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AD2-I20-A043

Small Vibration Test Facility

Users' Manual

Advanced Engineering Services Co., Ltd.

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Table of Contents

List of Figures

Appendix D

List of Tables

1 Introduction

This users' manual is to provide necessary information to the users of Small Vibration Test Facility (referred to as "this facility" hereafter) located in Spacecraft Integration and Test Building.

2 Brief Overview of this Facility

2.1 Usage Purposes and Features

This facility is used for simulating the vibration environment on spacecraft imposed during launch, for the purposes of understanding its environmental resistance, dynamic characteristics, etc. It is capable of providing excitation force of up to 178.0 kN (18,163 kgf) in sine wave vibration, up to 178.0 kN rms (18,163 kgf rms) in random wave vibration, and up to 334.0 kN p-p (34,082 kgf) in transient wave vibration (SHOCK), and performing tests on spacecraft systems, subsystems, components, etc., weighing 2t or less.

The facility consists of a shaking system, a control/measurement/analysis system, a supplementary operation system, etc. The shaker, which is the core of the shaking system, is of an electrodynamic type, and comes in all-in-one with the horizontal vibration table. The movable parts of the shaker have no water-cooled piping, which helps reducing the risk of failures taking place during tests and therefore contributes on raising reliability. The control/measurement/analysis system, meanwhile, controls and monitors the shaker, and acquires vibration data at measurement points. Each channel has a real-time processing function and high throughput performance, which together support efficient performance of tests especially on spacecraft that require multi channels.

At the scenes of facility operation, each software and hardware is provided with its best-suited interlock mechanism, which enhances reduction of human errors and safe performance of tests.

2.2 System Outline and Functions

The outline and functions of this facility are explained below. Also, its schematic drawing and system diagram are shown in Figures 2-1 and 2-2, respectively.

2.2.1 Shaking System

The shaking system, which is made up of a shaker and its related equipment, a cooling system, and a power supply system, transmits vibration designated by a controller to a test specimen (■abbreviated as TS hereafter). Each of the systems is explained below.

(1) Shaker and related equipment

(a) Shaker

The shaker of this facility is of an electrodynamic type. It is characterized to have a light and strong inductor-ring-type armature which operates without cooling water. The shaker is supported by air pressure in vertical excitation, and by plate springs in horizontal excitation. Being turned by 90 deg, the shaker can provide excitation in both horizontal and vertical directions.

(b) Horizontal/vertical vibration tables

The vibration table system consists of a horizontal table, vertical tables, an oil supply device, etc. The vertical table is supported by a supporting structure, and its neutral position is retained by air pressure. The horizontal table, on the other hand, is support by the combination of the hydrostatic bearings placed on the surface plate and the oil film filling the spaces between the vibration table and the surface plate. The oil supply device supplies a necessary amount of hydraulic pressure to the hydrostatic bearings of the horizontal table.

(c) Base and damper, load distribution board

The base and damper mechanism holds the shaker and vibration tables the way unnecessary vibration is not directly transmitted to the facility foundation. By inserting an air-pressure damper between the base and the load distribution board, the transmission of load to the facility foundation is damped. The load distribution board supports the shaker, a vibration table, and the base, while distributing and transmitting load to the facility foundation built apart from the building.

(2) Cooling system

There are air-cooled type and water-cooled type cooling systems. The armature of the shaker is cooled by circulating air with a blower and furthermore spraying water to make use of the vaporization heat when necessary. The exciting coil of the shaker keeps equipment in an adequate temperature range by circulating cooled water for heat exchange.

(3) Power supply system

The system is composed of a power amplifier, a console rack (remote control unit), etc. The power amplifier supplies necessary power to the shaker up to the maximum output of 360 kVA. It has a protection circuit to protect a TS from exposure to excessive shock due to the sudden stop of a shaker in its emergency abort in the middle of excitation application. The console rack (remote control unit), meanwhile, enables the operation and monitoring of equipment from the control room.

2.2.2 Control/Measurement/Analysis System

The control/measurement/analysis system consists of a “control system”, a “data measurement/analysis system”, and the monitors and printers, etc. connected to individual devices. The “control system” denotes a device that controls the shaking system, being made up of a control system frontend (control signal input/output module), a controlling software, a controlling work station, an emergency abort switch, etc. The “data measurement/analysis system” denotes a device that acquires data from the measurement sensors mounted on a TS and performs analysis on it, being made up of a frontend (measurement signal input/output module), a software, a work station, for measurement and analysis, etc. Those two systems explained above are collectively called a “control/measurement/analysis system.”

(1) Shaking controller

The shaking controller controls excitation spectrums, sweeps, notches, abort, etc., by transmitting control command signals to the shaker and its related equipment while receiving the feedback signals from a TS and the vibration tables. It can take in measurement signals from the vibration tables and a TS via up to 48 channels. After a test, such information as control levels, target function, output curves, etc., can be displayed on the monitor of the workstation and recorded.

(2) Data measurement/analysis system

The data measurement/analysis system measures and saves the vibration responses of a TS, being capable of dealing with voltage and charge signals of up to 224 channels. It can also perform real-time analysis on the measured data under the preset condition. The saved data can be subject to posttest analysis, e.g., sine wave, random wave, and transient wave (SHOCK), etc.

2.2.3 Supplementary Operation System

The supplementary operation system, consisting of an uninterruptible power supply, ITV cameras, and a vibration-exciter display panel, works as a supplementary and supportive facility for executing tests.

(1) Communication device

The device is used for mutual and simultaneous communications between and among test-concerned personnel in the test room or the measurement and control room. And individual workers can be addressed to from the speakers installed in the test room and the control room.

(2) ITV cameras

ITV devices monitor the states inside the test room and of a TS, displaying them on the monitor installed in the measurement and control room in real time. The captured images can be recorded in external memory media, e.g., BL/DVD disc, etc.

(3) Vibration-exciter display panel

The states of excitation during a test (test level, excitation frequency, excitation duration, etc.) is displayed on the panel installed in the test room, to help workers there get a handle on the excitation statuses. Other than that, users can put up the information they want to notify the workers in the test room on the panel.

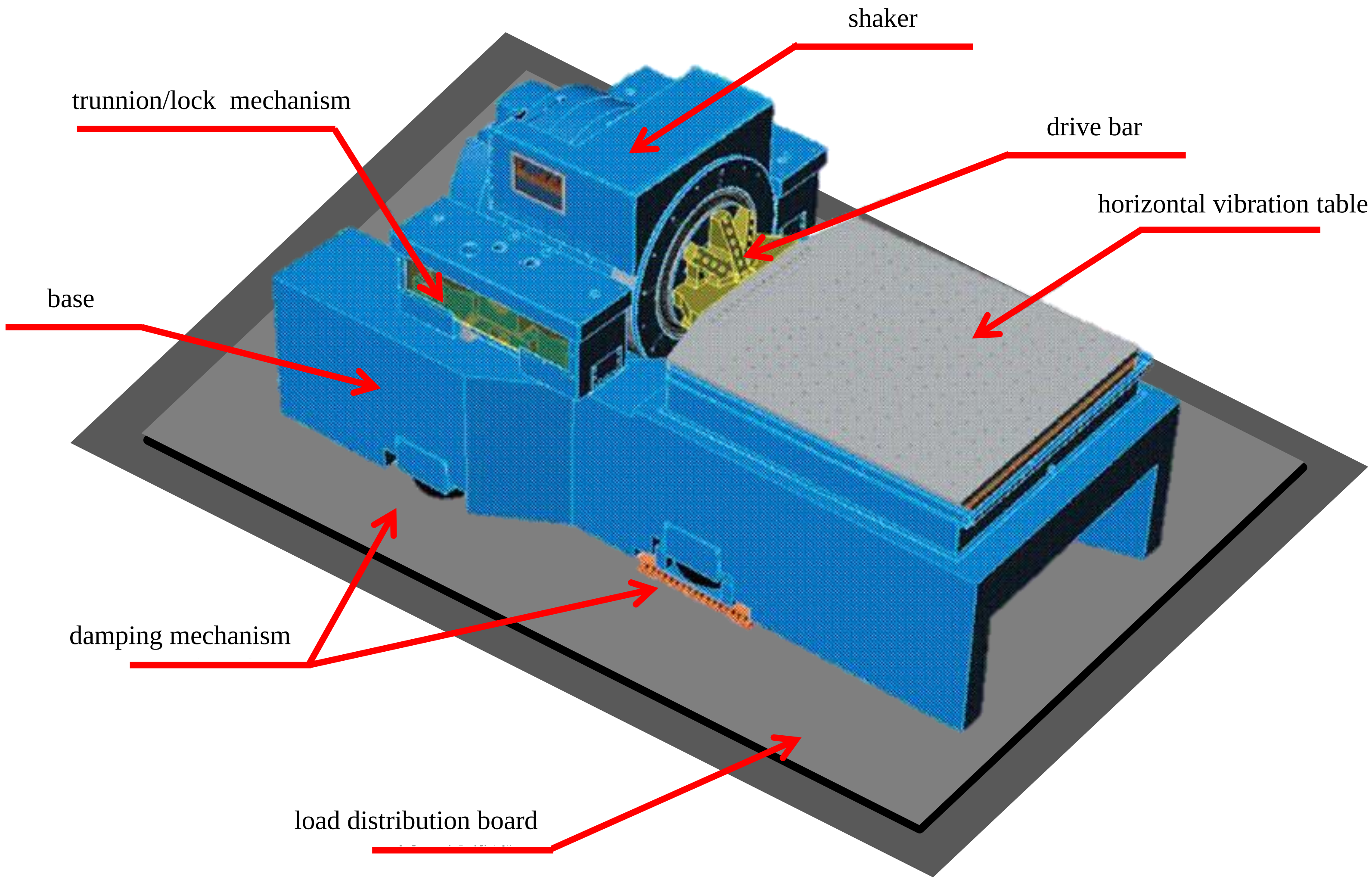


Figure 2-1 Bird's Eye View on Facility (shaker and its related equipment)

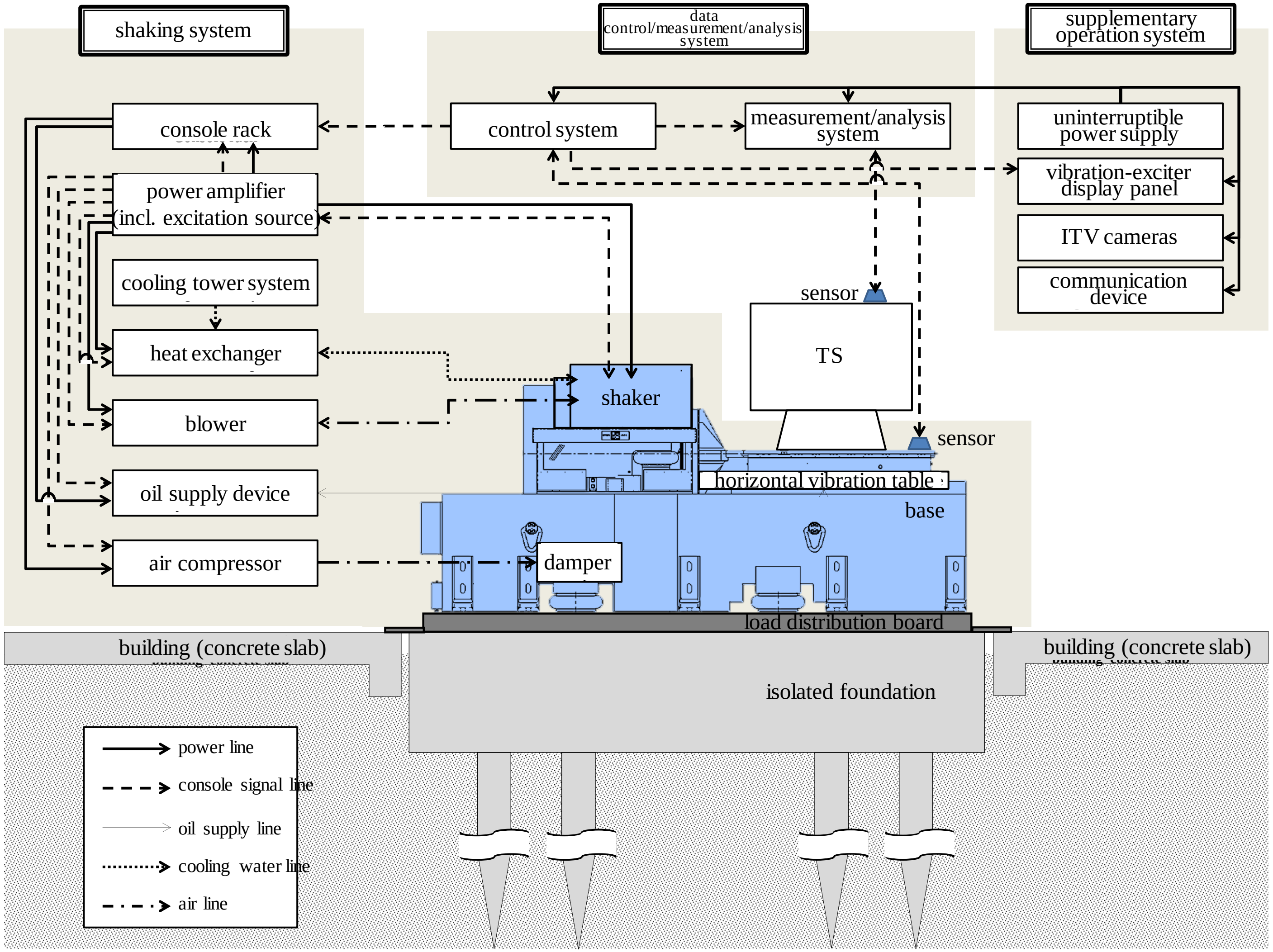
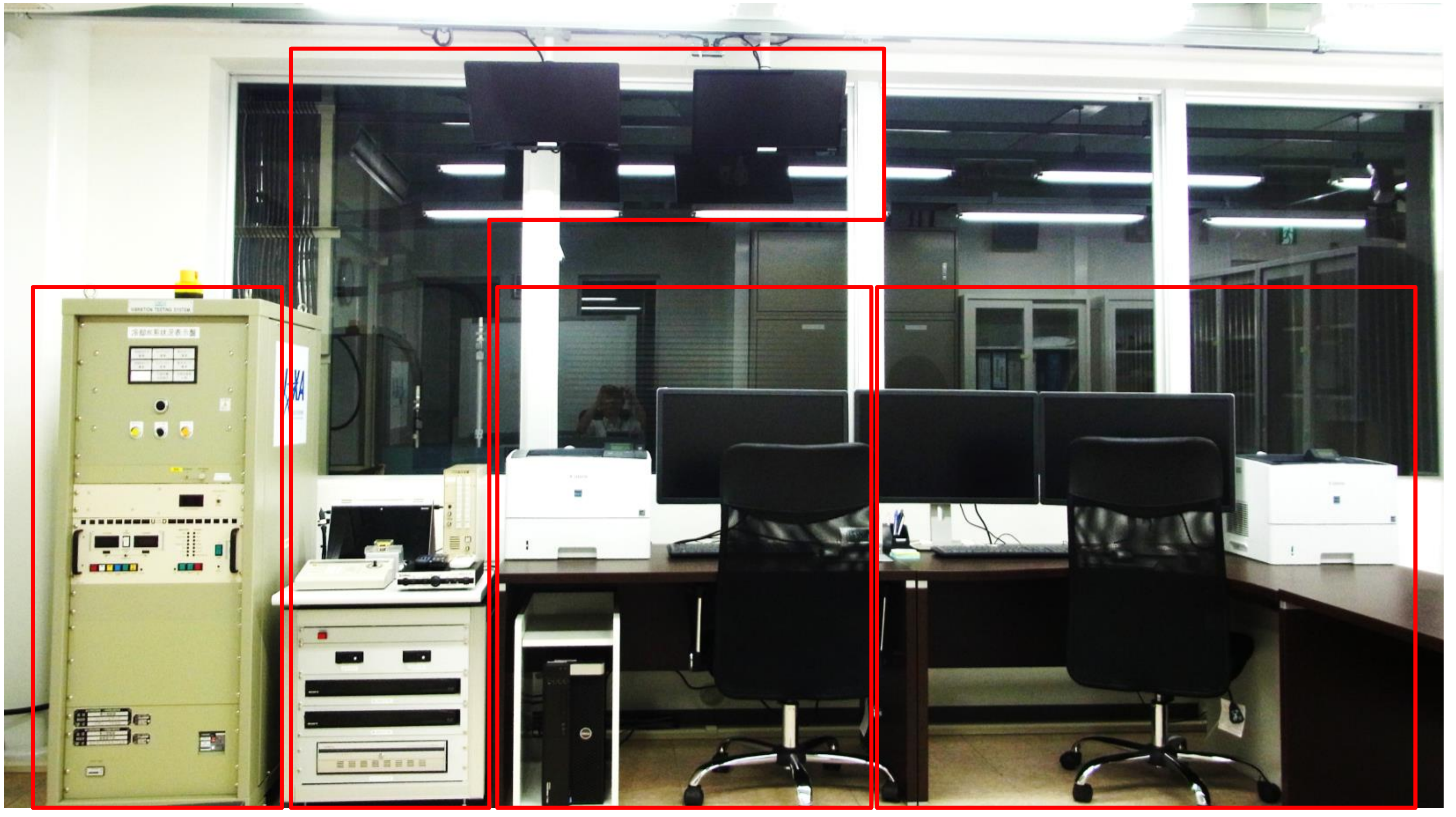


Figure 2-2 System Diagram



console rack
supplementary operation system
control system
data measurement/analysis system

Figure 2-3 External Appearance of Control Room Systems

2.3 Main Specifications

2.3.1 Shaker and Related Equipment

The specifications of the shaker and its related equipment in this facility are shown below.

(1) Excitation system — electrodynamic shaker

(2) Frequency range — 5 ~ 2,000Hz

* Some transient waves can achieve a test of up to 4,000Hz, which may differ depending on individual excitation waveforms and vibration tables; refer to Table 2-5 for more details.)

(3) Vibration direction — vertical or horizontal

Table 2-1 Days Required for Axes Conversion

	required days
vertical → horizontal	0.5
horizontal → vertical	0.5

(4) Vibration tables — two vertical vibration tables (cf. Table 2-5 for details)

one horizontal vibration table (cf. Table 2-5 for details)

(5) Excitation waveform — sine wave, random wave, transient wave (classical shock, shock synthesis)

(6) Support for movable part — neutral position retention by air springs horizontal and rotation direction control by mechanical springs

(7) Excitation ability

Table 2-2 Excitation Ability

	normal mode*1	high mode*1
sine wave	150.9 kN	178.0 kN
random wave*2	146.9 kN	178.0 kN
transient wave	275.6 kN	334.0 kN

*1 Either normal mode or high mode can be chosen depending on excitation specifications. The high mode allows the maximum excitation ability to be performed.

*2 The lowest limit frequency is to be 20Hz or higher in the maximum capable random wave excitation.

(8) Maximum acceleration — The maximum accelerations of the unloaded shaker and of each vibration table are shown in Figures 2-5～2-9. (Prior checking is required when tests are performed around the maximum excitation ability.)

$$\alpha = \frac{F}{M1 + M2}$$

α: maximum acceleration (m/s^2)
F: excitation ability (N or N rms)
M1: mass of movable part (kg)
(cf. Table 2-5 for details)
M2: mass of TS (kg)

(9) Maximum velocity

Table 2-3 Maximum Velocity

	normal mode	high mode
sine wave	2.1 m/s 0-p	1.9 m/s 0-p
random wave	2.1 m/s 0-p	1.9 m/s 0-p
transient wave	3.5 m/s 0-p	3.1 m/s 0-p

(10) Maximum displacement

Table 2-4 Maximum Displacement

	normal mode	high mode
sine wave	43.1 mm p-p	38.0 mm p-p
random wave	43.1 mm p-p	38.0 mm p-p
transient wave	51.0 mm p-p	40.0 mm p-p

(11) Minimum control level sine wave: 1.96 m/s^2 (0.2G)

random wave: 1.96 m/s^2 rms (0.2 G rms)

(12) Noise level 1.96 m/s^2 (0.2G) or less (unloaded)

(13) Magnetic flux leakage 4 mT (40 gauss) or less at 152 mm above the vibration plate

(14) Acceleration waveform strain within 10% (within vibration frequency range, unloaded)

(15) Transverse motion cf. Table 2-5

(crosstalk components)

(16) Acceleration distribution cf. Table 2-5

(17) Sigma limit level 3.0 σ

Table 2-5 Specifications of Vibration Tables

	unloaded vertical shaker	vertical vibration table		horizontal vibration table
vibration table	——	HEG24-63R-20	*3AST－210VDM	483.48-16
excitation frequency range	5 ~ 2,500Hz	5 ~ 2,000Hz	5 ~ 2,000Hz	5 ~ 2,000Hz
minimum fundamental frequency	2,000Hz	670Hz	1,000Hz	680Hz
mass of movable part	114 kg	614 kg	346 kg	409 kg
maximum load	1,818 kg	2,000 kg	1,586 kg	2,000 kg
(allowable) overturning moment	4,903 N･m (500 kg･m)	16.9 kN･m (1,724 kg･m)	4,903 N･m (500 kg･m)	M_R310 kN･m*1 (31,633 kg･m) M_P310 kN･m*1 (31,633 kg･m) M_Y16 kN･m*1 (1,632 kg･m)
transverse motion*2 (crosstalk) 【reference value】	20% or less (5 ~ 500Hz) 100% or less (500 ~ 2,000Hz)	10% or less (5 ~ 100Hz) 20% or less (100 ~ 500Hz)	10% or less (5 ~ 100Hz) 30% or less (100 ~ 500Hz) 150%以下 (500 ~ 2,000Hz)	10% or less (5 ~ 300Hz) 25% or less (300 ~ 500Hz)
acceleration distribution*2 【reference value】	within ±5% (5 ~ 500Hz) within ±20% (500 ~ 1,000Hz) within ±100% (1,000 ~ 2,000Hz)	within ±10% (5 ~ 300Hz) within ±50% 300 ~ 500Hz	within ±5% (5 ~ 200Hz) within ±20% (200 ~ 500Hz) within ±250% (500 ~ 2,000Hz)	within ±5% 5 ~ 150Hz within ±20% 150 ~ 300Hz within ±50% 300 ~ 500Hz
dimensions	about 0.6 mφ cf. Figure 3-5 for more details	about 1.6 mφ cf. Figure 3-6 for more details	about 1.1 mφ cf. Figure 3-7 for more details	about 1.2 × 1.2m cf. Figure 3-9 for more details

*1 The directions of M_R, M_P, and M_Y are shown in the following Figure.

*2 The figures denote the reference values of unloaded statuses. That is, the values change depending on the positions of control points and the geometries of a TS and a jig. The acceleration distribution ranges specified in the table can be exceeded especially when the CG offset and overturning moment of a TS are large, even when the moment is within the level allowed by the facility.

*3 AST-210VDM is shared by the 18t Vibration Test Facility.

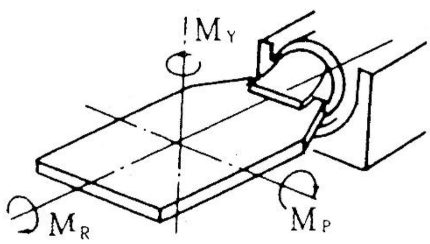
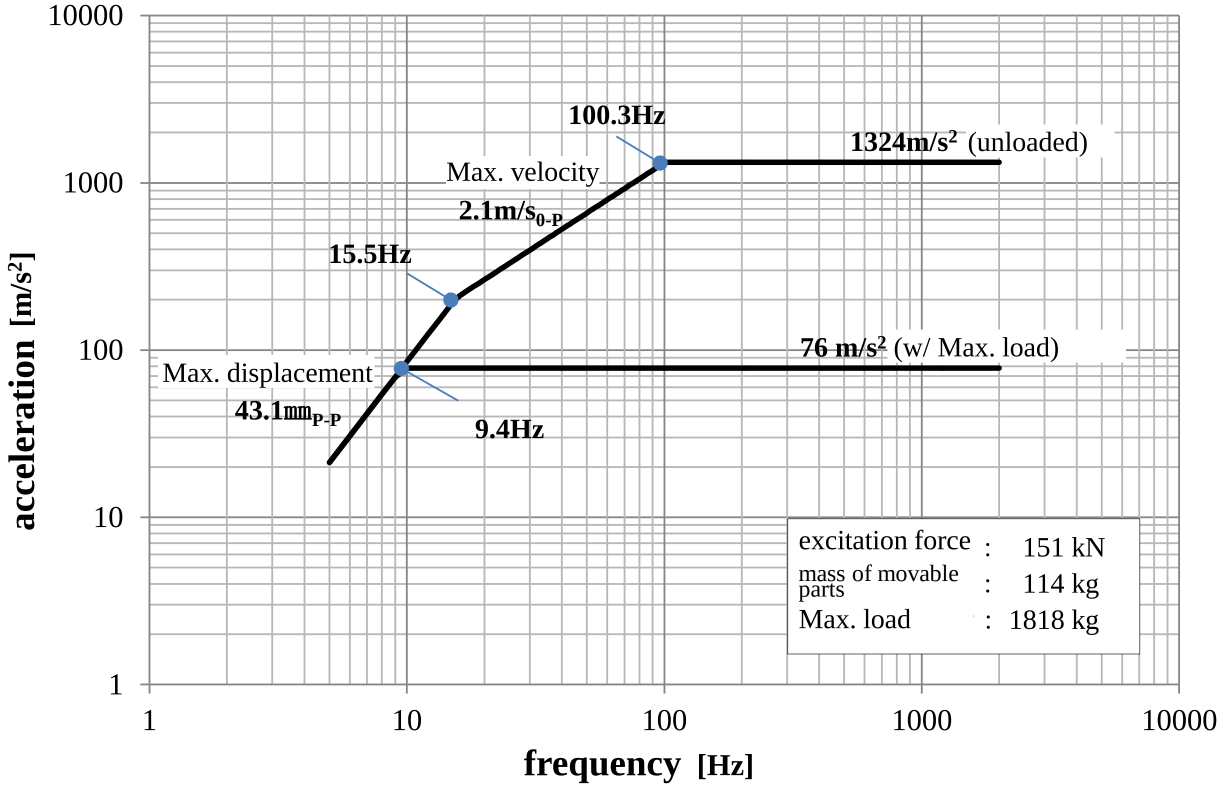
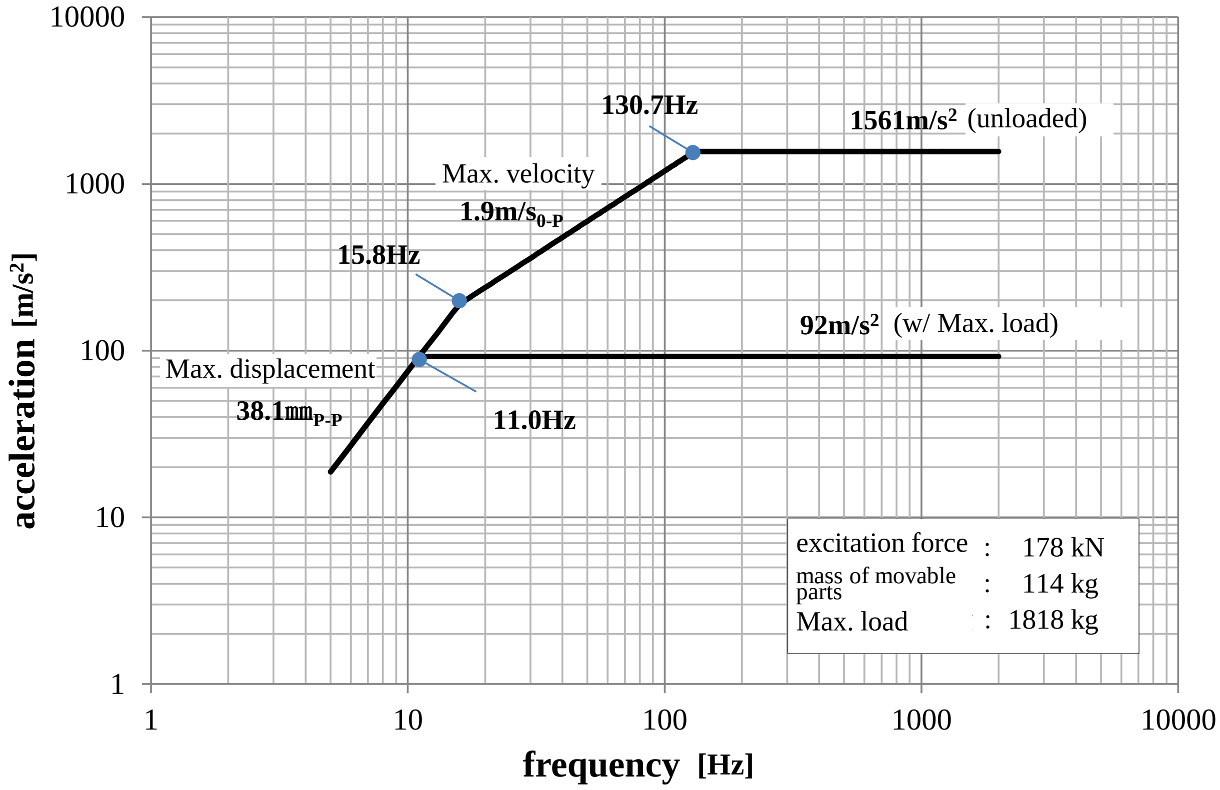


Figure 2-4 Definition of Rotary Axes



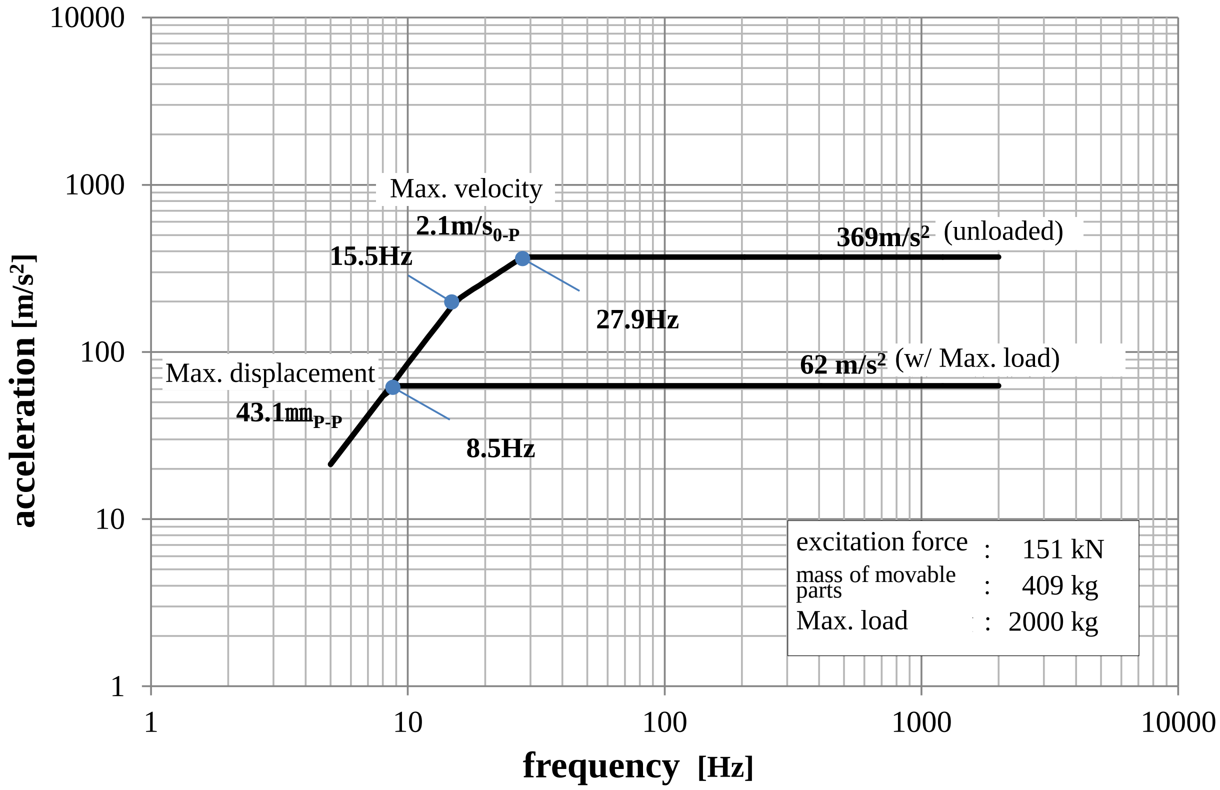
(a) NORMAL mode



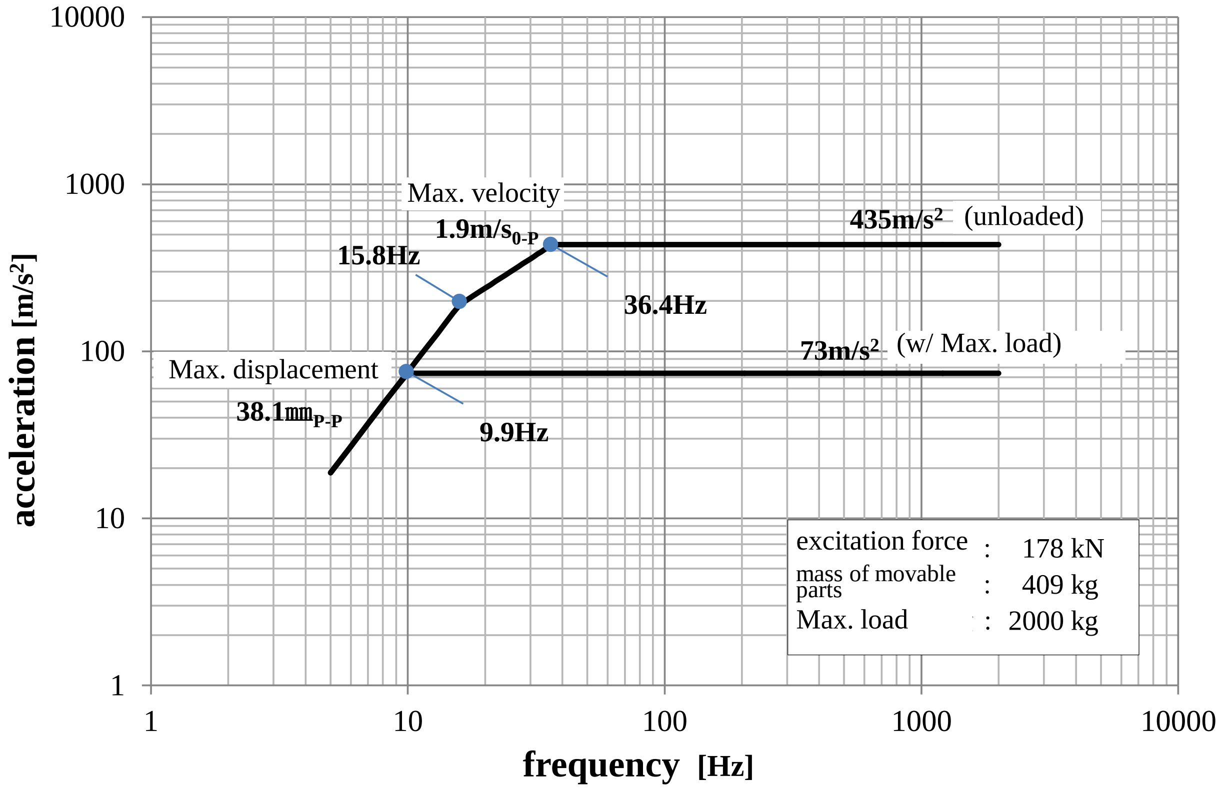
(b) HIGH mode

Note) The maximum loadable acceleration may be unachievable depending on test waves and levels; users are therefore to perform prior checking.

Figure 2-5 Maximum Acceleration (Unloaded Shaker)



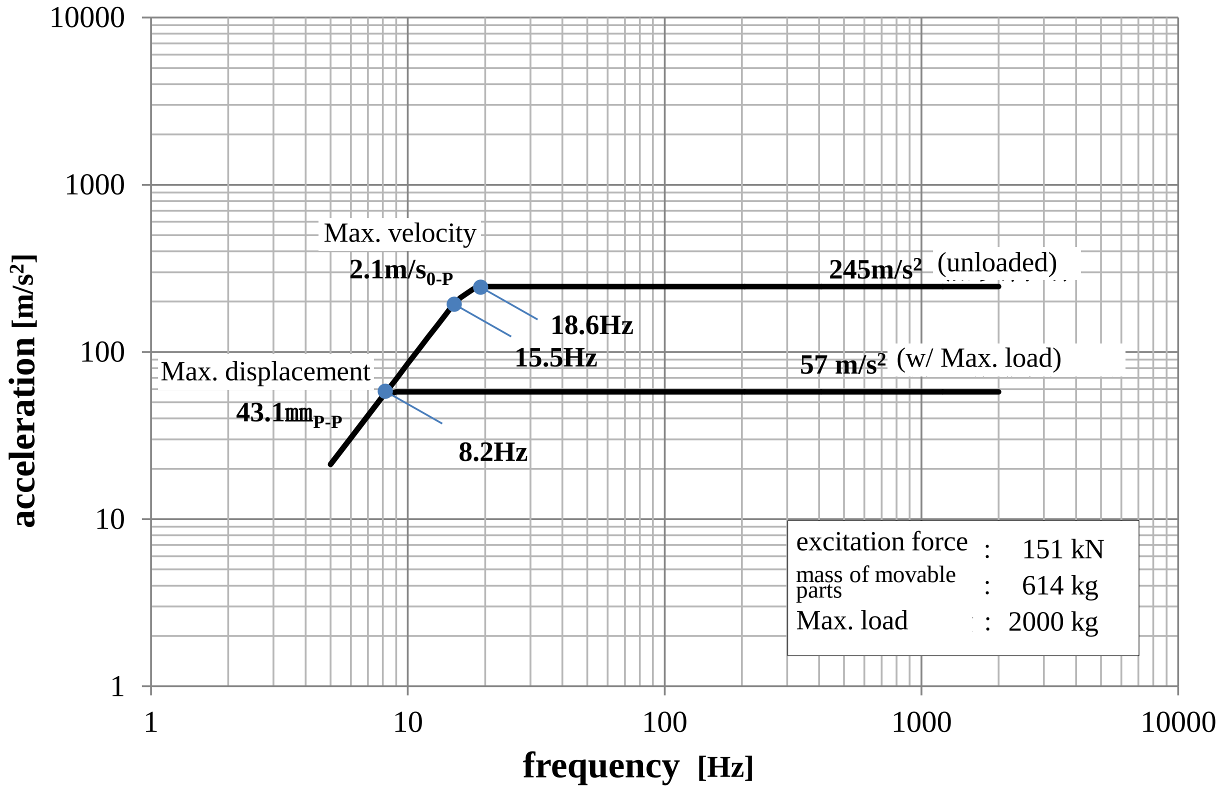
(a) NORMAL mode



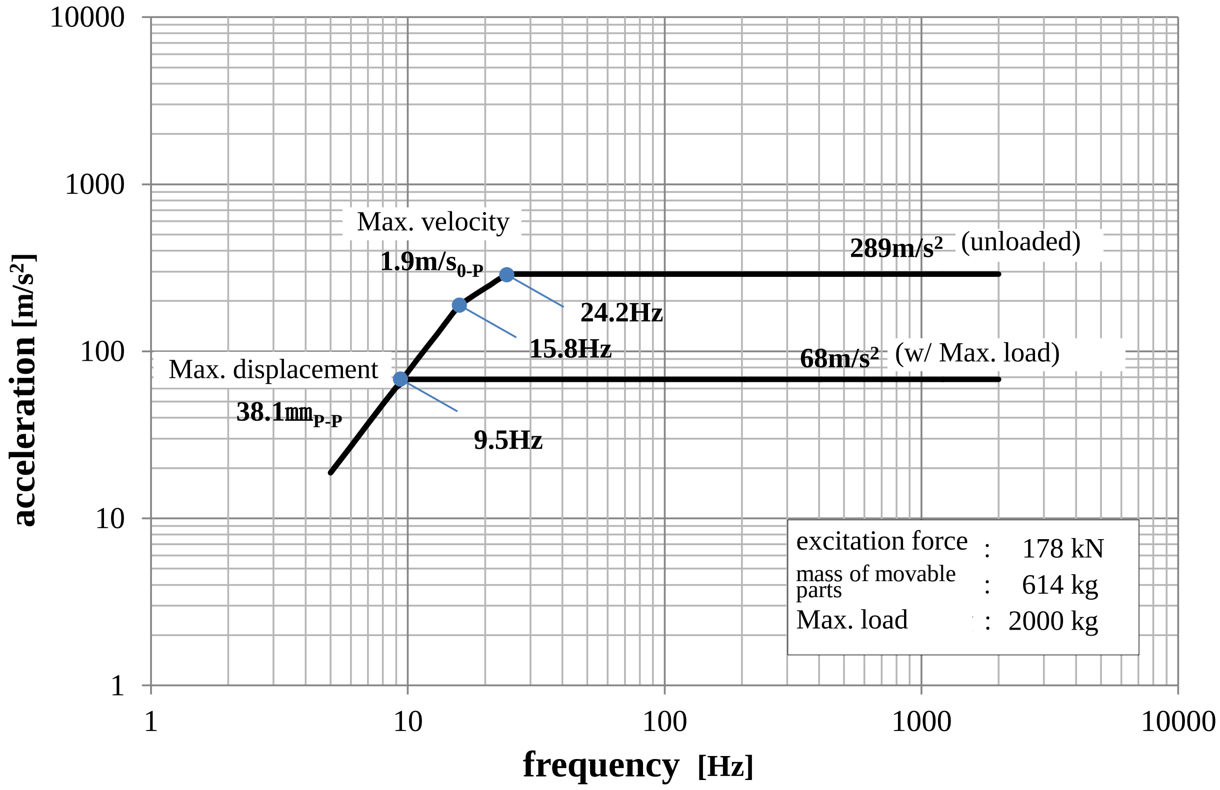
(b) HIGH mode

Note) The maximum loadable acceleration may be unachievable depending on test waves and levels; users are therefore to perform prior checking.

Figure 2-6 Maximum Acceleration (Horizontal Vibration Table 483.48-16)



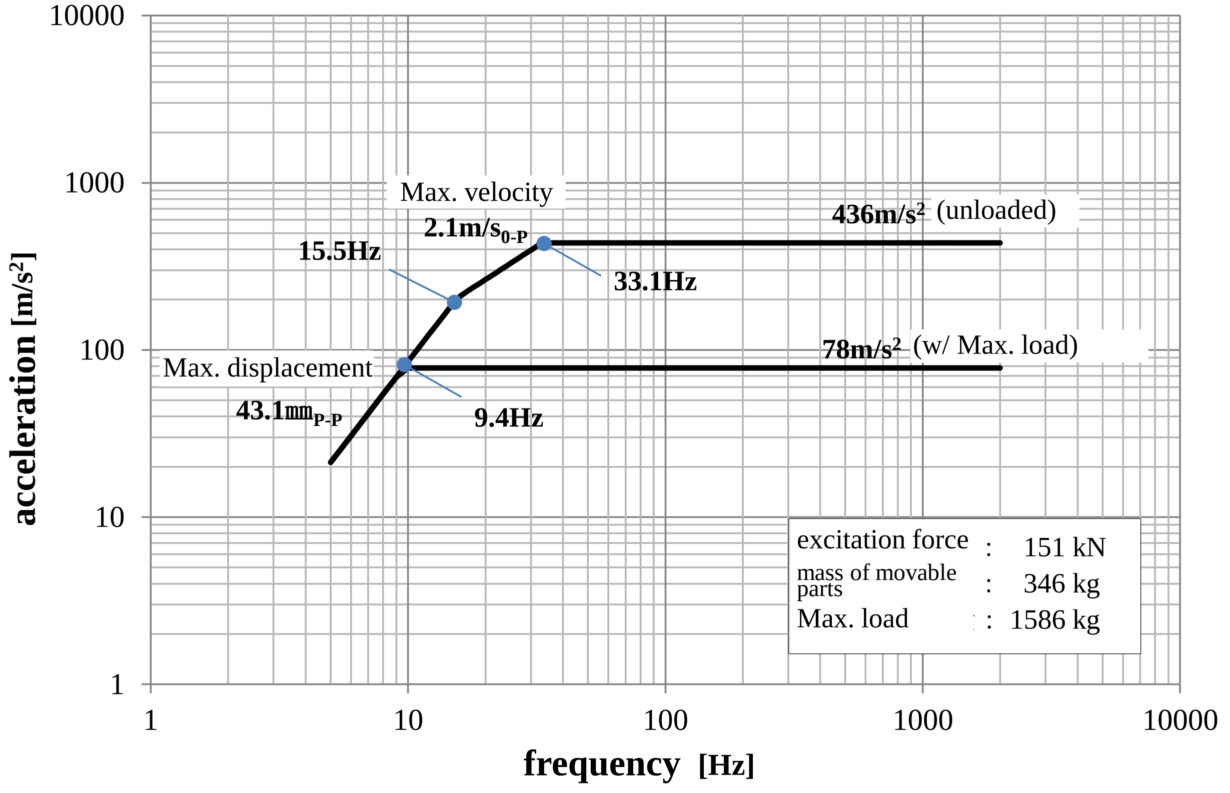
(a) NORMAL mode



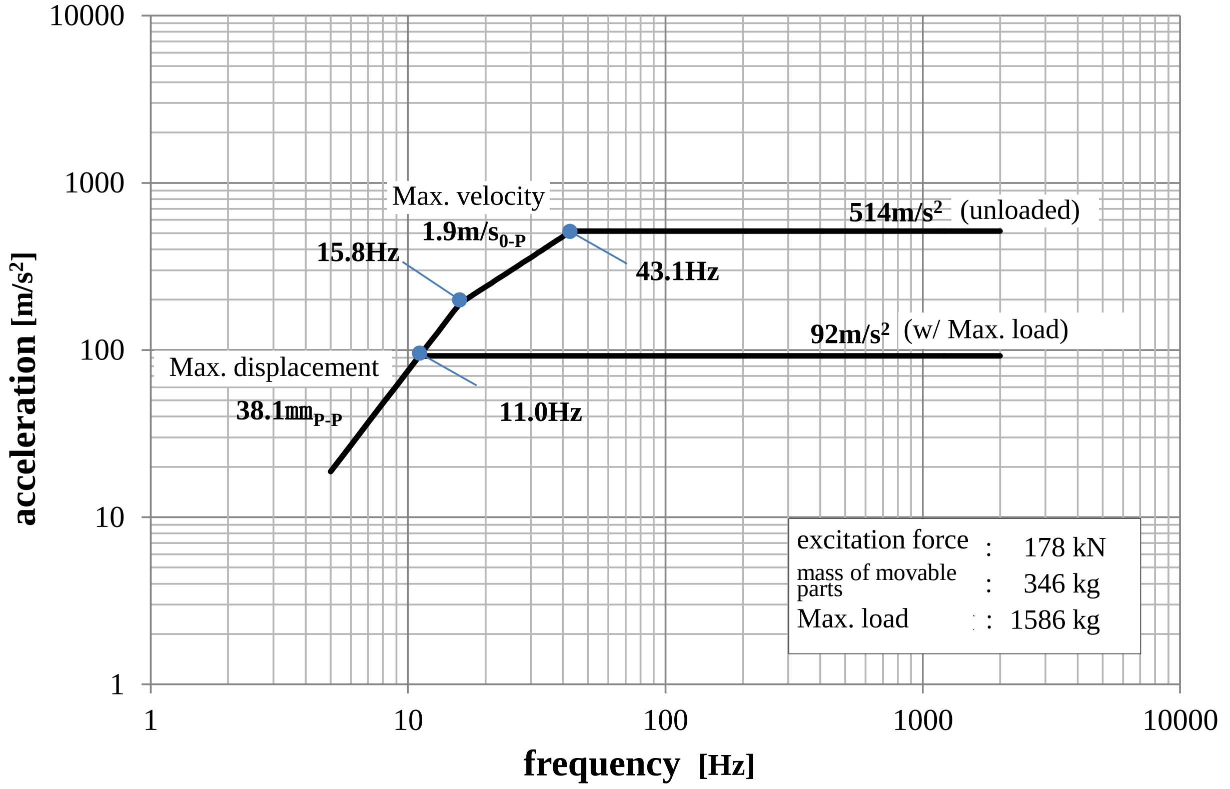
(b) HIGH mode

Note) The maximum loadable acceleration may be unachievable depending on test waves and levels; users are therefore to perform prior checking.

Figure 2-7 Maximum Acceleration (Vertical Vibration Table HEG24-63R-20)



(a) NORMAL mode



(b) HIGH mode

Note) The maximum loadable acceleration may be unachievable depending on test waves and levels; users are therefore to perform prior checking.

Figure 2-8 Maximum Acceleration (Vertical Vibration Table AST-210VDM)

(Reference) Transient Wave (Shock) Test Performance Curve

The performance curves of a shaker in transient waves (shock) are shown below. The levels here are to be considered as reference values, because shock tests adopting an instantaneous pulse can be easily influenced by a TS, jig, etc., making it difficult to judge if a test can be conducted solely based on a performance curve.

Users are to discuss the possibility of conducting a test for the specified test conditions and configurations with the facility-side personnel in advance.

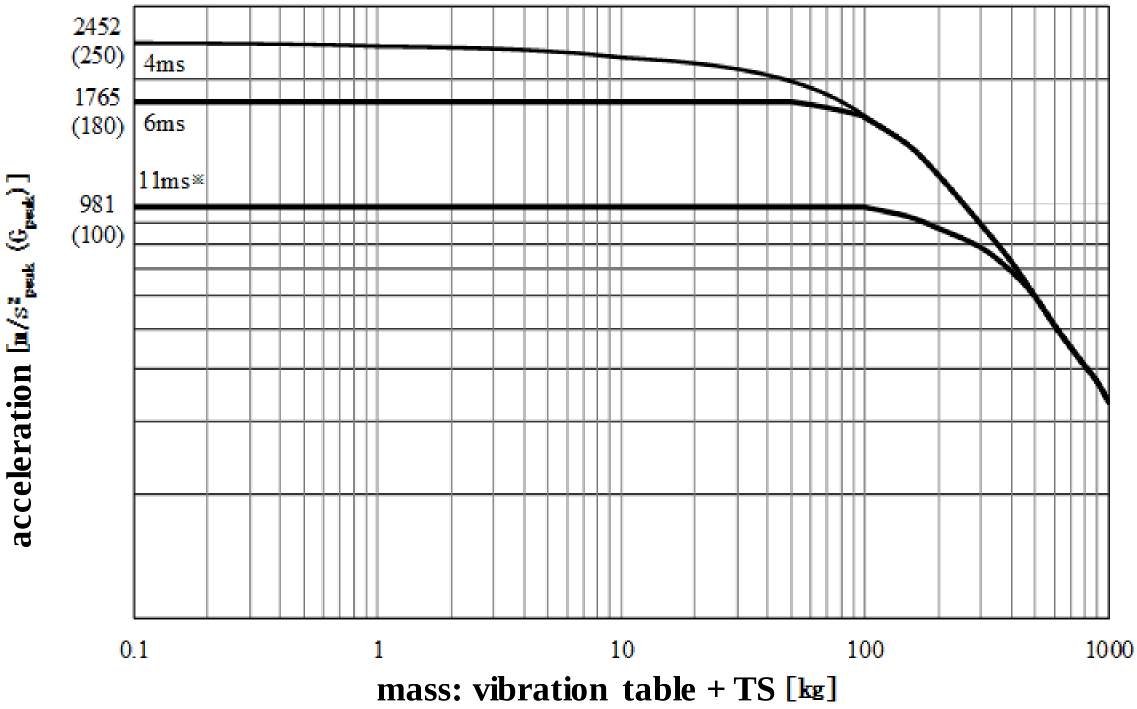


Figure 2-9 Maximum Acceleration (Unloaded Shaker: Transient Wave (Half Sine*))

* Prepulse and postpulse: +12% and -24%, except for 11-ms waveform for which postpulse is to be set at +12% and -30%.

2.3.2 Control System

The specifications of the excitation control system in this facility are shown below.

(1) Common

The common specifications among control systems for different waveforms, e.g., data output, format, etc., are shown in Table 2-6.

Table 2-6 Common Basic Performance among Control Systems

item	specification
data output	target spectrum, upper/lower limit alarm, upper/lower limit abort, transfer function, frequency spectrum averaged among control channels, frequency spectrum of each control channel, frequency spectrum of each measurement channel, drive spectrum, error spectrum, results of each analysis
output data format	outputtable to universal file, MATLAB format, Excel format (CSV format)

(2) Sine wave

The basic performance of the control system for sine wave sweep tests is shown in Table 2-7.

Table 2-7 Basic Performance of Control System (sine wave)

item	specification
input channel	48 channels (total of excitation control channels and targeted limit channels for test)
control strategy	average / maximum / minimum level
calculation method for control levels	One of harmonic (tracking filter), RMS level, peak level, and average level, is chosen.
excitation frequency range	range between 0.05Hz ~ 40,000Hz
sweep method	linear sweep (0.001 ~ 400 Hz/Sec), logarithmic sweep (0.001 ~ 400 Oct/Min)
sweep direction	UP, Down, sequential UP/Down, sequential Down/Up
targeted control levels	fixed displacement, fixed velocity, fixed acceleration, acceleration-acceleration (slope)
protection function	control alarm / abort, limit abort, detection of open channels, abort by external signals, manual abort, channel overload
kinds of analysis data	frequency spectrum, transfer function, time history waveform

(3) Random wave

The basic performance of the control system for random vibration tests is shown in Table 2-8.

Table 2-8 Basic Performance of Control System (random wave)

item	specification
input channel	48 channels (total of excitation control channels and targeted limit channels for test)
control strategy	average / maximum / minimum level
frequency resolution	100, 200, 400, 800, 1,600, 3,200 lines (up to 12,800 lines)
output waveform	pure random wave, or repeated random wave
drive clipping	2σ ~ 5σ
excitation frequency range	range between 0.025 ~ 40,000Hz
targeted control levels (setting of limits)	fixed acceleration, acceleration-acceleration (slope)
protective function	control alarm / abort, limit abort, detection of open channels, abort by external signals, manual abort, channel overload
kinds of analysis data	power spectrum density (PSD), transfer function, time history waveform, auto power spectrum

(4) Transient wave (classical shock, shock synthesis)

The specifications of the control system for tests adopting transient waves (classical shock, shock synthesis) are shown in Table 2-9.

Table 2-9 Basic Performance of Control System (transient wave)

item	specification
input channel	control: 1 channel, measurement: 47 channels
excitation frequency range	in the range for DC-20,000Hz according to control waveforms
control waveform	classical shock: one of half sine wave, saw-tooth wave, trapezoidal wave, rectangular wave, and sine burst, is to be chosen.
protective function	control abort, detection of open channels, abort by external signals, manual abort, protective function for channel overload
excitation frequency range	range between 0.025 ~ 40,000Hz
kinds of analysis data	power spectrum density (PSD), transfer function, time-series waveform, auto power spectrum, SRS, are output
SRS analysis	For the Amplitude selection, one of Positive (Max. positive), Negative (Max. Negative), and Absolute (Maxi-Max), is to be chosen. An octave band width is also to be arbitrarily set.

2.3.3 Data Measurement / Analysis System

The specifications of the shaking controller in this facility are shown below.

(1) Common

The common specifications among all the measurement/analysis functions, e.g., data output, formatting of output data, etc., are shown in Tables 2-10 and 2-11.

Table 2-10 Basic Performance of Measurement/Analysis System (for acceleration measurement)

item	specification
analysis channel	192 channels (16 chs of them can be backed up by a recorder which belongs to the facility.)
input terminal	microdot (miniature) connector
compatible sensors	electric charge type acceleration sensor, voltage type acceleration sensor (supported by TEDS format) other voltage output sensors
input range	voltage: ±316 mV, ±1V, ±3.16V, ±10V electric charge: ±316 pC, ±1000 pC, ±3,160 pC, ±10,000 pC ※In addition to the ranges above, the backup-supported 16 chs correspond to the ranges below. ±31,600 pC (64 kHz), ±100,000 pC (20 kHz), ±316,000 pC (6.4 kHz)
maximum input	voltage: 28 Vrms / electric charge: ±500,000 pC
input impedance (voltage)	1 MΩ / 260 pF (1 MΩ/50 pF for the backup-supported 16 chs)
output results	The results and conditions of each type of analysis can be output on the screen or into a file.
output data format	outputtable to a universal file, the MATLAB format, or the Excel format (CSV format)

Table 2-11 Basic Performance of Measurement/Analysis System (for strain measurement)

item	specification
analysis channel	32 channels
input terminal	7-pin LEMO, Pigtail coaxial BNC (only for voltage signals)
compatible sensors	strain gauge (DC-bridge, AC-bridge), AC linear voltage differential transformer (AC-LVDT), potentiometer, voltage type acceleration sensor (compatible with TEDS), other voltage output sensors
input range	bridge mode: ±31.6 mV, ±100 mV, ±1V, ±10V other than above: ±10V
maximum input	voltage: 28 Vrms
alias-free frequency	5,000Hz
input impedance	bridge mode: 1 MΩ//20 pF other than above: 1 MΩ//50 pF
gauge resistance	120Ω / 350Ω
bridge	DC: 4-gauge method (full bridge), 2-gauge method (half bridge) 1-gauge method (quarter bridge) AC: 4-gauge method (full bridge), 2-gauge method (half bridge) 1-gauge method (quarter bridge), electromagnetic induction half bridge, AC-LVDT

(2) Sine wave

The basic performance of the measurement/analysis system for sine-wave sweep tests is shown in Table 2-12.

Table 2-12 Basic Performance of Measurement/Analysis System (sine wave)

item	specification
analysis frequency range	range between 0.05 – 20,000Hz
analysis method	One of harmonic (tracking filter), RMS level, peak level, and average level, is chosen.
kinds of analysis data	frequency spectrum, transfer function, time history waveform

(3) Random wave

The basic performance of the control system for random vibration tests is shown in Table 2-13.

Table 2-13 Basic Performance of Measurement/Analysis System (random wave)

item	specification
window function	Window function necessary for analysis (including Hanning) can be adopted.
overlap processing	Overlap processing can be adopted. The amount of overlap can be arbitrarily chosen.
Degrees of freedom for analysis	The degrees of freedom（■DOF hereafter） for analysis can be arbitrarily set.
number of average operations for analysis	The number of average operations for analysis can be arbitrarily set.
frequency resolution	100, 200, 400, 800, 1,600, 3,200 lines (up to 12,800 lines)
frequency range for analysis	range between 0.01 – 80,000Hz
kinds of analysis data	power spectrum density (PSD), transfer function, time history waveform, auto power spectrum

(4) Transient wave (classical shock, shock synthesis)

The specifications of the measurement/analysis system for tests adopting transient waves (classical shock, shock synthesis) are shown in Table 2-14.

Table 2-14 Basic Performance of Measurement/Analysis System (shock wave)

item	specification
analysis frequency range	in the range for DC-1 MHz
kinds of analysis data	power spectrum density (PSD), transfer function, time-series waveform, auto power spectrum, SRS
SRS analysis	For the Amplitude selection, one of Positive (Max. positive), Negative (Max. Negative), and Absolute (Maxi-Max), is to be chosen. An octave band width and a quality factor (damping) are also to be arbitrarily set.

2.3.4 Supplementary Operation System

The specifications of the utility equipment in this facility are explained below.

(1) Communication device

This device enables mutual and simultaneous communications between and among test-concerned personnel during the operation of this facility or the preparatory work on a TS, etc. There are headsets prepared, and up to three of them are available to users. In case more are needed, ex-ante adjustment is to be made.

(2) ITV devices

Two color cameras are installed in the test room to monitor the on-going status of a TS during a test. Their images are displayed (zoomed, panned, and rotated by a controller) on the two-color monitors in the measurement and control room. Furthermore, the images can be recorded/replayed by the specific hard disc for that purpose or a BL/DVD recorder, or copied on BL/DVD-RWs.

Max. recording time:
about 400 hrs (500 GB hard disc)
about 20 hrs (25 GB Blue-ray)
about 4 hrs (4.7 GB DVD-RW)

file format: MPEG-2, MPEG-4 AVC

(3) Excitation state display system

This system reads in the control signals output from the control system, and displays the on-going excitation states of a test on the 60-inch panel in the test room on a real-time basis. In addition to the test statuses, the panel shows other information, e.g., frequency for sine wave vibration and elapsed time for random wave vibration. Being a monitor itself, it has functions as a general display.

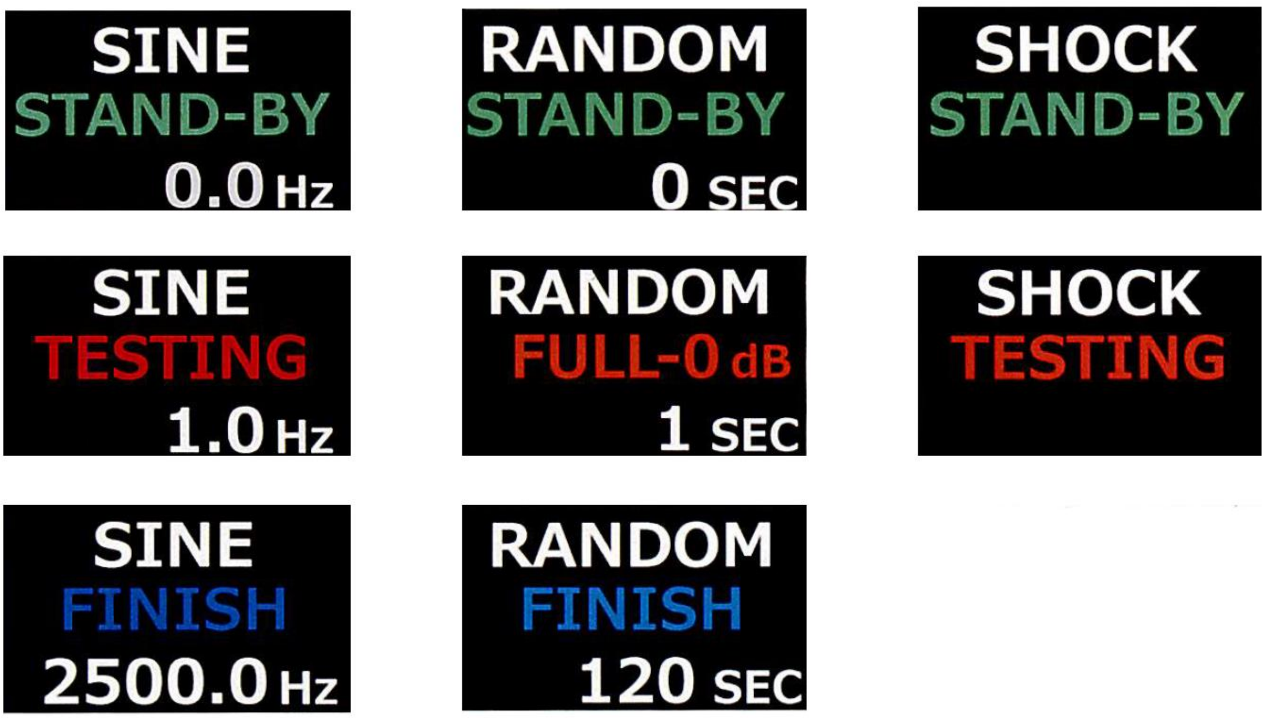


Figure 2-10 Image of Displayed Content on Excitation State Display System

3 User I/F

3.1 Configurations in Small Vibration Test Room and Measurement/Control Room

The configurations in the test room and the measurement/control room are shown in Figure 3-3. The cleanliness level inside the test room is kept to satisfy ISO class 8 (class 100,000.)

3.2 Device I/Fs

(1) Hole patterns

The hole patterns on the unloaded shaker and each vibration table are shown in Figures 3-4 ~ 3-9 for the purpose of mounting a TS on a test system. If a test jig for an I/F is necessary between a vibration table and a TS, the bolts, etc., for mounting the jig are to be prepared by users.

(2) Measurement/analysis system

(a) Acceleration measurement

The acceleration sensors mounted on a TS are to be connected to the frontend for data measurement/analysis in the test room via low-noise cables. The connectors are microdot (miniature) connectors.

Figure 3-1 Measurement Sensor I/F of Measurement/Analysis System (acceleration)
(left: normal measurement module 8 chs × 22 modules, right: backup module 4 chs × 4 modules)

(b) Strain measurement

The strain gauges mounted on a TS are to be connected to the measurement/analysis front end in the test room. The connector for the front end is the 7-pin LEMO-FGB.0B.307.CLAD. The conversion cables for the LEMO-Pigtail (3m) are also applicable.

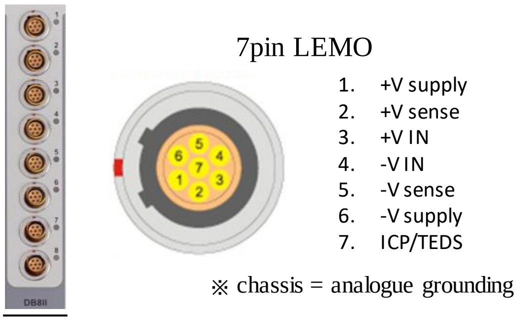


Figure 3-2 Measurement Sensor I/F of Measurement/Analysis System (strain)

(3) I/F for carrying in/out TS

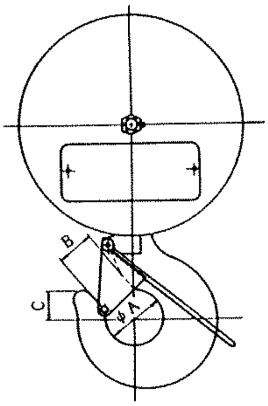
A TS, if it is small enough, can be carried in/out to/of the air shower room (the size of the air shower room: 700 (W) × 900 (D) × 1,900 (H)) via hand carry. As for the matters related to the carriage of a large-size TS from the unpacking room in the Spacecraft Integration and Test Building into the test room, refer to “vol. 1 Common Matters (GCA-02006)” of “Users’ Manual for Spacecraft Integration and Test Building.”

(4) Test room crane

The specifications of the crane in the small vibration test room are shown below. When the crane is used, the ceiling shutter shown in the next item is to be kept open. Also, it is to be confirmed before using the crane that the temperature, humidity, and cleanliness outside the test room satisfy their reference values. The movable range of the crane hook is shown in Figure 3-11.

Table 3-1 Specifications of Crane in Small Vibration Test Room

capacity	velocity (low/high)				height below hook (m)	hook size (mm)
	model #	travel	traverse	hoist		
2,800 kg	X-Y	1/10	1/10	0.8/8	16.5	A: 90 B: 63 C: 45



velocity: (m/min)

(5) Test room shutter

Pay attention to the temperature/humidity and cleanliness outside the test room when opening the shutters for using the crane, etc. When a TS is carried in and out of the test room, both the shutter facing the satellite path and the one on the loading dock shown in Figure 3-3 are to be left open. As with the case of using the crane, it is to be confirmed before carrying in/out a TS that the temperature/humidity and cleanliness inside and outside the test room satisfy their reference values.

Dimensions of shutter facing satellite path:	8.3m (width) × 14m (height)
Dimensions of loading dock shutter:	5.8m (width) × 7.0m (height)
Dimensions of ceiling shutter:	4.5m (width) × 9.0m (length)

(6) Items related to power supplies

The configuration of distribution boards and sockets available to users is shown in Figures 3-10, while the information of the distribution boards is provided in Table 3-2.

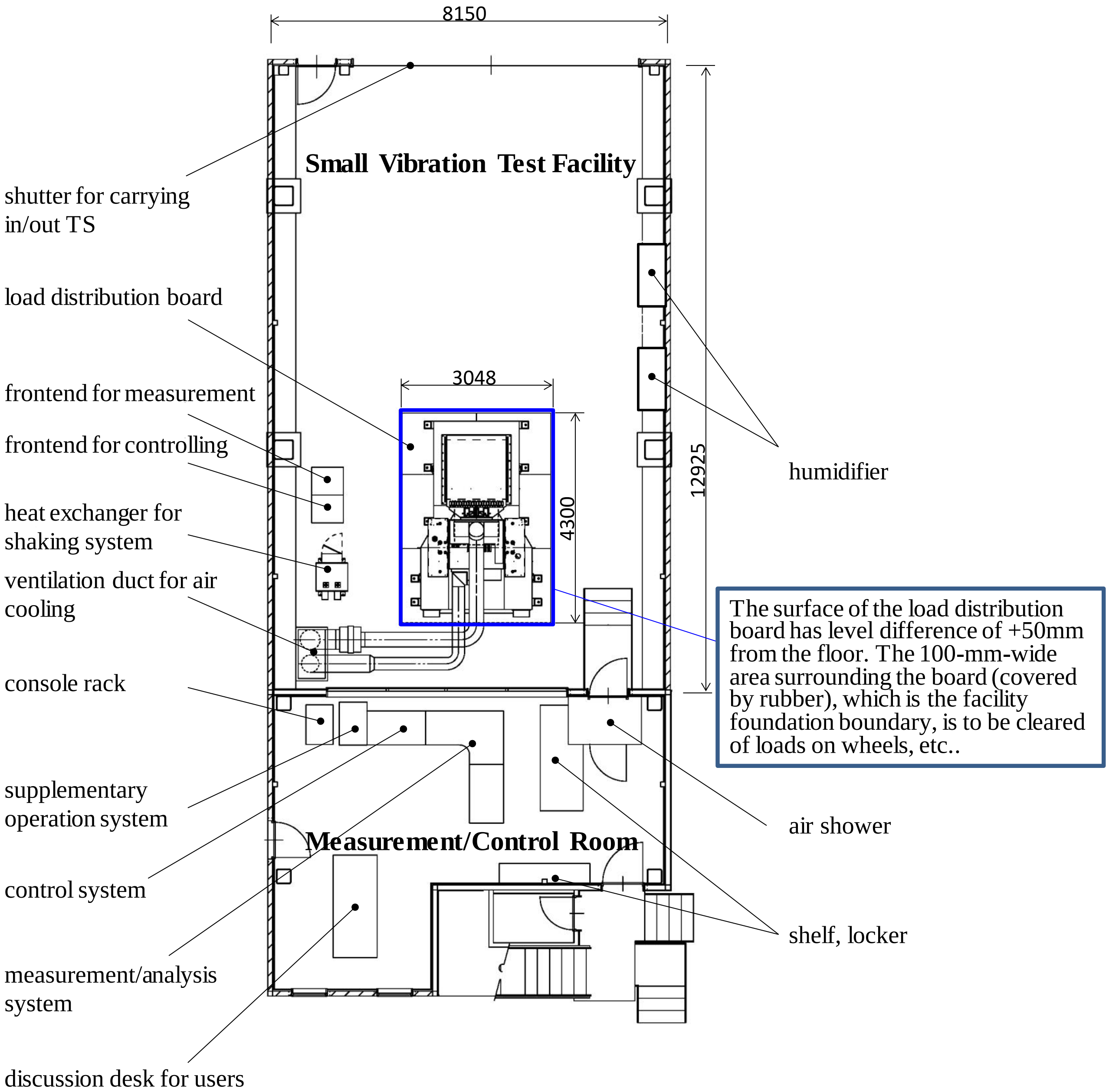
Table 3-2 Distribution Boards for Users

name				SL-1	
installation site				small vibration facility measurement/control room	
No.	specifications of breaker: number of phases × voltage	rating	capacity (kVA)	sign of breaker	notes
1	3φ×200V	MCB2P 50 / 20AT		①, ②	spare
2	1φ×100V	MCB2P 50 / 20AT	20 kVA	① ~ ⑩	Extension codes connected to those breakers are available to users.
	1φ×100V	MCB2P 50 / 20AT		⑪ ~ ⑭	spare
type of earth wire				type C, type D	

name				SP-1	
installation site				small vibration facility measurement/control room	
No.	specifications of breaker: number of phases × voltage	rating	capacity (kVA)	sign of breaker	notes
1	3φ × 210V	ELB3P 50 / 20AT	—	◇2	spare
2	3φ × 210V	MCB3P 50 / 30AT		◇3	Extention codes connected to those breakers are available to users.
3	3φ × 210V	MCB3P 50 / 20AT		◇4	Extention codes connected to those breakers are available to users.
4	3φ × 210V	MCB3P 50 / 20AT		◇5	spare
type of earth wire				type C	

(7) Emergency abort button

The application of excitation can be aborted (soft stop) in the middle of its operation by pressing the emergency abort button in the test room whenever abnormalities are found. The basic rule in general cases, however, is that our operator in the test facility presses the emergency abort button in the control room. Users who want to be prepared for emergency abort using the button in the test room are to make ex-ante adjustment with our facility operator concerning how to operate it, etc.



area	withstand load
test room	8,700 N/m^{2*}
measurement/ control room	32,000 N/m^2

* excluding the 100-mm-wide area surrounding the load distribution board (covered by rubber)

Figure 3-3 Configuration of Test Room and Measurement/Control Room

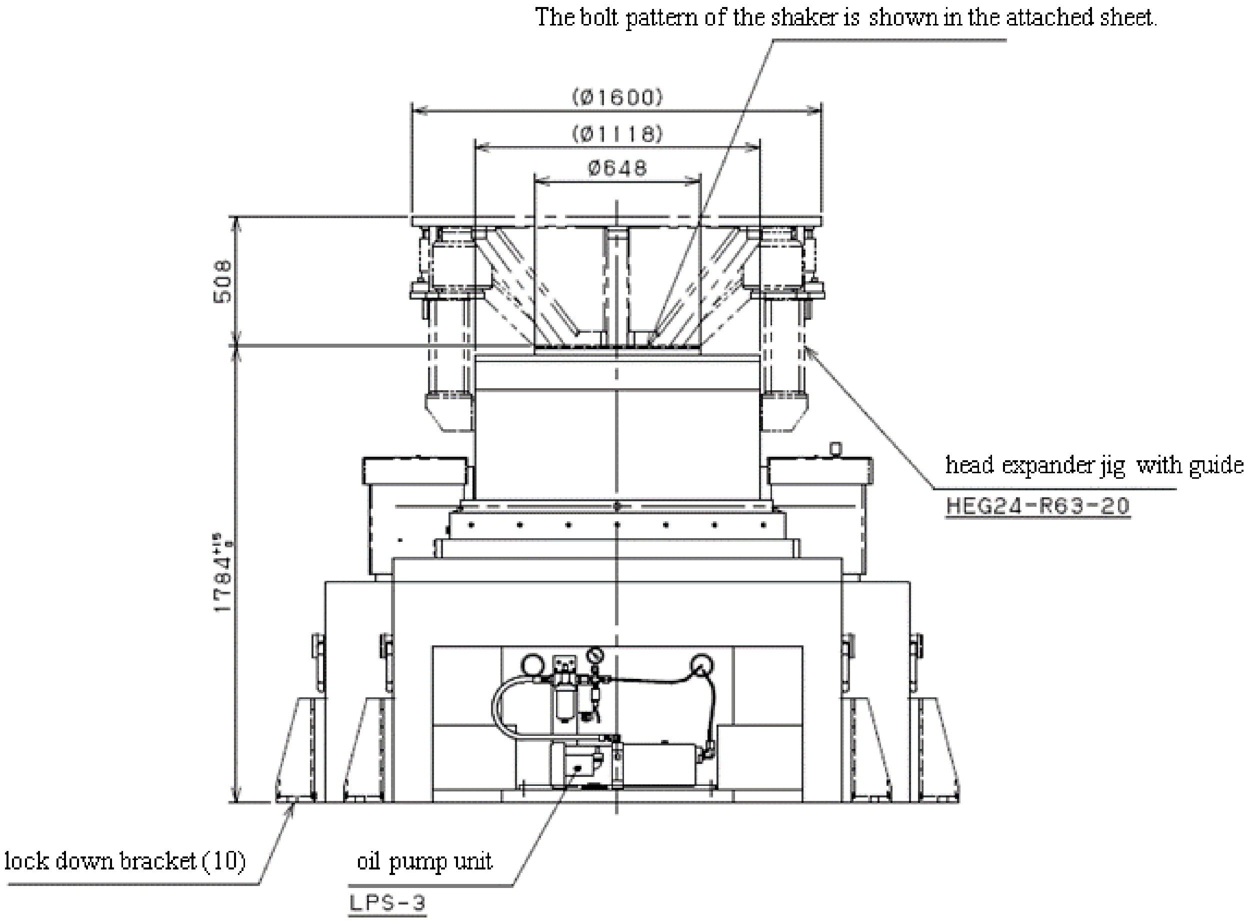
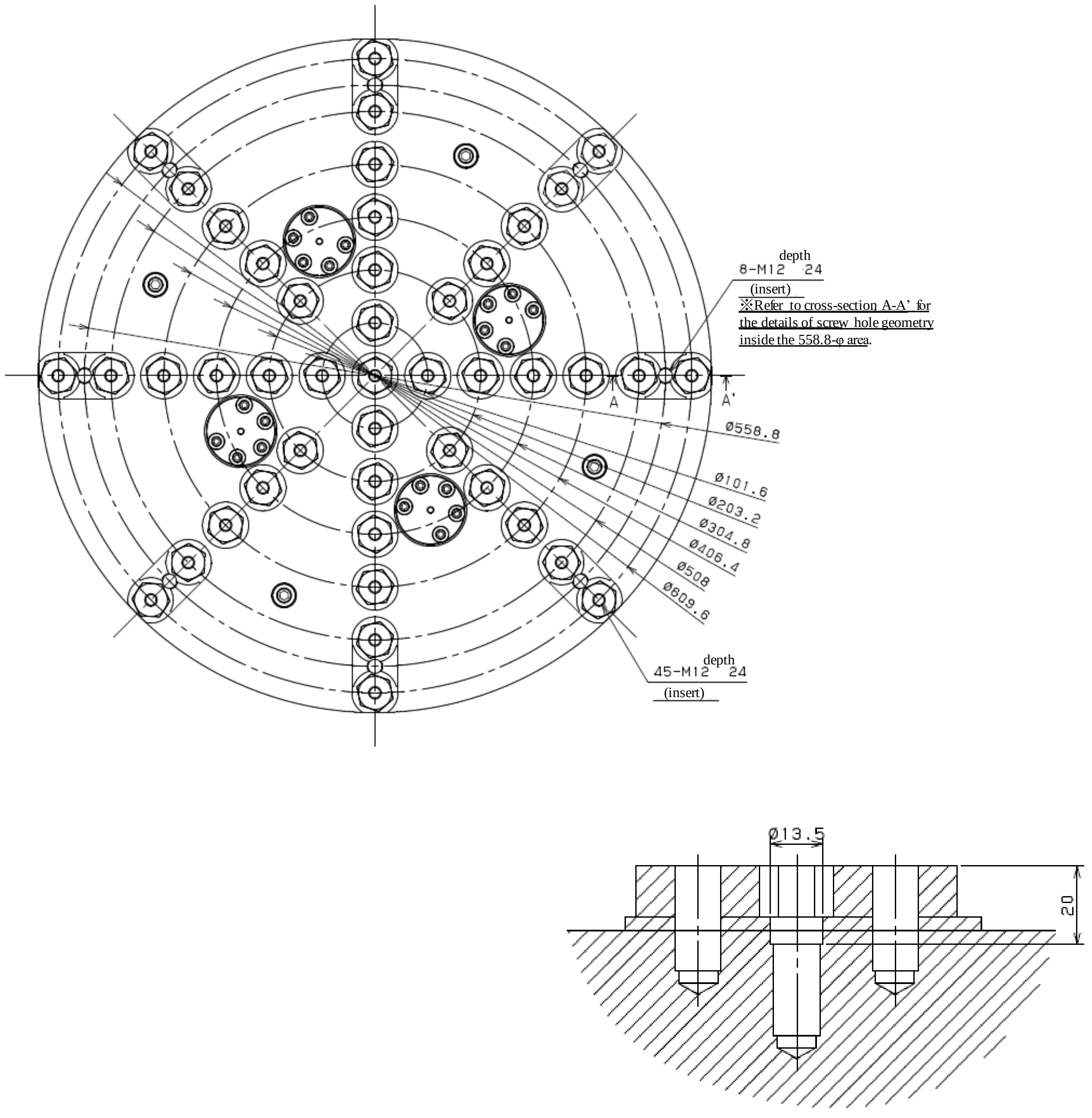


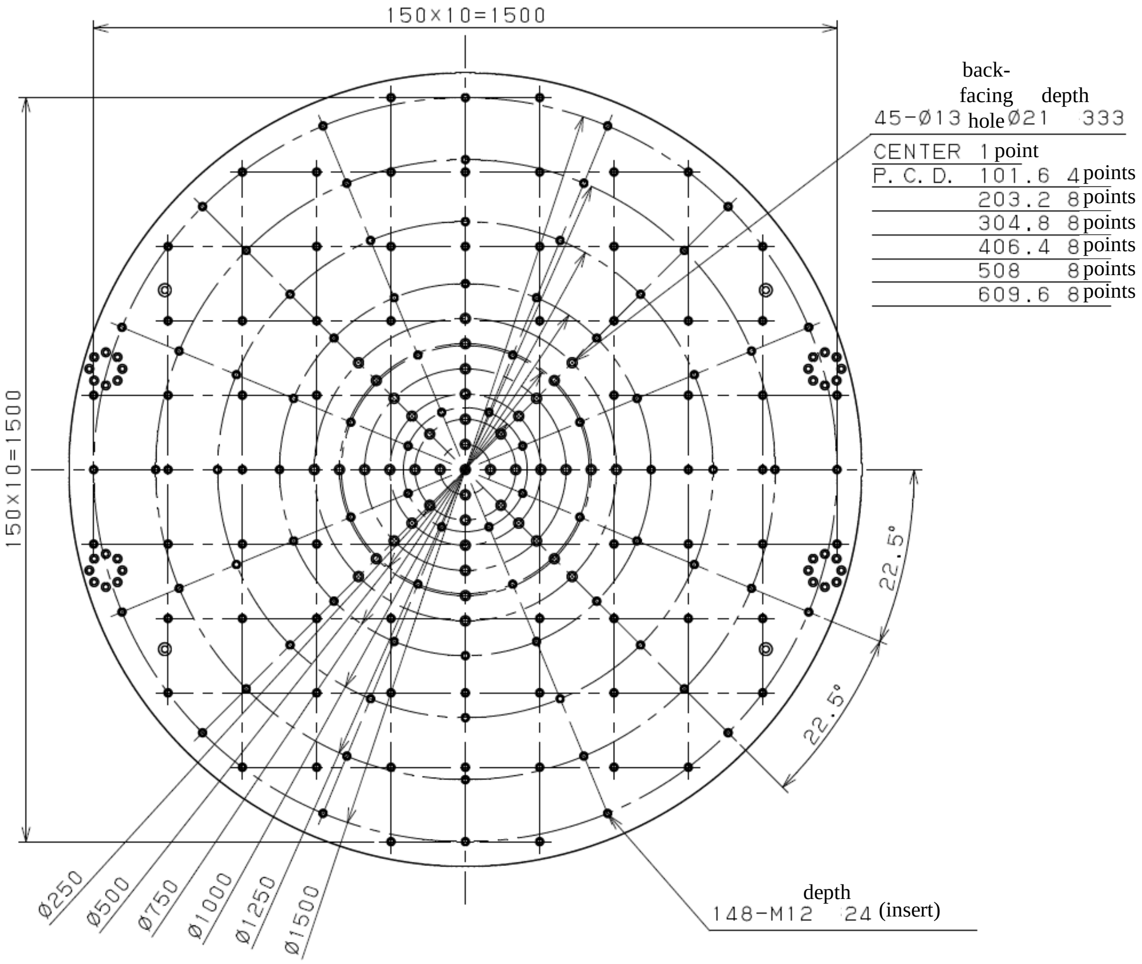
Figure 3-4 External Appearance of Unloaded Shaking System and Vertical Vibration Table in Use



cross-section A-A' (scale: 1/1)
details of screw hole geometry inside the 558.8-φ area (8 places)
※Pay attention to the length of bolt to be placed in the hole

Figure 3-5 Hole Pattern on Unloaded Shaker

vibration table
HEG24-63R-20



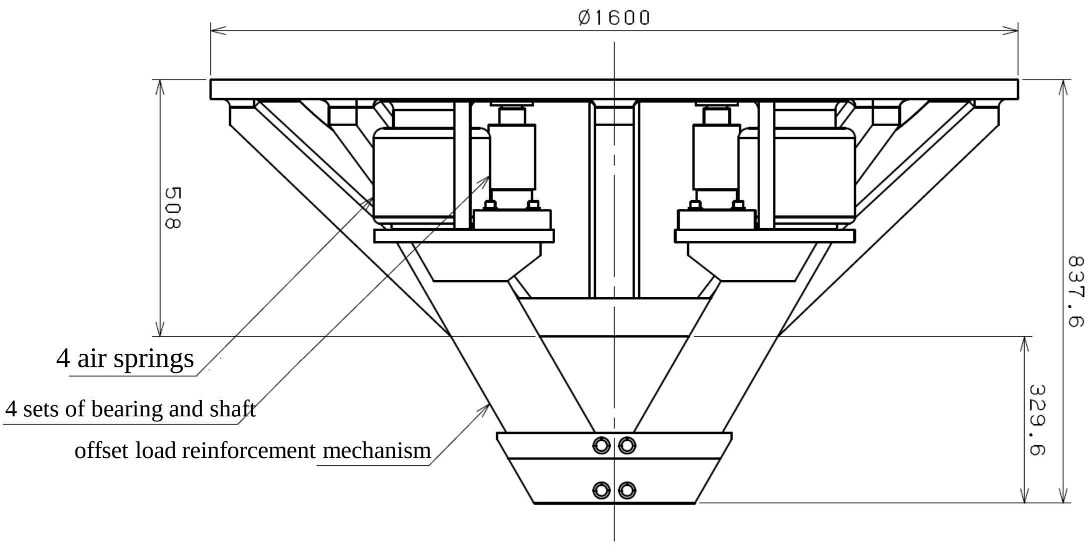
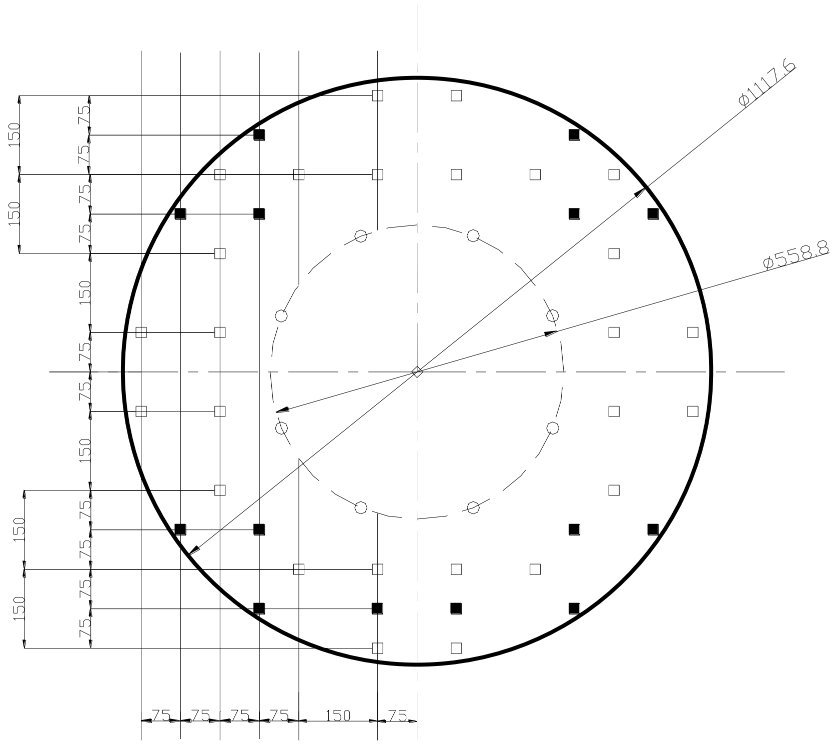


Figure 3-6 Hole Pattern on Vertical Vibration Table (HEG24-63R-20)

vibration table AST-210VDM



	M12 hole pattern	quant.	depth	d
◇	PCD0	1	24	20
○	PCD558.8	8	24	20
■	75,150 PITCH	14	30	24
□	150 PITCH	26	30	24

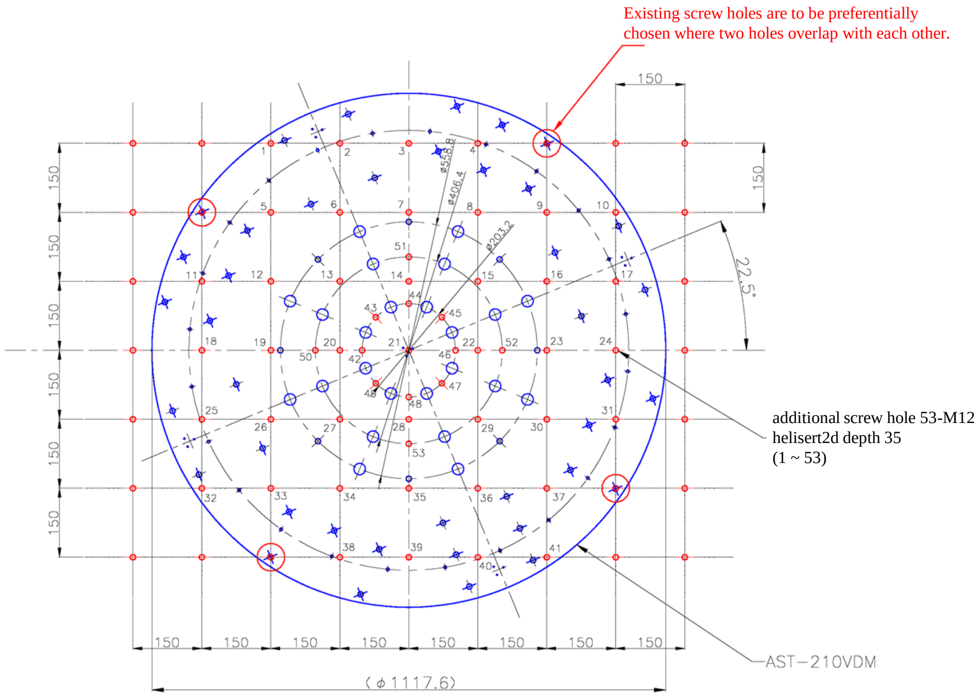
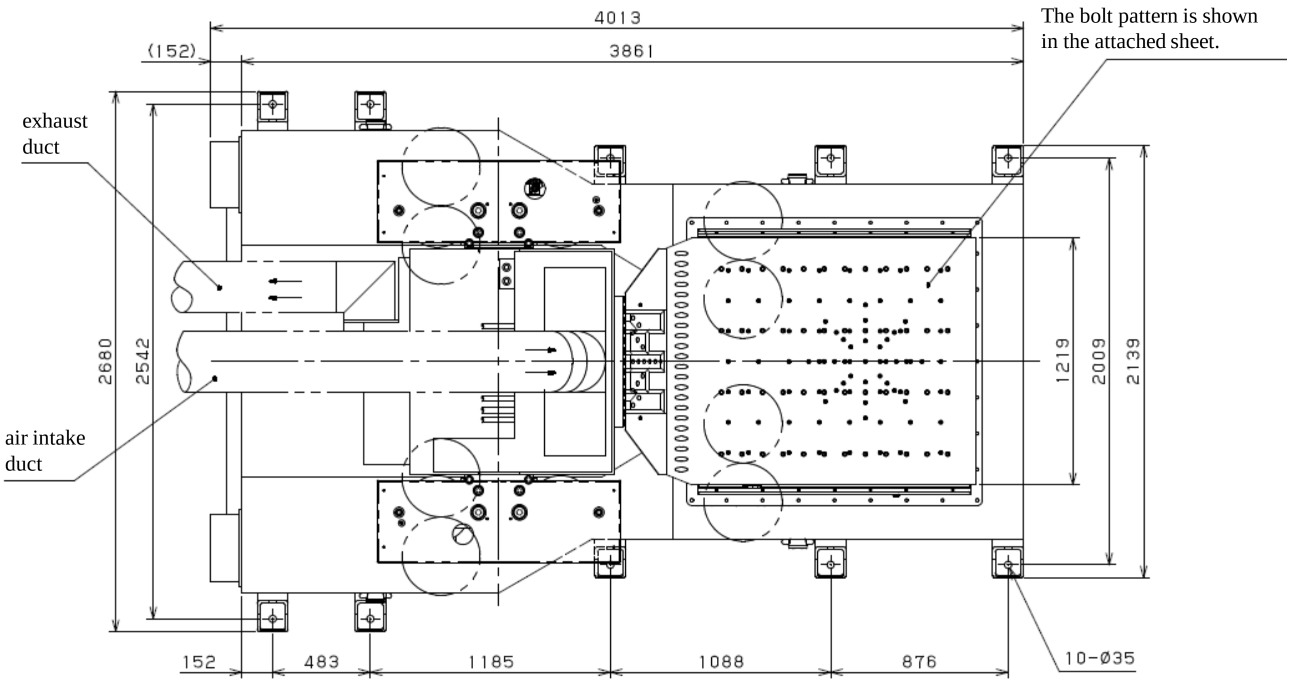


Figure 3-7 Hole Pattern on Vertical Vibration Table (AST-210VDM)



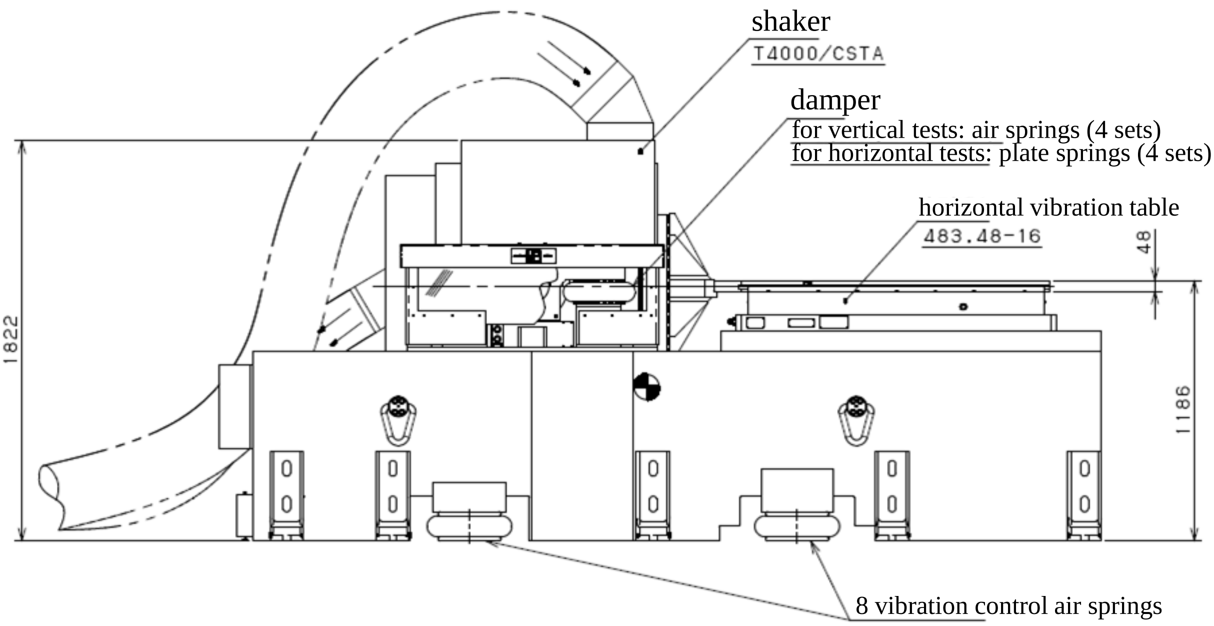


Figure 3-8 External Appearance of Horizontal Vibration Table in Use

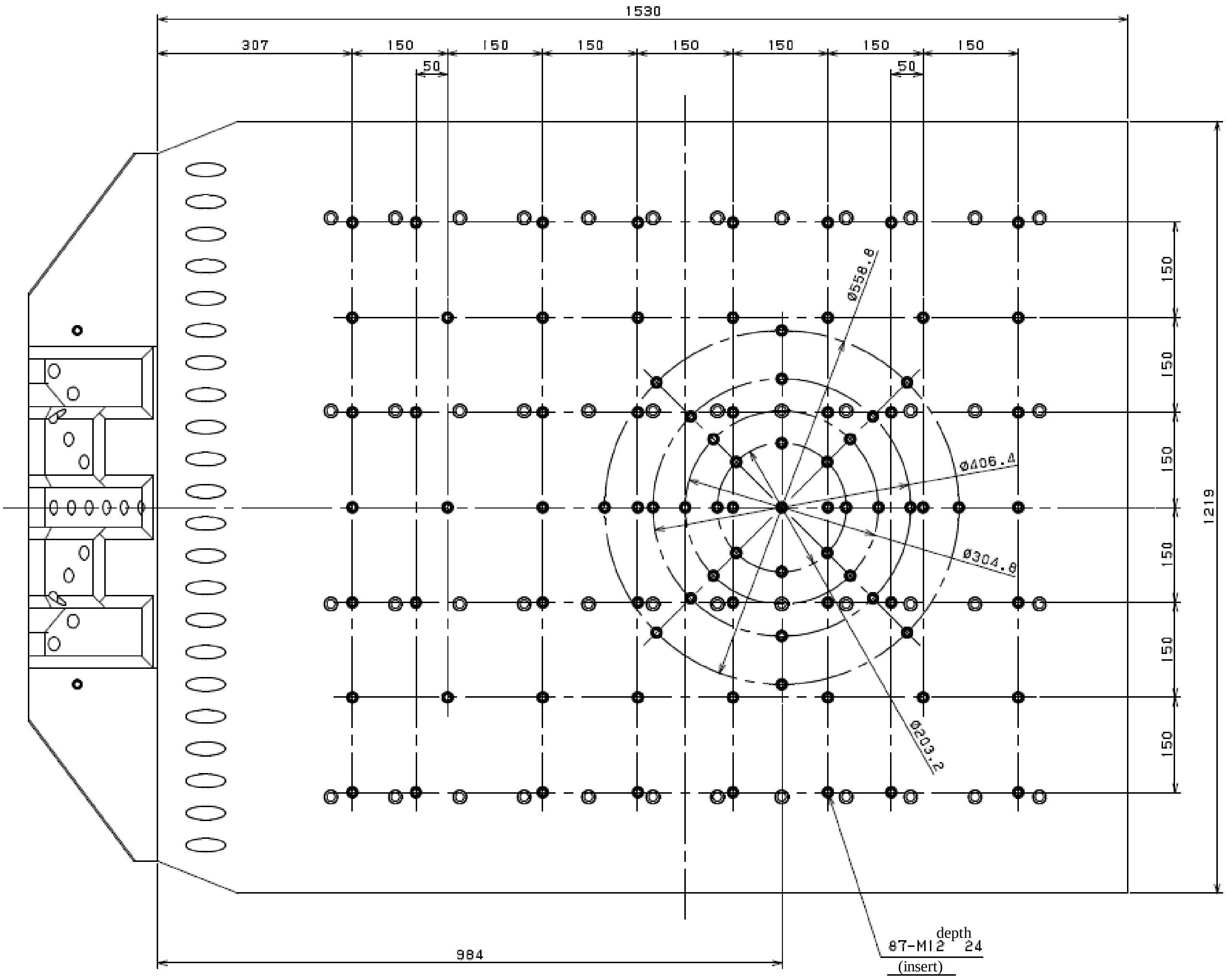
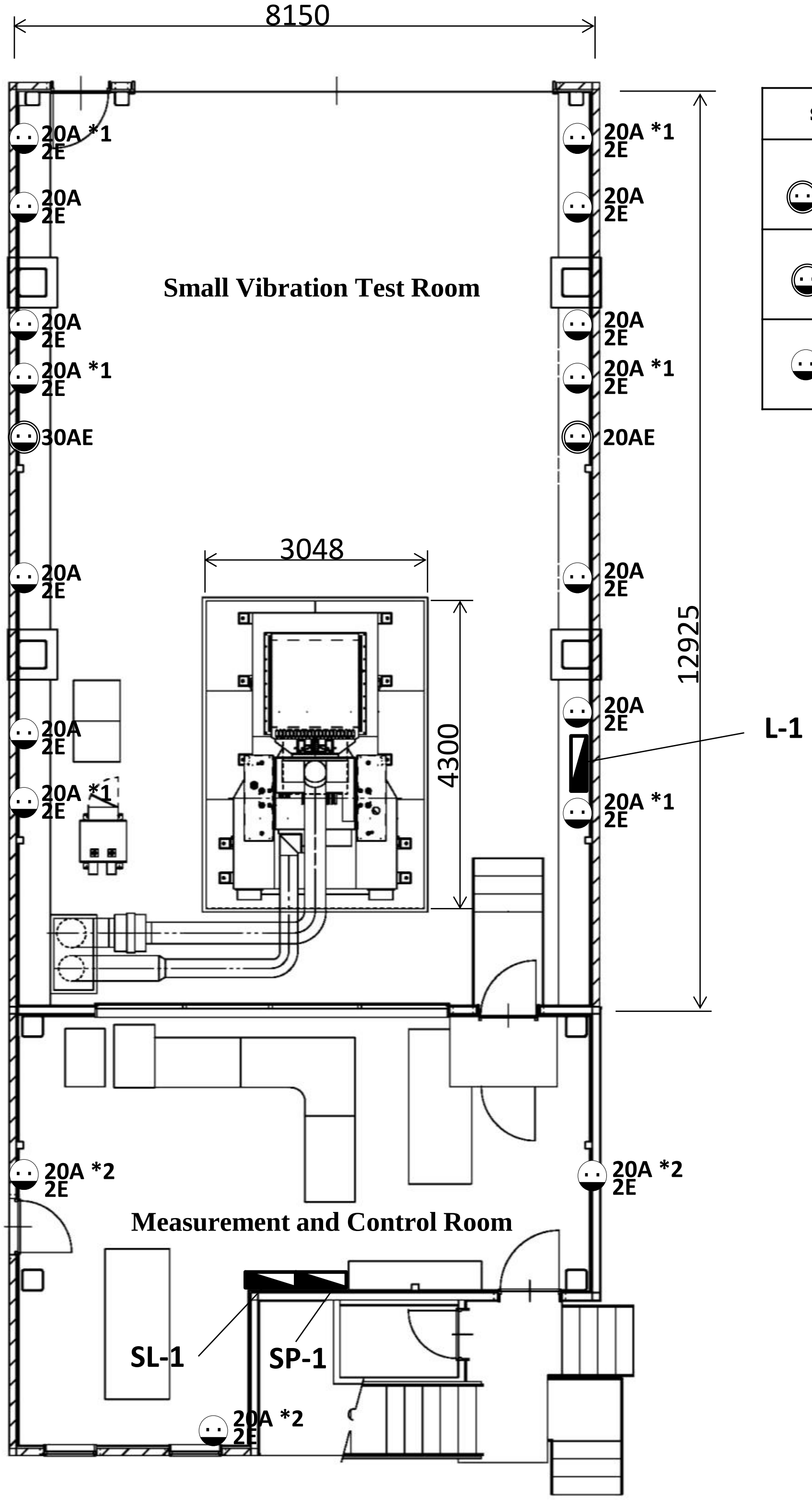


Figure 3-9 Hole Pattern on Horizontal Vibration Table



sign	kind
20AE	AC,3ϕ,200V,20A socket with earth electrode
30AE	AC,3ϕ,200V,30A socket with earth electrode
20A 2E	AC,1ϕ,100V × 2, 20A socket with earth electrode

***1：2口 × 6 points 20A**

***2：2口 × 2 points 20A**

Figure 3-10 Configuration of Distribution Boards and Sockets
(Small Vibration Test Room, Measurement/ Analysis Room)

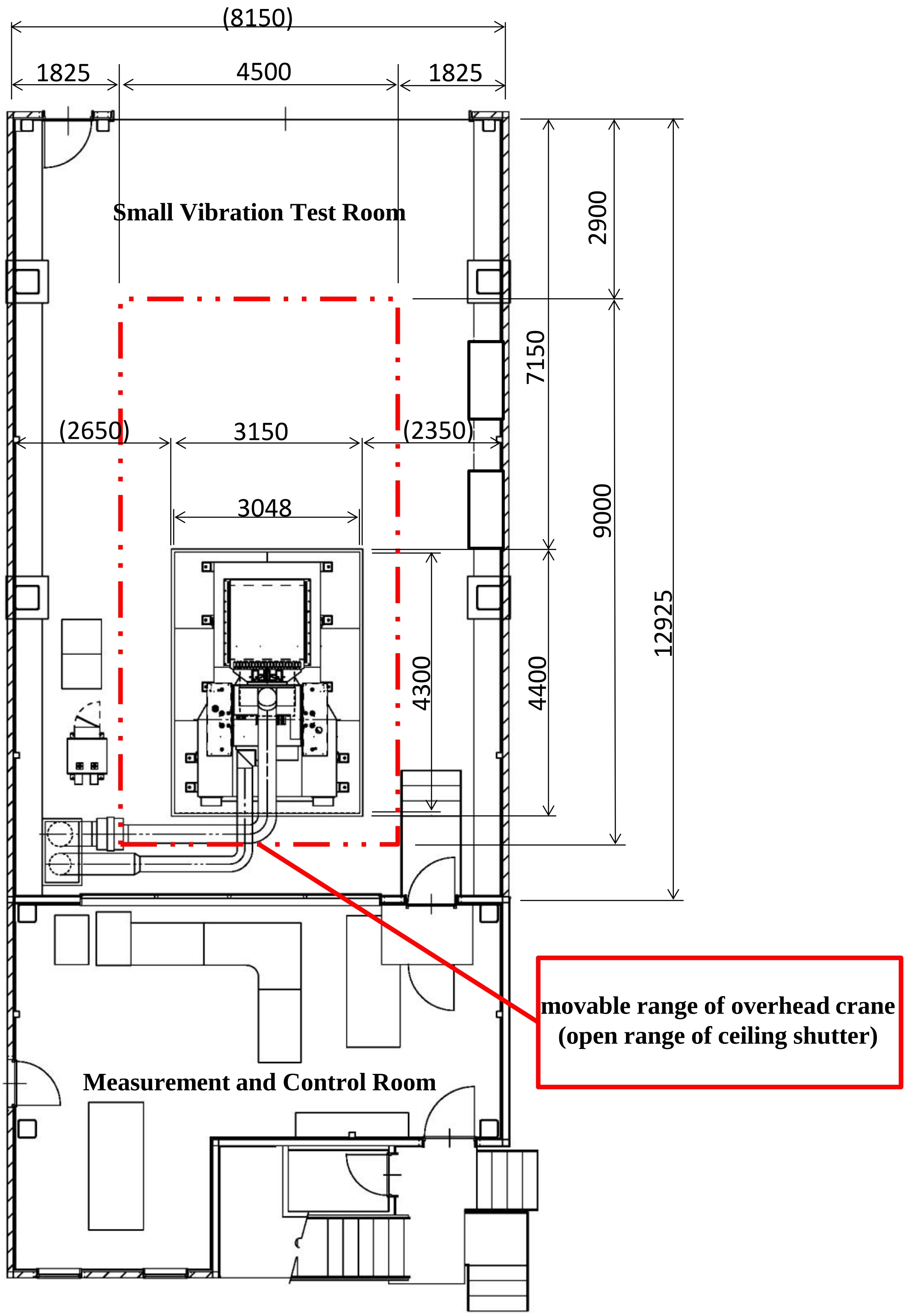


Figure 3-11 Movable Range of Overhead Crane

4 Execution of Tests

4.1 Test-related Work Procedure

The flow of test-related work procedure is shown in Figure 4-1. The work sequence, etc., is explained below.

(1) Kickoff meeting

A kickoff meeting is held to confirm test purposes, contents, schedule, conditions, etc. Users are to prepare a “test implementation plan”, a “test conditions requisition sheet (to be submitted at K/O)”, etc.

(2) Rental of acceleration sensors, etc.

Users can rent acceleration sensors and low-noise cables to be used for tests from the facility. In that case, make arrangements in advance and clarify your request in a test implementation plan, etc. The acceleration sensors and low-noise cables for controlling are basically prepared by the facility. If users wish to prepare them by themselves, let us know of it beforehand.

(3) Task briefing (pre-test meeting)

A task briefing is held for the final checking on test contents and the status of facilities, etc., in preparation for performing a test. Its main purpose is to discuss the changes made after the kickoff meeting.

(4) Installation of TS

When opening the shutter to the satellite path, it is to be made sure that the cleanliness in the external room of the test room is under control. Pay attention to the withstand load of the work floor, etc., during the installation of a TS into the facility.

(5) Mounting of acceleration sensors

The work of mounting acceleration sensors for measurement on a TS is basically to be executed in the Small Vibration Test Room.

(6) Excitation of jig

Upon users’ request, the staff of the Agency checks the safety of the vibration property of the test jig prepared by users, before a test is performed on a TS. In that case, the jig is excited following the same procedures as in the actual test on the TS.

(7) Mounting of TS

When mounting a TS onto a vibration table, pay full attention not to damage the shaker and the equipment installed around the vibration table.

(8) Actual excitation

A test is performed on a TS. Users are to prepare a “test conditions requisition sheet.” Refer to section 4.2 for the work sequence of a vibration test.

(9) Changing of axes/vibration tables

After providing the actual excitation to either vertical or horizontal direction, the axes and the vibration tables are switched to the other excitation direction. The procedures from (6) to (9) are then repeated as designated for the test.

(10) Task review (post-test meeting)

The final evaluation on the achievements of test purposes is performed at the end of the test. Users are to prepare a “newsboard” or the like which binds together the test results of a TS, to check for the achievement of test purposes.

(11) Removal of TS and cleaning of test room

When carrying a TS out of the test room, pay close attention to the open/close states of the shutters. Also, users are to clean the test room or other areas used during the test after the removal of a TS.

(12) Saving and transference of test data

The data acquired during a test is recorded in DVD and kept by the facility. Users who wish to keep the electronic data of the test are to prepare external memory medium of their own.

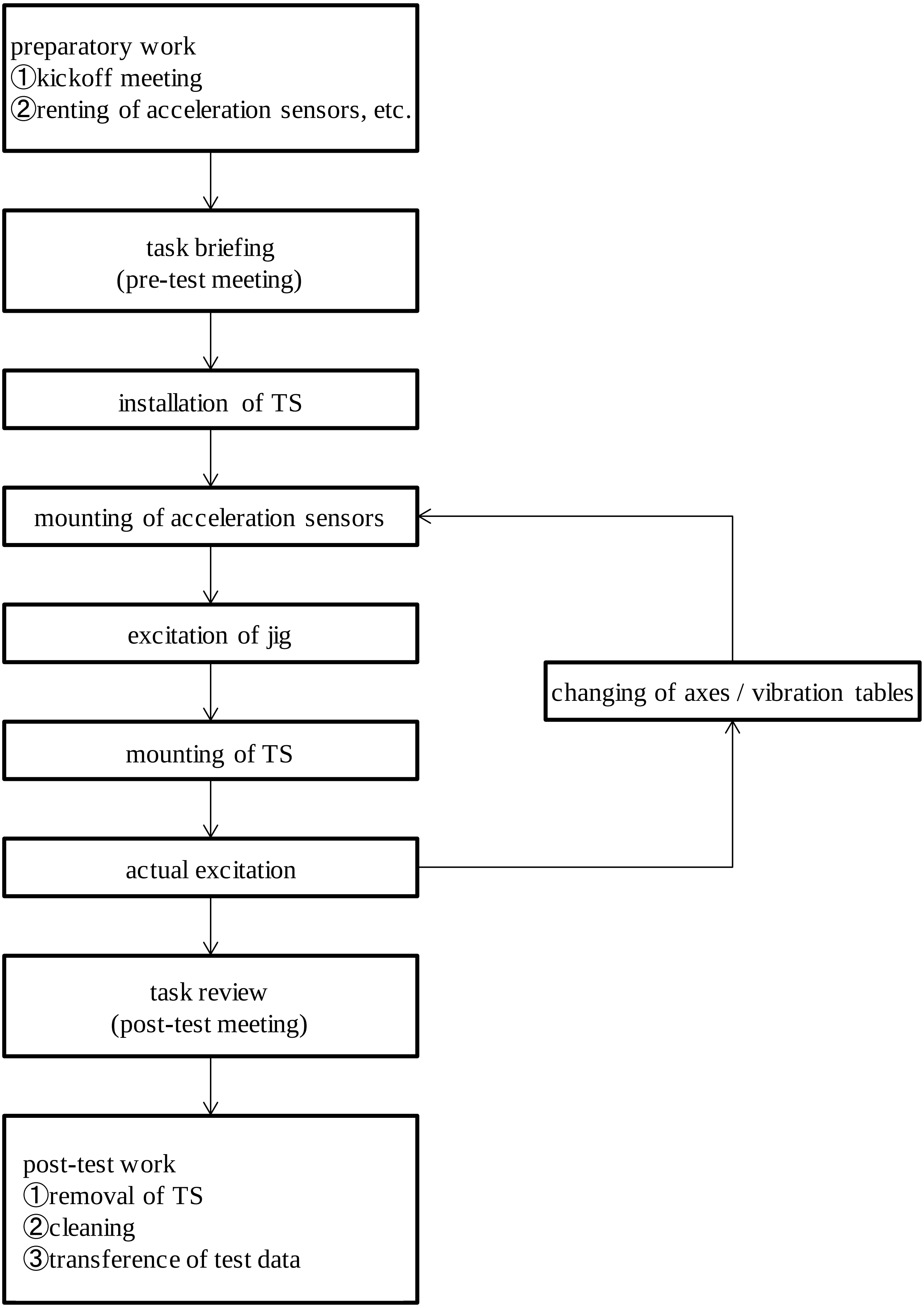


Figure 4-1 Test-related Work Flow

4.2 Test Procedure

The test procedure is shown in Figure 4-2, and each work in the operation sequence is explained below.

(1) Setting of test parameters

Each parameter for the shaking controller is set based on the test conditions requisition sheet.

(2) Tap checking

A test jig is tapped with a plastic hammer, etc., to confirm the normal response of the acceleration sensors mounted on a TS and the facility controlling sensors.

(3) Activation of high voltage power supplies for horizontal/vertical devices, and damper

The high voltage power supplies for the horizontal/vertical devices are activated. Furthermore, compressed air is introduced into the airbags of the damper to uplift and separate the base from the load distribution board.

(4) Start of self-checking (loop checking)

Low-level excitation is loaded in the tested excitation frequency band to confirm the health of the control loop. While limit control cannot be performed during loop checking, the upper excitation level can be manually preset to the shaker when overload is anticipated.

(5) Checking of signals

Measurement signals are checked on the monitors of the data measurement/analysis system.

(6) Start of full test and data acquisition

A full test (the actual excitation) is started. At the same time, the data measurement/analysis system starts acquiring the test data of the TS.

(7) End of test/data acquisition

The test ends when the pre-set excitation is completed. Simultaneously, the data measurement/analysis system stops acquiring the test data of a TS.

(8) Data analysis

The test data of the measurement points on the TS is analyzed and evaluated.

(9) Cutoff of high voltage power supplies for horizontal/vertical devices, and stoppage of damper

The high voltage power supplies for horizontal/vertical devices are cut off. In addition to that, air is let out from the airbags of the damper to land the base back onto the load distribution board.

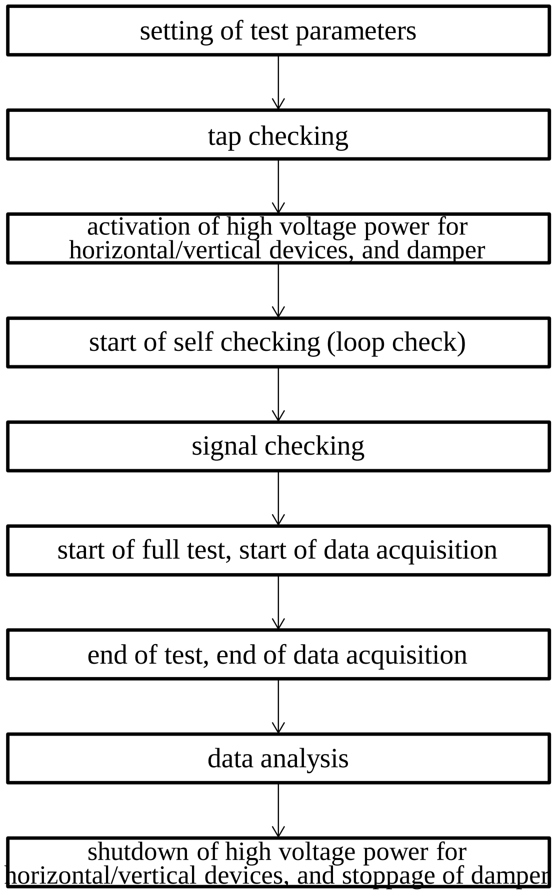


Figure 4-2 Test Flow

4.3 Designation of Test Conditions

Users are to submit a “test conditions requisition sheet” as follows so that a vibration test can be smoothly performed without errors.

Test Conditions Requisition Sheet

(1) Excitation conditions requisition sheet

An “excitation conditions requisition sheet” is to be filled in with vibration test level conditions and submitted prior to the test date.

(2) Data acquisition database list

A “data acquisition database list” is to be filled in with the measurement conditions for measurement points and submitted prior to the test date.

(3) Data acquisition/analysis conditions sheet

A “data acquisition/analysis conditions sheet” is to be filled in with the data acquisition and analysis conditions for measurement points and submitted prior to the test date.

5 Special Notes

Especially important matters to take into account for performing a vibration test in this facility are shown below.

5.1 Changing of Axes and Vibration Tables

To shift excitation axes, the axes of the shaker are to be switched. The days to achieve that purpose are shown below. Take the listed time into account when planning a test schedule. When the replacement of vertical vibration tables are being planned, furthermore, time required for the replacement is also to be included in the schedule.

Table 5-1 Approximate Days Required for Changing Axes and Vibration Tables

	approximate required days
vertical → horizontal	0.5
horizontal → vertical	0.5
replacement of vertical vibration tables	0.5

5.2 Heat Run

The heat run time necessary for this facility is about 30 minutes after the activation of power. That time is to be included when planning a test schedule.

5.3 Length of Measurement Cables

The measurement and analysis front end to which cables for acceleration/strain measurement are connected is located at about 2m away from the horizontal vibration table, and about 6m away from the vertical vibration table. Therefore, especially when executing vertical excitation tests, attention is required to the length of a low-noise cable, which is to be at least 6 m plus the distance between the shaker and a TS.

5.4 Wearing Helmet

The TS observers, etc., in the test room are to wear a helmet (to be prepared by users) during crane operations and a test.

5.5 Cleanliness Control / Air Conditioning Conditions

The cleanliness in the test room is controlled to keep ISO class 8 (class 100,000.) Therefore, users are to wear a clean garment (to be prepared by users) when entering the room. Meanwhile, the test room is air-conditioned to keep the temperature of 23℃±3℃ and the humidity of 30% ~ 60%.

5.6 Test Jig

The test jig prepared by users is to be manufactured based on the following points in mind.

(1) Natural frequency

The minimum fundamental frequency is to be more than four times the upper-limit frequency for a test. That condition, however, does not have to be strictly met when the increased mass of a jig interferes with the execution of the test.

(2) CG position

A jig and a TS are basically to be symmetrical in shape, and the CG position of the two combined is to be as close as possible to the center of the vibration table used in a test. When the resultant CG position unavoidably deviates largely from the center of the vibration table, the CG position is to be adjusted using a “counter weight”, etc., so that the overturning moment of a TS does not exceed the allowable overturning moment of each vibration table. The necessary counter weights are to be prepared by users.

The following show the idea of overturning moment.

Table 5-2 Overturning Moment Conditions

vibration table	overturning moment conditions
vertical[*1]	$M > W \times A \times Oxy + W \times A \times Txy \times Oz$
horizontal	$Mp > W \times A \times Oz + W \times A \times Tz \times Oy$
	$Mr > W \times A \times Tz \times Ox + W \times A \times Tx \times Oz$
	$My > W \times A \times Ox + W \times A \times Tx \times Oy$

M[*2] : Vertical vibration table allowable overturning moment [N・m]
Mp[*2] : Horizontal vibration table allowable overturning moment (pitch axis) [N・m]
Mr[*2] : Horizontal vibration table allowable overturning moment (roll axis) [N・m]
My[*2] : Horizontal vibration table allowable overturning moment (yawing axis) [N・m]
W : Summed mass of a TS and a jig [kg]
A : Maximum acceleration [m/s^2]
T[*2] : Transverse (crosstalk) factor [%] (the subscripts x, y, z denote the directions of transverse motion.)
O[*3] : the CG offset volume from the center of the vibration table [m] (the subscripts x,y,z denote offset directions[*4]

*1 When using a vibration table, its mass and CG position are to be taken into the above equations.
*2 Refer to Table 2-5 “Specifications of Vibration Tables” for the values of allowable overturning moment and transverse.
*3 The axes directions of the vibration tables are shown below.

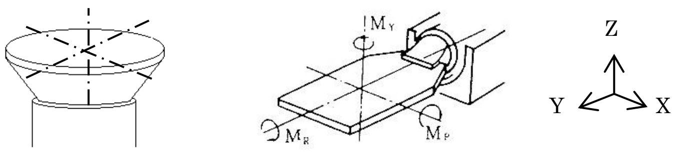


Figure 5-1 Definition of Rotary Axes on Vibration Tables

*4 The X and Y axes are not distinguished on a vertical vibration table, and therefore Oxy denotes the distance from the center of the vibration table on the XY plane. For further information, contact the Test Facilities Administration Room.

(3) Flatness of test jig

When mounting a test jig on a shaker, vertical/horizontal vibration table, the I/F plane of the jig to the vibration table is to be manufactured the way it has a flatness of within 0.1 mm/m. When a jig is made of steel, etc., machining on its surface or application of a spacer between the table and itself are required to get rid of bending torque on the shaker or a vibration table. The latter means, however, lacks in repeatability and therefore the former method is more recommendable.

5.7 Mounting on Shaker or Vibration Table

Keep the following matters in mind when mounting a jig, etc., on a shaker or a vibration table.

(1) Attachment bolt

The bolts necessary for mounting a jig are to be prepared by users. Those bolts are to be made of metal other than stainless steel (high-tensile bolts are recommended), and the tightening torque is to be based on the following table.

Table 5-3 Tightening Torque

fixed position		tightening torque
movable parts of unloaded shaker		88.0 N・m or less
horizontal vibration table 483.48-16		56.0 N・m or less
vertical vibration table	HEG24-63R-20	56.0 N・m or less
	AST-210VDM	68.6 N・m or less

(2) Timing of mounting jig and TS

A jig or/and a TS is to be mounted after the oil supply device and the air compressor of this facility are activated.

(3) Application of crane

The crane (2.8t) of this facility is to be operated by personnel who have the designated crane operator’s license. Anybody who uses the crane is to keep records of its usage history in the designated registry.

(4) Connecting cables for strain gauge

Shield wires are to be used as the connecting cables for strain gauges.

5.8 Protection of Test Room Floor

The floor of this test room is made of a material that causes little contamination, whose surface has a possible drawback of being fragile to shock loaded upon it. Therefore, users are to abide by the following directions. In case any condition comes out to interfere with the abidance of them, contact the Test Facilities Administration Room in advance to take measures for it.

(1) It is forbidden to use a dolly with steel wheels for carrying heavy things such as a TS, jigs, etc.

(2) The floor is to be cured in advance to protect its surface from being damaged by the shock due to dropped tools, etc.

5.9 Opening/Closing of Shutters

When carrying in/out a TS, or using a crane, etc., check up on the display of the thermohydrometer placed in the control room to see if the air-conditioning is working in the external room of the test room. Shutters can be opened and closed when the temperature and humidity are more or less equal inside and outside the test room. Otherwise, the shutters are to be kept closed.

5.10 Security Checking

When transferring data back and forth with this facility, it is necessary to put the external recording medium to be used through virus checking with the latest version of checking software prior to its application. Also, the information of all the data transferences is to be tracked and recorded on the “table of records for data transference via medium” and submitted to the Test Facilities Administration Room.

5.11 Emergency Stop Switch

When using the emergency stop switch in the test room in the middle of excitation application, be aware not to give a shock to the switch box, because that may activate the emergency stop interlock installed in the facility.

Appendix A

Test Conditions Requisition Sheet (to be submitted at K/O)

Small Vibration Test Facility
Test Conditions Requisition Sheet

(to be Submitted at K/O)

☐ COMMON

☐ SINE

☐ RANDOM

☐ CLASSICAL SHOCK

☐ SHOCK SYNTHESIS

☐ SINE BURST

This may not be the latest edition.

Small Vibration Test Facility Test Conditions Requisition Sheet (to be submitted at K/O)

COMMON

<table>
<tr><td>test name</td><td colspan="3"></td><td>notes</td></tr>
<tr><td>TS name</td><td colspan="3"></td><td></td></tr>
<tr><td>number of control chs</td><td colspan="3">ch(s)</td><td>up to 4 chs</td></tr>
<tr><td>number of limit chs</td><td colspan="3">ch(s)</td><td>up to (48 - number of control chs) chs</td></tr>
<tr><td>number of measurement chs</td><td colspan="3">charge: ch(s) / strain: ch(s)
voltage: ch(s)</td><td>224 chs or less in total
(up to 192 chs for charge signals, up to 32 chs for strain)</td></tr>
<tr><td rowspan="3">excitation direction
(Check☑ either vertical or horizontal.)</td><td>X axis</td><td colspan="2">☐vertical ☐horizontal</td><td rowspan="3"></td></tr>
<tr><td>Y axis</td><td colspan="2">☐vertical ☐horizontal</td></tr>
<tr><td>Z axis</td><td colspan="2">☐vertical ☐horizontal</td></tr>
<tr><td rowspan="4">vibration table
(Check☑ the model # of the vibration table to be used.)</td><td rowspan="3">vertical</td><td colspan="2">☐unloaded shaker</td><td>Max. load mass: 1,818 kg</td></tr>
<tr><td colspan="2">☐HEG24-63R-20</td><td>cf. φ1.6m, Max. load mass: 2,000 kg</td></tr>
<tr><td colspan="2">☐AST-210VDM</td><td>cf. φ1.1m, Max. load mass: 1,586 kg</td></tr>
<tr><td>horizontal</td><td colspan="2">☐483.48-16</td><td>cf. ☐1.2×1.2m, Max. load mass: 2,000 kg</td></tr>
<tr><td>environmental requirements for TS in clean room</td><td colspan="3">temperature:
humidity:
cleanliness:</td><td>【air conditioning conditions in test room (reference)】
temperature: 23±3℃
humidity: 45±15%
cleanliness: ISO class 8 (CLASS100,000)</td></tr>
<tr><td>TS mass</td><td colspan="3">kg</td><td rowspan="2">Maximum load mass is to be determined based on the specifications of the vibration table.</td></tr>
<tr><td>jig mass</td><td colspan="3">kg</td></tr>
<tr><td rowspan="3">CG position</td><td colspan="3">X = ＋･− mm</td><td rowspan="3">CG position is to be of a TS and a jig combined (from the center on the upper plane of the vibration table.)</td></tr>
<tr><td colspan="3">Y = ＋･− mm</td></tr>
<tr><td colspan="3">Z = ＋･− mm</td></tr>
<tr><td rowspan="3">excitation waveform and analysis condition</td><td>☐RANDOM</td><td colspan="2">☐PSD/time history waveform
☐transfer function/coherence
☐time history waveform
☐auto power spectrum</td><td rowspan="3">Check☑ the targeted excitation / analysis methods.</td></tr>
<tr><td>☐SINE
(☐UP / ☐DOWN)</td><td colspan="2">☐acceleration response
☐transfer function
☐time history waveform</td></tr>
<tr><td>☐SHOCK</td><td colspan="2">☐PSD/SRS
☐transfer function
☐time history waveform
☐autopower spectrum</td></tr>
<tr><td>video recording
(Check☑ either one.)</td><td colspan="3">☐necessary ・ ☐not necessary</td><td></td></tr>
</table>

SINE

setting of control parameters		notes
Max. frequency	Hz	frequency range: 5 ~ 2,000Hz
Min. frequency	Hz	
start frequency	Hz	
sweep direction	☐Up ☐Down	Check☑ either one.
sweep mode	☐Linear ☐Log	Check☑ either one.
number of sweeps	time(s)	Set the number of excitation cycles. ex. Set "2" for sequential Up/Down sweep.
sweep rate	☐Oct/min・☐Hz/sec	generally 1 ~ 4 Oct/min for spacecraft

setting of control levels							
frequency Hz	acceleration (m/s^2) (G)	velocity m/s	half amplitude m0-p	upper limit alarm level +dB	lower limit alarm level -dB	upper limit abort level +dB	lower limit abort level -dB
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-

RANDOM

setting of control parameters		notes
Max. frequency	Hz	frequency range: 5～2,000Hz
Min. frequency	Hz	
test time	: :	hh : mm : ss
frequency resolution	Hz	

setting of control levels							
overall RMS	m/s^2 rms (Grms)						
frequency Hz	level $(m/s^2)^2$/Hz	left inclination dB/oct	right inclination dB/oct	upper limit alarm leve: +dB	lower limit alarm leve: -dB	upper limit abort leve: +dB	lower limit abort leve: -dB
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-
				+	-	+	-

SHOCK SYNTHESIS

setting of control parameters		notes
number of full-level output pulses	time(s)	range: 1〜1,000,000,000 times
Min. frequency for analysis	Hz	range: DC ~ Max. frequency
Max. frequency for analysis	Hz	range: Min. frequency ~ 102.4 kHz

setting of control levels			
frequency Hz	amplitude m/s^2	tolerance (-allowable range) (-dB) range: -100 ~ 0dB	tolerance (+allowable range) (+dB) range: 0 ~ 100dB
		-	+
		-	+
		-	+
		-	+
		-	+
		-	+
		-	+
		-	+
		-	+
		-	+

CLASSICAL SHOCK

setting of control parameters		ntoes
number of full-level output pulses	time(s)	range: 1 ~ 1,000,000 times
duration (pulse width)	ms	range: 0.01 or more Max. pulse width depends on pulse amplitudes.
amplitude (Max. amplitude)	m/s^2	Max. pulse amplitude depends on vibration tables.
pulse type	☐Half Sine ☐Rectangular ☐Terminal Peak Sawtooth ☐Triangle ☐Initial Peak Sawtooth ☐Trapezoidal	Check☑ the pulse type to be applied in a test.

SINE BURST

setting of control parameters		notes
number of full-level output pulses	time(s)	range: 1 ~ 1,000,000 times
frequency	Hz	
amplitude (Max. amplitude)	m/s^2	
number of cycles	time(s)	

Example of Test Conditions Requisition Sheet (to be submitted at K/O)

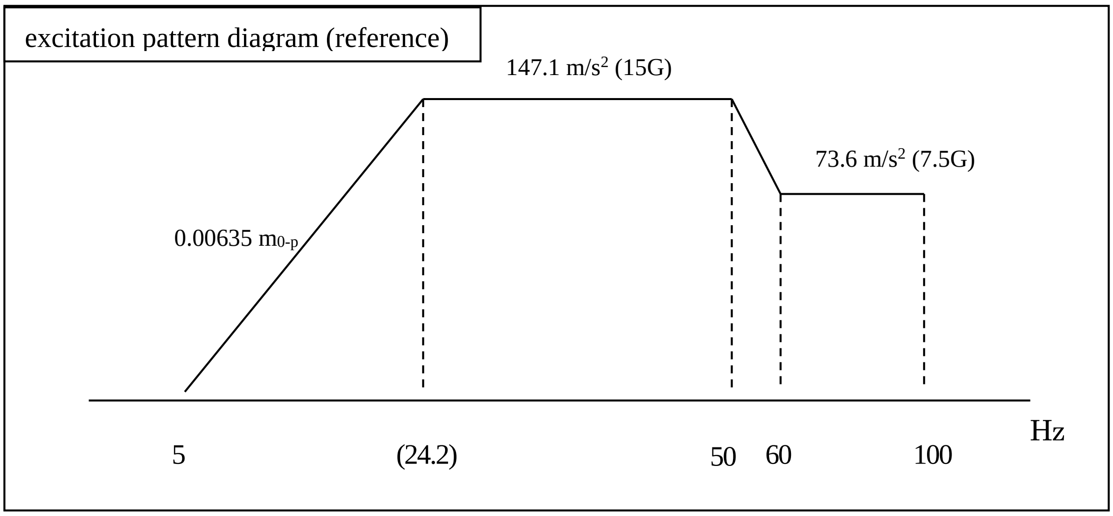
COMMON

No.	item	explanation	notes
1	Test name	Fill in the space with the name of the test the way its content can be understood.	
2	TS name	Fill in the space with the name of the TS.	
3	Number of control chs	Set the number of control channels.	up to 4 chs
4	Number of limit chs	Fill in the space with the number of limit control channels.	up to (48chs - number of control chs)
5	Number of measurement chs	Fill in the space with the number of measurement channels.	electric charge: up to 192 chs bridge: up to 32 chs voltage: up to (224 chs – number of chs for electric charge and bridge)
6	Excitation direction	Choose which one of the three axes of a TS corresponds to the excitation direction. (Check one of the alternatives.)	
7	Vibration table	Choose the model number of the vibration table to be used for vertical/horizontal excitation. (Check one of the alternatives).	
8	Environmental requirements for TS in clean room	Fill in the space with the air-conditioning conditions inside the test room.	
9	TS mass	Fill in the space with the mass of a TS.	Refer to the maximum load mass of the vibration table.
10	Jig mass	Fill in the space with the mass of a jig.	
11	CG position	Fill in the space with the CG position of a TS and a jig combined (from the center on the upper plane of the vibration table.)	
12	Excitation waveform and analysis condition	Choose the excitation waveform from RANDOM, SINE (UP, DOWN, sequential UP/DOWN), and SHOCK. (Check one of the alternatives.)	
		Choose the analysis condition for the chosen excitation waveform from the alternatives in the box to the right. (Check one of the alternatives.)	
13	Video recording	Choose whether or not to shoot and record the state of a TS during a test with the ITV cameras installed in the test room.	

SINE

No.	item	explanation	notes
	setting of control parameters		
1	Max. frequency	Set the Max. frequency.	2,000Hz or lower
2	Min. frequency	Set the Min. frequency.	5Hz or higher
3	Start frequency	Set the frequency at which excitation starts to be applied.	
4	Sweep direction	Choose the sweep-starting direction. (Check either one.)	
5	Sweep mode	Choose an excitation sweep mode. (Check either one.) Linear: linear sweep Log: logarithmic sweep	
6	Number of sweeps	Set the number of sweeps.	“1” for either UP or DOWN “2” for sequential UP/DOWN
7	Sweep rate	Set the sweep rate and choose the unit (Check either one.)	for log sweep mode: ☑[Oct/min] for linear sweep mode: ☑[Hz/sec]
	setting of control levels	An example of setting control levels is shown below.	
8	Frequency Hz	Set the frequencies at breakpoints on an excitation pattern.	
9	Acceleration	control over fixed acceleration (m/s^2) (G)	
10	Velocity	control over fixed velocity (m/s)	
11	Displacement	control over fixed displacement ($mm_{p\text{-}p}$)	
12	Lower limit abort level –dB	Set the minus abort level.	
13	Upper limit abort level +dB	Set the plus abort level.	

Example of Setting Control Levels
SINE



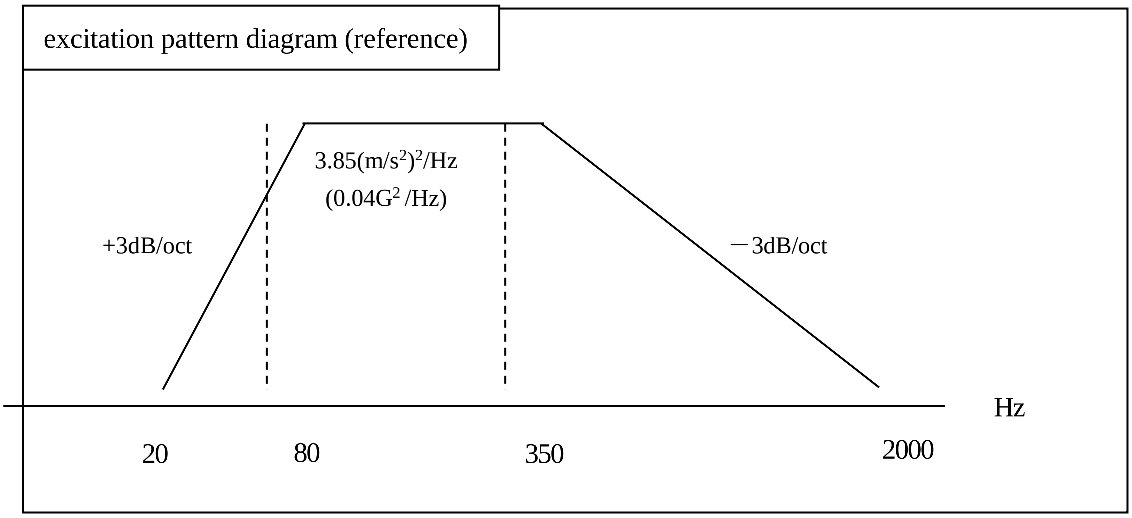
The excitation pattern as above, for example, can be specified as follows.

frequency Hz	acceleration m/s^2 (G)	velocity m/s	half amplitude $m_{0\text{-}p}$	upper limit alarm level + dB	lower limit alarm level - dB	upper limit abort level + dB	lower limit abort level - dB
5			0.00635	＋3	－3	＋6	－6
(24.2)	147.1 (15G)		0.00635	＋3	－3	＋6	－6
50	147.1 (15G)			＋3	－3	＋6	－6
60	73.6 (7.5G)			＋3	－3	＋6	－6
100	73.6 (7.5G)			＋3	－3	＋6	－6

RANDOM

No.	item	explanation	notes
	setting of control parameters		
1	Max. frequency	Set the Max. frequency.	2,000Hz or lower
2	Min. frequency	Set the Min. frequency.	5Hz or lower
3	Test time	Set the full level test time.	hh : mm : ss
4	Frequency resolution	Set the frequency resolution.	The number of sampling frequencies and the number of lines are automatically calculated according to the frequency resolution and excitation frequency.
	setting of control levels	An example of setting control levels is shown below.	
5	Overall RMS	Fill in the space with the RMS of the pre-set excitation pattern.	
6	Frequency Hz	Set the frequencies at breakpoints on an excitation pattern.	The number of breakpoints is up to 98.
7	Level $(m/s^2)^2/Hz$ (G^2/Hz) Left inclination dB/oct Right inclination dB/oct	Set the PSD level or the gradient of slope in terms of ±dB from breakpoints.	
8	Lower limit abort level –dB	Set the minus abort level.	
9	Upper limit abort level +dB	Set the plus abort level.	

Example of Setting Control Levels
RANDOM



The excitation pattern as above, for example, can be specified as follows.

setting of control levels							
overall RMS	m/s^2 rms （ Grms）						
frequency Hz	level $(m/s^2)^2$/Hz	left inclination dB/oct	right inclination dB/oct	upper limit alarm level: + dB	lower limit alarm level: - dB	upper limit abort level: + dB	lower limit abort level: - dB
20			3	+3	-3	+6	- 6
80	3.85 (0.04 G^2/Hz)			+3	-3	+6	- 6
350	3.85 (0.04 G^2/Hz)			+3	-3	+6	- 6
2,000		-3		+3	-3	+6	- 6

SHOCK SYNTHESIS

No.	item	explanation	notes
	setting of control parameters		
1	Number of full level pulses	Set the number of full level output pulses.	1 ~ 1,000,000,000 times
2	Min. frequency for analysis	Set the lower-limit frequency for measurement and analysis.	DC ~ Max. frequency
3	Max. frequency for analysis	Set the upper-limit frequency for measurement and analysis.	Min. frequency ~ 102.4 kHz
	setting of control levels		
4	Frequency Hz	Set the frequencies at breakpoints.	
5	Amplitude m/s^2 （G）	Set the pulse amplitude.	
6	Left inclination dB/oct	Set the gradient of slope in terms of ±dB from breakpoints.	
7	Right inclination dB/oct	Set the gradient of slope in terms of ±dB from breakpoints.	
8	Tolerance (allowable range) (- dB)	Set the minus tolerance range.	range: -100 ~ 0 dB
9	Tolerance (allowable range) (+ dB)	Set the plus tolerance range.	range: 0 ~ 100 dB

CLASSICAL SHOCK

No.	item	explanation	notes
	setting of control parameters		
1	Number of full level pulses	Set the number of full level output pulses.	1 ~ 1,000,000,000 times
2	Duration	Set the pulse width.	0.01 ~ one determined by Max. freq.
3	Amplitude	Set the pulse amplitude.	Max. pulse amplitude depends on vibration tables.
4	Pulse type	Choose the pulse type to be applied in a test. (Check one of the alternatives.)	

SINE BURST

No.	item	explanation	notes
	setting of control parameters		
1	Number of full level pulses	Set the number of full level output pulses.	1 ~ 1,000,000,000 times
2	Frequency	Set the frequency for burst waves.	
3	Amplitude	Set the pulse amplitude for burst waves.	Max. pulse amplitude depends on vibration tables.
4	Number of cycles	Set the number of cycles for burst waves.	

Appendix B
Test Conditions Requisition Sheet (to be submitted at test)

Small Vibration Test Facility
Test Conditions Requisition Sheet

(to be submitted at test)

Excitation Conditions Requisition Sheet

- ☐ SINE
- ☐ RANDOM
- ☐ CLASSICAL SHOCK
- ☐ SHOCK SYNTHESIS
- ☐ SINE BURST

Data Acquisition/Analysis Conditions Sheet

- ☐ RESPONSE CURVE ANALYSIS
- ☐ PSD / AUTO POWER SPECTRUM
- ☐ TRANSFER FUNCTION ANALYSIS / COHERENCE
- ☐ SRS
- ☐ TIME HISTORY WAVEFORM

Data Acquisition Database List

- ☐ ACCELERATION
- ☐ STRAIN

Excitation Conditions Requisition Sheet (1)

SINE

issue №

Test Specimen Name

date of issue

Test Name

issued by

final check	
TS	OP

CONTROL PARAMETERS (setting of control parameters)

		example
Test name (name of test in alphanumerics)		xyz_pft
Number of control channels	ch(s)	4 chs
Frequency resolution	☐Lines/Oct ☐Hz	100 ☑Lines/Oct
Min. frequency (lower limit frequency for excitation)	Hz	5 Hz
Max. frequency (upper limit frequency for excitation)	Hz	100 Hz
Control estimation (calculation method for amplitude of each channel)	☐Rms ☐Harmonic ☐Peak ☐Average	☑Harmonic
Control strategy	☐Average ☐Maximum ☐Minimum	☑Average

MEASUREMENT PARAMETERS (setting of measurement parameters – limit –)

		example
Number of measurement channels	ch(s)	32 chs
Reference channel	No. ch	1 ch
Measurement estimator	☐Rms ☐Filter ☐Peak ☐Average ☐THD	☑Rms
Measure FRF (setting of function measurement)	☐Spectrum ☐Spectrum + FRF	☑Spectrum

Note) Due to the operation of this facility, “(G)” is 9.80665 m/s^2 in SI unit.

Excitation Conditions Requisition Sheet (2)

SINE

issue №

Test Specimen Name

date of issue

Test Name

issued by

SWEEP PARAMETERS (setting of sweep parameters)

		example
Start up time (time to take for starting up)	sec	10 sec
Shut down time (time to take for shutting down)	sec	5 sec
Sweep mode (mode of sweep rate)	☐Log ☐Linear	☑Log
Sweep rate	☐Oct/min ☐Hz/sec	4 ☑Oct/min
Start frequency (excitation-starting frequency)	Hz	5 Hz
Sweep direction (setting of sweep-starting direction)	☐Up ☐Down	☑Up
Number of sweeps	time(s)	1 time
Compression factor (compression speed)		4
Activate recording (time-series saving of control data)	☐Yes ☐No	☑Yes (save)
Over sampling factor (the sampling factor for measurement)	Control Sampling ×	1

Excitation Conditions Requisition Sheet (3)

SINE

issue №

Test Specimen Name

date of issue

Test Name

issued by

Channel Setup (setting of control/measurement channels)

No.	group ID	point	direction	input mode	measured quantity	actual sensitivity	sensor ID
1	-	Tacho1	None	☑Voltage DC /☐AC ☐ICP /☐Charge			
2	Control	CTRL1	+X	☐Voltage DC /☐AC ☐ICP /☐Charge			
3	Control	CTRL2	+X	☐Voltage DC /☐AC ☐ICP /☐Charge			
4	Control	CTRL3	+X	☐Voltage DC /☐AC ☐ICP /☐Charge			
5	Control	CTRL4	+X	☐Voltage DC /☐AC ☐ICP /☐Charge			
6				☐Voltage DC /☐AC ☐ICP /☐Charge			
7				☐Voltage DC /☐AC ☐ICP /☐Charge			
8				☐Voltage DC /☐AC ☐ICP /☐Charge			
9				☐Voltage DC /☐AC ☐ICP /☐Charge			
10				☐Voltage DC /☐AC ☐ICP /☐Charge			
11				☐Voltage DC /☐AC ☐ICP /☐Charge			
12				☐Voltage DC /☐AC ☐ICP /☐Charge			
13				☐Voltage DC /☐AC ☐ICP /☐Charge			
14				☐Voltage DC /☐AC ☐ICP /☐Charge			
15				☐Voltage DC /☐AC ☐ICP /☐Charge			
16				☐Voltage DC /☐AC ☐ICP /☐Charge			
17				☐Voltage DC /☐AC ☐ICP /☐Charge			
18				☐Voltage DC /☐AC ☐ICP /☐Charge			
19				☐Voltage DC /☐AC ☐ICP /☐Charge			
20				☐Voltage DC /☐AC ☐ICP /☐Charge			
21				☐Voltage DC /☐AC ☐ICP /☐Charge			
22				☐Voltage DC /☐AC ☐ICP /☐Charge			
23				☐Voltage DC /☐AC ☐ICP /☐Charge			
24				☐Voltage DC /☐AC ☐ICP /☐Charge			
25				☐Voltage DC /☐AC ☐ICP /☐Charge			
26				☐Voltage DC /☐AC ☐ICP /☐Charge			

27				☐Voltage DC /☐AC ☐ICP /☐Charge			
28				☐Voltage DC /☐AC ☐ICP /☐Charge			
29				☐Voltage DC /☐AC ☐ICP /☐Charge			
30				☐Voltage DC /☐AC ☐ICP /☐Charge			
31				☐Voltage DC /☐AC ☐ICP /☐Charge			
32				☐Voltage DC /☐AC ☐ICP /☐Charge			
33				☐Voltage DC /☐AC ☐ICP /☐Charge			
34				☐Voltage DC /☐AC ☐ICP /☐Charge			
35				☐Voltage DC /☐AC ☐ICP /☐Charge			
36				☐Voltage DC /☐AC ☐ICP /☐Charge			
37				☐Voltage DC /☐AC ☐ICP /☐Charge			
38				☐Voltage DC /☐AC ☐ICP /☐Charge			
39				☐Voltage DC /☐AC ☐ICP /☐Charge			
40				☐Voltage DC /☐AC ☐ICP /☐Charge			
41				☐Voltage DC /☐AC ☐ICP /☐Charge			
42				☐Voltage DC /☐AC ☐ICP /☐Charge			
43				☐Voltage DC /☐AC ☐ICP /☐Charge			
44				☐Voltage DC /☐AC ☐ICP /☐Charge			
45				☐Voltage DC /☐AC ☐ICP /☐Charge			
46				☐Voltage DC /☐AC ☐ICP /☐Charge			
47				☐Voltage DC /☐AC ☐ICP /☐Charge			
48				☐Voltage DC /☐AC ☐ICP /☐Charge			
49				☐Voltage DC /☐AC ☐ICP /☐Charge			

example

No.	group ID	point	direction	input mode	measured quantity	actual sensitivity	sensor ID
1	Control	Panel_1	+Y	☐Voltage DC /☐AC ☐ICP /☑Charge	Acceleration	1.2991 pC/(m/s^2)	XY1234
2	Measure	ACP_1	-X	☐Voltage DC /☐AC ☑ICP /☐Charge	Acceleration	1.1 mV/(m/s^2)	AX2345
3	Control	PIU_2	+Z	☑Voltage DC /☐AC ☐ICP /☐Charge	Force	0.203 mV/N	ZZ3456

Excitation Conditions Requisition Sheet (4)

SINE

issue № ____________

Test Specimen Name ____________________ date of issue ____________

Test Name ____________________ issued by ____________

EXCITATION PATTERN DIAGRAM (reference)

REFERENCE PROFILE (setting of control levels)

frequency Hz	acceleration m/s^2 (G)	velocity m/s	half amplitude $m_{0\text{-}p}$	upper limit alarm level + dB	lower limit alarm level - dB	upper limit abort level + dB	lower limit abort level - dB

example

5			0.00635	＋3	－3	＋6	－6
(24.2)	147.1 (15G)		0.00635	＋3	－3	＋6	－6
50	147.1 (15G)			＋3	－3	＋6	－6
60	73.6 (7.5G)			＋3	－3	＋6	－6
100	73.6 (7.5G)			＋3	－3	＋6	－6

Note) Due to the operation of this facility, “(G)” is 9.80665 m/s^2 in SI unit.

Excitation Conditions Requisition Sheet (5)

SINE

issue №

Test Specimen Name　　date of issue

Test Name　　issued by

Notching Profile (setting of notching profile)　　(No.　/　)

PROFILE TABLE	Channel ID	[　]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[　]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[　]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[　]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[　]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[　]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[　]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[　]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

*　Fill in the blanks with "－" if Minimum/ Maximum Frequencies as control parameters coincide with those of notching.

Notching Profile (setting of notching profile) (No. /)

PROFILE TABLE	Channel ID	[ ]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*		Hz	
Max. frequency*		Hz	

PROFILE TABLE	Channel ID	[ ]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*		Hz	
Max. frequency*		Hz	

PROFILE TABLE	Channel ID	[ ]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*		Hz	
Max. frequency*		Hz	

PROFILE TABLE	Channel ID	[ ]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*		Hz	
Max. frequency*		Hz	

PROFILE TABLE	Channel ID	[ ]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*		Hz	
Max. frequency*		Hz	

PROFILE TABLE	Channel ID	[ ]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*		Hz	
Max. frequency*		Hz	

PROFILE TABLE	Channel ID	[ ]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*		Hz	
Max. frequency*		Hz	

PROFILE TABLE	Channel ID	[ ]	
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*		Hz	
Max. frequency*		Hz	

* Fill in the blanks with "—" if Minimum/ Maximum Frequencies as control parameters coincide with those of notching.

Example of Excitation Conditions Requisition Sheet

SINE

No.	item	explanation	parameter range	example
	< Excitation Conditions Requisition Sheet (1) >			
1	Test name	Fill in the space with an ID that distinguishes the test.	with only alphanumerics	xyz_pft
2	Number of control channels	Set the number of control channels.	1 ~ 4 chs	4 chs
3	Frequency resolution	Set the frequency resolution.	for log sweep mode: lines/Oct for linear sweep mode: Hz	100 ☑lines/Oct
4	Min. frequency	Set the lower limit of excitation frequency band.	5Hz or higher	5Hz
5	Max. frequency	Set the upper limit of excitation frequency band.	2 kHz or lower	100Hz
6	Control estimation	Choose a calculation method for amplitude of each channel.	Choose one from Rms, Harmonic, Peak, and Average.	☑ Harmonic
7	Control strategy	Choose an excitation control method.	Choose one from Average, Maximum, and Minimun.	☑Average
8	Number of measurement channels	Set the number of measurement channels on the controller side.	1 ~ 48 chs (including control channels.)	32 chs
9	Reference channel	Choose the reference channel number for calculating spectrum and FRF.	Choose one from chs 1 ~ 48 as the reference channel, and choose either Drive or Average as the calculation method.	1 ch
10	Measurement estimator	Choose a method of obtaining amplitude.	Choose one from Rms, Filter, Peak, Average, and THD.	☑Rms
11	Measure FRF	Set the measured function.	Choose either Spectrum or Spectrum+FRF	☑Spectrum
	< Excitation Conditions Requisition Sheet (2) >			
12	Start up time	Set the time to take for starting up.	0.02 or longer	10sec
13	Shut down time	Set the time to take for shutting down.	0.02 or longer	5sec
14	Sweep mode	Choose an excitation sweep mode.	Choose either Log or Linear.	☑Log
15	Sweep rate	Set the sweep rate and choose the unit (Check either one.)	0.001 or higher for log sweep mode: [Oct/min] for linear sweep mode: [Hz/sec]	4☑Oct/min
16	Start frequency	Set the frequency at which excitation starts to be applied.	5 ~ 2 kHz	5Hz
17	Sweep direction	Choose the sweep-starting direction.	Choose either Up or Down	☑Up
18	Number of sweeps	Set the number of sweeps.	1 or more (one way of Up or Down is counted as 1 time.)	1 time
19	Compression factor	Set the initial level of compression speed.	Choose from 1 ~ 20.	4
20	Activate recording	Choose whether or not to execute time-series saving of control data	Choose from Yes or No.	☑Yes
21	Over sampling factor	Set the sampling factor for measurement	Designate the multiplication for control samplings; possible up to 102.4 kHz.	1

Excitation Conditions Requisition Sheet (1)

RANDOM

issue №
date of issue
issued by

Test Specimen Name
Test Name

final check	
TS	OP

CONTROL PARAMETERS (setting of control parameters)

		example
Test name (name of test in alphanumerics)		y_pft_pre_modal
Number of control channels	ch(s)	4 chs
Frequency resolution	Hz	1.00Hz
Min. frequency (lower limit frequency for excitation)	Hz	20Hz
Max. frequency (upper limit frequency for excitation)	Hz	2,000Hz
Degrees of freedom (DOF for analysis on control channels)		100
Control strategy	☐Average ☐Maximum ☐Minimum	☑Average
Average per loop		4
Average weight factor (average factor of control signals)		8
Sigma limiting		3
Random signal type	☐True ☐False	☑True

Note) Due to the operation of this facility, “(G)” is 9.80665 m/s^2 in SI unit.

Excitation Conditions Requisition Sheet (2)

RANDOM

issue №
Test Specimen Name
date of issue
Test Name
issued by

MEASUREMENT PARAMETERS (setting of measurement parameters – limit –)

		example
Number of measurement channels	ch(s)	28 chs
Measure FRF	☐AP ☐AP+FRF	☑AP (Autopower)
Number reference channel	No. ch	1 ch

Safety

		example
RMS abort limit	dB	3.00dB
Max. allowed alarm lines (number of alarm lines)		3
Max. allowed abort lines (number of abort lines)		1
Max. repeated aborts	time(s)	5 times
Shutdown/abort time	sec	5 sec
Abort check enable level	dB	-3dB
Line abort enable level	dB	-3dB

Throughput Recording

Activate recording (time-series saving of control data)	☐Yes ☐No	☑Yes (save)
Over sampling factor (the sampling factor for measurement)	Control sampling ×	4

Excitation Conditions Requisition Sheet (3)

RANDOM

issue №____________________

Test Specimen Name________________________________

date of issue____________________

Test Name_______________________________________

issued by____________________

Channel Setup (setting of control/measurement channels)

No.	group ID	point	direction	input mode	measured quantity	actual sensitivity	sensor ID
1	-	Tacho1	None	☑Voltage DC /☐AC ☐ICP /☐Charge			
2	Control	CTRL1	+X	☐Voltage DC /☐AC ☐ICP /☐Charge			
3	Control	CTRL2	+X	☐Voltage DC /☐AC ☐ICP /☐Charge			
4	Control	CTRL3	+X	☐Voltage DC /☐AC ☐ICP /☐Charge			
5	Control	CTRL4	+X	☐Voltage DC /☐AC ☐ICP /☐Charge			
6				☐Voltage DC /☐AC ☐ICP /☐Charge			
7				☐Voltage DC /☐AC ☐ICP /☐Charge			
8				☐Voltage DC /☐AC ☐ICP /☐Charge			
9				☐Voltage DC /☐AC ☐ICP /☐Charge			
10				☐Voltage DC /☐AC ☐ICP /☐Charge			
11				☐Voltage DC /☐AC ☐ICP /☐Charge			
12				☐Voltage DC /☐AC ☐ICP /☐Charge			
13				☐Voltage DC /☐AC ☐ICP /☐Charge			
14				☐Voltage DC /☐AC ☐ICP /☐Charge			
15				☐Voltage DC /☐AC ☐ICP /☐Charge			
16				☐Voltage DC /☐AC ☐ICP /☐Charge			
17				☐Voltage DC /☐AC ☐ICP /☐Charge			
18				☐Voltage DC /☐AC ☐ICP /☐Charge			
19				☐Voltage DC /☐AC ☐ICP /☐Charge			
20				☐Voltage DC /☐AC ☐ICP /☐Charge			
21				☐Voltage DC /☐AC ☐ICP /☐Charge			
22				☐Voltage DC /☐AC ☐ICP /☐Charge			
23				☐Voltage DC /☐AC ☐ICP /☐Charge			
24				☐Voltage DC /☐AC ☐ICP /☐Charge			
25				☐Voltage DC /☐AC ☐ICP /☐Charge			
26				☐Voltage DC /☐AC ☐ICP /☐Charge			

27				☐Voltage DC /☐AC ☐ICP /☐Charge			
28				☐Voltage DC /☐AC ☐ICP /☐Charge			
29				☐Voltage DC /☐AC ☐ICP /☐Charge			
30				☐Voltage DC /☐AC ☐ICP /☐Charge			
31				☐Voltage DC /☐AC ☐ICP /☐Charge			
32				☐Voltage DC /☐AC ☐ICP /☐Charge			
33				☐Voltage DC /☐AC ☐ICP /☐Charge			
34				☐Voltage DC /☐AC ☐ICP /☐Charge			
35				☐Voltage DC /☐AC ☐ICP /☐Charge			
36				☐Voltage DC /☐AC ☐ICP /☐Charge			
37				☐Voltage DC /☐AC ☐ICP /☐Charge			
38				☐Voltage DC /☐AC ☐ICP /☐Charge			
39				☐Voltage DC /☐AC ☐ICP /☐Charge			
40				☐Voltage DC /☐AC ☐ICP /☐Charge			
41				☐Voltage DC /☐AC ☐ICP /☐Charge			
42				☐Voltage DC /☐AC ☐ICP /☐Charge			
43				☐Voltage DC /☐AC ☐ICP /☐Charge			
44				☐Voltage DC /☐AC ☐ICP /☐Charge			
45				☐Voltage DC /☐AC ☐ICP /☐Charge			
46				☐Voltage DC /☐AC ☐ICP /☐Charge			
47				☐Voltage DC /☐AC ☐ICP /☐Charge			
48				☐Voltage DC /☐AC ☐ICP /☐Charge			
49				☐Voltage DC /☐AC ☐ICP /☐Charge			

example

No.	group ID	point	direction	input mode	measured quantity	actual sensitivity	sensor ID
1	Control	Panel_1	+Y	☐Voltage DC /☐AC ☐ICP /☑Charge	Acceleration	1.2991 pC/(m/s^2)	XY1234
2	Measure	ACP_1	-X	☐Voltage DC /☐AC ☑ICP /☐Charge	Acceleration	1.1 mV/(m/s^2)	AX2345
3	Control	PIU_2	+Z	☑Voltage DC /☐AC ☐ICP /☐Charge	Force	0.203 mV/N	ZZ3456

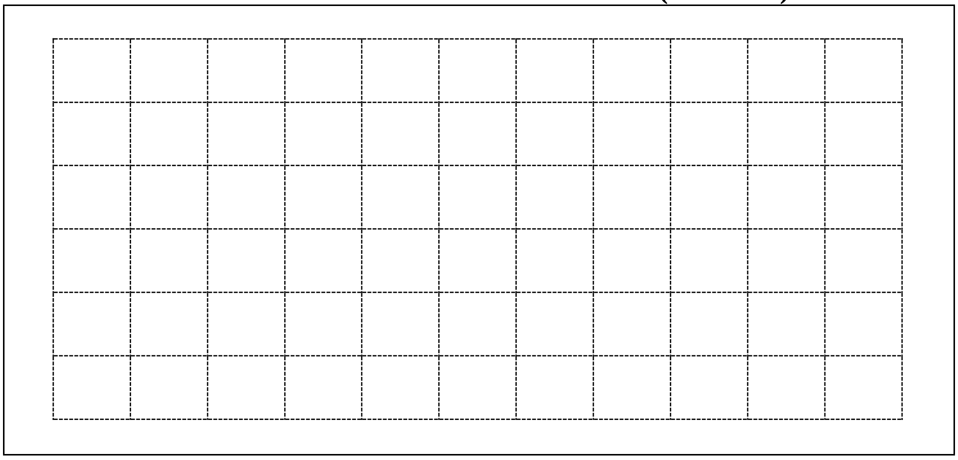
Excitation Conditions Requisition Sheet (4)
RANDOM

issue №____________________

Test Specimen Name________________________________ date of issue________________

Test Name_______________________________________ issued by____________________

EXCITATION PATTERN DIAGRAM (reference)



REFERENCE SPECTRUM (setting of control levels)

overall RMS	m/s^2 rms (Grms)						
frequency Hz	level $(m/s^2)^2/Hz$	left inclination dB/oct	right inclination dB/oct	upper limit alarm level: + dB	lower limit alarm level: - dB	upper limit abort level: + dB	lower limit abort level: - dB

example

20			3	+3	-3	+6	- 6
80	3.85 $(0.04G^2/Hz)$			+3	-3	+6	- 6
350	3.85 $(0.04G^2/Hz)$			+3	-3	+6	- 6
2,000		−3		+3	-3	+6	- 6

Note) Due to the operation of this facility, "(G)" is 9.80665 m/s^2 in SI unit.

Excitation Conditions Requisition Sheet (5)

RANDOM

issue №

Test Specimen Name　　　　　　　　　　　　　　　date of issue

Test Name　　　　　　　　　　　　　　　　　　　issued by

LEVEL/TIME SEQUENCE (setting of level/time)

command	level [dB/Ref] (excitation level)	time [h:min:s] (test time)	measure Y/N (whether or not to measure)	offset [h:min:s] (start time)	period [h:min:s] (measurement time)	averages [time]
			☐Y/☐N			
			☐Y/☐N			
			☐Y/☐N			
			☐Y/☐N			
			☐Y/☐N			
			☐Y/☐N			
			☐Y/☐N			

example

level	-6.00	0:1:0.0	☐Y/☑N	0:0:0.0	0:0:0.0	0
hold	-3.00	—	—	—	—	—
level	0.00	0:1:0.0	☑Y/☐N	0:0:15.0	0:0:30.0	20

Excitation Conditions Requisition Sheet (6)

RANDOM

issue №
Test Specimen Name
date of issue
Test Name
issued by

Notching Profile (setting of notching profile) (No. /)

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

* Fill in the blanks with "―" if Minimum/ Maximum Frequencies as control parameters coincide with those of notching.

Notching Profile (setting of notching profile) (No. /)

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

PROFILE TABLE	Channel ID	[ ]	
RMS limiting (m/s^2)			
up/low abort (m/s^2)			
No	frequency (Hz)	acc (m/s^2)	upper abort (dB)
1			
2			
3			
4			
5			
Min. frequency*			Hz
Max. frequency*			Hz

* Fill in the blanks with “―” if Minimum/ Maximum Frequencies as control parameters coincide with those of notching.

Example of Excitation Conditions Requisition Sheet

RANDOM

No.	item	explanation	parameter range	example
	＜ Excitation Conditions Requisition Sheet (1) ＞			
1	Test name	Fill in the space with an ID that distinguishes the test.	with only alphanumerics	y_pft_pre_modal
2	Number of control channels	Set the number of control channels.	1 ~ 4 chs	4 chs
3	Frequency resolution	Set the frequency resolution.		1.00Hz
4	Min. frequency	Set the lower limit of excitation frequency band.	5Hz or higher	20Hz
5	Max. frequency	Set the upper limit of excitation frequency band.	2 kHz or lower	2,000Hz
6	Degrees of freedom	Set the DOF for analysis on control channels.	100 or more is recommended.	100
7	Control strategy	Choose an excitation control method.	“Average” is to be chosen.	☑Average
8	Average per loop	Set the number of average operations on control signals per one control loop.	4 is recommended.	4
9	Average weight factor	Set the average factor of control signals.	8 is recommended.	8
10	Sigma limiting	Set the sigma limit.	3 is recommended.	3
11	Random signal type	Set the random signal type.	Choose “True.”	☑True
	＜ Excitation Conditions Requisition Sheet (2) ＞			
14	Number of measurement channels	Set the number of measurement channels on the controller side.	1 ~ 48 chs (including control channels)	28 chs
15	Measure FRF	Set the measured function.	Choose either AP or AP+FRF	☑AP
16	Number reference channel	Choose the reference channel number for calculating cross power and FRF.	Choose one from chs 1 ~ 48 as the reference channel, and choose either Drive or Average as the calculation method.	1ch
17	RMS Abort Limit	Set the RMS abort limit.	0 or more	3.00dB
18	Max. allowed alarm lines	Set the Max. alarm lines.	0 or more	3
19	Max. allowed abort lines	Set the Max. abort lines.	0 or more	1
20	Max. repeated aborts	Set the maximum number of repeated aborts.	0 or more	5times
21	Shutdown/abort time	Set the time to take for shutting down drive signals in abort.	0.5 or longer	5sec
22	Abort check enable level	Set the level for enabling abort checking.	0 or lower	-3dB
23	Line abort enable level	Set the level for enabling line abort.	0 or lower	-3dB
24	Activate recording	Choose whether or not to execute time-series saving of control data.	Choose from Yes or No.	☑Yes
25	Over sampling factor	Set the sampling factor for measurement.	Designate the multiplication for control samplings; possible up to 102.4 kHz.	4

Excitation Conditions Requisition Sheet (1)

SHOCK

issue №

date of issue

issued by

Test Specimen Name

Test Name

final check	
TS	OP

CONTROL PARAMETERS (setting of control parameters)

		example
Test name (name of test in alphanumerics)		y_shock
Number of control channels	ch(s)	1 ch
Min. frequency (lower limit frequency for excitation)	Hz	2Hz
Max. frequency (upper limit frequency for excitation)	Hz	2,000Hz
Average per loop	time(s)	2 times
Pulse repetition rate (number of applied pulses / sec.)	time(s)/sec	1 time/sec

REFERENCE PULSE (setting of pulse)

			example
Pulse type	☐Classical	☐Half sine ☐Triangular ☐Rectangular ☐Initial Peak ☐Terminal Peak ☐Trapezoid	☑SRS
	☐Measured	Sine burst	
	☐Synthesized	SRS	

Excitation Conditions Requisition Sheet (2)

SHOCK

issue №
Test Specimen Name
date of issue
Test Name
issued by

MEASUREMENT PARAMETERS (setting of measurement parameters)

		example
Number of measurement channels	chs	2 chs
Number of averages		2
Number reference channel	No. ch	1ch
Measure FRF	☐Time ☐Time & FRF	☑Time & FRF
Online SRA (online shock response analysis)	☐Yes ☐No	☑Yes

ALARM AND ABORT CONDITIONS (setting of alarm / abort)

		example
Max. percent of alarm points	%	10%
Max. percent of abort points	%	0%
Max. number of repeated aborts	time(s)	5 times
Line abort enable level	dB	-3dB

Excitation Conditions Requisition Sheet (3)

SHOCK

issue № ________________
date of issue ________________
issued by ________________

Test Specimen Name ____________________________
Test Name ____________________________

SHOCK REFERENCE PROFILE EDITOR (setting of reference pulse)

		example
Reference name (name of pulse in alphanumerics)		y_pulse
Amplitude (max. amplitude)	m/s^2	200 m/s^2
Duration (pulse width)	ms	11.00 ms
Pulse polarity	☐Positive ☐Negative	☑Positive
Min. number of point (the min. number of samples in a pulse)		5
Pre and post pulse	☐Single-Sided ☐Double-Sided ☐Optimized ☐Minimized	☑Double-Sided
Pre pulse amplitude	% Pulse peak	30.00% Pulse peak
Post pulse amplitude	% Pulse peak	30.00% Pulse peak
Abort limit	% Pulse peak	50.00% Pulse peak
Alarm limit	% Abort	50.00% Abort
Pre pulse abort (pre pulse abort limit in percentage)	% Pulse peak	50.00% Pulse peak
Post pulse abort (post pulse abort limit in percentage)	% Pulse peak	50.00% Pulse peak

Note) Those who chose “Measured” for the reference pulse item in the excitation conditions requisition sheet (1) are to use the excitation conditions requisition sheet (3) SINE BURST. When “Synthesized” was chosen in that item, use the excitation conditions requisition sheet (3) SHOCK-SRS.

Excitation Conditions Requisition Sheet (4)

SHOCK

issue №

Test Specimen Name

date of issue

Test Name

issued by

Channel Setup (setting of control/measurement channels)

No.	group ID	point	direction	input mode	measured quantity	actual sensitivity	sensor ID
1	-	Tacho1	None	☑Voltage DC /☐AC ☐ICP /☐Charge			
2	Control	CTRL1	+X	☐Voltage DC /☐AC ☐ICP /☐Charge			
3				☐Voltage DC /☐AC ☐ICP /☐Charge			
4				☐Voltage DC /☐AC ☐ICP /☐Charge			
5				☐Voltage DC /☐AC ☐ICP /☐Charge			
6				☐Voltage DC /☐AC ☐ICP /☐Charge			
7				☐Voltage DC /☐AC ☐ICP /☐Charge			
8				☐Voltage DC /☐AC ☐ICP /☐Charge			
9				☐Voltage DC /☐AC ☐ICP /☐Charge			
10				☐Voltage DC /☐AC ☐ICP /☐Charge			
11				☐Voltage DC /☐AC ☐ICP /☐Charge			
12				☐Voltage DC /☐AC ☐ICP /☐Charge			
13				☐Voltage DC /☐AC ☐ICP /☐Charge			
14				☐Voltage DC /☐AC ☐ICP /☐Charge			
15				☐Voltage DC /☐AC ☐ICP /☐Charge			
16				☐Voltage DC /☐AC ☐ICP /☐Charge			
17				☐Voltage DC /☐AC ☐ICP /☐Charge			
18				☐Voltage DC /☐AC ☐ICP /☐Charge			
19				☐Voltage DC /☐AC ☐ICP /☐Charge			
20				☐Voltage DC /☐AC ☐ICP /☐Charge			
21				☐Voltage DC /☐AC ☐ICP /☐Charge			
22				☐Voltage DC /☐AC ☐ICP /☐Charge			
23				☐Voltage DC /☐AC ☐ICP /☐Charge			
24				☐Voltage DC /☐AC ☐ICP /☐Charge			
25				☐Voltage DC /☐AC ☐ICP /☐Charge			
26				☐Voltage DC /☐AC ☐ICP /☐Charge			

27				☐Voltage DC /☐AC ☐ICP /☐Charge			
28				☐Voltage DC /☐AC ☐ICP /☐Charge			
29				☐Voltage DC /☐AC ☐ICP /☐Charge			
30				☐Voltage DC /☐AC ☐ICP /☐Charge			
31				☐Voltage DC /☐AC ☐ICP /☐Charge			
32				☐Voltage DC /☐AC ☐ICP /☐Charge			
33				☐Voltage DC /☐AC ☐ICP /☐Charge			
34				☐Voltage DC /☐AC ☐ICP /☐Charge			
35				☐Voltage DC /☐AC ☐ICP /☐Charge			
36				☐Voltage DC /☐AC ☐ICP /☐Charge			
37				☐Voltage DC /☐AC ☐ICP /☐Charge			
38				☐Voltage DC /☐AC ☐ICP /☐Charge			
39				☐Voltage DC /☐AC ☐ICP /☐Charge			
40				☐Voltage DC /☐AC ☐ICP /☐Charge			
41				☐Voltage DC /☐AC ☐ICP /☐Charge			
42				☐Voltage DC /☐AC ☐ICP /☐Charge			
43				☐Voltage DC /☐AC ☐ICP /☐Charge			
44				☐Voltage DC /☐AC ☐ICP /☐Charge			
45				☐Voltage DC /☐AC ☐ICP /☐Charge			
46				☐Voltage DC /☐AC ☐ICP /☐Charge			
47				☐Voltage DC /☐AC ☐ICP /☐Charge			
48				☐Voltage DC /☐AC ☐ICP /☐Charge			
49				☐Voltage DC /☐AC ☐ICP /☐Charge			

example

No.	group ID	point	direction	input mode	measured quantity	actual sensitivity	sensor ID
1	Control	Panel_1	+Y	☐Voltage DC /☐AC ☐ICP /☑Charge	Acceleration	1.2991 pC/(m/s^2)	XY1234
2	Measure	ACP_1	-X	☐Voltage DC /☐AC ☑ICP /☐Charge	Acceleration	1.1 mV/(m/s^2)	AX2345
3	Control	PIU_2	+Z	☑Voltage DC /☐AC ☐ICP /☐Charge	Force	0.203 mV/N	ZZ3456

Excitation Conditions Requisition Sheet (5)

SHOCK

issue №________________

Test Specimen Name____________________________ date of issue________________

Test Name____________________________ issued by________________

LEVEL/TIME SEQUENCE (setting of level/time)

command	level [dB/Ref] (excitation level)	pulses [time] (number of pulses)	startup mode [time] (excitation-starting mode)	measure ☑Y/☐N (whether or not to measure)	offset [time] (measurement-starting pulse)	period [time] (measurement pulse)	averages [time]
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			
				☐Y/☐N			

example

level	-10.00	30	automatic	☐Y/☑N	—	—	—
hold	-6.00	30	automatic	☐Y/☑N	—	—	—
level	-3.00	3	automatic	☐Y/☑N	—	—	—
level	0.00	3	single shot	☑Y/☐N	0	1	1

Example of Excitation Conditions Requisition Sheet

SHOCK

No.	item	explanation	parameter range	example
	＜ Excitation Conditions Requisition Sheet (1) ＞			
1	Test name	Fill in the space with an ID that distinguishes the test.	with only alphanumerics	y_shock
2	Number of control channels	Set the number of control channels.	1ch	1ch
3	Min. frequency	Set the lower-limit frequency for control	5Hz or higher	2Hz
4	Max. frequency	Set the upper-limit frequency for control	2,000Hz or lower	2,000Hz
5	Average per loop	Set the number of average operations on control signals per one control loop	1 or more	2 times
6	Pulse repetition rate	Set the number of applied pulses per a second	Set in the range of 0.001 ~ 10	1 time/sec
7	Pulse type	Choose a reference pulse type.	Choose one from Half sine, Triangular, Rectangular, Initial Peak, Terminal Peak, Trapezoid, Sine burst, and SRS	☑SRS
	＜ Excitation Conditions Requisition Sheet (2) ＞			
8	Number of measurement channels	Set the number of measurement channels on the controller side.	1 ~ 48 chs (including control channels)	2 chs
9	Number of averages			2
10	Number reference channel	Choose the reference channel number for calculating FRF.	Choose one from chs 1 ~ 48 as the reference channel, and choose Drive as the calculation method.	1ch
11	Measure FRF	Set the measured function.	Choose either Time or Time＋FRF	☑Time＋FRF
12	Online SRA	Choose whether or not to execute online shock response analysis	Choose from Yes or No.	☑Yes
13	Max. percent of alarm points	Set the maximum number of points among measurement points (%) to release alarm.	0 ~ 100	10%
14	Max. percent of abort points	Set the maximum number of points among measurement points (%) to abort operation.	0 ~ 100	0%
15	Max. number of repeated aborts	Set the maximum number of repeated aborts.	1 or more	5times
16	Line abort enable level	Set the level for enabling abort checking.	0 or lower	-3dB
	＜ Excitation Conditions Requisition Sheet (3) ＞			
17	Reference name	Fill in the space with the name of the given pulse	with only alphanumerics	y_pulse
18	Amplitude	Set the maximum amplitude (m/s^2.)	0 or more (depending on waveforms)	200 m/s^2
19	Duration	Set the pulse width.	0 or more (depending on waveforms)	11.00 ms
20	Pulse polarity	Choose the pulse direction.	Choose either positive or negative.	☑Positive
21	Min. number of point	Set the minimum number of samples in a pulse.	3 ~ 32,768	5
22	Pre and post Pulse	Choose the pre and post pulse.	Choose one from Single-sided, Double-sided, Optimized, and Minimized.	☑Double-sided
23	Pre pulse amplitude	Set the pre pulse amplitude against the main pulse.	0 ~ 10,000	30.00%
24	Post pulse amplitude	Set the post pulse amplitude against the main pulse.	0 ~ 10,000	30.00%
25	Abort limit	Set the abort limit percentage against the pulse peak. (%)	0 ~ 10,000	50.00%
26	Alarm limit	Set the alarm limit percentage against the abort limit. (%)	0 ~ 100	50.00%
27	Pre pulse abort	Set the abort limit for the pre pulse against its amplitude.	0 ~ 10,000	50.00%
28	Post pulse abort	Set the abort limit for the post pulse against its amplitude.	0 ~ 10,000	50.00%

Excitation Conditions Requisition Sheet (3)

SINE BURST

issue №
Test Specimen Name ______ date of issue
Test Name ______ issued by

SINE BURST

			example
Reference name (name of pulse in alphanumerics)			y_pulse
Frequency	Hz		10Hz
Amplitude (max. amplitude)	m/s^2		2.00 m/s^2
Sampling rate (sampling frequency)	Hz		4000.00Hz
# Periods constant (number of constant waves)			5
# Periods up / down (number of amplified/damped waves)	/		2/2
Min. number of point (the min. number of samples in a pulse)			5
Pre and post pulse	☐Single-Sided ☐Double-Sided ☐Optimized ☐Minimized		☑Double-Sided
Pre pulse amplitude	% Pulse peak		30.00% Pulse peak
Post pulse amplitude	% Pulse peak		30.00% Pulse peak
Abort limit	% Pulse peak		50.00% Pulse peak
Alarm limit	% Abort		50.00% Abort
Pre pulse abort (pre pulse abort limit in percentage)	% Pulse peak		50.00% Pulse peak
Post pulse abort (post pulse abort limit in percentage)	% Pulse peak		50.00% Pulse peak

Note) Those who chose “Measured” for the reference pulse item in the excitation conditions requisition sheet (1) are to use this sheet.

Example of Excitation Conditions Requisition Sheet

SINE BURST

No	item	explanation	parameter range	example
	＜ Excitation Conditions Requisition Sheet (3) ＞			
1	Reference name	Fill in the space with the name of the given pulse	with only alphanumerics	y_pulse
2	Frequency	Set the excitation frequency (Hz)	5 ~ 2,000Hz	10Hz
3	Amplitude	Set the maximum amplitude (m/s^2.)	0 or more (depending on waveforms)	2.00 m/s^2
4	Sampling rate	Set the sampling frequency.	102.4 kHz or less	4000.00Hz
5	# Periods constant	Set the number of waves in stationary state.	1 or more	5
6	# Periods up/down	Set the number of waves with amplification/damping.	0 or more	2/2
7	Min. number of point	Set the minimum number of samples in a pulse.	3 ~ 32,768	5
8	Pre and post pulse	Choose the pre and post pulse.	Choose one from Single-sided, Double-sided, Optimized, and Minimized.	☑Double-sided
9	Pre pulse amplitude	Set the pre pulse amplitude against the main pulse.	0 ~ 10,000	30.00% Pulse peak
10	Post pulse amplitude	Set the post pulse amplitude against the main pulse.	0 ~ 10,000	30.00% Pulse peak
11	Abort limit	Set the abort limit percentage against the pulse peak. (%)	0 ~ 10,000	50.00% Pulse peak
12	Alarm limit	Set the alarm limit percentage against the abort limit. (%)	0 ~ 100	50.00% Abort
13	Pre pulse abort	Set the abort limit for the pre pulse against its amplitude.	0 ~ 10,000	50.00% Pulse peak
14	Post pulse abort	Set the abort limit for the post pulse against its amplitude.	0 ~ 10,000	50.00% Pulse peak

Excitation Conditions Requisition Sheet (3)

SHOCK-SRS

issue №
Test Specimen Name ______ date of issue
Test Name ______ issued by

Shock Response Synthesis

		example
Name (data name within 16 alphanumerics)		y_srs
Min. frequency	Hz	20Hz
Max. frequency	Hz	2,000Hz
Point per octave		3
Q-factor		10
Dimension (unit of shock response analysis)	☐ABS acc / ☐real vel / ☐real disp	☑ABS acc

TIME Synthesis

		example
Type (type of waveform)	☐WAVELET ☐DAMPED SINE	☑WAVELET
Duration (damping duration)	s	0.02s
Abort limit	% Pulse peak	50% Pulse peak
Alarm limit	% Abort	50% Abort

Target SRS

frequency [Hz]	left slope [dB/oct]	amplitude [m/s^2]	right slope [dB/oct]	lower tol. [dB]	upper tol. [dB]	upper abort [dB]

example

100	+9			3	3	6
1,000		1,000		3	3	6

Note) Those who chose "Synthesized" for the reference pulse item in the excitation conditions requisition sheet (1) are to use this sheet.

Example of Excitation Conditions Requisition Sheet

SHOCK-SRS

No	item	explanation	parameter range	example
	＜Shock Response Synthesis＞			
1	Name	Fill in the space with an ID that distinguishes the test.	within 16 alphanumeric letters	y_srs
2	Min. frequency	Set the lower-limit frequency of the target SRS.	5Hz or higher	20Hz
3	Max. frequency	Set the upper-limit frequency of the target SRS.	2,000Hz or lower	2,000Hz
4	Point per octave	Set the number of samples per octave.	1 ~ 99	3
5	Q-factor	Set the quality factor for SRS analysis.	10 or more is recommended.	10
6	Dimension	Choose the unit for SRS analysis.	Choose one from ABS acc, real vel, or real disp.	☑ABS acc
	＜SR - Time pulse＞			
7	Type	Choose the type of waveform to be laid on top of each other.	Choose either WAVELET or DAMPED SINE.	☑WAVELET
8	Duration	Set the total time of the synthesized pulse.	0 or longer	0.02s
9	Abort limit	Set the abort limit percentage against the pulse peak. (%)	0 ~ 100,000	50% Pulse peak
10	Alarm limit	Set the alarm limit percentage against the abort limit. (%)	0 ~ 100	50% Abort

Appendix C
Data Acquisition/Analysis Conditions Sheet

Small Vibration Test Facility

Data Acquisition/Analysis Conditions Sheet

check		by
	AES	

1. Name of Test :____

   Note) in alphanumerics, underlines, and hyphens

2. Excitation Waveform :
   - ☐ SINE（UP ・ DOWN ・ UP-DOWN）
   - ☐ RANDOM
   - ☐ CLASSICAL SHOCK
   - ☐ SHOCK SYNTHSIS
   - ☐ SINE BURST

3. Data Acquisition Conditions:

   Channel Information ＞＞＞ cf. data acquisition database list

   Lower-limit Analysis Frequency ＞＞＞ ________________ Hz

   Upper-limit Analysis Frequency ＞＞＞ ________________ Hz

   Sampling Factor ＞＞＞ Sampling Frequency× __________ times

   (The sampling frequency is automatically set based on the upper-limit analysis frequency.)

   Acquisition Range ＞＞＞
   - ☐ PRE level ＋ FULL level
   - ☐ only FULL level
   - ☐ others __________________________

4. Analysis Conditions
   - ☐ Response Curve — shown in the data acquisition/analysis conditions sheet - 1
   - ☐ PSD/Auto Power Spectrum — shown in the data acquisition/analysis conditions sheet - 2
   - ☐ Transfer Function/Coherence — shown in the data acquisition/analysis conditions sheet - 3
   - ☐ SRS — shown in the data acquisition/analysis conditions sheet - 4
   - ☐ Time History Waveform — shown in the data acquisition/analysis conditions sheet - 5

Data Acquisition/Analysis Conditions Sheet 1

1. Name of Analysis: Response Curve Analysis

2. Analysis Range
☐ UP ☐ DOWN ☐ UP－DOWN

3. Acquisition by Measurement Channels
☐ Harmonic ☐ Rms ☐ Peak ☐ Average ☐ THD

4. Analysis Channel
4.1 Response Channel
☐ ALL
☐ PhysicalChannel ID ____

5. Graph Display Designation
5.1 X-axis Scale (frequency)
upper limit__________Hz ☐ logarithm ☐ linear
lower limit__________Hz
5.2 Y-axis Scale
☐ upper-limit scale: AUTO ☐ upper-limit scale: __________
display width_____decade display width_____decade
☐logarithm ☐linear ☐logarithm ☐linear

Data Acquisition/Analysis Conditions Sheet 2

1. Name of Analysis: PSD / Auto Power Spectrum
   - ☐ PSD
   - ☐ Auto Power Spectrum

2. Analysis Range

   2.1 Time
   - ☐ Entire Full-level Time
   - ☐ from ( ) sec. to ( ) sec. after the start of full level
   - ☐ Others. from______________________to______________________

3. DOF for Analysis: __________

4. Analysis Channel

   5.1 Response Channel
   - ☐ ALL
   - ☐ PhysicalChannel ID ____

5. Graph Display Designation

   5.1 X-axis Scale (frequency)

   upper limit____________Hz ☐ logarithm ☐ linear

   lower limit____________Hz

   5.2 Y-axis Scale

   ☐ upper-limit scale: AUTO
   display width______decade
   ☐logarithm ☐linear

   ☐ upper-limit scale: ____________
   display width______decade
   ☐logarithm ☐linear

Data Acquisition/Analysis Conditions Sheet 3

1. Name of Analysis: Transfer Function Analysis / Coherence
   ☐ Transfer Function Analysis
   ☐ Coherence

2. Analysis Range
   2.1 Time
   ☐ Entire Full-level Time
   ☐ from (   ) sec. to (   ) sec. after the start of full level
   ☐ Others. from______________________to______________________

3. Number of Average Operations : __________

4. Analysis Channel
   4.1 Reference Channel
   PhysicalChannel ID __________ （name of signals:__________）

   4.2 Response Channel
   ☐ ALL
   ☐ PhysicalChannel ID ____

5. Graph Display Designation
   5.1 X-axis Scale (frequency)
   upper limit____________Hz ☐ logarithm ☐ linear
   lower limit____________Hz
   5.2 Y-axis Scale
   ☐ upper-limit scale: AUTO
   display width______decade
   ☐logarithm ☐linear
   ☐ upper-limit scale: ____________
   display width______decade
   ☐logarithm ☐linear

Data Acquisition/Analysis Conditions Sheet 4

1. Name of Analysis: SRS

2. Analysis Bandwidth
   upper limit____________Hz
   lower limit____________Hz

3. Point per octave (1/n octave) : __________
   * The level of *n* is set in the range of 1 ~ 24 (normally 12)

4. SRS Type

	Maximum	Primary	Residual
Absolute value	☐	☐	☐
Positive (+)	☐	☐	☐
Negative (−)	☐	☐	☐

* Multiple options can be chosen.

5. SRS Q factor
   ☐ SRS Q : ________

6. Analysis Channel
   6.1 Response Channel
   ☐ ALL
   ☐ PhysicalChannel ID ____

7. Graph Display Designation
   7.1 X-axis Scale (frequency)
   upper limit____________Hz ☐ logarithm ☐ linear
   lower limit____________Hz
   7.2 Y-axis Scale
   ☐ upper-limit scale: AUTO
   display width______decade
   ☐logarithm ☐linear
   ☐ upper-limit scale: ____________
   display width______decade
   ☐logarithm ☐linear

Data Acquisition/Analysis Conditions Sheet 5

1. Name of Analysis: Time History Waveform
   - ☐ Acceleration
   - ☐ Velocity
   - ☐ Displacement
   - ☐ Strain

2. Analysis Range

   2.1 Time
   - ☐ Entire Full-level Time
   - ☐ from (   ) sec. to (   ) sec. after the start of full level
   - ☐ Others. from______________________to______________________

3. Analysis Channel

   3.1 Response Channel
   - ☐ ALL
   - ☐ PhysicalChannel ID ____

4. Graph Display Designation

   4.1 X-axis Scale (time series axis)
   - ☐ Auto Scale
   - ☐ Time ____________ sec ~ ____________sec
   - ☐ Others ______________ ~ ______________

   4.2 Y-axis Scale (amplitude)
   - ☐ Auto Scale
   - ☐ Time ____________ sec ~ ____________ sec
   - ☐ Others ______________ ~ ______________

Example of Data Acquisition Database List

fixed	choice	fixed	free memo	choice	choice	choice	auto setting	choice	memo	auto setting	memo	auto setting	choice
PhysicalChannel ID	OnOff	ChannelGroupID	Point	Direction	InputMode	Mesured Quantity	Coupling	ElectricalUnit	Actual Sensitivity		Serial number	Range EU	Range
Input1	TRUE	Measure	REF1	'+X	ICP	Acceleration	Single Ended	V	100	V/(m/s^2)		0.1 m/s^2	10
Input2	TRUE	Measure	REF2	'-X	Charge	Acceleration		pC	100	pC/(m/s^2)		100 m/s^2	1.00E-08
Input3	TRUE	Measure	Panel1	'+Y	Voltage DC	Angle	Single Ended	mV	100	mV/°		31.6 °	3.16
Input4	TRUE	Measure	Panel2	'-Y	Voltage DC	AngularAcceleration	Single Ended	mV	100	mV/(rad/s^2)		10 rad/s^2	1
Input5	TRUE	Measure	Panel3	'+Z	Voltage DC	AngularDisplacement	Single Ended	mV	100	mV/rad		3.16 rad	0.316
Input6	TRUE	Measure	Panel4	'-Z	Voltage DC	AngularVelocity	Single Ended	mV	100	mV/(rad/s)		1.58 rad/s	0.158
Input7	TRUE	Measure	Panel5	'+RX	Voltage DC	AtmosphericPressure	Single Ended	mV	100	mV/bar		0.79 bar	0.079
Input8	TRUE	Measure	Panel6	'-RX	Voltage DC	Current	Single Ended	mV	100	mV/A		0.395 A	0.0395
Input9	TRUE	Measure	Panel7	'+X	Voltage DC	Displacement	Single Ended	mV	100	mV/mm		0.0001975 m	0.01975
Input10	TRUE	Measure	Panel8	'+X	Voltage DC	Force	Single Ended	mV	100	mV/N		100 N	10
Input11	TRUE	Measure	Panel9	'+X	Voltage DC	Frequency	Single Ended	mV	100	mV/Hz		31.6 Hz	3.16
Input12	TRUE	Measure	Panel10	'+X	Voltage DC	Position	Single Ended	mV	100	mV/m		10 m	1
Input13	TRUE	Measure	AAAA1	'+X	Voltage DC	Length	Single Ended	mV	100	mV/m		3.16 m	0.316
Input14	TRUE	Measure	AAAA2	'+X	Voltage DC	MomentOfForce	Single Ended	mV	100	mV/Nm		1.58 Nm	0.158
Input15	TRUE	Measure	AAAA3	'+X	Voltage DC	ParticleVelocity	Single Ended	mV	100	mV/(m/s(pv))		0.79 m/s(pv)	0.079
Input16	TRUE	Measure	AAAA4	'+X	Voltage DC	Power	Single Ended	mV	100	mV/W		0.395 W	0.0395
Input17	TRUE	Measure	BBBB1	'+X	Voltage DC	Pressure	Single Ended	mV	100	mV/Pa		0.1975 Pa	0.01975
Input18	TRUE	Measure	BBBB2	'+X	Voltage DC	Acceleration	Single Ended	mV	100	mV/(m/s^2)		100 m/s^2	10
Input19	TRUE	Measure	BBBB3	'+X	Voltage DC	RatioPercentage	Single Ended	mV	100	mV/%		31.60%	3.16
Input20	TRUE	Measure	BBBB4	'+X	Voltage DC	Resistance	Single Ended	mV	100	mV/Ohm		10 Ohm	1
Input21	TRUE	Measure	BBBB5	'+X	Voltage DC	RotationalSpeed	Single Ended	mV	100	mV/rpm		3.16 rpm	0.316
Input22	TRUE	Measure	BBBB6	'+X	Voltage DC	Speed	Single Ended	mV	100	mV/(km/h)		1.58 km/h	0.158
Input23	TRUE	Measure	BBBB7	'+X	Voltage DC	Speed	Single Ended	mV	100	mV/(km/h)		0.79 km/h	0.079
Input24	TRUE	Measure	BBBB8	'+X	Voltage DC	Strain	Single Ended	mV	100	mV/uE		0.395 uE	0.0395
Input25	TRUE	Measure	CCCC1a	'+X	Voltage DC	Stress	Single Ended	mV	100	mV/MPa		0.1975 MPa	0.01975
Input26	TRUE	Measure	CCCC2a	'+X	Voltage DC	Temperature	Single Ended	mV	100	mV/K		100 K	10
Input27	TRUE	Measure	CCCC3a	'+X	Voltage DC	Velocity	Single Ended	mV	100	mV/(m/s)		31.6 m/s	3.16
Input28	TRUE	Measure	CCCC4a	'+X	Voltage DC	Voltage	Single Ended	mV	100	mV/V		10 V	1
Input29	TRUE	Measure	CCCC5a	'+X	Voltage DC	VolumeAcceleration	Single Ended	mV	100	mV/(m^3/s^2)		3.16 m^3/s^2	0.316
Input30	TRUE	Measure	CCCC6a	'+X	Voltage DC	VolumeDisplacement	Single Ended	mV	100	mV/m^3		1.58 m^3	0.158
Input31	TRUE	Measure	CCCC7a	'+X	Voltage DC	VolumeFlow	Single Ended	mV	100	mV/(l/s)		0.79 l/s	0.079
Input32	TRUE	Measure	CCCC8a	'+X	Voltage DC	Acceleration	Single Ended	mV	100	mV/(m/s^2)		0.395 m/s^2	0.0395
Input33	FALSE	Measure	Point33	None	Charge	Acceleration		pC	100	pC/(m/s^2)		100 m/s^2	1.00E-08
Input34	FALSE	Measure	Point34	None	Charge	Acceleration		pC	100	pC/(m/s^2)		31.6 m/s^2	3.16E-09
Input35	FALSE	Measure	Point35	None	Charge	Acceleration		pC	100	pC/(m/s^2)		10 m/s^2	1.00E-09
Input36	FALSE	Measure	Point36	None	Charge	Acceleration		pC	100	pC/(m/s^2)		31.6 m/s^2	3.16E-09
Input37	FALSE	Measure	Point37	None	Charge	Acceleration		pC	100	pC/(m/s^2)		10 m/s^2	1.00E-09
Input38	FALSE	Measure	Point38	None	Charge	Acceleration		pC	100	pC/(m/s^2)		3.16 m/s^2	3.16E-10
Input39	FALSE	Measure	Point39	None	Charge	Acceleration		pC	100	pC/(m/s^2)		1.58 m/s^2	1.58E-10
Input40	FALSE	Measure	Point40	None	Charge	Acceleration		pC	100	pC/(m/s^2)		0.79 m/s^2	7.90E-11
Input41	FALSE	Measure	Point41	None	Charge	Acceleration		pC	100	pC/(m/s^2)		0.395 m/s^2	3.95E-11
Input42	FALSE	Measure	Point42	None	Charge	Acceleration		pC	100	pC/(m/s^2)		0.1975 m/s^2	1.98E-11

<Explanation for the Information to be Filled in the Acceleration Database List>

item	description	content
Physical Channel ID	fixed	physical ID of frontend; unchangeable
On Off	choice	whether or not to use the corresponding channels; chosen from TRUE/FALSE
Channel Group ID	fixed	The channel group IDs for measurement are fixed with “Measure.”
Point	free memo	names of measured points; described with alphanumerics, hyphens, underbars, spaces, etc. (capital/small letters discriminable)
Direction	choice	sensor directions; chosen in terms of polarities (+, -), + directions (X, Y, Z, RX, RY, RZ), or S
Input Mode	choice	input formats for sensors; chosen from Voltage AC, Voltage DC, ICP, and Charge
Measured Quantity	choice	physical quantity for measurement; chosen from Acceleration, Angle, AngularAcceleration, AngularDisplacement, AngularVelocity, AtmosphericPressure, Current, Displacement, Force, Frequency, Position, Length, MomentOfForce, ParticleVelocity, Power, Pressure, Acceleration, RatioPercentage, Resistance, RotationalSpeed, Speed, Strain, Stress, Temperature, Velocity, Voltage, VolumeAcceleration, VolumeDisplacement, and VolumeFlow.
Coupling	auto setting	automatically determined by the InputMode
Electrical Unit	choice	chosen according to the Measured Quantity
Actual Sensitivity	memo	Sensor sensitivity is to be written.
	auto setting	The unit is automatically set according to the Measured Quantity and the Electrical Unit.
Serial number	memo	The serial numbers of sensors are to be written.
Range EU	auto setting	automatically set according to the Actual Sensitivity and the Range
Range	choice	The input ranges for sensors are to be chosen.

Appendix D
Example of Data Output

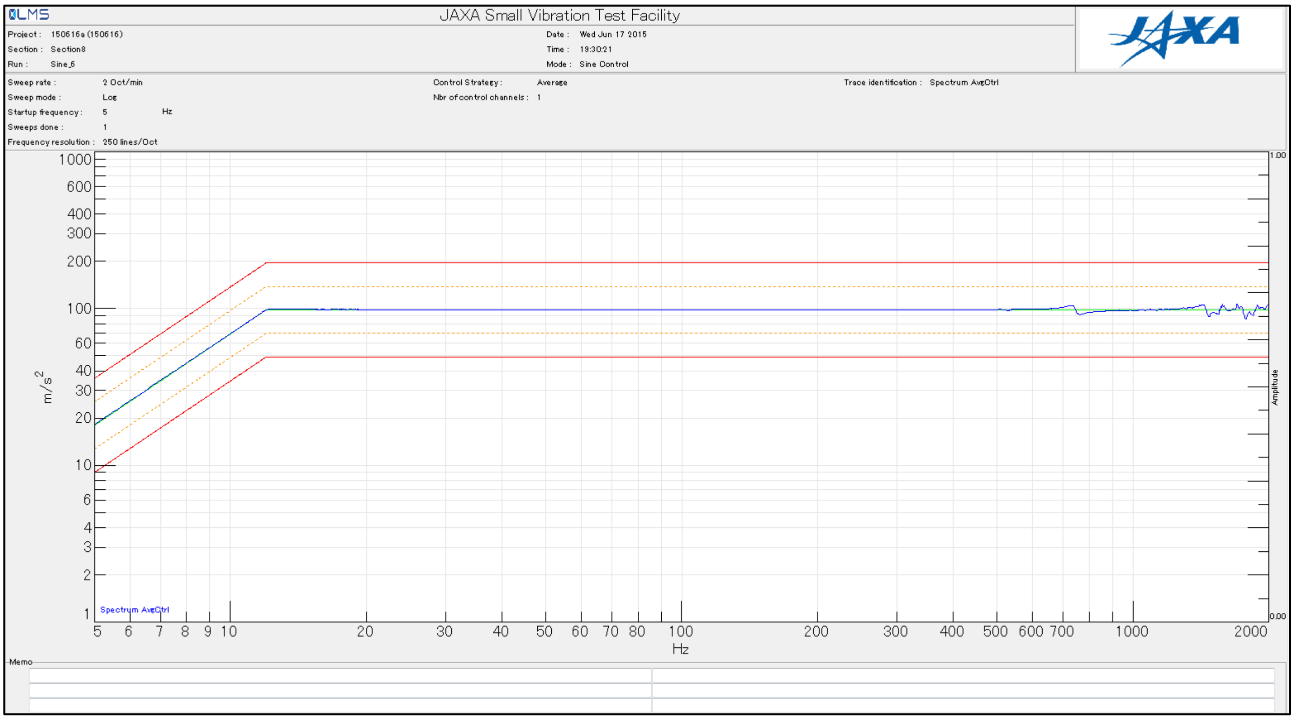


Figure D-1 Results of Excitation Control

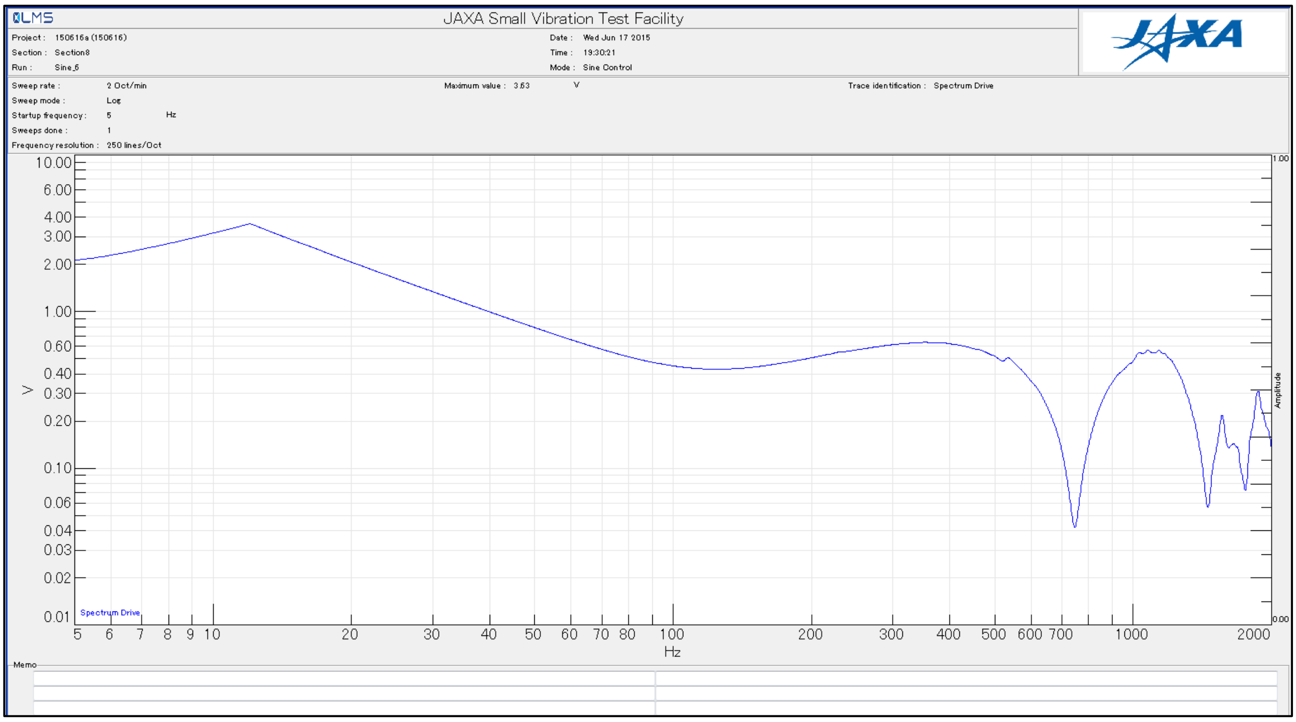


Figure D-2 Drive Signals

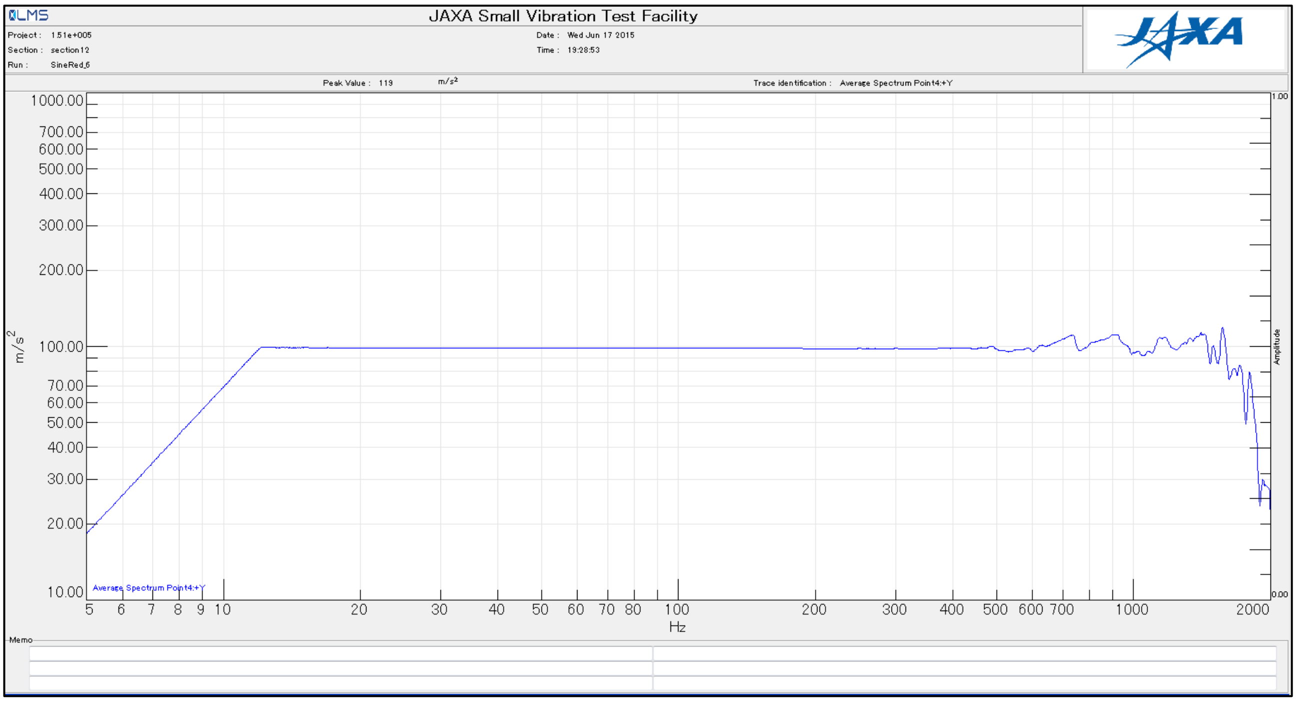


Figure D-3 Acceleration Responses

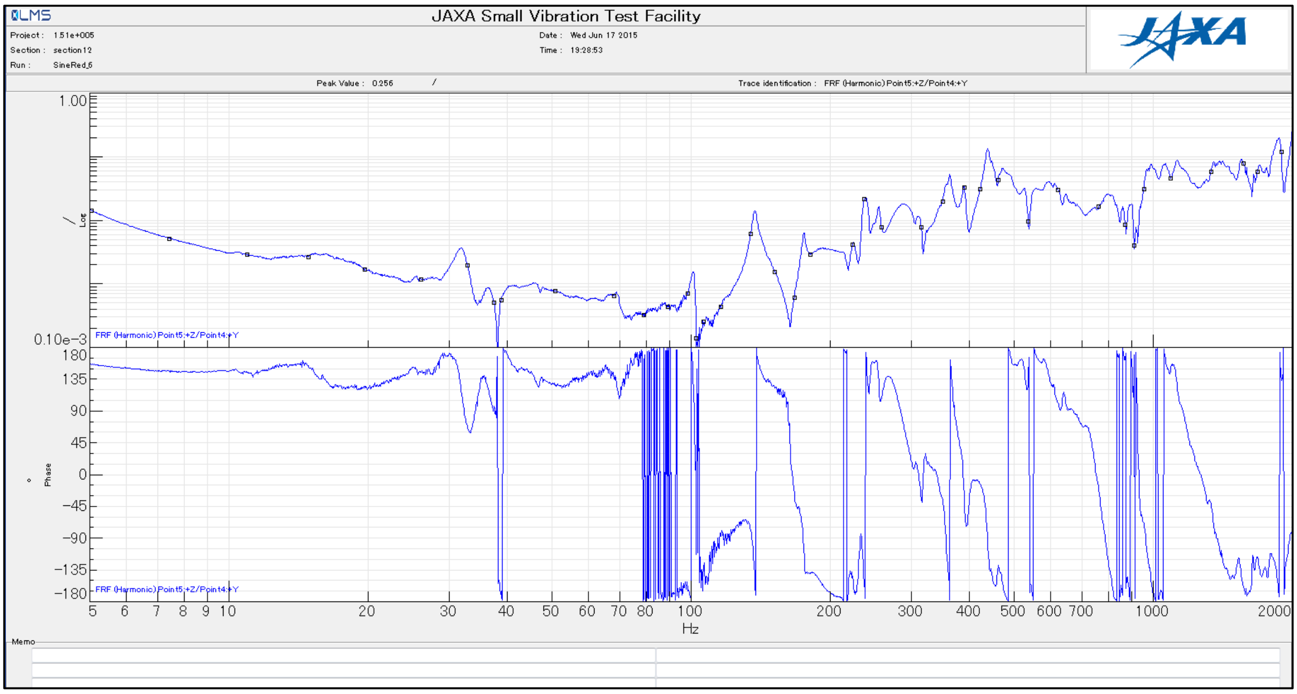


Figure D-4 Transfer Function