

INSTRUCTION MANUAL

LOW NOISE COMPACT VIBRATION SIMULATOR

[MODEL]

m030/MA1

m060/MA1

IMV CORPORATION

No. 1 5 4 4

■ Record of Changes

No.	Date	Description of Changes
1. 0. 0	9 April, 2009	The 1st edition
1. 0. 1	5 June, 2009	Revised
1. 0. 2	8 July, 2009	Revised
1. 0. 3	27 July, 2009	Revised
1. 0. 4	04 Dece, 2009	Revised

■ Published

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●COMPANY INFORMATION●

1. INTRODUCTION

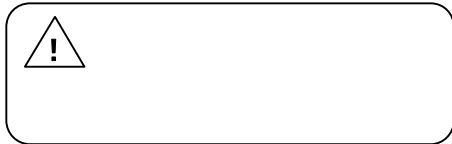
This manual is made for you to operate IMV vibration testing system safely and correctly. If you perform incorrect operation, the system may have any damage. Therefore, we hope you will read this manual surely before you start to use the system.

We hope you will keep the manual at hand during operation.

When you will move the installation place of this testing system to the new site, please check the existence of this manual together.

To use the system more safely and longer, IMV recommends you to perform the periodic or daily maintenance working.

In this manual, the required items to prevent any accident, that may cause serious personal injury or that may cause some damage to the testing system, are described as below.



Specifications and equipment may be subject to change without any notice.

Please call to IMV or our sales representative in your country if you have any questions.

2. INTRODUCTION FOR SAFETY

In this chapter, the details of notice and warning labels for safely use of the vibration testing system are described.

Please check the following descriptions before using the testing system.

2.1 NOTICE FOR YOUR SAFETY

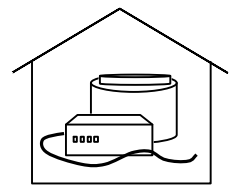
Note that followings for your safety operation.

● Space

For your working safety, IMV recommends you to keep “2 meters around area” from the unit and cables in this system as “Dangerous zone”. Keep the zone to be clear and you must not put unnecessary things in the zone.

The person except trained testing operator must not enter to the zone, because acoustic noise due to the system running may affect to his health even if he is staying out of the area.

Please stand away from the system for safety, especially for a person who is using medical device such as a cardiac pacemaker.

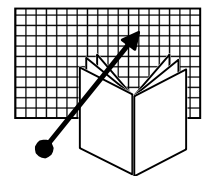


● Training

To use this system, IMV recommends operation training for the testing operator. The person, who is not trained, must not operate this system.

Such training is performed when the system is installed on-site.

After the initial training, we hope the operator to take place the required in house training for the other operator.



● Pre-operation check

In order to use the system safely, IMV recommends you to perform daily pre-operation check. (see ‘5.1 DAILY CHECK’.)

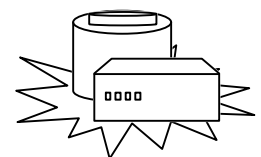
Also, the periodic check is recommended. Please contact IMV when you need the periodic maintenance check.



● Transportation of the system

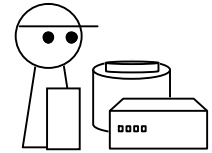
Please note that the vibration shaker and the power amplifier in this system are heavy. It should be moved by more than two person. You must not try to move or lift up the vibration shaker and / or the power amplifier alone. It may cause to injure you or an accident.

You must use suitable cart for the transportation.



● **Place**

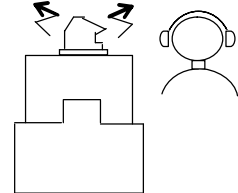
Main operation panels for vibration test system should be placed where the operator can see the vibration shaker and the power amplifier by eyes directly.



● **Acoustic noise**

Since this testing system generates high level acoustic noise during excitation, all the members on-site must use “Ear Protector” during testing.

IMV recommends “Acoustic Enclosure / Anti-acoustic Room” for this countermeasure.

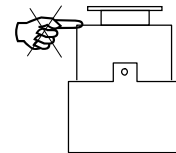


● **Mechanical**

Do not touch any vibrating part, such as the armature, specimen or fixture during excitation.

When the shaker is excited in low frequency (lower than 10 Hz), the shaker itself vibrates also. Please pay attention for vibrating part.

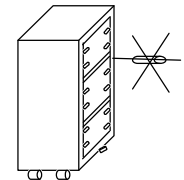
Also, please pay attention for treating the heavy items, such as excitation fixtures, specimens, the auxiliary H/V tables.



● **Electric**

Do not remove any cover in the power amplifier, Cabinet, Vibration Shaker and other units.

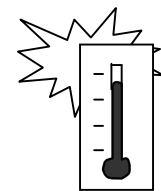
There is “High Voltage Terminal” inside cover and it causes serious personal injury by High Voltage/Current.



● **Heating**

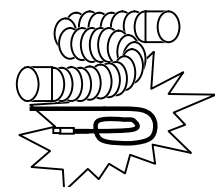
Do not remove any cover in the power amplifier, Cabinet, Vibration Shaker and other units.

Some parts of the system may be heated to high temperature during the operation.



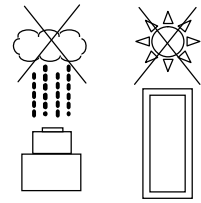
● **Cables and hoses**

You must pay attention for your steps when you walk across cables and/or hoses. Do not apply excessive force to the cables and hoses to prevent any damage.



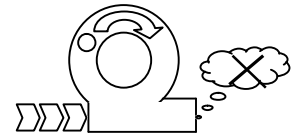
● **Water / Chemicals / Sunshine**

Keep away Vibration Shaker and other units from water and chemicals. Do not install the system where water or direct sunshine may affect to the system. There is “High Voltage Terminal” inside cover and it causes serious personal injury and mechanical breakdown by High Voltage/Current. Please call to IMV or our sales representative in your country if it happened.



● **Blower outlet (air-cooled vibrators)**

The air outlet from the cooling blower in air-cooled vibrator systems should be positioned such that an operator cannot stand directly in line with the airflow. This is a precaution to prevent injury in the event of small objects, e.g. nuts or screws becoming detached in the vibrator and ejected at high velocity from the blower. Keep away the things from the rotating parts.



● **Hydraulic equipments (hydraulic units)**

The oil must be removed immediately when you touch it at the maintenance.

Do not step the split oil on the floor. It may cause an accident by slipping.

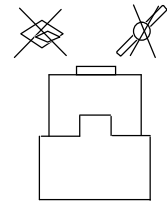
The oil must be washed off immediately.



● **Vibration shaker**

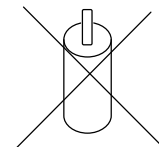
Note that the vibration shaker body has magnetism. You must keep the products, which is affected by magnetic field such as floppy disk or clock, away from the vibration shaker.

Please stand away from the system for safety, especially for a person who is using medical device such as a cardiac pacemaker.



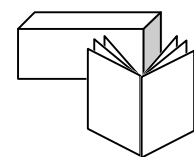
● **Explosion**

Do not make an environment of explosive gas, corrosive gas or inflammable gas around this testing system.



● **Equipment from other manufacturer**


The attached instruction manual of the equipment from other manufacturer must be read well before you start to use it.




2.2 WARNING LABELS

To use the system more safely and longer, IMV explains required items to prevent any accident, that may cause serious personal injury or that may cause some damage to the testing system as below.

 **WARNING** This is a precaution to prevent personal injury or damage to the system.

 **OBSERVANCE** This is a precaution to prevent personal serious injury or endangerment your life.

 **DANGER** This is a warning to prevent personal serious injury or endangerment your life.




● Warning Labels




The following warning labels are fitted on the required part in this testing system.

You must keep the labels clean, and must not cover it to prevent to show the warning message.



If you are aware of any peeled or dirty warning label, please inform IMV or our sales representative in your country.

1) Warning


 <p>WARNING ELECTRIC SHOCK To avoid electric shock, do not open. You will be struck by electric.</p> <p>PL-011E(1)</p>	<p>Dangerous high voltage 100V over is applied in the cabinet, and it may cause serious personal injury by high voltage electric shock.</p> <p>Do not remove any 'Safety Cover' or each front panel of the power amplifier.</p>
 <p>WARNING ROTATION OF TRUNNION Fix the TRUNNION LOCK BOLTS securely. VIBRATION SHAKER will be turned.</p> <p>PL-041E(1)</p>	<p>Tighten up Trunnion Lock Bolts firmly with the IMV's specified torque.</p> <p>If the bolt is loosen, the vibration shaker body may overturn during excitation and may cause serious personal injury, damage to the system or specimen.</p>
 <p>WARNING DANGER ZONE Do not touch. Take care of your body. You will be injured.</p> <p>PL-021E(1)</p>	<p>Do not catch your finger or cable during the excitation, rotation working of vibration shaker body, or handling of fixture.</p>

 <p>PL-031E(1)</p>	<p>WARNING</p> <p>OVER-TURNING Do not put on unstable position. Will be over-turned.</p>	<p>This system may overturn during transportation, or by earthquake. IMV recommends you to apply “Floor fixing” to the unit by using anchor bolts.</p>
 <p>PL-051E(1)</p>	<p>WARNING</p> <p>ROTATION Do not touch. Take care of your body. You will be injured.</p>	<p>Cooling blower and Cooling fan motors have rotational fin blades in it. Do not insert things or your finger into the rotating parts.</p>
 <p>PL-051E(1)</p>	<p>WARNING</p> <p>HIGH TEMPERATURE Do not touch. You will be burn.</p>	<p>The temperature around here becomes very high. Do not remove the panel and cover.</p>

2) Observance

 <p>PL-071E(1)</p>	<p>OBSERVANCE</p> <p>NOISE Noise generates. Use ear protector.</p>	<p>This testing system generates acoustic noise by excitation or running of Cooling blower, etc. Use 'Ear Protector' to prevent that the acoustic noise affects to your health.</p>
 <p>PL-081E(1)</p>	<p>OBSERVANCE</p> <p>VIBRATION Keep away during operation. Will be vibrating.</p>	<p>This testing system generates vibration. Be careful of accident due to dropping or flipping of specimen or fixture itself, or part of them, during excitation.</p>

3) Danger

 <p>PL-091E(1)</p>	<p>WARNING</p> <p>Do not touch the JOINT when turning VIBRATION SHAKER. Your finger may be caught in.</p>	<p>Your hand or finger may be caught in. Never turn vibrator with holding joint when horizontal slip table is connected.</p>
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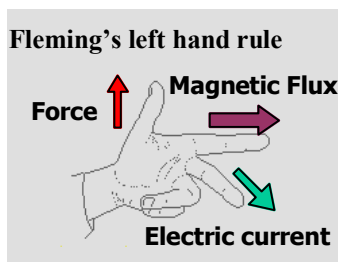
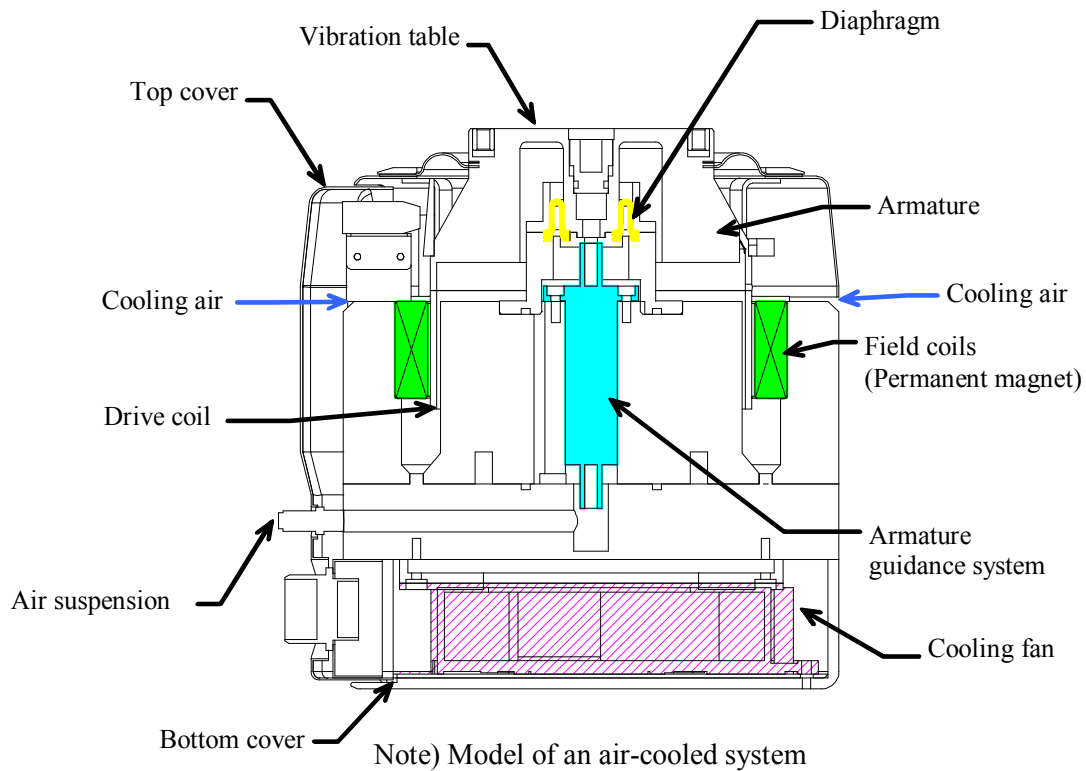
3. OUTLINE OF THE SYSTEM

In this chapter, the details of equipments composing the system are described.

3.1 PRINCIPLE

The operation of the Electro-dynamic Vibration Test System is the same as that of an audio speaker and “Fleming’s left hand rule” is applied. When electric current flows through the wire across a magnetic flux (magnetic field), the force is generated toward the rectangular direction from the wire as shown below. The force (rated force) vibrates the armature table in the Electro-dynamic vibration test systems.

The electro-dynamic vibration shaker generates its rated force by the flow of an electric AC signal through the Drive Coil that is located in a strong magnetic flux generated by “Permanent magnet” or “Field coil” as shown below.



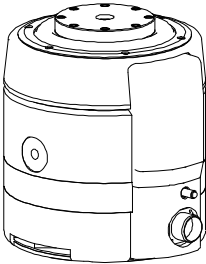
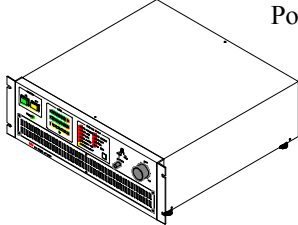
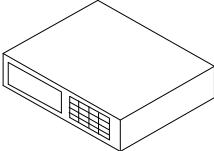
3.2 COMPOSITION AND SPECIFICATION OF THE SYSTEM

The composition and specification of purchased system is explained. Please check the content and confirm the detailed composition mentioned in “Acceptance Specifications”.

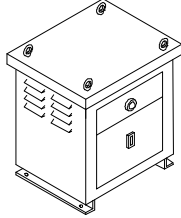
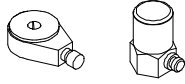
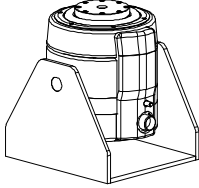
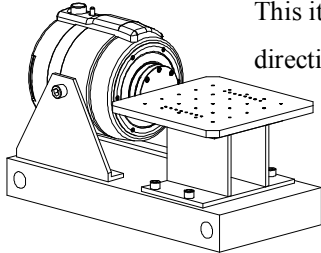
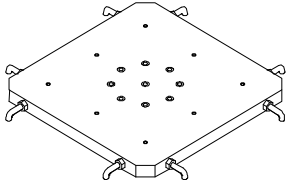
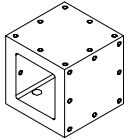
The system is composed of the following units.

Please refer to “3.2 COMPOSITION AND SPECIFICATION OF THE SYSTEM” about the detailed composing units of each system that you purchased.

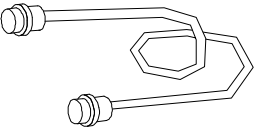
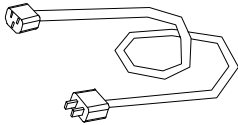
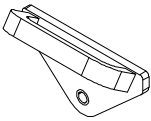




● Main composition




System model	m030/MA1	m060/MA1
<p data-bbox="177 689 376 719">Vibration shaker</p>  <p data-bbox="435 741 1007 1055">The operation principal of Vibration Test System is as same as that of an audio speaker and “Fleming’s left hand rule” is applied. The vibration shaker generates its force by the flow of an electric AC signal through the Drive Coil that is located in a strong magnetic flux generated by “Permanent magnet” or “Field coil”.</p>	<p data-bbox="1082 860 1161 936">1 (m030)</p>	<p data-bbox="1251 860 1331 936">1 (m060)</p>
<p data-bbox="177 1122 368 1151">Power amplifier</p>  <p data-bbox="451 1173 999 1202">Power amplifier is for driving the vibration shaker.</p>	<p data-bbox="1082 1234 1161 1310">1 (MA1)</p>	<p data-bbox="1251 1234 1331 1310">1 (MA1)</p>
<p data-bbox="177 1435 491 1512">Vibration controller (Vibration control system)</p>  <p data-bbox="435 1585 991 1662">Test condition definition / control / data acquisition and analysis are operated in various vibration tests.</p>	<p data-bbox="1123 1563 1318 1639">Refer Acceptance specifications.</p>	

● Option



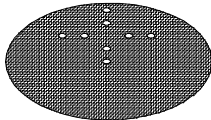
System model		m030/MA1	m060/MA1
<p>Down transformer</p>  <p>This item is for transforming the power voltage other than 200V (such as 380V, 400V) to 200V. Especially, it is used in electric power environment of foreign countries.</p>		Refer Acceptance specifications.	
<p>Accelerometer</p>  <p>This item is used as a sensor for control at vibration testing and monitoring the specimen.</p>		Refer Acceptance specifications.	
<p>Column base</p>  <p>It is the base for fixing the vibration shaker. This item is used for fixing the vibration shaker in horizontal direction.</p>		Refer Acceptance specifications..	
<p>Horizontal auxiliary table</p>  <p>This item is used for testing operation in horizontal direction.</p>		Refer Acceptance specifications.	
<p>Head expander</p>  <p>This item is used for testing operation in vertical direction. It is mounted on the vibration table.</p>		Refer Acceptance specifications.	
<p>Fixture</p>  <p>IMV recommends various types of fixtures according to the test conditions. Cube and L shaped fixtures are popularly used.</p>		Refer Acceptance specifications.	

● Accessories

names	m030/MA1	m060/MA1
<p>Drive cable</p>  <p>(Power amplifier to Vibration shaker) For supplying the AC power current to drive coil. [Including displacement signal cable and cooling fan cable]</p>	1	1
<p>Power supply cable</p>  <p>(Power amplifier to Power supply) For connecting with main power supply.</p>	1	1
<p>Handle</p>  <p>This item is used for moving the vibration shaker. It is removed before testing operation.</p>	1	1
<p>Cap for the handle attaching socket hole</p>  <p>This cap is put on the attaching socket hole while the handle is not attached.</p>	1 set	1 set
<p>L wrench (B=5mm)</p>  <p>This item is for screwing the bolts at setting a vibration shaker.</p>	1	1
<p>Pickup adapter</p>  <p>This item is for attaching a pickup.</p>	1	1
<p>Conversion table</p>  <p>The table for calculating the required value from other two values among Acceleration / Velocity / Displacement.</p> <p>See “6.3 CONVERSION TABLE”.</p>	2	2

System parts		m030/MA1	m060/MA1
Wedge scale seal 	The scale for checking accelerometer sensitivity. See “ 6.2 SENSITIVITY CHECK FOR ACCELEROMETER ”.	2	2
Instruction manual 	Please keep this manual at hand during the operation.	2	2
Factory test data 	The data showing the system have passed the performance check at the shipping from the factory.	2	2

● Spare parts

System parts		m030/MA1	m060/MA1
Alarm fuse (10A、5A) 	Used in the power amplifier.	each 2	each 2
Lead wire 	Used in vibration shaker The cable for supplying the power to vibration table.	1 set	1 set
Dust rubber 	Used for vibration shaker. This item prevents water dew and dust coming into the shaker.	1	1

● Specification

	m030/MA1	m060/MA1
Rated Force		
<ul style="list-style-type: none"> • Sine Wave • Random Wave • Shock Wave 	300 N 210 N rms 300 N peak	600 N 420 N rms 600 N peak
Maximum Acceleration	500 m/s ²	500 m/s ²
Maximum Velocity	1.6 m/s	1.6 m/s
Maximum Displacement	26 mmp-p	30 mmp-p
Armature Mass	5~3 000 Hz	5~3 000 Hz
Frequency Range	0.6 kg	1.2 kg
Maximum Payload	15 kg	15 kg
Table dimensions	φ 114 mm	φ 114 mm
Ambient Condition		
<ul style="list-style-type: none"> • Temperature • Humidity 	0~40 °C 0~85 %RH (No dew condensation)	0~40 °C 0~85 %RH (No dew condensation)
Power Supply	1 φ AC 100/200 V±10 % 50/60 Hz 0.4 kVA	1 φ AC 100/200 V±10 % 50/60 Hz 0.7 kVA
Painted Color	IMV STANDARD COLOR	
<ul style="list-style-type: none"> • Upright Cabinet • Vibration Shaker 	Munsell 4GY 8.5/0.3 Munsell 4GY 8.5/0.3、Munsell 4.3 PB2.6 /2.1	
Protective device	Safety circuit for over-current and over-voltage	

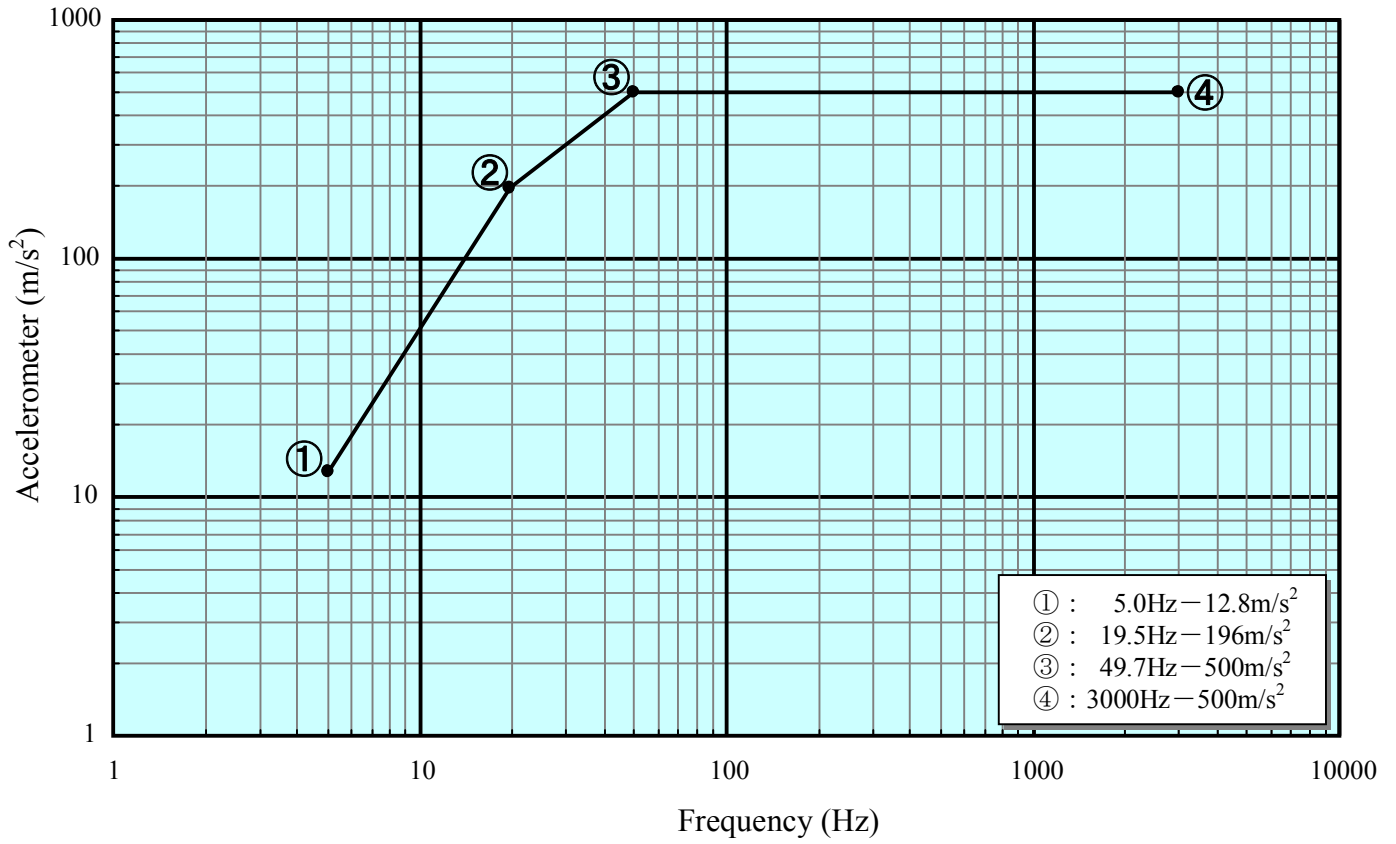
《Special Specification》

- ISO 5344 RATED RANDOM FORCE BROAD BAND.

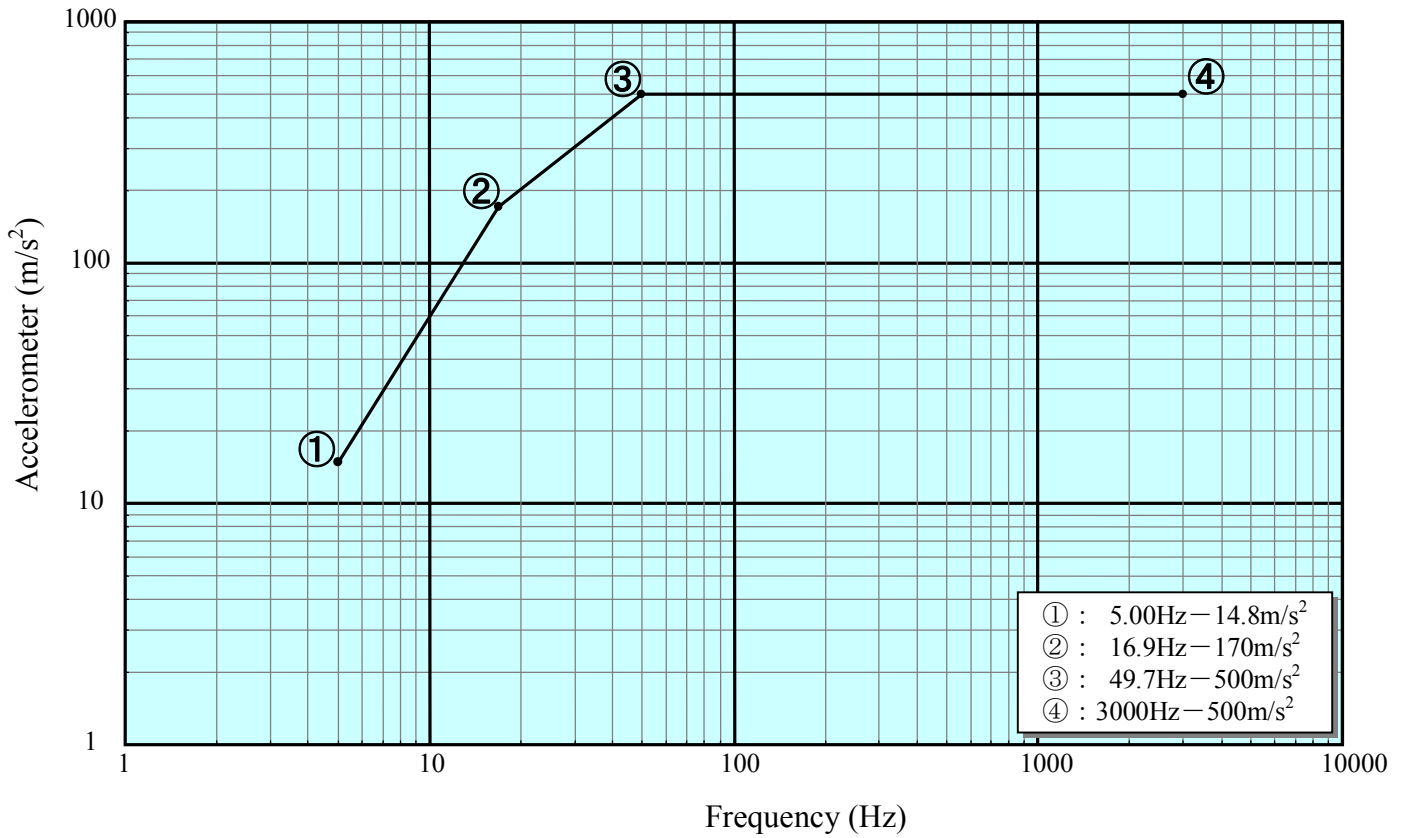
Electro-dynamic test equipment for generating vibration methods of describing equipment characteristics

● Maximum Performance Curve

< m030/MA1 >



< m060/MA1 >



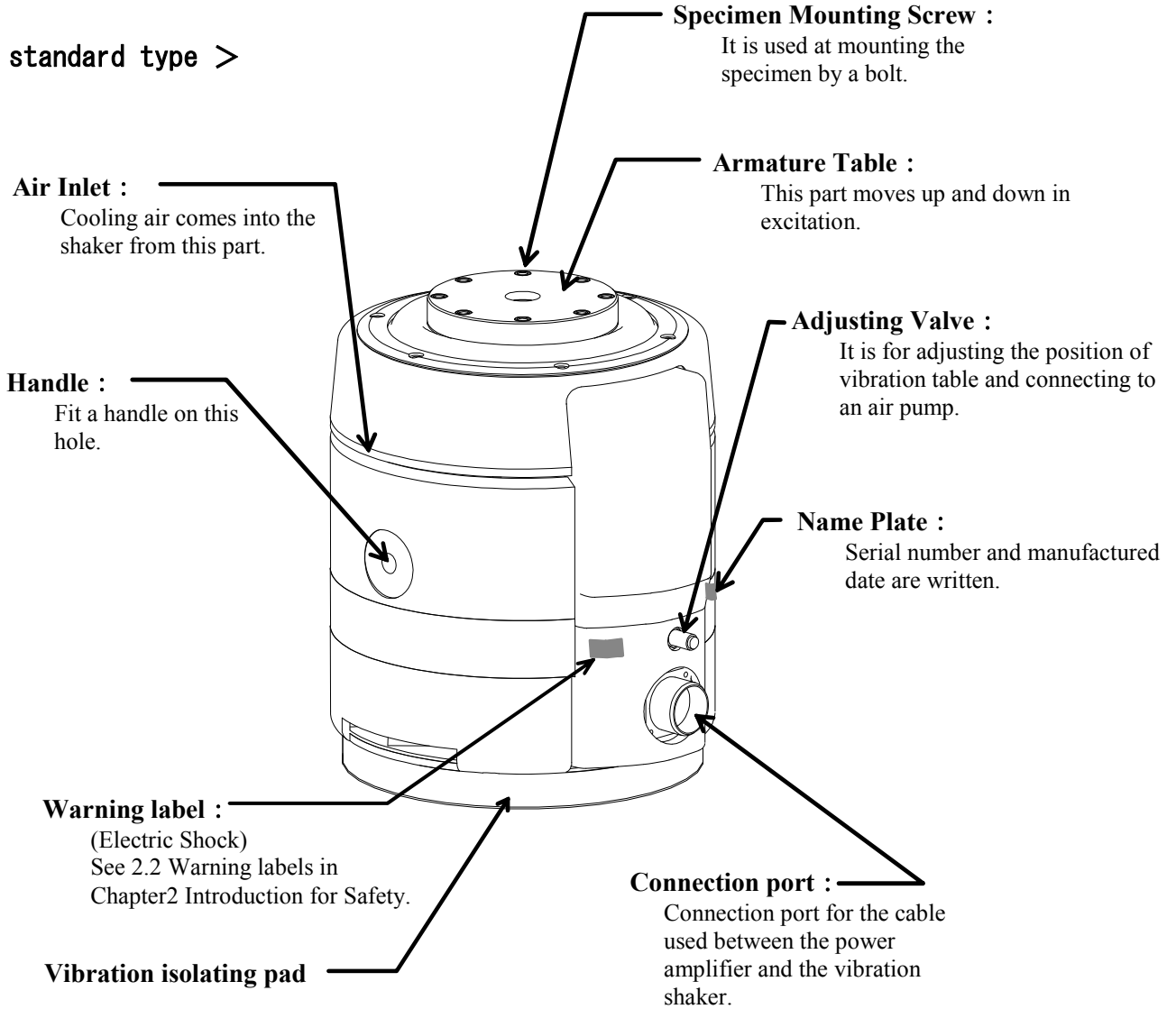
3.3 NAME OF PARTS

In this chapter, typical models are illustrated.

Refer to the equipment that you purchased if the appearance is slightly different.

● Vibration Shaker

< standard type >

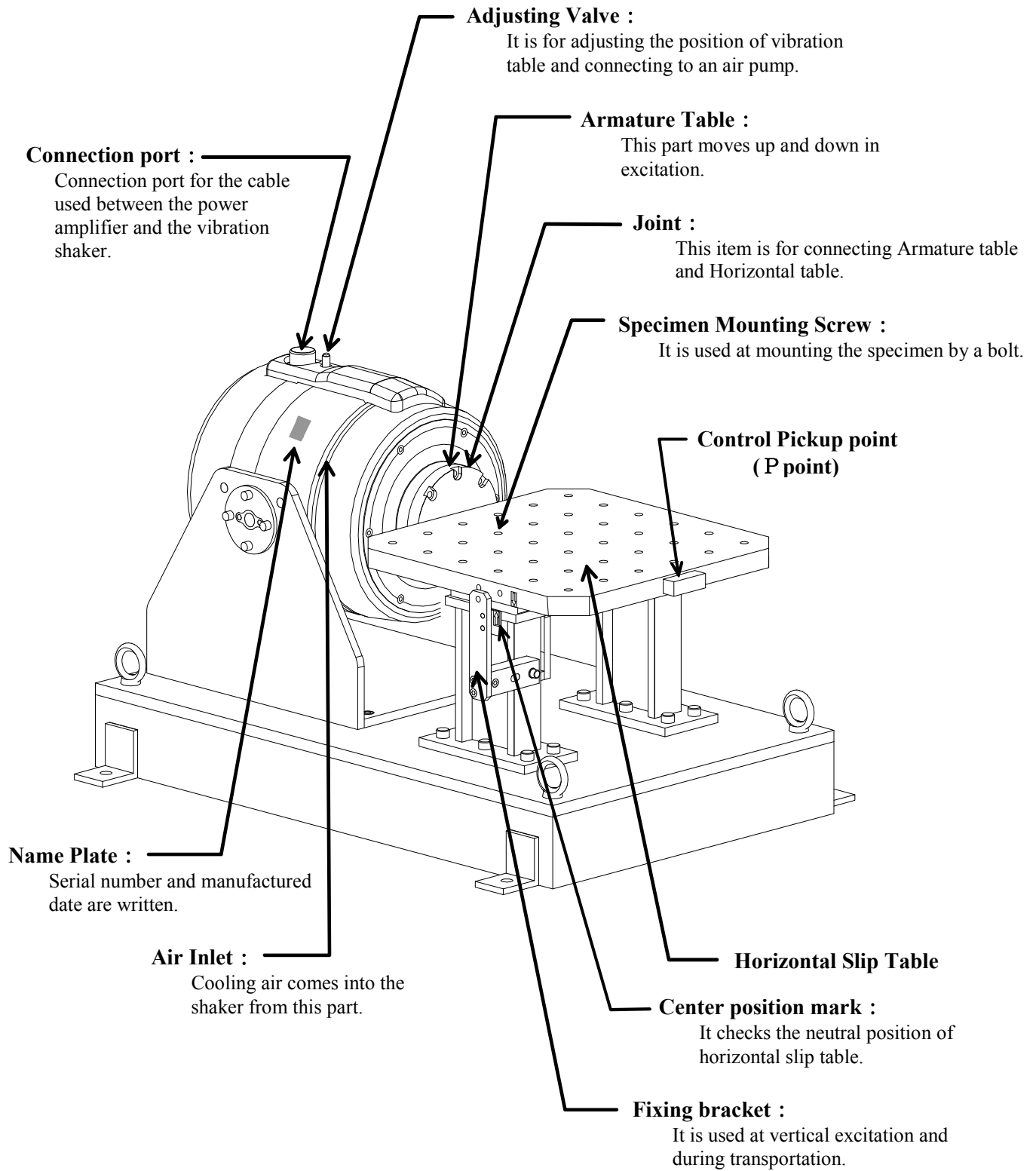


CAUTION : Knock vibration

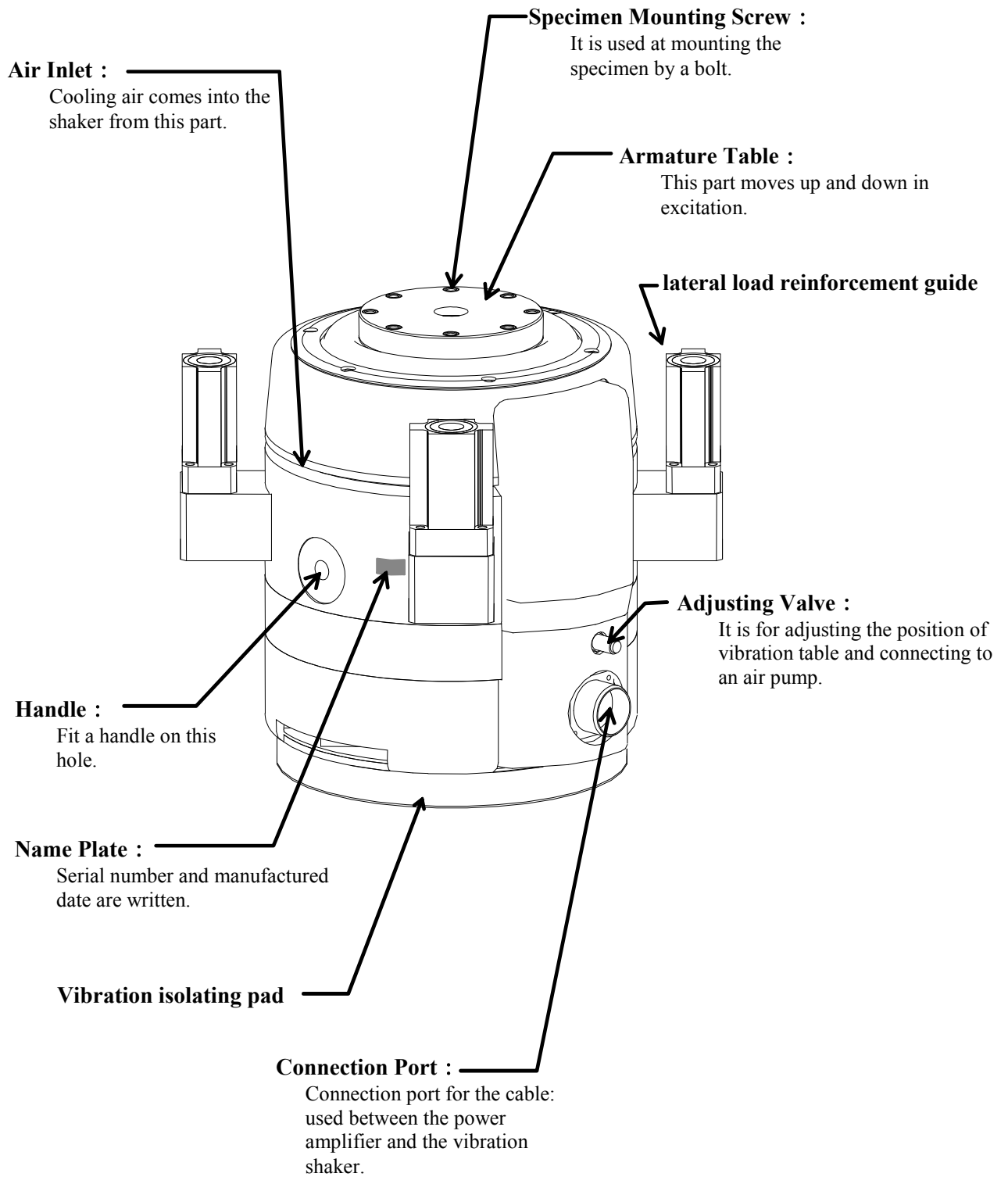
Accessory (or built-in type) vibration isolation pad is fixed by adhering to the floor. If some foreign objects, such as dirt and dust, stick to the bottom of the vibration isolation pad, it may cause the unwilling knock vibration of the shaker in operation. The installation site of the vibration shaker must be cleaned up the dust. Also the bottom of the isolation pad must be kept clean by wiping with a wet soft cloth when any dirt retention is found.

The condition of installation site, the excitation condition and the environment condition might influence the vibration operation. In this case, IMV recommends that the vibration isolation base of option products is used for reducing the knock vibration.

<horizontal auxiliary table type>



< lateral load reinforcement guide type >



< column base type >

Specimen Mounting Screw :

It is used at mounting the specimen by a bolt.

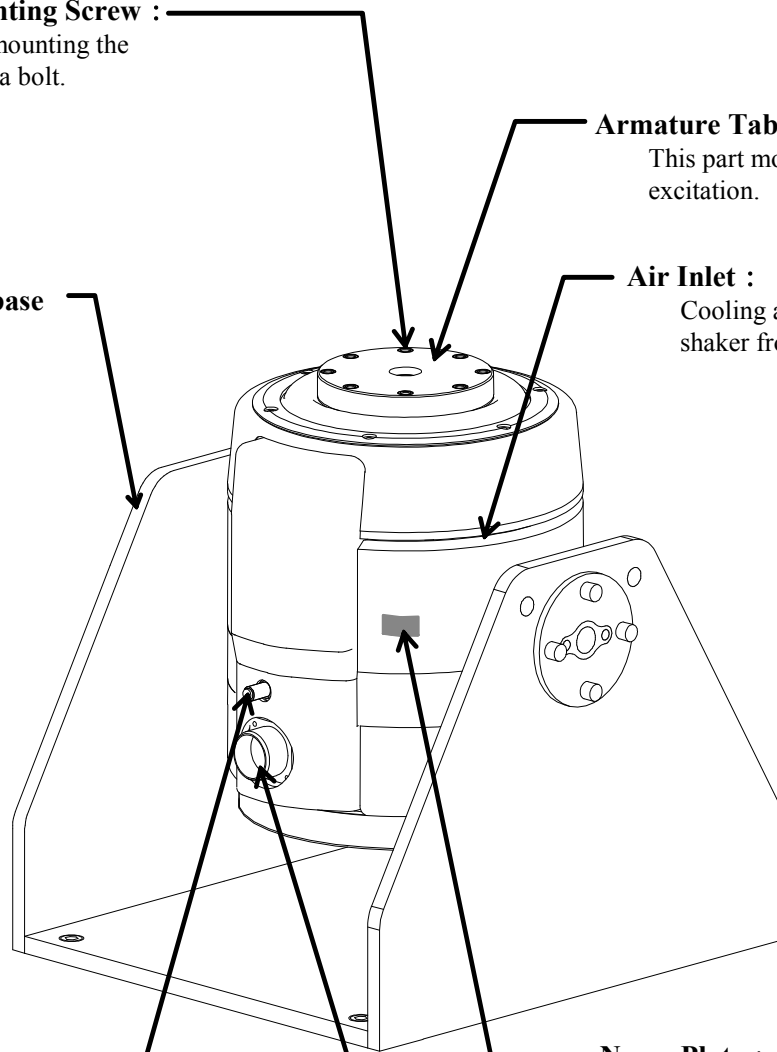
Armature Table :

This part moves up and down in excitation.

Air Inlet :

Cooling air comes into the shaker from this part.

Column base



Name Plate :

Serial number and manufactured date are written.

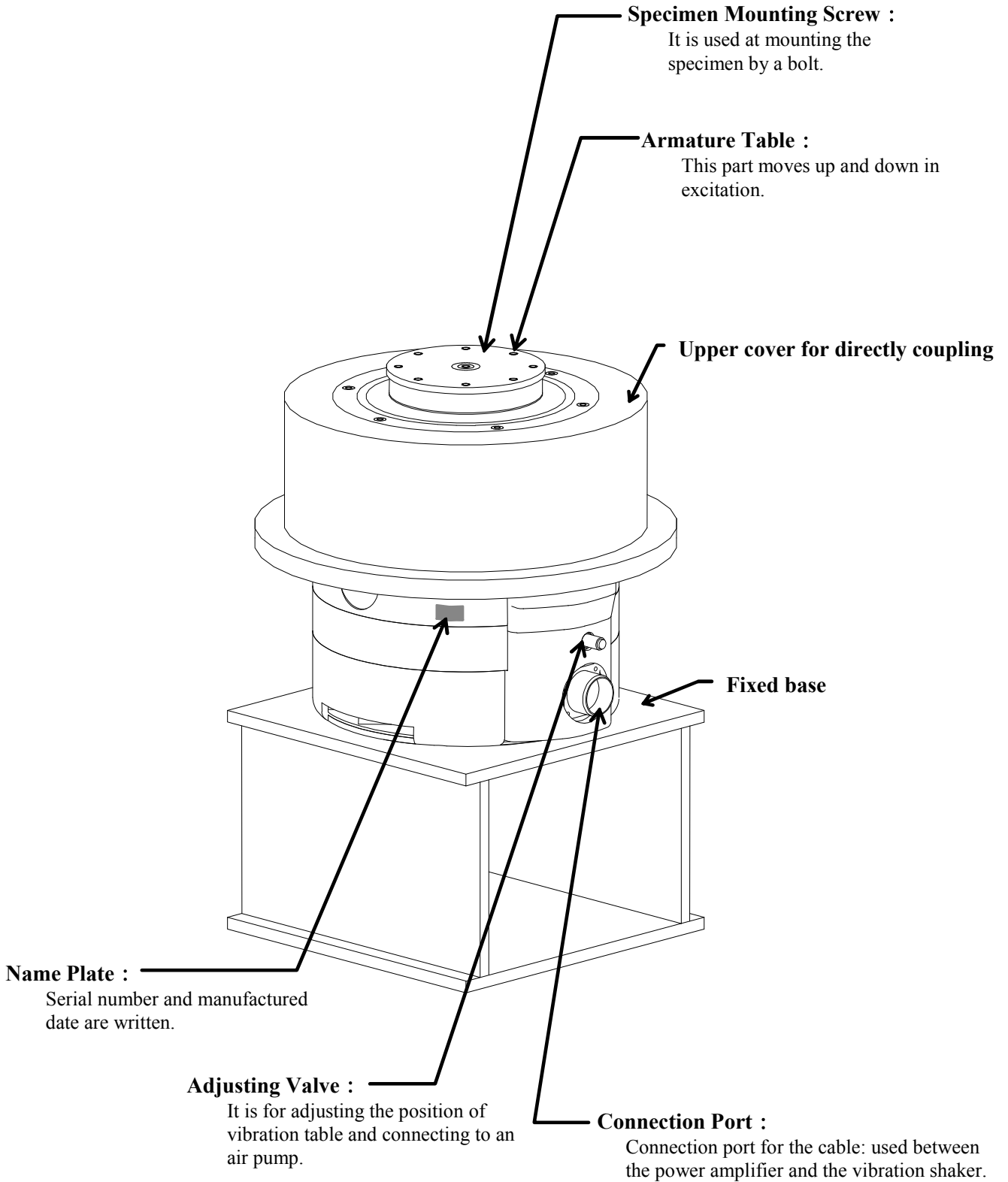
Adjusting Valve :

It is for adjusting the position of vibration table and connecting to an air pump.

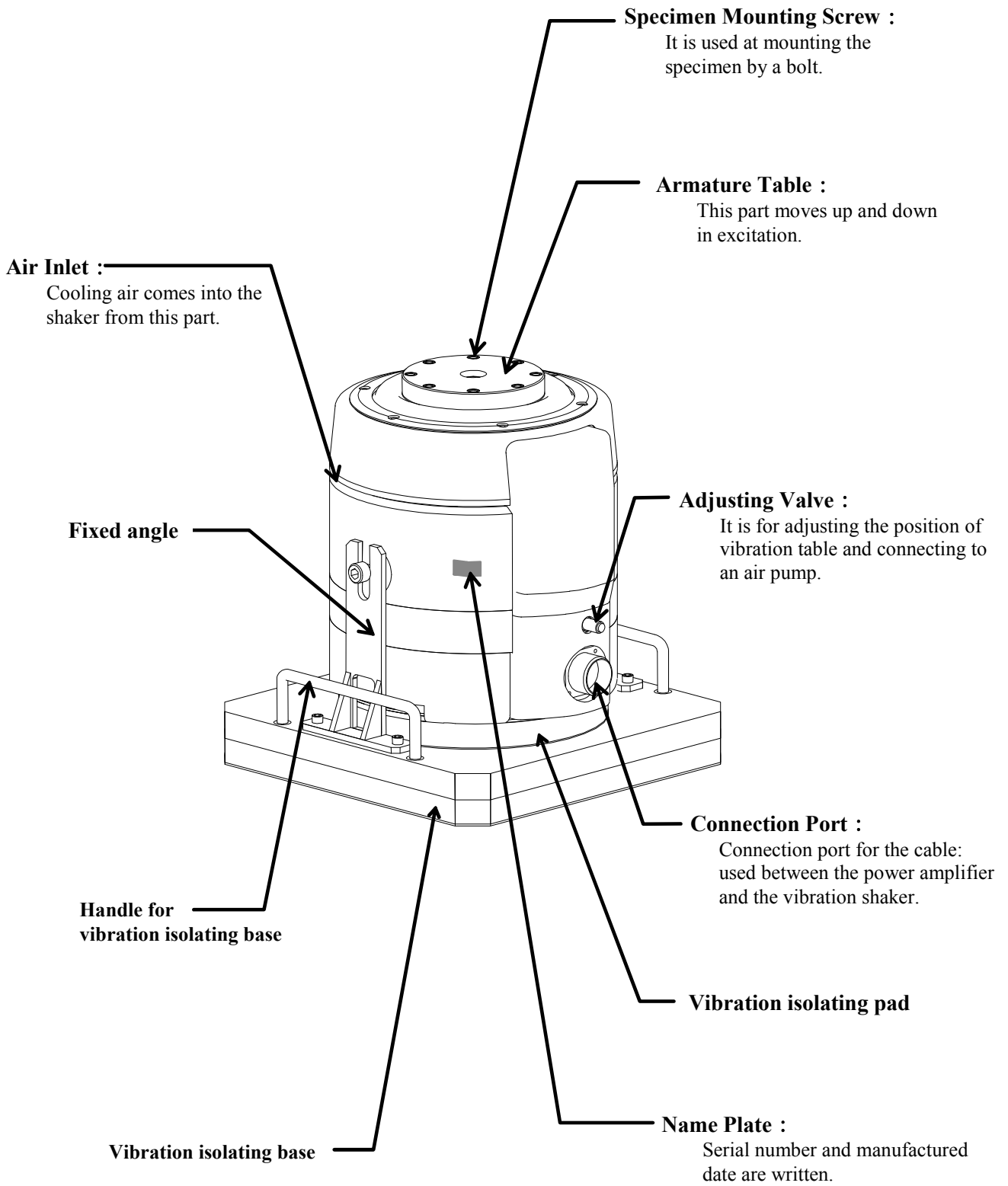
Connection Port :

Connection port for the cable: used between the power amplifier and the vibration shaker.

< directly coupling type, fixed base type >

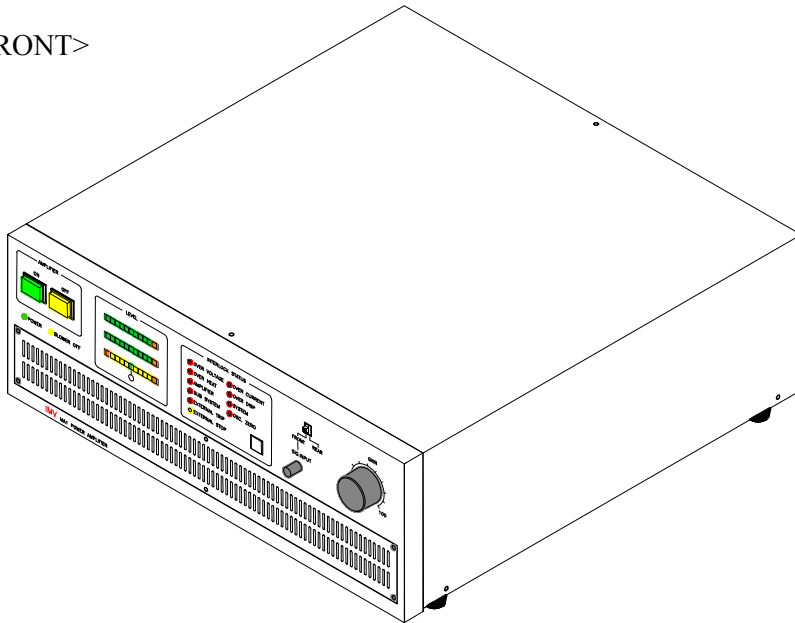


< vibration isolating base type >

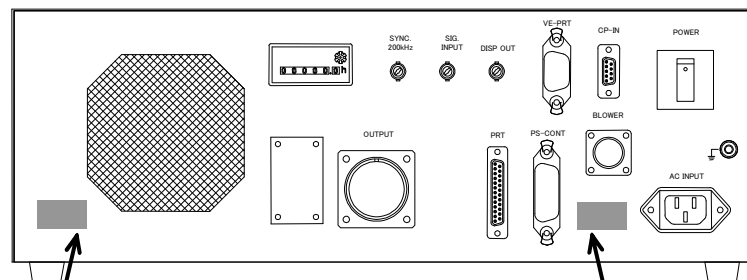


• Power Amplifier

<FRONT>



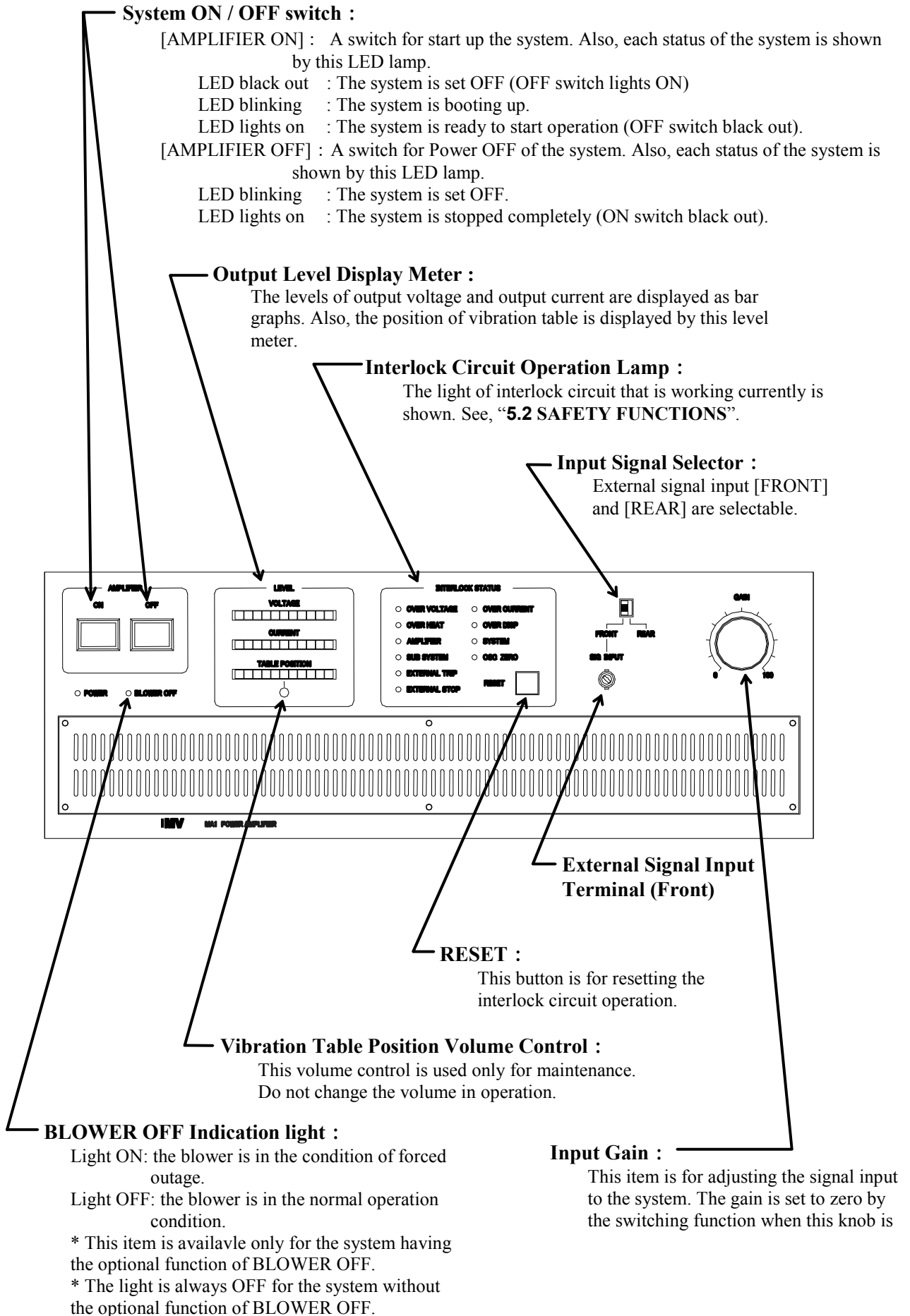
<REAR>



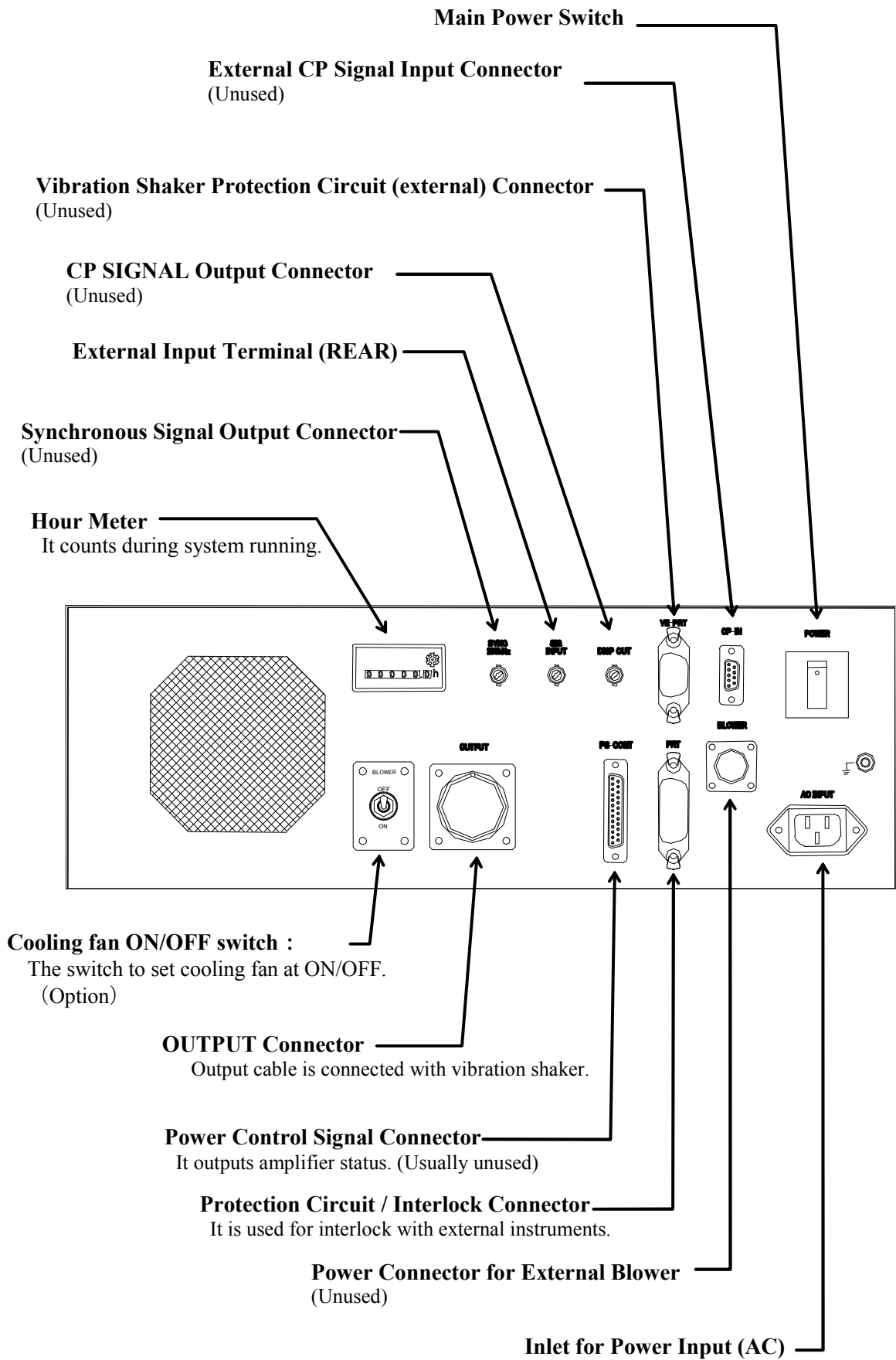
Name Plate :
Serial number and manufactured date are written.

Warning label :
(Electric Shock)
See 2.2 Warning labels in Chapter2 Introduction for Safety.

<FRONT PANEL>



<REAR PANEL>



※CP (CENTER POSITIONER) : It keeps the table position of vibration shaker at neutral position electrically.

• **External Input/Output Part**

Connector for Protective circuit·Interlock

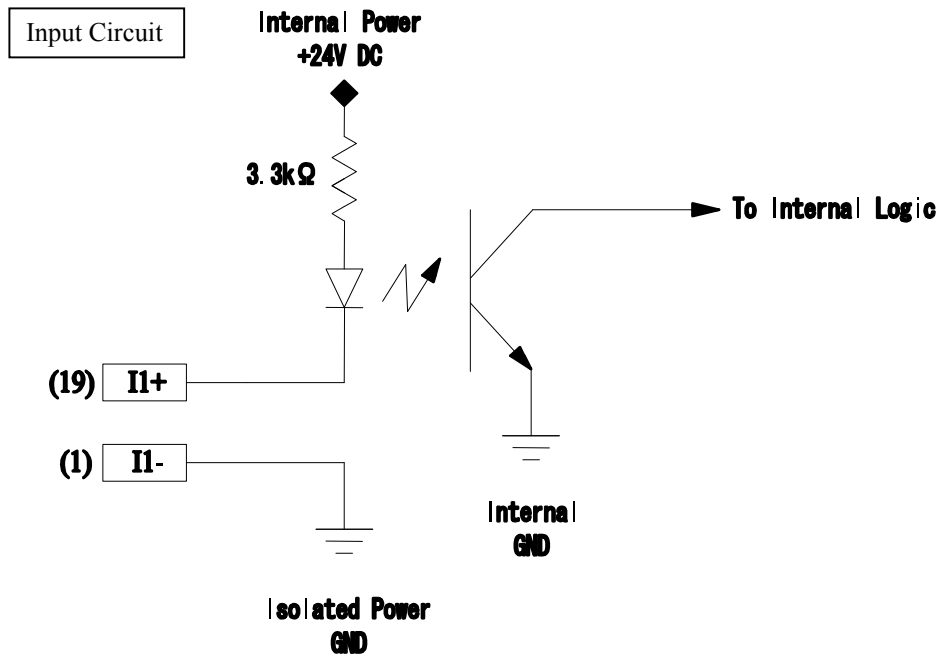
Connector : 36-pole ribbon connector (female) Used part : DDK 57-40360

Input : Isolated input by photo coupler

Input current : 7mA

With 24V power supply

Output : Nil



<Signal specification (Input)>

Pin No	Name	Function
1, 19	FS FUSE	'SYSTEM' lamp turns on and 'AMPLIFIER' turns OFF.
2, 20	TH	'OVERT HEAT' lamp turns on and 'AMPLIFIER' turns OFF.
3, 21	POWER ON	'AMPLIFIER' turns ON.
4, 22	POWER OFF	'AMPLIFIER' turns OFF.
5, 23	RESET	Protective circuit is reset.
6, 24	TIME UP	'AMPLIFIER' turns OFF.
7, 25	OTHER1	'SUBSYSTEM' lamp turns on and 'AMPLIFIER' turns OFF.
8, 26	OTHER2	'SUBSYSTEM' lamp turns on and 'AMPLIFIER' turns OFF.
9, 27	EXT. STOP	'EXTERNAL STOP' lamp turns on and 'AMPLIFIER' turns OFF.
10, 28	CP ON	CP (CENTER POSITIONER) turns ON.
11, 29	CP OFF	CP (CENTER POSITIONER) turns OFF.
12, 30	RESERVE1	Auxiliary. 'SYSTEM' lamp turns on and 'AMPLIFIER' turns OFF.
13, 31	RESERVE2	Auxiliary. 'SYSTEM' lamp turns on and 'AMPLIFIER' turns OFF.
14, 32	RESERVE3	Auxiliary. 'SYSTEM' lamp turns on and 'AMPLIFIER' turns OFF.
15, 33	-	Unused.
16, 34	-	Unused.
17, 35	-	Unused.
18, 36	-	Unused.

4. OPERATION PROCEDURE

This chapter describes the concrete procedures of preparation, operation, operation stop and the notice.

4.1 PREPARATION

4.1.1 Environment

Environment conditions concerning to the vibration system are needed to be prepared as below.

<Power supply>

The required main power supply is 1 ϕ 100/220 VAC \pm 10 % 50/60 Hz 0.4 kVA.

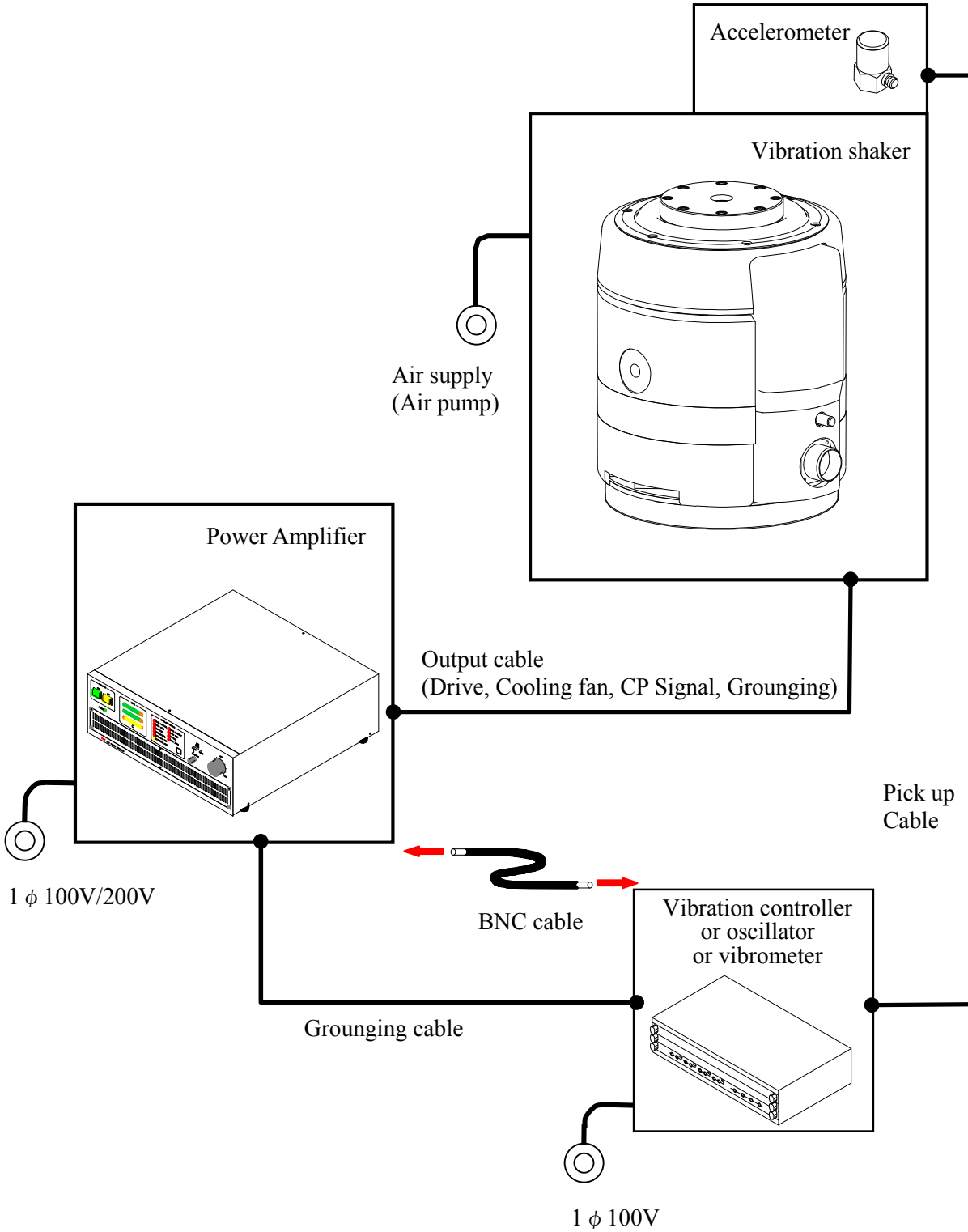
The power supply for the personal computer is also required separately.

<Installation Place>

- (1) The system must be placed in the temperature within 0 ~ 40 °C.
- (2) Keep the installation place away from dust and high humidity.
- (3) For smooth installation, the size and the weight of equipment must be checked in advance.
- (4) The vibration is needed to be avoided by Vibration-isolation Pad for reducing the bad influence to the other equipment when Vibration Shaker is placed with the controller or the other measurement equipment together.

4.1.2 Wiring and Piping

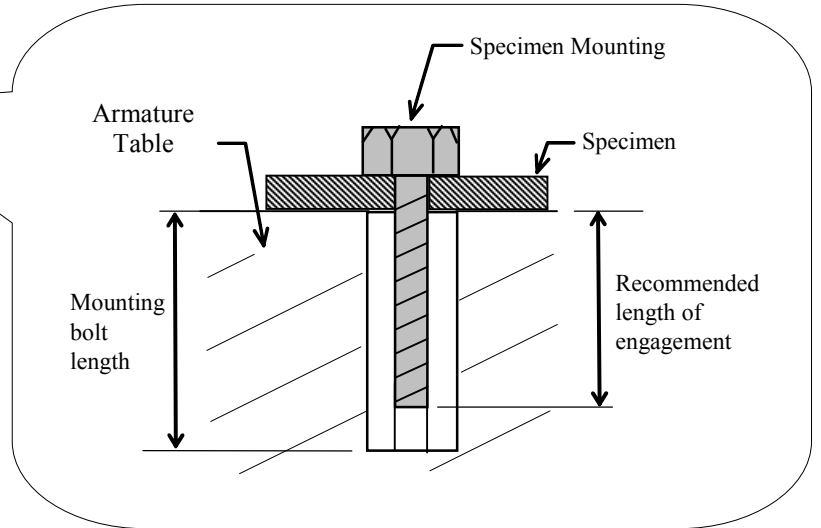
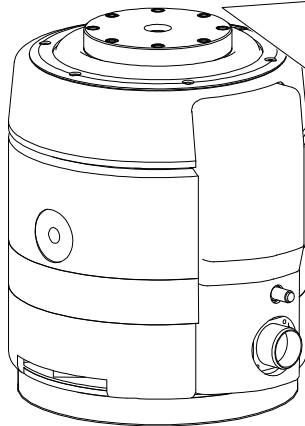
This connection model is for the vibration system of IMV. Refer to each instruction manual when the other equipment is connected. Please check the system that is connected correctly.



4.1.3 Fitting of Fixture and Specimen

Mount your fixture and specimen to the armature table keeping the center of gravity (c.o.g) of them on the vertical center line of armature. When you intend to attach them with some eccentric deviation, the attachment method shall be limited by the rated “Allowable Overturning Moment” value. Refer to “4.4 REMARKS”.

<Fitting with bolts>



(1) Effective screw length of specimen mounting screw bolt should be longer than the recommended length of engagement with specimen fitting. However, when a too long screw is used, enough fixing cannot be done. In case of shorter screw used, specimen mounting screw bush may be broken or specimen may fall off during excitation.

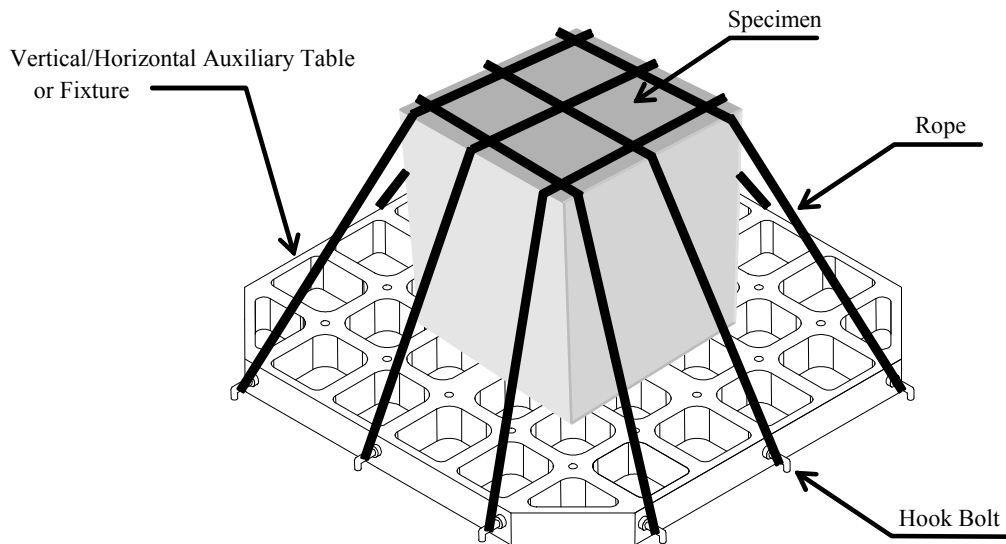
Vibration Shaker Model	Specimen Mounting Screw Bush		Mounting Screw Bush
	Size [mm]	Length [mm]	Recommended length of engagement [mm]
m030,m060	M6	10	Longer than 9

(2) The screwing torque of mounting bolt depends on the material of specimen surface fixed by bolt. Refer to “6. SUPPLEMENT, 6.1 SCREWING TORQUE”.

<Fitting with rope>

- (1) Hook bolts are provided on vertical/horizontal auxiliary tables and other fixtures. These hook bolts are usable to fix the specimen by rope.

The shearing force applied to hook bolt is 78 N(8 kgf) at the maximum. Be careful not to load more force over the maximum.



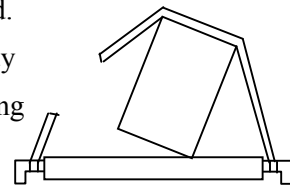
- (2) In testing over 500Hz, the hook bolts should be taken off.

Or, the specimen may be influenced by the partial resonance caused by hook bolts.



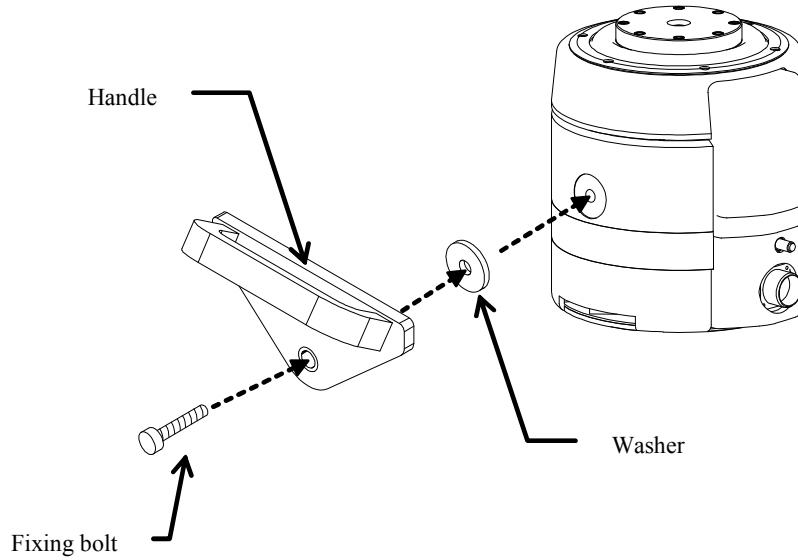
CAUTION

If the shearing force over than 78N (8kgf) is applied, a vertical/horizontal auxiliary table will be deformed and damaged. So, a proper testing may be impossible to execute. Specimen may be scattered and fallen off due to the damage of hook bolts. Fixing by rope, a specimen may be scattered or fallen off due to the looseness of rope and slip of specimen.

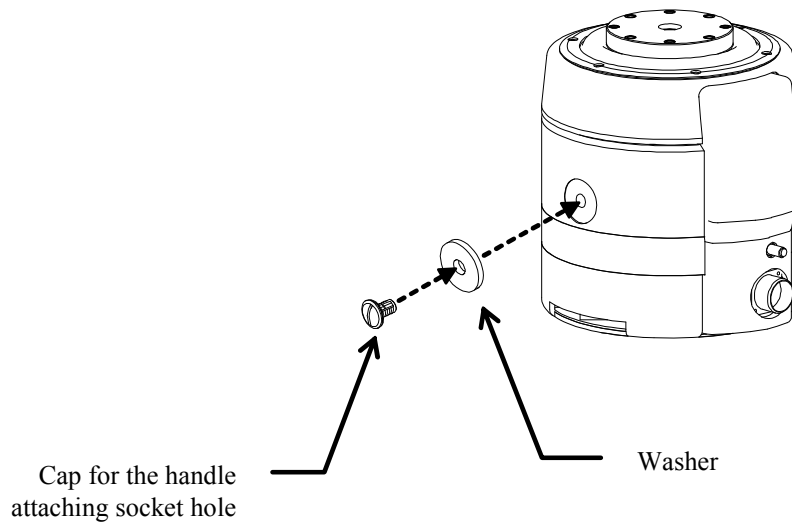


4.1.4 Handle and Cap for the handle attaching socket hole

- (1) The dedicated handle is used by attaching to the vibration shaker when you carry the vibration shaker.



- (2) After moving the vibration shaker. Remove the handle and attach the cap to the handle attaching socket hole.



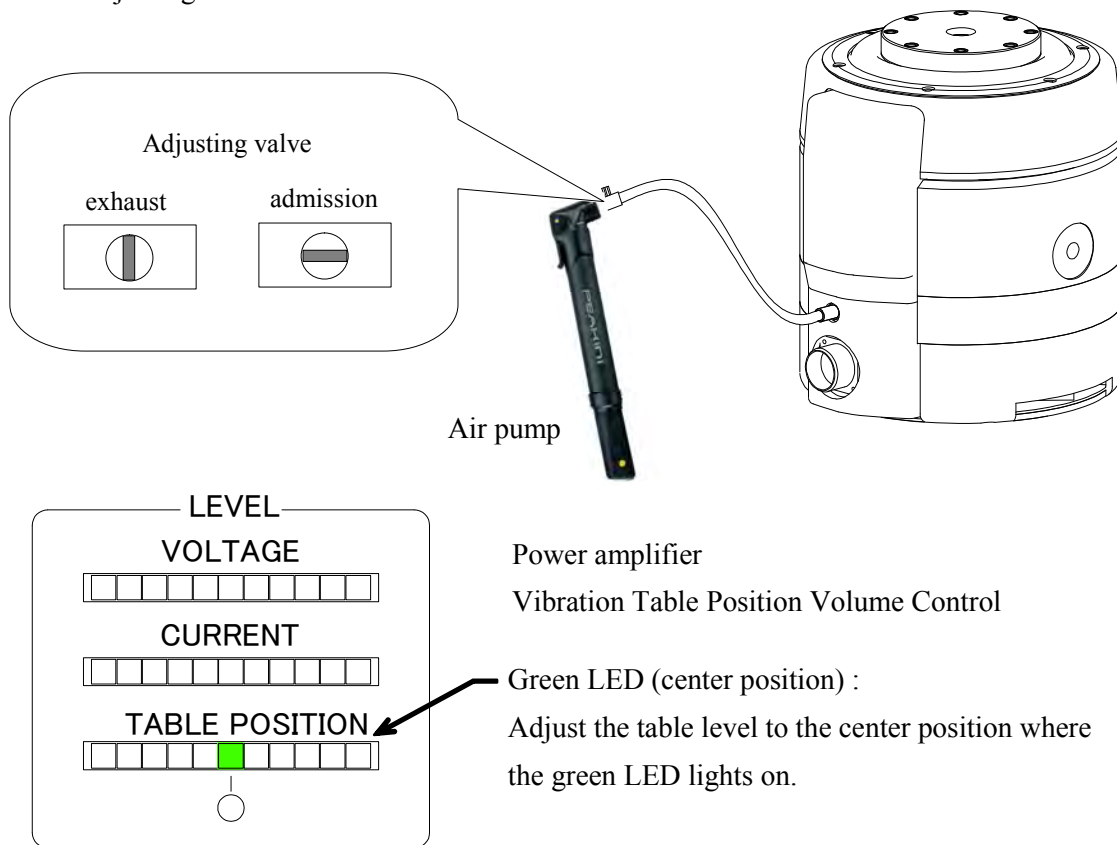
4.1.5 Adjusting of Armature's Center Position

■ When Neutralizer (Option) is not attached

This system has the air pump to adjust the armature table position instead of a neutralizer which is not used for this system. After attaching of specimen, let the air in or out by using the air pump from the adjusting valve to make the level of table position meter comes to at the center position.

Be sure to remove the air pump after finishing the operation of table position adjusting.

Notice) The air can be removed by turning the adjusting valve of air pump when too much air is pumped up. The armature table will sink down suddenly if the air is removed too quickly with mounting the specimen on it. Please be careful when you remove the air from the adjusting valve.



■ When Neutralizer (Option) is attached

Neutralizer performs the adjustment automatically.



CAUTION

Air source is necessary to use Neutralizer.

Set the air source valve at "Open" to enter the air into the system.

When air compressor is used, check that the air compressor provides the air of the rated pressure.

! CAUTION

Excitation fixtures and specimen have to be mounted on or removed from the armature table when power of amplifier is turned OFF.

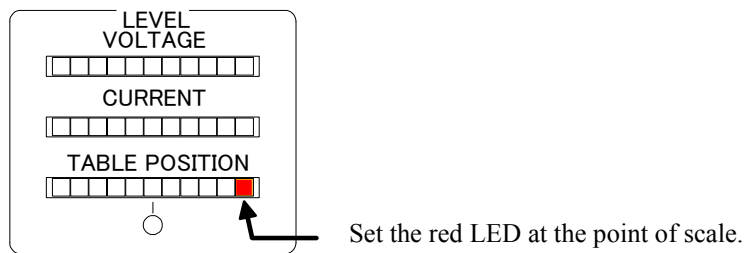
! CAUTION

If the excitation operation is executed without air filled, the vibration shaker may be damaged.

! CAUTION : Excitation with no-load or approximate condition

Abnormal sound may be generated when the shaker is excited with no-load or its approximate condition with loading, specimen + fixture < 0.5kg. It is because the air pressure that acts as loading at the maximum amplitude to the upward.

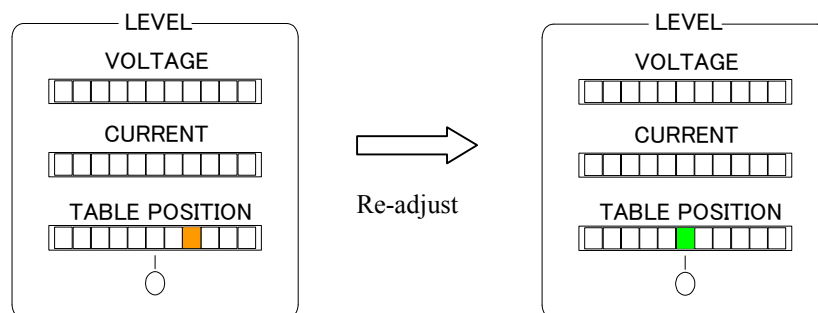
Abnormal noise will be nil if the air is admitted to the maximum scale (red LED lighting) from the scale at "TABLE POSITION".



! CAUTION : Over heating of excitation shaker caused by continuous excitation

Continuous excitation operation may cause the over heating of excitation shaker. It also makes the armature table position higher at [AMPLIFIER-OFF]. The air in the shaker that expanded with heat is pushing up the table.

In this case, do not operate the excitation continuously. It may cause the over voltage. Stop the system and re-adjust the air pressure.



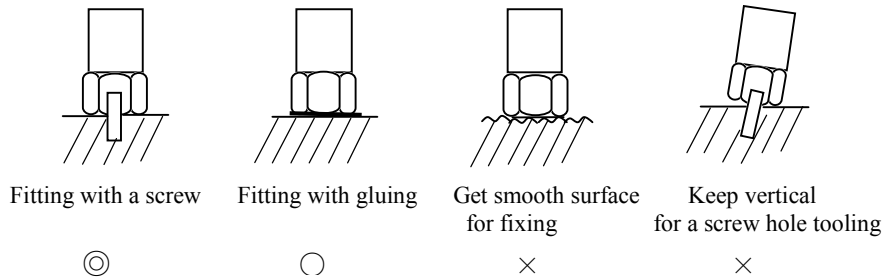
After the continuous excitation (over heat)

After the re-adjustment of table position

4.1.6 Fitting of Accelerometer

(1) Fixing

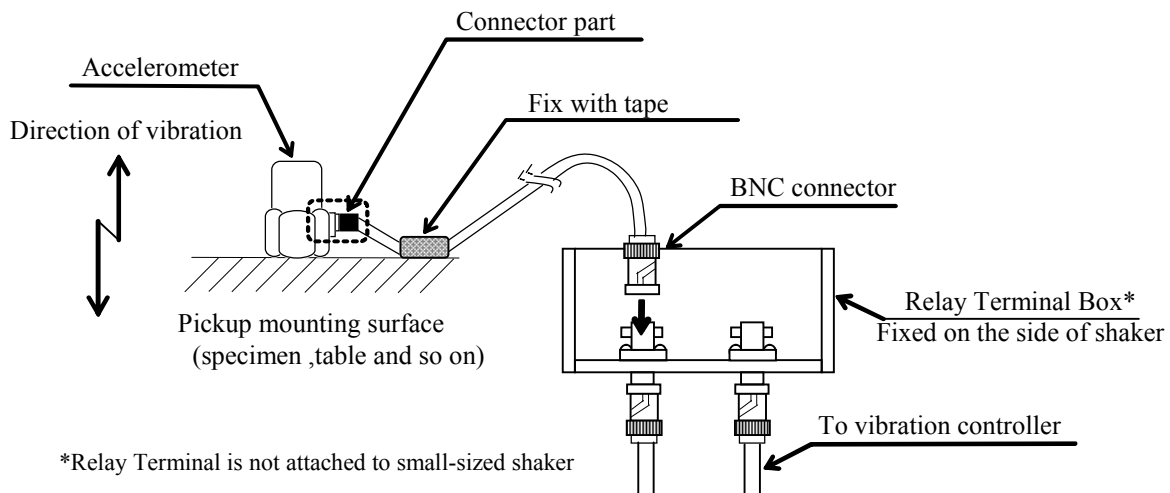
Attach the accelerometer to the control point firmly referring to the following figures. Refer to “**6. SUPPLEMENT, 6.1 SCREWING TORQUE**” about suitable fastening torque value in case of fixing with a screw.



(2) Fixing of pick-up cable

Low noise cable is used for the pick-up cable. Do not bend it hard, or do not give any hard tension for it. Too big vibration of pick-up cable during excitation may break the cable.

You must fix the cable especially near around the connector of accelerometer with adhesive cloth tape or sealing tape.



(3) Waterproofing for Accelerometer

When Accelerometer has any possibility of “water soak” in a combined (climatic and vibration) testing, it must be waterproof around the connector by using Silicon Sealing Agent.

(4) Removing

Remove the accelerometer with a wrench not to give any unacceptable shock or force to casing of Accelerometer.

(5) Setting of Input Sensitivity

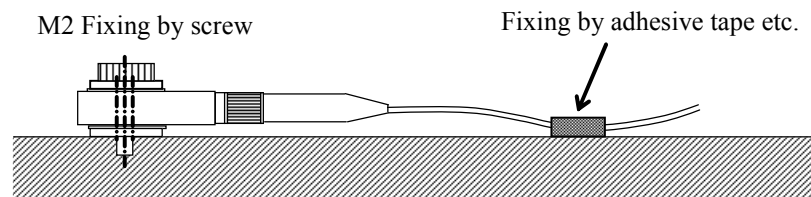
Accelerometer has its own sensitivity individually. You should set 'Input Sensitivity' for using Accelerometer at the input channel of Vibration Controller or Charge Amplifier.

Refer to "6. SUPPLEMENT, 6.2 SENSITIVITY CHECK FOR ACCELEROMETER".

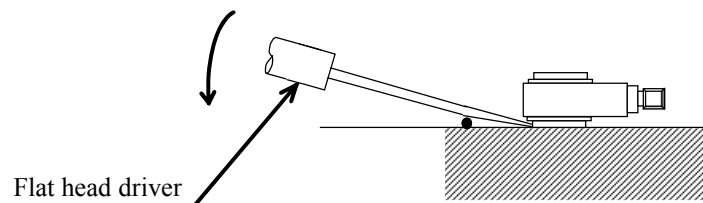
<Fitting and Removing of Accelerometer (VP-02S)>

(1) Fitting by M2 screw is recommended.

(2) Fix the cable as below near the connector of an accelerometer.



(3) When fixed by adhesive tapes, etc., remove it as below by using a flat head driver. It may be caused of trouble if it is forced to remove with twisting.

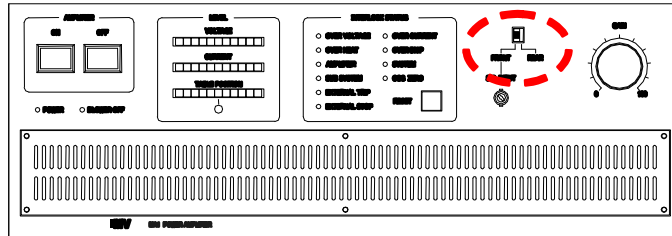


CAUTION

- (1) Accelerometers are precise products. If an accelerometer is subjected to shock due to drop or unacceptable force, it may have damage or its sensitivity characteristics may be changed. Be careful to handle the accelerometers.
- (2) Take care of mounting an accelerometer on the position where it will be interfered with other material under excitation.

4.2 OPERATION

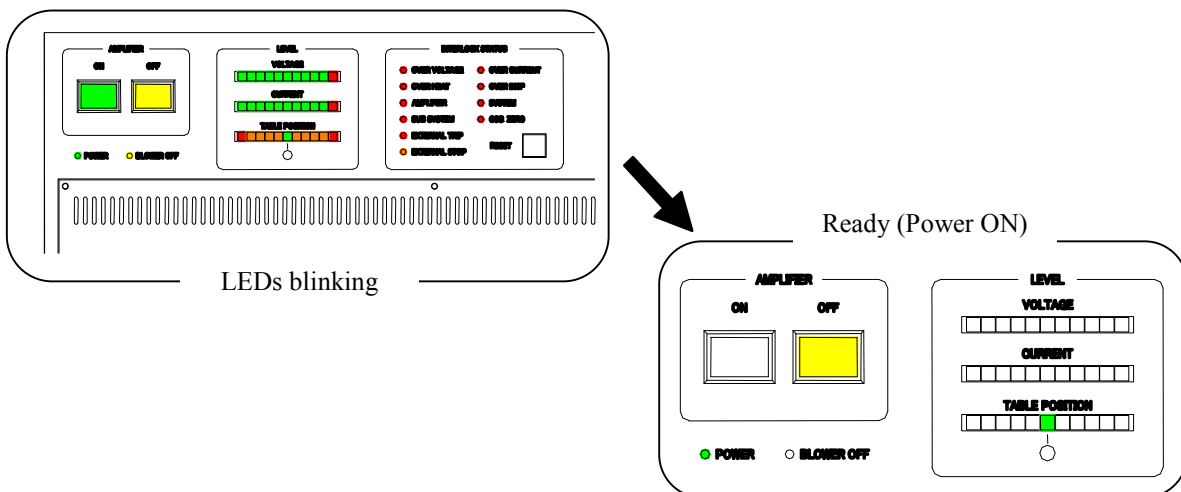
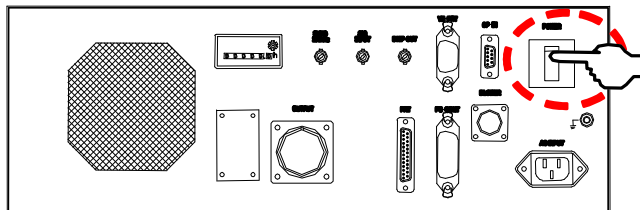
- (1) Check that the system is connected according to “4 OPERATION PROCEDURE 4.1 PREPARATION” correctly.
- (2) Set the Input signal selector to [FRONT / REAR] on the front panel.



This switch is to be set according to the connection condition of signal input from the vibration controller, etc.

- When the signal input is connected to the connector SIG.IN on the front panel : [FRONT]
- When the signal input is connected to the connector SIG.IN on the rear panel : [REAR]

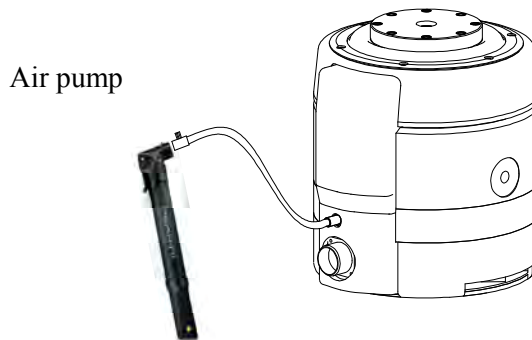
- (3) Turn on the [Power] switch of the main power supply on the rear panel.
(At this moment, all the LED lamps on the front panel blink for about 2 seconds because of the lighting test.)



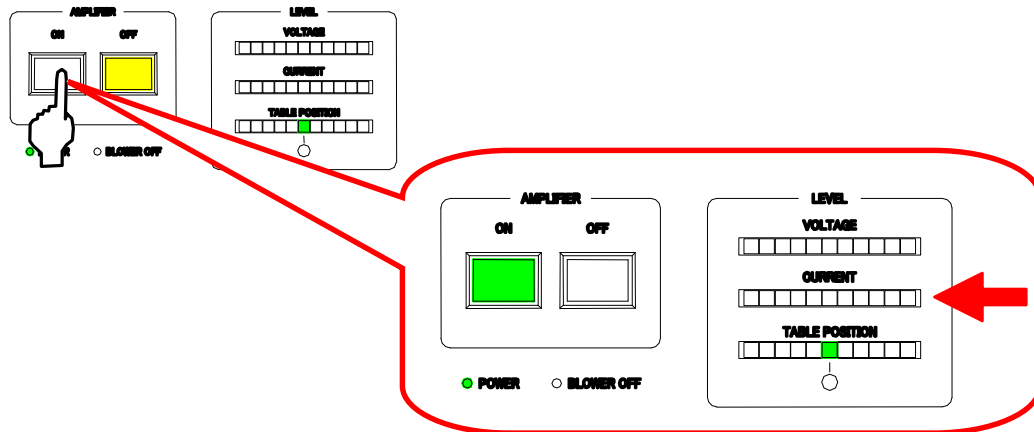
- (4) Mount and fix the specimen on the vibration shaker.

- (5) Check the displayed level of TABLE POSITION in the front panel and adjust the table position at the center shown by the green LED at the center level. The adjusting position can be done by letting the air in or out with the air pump.

Refer to “4.1.5 Adjusting of Armature’s Center Position”.



- (6) Start up the system by pressing the [AMPLIFIER ON] switch on the front panel. The [AMPLIFIER ON] switch blinks during the starting up operation. Then the [AMPLIFIER ON] switch lights on when the starting up operation is completed.



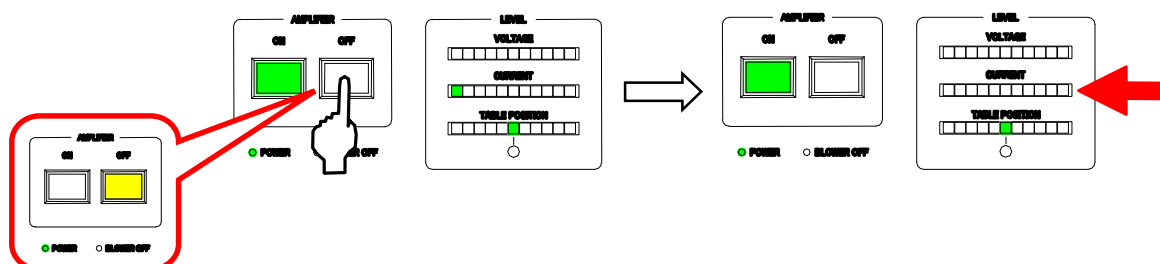
Check that the LED of the level display of CURRENT does not light on in this state.

CAUTION

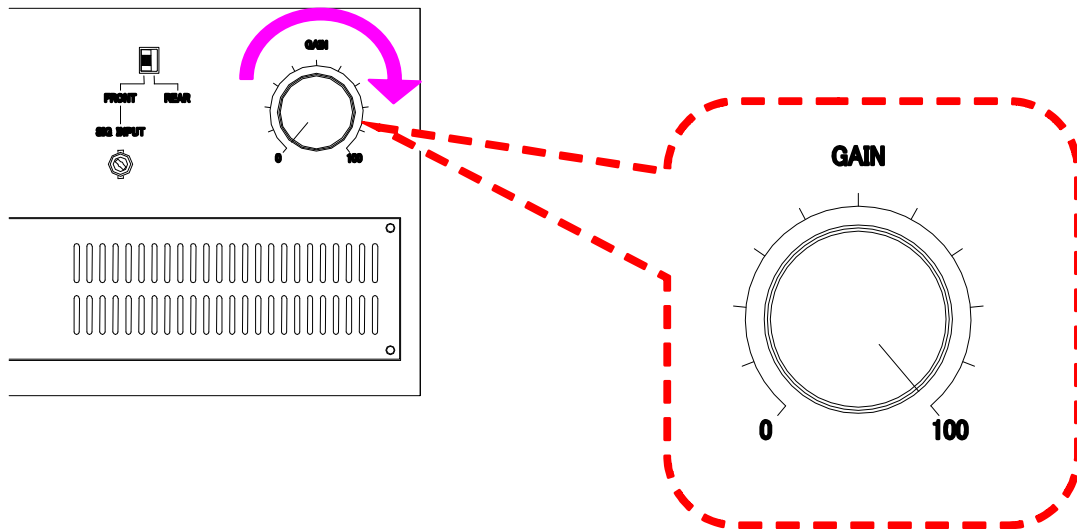
In case more than 2 ea of "current" level display light on.;

Turn the power of amplifier off by pressing the [AMPLIFIER OFF] switch. Then operate the air pressure adjustment of table position again. The air for setting table position is needed to be adjusted as much as the error indication of CURRENT will not be shown when the starting up operation is completed.

Refer to 4.1.5 Adjusting of Armature’s Center Position.



(7) Rotate the input gain knob to 100% on the front panel.



(8) Then the system is ready to execute the testing operation.

The required vibration test can be operated by using the vibration controller.

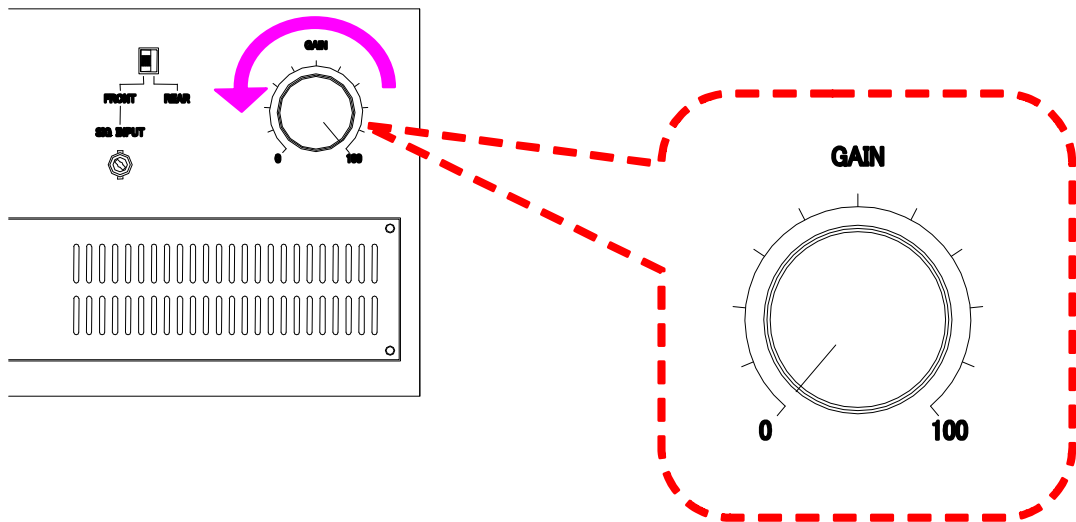
* When the signal input from an external signal source such as oscillator is used, the gain of input signal is needed to be adjusted by operating the GAIN knob.



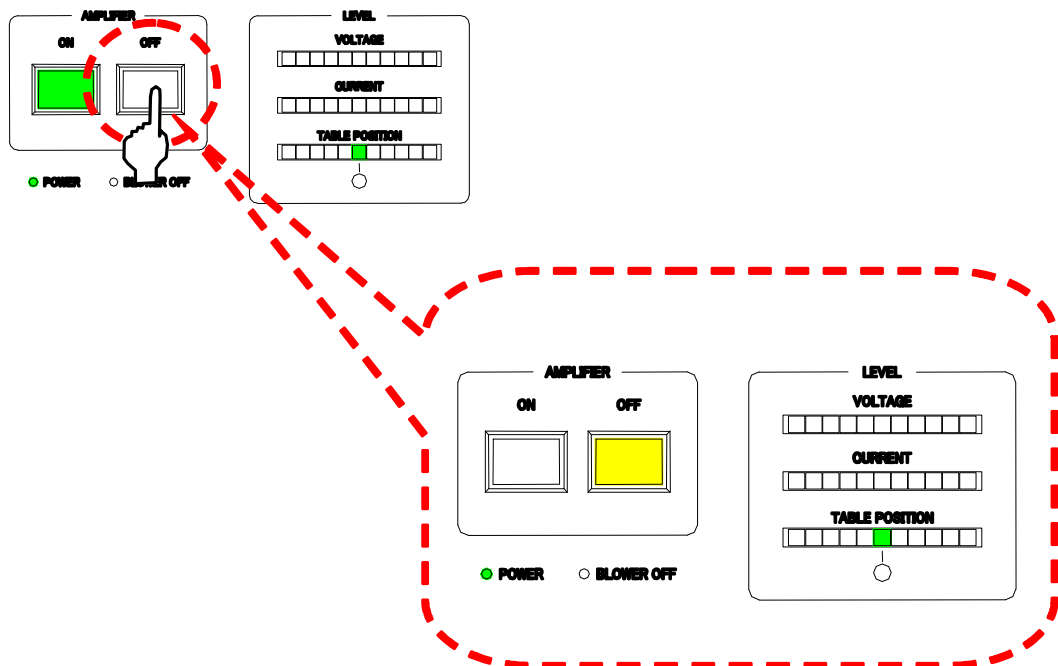
CAUTION The flickering of all LED lamps is to check LED lamp lighting. If there is LED lamp which lights off at all LED lamps lighting, the repairing is necessary.

4.3 STOP

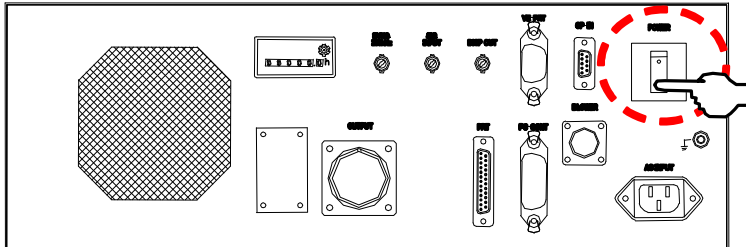
- (1) Stop the input signal from vibration controller or other external signal generating equipment into the power amplifier.
- (2) Rotate the input gain knob to 0% on the front panel. In this case, the knob clicks at the end.



- (3) Push the [AMPLIFIER OFF] switch to stop the system.
The [AMPLIFIER OFF] switch blinks during the finishing operation.
Then the [AMPLIFIER OFF] switch lights on when the finishing operation is completed.



- (4) Cooling blower keeps on run for a few minutes for cooling after you push this button, then the blower will stop automatically. Turn off the main power switch on the rear panel after the blower stopped.



4.4 REMARKS

4.4.1 Limitation of Maximum Acceleration

The maximum acceleration is limited by the mass of fixture, specimen and vertical/horizontal auxiliary table. Please calculate to estimate the maximum acceleration as below.

$$a = \frac{F}{m + M}$$

F	: Rated sine force	[N]
a	: Maximum acceleration	[m/s ²]
m	: Mass of armature	[kg]
M	: Total mass of fixture, specimen and vertical/horizontal vibration table	[kg]

Example :

When the value of rated sine force $F = 600$ [N] and mass of armature $m = 1.2$ [kg] ;

When each value is specified as below ;

Weight of specimen : 1 kg

Weight of auxiliary table : 2 kg

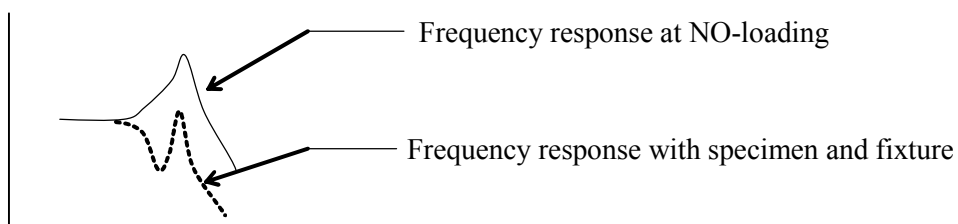
Weight of fixture : 3 kg

Max. acceleration $a = \frac{600}{1.2 + (1 + 2 + 3)} = 83.3$ [m/s²]

Testing operation should not be done over 83.3 [m/s²] at the maximum acceleration.

Usable Maximum Frequency

When specimen and/or fixture is attached to the armature, it may occur that the required acceleration level can not be reproduced within the usable frequency range because of resonance or anti-resonance of the attached specimen and / or fixture.



In such case, you should consider to change the mounting point of vibration control accelerometer, to change shape of the fixture, or to change attachment position of specimen on the fixture.



CAUTION

Testing operation should not be done over the maximum acceleration.

Or, it may damage the system.

4.4.2 Limitation of Maximum Acceleration by Accelerometer Sensitivity

The maximum acceleration is limited by sensitivity of accelerometer to be used. The maximum charge input and maximum voltage input of controller vary depending on the types of controllers. When exceeding this level, the controller stops the output. (The Vibration Test System is stopped.)

Vibration controller	F2	K2, RC-1120, SC-1000
Max. charge input	33 333pC	10 000pC
Max. voltage input	10 000mV	10 000mV

<In SINE / SHOCK excitation>

- (1) Using the accelerometer having charge sensitivity : X [pC/(m/s²)] ([pC/G]), the limited acceleration is calculated as below;

$$\left(\begin{array}{ll} \text{A : Acceleration [m/s}^2\text{]} & \text{Gravity Unit} \\ & \text{[G]} \\ \text{X : Charge sensitivity [pC/(m/s}^2\text{)]} & \text{[pC/G]} \end{array} \right)$$

Vibration controller	F2	K2, RC-1120, SC-1000
Limited acceleration	$A = \frac{33\,333}{X} [\text{m/s}^2] (\text{ [G]})$	$A = \frac{10\,000}{X} [\text{m/s}^2] (\text{ [G]})$

- (2) Using the accelerometer having voltage sensitivity : Y [mV/(m/s²)] ([mV/G]), the limited acceleration is calculated as below;

$$\left(\begin{array}{ll} \text{A : Acceleration [m/s}^2\text{]} & \text{Gravity Unit} \\ & \text{[G]} \\ \text{Y : Voltage sensitivity [mV/(m/s}^2\text{)]} & \text{[mV/G]} \end{array} \right)$$

Vibration controller	F2	K2, RC-1120, SC-1000
Limited acceleration	$A = \frac{10\,000}{Y} [\text{m/s}^2] (\text{ [G]})$	$A = \frac{10\,000}{Y} [\text{m/s}^2] (\text{ [G]})$

< Example 1 > Charge sensitivity : 5[pC/(m/s²)] (50[pC/G])

In this case, the maximum acceleration is limited as below ;

Vibration controller	F2	K2, RC-1120, SC-1000
Limited acceleration	$A = \frac{33\,333}{5} \doteq 6\,666 [\text{m/s}^2]$ (666[G])	$A = \frac{10\,000}{5} \doteq 2\,000 [\text{m/s}^2]$ (200[G])

<In RANDOM excitation>

- (1) Using the accelerometer of charge sensitivity : X [$\text{pC}/(\text{m}/\text{s}^2)$] ($[\text{pC}/\text{G}]$), the limited acceleration is calculated as below. When the crest-factor considered statistical variation is 4, the peak level of four times of RMS level is output.

$$\left(\begin{array}{ll} \text{B : Acceleration RMS value } [\text{m}/\text{s}^2 \text{ rms}] & \text{Gravity Unit } [\text{G rms}] \\ \text{X : Charge sensitivity } [\text{pC}/(\text{m}/\text{s}^2)] & [\text{pC}/\text{G}] \end{array} \right)$$

Vibration controller	F2	K2, RC-1120, SC-1000
Limited acceleration	$B = \frac{33\,333}{4X} [\text{m}/\text{s}^2 \text{ rms}]$ ([G rms])	$B = \frac{10\,000}{4X} [\text{m}/\text{s}^2 \text{ rms}]$ ([G rms])

- (2) Using the accelerometer of voltage sensitivity : Y [$\text{mV}/(\text{m}/\text{s}^2)$] ($[\text{mV}/\text{G}]$), the limited acceleration is calculated as below. When the crest-factor considered statistical variation is 4, the peak level of four times of RMS level is output.

$$\left(\begin{array}{ll} \text{B : Acceleration RMS value } [\text{m}/\text{s}^2 \text{ rms}] & \text{Gravity Unit } [\text{G rms}] \\ \text{Y : Voltage sensitivity } [\text{mV}/(\text{m}/\text{s}^2)] & [\text{mV}/\text{G}] \end{array} \right)$$

Vibration controller	F2	K2, RC-1120, SC-1000
Limited acceleration	$B = \frac{10\,000}{4Y} [\text{m}/\text{s}^2 \text{ rms}]$ ([G rms])	$B = \frac{10\,000}{4Y} [\text{m}/\text{s}^2 \text{ rms}]$ ([G rms])

< Example 2 > Charge sensitivity : 10 [$\text{pC}/(\text{m}/\text{s}^2)$] (100[pC/G])

In this case, the maximum acceleration is limited as below ;

Vibration controller	F2	K2, RC-1120, SC-1000
Limited acceleration	$B = \frac{33\,333}{4 \times 10}$ $\div 833$ [$\text{m}/\text{s}^2 \text{ rms}$] (85 [G rms])	$B = \frac{10\,000}{4 \times 10}$ $\div 1250$ [$\text{m}/\text{s}^2 \text{ rms}$] (25 [G rms])

- * When input signal exceeds the input trip level because of distortion of waveform during testing, the excitation will stop. In this case, replace by an accelerometer whose charge sensitivity is small.

4.4.3 Eccentric mounting of specimen

In case to mount the fixture and specimen on vibration shaker, do the center of gravity to come to the center of vibration table as near as possible. If mounted at eccentric center of gravity, the eccentric moment generates and the maximum rated force may not be obtained.



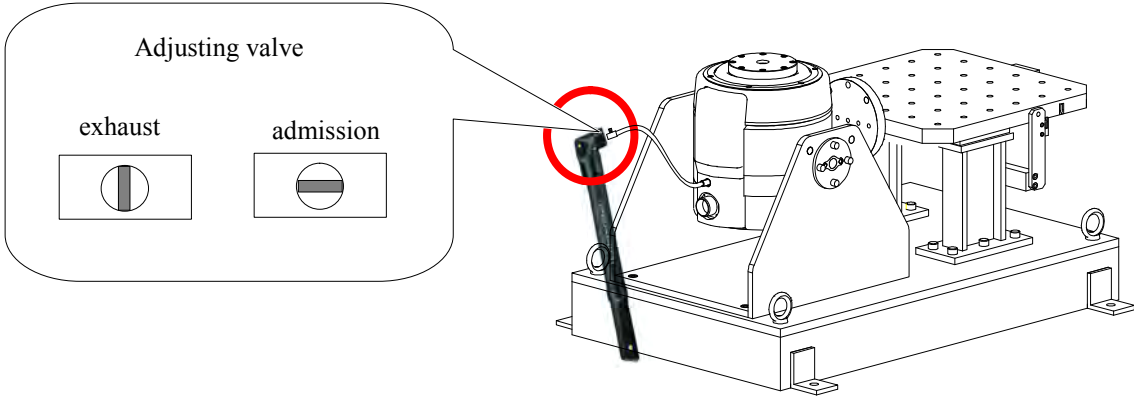
CAUTION

The vibration shaker may be damaged or turned over, mount carefully.

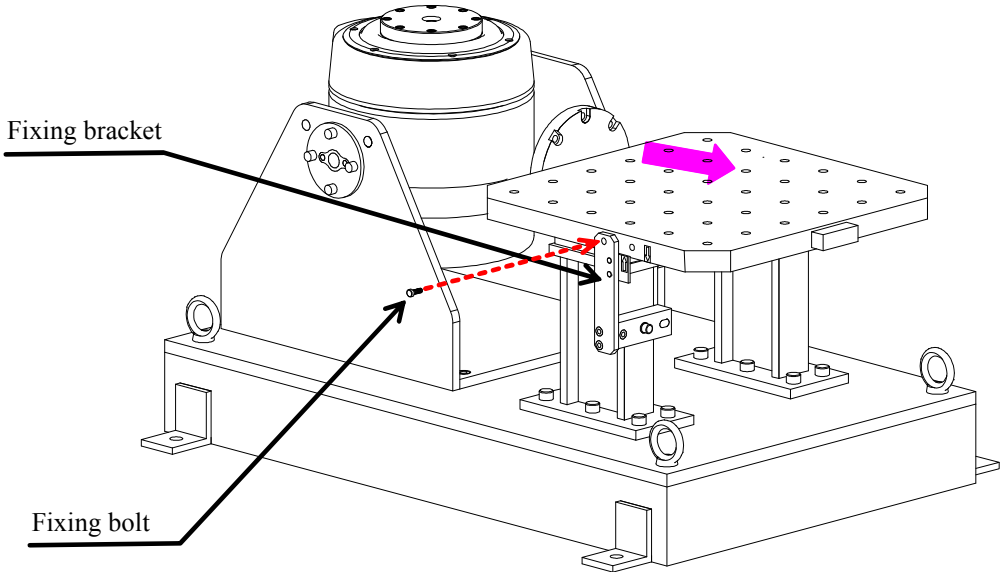
4.5 Option

4.5.1 Horizontal Slip Table

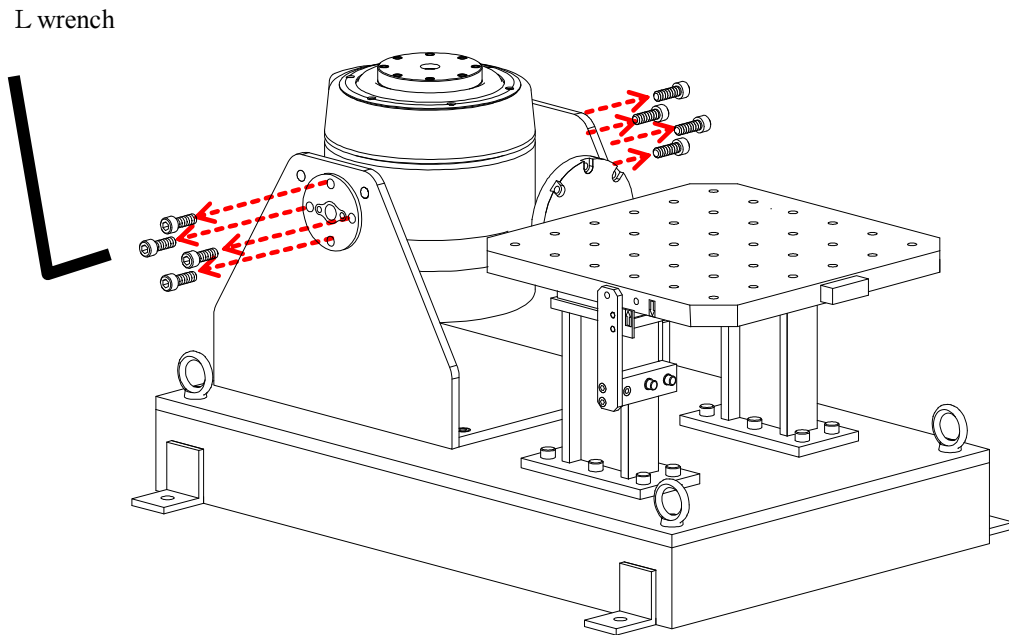
- (1) Turn the system power at OFF and leave horizontal slip table and joint at mounted condition.
- (2) Remove all specimen and fixture from the shaker.
- (3) Operate the adjusting valve and bring down the body to the bottom.



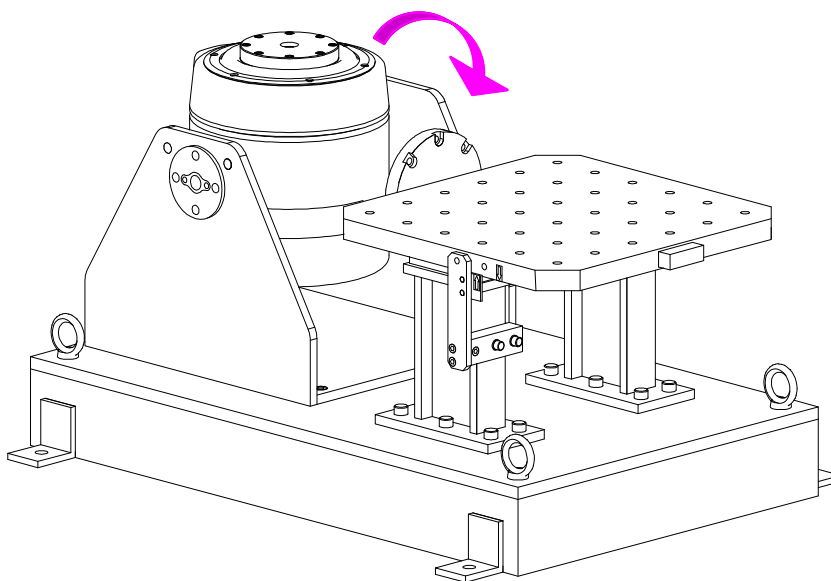
- (4) Shift horizontal slip table to the opposite direction to the vibration shaker and fix the metal fixture with bolt.



(5) Remove all trunnion shaft fixing bolts on right and left side.

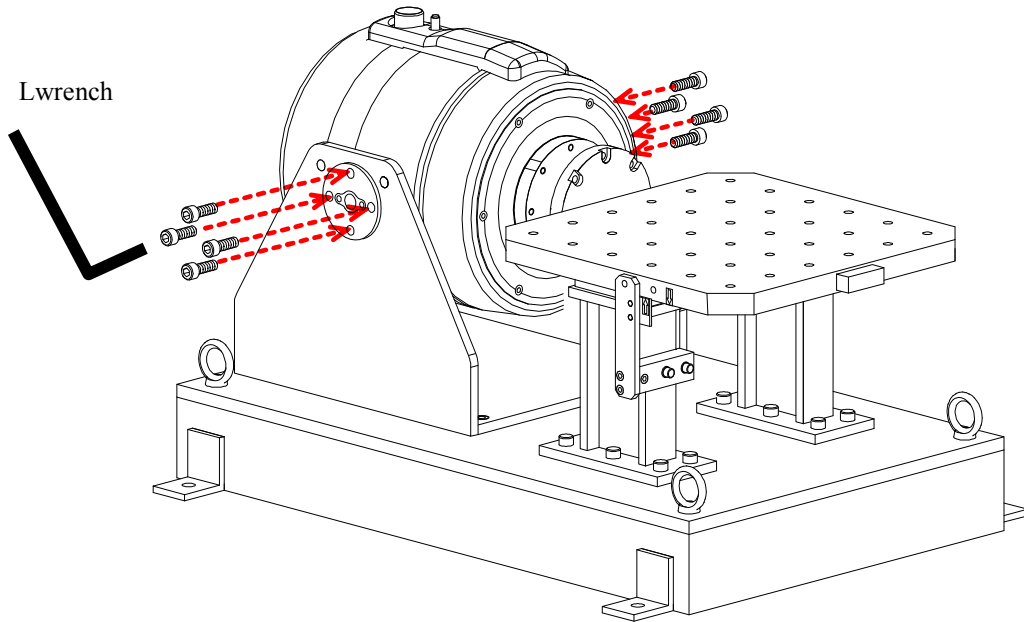


(6) Turn to horizontal direction gradually until vibration shaker touches with stopper. Take care that joint will not touch the top of Horizontal slip table.



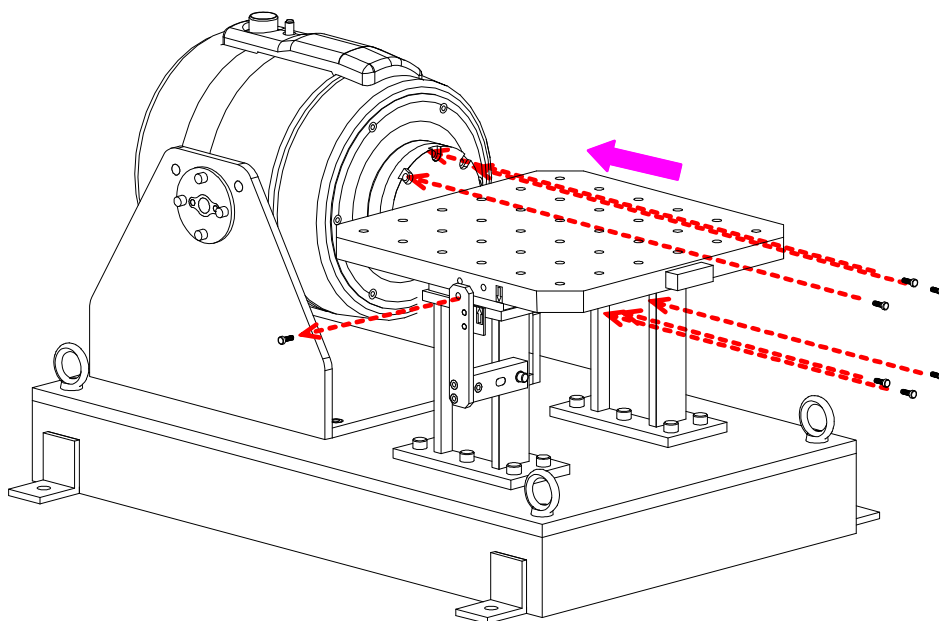
- (7) Insert the trunnion shaft fixing bolts into right and left of **column base**. Fasten tightly with the rated torque.

Refer to : “**6.SUPPLEMENT 6.1 SCREWING TORQUE**”



- (8) Take out the bolt which fixes the metal fixture and horizontal slip table, shift horizontal slip table to vibration shaker side and fasten tightly vibration shaker and joint with bolt.

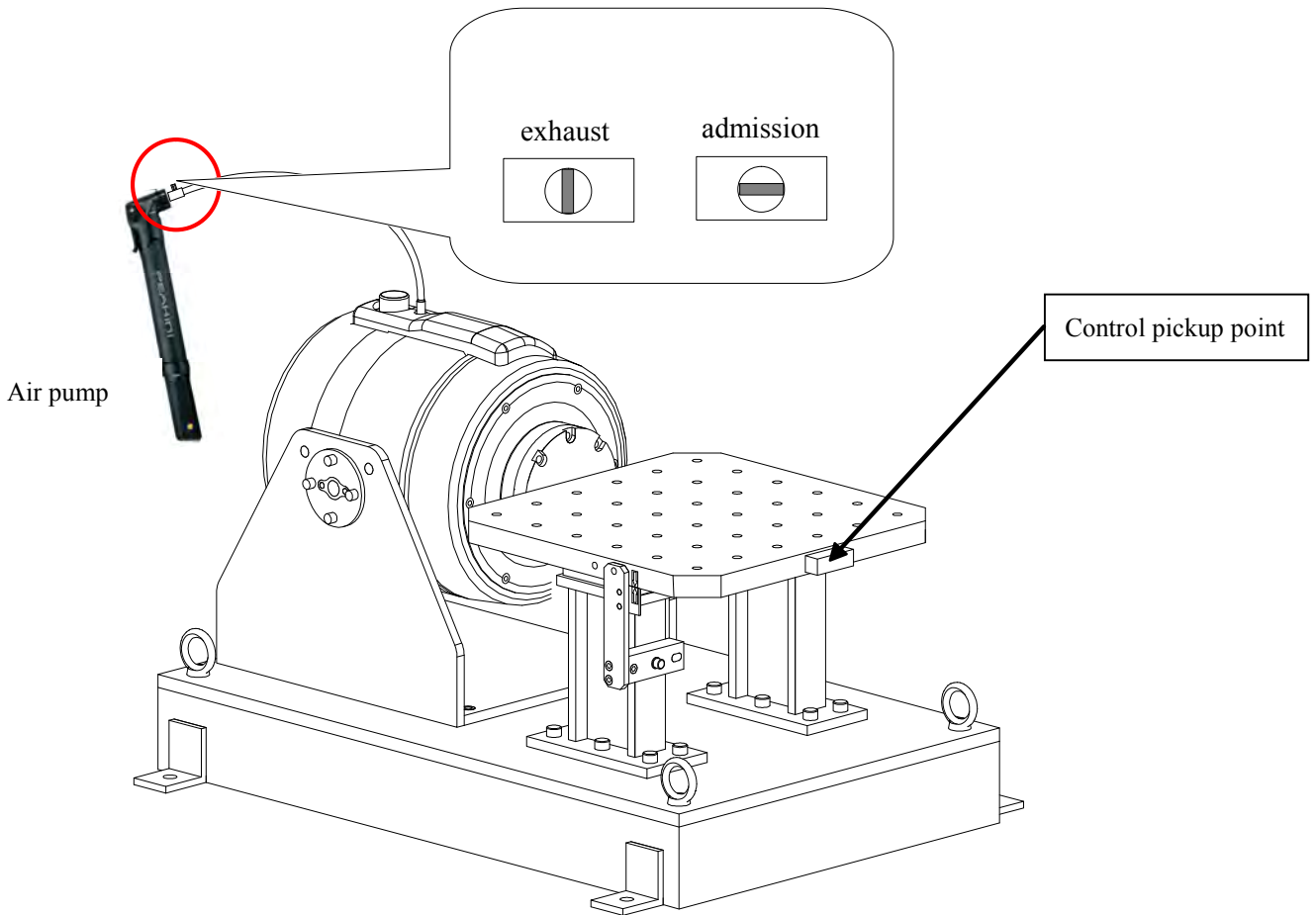
Refer to : “**6.SUPPLEMENT 6.1 SCREWING TORQUE**”



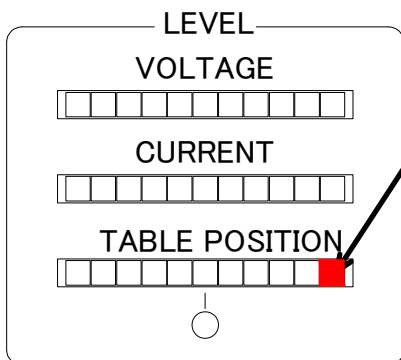
(9) Admit and exhaust the air by air pump. Adjust the position of horizontal slip table according to the table position display on power amplifier.

Refer to : **“4.OPTION 4.1.5 Fitting of Fixture and Specimen”**

(10) Control pickup positioned at the front of Horizontal slip table. Take care not to mistake the setting of control channel.



Power amplifier
Table position display



RED LED :

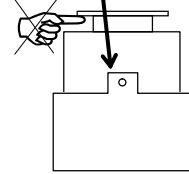
Admit the air till this LED lights on and adjust the table position with pressing by hand softly. Push AMPLIFIER ON switch and confirm that level display of CURRENT does not light on.

(11) When it is returned to vertical position, the procedure is the reverse.

⚠ CAUTION: Danger Zone

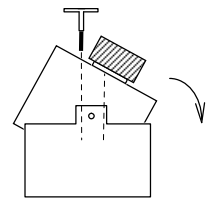
Do not catch your finger or cable during the excitation, rotation working of vibration shaker body, or handling of fixture.

Rotation of Trunnion



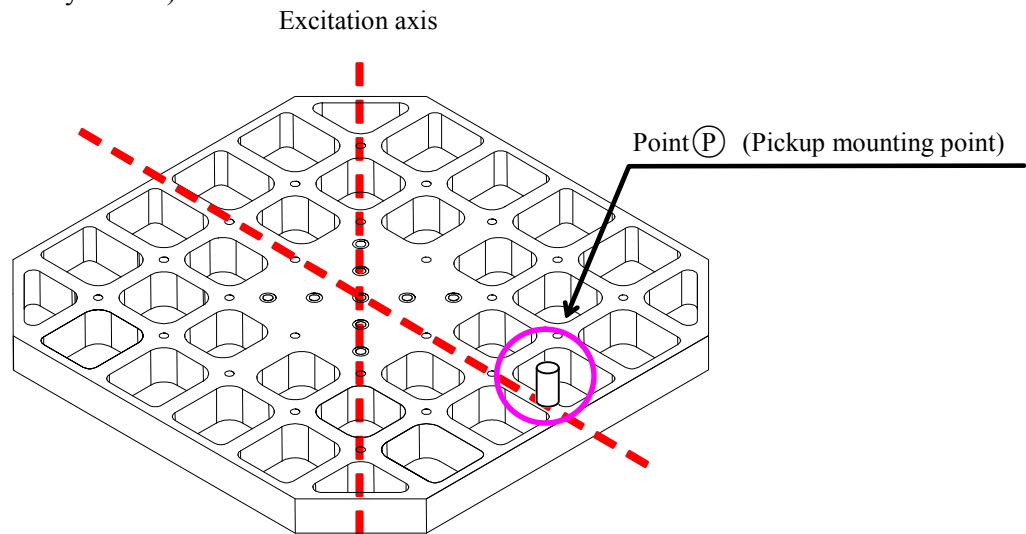
⚠ CAUTION : Rotation of Trunnion

Tighten up Trunnion Shaft Fixing Bolts firmly with the IMV's specified torque. If the bolt is loosen, the vibration shaker body may overturn during excitation and may cause serious personal injury, damage to the system or specimen.



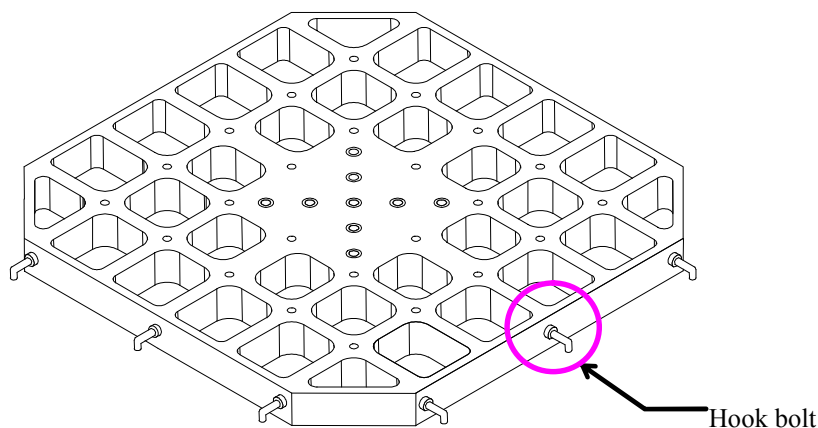
4.5.2 Head expander (Head Expander)

- (1) Fit tightly Head expander with using accessory screws, by rated torque value.
Refer to “6. SUPPLEMENT, 6.1 SCREWING TORQUE”.
- (2) Normally, Accelerometer should be fixed at the point (P). When excitation fixtures and specimens are loaded, the required acceleration cannot be obtained by the influence of each characteristic even within the available frequency range. In such a case, mount again pickup on suitable position. (Do trial test before main test to confirm the possibility of test.)



<Head expander>

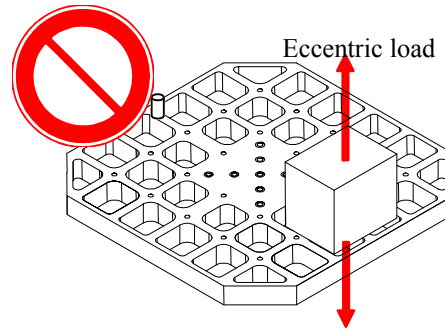
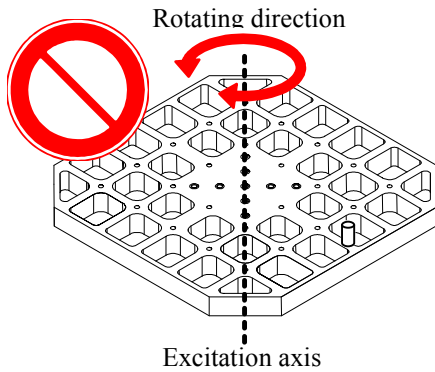
- (3) Hook bolts for transportation test are attached around the head expander. However, in testing over 500Hz, these bolts should be taken off to prevent the influence of partial resonance caused by hook bolts.





CAUTION

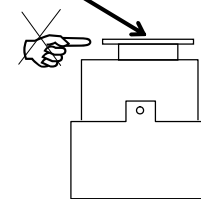
Do not add the force to excitation axis in rotating direction.
 (When the head expander is used, it causes the stronger turning force by the longer throw of an eccentric. To prevent additional eccentric load, the specimens need to be loaded as closer to the center position as possible.



CAUTION : Danger Zone

Do not catch your finger or cable during the excitation, rotation working of vibration shaker body, or handling of fixture.

Rotation of Trunnion



Uniformity of Vibration

- In case Vibration uniformity on head expander (the vibration difference on Point (P) where control pickup is mounted from that on other point is approximate 30%) is required, it is recommended that used frequency shall be less than 1/3 of maximum frequency of head expander. (However the zone where is affected by the rigid body rotational motion of head expander is excluded.)
- In high frequency, vibration level on the end (Point (P): Control pickup is mounted) of head expander may be different over 100% from that on the center.

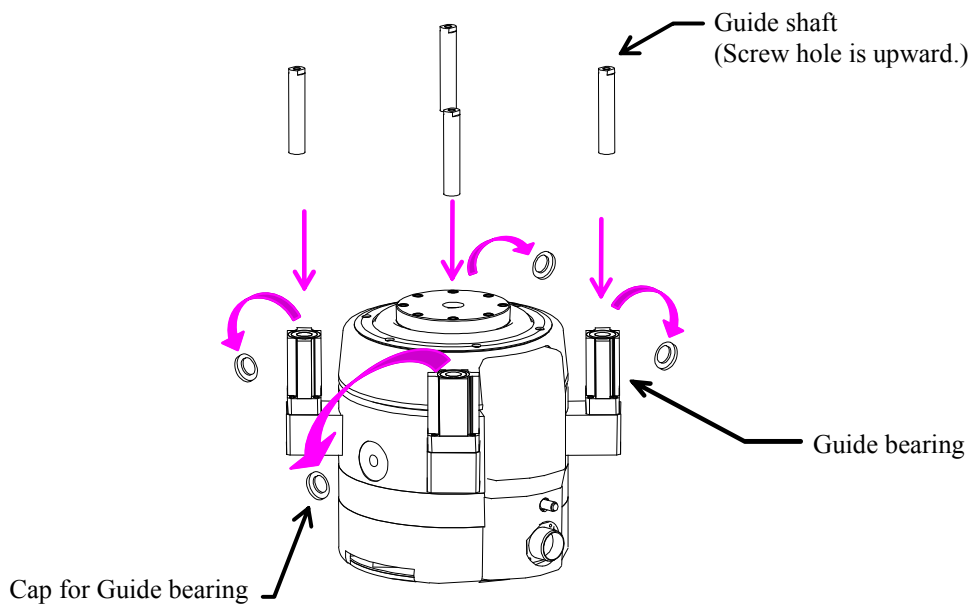
Usable Frequency Range

- In case vibration pickup is mounted only on point (P), max. rated force is warranted in the range of used frequency range.
- In case it is mounted on other point, the maximum rated force is not warranted.

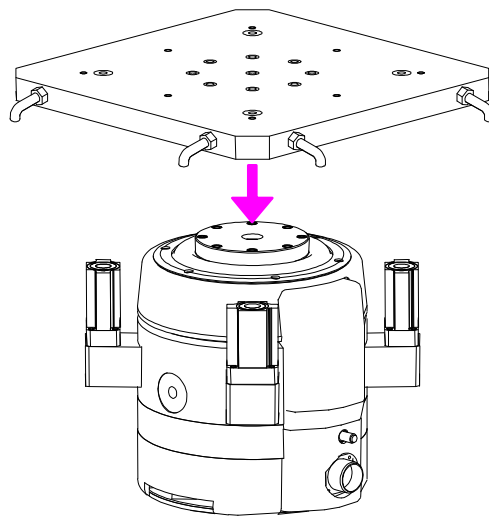
4.5.3 Mounting / Detaching the Head expander with Lateral load reinforcement guide

This clause describes the procedure of mounting / detaching the head expander with Lateral load reinforcement guide.

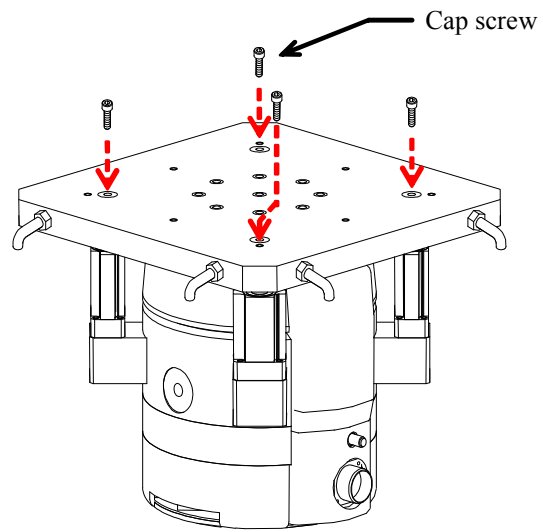
- (1) Turn OFF the main power .
- (2) Take out the cap for guide bearing and insert the guide shaft which screw hole is upward to the guide bearing.



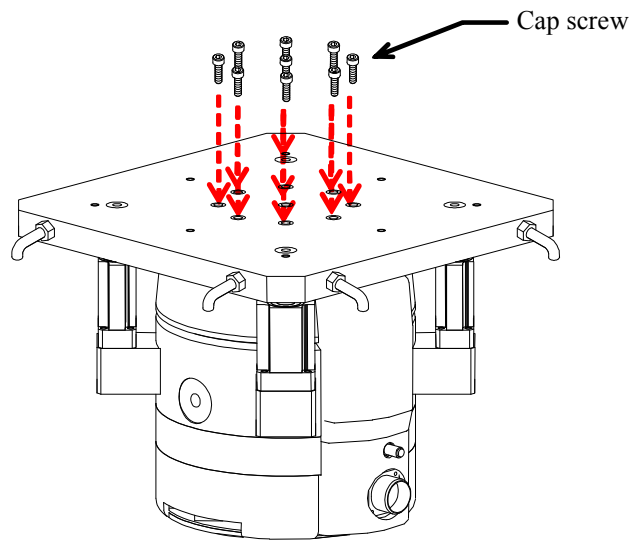
- (3) Mount the table on the vibration table of shaker.



- (4) Fix temporarily head expander to the guide bearing with cap screws.

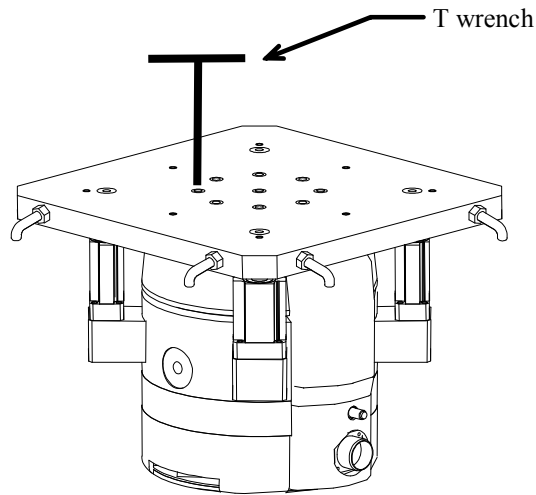


(5) Fix temporarily head expander to vibration shaker with cap screws.



- (6) Fasten the guide shaft fixing bolts with the rated torque. Then fasten the fixing bolts for head expander with the rated torque.

Refer to : : **6. Supplement, 6.1 Screwing Torque**



Now, the procedure of the vertical table mounting is completed.

When you want to detach the head expander from the shaker, please operate this procedure inversely.

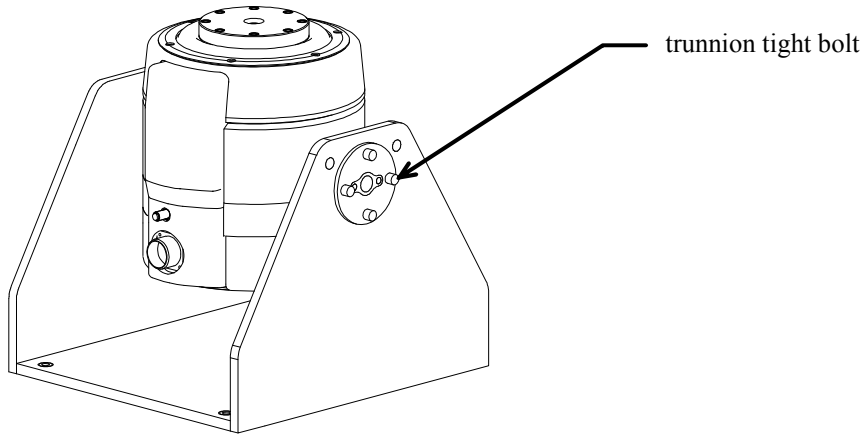
! CAUTION

- 1) Attach the caps of guide bearings every time when the guide bearings are not used.
Or, dusts may damage the inside of guide system.
- 2) Remove the guide shaft when the guide system is not used. The guide shaft may be dropped and damaged when the vibration shaker is set to the horizontal position.

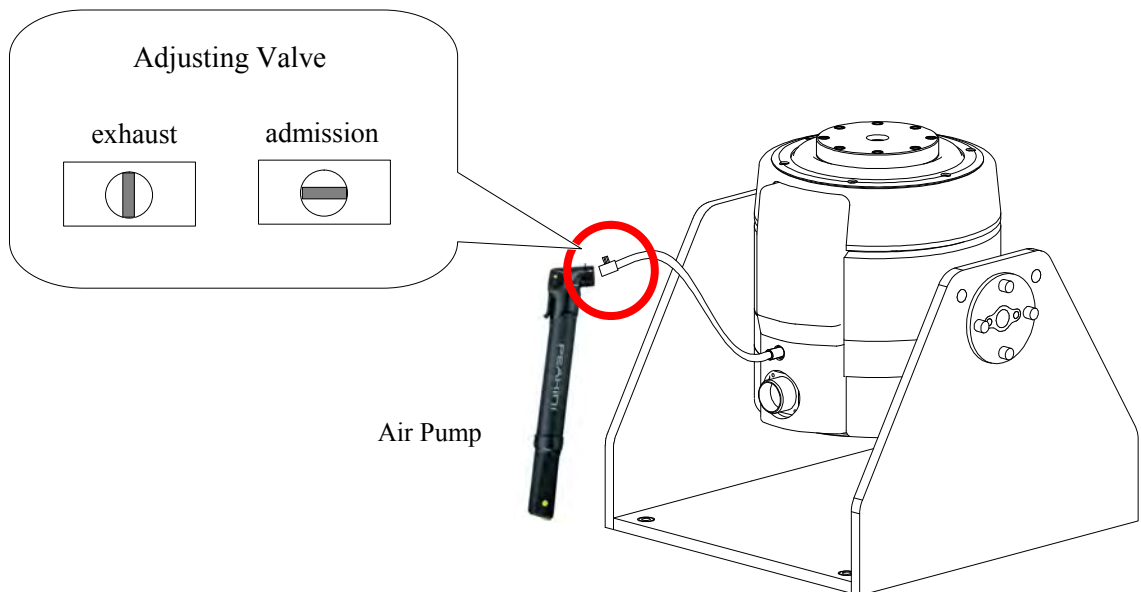
4.5.4 Center positioning of the vibration shaker's body in case to use column base

■ In Horizontal Excitation

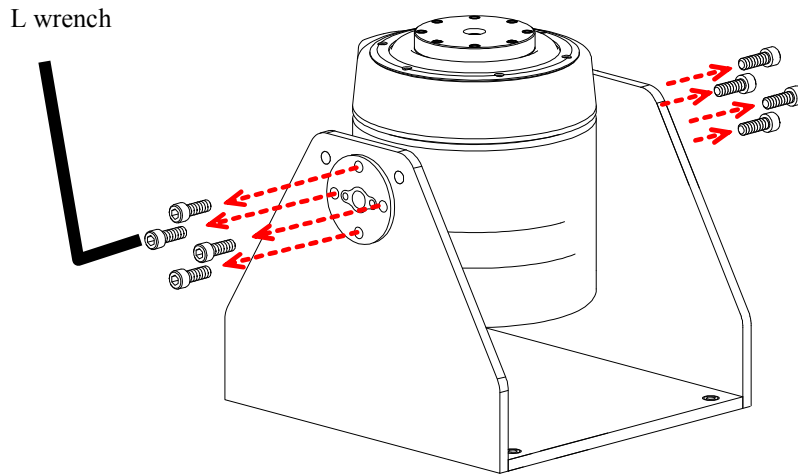
Execute the below operation



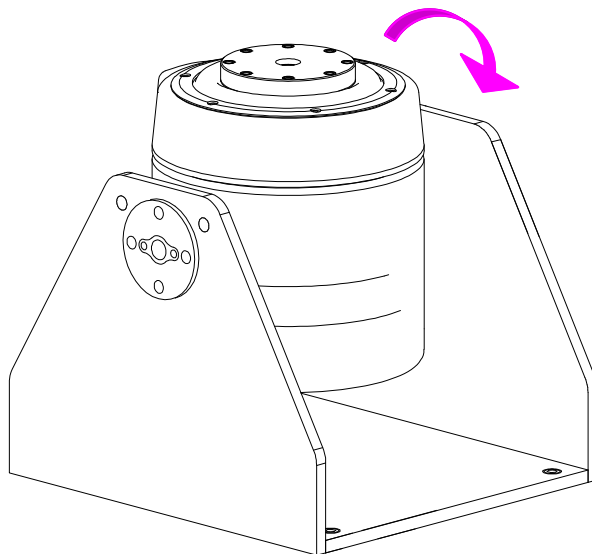
- (1) Remove all specimen and fixture from the shaker.
- (2) Operate the adjusting valve and bring down the body to the bottom.



- (3) Remove all trunnion shaft fixing bolts on right and left side.

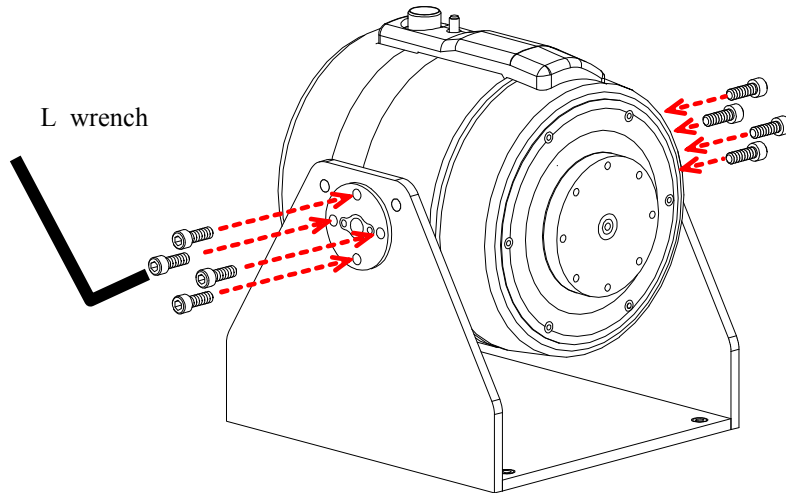


- (4) Turn to horizontal direction gradually until vibration shaker touches with stopper. Take care that joint will not touch the top of Horizontal slip table.



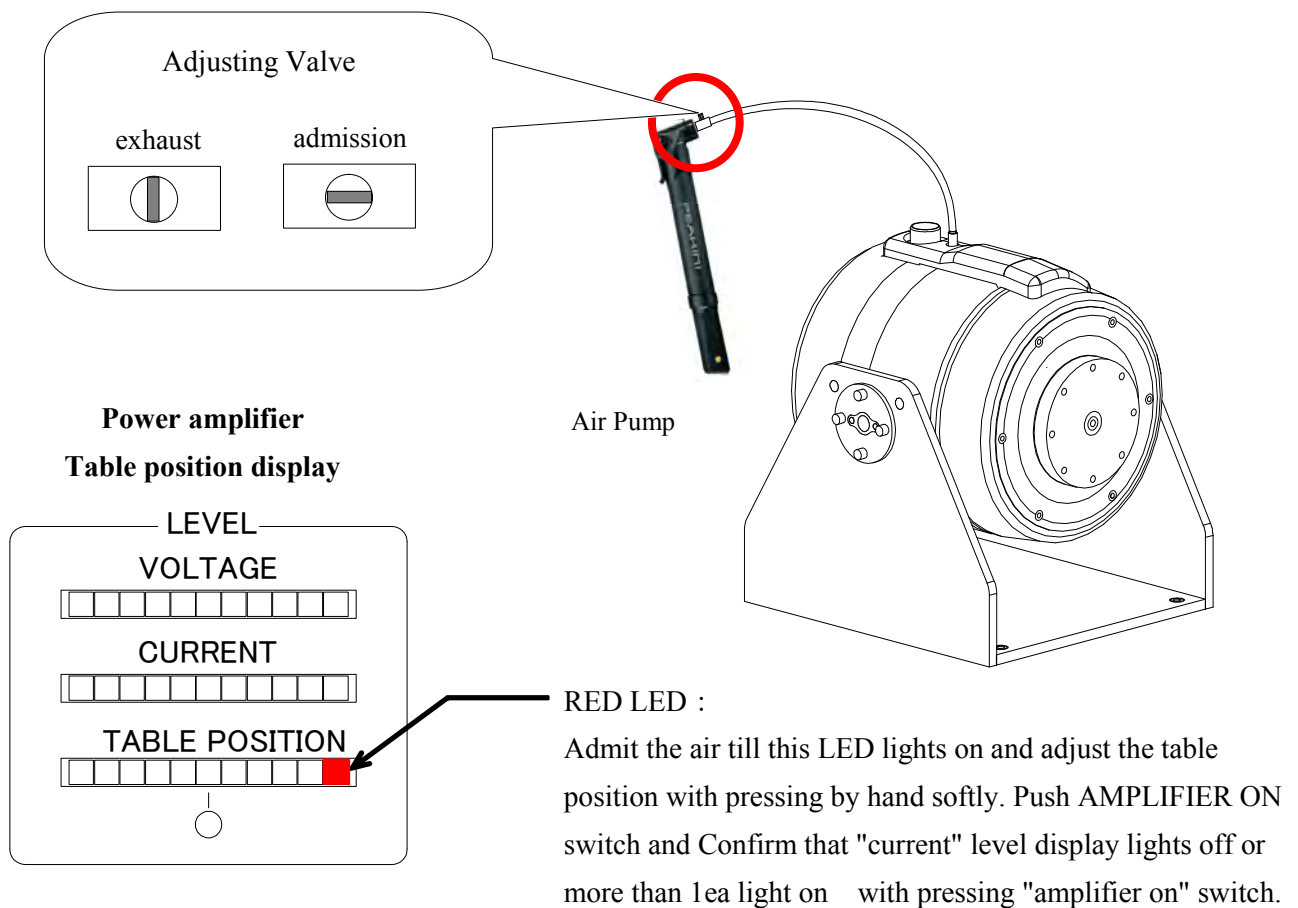
- (5) Insert the trunnion shaft fixing bolts into right and left of column base. Fasten tightly with the rated torque.

Refer to : **“6.SUPPLEMENT 6.1 SCREWING TORQUE”**



- (6) Admit and exhaust the air by air pump. Adjust the position of horizontal slip table according to the table position display on power amplifier.

Refer to : **“4.OPERATION PROCEDURE 4.1.5 Adjusting of Armature’s Center Position”**

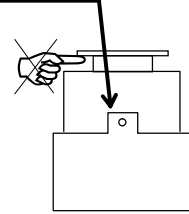


(7) When it is returned to vertical position, the procedure is the reverse.

⚠ CAUTION: Danger Zone

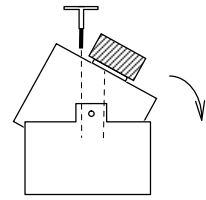
Do not catch your finger or cable during the excitation, rotation working of vibration shaker body, or handling of fixture.

Rotation of Trunnion



⚠ CAUTION : Rotation of Trunnion

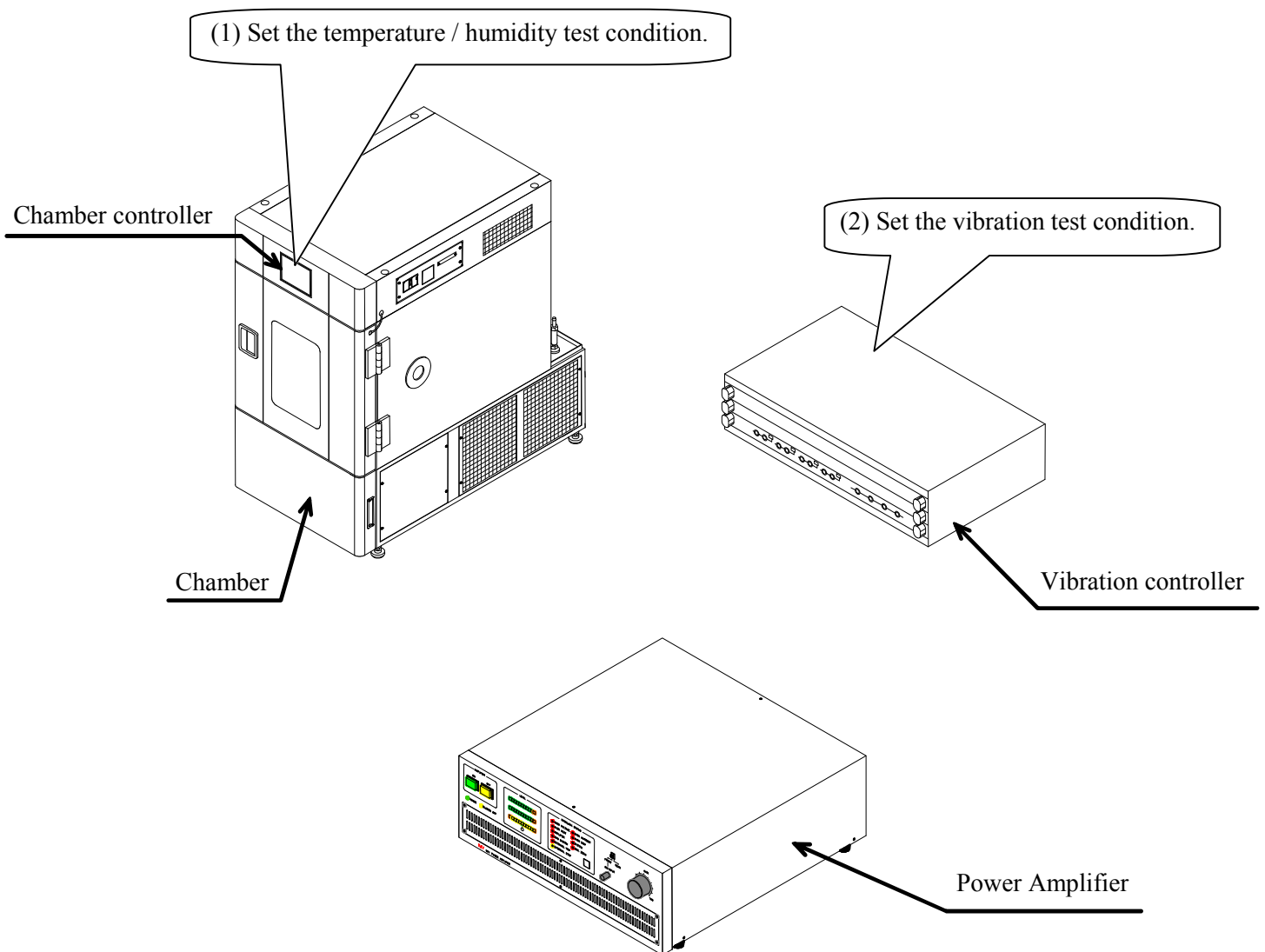
Tighten up Trunnion Shaft Fixing Bolts firmly with the IMV's specified torque. If the bolt is loosen, the vibration shaker body may overturn during excitation and may cause serious personal injury, damage to the system or specimen.



4.5.5 Combined Circuit

<Preparation>

- (1) Set the temperature /humidity test condition by the chamber controller. Please refer to the instruction manual of chamber about the detailed setting procedure.
- (2) Set the vibration test condition by the vibration controller. Please refer to the instruction manual of vibration controller about the detailed setting procedure.



- (3) Mount the accelerometer on the specimen or the fixture tightly. Be sure to set the accelerometer sensitivity and specify the control channel on the vibration controller correctly.

<Operation>

- (1) Set the vibration test system to operation status. See, “**4.2 OPERATION**”.
- (2) Set the chamber to operation status. See the dedicated instruction manual of chamber.

Vibration controller	K2、F2
SINE	Execute the testing operation and proceed to the state of “waiting for excitation start”.
RANDOM	Execute the testing operation and proceed to “excitation start”. The vibration shaker is started to excite for acquiring the initial excitation data. Go to the next step when the initial data acquisition is completed by reaching the reference excitation level of 0 dB.

- (3) Set the [Mode] switch of the chamber to [COMBINATION]. This setting is necessary only for the system having the [Mode] selection switch.
- (4) Start the program, the Environmental Test Specification, of the chamber. Then, the combined test can be operated by the vibration test system with chamber.

<Caution>

- (1) Chamber controls the time of combined operation by its timer in combined use. Therefore, the test time of vibration test system is needed to be set longer than that of chamber.
- (2) Contact I/O definition file, the file name is 'IMV', must be assigned for the test definition used in combined operation.
- (3) The indication lamp of external stop circuit, EXT. STOP, lights up also when the chamber is stopped by an abnormal event. In single operation, this lamp lights up when the test operation of the controller is completed.

* You can find the setting items for Contact I/O assignment in Fundamental / Control Condition of Test definition. These are available only when F2 or K2 is used as the vibration controller.

5. MAINTENANCE

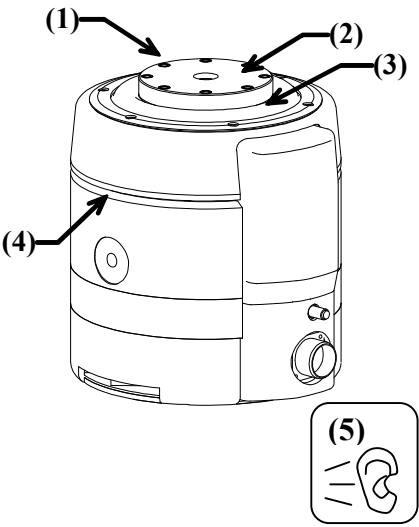
To use the Vibration testing system longer and more safely, please check the following items when you carry out pre-check working before testing.

5.1 DAILY CHECK

Please check the following items of equipment.

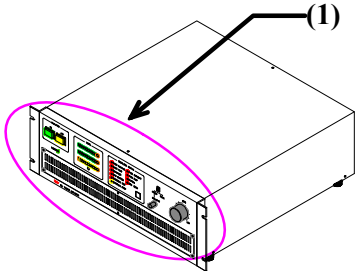
● Vibration Shaker

Please give your call to IMV or our Sales Agent if you can be aware of any abnormal situations in the vibration testing system.

Item		Check
	(1) Specimen mounting screw bush	Each bush has not damaged.
	(2) Vibration table	There is no metal powder, dust or oil stain on it.
	(3) Dust rubber	Dust rubber has no damage.
	(4) Cooling air inlet	No clogging with dust or trash at its air flow.
	(5) Excitation noise	Some unusual sound is not heard during the excitation.

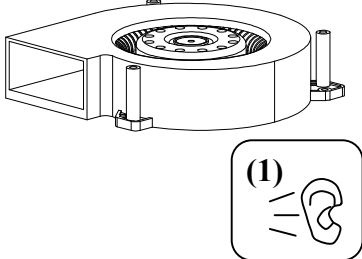
● Power Amplifier

Please give your call to IMV or our Sales Agent if you can be aware of any abnormal situations in the vibration testing system.

Item		Check
	(1) Appearance and motion	There are no abnormal phenomenon in display, at operation switches and buttons. There is no dust in the cooling air inlet on the front of power unit.

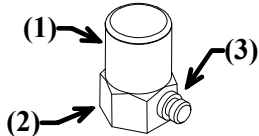
● **Blower**

Please give your call to IMV or our Sales Agent if you can be aware of any abnormal situations in the vibration testing system.

Item		Check
<p>* It can't be execute by visual check because of the built-in blower.</p> 	<p>(1) Rotational sound / noise of blowing at power on</p>	<p>Some unusual sound is not heard during the rotation.</p>



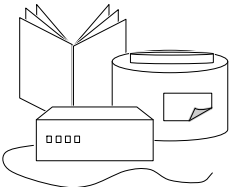
● **Accelerometer**

Please give your call to IMV or our Sales Agent if you can be aware of any abnormal situations in the vibration testing system.

Item		Check
	<p>(1) Case (2) Fixing screw (3) Micro connector</p>	<p>There is any damage or deforming.</p>

● **Accessories**

Please give your call to IMV or our Sales Agent if you can be aware of any abnormal situations in the vibration testing system.

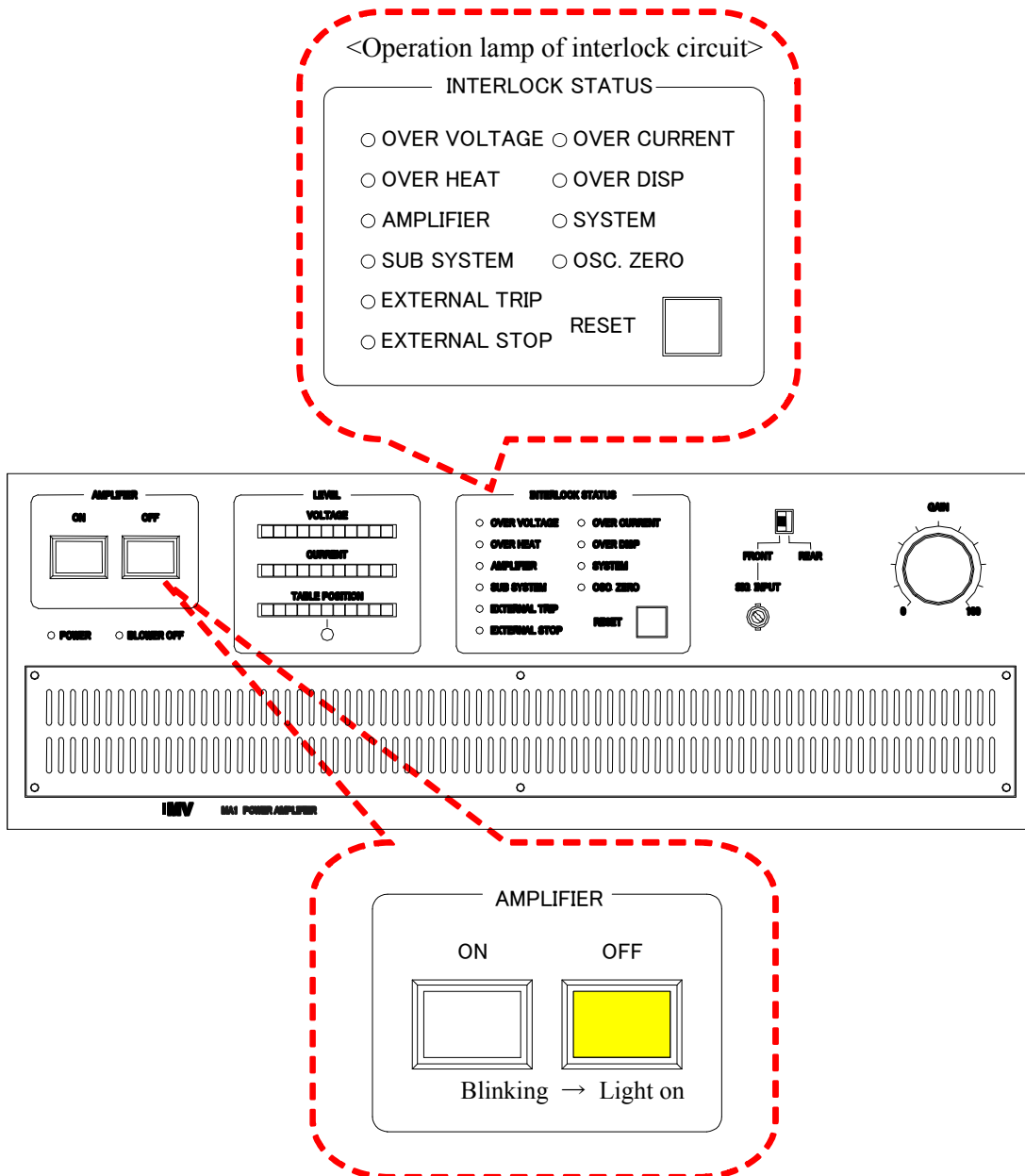
Item		Check
	<p>Air pump</p>	<p>There is no broken part.</p>
	<p>Cables</p>	<p>There is no broken part on covering. There is no broken cable.</p>
<p>Others</p> 	<p>Caution or notice labels</p>	<p>The labels are not dirty or damaged.</p>
	<p>Instruction manual</p>	<p>It is kept with shaker.</p>
	<p>Bolts, nuts and screws</p>	<p>They haven't been loosen or have any damage.</p>
	<p>Safety cover</p>	<p>It is attached correctly.</p>

5.2 SAFETY FUNCTIONS

When the signal exceeds over the system rating or the fault occurs in the system, the interlock circuit of power amplifier operates. It makes turn <POWER> switch to 'OFF' and stop excitation automatically.



5.2.1 Interlock Circuit

- (1) When the interlock circuit is executed to stop the system automatically, the operation lamp of interlock circuit lights on. The assumed cause and the countermeasure are as below ;



- (2) At the same time, the lamp of [AMPLIFIER ON] switch black out. And the lamp of [AMPLIFIER OFF] switch blinks, then, lights on. The system is stopped completely.

5.2.2 Meaning and Check

Display	Meaning	Cause	Check / Countermeasure
 OVER VOLTAGE	Excessive voltage signal output	Because of excessive signal is input to the power amplifier. The voltage of output signal from the power amplifier exceeds over the rated value. Fault of the power amplifier.	(1) Check that whether a proper value is set for the signal. ⇒ Reset the system and set a proper value for the signal. Reboot the system. (2) Check that the control pickup is attached correctly or is not damaged. ⇒ Attach a pickup for control. (3) Check that the cable of pickup is not broken. ⇒ Replace the pickup cable with a normal one. (4) The breaking of lead wire in the vibration shaker is found. ⇒ Please contact the after sales service of IMV.
 OVER CURRENT	Excessive current signal output	Because of excessive signal is input to the power amplifier. The current of output signal from the power amplifier exceeds over the rated value. Fault of the power amplifier.	(1) Check that whether a proper value is set for the signal. ⇒ Reset the system and set a proper value for the signal. Reboot the system. (2) Check that the control pickup is attached correctly or is not damaged. ⇒ Attach a pickup for control. (3) Check that the cable of pickup is not broken. ⇒ Replace the pickup cable with a normal one. (4) The breaking of lead wire in the vibration shaker is found. ⇒ Please contact IMV.

Display	Meaning	Cause	Check / Countermeasure
● OVER HEAT	Over heat of the vibration shaker or the power amplifier	The temperature of power amplifier inside rises abnormally because of some failure of cooling system.	(1) Check that there is any disturbance of air inlet flow or air filter to the power amplifier. ⇒ Clean up the filter or replace with a new one. (2) Check that the temperature of test room is not over 40°C. ⇒ Adjust the room temperature properly. After trying the operations (1) ~ (2), wait for a while until the temperature is cooled down. Then, reset the system and check the interlock circuit status. If there is no improvement for the system, please contact IMV.
● OVER DISP	Over displacement	Because of excessive signal is input to the power amplifier. The interlock circuit of displacement is executed.	(1) Check that the value if input signal is set correctly. ⇒ Reset the system and set a proper value for the signal. Reboot the system. (2) Check that the vibration table position is centered correctly. ⇒ Stop the system. Adjust the table position at center by letting the air in or out with the air pump.
● AMPLIFIER	Abnormal power module (PM) DC power supply : high V DC power supply : low V DC power supply : over current Disconnection of power fuse / Abnormal CPU	Interlock circuit of power amplifier and its peripheral equipment is operated.	When the system can not be start again, please contact IMV.
● SYSTEM	Field power supply fuse broken Thermistor broken Auxiliary 1 ~ 3	Interlock circuit of system and its peripheral equipment is operated.	When the system can not be start again, please contact IMV. (*It is not used in this system.)
● SUB SYSTEM	Others 1 ~ 2	Interlock circuit of accessories and other equipment is operated.	When the system can not be start again, please contact IMV. (*It is not used in this system.)
● OSC. ZERO	Signal input	The signal is input while starting up the system of power amplifier.	Turn the input gain knob left to zero. Or Set the input signal to zero and reset the system. Then, start it up again.

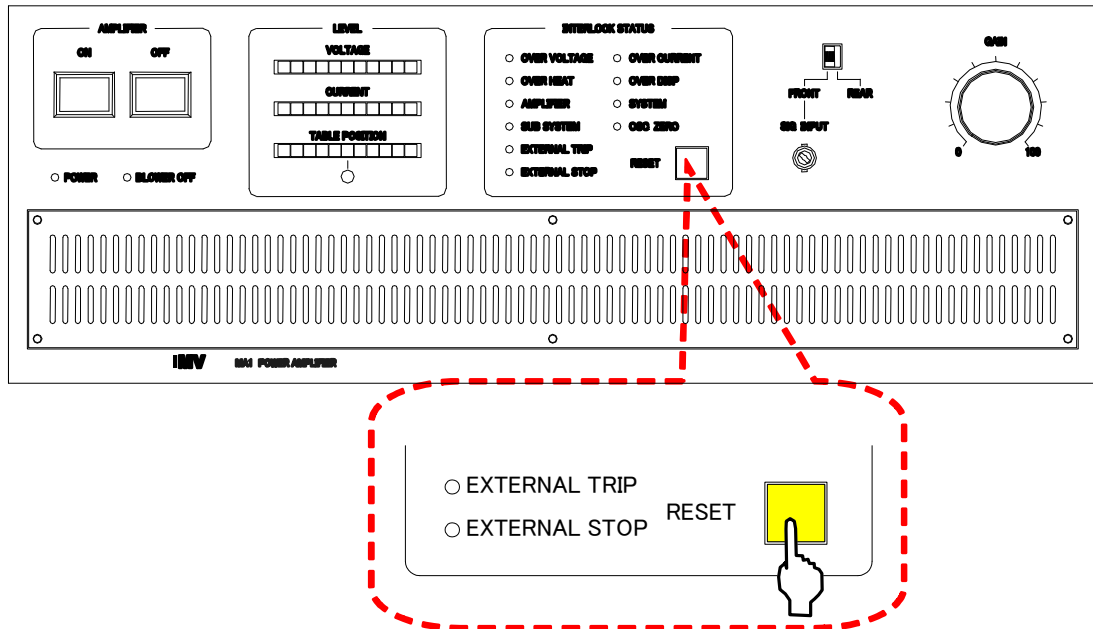
Display	Meaning	Cause	Check / Countermeasure
● EXTERNAL TRIP	External signal input of emergency stop	System is stopped by the emergency stop signal from the external equipment.	Release the emergency stop signal input from the external equipment. Start up the system again after resetting it. (*It is not used in this system.)
● EXTERNAL STOP	External signal input of stop	System is stopped by the stop signal from the external equipment.	Release the stop signal input from the external equipment. Start up the system again after resetting it.

5.2.3 RESET

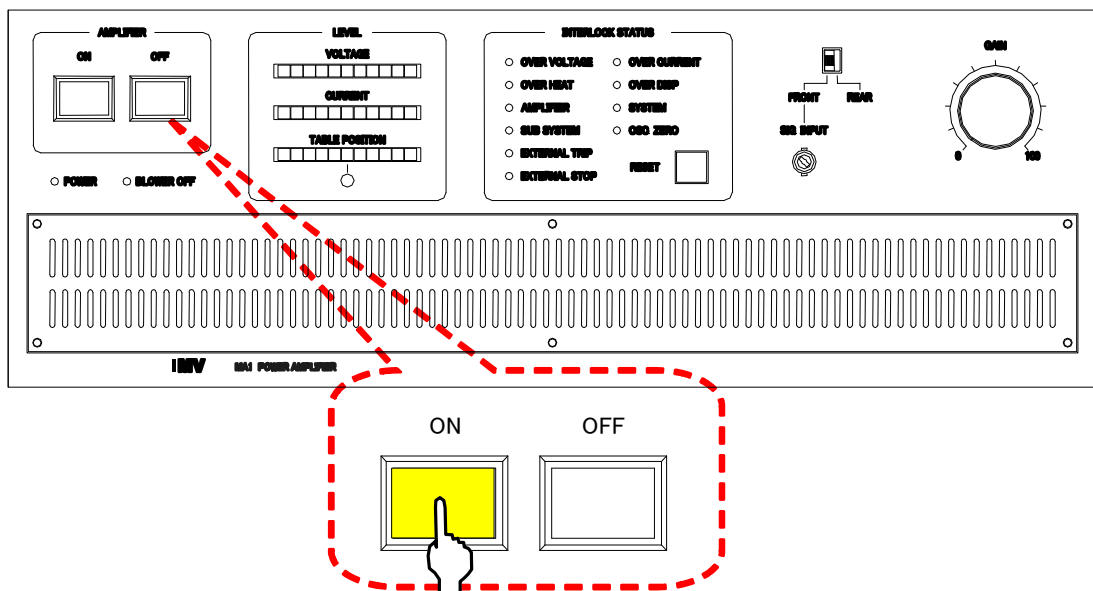
(1) Stop the output from the signal generating system such as vibration controller.

(2) Press the [RESET] button for 3 seconds.

*When the time for pressing button is not enough to reset the system, only the buzzer is stopped.



(3) Press the switch of [AMPLIFIER ON] to start the system again.



CAUTION

Before resetting the system, it is important to research the cause of an interlock circuit operation. When repeatedly operated “Interlock circuit operation and restarting system operation”, the system may be damaged.

6. SUPPLEMENT

This clause describes that the purpose and the use of accessories for vibration test system.

6.1 RECOMMENDED SCREWING TORQUE (For Reference)

The recommended screwing torque of mounting bolt depends on the size of bolt and with or without washer. See the table below.

Size	Screwing torque	
	with washer	without washer
M4	3.2 N·m	2.3 N·m
M5	6.6 N·m	4.4 N·m
M6	11.3 N·m	6.9 N·m
M8	27.4 N·m	14.7 N·m
M10	53.9 N·m	27.4 N·m
M12	95.1 N·m	31.4 N·m
M16	186 N·m	84.3 N·m

The values on the list are in case of the material of specimen surface fixed by bolt is Aluminum or Magnesium

<Fastening torque of Bolt>

- (1) Use the torque wrench to fasten with the accurate fastening torque.
- (2) Use the accessory T-wrench or L-wrench as auxiliary tool.
- (3) Use the structural steel bolt (the strength 10.9~12.9) for mounting of specimen. In case the stainless steel bolt is used, its strength shall be A2-70~A2-80.

6.2 SENSITIVITY CHECK FOR ACCELEROMETER)

● Purpose

The sensitivity of accelerometer may change by secular change or any dropping shock. The following method is used to check the sensitivity of Accelerometer periodically. However, this check method should be performed as a simple check method by customer. (Please contact with IMV as for the calibration according to your National Standard.)

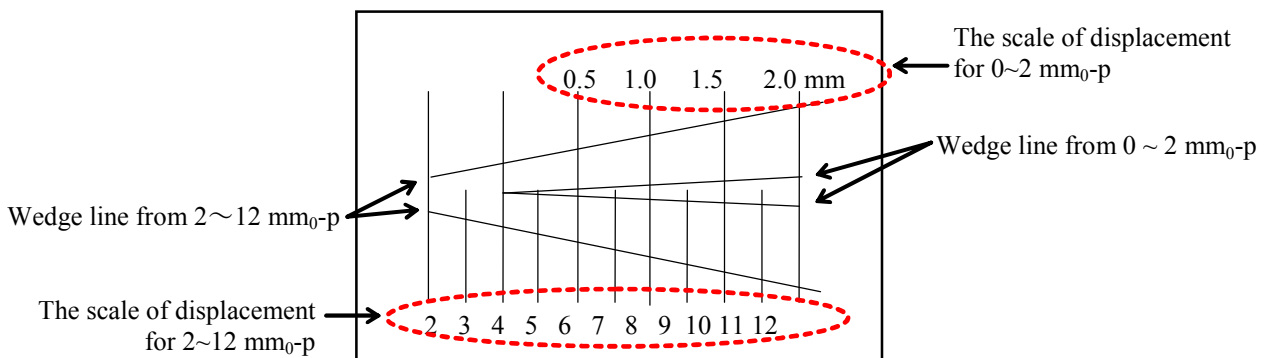
● Wedge Scale Seal

You can observe the displacement under sine excitation with 'Wedge scale seal' as shown in the following figure.

(1) Scale

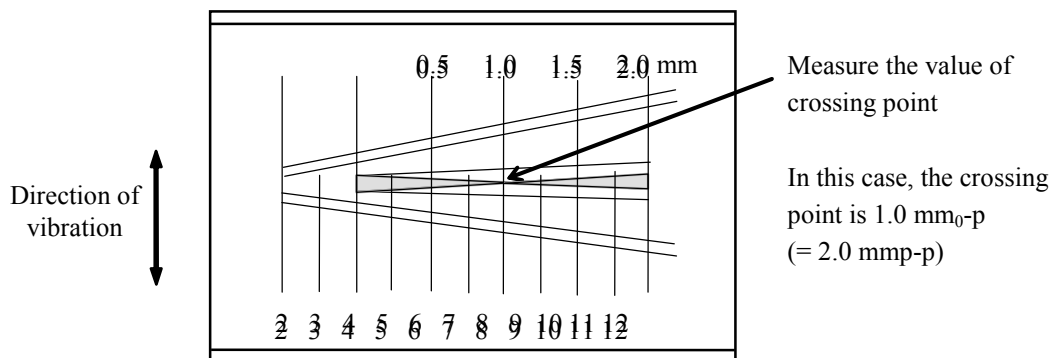
The displacement indicated on the wedge scale seal is scaled as 'single amplitude' [$\text{mm}_0\text{-p}$] (millimeter in 'zero to peak' amplitude).

If you need double amplitude' [mmp-p] (a full amplitude in 'peak to peak') value, please calculate the acquired value by twice.



(2) Measurement (By using your afterimage of vibration)

< Under vibration >

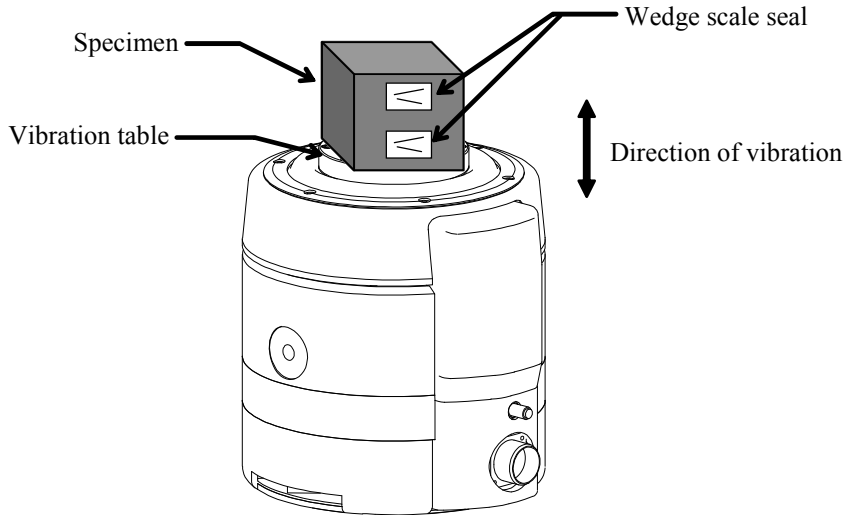


* The accuracy of measured data will be about 5 % order.

● **Check Method**

(1) Attachment of the wedge scale seal.

Fit this adhesive wedge scale seal on the specimen or fixture to be the same direction between the direction of vibration and the measurement direction on the seal.



(2) Measurement of displacement under excitation

(a) In case of SI unit system

Run the sine excitation at 50.3 Hz of frequency and adjust the vibration level to obtain the crossing point at 1.0 mm_{0-p} (=2.0 mmp-p) displacement on the seal.

(Refer to the previous page (2) Measurement.)

Then, read the indicated acceleration value by vibration controller or vibration meter. In this case, the acceleration at the seal is equivalent to 100 m/s².

(b) In case of Gravity unit system

Run the sine excitation at 49.8 Hz of frequency and adjust the vibration level to obtain the crossing point at 1.0mm_{0-p} (=2.0mmp-p) displacement on the seal.

Then, read the indicated acceleration value by vibration controller or vibration meter. In this case, the acceleration at the seal is equivalent to 10 G.

[Simple calibration at 1.0 mm_{0-p} (2.0 mmp-p)]

Unit	Frequency	True acceleration
SI Unit	50.3 Hz	100 m/s ²
Gravity Unit	49.8 Hz	10.0 G

(3) Check for sensitivity

When the measured acceleration value is deviated over 10% from ‘the true acceleration’ value, the accelerometer seems to be fault. In such case, replace it to the new one.

6.3 CONVERSION TABLE (SINE VIBRATION CHART)

● Purpose

When you derive acceleration, velocity, displacement ('zero-peak' value) and frequency in sine vibration, you can use the conversion table (Sine Vibration Chart) as attached. If any 2 parameters among acceleration, velocity, displacement ('zero-peak') and frequency in sine vibration is known, you can derive the other 2 parameters from the conversion table.

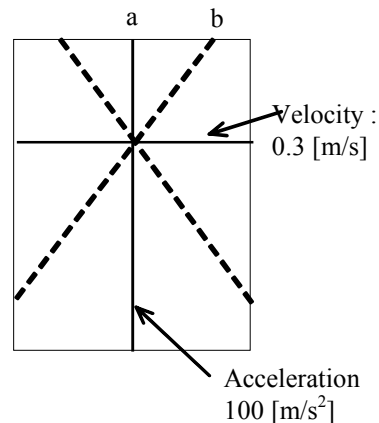
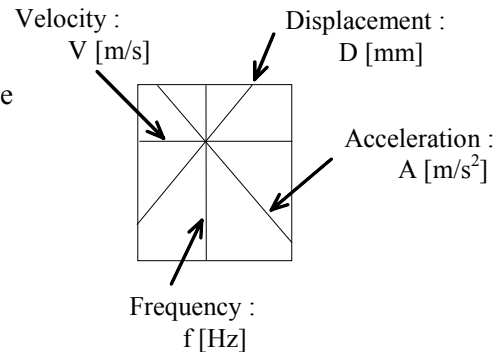
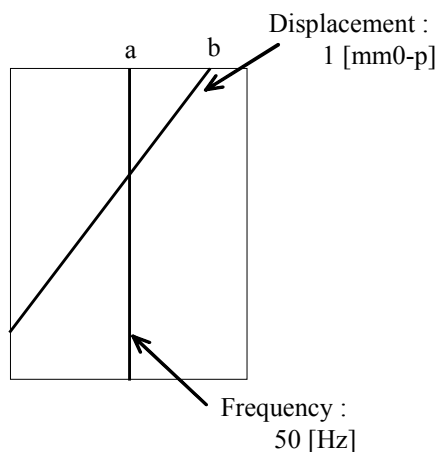
● Conversion Table

Use the conversion table to obtain each value. However, note that the displacement quantity is a single displacement [mm0-p].

<Example>

Frequency : $f = 50$ [Hz]
 Displacement : $D = 1$ [mm0-p]
 Acceleration A and velocity V values will be derived ;

- (1) Draw a line 'a' of frequency 50Hz and a line 'b' of displacement 1 [mmp-p]
- (2) Read the velocity value on velocity axis from the crossing point of the line 'a' and 'b'. In this example, the values become as acceleration 100 [m/s^2] and d velocity 0.3 [m/s]



<Calculation>

The conversion table gives approximate values only. Please calculate the accurate values by using the following formulas if you need them.

$$\text{Velocity } V = \frac{2\pi f}{1000} D$$

A : Acceleration [m/s^2]

V : Velocity [m/s]

$$\text{Acceleration } A = \frac{(2\pi f)^2}{1000} D$$

D : Displacement [mm0-p]

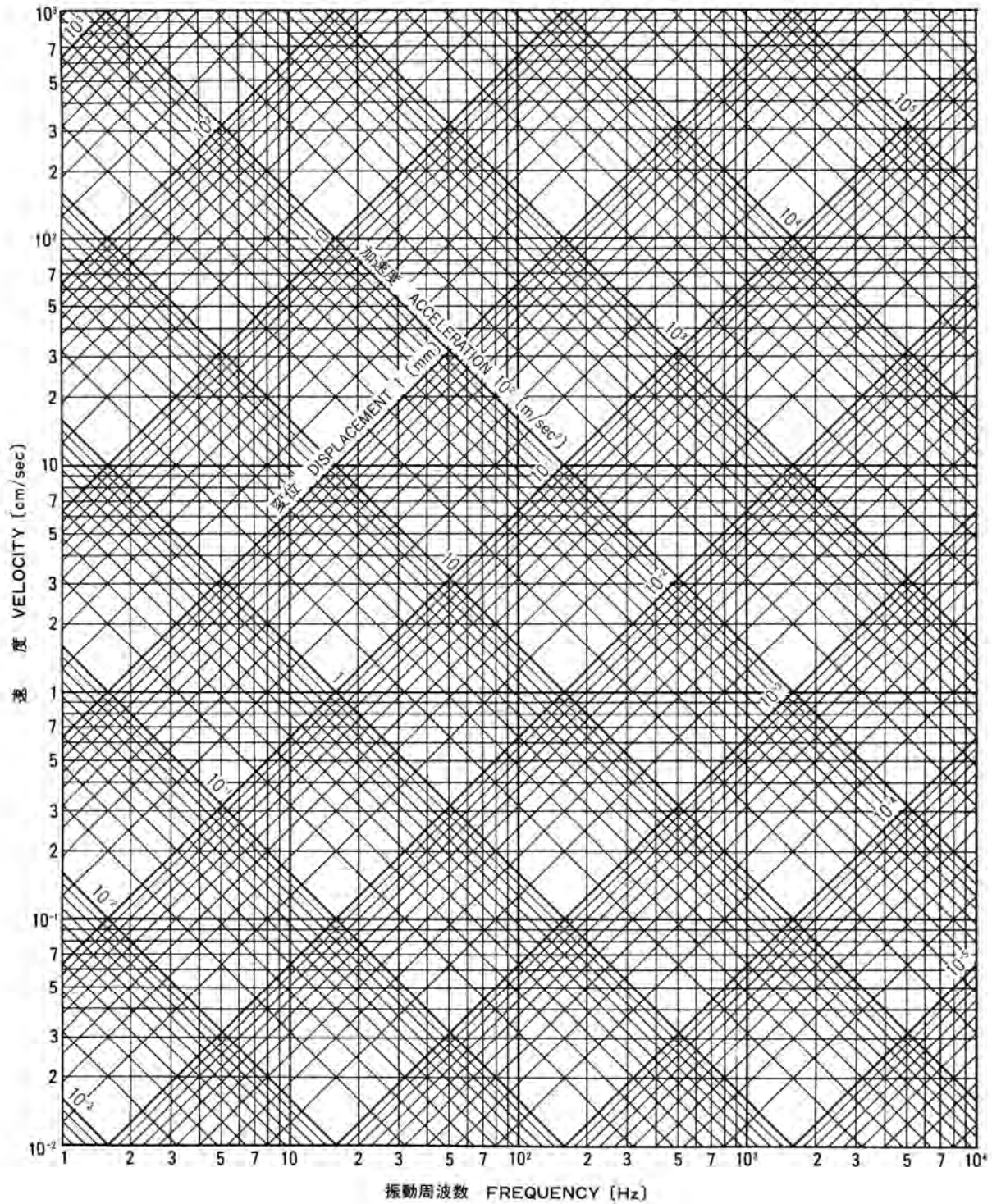
According to the above example, each value can be calculated as below ;

$$V = \frac{2 \times \pi \times 50 \times 1}{1000} = 0.314 \text{ [m/s]}$$

$$A = \frac{(2 \times \pi \times 50)^2 \times 1}{1000} = 98.7 \text{ [m/s}^2\text{]}$$

SINE VIBRATION CHART

CONVERSION TABLE



Displacement $D = d$ [mm]

Velocity $V = \frac{2\pi fd}{10}$ [cm/sec]

Acceleration $A = \frac{(2\pi fd)^2}{1000} d$ [m/sec²]

f : Frequency [Hz]

Note : D, V, A are Single Amplitude.

Example

- 1) When $f = 50$ Hz, $D = 1$ mm,
 $V = 31$ cm/sec, $A = 99$ m/sec²
- 2) When $f = 100$ Hz, $V = 100$ cm/sec,
 $D = 1.6$ mm, $A = 630$ m/sec²
- 3) When $f = 600$ Hz, $A = 60$ m/sec²,
 $D = 0.0042$ mm (4.2μ m), $V = 1.6$ cm/sec

7. GLOSSARY

Frequency Range : The frequency range that the manufacturer (maker) of vibration test system defines the rated force, the maximum acceleration, the maximum velocity and the maximum displacement of the system.

Rated Force : The force that the vibration test system can generate. (Unit:kN) The force is defined as ‘peak value’ in case of SINE vibration and ‘RMS value’ (Root Mean Square) in case of RANDOM vibration.

Max. Acceleration : The maximum acceleration value (Unit:m/s²) that the vibration test system can generate at no loading condition. This value is calculated by the maximum rated (excitation) force divided by the armature mass.

Max. Velocity : The maximum velocity value (Unit:m/s) that the vibration test system can generate.

Max. Displacement : The maximum displacement value (Unit:mmp-p) that the vibration test system can generate. This value is limited by the allowable mechanical stroke of the vibrator’s armature and usually described in double amplitude (peak-to-peak) value.

Max. Loading Weight : The maximum loading weight on the armature (or the vibration table) of the vibrator. (Unit:kg)

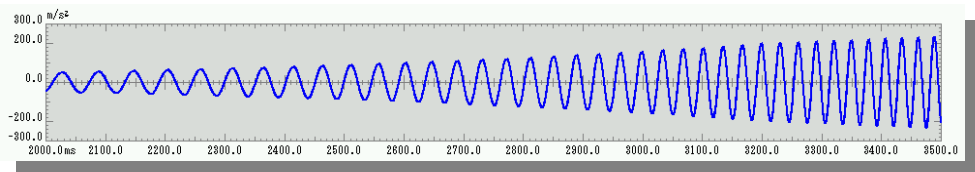
Armature Mass : An armature is the vibration parting of a vibrator and is assembled of ‘Vibration table’ that specimens or fixtures are mounted, and ‘Drive coil’. When the rated force is the same, the smaller mass armature vibration systems the larger acceleration can be tested.

Allowable Overturning Moment : The eccentric (off-centered) moment value that the guidance system for the vibration table allows.

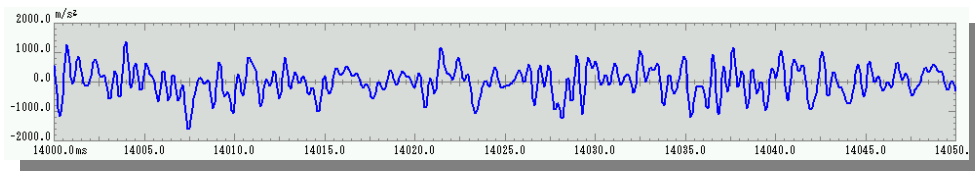
Stiffness of Armature Suspension System : Stiffness of suspension system when the mass is added on the armature in vertical direction. (Unit : kN/m)

Maximum Performance Curve : The graph having ‘Horizontal axis – Frequency’ and ‘Vertical axis – Acceleration’ expresses the maximum performance of vibration test (sine excitation without loading).

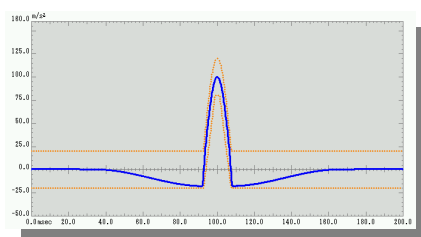
SINE Vibration Test : The two type test methods are done ; the one is SWEEP (Frequency Sweep or Swept SINE) test, that changes the excitation frequency continuously according to the frequency sweep method specified in the test, and the other is the fixed excitation frequency test. SINE vibration tests are performed for ordinary industrial standard vibration tests including measurement of dynamic characteristics of specimens, such as in JIS or IEC. RESONANCE DWELL test, that performs measurement and tracking of change of resonance frequency of the specimen automatically and that performs the SINE vibration durability test at the changed new resonance frequency, is also done. (JIS C 0040, IEC 68-2-6, etc.)



RANDOM Vibration Test : Real vibration is not a simple or periodic vibration waveform, like SINE vibration. Rather, real vibration waveform is of a random or transient shock waveform, including many vibration spectra. In SINE vibration tests, only the one frequency resonance of specimens can be excited. In RANDOM vibration tests, specimens are subjected to vibration energy spectra in a wide frequency range and excited at many response frequencies simultaneously. (JIS C 0036, IEC 68-2-64, etc.)



SHOCK Test : Like RANDOM vibration, SHOCK waveform has wide frequency range spectrum and enables to excite lots of resonance of the specimen simultaneously at many frequencies. In case of RANDOM vibration, the excitation gives so-called ‘Gaussian Distribution’ type vibration that is very close to long time real vibration waveform. In case of SHOCK tests using real transient waveform, outstanding field failure due to the stress can be reproduced on the testing system. (Shock of vehicle or handling, etc.) (JIS C 0041, IEC 68-2-27, etc.)



8. WARRANTY AND AFTER SALES SERVICE

The following description must be read well.

● WARRANTY

The system is shipped after severe testing and checking for the ability of the system that satisfies the rating value by IMV Corporation. The warranty of the system is described as below ;

(1) Guarantee period

In case of defects/faults of quality, materials or workmanship within the guarantee period, we will repair or replace such defective parts without any charge.

The guarantee period shall be earlier one either 12 months counting from the date when the equipment arrives at your port or 18 months from FOB port. But our guarantee shall not be applied even in the guarantee period against the damage due to accidents on importers handling and wrong or unreasonable operation/driving.

(2) Range of guarantee

In case of defects / faults quality, material or workmanship within the above guarantee period will repair or replace such defective parts without any charge.

However, our guarantee shall not be applied even in the guarantee period for the damage due to accident, importers incorrect handling, or wrong unreasonable operation of the system.

(3) Responsibility

The followings are out of our responsibility even in guarantee period.

- (1) The accident during attachment / removing of specimen or fixture, or due to dropping of them to the system.
- (2) The accident due to customer's utilities for the system.
(Due to extend duct hose, Cooling water, power supply, Earth facility, or air conditioning, etc.)
- (3) The accident due to customer's operation out of the rated specifications.
- (4) The accident due to some corrosive environment by direct sunlight, water leakage and salty or some chemical atmosphere, or due to some particular environment.
- (5) The accident due to unreasonable operation.
- (6) The accident due to customer's specimen.

Please call to IMV or our sales representative company in your country if you have any questions regarding the above.

● Maintenance and Calibration

By performance of periodic Maintenance, Electro-dynamic vibration test systems can be used for a long time and with high-quality performance. The periodic maintenance and calibration workings are essential for the customers to keep the test systems under the original traceabilities. For this, IMV recommends the customers to perform periodic maintenance and calibration of the installed vibration test systems every year.

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