OPTIONAL QUALITY ASSURANCE PROCEDURES AND DOCUMENTATION

Technical Report
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1.0 DISCUSSION

BAL™ Seal springs, seal assemblies, and bar stock are inspected for certain dimensions and quality. As to Bal Seal Engineering's standard quality control procedures, various types of optional quality control procedures and documentation are available at extra cost to meet specific customer requirements.

The following procedures are available:

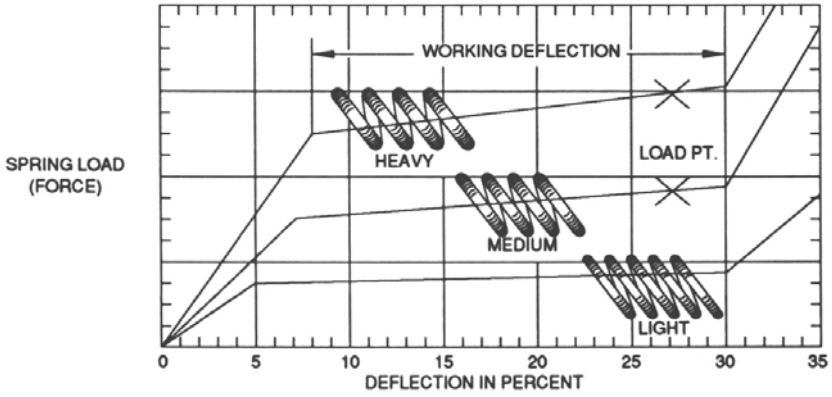
- Measuring the seal force of each individual seal and providing a computer printout
- Measuring the force of each spring and providing a computer printout
- Batch analysis of the seal forces by lot and providing a computer printout
- Batch analysis of all spring forces by lot and providing a computer printout
- Counting the number of coils on each spring
- Analyzing the weld of each spring weld
- Reporting spring wire tensile and elongation with support charts
- Other customer requirements

2.0 SEAL FRICTION FORCE TESTING

Force testing can be implemented as part of the quality control procedure in order to maintain greater consistency to achieve customer seal requirements. A specified seal force may be met by changing to a load spring having a higher or lower force, depending on requirements. BAL Seals are available in various spring forces, such as light, medium, and heavy, and the force determines to a great extent the sealing ability, friction, and seal life.

Figure 1 shows three springs, which typify the unique properties of BAL Seal canted-coil springs. Note that an increase in deflection does not cause a proportional increase in load, but rather the force tends to remain relatively constant over a wide deflection range (in this case, from 5% to 30%). This allows for variations due to wear, eccentricities, tolerance variations, and other irregularities and at the same time maintain essentially the same spring force.

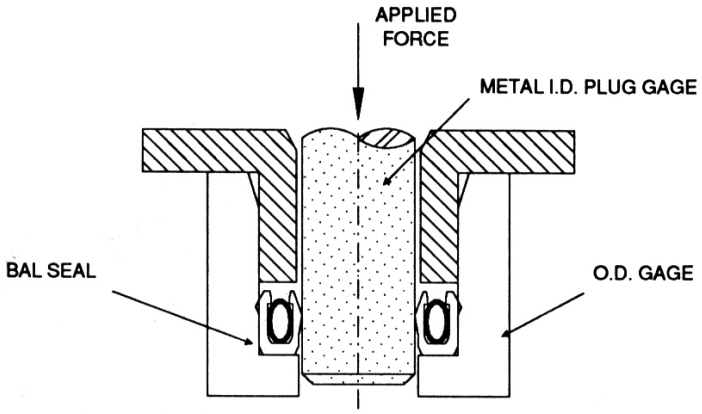
BAL™ SEAL PARTS AVAILABLE TO MEET MOST FRICTION FORCE OR TORQUE REQUIREMENTS.



Various Types of Springs with Variable Force
FIGURE 1

2.1 Method used to measure frictional seal force

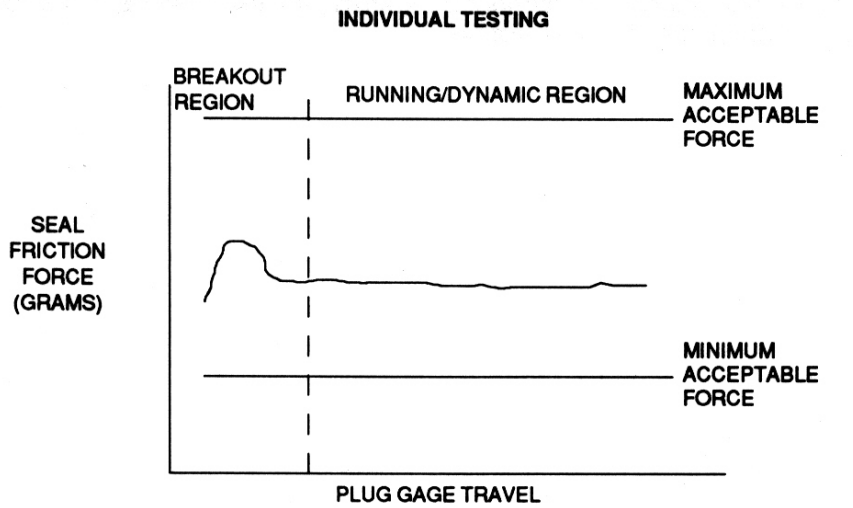
To measure seal force on the I.D., a plug gage (or customer-supplied gage) is passed through the I.D. of the seal. (See Figure 2). A similar method is used for measuring the OD seal frictional force. A computer reads the load to move the plug and plots it as a function of the time or distance traveled. The average force is then saved for a batch analysis. Maximum and minimum force values are also supplied.



Schematic Showing Seal Force Testing Procedure
FIGURE 2

2.2 Individual seal test results

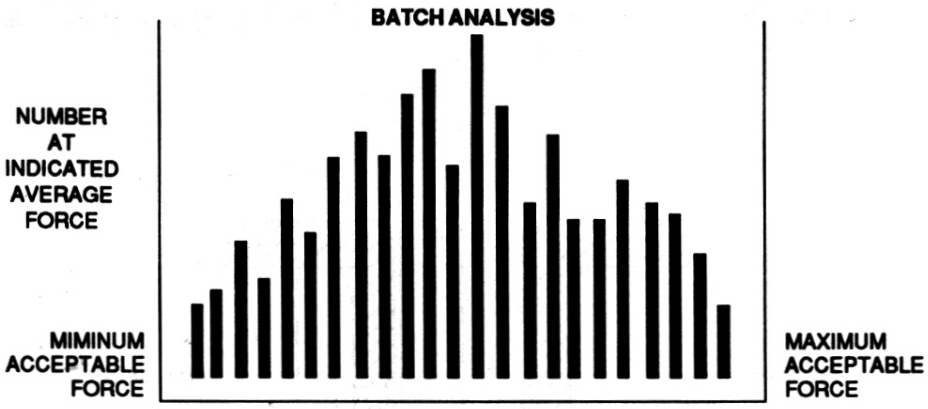
A computer readout shows the seal force measured while moving the plug gage at specified rate (Figure 3). The seal force, measured in grams, is plotted as a function of distance traveled. The test is based on a pass/fail mode. The seal will pass if the force falls within the specified tolerance range per the acceptance criteria noted below.



Individual Testing of Each Seal Force vs. Stroke in Percentage
FIGURE 3

2.3 Batch analysis of seal forces

A computer readout of the average force values of the seals after individual testing is shown in Figure 4. It points out the developed seal forces of the entire batch within the maximum/minimum force tolerances.



Batch Analysis of Seals Tested
FIGURE 4

2.4 Method used to measure radial frictional spring force

To measure radial spring force on the ID, a plug gage (or customer-supplied gage) is passed through the ID of the spring (see Figure 5). A computer reads the load to move the plug and plots it as a function of the time or distance traveled. The average force is then saved for a batch analysis. Maximum and minimum force values are also supplied.

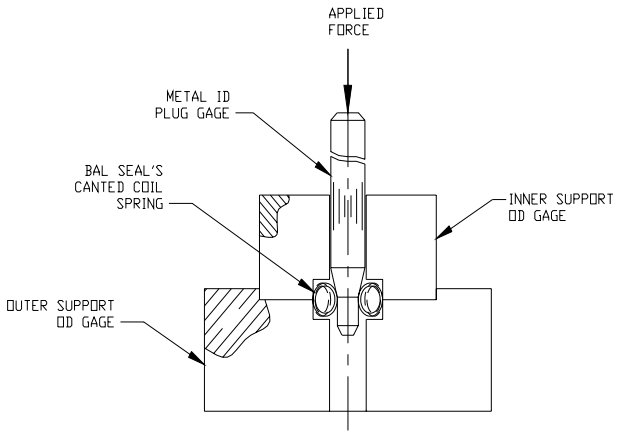


Figure 5

2.5 Individual spring test results

A computer readout shows the spring force measured while moving the plug gage (Figure 6). The spring force, measured in grams, is plotted as a function of a distance traveled. The test is based on a pass/fail mode. The spring will pass if the force falls within the specified tolerance range per the acceptance criteria noted below.

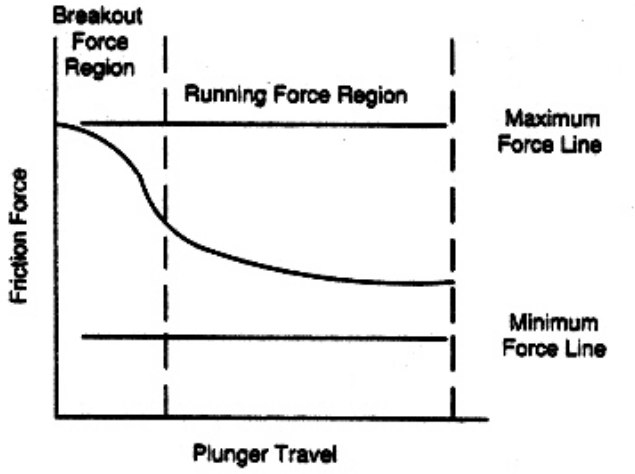


Figure 6

2.6 Batch analysis of spring forces

Bal Seal Engineering Company supplies a batch analysis (Figure 7) with each shipment of springs having a force requirement. A computer readout of the average force values of the springs after individual testing is shown in Figure 7. It points out the developed spring forces of the entire batch within the maximum/minimum force tolerances.

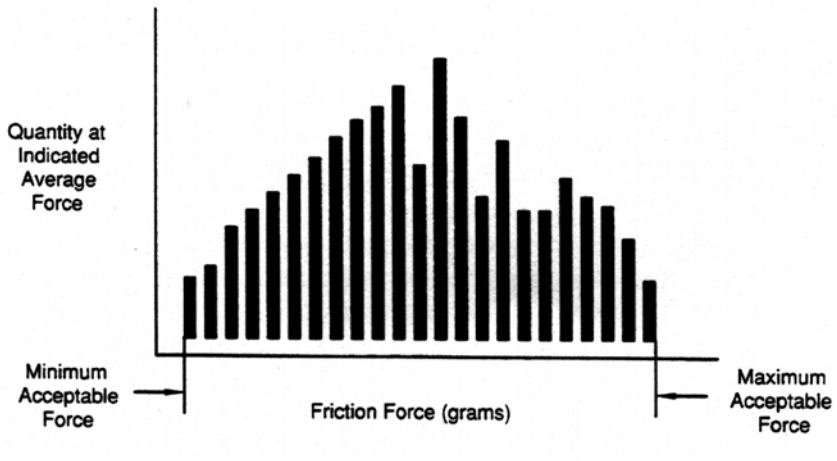


Figure 7

3.0 QUALITY CONTROL OF BAL™ SEAL SPRINGS

Dimensional inspection and visual inspection of the weld can be supplemented by computerized friction force testing of individual springs; batch analysis of spring forces for an entire lot; counting of spring coils, microscopic weld analysis; tensile and elongation data of spring wire, etc.

4.0 PTFE AND PTFE COMPOSITION TENSILE, ELONGATION AND SPECIFIC GRAVITY

The above mechanical properties can be furnished on the products being supplied by making and testing specimens from the material to be used in the fabrication of our products per ASTM and Bal Seal Engineering's general specifications.

Consult our technical sales department concerning the establishment of quality assurance procedures, testing and documentation.