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Application News

Dynamic and Fatigue Testing Machines Servo Pulser EHF-EV100k1A/2A

Accurate Measurements of Micro-Displacements in a Compression Fatigue Test of a Gasket

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User Benefits

- The Servo Controller 4830 enables high-precision dynamic control.
- A compression plate displacement measuring device allows accurate measurements of micro-displacements of a few µm and sample displacements and excludes the deflections of the testing machine.

■ Introduction

Gaskets are sealants that prevent the leakage of gases and liquids inside metal pipes and the entry of foreign substances. They are used in various applications, such as automobile engines and chemical and power plants. In the case of an automobile engine, the pressure of combustion gases generated during operations is repeatedly applied. So resistance to the internal pressure is important, which is why gaskets are evaluated by compression tests. Gaskets used in automobiles are typically 1–1.5 mm thick, and the displacement is expected to be a few µm when such samples are compressed.

If the displacement of a sample in a compression test is small, it is not desirable to evaluate the actuator stroke of the testing machine as the displacement of the sample. This is because the stroke displacement of the actuator includes the deformation of the load cell and test jig. In this article, a compression fatigue test of a gasket was carried out by attaching a compression plate displacement measuring device capable of measuring micro-displacements to the dynamic and fatigue testing machines servo pulser. The displacement data obtained from the compression plate displacement measuring device was approximately 1/3 of the stroke displacement, which enabled measuring the displacement of the sample with greater accuracy.

■ Measurement System

Dynamic and fatigue testing machines servo pulser EHF was used for the measurements. A specimen consisting of a Φ50 mm compression plate (spacer) and a gasket sample was placed between Φ200 mm spherical seat compression plates. Spherical seat compression plates can apply a uniform load to the specimen because the compression plate surface is adjusted to match the parallelism of the upper and lower surfaces of the specimen. In addition, a compression plate displacement measuring device was used to measure more accurately the displacement of the specimen. Since the stroke displacement includes the deformation of load cells, actuators, test jigs, etc., it is not considered to be suitable for the measurement of micro-displacements such as in this case. In this test, displacement gauges were installed at two locations on the left and right sides of the compression plates, and the average value was used to measure the change in the distance between the compression plates. This allowed for the displacement of the center of the compression plates (the center of the specimen) to be measured even when the compression plates were slanting against the specimen. The test equipment is listed in Table 1 and shown in the photographs in Fig. 1.

Table 1 Test Equipment

Dynamic and Fatigue Testing Machine	:	Servo Pulser EHF-EV100k1A
Load Cell	:	100 kN
Compression Plate	:	Φ200 mm (upper) Φ200 mm (lower)
Actuator Stroke	:	±25 mm
Compression Plate Displacement Measuring Device	:	2 mm (Full Stroke)

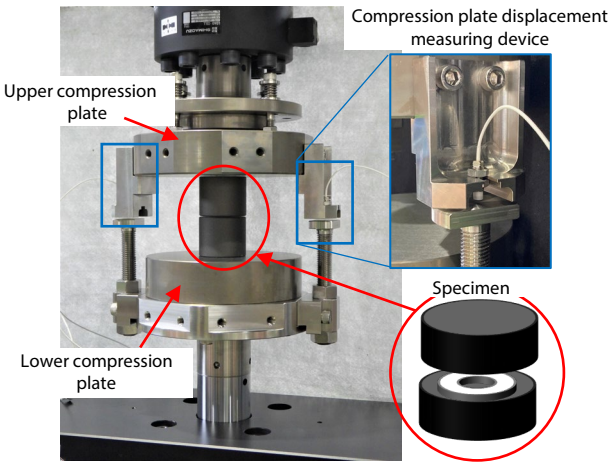

Fig. 1 Test Equipment

■ Measurement Conditions

Force was repeatedly applied to the specimens, and the stroke and displacement gauge value were compared. Table 2 shows the measurement conditions, and Fig. 2 shows the force waveform at cycle 1000.

Table 2 Measurement Conditions

Waveform	:	Sine wave
Controlled System	:	Force
Maximum Force	:	1 kN
Minimum Force	:	0.1 kN
Frequency	:	10 Hz

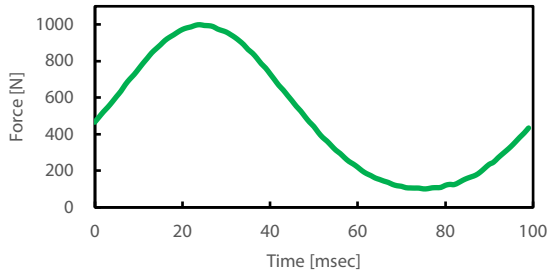

Fig. 2 Force Waveform over Time

■ Measurement Results

Fig. 3 shows the stroke and displacement gauge waveforms at cycle 1000, and Table 3 shows the peak values of each waveform. The tests confirmed that at the maximum value, the stroke was about three times larger than the displacement gauge value. This was because the displacement gauge only measured the change in the distance between the compression plates, while the stroke measured the deformation of the jig, etc. Therefore, the measurement points were different. The test demonstrated that the displacement gauge can measure the deformation of a specimen more accurately than the actuator stroke when measuring a displacement of a few µm to tens of µm.

Table 3 Peak Values of Stroke and Displacement Gauge Waveforms

	Minimum Value [µm]	Maximum Value [µm]
Stroke	12.3	32.1
Displacement Gauge	7.4	12.4

■ Conclusion

In this article, compression fatigue tests of gaskets were performed using a compression plate displacement measuring device to compare the stroke waveform with that of the displacement gauge. The stroke displacement was about three times larger than the displacement gauge value because the stroke included the deformation of jigs and other objects. On the other hand, a compression plate displacement measuring device can measure micro-displacements more accurately than an actuator stroke because it does not include the deformation of the jigs, etc., making it a suitable device for measuring gaskets.

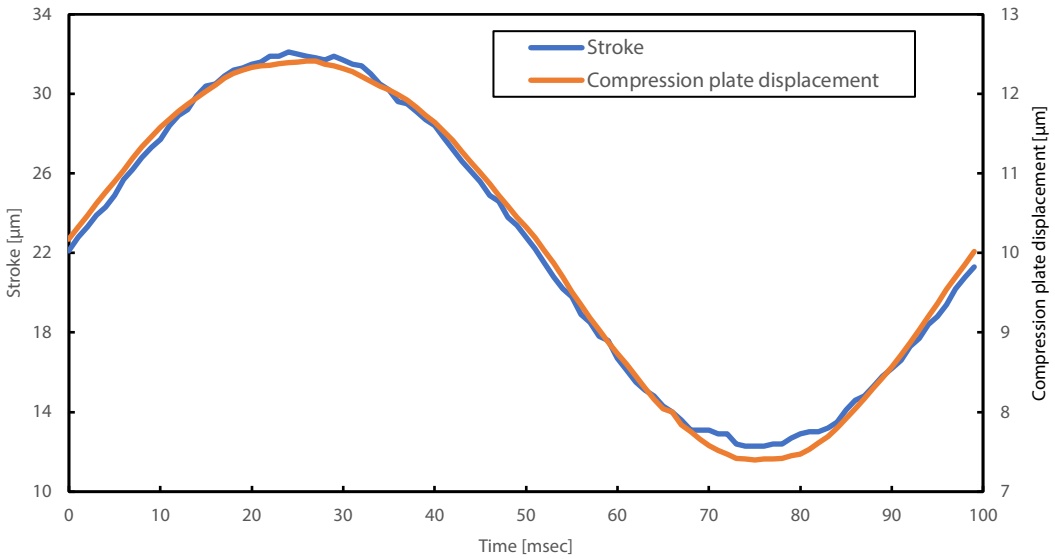

Fig. 3 Displacement Waveform over Time

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