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EHF-L Servopulser Table-Top Fatigue and Endurance Testing Machine

Application News

Dynamic Fatigue Test of Endosseous Dental Implant

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User Benefits

- Dynamic fatigue tests of endosseous dental implants conforming to ISO 14801 : 2016 and JIS T 6005 : 2020 can be conducted.
- High-accuracy dynamic control is possible by using the Servo Controller 4830.

■ Introduction

Endosseous dental implants consist of a tooth root part (implant body), an abutment which is attached to the implant body, and an artificial tooth, and are implanted in the bone of the jaw where a tooth has been lost. A titanium screw is generally used in the implant body. Although a fatigue test method for endosseous dental implants is provided in JIS T 6005 : 2020, this is not related to the fatigue characteristics of the component materials of endosseous dental implants, but rather, describes effective methods for comparing implants with various designs or dimensions [1].

This article introduces an example of a test using a tensile test jig conforming to JIS T 6005 : 2020.

■ Measurement System

The test material used here was a dummy test piece fabricated from an aluminum alloy. Fig. 1 shows the condition of the test. JIS T 6005 : 2020 specifies that the test piece shall not be constrained in the lateral direction during loading. Therefore, a thrust plate with a bearing must be used. Table 1 shows the instrument configuration.

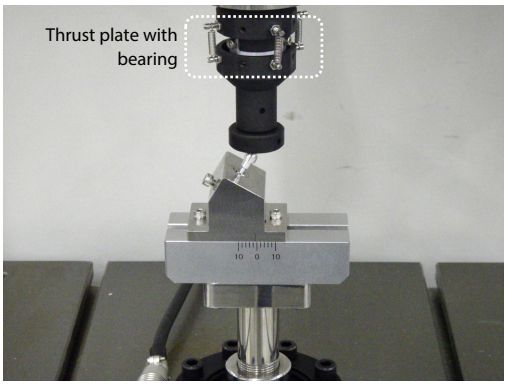

Fig. 1 Condition of Test

Table 1 Instrument Configuration

Servopulser	: EHF-LV
Load cell	: 5 kN
Test jig	: Implant test jig
Software	: Windows software for 4830

■ Static Test

First, a static test was carried out to set the load conditions for the fatigue test. JIS T 6005 : 2020 states that, as a standard, the test condition is to be set to 80 % of the load at which failure occurs in the static test. Fig. 2 shows the results of the static test. The test speed was set to 5 mm/min. As a result of the static test, the average value of the maximum test force was 377 N. Therefore, the load conditions in the fatigue test were set as shown in Table 2 using this value as a standard.

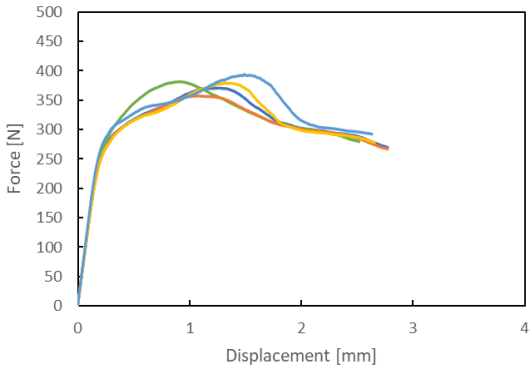

Fig. 2 Results of Static Test

Table 2 Load Conditions in Fatigue Test

Percentage of load at failure in static test [%]	Maximum load test force in fatigue test [N]
80	302
70	264
60	226
50	188
40	151

■ Fatigue Test

The maximum number of cycles to failure in the fatigue test differs depending on the set frequency. For example, when the test is conducted at 2 Hz, the maximum number of cycles to failure is 2×10^6, but when the frequency exceeds 2 Hz, the number of cycles increases to 5×10^6. Although the JIS standard specifies that the number of tests under each load condition is to be at least 2 and preferably 3 tests, n = 1 test was carried out in this experiment. Table 3 shows the conditions of the fatigue test. As an example of the waveform in the fatigue test, Fig. 3 shows the time-test force/stroke curve at the 1000th cycle in the test with the maximum load test force of 226 N, and Fig. 4 shows the cycle number- test force/stroke curves. As shown in Fig. 4, both the test force and the stroke show constant values for some time (number of cycles) after the start of the test, but as the damage to the test piece increases, the stroke gradually becomes larger, finally resulting in failure. Fig. 5 shows the test force-number of cycles to failure diagram obtained as the final result.

Table 3 Conditions of Fatigue Test

Maximum load test force [N]	: 302, 264, 226, 188, 151
Stress ratio	: 0.1
Frequency [Hz]	: 2
Maximum number of cycles	: 2×10^6
Test stop condition	: Stroke limit (3 mm)

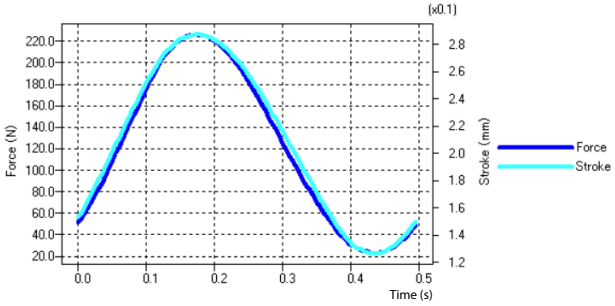

Fig. 3 Example of Time-Test Force/Stroke Curve
(Maximum load test force: 226 N, 1000th cycle)

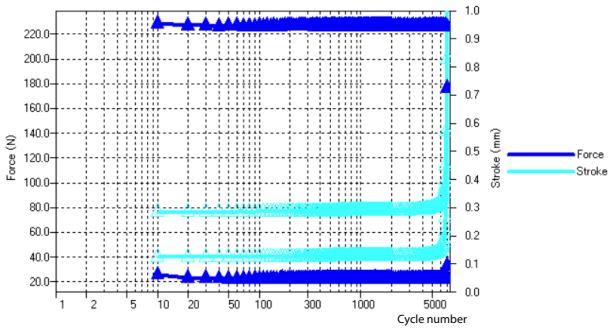

Fig. 4 Example of Cycle Number-Test Force/Stoke Curves
(Maximum load test force: 226 N)

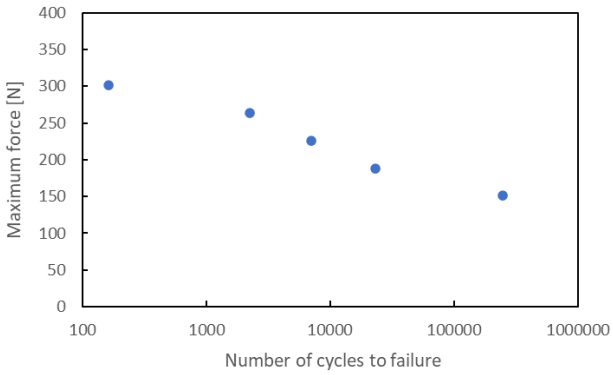

Fig. 5 Test Force-Number of Cycles to Failure Diagram

■ Conclusion

In this experiment, a dynamic fatigue test of an endosseous dental implant conforming to the test method in JIS T 6005 : 2020 was carried out using a dummy test piece. The experiment demonstrated that it is possible to conduct dynamic fatigue tests of endosseous dental implants with the instrument configuration used here.

<References>

1) Japanese Industrial Standard JIS T 6005 : 2020, Dynamic fatigue test method for endosseous dental implants

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