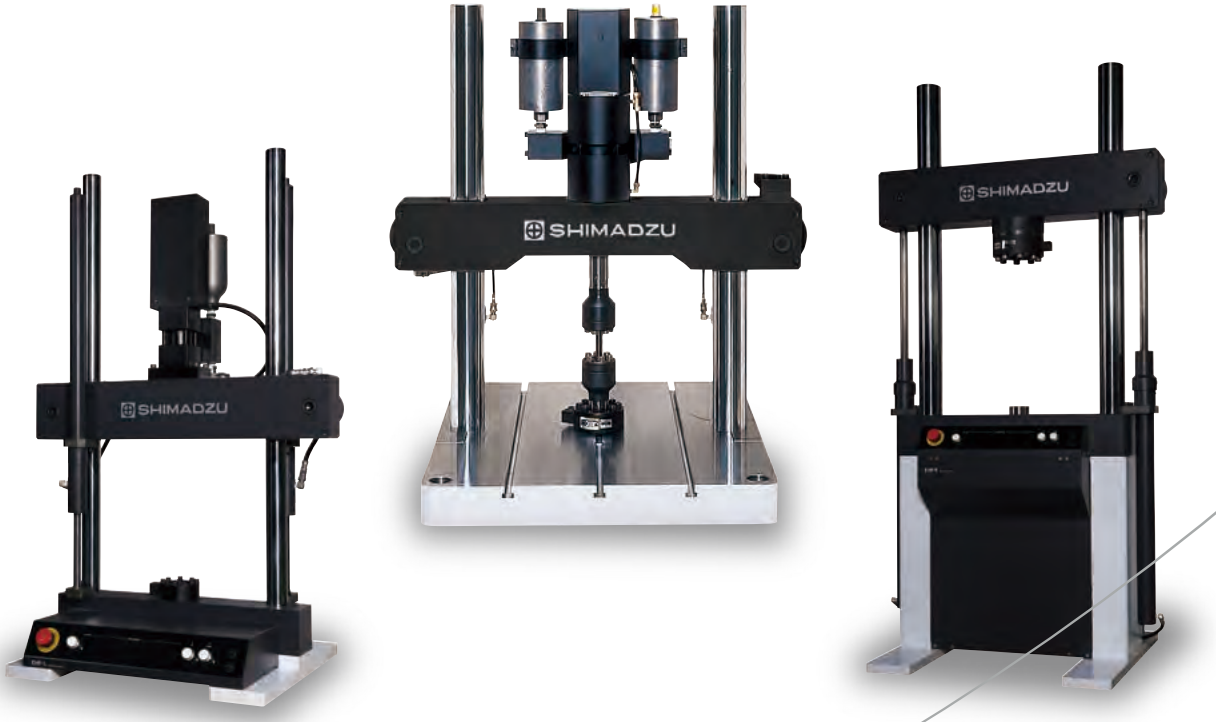
C225-E029C

SHIMADZU
Excellence in Science

Dynamic and Fatigue Testing Systems

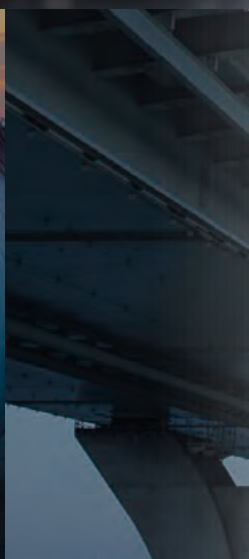


Your Partner for Dynamic and Fatigue Tests

The level and complexity of product reliability and safety requirements have been increasing in many industrial fields. Complying with such requirements requires performing a wide variety of tests and evaluations at each stage of production, from research and development of materials to evaluation of finished products.

Materials and parts can sometimes form cracks from repeated exposure to even small forces and, in the worst case, even completely fail. Therefore, for products that are exposed to repetitive loads, such as automobiles, mobile phones and other frequently handled items, and artificial bones and other biological materials or implants, it is essential that materials, parts, and finished products be evaluated by dynamic/fatigue testing and endurance/reliability testing. In addition, to more closely approximate actual usage conditions, an increasing number of tests used in research and development of various materials with special functional properties require more complicated and accurate control or measurement methods.

Therefore, Shimadzu offers a wide variety of testing machines that can be configured to satisfy increasingly sophisticated and diverse evaluation and testing requirements in a wide range of fields.



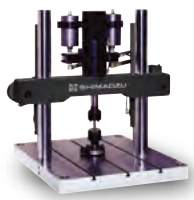
Dynamic and Fatigue Test Machines Servo Pulser Series

Servopulser Series Dynamic and Fatigue Testing Machines

P.12 P.32 P.40

Servo-hydraulic actuators are able to apply a wide range of loads, from small to large test forces. Therefore, they are ideal for fatigue testing of materials and a wide range of other dynamic testing applications. Backed by Shimadzu's extensive experience-making actuators, frames, and controllers, these systems are capable of a wide variety of tests and evaluations.

Hydraulic



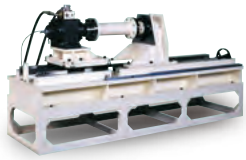
EHF-U

EHF-L

EHF-J

EHF-JF

EHF-E



EHF-T

EHF-TQJ

Electric

EMT-1kN

EMT-5kN

NJ-SERVO

MMT

Ultrasonic

Ultrasonic Fatigue Testing System

USF-2000A

P.64

Ultra efficient for gigacycle testing.
Also ideal for analyzing inclusions in metals.

Allows testing at 20 kHz ultrahigh cycle rates and significantly reduces the time required for fatigue testing.

Hydraulic

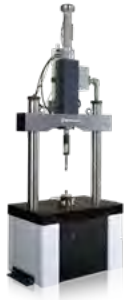
High-Speed Impact Testing Machine

HITS Series

P.66

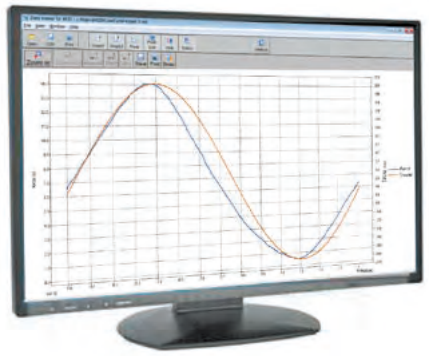
Integrates various cutting-edge technologies for high-speed impact testing.

Allows evaluating high-speed deformation behavior with tensile and puncture impact tests at speeds up to 20 m/s (72 km/h).



High Accuracy and Reliability

Dynamic and fatigue testing machines are used to measure the behavior and response characteristics of materials, products, and structural members in response to varied loads. Extremely sophisticated testing control capabilities are required for controlling the waveform of the load input, from a basic sine wave to waveforms that simulate earthquakes or the loading behavior experienced in actual usage.
Shimadzu Servopulser dynamic and fatigue testing systems are based on Shimadzu's extensive dynamic testing and design technology expertise. They provide high-quality solutions for a wide variety of material testing and dynamic component evaluation applications.



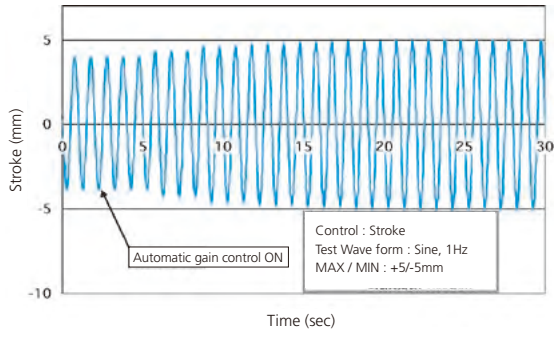
- High-rigidity loading frame
- Low-friction actuator
- Controller with high waveform reproducibility and easy operability
- Software capable of diverse testing requirements and compliant with the testing standards

Designed for User-Friendly Operability

The Servo Controller 4830 for Servopulser series dynamic/fatigue testing machines features both an LCD touch panel and physical keys. This allows users to specify test settings and operate actuators easily and intuitively. An automatic gain control function ensures that input waveforms are reproduced accurately, which is especially important for fatigue testing. In addition to improving the efficiency of testing, it also provides assistance for users performing tests for the first time.

● Easy Operability and Broad Applicability

The LCD touch panel and jog dial allow users to specify test parameter settings or change parameters such as frequency, test force, or displacement at any time during tests. It also consolidates the various functions required for testing, such as real-time display of time graphs, X-Y graphs, and peak graphs, in a single location.



● Automatic Gain Control Function Ensures Waveforms are Reproduced Accurately

When configuring parameter settings for fatigue testing, or other tests that involve repetitive waveforms, tuning and optimizing control parameter settings can be very time-consuming. However, by entering approximate settings, the automatic gain control function can be used to correct the specified signal so that the peak measurement values are consistent with specified parameters.
In cases where the settings must be changed frequently for testing a variety of materials or because the intended amplitude cannot be maintained due to fatigue degradation during the fatigue testing process, the automatic gain control function ensures that input waveforms are maintained accurately without having to reset control parameters.

Easier, More Convenient, and More Sophisticated Testing

Fatigue and Endurance Testing

Static Characteristics Testing

Program Function Testing

Combination Testing

Static Testing

Frequency-Sweep Testing
Resonance Frequency Tracking Testing

Multi-Axis Combination Sine Wave Testing

Multi-Axis Working Waveform Simulation Testing

● Windows Software for 4830

Allows users to perform a variety of tests, such as material fatigue testing, programmed testing that combines various control waveforms, and static testing. Optional software is also available for performing more sophisticated tests, easily, such as multi-axis working waveform simulation tests, multi-axis combination sine wave tests, frequency-sweep tests, and resonance frequency tracking tests, in an easier manner.

See page 56.

Fracture Toughness Test

GLUON 4830

● GLUON 4830 Software for Fracture Toughness Testing Compliant with the Standards

Using Shimadzu's Servopulser with fracture toughness test software allows use of simple procedures to perform complicated tests that comply with the standards, such as crack propagation tests, KIC/CTOD tests, or JIC tests.

ASTM E647-13, ISO 12108:2012	ASTM E399-12, ISO 12737-96 BS 7448-1:1991, ASTM E1820-11	ASTM E1820-11, ASTM E813-89 JIS Z 2284-98

Safety

Both hardware and software help ensure operator safety by positioning emergency stop buttons, crosshead adjustment buttons, and other important switches where they are easy to operate.

● Dual-Stage Crosshead Drive Mechanism

The crosshead vertical actuation system is equipped with various safety features, such as a two-stage operation for raising or lowering the crosshead and stoppers to prevent grips from falling off. A safety cover can also be installed to protect operators from flying debris.

● Anti-Spiking Mechanism for Hydraulic Power Supply Unit Startup

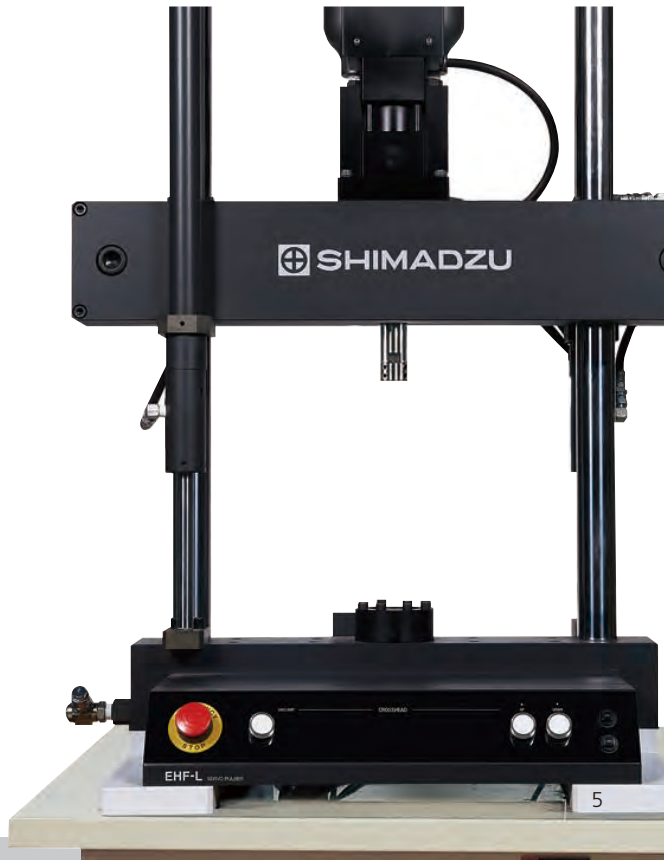
This mechanism prevents spiking during hydraulic power supply unit startup by setting control deviations to zero.

● Contact Load Function

This prevents applying excessive loads during manual actuator operations, such as when mounting or removing test samples.

● Various Software Alarms

Numerous software and controller limit functions and post-limit actions ensure that even unattended operations are safe.



Stable Input Waveform

Due to the highly controlled response and accurate waveform reproducibility of Shimadzu dynamic and fatigue testing machines, they can apply loads to products based on highly precise input waveforms.
Providing such a stable input waveform ensures that material fatigue testing can be performed with high accuracy and high reproducibility. Therefore, even slight differences in product performance or endurance can be evaluated.

24-Bit High Resolution
World's Highest Resolution

Two-Degree-of-Freedom PID Control

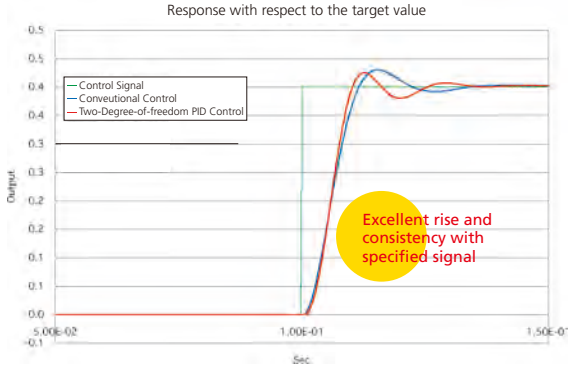
10 kHz High-Speed Feedback
World's Fastest Feedback

Autotuning and Automatic Gain Control Functions

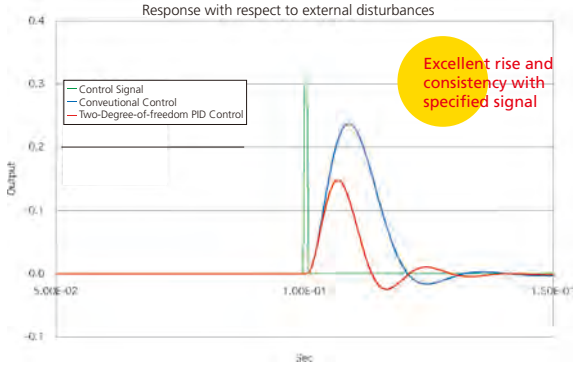
● Two-Degree-of-Freedom PID Control Minimizes Effects from External Disturbances

The control method (two-degree-of-freedom PID control) is able to optimize the target response for specified signals and the response to external noise. Optimizing the control parameters using the autotuning feature helps maximize the system performance. The 24-bit high-resolution measurement function and 10 kHz high-speed feedback ensure even sharp changes in test force or stroke can be controlled reliably.

Response with respect to the target value

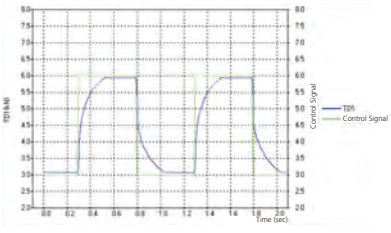


Response with respect to external disturbances

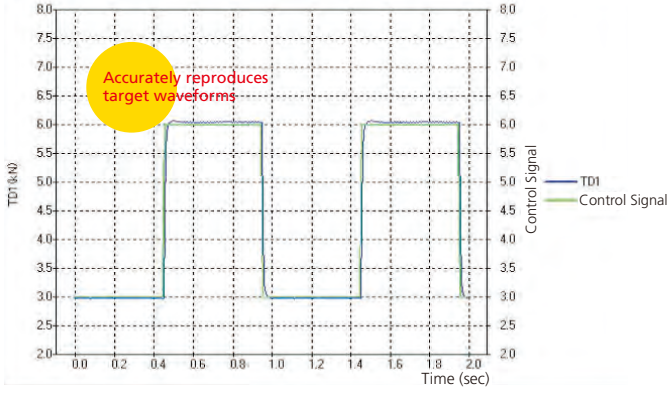


● Autotuning Function

The autotuning function accurately reproduces target waveforms by automatically determining optimal control parameters. Simply set up the sample in a similar state as for the intended testing and then specify the preload. Then the function automatically tunes the manually adjusted control parameters.

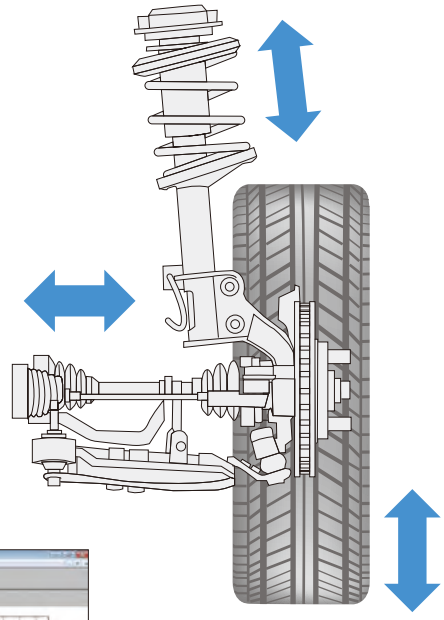


Automatically selects optimal control parameters



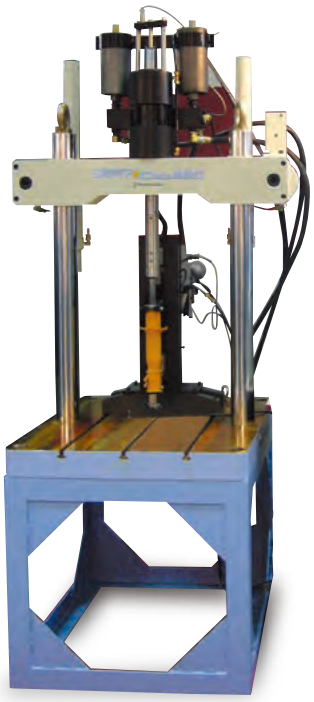
Measures Even Slight Differences in Performance

Dynamic testing machines apply a load waveform to a product and measure the corresponding response. The precise and reliable waveform input provided by Shimadzu dynamic testing machines and controllers allows identification of even slight differences in product performance and helps provide feedback for product design.

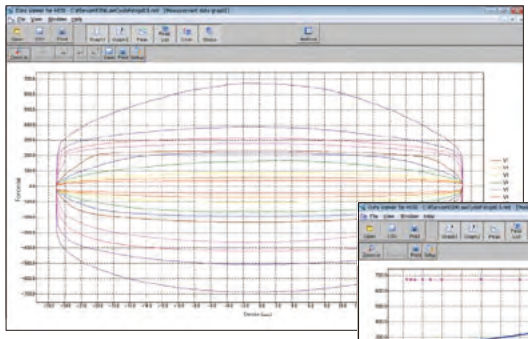


For example ...

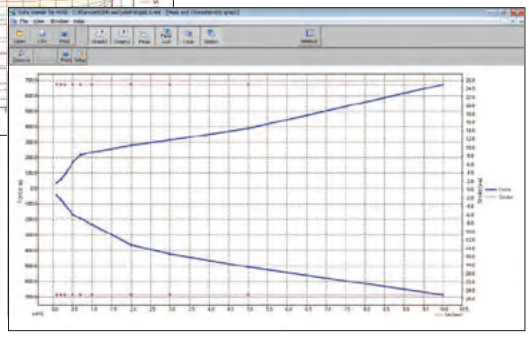
A variety of parts is used to achieve a comfortable ride in automobiles. To improve the performance of those parts, data from evaluating their characteristics is essential. Therefore, the damping force is measured as test frequency is varied. Shock absorber performance can be confirmed by measuring the relationship between velocity and damping force or the response to a Lissajous or other waveform. The input waveform is important for evaluating slight differences in performance.



Electric-Hydraulic Dynamic and Fatigue Testing System
EHF-U Series
Two-Axis Shock Absorber Testing System



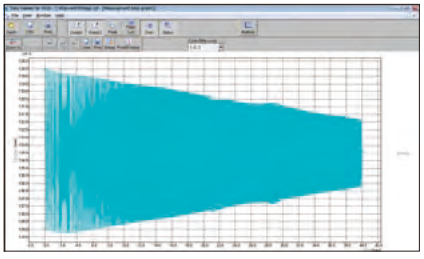
Lissajous Waveform



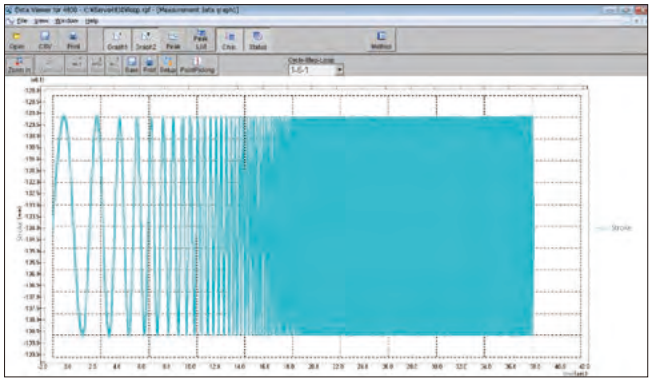
Velocity vs. Damping Force Waveform

● Impressive Waveform Reproducibility

The 10 kHz high-speed feedback and 24-bit high resolution provides highly precise control waveforms for all measurement ranges.
Tests can be done with accurately controlled waveforms even in cases where the frequency of the input waveform varies, such for assemblies or finished products, or when the status of the item being tested changes from hour to hour.

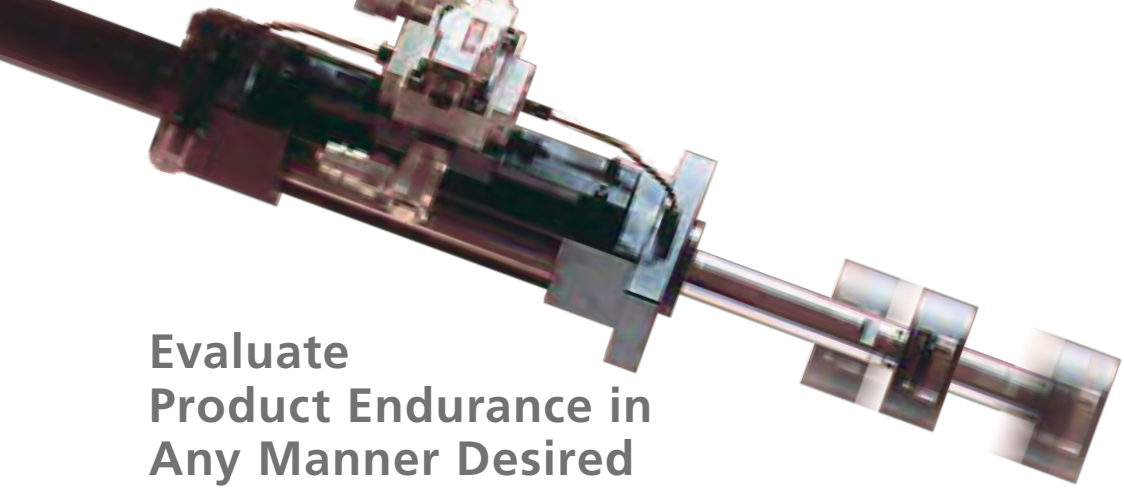


Frequency-sweep
AGC function



If tests are affected by servo valve frequency characteristics or PID control settings are inadequate, then the amplitude can vary depending on the frequency, as shown above. However, the frequency-sweep AGC function corrects the amplitude to keep it constant at all frequency levels.

Dedicated Shock Absorber Testing Software



Evaluate Product Endurance in Any Manner Desired

Endurance testing requires a wide variety of testing inputs in order to evaluate the reliability of products or assemblies or to verify design specifications. Shimadzu's light-weight and compact hydraulic actuators can be installed on a wide variety of stands and used to generate test inputs that closely approximate the conditions under which samples are used. Therefore, they satisfy a wide variety of testing requirements, such as for actuator installation, loading mechanism design, multi-axis synchronized actuator testing, and multi-sample batch testing.

Two-Degree-of-Freedom PID Control Minimizes Effects from External Disturbances

The control method (two-degree-of-freedom PID control) is able to optimize the target response for specified signals and the response to external noise. Optimizing the control parameters using the autotuning feature helps maximize the system performance. The 24-bit high-resolution measurement function and 10 kHz high-speed feedback ensure that even sharp changes in test force or stroke can be controlled reliably.

Light
Compact
Long Stroke

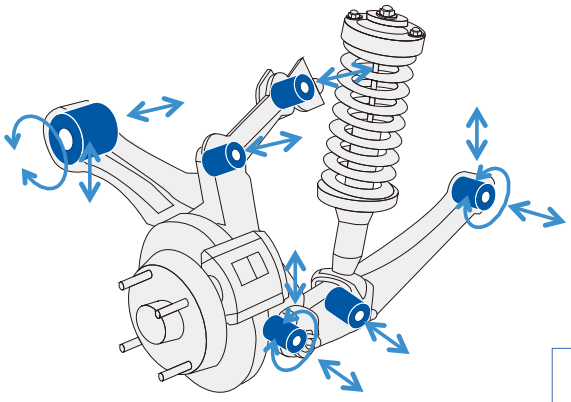
With a trunnion bracket

With vertical movement and left/right rotation mechanisms

With vertical and left/right rotation mechanisms

XYZ 3-axis loading frame

Portable torsional actuator



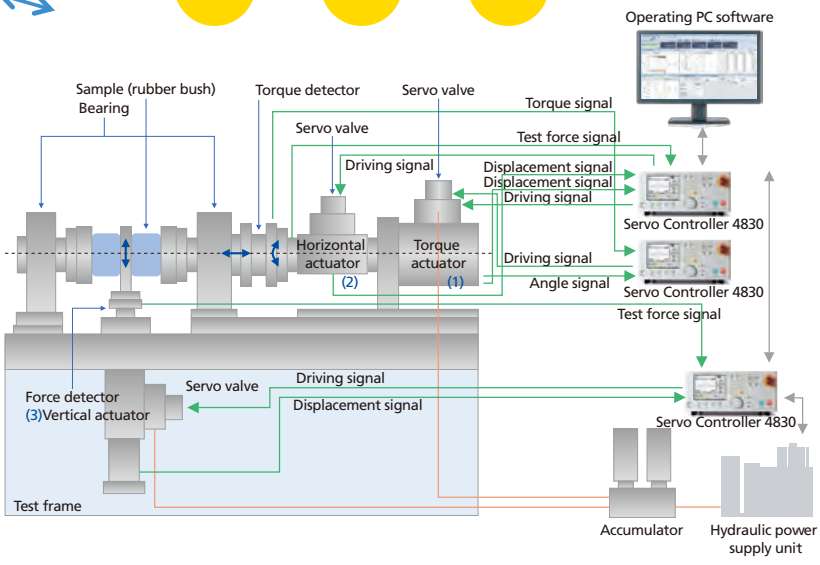
This allows users to perform 3-axis endurance tests with forces in axial and torsional directions to evaluate the endurance of rubber bushings, which are exposed to forces in various directions. The interference correction function permits tests using waveforms that are even closer to target waveforms.

Note: The interference correction function corrects for interference in other directions that result from dynamic loads. In various types of tests, it sends command signals for the opposite phase as the interference components and cancels out interference components, which achieves a waveform that more closely resembles the target waveform.

For example ...

The riding comfort of automobiles is directly related to reducing the amount of vibration and noise. Synchronizing multiple actuators using the Servo Controller 4830 allows accurately simulating the dynamic waveform experienced by parts and components during actual travel.

Horizontal actuator + Vertical actuator + Torsional actuator



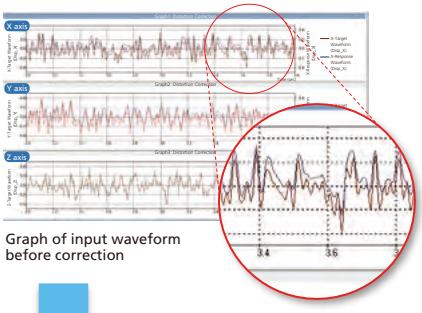
Accurately Reproduces Actual Operating Waveforms

The Servo Controller 4830 has a waveform correction function that helps accurately reproduce input waveforms. Used in combination with various additional software, it can be used to simulate actual operating waveforms determined by measuring the status of actual loads or simulate the most severe conditions by continuously applying loads at the resonant frequency. The Servo Controller 4830 optimizes actuator control based on various testing requirements to enable highly precise and accurate testing.

● Waveform Distortion Correction

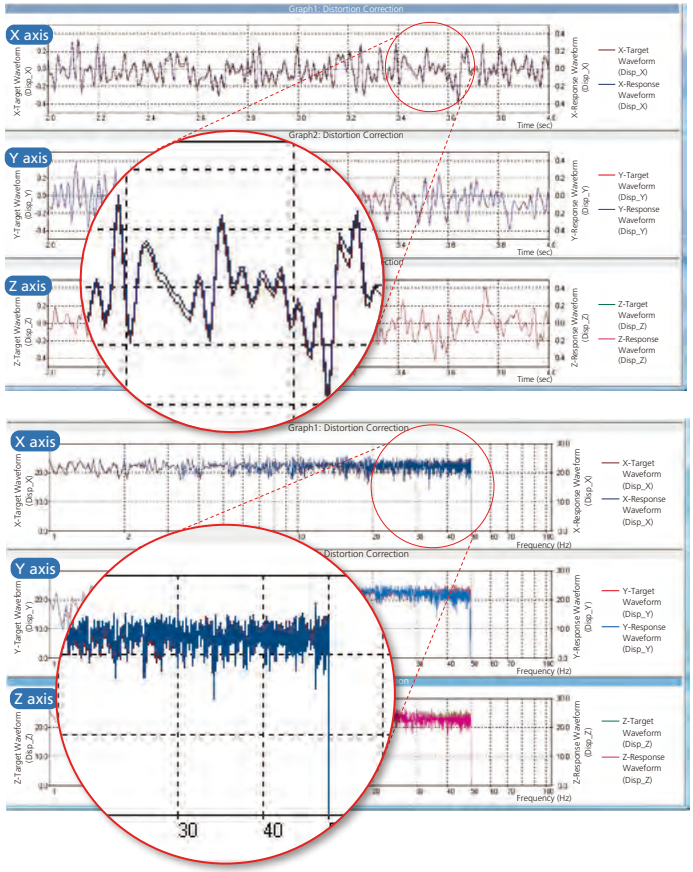
This function makes it possible to correct the waveform based on the frequency characteristics of the loading mechanism (transfer function correction), which helps achieve the intended target waveform. Because it can correct for loading mechanism-specific periodic strain, it can cancel out unwanted strain components and accurately control loads according to the target waveform. Complicated actual loading profiles that were difficult to simulate can now be specified easily using this controller and software.

The response waveform is rounded and the high-frequency region waveform cannot be reproduced.

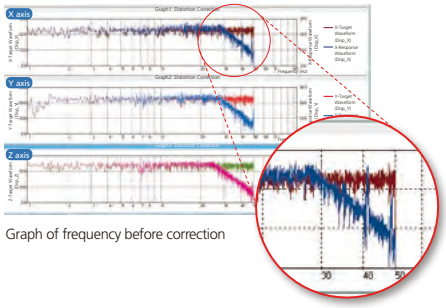


Graph of input waveform before correction

Precisely matches the target waveform due to correction.



Response drops above 30 Hz.



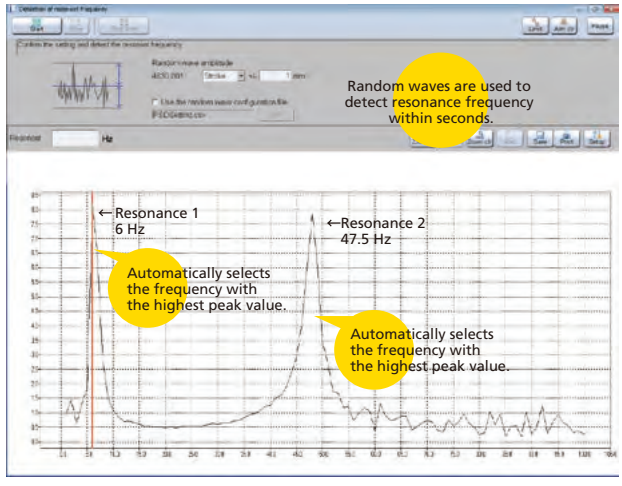
Graph of frequency before correction

Accurately reproduces the 50 Hz maximum frequency of the target.

Guaranteeing Endurance

● Simulates the Most Severe Loading Conditions Using the Resonance Frequency Tracking Testing

To guarantee product endurance, the resonance frequency is input because it results in the highest load levels. The resonance frequency can be determined in only a few seconds. It can also be automatically tracked if it changes due to sample fatigue. This reduces the labor required to manually specify the resonance frequency and the stress on samples.



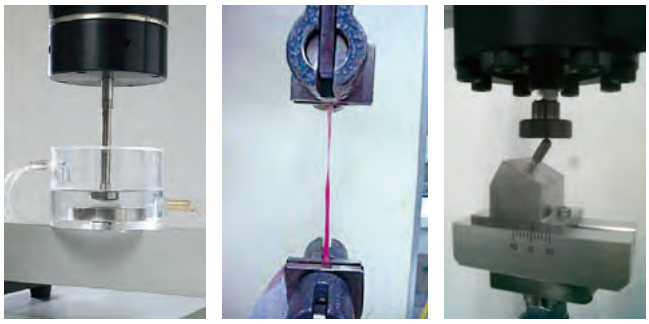
Extensive Experience in a Wide Variety of Fields

From dynamic testing in automotive, aircraft, train, shipbuilding, healthcare, and construction fields to fatigue testing of materials, Shimadzu has developed various dynamic testing machines for all sorts of fields. Shimadzu's extensive dynamic testing experience is available for consulting with customers.

Multiple Jack System on the Railway Rail
System Installed for East Japan Railway Company

● Load Testing for Large-Scale Structural Members

The ground strength, bearing capacity of pilings, stability of basic structural members, etc. are evaluated by applying static and dynamic loads on large structural members using the Shimadzu Servopulser jack system to determine the relationship between test force and displacement. For load testing, actuator endurance and stable control technology are essential.
Shimadzu offers support for a wide range of evaluations, such as evaluating structural members made with new materials, evaluating the endurance of large-scale structural members, and inspecting old building structural members.

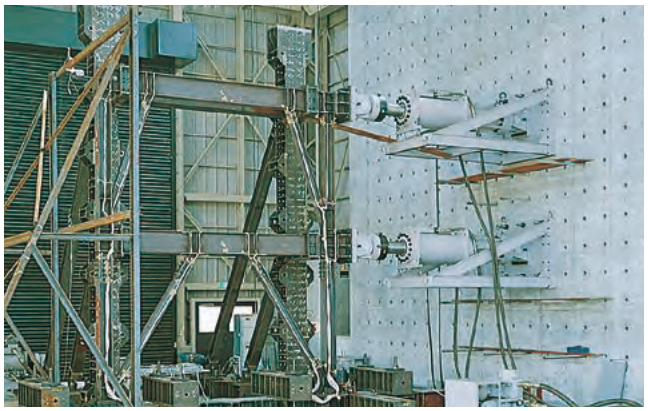


● Dynamic and Fatigue Testing in Controlled Atmospheres

Servopulser systems can be fitted with an environmental control system that reproduces loads under high temperature or severe environmental conditions or under environmental conditions experienced during actual usage. This system accommodates a variety of testing requirements, such as testing at high temperatures, in a vacuum or gas atmosphere, or thermal fatigue testing.

● Dynamic Evaluation of Automotive, Aircraft, Rail, Ship, and Various Other Transportation Equipment

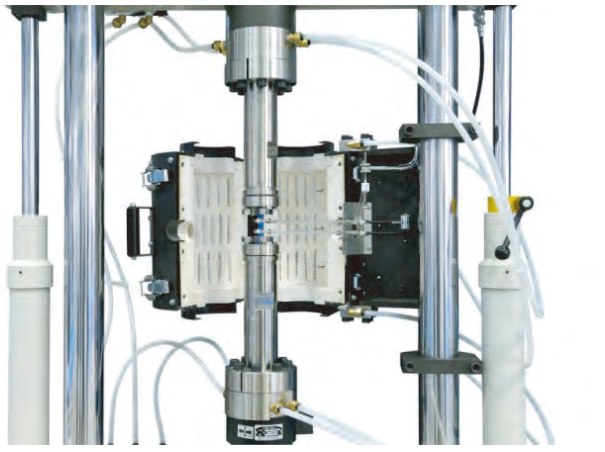
Increasing the reliability of transportation equipment used to carry people and freight involves a variety of dynamic testing requirements, from various design verification work to evaluation of endurance. Shimadzu dynamic testing systems can be configured to meet unique customer requirements by combining various standard models or utilizing customized actuators and loading frames based on Shimadzu's extensive track record and experience.



Loading Test System for Steel Structural Members

● Evaluating Implants and Biological Materials

Implants and other products in the biomedical industry must be subjected to various design verification testing and endurance evaluation before they can be released to the market. Shimadzu electromagnetic force and pneumatic Servopulser systems are ideal for clean environments and are capable of highly accurate testing at low load levels. Therefore, they are used to evaluate the endurance of knee, hip, and spinal implants or in human kinematic research.



Resistance Heat High-Temperature Testing System

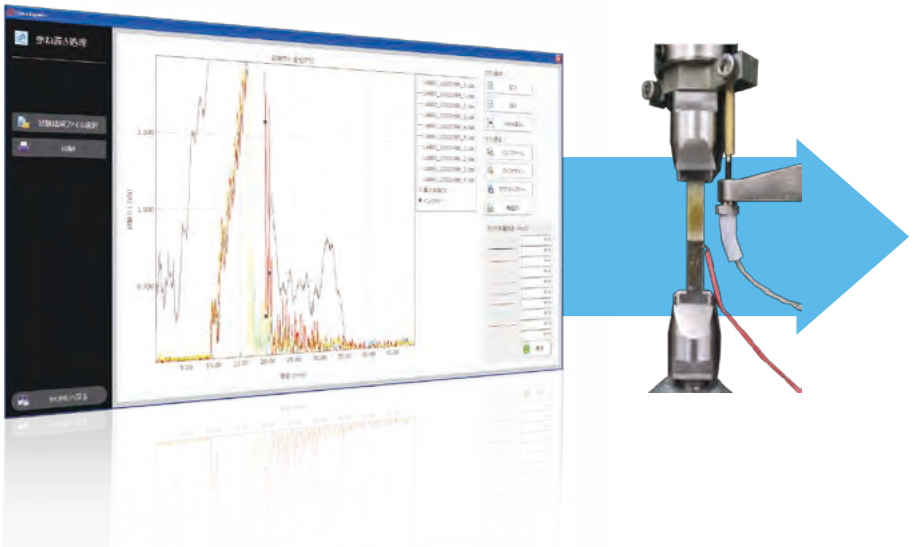
Evaluating Strain Rate Dependence

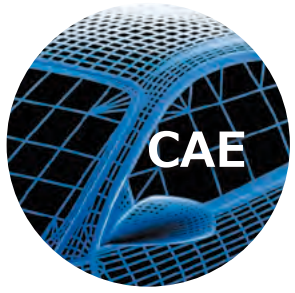
In order to accommodate increasingly sophisticated designs, computers are now being used in design simulation technologies. In particular, to ensure safety with respect to impacts or determine the behavior during impact fracture, material property parameters are measured at speeds experienced during actual operation or the simulated deformation rate. Using these parameters in calculations can contribute significantly to calculation results.

High-Speed Impact Testing System
Hydroshot HITS Series

● High-Speed Impact Testing at Speeds Up to 20 m/sec

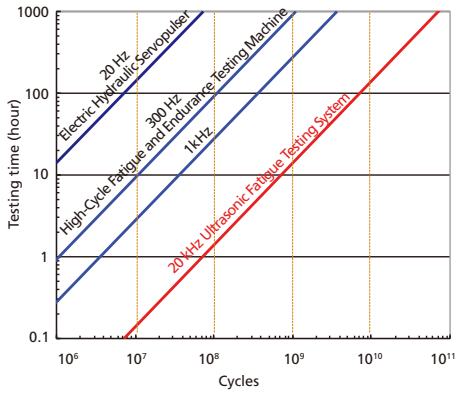
This high-speed impact testing system integrates several of Shimadzu's advanced technologies, such as actuators engineered for high-speed testing and shock-absorbing mechanisms that minimize the effects from impact testing, to realize a maximum impact speed of 20 m/sec (72 km/h).





For Reducing the Time Required for Fatigue Testing of Metal Materials and Gigacycle Fatigue Testing

Now that materials used in products are procured from around the world, it is especially important to evaluate the material properties when receiving materials. With cycle rates up to 20 kHz, the USF-2000 Ultrasonic Fatigue Testing System is able to accelerate fatigue life evaluations of metal materials. This means it can perform tests of 10^{10} cycles, which would normally take 3.2 years at 100 Hz, in only six days. This exceeds the gigacycle level to achieve ultrahigh efficiency.

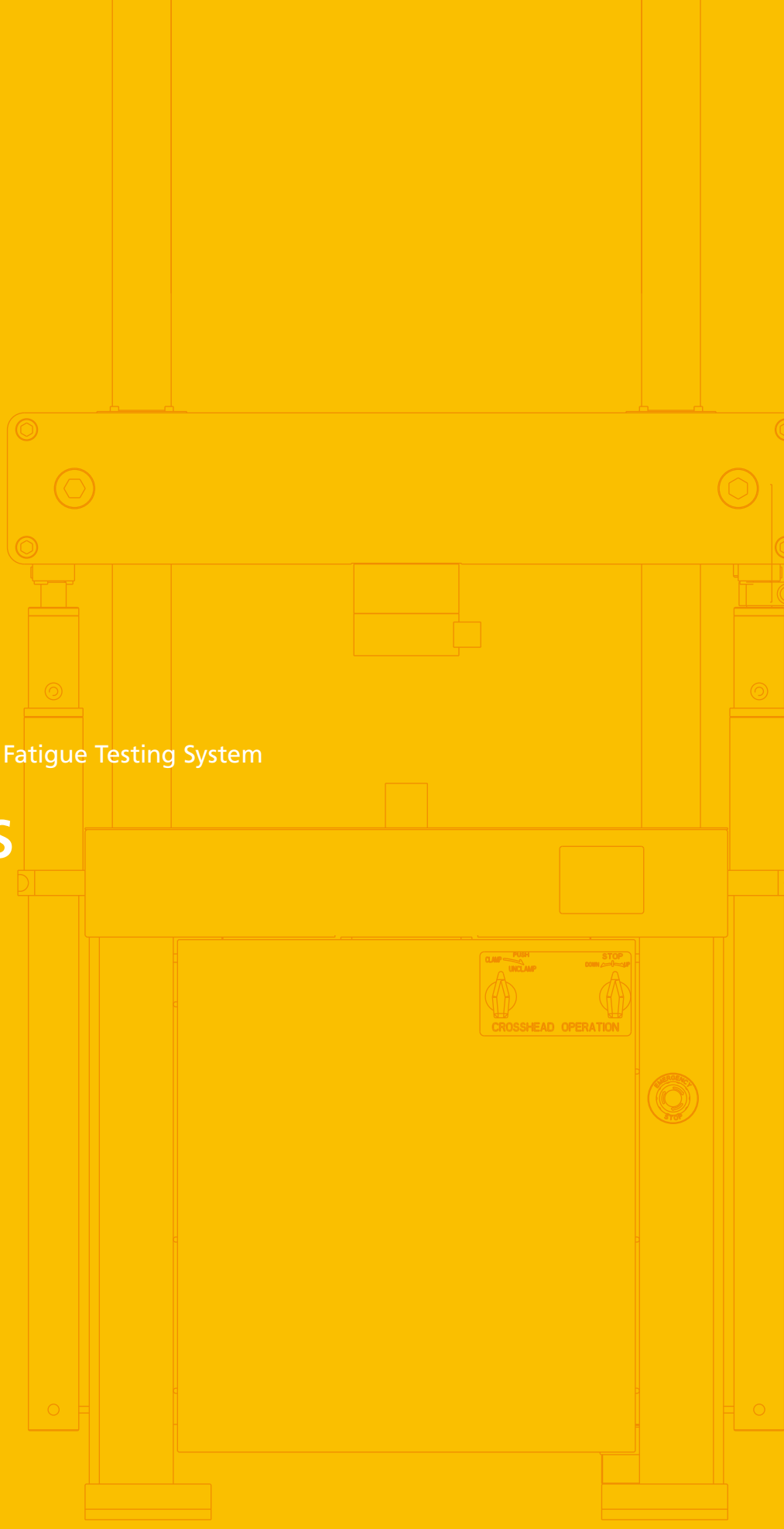


For example ...

Assume a 10^8 cycle test is performed at 20 Hz and 20 kHz.

Electric Hydraulic Dynamic and Fatigue Testing System

EHF Series



Electric-Hydraulic Dynamic and Fatigue Testing System

Servopulser series electric-hydraulic dynamic and fatigue testing systems feature servo-hydraulic actuators, which are able to accurately reproduce input waveforms. Therefore, they are highly accurate in applying loads ranging from low to high. From high-performance standard models to products customized to satisfy various unique testing requirements, these systems support a wide range of dynamic testing applications.

High Capacity and Compact

By controlling the flow rate of oil, compact hydraulic actuators can apply large forces at a wide range of testing speeds, from extremely slow to very fast. This means they can be used for a wide variety of testing applications.

High-Rigidity Frame

A very rigid loading frame is used to prevent buckling samples.
This ensures high reliability for a variety of testing applications.

From Low to High Speeds From Low to High Loads

High-performance servo valves allow seamless and immediate change of the test force or speed.

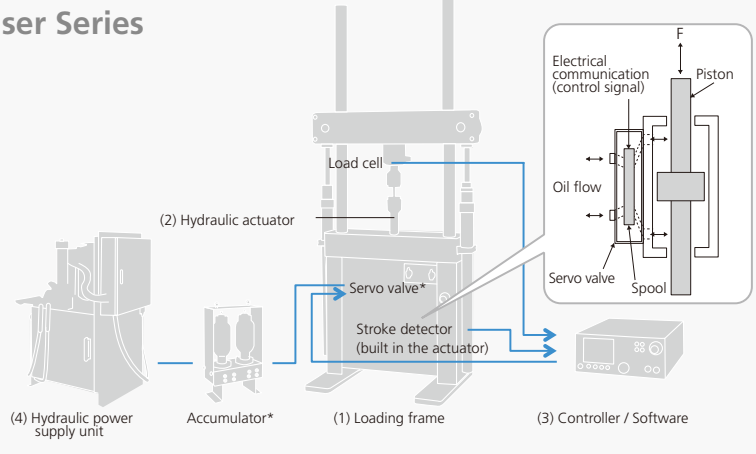
An Energy-Saving Operating Mode Is Also Available

By using the optional energy-conservation unit (ECU) (page 36), an energy-saving mode can be used to optimize the hydraulic power supply unit's power level based on the testing parameters and testing status. It reduces the hydraulic power supply unit's power level when tests are in standby mode.

Basic Configuration of Servopulser Series Electric-Hydraulic Systems

By selecting (1) a loading frame, (2) a hydraulic actuator, (3) a controller and software, and (4) a hydraulic power supply unit, Servopulser series electric-hydraulic systems are able to accommodate a wide variety of test force and testing speed requirements. The hydraulic drive actuator, which is electrically controlled via a servo valve, provides reciprocating motion capable of high test forces and a wide response range, from low to high frequency.

* Items marked with an asterisk are included based on the actuator and hydraulic power supply unit combination.



Electric-Hydraulic Dynamic and Fatigue Testing System

EHF-E Series

Automobiles | Steel, Metals, Machines | R&D

For Dynamic and Fatigue Testing of Various Materials and Small Parts

This series features an E-type frame with a bottom-mounted actuator, which can satisfy a wide variety of dynamic and fatigue testing requirements, from fatigue testing of materials to evaluating the performance of components.

Dynamic Capacity Rating of Actuators 50 kN / 100 kN / 200 kN

This series is capable of static, dynamic, and fatigue testing of a wide range of materials, from plastics to aluminum, composites, and steel.

High Rigidity and Large Testing Space

The large testing space supports material fatigue testing in a high-temperature or thermostatically controlled environment, thermal fatigue testing, fracture toughness evaluation, component performance and endurance testing, and so on. Accessories for respective tests are available. These include grips, compression plates, extensometers, and testing environmental control systems.

±0.5 % Test Force Accuracy

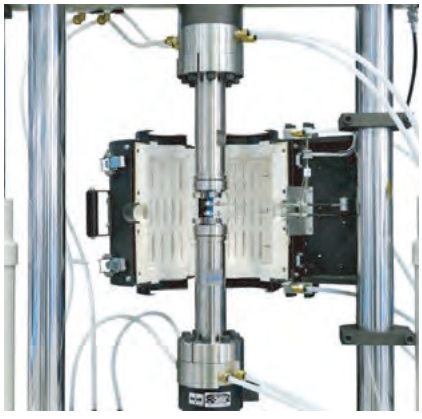
Test force accuracy is guaranteed to within ±0.5 % of the indicated value.

Bottom-Mounted Actuator

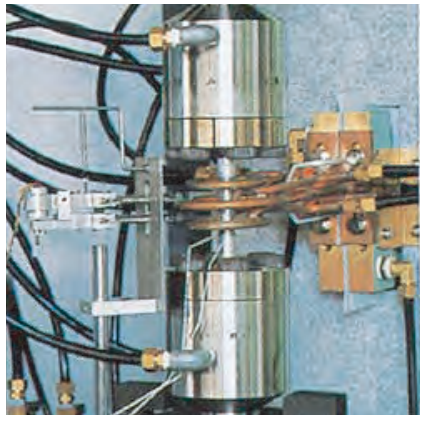
This supports a wide variety of tests, including component tensile, high/low cycle fatigue, failure, performance, and endurance tests.

Dual-Stage Crosshead Drive Mechanism

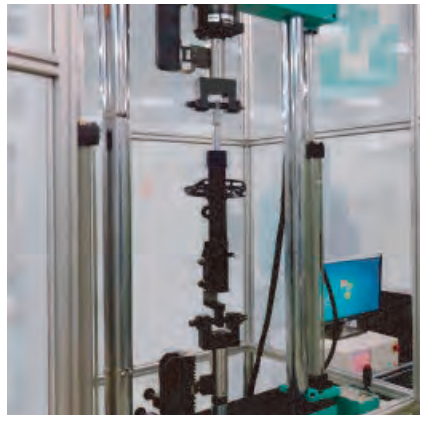
The hydraulic crosshead drive and hydraulic clamp can be operated more intuitively using handles.
This dual-stage configuration helps prevent operating errors and accidents.



Resistance Heat High-Temperature Testing System



High-Frequency Induction Heat
High-Temperature Testing System

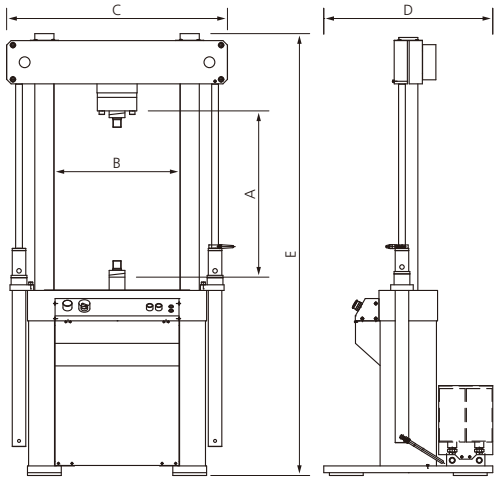


Component Test

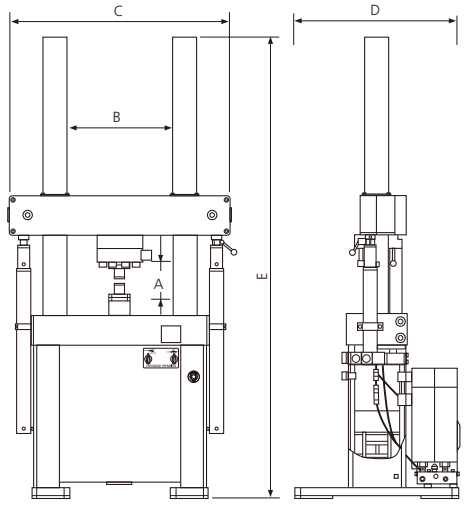
Specifications

Model		EHF -EV051k1	EHF -EV051k2	EHF -EV101k1	EHF -EV101k2	EHF -EV200k1	EHF -EV200k2
Max. dynamic test force		±50kN		±100kN		±200kN	
Max. static test force		±60kN		±120kN		±240kN	
Actuator stroke		±25mm	±50mm	±25mm	±50mm	±25mm	±50mm
Cycle speed and amplitude		See amplitude characteristics charts.					
Controlled items		Test force and stroke (two can be added as options)					
Test force	Range	24-bit rangeless					
	Indication accuracy	Within 0.5 % of indicated value or ±0.02 % of maximum dynamic test force, whichever is greater					
Crosshead drive mechanism		Hydraulic drive (with hydraulic clamp)					
Applicable hydraulic power supply unit		QF-10B, QF-20B, QF-40B, QF-70B, QF-110, QF-140 AF-10B, AF-20B					
Power requirements		Varies depending on the hydraulic power supply unit (see pages 34 and 35).					

Testing Machine Main Unit Dimensions



50/100kN (non-CE type)



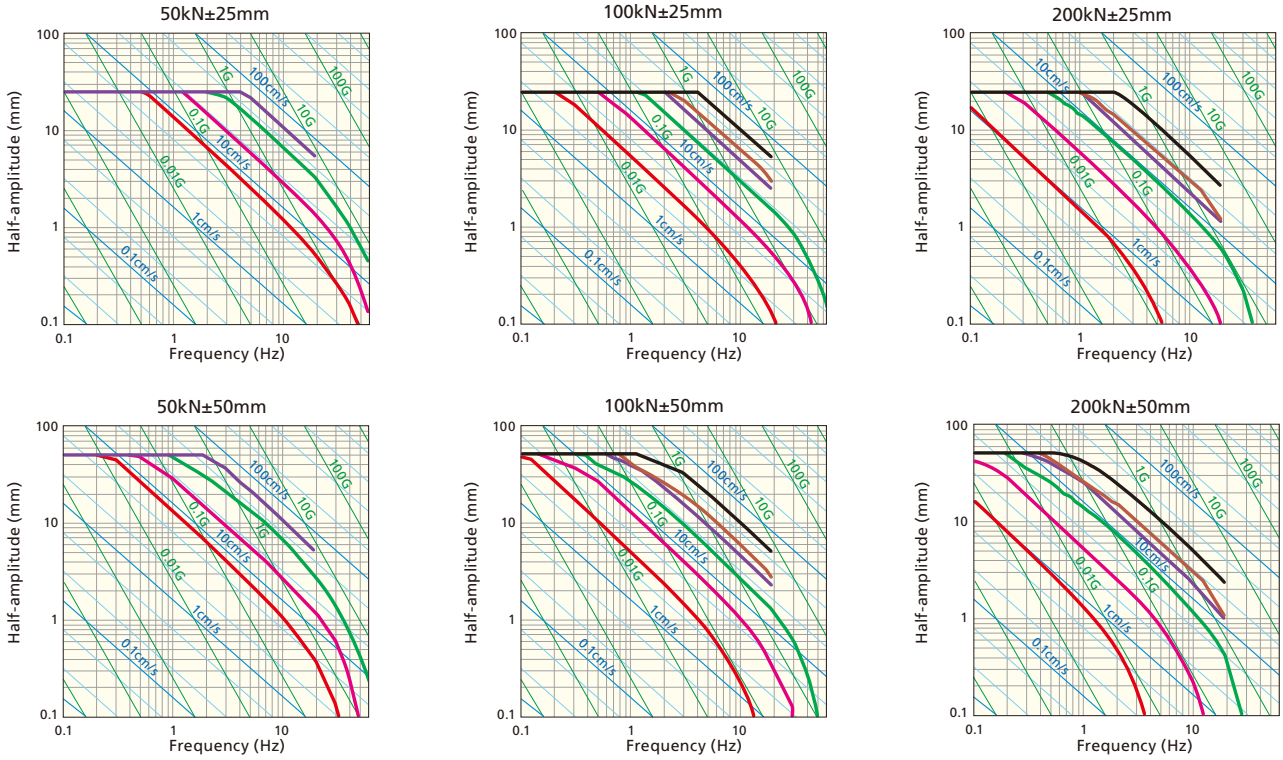
200kN

Capacity		50kN				100kN				200kN			
Actuator stroke		±25mm		±50mm		±25mm		±50mm		±25mm		±50mm	
Column length		Standard	Standard + 600	Standard	Standard + 600	Standard	Standard + 600	Standard	Standard + 600	Standard	Standard + 400	Standard	Standard + 400
Testing space (mm)	A	65 to 760	365 to 1360	40 to 735	340 to 1335	40 to 735	340 to 1335	15 to 710	315 to 1310	200 to 995	400 to 1395	175 to 970	375 to 1370
	B	560											
Main unit dimensions (mm)	C	980				980				1170			
	D	750				750				850			
	E	1965	2565	1965	2565	1965	2565	1965	2565	2405	2805	2405	2805
Weight (kg)*1/*2		840	900	850	910	880	940	890	950	1500	1580	1520	1600
Frame rigidity (mm/kN)*3		0.0012				0.0012				0.00065			

*1 Including actuator weight. Test jigs are not included.
*2 Weight may vary slightly depending on the type and number of servo valves.
*3 When the distance between the crosshead and the table is 500 mm

Amplitude Characteristics (60 Hz)

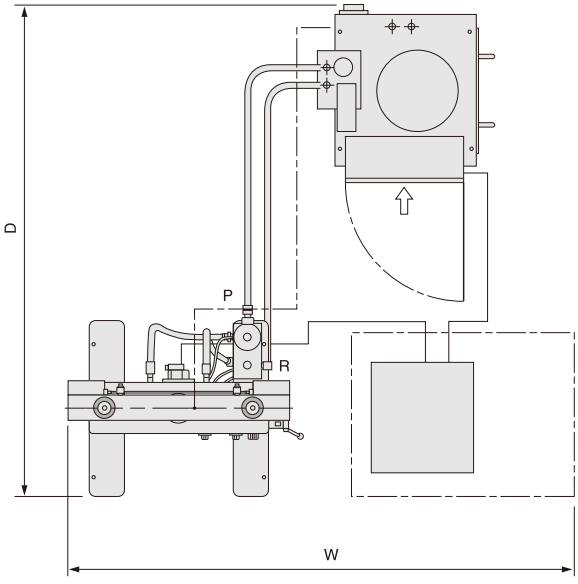
QF-10B/AF-10B
QF-20B/AF-20B
QF-40B
QF-70B*
QF-110*
QF-140*



* It is not possible to use standard configurations of models QF-70B or higher for high-frequency regions due to the servo valve characteristics. However, these models may be used for testing at high frequencies if the servo valve is changed, for example. Contact Shimadzu for more information.

- The above characteristic curves indicate the relation between half-amplitude and cycle speed, given sine wave motion at the rated load level.
- The above indicates the amplitude characteristics given a 60 Hz power supply. Characteristics with a 50 Hz power supply will be about 5/6 of indicated values.
- The above characteristics do not include the frame or load cell characteristics. Compensate for the influence of these factors to determine actual amplitude characteristics.
- The indicated characteristics values were calculated based on typical characteristics of the servo valve being used, which may result in a difference of about 10 % on the frequency axis.
- There may be limitations on testing frequencies, depending on jig, sample, or other characteristics.

Standard Layout

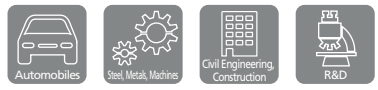


Main Unit	Hydraulic Power Supply Unit	Space Required (W x D)
E50kN	QF-10B	2300×2100
	QF-20B	2300×2200
	QF-40B	2300×2600
	QF-70B	2300×2800
	AF-10B	2300×2200
	AF-20B	2300×2200
E100kN	QF-10B	2300×2100
	QF-20B	2300×2200
	QF-40B	2300×2600
	QF-70B	2300×2800
	AF-10B	2300×2200
	AF-20B	2300×2200
E200kN	QF-10B	2500×2100
	QF-20B	2500×2200
	QF-40B	2500×2600
	QF-70B	2500×2800
	AF-10B	2500×2200
	AF-20B	2500×2200

- At the installation site, provide about 500 mm of space on all four sides of the system, in addition to the space requirements indicated above, to allow access for operation and maintenance.
- The drawing above indicates the dedicated space requirements. The shape and orientation of the hydraulic power supply unit may vary depending on its capacity.
- For a more detailed standard layout drawing, contact Shimadzu.
- The standard system configuration does not include the table, computer, or printer.

Electric-Hydraulic Dynamic and Fatigue Testing System

EHF-U Series



For Full-Scale Fatigue and Endurance Testing of Structural Materials and Large Samples

By providing a T-slot surface plate at the bottom of a U-type loading frame with a top-mounted actuator, these systems allow installation of extra large components and parts. Due to the large testing space, dynamic testing and evaluation can be performed on a variety of samples, including full-size samples and structural members.

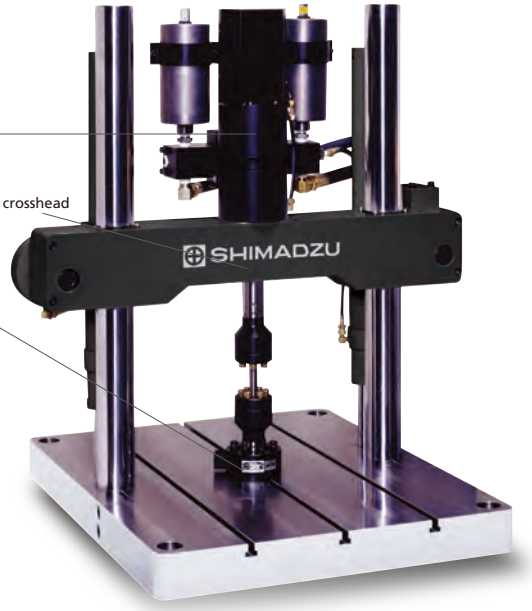
Rated Actuator Capacities of 50 kN, 100 kN, and 200 kN Support a Wide Range of Dynamic Testing

Top-Mounted Actuator

Supports dynamic and endurance testing of full-size samples, large components, and structural members.

±0.5 % test force accuracy

Test force accuracy is guaranteed to within ±0.5 % of the indicated value.



High Rigidity and Large Testing Space

A T-slot surface plate makes it easy to secure samples.
The size of the surface plate and length of the columns can be customized based on the size of samples.

Crosshead drive handle

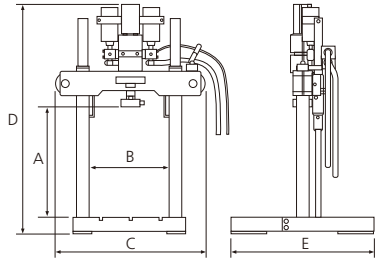
Crosshead Drive System with Operating Error Prevention Mechanism

The hydraulic crosshead drive and hydraulic clamp can be operated intuitively using the handle.

Specifications

Model		EHF -UV050k1A	EHF -UV050k2A	EHF -UV100k1A	EHF -UV100k2A	EHF -UV200k1A	EHF -UV200k2A
Max. dynamic test force		±50kN		±100kN		±200kN	
Max. static test force		±60kN		±120kN		±240kN	
Piston stroke		±25mm	±50mm	±25mm	±50mm	±25mm	±50mm
Cycle speed and amplitude		See amplitude characteristics charts.					
Controlled items		Test force and stroke (two can be added as options)					
Test force	Range	24-bit rangeless					
	Indication accuracy	Within 0.5 % of indicated value or ±0.02 % of maximum dynamic test force, whichever is greater					
Crosshead drive mechanism		Hydraulic drive (with hydraulic clamp)					
Applicable hydraulic power supply unit		QF-10B, QF-20B, QF-40B, QF-70B, QF-110, QF-140, AF-10B, AF-20B					
Power requirements		Varies depending on the hydraulic power supply unit (see pages 34 and 35).					

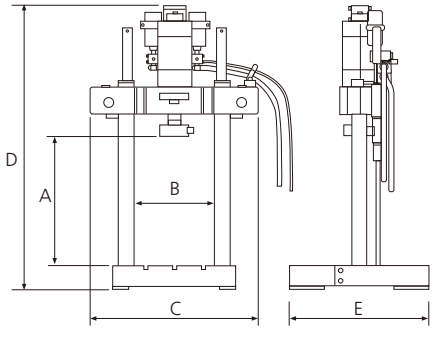
Testing Machine Main Unit Dimensions



50/100 kN frame

	Capacity	50kN												100kN									
	Actuator stroke	±25mm						±50mm						±25mm						±50mm			
	Column length	Standard			Standard + 400			Standard			Standard + 400			Standard			Standard + 400			Standard			Standard + 400		
Testing space (mm)	A	180 to 785			380 to 1185			155 to 760			355 to 1160			180 to 735			380 to 1135			155 to 710			355 to 1110		
	B	560																					
Main unit dimensions (mm)	C	1046																					
	D	1610			2010			1710			2110			1655			2055			1755			2155		
	E	1000	1500	2000	1000	1500	2000	1000	1500	2000	1000	1500	2000	1000	1500	2000	1000	1500	2000	1000	1500	2000	1000	1500	2000
Weight (kg)		970	1330	1630	1000	1360	1660	970	1330	1630	1000	1360	1660	1070	1460	1900	1100	1500	1940	1070	1460	1900	1100	1500	1940
Frame rigidity (mm/kN)*		0.0025												0.0019									

* Crosshead table clearance: 500 mm



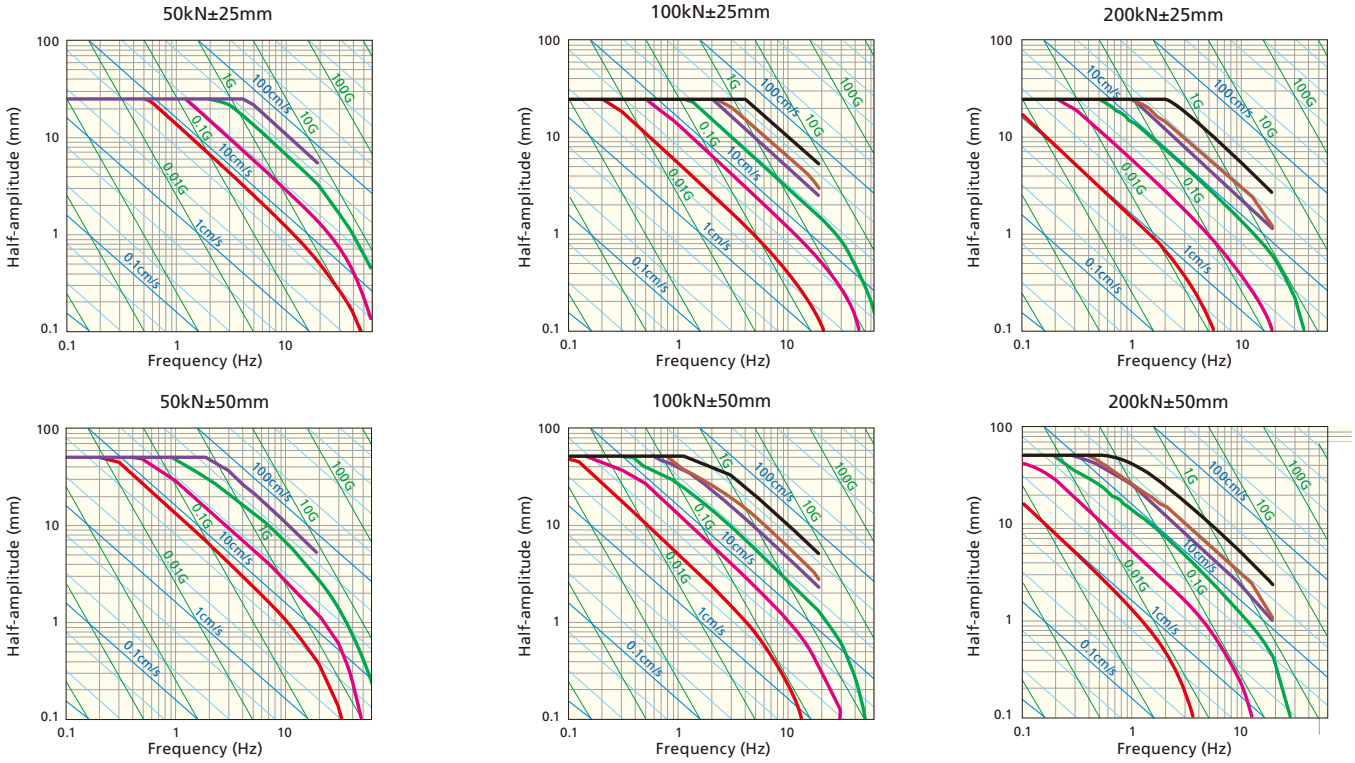
200 kN Frame

	Capacity	200kN											
	Actuator stroke	±25mm						±50mm					
	Column length	Standard			Standard + 400			Standard			Standard + 400		
Testing space (mm)	A	200 to 950			400 to 1350			175 to 925			375 to 1325		
	B	560											
Main unit dimensions (mm)	C	1200											
	D	2255			2655			2305			2705		
	E	1000	1500	2000	1000	1500	2000	1000	1500	2000	1000	1500	2000
Weight (kg)		2020	2690	3430	2100	2770	3510	2050	2720	3460	2130	2800	3540
Frame rigidity (mm/kN)*		0.0009											

* Crosshead table clearance: 500 mm

Amplitude Characteristics (60 Hz)

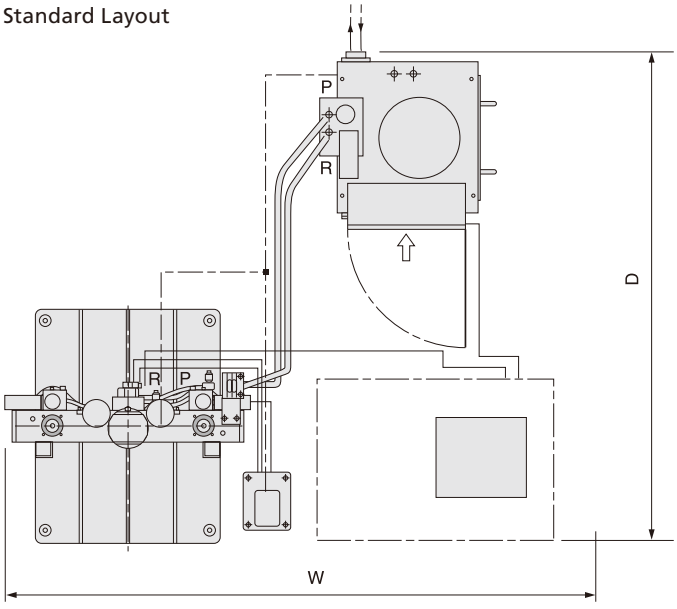
QF-10B/AF-10B
QF-20B/AF-20B
QF-40B
QF-70B*
QF-110*
QF-140*



* It is not possible to use standard configurations of models QF-70B or higher for high-frequency regions, due to the servo valve characteristics. However, these models may be used for testing at high frequencies if the servo valve is changed, for example. Contact Shimadzu for more information.

- The above characteristic curves indicate the relation between half-amplitude and cycle speed, given sine wave motion at the rated load level.
- The above indicates the amplitude characteristics given a 60 Hz power supply. Characteristics with a 50 Hz power supply will be about 5/6 of indicated values.
- The above characteristics do not include the frame or load cell characteristics. Compensate for the influence of these factors to determine actual amplitude characteristics.
- The indicated characteristics values were calculated based on typical characteristics of the servo valve being used, which may result in a difference of about 10 % on the frequency axis.
- There may be limitations on testing frequencies, depending on jig, sample, or other characteristics.

Standard Layout



Main Unit	Hydraulic Power Supply Unit	Space Required (W x D)
U50kN	QF-10B	2500×2100
	QF-20B	2500×2200
	QF-40B	2500×2600
	QF-70B	2500×2800
	AF-10B	2500×2200
	AF-20B	2500×2200
U100kN	QF-10B	2500×2100
	QF-20B	2500×2200
	QF-40B	2500×2600
	QF-70B	2500×2800
	AF-10B	2500×2200
	AF-20B	2500×2200
U200kN	QF-10B	2600×2100
	QF-20B	2600×2200
	QF-40B	2600×2600
	QF-70B	2600×2800
	AF-10B	2600×2200
	AF-20B	2600×2200

- At the installation site, provide about 500 mm of space on all four sides of the system, in addition to the space requirements indicated above, to allow access for operation and maintenance.
- The drawing above indicates the dedicated space requirements. The shape and orientation of the hydraulic power supply unit may vary depending on its capacity.
- For a more detailed standard layout drawing, contact Shimadzu.
- The standard system configuration does not include the table, computer, or printer.

Tabletop Electric-Hydraulic Dynamic and Fatigue Testing System

EHF-L Series

For Fatigue and Endurance Testing of Various Materials and Small Parts

These compact tabletop models with a top-mounted actuator on an L-type loading frame can perform a wide range of fatigue and endurance tests, from fatigue testing materials to testing small components or parts.

With Dynamic Actuator Capacities of 5 kN, 10 kN, and 20 kN, the Compact Actuators Support a Wide Range of Tests

Top-Mounted Actuator

Capable of testing low-to-medium strength materials. From plastic to aluminum, even small component parts can be evaluated by installing an optional T-slot surface plate.

±0.5 % Test Force Accuracy

Test force accuracy is guaranteed to within ±0.5 % of the indicated value.

Dual-Stage Crosshead Drive Mechanism

The hydraulic crosshead drive and hydraulic clamp can be operated intuitively using handles.
This dual-stage configuration helps prevent operating errors and accidents.

High Rigidity and Large Testing Space

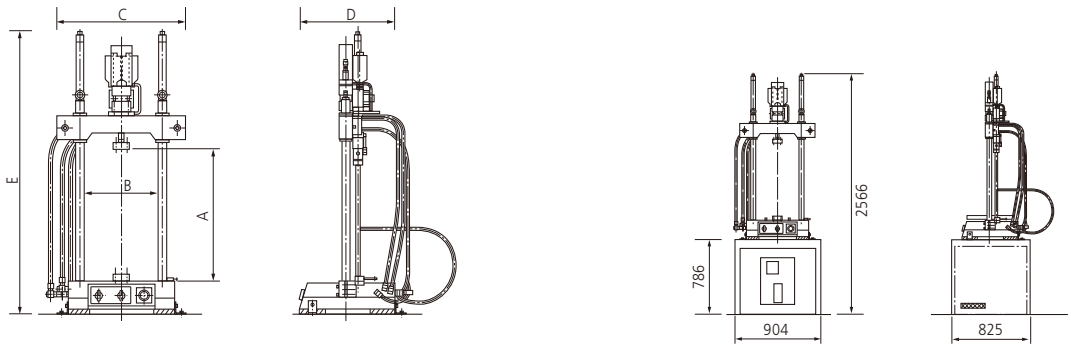
A T-slot surface plate makes it easy to secure components.

Compact Tabletop Testing Machine

A dedicated table for supporting the main testing machine (optional) and a table for enclosing the hydraulic power supply unit are available.

Optional Surface Plate Allows Full-Scale Testing

Specifications



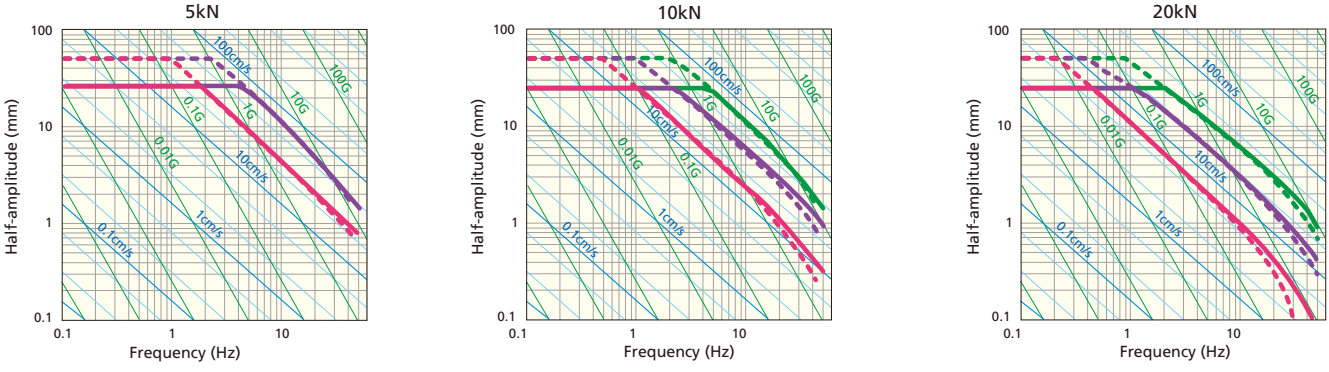
With Table Housing AF-4 Hydraulic Power Supply Unit

Model		EHF -LV005k1A	EHF -LV005k2A	EHF -LV010k1A	EHF -LV010k2A	EHF -LV020k1A	EHF -LV020k2A
Max. dynamic test force		±5kN		±10kN		±20kN	
Max. static test force		±6kN		±12kN		±24kN	
Piston stroke		±25mm	±50mm	±25mm	±50mm	±25mm	±50mm
		Units with a maximum stroke of ±100 mm can also be made.					
Cycle speed and amplitude		See amplitude characteristics charts.					
Controlled items		Test force and stroke (two can be added as options)					
Test force	Range	24-bit rangeless					
	Indication accuracy	Within 0.5 % of indicated value or ±0.02 % of maximum dynamic test force, whichever is greater					
Crosshead drive mechanism		Hydraulic drive (with hydraulic clamp)					
Applicable hydraulic power supply unit		AF-4, AF-10B, AF-20B, QF-10B, QF-20B					
Power requirements		Varies depending on the hydraulic power supply unit (see pages 34 and 35).					
Testing space (mm)	A	140 to 830	115 to 805	140 to 830	115 to 805	140 to 830	115 to 805
	B	460					
Main unit dimensions (mm)	C	800					
	D	600					
	E	1760	1770	1760	1770	1760	1770
Weight (kg)		360	370	365	375	370	380
Frame rigidity (mm/kN)		0.0033 (given a 500 mm crosshead-table clearance)					

Amplitude Characteristics (60 Hz)

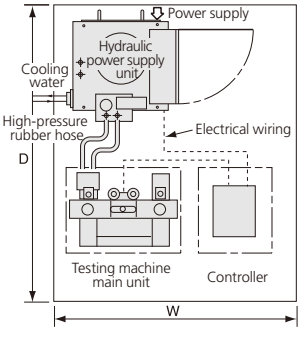
AF-4
QF-10B/AF-10B
QF-20B/AF-20B
25 mm stroke
50 mm stroke

- The above characteristic curves indicate the relation between half-amplitude and cycle speed, given sine wave motion at the rated load level.
- The above indicates the amplitude characteristics given a 60 Hz power supply. Characteristics with a 50 Hz power supply will be about 5/6 of indicated values.
- The above characteristics do not include the frame or load cell characteristics. Compensate for the influence of these factors to determine actual amplitude characteristics.
- The indicated characteristics values were calculated based on typical characteristics of the servo valve being used, which may result in a difference of about 10 % on the frequency axis.
- There may be limitations on testing frequencies, depending on jig, sample, or other characteristics.



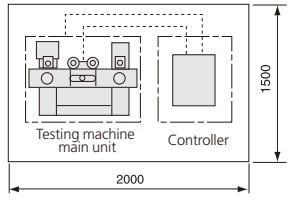
Standard Layout

- At the installation site, provide about 500 mm of space on all four sides of the system, in addition to the space requirements indicated above, to allow access for operation and maintenance.
- The drawing above indicates the dedicated space requirements. The shape and orientation of the hydraulic power supply unit may vary depending on its capacity.
- For a more detailed standard layout drawing, contact Shimadzu.
- The standard system configuration does not include the table, computer, or printer.



Main unit	Hydraulic power supply unit	Space required (W x D)
L5kN	QF-10B	2000×2200
L10kN	QF-20B	2000×2400
L20kN	AF-10B	2000×2400
	AF-20B	2000×2400

With Table Housing AF-4
Hydraulic Power Supply Unit



Optional Accessories and Systems

Servopulser series systems allow selection of the optimal combination of units based on testing objectives. In addition, an extensive selection of optional testing equipment, such as various testing jigs, detectors, and atmospheric control testing units, is available. For more details, refer to the separate optional accessories brochure.

Tensile and Compression Test Jigs

● Front-Opening Hydraulic Grip

Designed for full-amplitude tensile and compression fatigue testing, these grips offer superior ease-of-operation and ensure high-accuracy testing for a wide range of tests.

Maximum test force	±20 to 200 kN (multiple capacities available)
Operating temperature range	RT to +50 °C
Applicable sample	Rod / flat plate

Metals | Plastics | Composite materials

● Manual Non-Shift Plate Grip

These grips are designed for full-amplitude tensile and compression fatigue testing of flat plate materials and feature a simple and efficient construction.

Maximum test force	±5 to 100 kN (multiple capacities available)
Operating temperature range	RT to +50 °C -196 to +300 °C
Applicable sample	Flat plate

Metals | Plastics | Composite materials

● Split Flange Rod Grip

These grips allow samples to be secured easily and firmly. They are ideal for full-amplitude tensile and compression fatigue testing of round rod samples.

Maximum test force	±10 to 200 kN (multiple capacities available)
Operating temperature range	RT to +100 °C -196 to 300 °C
Applicable sample	Rod

Metals | Plastics | Composite materials

● Pin-Type Grip for Flat Samples + Dynamic Strain Gauge (for gauge length displacement)

These grips are designed for half-amplitude tensile fatigue testing.

Note: Supports only tensile testing.

Maximum test force	+6 kN/10 kN
Operating temperature range	-196 to +300 °C (±6 kN) -20 to +300 °C (±10 kN)
Applicable sample	Flat plate (max. 30 mm wide and 5 mm thick)

Metals | Composite materials | Lumber | Plastics

● Non-Shift Wedge Grip for Static Testing

These grips can only be used for static testing. These high-capacity grips apply the self-tightening action of a wedge.

Note: Supports only tensile testing.

Maximum test force	±20 to 250 kN (multiple capacities available)
Operating temperature range	0 to +120 °C
Applicable sample	Rod / flat plate

Metals | Composite materials | Lumber | Plastics

● Grips for CT Test Samples + Clip Gauge

These compact grips are designed specifically for tensile test samples and are compliant with ASTM E399 and E1820 standards. They can be used for tests performed to determine fracture toughness or crack propagation.

Note: Supports only tensile testing.

Maximum test force	±6 to 80 kN
Operating temperature range	RT to +100 °C -20 to 300 °C
Applicable sample	CT test sample

Metals | Plastics | Composite materials

Bolt Testing Jigs

● Screw Tensile Test Jig

This jig is for tensile fatigue testing of various nuts and bolts. Various grips sizes are available depending on the bolt size.

Maximum test force	±100/250 kN
Operating temperature range	RT to +50 °C
Applicable sample	Nuts/bolts

Metals | Plastics | Composite materials

● Screw Looseness Test Device

This device allows testing various parameters to determine the loosening process of bolts. It applies a vibrational displacement in the thread tightening direction and in the perpendicular direction and then measures the change in tightening force in relation to the number of vibrations.

Maximum test force	±20 kN
Operating temperature range	RT to +100 °C -20 to +300 °C
Applicable sample	CT test sample

Metals | Plastics | Composite materials

Compression and Bending Test Jigs

● Compression Plate

Compression plates are available with both he top and bottom fixed or with the top compression plate mounted on a spherical seat.

Maximum test force	20 to 500 kN (multiple capacities available)
Operating temperature range	RT to +250 °C
Applicable sample	60 to 220 mm dia.

Metals | Plastics | Composite materials | Rubber | Rock | Component

● 3-Point/4-Point Bending Test Jig (for partial half-amplitude fatigue testing)

Maximum test force	2kN
Max. dynamic bending moment	50 N/m
Operating temperature range	RT to +100 °C -196 to +300 °C
Jig dimensions	Lower span: 30 to 100 mm Upper span: 15 to 50 mm

Metals | Plastics | Composite materials

● Uniform Bending Test Jig (for full-amplitude fatigue testing)

This jig uses ball bearings at each support point to apply uniform bending loads.

Maximum test force	±2 to 10 kN
Max. dynamic bending moment	±20 to 250 N/m
Operating temperature range	RT to +50 °C -196 to +200 °C

● CTOD Bending Test Jig + Clip Gauge

This jig is for CTOD bending tests compliant with ASTM E339. It is used for fracture toughness testing.

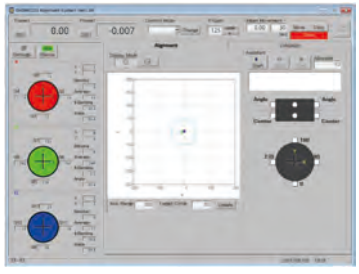
Maximum test force	50/100 kN
Max. dynamic bending moment	2/6 k N/m
Operating temperature range	RT to +100 °C -196 to +300 °C

Metals | Plastics | Composite materials

Axis Adjustment System

Consisting of an axis adjustment unit, axis center sensor testing sample, strain amplifier unit, and dedicated axis adjustment software, this system allows adjusting the tilt between grips and adjusting the axis centers in the horizontal direction. It allows users to obtain highly reliable data by eliminating any bending stresses on samples.

Metals | Plastics | Composite materials



Various Environmental Control Testing Systems

Various environmental control testing systems are required to simulate harsh environments or environments where materials are actually used, such as thermostatic, high-temperature, or extremely low-temperature environments. Therefore, an environmental control system can be added in the large testing space provided by the Servopulser series system.

See page 58.

Metals

Compact Hydraulic Actuator

Force Simulator EHF-JF Series

Automobiles | Steel, Metals, Machines | Furniture, Office Supplies

For Testing the Endurance of Various Parts and Components

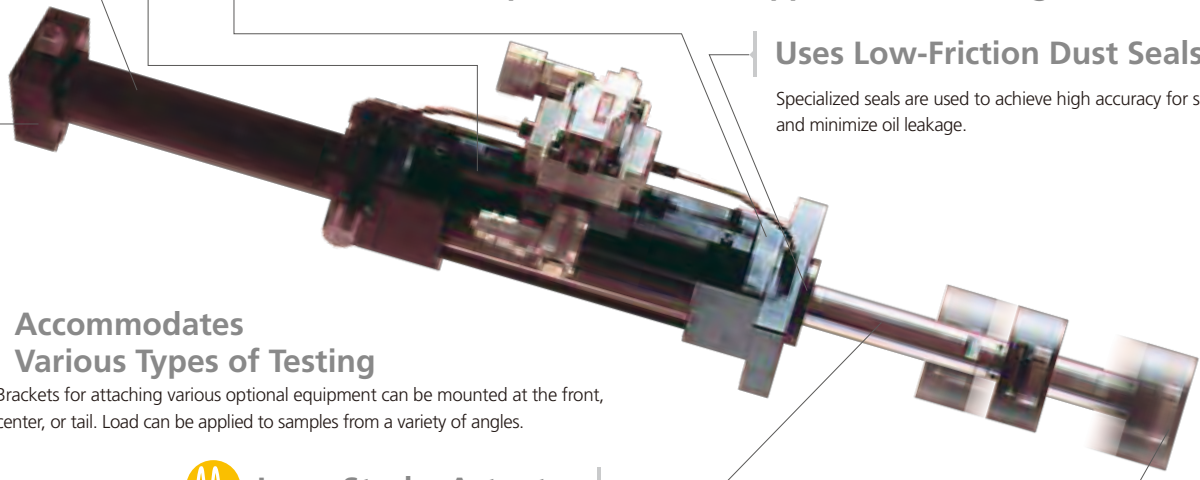
Lightweight and Easy to Install

The 20 kN ±100 mm model weighs only 25 kg. The aluminum body (20 kN model) makes it easy to transport or reinstall on a different testing system. This gives it the flexibility to be used for evaluating a variety of components, large structural members, or parts.

Compact

The small size of the actuator requires less space for attaching it to samples. Hydraulic lines are connected using quick couplers. This makes it easy to configure testing systems.

With Dynamic Actuator Capacities of 5 kN, 10 kN, 20 kN, 30 kN, and 50 kN, the Compact Actuators Support a Wide Range of Tests



Uses Low-Friction Dust Seals

Specialized seals are used to achieve high accuracy for small forces and minimize oil leakage.

Accommodates Various Types of Testing

Brackets for attaching various optional equipment can be mounted at the front, center, or tail. Load can be applied to samples from a variety of angles.

Long-Stroke Actuator

±50 mm, ±100 mm, or ±150 mm. Long-stroke actuators can even simulate forces over long stroke distances.

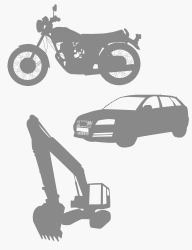
±0.5 % Test Force Accuracy

Test force accuracy is guaranteed to within ±0.5 % of the indicated value

Satisfies Requirements for a Diverse Range of Fields

It can be used to evaluate strength, verify or rationalize designs, or evaluate the safety and reliability of a variety of items via dynamic and fatigue testing, simulation testing, or actual dynamic waveform input testing.

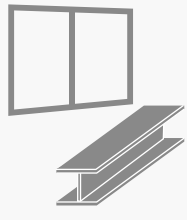
- Automobiles
- Motorcycles
- Construction equipment



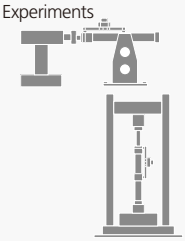
- Aircraft
- Ships
- Trains

- Drinking water
- Light-gauge steel structures
- Prefabricated buildings
- Two-by-four method buildings

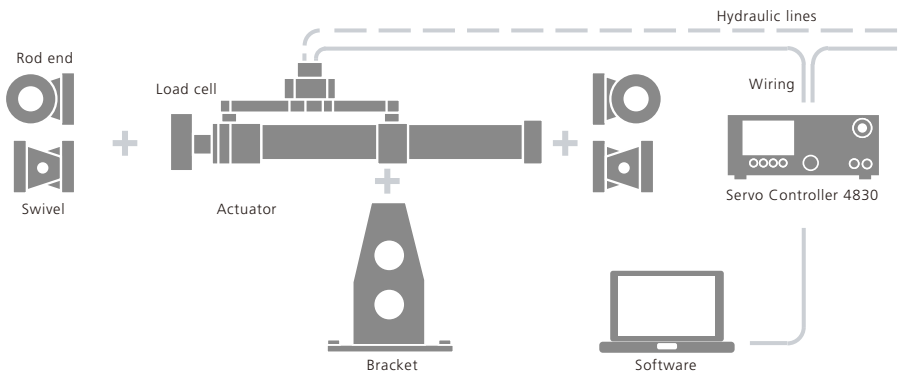
- Parts materials
- New materials
- Pipes
- Chassis
- Shape steel
- Aluminum materials



- Schools
- Research laboratories
- Industrial testing laboratories
- Training
- Experiments

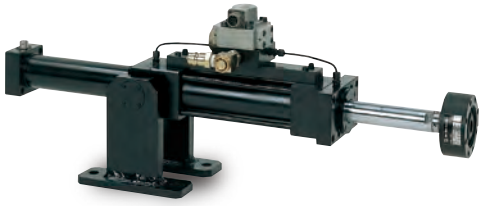


System Example



AF Series Portable Air-Cooled Hydraulic Power Supply Unit

This air-cooled hydraulic power supply unit requires no cooling water. Also, all of the required hydraulic equipment is installed in a case mounted on caster wheels so that it can be relocated easily.



● With a trunnion bracket

● With vertical and left/right rotation mechanisms

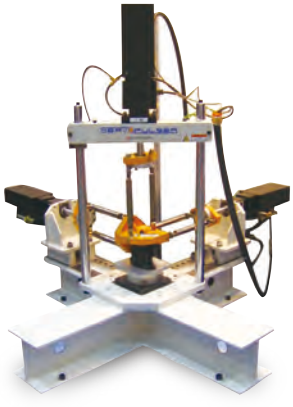
● With vertical movement and vertical rotation mechanisms

● Bed Endurance Evaluation System

This system allows testing of bed mattresses or other large samples. By installing an EHF-J system on a reaction frame, loads can be repeatedly applied from perpendicular directions.

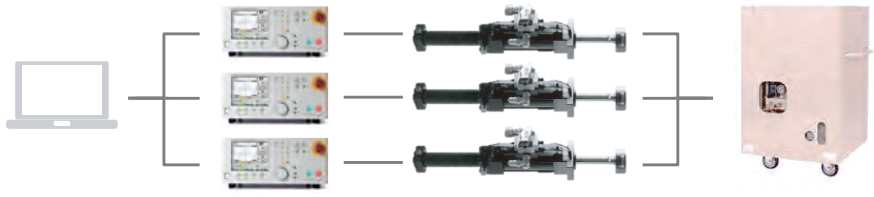
● Part Endurance Evaluation System

This system features a reaction frame with a hydraulically actuated crosshead installed on a large surface plate. The actuator can be adjusted to any angle or left/right position. Therefore, it can be used as a general-purpose system for testing the endurance of various parts and components.



● XYZ 3-Axis Engine Mount Testing System

This system is capable of applying synchronized loads in three directions, X, Y, and Z.
It can also be used to accurately reproduce actual load profiles experienced by vehicles during travel.



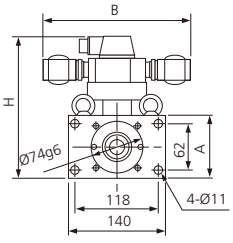
Specifications

Model		EHF -JF5kNV-XX-A10	EHF -JF10kNV-XX-A10	EHF -JF20kNV-XX-A10	EHF -JF30kNV-XX-A10	EHF -JF50kNV-XX-A10
Max. dynamic test force		±5kN	±10kN	±20kN	±30kN	±50kN
Max. static test force		Approx. ±7 kN	Approx. ±13 kN	Approx. ±27 kN	Approx. ±39 kN	Approx. ±63 kN
Load cell		SCL-5kN	SCL-10kN	SCL-20kN	SFL-30kN	SFL-50kN
Piston stroke		Select from ±50 mm, ±100 mm, or ±150 mm				
Cycle speed and amplitude		See amplitude characteristics charts.				
Controlled items		Test force and stroke (two can be added as options)				
Test force	Range	24-bit rangeless				
	Indication accuracy	Within ±0.5 % of indicated value or ±0.02 % of maximum dynamic test force, whichever is greater				
Applicable hydraulic power supply unit		AF-10B, AF-20B				
Hydraulic lines		1/2" hoses with couplers on both ends and protected with spiral wire guards				
Power requirements		Varies depending on the hydraulic power supply unit (see pages 34 and 35).				

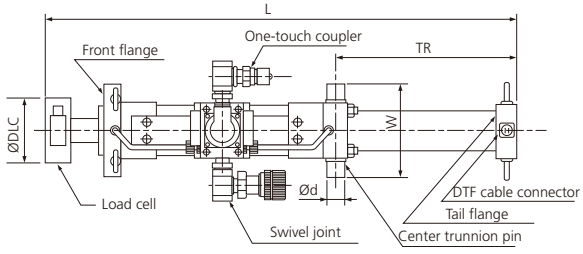
Note: In actual model names, the "XX" is substituted with the actuator stroke value. Select from the table below.

Testing Machine Main Unit Dimensions

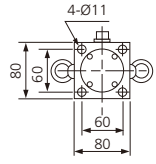
5/10/20kN



Front (with load cell removed)

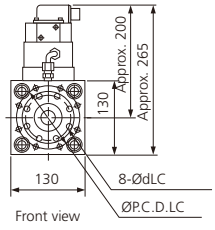


Note: Front flange on 5 kN, 10 kN, and 20 kN models only.

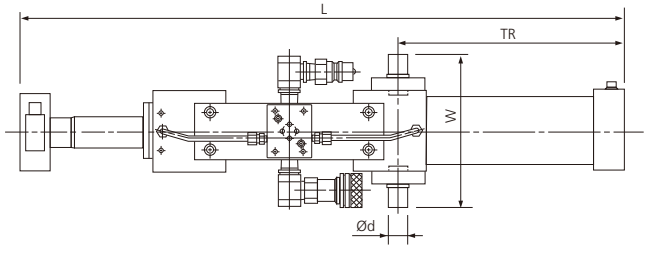


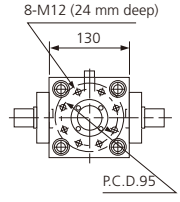
Rear view (Tail flange)

30/50kN



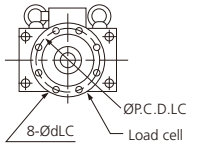
Front view





Rear view

Load cell



Front view (with load cell attached)

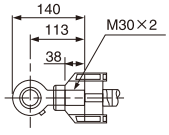
Capacity		5kN			10/20kN			30/50kN		
Actuator stroke		±50mm	±100mm	±150mm	±50mm	±100mm	±150mm	±50mm	±100mm	±150mm
Weight (kg)		17	20	26	21	25	28	74	84	94
Dimensions (mm)	L	565	815	1065	570	820	1070	715	965	1215
	W	140			140			245		
	Ød	25			25			30		
	TR	169	269	369	176	276	376	278	378	478
	ØDLC	100			100			125		
	ØP.C.D.L.C	85			85			110		
	ØdLC	9			9			13		
	B	210			210			—		
	H	196			200			—		
	A	80			84			—		

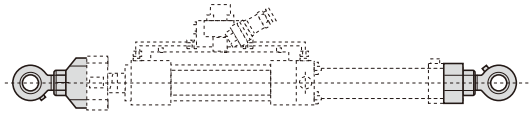
Optional Bracket

The optional brackets indicated below can be installed on the front flange, center trunnion, or tail flange. For details on where to install and dimensions, see the figure below.

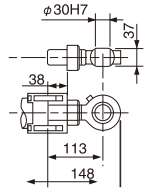
Optional bracket		Rod end			Swivel			Bracket		
		Set	Front	Tail	Set	Front	Tail	Front	Trunnion	Angle set
Model name	±5 to 20 kN	JRS-20	JRF-20	JRT-20	JSS-20	JSF-20	JST-20	JF-20	JT-20	JA-20
	30/50kN	-	-	-	If the base and head are used in combination, purchase two sets.	JS-50		JF-50	JT-50	-

Rod End

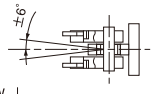


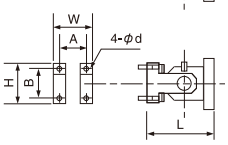


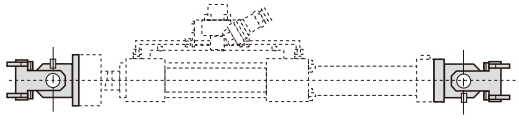
Front rod end Tail rod end



Swivel



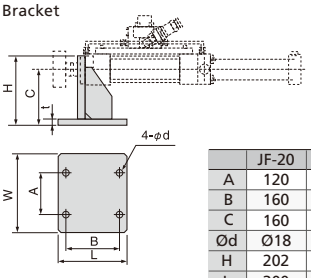




Swivel head Swivel base

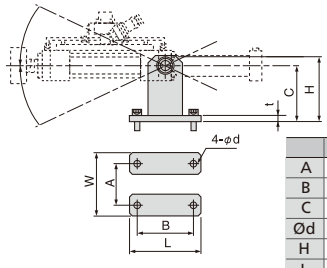
	JSF-20,JST-20	JS-50
A	60	200
B	60	200
Ød	Ø11	Ø22
H	80	140
L	135	200
W	78	140

Bracket



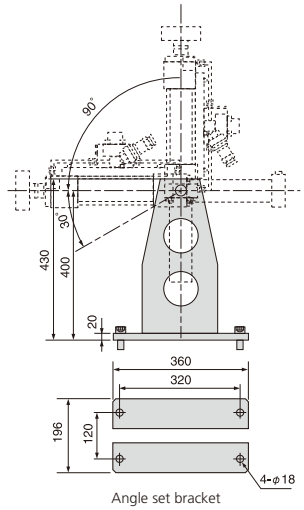
	JF-20	JF-50
A	120	200
B	160	200
C	160	200
Ød	Ø18	Ø22
H	202	265
L	200	255
W	230	270

Front bracket



	JT-20	JT-50
A	120	200
B	160	200
C	160	200
Ød	Ø18	Ø22
H	190	240
L	200	250
W	184	280

Trunnion bracket



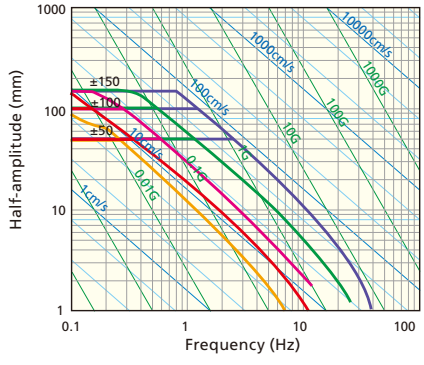
Angle set bracket

Amplitude Characteristics (60 Hz)

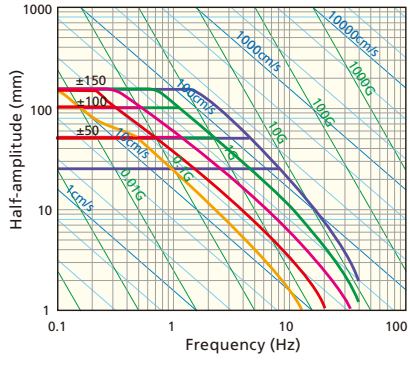
JF5kN
JF10kN
JF20kN
JF30kN
JF50kN

- The above characteristic curves indicate the relation between half-amplitude and cycle speed, given sine wave motion at the rated load level.
- The above indicates the amplitude characteristics given a 60 Hz power supply. Characteristics with a 50 Hz power supply will be about 5/6 of indicated values.
- The above characteristics do not include the frame or load cell characteristics. Compensate for the influence of these factors to determine actual amplitude characteristics.
- The indicated characteristics values were calculated based on typical characteristics of the servo valve being used, which may result in a difference of about 10 % on the frequency axis.
- There may be limitations on testing frequencies, depending on jig, sample, or other characteristics.

When Using an AF-10B



When Using an AF-20B



High-Capacity Hydraulic Actuator

EHF-J Series

Civil Engineering, Construction

R&D

For Full-Scale Testing and Evaluating Large Samples

Jack systems are used to test strength characteristics by attaching a jack to a test floor in a strong room, to a reaction wall, to a base plate (made of steel) or a testing frame, and then applying loads to samples in a specified mode. Two types of jack systems are available, either dynamic or static, based on the test objectives.

Low-Friction Actuator

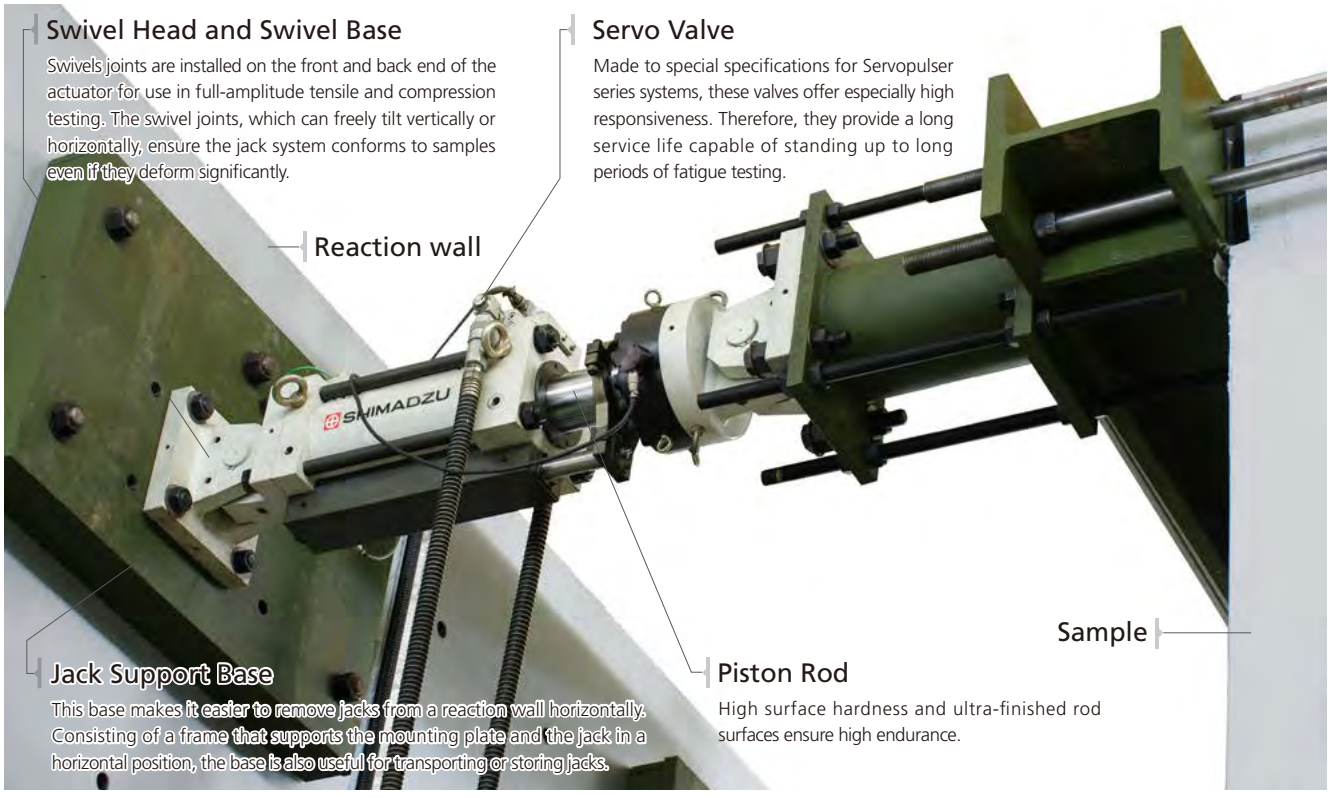
Dynamic testing jacks are designed with low friction to maximize endurance.

Supports Multi-Jack Systems

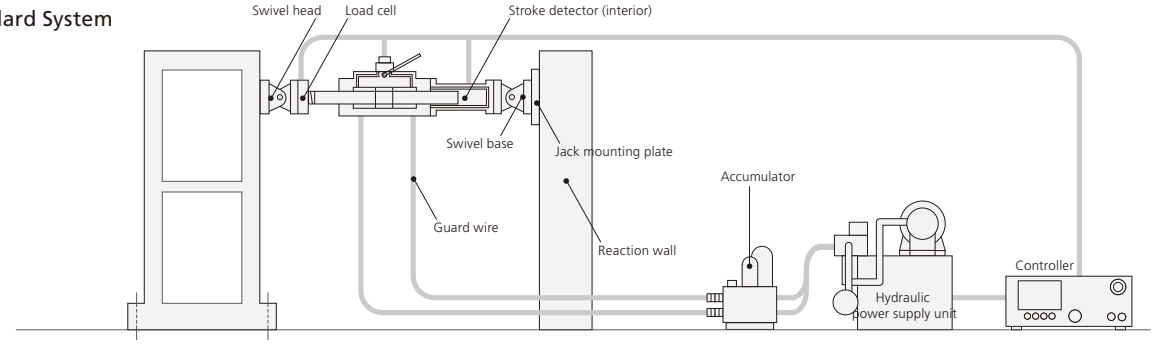
Customized multiple jack systems, to multiple jacks are linked and controlled to apply loads in any XYZ direction, are also available.

Jacks Can Also Be Installed on Cross Beam Type Testing Frames

By installing a cross beam type testing frame on a testing floor, jacks can be mounted and used as a testing machine for structural members.

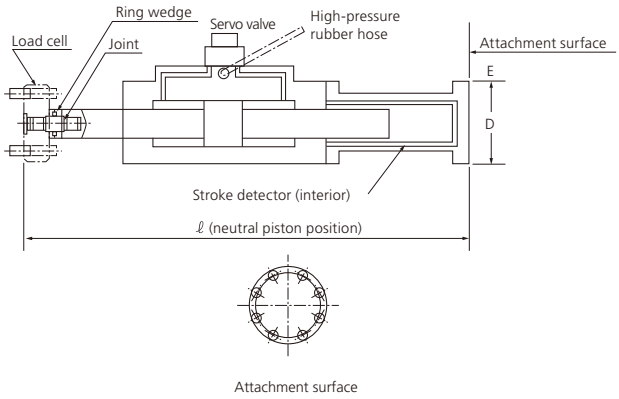


Example of Standard System

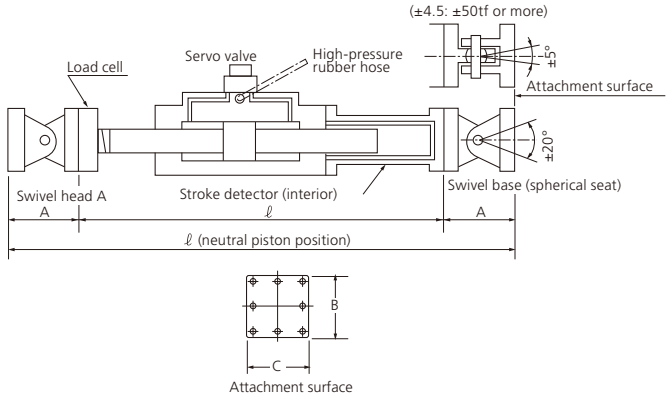


Dynamic Jack Specifications

Basic Dynamic Jack Model



Dynamic Jack with Swivel Head and Swivel Base

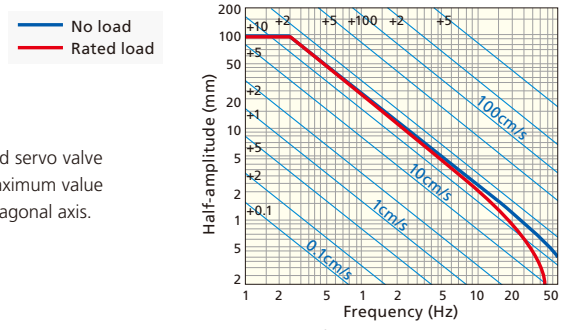


Capacity (kN)		Dynamic	±100	±200	±300	±500	±750	±1000
		Static	±150	±300	±450	±750	±1100	±1500
Actuator Stroke (mm)			±50/±100	±50/±100/±150	±50/±100	±50/±100	±50/±100	±100/±150/±200
Dimensions (mm)	Actuator	ℓ	770/1020	935/1170/1400	1165/1395	1330/1580	1540/1790	1860/2110/2360
		L	1240/1490	1495/1730/1960	1885/2085	2230/2480	2540/2790	3040/3290/3540
	Swivel head and swivel base	A	235	280	345	450	500	590
		B	200	240	300	460	530	600
		C				320	440	450
		D	Ø 180	Ø 240	Ø 300	Ø 380	Ø 430	Ø 560
Load cell			SFL-100kN	SFL-200kN	SFL-300kN	SFL-500kN	SFL-750kN	SFL-1000kN
Hydraulic power supply unit			QF-10B QF-20B QF-40B	QF-20B QF-40B QF-70B	QF-20B QF-40B QF-70B	QF-40B QF-70B QF-140B	QF-40B QF-70B QF-140B	QF-40B QF-70B QF-140B

Notes:
1. Lengths ℓ and L are the distances to the neutral positions of the pistons.
2. The full stroke is 200 mm for a ±100 mm model.
3. Models with specifications other than indicated in this table can also be made.

Amplitude Characteristics (60 Hz)

Characteristic amplitude curves are determined by the hydraulic power supply unit capacity and servo valve properties. The chart on the right is only one example. The loading speed is expressed as the maximum value from one sine wave cycle (π /2 of the average value). The loading rate values are read on the diagonal axis.



Amplitude Curves for EHF-J, 200 kN, ±100 mm, and QF-70B Hydraulic Power Supply Unit

Max. Loading Speed Table

Maximum Loading Speed of Dynamic Jack System

The table on the right indicates the maximum loading speeds determined by the combination of the dynamic jack, hydraulic power supply unit, and servo valve used. It assumes that the system is equipped with an adequately large accumulator.

- For ramp wave or triangular wave loading waveforms or if the accumulator is ineffective, values are $2/\pi$ of the values indicated in the table.

Note: An accumulator sized proportional to the jack capacity and stroke is required.

● Max. Loading Speed (cm/s)

Dynamic jack capacity (kN)		±100	±200	±300	±500	±750	±1000
Hydraulic power supply	QF-10B	3.8	2.0	1.3	0.7	0.5	0.4
	QF-20B	8.0	4.1	2.7	1.6	1.1	0.8
	QF-40B	12.7	6.5	4.3	2.5	1.7	1.3
	QF-70B	28.4	14.6	9.7	5.6	3.8	3.0
	QF-140B	50	26	17.3	10.0	6.9	5.3
	QF-210B	85	43	29.0	16.9	11.6	9.0
	QF-330		73	48	28.1	19.3	15.0

Note: Indicated values are for regions with a 60 Hz power supply. For regions with 50 Hz power, values are 5/6 of the indicated values.

Various Test Jigs

For testing structural members, a test jig of appropriate size for the given samples is required. Shimadzu can fabricate various types of jigs based on customer requirements.

- Perpendicular loading unit
  (jig applying pressures equivalent to its own weight)
- Horizontal loading frame
  (supplemental reaction wall)
- Tensile test jig and hydraulic non-shift wedge grips
- Compression test jig
- Bending test jig
- Swivel Head and Swivel Base
- Jack Support Base

  This base makes it easier to remove jacks from a reaction wall horizontally. Consisting of a frame that supports the mounting plate and the jack in a horizontal position, the base is also useful for transporting or storing jacks.

Jack Support Base

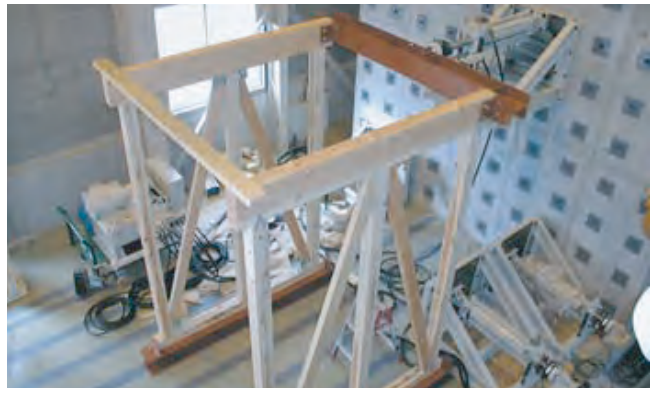
Tensile Test Jig

Bending Test Jig

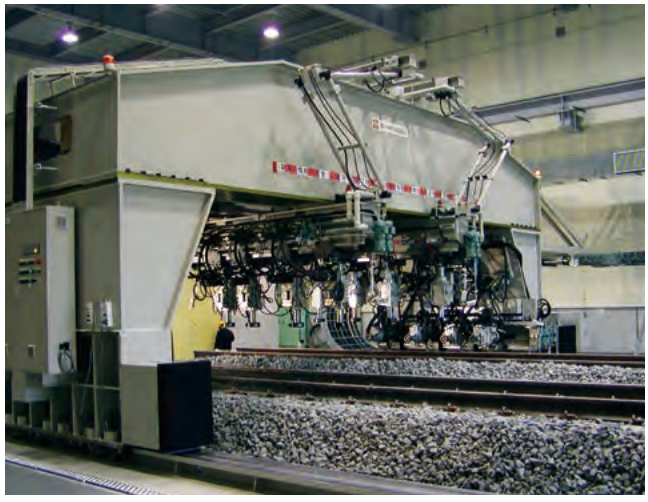
Example of Large Jack Testing System

Loading Test for Steel Structural Members ±1000 kN

Loading Test for Wooden Structural Members Panel Shear Testing System

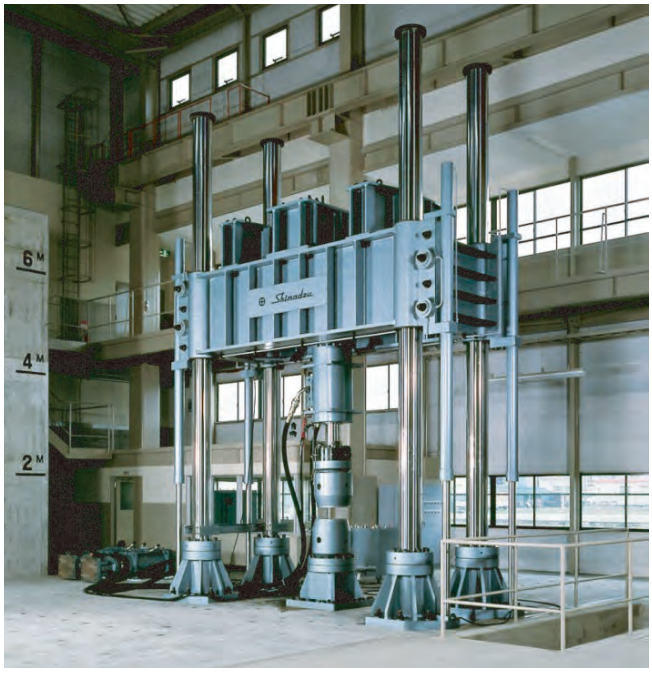


Multiple Jack System on a Railway Rail



System Installed for East Japan Railway Company

Compressive Fatigue Test of Steel Reinforced Concrete Manhole Covers ±1000 kN



±1000 kN Structural Member Testing Machine

The loading unit consists of a cross beam type frame (with friction clamps) built on a test floor in combination with dynamic jacks. The frame was constructed with friction clamps clamped to four columns.

Specifications	Model name
Capacity	Dynamic: ±1000 kN
	Static: ±1500 kN
Stroke	±100mm
Jig attachment spacing	Max. 5 m
Distance between columns	3.7m
Grips	Hydraulic

±10 MN Structural Member Testing Machine

This large structural member testing machine is cable of dynamic loads up to 8 MN (static loads up to 10 MN). The system is used to evaluate large full-scale CFRP aircraft materials and components by applying estimated loads experienced during takeoff and landing or during rocket launches.

Specifications	Model name
Capacity	Dynamic: ±8 MN
	Static: ±10 MN
Stroke	±150mm
Jig attachment spacing	1000 to 4000 mm
Distance between columns	3000mm×3000mm

Grips for Tensile Test

Torsional Dynamic and Fatigue Testing System

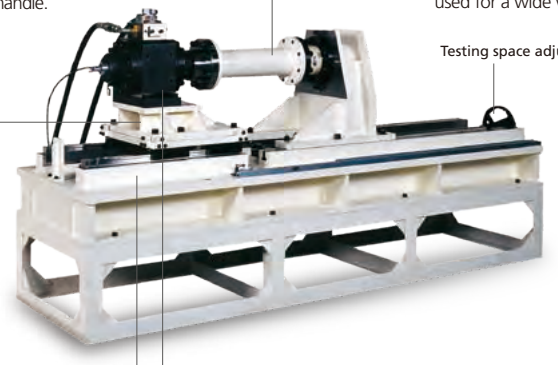
EHF-T Series

Automobiles | Steel, Metals, Machines | R&D

Stationary Torsional Dynamic and Fatigue Testing System with High Rigidity Frame and Large Testing Space

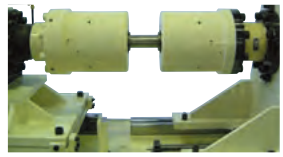
Large Testing Space

With a 1000 mm wide testing space, this system is perfect for evaluating the reliability and endurance of long parts, such as composite parts that combine multiple materials or structural materials. The testing space can be adjusted using a handle.



Supports a Wide Variety of Tests

By using an extensive selection of optional products, such as grips and atmospheric control testing units, these systems can be used for a wide variety of applications.


Hydraulic collet-type rod grip


Testing space adjustment handle

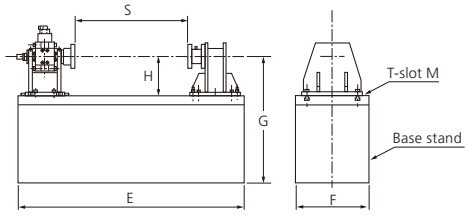
High-Rigidity Frame

A frame with high torsional rigidity allows the system to accurately control torque and rotation angle during measurements.

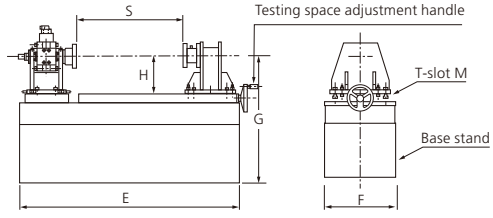
High-Performance Torque Actuator

Loads up to the actuator capacity of ±0.5 to 10 k/N can be applied. It can be used in combination with various other testing systems as well.

Specifications



Testing machine for 0.5 kNm loads

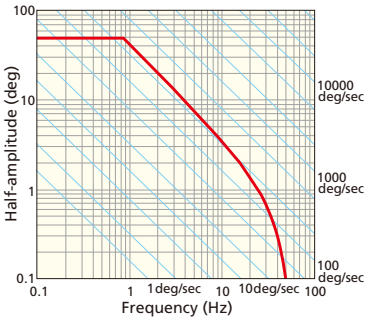


Testing machine for 1 to 10 kNm loads

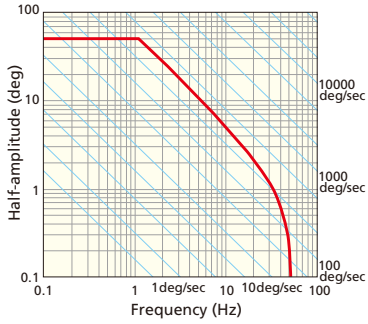
Model		EHF-TV05kNm-010	EHF-TV1kNm-020	EHF-TV2kNm-040	EHF-TV5kNm-070	EHF-TV10kNm-110
Maximum capacity	Dynamic / static	±0.5/±0.75kN/m	±1/±1.5kN/m	±2/±3kN/m	±5/±7.5kN/m	±10/±15kN/m
Loading method		Electric-hydraulic servo (cross-looped system)				
Max. torsion angle		±50 deg				
Cycle speed and amplitude (sine wave)		See amplitude characteristics charts.				
Control mode		Torque control and torsion angle control				
Static accuracy	Torque	Within ±1 % of indicated value or within ±0.05 % of dynamic rating, whichever is greater				
	Torsion angle	Within ±1.5 % of indicated value or within ±0.15 % of dynamic rating, whichever is greater				
Loading frame (testing space)	S : Flange spacing	0 to 1000 mm				0 to 1200 mm
	H : Height at center of torque	300 mm	300 mm	350 mm	400 mm	400 mm
	F×E : Table area(width × length)	600×1600 mm	760×1900 mm	650×2000 mm	800×2100 mm	1000×2500 mm
	G : Torque shaft height	900 mm	1100 mm	1150 mm	850 mm	850 mm
	M : T-slot size (nominal)	14 mm	22 mm	22 mm	22 mm	22 mm
	Weight (including actuator)	About 830 kg	Approx. 950 kg	Approx. 1700 kg	Approx. 2600 kg	Approx. 3200 kg (excluding base stand)
Hydraulic power supply unit used	Model	QF-10B	QF-20B	QF-40B	QF-70B	QF-110B

Characteristic Amplitude Curves (60 Hz)

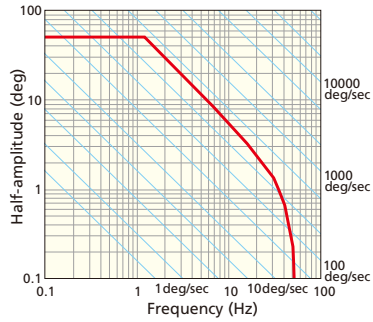
TV05kNm-010



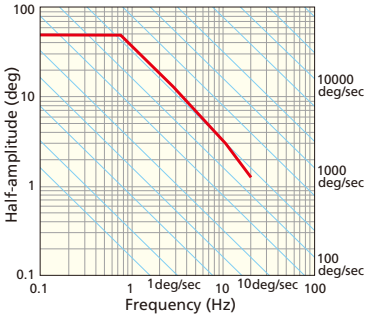
TV1kNm-020



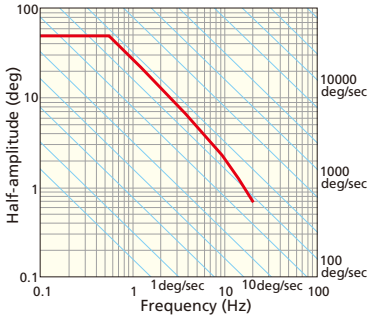
TV2kNm-040



TV5kNm-070



TV10kNm-110



- The above characteristic curves indicate the relation between half-amplitude and cycle speed, given sine wave motion at the rated load level.
- The above characteristics do not include the frame or torque cell characteristics. Compensate for the influence of these factors to determine actual amplitude characteristics.
- The indicated characteristic values were calculated based on typical characteristics of the servo valve being used, which may result in a frequency band difference of about 10 %.
- The indicated characteristic values were calculated assuming a moment of inertia of zero for the jig and sample.
- The indicated characteristics are for regions with a 60 Hz power supply. Characteristics in regions with 50 Hz power will be about 5/6 of indicated values.

Portable Torsional Actuator

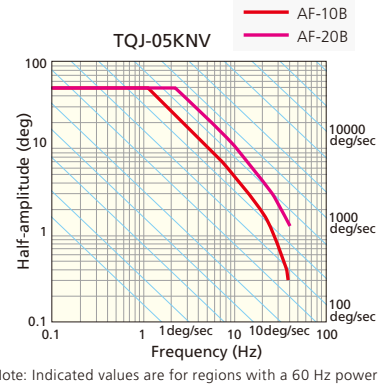
EHF-TQJ Series

For Testing the Torsional Endurance of Various Parts and Components

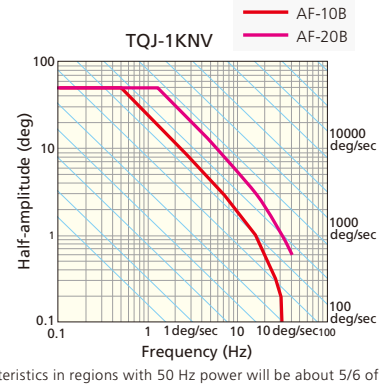
Freely Movable Testing Machine Based on Sample

In addition to a movable air-cooled hydraulic power supply unit, the torsional actuator can also be freely moved. Therefore, it offers broad applicability for evaluating the torsional endurance of products, components, and other full-size samples.

TQJ-05KNV



TQJ-1KNV



Note: Indicated values are for regions with a 60 Hz power supply. Characteristics in regions with 50 Hz power will be about 5/6 of indicated values.

Specifications

Model		TQJ-05kNV-A10	TQJ-05kNV-A20	TQJ-1kNV-A10	TQJ-1kNV-A20
Maximum capacity		Dynamic: 500 Nm Static: 750 Nm		Dynamic: 1 kNm Static: 1.5 kNm	
Product composition		Main movable testing machine unit (excluding torque actuator, torque cell, and servo valve), Servo Controller 4830*, air-cooled hydraulic power supply unit (with casters), hydraulic lines (5 m high-pressure rubber hose, routed above floor), wiring (routed above floor), and standard accessories			
Max. torsion angle		±50 deg			
Cycle speed and amplitude (sine wave)		See the amplitude characteristics curves.			
Control mode		Torque control and torsion angle control			
Static accuracy	Torque	Within ±1 % of indicated value or within ±0.05 % of dynamic rating, whichever is greater			
	Torsion angle	Within ±1.5 % of indicated value or within ±0.15 % of dynamic rating, whichever is greater			
Hydraulic power supply unit used		AF-10B	AF-20B	AF-10B	AF-20B
Weight		Approx. 140 kg	Approx. 160 kg	Approx. 140 kg	Approx. 160 kg

* A separate table is required for installation of the controller.

Water-Cooled Hydraulic Power Supply Unit

QF Series

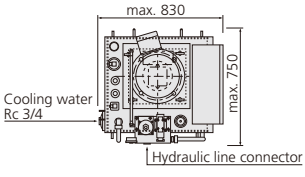
These hydraulic power supply units are designed specifically for electric-hydraulic dynamic and fatigue testing systems. The system includes an oil pump, oil tank, filter, cooler, pressure regulator, and other equipment.

- The oil pump is a gear pump with minimal pulsing and low noise.
- The filter includes a 3-micron element that helps prevent wear in the servo valve and other equipment.
- Space savings have been achieved by orienting the pump and motor vertically (QF-10B to 70B, AF-4, and AF-10B to 20B).

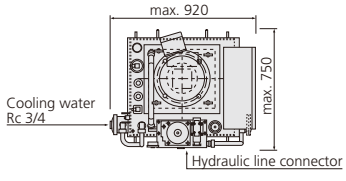
Model		QF-10B	QF-20B	QF-40B	QF-70B	QF-110*	QF-140
Applicable testing system	E-type	○	○	○	○	○	○
	U-type	○	○	○	○	○	○
	L-type	○	○	○			
	JF-type	○	○				
	J-type	○	○	○	○	○	○
	T-type	○	○	○	○	○	○
	TQJ-type						
Output (approx.)	50Hz	9L/min	19L/min	42L/min	68L/min	108L/min	138L/min
	60Hz	11L/min	24L/min	51L/min	81L/min	104L/min	162L/min
Oil pressure	Normal	21MPa					
Hydraulic oil		Mobil DTE 25					
Pump	Type	Fixed output gear pump					
	Number of units	1					2
Motor	Capacity	5.5kw	11kw	22kw	37kw	45kw	37kw×2
Oil filter		3μm					
Tank capacity		90L	90L	190L	300L	500L	590L
Operating noise (at 21 MPa)		74dBA	76dBA	78dBA	80dBA	83dBA	85dBA
Power requirements	Single-phase 100 V	1.5kVA					
	Three-phase 200 V	8kVA	16kVA	32kVA	47kVA	57kVA	93kVA
Cooling water volume required		20L/min	20L/min	65L/min	80L/min	110L/min	150/180L/min(050Hz/60Hz)
Compatible cooling tower (tons of cooling)		2	3	5	10	20	20
Main unit dimensions (approx.)	Width (mm)	830mm	920mm	1100mm	1200mm	1730mm	1950mm
	Depth	750mm	750mm	860mm	1000mm	1290mm	1500mm
	Height	1235mm	1235mm	1400mm	1600mm	1370mm	1550mm
Weight	Including oil	Approx. 530 kg	Approx. 530 kg	Approx. 720 kg	Approx. 1040 kg	Approx. 1500 kg	Approx. 2200 kg
Recommended circuit breaker capacity (3-phase 200 V / 1-phase 100 V)		50A/15A	100A/15A	150A/15A	225A/15A	300A/15A	400A/15A

Notes
- The indicated operating noise values are provided for reference and are not guaranteed.
- The operating noise level may vary depending on the installation site conditions.

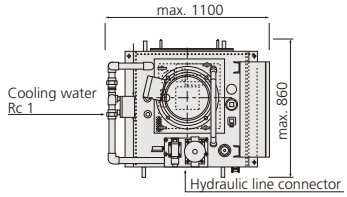
* 50 Hz and 60 Hz models are available for the QF-110 only.



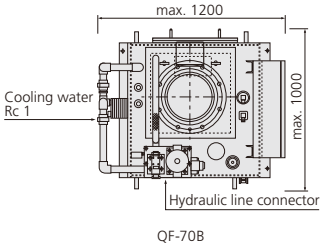
QF-10B



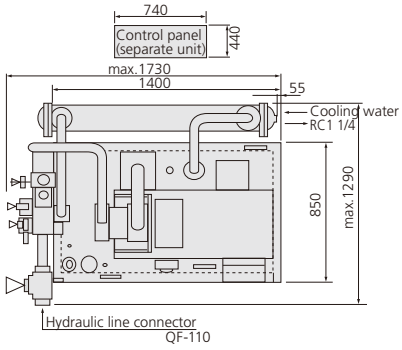
QF-20B



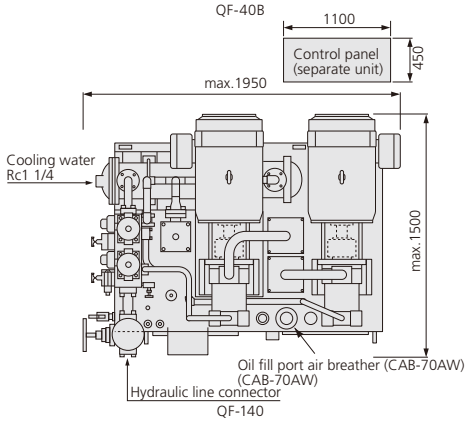
QF-40B



QF-70B



QF-110



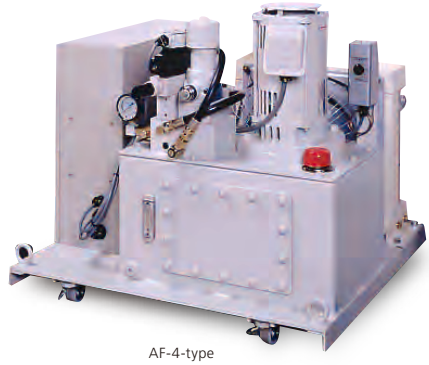
QF-140

Air-Cooled Hydraulic Power Supply Unit

AF Series

These hydraulic power supply units are designed specifically for electric-hydraulic dynamic and fatigue testing systems. The system includes an oil pump, oil tank, filter, cooler, pressure regulator, and other equipment.

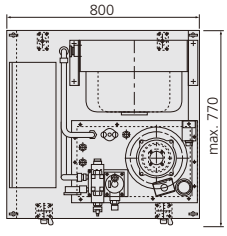
- The oil pump is a gear pump with minimal pulsing and low noise.
- Does not need any cooling water.



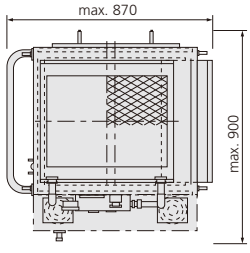
AF-4-type

Model		AF-4	AF-10B	AF-20B
Applicable testing system	E-type		○	○
	U-type		○	○
	L-type	○	○	○
	JF-type		○	○
	J-type		○	○
	T-type		○	○
	TQJ-type		○	○
Output (approx.)	50Hz	3.7L/min	9L/min	19L/min
	60Hz	4.5L/min	11L/min	24L/min
Oil Pressure	Normal	21MPa		
Hydraulic oil		Mobil DTE 25		
Pump	Type	Fixed output gear pump		
	Number of units	1		
Motor	Capacity	2.2kw	5.5kw	11kw
Cooling fan		0.1kw	0.1kw	0.2kw
Oil filter		3μm		
Tank capacity		24L	90L	90L
Operating noise*		56dBA	71dBA	76dBA
Power Supply	Single-phase 100 V	1.5kVA		
	Three-phase 200 V	3.5kVA	8kVA	17kVA
	Width (mm)	800mm	870mm	870mm
	Depth	770mm	900mm	900mm
	Height	700mm	1700mm	1700mm
Weight	Including oil	Approx. 235 kg	Approx. 630 kg	Approx. 630 kg
Recommended circuit breaker capacity (3-phase 200 V / 1-phase 100 V)		20A/15A	50A/15A	100A/15A

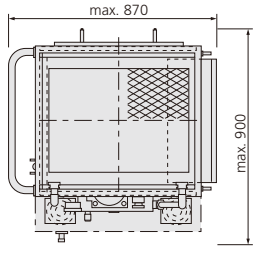
* The AF-4 operating noise value indicates the level in front of the unit when it is installed in the dedicated base stand.
Note: The AF series is air-cooled. Keep the ambient temperature at the hydraulic power supply unit installation site at 25 °C or less.
* The indicated operating noise values are provided for reference and are not guaranteed.
* The operating noise level may vary depending on the installation site conditions.



AF-4



AF-10B



AF-20B

Energy-Conservation Unit for
Servopulser Series Hydraulic Power Supply Units

ECU Series

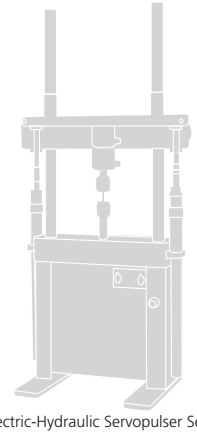
This product is certified as Shimadzu's Eco-Products Plus.

ECU1 Series: Up to 30% energy savings compared to previous models
ECU2 Series: Up to 50% energy savings compared to previous models

Helps Reduce Energy Consumption, CO2 Emissions, and Running Costs by Up to 50 %

Controller

Hydraulic Power Source Unit



Electric-Hydraulic Servopulser Series

Up to 50 % Lower Power Consumption

Automatic Energy-Saving Operation

Remote Operation

ECU Controller

Lower Running Costs

Using the ECU energy-conservation unit enables an energy-saving mode that can switch OFF the hydraulic power supply unit power depending on the testing parameters and testing status. It also reduces the hydraulic power supply unit's power level when tests are in standby mode.

Note: When using the ECU2 in a region with 60 Hz power supply (up to 30 % when using the ECU1).

Automatically Sets the Optimal Energy-Saving Mode

Used in combination with Microsoft Windows software, the ECU unit can automatically set the optimal energy-saving mode based on test parameters or testing status. This efficiently reduces operating power consumption while continuing to perform intended tests.

Operation with a Hand-Held Controller

The unit can be operated with a hand-held controller.
The hydraulic power supply unit's energy-saving settings (motor frequency and supply pressure settings) can be set from the Servo Controller 4830 or from Windows software for 4830.

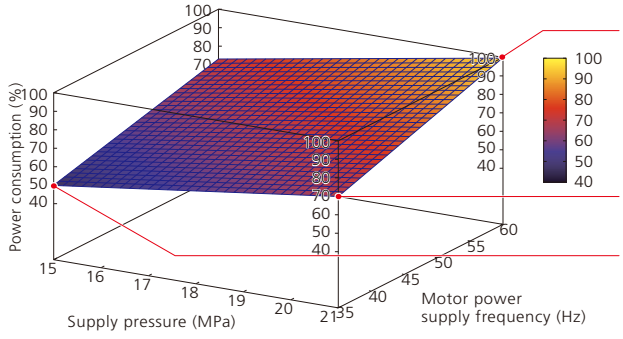
Lower Hydraulic Power Supply Unit Operating Noise and Heat Generation

The energy-saving mode reduces the operating noise and heat generated from the hydraulic power supply unit. It also reduces heat generated from the oil, which helps extend the life of the oil.

ECU Units Can Be Retrofitted on Existing Hydraulic Power Supply Units (QF-A, QF-B, and AF Series)

Notes
- For systems using a controller model prior to the Servo Controller 4830, an ECU controller is required.
- Retrofitting an ECU unit on an existing system requires an on-site survey of the system in advance.
- It may not be possible to retrofit an ECU unit on existing hydraulic power supply units in poor site conditions.

Energy-Saving Mode Reduces Power Consumption



Normal operation: Assumes a power consumption rate of 100 % when operated with a supply pressure of 21 MPa and power supply frequency of 60 Hz.

(1) Reducing the motor's power supply frequency to 35 Hz reduces power consumption by about 25 to 40 %.*

(2) Reducing the supply pressure to 15 MPa reduces power consumption by about 45 to 55 %.*

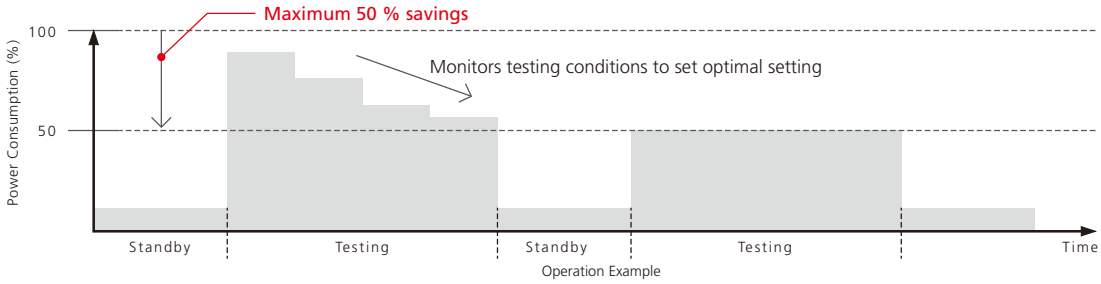
* Differs for regions with 50 Hz and 60 Hz power supplies

Energy-Saving Operation

Automatic Motor Power Supply Frequency and Supply Pressure Setting (with ECU2 and Windows software)

Automatically operates the system in energy-saving mode when the testing machine is in standby mode or depending on the test load status.

Note: Set manually via the Servo Controller 4830 if Windows software is not available.



Operation Example

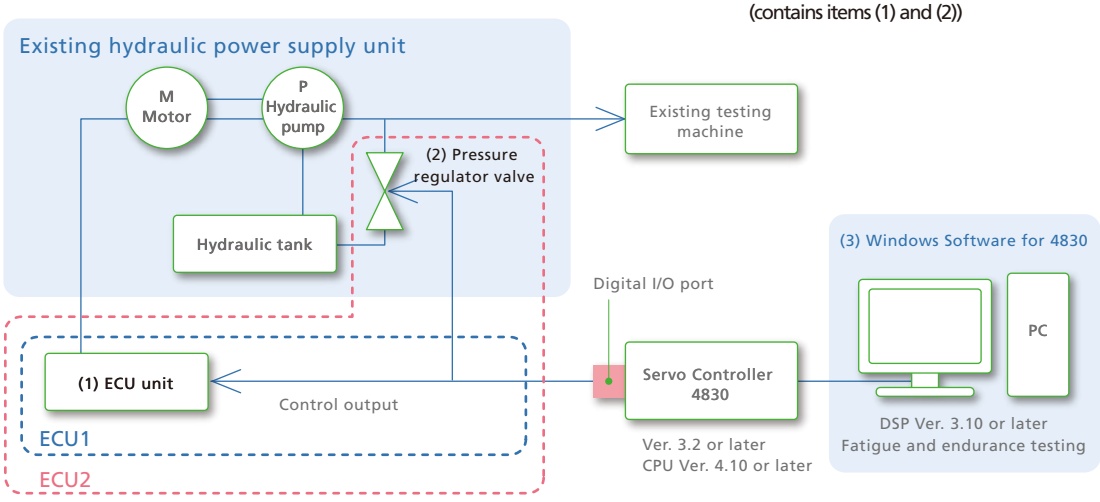
	Motor power supply frequency	Supply pressure
During standby	35Hz	7-9MPa
Just before testing	Automatically settings according to test conditions	
During testing	Periodically checks the displacement amplitude or test force to automatically set appropriate rpm or supply pressure.	

Note: If the function to automatically set the motor power supply frequency and supply pressure is used, the test conditions cannot be changed during testing.

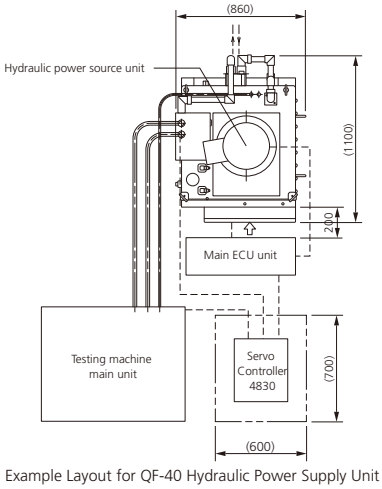
Configuration of Energy-Conservation Unit

ECU1 : Controls the motor's power supply frequency only (contains item (1))

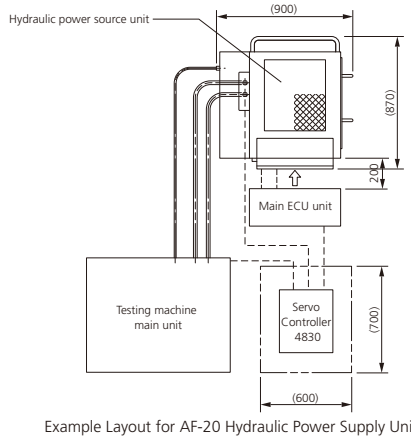
ECU2 : Controls both the motor's power supply frequency and supply pressure (contains items (1) and (2))



Layout Example



Example Layout for QF-40 Hydraulic Power Supply Unit



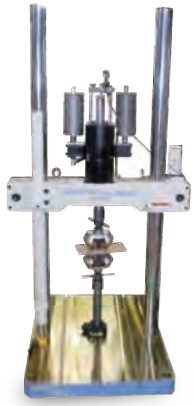
Example Layout for AF-20 Hydraulic Power Supply Unit

Units: mm

Customizing Electric-Hydraulic Dynamic and Fatigue Testing Systems

Servopulser series electric-hydraulic dynamic and fatigue testing systems can be customized to fit the needs of customers. Some special systems are featured on page 58.

300 Hz High-Cycle Fatigue Testing Machine



Long Sample Testing System

Multiple Load Testing Machine

Special Environmentally-Controlled Testing System

Examples of Customization

Applying large loads	300 kN, 500 kN, and 1000 kN testing systems (E and U types)
High-frequency testing	100 Hz and 300 Hz loading systems
Large deformation levels	200 L, 300 L, and 500 L high flow rate hydraulic power supply units
Large samples	Testing machine frames with 1200 mm column height extension and 1000 mm width between columns
Performing multiple tests simultaneously	Four-sample loading systems
Operating multiple testing machines using one hydraulic power supply unit	Central hydraulic supply system
Safety systems required	Units added to meet safety requirements of each company
Performing tests in specialized environments	Combination of thermostatic chamber, humidity-controlled thermostatic chamber, or furnace

Installing Electric-Hydraulic Dynamic and Fatigue Testing Systems

Installation Site

- Foundation construction work is not necessary for concrete floors about 150 mm thick. Since vibration occurs from the testing machine during the test, install on the first floor without the underground space.
- If there is concern about floor vibration, such as there are any devices that hate vibration in the surroundings, please install it on an independent foundation. The level of the floor should be 3mm/1000mm or less.
- For QF-70B or larger hydraulic power supply units or sites particularly sensitive to floor vibration, install a reinforced foundation.
- Site with minimal temperature variations (+10 to +35 °C recommended) (For air-cooled hydraulic power supply units, keep the ambient temperature at the site 25 °C or lower.)
- Site with low humidity (10 to 75 %RH recommended)
- Site not exposed to direct air flow from heating or cooling systems
- Site not exposed to direct sunlight
- Site with low dust levelst
- Site with no corrosive gas pollutants
- Site with low vibration levels (0.1 G or less recommended)
- For the AF series (air-cooled hydraulic power supply unit), keep ambient temperature of hydraulic power supply unit site at 25 °C or lower.

Note: For sites exposed to condensation, salt damage, or other such factors, countermeasures such as a dust-resistant enclosure should be considered.

Power Supply

- Provide a clean ground wire (type-D ground recommended).
- Avoid power supplies with large voltage fluctuations. If voltage fluctuations are unavoidable, use a constant-voltage power supply unit, noise filtering transformer, or other countermeasure.
- The customer is responsible for power supply installation work up to the power supply control panel terminals on the hydraulic power supply unit.
- Provide any additional power supply equipment required separately.
- There should be no high-capacity, noise-generating equipment on the same power supply line.

Cooling Water

- The customer is responsible for cooling water supply line installation work up to the cooling water line connectors on the hydraulic power supply unit.
- Provide any additional cooling water equipment required separately.
- Use clean water at a temperature of 32 °C or lower as cooling water.

Note: If the product is to be installed in a location where condensation or salt damage is possible, consider using a dustproof rack or other suitable product depending on the situation.

Hydraulic Piping

- The piping should be on the floor using a high-pressure rubber hose. If piping in the pit is necessary due to the location of the installation, we will make a separate estimate. Pit construction and its attached construction must be done by the customer.

EHF-E/U/L Series Electric-Hydraulic Dynamic and Fatigue Testing System Model Code

Electric-hydraulic Servopulser series systems can accommodate a wide variety of test force and testing speed requirements by selecting a combination of the following:

- Loading frame
- Actuator
- Controller and software
- Hydraulic power supply unit

EHF-E/U/L Series Electric-Hydraulic Dynamic and Fatigue Testing System Model Code

EHF - [E] [V] [0] [1] [0] K [1] A - [0] [1] [0] - [0] [ ]
(1) (2) (3) (4) (5) (6) (7)

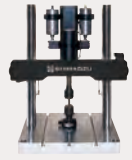
1 Select the loading frame.

Select the best-suited loading frame from the following three options.

[L] L-Type Loading Frame
Tabletop frame with top-mounted actuator
Suitable for testing actual and prepared samples at test forces up to 20 kN.
Application example: Bearing parts

[E] E-Type Loading Frame
Standard frame with bottom-mounted actuator
Suitable for testing small actual and prepared samples at test forces up to 200 kN.
Application example: Standard shape samples

[U] U-Type Loading Frame
Standard frame with top-mounted actuator
Suitable for testing structural materials and large full-size samples at test forces up to 200 kN.
Application example: Large parts



2 Select the controller.

→ [V]

Servo Controller 4830
This controller is capable of generating an extensive selection of test waveforms and provides a measurement, control, and waveform display. Optional software allows testing with a combination of waveforms or a simulation of actual waveforms experienced during operation.

3 Select the actuator capacity. (Select a capacity that matches the loading frame capacity.)

Select one of the following maximum test force capacities. Note: For EHF-E series models with 10 to 100 kN capacity, the third digit is a "1."

→ [ ][ ][ ] k

[0][0][5] : 5kN [0][1][0] : 10kN [0][2][0] : 20kN [0][5][0] : 50kN [1][0][0] : 100kN [2][0][0] : 200kN

4 Select the stroke length.

Select one of the following actuator stroke lengths (range of motion).

→ [ ]

[1] : ±25mm [2] : ±50mm

5 Select the hydraulic power supply unit's flow rate (testing range required).

Select a flow rate referring to the amplitude characteristic curves on pages 26 and 27.

→ [ ][ ][ ]

[0][1][0] : QF-10B [0][2][0] : QF-20B [0][4][0] : QF-40B [0][7][0] : QF-70B [1][1][E] *) : QF-110(for 50Hz)
[1][4][0] : QF-140 [A][0][4] : AF-4 [A][1][0] : AF-10B [A][2][0] : AF-20B [1][1][W] *) : QF-110(for 60Hz)

* Only for the QF-110, the model number differs depending on the frequency.

6 Select loading frame extensions.

Specify whether extended columns (E and U types) or an extended table length (U type) are required, based on the frame dimensions indicated on pages 14 and 15. (The L type is only available in the standard size.)

→ [ ]

[0] : Standard [1] : Columns extended [2] : Standard columns with table extended by 500 mm [3] : Columns extended and table extended by 500 mm
[4] : Standard columns with table extended by +1000 mm [5] : Columns extended and table extended by +1000 mm

- When installing a thermostatic chamber in an E-type or U-type testing machine, select the frame extension type. The L type uses the standard type. E type 100 kN or less is extended by + 600 mm. The others is extended by + 400 mm.
- Extended table length (U type only): Standard, +500 mm, or +1000 mm (3 types) The table length (depth) can be changed to accommodate the size of samples being tested.

7 Select optional items.

Indicate whether or not any of the following customization options is required.

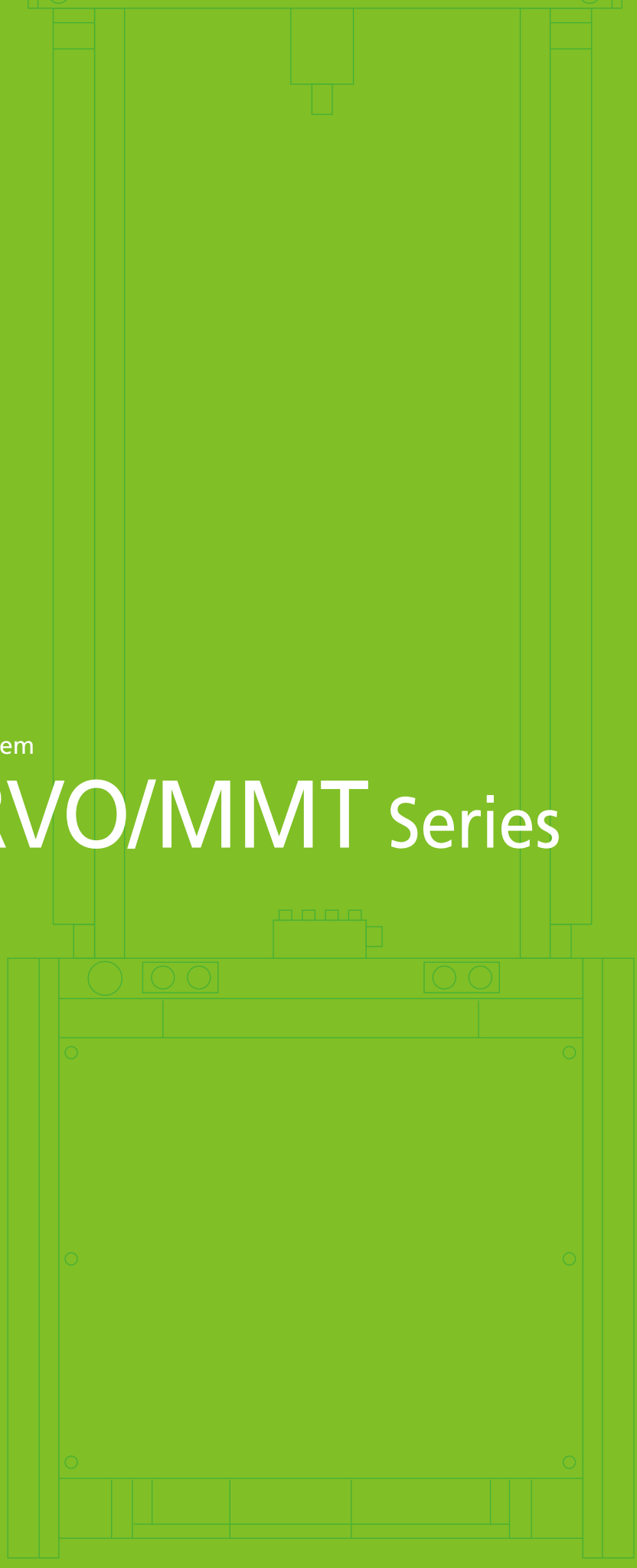
→ [ ][ ]

[U] : Includes base stand [S] : Special specifications (consult your Shimadzu representative separately)

Notes:
- Optional base stand (U50 kN and U100 kN only): Allows the system to be elevated about 700 mm higher than when the table is placed on the floor. This option is required when attaching a thermostatic chamber to a U-type loading frame.

Electric Fatigue and Endurance Test System

EMT/NJ-SERVO/MMT Series



Electromagnetic Force Dynamic and Fatigue Testing System

Shimadzu Servopulser series electromagnetic force dynamic and fatigue testing systems feature electromagnetic actuators with extremely high frequency response. In combination with a closed-loop control system, they allow testing in a clean environment at high speeds or with stroke lengths ranging from micro to long.

With No Hydraulic Oil Required, Maintenance Is Easy

Generates no environmentally unfriendly waste oil.
Requires no hydraulic oil, filters, or other consumables.

Eco-Friendly Energy Efficiency

The eco-friendly operation uses electricity efficiently based on the test force.
Power consumption is minimized to only what is required.
Since the system is clean, it will not contaminate the installation site.

High-Speed High-Accuracy Testing

Performs tests with strokes ranging from micro to long at high speeds and high frequencies. This allows dynamic testing with high accuracy.

Low Noise

Space Saving

Electromagnetic actuators are quieter than hydraulic actuators, which require a hydraulic power supply unit. The low noise provides more freedom in selecting an installation site.
The only things required are the main testing machine unit and controller.
Requires less space than electric-hydraulic dynamic testing machines.

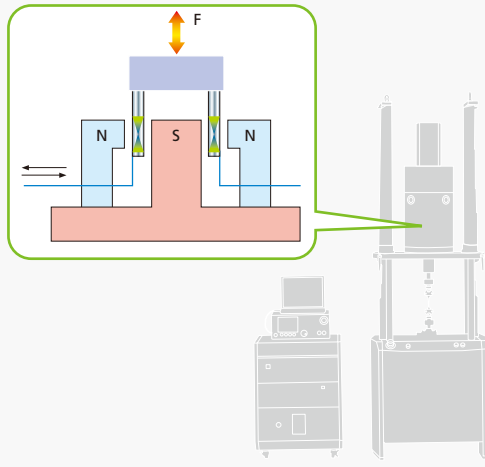
Electromagnetic Actuators

The section that generates test forces consists of a permanent magnet and a force coil, where the magnet is fixed and the coil moves up and down. Applying an electrical current to the coil generates an electromagnetic force F that is proportional to the coil current. This relationship is expressed by the following formula.

$F=2\pi nBIr$

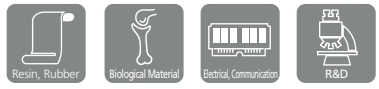
- r : Coil radius
- n : Number of coil turns
- B : Magnetic flux density of magnet
- I : Coil current

The micro test load is controlled with high accuracy by generating the electromagnetic force through the control of coil current I using the closed loop system.



Electromagnetic Force Dynamic and Fatigue Testing System

EMT Series



Allows Long Stroke Lengths and Fast and Highly Accurate Testing in a Clean Environment

High-Rigidity Frame

A very rigid loading frame is used that resistant to resonance is used.

Large Testing Table (EMT-1kN)

A larger testing table allows testing of even large samples.
Lifting/lowering the crosshead can provide a testing space large enough to install a thermostatic chamber.

EMT-1kN

Capable of ±20 µm Displacement Cycles at a 200 Hz Frequency (EMT-1kN)

Fatigue tests can be done at high frequency, which can significantly reduce the overall testing time.

EMT-5kN

Achieves Stroke Lengths from 0 to 100 mm (±50 mm)

The system can be used for large-displacement and high-speed fatigue testing of rubbers. It also supports tensile and compression testing.

A dual-stage drive mechanism enhances safety.

Dual type and light resistant test

Due to the large testing space, tests can be performed inside a thermostatic chamber.

Actuator

The electromagnetic actuator is coupled with low-friction bearings to achieve high waveform reproducibility.

Electric Crosshead Drive and Manual Clamp Levers

The crosshead can be raised or lowered using an electric switch. The crosshead can be immobilized easily using manual clamp levers.

Servo Controller 4830 and Control/Data Analysis Software

The controller allows high-performance and high-functionality dynamic and fatigue testing.

Power Amplifier Unit

Internal electronic power circuits are used to drive the electromagnetic actuator. The top surface can be used as a table for the controller.

Dual-Stage Crosshead Drive Mechanism

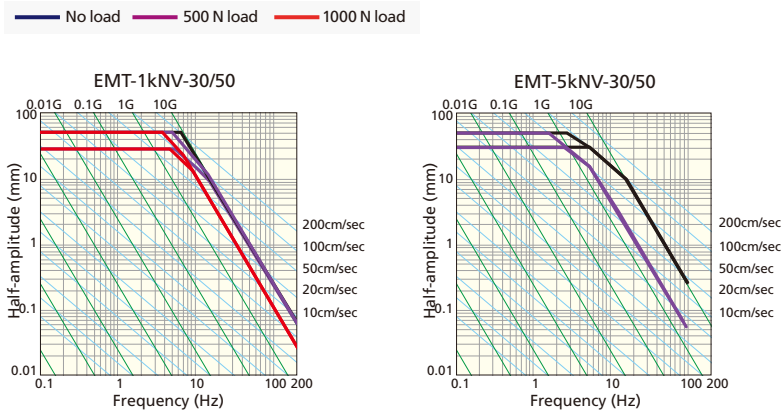
Using two buttons to operate the crosshead and clamps helps prevent operating errors and accidents.

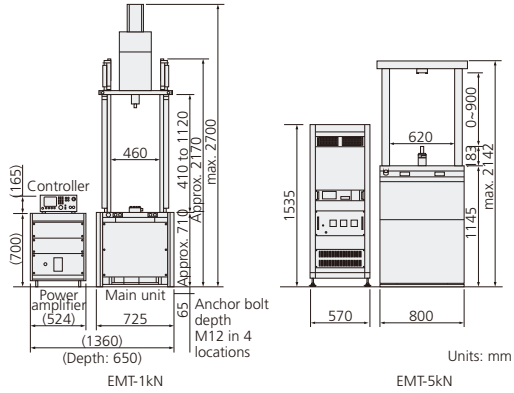
Specifications

Model	EMT-1kNV-30	EMT-1kNV-50	EMT-5kNV-30	EMT-5kNV-50
Maximum test force	±1 kN (static and dynamic tests)		Dynamic±5kN, Static±3.5kN	
Stroke	±30mm	±50mm	±30mm	±50mm
Cycle speed and amplitude	See amplitude characteristics charts.		See amplitude characteristics charts.	
Max. speed	1m/s	2m/s	1m/s	
Max. frequency	200Hz		100Hz	100Hz
Controller	Servo Controller 4830		Servo Controller 4830	
Controlled items	Test force and stroke (two can be added as option)		Test force and stroke (two can be added as option)	
Test force range and indication accuracy	Rangeless Within ±0.5 % of indicated value or ±0.02 % of maximum test force		Rangeless Within ±0.5 % of indicated value or ±0.02 % of maximum test force	
Stroke range and indication accuracy	Rangeless Within ±1 % of indicated value or ±0.1 % of rated value		Rangeless Within ±1 % of indicated value or ±0.1 % of rated value	
Frame drive mechanism	Electric		Electric	
Test space	Distance between columns: 460 mm Jig mounting spacing: 0 to 700 mm		Distance between columns: 460 mm Jig mounting spacing: 0 to 700 mm	
Weight	Main unit: 510 kg Power amplifier: 60 kg Controller: 8 kg		Main unit: 1100 kg Power amplifier: 300 kg Controller: 8 kg	
Operating noise	62 dB (reference value measured 1 m from front of main unit and floor)		-	
Power requirements	50/60 Hz, 3-phase, 200 V, 4 kVA	50/60 Hz, 3-phase, 200 V, 5 kVA	50/60Hz 3-phase 200V 9kVA, Single-phase 100V 300VA	
Power consumption at max load	4kW	5kW	5kW	6kW

Site requirements : No special foundation work is required, but the system should be installed on a sufficiently strong ground floor, with no basement. Machines must be installed with anchor bolts to prevent tipping.

Amplitude Characteristics





In addition to the above unit, a blower (5kN, 1kN) and a 4830 controller (5kN) will be installed.

- The above characteristic curves indicate the relation between half-amplitude and cycle speed during sine wave motion.
- The above characteristics do not include the frame, load cell, or sample characteristics. Compensate for the influence of these factors to determine actual amplitude characteristics.

Electric Motor Driven Actuator

NJ-SERVO

This product is certified as Shimadzu's Eco-Products Plus.

Energy Saving: Up to 78% energy savings compared to previous models

Evaluate Endurance As You Wish
Motorize a Variety of Endurance Testing Systems
From hydraulic to electronic····

High accuracy test control is enabled by a special servo motor and stroke displacement measurement sensor.
In addition, the system configuration is simpler in comparison to hydraulic actuators, so it is easy to maintain, and achieves power savings and space savings.

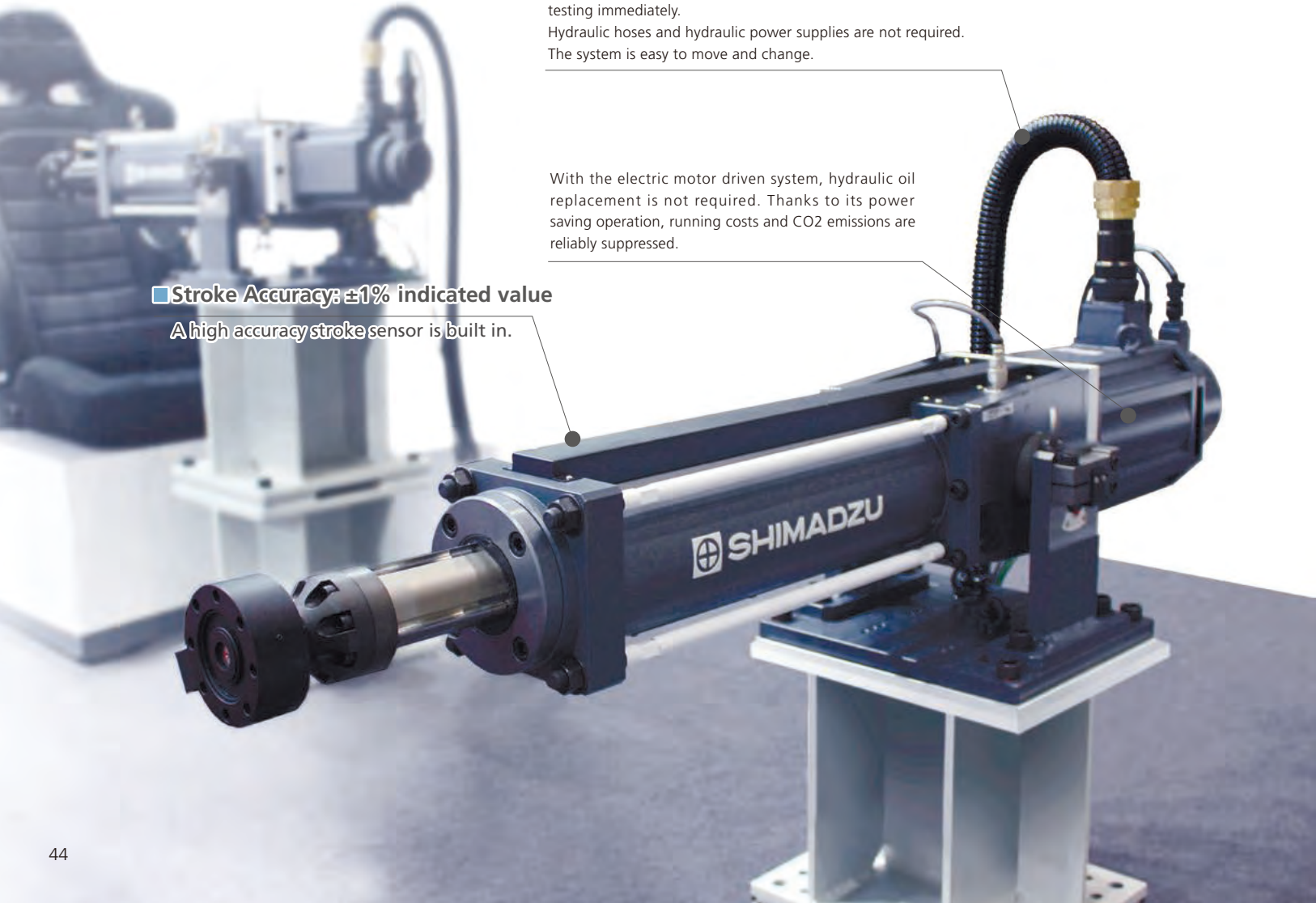
This system accommodates a wide range of tests with a high degree of expandability. This includes everything from endurance evaluations of the main body and assemblies of automobiles, aircrafts, and other transportation equipment to endurance evaluations of stand-alone parts; from multi-axis tests combining multiple actuators to uniaxial tests; and from sine waves to working waveform simulation tests.

Just connect the power supply and the servo amplifier to start testing immediately.
Hydraulic hoses and hydraulic power supplies are not required.
The system is easy to move and change.

With the electric motor driven system, hydraulic oil replacement is not required. Thanks to its power saving operation, running costs and CO_2 emissions are reliably suppressed.

■Stroke Accuracy: ±1% indicated value

A high accuracy stroke sensor is built in.



The Performance Required for Endurance Tests
—High Accuracy, High Speed, and Stable Control—

The same test force capacity is guaranteed in static tests and dynamic tests.

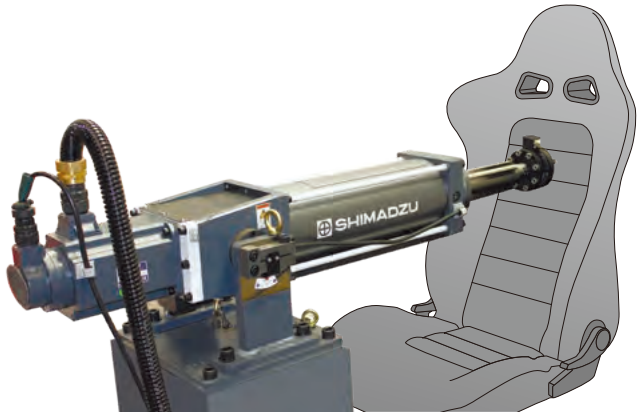
The system accommodates everything from static to dynamic tests across the full actuator capacity range.
The test conditions can be set as you wish.

High speed tests at up to 72 cm/sec are supported.

High speed control is achieved at 72 cm/sec in single wave tests and 50 m/sec in continuous endurance tests.
It can be applied to a variety of tests at low to high speeds.

The system achieves high peak reproducibility, and high accuracy measurement and control.

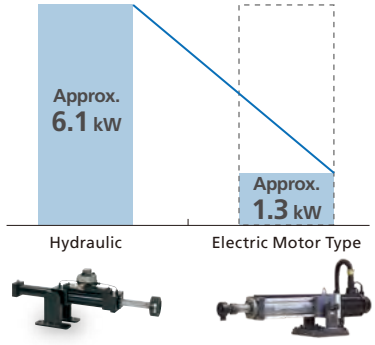
High accuracy measurements are achieved thanks to the built in stroke sensor and a special load cell for dynamic testing.
High stability test peaks are achieved thanks to the high response control of the 4830 controller.



Power Savings of Approximately 75%
—Power Savings and Eco-Friendly Operation—

The electric motor driven actuator only uses the power output required for each test, so power consumption is substantially reduced in comparison to hydraulic actuators with similar specifications.
If a 10 kN system is used, power consumption can be reduced approximately 75%, and CO2 emissions can be reduced approximately 305 kg.

- When implementing 7 day testing with a displacement of ±40 mm and a test force of ±2.3 kN
- Power conversion factor: 0.378 kg-CO_2/kWh
- During actual use, power consumption will differ depending on the installation conditions and the room temperature.



Approx. 75% reduction in power consumption

Approx. 305 kg reduction in CO_2 emissions

Labor-Saving System Changes
—Space Savings and Minimum Maintenance Required—

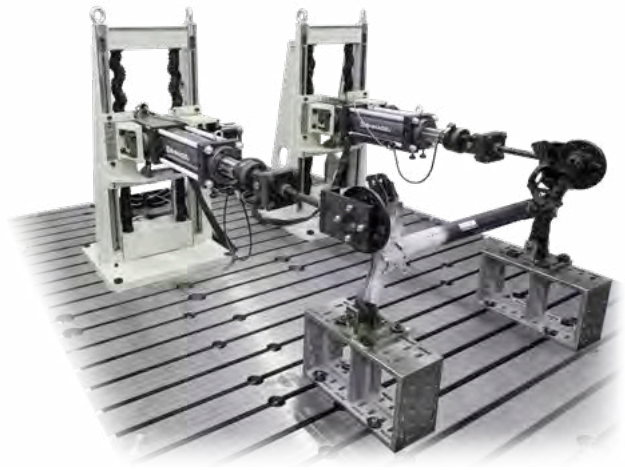
The electric motor driven actuator can be driven solely by a servo amplifier and a controller.
In contrast to a hydraulic type testing system, thick hydraulic hoses and a hydraulic power supply are not necessary. This saves on space, makes the system easy to move, and simplifies testing system changes.
Naturally, it is motor driven, so there is no need for periodic replacement of hydraulic oil, and hydraulic servo valve overhauls are not required.

Basic System

Electric jack unit (Option: Bracket mount and frame)
+ Servo amplifier
+ 4830 controller (Option: Software)

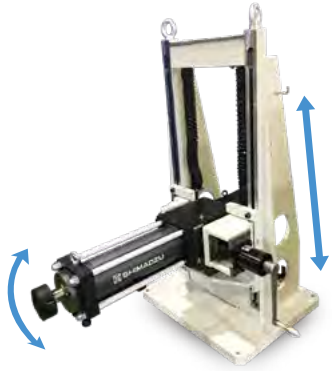
Electric Servo Type Endurance Testing Machine + Trunnion Bracket | Servo Amplifier | Servo Controller 4830

Bracket and Lifting Stand Equipped Type



Two-axis Testing System for Automobile Underbody

For testing real scale automotive parts/assemblies in real usage environment, right and left load points can be settled separately.



With vertical lifting and
lateral rotation mechanisms

Frame Mounted Type

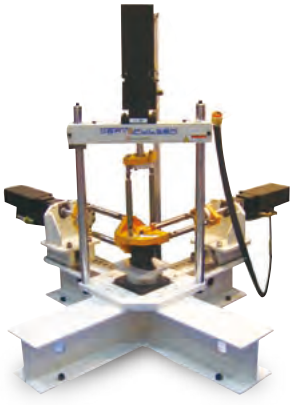
Variable Angle Top-Mounted Actuator Type

This testing machine, specialized for parts and assemblies, uses a large platen. Swinging the angle of the actuator enables dynamic loading from any angle.

Bottom-Mounted Actuator Type

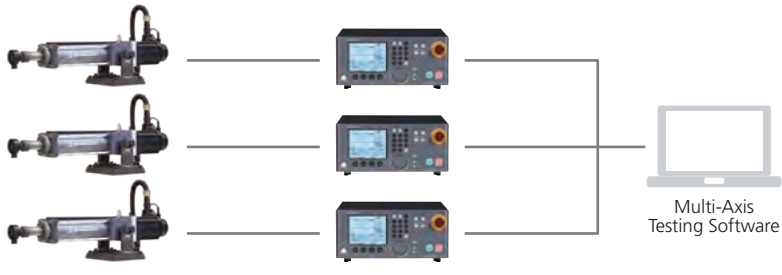
This is for endurance and performance evaluations with respect to small assembly parts such as shock absorbers.

Multi-Axis Frame Mounted Type



XYZ 3 Axis Testing System

Synchronized loads can be applied from 3 axes in the X, Y, and Z directions.
It is also possible to accurately reproduce loads applied during vehicle running conditions as actual working waveforms.

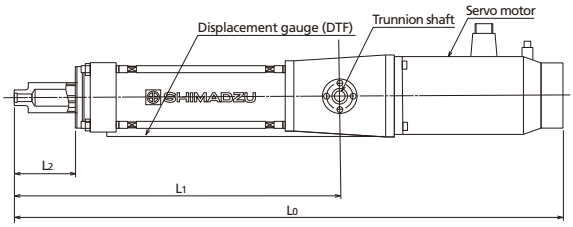


Specifications

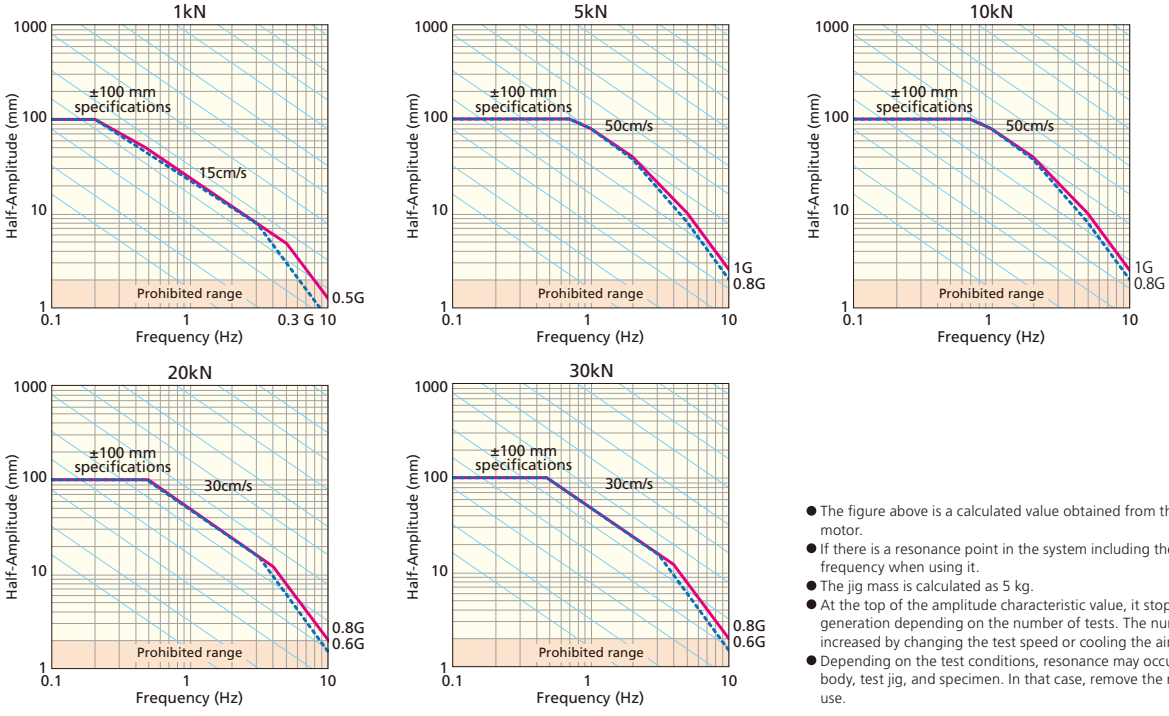
Model		NJ-1kNV-100	NJ-5kNV-100	NJ-10kNV-100	NJ-20kNV-100	NJ-30kNV-100
Test Force	Dynamic	±1 kN	±5 kN	±10 kN	±20 kN	±30 kN
	Static	±1 kN	±5 kN	±10 kN	±20 kN	±30 kN
Stroke (Full stroke)		±100 mm (200 mm)				
Max. Speed		Single wave: 20 cm/sec (loaded); Continuous: 15 cm/sec (loaded, sine wave)	Single wave: 72 cm/sec (loaded); Continuous: 50 cm/sec (loaded, sine wave)		Single wave: 40 cm/sec (loaded); Continuous: 30 cm/sec (loaded, sine wave)	
Sensor Indicator Accuracy	Test Force	±0.5% indicated value, or ±0.02% of the load cell rating, whichever is larger				
	Stroke	±1% indicated value, or ±0.1% of the rating, whichever is larger				
Actuator Unit Size	L_0	980 mm	1080 mm	1260 mm	1385 mm	1550 mm
	L_1	680 mm	730 mm	750 mm	840 mm	820 mm
	L_2	130 mm	140 mm	140 mm		
Servo Amplifier Size	W×H×D	700×715×552 mm		700×1250×350 mm		
Weight		Approx. 30 kg	Approx. 70 kg	Approx. 110 kg	Approx. 180 kg	Approx. 220 kg
Power Requirements		3-phase 200 V, 7 kVA Single-phase 100V 1.5kVA		3-phase 200 V, 12 kVA Single-phase 100V 1.5kVA	3-phase 200 V, 18 kVA Single-phase 100V 1.5kVA	3-phase 200 V, 23 kVA Single-phase 100V 1.5kVA
Compatible Controllers		Servo Controller 4830				
Amplitude Characteristics		See amplitude characteristics diagrams.				

※Each system is adaptable for longer stroke/higher speed.

Appearance of the Unit



Amplitude Characteristics Diagram



- The figure above is a calculated value obtained from the characteristics of the motor.
- If there is a resonance point in the system including the test piece, avoid that frequency when using it.
- The jig mass is calculated as 5 kg.
- At the top of the amplitude characteristic value, it stops due to heat generation depending on the number of tests. The number of tests can be increased by changing the test speed or cooling the air.
- Depending on the test conditions, resonance may occur including the tester body, test jig, and specimen. In that case, remove the resonance point before use.

Similarly, in the frequency sweep test, the resonance point may be included in the test conditions. In that case, change the test conditions and jig configuration, etc., and use under conditions where resonance does not occur. In addition to the resonance frequency, the inertial force due to vibration may be superimposed on the load cell detection value. (Case where resonance is likely to be a problem)
· When the upper and lower jigs are not restrained. (Ball seat pressure plate, etc.)
· When the mass of the jig under the cell is large and the distance to the load point is long. (Tests with in-tank rods, etc.)
· When a lateral force / moment (lateral displacement) is generated when the specimen is loaded.

Electromagnetic Force Micro Testing System

Microservo MMT Series

For Evaluating the Fatigue and Endurance Characteristics of Micro Materials and Parts in Clean Environments

Compact and High Rigidity

Lightweight, compact size and tabletop design allow it to be placed anywhere. Stationary installation is also easy.

For High-Speed and High-Accuracy Testing with Micro Test Forces and Displacements

This system allows high-accuracy testing using micro test forces and micro displacements. It supports high-speed testing at 100 Hz.

Actuator Can Be Top or Bottom-Mounted

The actuator mounting position can be changed depending on testing objectives. This offers high expandability for different types of tests.

Note: 500 N models with a top-mounted actuator are available on a special order basis.

Actuator Supports 100 Hz High-Speed Testing

The high-efficiency cooling system is very quiet.

Crosshead Drive Mechanism

Positioned easily by manual handle and lever operation.

Servo Controller 4830

Allows a wide variety of tests to be done, from static to dynamic. Various waveforms required for tests are also selectable.

Power Amplifier

All power amplifier operations are performed by the controller. Includes a shockless circuit to prevent hydraulic shock when switching the actuator power ON or OFF. An alarm circuit is included standard to ensure safe use of the system.

Large Testing Space

This makes it easy to install an atmospheric control system, microscope, or other equipment.

100 V AC Power Supply Is the Only Utility Required

The crosshead can be positioned easily using a manual handle and lever.

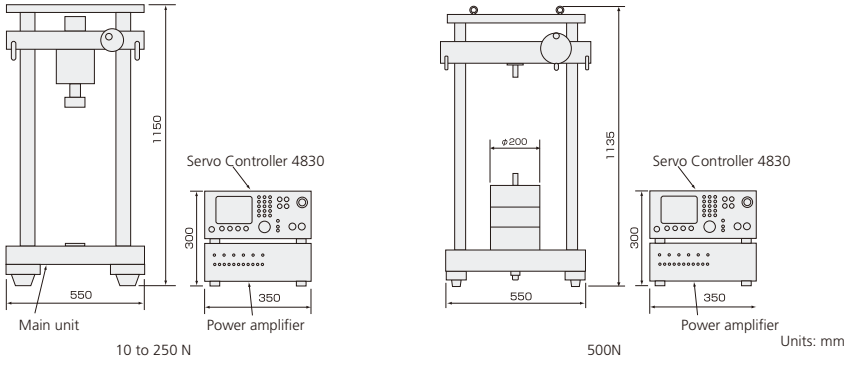
The actuator can be bottom-mounted as well.

A microscope can be installed for viewing micro samples during testing.

The thermostatic water immersion test unit is ideal for testing biological material and implants.

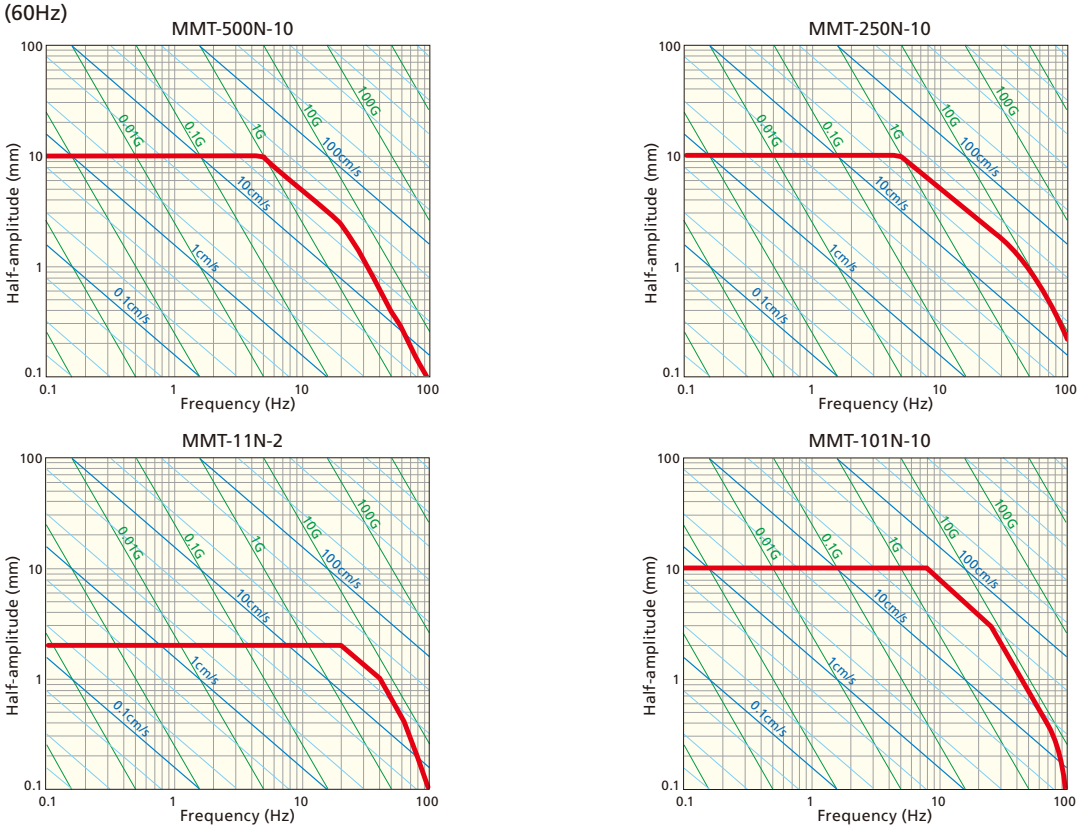
Specifications

Model		MMT-11NV-2	MMT-101NV-10	MMT-250NV-10	MMT-500NV-10
Test force		±10N	±100N	±250N	±500N
Piston stroke		±2mm	±10mm		
Cycle speed		60Hz	100Hz		
Controlled items		Test force and stroke (two can be added as options)			
Indication accuracy	Test force	Within ±1 % of indicated value or ±0.02 % of maximum dynamic test force, whichever is greater	Within ±0.5 % of indicated value or ±0.02 % of maximum dynamic test force, whichever is greater		
	Stroke	Stroke: Within +1 % of indicated value or ±0.1 % of maximum stroke, whichever is greater			
Installation space (W × D × H)		Approx. 1000 × 500 × 1200 mm			
Actuator mount		Bottom	Either top or bottom mount		
Total weight		Approx. 80 kg	Approx. 100 kg	Approx. 120 kg	Approx. 150 kg
Power requirements		1Ø 100V 500VA	1Ø 100V 1kVA		
Site requirements		● Minimal temperature variations (+10 to +40 °C recommended, with temperature variations within ±5 °C) ● Low humidity ● Not exposed to direct air flow from heating or cooling systems ● No direct sunlight ● Low dust ● No significant vibration			



Amplitude Characteristics (60Hz)

No load



- The above characteristic curves indicate the relation between half-amplitude and cycle speed during sine wave motion (without load).
- The above characteristics do not include the frame or load cell characteristics. Compensate for the influence of these factors to determine actual amplitude characteristics.
- The indicated characteristics values were calculated based on typical characteristics of the actuator being used, which may result in a difference of about 10 % on the frequency axis.

Optional Accessories

An extensive selection of optional testing equipment, such as various testing jigs, detectors, and atmospheric control testing units, is available. For more details, refer to the separate optional accessories brochure.

EMT Series Accessories

● Pin-Type Grip for Flat Samples

These grips are designed for half-amplitude tensile fatigue testing.

Max. dynamic test force	+10kN
Operating temperature range	-20 to +300 °C
Applicable sample	Flat plate (max. 30 mm wide and 5 mm thick)

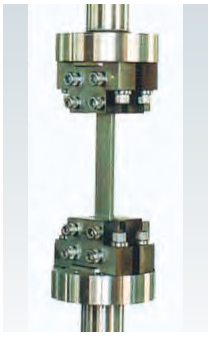
Plastics | Composite materials | Rubber

● Split Flange Rod Grip

These grips allow samples to be secured easily and firmly. They are ideal for full-amplitude tensile and compression fatigue testing of round rod samples.

Max. dynamic test force	+10kN
Operating temperature range	-RT to +100 °C -20 to 300 °C
Applicable sample	Rod

Composite materials



● Manual Non-Shift Plate Grip

These grips are designed for full-amplitude tensile and compression fatigue testing of flat plate materials and feature a simple and efficient construction.

Max. dynamic test force	±5/10kN
Operating temperature range	RT to +50 °C -196 to +300 °C
Applicable sample	Flat plate

Plastics | Composite materials

● Screw Flange Rod Grip

These grips are useful for samples with a small diameter.

Max. dynamic test force	±10kN
Operating temperature range	-RT to +100 °C -20 to 300 °C
Applicable sample	Rod

Metals | Plastics | Composite materials

● Compression Plate

Compression plates are available with both top and bottom fixed or with the top compression plate mounted on a spherical seat.

Max. dynamic test force	20 kN (multiple capacities available)
Operating temperature range	RT to +250 °C
Applicable sample	Ø60mm

Metals | Plastics | Composite materials | Rubber | Components

● 3-Point/4-Point Bending Test Jig (for partial half-amplitude fatigue testing)

Maximum test force	2kN
Max. dynamic bending moment	50 N/m
Operating temperature range	196 to +300 °C
Jig dimensions	Lower span: 30 to 100 mm Upper span: 15 to 50 mm

Metals | Plastics | Composite materials

● Uniform Bending Test Jig (for full-amplitude fatigue testing)

This jig uses ball bearings at each support point to all apply uniform bending loads.

Max. dynamic test force	+2kN
Max. dynamic bending moment	+20N/m
Applicable sample	RT to +50 °C -196 to +200 °C

Metals | Plastics | Composite materials

● Dynamic Strain Gauge

This strain gauge offers excellent performance as a displacement gauge for high-cycle fatigue testing.

Measurement range	±0.5mm/±1.0mm
Measurement accuracy	Within ±10 % of indicated value or within ±0.5 % of rating, whichever is greater
Operating temperature range	RT to +50 °C

Metals | Plastics | Composite materials

MMT/EMT Series Accessories

● Tensile Jig

Max. dynamic test force	250N
Sample shape	Round rod (4 mm dia.) or flat plate (max. 5 mm wide × 1 mm thick)
Operating temperature range	RT to 50 °C (250 N model) -65 to 300 °C (100 N model)

Metals | Plastics | Rubber, Film | Small parts

● Hand-Tightened Tensile Test Jig

Max. dynamic test force	150N
Sample shape	Flat plate (max. 20 mm wide × 2 mm)
Operating temperature range	-65 to 300 °C (100 N model)

Paper | Cloth | Metals | Plastics | Film | Fibers

● Compression Test Jig

Max. dynamic test force	250N
Compression plate	Ø110mm
Upper compression plate	Ø30mm
Operating temperature range	RT to 50 °C

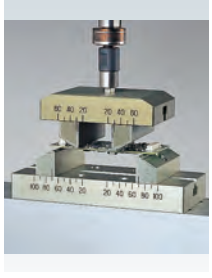
Note: Various kinds of compression test jigs are available, such as key press, toothed, and spherical types.

Metals | Plastics | Composite materials | Printed circuit boards | Surface mounted devices

● Drill Chuck Type Grip

Max. dynamic test force	250N
Sample shape	Round rod (0.5 to 3 mm dia.) or flat plate (max. 4 mm wide × 1 mm)
Operating temperature range	RT to 50 °C

Metals | Plastics | Small parts



● Compression Test Jig

Max. dynamic test force	250N
Punch tip diameter × width	R2×60mm
Punch span	20×60mm
Support roller diameter × width	R2×60mm
Distance between supports	20 to 100 mm
Operating temperature range	-65 to 300 °C

Metals | Plastics | Composite materials | Printed circuit boards | Surface mounted devices

● 3-Point Bending Test Jig

Max. dynamic test force	250N
Punch tip diameter × width	R2×60mm
Support roller diameter × width	R2×60mm
Distance between supports	20 to 100 mm
Operating temperature range	-65 to 300 °C

Metals | Plastics | Composite materials | Printed circuit boards | Surface mounted devices

● Card Insertion Test Jig

Max. dynamic test force	250N

● Key Press Test Jig

Max. dynamic test force	250N
Punch tip diameter	Ø3mm
Punch material	Rubber
Sample	Mobile phones, keyboards
Operating temperature range	RT to 50 °C

● Thermostatic Water Immersion Test Unit

Temperature range	R.T. +10 °C to +60 °C
Test jigs	30 mm dia. compression plate

● X-Y Stage

Movement range	±12.5mm
Test force	Max. 100 N compression

Controller for Dynamic and Fatigue Testing Systems

Servo Controller 4830

Controller for Dynamic and Fatigue Testing Systems
Servo Controller 4830

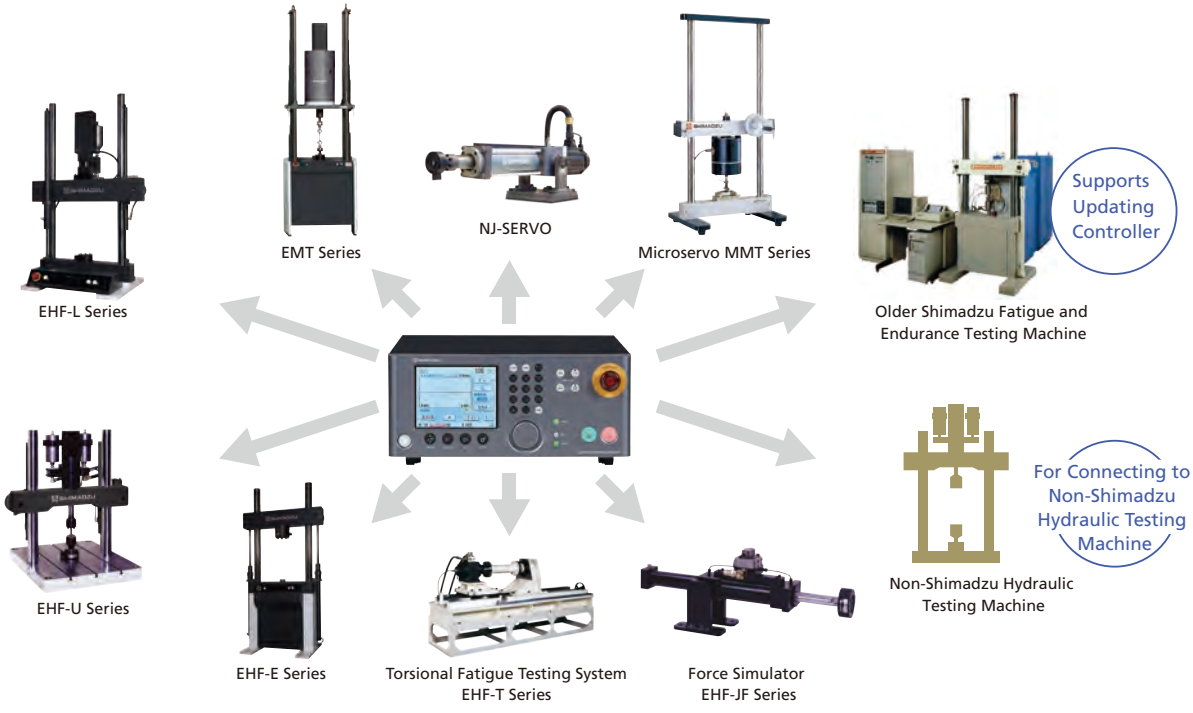
Dramatically Improves Accuracy in Evaluating Endurance and Dynamic Strength of Samples Ranging From Materials to Actual Samples

This controller is designed specifically for dynamic testing machines based on Shimadzu's long history of supplying dynamic and fatigue testing systems and based on feedback from many of our customers. It boasts high performance and exceptionally user-friendly operability. Equipped with a 24-bit high-resolution analog-digital converter, and featuring excellent reproducibility of load waveforms due to fully digital control, it can accommodate a wide variety of dynamic testing requirements.

Connectivity to the Entire Family of Shimadzu Dynamic and Fatigue Testing Machines and Non-Shimadzu Hydraulic Testing Machines

Note: Excludes HITS series and USF-2000 models.

The controller can be connected to Servopulser series electric-hydraulic, electromagnetic force, and pneumatic testing systems, jack systems (actuators), and various other testing machines.
It also can be used to update older Shimadzu systems, or controllers for non-Shimadzu hydraulic testing machines.



Very Easy to Operate

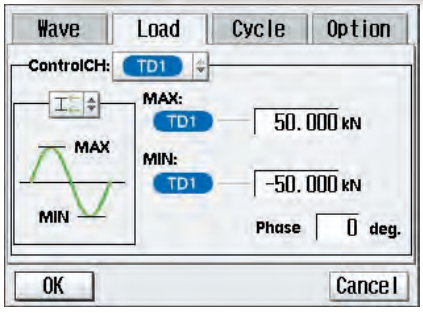
Testing parameters can be specified using the touch panel or jog dial.
Test parameter settings, such as test force and displacement, can be changed at any time during tests.

Color Touch Panel

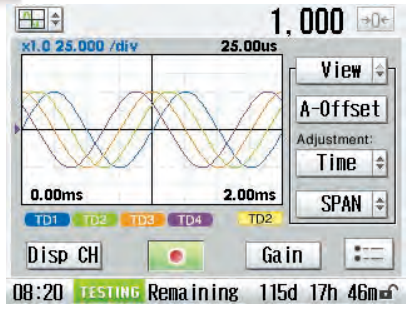
Enables all parameters to be specified and the test status to be monitored.

Jog Dial

Allows use of an analog type interface to make subtle operating adjustments.



Loading Parameter Settings

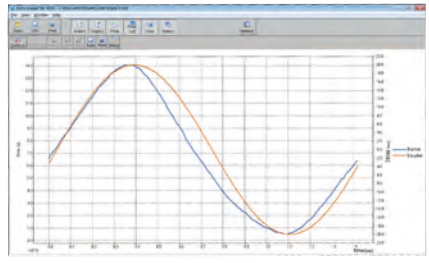


Waveform Display Functions


Jog Dial

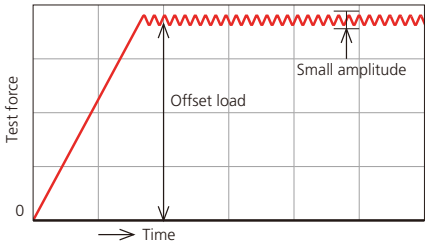
Autotuning and Automatic Gain Control Functions Ensure Loading Waveforms are Input Precisely

The autotuning function automatically determines the optimal parameters for controlling tests based on the actual test status and sample material. The automatic gain control function makes corrections so that peak values in loading cycles are consistent with parameter settings. Together, these functions help ensure precise loading waveforms. Consequently, even operators performing tests for the first time can automatically achieve highly accurate testing by simply setting parameters and starting testing.



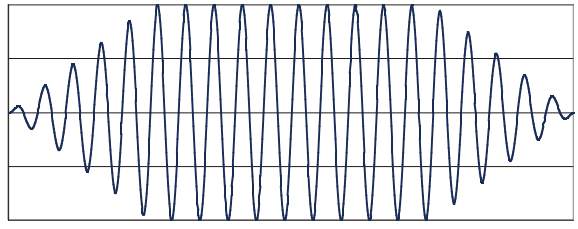
Offset Load Tests

Offset load testing makes it possible to accurately apply offset micro loads while applying large test force loads.



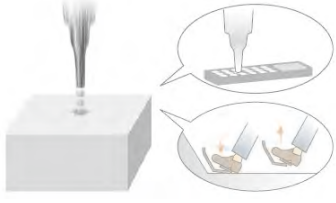
Slow Start/Stop

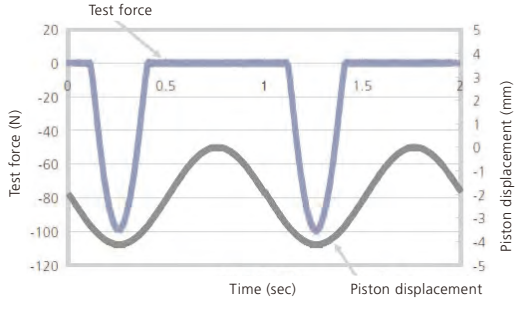
A slow start/stop time setting can be specified for tests. This eliminates operating differences between operators and helps ensure highly reproducible tests.



Push Test Function

This allows controlling peak test force values in a stable manner, even for samples with "play" (where no test force is applied).

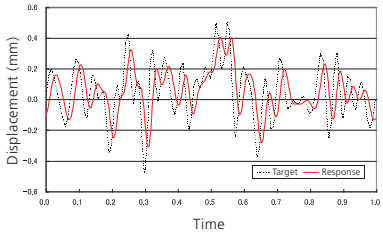




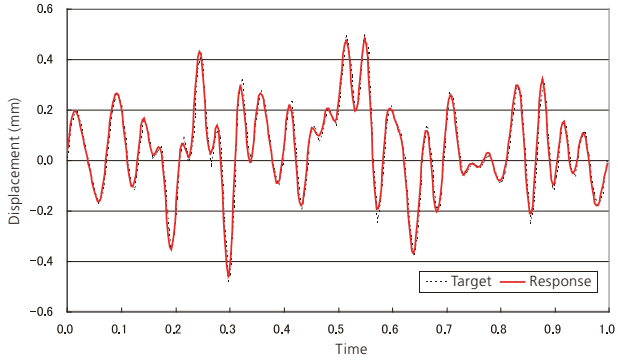
1 Hz Displacement Control with Target Test Force of -100 N

Waveform Distortion Correction Function

Because it can correct for loading mechanism-specific periodic strain, it can cancel out unwanted strain components and accurately control loads according to the target waveform.



The loading waveform is tracked to ensure consistency with the target waveform.

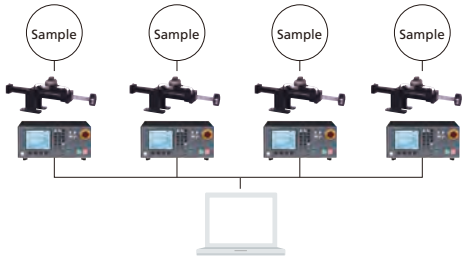


Broad Applicability

Up to four testing machines can be operated for synchronous testing. X-T, X-Y, peak graphs, and a variety of other waveforms can be displayed. By connecting to a computer via a USB cable, a wide variety of test settings and sophisticated data acquisition settings can be specified.

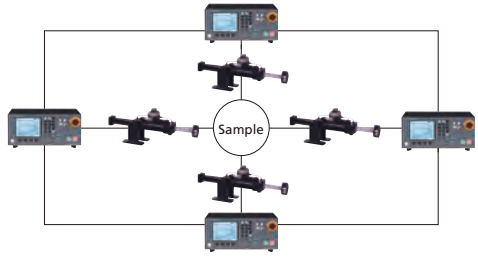
● Multiple Tests

A single computer can be used to simultaneously perform up to four different tests using different test parameters. For example, four endurance tests can be performed in parallel to acquire peak values and cycle data.



● Synchronized Testing

Control and measurements of up to four testing machines can be synchronized by synchronizing the controller connection. The phase can also be freely set for each actuator.



Specifications

Model	Servo Controller 4830
Display unit	5.7-inch color LCD
Control panel	Touch panel, function keys, jog dial, numeric keypad, test operation keys, power unit operation keys
Test waveforms	Sine, triangular, rectangular, haversine, haver-triangular, trapezoidal, ramp, 1/2 haversine, step, sweep, and random waves, external input, programmed waves (optional*1), file waves (optional*1)
Test frequency	0.00001 to 1000 Hz
Slow settings	Slow start/stop
Test parameter registration	Max. 9 parameters
Waveform display functions	Time, X-Y, and peak waveforms
Measurement functions	1 range (rangeless) 24-bit Max. 40 kHz sampling with 4 acquisition channels Linear correction (linearization) function
Size	W350 × D420 × H148 mm
Control method	Full digital two-degree-of-freedom PID
Control functions	Amplitude, average gain correction (AGC), PID autotuning, sample anti-overloading function (contact load), user-specified phase differential control by synchronized operation, waveform distortion correction*1(transfer function correction)
Limit functions	Measurement value 4-point limiter, cycle counter, external input
Communications functions	USB interface
Other functions	Calculation function (such as adding, subtracting, averaging, and stress/strain), push testing function, consumable consumption time management function
External input/output	Analog Output: 4 channels (±10 V), Input: 1 channel (±10 V) For monitoring or waveform input Digital Output: 8 channels Input: 8 channels
Control signal input	Test force (TD1), stroke (TD2), and external input (AUX) Note: Up to two amplifiers can be added as an option.
Power requirements	Single-phase AC 100 to 230 V*2 50/60 Hz 300 VA

*1 Only during software use
*2 The standard power cord included with the system is only for AC 100 V.

Also Supports Updating Controller

Updating older controllers to the latest model improves control performance and enables using the most up-to-date software.

Software for Servopulser Series Dynamic and Fatigue Testing Systems

Software for 4830

Easier, More Convenient, and More Sophisticated

Using systems in combination with dedicated software opens up a new world of testing. The dedicated software for the Servo Controller 4830 consists of basic software, add-on testing software, and GLUON 4830 fracture toughness testing software, which collectively support a variety of control and data analysis applications, such as basic fatigue testing, loading tests with simulated actual loads, and physical properties testing compliant with the standards.

Software		Single test	Multiple tests (simultaneous testing with 2 to 4 actuators)	Synchronized tests (measurement tests with synchronized control of up to 4 actuators)		
				2	3	4
Basic Software	Fatigue and Endurance Testing	◎	◎	○	○	○
	Program Function Testing	◎	◎	○	○	○
	Static Characteristics Testing	◎	◎	–	–	–
	Combination Testing	◎	◎	–	–	–
Add-On Software Note: Requires basic software	Static Testing	◎	–	–	–	–
	Frequency-Sweep Testing Resonance Frequency Tracking Testing	◎	–	○	–	–
	Multi-Axis Combination Sine Wave Testing (without waveform distortion correction)	◎	–	○	○	○
	Multi-Axis Combination Sine Wave Testing (with waveform distortion correction)	◎	–	☆	☆	○
	Multi-Axis Working Waveform Simulation Testing	◎	–	☆	☆	○
GLUON 4830	Crack Propagation Testing Software	◎	–	–	–	–
	KIC/COD Testing Software	◎	–	–	–	–
	JIC Testing Software	◎	–	–	–	–

◎ : Compatible ○ : Does not consider response results from other controllers (cannot be used if mutual interference is strong
☆ : Considers response results from other controllers (mutual interference correction)
– : Not compatible

Menu bar allows test operations such as starting and stopping, changing controls or resetting limits, etc.

Pause test

Immediate waveform data acquisition button

Dynamic characteristic values can be calculated for each cycle

Testing machine status display
Test in progress / stopped

Real-time measurement value display
Color-coded control parameters

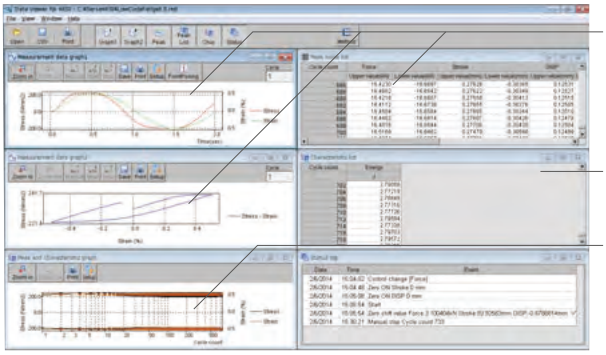
Cycle count vs. control parameter graph makes it possible to check reproducibility of test peaks

Plots S-S curves

Allows checking of waveforms in real time
Allows loading of waveform data from 1000 cycles

Test parameter confirmation window

Fatigue and Endurance Testing Window in Basic Software

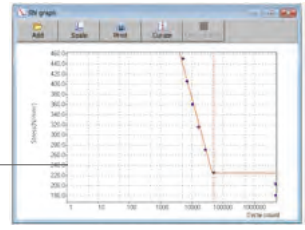


It is possible to confirm the input waveform, stress-strain curve, and various parameters for each acquisition cycle. Data for any specific point can also be extracted from any cycle waveform using the point picking function.

Dynamic characteristic values can be confirmed from each data acquisition cycle.

Peak value graph

S-N curves can be plotted automatically from test results.



Basic Software

Fatigue and Endurance Testing

During fatigue/endurance tests, dynamic characteristics can be calculated, which allows S-N curves plotting. Data can be acquired for up to 10,000 cycles (during interval acquisition).

Static Characteristics Testing

This allows users to apply static loads, such as tension or compression, to samples and measuring the static characteristic values (such as the static spring constant).

Combination Testing

Combining fatigue/endurance and static characteristics tests makes it possible to measure the changes in static spring constants.

Program Function Testing

This allows users to combine the loading waveforms available in the controller, such as ramp and sine waves.

Static Software

Static Testing

Available static tests include tensile, compression, 3-point bending, and 4-point bending. Various characteristic values can be calculated automatically. These include elasticity, upper yield point, lower yield point, yield strength, intermediate test force, intermediate displacement, maximum test force, break point, or energy.

Frequency-Sweep and Resonance Frequency Tracking Test Software

Frequency-Sweep Testing

Makes it possible to sweep across to test dynamic characteristics over a range of frequencies, and allows endurance testing that repeats sweep cycles. Dynamic characteristic values can also be calculated for each frequency.

Resonance Frequency Tracking Testing

This makes it possible to automatically detect the resonance frequency of test samples before applying loads. The frequency can be automatically tracked if it is changed due to sample fatigue. Acceleration and strain values can be set directly and automatically readjusted even during testing.

Multi-Axis Combination Sine Wave Testing Software

Multi-Axis Combination Sine Wave Testing

This allows use of multiple axes to perform tests with a combination of sine waves with different amplitudes.

Multi-Axis Actual Waveform Testing Software

Multi-Axis Working Waveform Simulation Testing

This allows users to load actual working waveform data in CSV format, and to perform sophisticated simulation tests of actual loads by simply starting the test. A strain correction function helps ensure even the waveform details are reproduced precisely and accurately.

Fracture Toughness Testing Software

GLUON 4830

Fracture Toughness Testing

Allows data analysis in compliance with the most up-to-date fracture toughness test standards. It supports crack propagation testing, KIC/CTOD testing, and JIC testing.

ASTM E647-13,ISO 12108:2012	ASTM E399-12, ISO 12737-96 BS 7448-1:1991, ASTM E1820-11	ASTM E1820-11, ASTM E813-89 JIS Z 2284-98
Crack Propagation Testing This is for evaluating the crack propagation behavior of notched samples. It is also ideal for introducing preliminary cracks for KIC and JIC testing.	**KIC/CTOD Testing** This is for evaluating fracture toughness values. It calculates CTOD values corresponding to the fracture mode and determines the validity of KIC values.	**JIC Testing** This is for evaluating elastic fracture toughness values (JIC). It makes it easy to perform JIC tests, which involve complicated procedures.

Various Dynamic Testing Systems

Various Testing Systems

Environmental Control Testing Systems

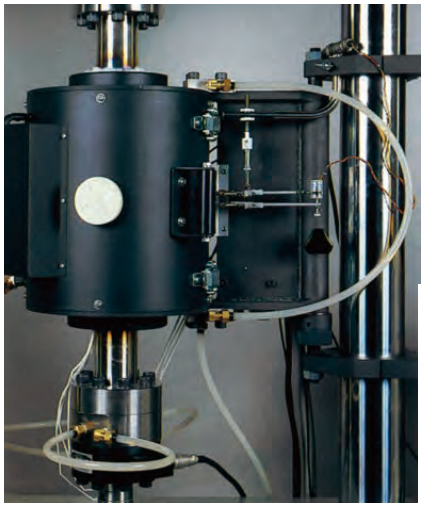
Thermostatic Atmospheric Control Testing System

Automobiles | Steel, Metals, Machines | Resin, Rubber | Electrical, Communication | R&D

A thermostatic atmospheric control can be installed to Shimadzu Servopulser series systems to simulate actual loads in harsh or other thermostatic controlled environments. A stable thermostatically controlled environment is ensured by forcibly circulating hot or cold air from a heater and cooling unit.

- Forced circulation of hot or cold air from a heater and cooling unit
- Extremely stable even when operated continuously for long periods

Temperature range	TCR2	-65 to +250 °C
	TCR1	-35 to +250 °C
	TCH	+50 to +300 °C



Resistance Heat High-Temperature Testing System

Automobiles | Steel, Metals, Machines | Resin, Rubber | Electrical, Communication | R&D

For High-Temperature Low-Cycle and High-Cycle Testing of Various Materials

This system allows highly accurate high-temperature low-cycle and high-cycle fatigue testing of steel, nonferrous, composite, and other materials.

- Designed with a small furnace and compact overall size
- A short overall grip and sample length provide a structure that resists buckling.
- Low thermal effects on the high-temperature displacement gauge (optional) and short overall length of the displacement gauge unit increase response.

Key Specifications

Test temperature	+300 to +1000 °C
Heating system	Resistance heating
Temperature distribution	±3 °C/+300 °C to less than +800 °C ±5 °C/+800 °C to +1000 °C

Ultra-Low-Temperature Testing System

Steel, Metals, Machines | R&D

For Fatigue and Fracture Toughness Testing of Various Materials in Ultra-Low 4 K Temperature Environments

Materials such as those used in superconductor coils are used in environments with ultra-low temperatures. Therefore, their material properties must be evaluated in such an environment. The system includes a vacuum insulated housing, liquid nitrogen/helium tank, and so on.

- The testing environment can be super-cooled to -269 °C using liquid helium or liquid nitrogen as a refrigerant.

Temperature range	Liquid helium	Immersion	-269°C
	Liquid nitrogen	Injection	-20 °C to +160 °C
		Immersion	-196°C

Note: Contact Shimadzu for further details.

High-Frequency Induction Heat High-Temperature Testing System

Steel, Metals, Machines R&D

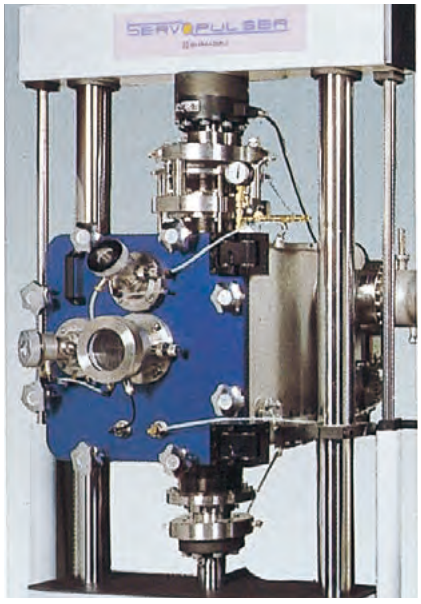
For Thermal Fatigue and High-Temperature Low-Cycle Testing of Various Materials

- Equipped with a high-frequency heating unit capable of rapid heating and a servo cooling gas injection unit capable of rapid cooling, the system allows performing high-accuracy temperature cycle testing.
- Supports high-temperature low-cycle fatigue testing, thermal fatigue testing in combination with a cooling unit, high-temperature low-cycle testing or thermal cycle simulation testing in a vacuum or inert gas environment in combination with an atmospheric control unit, crack propagation testing or fracture toughness testing using CT or CCT samples, superplastic testing or other hot working testing, creep testing, thermal ratchet testing, and overheating testing.

Key Specifications

Temperature range	+100 to +1200 °C
Max. heating rate	From room temperature to 1000 °C in 70 sec or less
Applicable testing machines	E-Series Servopulser

Requires Controller 4890 for thermal fatigue testing.

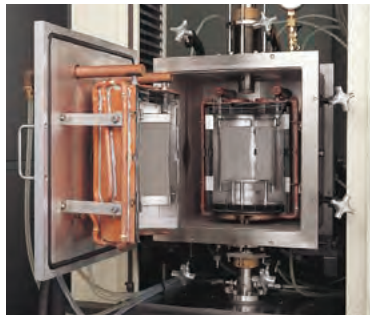


Vacuum (or Gas) Atmospheric Control Testing System

Steel, Metals, Machines R&D

For Evaluating Fatigue Strength or Crack Propagation Characteristics of Various Materials in a Vacuum or Purge Gas (Ar, He, or N_2) Atmosphere

This is used to heat samples to high temperatures in various atmospheres. Both an internally heated type (with the heater inside the chamber) and externally heated type (with the heater outside the chamber) are available to support various types of testing. The internally heated type allows testing at temperatures up to 2000 °C in a vacuum or inert gas atmosphere. The externally heated type allows testing in various corrosive gas atmospheres.

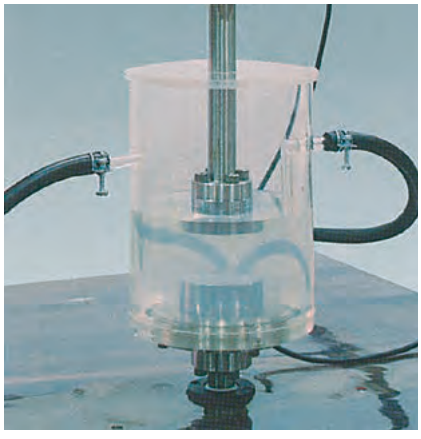


- Creates a vacuum (10^{-4} Pa level) or purge gas (Ar, He, or N_2 gas) atmosphere.
- The chamber is constructed of corrosion-resistant stainless steel.
- A large chamber interior and access door make it easier to put on or remove samples.
- It can also be used in combination with a high-frequency heater type high-temperature testing machine.

Main Specifications

Ultimate vacuum pressure	10^{-4} Pa level
Internal dimensions	Ø360×H280mm
Front door	360 mm dia., inspection window 110 mm dia.

Note: Contact Shimadzu for further details.



Thermostatic Water Immersion Testing System

Biological Material R&D

For Research and Development of Biological and Dental Materials and Food-Related Materials

This testing system is used to test biological, dental, or food-related materials immersed in circulating water (or saline or other solutions) thermostatically controlled to a constant temperature.

Main Specifications

Test temperature	+10 to +40 °C

Includes fixed type compression plates.

Note: Contact Shimadzu before using a non-aqueous solution or a jig other than compression plates.

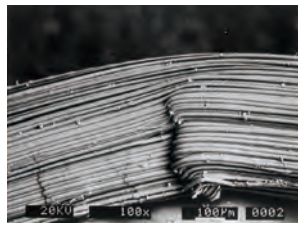
Testing Systems with Sample Observation Functions

High-Temperature Fatigue Testing Machine with Scanning Electron Microscope SEM Servopulser

Real-Time Observation of Microscopic Fractures in the Surface of Samples

This testing system combines a scanning electron microscope (SEM) with a Servopulser electric-hydraulic servo fatigue testing machine. It allows observation of microscopic surface fractures on samples in real time, over a wide range of temperatures.

- The SEM microscope is integrated with the main testing machine unit to maximize vibration resistance.
- Crack propagation tests can be done while observing samples with the SEM microscope.
- Cyclic loads can be applied to samples at temperatures ranging from room temperature up to 800 °C.
- Allows the SEM field of view to be aligned with the deformation area when loading samples during testing.



This shows an example of observing the fracture behavior of an aramid fiber-reinforced plastic (AFRP) material in real time during a 3-point bending test in a low-vacuum environment at room temperature.

● Fatigue Testing Machine

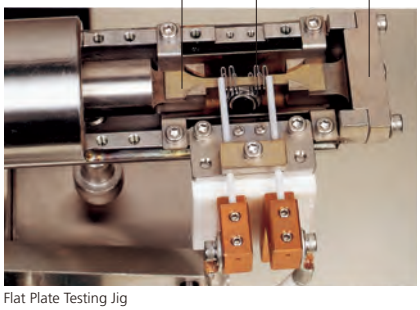
Key Specifications

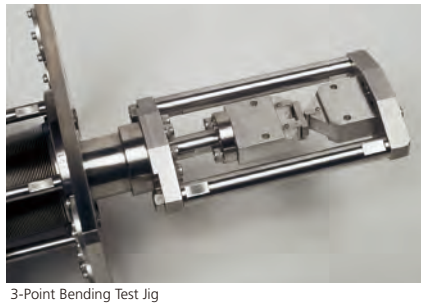
Maximum test force	10 kN (varies depending on the jig used)
Maximum stroke	+10 mm in tension or -10 mm in compression (-5 mm for high-temperature testing)
Cycle speed	0.001 to 5 Hz (sine wave)
Test waveforms	Sine, triangular, ramp, and trapezoidal waveforms
Test temperature	R.T. +300 to +800 °C (higher temperatures are optional)

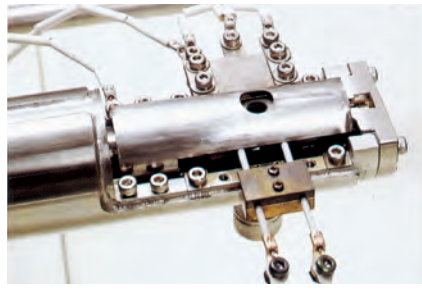
● Scanning Electron Microscope

Microscope Specifications

Resolution	3nm(30kV)
Magnification settings	From 5x to 300,000x, with automatic digital magnification display
Observation images	Secondary electron image and reflected electron image (optional)


Flat Plate Testing Jig


3-Point Bending Test Jig


High-Temperature Testing Machine (300 to 800 °C)

Air-Servo Microfocus X-Ray CT System

For Understanding the Complicated Localized Phenomena of Materials

By combining the Air-Servo Mini pneumatic dynamic and fatigue testing system with an X-ray CT system, it becomes possible to observe crack propagation three-dimensionally and obtain 3D crack data. This 5 kg weight compact fatigue testing machine is capable of tensile and compression test loads up to 1 kN.

- The loading frame is made of polycarbonate, which offers low X-ray absorption.
- Observes the fatigue status of bones, resin samples, etc. under cyclic tensile or compression loads.
- Achieves sharp CT images of cracks with sub-micron accuracy.


Shimadzu Microfocus X-Ray CT System inspeXio SMX-225CT FPD HR

3D CT Image of Cracks as They Propagate

Dynamic and Fatigue Testing System for XT CT Imaging Air-Servo Mini

High-Cycle Fatigue Testing Systems

Reduces the Time Required for Fatigue Testing

Reducing the testing time required for evaluating the fatigue characteristics of materials is the most effective way to improve testing productivity. Shimadzu is involved in creating customized systems such as high-frequency testing systems for high-cycle fatigue testing and multi-sample systems. These are used to help reduce the time required for evaluating the longevity of materials or for fatigue testing for over 10^8 cycles.

300 Hz High-Cycle Dynamic and Fatigue Testing Machine

Automobiles | Steel, Metals, Machines | Resin, Rubber | R&D

For Evaluating Long Service Life and 10^8 Cycle Fatigue Testing of Component Materials

- Max. 300 Hz testing frequency
- Servo-hydraulic mechanism allows ±20 kN dynamic loading

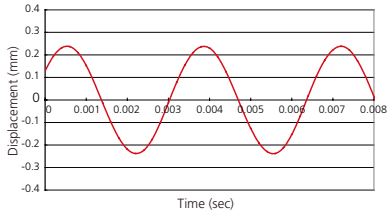
Ultra-High-Rigidity Frame

An ultra-high-rigidity frame is used to increase the stability of loading waveforms.

By exchanging jigs, it can support various types of testing.

Air Springs

Air springs help minimize vibration caused by high-frequency testing from affecting surrounding areas.



Example of 300 Hz Loading Waveform

Loading speed	300Hz
Displacement amplitude	±0.24mm

Ultrasonic Fatigue Testing System USF-2000A

Steel, Metals, Machines | R&D

For 20 kHz Fatigue Testing and Analyzing Inclusions in Metals

With cycle rates up to 20 kHz, the USF-2000 ultrasonic fatigue testing system is able to accelerate fatigue life evaluations of metals or other materials. This means it can perform 10^{10} test cycles in only six days, which would normally take 3.2 years at 100 Hz. This exceeds the gigacycle level and achieves ultra-high efficiency.

See page 64.

Multi-Sample Fatigue Testing System

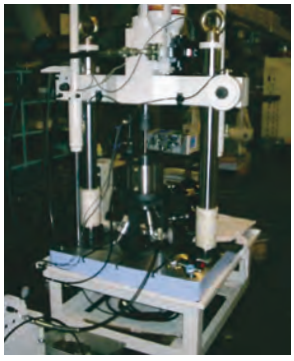
Multi-sample dynamic and fatigue testing systems can be designed by customizing electric hydraulic or electromagnetic force Servopulser systems. This allows fatigue testing of multiple samples at the same time, with individual loads applied to each sample.

Resin, Rubber

Hydraulic 4-Sample Testing System

Electromagnetic Force 4-Sample Testing System

Specialized Testing Systems



Internal Pressure Fatigue Testing Machine

Automobiles Resin, Rubber

For Pressure Fatigue Testing of Pipes

- Allows varying pressures to be applied on samples exposed to cyclic internal pressures.
- Highly varied pressure loads can be applied using a pressure amplifier.

Main Specifications

Maximum test force	300MPa
Maximum test frequency	10Hz

Note: Contact Shimadzu for further details.

Axial Force (Tensile/Compression) and Torsion Testing Machine

Automobiles Resin, Rubber

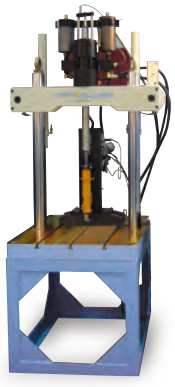
Evaluation Testing That Approximates Operating Conditions of Materials and Parts

- Loading methods similar to actual usage
- Allows simultaneous application of axial and torsional loads to samples

Main Specifications

Axial force: 50 kN Torsion: 0.5 kN-m
Axial force: 100 kN Torsion: 1 kN-m

Note: Contact Shimadzu for further details.



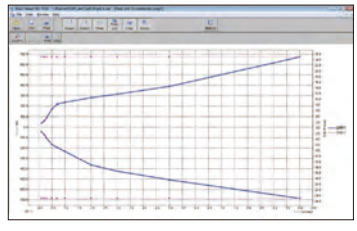
Shock Absorber Testing Machine

Automobiles

For Evaluating the Damping Characteristics of Automobile and Motorcycle Shock Absorbers

- Measures the damping force with respect to the shock absorber piston velocity.
- Allows plotting of velocity vs. damping force graphs, displacement vs. damping force Lissajous graphs, or other graphs.

Velocity vs. Damping Force Graph



Note: Contact Shimadzu for further details.

Dynamic Characteristics Testing Machine for Rubber Vibration Isolators

Automobiles Resin, Rubber

For Rubber Vibration Isolator Research and Development

- Allows calculation of viscoelastic material characteristics for everything from static tests to high-cycle (max. 300 Hz) dynamic tests.
- Allows easy measurement of the spring constant, damping coefficient, loss factor, etc.
- Tests can also be performed in a controlled-temperature environment inside a thermostatic chamber.

Main Specifications

Maximum test force	±10kN
Maximum displacement	±10mm
Cycle speed	5 to 300 Hz
Amplitude characteristics	50Hz ±2mm ,100Hz ±0.9mm , 200Hz ±0.36mm , 300Hz ±0.18mm

Note: Contact Shimadzu for further details.

Ultrasonic Fatigue Testing System

USF-2000A

20 kHz Fatigue Testing
Ultra Efficient for Gigacycle Testing
Also for Analyzing Inclusions in Metals

This ultrasonic fatigue testing system achieves a vibration rate of 20 kHz by applying a vibration generated by a Piezoelectric element and amplified by a horn. This not only significantly reduces cycle times, it also helps discover microscopic defects and inclusions in high-strength steel materials, which can cause fatigue fractures at the megacycle level.

Capable of Testing 1000 MPa Class Steel Material

High stresses can be generated by performing tests at resonance frequencies. With a 20 kHz cycle capacity, this system is able to accelerate fatigue life evaluations of metals and other materials. It is perfect for long service life evaluation of materials or high-speed vibration testing.

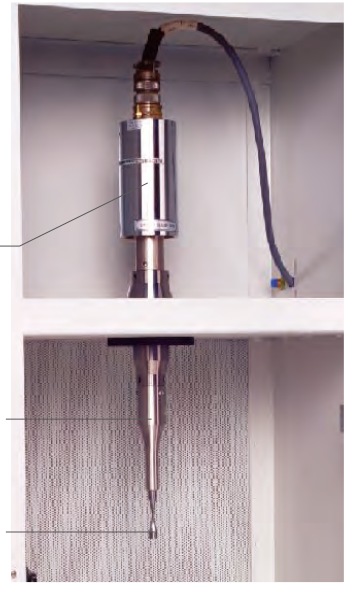
Extremely Economical with Power Consumption of Only 100 W

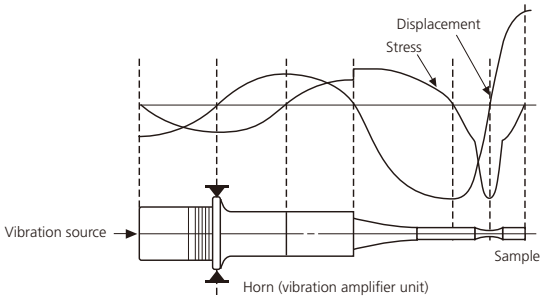
Use of resonance requires only minimal power consumption.

Ultrasonic Vibration Generator Unit

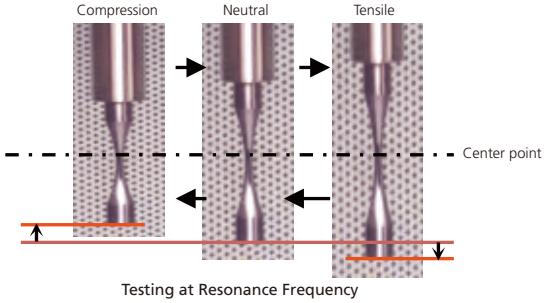
20 kHz Vibration Uses Resonance

The load applied to samples is a 20 kHz longitudinal wave vibration generated by an actuator (Piezoelectric element) and amplified by a booster and horn. Longitudinal waves travel through metals as the metal stretches and compresses in the longitudinal direction. Therefore, a cyclic stress is applied to the metal. The stress is calculated from the displacement of the front edge of the sample, rather than directly measuring the test force using a load cell.

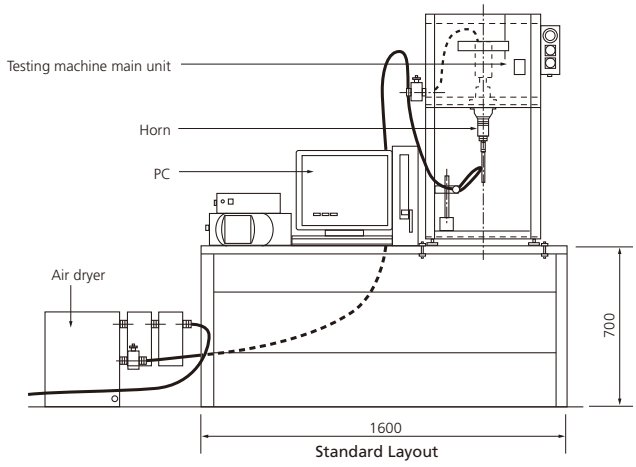




Operating Principle of the Ultrasonic Fatigue Testing System



Testing at Resonance Frequency



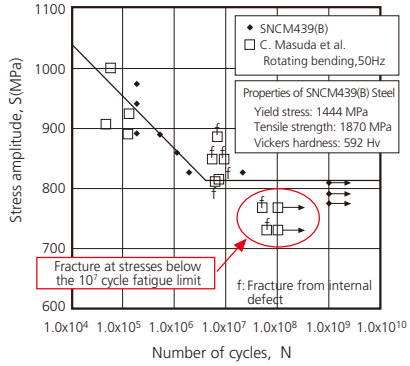
Standard Layout

For Evaluating Fatigue Strength at Cycle Level of 10^8 or Higher

Conventionally, it was assumed that fatigue strength of steel was constant beyond 10^7 cycles. In other words, it was assumed that fatigue failure would not occur at stresses below the fatigue limit for 10^7 cycles. However, we are now learning that in the case of materials strengthened by quenching or surface treatment, internal inclusions can cause fatigue fractures between 10^8 and 10^9 cycles even for stress levels below the 10^7 fatigue limit.
Therefore, now that products are being used for longer periods at higher speeds, fatigue fractures between 10^8 and 10^9 cycles have become an extremely important issue.

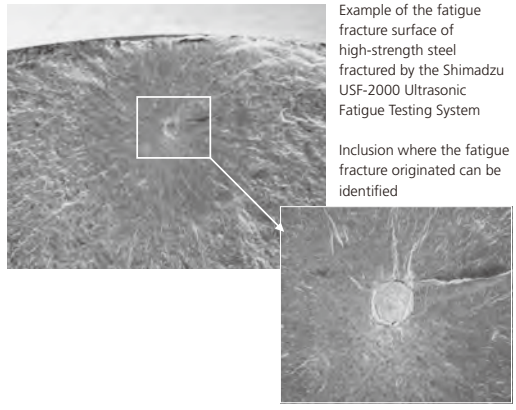
Allows tests of 10^{10} cycles to be completed in only six days, which would normally take 3.2 years at 100 Hz.

Fatigue Strength of SNCM439(B) Steel



For Analyzing Inclusions in Test Materials

In high-strength steels and other materials, fatigue can propagate from micro defects and inclusions inside the material, which are known to result in fatigue fractures at the gigacycle level. Therefore, identifying and analyzing defects and inclusions in test materials are useful for developing materials with high fatigue strength.
Due to the extremely small size of such defects and inclusions, they are very difficult to identify using non-destructive methods. Typically, materials were sliced and the section surface visually inspected.
However, the efficiency of identifying and analyzing inclusions can be increased dramatically by using an ultrasonic fatigue testing machine to the point of fatigue fracture, which ensures a defect or inclusion will be discovered on the fracture surface.

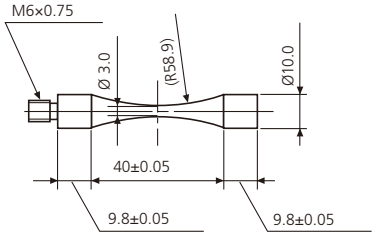


Example of the fatigue fracture surface of high-strength steel fractured by the Shimadzu USF-2000 Ultrasonic Fatigue Testing System

Inclusion where the fatigue fracture originated can be identified

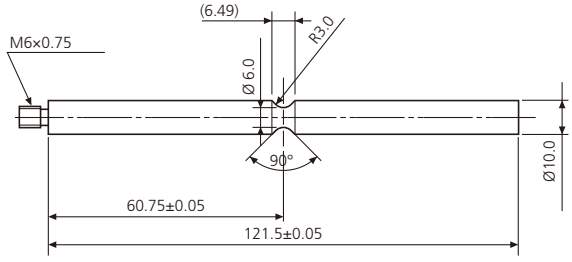
Example of Sample Dimensions (given Young's modulus of 206,000 MPa and density of 7.85 g/cm³)

Circular Tapered Sample



Test stress range: About 200 to 1000 MPa nominal

Notched Sample



Test stress range: About 140 to 700 MPa nominal
Stress concentration factor: About 1.56

Units: mm

Specifications

Test frequency	20 kHz ±500 Hz (recommended test range: 20 kHz ±30 Hz) Note: The test frequency is determined from the resonance frequency of the sample.
Vibration at horn tip	±10 to ±50 µm
Test stress range	Stress given ±10 to ±50 µm displacement of sample Note: Stress values depend on sample shape and physical property values.
Stress ratio	-1
Testable materials	Materials that can be resonated at 20 kHz and generate minimal heat during resonance Example: High-strength steel, duralumin, titanium alloy, aluminum, etc.
Not-testable materials	●Materials that cannot resonate at 20 kHz ●Materials for which samples are difficult to attach ●Materials that generate significant heat during resonance at 20 kHz, due to friction Examples: Resins, ceramics, etc.
Power requirements	3-phase 200 V: 2 kVA (air compressor) , 1-phase 200V: 3.5 kVA (ultrasonic fatigue testing system) , 1-phase 100V: 1 kVA (computer, displacement logger, air dryer, etc.)
Standard contents	USF-2000A Ultrasonic Fatigue Testing System main unit (including table), ultrasonic resonance system, control computer, ultrasonic testing control and measurement software, and cooling unit (air dryer and compressed air lines) Note: Air compressor for cooling is not included.
Required optional products	Air compressor (for regions with 50 Hz or 60 Hz power) 3-phase 200 V: 2 kVA
	Displacement measuring system (eddy current displacement gauge with 0.5 µm resolution) Note: A high-speed data logger or digital oscilloscope is required separately for reading voltages output from the displacement gauge.
	Displacement gauge calibrator (CDE-25 C1 high-performance micrometer)

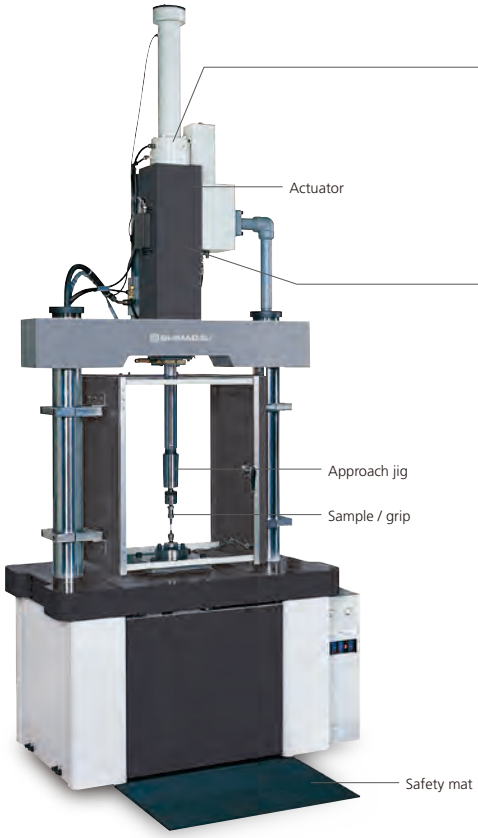
Note: Systems can be selected without an air compressor in cases where the customer will supply the compressed air. A 150 L/m flow rate of compressed air at a minimum 0.2 MPa is required.

High-Speed Impact Testing Machine

Hydroshot HITS-X Series

Steel, Metals, Machines | Resin, Rubber | R&D

Equipped with State-of-the-Art Technology



High-Speed Tensile Testing Machine
HITS-TX

High test speeds

The hydraulic operation allows impact tests to be conducted at any speed between 0.0001 m/s and 20 m/s (72 km/h). It allows a wide range of testing speeds using a single machine.

Vibration and Impact Resistant Displacement Detection

The volumetric displacement detector uses the movable piston rod portion of the actuator as an electrode. This provides highly accurate vibration and impact resistant displacement detection.

Environmentally friendly energy-saving design

The HITS Series employs an energy-saving operation system that changes the motor speed and supply pressure for the hydraulic power unit depending on the operating status of the testing machine (patent pending). In addition, the hydraulic power unit is air cooled, so water is not necessary for cooling.

Integrated Force Detector

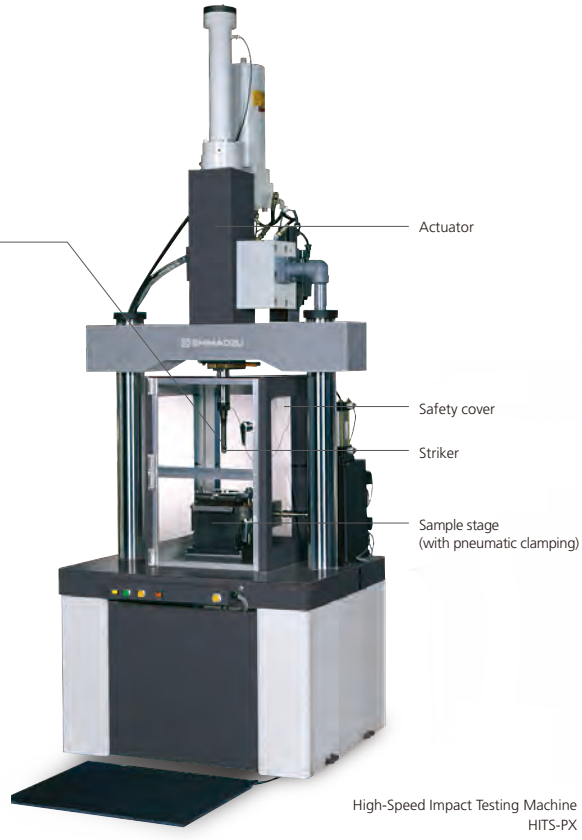
A high-response detector integrated with the grip (HITS-T10) or striker (HITS-P10) is used as the load cell. This minimizes the effects of vibration noise.

Design to minimize the effects of impacts

The HITS Series incorporates various features to minimize the effects of impacts, including metal springs with superior vibration absorption capacity, the displacement detector resistant to vibration and shock, a striker integrated with a load detector (HITS-PX), a load detector integrated with grips (HITS-TX), and a speed reduction and stopping function that combines braking control with hydraulic cushioning (patent pending).

Comprehensive safety features

The HITS Series is equipped with comprehensive safety features, such as a safety cover, safety mat, and dual switch system for starting tests. In addition, for extra safety, the piston uses a mechanism that allows high-speed travel only in the test direction.



High-Speed Impact Testing Machine
HITS-PX

Controller 4870 and Software Dedicated for the High-Speed Impact Testing Machines

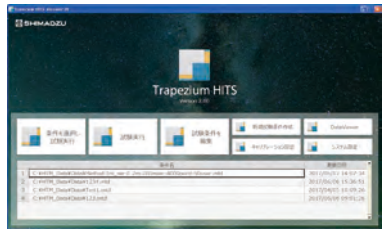
Dedicated Controller with Start Interlock System Incorporating High-Response Amplifier

Reliably controls the testing speed during high-speed impact tests, from start to finish. To ensure operator safety during impact testing, systems are designed to use hardware for manual operations, starting tests, and stopping the machine.

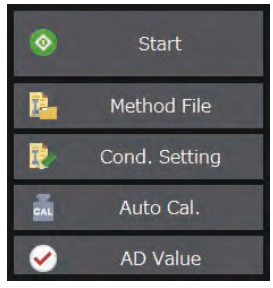
High-Speed Impact Testing Software

Dedicated High-Speed impact testing software for outstanding user friendliness

The software, which is specially designed for High-Speed impact testing, uses standard Windows 10 wizard format to allow intuitive and simple operation even for beginners. The software provides information such as load-displacement curve, maximum test force, displacement, energy, and inclination. Advanced processing, such as overlaying results from multiple tests or statistical analysis are standard functions. The software consists of two parts: the "Testing" and "Data Processing" components. Since both software components can be opened simultaneously, data can be processed while tests are being performed, allowing testing to be executed efficiently.



Home



Test Execution

Testing software

1. Setting parameters
   Test parameters are set via a wizard-style interface. Parameters can be entered via a dialog format.
2. Testing
   The testing screen shows measurement values with actually used and, online graphical displays of test results, and includes a measurement start button.

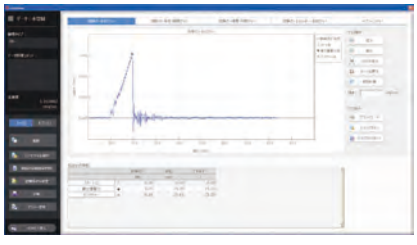
Parameters Setting Screen

Testing Screen

Data Processing Software

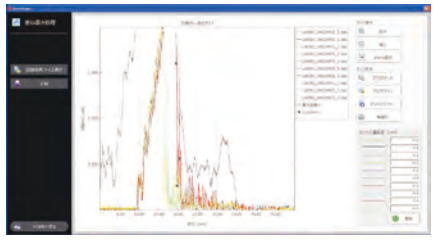
1. Data processing functions
   The software displays summary data for the maximum test force, corresponding energy and displacement, at specified points, as well as inclination. It also provides graphs, which include a smoothing feature.
2. Multiple data overlaying and statistical processing functions
   Up to ten test data curves can be overlaid. Statistical data for multiple data sets, such as mean values and standard deviation, can be obtained.
3. Report printing functions
   Numerous printing functions, such as overlaying graphs or indicating characteristic values at the point of maximum test force or specimen fracture, are available.

[Data processing screen]



(High Rate Tensile Testing Machine HITS-X)

[Data processing screen – overlaying data]



(High Rate Tensile Testing Machine HITS-X)

(Optional) Force Detectors and Applicable Grips

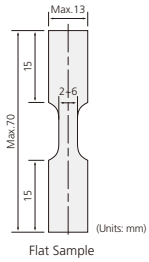
● Force Detector and Grip for Flat Plate Samples

Force Detector

Model	SHL–10 kN–P
Part number	346-77909-01
Capacity	Maximum 10 kN (tensile)

High-Speed Grip for Flat Plate Samples

Model	High-speed grip for flat plate samples
Part number	346-77160-02
Capacity	Maximum 10 kN (tensile)
Shape of Grip	Wedge shape: W 13 mm, H 15 mm, file teeth
Applicable Sample	Flat plate: Width max. 13 mm, thickness 0.5 to 3 mm



Flat Sample

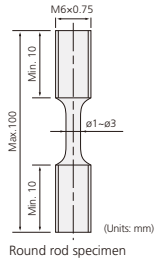
● Load detector and grips for round rods

The grips for small rods can be attached to the force detector.

Note: Please contact us for manufacture of a different shape of specimens and grips.
Note: Different sizes can also be accommodated.

Grips for high-speed testing of round rods

Model	Round rod grips for high-speed tensile testing
Part number	346-77184-01
Capacity	Maximum 10 kN (tension)
Shape of Grip	M12 × 1.5 female threads
Applicable Sample	Round rod specimens with M12 × 1.5 threaded ends (threaded length of 20 mm or more)



Round rod specimen

Optional Accessories Striker, Clamping Plates

● Striker (with load detector)

Main striker unit and tip

Model name	Striker ø12.7	Striker ø20	Striker ø10
Part No. for main unit	339-83665-02	339-83665-03	339-83665-01
Part No. for tip	347-40060-06	347-40062-09	347-41604-00

Capacity (puncture)	10kN	10 kN	10 kN
Striker diameter	ø12.7 mm	ø20 mm	ø10 mm
Compatible with	ASTM D 7363	ISO 6603-2	ISO 6603-2

Note: Striker units with other load capacities and shapes are supplied as options.

● Clamping Plates

Clamping plates

Part number	346-77213-02	346-77213-01	346-77213-03
Hole diameter	ø76 mm	ø40 mm	ø100 mm
Compatible with	ASTM	ISO	ISO
Applicable specimen size	☐ 100 mm t = 1 to 3 mm	☐ 60 mm t = 1 to 3 mm	☐ 140 mm t = 1 to 3 mm

Examples of striker-clamp combinations for specific standards

Standard	ISO 6603-2	ISO 6603-2	ASTM D 3763
Striker diameter	ø20.0 mm	ø10.0 mm	ø12.7 mm
Clamping plates	ø140 mm	ø100 mm	ø176 mm
Standard combination	Remarks	For fragile materials or low fracture strain	-

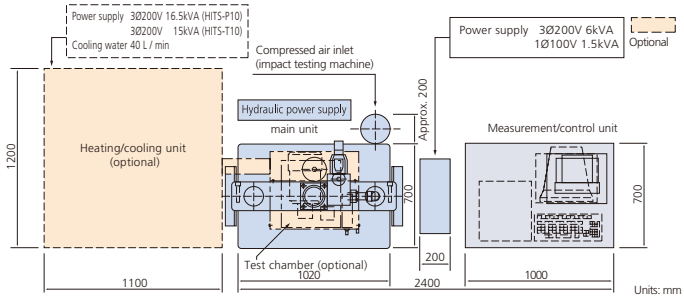
Note: Non-standards combinations are supplied as options.

Using an Optional Thermostatic Chamber
Acquire Data for Temperature-Dependent High-Speed Behavior

A thermostatic chamber (-40 to +150 °C) can be used to obtain temperature-dependent data for high-speed behavior.

Layout Diagram (same for HITS-PX and HITS-TX)

Install the main testing machine on the ground floor, on a concrete floor at least 200 mm thick (able to withstand 1500 kg). The machine includes springs and other measures to isolate vibration, but avoid installing the machine in locations prone to transmitting vibrations.



Standard Specifications

Main Unit, Controller and Software

Model Name	High Speed Tensile Testing Machine HITS-TX	High Speed Puncture Impact Testing Machine HITS-PX
Product Number	346-72545	346-72457
Impact Test Force	10 kN	
Maximum Speed	0.0001 m/s to 20 m/s*1	20 m/s 1 m/s to 20 m/s
Range Of Speed Settings		
Piston Stroke	300 mm	
Force Amplifier	Range: 20%, 50% or 100% of load detector rating / Accuracy: Within 1.0% of full scale Response frequency: DC- 100 kHz (-3 dB)	
Displacement Amplifier	Range: 10%, 20%, 50% or 100% of 150 mm / Accuracy: Within 1.0% of full scale Response frequency: DC- 10 kHz (-3 dB)	
AD Converter	Sampling rate: Max. 2 MHz with 12-bit resolution	
Specimen Holder	—	Pneumtic clamping
Acceleration Jig	Tapered acceleration mechanism	—
Hydraulic Pressure Supply	Model AF-7H, 7 L/min, air cooled, installed below main unit	
Safety Devices	Door open/close interlock switch Safety mat interlock switch Two-switch start operation Start timer, etc.	
Controller	Model 4870 controller (specialized for high-speed impact testing)	
Software	High-speed impact testing software	
PC Environment Required for Operation*2	Compatible OS: Windows 10 (Japanese, English) / Memory capacity: 4 GB or more / HDD capacity: 120 GB or more / Display resolution and colors: 1024 × 768, 65,535 colors / Other required peripheral equipment: CD-ROM / Expansion bus: One full-size PCI bus empty slot / Communications: RS-232C communication port (required for communication with 4875 controllers)	
Power Supply Requirements	200 V 3-phase 6 kVA, 100 V single-phase 1.5 kVA	
Air Supply Requirements	Not required	0.6 to 0.7 MPa
Dimensions (Main Testing Unit)	Approx. W1,100 × D700 × H2,850 mm	Approx. W1,100 × D900 × H2850 mm
Weight (Main Testing Unit)	Approx. 1,500 kg	

*1: Duration of one test must be within five minutes. *2: The computer and operating system are not included in the standard system configuration. Please acquire them separately.

High-Speed Video Camera and High-Speed Impact Testing Machine

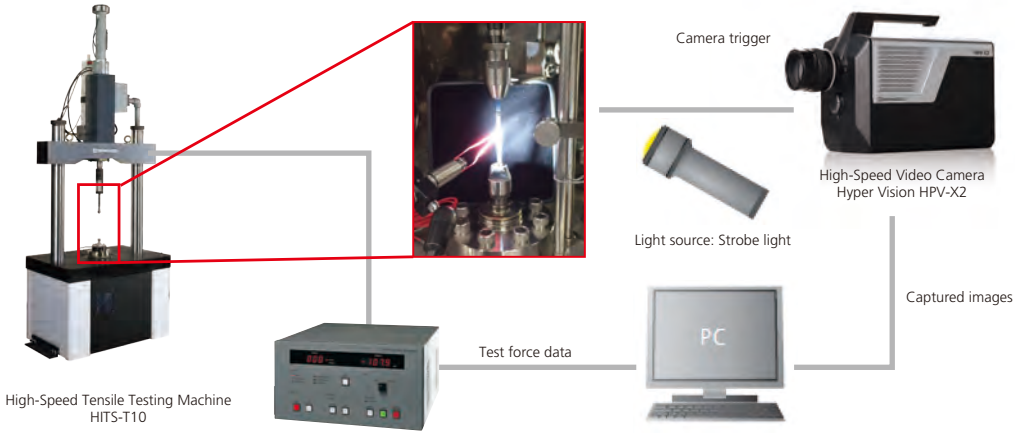
HPV-X2 and Hydroshot HITS-X Series

Analyzing Strain Using a 10 Million Frame-per-Second Ultra High-Speed Camera and a DIC Data Analysis System

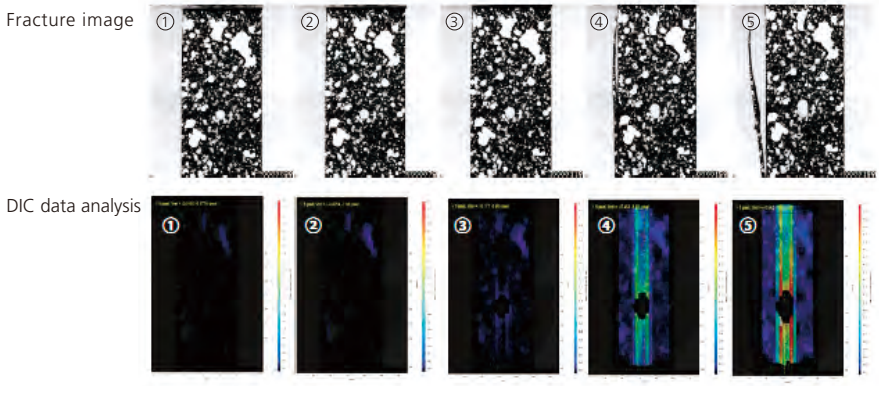
Verifying material characteristics to ensure dynamic safety during composite material development requires both static strength testing and an understanding of the impact fracture strength and the fracture process. Using an HPV-X2 high-speed video camera in combination with a Hydroshot HITS series high-speed tensile impact testing machine allows observation of the high-speed failure behavior with high time resolution.

HyperVision HPV-X2

To start the high-speed video recording, the system uses an external trigger mechanism, where the testing machine sends a video start signal synchronized with the tensile load to the camera. Strobe lighting is also synchronized with the video timing. Combining a high-speed video camera and impact testing machine makes it possible to evaluate material impact properties and observe fracture behavior at the same time. This allows a multifaceted evaluation of the complicated failure behavior of composite materials.



Example of High-Speed Tensile Testing of Multilayered Porous CFRP Material

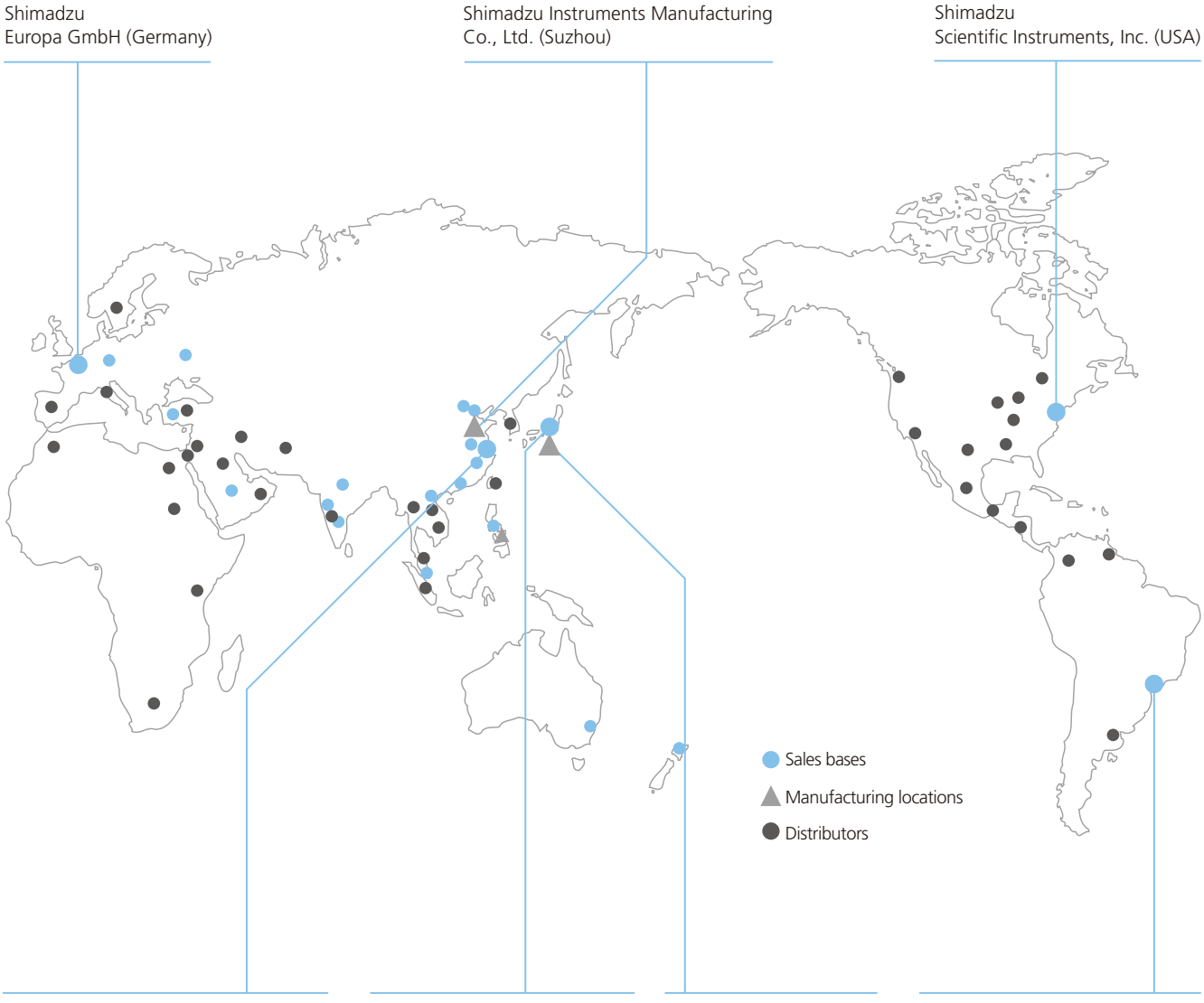


This shows a series of representative fracture images, arranged in chronological order. The images were acquired at 500,000 frames per second, from the start of the test until the sample failed. The acquired fracture images were processed by digital image correction (DIC) data processing to generate a 2D map of the strain distribution generated across the sample. The strain magnitude is represented with colors ranging from blue to red, where the warmer the color the greater the sample strain level.

References : H.Kusano, et al., "The experimental comparison of the strain measurement techniques on tensile test", ECCM-15, We.2.8.3, Venice, Italy, 24-28 June 2012

Global Sales and Service Network

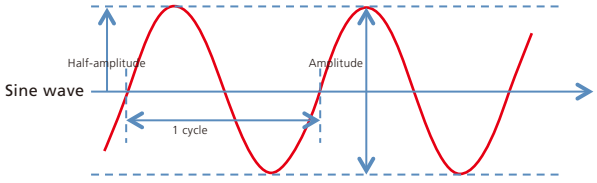
Shimadzu has about 800 highly experienced field service engineers stationed around the world to ensure quick, reliable response to customers' testing and measuring requirements.



Amplitude Characteristics

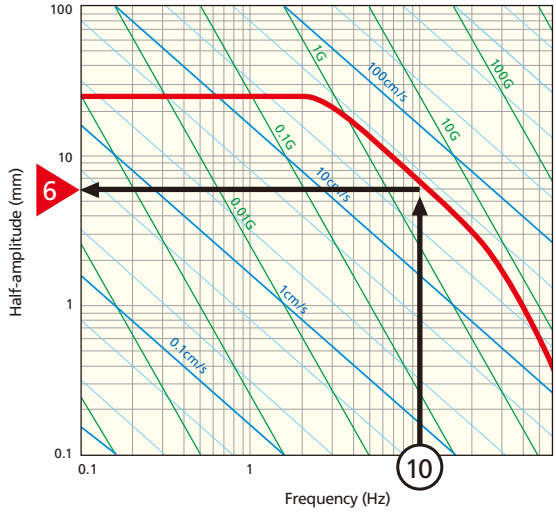
Amplitude characteristic curves are logarithmic graphs that indicate the testing capacity of systems, with frequency plotted on the horizontal axis and the half-amplitude plotted on the vertical axis. Characteristics of the Servopulser series dynamic and fatigue testing systems are determined by the actuator, hydraulic power supply unit capacity, and the servo valve flow rate rating and frequency characteristics. Select the optimal system by checking the amplitude characteristics to see that they are consistent with the corresponding test conditions. Tests can also be performed at frequencies below 0.1 Hz; these are not shown here.

- The amplitude characteristic curves in this product brochure indicate the relation between half-amplitude and cycle speed, given sine wave motion at the rated load level.
- The lower left area of each characteristic curve indicates the testing capacity range, which depends on the capacity and stroke length of the selected actuator and the capacity of the hydraulic power supply unit.
  The curve below indicates the amplitude characteristics given a 60 Hz power supply. Characteristics with a 50 Hz power supply will be about 5/6 of indicated values.
- The amplitude characteristics indicated in this brochure do not include the frame or load cell characteristics. Compensate for the influence of these factors to determine actual amplitude characteristics.
- The amplitude characteristics indicated in this brochure were calculated based on typical characteristics of the servo valve being used, which may result in a difference of about 10 % on the frequency axis.
- There may be limitations on testing frequencies, due to the jig, sample, or other characteristics.



● To Perform Tests at a Frequency of 10 Hz

Starting at 10 Hz on the horizontal axis, move your finger upward parallel to the vertical axis until it intersects the amplitude characteristics curve. Then move it left parallel to the horizontal axis until it intersects the vertical axis. The value at that intersection point indicates the half-amplitude testing capacity at 10 Hz. In other words, it indicates that at 10 Hz the system is capable of applying a maximum amplitude of ±6 mm.



Frequency vs. Testing Time

This table indicates the time required to perform 10^7 test cycles at the given frequency.
Fatigue tests involve a huge number of cycles. Therefore, performing tests at high frequencies can significantly reduce the overall testing time.

Test frequency	Cycles	Testing time
1Hz	10^7 cycles	116 days
3Hz	10^7 cycles	29 days
5Hz	10^7 cycles	23 days
10Hz	10^7 cycles	12 days
30Hz	10^7 cycles	3.9 days
50Hz	10^7 cycles	2.3 days
100Hz	10^7 cycles	1.2 days
300Hz	10^7 cycles	9 hours
20kHz	10^7 cycles	8 minutes

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