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Application News

Fatigue and Endurance Testing Machine EMT-1kNV-50/30

Improvement of Test Control of Fatigue Testing Machine Subject to Horizontal Load using a Gas Bearing

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User Benefits

- Improvement of test control when the testing machine is subject to horizontal load.
- Tests according to the ASTM F384 standard can be performed with accurate control.

Introduction

In fatigue testing, samples are cyclically loaded with different patterns, directions, frequencies, and magnitudes to simulate the in-use conditions of mechanical components. In some cases, a load perpendicular to the actuator's movement direction (horizontal force) is applied, depending on the test. In such conditions, frictional forces occur in the actuator's internal bearing, and achieving smooth test control becomes difficult.

A newly developed gas bearing has been employed instead of the traditional standard bearing, resulting in smoother test control. In this article, an electromagnetic fatigue testing machine was loaded with a horizontal load, and the output waves obtained using a standard bearing and a gas bearing were compared to evaluate the control accuracy.

Fig. 1 Fatigue Testing Machine

Testing Equipment

Tests were conducted with an electromagnetic-type fatigue testing machine. These testing machines are equipped with an electromagnetic actuator having an extremely high frequency response, allowing for highly precise fatigue tests (the controller was a Controller 4830). The testing machine was equipped with a standard (oil-less) and a gas bearing. In gas bearings, pressurized air creates a thin gas layer between the actuator and the bearing, reducing the friction caused by lateral forces and improving the test control accuracy.

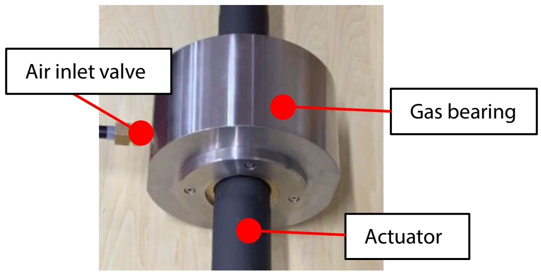

Fig. 2 Gas Bearing

Experimental Procedure

Tests were conducted using the conditions shown in Table 1 to evaluate the effect of the gas bearing on the control accuracy. As shown in Fig. 3, a 100 N horizontal force was applied to the actuator with a weight and pulley. The tests were stroke-controlled with a sinusoidal load path. The details of the tests are shown in Table 1, and the test results are shown in Fig. 4. Although the maximum and minimum set values were applied correctly, the actuator return movement was delayed when using the standard bearing. In the case of the gas bearing loaded with pressurized air at 0.5 MPa, the movement of the actuator appears smoother. When the air pressure was increased to 0.65 MPa, the stroke signal assumed a shape close to an ideal sine wave.

Table 1 Testing Conditions for the Gas Bearing Evaluation

Waveform	Sine wave
Control	Stroke
Max. Stroke	1 mm
Min. Stroke	-1 mm
Test Frequency	1 Hz
Horizontal Load	100 N
Bearing	Standard Bearing Gas bearing (0.5 MPa, 0.65 MPa)

■ ASTM F384 Compression Bending Test

Tests were conducted using jigs for orthopedic fracture fixation devices according to the ASTM F384 standard. A photograph of the apparatus employed is shown in Fig. 5. In the ASTM F384 test, the specimen is tilted, and the actuator is subjected to both vertical and horizontal components of the force. A test with a maximum force of 50 N and a stress ratio of 0.1 was conducted. The details of the tests are shown in Table 2. The waveform obtained using the gas bearing loaded with 0.65 MPa is the closest to an ideal sinusoidal waveform, similar to the previous test data shown in Fig. 4.

■ Conclusions

These tests compared the output wave (stroke and force) of a testing machine subject to horizontal load when using a standard and an air bearing. In the case of the standard and the gas bearing loaded with pressurized air at 0.5 MPa, the actuator movement was not smooth due to the friction caused by the lateral force. However, when the air pressure was raised to 0.65 MPa, the output wave resulted in an ideal sinewave. Therefore, when conducting tests where horizontal forces occur (such as the ASTM F384), using a gas bearing allows accurately controlled tests to be conducted.

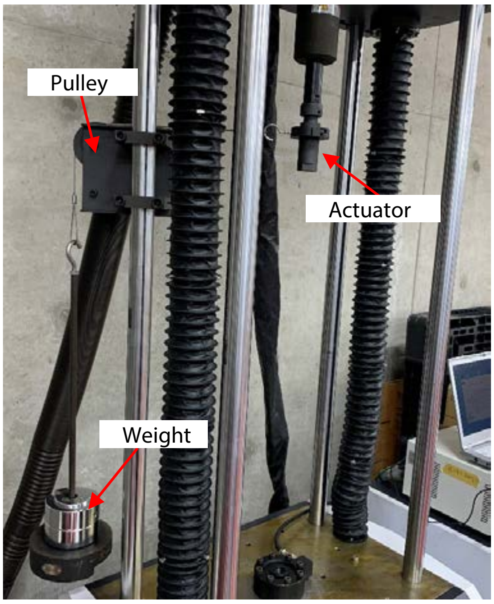

Fig. 3 Application of Horizontal Load to the Testing Machine

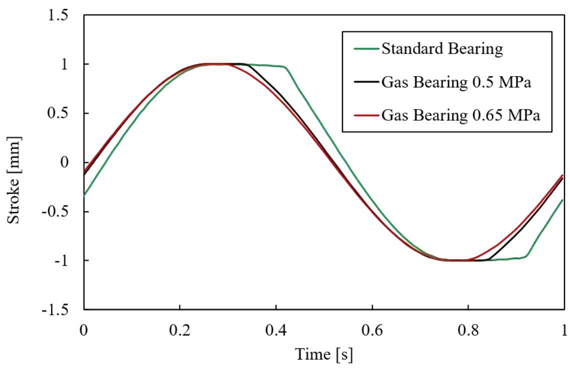

Fig. 4 Test Results

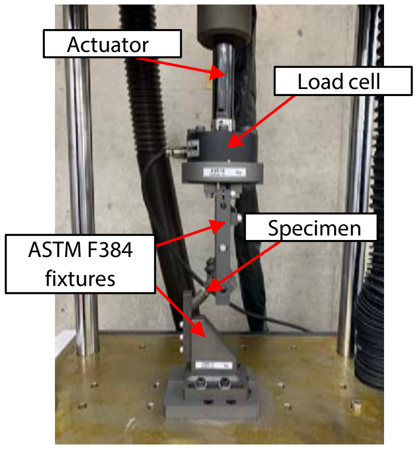

Fig. 5 ASTM F384 Bending Compression Test

Table 2 Test Conditions for ASTM F384 Bending Compression Test

Waveform	Sine wave
Control	Force
Maximum Load	50 N
Stress Ratio	0.1
Test Frequency	1 Hz
Bearing	Standard bearing Gas bearing (0.65 MPa)

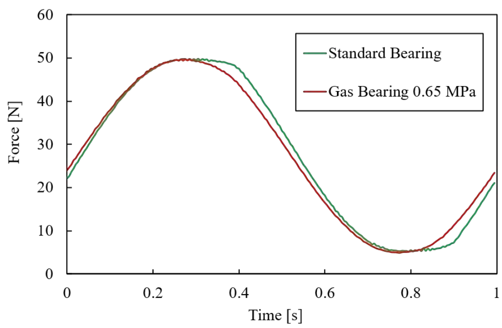

Fig. 6 Test Results

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01-00292-EN First Edition: Mar. 2022