Examples of Reciprocal Motion Applications of LFR SEAL™

1. Introduction

Since its development and launch as a low-torque seal for rotary applications, LFR SEAL™ has been used mainly in the circular tables of machine tools, and has received a good reputation with our customers. In order to further expand the application of LFR SEAL™, we have considered the application of LFR SEAL™ as a seal for reciprocating machinery. In this report, we introduce the results of evaluating LFR SEAL™ by air pressure under reciprocating motion test conditions.

2. Features of the LFR SEAL™ low-torque seal for rotary applications

2-1) Design concept

The design concept of the LFR SEAL™ is shown in (1)-(5). This concept solves the problem of conventional rotary seals, which has been a challenge. Figure 1 shows the structure of the LFR SEAL™. The base material is an elastomer with excellent elasticity, and the sliding surface is covered with a low-friction resin material, which is simultaneously molded into a single structure.

Design concept

(1)Small space
In consideration of versatility, the seal mounting groove is the same as the groove dimensions of the standard O-ring for motion (JIS B 2401-1 P series). It is smaller in space than conventional slipper seals.

(2)Low-torque
Low-torque was realized by placing a resin material with a low coefficient of friction on the sliding surface with the axis, and by designing a unique shape.

(3)Improvement of pressure resistance
In order to prevent the seal from protruding into the gap between the axis and the seal, the shape of the seal is designed to prevent protrusion, thereby improving pressure resistance.

(4)Longer life
(2) Low-torque and (3) improvement of pressure resistance achieved longer life.

(5)Improvement in ease of installation
The seal has a double pressure seal shape with no specific direction to prevent incorrect installation. By making it a single structure of elastomer and resin material, it has the equivalent ease of installation as an O-ring.
installation as for O-rings.

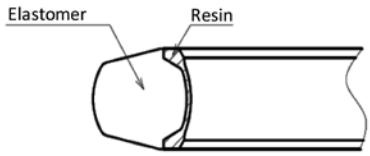

Figure1 Structure of LFR SEAL™

2-2) Comparison of rotational torque

The specifications of LFR SEAL™ and rotary torque comparison packing are shown in Table1. The packing is for axis diameter of ϕ30mm, and it was measured at a rotational speed of 100 rpm and air pressure of 0 to 0.5 MPa.

The results of rotational torque measurement are shown in Figure2. It can be confirmed that LFR SEAL™ has low-torque compared to O-rings and U-packings.

Table1　Specifications of comparison packing

No.	Comparison packing (Model)	Cross-sectional shape	Material
①	LFR SEAL (LFR30)		NBR + PTFE with filler
②	O-ring (P30)		NBR
③	U-packing (UPR30)		NBR
④	Σ-ring (For ϕ30)		NBR + PTFE with filler
⑤	X-ring (R30)		NBR

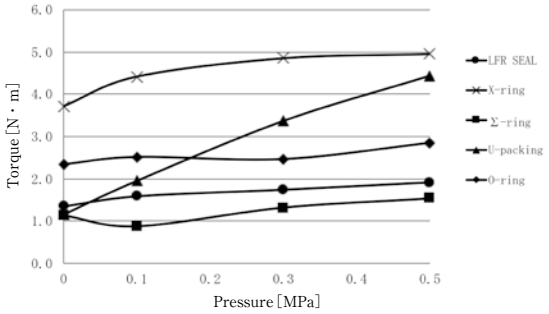

Figure2　Measurement results of rotational torque

3. Reciprocating motion test conditions

The specifications of LFR SEAL™ and comparison packings are shown in Table2. The packing was for axis diameter of ϕ30mm. The evaluation packings were the same type as the packings used in the rotational torque measurement in section 2-2). The evaluation test conditions are shown in Table3, and the schematics of the testing machine is shown in Figure3.

Table2　Specifications of comparison packing

No.	Comparison packing (Model)	Cross-sectional shape	Material
①	LFR SEAL (LFR30)		NBR + PTFE with filler
②	O-ring (P30)		NBR
③	U-packing (UPR30)		NBR
④	Σ-ring (For ϕ30) (Composite packing of O-ring and PTFE resin processed product)		NBR + PTFE with filler
⑤	X-ring (R30)		NBR

Table3　Evaluation test conditions

Item	Conditions
Shaft diametar	ϕ30mm
Stroke	200mm
Speed	150mm/s
Gas	Air
Pressure	0.5MPa
Motion	200mm stroke、4,500cycle
Lubrication condition	Apply grease to the packing and shaft. For your reference : Amount of grease 10cc/packing per 1pc Apply a thin layer of grease to the shaft.

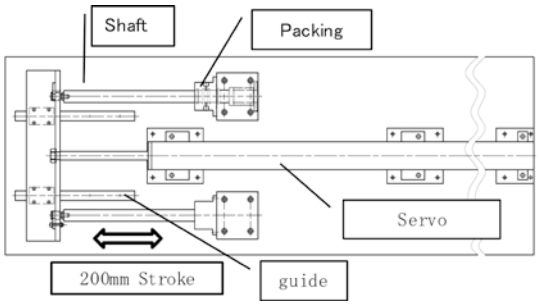

Figure3　Schematics of the testing machine

The sliding of the axis is designed to reciprocate with a servo cylinder (STP servo cylinder manufactured by Horiuchi Machinery). The groove size of each packing is designed to match the groove size of each evaluation packing.

4. Reciprocating motion evaluation test results

The results of the characterization are shown in Table4. The measurement results of leakage amount and sliding resistance are shown in Figures4 and 5.

The amount of leakage of LFR SEAL™ was small at less than 0.05 cc/min, and it was confirmed that it could be used under reciprocating conditions. In addition, at low air pressure, the sliding resistance of LFR SEAL™ was larger than that of U-packing and other comparable products.

Table4 Characterization results

No.	Comparison packing	Leakage (Standard leakage Compared with 3.4cc/min or less)	Sliding resistance (Compare with U-packing)	Presence of stick-slip	exothermic temperature [℃] ※1
①	LFR SEAL	Good	Large	None	25℃
②	O-ring	Good	Large	None	25℃
③	U-packing	Good	—	None	26℃
④	Σ-ring	Good	Large	None	26℃
⑤	X-ring	Good	Large	None	26℃

※1 Ambient temperature of testing machine : 23℃

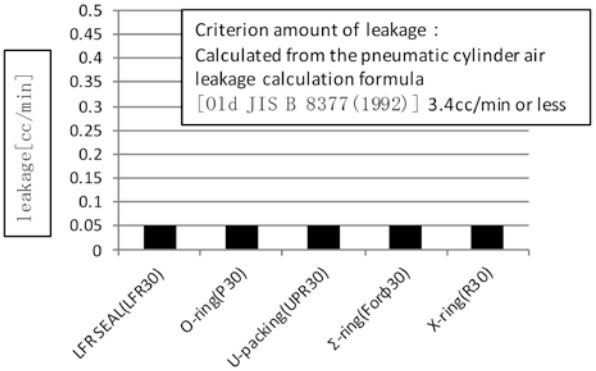

Figure4 Leakage measurement results

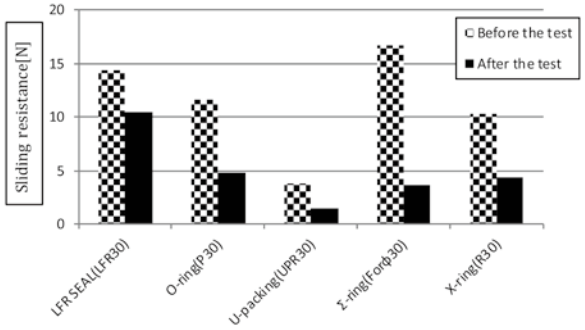

Figure5 Measurement results of sliding resistance

5. Summary

We believe that LFR SEAL™ can be used as a seal for reciprocating motion without any sealing problems. However, since the design concept of LFR SEAL™ is such that it can be used for hydraulic pressure at 14 MPa without protrusion, the sliding resistance value may be large when used for air pressure applications.

6. Conclusion

In this report, we introduced the evaluation results of LFR SEAL™ under air pressure and reciprocating conditions. We are also planning to do an evaluation test under hydraulic pressure and reciprocating conditions. In the future, we are planning to conduct evaluation under high-pressure hydraulic environment, which is LFR SEAL™'s specialty, and introduce examples of its use in reciprocating motion, so please look forward to it. If you are interested in LFR SEAL™ as a rotary seal, reciprocating seal, or "rotary & reciprocating" seal, please contact your nearest LFR SEAL™ sales representative.

7. References

1) Akihiro Nagano: VALQUA Technical Journal, No.30, 9-13 (2016)
2) Low Friction Seal for VALQUA Rotation, Catalog, LA08, (2017)

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