FACTORS THAT AFFECT LINEAR FORCE VALUES WHILE MEASURING THE FRICTION OF BAL SEAL SPRING-ENERGIZED SEALS

Technical Report
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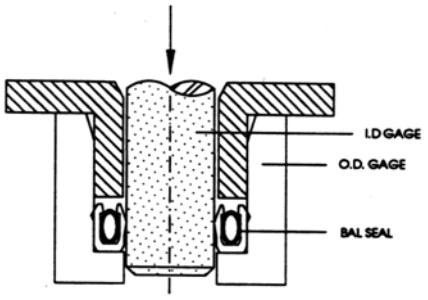
1.0 SUMMARY

Bal Seal Engineering Company provides computer printouts of the individual forces of BAL™ Seals measured during inspection for an additional fee. This report discusses some of the factors that affect the linear force values. These factors include gage speed; the surface finish of the gage; the hardness of the gage; the extent, or lack, of lubrication; gage tolerances and temperature.

2.0 LINEAR FORCE MEASUREMENT METHODS

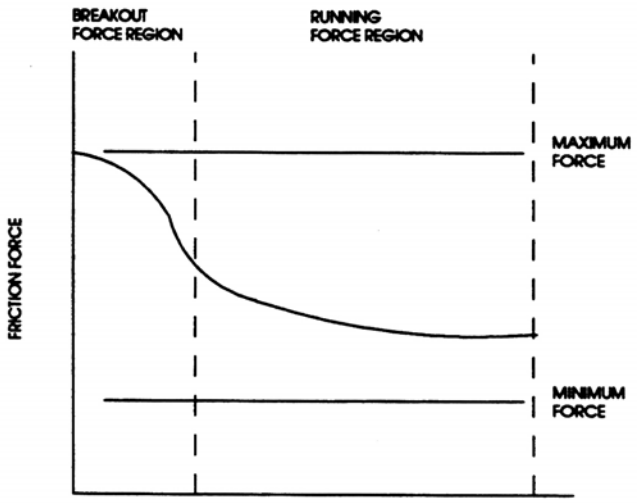
The method used to measure the linear force of BAL™ Seals is shown in Figure 1. All tests are run non-lubricated under the parameters indicated. The ID gage is wiped with a lint-free towel and actuated three times before each seal force is measured. The weight of the ID gage is added to the linear force measurement.



Bal Seal Linear Force Testing Procedure
FIGURE 1

Force Testing Parameters	
I.D. Gage Speed	= 4 in/min (10.2 cm/min)
I.D. Gage Travel	= 0.5 in (1.3 cm)
Number of Readings	= 5 point per second
I.D. Gage Surface Finish	= 4 to 7 microinches Ra
I.D. Gage Material	= 0il Hardening Tool Steel
I.D. Gage Hardness	= 60 Rc
I.D. Gage Tolerance	= +0.0000/0.0005 in (+0.0000/0.0127 mm)
O.D. Gage Tolerance	= +0.0010;/-0.000 in (+0.0250/-0.0000 mm)
Temperature	= 74°F ± 2°F (23°C ± 1°C)

A computer records the force required to move the gage and plots it as a function of distance traveled. Force readings are divided into two regions: the breakout force region and the running force region. The breakout force region is defined as the first 20% of gage travel. The running force region is defined as the last 80% of gage travel. These parameters have provided reliable and consistent seal force results.



Typical Breakout and Running Friction Forces as Measured Over a 0.500 Inch Linear Travel
FIGURE 2

3.0 FACTORS THAT AFFECT LINEAR FORCE VALUES

The linear force of BAL Seals may vary considerably when tested under conditions that do not conform to BAL Seal Engineering force testing parameters. Following is a discussion of several factors that may affect force values.

3.1 Gage speed

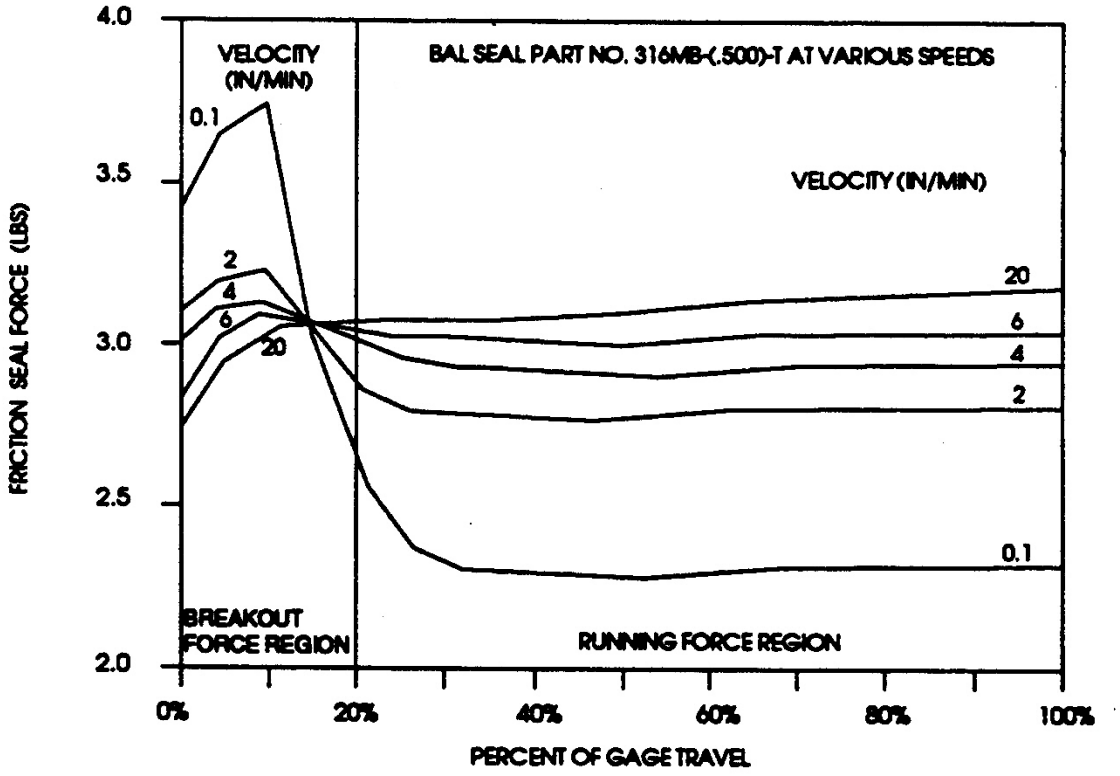
Testing has been conducted at Bal Seal Engineering to determine the effect of gage speed on measured linear force values. The testing was conducted per the procedure and parameters indicated in Figure 1 except that the gage speed was varied from 0.1 to 20 in/min.

3.1.1 Breakout force

Breakout force values are affected by the gage speed during force testing. Results (see Figure 3) show that as the gage speed increases, the breakout force values decrease. This means that linear force testing done at a speed of other than 4 in/min, the gage speed used in BAL Seal testing, will provide different results.

3.1.2 Running force

Running force values are also affected by the gage speed during force testing. Results (see Figure 3) show that as the gage speed increases, the running force values increase. This means that linear force testing done at a speed of other than 4 in/min, the gage speed used in BAL Seal testing, will provide different results.



The Effect of Gage Speed on Breakout and Running Friction Values
FIGURE 3

3.2 Gage surface finish

In general, the better the surface finish of the gage, the lower the linear force values. Force testing with gages that have higher or lower surface finish values than BAL Seal gages will produce different results.

3.3 Gage hardness

In general, the greater the hardness of the gage, the lower the adhesion between the BAL Seal and the gage. Reduced adhesion produces lower friction values. Force testing with gages that have a higher or lower hardness than BAL Seal gages will produce different results.

3.4 Lubrication

All BAL Seal testing is performed under non-lubricated conditions. Gages are wiped clean before each test with a lint-free towel. The presence of lubrication between the BAL Seal and the gage will produce lower friction values than those obtained during Bal Seal Engineering testing.

3.5 Temperature

Bal Seal Engineering Company performs force testing in a controlled temperature environment. PTFE-based seals are subject to dimensional changes due to temperature fluctuations. Force testing at temperatures outside of Bal Seal Engineering temperature parameters will produce different results.

4.0 CONCLUSION

Bal Seal Engineering force testing parameters are carefully controlled to insure consistent seal force testing results. In general, force testing which does not conform to all Bal Seal Engineering force testing parameters will produce different results. For any question or comments regarding Bal Seal Engineering's optional seal force testing procedure, contact the technical sales department.

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