

High Speed Impact Testing Machines

# HITS-X Series



# HITS-X Series

## CAE Analysis Simulations Baseline Data for Product Design

To reduce weight and fuel costs in the automotive industry and other transportation equipment markets, the use of plastics and composite materials has increased. Due to the superior workability of plastics compared to metals, many parts that were made of metal are now being made of plastics. However, plastics are not as resistant as metals to heat and shock.

For this reason, new materials are continually being developed and these materials need to be tested.

Additionally, in order to improve the efficiency of development, the manufacturing technique is simulated during the design stage, so the accuracy of these processes is very important.

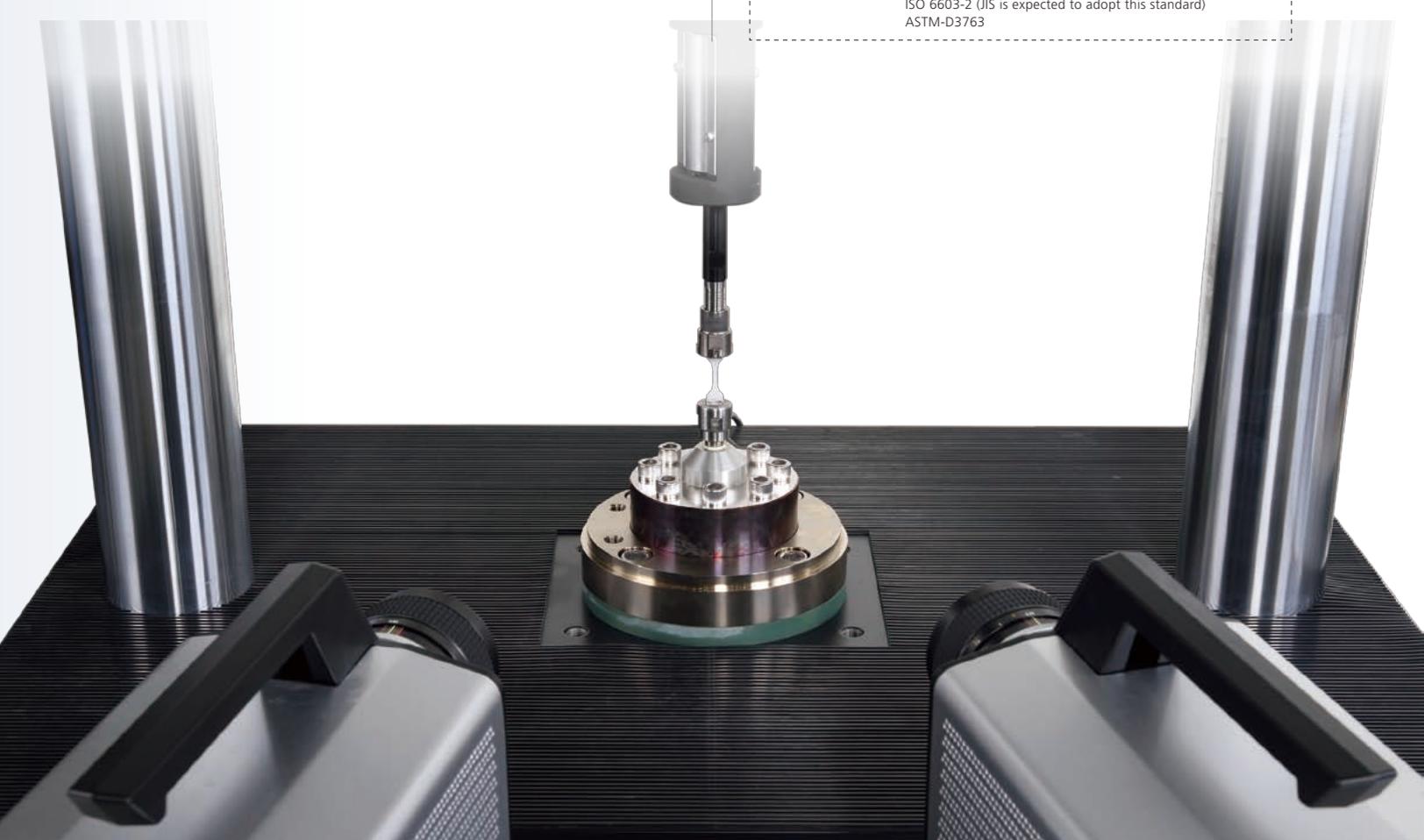
An improvement in the simulation accuracy can be expected by making use of yield stress, maximum test force, and energy obtained through high-speed tensile testing.

The HITS-X high-speed tensile testing machine is capable of control at speeds up to a maximum of 20 m/s (72 km/h). By combining a high-response force detector, a volumetric displacement gauge resistant to vibration and impacts, and software that minimizes vibrational noise, sophisticated data with very little noise can be obtained.

The **HITS-TX** model allows obtaining baseline high speed deformation behavioral data for materials by tensile testing materials at freely selectable tensile speeds. It incorporates a newly developed high response detector and a vibration resistant volumetric displacement meter, which allow obtaining highly accurate data with minimal vibration noise.

The **HITS-PX** model allows puncture testing materials using impact speeds that are freely selectable. Puncture impact testing involves puncturing a flat plate specimen with a striker that has a semi-spherical tip. This testing machine allows various data, such as test force vs. displacement curves, max. test force values, energy, and displacement to be obtained easily.

Testing Standards Complies with:  
ISO 6603-2 (JIS is expected to adopt this standard)  
ASTM-D3763



# Equipped with State-of-the-Art Technology

## High test speeds

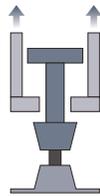
The hydraulic operation allows impact tests to be conducted at any speed between 0.0001 m/s and 20 m/s (72 km/h). It allows a wide range of testing speeds using a single machine.

## 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).

## Specialized approach jig (HITS-TX)

Allows target speed to be reached rapidly.



- Reduction in acceleration time
- Large inertial force

## State-of-the-art software

The software 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.

## 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.

## 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.

## Temperature dependency for high-speed behavior (optional)

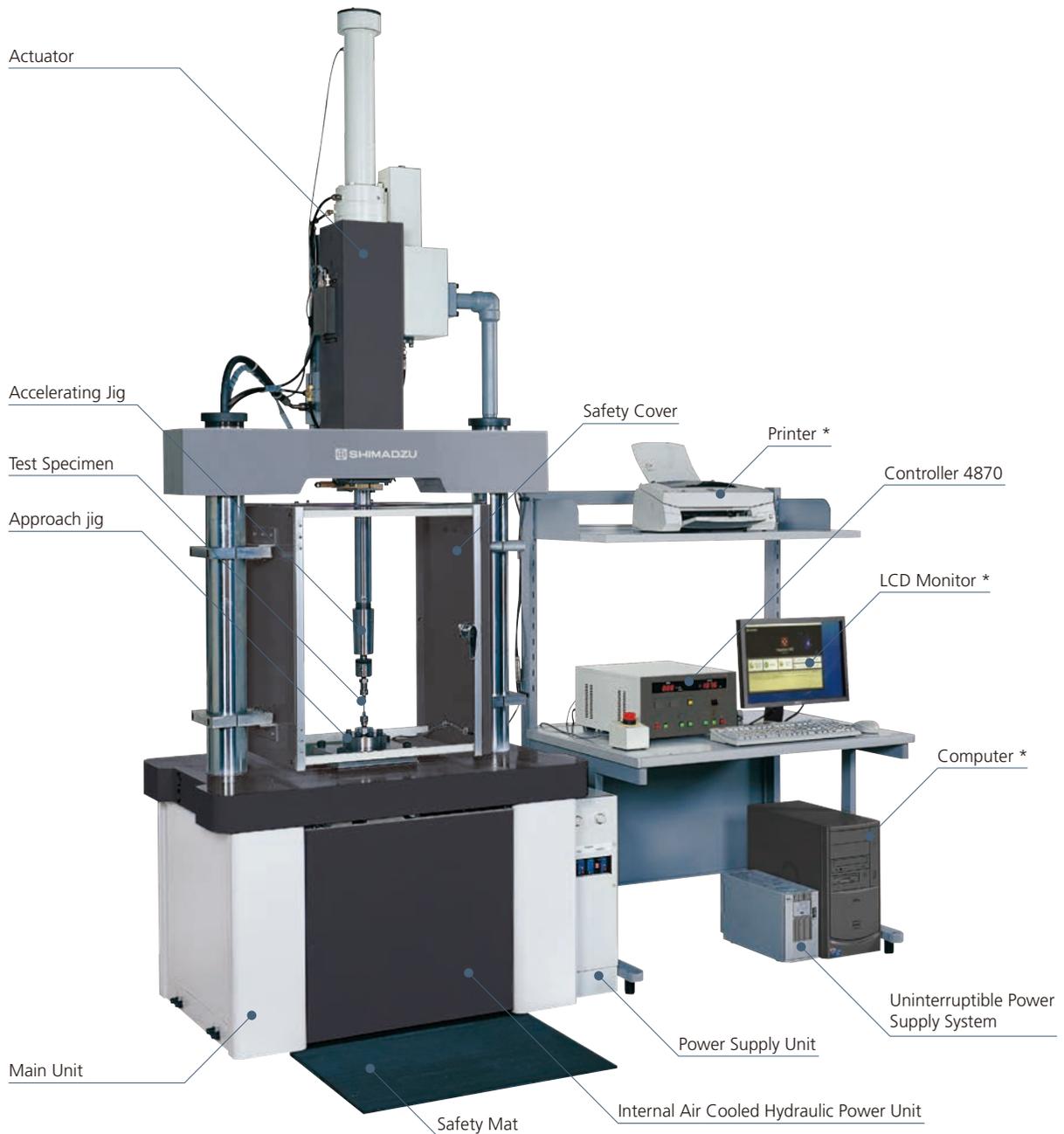
Information on the temperature dependency for specimens' high-speed behavior can be obtained using the optional thermostatic chamber (-40 to +150°C).



# High Speed Tensile Testing Machine HITS-TX

## High Rate Tensile Testing Machine

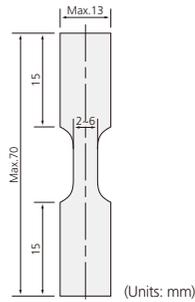
Vibration Resistant Design Reduces Vibration Noise



\* The standard configuration does not include a computer, monitor and printer. Please procure them separately.

## (Optional) Force Detectors and Applicable Grips

### Force Detector and Grip for Flat Plate Samples



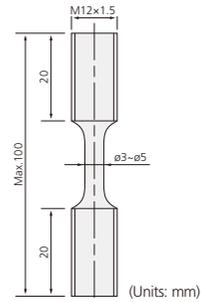
Flat Sample

### 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.



Round rod specimen

#### 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

#### 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 x 1.5 female threads
Applicable Sample	Round rod specimens with M12 x 1.5 threaded ends (threaded length of 20 mm or more)

## System Functions

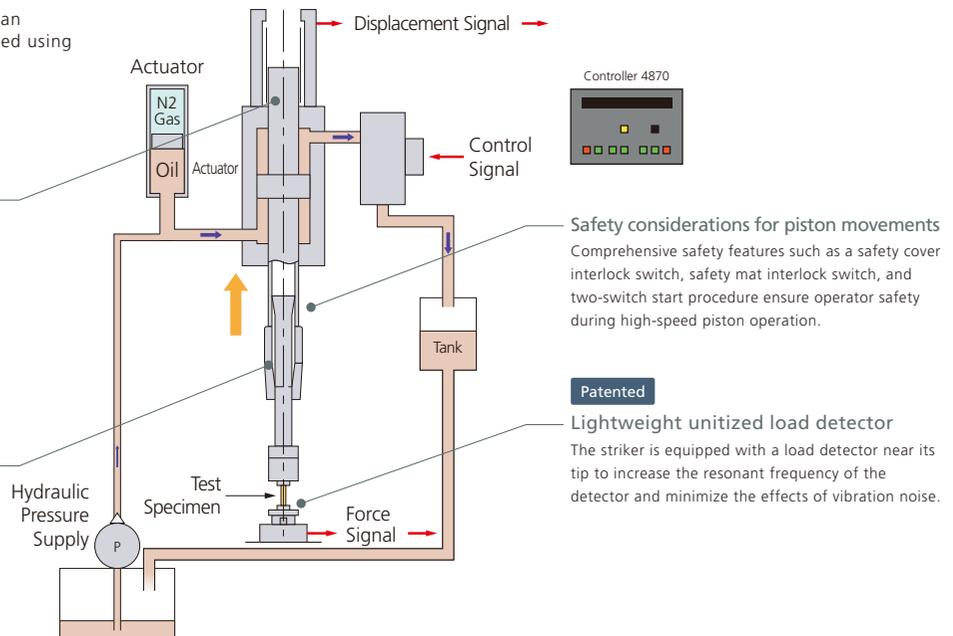
The hydraulic energy is temporarily stored in an accumulator, and the piston speed is controlled using a high-speed servo valve.

#### Accelerating mechanism for efficient tensile testing

An acceleration mechanism is required to load the specimen at a specified rate. The tapered section of the acceleration rod incorporated in the space inside the piston engages with the tapered surface of the acceleration guide, ensuring a stable speed during testing.

#### Approach mechanism that heightens acceleration capability

In order to apply the load at the speed that is set for the sample, an approach mechanism is required. The tapered portion of the approach rod, which is stored within the space inside the piston, engages with the tapered surface of the approach guide, and applies the load. This mechanism enables testing at a stable speed.



# High Speed Puncture Impact Testing Machine HITS-PX

## High Speed Puncture Impact Testing Machine

Complies with ISO 6603-2 and ASTM D 3763-93 Testing Standards (see note)

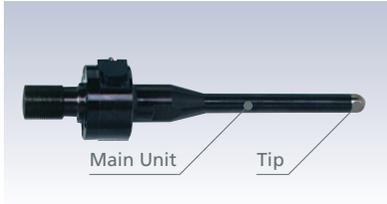
Note)  
● ISO 6603-2  
Plastics – Determination of puncture impact behaviour of rigid plastics –  
● Part 2:  
Instrumented impact testing  
● ASTM D 3763-93  
High Speed Puncture Properties of Plastics Using Load and Displacement Sensors



\* The standard configuration does not include a computer, monitor and printer. Please procure them separately.

## Optional Accessories Striker, Clamping Plates

### Striker (with load detector)

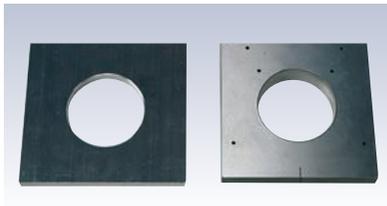


#### Main striker unit and tip

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

Note: Non-standards combinations are supplied as options.

## System Functions

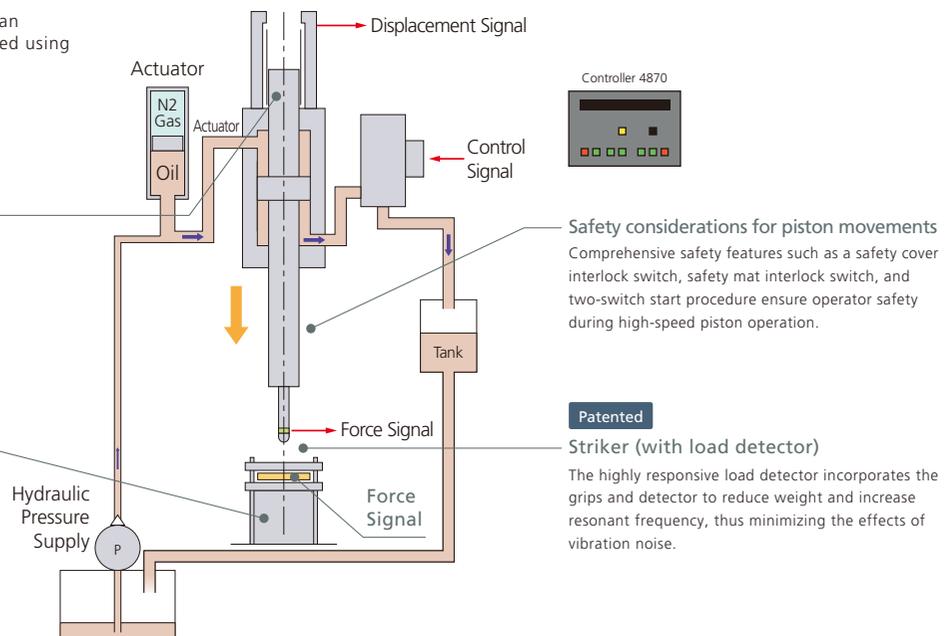
The hydraulic energy is temporarily stored in an accumulator, and the piston speed is controlled using a high-speed servo valve.

#### Vibration and shock-resistant displacement detection mechanism

This volumetric displacement detector uses the moveable piston rod of the accumulator as an electrode. The simple mechanism that is resistant to vibration and shock provides highly precise displacement detection.

#### Specimen Holder

The mounting and fixing plates can be easily replaced, complying with various standards. Specimens are secured pneumatically with one-touch operation.



# High-Speed Impact Testing Software

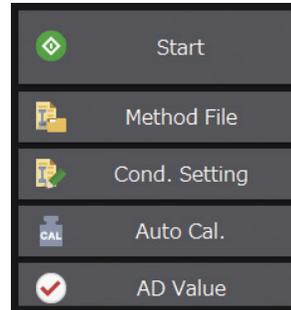
## Dedicated High-Speed impact testing software for outstanding user friendliness

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

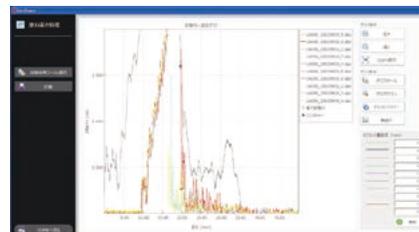
Numerous printing functions, such as overlaying graphs or indicating characteristic values at the point of maximum test force or specimen fracture, are available.

[ Data processing screen ]



( High Rate Tensile Testing Machine HITS-X )

[ Data processing screen – overlaying data ]



( High Rate Tensile Testing Machine HITS-X )

# Controller 4870

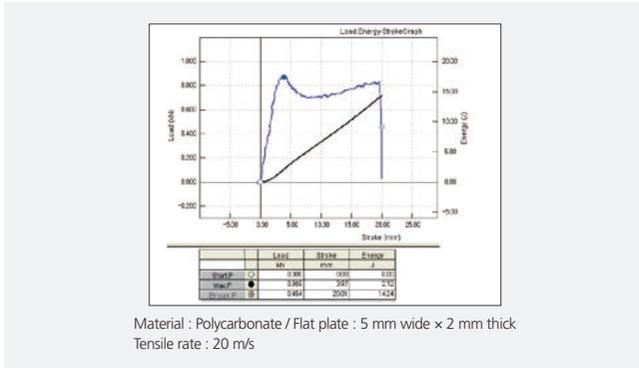
A specialized control system equipped with an internal highly responsive amplifier and start interlock system

The controller is specifically designed for High-Speed impact testing systems. In order to assure safety, manual piston operations and test start/stop operations are performed via hardware controls.



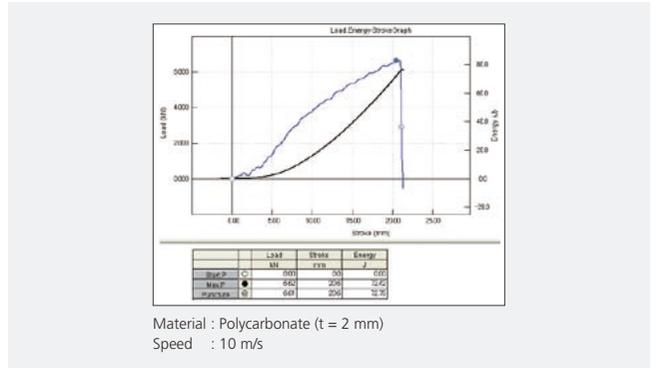
## High-Speed Tensile Test Measurement Data

Data example for plastics

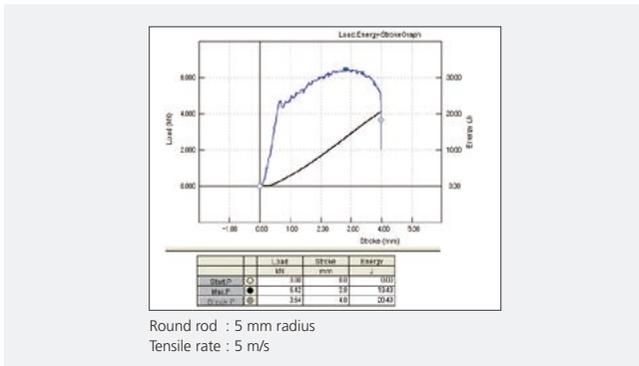


## Puncture Impact Measurement Data

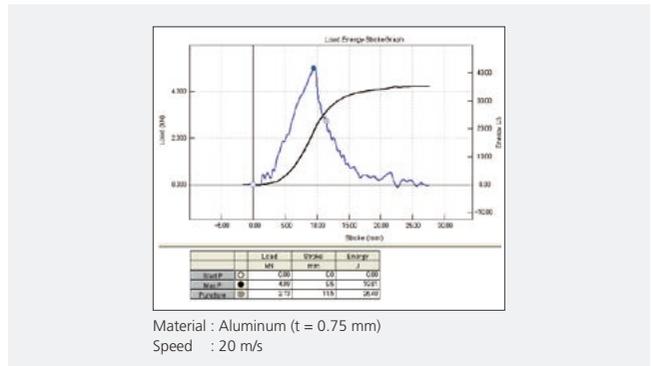
Data example for plastics



Data example for aluminum



Data example for aluminum



## HPV-X2 & HITS X Series Visualization and Strain Measurement

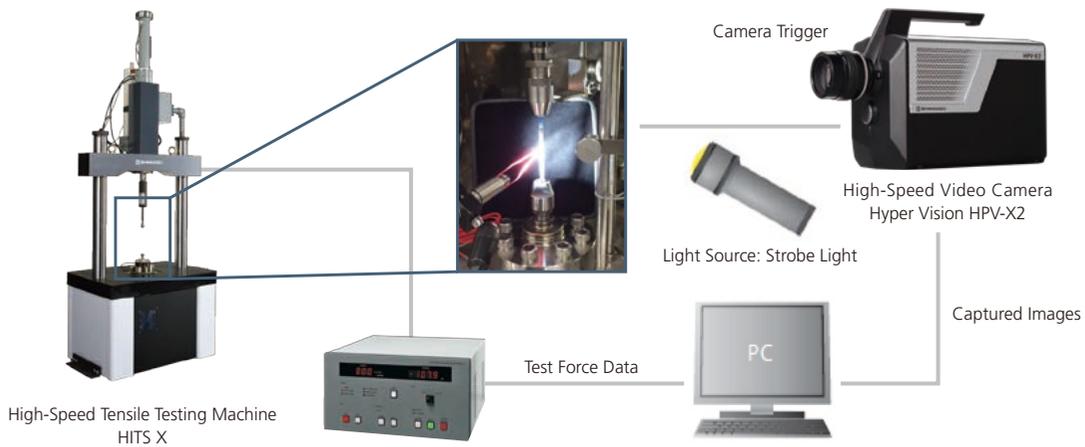
### Analyzing Strain Distribution Using a 10 Million Frame-per-Second Ultra High-Speed Camera and a DIC Data Analysis System

Verifying material characteristics to ensure dynamic safety during composite material development requires not only static strength testing, but also understanding 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.

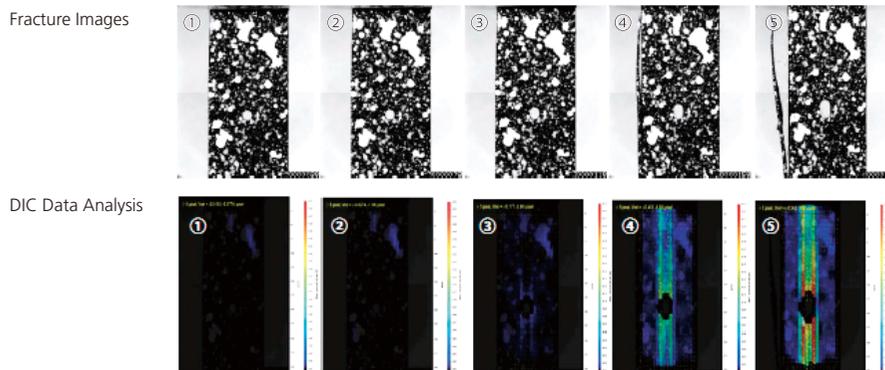


HyperVision HPV-X2

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

# Standard Specifications

## Main Unit, Controller and Software

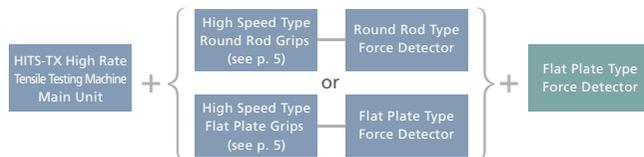
Model Name	High Speed Tensile Testing Machine HITS-TX	High Speed Puncture Impact Testing Machine HITS-PX
Product Number	346-72545	346-72457
Impact Test Force	10 kN	
Maximum Speed	20 m/s	
Range Of Speed Settings	0.0001 m/s to 20 m/s <sup>*1</sup>	1 m/s to 20 m/s
Piston Stroke	300 mm	
Force Amplifier	Range: 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	—	Pneumatic 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 <sup>*2</sup>	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.

## Standard System Configuration

The standard **HITS-TX** system is configured as follows.



The grips, force detector (either for round rods or flat plates) are selected and combined with the main high-speed tensile testing machine.

©The heating/cooling unit is separated from the main testing machine so it is not affected by impact testing.

For HITS-TX (High Rate Tensile Testing)

Model Name	Thermostatic chamber for HITS-T
Part Name	346-72457-31
Temperature Range	-40°C to +150°C with two refrigerating sources
Power Supply Requirements	200 V 3-phase 12 kVA
Cooling Water Capacity Requirements	50 L/min (20°C or lower water temp)
Dimensions	Main unit: W1200 × D1200 × H1800 mm
Weight	Approx. 800 kg

Note: Units with other temperature ranges can also be manufactured.

The standard **HITS-PX** system is configured as follows.



The striker, striker tip, specimen holder and clamp are selected and combined with the main high speed puncture impact testing machine.

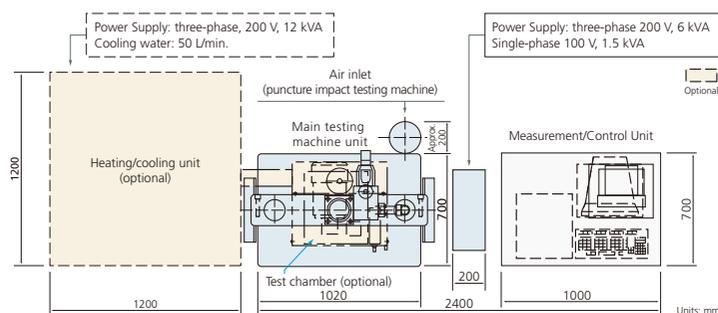
©The testing chamber includes racks that can hold up to 80 specimens for preheating or precooling.

For HITS-PX (High Speed Puncture Testing)

Model Name	Thermostatic chamber for HITS-P
Part Number	346-72545-31
Temperature Range	-40°C to +150°C with two refrigerating sources
Internal Specimen Holding Racks	4 racks x 20 specimens per rack
Power Supply Requirements	200 V 3-phase 12 kVA
Cooling Water Requirements	50 L/min (20°C or lower water temp.)
Dimensions	Main unit: W1200 × D1200 × H1800 mm
Weight	Approx. 800 kg

Note: Units with other temperature ranges can also be manufactured.

## Layout Diagram and Site Requirements (HITS-TX, HITS-PX)



Note: The main unit of the testing machine must be installed on the first floor of a building, on a concrete floor that has a thickness of at least 250 mm (capable of withstanding the own weight of 1,500 kg). The foundation needs to be constructed by the user. Avoid installing the machine on an upper or hollow floor, due to the impacts and vibration generated during high-speed testing. Although the machine is equipped with vibration-damping springs, care should be taken when selecting an installation location where vibrations could be easily transmitted. Note that the weight of the thermostatic chamber is approximately 800 kg.

**Caution: Avoid locations with unsuitable conditions such as those listed below.**

- 1) Locations subject to large fluctuations in temperature (Recommended: +10 °C to +35 °C)
  - 2) Locations with high humidity, where dew condensation may form (Recommended: 20 % to 80 %)
  - 3) Locations exposed to the direct air flow from heating/cooling systems
  - 4) Locations exposed to direct sunlight
  - 5) Locations with large amounts of dust
  - 6) Locations with significant amounts of corrosive gases
  - 7) Locations subject to strong vibrations (Recommended: 0.1 G max.)
  - 8) Locations subject to large voltage fluctuations (Recommended: Single phase 100 V ±5 % max., Three-phase 200 V ±10 % max.)
- Note: Avoid installing devices that can be negatively impacted by vibrations (such as balances) in the vicinity of the testing machine.

## Related Products

Electromagnetic Force Fatigue / Endurance Testing System

### EMT Series

- 1kN
- 5kN



Benchtop Hydraulic Servo Strength Testing Machine

### L-Series Servopulser

- EHF-LM20kN-10L



Capillary Rheometer Flowtester

### CFT-EX Series

- CFT-EX
- CFT-500EX
- CFT-100EX



Electromagnetic Micro Testing Machine

### MMT Series Micro-Servo

- MMT-101NV-10



Electric Motor Driven Actuator

### NJ-SERVO Series

- NJ-10kN SERVO



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