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- Need to know information
- Function
- Non-Contact Seal benefits
- Application examples
- Characteristics of sealing system
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GMN Labyrinth Metal Seals
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- Product characteristics
- Dimension table
- Specials - width, material, etc.
- Dimensional tolerances

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GMN Labyrinth Plastic Seals
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- Product characteristics
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The machine tool industry and its end users are continuously demanding the most in quality in every aspect of their machine. Highly specialized components are resulting in shorter process time, higher rotating speed, flexible material characteristics and a huge range of operating conditions. Simultaneously, new energy-saving solutions and maintenance-free characteristics are increasing economic efficiency of modern machine systems.

Based on decades of experience, GMN has specialized in producing extremely high quality machine tool components. Through this strategy, GMN manufactures a wide range of standard non-contact seals and customized solutions.

The frictionless, no-wear characteristics of GMN Non-Contact Seals offer effective, economical and ecological solutions for modern applications in and outside of the machine tool industry.
Comparisons of Non-Contact Seals vs. Contact Seals

The design of GMN Non-Contact Seals offers – compared to conventional contact seals – operation without any friction, an essential advantage for many seal applications.

Table: Comparisons of Non-Contact Seals vs. Contact Seals

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Non-Contact Seals</th>
<th>Contact Seals</th>
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</thead>
<tbody>
<tr>
<td>Seal wear</td>
<td>Absolutely no wear of any component</td>
<td>Rubbing wear due to relative movement (rotation) at the sealing lip</td>
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<tr>
<td>Power loss</td>
<td>No power loss</td>
<td>Power loss due to friction</td>
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<tr>
<td>Speed limit</td>
<td>At high speed rotation only, the inner-ring can lift-off from the shaft due to its weight combating centrifugal forces</td>
<td>Limited applications for high speed rotation due to the increased wear</td>
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<tr>
<td>Contamination / abrasion</td>
<td>Absolute no contamination</td>
<td>Micro-wear due to friction Wear may turn into contaminant</td>
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<td>Lifetime</td>
<td>Unlimited lifetime</td>
<td>Lifetime/function is limited due to wear</td>
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<td>Lubrication of the seal</td>
<td>Not necessary</td>
<td>Often recommended</td>
</tr>
<tr>
<td>Mating components - Hardening and grinding</td>
<td>No hardening or grinding of the mating parts Simple turning quality (IT6) is sufficient</td>
<td>Shaft must be hardened and ground in most applications</td>
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<tr>
<td>Increase of temperature</td>
<td>No increase of temperature</td>
<td>Increase of temperature due to friction</td>
</tr>
<tr>
<td>Temperature range</td>
<td>High operating range</td>
<td>Narrow operating range Because of materials such as various rubbers and elastomers.</td>
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</table>

GMN Non-Contact Seals

GMN provides efficient, economical, quality sealing components made of metal or plastic for concentric rotating parts.

Seals Classification

Varying industrial processes and demands require specialized sealing systems which could be classified into several product groups.

Classification of Seals

1. Dynamic seals
   - Linear movement
   - Rotary movement

2. Static seals
   - Rod, piston, linear guided seals
   - Shaft seals

Non-Contact Seals

GMN Non-Contact Seals offer operation without any friction, an essential advantage for many seal applications.

- Grooved ring
- Wiper ring
- Edge sealing ring
- Compact seal
- GMN Labyrinth Seal
  - Metal
  - Plastic
- Special solutions
- Felt ring
- Compression gland
- Slide ring seal
- Radial shaft seal
- Ventilation
- O-Ring
- Sealing mass
- Bellow-type seal
- Profile seal
- Flat seal
- Membrane seal
- High pressure seal
- Cutting ring seal

Contact Seals

Contact seals offer

- Absolutely no wear of any component
- Minimal maintenance
- No power loss
- Increases the possibility for smaller drives
- No increase of temperature
- Lifetime

- Shaft must be hardened and ground in most applications
- High operating range
- Due to the steel and aluminium construction, 392°F [200°C]
- Plastic (POM) is rated to 140°F [60°C]
Non-Contact Seals

Basics

In correlation with the application’s design, non-contact seals also:
- Protect/shield inner workings of the application
- Throttling/switching
- Back transport of application medium(s)
- Optional draining within the seal design

The seal itself as well as the specific design encompassing the seal satisfies only parts of the sealing requirement.

The maximum efficiency of a GMN labyrinth seal is achieved with an optimised interaction of the seal-component and the surrounding construction/design.

Sealing function at machine standstill
The functions of protecting, shielding, throttling and switching are effective even when the shaft stands still. The seal functions of back transport and draining require the shaft to be rotating.

GMN produces non-contact seals in two different types:

GMN Labyrinth Metal Seals are made from two different materials with different stiffness. A special production process creates a tight horizontal labyrinth gap between the steel inner ring and the aluminium outer ring.

GMN Labyrinth Plastic Seals are made from the same material (POM). The gap within the labyrinth geometry has a conical design.

Gap height
The theory of non-contact seals is based on the gap height between inner and outer rings. The tighter the gap height is on the seal (reduction in ring gap area), diminishes the opportunity for any contaminant entry. Depending on amount, direction and speed (intensity) of the contamination, an additional protection against direct splashing liquids is recommended.

As an additional supporting effect inherent in a non-contact seal, tight gaps create an air cushion inside the gap. This air cushion increases in correlation to rotational speed.

Labyrinth
The labyrinth geometry acts as a barrier against any liquids or dust. Particles entering the labyrinth seal bump against the labyrinth, therefore any media is slowed. The shifts in direction inside the labyrinth make passing the seal almost impossible.

Metal seals provide 2 to 4 labyrinth steps (depending on size) in a mini-mized space. GMN's proprietary manufacturing process guarantees 100% conformity of inner- and outer ring’s labyrinth geometry to each other.

Plastic seals are providing 3 to 4 labyrinth steps depending on size. With this type, the conical gap design increases sealing efficiency due to centrifugal forces of rotation. Penetrated media is transported back to the larger gap diameter when the shaft is rotating. The larger gap diameter always faces the contamination.

In case of heavy splashing liquids, type M and SA with drain grooves are preferred.

With the constant gap height of only 0.2 to 0.5 mm. The complete product line of GMN Labyrinth Metal Seals achieves the highest efficiency.

Plastic seals have a varying internal gap height due to the asymmetric labyrinth geometry. The minimal gap height of approximately 0.5 mm also guarantees the highest efficiency.

Labyrinth (metal)
Labyrinth (plastic)

Drain groove (metal) Type M
Drain groove (plastic) Type SA

Sealing gap

Function

GMN Non-Contact Seal (metal)
GMN Non-Contact Seal (plastic)
GMN Non-Contact Seals
Benefits and applications

Benefits
The specific design of GMN Labyrinth Seals allows operation without any friction. Many different applications are taking advantage of this major benefit:

Technical benefits
- No wear
- Rated for high rotating speeds
- Sealing efficiency is independent from direction of rotation
- No abrasion, no contamination

Thermal benefits
- No frictional heat increase
- No thermal effects to the surrounding application

Functional benefits
- Maintenance free
- Constant sealing efficiency during operation
- No adjustment required
- No lubrication required (approved for dry operation)

Economic benefits
- No hardening or grinding of mating parts
- Unlimited lifetime – no replacement due to the Non-Contact design
- Cost saving component instead of expensive self-made labyrinth
- Less maintenance results in higher machine yield
- No frictional loss results in reduced demand to engine output

Ecological benefits
- Operation without friction saves energy

Applications
- High-speed
  (no-wear operation)
- Sealing against dust
  (Pre-greased GMN Labyrinth Seal made of plastic)
- High cleanliness
  (Freedom from any wear)
- Positioning without resistance
  (No opposing forces during operation)
- Protection for lip seals
  (Guarding against wear from chips and abrasive particles)

Practical examples

Textile / paper industry
Sealing against dust
The sealing of fine textile fibres is a challenge for any sealing system. Fibres and micro-fibres have the tendency to cling to the sealing gap of a lip seal. As a result, friction and wear are increasing with use. With time, the fibres are making their way to the bearings. In applications like this, pre-greased GMN Labyrinth Seals made of plastic are providing an established, proven alternative.

Examples in the textile industry are; carding engines, spinning machines, cutting machines, etc. Similar applications can be found in the paper industry. Pre-greased GMN Labyrinth Seals made of plastic are providing high efficiency sealing alternatives against fine paper dust.

Food / chemical / electronic industries
High cleanliness
Cleanliness and freedom from wear is essential in the food industry. Every contact seal is operating with some kind of relative movement between two different components being in contact continuously. With this friction, small amounts of wear (i.e. rubber material) have to be accepted, it could never be fully excluded. In the worst case, this wear could contaminate food.

A Non-Contact Seal is absolutely free from any frictional contact and freedom from maintenance and no loss of power provide a perfect economic solution.

Sealing against chips and abrasive contaminations
Protection for a lip seal
Lip Seal life is extremely limited with contact of chips and abrasive particles. This contact greatly accelerates the wear of the rubber material. An optimal solution is the combination of both seal systems. In a first step the GMN Non-Contact Seal keeps chips and abrasive particles away from the lip seal. In this scenario the contact seal is protected and the lifetime of the complete sealing system increases greatly.

The additional investment for the GMN Non-Contact Seal is minimal compared to the lost time to repair and/or replace worn seals.

Machine tool industry, spindle heads
High-speed applications
The maximum speed of contact seals is limited because of temperature, wear and resultant life expectancy.

GMN Non-Contact Seals protect spindle bearings against cooling fluid and metal/wood chips. They are operating free from wear and any frictional contact. Unlimited life, no temperature increase from operation, freedom from maintenance and no loss of power provide a perfect economic solution.

Highly accurate positioning
Positioning without resistance
Sophisticated optical or magnetic systems have to be reliably protected against any external contamination. Encoders are exposed to high dynamic accelerations at an already high speed. With GMN Non-Contact Seals encoders could be positioned without resistance to the highest accuracy. This is a requirement of many high-tech performance applications.

Ecological benefits
Operation without friction saves energy

GMN Labyrinth Plastic Seals is the resistance against many acids (i.e. lactic acid), chemicals (cleaning processes) and fungi; the material (POM) is already FDA-approved.
Characteristics of sealing systems

The performance of any seal in various machines is extremely important to the life and efficiency of the complete system. Because of this, GMN prefers to help customers early in the design phase to ensure that everything will perform as planned and the correct design choices are made.

Different applications require specialized and individual solutions; there is a large variety of products on the market.

The table below includes some general information to help find the best seal for your application.

In many cases the combination of different sealing systems provides the perfect solution. An additional GMN Non-Contact Seal could protect a standard contact seal against chips to increase the lifetime of the complete sealing system.

Limits of use

GMN Non-Contact Seals are providing solutions for a wide field of applications. However, in certain cases the use of GMN seals is also limited.

Liquid levels and pressure differentials

The design of a GMN Non-Contact Seal requires a gap between the outer and the inner ring. With this gap liquid levels and any difference of pressure could be reduced, but not sealed.

Power efficiency

Life time

Thermal effects to surrounding construction

Requirements to the mating parts

Maintenance

The maximum circumferential speed is (depending on the size) $v = 35 - 60 \text{ m/s}$ for GMN Labyrinth Plastic Seals and $v = 45 - 70 \text{ m/s}$ for GMN Labyrinth Metal Seals.
GMN Labyrinth Metal Seals
Type L and M

Type M with drain grooves
Against heavy splashing liquids (optimized back transport) for rotating shafts only

Type L
Against splashing liquids for rotating shafts and housings
**Technical data**

**Material**
- Outer ring: Aluminium (GD AlSi 12)
- Inner ring: Non-alloy steel

**Range of temperature:** -40°– 390°F (-40°– 200°C)

**Design**
- Shaft diameter: 15 – 210 mm
- Width: 10, 14, 15, 20, 22 mm (depending on size)
- Gap height: Constantly 0.2 – 0.5 mm
- Sealing gap: Horizontal
- Axial clearance: \( S_{ax} \) (see table of dimensions) = total axial movement of the seals inner and outer ring in relation to each other; from one end position to the other.

**Increased axial clearance:** On request all types are also available with increased axial clearance: \( S_{ax}^{inc} = 1.5 \times S_{ax} \)

**Radial clearance:** \( S_{rad} = S_{ax} \tan (45.2°) \)

**Type M**
- Heavy and direct splashing liquids could be drained through a certain number of grooves in the outer ring into a circular groove inside the housing.

**Characteristics**

Material
- Robust
- Metallic materials of GMN seal components guarantee highest resistance against coarse and fine contamination.
- Well suited for high temperature applications
- Metallic materials are suitable for temperatures up to 200°C (392°F).

**Design**
- No friction
- GMN-Seals guarantee operation without any frictional contact.
- No wear
- GMN-Seals operate without any kind of wear, unlimited life possibilities.
- No abrasion
- The Non-Contact design of GMN-L-Seals guarantees operation without any metallic abrasion. The L-Seal is suitable for the highest demands of cleanliness.
- Effective
- The small distance between outer and inner ring of approx. 0.2 - 0.5 mm offers high sealing efficiency and effective protection against contamination.
- No increased temperatures
- No friction means no thermal effects to the surrounding parts and/or the lubricant.
- Power saving performance
- The specific design of the GMN Labyrinth Seal allows operating conditions without any power loss. The result is the highest efficiency and power saving performance in high speed applications.
- Compact design
- GMN Labyrinth Seals are offering 2 to 4 labyrinth steps within a tight space.
- Efficiency
- The small gap height creates an air cushion inside the gap at high rotating speeds which helps increase efficiency.
- Back transporting
- Drain grooves on the outer ring are draining liquids with great effectiveness (Type M).

**Surrounding constructions (mating component)**

**Fits**
- Housing: K7
- Shaft: h6

**Surface:** Rz \( \leq 16 \) µm, Ra \( \leq 3.2 \) µm

**Assembly**
- "W" Length (chamber of housing and shaft) depending on the width of the outer ring.
- The softer aluminium outer ring may be deformed during transport and arrive out of roundness. When the seal is then pressed into the housing, the outer ring easily re-forms to the circular housing.
- The outer ring could also be wider by max. 0.1 mm than the inner ring.

GMN Metal Seals are pressed through a round steel ring to calibrate the outer ring. After this process the outer ring widens again a little bit due to its elasticity.
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GMN Labyrinth Plastic Seals
Type S and SA

Type S
Against normal splashing liquids
For rotating shafts and housings

Type SA with drain groove
Against heavy splashing liquids
For rotating shafts only (increased back transport)
GMN Labyrinth Plastic Seals

**Type S and SA**

**Technical Data**

- **Material**
  - Outer- and inner ring: high quality Polyoxymethylene plastic (POM)
  - Temperature range: -40° to 140°F (-40° to 60°C)

- **Design**
  - Shaft diameter: 10–160 mm
  - Width: 10, 12, 15 mm (depending on size)
  - Sealing gap: Conical
  - Axial clearance: \( S_{\text{a}} = 0.8 \text{ mm} \)
  - Greased seals: Pre-greased Seals Type S – available in all sizes – provide improved protection against dust.

**Characteristics**

- **Material**
  - Non corrosive
  - Chemical resistant
  - GMN Plastic Seals are made from non corrosive material and are particularly suitable against watery liquids.
  - Polyoxymethylene (POM) guarantees high resistance against a lot of acids (i.e. lactic acid), chemicals and fungi. GMN Non-Contact Plastic Seals are approved for the food Industry.

- **Design**
  - No friction
  - No wear
  - No abrasion
  - The Non-Contact design of GMN Labyrinth Seals guarantee operation without any abrasion. (GMN Plastic Non-Contact Seals are suitable for the highest demands of cleanliness.)
  - Effective
  - No increased temperatures
  - No friction means no thermal effects to the surrounding parts and/or the lubricant.
  - Power saving performance
  - The specific design of the GMN Labyrinth Seal allows operating conditions without any power loss. The result is the highest efficiency and power saving performance in high speed applications.
  - Compact design
  - GMN Labyrinth Plastic Seals are offering 3 to 4 labyrinth steps within a small space.
  - Efficient
  - GMN Labyrinth Seal Type S and SA take advantage of the centrifugal force to improve the sealing efficiency. Entering liquids are transported back to the bigger gap diameter with the rotation of the inner ring. Because of this effect, the bigger gap diameter (e2) of the Labyrinth seal must always face the splashing liquids/contamination.
  - Dust-free
  - The gap of pre-greased seals is filled with a specific grease type and improves protection against dust and fine particles.

**Mounting**

- **Tolerances**
  - Surrounding constructions (mating component)
  - Fits: Housing: H7
  - Shaft: h7
  - Surface: \( R_z \leq 16 \mu m \), \( R_a \leq 3.2 \mu m \)

- **Assembly**
  - "I" Length (chamfer of housing and shaft) depending on the width
  - \( W \)
  - \( l = 0.1 \times W \)

- **Special design with O-ring for higher temperatures up to 176°F [80°C]**
  - In applications with high temperatures, an additional O-ring at the outer ring (also available at the inner ring) saves the press fit and keeps the seal in position.
### Labyrinth Plastic Seals

#### Type 5

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#### OD = Outer diameter [mm]

#### ID = Inner diameter [mm]

#### W = Width [mm]

#### e1 = Gap diameter [mm]

#### e2 = Gap diameter [mm]

#### S₀ = Axial clearance [mm]

#### Max. speed [rpm]

#### Weight [kg]
General information
When installing a GMN Non-Contact Seal, one must be certain that both the inner and outer races are axially aligned. Furthermore, the races need to be unrestricted by any shoulder, nut(s), and/or other restrictions from axial movement.

Surrounding construction
An additional disc in front of the seal protects the gap against strong and direct splashing liquids. The disc should be assembled in front of the seal with sufficient distance (capillary forces should be considered).

Non-Contact Seal (metal):   Non-Contact Seal (plastic):
Type L   Type S
with disc  with disc
Any kind of high liquid level in front of the seal’s gap needs to be avoided. (Attention: High liquid levels may cause leakage.)

In a non-horizontal working application, GMN can offer specific advice to optimize your individual design in order to protect the sealing gap effectively.

When using Type SA, care should be taken that the drain groove in the stationary part is always positioned at the lowest point.

Installation
Assembly inside the unit
1. The GMN seal is pre-assembled onto the shaft. A thin metal sheet mounting aid (Thickness $s_a/2$, half the amount of the seal’s axial clearance) should be inserted between the housing and an additional ring.

2. Shaft (with the seal) and housing (with the bearing) are fitted into each other carefully. Now the outer ring stands in the right end position of the seal.

3. Finally the mounting aid is removed and the screws are tightened. With this process the seal’s outer ring moves to the left by $s_a/2$ and finds itself in the final, correct non-contact position.

Orientation of Plastic Seals
The bigger gap diameter ($e_2$) of the GMN Labyrinth Plastic Seals must always face the splashing liquids/contamination.

Face-mounting with pre-assembled bearing
Both rings of the seal are pressed-in with an assembling aid (i.e. tube) together at the same time. If pressure would be applied on one ring only the labyrinth could be destroyed.

(The outer ring could be wider by maximum 0.1 mm than the inner ring.)
Seals with drain groove

Metal Seal (Type M)
In case of limited construction space Type M offers a compromise of the tandem arrangement in a tight package. Passing liquid is centrifugally forced through the outer ring’s grooves into a drain groove inside the housing. Width of the drain groove in housing: \( R = c + 1 \text{ mm} \) (\( c \) = drain groove width)

Plastic Seal (Type SA)
When using the Type SA, care should be taken that the drain groove in the stationary part is always positioned at the lowest point.

Sealing air
Sealing air improves the efficiency of the seal, but please note the reasonable amount of air consumption. If sealing air should be applied through the grooves of the M Type the air releases in both directions of the seal, paying special attention with the bearing.

Specific Assembly Situations
Assembly with pre-loaded spindle bearings
The seal’s outer and inner ring must not be affected when the bearing is pre-loaded. The assembly into the cover keeps the seal independent from any bearing displacement.

Shaft Expansion with Temperature
To avoid any increase of the maximum axial clearance, GMN recommends a seal with an increased axial clearance or an asymmetrical seal adjustment in the extension direction. (The excess of maximum axial clearance could destroy the seal.)

Tandem arrangement
Metal Seal (Type L)
100% sealing efficiency is guaranteed with two seals in a row (minimum sealing distance 5 mm) with a drain hole in between. With this design any liquid between the seals could be drained reliably.

Plastic Seal (Type S)
The tandem arrangement of the plastic seals with a drain hole in between require opposite orientation with the assembly. One seal is operating specifically against possible contamination from outside while the other seal keeps the bearing’s lubrication inside. The bigger gap-diameter always faces the contamination. (Space between the seals: min. 5 mm)

Plastic Seal (Type SA)
When using the Type SA, care should be taken that the drain groove in the stationary part is always positioned at the lowest point.

Additional aspects to consider
Correct choice of the seal as well as customized design of the mating parts is the most important aspects for a successful application, but there is more. If a milling machine is stopped suddenly within a very short time, a temporary oil level could be created in front of the sealing gap. The following questions should help to analyze your application from different points of view:

- Is the level of the sealing gap fixed?
- Would another size of the seal move the sealing gap into a more protected area?
- Could the viscosity of the cooling/oil etc. be influenced in a positive way?
- Are there any existing components (i.e. shield) which could be included into a complete design?
- Are all drain holes and drain grooves big enough?
- Could any possibility of backwater be excluded?
- What is the size of any particles to be sealed? What is their speed and direction?
- Could any negative aspects be changed in a positive way with the control system?

On request, GMN would be pleased to give advice based on our decades of experience in order to optimize your individual solution.
# Product overview

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**Note:** Special Sizes on request.

*ID and OD according to bearing sizes

**Width W off-size**

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**GMN Non-Contact Seal (metal)**

**GMN Non-Contact Seal (plastic)**

**Bearing size**

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**Note:** Special Sizes on request.

*ID and OD according to bearing sizes

**Width W off-size**
## Tolerance Table

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### Shaft

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