Operation manual

Pendulum shock testing machine   PST-300
Introduction

Please read the text of this instruction manual after understanding the following items before using this system. Keep this instruction manual nearby during the use.

Marks display on the shock testing machine

![Warning](image)

Beware of this mark, otherwise it may result in death or serious wound of the worker. Please strictly follow the message indicated.

![No dismantling](image)

When you fail to heed this warning in working the tester, you are likely to cause a fire accident, and electrify or otherwise injure people. It is hazardous to dismantle the tester in electrified condition. Please follow the instruction.

![Electric shock](image)

If you work disregarding this mark, you are likely to get electrified. Please observe what is instructed.

Brands

The proper nouns such as product names, etc. being described in this instruction manual are registered brands or trademarks of each company.

Foreign Exchange and Foreign Trade Control Act

Take necessary procedures such as the export license application, etc. according to the provisions of the Foreign Trade Control Act, if you export this system.
General cautions

- No part of the contents of this manual can be reproduced in any form without permission.
- For the contents of this manual, alteration is reserved without notice.
- We are not responsible for any damage and/or troubles of the system caused by negligence of operation methods and cautions on operation and handling of the system described in this manual.
- This manual has been prepared by making assurance doubly sure. We are not responsible for any damage that might have happened in regard to the contents. If you should have found an obscure point, an error, a description skip, or the like, please contact our company.

Cautions on handing and operation

Specimen
You must always set the specimen in the instructed position on the test piece fixing bed and thereafter start the tester within the rated loading (800g: included test piece fixing jig.)

Impact head and buffer
The impact head at the end of the test piece fixing bed and the buffer which is fixed on the anvil are two most important portions for determining the greatness of acceleration.
Take care not to damage them. Never try to apply any oil on their respective faces.

Refueling
Never try to apply oil to the fulcrum of the pendulum nor to the drive system, which have been sufficiently fed oil.

Automatic operation mode
In automatic operation mode, never fail to depress the reset button after setting the frequency of the preset counter. Unless the reset button is pushed down, automatic operation will not work even if the pushbutton [AUTO ON] button is depressed.

Monitoring
Even the automatic operation requires somehow the monitoring. A great hock may cause an accident or trouble such as test piece falling.
Testing machine

- Don't place anything heavy on the power cord, nor pull or forcibly bend or break it. It may also be the cause of a fire or electrification.

- The rotary arm of this tester runs at high speed. You must remain out of its working range, otherwise an untoward accident may happen to you.

- The specimen may drop and hit in a direction you do not expect or it may be broken and scatter. You should be prepared for such happenings.

- You must be always alert to see that there are no tools, specimen or other objects placed within movement area of rotary arm and around rubber pad.

- When there is another test machine working around, you must accost the worker operating it to avoid mutual interference in work.

- You must refrain from handling any poisonous chemicals near the tester, otherwise the painted coat may be discolored or an accident may happen.

- When an abnormally such as fume or a strange odor occurs while you are operating the tester, you must immediately switch off power supply. Also when water has invaded from outside into the tester or its control, you must act the same way and switch off power supply. If instead you continue to operate the tester, a fire of electrification of human body may be caused. You must act swiftly to contact our office.

- You are cautioned against uncovering the body of the tester or holding the control device out of the casing for the purpose of operation; it may cause a foreign matter to get mixed into the tester, leading to a trouble. In the event that a foreign matter has invaded the tester, you must switch off power supply and contact office. If you continue to work instead, a trouble will happen or people may be electrified.

- An attempt to modify the tester may invite a fire accident, human electrification or other trouble. You must refrain from such an attempt.

- When you consider relocating the device, please contact our office and follow its instruction. If you lift the device to a wrong height for relocation or follow a wrong procedure of working, it may result in damage to the device itself or to its controller. Besides, you must avoid people riding the device or its controller or a heavy load being imposed on them. It may result in people being hurt or the load being dropped and broken. When such an accident should happen, please call our office for help.
Transformer unit

- Please connect the earth of ground protective to the terminal block in yellow and green.

- Please draw the AC cable with attached bushing, and fasten it tight.

- The appropriate $2.5\text{N} \cdot \text{m} \sim 4.0\text{N} \cdot \text{m}$ clamping torque of bushing

- At the input side, please certainly prepare the circuit breaker of 250Vac 15A.
User support

Periodical calibration
You are recommended to calibrate the instrument for confirming the performance once every year. Please contact us.

Reference

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09:00 hours to 17:30 hours (Japan time)

Home Pages
For the guidance and latest information on this product and commodities being manufactured and sold by our company, please refer to our home page.

URL: http://www.shinyei-tm.com/

Other
Please ask us if you have any question about the measurement and analysis of shocks and vibrations, related standards (JIS, ISO, etc.) on shock testing methods as well as this product.
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This equipment is designed to impose a shock with required uniform acceleration no small test pieces as a whole. It can be used for research and study, qualification test, shipping inspection and acceptance test for impact resistance of specimens. This testing machine is suited in particular to application of high acceleration on such products as electronics and electrical parts. This testing equipment can be used for such tests as conforming to the following standards:

JIS C 60068-2-27 Environmental testing-Part 2-27: Tests-Test Ea: Shock
IEC 60068-2-27 Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock
MIL-STD-202F Test methods for electronic and electrical component parts shock
MIL-STD-750C Test methods for semiconductor devices, shock
MIL-STD-883 Test methods and procedures for microelectronics Mechanical shock

Testing machine has a pendulum formed stand to fix the test pieces. The rotary arm is motor-driven. The arm is lifted up and stops at a given height. Then clutching will make it fall freely rotating. When it collides the anvil with buffer fixed, it generates impact acceleration in half-sine wave form. After the pendulum once rebounds, the brake will prevent it from colliding again, thus allowing to impose required acceleration only once on the test piece. Required acceleration can however be applied in continuous way.

Figure 1 General view
§2 Structure of each part

2-1 The main part of a testing machine

![Diagram of the main body of a testing machine with labeled parts:]

- Pointer scale
- Swing-up angle setting arm
- Pointer
- Rotation arm
- Fixing bad for specimen
- Jig tightening metal
- Fixing jig
- Impact head
- Collision detect switch
- Base
- Anvil adjusting handle
- Horizontal adjust screw
- Cast iron angle plate
- Shock absorber
- Buffer
- Anvil
- Figure 2 main body
Figure 3  Front panel

Figure 4  Rear panel
1) [POWER] switch (push button)
   Depressing this switch will illuminate the switch itself white and activate the motor to turn.
   At the same time the brake and clutch will enter into stand-by state, but will not act.
   Depressing again will turn off both the lamp and power supply.

2) [SET COUNTER] (4 digits)
   It is counter to set the number of continuous operation.

3) [AUTO ON] switch (push button)
   Depressing this switch will illuminate the switch itself amber thereby enabling continuation of
   single test action, unless the frequency of the tests surpasses the set value of the set counter.

4) [OFF] switch (push button)
   It is a switch pushed to interrupt continuous running. Continuous running is interrupted by
   pushing a switch. (Lamp [AUTO] ON switch is turned off)
   To resume playback, please press again the [AUTO ON] illuminated switch.

5) [SINGLE] switch (push button)
   Touching once this switch will swing the pendulum to rise up to its set swing-up angle and then
   stop it there.
   Then an alarm buzzer will ring. About 1 second after the clutch will be disengaged, and the
   pendulum will fall swinging freely as gravity pendulum to collide with the anvil having the buffer,
   thereby imposing required acceleration to the test piece.
   The pendulum will then rebound and rises up again. The braking mechanism will then function
   so that the pendulum may stop at its highest position.

6) [TOTAL] (Total counter)
   Shows seven digits the total number of tests from the beginning to use the tester. It is not
   possible to return to the "0000000" the number of times on the way.

7) [ALARM]
   Properly in the event of a failure, I want lights flashing

<table>
<thead>
<tr>
<th>The state of ALARM</th>
<th>Cause</th>
<th>ALARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>lights</td>
<td>①The reed switch for over-lifting limit is ON</td>
<td>①Please check (R type lever is pushed.)</td>
</tr>
<tr>
<td></td>
<td>②The reed switch for Height setting switch is not detected.</td>
<td>②Please check</td>
</tr>
<tr>
<td></td>
<td>• Is located at a position above swing-up angle setting arm up set angle of rotation arm</td>
<td>• The check of a position</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wiring is checked.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Replace if there is nothing wrong.)</td>
</tr>
</tbody>
</table>
| flashing | 1 second | ① The reed switch for collision switch is not on.  
② Failure or disconnection of the reed switch for collision switch | ① Adjust the position of the collision detection switch  
② Wiring is checked.  
（Replace if there is nothing wrong.） |
| 0.2 second | Within 5 seconds after setting rise, to set angle rotation arm action is not (rise) | ① Please check  
・ The rotation arm is not moving.  
・ Specimen weight is over  
② Clutch failure, the motor (Must be replaced)  
（Please contact us） |
2-3 Drive system

The motor rotation is transmitted to the bevel gear through the gear head (reducer), thereby turning the fulcrum shaft by way of the ratchet mechanism and main clutch.

Use of the motor with electromagnetic brake provided will bring the motor at a standstill instantaneously after isolation.

Figure 3
2-4 Time chart

- POWER switch
  - ON: H
  - OFF: L

- SINGLE switch
  - ON: H
  - OFF: L

- Brake motor
  - H: L

- Height of action pendulum
  - H: L

- Main clutch
  - H: L

- Angle set switch
  - H: L

- Angle of pendulum

- Collision detect switch
  - H: L

- Collision acceleration

→ time[t]
2-5 Brake Mechanism
As has been shown in the time chart, the main electromagnetic clutch couples about 10ms after the pendulum passes above the collision detect switch.
So they swing up as mono block up to the position of the ratchet gear.
When the pendulum begins to come down swinging, it is engaged with the ratchet and the portions up to the brake all through the reducer will stop as one block.

2-6 Dynamic Model of the Tester
The turning arm of the pendulum, which is of light alloy, has light and rigid cross section and the armature of the main clutch has been designed to be compact so that the turning radius of the pendulum and the working radius should coincide.
The fulcrum shaft has been supported with ball bearing to avoid any friction as far as possible. The buffer uses, as its material, polydactyl resin if the impact duration is 1ms or shorter, and rubber based material if it exceeds this limit.
The shock absorber behind the anvil is intended for shock insulation.
When $15000 \text{m/s}^2$ of acceleration is produced in 0.5ms of shock duration time, only $30 \text{m/s}^2$ of acceleration in produced on the base.
Further the rubber vibration insulator (pad) beneath the base will produce attenuated vibration on the mount face.
The equivalent weight of the pendulum is about 2kg, and the working force under $15000 \text{m/s}^2$ of acceleration reaches even 3000kg.

![Figure 4](image_url)  
**Figure 4** a dynamic model of the shock producing system
§3 Installation

This testing equipment, though it is compact, weighs 100kg, and produces a great impact. Double shock absorber has been provided so that the impact should not be transmitted directly to the installation position.

3-1 Installation

It is recommended however to install the equipment on a solid stand, working table or the like so that the impact may be absorbed as far as possible. Leveling should be performed by means of 4 adjust screws on the lower face of the base with buffer rubber plate put under the adjust screws so that the air bubble in the round level on the base should be within the red referential circle on the glass face. Unstable installation face will not allow an accurate testing. If the place of installation is well horizontal or allows retaining horizontality, the value of acceleration imposed on the test piece will not fluctuate even if the installation place (such as desk) is a structure of poor rigidity causing thus a vibration during testing.

3-2 Wiring

Connect the control unit with the metallic receptacles of respective cords coming from the equipment body.

No fear of erroneous connection, because respective receptacles have their own different diameters and pin number.
§4 Operation

4-1 Replacement of the Buffer

The plastic and rubber buffers which produce half-sine wave acceleration differ in their geometrical shapes and dimensions depending on their impact duration. Fix them on the anvil by the respective retainer rings that suit them. Because the waveform may be distorted unless the buffer sticks fast to the anvil, tighten the set bolts uniformly. Detach the buffer for half-sine wave and stick it directly on the anvil. Detach the adhesive tape provided as one of accessories at the bottom of the conical lead and stick it on the center of the engraved line on the anvil which indicates the impact center. The lead buffer should be replaced for each test. When replacing the duffer, turn off the power source.
4-2 Setting the Swing-Up Angle

Look for the swing-up angle in terms of the acceleration applied to test piece in the impact acceleration-swing-up angle graph given in the test results. Loosen the fixing thumb screw of the set arm and match the pointer under the fixing thumb screw of the set arm with the graduation of the pointer scale so that required angle is given.

![Diagram of Swing-Up Angle Setting Arm](Figure 6)
4-3 Position of the Collision Detect Switch

The switch which detects that the pendulum comes nearer to the collision position has been screwed into the center of the base.

This switch is a non-contact type reed switch.

If only with the brake mechanism, normal action can be expected when it is at the central position of the seat.

If the swing-up angle of the pendulum is too low (20° or less), deviate it to the left side.

The ideal position is that where the pendulum does not hit twice and the brake does not act before collision.

Figure 7
§5 Performance and characteristics

5-1 Name
Pendulum shock testing machine

5-2 Model
PST-300

5-3 Specimen fixing area
φ 100mm

5-4 Max. mass of specimen
800g (fixing jig include)

5-5 Severity Range of Shock

<table>
<thead>
<tr>
<th>Duration of shock pulse [ms]</th>
<th>11</th>
<th>6</th>
<th>1</th>
<th>0.5</th>
<th>0.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration [m/s²] [G]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5~80</td>
<td>49~784</td>
<td>98~1568</td>
<td>490~8820</td>
<td>980~19600</td>
<td>9800~49000</td>
</tr>
<tr>
<td>10~160</td>
<td></td>
<td>50~900</td>
<td>100~2000</td>
<td>1000~5000</td>
<td></td>
</tr>
</tbody>
</table>

5-6 Shock waveform
Half-sine wave

5-7 Pendulum turning radius
300mm

5-8 Brake mechanism
Mounted

5-9 Control method
Single-turn and continuous operation, Full automatic

5-10 Set count in auto cycle
4 digits (1~9999 times)

5-11 Power
100VAC, 50-60Hz, for PST-300
220/230/240VAC, 50/60Hz, for Transformer Unit

5-12 Dimensions of main body
W620×D360×H675mm

5-13 Weight of main body
Approx. 100kg

5-14 Dimension of control unit
W380×D250×H220mm

5-15 Working temperature range
5~35°C

5-16 Accessories
1) Buffer
By product specifications
2) Fixing jig
1 each
3) Tools
1 set
4) Power cord
1 piece
5) Fuse (5A)
2 pieces
6) Carrying handle
4 pieces
7) Operation manual
1 copy
8) Test report
1 copy

1 A table is a reference value. Refer to the test report for the range of the buffer.
Circuit diagram of control unit
## Control unit parts list

**Type:** K1MA-30B

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLC</td>
<td>Sequencer (basic unit)</td>
<td>KV-24DR</td>
<td>Input: 16  Output: 8</td>
</tr>
<tr>
<td>PS</td>
<td>Power Supply</td>
<td>MS2-H50</td>
<td>IN : AC85 - 264V  OUT: DC24V 50W(2.1A)</td>
</tr>
<tr>
<td>S1</td>
<td>Lighting type push-button switch</td>
<td>AOLF2B1620DW</td>
<td>[POWER] AC100V  PL1(White)</td>
</tr>
<tr>
<td>S2</td>
<td>Push-button switch</td>
<td>ABW310G</td>
<td>[SINGLE] Green</td>
</tr>
<tr>
<td>S3</td>
<td>Lighting type push-button switch</td>
<td>ALFW2B2222DA</td>
<td>[AUTO ON] LED DC24V  PL10 (Amber)</td>
</tr>
<tr>
<td>S4</td>
<td>Push-button switch</td>
<td>ABW310R</td>
<td>[AUTO OFF] red</td>
</tr>
<tr>
<td>PL20</td>
<td>Telltale light</td>
<td>AL2M-P1PR</td>
<td>[ALARM] LED DC24V (Red)</td>
</tr>
<tr>
<td>RY1</td>
<td>Power relay</td>
<td>LY2N-D2-DC24V</td>
<td>[For Motor starting]</td>
</tr>
<tr>
<td>RY2</td>
<td>Power relay</td>
<td>LY2N-D2-DC24V</td>
<td>[Clutch operation / brake operation]</td>
</tr>
<tr>
<td>RY3</td>
<td>Power relay</td>
<td>LY2N-D2-DC24V</td>
<td>[For Preset counter]</td>
</tr>
<tr>
<td>RY4</td>
<td>Power relay</td>
<td>MY2N-D2-DC24V</td>
<td>[For Total counter]</td>
</tr>
<tr>
<td>FU</td>
<td>Fuse</td>
<td>P450H</td>
<td>5A Plug type</td>
</tr>
<tr>
<td>Fuse holder</td>
<td>P4-1S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N・F</td>
<td>Noise filter</td>
<td>RSHN-2006</td>
<td>AC250V 6A</td>
</tr>
</tbody>
</table>
| CU     | Preset counter | MB-4111 | DC24V 4 figures  
Reset system: Manual operation |
<p>| TC     | Total counter | ME-7030 | DC24V 7 figures |
| Di 1~2 | Diode | U15G | For Buzzer, Total counter |
| Bz     | Buzzer | EB2114 | DC24V |
| Co.1   | Metal electric socket | NJC-163PF-ULCSA  NJC-163RM-ULCSA | [For power supplies] |
| Co.2   | Metal electric socket | NCS-256-RF, NCS-256-PM | [For motors] |
| Co.3   | Metal electric socket | NCS-255-P,-R | [Height setting]  [Contention detection]  [Rise restriction] |
| Co.4   | Metal electric socket | NCS-164-PCH NCS-164-RCH | [For clutch] |
| Co.5   | Metal electric socket | NJC-163-RF-ULCSA NJC-163-PM-ULCSA | [For TRANS] |
| Co.6   | Metal electric socket | NCS-256-P,-R | [For motors cover] |
| Reserve | Metal electric socket | NCS-257-P,-R | 7P |
| GMG    | Motor with an electromagnetic brake | 5RK40GN-AW2MJ | AC100V 40W |
| Gear head | 5GN-100K | Moderating ratio 100 |
| C      | Capacitor | CH160CFAUL2 | Attachment of a motors |
| CR     | Clutch / Brake | TMF 1.2 | DC 24V 15W |
| C-3B5  | Varistor for clutches | C-3B5 | Attachment of a clutch |</p>
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Code</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS1</td>
<td>The reed switch for Height setting</td>
<td>RS-7A</td>
<td></td>
</tr>
<tr>
<td>RS2</td>
<td>The reed switch for Collision</td>
<td>RS-7A</td>
<td></td>
</tr>
<tr>
<td>RS3</td>
<td>The reed switch for Over-lifting limit</td>
<td>S-5GL13</td>
<td>R type lever</td>
</tr>
<tr>
<td>Case</td>
<td>Case</td>
<td>SI-1</td>
<td>W380 D250 H220</td>
</tr>
<tr>
<td>TR</td>
<td>TORANSFORMER UNIT</td>
<td>UEE7.5A</td>
<td>AC230V→AC100V</td>
</tr>
<tr>
<td></td>
<td>Cable bushing</td>
<td>AGE16-10.5</td>
<td>W380 D250 H220</td>
</tr>
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</table>