

# Application News

## Fatigue Test of Small Metal Specimen

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### User Benefits

- ◆ Use of the Microservo MMT series of magnetic micro testing system enables evaluation of the fatigue and durability of small specimens.
- ◆ High-accuracy dynamic control can be achieved by using the Servo Controller 4830.

### Introduction

Fatigue tests are tests to evaluate the fatigue life of materials, in which cyclical loading is applied repeatedly to the material. Considering the risk of a serious accident if fatigue fracture occurs, fatigue tests are indispensable for developing highly reliable products.

This article introduces a fatigue test of a small aluminum alloy test specimen using an MMT-250NV-10 Microservo magnetic micro testing system. The MMT series has the advantages of high-speed, high-accuracy control of small test forces and displacement, and is suitable for fatigue testing of small test specimens.

### Test Specimen and Test Jig

As a small specimen of a metallic material, a specimen of aluminum alloy A1050 was prepared. A Microservo magnetic micro testing (MMT) system was used in the test. Fig. 1 and Fig. 2 show the geometry of the specimen and the condition of the test, respectively. In this experiment, a modified prototype jig that allows easy gripping of small specimens was used.

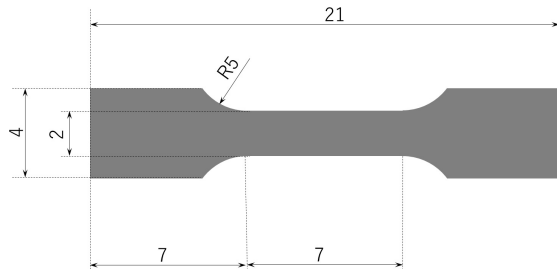


Fig. 1 Specimen Geometry (Thickness: 0.5 mm)

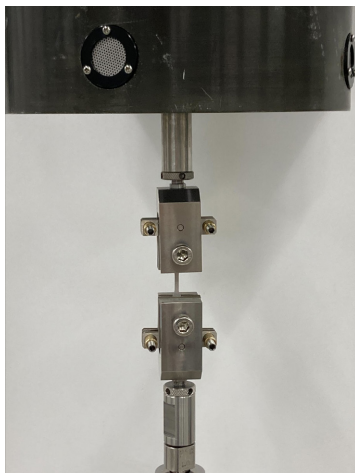


Fig. 2 Condition of Fatigue Test

### Static Tensile Test Results

In order to set the conditions for the fatigue test, first, a static tensile test was conducted using an AGX™-10kNV2 precision universal testing machine\*1. Table 1, Table 2, and Fig. 3 show the instrument configuration, test conditions, and stress-displacement diagram, respectively. As a result of the test, the average value of tensile strength was 262 MPa. The conditions of the fatigue test were set based on this value.

Table 1 Instrument Configuration

Instrument	: AGX-10kNV2
Load cell	: 1 kN
Software	: TRAPEZIUM™X-V
Test jig	: Grip for small test piece (prototype)

Table 2 Test Conditions

Test speed	: 1 mm/min
Number of tests	: n = 3

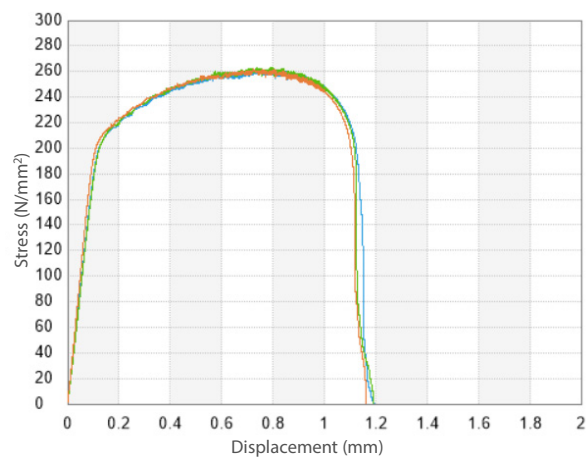


Fig. 3 Stress-Displacement Diagram

\*1 Since the maximum test force of the A1050 test piece prepared for these measurements was larger than the capacity of the instrument owned by this company's laboratory, this time, the AGX-V2 and MMT-250NV-10 were used as appropriate. By using the MMT-500NV-10, all measurements could be carried out with one instrument.

## Fatigue Test Results

Table 3 and Table 4 show the instruments used in the test and the fatigue test conditions, respectively. Six conditions from 70 % to 90 % of the tensile strength in the static tensile test were set as the maximum applied stress in the fatigue test.

As an example of the test waveform in the fatigue test, Fig. 4 shows the waveform of the 1000<sup>th</sup> cycle at the maximum applied stress of 236 MPa. From Fig. 4, the waveform has become a stable sine wave, indicating that satisfactory control is possible. Fig. 5 shows the S-N diagram.

Table 3 Instrument Configuration

Instrument	: MMT-250-NV-10
Load cell	: 250 N
Control device	: Servo Controller 4830
Software	: Windows software for 4830
Test jig	: Grip for small test piece (prototype)

Table 4 Fatigue Test Conditions

Maximum applied stress	: 70, 73, 75, 80, 85, 90 % of tensile strength (183 MPa - 236 MPa)
Stress ratio	: 0.1
Frequency	: 30 Hz

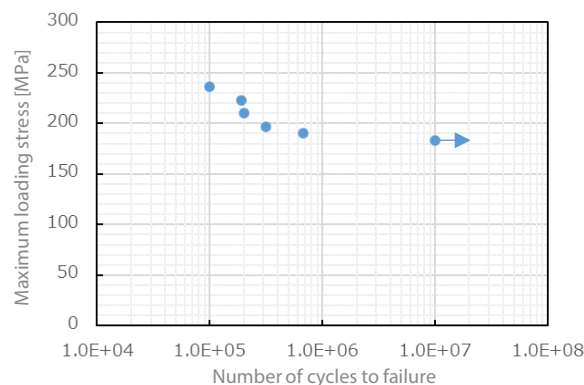


Fig. 5 S-N Diagram

## Conclusion

A small metal test specimen was prepared using aluminum alloy A1050, and a fatigue test was conducted. Satisfactory control was possible by using a Microservo magnetic micro testing system and a grip for small test pieces.

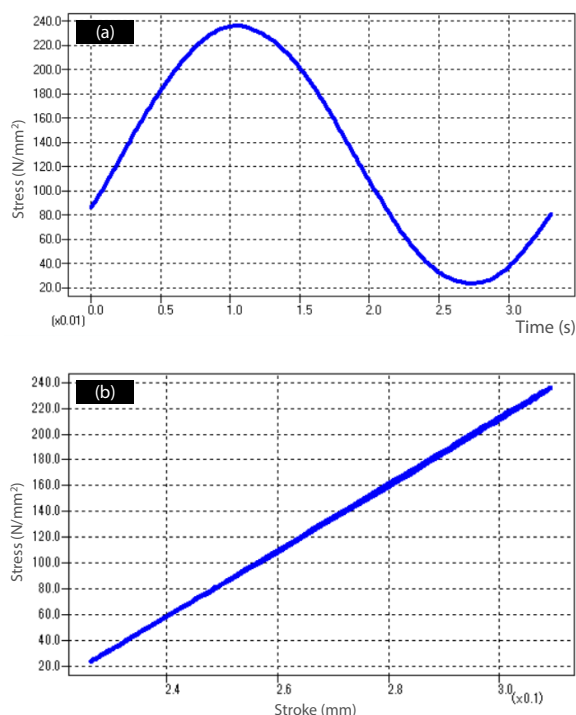


Fig. 4 (a) Stress vs. Time at 1000<sup>th</sup> Cycle,  
(b) Stress vs. Stroke at 1000<sup>th</sup> Cycle

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› **Microservo MMT Series**  
Magnetic Micro Testing System



› **4830 Controller**  
Servo Controller for Fatigue and Endurance System

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