSO -4.85	+/- 0.03
50,00-85,00	SD+6.25	+0,03	BD -6.25	-0,03	2,64	0,76	3.18M	3,22	0,38	BD +0.10	DSO -6.45	+/- 0.03
85,01-150,00	SD+6.15	+0,05	BD -6.15	-0,05	2,64	0,76	3.18M	3,22	0,38	BD +0.15	DSO -6.45	+/- 0.05
150,01-200,00	SD+6.05	+0,05	BD -6.05	-0,05	2,64	0,76	3.18M	3,22	0,38	BD +0.20	DSO -6.45	+/- 0.05
85,00-150,00	SD+7.72	+0,05	BD -7.72	-0,05	3,28	1,27	3.96M	4,01	0,38	BD +0.15	DSO -8.03	+/- 0.05
150,01-250,00	SD+7.62	+0,05	BD -7.62	-0,05	3,28	1,27	3.96M	4,01	0,38	BD +0.20	DSO -8.03	+/- 0.05
100,00-150,00	SD+9.32	+0,05	BD -9.32	-0,05	3,96	1,27	4.78M	4,81	0,51	BD +0.15	DSO -9.63	+/- 0.05
150,01-300,00	SD+9.22	+0,05	BD -9.22	-0,05	3,96	1,27	4.78M	4,81	0,51	BD +0.20	DSO -9.63	+/- 0.05
150,00-300,00	SD+12.40	+0,05	BD -12.40	-0,05	5,28	1,52	6.35M	6,4	0,64	BD +0.20	DSO -12.80	+/- 0.05

Bore/Shaft concentricity: for bore < 85 mm; 0,015 mm. For bore >85 mm; 0,03 mm.
Leading edge, shaft and bore side required.





example

CA-008715-3.18M-2/0-1-C50

Seal Type

CA: Axial pressure, System Pressure Energised

CSA: Axial Pressure with additional energising spring

Cross Section

Select the proper cross section or radial section (RS)

Treatment

1: Work hardened

See Tab on the last page →

Seal Diameter (DSO)

008715 = 87,15 mm, for Bore Diameter (BD) = 87,00
for Shaft Diameter (SD) = 80,70

The seal diameter is always the **outside** diameter without plating.
Select the desired cross section in relation with the bore diameter
Starting from the shaft size 80,70 the DSO (diameter seal outside)
equals Shaft size 80,70 + 6,45 DSO = 87,15
Starting from the bore diameter 87,00 the DSO (diameter seal outside)
equals Bore size 87,00 + 0,15 DSO = 87,15
Plating thickness on radial seals should be limited to 50 microns. Seal diameters remain unchanged for plated seals.

Plating

Plating Code "C"
= Copper Plating
Plating Thickness "50"
= 30 to 50 Microns

See Tab on the last page →

Material

The first digit designates the jacket material, the second digit is always a "0". For CSA type seals the second digit designates the spring material.

Available Materials & Codes			
Jacket		**Spring**	
Code	**Material**	**Code**	**Material**
1	Alloy X-750 *	1	Alloy X-750 *
2	Alloy 718	2	Alloy 718
5	304 SS	9	302 SS
-	-	A	Elgiloy
-	-	E	Nimonic
(*) X-750 will become obsolete Other materials on special request			

Commaseal® - Axial Pressure:

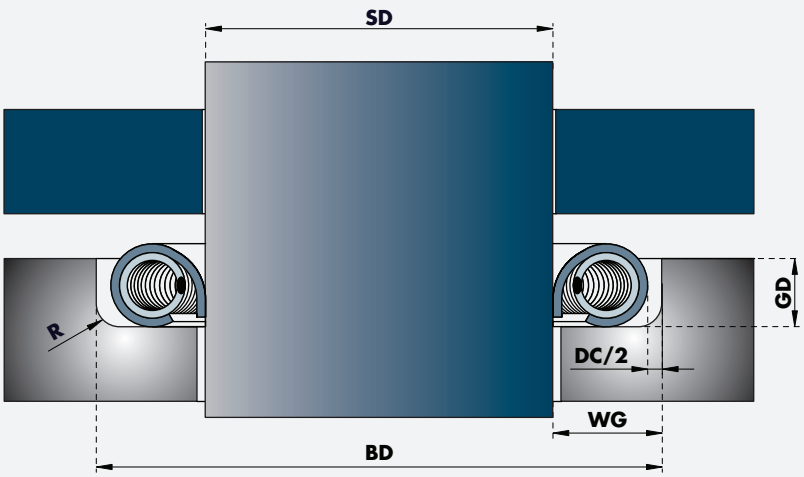
COI

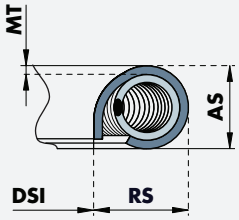
Seal dimension						Groove dimensions					Load
AS		RS		MT	DC	SD range	BD	Tol. SD	GD	R	Rad.
Axial section	Tolerance on AS (cross section)	Radial section	Material code	Material thickness	Diame-trical clearance	Shaft Diameter (range)	SD +	+0	Groove Depth (min/max)	Radius (max)	N/mm Circum-ference *
1,57	+/-0,03	1,79	M	0,15	0,03	20-150	3,61	-0,03	1,27-1,37	0,30	60
2,39	+/-0,05	2,73	M	0,25	0,05	35-200	5,51	-0,03	1,91-2,01	0,50	70
3,18	+/-0,08	3,63	M	0,38	0,06	45-200	7,32	-0,03	2,54-2,67	0,75	100
3,96	+/-0,08	4,52	M	0,41	0,08	60-200	9,12	-0,05	3,18-3,30	1,20	105
4,78	+/-0,10	5,46	M	0,51	0,10	100-200	11,02	-0,05	3,84-3,99	1,20	130

* Load and spring back figures are based on Inconel 718 in the heat treated condition. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.

Tightness

The tightness with a Commaseal® (COI) is more than with any other metal seal a function of the shaft condition. The surface finish of the shaft shall be mirror polished and the hardness shall be high enough so that the sliding motion of seal and shaft does not detoriate either of them.
In addition we advise to silver plate Commaseal® for better tightness, reduced friction and wear.





example

COI-010000-3.96M-2/2-1-S50

Seal Type

COI: Dynamic side
at Shaft diameter

Cross Section

Select the proper axial cross section or radial section (RS)

Seal Diameter (DSI)

010000 = 100,00 mm, for Bore Diameter (BD) = 109,71
The seal diameter is always the shaft diameter without plating.
DSI = SD

Treatment

1: Work hardened

See Tab on the last page →

Plating

Plating Code "S"
= Silver Plating
Plating Thickness "50"
= 30 to 50 Microns

See Tab on the last page →

Material

The first digit designates the Commaseal® material, the second, the selected spring.

Available Materials & Codes			
Jacket		**Spring**	
Code	**Material**	**Code**	**Material**
1	Alloy X-750 *	1	Alloy X-750 *
2	Alloy 718	2	Alloy 718
(*) X-750 will become obsolete Other materials on special request			

Commaseal® - Axial Pressure:

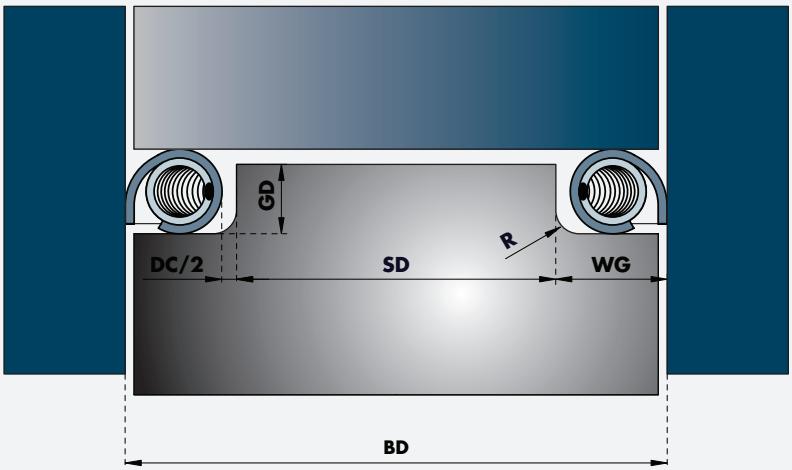
COE

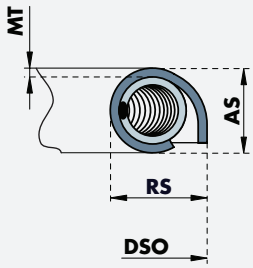
Seal dimension						Groove dimensions					Load
AS		RS		MT	DC	SD range	BD	Tol. SD	GD	R	Rad.
Axial section	Tolerance on AS (cross section)	Radial section	Material code	Material thickness	Diame-trical clearance	Shaft Diameter (range)	SD +	+0	Groove Depth (min/max)	Radius (max)	N/mm Circum-ference *
1,57	+/-0,03	1,79	M	0,15	0,03	20-150	3,61	-0,03	1,27-1,37	0,30	60
2,39	+/-0,05	2,73	M	0,25	0,05	35-200	5,51	-0,03	1,91-2,01	0,50	70
3,18	+/-0,08	3,63	M	0,38	0,06	45-200	7,32	-0,03	2,54-2,67	0,75	100
3,96	+/-0,08	4,52	M	0,41	0,08	60-200	9,12	-0,05	3,18-3,30	1,20	105
4,78	+/-0,10	5,46	M	0,51	0,10	100-200	11,02	-0,05	3,84-3,99	1,20	130

* Load and spring back figures are based on Inconel 718 in the heat treated condition. Actual load figures and to a lesser extend spring back can differ hugely from the given data. Tolerances on groove depth, plating, diametrical clearance and differences in material batches can create differences of up to 100% for the smaller cross sections, down to 50% for the bigger cross section.

Tightness

The tightness with a Commaseal® (COE) is more than with any other metal seal a function of the bore condition. The surface finish of the bore shall be mirror polished and the hardness shall be high enough so that the sliding motion of seal versus the bore does not detoriate either of them.
In addition we advise to silver plate Commaseal® for better tightness, reduced friction and wear.





example

COE-010000-3.18M-2/2-1-C30

Seal Type

COE: Dynamic side
at Bore diameter

Cross Section

Select the proper cross section or radial section (RS)

Seal Diameter (DSO)

010000 = 100,00 mm, for Shaft Diameter (SD) = 92,19
The seal diameter is always the bore diameter without plating.
DSO = BD

Treatment

1: Work hardened

See Tab on the last page →

Plating

Plating Code "C"
= Copper Plating
Plating Thickness "30"
= 10 to 30 Microns

See Tab on the last page →

Material

The first digit designates the Commaseal® material, the second, the selected spring.

Available Materials & Codes			
Jacket		**Spring**	
Code	**Material**	**Code**	**Material**
1	Alloy X-750 *	1	Alloy X-750 *
2	Alloy 718	2	Alloy 718
(*) X-750 will become obsolete Other materials on special request			

Shaped Seals

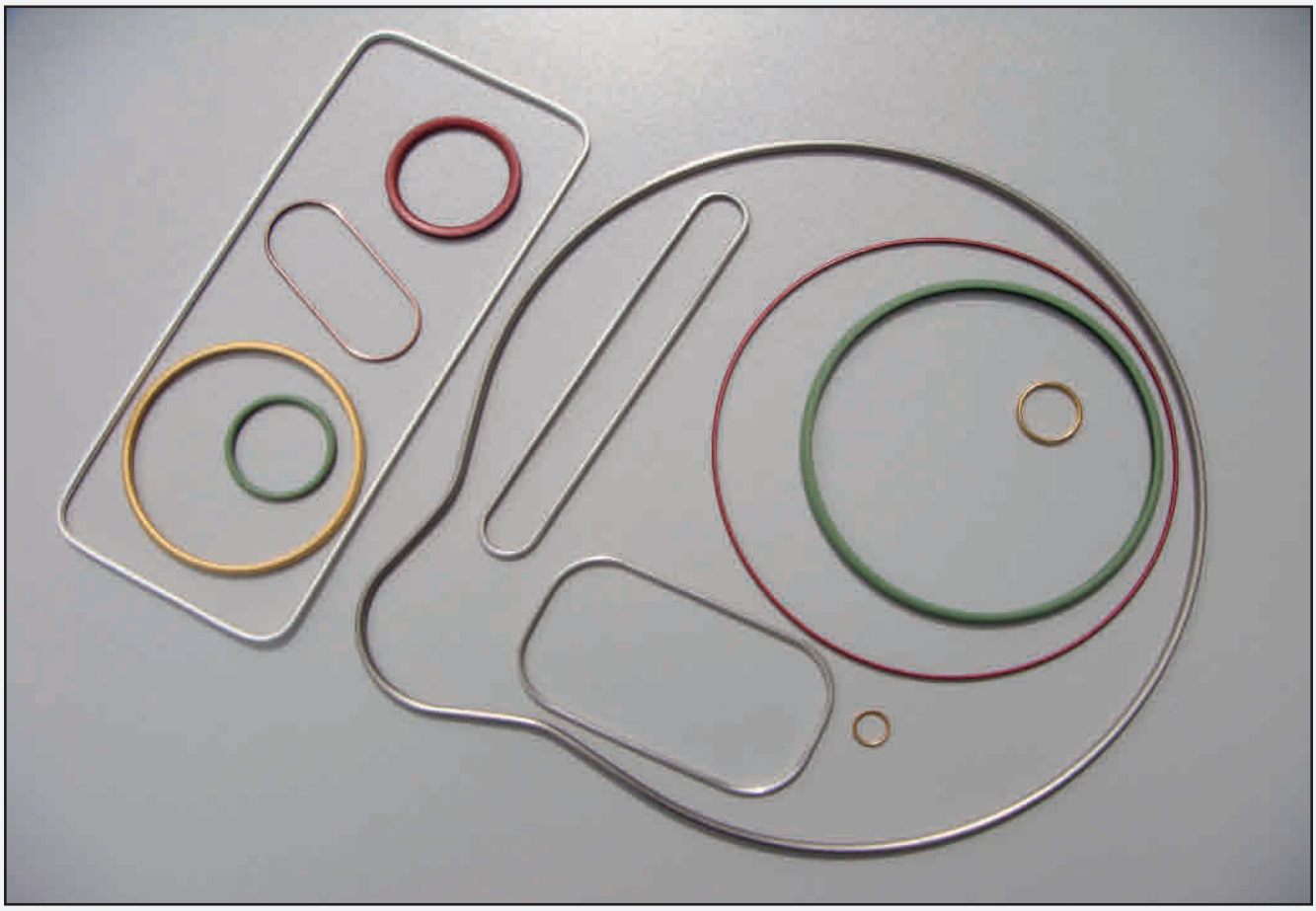
Non Circular seals or so called shaped seals can be manufactured in O Ring, C Ring and spring energised C Ring and from cross section 0,89 to 12,7 mm.

The picture below shows a number of examples used in the industry.

The minimum radius for each of the metal Ring types is given in the table below.

More than for other Metal Seals, HTMS asks to complete an application datasheet and to provide a sketch or a drawing.

Minimum Radii in mm for shaped Seals									
Free Height mm	**0,89**	**1,57**	**2,39**	**3,18**	**3,96**	**4,78**	**6,35**	**9,53**	**12,7**
Metal O Ring	5	10	15	25	50	75	100	200	300
Metal O Spring Ring			15	25	50	75	100	200	300
Metal C Ring	5	7	12	15	25	50	75	200	250
Metal C Spring Ring			12	15	25	50	75	200	250



Shaped Seals

Tolerances

The actual as produced seal diameter shall be as close as possible to the groove diameter.
By compressing the seal in the groove, the seal outside diameter for internal pressure seals will try to grow and the seal inside diameter for external pressure will try to shrink.

This phenomena is covered by the DC or diametrical clearance. The DC will give allowance for this increase or decrease of the seal diameter.

The seal tolerance and also groove tolerance shall be kept as small as possible. It is better for the seal performance to keep the DC in compressed condition as small as possible.
Ideally, once compressed the seal outer diameter should slightly touch the groove outer diameter or for an external pressure seal the inner seal diameter should slightly touch the groove ID.

Internal Pressure			
Groove OD Tolerance			
Type ------ Cross Section	O Ring	C Ring & Oyster Seal	CS Ring
0,79	+ 0.05	+ 0.05	------
0,89	+ 0.10	+ 0.05	------
1,19	+ 0.10	+ 0.08	------
1,57	+ 0.10	+ 0.08	------
2,00	------	------	+ 0.10
2,39	+ 0.15	+ 0.10	+ 0.10
3,18	+ 0.15	+ 0.10	+ 0.13
3,96	+ 0.15	+ 0.13	+ 0.15
4,78	+ 0.20	+ 0.15	+ 0.15
5,60	------	+ 0.20	+ 0.20
6,35	+ 0.20	+ 0.20	+ 0.20
7,90	+ 0.20	+ 0.20	+ 0.20
9,53	+ 0.25	+ 0.25	+ 0.25
12,7	+ 0.25	+ 0.25	+ 0.25

External Pressure			
Groove ID Tolerance			
Type ------ Cross Section	O Ring	C Ring & Oyster Seal	CS Ring
0,79	- 0.05	- 0.05	------
0,89	- 0.10	- 0.05	------
1,19	- 0.10	- 0.08	------
1,57	- 0.10	- 0.08	------
2,00	------	------	- 0.10
2,39	- 0.15	- 0.10	- 0.10
5,60	- 0.15	- 0.10	- 0.13
3,96	- 0.15	- 0.13	- 0.15
4,78	- 0.20	- 0.15	- 0.15
5,60		- 0.20	- 0.20
6,35	- 0.20	- 0.20	- 0.20
7,90	- 0.20	- 0.20	- 0.20
9,53	- 0.25	- 0.25	- 0.25
12,7	- 0.25	- 0.25	- 0.25

Groove tolerances for face type seals

Warranty

HTMS is experienced in the design and manufacture of resilient metal seals for extreme environmental service conditions. HTMS metal seals, O-Rings, C-Rings, spring energised C Rings and O-Rings are produced from high quality alloy materials with full lot control, full traceability and inspection procedures at all production steps.

All production procedures starting from purchase to shipment are controlled by our Q.A. manual. HTMS is an ISO 9001 certified manufacturer of resilient metal seals. Regular internal audits verify that work procedures are maintained and compliant with our Q.A. manual.

HTMS works closely with their customers to analyse as correct as possible the sealing problem and based on this application data, design and manufacture the best seal for the given application.

We strive to manufacture only correct products and are confident that our seals will be free of all material or manufacturing defects. Should a mistake being made then we will replace, free of charge, any defective products with the highest priority.

Our warranty is limited to the replacement value of the defective seals only, and does not include any additional or consequential liabilities.
Resilient metal seals are by design and depending on the performance requirement sensible seals, where other parameters such as, handling, effective groove sizes and surface roughness are evenly important to achieve the desired results.

The seal , being only one part of the sealing solution, HTMS cannot guarantee any leakrate, nor can we accept any liability for costs following poor sealing results.
However, should the problem be related to faulty parts HTMS will replace free of charge the parts.

Except for the general recommendations found in this design manual, we cannot give specific warranties for life-expectancy, leak-rate or other operational parameter.
Customers are always advised to qualify seals, preferably by real life test, or by similarity, in
the exact configuration of their intended use.

HTMS
High Tech Metal Seals

Resilient Metal Seals Application Data Sheet

Company		Data	
Addres		Phone	
Zip		Fax	
City		E-Mail	
Contact		Title	

Application and/or Equipment						
Current seal						
Customer Item Number						
Closing load						
Surface finish						
Flange Materials						
Flange Hardness						
Static Pressure		Cyclic				
Internal Pressure		Frequency				
External pressure		Amplitude				
Fluid Medium		Max. Leak				
Leak test procedure		Max. Leak				
Additional Info						

(Add Units)	At Test	Minimum	Maximum		Operating
Temperature					
Pressure					
Groove Depth (GD)					
Groove Width (GW)					
Groove OD (DG) for Internal Pressure					
Groove ID (DG) for External Pressure					

Yearly Quantities							
Lot Sizes							
Sample Size							

Sketch

Plating Code	Plating / Coating
S	Silver - max 430°C
G	Gold - max 930°C
C	Copper - max 930°C
N	Nickel - max 1200°C
L	Lead - max 200°C
T	PTFE - max 290°C
SN	Tin-max 200°C
IN	Indium-max 130°C

Thickness Code	Plating Thickness in μ
30	10 - 30
50	30 - 50
70	50 - 70

Temper Code	Temper Description
1	Work hardened-----All
2	Age Hardened----- X-750 & 718
3	Annealed----- X-750,718, Nickel Alloy 600, Alu 1050
4	Sol. and Prec. HT----- X-750&718
5	Nace MR0175 -- Inco 718
6	Nace Alloy 625
7	Stress Relief Haynes 214
8	HT Elgiloy

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