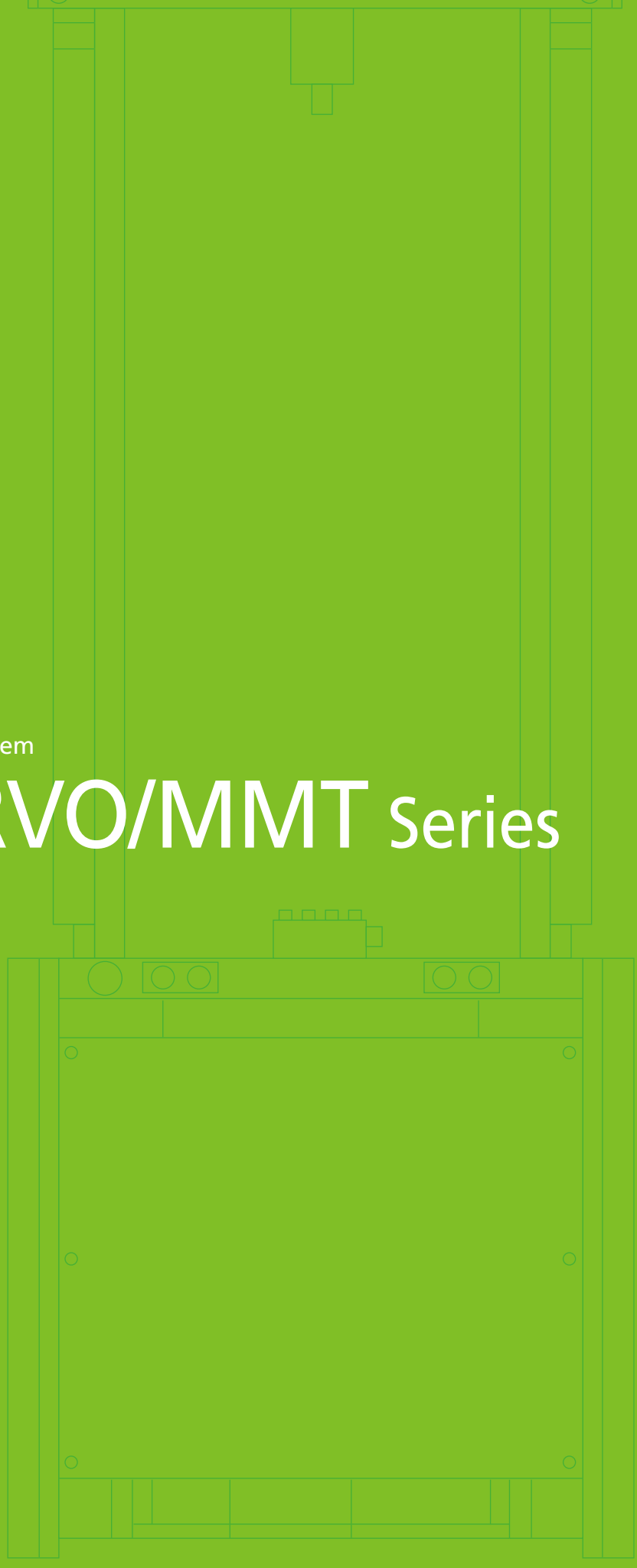
Electric Fatigue and Endurance Test System

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.

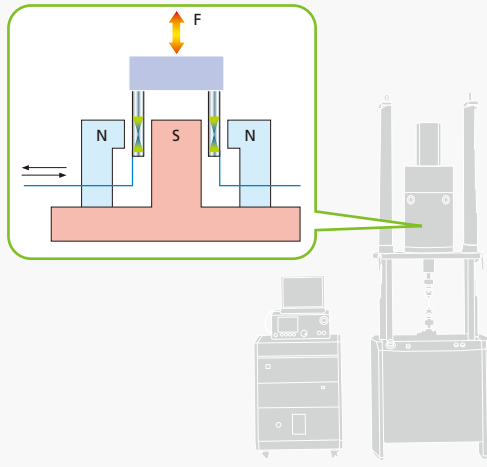
Electromagnetic Actuators

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.

$F=2\pi nBl$

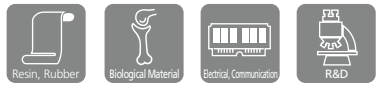
r : Coil radius
n : Number of coil turns
B : Magnetic flux density of magnet
I : Coil current

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

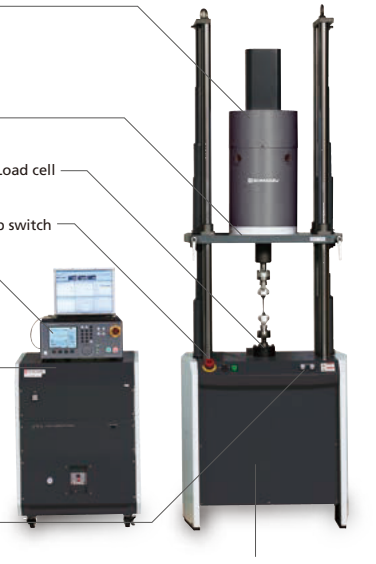
The controller allows high-performance and high-functionality dynamic and fatigue testing.

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.

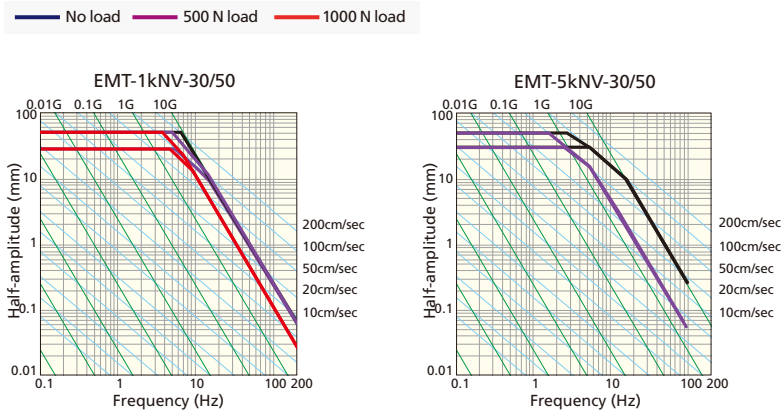


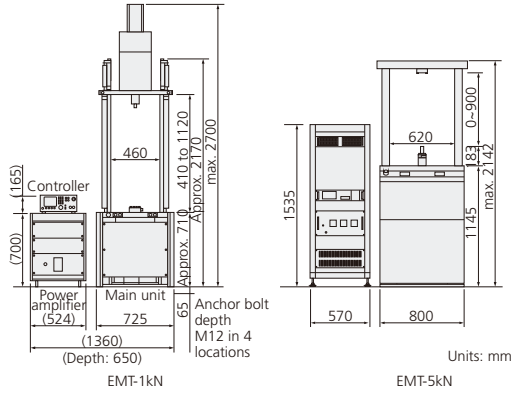
Specifications

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.

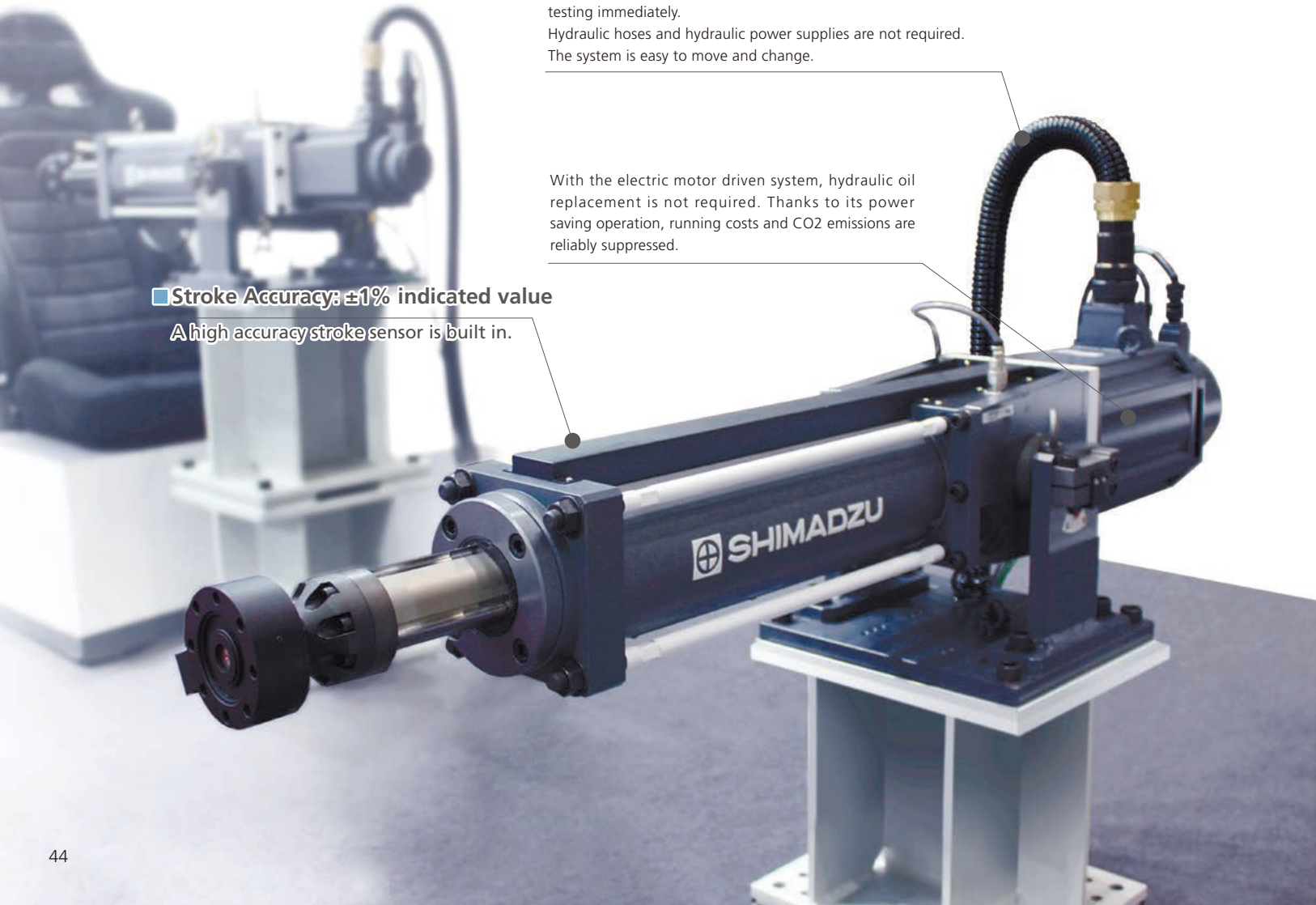
This system accommodates a wide range of tests with a high degree of expandability. This includes everything from endurance evaluations of the main body and assemblies of automobiles, aircrafts, and other transportation equipment to endurance evaluations of stand-alone parts; from multi-axis tests combining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

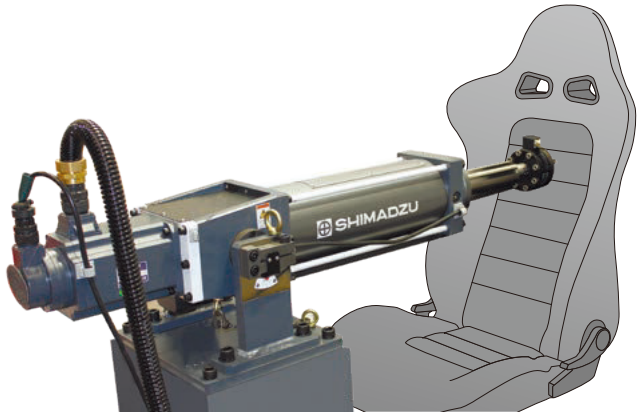
The system accommodates everything from static to dynamic tests across the full actuator capacity range.
The test conditions can be set as you wish.

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.

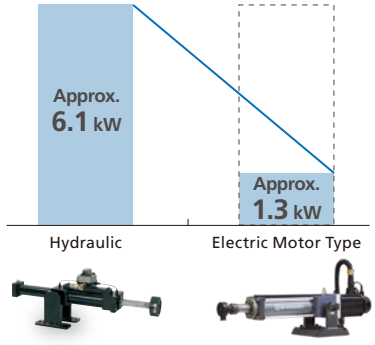
High accuracy measurements are achieved thanks to the built in stroke sensor and a special load cell for dynamic testing.
High stability test peaks are achieved thanks to the high response control of the 4830 controller.



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—

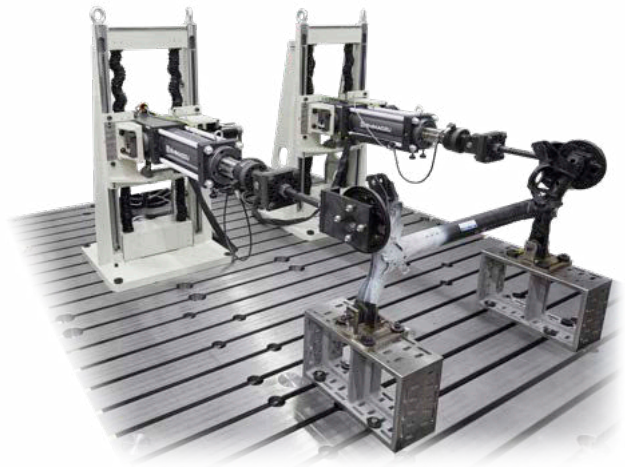
The electric motor driven actuator can be driven solely by a servo amplifier and a controller.
In contrast to a hydraulic type testing system, thick hydraulic hoses and a hydraulic power supply are not necessary. This saves on space, makes the system easy to move, and simplifies testing system changes.
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)

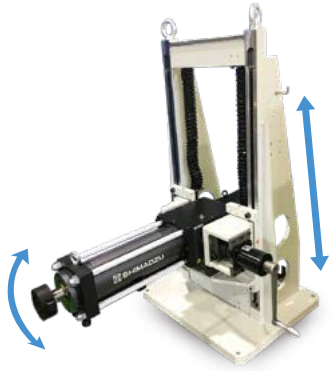
Electric Servo Type Endurance Testing Machine + Trunnion Bracket | Servo Amplifier | Servo Controller 4830

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

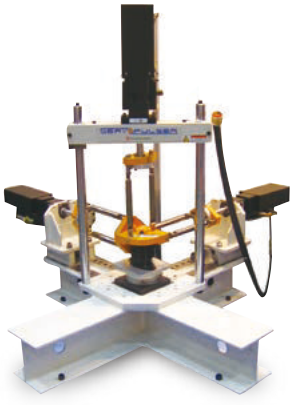
Variable Angle Top-Mounted Actuator Type

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

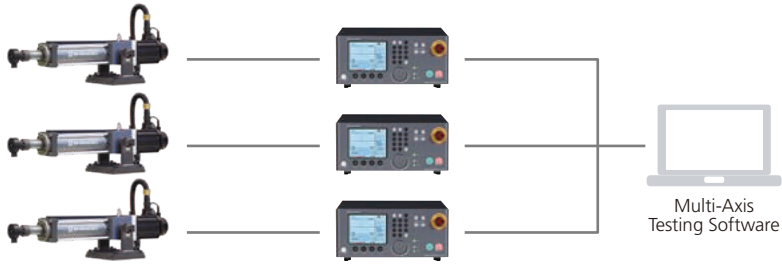
This is for endurance and performance evaluations with respect to small assembly parts such as shock absorbers.

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.

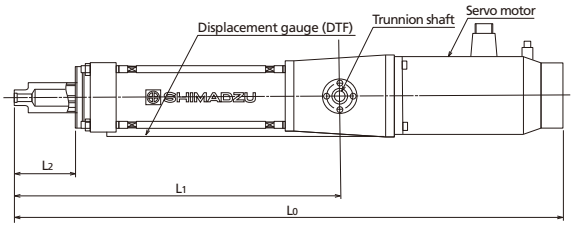


Specifications

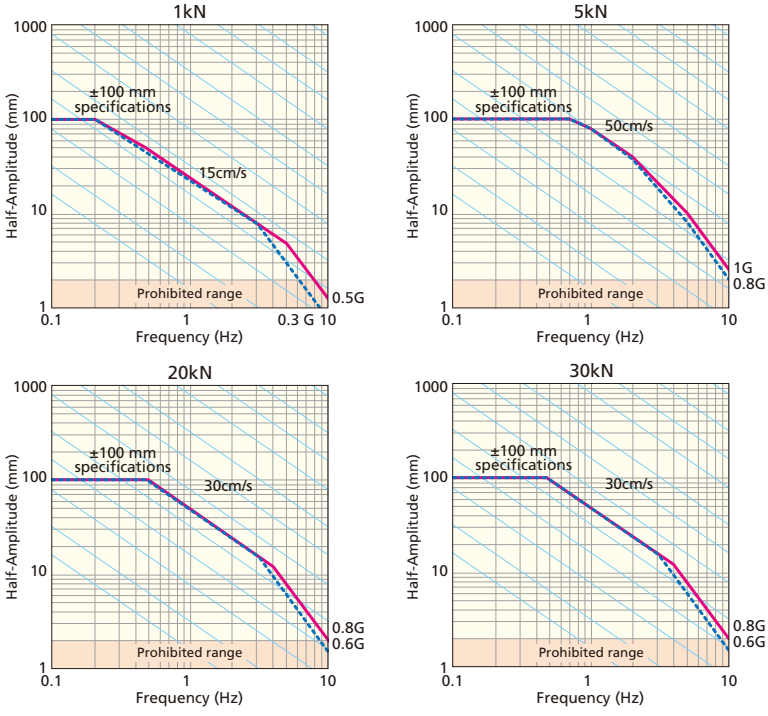
Model		NJ-1kNV-100	NJ-5kNV-100	NJ-10kNV-100	NJ-20kNV-100	NJ-30kNV-100
Test Force	Dynamic	±1 kN	±5 kN	±10 kN	±20 kN	±30 kN
	Static	±1 kN	±5 kN	±10 kN	±20 kN	±30 kN
Stroke (Full stroke)		±100 mm (200 mm)				
Max. Speed		Single wave: 20 cm/sec (loaded); Continuous: 15 cm/sec (loaded, sine wave)	Single wave: 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.

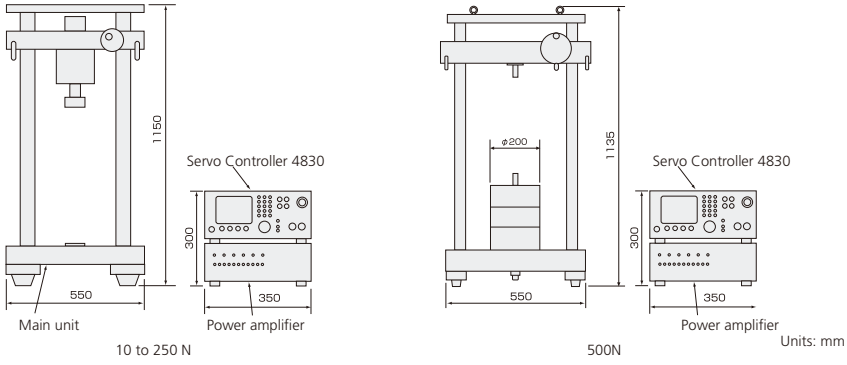
The actuator can be bottom-mounted as well.

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.

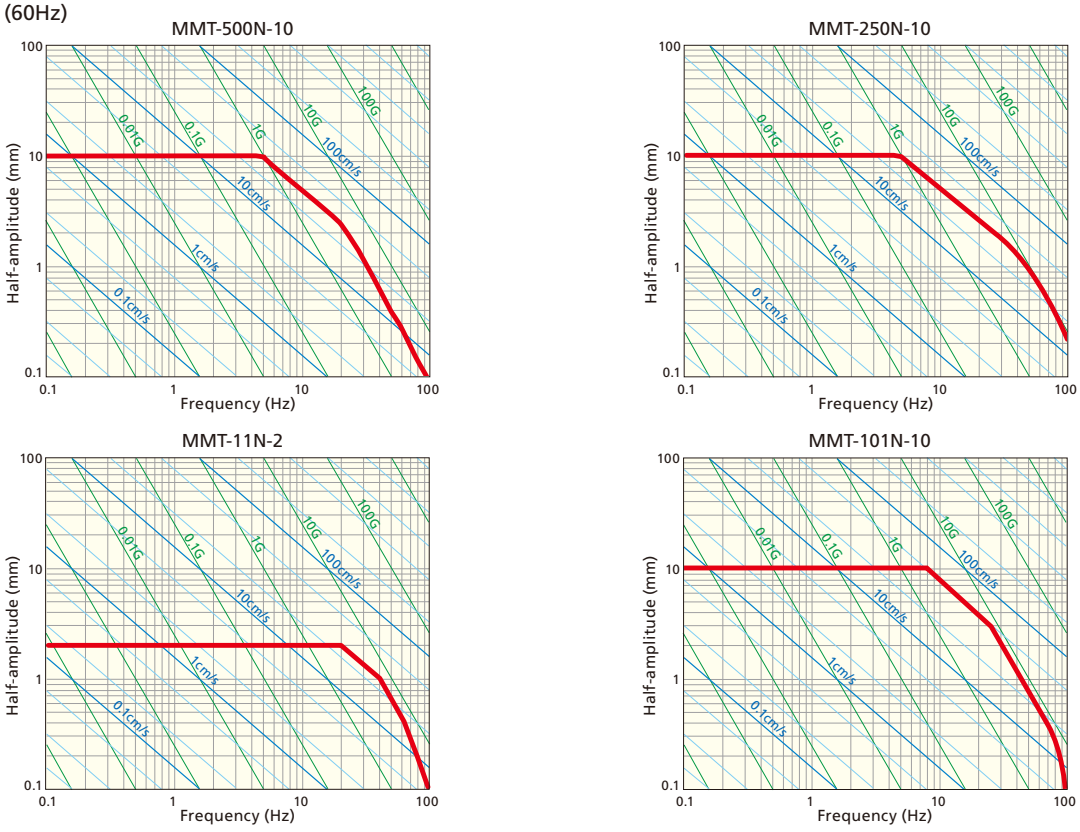
Specifications

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)

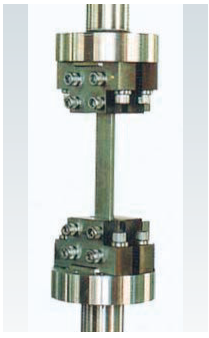
Plastics | Composite materials | Rubber

● 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

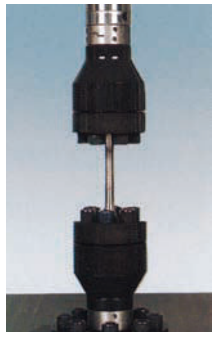


● Manual Non-Shift Plate Grip

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

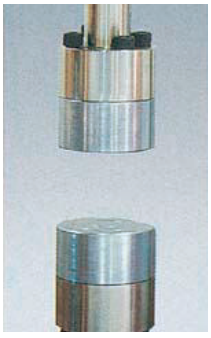


● Screw Flange Rod Grip

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

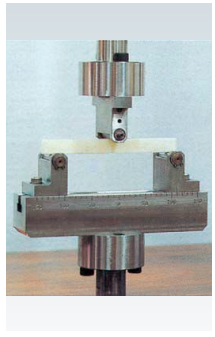


● Compression Plate

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

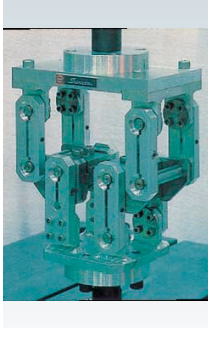
Metals | Plastics | Composite materials | Rubber | Components



● 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

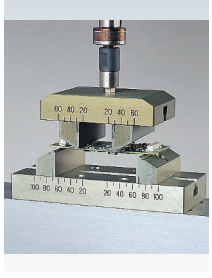
Note: Various kinds of compression test jigs are available, such as key press, toothed, and spherical types.

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

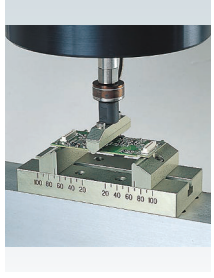
Metals | Plastics | Small parts



● 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