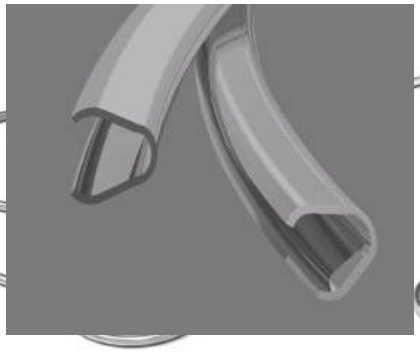
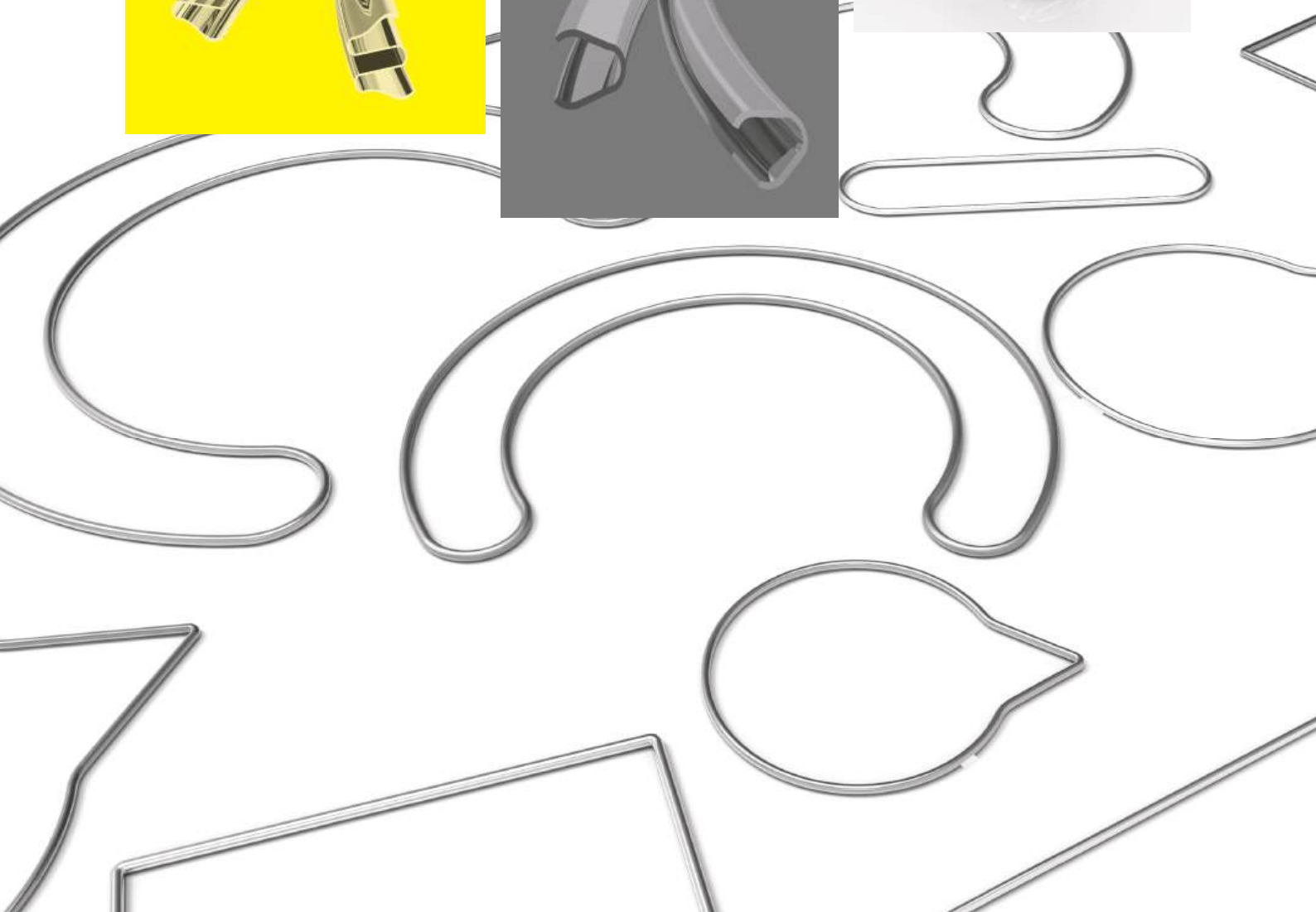

Flexoresist Technologies Pvt. Ltd.

# Metal Seals Catalogue





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# The company

Flexoresist Technologies Pvt. Ltd. is a pioneering entity in the Indian market, specializing in the design and manufacturing of innovative products previously unavailable domestically. Founded with the vision to fill the gap in the market, Flexoresist embarked on its journey under the leadership of Mr. Anand Uttarkar, an esteemed Industrial engineer with a Master's degree from Texas, USA.

**Mission and Vision:** At Flexoresist, our mission is to revolutionize the Indian engineering landscape by introducing cutting-edge products that cater to the evolving needs of various industries. We envision a future where indigenous innovation drives technological advancement and economic growth.

### Core Values

- **Technical Excellence:** With a culture deeply rooted in technical proficiency, Flexoresist prioritizes excellence in design, engineering, and manufacturing processes.
- **Customer Satisfaction:** We are committed to exceeding customer expectations by delivering superior quality products and unparalleled service.
- **Innovation:** Flexoresist fosters a culture of innovation, encouraging creativity and out-of-the-box thinking to develop groundbreaking solutions.
- **Integrity:** We uphold the highest standards of integrity, transparency, and ethical conduct in all our business dealings.

**Products and Services:**

Flexoresist Technologies Pvt. Ltd. stands as a leading authority in the design and manufacturing of the following products:

1. **Metal O rings- Made from Tube**
2. **C Rings – Made from Sheet**
3. **Spring Energised C Rings – Made from Sheet**

**Other Products:**

1. Metal Bellows and Expansion Joints

**Customer Satisfaction:**

With a growing clientele of more than 50 satisfied customers and counting, Flexoresist has earned a reputation for reliability, quality, and innovation. Our commitment to understanding and addressing customer needs sets us apart in the market, fostering long-lasting partnerships built on trust and mutual success.

**Future Outlook:**

As we continue to expand our product portfolio and reach, Flexoresist remains dedicated to pushing the boundaries of technological advancement in India. With a relentless focus on innovation and customer satisfaction.

## Infrastructure

- State of the art machines to manufacture seals
- Established and proven inspection facility
- In-house plating plant
- Laser welding facility
- In-house LP test facility
- In-house ultrasonic cleaning facility
- Licensed design software's

## Key Features

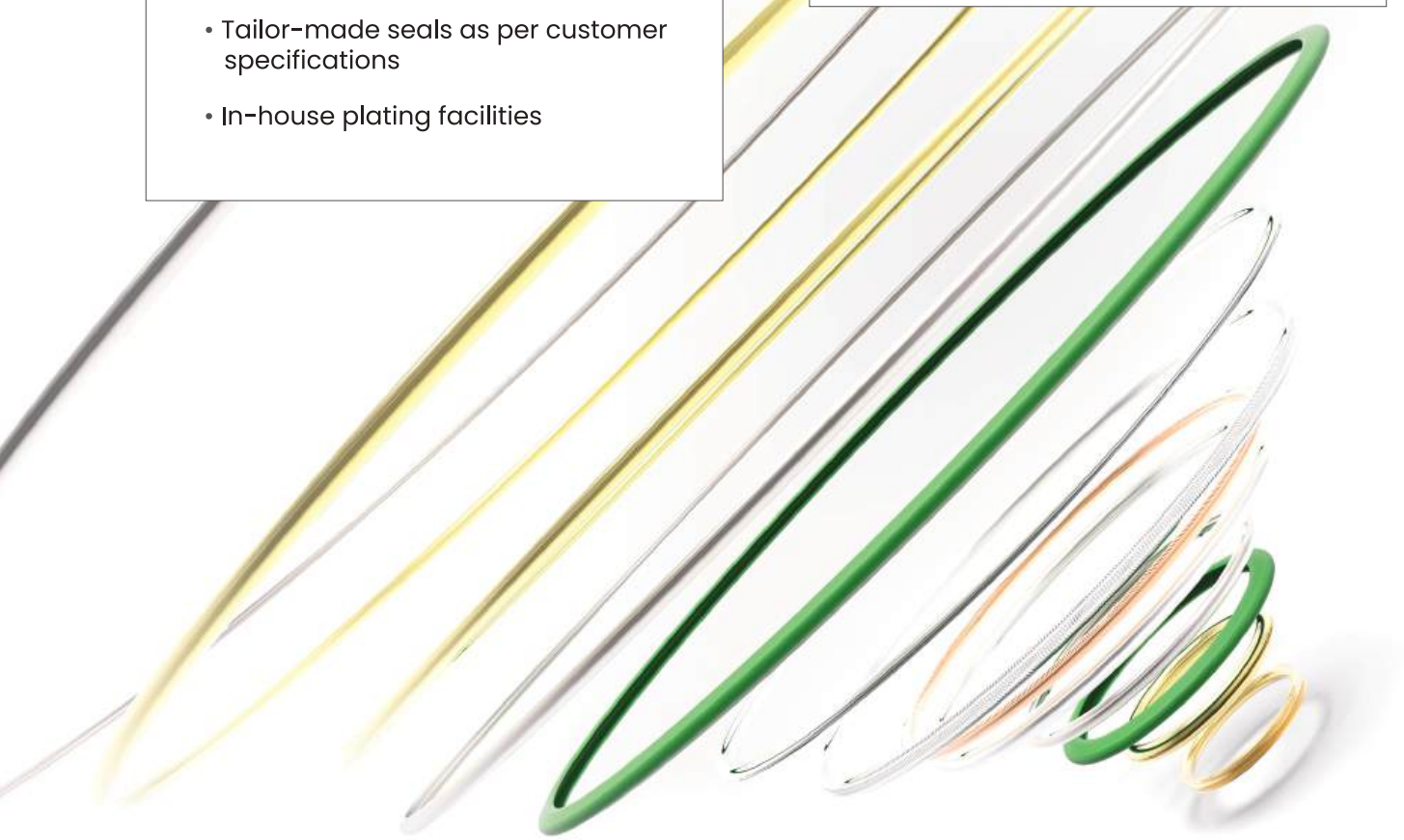
- Short lead times
- Procedure for rush production
- Quick response time
- Custom-made sealing solutions
- Dedicated staff
- In stock inventory for certain sizes
- Trained and qualified manpower

## Production Capabilities

- Seal diameter range from 5 mm up to 1500 mm
- Cross sections from 0.79 mm up to 12.70 mm
- Shaped seals, race track, rectangular and other shapes on request
- Tailor-made seals as per customer specifications
- In-house plating facilities

## Other Capabilities

- Helium leak detection of seals
- Seal destructive testing capabilities
- Hydro-test facilities
- ISO 9001 certified company



# Metal Seal Introduction and Selection:

## Metal Seals

Why we use metal seals? Metal seals are mainly used in extreme conditions where you cannot use regular elastomeric seals. Specially in the extremes of Temperature – from cryogenic to above 300 deg C, Pressure – above 100 bar, ultra high vacuum – 1 x 10-9 mbar.lit/sec and above, Radioactive environment and so on. One should go for the metal seals only in the case when regular elastomeric seals do not do the job. Commonly used material for these seals are, SS321, Alloy 600, Alloy 718, Alloy 750.

## Seal Functioning

How does a metal seal work? A metal seal is placed in the groove of a flange. The other mating flange compresses the seal by 20% (15 – 25% is the range of compression) in to the groove. Once the seal is compressed a seating load is created which is a direct function of seal material, size and its wall thickness. The flange waviness creates an impression on the seal surface. This impression/ foot print is the leak prevention zone. The wider the foot prints better the sealing. To achieve higher leak tightness the seals are altered by adding springs, surface coating/plating. Higher the seating load accompanied with surface coatings/plating will give better leak tightness.

## Requirements of Metal Seals

Metal seals need to avoid permanent deformation. To avoid this deformation seals are placed in the grooves of the flange. These grooves are made 80% deep of seal height. On complete compression of these seals they can get maximum 20% compressed, which is optimum to achieve max leak tightness. If grooves cannot be made then retainers are required to prevent over compression. The flange Ra value i.e. the roughness plays a very important role in achieving the desired leak tightness. Enough bolt load is required to compress the seal for creating sufficient seating load. The number of bolts used for clamping plays an important load in applying load on the circumference of the seal.

## Seal Selection

Selecting the optimum seal for any application is often a tradeoff between available load, required tightness, surface finish and cost. Temperature, Pressure and type of medium are important criteria's in seal selection.

## Though following can be the guidelines

Select the biggest possible cross-section for a given diameter. A bigger cross section always gives higher spring back. The impact of the weld region is smaller. The variations in operating temperatures are better compensated.

The material and plating/coating of seal also plays an important role in the performance of the seal. It is important for the designer to understand what material is suitable for the application along with the plating type. In case any help is required Flexoresist can provide guidance based on our experience.

Available load is very important in deciding the seal sealing criteria. If load available is high enough one should go for seal with bigger cross section. Higher the cross sections better the spring back range..

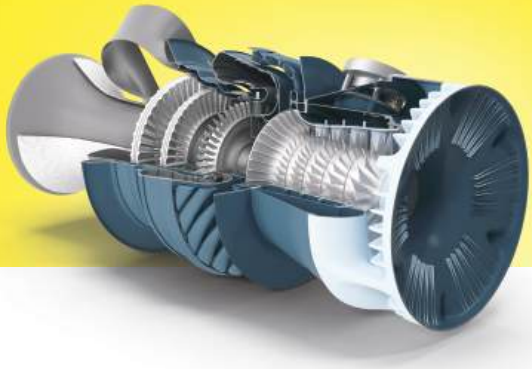
## Plating / Coating:

Plating/Coating is done on the seal surface. The purpose of plating/coating is to provide high leak tightness. The soft layer of plating is created so that it flows into the waviness of the flanges. Due to this the unevenness of flanges is filled and high leak tightness is achieved. The type of plating is decided based on application. Following are the types of plating/coating done on the seal.

**a. Silver**
**b. Gold**
**c. Copper**
**d. Nickel**
**e. PTFE**
**f. Tin**
**g. Aluminium**

# Applications:

# Aerospace:

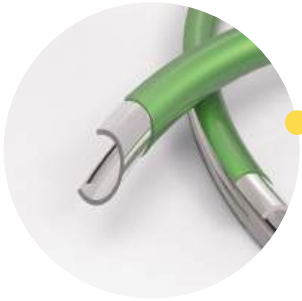


Metal seals are used in a wide variety of application in aerospace, specially the turbine engine section. Since the temppdfferature in engine crosses the limits of elastomeric seals the only optimum solution is metal seals. For high temperature applications exotic materials like Hastealloy, Haynes, Inconel and Eligiloy can be used.

## TYPE OF SEALS USED

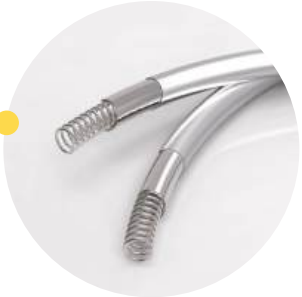
**METAL O-RING**
- Shaped as well as circular seals.

**GAS FILLED METAL O-RING**
- Shaped as well as circular seals.



**C-RING**
- Shaped as well ias circular seals.

**SPRING ENERGIZED C-RINGS**
- Shaped as well as circular seals.



# Oil & Gas, Power Generation:

In oil and gas applications metal seals are highly preferred. In applications like deep sea where the pressures are extreme and the environment is corrosive special seals are made. At times they are gold plated for excellent performance. In power generation these seals are used to seal various parts of turbine section.

## TYPE OF SEALS USED

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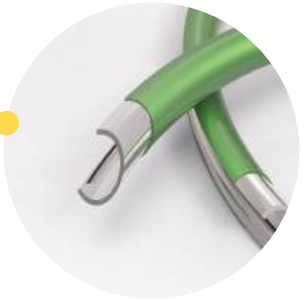
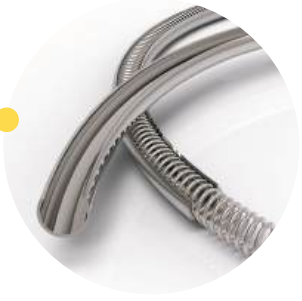
- Shaped as well as circular seals.

**C-RING**
- Shaped as well ias circular seals.



**SPRING ENERGIZED C-RINGS**
- Shaped as well as circular seals.

**RADIAL / CA SEALS**
– circular in shape



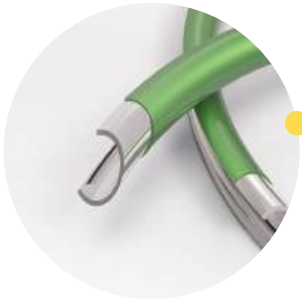
# Military:

Metal seals are used in a wide variety of areas in military and defense field. C-seals are used in the night vision systems which is a crucial part of today's defense technology. Also metal seals play an important part in space application. PTFE coated c-seals and spring energized c-seals are used in cryogenic applications.

## TYPE OF SEALS USED

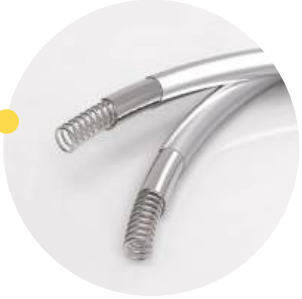
**METAL O-RING**
- Shaped as well as circular seals.

**GAS FILLED METAL O-RING**
- Shaped as well as circular seals.



**C-RING**
- Shaped as well ias circular seals.

**SPRING ENERGIZED C-RINGS**
- Shaped as well as circular seals.



# Metal O-Rings for Moulds:

We manufacture metal o-ring seals used in sealing the leakage path between nozzle and manifold of Hot Runner systems. The seal (SS321/SS304 material)is hollow with a small vent hole on the ID. Due to its hollow structure the polymer enters in through the vent hole and provides internal resilience. This internal resilience keeps the seal inflated which prevents the leak.

## TYPE OF SEALS USED

**METAL O-RING**
- Circular seals, Plastic mould seals

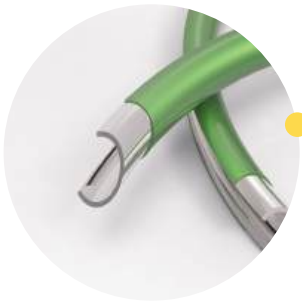
# Reactor and Nuclear Seals:

As we are aware that Nuclear energy is the best source to produce energy w.r.t. the cost involved and its return on investment. With the ever increasing no. of nuclear installations and the risk of radiation it is important to seal the vessels at its highest limit. In achieving the goal of optimum sealing metal seals like, c-rings and spring energized c-ring seals play a very crucial role. To achieve the desirable leak tightness for extended period of time spring energized c- seals with Nimonic 90 spring and 2 layers of jackets, viz – Inconel and Aluminum are used. Metal seals are also used in the nuclear waste containment. Seals with various shapes, like race track, oval, square are manufactured for special applications.

## TYPE OF SEALS USED

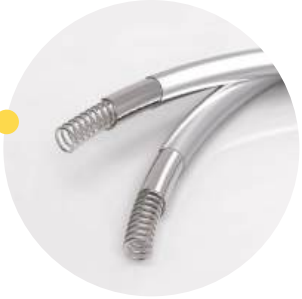
**METAL O-RING**
- Shaped as well as circular seals.

**GAS FILLED METAL O-RING**
- Shaped as well as circular seals.



**C-RING**
- Shaped as well ias circular seals.

**SPRING ENERGIZED C-RINGS**
- Shaped as well as circular seals.



# Heavy Duty Mobile, Transportation Automotive:

C-ring seals have been accepted as a good solution for sealing turbochargers. Also shaped seals have been accepted in sealing the engines of high end sports cars.

## TYPE OF SEALS USED

**METAL O-RING**
- Shaped as well as circular seals.

**GAS FILLED METAL O-RING**
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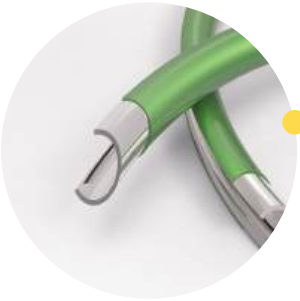

**C-RING**
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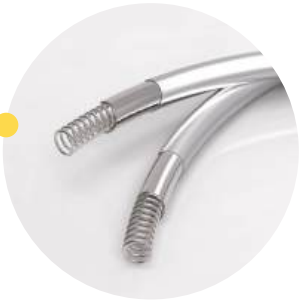


# Frequently asked Question:

**Should one replace elastomeric seals by metal seals?**

- One should replace elastomeric seals only if leakage issues cannot be resolved by it. Metal seals will increase the cost and requirements of the setup. Usage of metal seals is much more difficult and requires proper knowledge beginning from design phase.

**Where are metal seals used?**

- Metal seals are used in the extreme environment of temperature, pressure, radiation and so on. Almost all the applications where elastomeric seals fail.

**Can metal seals be used in Aluminum flanges?**

- Yes they can be used in Aluminum flanges. Low seating load seals are used for these applications.

**Is plating necessary for seals?**

- Plating is only done when high leak tightness is required e.g. 1 x 10-9 mbar.lit/sec.

**Is groove essential for the placement of seals?**

- Grooves are not essential one can have retainer rings or spacer rings. But there has to be some method to avoid compression of ring beyond the specified limit.

**Can soft solid wires be used instead of metal o rings?**

- One should not use soft solid wires especially in the applications involving high pressure and temperature. Due to high pressure the flange lifts off and due to high temperature thermal expansion of flanges takes place. This movement can only be compensated me resilient metal seals.

**What maximum pressure Flexoresist seal can withstand?**

- Flexoresist seal can withstand 3000 bar pressure provided the setup is up to mark. Though theoretically it is said that metal seals can withstand pressures up to 10000 bars. We at Kwality Products we have not tried pressures up to 10000 bars.

**Can these seals be used for cryogenic applications?**

► Yes they can be used for cryogenic application, most of the times they are PTFE coated.

**Can one use these seals multiple times?**

► Metal seals after compression gets a footprint on its surface due to waviness/roughness of flanges. These footprints do not match the mating surfaces once removed and can lead to leakage. So reuse of metal seals is never advised.

**What is the shelf life of metal seals?**

► The shelf life of metal seals is unlimited.

**What surface finish of flanges should is suggested?**

► The surface finish of flanges depends upon the requirement of leak tightness. The most important parameter is the flanges should be turned in circular manner with a uniform feed rate. The flanges should not have any vibration/chatter marks in the sealing area.

**Are the seals available only in circular form?**

► No they are available in various shapes; shaped seals are designed as per the requirements. One has to take in to consideration the turn radius of the seal as drastic turn in seal is not possible.

**Is constant torquing of flanges required?**

► No, the max torque has to be applied only once, but it is essential to select the right seal. A seal with maximum cross section should be selected, so that it can have maximum resilience and compensate the flange lift off due to high pressure or bolt relaxation.

**Can the same seal be used for internal/external pressure applications?**

► It depends on pressure difference between the internal and external pressure along with the application. If the pressure difference is negligible one can use it but in few applications like vacuum only certain seals can be used.

# Metallurgical Treatment:

Heat treatment plays very important role in the performance of the seal. It increases the yield strength with heat treatment the seating load of the seal increases which provides better sealing. Also the spring back quality of the seal improves which enhances the contact between the seal and the contact surface. These improved characteristics help the seal to sustain improved leak tightness especially in cyclic thermal applications. This heat treatment is mainly carried out on C-seals, V-seals and E-seals.

**Following treatments are carried out on metal seals:**

- Work hardened
- Age hardening (precipitation hardened)
- Soft annealing
- Solution annealing + precipitation hardened
- Solution annealing
- Stress annealing

# Flexoresist Technologies Code sheet

| Material code | Material |
|---|---|
| 1 | SS 321 |
| 2 | Inconel 718 |
| 3 | Inconel 750 |
| 4 | Inconel 600 |
| 5 | Inconel 625 |
| 6 | SS 302 |
| 7 | SS 304 |
| 8 | SS 304L |
| 9 | SS 316Ti |
| 10 | Aluminum 1050 |
| 11 | Aluminum IS 19500 |
| 12 | Aluminum 6060 |
| 13 | Elgiloy/Phynox |
| 14 | Nimonic 90 |
| 15 | Hastealloy C - 276 |

| Coating / Layer types | | Coating Thickness µm | |
|---|---|---|---|
| 0 (Zero) | No plating | 30 | 10 to 30 |
| Si | Silver | 60 | 30 to 60 |
| Go | Gold | 80 | 60 to 80 |
| Cu | Copper | 200 | 150 to 200 |
| Ni | Nickel | | |
| Pt | PTFE | | |
| Al | Aluminum | | |
| Ti | Tin | | |

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened - X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

### T-I / T-O

(without any drill holes on ID/OD)

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-8}$ mbar.l/s

### T-DI / T-DO

(with drill holes on ID/OD)

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-8}$ mbar.l/s

### T-SI / T-SO

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-10}$ mbar.l/s

### T-GI / T-GO

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-8}$ mbar.l/s

### S-I / S-O

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-8}$ mbar.l/s

### S-SI / S-SO

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-12}$ mbar.l/s

### LS-SI / LS-SO

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-10}$ mbar.l/s

### V-I / V-O

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-5}$ mbar.l/s

### E-I / E-O

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-5}$ mbar.l/s

### A

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-5}$ mbar.l/s

### A-S

Internal Pressure / External Pressure

Max Leak Tightness: $10^{-7}$ mbar.l/s

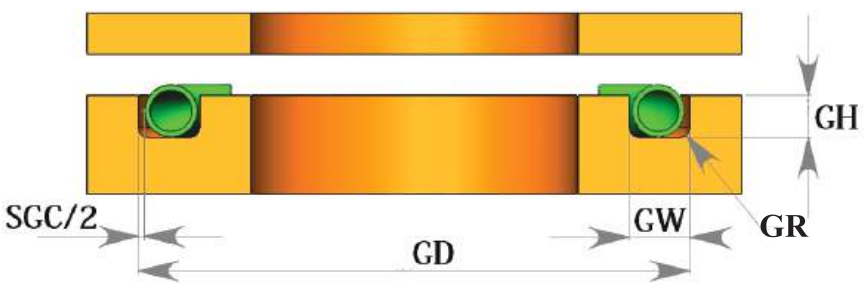
# Metal O-Rings made from tube - Internal Pressure

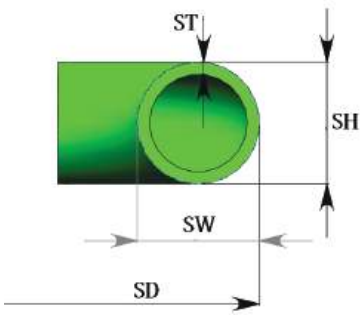
# T-I / T-DI / T-GI / T-SI

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Seal Tolerance | Seal Diameter Range | Wall Thickness | | Seal & Groove Clearance | Groove Height | Groove Corner Radius | Groove Width | Spring Back Values (mm) | | Load Values N/mm Circumference | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SH | | SD | ST | | SGC | GH | GR | GW | L | T | L | T |
| | | | L | T | | | | | | | | |
| 00.89 | (+0.08/-0.03) | 6 - 25 | 0.15 | - | 0.20 | 0.64- 0.69 | 0.25 | 1.40 | 0.01 | - | 67 | - |
| 01.19 | (+0.08/-0.03) | 10 - 50 | - | 0.20 | 0.25 | 0.94 - 1.02 | 0.30 | 1.78 | 0.03 | - | - | 81 |
| 01.57 | (+0.08/-0.03) | 12 - 200 | 0.25 | 0.36 | 0.28 | 1.14 - 1.27 | 0.38 | 2.29 | 0.03 | 0.03 | 102 | 222 |
| 02.39 | (+0.08/-0.03) | 25 - 220 | 0.25 | 0.46 | 0.33 | 1.88 - 2.01 | 0.51 | 3.18 | 0.05 | 0.03 | 57 | 202 |
| 03.18 | (+0.08/-0.03) | 50 - 400 | 0.25 | 0.51 | 0.43 | 2.54 - 2.67 | 0.76 | 4.06 | 0.07 | 0.04 | 36 | 161 |
| 03.96 | (+0.10) | 75- 650 | 0.41 | 0.51 | 0.61 | 3.18 - 3.30 | 1.27 | 5.08 | 0.10 | 0.08 | 72 | 114 |
| 04.78 | (+0.13) | 100 - 800 | 0.51 | 0.64 | 0.71 | 3.84 - 3.99 | 1.27 | 6.35 | 0.10 | 0.08 | 91 | 151 |
| 06.35 | (+0.13) | 200 - 1200 | 0.64 | 0.81 | 0.76 | 5.05 - 5.28 | 1.52 | 8.89 | 0.20 | 0.10 | 102 | 182 |
| 09.53 | (+0.13) | 300 - 2000 | 0.97 | 1.24 | 1.02 | 8.26 - 8.51 | 1.52 | 12.70 | 0.15 | 0.12 | 163 | 281 |
| 12.70 | (+0.15) | 800 - 3000 | 1.27 | 1.65 | 1.27 | 11.05 - 11.43 | 1.52 | 16.51 | 0.22 | 0.18 | 202 | 366 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# T-I/0100.00/3-0/00.89-L/H0/Si80

## Type of Seal

| | |
|---|---|
| T-I | Seal for internal pressure with no hole drilled |
| T-DI | Seal for internal pressure with hole drilled on ID |
| T-GI | Seal for internal pressure with Gas filled |
| T-SI | Seal for internal pressure with spring inside |

## Commonly used Material Type

| Material Code | Material |
|---|---|
| 1 | SS 321 |
| 3 | Inconel 750 |
| 7 | SS 304 |

## Seal External Diameter

(without plating)
0100.00 = 100.00 mm

## Tube Sizes

Tube Diameter = 0.89 mm

Refer SH column on adjacent page

L- Tube wall thickness

(Refer adjacent table for value of "L")

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

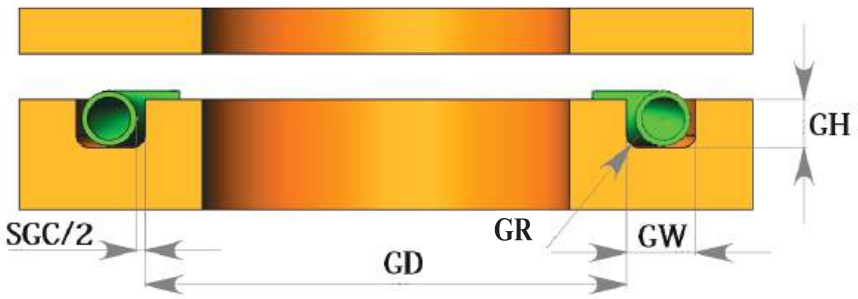
# Metal O-Rings made from tube - External Pressure

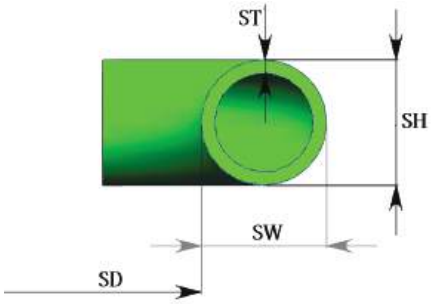
# T-O / T-DO / T-GO / T-SO

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Seal Tolerance | Seal Diameter Range | Wall Thickness | | Seal & Groove Clearance | Groove Height | Groove Corner Radius | Groove Width | Spring Back Values (mm) | | Load Values N/mm Circumference | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SH | | SD | ST | | SGC | GH | GR | GW | L | T | L | T |
| | | | L | T | | | | | | | | |
| 00.89 | (+0.08/-0.03) | 6 - 25 | 0.15 | - | 0.20 | 0.64- 0.69 | 0.25 | 1.40 | 0.01 | - | 67 | - |
| 01.19 | (+0.08/-0.03) | 10 - 50 | - | 0.20 | 0.25 | 0.94 - 1.02 | 0.30 | 1.78 | 0.03 | - | - | 81 |
| 01.57 | (+0.08/-0.03) | 12 - 200 | 0.25 | 0.36 | 0.28 | 1.14 - 1.27 | 0.38 | 2.29 | 0.03 | 0.03 | 102 | 222 |
| 02.39 | (+0.08/-0.03) | 25 - 220 | 0.25 | 0.46 | 0.33 | 1.88 - 2.01 | 0.51 | 3.18 | 0.05 | 0.03 | 57 | 202 |
| 03.18 | (+0.08/-0.03) | 50 - 400 | 0.25 | 0.51 | 0.43 | 2.54 - 2.67 | 0.76 | 4.06 | 0.07 | 0.04 | 36 | 161 |
| 03.96 | (+0.10) | 75- 650 | 0.41 | 0.51 | 0.61 | 3.18 - 3.30 | 1.27 | 5.08 | 0.10 | 0.08 | 72 | 114 |
| 04.78 | (+0.13) | 100 - 800 | 0.51 | 0.64 | 0.71 | 3.84 - 3.99 | 1.27 | 6.35 | 0.10 | 0.08 | 91 | 151 |
| 06.35 | (+0.13) | 200 - 1200 | 0.64 | 0.81 | 0.76 | 5.05 - 5.28 | 1.52 | 8.89 | 0.20 | 0.10 | 102 | 182 |
| 09.53 | (+0.13) | 300 - 2000 | 0.97 | 1.24 | 1.02 | 8.26 - 8.51 | 1.52 | 12.70 | 0.15 | 0.12 | 163 | 281 |
| 12.70 | (+0.15) | 800 - 3000 | 1.27 | 1.65 | 1.27 | 11.05 - 11.43 | 1.52 | 16.51 | 0.22 | 0.18 | 202 | 366 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# T-O/0100.00/3-0/00.89-L/H0/Si80

## Type of Seal

T-O Seal for external pressure with no hole drilled

T-DO Seal for external pressure with hole drilled on ID

T-GO Seal for external pressure with Gas filled

T-SO Seal for external pressure with spring inside

## Commonly used Material Type

| Material Code | Material |
|---|---|
| 1 | SS 321 |
| 3 | Inconel 750 |
| 7 | SS 304 |

## Seal Internal Diameter

(without plating)
0100.00 = 100.00 mm

## Tube Sizes

Tube Diameter = 0.89 mm

Refer SH column on adjacent page

L- Tube wall thickness

(Refer adjacent table for value of "L")

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | | Coating Thickness µm | |
|---|---|---|---|
| 0 (Zero) | No plating | 30 | 10 to 30 |
| Si | Silver | 60 | 30 to 60 |
| Go | Gold | 80 | 60 to 80 |
| Cu | Copper | 200 | 150 to 200 |
| Ni | Nickel | | |
| Pt | PTFE | | |
| Al | Aluminum | | |
| Ti | Tin | | |

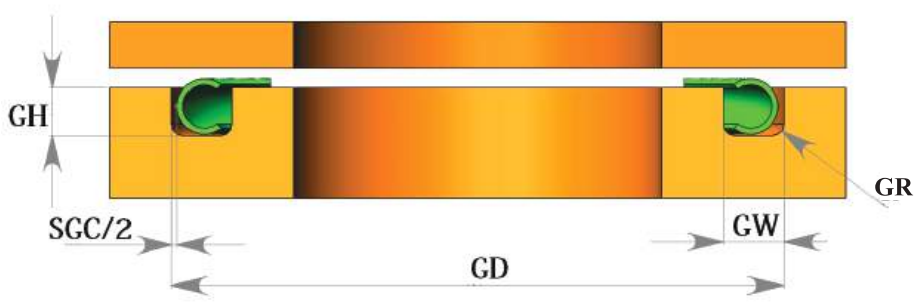
# Metal O-Rings (w/o spring) made from sheet - Internal Pressure

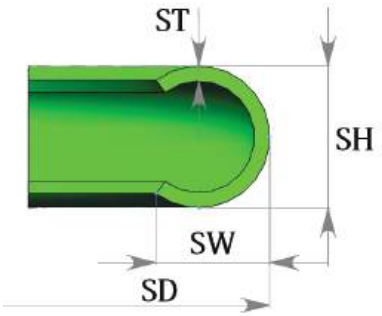
# S-I

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Tolerance | Seal Width | Seal Diameter Range | Sheet Thickness | | Seal & Groove Clearance | Groove Height | Groove Corner Radius | Groove Width | Spring Back Values (mm) | | Load Values N/mm Circumference | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SH | T | SW | SDR | ST | | SGC | GH | GR | GW | | | | |
| | | | | L | T | | | | | L | T | L | T |
| 00.79 | (+/-0.05) | 0.71 | 6-25 | 0.13 | 0.18 | 0.08 | 0.65 - 0.70 | 0.25 | 1.02 | 0.04 | 0.03 | 31 | 66 |
| 01.19 | (+/-0.05) | 0.96 | 8-50 | 0.13 | 0.20 | 0.13 | 0.94 - 1.02 | 0.30 | 1.40 | 0.05 | 0.04 | 22 | 52 |
| 01.57 | (+/-0.05) | 01.26 | 10-200 | 0.15 | 0.25 | 0.15 | 1.27 - 1.37 | 0.38 | 1.91 | 0.08 | 0.06 | 22 | 62 |
| 02.00 | (+/-0.05) | 01.60 | 13-200 | 0.25 | O.R | 0.20 | 1.60 - 1.68 | 0.45 | 2.30 | 0.06 | O.R | 44 | O.R |
| 02.20 | (+/-0.05) | 01.76 | 13-200 | 0.25 | O.R | 0.22 | 1.76 - 1.85 | 0.47 | 2.50 | 0.08 | O.R | 45 | O.R |
| 02.39 | (+/-0.05) | 01.91 | 13-400 | 0.25 | 0.38 | 0.24 | 1.91 - 2.01 | 0.51 | 2.67 | 0.10 | 0,08 | 46 | 97 |
| 02.79 | (+/-0.05) | 02.25 | 20-400 | 0.38 | O.R | 0.28 | 2.23 - 2.34 | 0.55 | 3.10 | 0.12 | O.R | 71 | O.R |
| 03.18 | (+/-0.08) | 02.54 | 30-600 | 0.38 | 0.51 | 0.32 | 2.54 - 2.67 | 0.76 | 3.43 | 0.15 | 0.13 | 56 | 107 |
| 03.60 | (+/-0.08) | 02.88 | 45-600 | 0.41 | O.R | 0.36 | 2.88 - 3.02 | 0.90 | 3.90 | 0.12 | O.R | 51 | O.R |
| 03.96 | (+/-0.08) | 03.17 | 45-750 | 0.41 | 0.61 | 0.39 | 3.18 - 3.30 | 1.27 | 4.32 | 0.2O | 0.17 | 46 | 117 |
| 04.40 | (+/-0.08) | 03.52 | 75-800 | 0.41 | O.R | 0.44 | 3.52 - 3.69 | 1.27 | 4.70 | 0.21 | O.R | 41 | O.R |
| 04.78 | (+/-0.10) | 03.82 | 75-900 | 0.51 | 0.76 | 0.47 | 3.84 - 3.99 | 1.27 | 5.08 | 0.22 | 0.18 | 81 | 147 |
| 05.00 | (+/-0.10) | 04.01 | 75-900 | 0.51 | O.R | 0.50 | 4.00 - 4.20 | 1.27 | 5.30 | 0.23 | O.R | 56 | O.R |
| 05.20 | (+/-0.10) | 04.16 | 75-900 | 0.51 | O.R | 0.52 | 4.16 - 4.37 | 1.27 | 5.50 | 0.23 | O.R | 57 | O.R |
| 05.60 | (+/-0.10) | 04.50 | 75-1000 | 0.51 | O.R | 0.56 | 4.48 - 4.70 | 1.27 | 5.90 | 0.22 | O.R | 51 | O.R |
| 06.35 | (+/-0.10) | 05.08 | 100-1200 | 0.64 | 0.97 | 0.64 | 5.08 - 5.28 | 1.52 | 6.60 | 0.30 | 0.27 | 66 | 177 |
| 07.90 | (+/-0.10) | 06.32 | 100-1500 | 0.97 | O.R | 0.79 | 6.32 - 6.58 | 1.52 | 8.22 | 0.30 | O.R | 131 | O.R |
| 09.53 | (+/-0.10) | 07.62 | 300-2000 | 0.97 | 1.27 | 0.96 | 7.62 - 8.03 | 1.52 | 9.65 | 0.40 | O.32 | 102 | 187 |
| 012.70 | (+/-0.13) | 10.16 | 600-3000 | 1.27 | 1.65 | 01.27 | 10.16 - 10.67 | 1.52 | 12.70 | 0.55 | 0.48 | 126 | 231 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# S-I/0100.00/2-0/01.57-L/H0/Si80

## Type of Seal

S-I Seal for internal pressure

## Commonly used Material Type

| Material Code | Material |
|---|---|
| 2 | Inconel 718 |
| 3 | Inconel 750 |
| 7 | SS 304 |

## Seal External Diameter

(without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 1.57 mm

Refer SH column on adjacent page

L- Sheet wall thickness

(Refer adjacent table for value of "L")

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

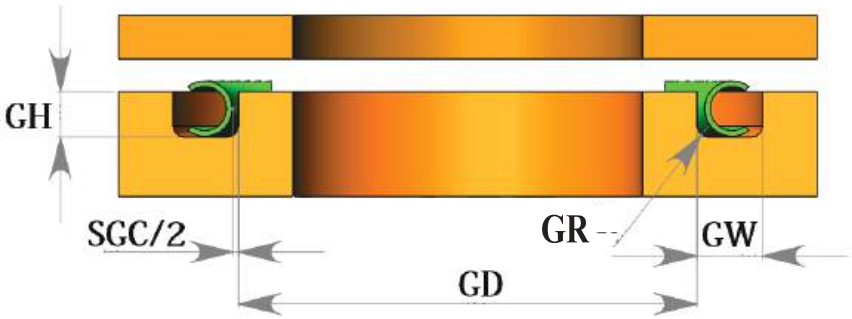
# Metal O-Rings (w/o spring) made from sheet - External Pressure S-O

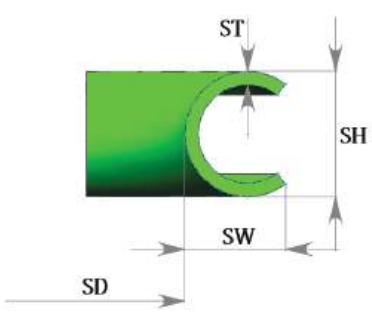
# S-O

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Tolerance | Seal Width | Seal Diameter Range | Sheet Thickness | | Seal & Groove Clearance | Groove Height | Groove Corner Radius | Groove Width | Spring Back Values (mm) | | Load Values N/mm Circumference | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SH | T | SW | SDR | ST | | SGC | GH | GR | GW | | | | |
| | | | | L | T | | | | | L | T | L | T |
| 00.79 | (+/-0.05) | 0.71 | 6-25 | 0.13 | 0.18 | 0.08 | 0.65 - 0.70 | 0.25 | 1.02 | 0.04 | 0.03 | 31 | 66 |
| 01.19 | (+/-0.05) | 0.96 | 8-50 | 0.13 | 0.20 | 0.13 | 0.94 - 1.02 | 0.30 | 1.40 | 0.05 | 0.04 | 22 | 52 |
| 01.57 | (+/-0.05) | 01.26 | 10-200 | 0.15 | 0.25 | 0.15 | 1.27 - 1.37 | 0.38 | 1.91 | 0.08 | 0.06 | 22 | 62 |
| 02.00 | (+/-0.05) | 01.60 | 13-200 | 0.25 | O.R | 0.20 | 1.60 - 1.68 | 0.45 | 2.30 | 0.06 | O.R | 44 | O.R |
| 02.20 | (+/-0.05) | 01.76 | 13-200 | 0.25 | O.R | 0.22 | 1.76 - 1.85 | 0.47 | 2.50 | 0.08 | O.R | 45 | O.R |
| 02.39 | (+/-0.05) | 01.91 | 13-400 | 0.25 | 0.38 | 0.24 | 1.91 - 2.01 | 0.51 | 2.67 | 0.10 | 0,08 | 46 | 97 |
| 02.79 | (+/-0.05) | 02.25 | 20-400 | 0.38 | O.R | 0.28 | 2.23 - 2.34 | 0.55 | 3.10 | 0.12 | O.R | 71 | O.R |
| 03.18 | (+/-0.08) | 02.54 | 30-600 | 0.38 | 0.51 | 0.32 | 2.54 - 2.67 | 0.76 | 3.43 | 0.15 | 0.13 | 56 | 107 |
| 03.60 | (+/-0.08) | 02.88 | 45-600 | 0.41 | O.R | 0.36 | 2.88 - 3.02 | 0.90 | 3.90 | 0.12 | O.R | 51 | O.R |
| 03.96 | (+/-0.08) | 03.17 | 45-750 | 0.41 | 0.61 | 0.39 | 3.18 - 3.30 | 1.27 | 4.32 | 0.2O | 0.17 | 46 | 117 |
| 04.40 | (+/-0.08) | 03.52 | 75-800 | 0.41 | O.R | 0.44 | 3.52 - 3.69 | 1.27 | 4.70 | 0.21 | O.R | 41 | O.R |
| 04.78 | (+/-0.10) | 03.82 | 75-900 | 0.51 | 0.76 | 0.47 | 3.84 - 3.99 | 1.27 | 5.08 | 0.22 | 0.18 | 81 | 147 |
| 05.00 | (+/-0.10) | 04.01 | 75-900 | 0.51 | O.R | 0.50 | 4.00 - 4.20 | 1.27 | 5.30 | 0.23 | O.R | 56 | O.R |
| 05.20 | (+/-0.10) | 04.16 | 75-900 | 0.51 | O.R | 0.52 | 4.16 - 4.37 | 1.27 | 5.50 | 0.23 | O.R | 57 | O.R |
| 05.60 | (+/-0.10) | 04.50 | 75-1000 | 0.51 | O.R | 0.56 | 4.48 - 4.70 | 1.27 | 5.90 | 0.22 | O.R | 51 | O.R |
| 06.35 | (+/-0.10) | 05.08 | 100-1200 | 0.64 | 0.97 | 0.64 | 5.08 - 5.28 | 1.52 | 6.60 | 0.30 | 0.27 | 66 | 177 |
| 07.90 | (+/-0.10) | 06.32 | 100-1500 | 0.97 | O.R | 0.79 | 6.32 - 6.58 | 1.52 | 8.22 | 0.30 | O.R | 131 | O.R |
| 09.53 | (+/-0.10) | 07.62 | 300-2000 | 0.97 | 1.27 | 0.96 | 7.62 - 8.03 | 1.52 | 9.65 | 0.40 | O.32 | 102 | 187 |
| 012.70 | (+/-0.13) | 10.16 | 600-3000 | 1.27 | 1.65 | 01.27 | 10.16 - 10.67 | 1.52 | 12.70 | 0.55 | 0.48 | 126 | 231 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# S-O/0100.00/2-0/01.57-L/H0/Si80

## Type of Seal

S-O Seal for external pressure

## Commonly used Material Type

| Material Code | Material |
|---|---|
| 2 | Inconel 718 |
| 3 | Inconel 750 |
| 7 | SS 304 |

## Seal Internal Diameter

(without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 1.57 mm

Refer SH column on adjacent page

L- Sheet wall thickness

(Refer adjacent table for value of "L")

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

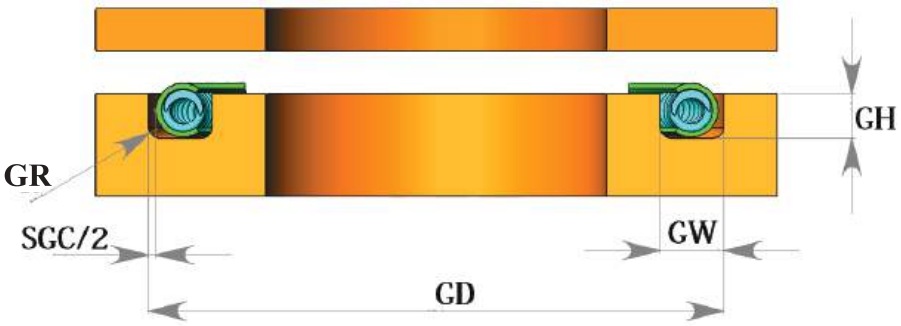
# Metal O-Rings with spring made from sheet - Internal Pressure

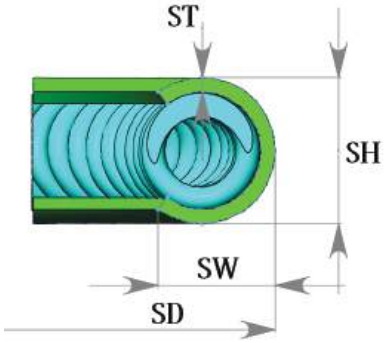
# S-SI

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Tolerance | Seal Width | Seal Diameter Range | Sheet & Spring Thickness | | Seal & Groove Clearance | Groove Height | Groove Corner Radius | Groove Width | Spring Back Values (mm) | | Load Values N/mm Circumference | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SH | T | SW | SDR | | | SGC | GH | GR | GW | | | | |
| | | | | | ST | | | | | L | T | L | T |
| 01.57 | (+/-0.05) | 01.42 | 15-280 | L/T | 0.15 | 0.15 | 1.27 - 1.37 | 0.35 | 2.05 | 0.08 | 0.07 | 76 | 177 |
| 02.00 | (+/-0.05) | 01.75 | 20-300 | L | 0.25 | 0.20 | 1.60 - 1.68 | 0.40 | 2.50 | 0.08 | O.R | 181 | 246 |
| 02.20 | (+/-0.05) | 01.95 | 25-300 | L | 0.25 | 0.32 | 1.76- 1.85 | 0.45 | 2.86 | 0.08 | O.R | 156 | 212 |
| 02.39 | (+/-0.05) | 02.14 | 25-400 | L/T | 0.25 | 0.24 | 1.91 - 2.01 | 0.50 | 3.10 | 0.13 | 0.11 | 142 | 312 |
| 02.79 | (+/-0.05) | 02.41 | 25-500 | L/T | 0.38 | 0.28 | 2.23 - 2.34 | 0.50 | 3.60 | 0.12 | 0.10 | 217 | 347 |
| 03.18 | (+/-0.08) | 02.80 | 25-600 | L/T | 0.38 | 0.32 | 2.54 - 2.67 | 0.75 | 4.10 | 0.15 | 0.12 | 142 | 287 |
| 03.60 | (+/-0.08) | 03.19 | 32-750 | L | 0.41 | 0.36 | 2.88 - 3.02 | 0.75 | 4.63 | 0.12 | O.R | 161 | 351 |
| 03.96 | (+/-0.08) | 03.55 | 32-750 | L/T | 0.41 | 0.39 | 3.18 - 3.30 | 1.20 | 5.10 | 0.20 | 0.15 | 146 | 322 |
| 04.40 | (+/-0.08) | 03.99 | 50-800 | L | 0.41 | 0.44 | 3.52 - 3.69 | 1.20 | 5.72 | 0.2O | O.R | 182 | 267 |
| 04.78 | (+/-0.10) | 04.37 | 75-900 | L/T | 0.51 | 0.47 | 3.84 - 3.99 | 1.20 | 6.20 | 0.28 | 0.20 | 187 | 421 |
| 05.00. | (+/-0.10) | 04.49 | 75-900 | L | 0.51 | 0.50 | 4.00 - 4.20 | 1.20 | 6.50 | 0.35 | O.R | 176 | 396 |
| 05.20 | (+/-0.10) | 04.69 | 75-900 | L/T | 0,51 | 0.52 | 4.16 - 4.37 | 1.20 | 6.76 | 0.29 | O.R | 237 | 377 |
| 05.60 | (+/-0.10) | 05.09 | 75-1000 | L/T | 0.51 | 0.56 | 4.48 - 4.70 | 1.20 | 7.30 | 0.30 | O.R | 217 | 342 |
| 06.35 | (+/-0.10) | 05.71 | 100-1800 | L/T | 0.64 | 0.64 | 5.08 - 5.28 | 1.50 | 8.30 | 0.35 | 0.30 | 326 | 557 |
| 07.90 | (+/-0.10) | 06.93 | 150-3000 | L/T | 0.97 | 0.79 | 6.32 - 6.58 | 1.50 | 10.40 | 0.40 | O.R | 337 | 676 |
| 09.53 | (+/-0.10) | 08.56 | 300-3000 | L/T | 0.97 | 0.96 | 7.62 - 8.03 | 1.50 | 12.40 | 0.43 | 0.35 | 507 | 806 |
| 12.70 | (+/-0.13) | 11.43 | 600-7600 | L/T | 1.27 | 1.27 | 10.16 - 1067 | 1.50 | 16.50 | 0.56 | O.R | 634 | 916 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# S-SI/0100.00/2-2/01.57-L/H0/Si80

## Type of Seal

S-SI Seal with spring internal pressure

## Commonly used Material Type

| Material Code | Material | Jacket | Spring |
|---|---|---|---|
| 2 | Inconel 718 | ✓ | ✓ |
| 3 | Inconel 750 | ✓ | |
| 6 | SS 302 | | ✓ |
| 7 | SS 304 | ✓ | ✓ |
| 13 | Elgiloy | | ✓ |
| 14 | Nimonic 90 | | ✓ |

## Seal External Diameter

(without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 1.57 mm

Refer SH column on adjacent page

L- Spring thickness light

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

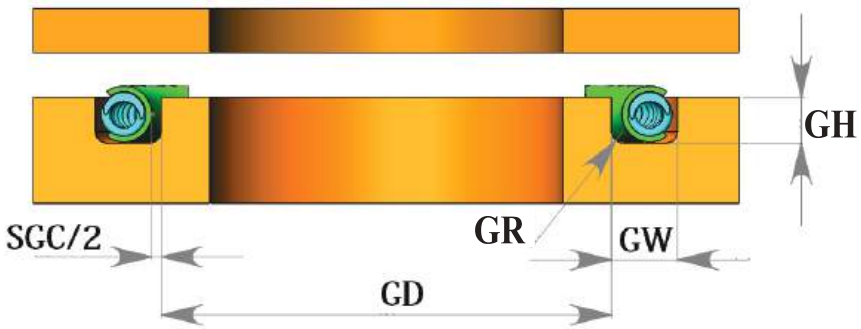
# Metal O-Rings with spring made from sheet - External Pressure

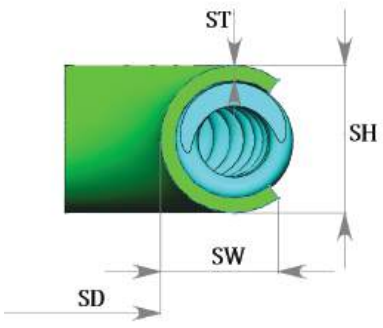
# S-S0

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Tolerance | Seal Width | Seal Diameter Range | Sheet & Spring Thickness | | Seal & Groove Clearance | Groove Height | Groove Corner Radius | Groove Width | Spring Back Values (mm) | | Load Values N/mm Circumference | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SH | T | SW | SDR | | | SGC | GH | GR | GW | | | | |
| | | | | | ST | | | | | L | T | L | T |
| 01.57 | (+/-0.05) | 01.42 | 15-280 | L/T | 0.15 | 0.15 | 1.27 - 1.37 | 0.35 | 2.05 | 0.08 | 0.07 | 76 | 177 |
| 02.00 | (+/-0.05) | 01.75 | 20-300 | L | 0.25 | 0.20 | 1.60 - 1.68 | 0.40 | 2.50 | 0.08 | O.R | 181 | 246 |
| 02.20 | (+/-0.05) | 01.95 | 25-300 | L | 0.25 | 0.32 | 1.76- 1.85 | 0.45 | 2.86 | 0.08 | O.R | 156 | 212 |
| 02.39 | (+/-0.05) | 02.14 | 25-400 | L/T | 0.25 | 0.24 | 1.91 - 2.01 | 0.50 | 3.10 | 0.13 | 0.11 | 142 | 312 |
| 02.79 | (+/-0.05) | 02.41 | 25-500 | L/T | 0.38 | 0.28 | 2.23 - 2.34 | 0.50 | 3.60 | 0.12 | 0.10 | 217 | 347 |
| 03.18 | (+/-0.08) | 02.80 | 25-600 | L/T | 0.38 | 0.32 | 2.54 - 2.67 | 0.75 | 4.10 | 0.15 | 0.12 | 142 | 287 |
| 03.60 | (+/-0.08) | 03.19 | 32-750 | L | 0.41 | 0.36 | 2.88 - 3.02 | 0.75 | 4.63 | 0.12 | O.R | 161 | 351 |
| 03.96 | (+/-0.08) | 03.55 | 32-750 | L/T | 0.41 | 0.39 | 3.18 - 3.30 | 1.20 | 5.10 | 0.20 | 0.15 | 146 | 322 |
| 04.40 | (+/-0.08) | 03.99 | 50-800 | L | 0.41 | 0.44 | 3.52 - 3.69 | 1.20 | 5.72 | 0.2O | O.R | 182 | 267 |
| 04.78 | (+/-0.10) | 04.37 | 75-900 | L/T | 0.51 | 0.47 | 3.84 - 3.99 | 1.20 | 6.20 | 0.28 | 0.20 | 187 | 421 |
| 05.00. | (+/-0.10) | 04.49 | 75-900 | L | 0.51 | 0.50 | 4.00 - 4.20 | 1.20 | 6.50 | 0.35 | O.R | 176 | 396 |
| 05.20 | (+/-0.10) | 04.69 | 75-900 | L/T | 0,51 | 0.52 | 4.16 - 4.37 | 1.20 | 6.76 | 0.29 | O.R | 237 | 377 |
| 05.60 | (+/-0.10) | 05.09 | 75-1000 | L/T | 0.51 | 0.56 | 4.48 - 4.70 | 1.20 | 7.30 | 0.30 | O.R | 217 | 342 |
| 06.35 | (+/-0.10) | 05.71 | 100-1800 | L/T | 0.64 | 0.64 | 5.08 - 5.28 | 1.50 | 8.30 | 0.35 | 0.30 | 326 | 557 |
| 07.90 | (+/-0.10) | 06.93 | 150-3000 | L/T | 0.97 | 0.79 | 6.32 - 6.58 | 1.50 | 10.40 | 0.40 | O.R | 337 | 676 |
| 09.53 | (+/-0.10) | 08.56 | 300-3000 | L/T | 0.97 | 0.96 | 7.62 - 8.03 | 1.50 | 12.40 | 0.43 | 0.35 | 507 | 806 |
| 12.70 | (+/-0.13) | 11.43 | 600-7600 | L/T | 1.27 | 1.27 | 10.16 - 1067 | 1.50 | 16.50 | 0.56 | O.R | 634 | 916 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# S-SO/0100.00/2-2/01.57-L/H0/Si80

## Type of Seal

S-SO Seal with spring - external pressure

## Commonly used Material Types

| Material Code | Material | Jacket | Spring |
|---|---|---|---|
| 2 | Inconel 718 | ✓ | ✓ |
| 3 | Inconel 750 | ✓ | |
| 6 | SS 302 | | ✓ |
| 7 | SS 304 | ✓ | ✓ |
| 13 | Elgiloy | | ✓ |
| 14 | Nimonic 90 | | ✓ |

## Seal Internal Diameter

(without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 1.57 mm

Refer SH column on adjacent page

L- Spring thickness light

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

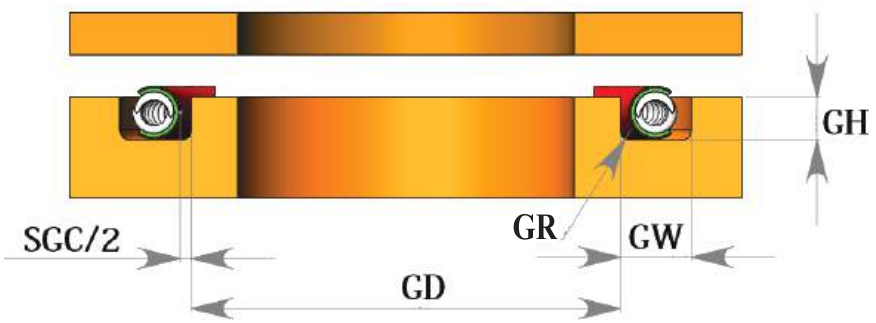
# Metal O-Rings with spring made from 2 sheets - External Pressure

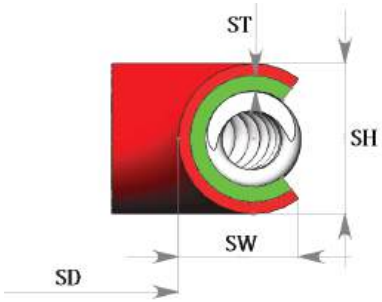
# LS-S0

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Seal Tolerance | Seal Width | Seal Diameter | Seal Details | | | Seal & Groove Clearance | Groove Height | Groove Width | Groove Radius |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Spring Code | Inner Jacket Thickness | Alu Jacket Thickness | | | | |
| SH | | SW | SD | | ST | AST | SGC | GH | GW | GR |
| 2.00 | (-0.10/+0.20) | 01.65 | 20-180 | L | 0.15 | 0.20 | 0.20 | 1.60-168 | 2.50 | 0.40 |
| 2.60 | (-0.10/+0.20) | 02.20 | 20-180 | L | 0.25 | 0.20 | 0.25 | 2.08-2.18 | 3.50 | 0.50 |
| 3.50 | (-0.10/+0.20) | 02.92 | 35-300 | L | 0.38 | 0.20 | 0.35 | 2.80-2.94 | 4.60 | 0.75 |
| 4.00 | (-0.10/+0.20) | 03.39 | 40-400 | L | 0.41 | 0.20 | 0.40 | 3.20-3.36 | 5.10 | 1.20 |
| 4.50 | (-0.10/+0.20) | 03.79 | 50-500 | L | 0.41 | 0.30 | 0.45 | 3.60-3.78 | 5.80 | 1.20 |
| 4.80 | (-0.10/+0.20) | 04.19 | 60-600 | L | 0.41 | 0.20 | 0.48 | 3.84-4,03 | 6.20 | 1.20 |
| 5.60 | (-0.10/+0.20) | 04.79 | 80-750 | L | 0.51 | 0.30 | 0.56 | 4.48-4.70 | 7.30 | 1.20 |
| 6.20 | (-0.10/+0.20) | 05.39 | 100-750 | L | 0.51 | 0.30 | 0.62 | 4.96-5.20 | 8.10 | 1.40 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# LS-SO/0100.00/2-2/02.00-L/H0/Al200

## Type of Seal

| | |
|---|---|
| LS-SO | Seal with spring and extra layer - external pressure |

## Commonly used Material Types

| Material Code | Material | Outer Jacket | Inner Jacket | Spring |
|---|---|---|---|---|
| 2 | Inconel 718 | | ✓ | ✓ |
| 7 | SS 304 | | ✓ | ✓ |
| 10 | Aluminum 1050 | ✓ | | |
| 11 | Aluminum IS 19500 | ✓ | | |
| 12 | Aluminum 6060 | ✓ | | |
| 14 | Nimonic 90 | | | ✓ |

Outer Jacket can be of any of the mentioned material code based on availability of raw material: 10/11/12

## Seal Internal Diameter

(without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 2.00 mm

Refer SH column on adjacent page

L- Spring thickness light

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

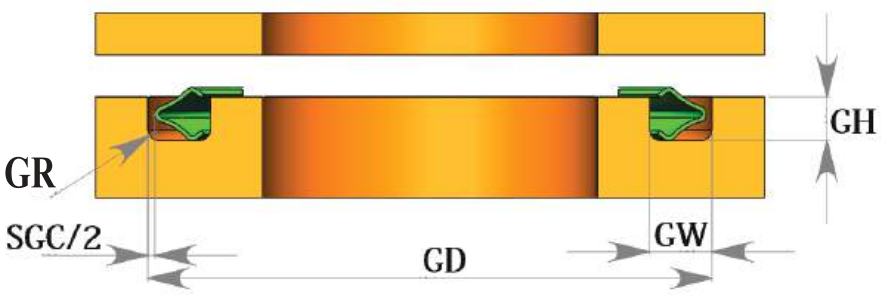
# V-Shaped Metal O-Rings (w/o spring) made from sheet – Internal Pressure

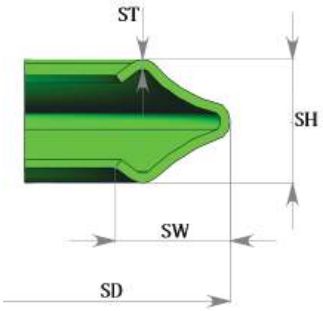
# V-I

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Seal Tolerance | Seal Width | Seal Diameter | Seal Details | | Seal & Groove Clearance | Groove Width | Groove Height | Groove Radius | Load Values N/mm Circumfer-ence | Spring Back Values (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SH | | SW | SD | ST | ST | SGC | GW | GH | GR | LO | SB |
| | | | | | | | | | | | |
| 2.39 | (+/-0.05) | 02.63 | 30-400 | L | 0.25 | 0.14 | 3.10 | 1.91-2.01 | 0.50 | 23 | 0.28 |
| 3.18 | (+/-0.08) | 03.50 | 45-600 | L | 0.38 | 0.19 | 4.10 | 2.54-2.67 | 0.75 | 32 | 0.27 |
| 3.96 | (+/-0.08) | 04.36 | 65-750 | L | 0.41 | 0.24 | 5.10 | 3.18-3.30 | 1.20 | 22 | 0.37 |
| 4.78 | (+/-0.10) | 05.26 | 70-900 | L | 0.51 | 0.29 | 6.20 | 3.84-3.99 | 1.20 | 23 | 0.56 |
| 5.60 | (+/-0.10) | 06.16 | 80-1000 | L | 0.51 | 0.34 | 7.30 | 4.48-4.70 | 1.20 | 21 | 0.60 |
| 6.35 | (+/-0.10) | 06.99 | 120-1800 | L | 0.64 | 0.38 | 8.30 | 5.08-5.28 | 1.50 | 31 | 0.60 |
| 9.53 | (+/-0.10) | 10.49 | 300=3000 | L | 0.97 | 0.57 | 12.40 | 7.62-8.03 | 1.50 | 46 | 0.90 |
| 12.70 | (+/-0.13) | 13.98 | 600-7600 | L | 1.27 | 0.76 | 16.50 | 10.16-10.67 | 1.50 | 58 | 1.20 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# V-I/0100.00/2-0/02.39-L/H0/Si80

## Type of Seal

V-I Seal for internal pressure

## Commonly used Material Type

| Material Code | Material |
|---|---|
| 2 | Inconel 718 |

## Seal External Diameter

(without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 2.39 mm

Refer SH column on adjacent page

L- Sheet wall thickness

(Refer adjacent table for value of "L")

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

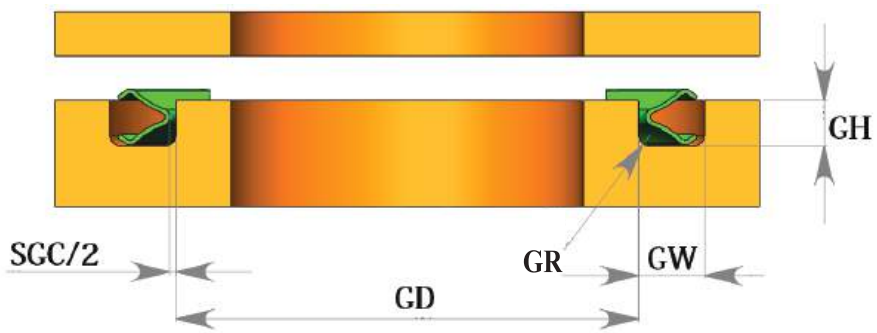
# V-Shaped Metal O-Rings (w/o spring) made from sheet – External Pressure

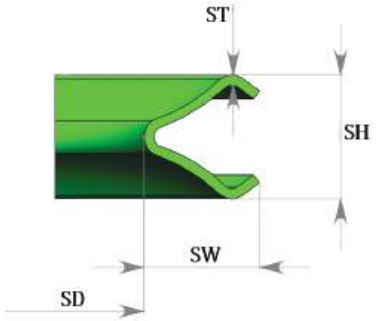
# V-O

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Seal Tolerance | Seal Width | Seal Diameter | Seal Details | | Seal & Groove Clearance | Groove Width | Groove Height | Groove Radius | Load Values N/mm Circumfer-ence | Spring Back Values (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SH | | SW | SD | ST | ST | SGC | GW | GH | GR | LO | SB |
| | | | | | | | | | | | |
| 2.39 | (+/-0.05) | 02.63 | 30-400 | L | 0.25 | 0.14 | 3.10 | 1.91-2.01 | 0.50 | 23 | 0.28 |
| 3.18 | (+/-0.08) | 03.50 | 45-600 | L | 0.38 | 0.19 | 4.10 | 2.54-2.67 | 0.75 | 32 | 0.27 |
| 3.96 | (+/-0.08) | 04.36 | 65-750 | L | 0.41 | 0.24 | 5.10 | 3.18-3.30 | 1.20 | 22 | 0.37 |
| 4.78 | (+/-0.10) | 05.26 | 70-900 | L | 0.51 | 0.29 | 6.20 | 3.84-3.99 | 1.20 | 23 | 0.56 |
| 5.60 | (+/-0.10) | 06.16 | 80-1000 | L | 0.51 | 0.34 | 7.30 | 4.48-4.70 | 1.20 | 21 | 0.60 |
| 6.35 | (+/-0.10) | 06.99 | 120-1800 | L | 0.64 | 0.38 | 8.30 | 5.08-5.28 | 1.50 | 31 | 0.60 |
| 9.53 | (+/-0.10) | 10.49 | 300=3000 | L | 0.97 | 0.57 | 12.40 | 7.62-8.03 | 1.50 | 46 | 0.90 |
| 12.70 | (+/-0.13) | 13.98 | 600-7600 | L | 1.27 | 0.76 | 16.50 | 10.16-10.67 | 1.50 | 58 | 1.20 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# V-O/0100.00/2-0/02.39-L/H0/Si80

## Type of Seal

V-O Seal for external pressure

## Commonly used Material Type

| Material Code | Material |
|---|---|
| 2 | Inconel 718 |

## Seal Internal Diameter

(without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 2.39 mm

Refer SH column on adjacent page

L- Sheet wall thickness

(Refer adjacent table for value of "L")

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

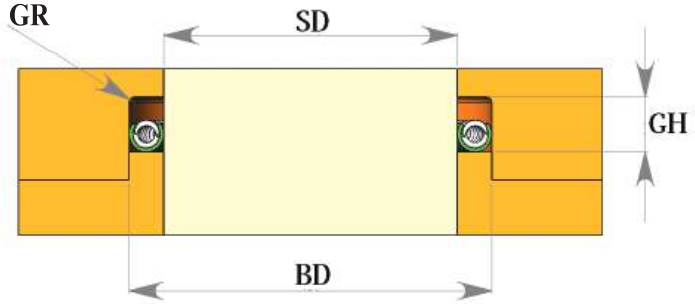
# Metal O-Rings with and without spring made from sheet - Axial Pressure

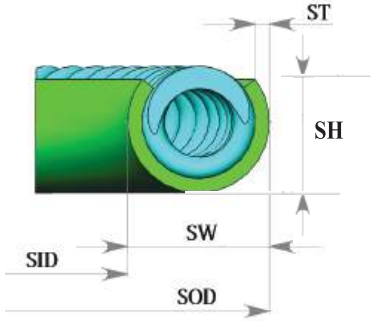
# A / A-S

## Seal and Groove Dimensions in Millimeters (mm)

| Diameter Range | Material Code | Seal Height | Toler-ance on SH | Seal Width | Material Thick-ness | Diameter Seal Outside | Toler-ance on SOD | Diameter Seal Inside | Toler-ance on SID | Bore Diameter | Toler-ance on BD | Shaft/Rod Diameter | Toler-ance on SD | Groove Depth (min) | Radius (Max) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | MC | SH | | SW | ST | SOD | | SID | | BD | GW | SD | | GH | GR |
| 12 < 38 | 1.57M | 1.35 | +0.05/ -0.10 | 1.64 | 0.15 | BD+0.08 | +0.06/ -0.03 | DSO-3.28 | +0.03/ -0.06 | SD+3.12 | +0.03 | BD-3.12 | -0.03 | 1.50 | 0.25 |
| 38 - 45 | 1.57M | 1.35 | +0.05/ -0.10 | 1.64 | 0.15 | BD+0.10 | +0.06/ -0.03 | DSO-3.28 | +0.03/ -0.06 | SD+3.07 | +0.03 | BD-3.07 | -0.03 | 1.50 | 0.25 |
| 30 < 38 | 2.39M | 1.99 | +0.05/ -0.10 | 2.42 | 0.25 | BD+0.08 | +0.06/ -0.03 | DSO-4.85 | +0.03/ -0.06 | SD+4.70 | +0.03 | BD-4.70 | -0.03 | 2.14 | 0.28 |
| 38 - 85 | 2.39M | 1.99 | +0.05/ -0.10 | 2.42 | 0.25 | BD+0.10 | +0.06/ -0.03 | DSO-4.85 | +0.03/ -0.06 | SD+4.65 | +0.03 | BD-4.65 | -0.03 | 2.14 | 0.28 |
| 50 < 85 | 3.18M | 2.65 | +0.05/ -0.15 | 3.22 | 0.38 | BD+0.10 | +0.06/ -0.03 | DSO-6.45 | +0.03/ -0.06 | SD+6.25 | +0.03 | BD-6.25 | -0.03 | 2.80 | 0.38 |
| 85 < 150 | 3.18M | 2.65 | +0.05/ -0.15 | 3.22 | 0.38 | BD+0.15 | +0.08/ -0.05 | DSO-6.45 | +0.05/ -0.08 | SD+6.15 | +0.05 | BD-6.15 | -0.05 | 2.80 | 0.38 |
| 150 - 200 | 3.18M | 2.65 | +0.05/ -0.15 | 3.22 | 0.38 | BD+0.20 | +0.08/ -0.05 | DSO-6.45 | +0.05/ -0.08 | SD+6.05 | +0.05 | BD-6.05 | -0.05 | 2.80 | 0.38 |
| 85 < 150 | 3.96M | 3.30 | +0.05/ -0.20 | 4.01 | 0.38 | BD+0.15 | +0.08/ -0.05 | DSO-8.03 | +0.05/ -0.08 | SD+7.72 | +0.05 | BD-7.72 | -0.05 | 3.45 | 0.51 |
| 150 - 250 | 3.96M | 3.30 | +0.05/ -0.20 | 4.01 | 0.38 | BD+0.20 | +0.08/ -0.05 | DSO-8.03 | +0.05/ -0.08 | SD+7.62 | +0.05 | BD-7.62 | -0.05 | 3.45 | 0.51 |
| 100 < 150 | 4.78M | 3.96 | +0.05/ -0.20 | 4.81 | 0.51 | BD+0.15 | +0.08/ -0.05 | DSO-9.63 | +0.05/ -0.08 | SD+9.32 | +0.05 | BD-9.32 | -0.05 | 4.11 | 0.51 |
| 150 - 300 | 4.78M | 3.96 | +0.05/ -0.20 | 4.81 | 0.51 | BD+0.20 | +0.08/ -0.05 | DSO-9.63 | +0.05/ -0.08 | SD+9.22 | +0.05 | BD-9.22 | -0.05 | 4.11 | 0.51 |
| 150 - 300 | 6.35M | 5.27 | +0.05/ -0.25 | 6.40 | 0.64 | BD+0.20 | +0.08/ -0.05 | DSO-12.80 | +0.05/ -0.08 | SD+12.40 | +0.05 | BD-12.40 | -0.05 | 5.42 | 0.76 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# A-S/0100.00/2-2/01.57-L/H0/Si80

## Type of Seal

| | |
|---|---|
| A | Axial seal without spring |
| A-S | Axial seal with spring |

## Commonly used Material Type

| Material Code | Material | Jacket | Spring |
|---|---|---|---|
| 2 | Inconel 718 | ✓ | ✓ |
| 3 | Inconel 750 | ✓ | |
| 6 | SS 302 | | ✓ |
| 7 | SS 304 | ✓ | ✓ |
| 13 | Elgiloy | | ✓ |
| 14 | Nimonic 90 | | ✓ |

## Seal Outside Diameter

SOD (without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 1.57 mm

Refer SC column on adjacent page

L- Spring thickness light

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

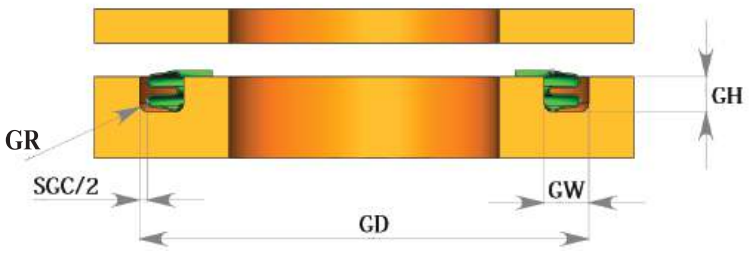
# E-Shaped Metal O-Rings (w/o spring) made from sheet – Internal Pressure

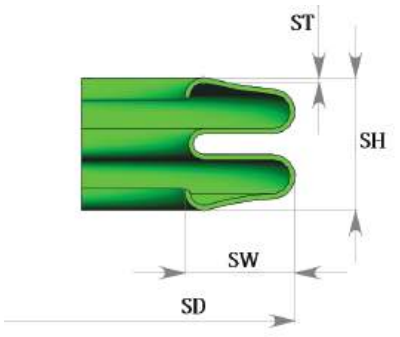
# E-I

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Seal Width | Seal Diameter Range | Sheet Thickness | Seal & Groove Clearance | Groove Height | Groove Corner Radius | Groove Width | Spring Back Values (mm) | Load Values N/mm Circumference |
|---|---|---|---|---|---|---|---|---|---|
| SH | SW | SD | ST | SGS | GH | GR | GW | SB | LO |
| | | | L | | | | | | |
| 01.88 (+/-0.08) | 1.68 | 45 – 200 | 0.127 | 0.076 | 1.55 - 1.60 | 0.38 | 2.30 | 0.30 | 6 |
| 02.59 (+/-0.08) | 2.31 | 50 – 300 | 0.25 | 0.076 | 2.15 - 2.21 | 0.50 | 2.95 | 0.38 | 6 |
| 02.74 (+/-0.08) | 3.68 | 60 - 300 | 0.25 | 0.076 | 2.15 - 2.25 | 0.50 | 4.35 | 0.53 | 7 |
| 02.74 (+/-0.10) | 2.31 | 50 - 300 | 0.25 | 0.076 | 2.15 - 2.25 | 0.50 | 2.95 | 0.46 | 16 |
| 03.56 (+/-0.10) | 3.10 | 50 - 600 | 0.30 | 0.130 | 2.95 - 3.05 | 0.75 | 4.20 | 0.56 | 11 |
| 03.35 (+/-0.10) | 3.10 | 50 - 600 | 0.38 | 0.130 | 2.95 - 3.05 | 0.75 | 4.20 | 0.36 | 13 |
| 05.54 (+/-0.13) | 4.83 | 85 - 900 | 0.38 | 0.15 | 4.55 - 4.65 | 1.00 | 5.85 | 0.94 | 9 |
| 07.49 (+/-0.13) | 6.78 | 150 - 1200 | 0.51 | 0.20 | 6.20 - 6.35 | 1.50 | 8.00 | 1.22 | 14 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# E-I/0100.00/2-0/02.74-L/H0/Si80

## Type of Seal

E-I E-Seal for internal pressure

## Commonly used Material Type

| Material Code | Material |
|---|---|
| 2 | Inconel 718 |
| 3 | Inconel 750 |

## Seal External Diameter

(without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 2.74 mm

Refer SH column on adjacent page

L- Sheet wall thickness light

(Refer adjacent table for value of "L")

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
| H2 | Solution Annealing + Precipitation Hardened (NACE MR 0175) - X718 |
| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

# E-Shaped Metal O-Rings (w/o spring) made from sheet – External Pressure

# E-O

## Seal and Groove Dimensions in Millimeters (mm)

| Seal Height | Seal Width | Seal Diameter Range | Sheet Thickness | Seal & Groove Clearance | Groove Height | Groove Corner Radius | Groove Width | Spring Back Values (mm) | Load Values N/mm Circumference |
|---|---|---|---|---|---|---|---|---|---|
| SH | SW | SD | ST | SGS | GH | GR | GW | SB | LO |
| | | | L | | | | | | |
| 01.88 (+/-0.08) | 1.68 | 45 – 200 | 0.127 | 0.076 | 1.55 - 1.60 | 0.38 | 2.30 | 0.30 | 6 |
| 02.59 (+/-0.08) | 2.31 | 50 – 300 | 0.25 | 0.076 | 2.15 - 2.21 | 0.50 | 2.95 | 0.38 | 6 |
| 02.74 (+/-0.08) | 3.68 | 60 - 300 | 0.25 | 0.076 | 2.15 - 2.25 | 0.50 | 4.35 | 0.53 | 7 |
| 02.74 (+/-0.10) | 2.31 | 50 - 300 | 0.25 | 0.076 | 2.15 - 2.25 | 0.50 | 2.95 | 0.46 | 16 |
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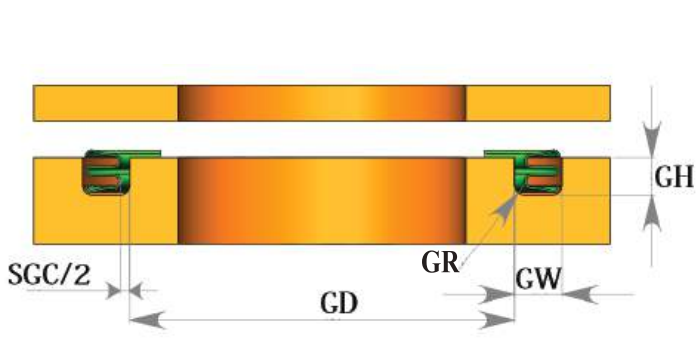
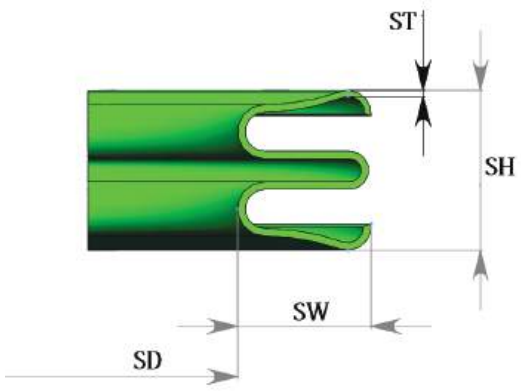
| 05.54 (+/-0.13) | 4.83 | 85 - 900 | 0.38 | 0.15 | 4.55 - 4.65 | 1.00 | 5.85 | 0.94 | 9 |
| 07.49 (+/-0.13) | 6.78 | 150 - 1200 | 0.51 | 0.20 | 6.20 - 6.35 | 1.50 | 8.00 | 1.22 | 14 |

Note: Above given values are based on lab setup conditions especially the Load and Spring-Back values. Practically the values can differ based on the actual seal size, groove conditions, groove dimensions, surface finish and seal plating conditions.



# E-O/0100.00/2-0/02.74-L/H0/Si80

## Type of Seal

E-O E-Seal for external pressure

## Commonly used Material Type

| Material Code | Material |
|---|---|
| 2 | Inconel 718 |
| 3 | Inconel 750 |

## Seal Internal Diameter

(without plating)
0100.00 = 100.00 mm

## Seal Sizes

Seal Height = 2.74 mm

Refer SH column on adjacent page

L- Sheet wall thickness light

(Refer adjacent table for value of "L")

## Heat Treatment

| Heat Treatment Code | Heat Treatment Code Description |
|---|---|
| H0 | No Heat Treatment i.e. work hardened |
| H1 | Solution Annealing + Precipitation Hardened -X750 & X718 |
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| H3 | Solution Annealing |
| H4 | Stress Annealing |
| H5 | Age Hardened - X750 & X718 |
| H6 | Soft Annealing - Alloy 600, Alu 1050, Alloy 625 & Alu 6060 |

## Plating / Coating

| Coating / Layer types | |
|---|---|
| 0 (Zero) | No plating |
| Si | Silver |
| Go | Gold |
| Cu | Copper |
| Ni | Nickel |
| Pt | PTFE |
| Al | Aluminum |
| Ti | Tin |

| Coating Thickness µm | |
|---|---|
| 30 | 10 to 30 |
| 60 | 30 to 60 |
| 80 | 60 to 80 |
| 200 | 150 to 200 |

# Non Circular Seals:

Flexoresist can manufacture various shaped seals depending on customer requirements. The shaped seals radius is the main limitation in the manufacturing of these seals. As the crossection of the seal increases the seal turn radius will increase. Thus sharp radius should be avoided while designing the seal shapes.

Below is the table which can guide the minimum radius for corresponding seal size

| Minimum Radius of Non Circular Seals | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Seal Height in mm | 0.89 | 1.57 | 2.39 | 3.18 | 3.96 | 4.78 | 6.35 | 9.53 | 12.70 |
| Metal O-Ring | 5 | 10 | 15 | 25 | 50 | 75 | 100 | 200 | 300 |
| Metal O-Ring with spring | - | - | 15 | 25 | 50 | 75 | 100 | 200 | 300 |
| Metal C-Ring | 5 | 7 | 12 | 15 | 25 | 50 | 75 | 200 | 250 |
| Metal C-Ring with spring | - | - | 12 | 15 | 25 | 50 | 75 | 200 | 250 |

# Bolt Torque Calculation:

The hereby proposed calculation method is a very simple one, showing the required elements to calculate the bolt-torque. As there are always many other parameters influencing an assembly and having their importance for a seal tight construction, the customer remains responsible for the flange design and the applied bolt load.

**Calculate the hydrostatic area (biggest diameter of the seal)**
- HA = 3.14 * D2 / 4 (mm2)
Where D = OD of the seal

**Calculate the hydrostatic force**
- HF = HA * P (N)
Where P = test pressure

**Calculate the required force to compress the seal as prescribed**
- RF = 3.14 * D * linear load (N)

**Calculate the total force required**
- TF = HF + RF (N)

**Calculate the force per bolt**
- BF = TF / number of bolts (N)

**Calculate the bolt stress area**
- BA = (3.14 * (de + dr / 2)2/4 (mm2)
Where de = effective diameter of the tread / dr = root diameter

**Calculate bolt stress**
- Stress = BF / BA (N/mm2)

**Calculate the max allowable force / bolt**
- Fmax = Max suggested bolt stress * BA (N)

**Calculate bolt-torque**
- In function of TF calculated above
    - T = Coefficient of friction * ((de + dr / 2)2/4) * BF (Nm)
- In function of max allowable bolt stress
    - T = Coefficient of friction * ((de + dr / 2)2/4) * Fmax bolt (Nm)

Use the highest torque allowed

# Seal and Groove Tolerances:

| Seal and Groove Tolerances | |
|---|---|
| **Seal Height / Crossection (SH)** | **Diameter Tolerance** |
| 0.89 to 4.78 | +0.14 |
| 6.35 | +0.20 |
| 9.53 to 12.70 | +0.25 |

| Groove Tolerances | | | C-Ring Tolerances | | |
|---|---|---|---|---|---|
| **Nominal Diameter** | **Groove ID** | **Groove OD** | **Nominal Diameter** | **Seal ID** | **Seal OD** |
| 0-3 | 0/-0.040 | 0/+0.040 | 0-3 | 0/+0.060 | 0/-0.060 |
| 3-6 | 0/-0.048 | 0/+0.048 | 3-6 | 0/+0.075 | 0/-0.075 |
| 6-10 | 0/-0.058 | 0/+0.058 | 6-10 | 0/+0.090 | 0/-0.090 |
| 10-18 | 0/-0.070 | 0/+0.070 | 10-18 | 0/+0.110 | 0/-0.110 |
| 18-30 | 0/-0.084 | 0/+0.084 | 18-30 | 0/+0.130 | 0/-0.130 |
| 30-50 | 0/-0.100 | 0/+0.100 | 30-50 | 0/+0.160 | 0/-0.160 |
| 50-80 | 0/-0.120 | 0/+0.120 | 50-80 | 0/+0.190 | 0/-0.190 |
| 80-120 | 0/-0.140 | 0/+0.140 | 80-120 | 0/+0.220 | 0/-0.220 |
| 120-180 | 0/-0.160 | 0/+0.160 | 120-180 | 0/+0.250 | 0/-0.250 |
| 180-250 | 0/-0.185 | 0/+0.185 | 180-250 | 0/+0.290 | 0/-0.290 |
| 250-315 | 0/-0.210 | 0/+0.210 | 250-315 | 0/+0.320 | 0/-0.320 |
| 315-400 | 0/-0.230 | 0/+0.230 | 315-400 | 0/+0.360 | 0/-0.360 |
| 400-500 | 0/-0.250 | 0/+0.250 | 400-500 | 0/+0.400 | 0/-0.400 |
| 500-760 | 0/-0.300 | 0/+0.300 | 500-760 | 0/+0.500 | 0/-0.500 |
| 760-1050 | 0/-0.400 | 0/+0.400 | 760-1050 | 0/+0.630 | 0/-0.630 |
| 1050-1425 | 0/-0.500 | 0/+0.500 | 1050-1425 | 0/+0.760 | 0/-0.760 |
| 1425-1940 | 0/-0.630 | 0/+0.630 | 1425-1940 | 0/+1.000 | 0/-1.000 |

# Guidelines, Precautions and Installation

For proper functioning of metal seals following guidelines are to be followed.

**Flange:**

- Make sure the flanges are turned and not milled. The turning operation will create circular pattern which is good for sealing.
- In case of elliptical / square seals the milled groove needs to be properly polished to remove the circular pattern created in the groove by the cutter.
- Make sure the flanges have enough holes for proper clamping of seals.
- Make sure the bolt sizes are sturdy enough to create the seating load on the seals.
- Make sure the flanges are rigid enough to avoid bending.
- Make sure the seal is as close as possible to the bolting position.
- Check if the Ra value of the flanges is 0.4 um.
- Grooves should be scratch free.

**Seal:**

- Make sure the seal packet is opened at the time of installation only.
- Once the seal is out of the packing make sure it directly goes in the groove.
- No surface scratches on the seal surface permitted.
- Make sure the groove is free from oil and other unwanted particles which will affect the seal performance.
- In case of high leak tightness requirement, one should use hand gloves.
- Make sure the seal is not in contact of any sharp object.

**Installation:**

- Before installing the seal, the groove should be cleaned properly with a dust free cloth. One can use acetone or isopropyl alcohol for a dust free groove.
- Avoid scratches on seal as well as grooves.
- Install the top flange on the seal avoiding rubbing on the seal surface.
- Tighten the bolts cross wise to create a uniform seating load on the seal.
- Do not use sharp objects to place or remove the seals.
- Open the seal packing only at the time of installation.
- Use hand for installation an avoid metal parts for handling.

# Flexoresist DATASHEET

Website: www.metaloring.com | 9890977244 / 9890454224

**Customer:** ..... **Date:** .....

**Email id:** ..... **Mob. No.:** .....

**Address:** .....

.....

| | |
|---|---|
| **Type of Seal** | **Circular:** ..... **Rectangular:** ..... **Other:** .....<br>**Quantity:** ..... **Size:** ..... **Part No.:** ..... |
| **Installation** | **Vertical:** ..... **Horizontal:** ..... **Universal:** ..... |
| **Seal Material** | **Sheet/Tube Material:** ..... **Spring Material:** ..... |
| **Plating/ Coating** | **Yes:** ..... **No:** .....<br>**Material:** ..... **Plating/Coating Thk:** ..... |
| **Application** | |
| **Temperature** | **Operating:** ..... **Design:** ..... |
| **Pressure** | **Operating:** ..... **Design:** ..... |
| **Media** | **Media:** ..... **Flow Velocity:** ..... |
| **Load Available** | **No of Bolts:** ..... **Size of Bolts:** ..... |
| **Flange** | **Material:** ..... **Type:** .....<br>**Surface Finish:** ..... |
| **Leak Tightness** | **Required Leak Tightness:** ..... |
| **Groove Dimensions** | **Groove Width (WG):** ..... **Groove Height (GH):** .....<br>**Groove OD:** ..... **Groove ID:** ..... |
| **Notes** | |

# Other Products

Flexoresist and its other group companies have range of products.

**METAL BELLOWS**
- Widely used in Valve, Gauges and Sensor applications.

**METAL BELLOWS EXPANSION JOINTS**
- Used in Oil and Gas, Piping, Vacuum, Chemical, Food and other industries.

**AEROSPACE**
- Vanes and Stator Assemblies for Aerospace Industry.

**Flexoresist Technologies Pvt. Ltd.**

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Website: **www.metaloring.com**

Flexoresist
Isolate Every Leak