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RESEARCHES REGARDING THE INFLUENCE OF SOME DIMENSIONAL CHARACTERISTICS OF TRANSLATION LIP-RING GASKETS ON HIS EFFICIENCY AND TRIBOLOGY

C.T. Falticeanu, G.M.Patilea, S. Ciortan

Dunarea de Jos University, Galati

Romania

1.Generalities

Translation lip-ring gaskets are used both in hydraulic installations, at linear hydraulic drives and in pneumatic installation. They are used as piston seal, moving with the piston and sealing on external surface, or as rod seal, fixed in the box and sealing on internal surface. The cross-section can be V, U, T, flange or cup shaped, following the functioning requirements and conditions. The differences between the pneumatic and hydraulic installation gaskets are both as shape, material (especially the hardness) and from gasket functioning mechanics point of view.

As in all seals with mobile contact case, in translation seals design two opposite problems occur. First, in order to obtain a perfect tightening, the space between the rod and the gasket must be as small as possible. This can be done by a high tightening of the gasket on the rod. The tightening is the result both of the difference between the diameters of the two pieces prior the assembly operation and of the gasket elasticity. On the other hand, the high tightening leads to a high friction force between the gasket and the rod, growing as the tightening is growing. The result is a high gasket wear rate, a high contact temperature, leading to a lubricant fluidization and, this way, to lubrication conditions degradation. All these conditions leads to the sealing durability decrease through excessive wear of the gasket.

As is mentioned in [1], in our country there are not any researches on this aspect, the gasket dimensions being established based on foreign standards. The author, running such investigations, observed that there are some differences between tightening pressures, between shaft and gasket, for the same values of the diameter differences between gasket made in Romania and others made abroad, or even between gaskets made by different local suppliers.

As follow, the necessity of some detailed researches in this direction and in every case when a certain tightening value is required. Also, in such cases, the gasket material must be specified, assuming that the recipe and the technology for that material are respected.

The author worked in this direction for rotating cuffs [1] but, because of different shape of translation cuffs, a research in this domain is required too.

The present paper's goal is to praise some aspects of this problem, presenting few research results and the rig used for testing.

2.Research methodology and the used outfits.

In order to study the before mentioned samples, the author designed and build a test rig that simulates the real functioning conditions of translation cuff sealing for rods. The rig's draft is presented in figure 1.

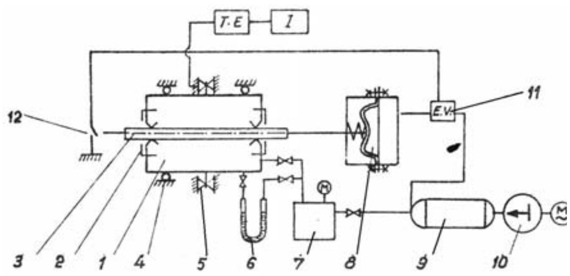

Fig. 1
The main test rig

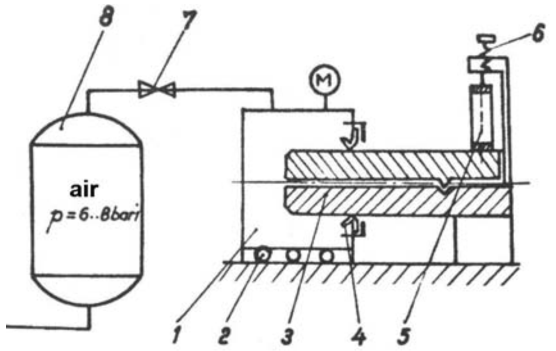

Fig. 2
The second test rig

The main dynamic test rig is composed by an enclosure 1 with a axial moving rod 3. Both ends of the rod are sealed by the studied translation cuff systems. In order to study different couplings rod-seals (different diameters) the rig is build up by modules. The rod is driven by a pneumatic device, with elastic diaphragm 8, ensuring a maximum rod displacement of 20 mm, required for this research program. The pneumatic device has an automatic functioning due to the vent 11, driven by switcher 12, positioned at the end of the rod, with the possibility to be moved following the rod displacement value requirements.

Establishing of air losses through the seal is done using a differential manometer, 6. The manometer is connected to the enclosure and to a constant pressure chamber. In the beginning of the tests the pressure has the same value both in the enclosure and in the chamber 5 barr.

Measuring the friction force between the rod and the gasket is done by measuring the stress created in the elastic blades 5, mounted on the enclosure exterior wall. When the rod is moving, due to the friction between the rod and the gasket, the blades are bending, the mechanical stresses providing the value of frictional force. For the increase of the measurements precision, the friction force between the enclosure and the railway is excluded, by previous measurements. The measurements are done and recorded by a tensometric bridge. The air for the pressure test (8 barr maximum) is provided by an compressor driven by an electrical engine.

The second rig is a static type one, equipped with precision measurements systems. A rig draft is presented in figure 2.

The main part of this test rig is an enclosure 1, a conical (3/100) rod 3 sectioned axis parallel. The rod have a knife shaped backing, this one allowing to one of the rod's section to function as a cantilever for tightening force measuring using the force ring 5. The opposite rod end penetrate the enclosure, using the tested cuff as sealing.

The measuring of the gasket-rod tightening pressure is made in two cases: without air pressure in the enclosure and with air pressure in the enclosure.

In first case, using the screw 6 the ring diameter, in vertical direction, is settled to the nominal value. By penetrating the rod through the gasket in the enclosure, the modification of the diameter will measure the tightening pressure between gasket and the rod.

In order to measure the tightening pressure variation with the difference between rod and gasket diameters (the tightening), the enclosure can be moved along the rod by a railway 2, following some pre-calculated distances.

In the second case, the sectioned rod is insulated with a very elastic rubber shirt (to prevent the air pressure loss) and the same measuring tests are taken. This way, some conclusions regarding the influence of sealed air pressure on tightening force variation can be drawn.

3.Some experimental results

First of all, it is interesting to establish the tightening pressure value for different gasket rubber compositions and different rubber hardness, both for local and abroad suppliers.

In figure 3 is presented the tightening pressure variation with the rubber hardness PT and PN.

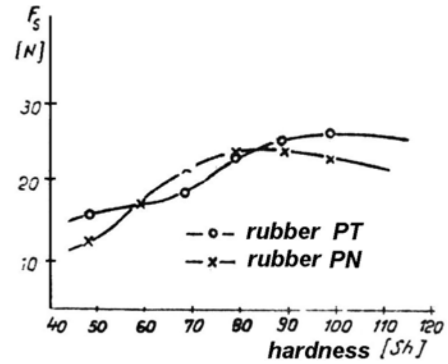

Fig. 3

Tightening force variation by rubber hardness

It can be observed that the tightening force is increasing for hardness values between 50 sh to 80 sh and after that the force remain constant. For higher hardness values (over 90 sh) a decrease of the force, due to gasket elasticity decrease, can be observed.

In figure 4 present the differences between tightening forces for a same hardness rubber but obtained from different suppliers.

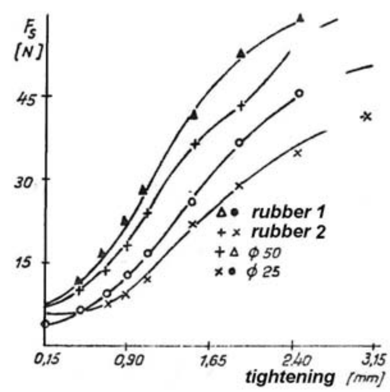

Fig. 4

Tightening force variation by tightening value

The tested gaskets are used in railway wagons brake system. It can be observed that for small tightening values (between 0.1 – 1 mm) the tightening force values are almost the same. In raising tightening case, the force values are spreading until a 3 mm tightening and after that the curves remain almost parallel. This can be explained by the higher elasticity of imported rubber comparing with the local one. Also, can be observed that at higher diameter values both gaskets have the same behaviour with the difference and that the tightening force values are bigger.

In figure 5 is presented the tightening force variation with sealed air pressure, for different gasket rubber hardness.

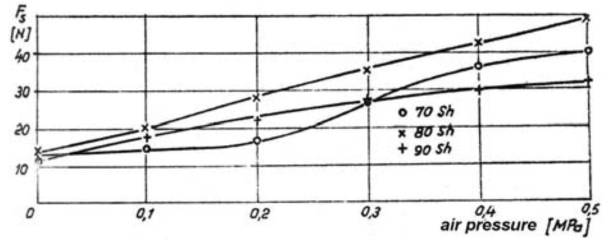

Fig. 5

Tightening force variation by sealed air pressure value

It can be observed that at higher hardness the behaviour is almost linear but with a lower tangent value.

In figure 6 is presented the frictional force time evolution, between rod and gasket, for different materials, roughness and lubricating regimes, for a prescribed tightness value of gasket on rod.

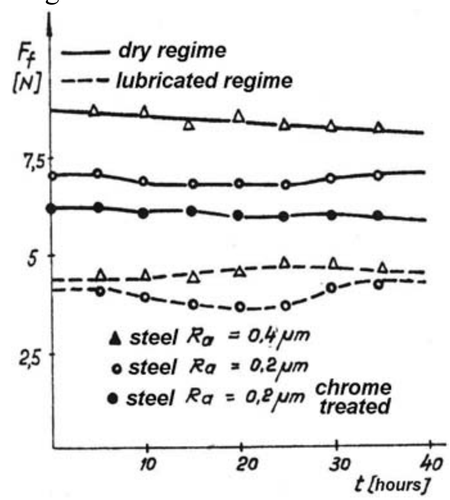

Fig. 6

Frictional force evolution for prescribed tightening value

First observation is that the friction force has a very little variation in time, being almost constant during the test.

It can be observed that in steel rod case, with same roughness degree, the friction force has higher values than in bronze rod case, both in fluid and in dry lubricating regime.

In figure 7 it can be observed that in both steel and bronze rod case the friction force is decreasing with decreasing of the roughness degree. In lubricated rod case, decreasing the roughness below Ra=0.2 μm, the friction force value remain almost constant because of the transportation of lubricant fluid outside during the movements of the rod.

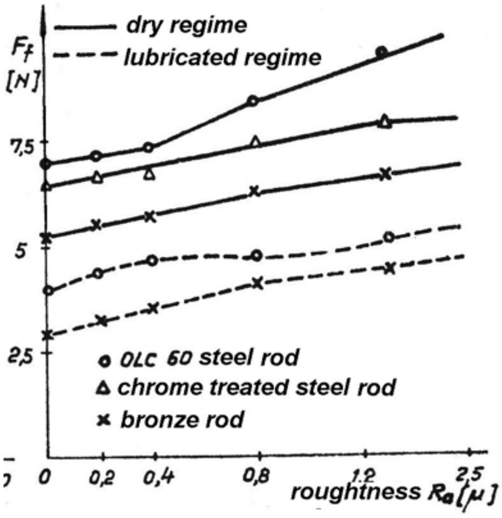

Fig. 7

Frictional force evolution by roughness value

Another influencing factor is the obtaining technology of the rod surface, at same roughness degree, because of the grooves comparing with the sealing direction.

Of course the wear of the gasket is in dependency with same factors as the friction force, and supplementary being involved some parameters depending to the gasket material.

4. Conclusions

The researches regarding the behaviour of that tightening are in development. Efficacity of selas is in dependence by elastics rubber characteristics and tightening force, but reliability is in dependence by friction force factors as tribosistem shaft-gasket with his characteristics and the air pressure.

5. References

1 Falticeanu C. - Some experimental results on rotary cuff sealing behaviour. Tribotehnica'82, Ploiesti

2 Falticeanu C. – Researches on efficiency and durability of translation cuff sealing in pneumatic drivers.Bulletin of Politechnic Institute, Iasi 1988.

3 Falticeanu C.- Researches upon the tribological proceses from the translation cuff sealing in pneumatic devices. Tribotehnica' 90 Cluj Napoca 1990.