O-RING FOR TUBELESS SYSTEM ALPINA-STS

2

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INDEX

GENERAL FEATURES

SPECIFIC FEATURES

GENERAL CHARACTERISTICS

BENEFITS OF O-RING

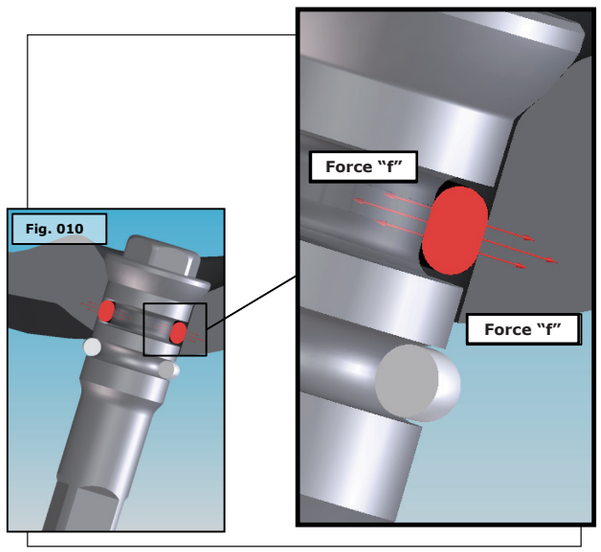
Compared with other sealing elements, the OR seal has many advantages, among which the following stand out:

- Simple, compact and symmetrical shape at all levels of centre line.
- Thanks to the limited overall dimensions, it requires a hollow housing of simple and economic achievement.
- It allows the simplification of projects and the reduction of overall costs.
- It addresses a large series of problems of both static and dynamic seal.
- It is suitable for use in contact with a wide range of fluids and in extensive fields of pressures and temperatures.

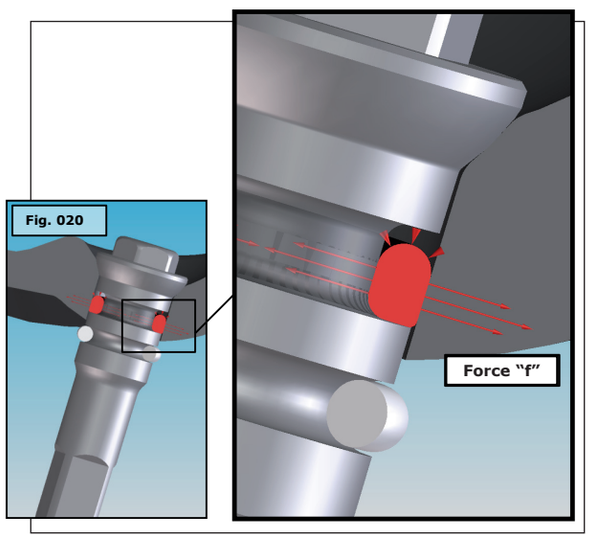
The simplicity of its allocation for easy disassembly and replacement maintenance.

OPERATION OF O-RING

Elastomers behave like high density and with high surface tension liquids, and as such they are deformable but not compressible.
According to this law of hydrostatics, the pressure exerted on a body of elastomer is transmitted equally in all directions consistent to the conformation of the body.
It is inferred that the OR, as a result of the crushing determined by the housing dimensions in assembly, as well as developing a spring force, it expands in the surrounding free space without changing the volume, therefore, these spaces should always be provided to ensure its optimum operation.



The elastic reaction of the OR in axial, radial or combined direction against the retaining walls **(Fig. 010 Force "f")** determines the base or initial resilience, even without any pressure.
In the presence of fluid or gas pressure to hold, the ring is urged by a pressure **(Fig. 020, Pressure "P")** which causes a further elastic deformation and reaction against the walls of containment.



This reaction force is added to the initial one due to housing allowances, creating a total force **(Fig. 020, Force "F")** that determines the effect of changes required automatically modifying itself in proportion to the gas pressure.
It follows that the OR is a seal element of automatic action besides single or double acting .

GENERAL CHARACTERISTICS

USES OF THE O-RING

Both in the standard and in the special version the OR seal is used in each production sector.
The prevalent applications include:

- For static radial seal(cylinders, pipes, sockets, etc.).
- For axial static seal (flange, planes, caps, etc.).
- For dynamic axial and rotary seal (pistons, piston rods, shafts, spindles)
  where there is an optimum lubrication, low speed (about 0.5m/sec), limited pressure.

Owing to qualitative evolution of elastomers, compounds in general and of application technologies, the OR still confirms itself as a reference element for the solutions both simple and compound, even in the most demanding sectors such as food, pharmaceutical, aeronautics and aerospace.

OPERATING PARAMETERS

The permissible operating parameters, in relation to pressure, temperature, speed and resistance to aggressive agents depend directly on the type of application (which can be static or dynamic), the entity of the clearance between the sides involved, the operating environment and the type of elastomer used. It is generally possible to draw the following breakdown:

PRESSURE

Up to 50 BAR (static or dynamic) without any limitation.
Up to 400 BAR(static) with loosely coupled clearance or support Back-up Ring
(dynamic applications considered case by case).
Up to 2000 BAR(static) with support for Back-up Ring reinforced.

SPEED

Linear up to 0.5m/sec
Spinning up to 0.2m/sec

TEMPERATURE - Continuous Operation

Elastomer NBR: -30 to +100 ° C - With special elastomers: -60 to +316 ° C

SPECIFIC FEATURES

APPLICATION ALPINA-STS

ALPINA-STS system provides for the use of O-ring 2025 in NBR.
The type of use is in simple static applications, with one-way route low-pressure.
The seal is radial external static.
The gap dimension between the rim,the nipple and the hole is between 0.3 and 0.15mm.
The OR crushing section between 12 and 23.5% (between 6-20% recommended for dynamic applications, and between 15-30% eligible for static applications).
The surfaces have roughness Ra (mm) 1.6, and the entrance of the hole rim is provided with bevel lead.

FEATURES OF THE NBR ELASTOMER

Elastomer scientific name	Designation din / iso 1629	Astm designation 1418	Specific weight 1.2 To 1.3 G/cm3	Specific weight 1.2 To 1.3 G/cm3 hardness sh a + / - 5	Heat resistance
Acrylonitrile butadiene rubber	NBR	NBR	1.2 To 1.3 G/cm3	70 (*) 60-80-90	-30 + 100

(*) Standard hardness
(**) The temperature listed is for continuous operation.

Generally known as Perbunam or nitrile rubber, the NBR is most widely used elastomer in the holding techniques thanks to its good mechanical properties and the wide range of chemical compatibility with oils and greases.

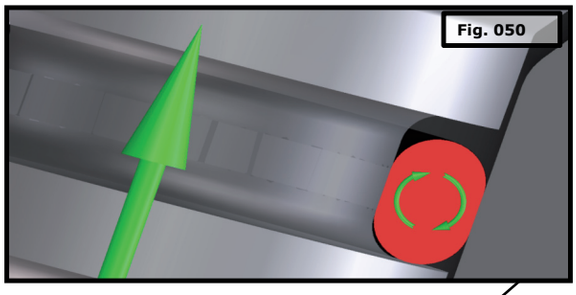
Its use has been confirmed to work in contact with:

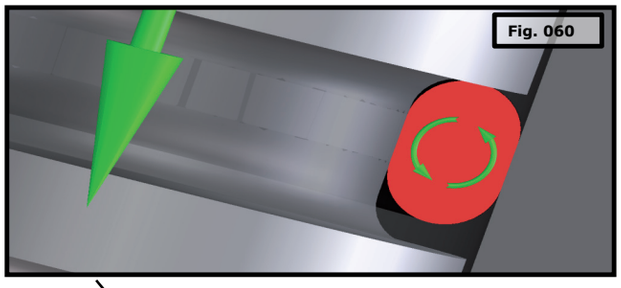
- Mineral, animal and plant based hydraulic fluids;
- Explosion-proof liquids and aliphatic hydrocarbons (propane, butane, oil);
- Silicone oils and greases;

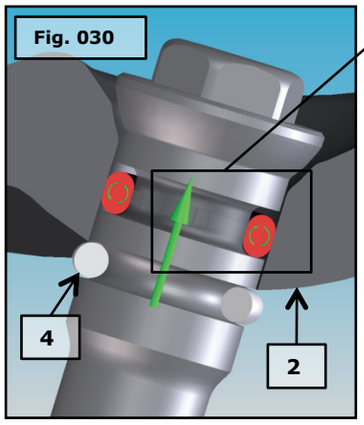
SPECIFIC FEATURES

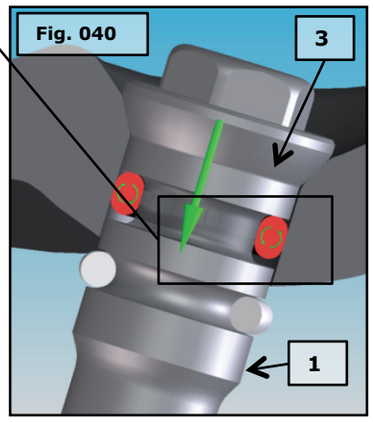
WEAR AND AGING

The synthetic elastomers used in the production of O-rings are treated with additives to resist aging. ALPINA takes care of lightly greasing the seals before they are inserted into their housing, which also offers natural protection over the time from external agents such as liquids, gases or light.









STS SYSTEM LIFE CYCLE

We could also represent the application of the rim/nipple as an application cylinder/piston where the piston stroke **(nipple Fig 040 "1")** is limited in the cylinder **(rim Fig. 030 "2")** on the one hand by means of the head of the nipple itself **(Fig 040 "3")** and on the other by the action of the safety ring **(Fig 030 "4")**.
This race is circumscribed in an axial displacement between 0.2 and 0.5 mm.
Logically, it should be said that with such a short longitudinal stroke the sliding of the seal on the cylinder walls is limited by the oscillatory rolling of the rope over itself **(Fig. 050 and 060)**.
However assuming that there is still a friction between the parts, it must be considered that this takes place only under extreme circumstances in which the channel, in its central location close to the nipple, is enduring a deformation superior to 0.2mm so that it overcomes the elastic component of the spoke.
We can also note that the stroke can, in no way, exceed + /-0.5mm, because as previously expressed, this is limited by the security seal on the one hand and by the head of the nipple on the other.

In order to increase the safety of the verification we will proceed by completely excluding the possibility that the spoke can slide into the housing of the hub, even though as per provision of the constraints in force it is absolutely more real the assumption that the spoke can slide axially in the hole of the hub where it has no detention.

Under those circumstances; how many limit work cycles is the seal able to guarantee?

Consider what above in accordance with the criteria of the precautionary of seal manufacturers: if the OR were used to ensure the tightness in a dynamic linear alternative (cylinder-piston), the manufacturers recommend a linear speed that does not exceed 0.5m / s.

Even though manufacturers prefer not to risk ensuring a long life of the seal because it is subject to external variables such as pressure, lubrication, local temperature, and so on let's all imagine that at least one work shift must be guaranteed (rather, if the application had to endure only 8 hours, it would definitely be considered a failure).

Yet, how much space would it have travelled in just 8 hours? 0.5 x 3600 x 8 = 14,400 meters!

Should we want to transform the hypothetical rubbing of the OR guaranteed of 14.400m in the limit number of strokes of the nipple (+ / - 0.5mm) inside the hole of the rim we would have a projection of approximately 14,400,000 cycles (limit). Assuming that the vehicle receives a stress limit (able to deform the central portion of the channel of at least 0.7mm (0.2 +0.5)) every 100m travelled, it would be capable of covering 1,440,000 km before reaching the minimum value of wear guaranteed by the O-ring.

A 5.5x17 wheel mounted with 36 spokes 4 / 3, 5 / 4 subject to a radial load of 500 Kg undergoes a deformation of the central area of the channel of about 0.03 mm (24 times less than the suggested limit of 0.7mm (0.2 +0.5)) .

SUMMARIZING:

DATA AND CONSTRAINTS

Assumed limit stroke nipple/rim + /- 0.5mm (real between + / - 0.2 and + / - 0.5mm)

Seal rubs throughout the assumed race (thus excluding that it can rotate on itself)

Minimum elastic deformation required in the central area of the rim> = 0.7mm (0.2 +0.5)

Assuming that the warranty of rubbing of the seal is only 14.400m (as precaution)

EXCLUDING

that the spoke can slide into the hole of the hub

RESULT

By analyzing the system with these data and limit constraints, we can conclude that the guaranteed minimum wear of the seal is not conceivable before 1,440,000 km

* The deformation of the channel is to cancel the elastic component of the spoke, which, when tightened to 5 Nm stretches of about 0.2mm. It is important to consider also that the loosening of the nipple of the spoke is completely prevented due to the friction generated by the O-ring seal between the nipple and the rim hole.

SPECIFIC FEATURES

CONCLUSIONS

Considering that no laboratory test provides for such extreme or penalizing conditions with such long cycles, we can say that the OR system security sealing ring warranty exceeds the natural life cycle of the wheel. Therefore, the use of OR type seals in the ALPINA-STS sealing system is not a critical element.

It remains obvious that what above is to be considered valid as long as the data, the size calculations, and the assembly prescriptions are met at all times. In particular, it is important to ensure maximum accuracy during the process of drilling of the channel (alignment rim hole / spoke axle, finishing, and size of the hole), and maximum cleanliness during the assembly cycle.

The ALPINA-STS system is already standard equipment on production motorcycles as from 2006.

TEST, RACING AND REFERENCE

The wheels had to pass all the laboratory tests of homologation
The wheels had to pass the long-distance tests imposed by the specifications
of the manufacturers of the vehicle
The ALPINA -STS system is marketed in the AFTERMARKET as from the year 2007
Some products (BMW R1200GS - BMW F800GS) are provided with TUV type-testing
The ALPINA-STS system is used in motorcycle racing (Cross World Championship - Super Motard)
by individuals and TEAM FACTORY directly followed by ALPINA since 2006
The Alpina STS System has equipped 10 Supermoto World Championships since 2006.

INDUSTRIALIZATION AND COST COMPARISON

1	no investment costs for component projects and machineries
2	utilisation of original hubs (no additional costs)
3	utilisation of original spokes, only a little bit shorter (no additional costs)
4	utilisation of nipples with blind hole instead of through-hole
5	utilisation of original rims and anyway commercial standard rims with drilling instead of punching
6	possibility to assemble the original BMW sensor for the tire pressure control
7	utilisation of the same kind of spoking, and assembling as for a tube-type wheel. Also the staff doesn't have to modify their work experience
8	Regarding BMW the Behr rim must be drilled on the border; changing to our system has no additional costs as the same drilling machine can be used with the same machining time
9	the assembling of the Kreuzspeichenrad (BMW crossed spoke wheel) is much more complicated and cost-intensive than our STS system
10	putting the clips can be considered like their set-screw nipples/spoke blocking in order to avoid their loosening

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