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AD2-I20-A047

$1600m^3$ Acoustic Test Facility

Users' Manual

Advanced Engineering Services Co., Ltd.

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tfcd_rikatsu@aes.co.jp

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tfcd_rikatsu@aes.co.jp

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Appendix A

1 Introduction

This users' manual is to provide necessary information to the users of 1600m^3 Acoustic Test Facility (referred to as "this facility" hereafter) located in Spacecraft Integration and Test Building.

The information contained in this manual is limited to this facility. For further information on the Spacecraft Integration and Test Building in which this facility is located, refer to "vol. 1 Common Matters (GCA-02006)" of "Users' Manual for Spacecraft Integration and Test Building."

This facility is used for acoustic tests on spacecraft, etc., and is capable of performing not only qualification/acceptance tests on satellite systems and subsystems, but development tests, or the like, to see the acoustic durability and vibroacoustic properties of materials, and so on.

This facility has the performance and specifications that can satisfy acoustic tests on large and various kinds of test specimens (■abbreviated as TS hereafter), e. g., satellites, that are launched by an H-IIA launch vehicle, etc.

2 Brief Overview of this Facility Brief Overview of this Facility

2.1 **System** Outline

The system diagram of this facility is shown in Figure 2-1. This facility broadly consists of a sound generating system, a monitor and control system, a reverberation chamber system, a data acquisition system, and other utility equipment.

2.1.1 Sound Generating System

The sound generating system is made up of a GN_2 system, a sound generator, and a sound spectrum control system. The GN_2 flow generated by the GN_2 system is converted into sound by the sound generator. Meanwhile, the sound spectrum control system controls the sound generator the way pre-input test specifications can be satisfied. The sound generating system is so to speak a set of significant devices to produce the acoustic energy necessary for forming a sound field and control the sound source to form any type of sound field.

The users of this facility are to draw up the test specifications (target sound pressure level, load time, etc.) to be pre-set into the sound spectrum control system (control computer) before starting a test, following the form in section 4.2.

2.1.2 Monitor and Control System

The monitor and control system is composed of a facility controller and a safety monitor device.

The facility controller is made up of a control console, equipment racks, display panels, etc., and controls the sequence of equipment including all sorts of interlocks.

The safety monitor device consists of a monitor device that visually monitors and records the behaviors of the oximeters attached to several parts of this facility and a TS during a test, and a broadcast communication system that enables communications between workers.

2.1.3 Reverberation Chamber System

The reverberation chamber system consists of a reverberation chamber and equipment belonging to it.

This facility adopts a diffused sound field produced in its reverberation chamber, and the chamber is therefore a key factor to determine the performance of this facility. The reverberation chamber in this facility is designed and manufactured the way it can store a TS and produce a diffused sound field in it.

The reverberation chamber is the only I/F to a TS in this facility, where test configuration and preparation are to be based upon the effective area in the chamber, the movable range of a crane, the hole pattern on the floor, etc. The details of the users' I/F in the chamber are shown in section 3.2.1.

Upon the roof of the chamber, there exists a reverberation chamber ventilation system to ventilate the chamber after performing an acoustic test.

2.1.4 Data Acquisition System

The data acquisition system, being made up of a measurement and control device, an operation PC, and an analysis PC, measures and records the acceleration data (200 chs) and strain data (32 chs) at different parts of a TS, as well as the sound pressure data in the chamber (36 chs), and performs various analyses on the data. It can also acquire acceleration data with up to 602 channels by adopting the measurement rack of the large-scale separation shock test facility. Contact AES when acceleration measurement with 200 channels or more is planned.

The details of the devices that make up the data acquisition system are shown below.

The measurement and control device allows the real-time amplification and A/D conversion of the analogue signals of acceleration/strain/sound-pressure data, and records them in the hard disk.

The operation PC is equipped with a function to operate the measurement and control device via various settings (sampling frequency, sensor sensitivity, measurement range, etc.)

The analysis PC executes various kinds of analyses (octave analysis, PSD analysis, etc.) on measurement data.

2.1.5 Utility Equipment

The TS dolly, which is one of the main devices among the utility equipment, functions both as a raising jig and a moving dolly, which helps efficient test preparations with a TS. Refer to the I/F shown in section 3.3.3 when using the TS dolly.

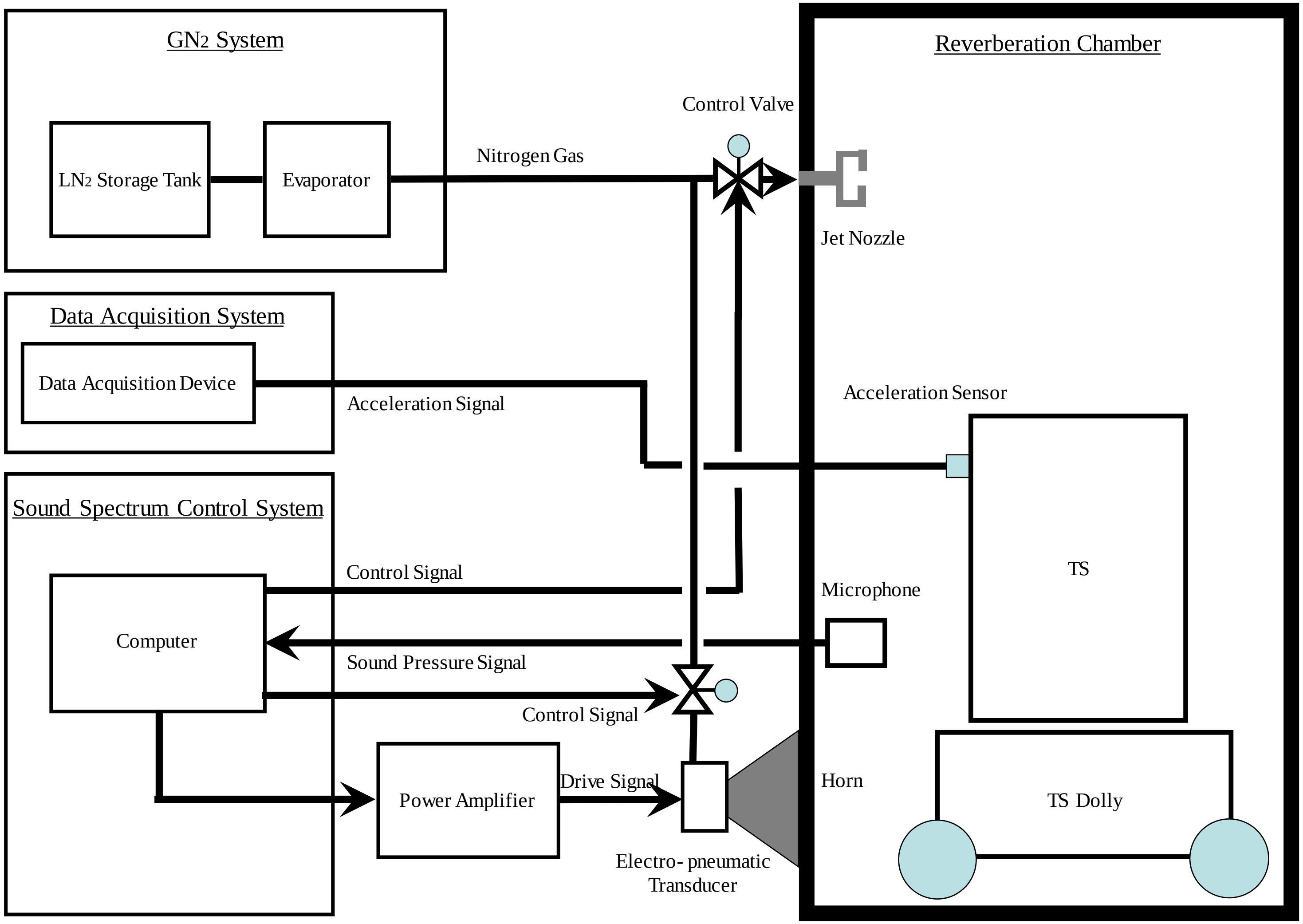


Figure 2-1 System Diagram

2.2 Main Specifications

2.2.1 Total Performance

The main specifications of this facility are shown in Table 2-1. The maximum sound pressure level in the empty sound field is 151dB (overall), and the capacity of the reverberation chamber is about 1600m^3. The empty sound field denotes the sound field in an empty reverberation chamber, and the actual maximum sound pressure level is therefore more or less lower than 151dB due to the sound absorption by a TS or other reasons.

A sound field (sound pressure spectrum) is controlled by the sound spectrum control system in real time. The controlled variable is calculated by the computer (a component of the sound spectrum control system) based on the actual sound pressure level acquired by the control microphones (up to 6) placed in the reverberation chamber and the pre-set target sound pressure level. Then, the electric signals and GN_2 gas are controlled before being sent into the electro-pneumatic transducer and the jet nozzle (both are the components of the sound generator).

The 1/1 octave band sound pressure spectrum and control accuracy for the maximum overall sound pressure level of 151dB are shown in Table 2-2. (The control accuracy denotes the difference between the actual sound pressure level and the target sound pressure level (dB) indicated for each 1-1 octave band.)

The settable range of target levels is shown in Figure 2-2. One can set a sound pressure spectrum in a continuous curve, not in discrete steps, that corresponds to the frequencies in this range as a test condition. (The target levels can be set as a 1/3-octave-band sound pressure spectrum.)

Also, there are cases where the sound pressure cannot be controlled to be within the target sound pressure levels when performing a test in unique conditions (e. g., when the spectrum is discrete or when only specific frequency bands have high levels, etc.) Especially, it is known that the high sound pressure level at 200Hz (1/3 oct. band) influences on high frequency bands at its high order harmonic frequencies such as 400Hz or 800Hz turning out to exceed the target levels. To avoid such phenomena, the pre-set accuracy is to be checked by loading preliminary sound before a test, so that the target/allowable levels can be changed according to the results if necessary.

The precise performance and specifications of the component devices/equipment in this facility are described in the “Device I/F” in section 3.2.

Table 2-1 Total Performance

<table>
<tr><td colspan="3">Max. sound pressure level in empty sound field (dB)*</td><td>151</td></tr>
<tr><td rowspan="5">reverberation chamber</td><td colspan="2">shape</td><td>cuboid</td></tr>
<tr><td colspan="2">capacity (m^3)</td><td>1,607</td></tr>
<tr><td rowspan="3">dimensions</td><td>height (m)</td><td>17.1</td></tr>
<tr><td>width (m)</td><td>10.5</td></tr>
<tr><td>depth (m)</td><td>9</td></tr>
<tr><td rowspan="4">number of measurement channels</td><td colspan="2">sound pressure</td><td>36</td></tr>
<tr><td colspan="2" rowspan="2">acceleration</td><td>200
(standard)</td></tr>
<tr><td>602
(when additionally adopting the measurement rack of the large-scale separation shock test facility.)</td></tr>
<tr><td colspan="2">strain</td><td>32</td></tr>
<tr><td colspan="3">acoustic output (kW)</td><td>about 70</td></tr>
<tr><td colspan="3">electro-pneumatic transducer components</td><td>EPT－1094 × 4
EPT－200 × 3
jet nozzle × 1</td></tr>
<tr><td colspan="3">reverberation chamber crane capacity (t)</td><td>10</td></tr>
</table>

* 0dB: 2×10^{-5} Pa

Table 2-2 Sound Pressure Spectrum and Control Accuracy[*1] (for empty sound field[*2])

1/1 OCT center frequency (Hz)	sound pressure level (dB)[*3]		control accuracy
	Min.	Max.	
31.5	121	138	±5
63	126	143.5	±3
125	128	144	±1
250	126	146	±1
500	122	142.5	±1
1k	116	140	±1
2k	111	134	±3
4k	110	125	±3
8k	107	122	±3
overall	132.5	151	±2

*1 The control accuracy denotes the difference between the time-and-space-averaged actual sound pressure level and the target sound pressure level.

*2 The empty sound field denotes the sound field in an empty reverberation chamber.

*3 0dB ＝ 2×10^{-5}Pa

A successive (smooth) sound pressure spectrum that corresponds to frequencies in this range can be set as a test condition.

Note) When performing a test under particular test conditions (e. g., a discrete spectrum, when specific frequency bands have high levels, etc.), there are cases where the sound pressure control within the target sound pressure levels is not possible.

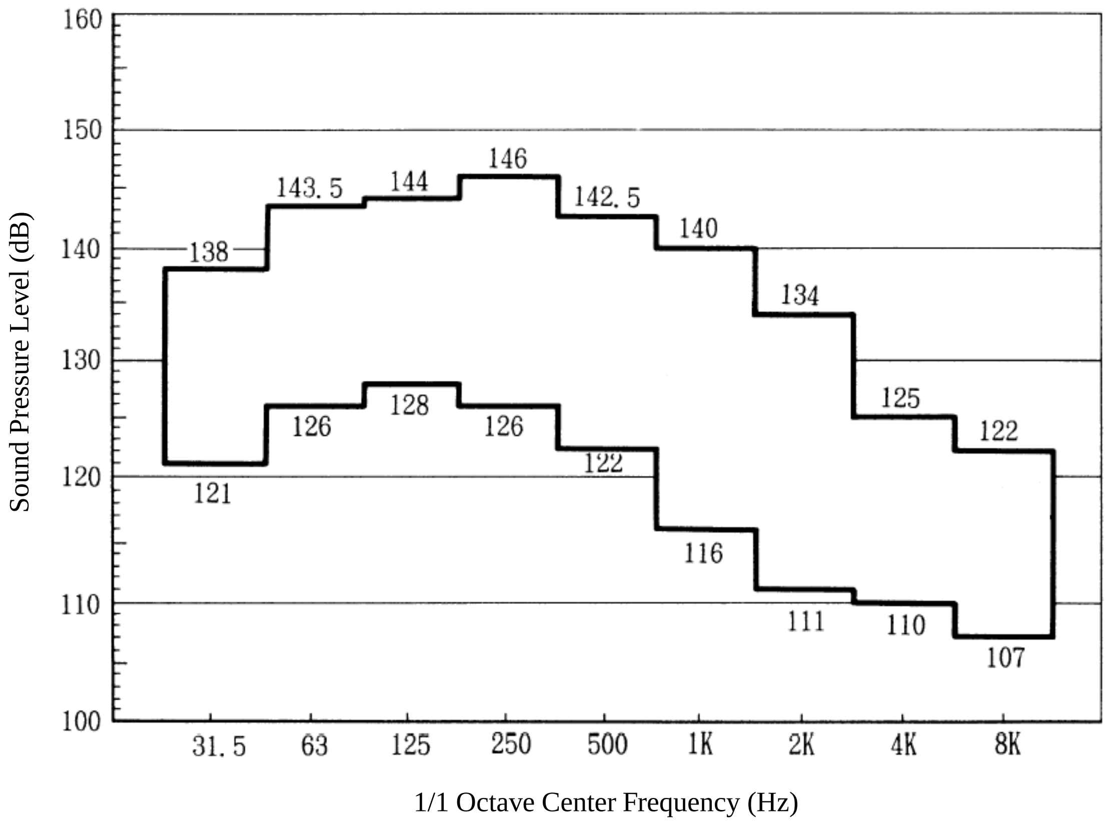


Figure 2-2 Settable Range of Target Levels

2.2.2 Data Acquisition System

The data acquisition system allows the measurement and recording of the acceleration/strain data of different parts of a TS and the sound pressure data in the reverberation chamber, and performs various types of analyses on the data. The functions and performance of the data acquisition system are shown in Table 2-3.

Furthermore, the acquisition of acceleration data with 602 channels in total can be achieved by using a data acquisition system on the measurement rack of the large-scale separation shock test facility in addition to the original data acquisition system. That, however, accompanies the following restrictions due to the difference between the two data acquisition systems.

- Transfer function analysis cannot be performed between the data acquired by the two data acquisition systems mentioned above.
- The data acquisition system on the measurement rack of the large-scale separation shock test facility is not equipped with an automatic range adjustment function (section 3.2.2.)

The functions and performance of the data acquisition system on the measurement rack of the large-scale separation shock test facility are shown in Table 2-4.

Table 2-3 Functions and Performance of Data Acquisition System

item	functions / performance
number of measurement points	acceleration lines 200 chs (channel # 2001 ~ 2200) strain lines 32 chs (channel # 3001 ~ 3032) sound pressure lines 36 chs (channel # 1001 ~ 1036)
measurement accuracy	acceleration lines: within 3.4% strain lines: within 6% sound pressure lines: within 2% Note) The accuracy is of the signal lines, w/o sensors included.
data analysis	1. waveform display 2. FFT analysis 3. coherence analysis 4. cross spectrum analysis 5. autocorrelation function analysis 6. crosscorrelation function analysis 7. histogram analysis 8. PSD analysis 9. transfer function analysis 10. RMS time history analysis 11. octave analysis (1/48 - 1/1) 12. AL-SPL analysis 13. RRS analysis
analysis processing rate	The results of PSD/octave analyses on 200 chs of acceleration and 36 chs of sound pressure can be output within about 25 minutes.
consecutive data acquisition time	Max. of 1 hour for the successive measurement of 268 chs at 100 kHz (capacity of 6 hours in total)
sampling frequency	Max. 200 kHz（4.96 kHz ~ 200 kHz） Settable at every 1Hz in the range of 4.96 kHz ~ 200 kHz Sampling frequencies can be changed at every 32 chs. (In that case, the pre-set levels are to be the 1/2 multiples of the maximum sampling frequency level.)
calibration	Calibration using a calibration signals generator is possible (except for sensors.)
power failure protective measures	The system can be shut down by an operator following the acquisition of data for 10 minutes after the occurrence of power failure, using an uninterruptible power supply (UPS.)
automatic range adjustment function	equipped

Table 2-4 Functions and Performance of Data Acquisition System on Measurement Rack of Large-scale Separation Shock Test Facility

item	functions / performance
number of measurement points	acceleration lines402 chs (channel # 1 ~ 402)
measurement accuracy	within ±3.4% Note) The accuracy is of the signal lines, w/o sensors included.
data analysis	1. waveform display 2. FFT analysis 3. coherence analysis 4. cross spectrum analysis 5. autocorrelation function analysis 6. crosscorrelation function analysis 7. histogram analysis 8. PSD analysis 9. transfer function analysis 10. RMS time history analysis 11. octave analysis (1/48 - 1/1) 12. AL-SPL analysis 13.RRS analysis
analysis processing rate	The results of PSD/octave analyses on 402 chs of acceleration can be output within about 50 minutes. Note) It denotes the analysis time for the data acquired by the measurement rack of the large-scale separation shock test facility.
consecutive data acquisition time	Max. of 1 hour for the successive measurement of 402 chs at 100 kHz
sampling frequency	Max. 100 kHz (4.96 kHz ~ 100 kHz) Settable at every 1Hz in the range of 4.96 kHz ~ 100 kHz
calibration	Calibration with a calibration signals generator is possible (except for sensors.)
power failure protective measures	The system can be shut down by an operator following the acquisition of data for 10 minutes after the occurrence of power failure, using an uninterruptible power supply (UPS.)
automatic range adjustment function	not equipped

3 Users' I/F

3.1 Layout

This facility is located at the southeastern end of the Satellite Integration and Test Building (SITE) in Tsukuba Space Center, with its reverberation chamber, GN_2 system, and sound spectrum control system respectively located in the acoustic test room, the acoustic machine room (the first floor), and the acoustic measurement and control room (the second floor.) The basic working areas for users are limited to the acoustic test room, the acoustic measurement and control room, the fore-room of the unpacking room, and the assembly preparation room (in some cases the check-out room is included) assigned to users. For further information on the assembly preparation rooms, refer to "vol. 1 Common Matters (GCA-02006)" of "Users' Manual for Spacecraft Integration and Test Building."

The layouts of the acoustic test room and the acoustic measurement and control room, which are the main working areas for users, are shown in Figure 3-1.

The satellite path and all the assembly preparation rooms are cleanrooms with ISO class 8 level (class 100,000.) The reverberation chamber is not equipped with a ventilation system, but is structured the way clean air flows into the chamber from the satellite path when the heavy door (the door standing between the satellite path and the reverberation chamber) is open.

The acoustic test room consists of the reverberation chamber, the chamber fore-room, and the chamber outer-rooms. The chamber fore-room is sandwiched by two heavy loading dock doors and mitigates the leaks of noise. The chamber outer-rooms, where the main equipment of the sound generator is placed, are also made to mitigate noise.

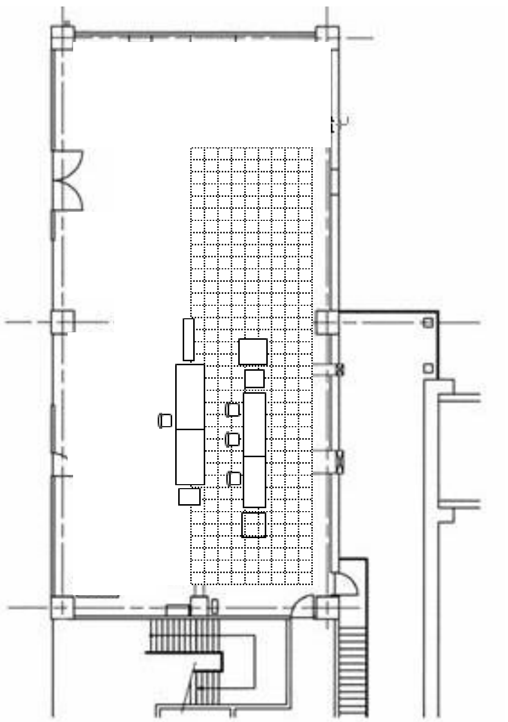
User workers have two routes to enter the reverberation chamber; one is "the acoustic measurement and control room on the second floor ~ the air shower room on the first floor ~ the outer-room ~ the reverberation chamber" and the other is "each assembly preparation room ~ the satellite path ~ the reverberation chamber." Meanwhile, workers are to keep out of the area shown in Figure 3-2, the acoustic machine room, and the tank yard (that is, the areas between the acoustic measurement and control room on the second floor ~ the air shower room on the first floor, and the satellite path ~ the outer-room and the reverberation chamber, are locked with electrical locks to keep out workers) for the sake of safety because GN_2 flows into the reverberation chamber during an acoustic test.

The configuration of the sockets in and around the reverberation chamber is shown in Figure 3-3. The sockets with a single-phase circuit are 100/115V each, and those with a triple-phase circuit are 200V each. The one with 200V (50A) is used as the drive power supply for the TS dolly shown in section 3.2 (3.)

Use the distribution boards equipped in this facility for the power supplies of large-capacity devices, e. g., a TS check-out device. Refer to Appendix A for the details of distribution boards

(voltage, capacity, etc.)

The acoustic measurement and control room, which is the main working area during an acoustic test, has the control consoles for different devices including a sound spectrum control system as the main device.



Top View of Acoustic Measurement and Control Room on 2nd Floor

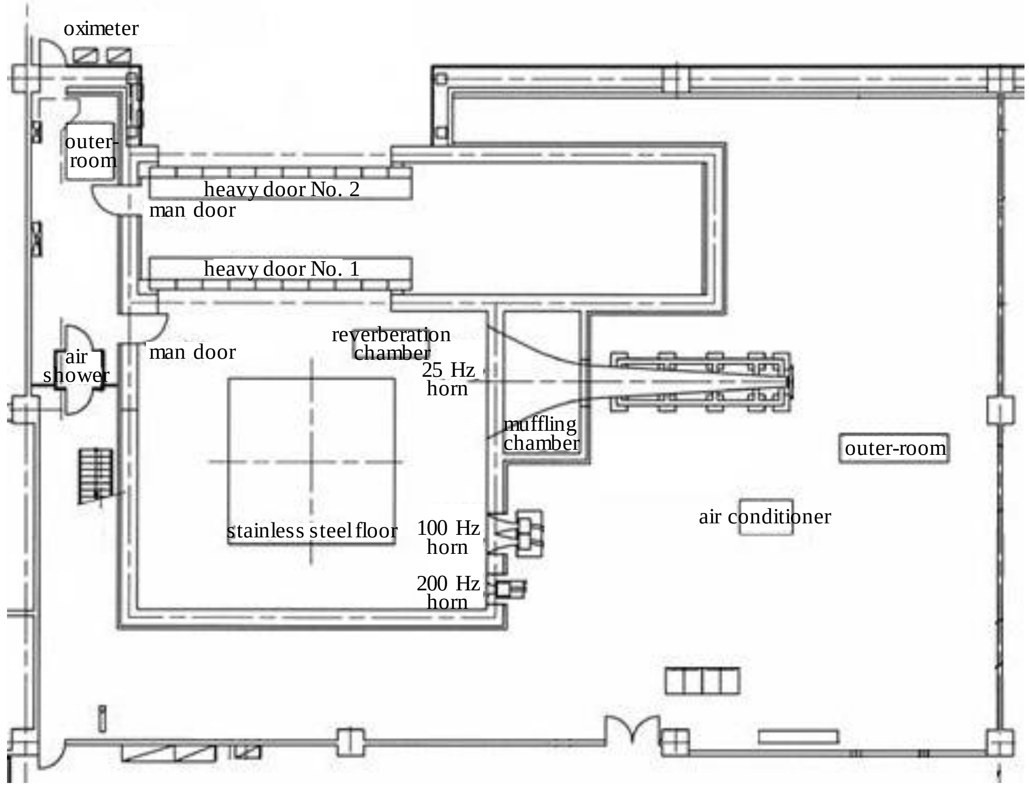


Figure 3-1 Layout Drawing of 1600m^3 Acoustic Test Facility

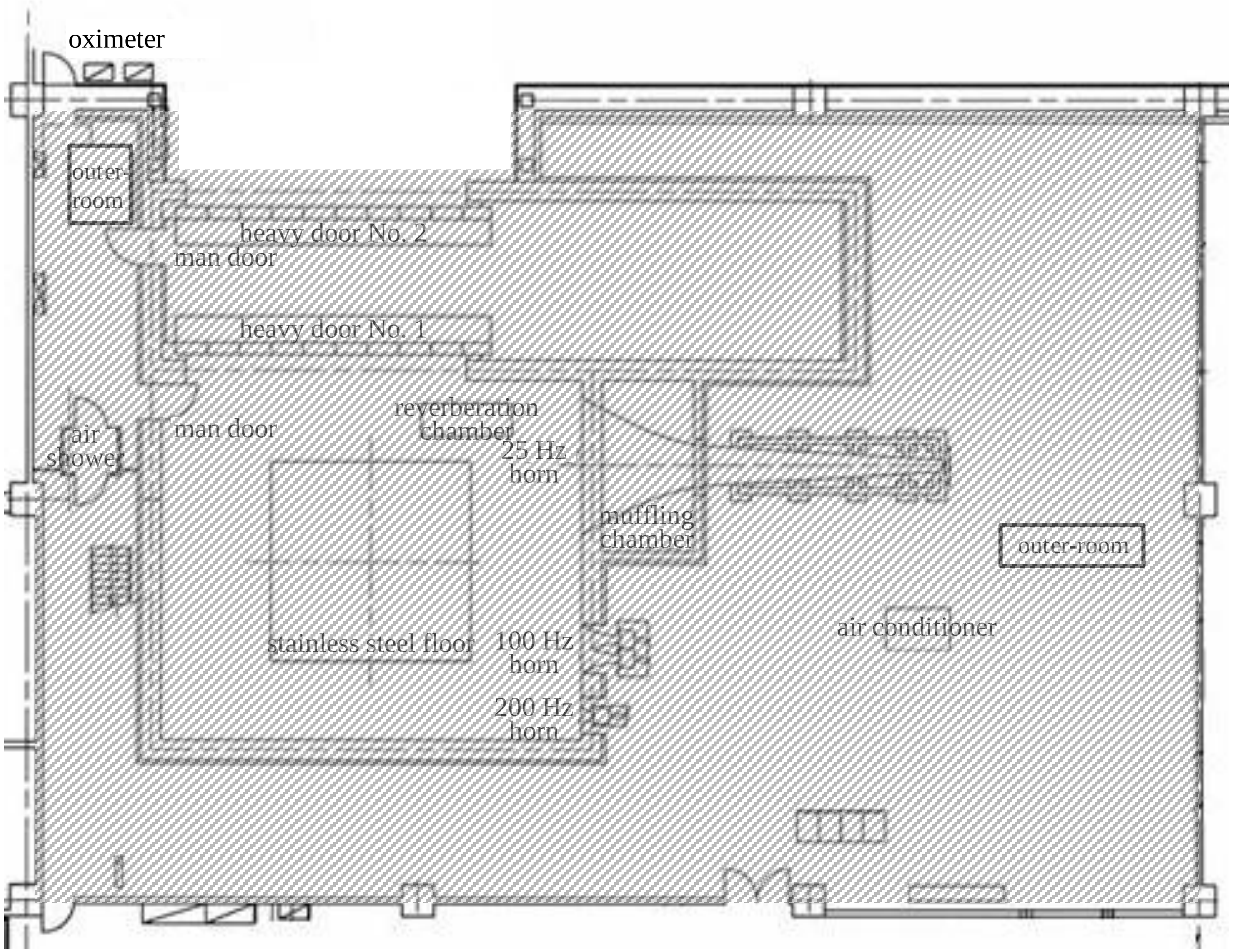


Figure 3-2 Keepout Area during Acoustic Test

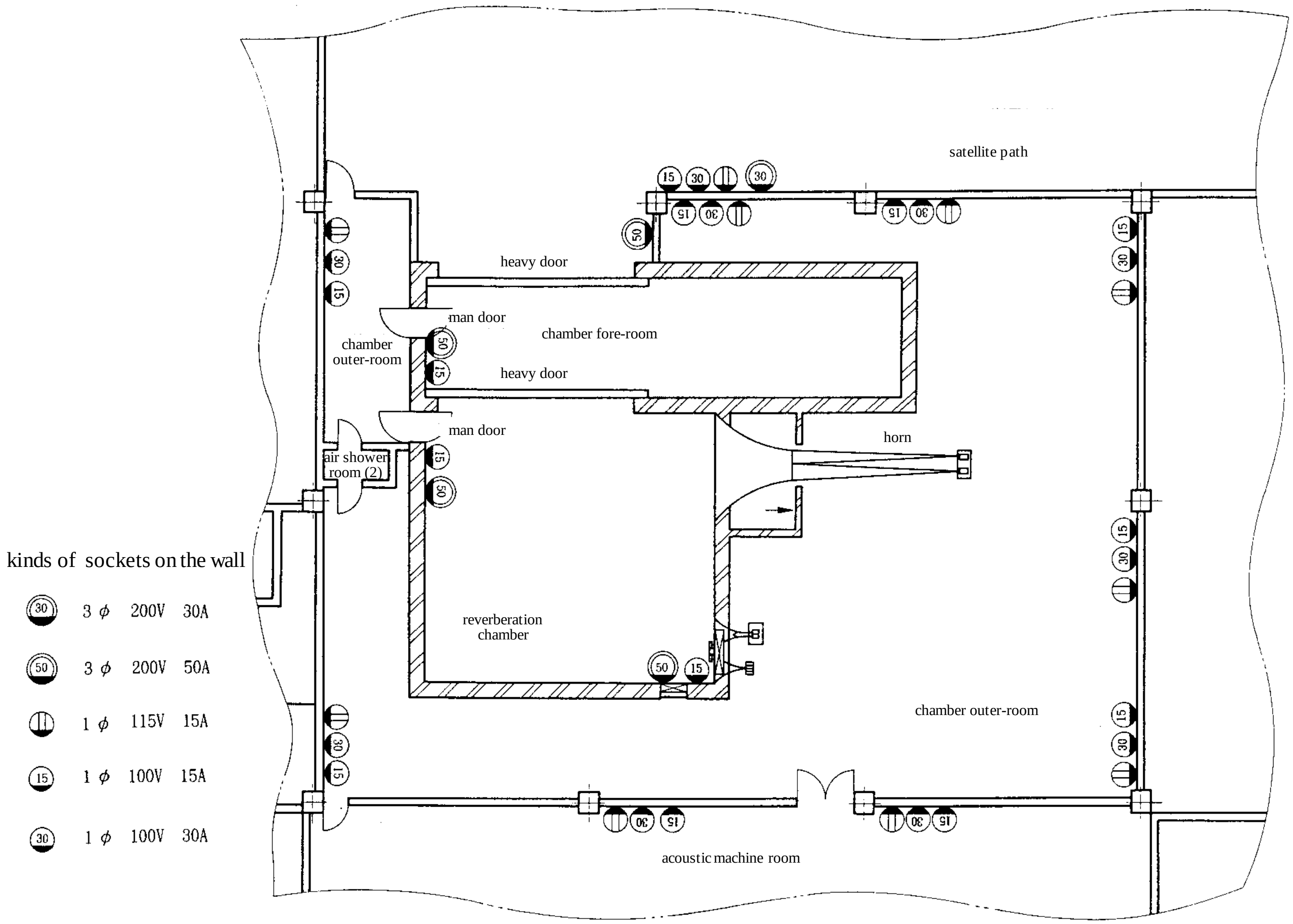


Figure 3-3 Configuration of Sockets

3.2 Device I/F

The I/Fs of the reverberation chamber system, the data acquisition system, and the facility equipment system, which are related to users, are shown below. In case the details of the systems or the specifications and performance of any device that is not encompassed in this manual are necessary, contact AES.

3.2.1 Reverberation Chamber System I/F

The reverberation chamber is a cuboid with the dimensions of 10.5m (width) × 9.0m (depth) × 17.1m (height.) The dimensional diagram of the reverberation chamber is shown in Figure 3-4.

A TS is carried in/out to/of the chamber through the heavy door on the wall facing the satellite path. The aperture of the heavy door is approximately 7m (width) × 13m (height.)

On the wall there are a measurement relay unit that transmits the measurement signals of a TS to the data acquisition room, a patch panel, lighting equipment (a mercury lamp, a preliminary fluorescent lamp), and ITV cameras installed. Meanwhile, the three walls other than the one with the heavy door have side-wall rails at the heights of 6m and 12m. The rails which withstand the tensile load of 500 kg are effective for fixing jigs, or preventing them from turning over, for example. The diagrams of the wall faces are shown in Figure 3-5.

On the ceiling, a crane for handling a TS is being set. It is an X-Y travel motion type, with a capacity of 10t and height of 15m beneath its hook. The movable range of the hook is shown in Figure 3-6.

The floor of the reverberation chamber is made of stainless steel plates in its center area of 5m × 5m, and steel plates with epoxy coasting in the rest of the area. There are 89 screw holes (for M-20 bolts) on the floor, which can be used for fixing TS jigs, microphone stands, etc. The screw holes pattern is shown in Figure 3-7 (1/2)(2/2).

The rough dimensions of a TS that can be set in the reverberation chamber are presented in Figure 3-8. The several cases shown here are based on the idea that the volume of a TS is 10% or less of the reverberation chamber volume. In addition to that, the aperture size of the heavy door and the state of sound field are to be taken into account in an actual test.

There are some points to be careful of to load a well-conditioned sound field on a TS.

First of all, a TS needs to be placed in a location where the influence of reflected waves (standing waves) from the surfaces of the reverberation chamber is little. Also, it is desirable to keep enough distance (basically, 1/4 or longer wavelength of the lowest frequency of the test condition) among microphones, between the microphones and a TS, and between the microphones and the chamber walls, to help control microphones (at least 4 of them) to obtain accurate sound field data. As for other general test methods, refer to “JERG-2-130, Satellite General Test Standard.”

Taking the above into account, users are to plan for the test configuration in the reverberation chamber (how and where to set a TS, the positions of six control microphones, etc.)

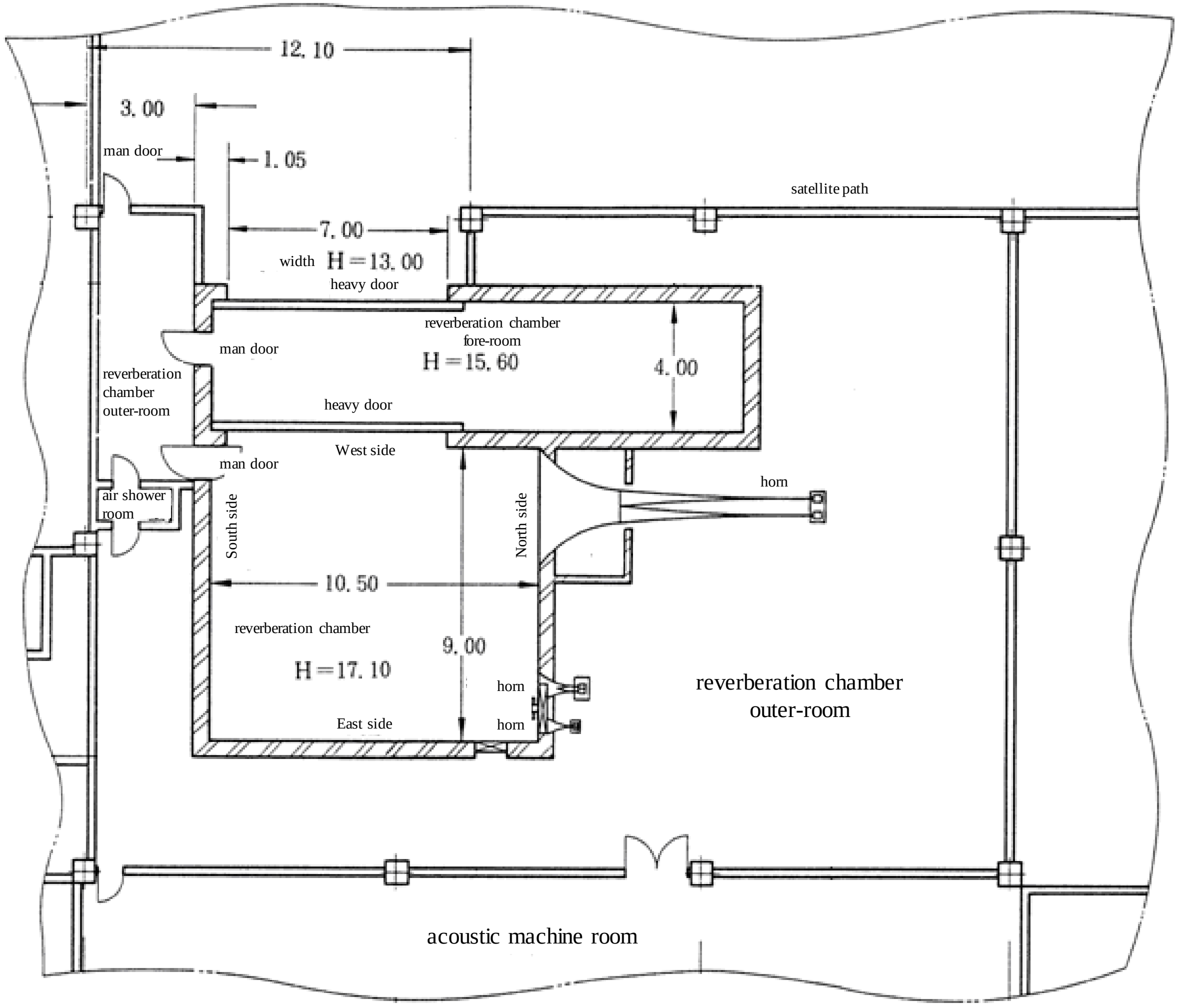


Figure 3-4 Dimension Diagram of Reverberation Chamber (unit: m)

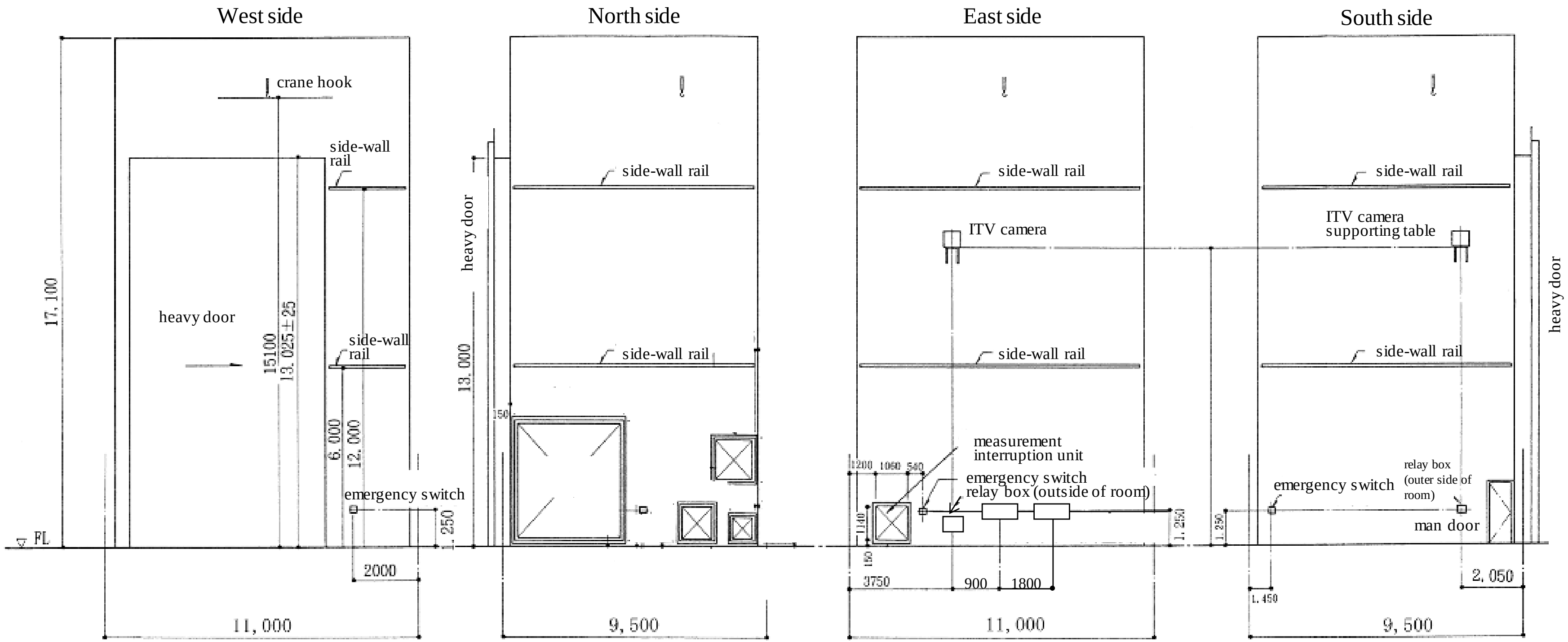


Figure 3-5 Diagram of Reverberation Chamber Wall Faces

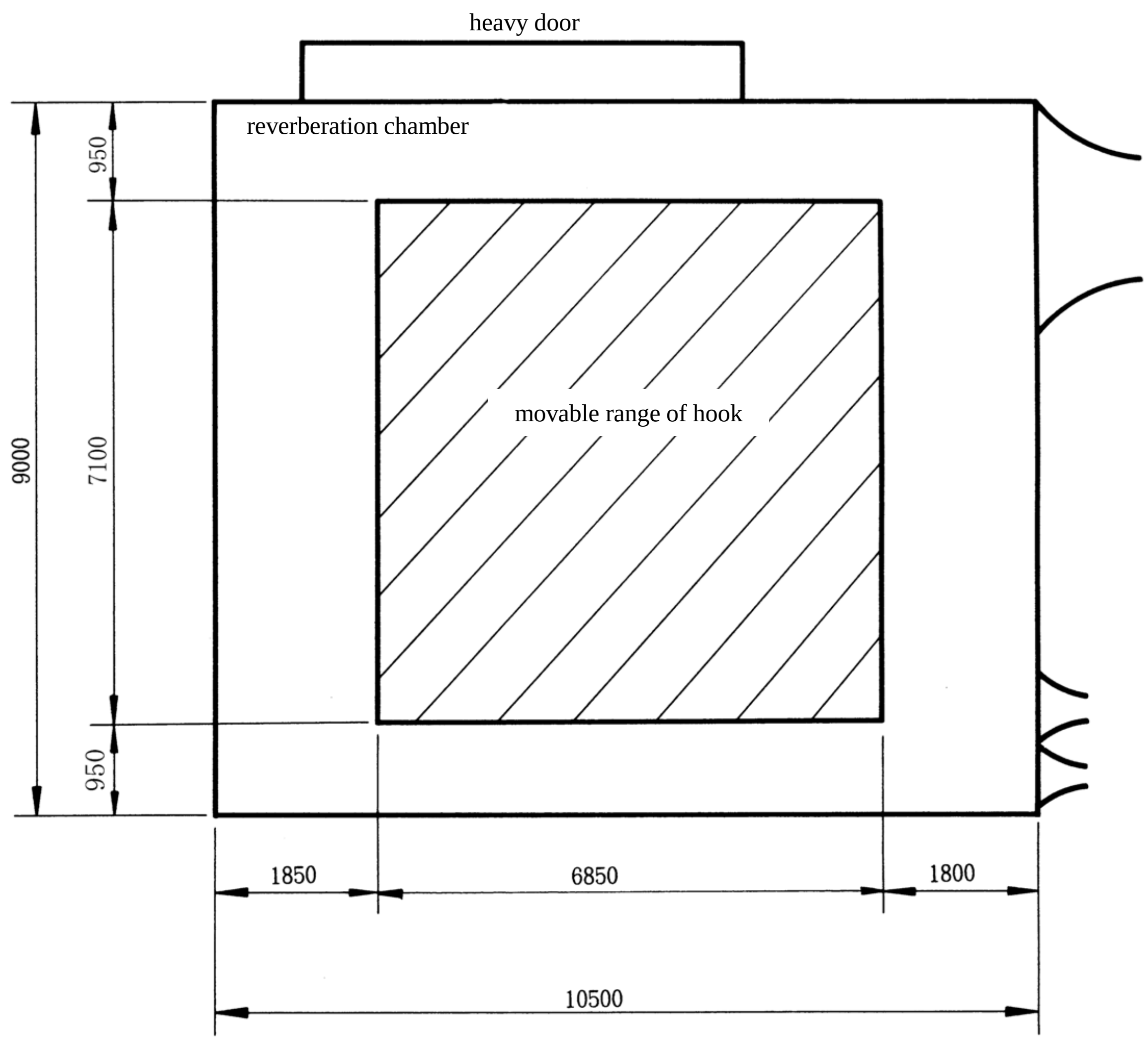


Figure 3-6 Movable Range of Crane Hook

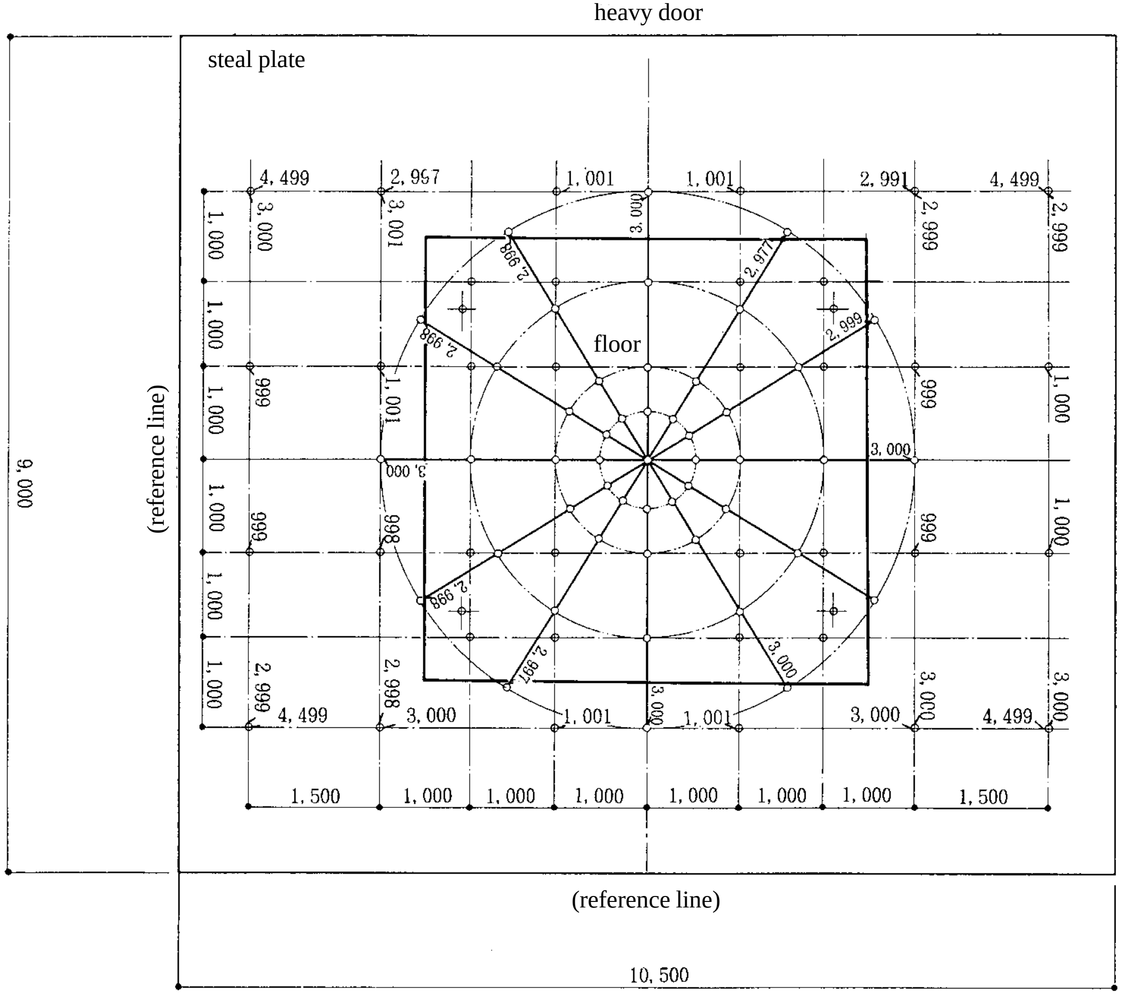
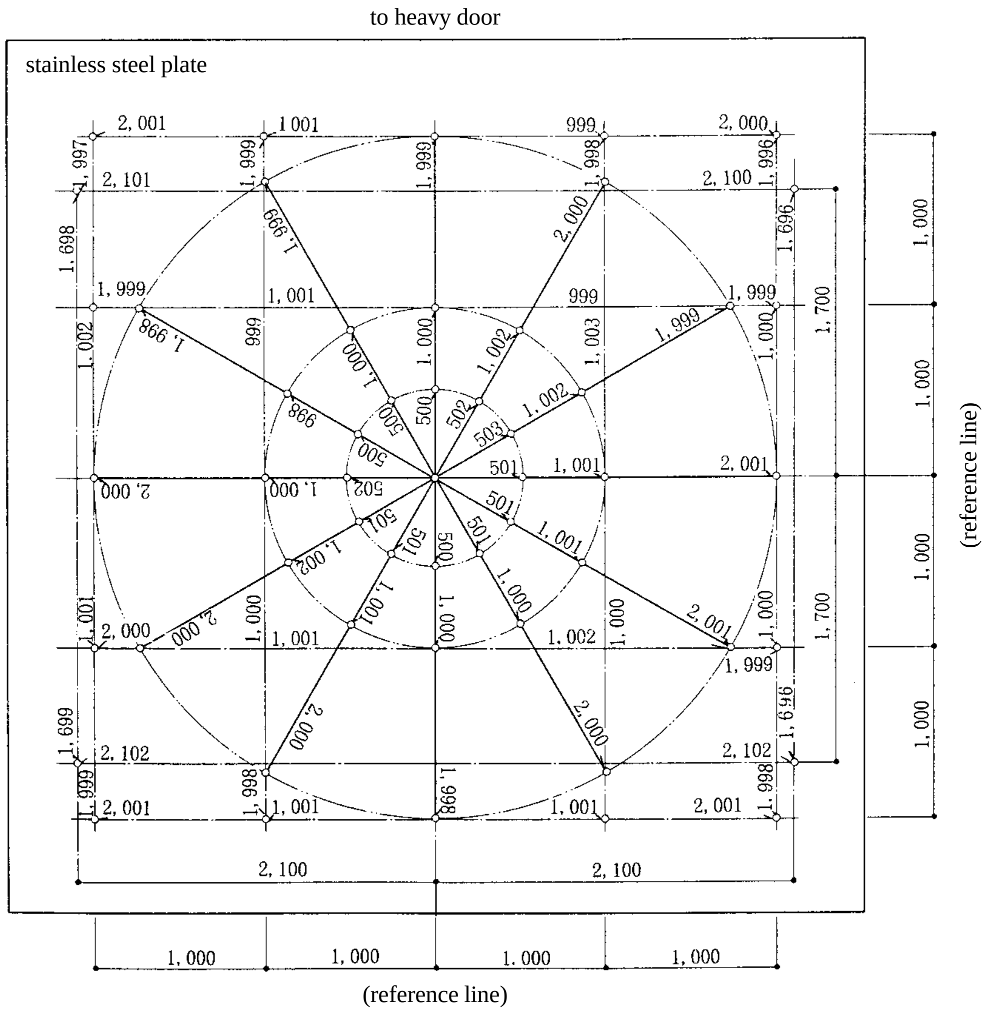


Figure 3-7 Hole Pattern on Reverberation Chamber Floor (1/2)



bolt specification: M20, Depth 30mm

Figure 3-7 Hole Pattern on Reverberation Chamber Floor (2/2)

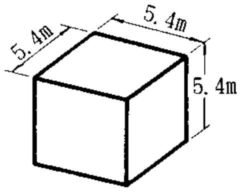
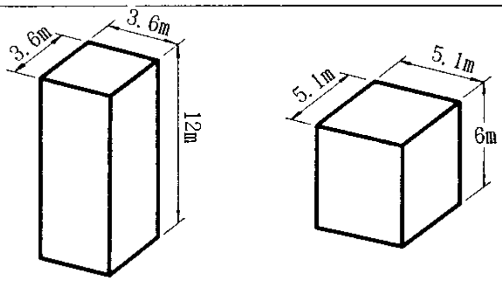
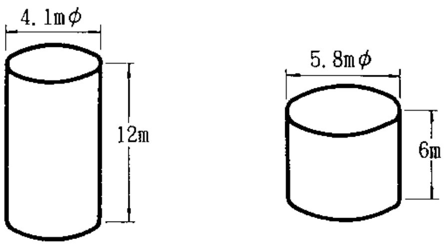
shape of TS	approximate dimensions
1. cuboid	
2. rectangular solid	
3. cylinder	

Figure 3-8 Examples of TS Dimensions

3.2.2 Data Acquisition System I/F

There are a measurement relay unit (cf. Figure 3-10) and a patch panel (cf. Figure 3-11) equipped in the reverberation chamber as the I/F between a data acquisition system and a TS to relay the cables from sensors. The cables that fit the connectors on the front face are to be prepared and connected by users. Meanwhile, a bridge box for strain measurement and the microphones and cables for sound pressure measurement are prepared by the facility-side personnel. How to connect a bridge box for strain measurement is shown in Table 3-1.

The sensor cables between the data acquisition system on the measurement rack of the large-scale separation shock test facility and a TS, or other measurement lines, check-out cables, etc., prepared by users, can be laid to the reverberation chamber outer-rooms, satellite path, etc., through the measurement relay unit or the feed-through hole next to the heavy door. Since no one can enter the reverberation chamber outer-rooms during a test, the check-out device that belongs to a TS is to be set in the satellite path (next to the heavy door.) Also, when using the feed-through hole, make sure to fill any clearance with clay, etc., after connecting cables through it, so that GN_2 wouldn't leak out during a test.

(1) Connection of sensors and cables

When measuring acceleration, attach acceleration sensors on a TS, and connect them to the measurement relay unit and patch panel in the reverberation chamber using low-noise cables.

When measuring strain, attach a strain gauge onto a TS, and connect it to a bridge box. Use a 120.0 Ω strain gauge, since this facility has no zero-balance function.

(2) Line checking

For verifying the test configuration, the connected measurement lines are to be checked using the oscilloscope function of an operation PC. That can be efficiently carried out when TS users and AES work hand in hand. The operation PC can also check the noise of the data acquisition system.

(3) Automatic range adjustment function of data acquisition system

The data acquisition system in this facility owns an automatic range adjustment function. That is, it can automatically adjust a range by predicting the response peak level at the Full Level state from the response level of each acceleration/strain channel at the Blow Noise state. That function, however, is not possessed by the data acquisition system on the measurement rack of the large-scale separation shock test facility.

First of all, the response RMS (rms level) at the Full Level state is calculated from the response RMS (rms level) of each acceleration/strain channel at the Blow Noise state based on the assumption that acceleration/strain response RMS is in proportion to sound pressure level (equation 1), then multiplied by a factor C the way response peak levels can be enveloped (to avoid overload), to set a range (equation 2.) The factor C can be specified by users (if not specified, “5” is chosen.)

The image diagram of the automatic range adjustment function is shown in Figure 3-9.

$$Res\_Full\_rms = Res\_Blownoise\_rms \times \alpha$$
$$\alpha = 10^{(Full\_OA - Blownoise\_OA)/20} \quad \text{(equation 1)}$$

$$\text{pre-set range} = Res\_Full\_rms \times C \quad \text{(equation 2)}$$

Res_Full_rms: response RMS at Full Level state

Res_Blownoise_rms: response RMS at Blownoise state (measurement levels at Blownoise state)

Full_OA: sound pressure level at Full Level state (specified by users)

Blownoise_OA: sound pressure level at Blownoise state (measurement levels at Blownoise state)

C: factor (specified by users)

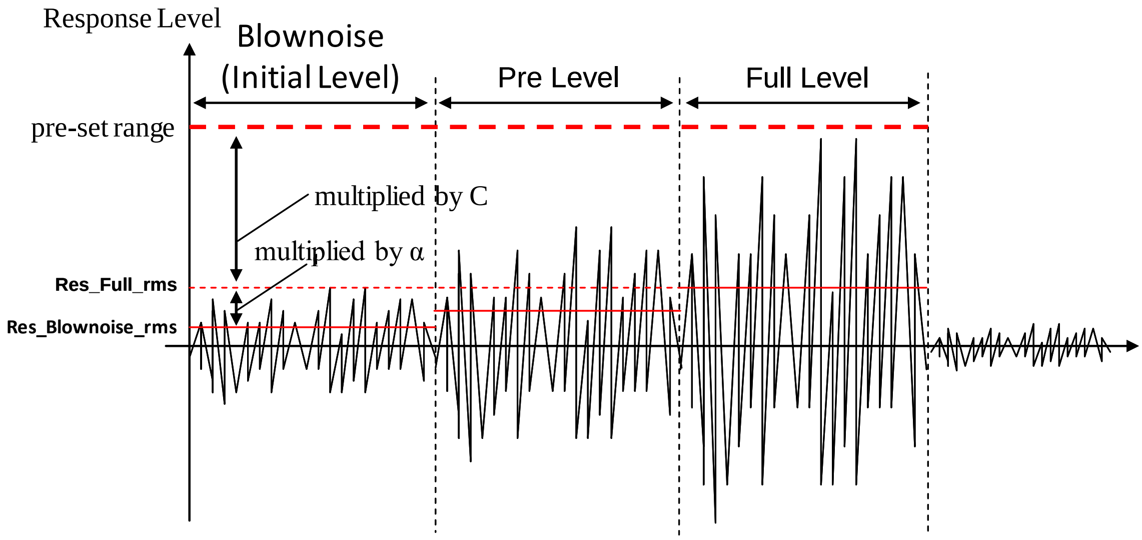
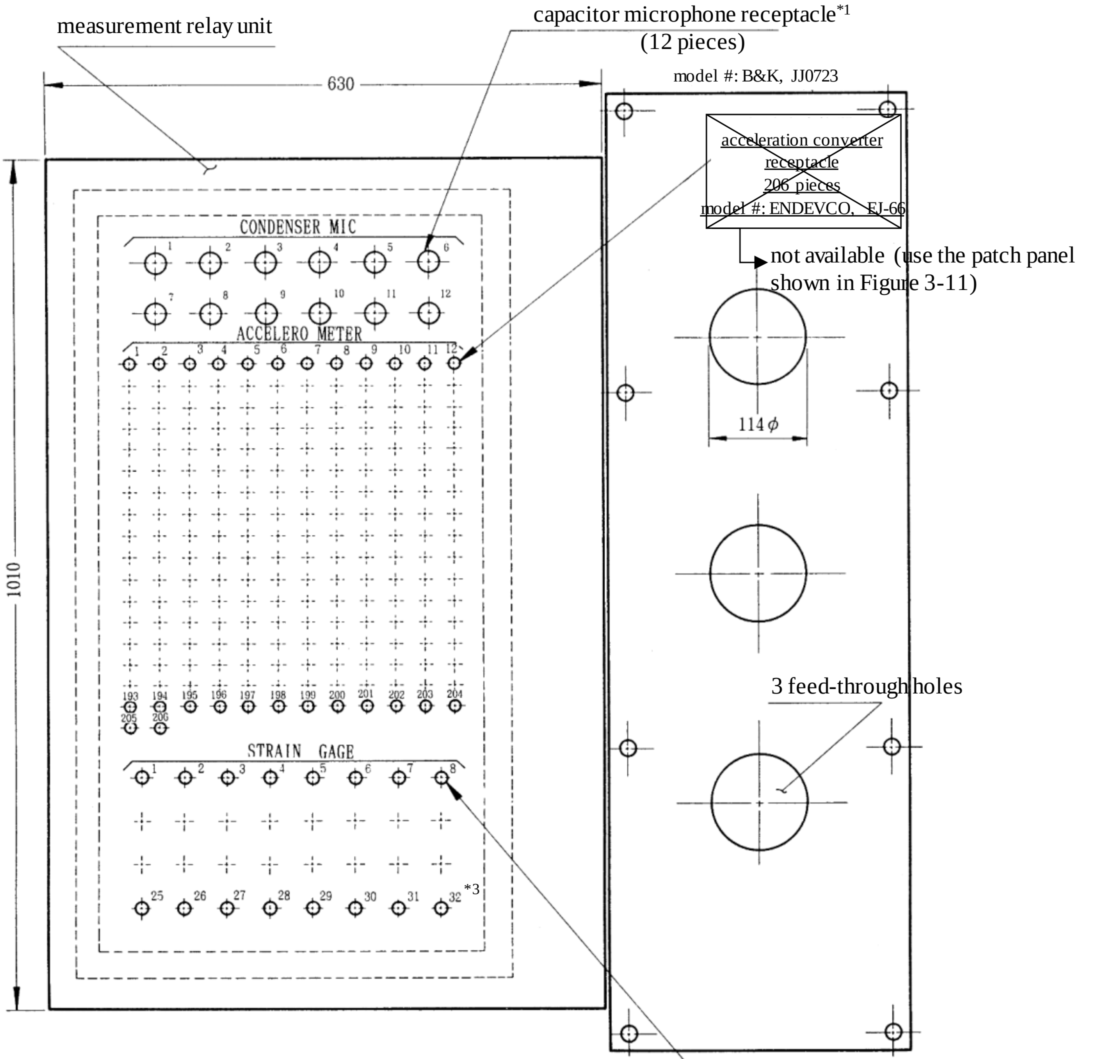


Figure 3-9 Image Diagram of Automatic Range Adjustment Function



*1 12 microphone cartridges (B&K 4939), 12 microphone preamplifiers (B&K 2669T) and six 10-m extension cables (A00028), and six 30-m extension cables (A00029), are prepared by the facility.

*2 32 bridge boxes (San-ei, 5370Y) are prepared by the facility.

*3 The strain receptacles 31 and 32 are preliminary channels.

Figure 3-10 Measurement Relay Unit

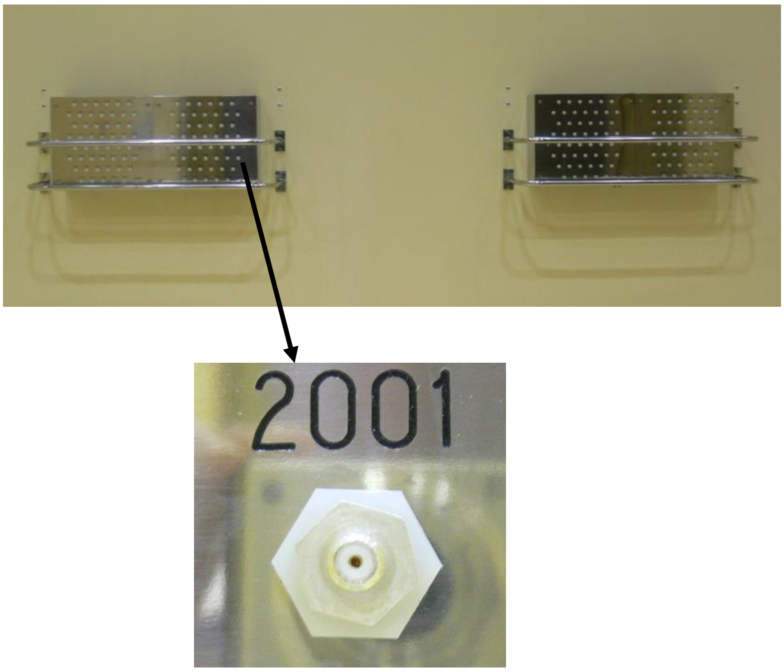
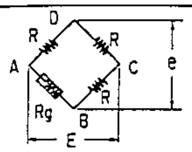
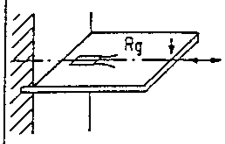
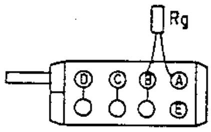
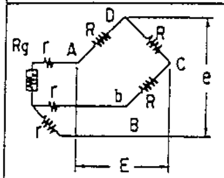
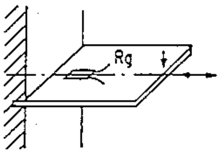
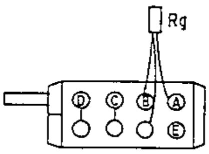
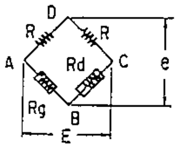
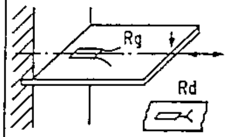
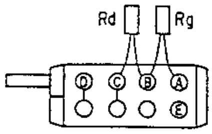


Figure 3-11 Patch Panel

Table 3-1 Table of Bridge Box WBD

circuit	gauge method	specific example	bridge box connection method	notes
	1-gauge method			･suitable for simple tension, compression, and simple bending. ･suitable for almost stable ambient temperature. ･calculatable with calibration value as it is.
	1-gauge 3-wire connection method			･suitable for simple tension, compression, and simple bending. ･strain gauge lead is previously temperature-compensated. ･ calculatable with calibration value as it is.
	1-active 1-dummy gauge method			･suitable for simple tension, compression, and simple bending. ･ previously temperature-compensated. ･ calculatable with calibration value as it is.

Note) As for the strain measurement channels, 3 channels make up 1 set (chs 3001 ~ 3003, chs 3004 ~ 3006...) due to the functional restriction of the amplifier. That is, when users use only 1 or 2 channels, bridge box(es) with the resistance of 120Ω will be connected to the rest of the channel(s) by the facility-side personnel.

Example:

When only the channels 3001 and 3002 are used by users, the facility-side personnel connects a bridge box with the resistance of 120Ω to channel 3003 (cf. Figure 3-12.)

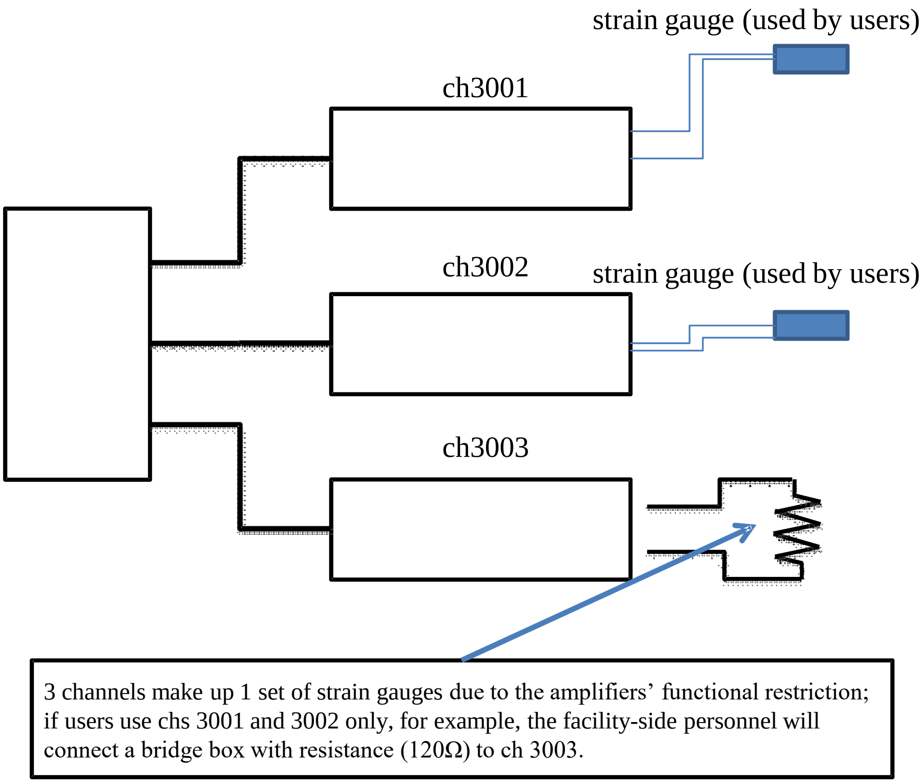


Figure 3-12 Cautions for Applying Strain Gauges

Table 3-2 Gain Setting Ranges for Amplifier

acceleration	1 ~ 10,000
strain	1 ~ 1,000

3.2.3 Facility Equipment I/F

The facility equipment consists of a TS dolly, microphone stands, etc.

The TS dolly, which consists of the main body, a raising jig, and a towing tractor, functions both as a raising jig and a moving dolly. Its external appearance is shown in Figure 3-13. A TS (Max. mass of about 4t) is mounted on the dolly, moved from the preparation room, etc., to the reverberation chamber, and set there. By using a TS dolly, a TS does not have to be suspended nor relocated onto a jig in the chamber. The height adjustment and transfer of the raising jig are performed using an electric jack and an electric towing tractor, respectively.

A raising jig is fixed onto the stainless plate in the center of the chamber floor with bolts (M20 × 12 pieces) to keep its rigidity. Its performance and specifications are shown in Table 3-3. A TS is mounted on top of the cylindrical raising jig (cf. Figure 3-14), whose TS I/F is made to fit the I/F of an H-IIA launch vehicle, which allows an H-IIA launch vehicle PAF to be directly mounted on the I/F.

In case a TS with other types of I/F is to be mounted on the raising jig, users are to have an adapter manufactured on their own for each TS. (Use the M12 screw holes with diameters of 2,030 mm and 2,350 mm for fixing an adapter to the raising jig.)

The travelling and operation of the TS dolly with a TS mounted on it are to be performed by users.

Microphone stands are to be fixed to the hole pattern positions on the floor shown in section 3.2.1. Microphones can be configured up to the height of 5m. The microphone stands can be bent and used.

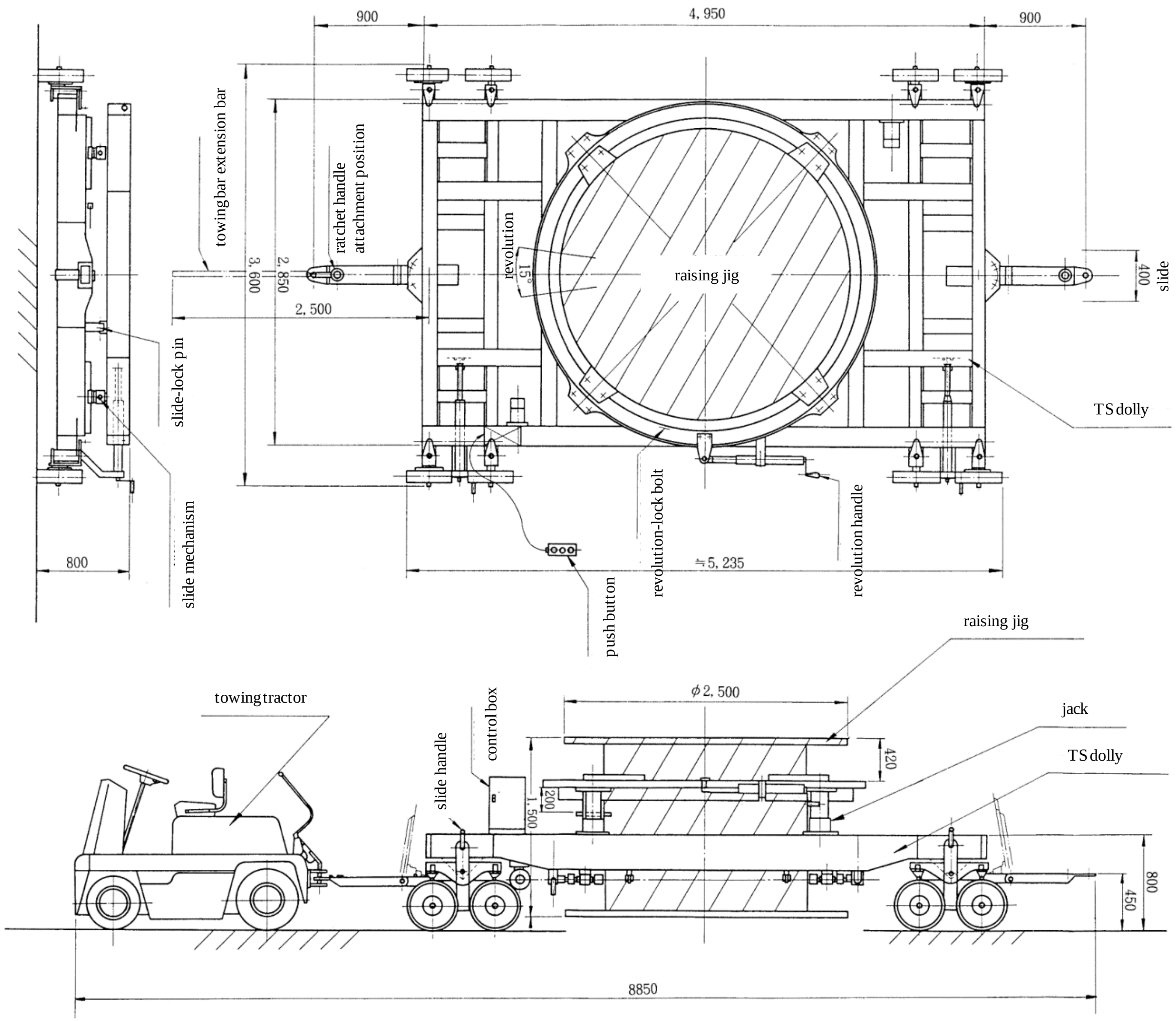


Figure 3-13 TS Dolly

Table 3-3 Performance/Specifications of TS Dolly

dolly’s own weight (w/o raising jig)	4,000 kg
tractor’s own weight	2,700 kg
mass on board (w/ raising jig)	6,000 kg
turning radius (radius to the outmost point of dolly)	5,250 mm (front-AND-rear-wheels towing) 6,670 mm (front-wheels towing)
Max. allowable load eccentricity (for Max. load mass)	1,406 mm (front/back directions) 766 mm (left/right directions)
height adjustable distance of jack	＋170 mm –30 mm
height adjustment rate of jack (unloaded)	1 mm/sec (up) 1 mm/sec (down)
tractor’s tow speed	6 km/h
tractor’s tow force	about 800 kg

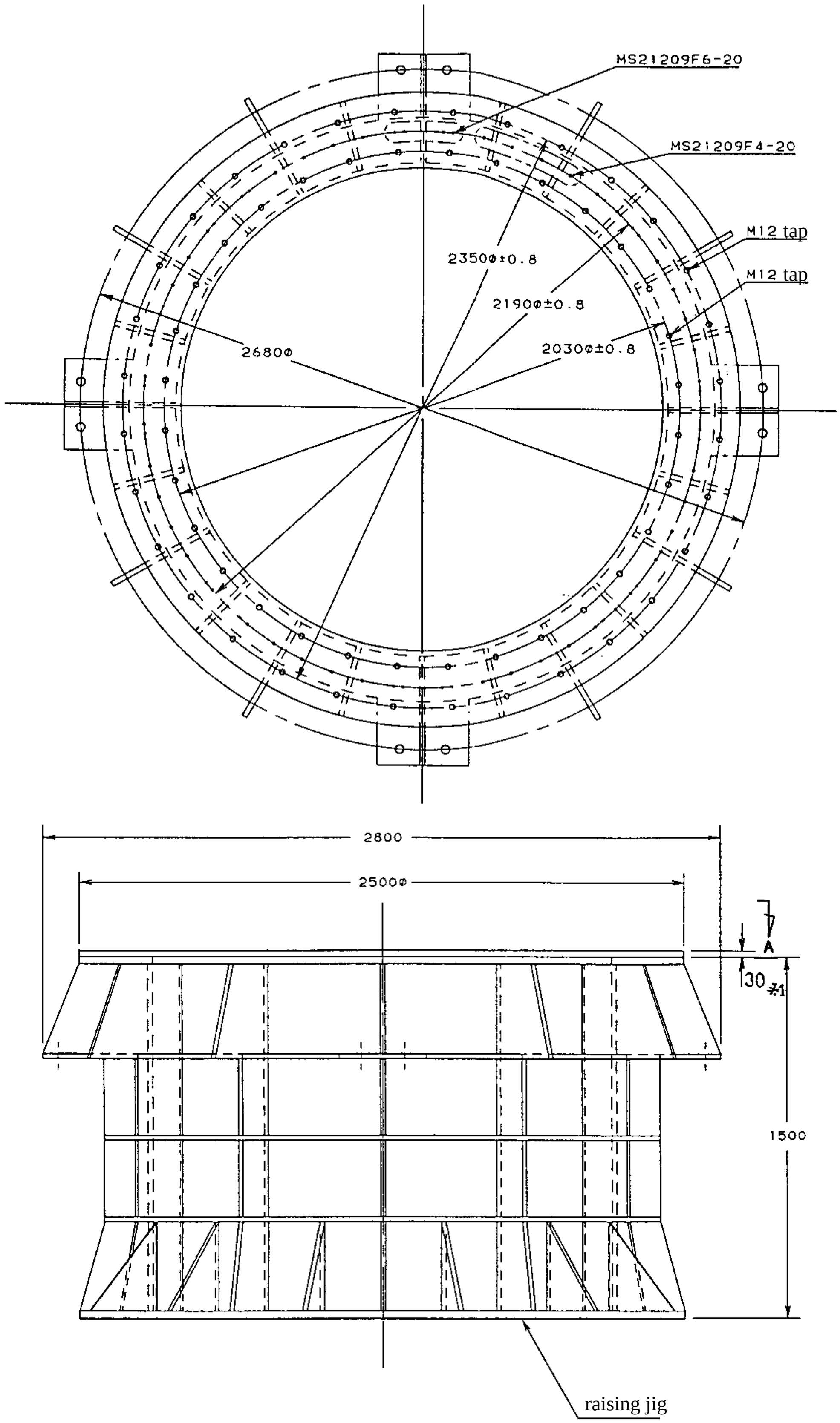


Figure 3-14 Raising Jig

4 Execution of Tests

4.1 Test-related Work Procedure

A general flow of test-related work after carrying a TS into the Satellite Integration and Test Building is shown in Figure 4-1. It generally proceeds as follows. Refer to the “Special Notes” in section 4.3 for the matters concerning the performance of tests.

4.1.1 Preparation for Test

(1) Users are to transport a TS to Tsukuba Space Center on a trailer, etc., and carry it into the Satellite Integration and Test Building through its two unpacking rooms. Users are to submit necessary documents in the “management/procedure manual of Tsukuba Space Center (VAA-2003003)” beforehand (likewise before carrying out a TS.)

- Unpacking room (1)
  dimensions of shutter: 8.3m (width) × 14m (height)
  rated load of overhead crane: 20t
- Unpacking room (2)
  dimensions of shutter: 8.3m (width) × 12m (height)
  rated load of overhead crane: 5t

(2) Users are to open containers in the fore-room, mount a TS on the TS dolly or a dolly prepared by users themselves, and transfer it to a designated assembly preparation room.

(3) In the assembly preparation room, test preparation, e. g., assembling of a TS, mounting of sensors, etc., is to be executed.

(4) After completing the test preparation, users are to transfer a TS to the reverberation chamber and set it there. A TS dolly enables users to transfer and set a TS without dismounting it from the dolly as mentioned above; in other test configurations, however, (e. g., using a jig prepared by users, or suspending a TS, etc.), another dolly for carrying a TS is to be prepared by users as well.

(5) The work in the reverberation chamber is to be limited to the least necessary (as little as measurement lines WBD, conductance check, etc.) Therefore, users are to complete preparatory work that is required immediately before a test (functional test, loading of simulation propellant, pressurization, etc.) outside the chamber to the extent possible.

(6) After completing the WBD/continuity checking as well as visual checking of measurement lines, users can conduct a test.

4.1.2 Start of Test

(1) An acoustic test is started by blasting GN_2 into the chamber from the GN_2 system. The sound generated in the chamber at that moment is as high as about 115dB (Blow Noise level.)

(2) While Blow Noise level is being loaded in the chamber, the response level of an acoustic test is predicted from that of measurement channels, based on which the range of the data acquisition system is automatically controlled to be appropriate. After controlling the range of the data acquisition system, data starts to be recorded.

(3) After the start of measurement is confirmed, the test-level sound pressure is loaded in the chamber using the electro-pneumatic transducer (viz. Full Level test.) A timer starts counting when all the 1/1 (or 1/3) octave-band sound pressure levels reach the pre-set levels, and the test is automatically finished when the pre-set test time has passed.

(4) It is also possible to set a Full-XdB test level as a Pre-level test before starting a Full Level test. The load time and sound pressure level for a Pre-level test (viz. what level of dB is to be deducted from the Full level) can be determined within the performance of this facility. The shift from a Pre-level test to a Full Level test is achieved by automatic sequence.

(5) The maximum testable time of this facility is 10 minutes including the Blow Noise level phase. It takes about 60 seconds to adjust the range of the data acquisition system during the Blow Noise level phase (when the number of measurement channels = 232 chs (acceleration 200 chs + strain 32 chs)), and another 60 seconds to operate the sound generator to let it generate the test-level sound pressure. Pay attention to the maximum testable time when setting the test time for a Full Level test (or a Pre-level test.)

(6) The measurement state of the data acquisition system can be displayed on the screen (oscilloscope screen) in terms of up to 36 chs per one screen by using the oscilloscope function (multi scope display function) of the operation PC in the data acquisition system during a test. (cf. Figure 4-2 for an example of the screen.)

4.1.3 Completion of Test

(1) The chamber is ventilated after finishing a Full Level test. The air inside the chamber is replaced by the air in the satellite path. It takes about half an hour, while depending on the acoustic test time, before the oxygen concentration in the chamber returns to the level which allows the safe entrance by personnel. Until then, no one is allowed to enter the off-limits area.

(2) While GN_2 is being ventilated and replaced, the sound pressure control data is output from the computer in the sound spectrum control system (examples of output data are provided in Appendix B.) This data tells whether or not acoustic load of the specified sound pressure level has been applied for the specified time.

(3) The measurement results of a TS are to be analyzed simultaneously with (1) and (2) above. It takes about 40 minutes after the end of a Full Level acoustic test to complete PSD analysis and obtain results for 200 chs.

(4) A test is judged as having been completed based on the loading status of sound, the measurement/analysis results of a TS, the visual inspection on a TS, etc.

(5) In case a retest is necessary, 1 ~ 2 hours (depending on test conditions, temperature/humidity environment, etc.) are to be spared after the completion of a Full Level test to get the GN_2 system ready. Also, the LN_2 storage tank, which has a capacity for three times of acoustic tests (again, depending on test conditions), may require filling if the residual amount is little.

(6) The removal work is to be started after a test is judged to have been completed. It is desirable to carry out a TS from the reverberation chamber as soon as possible.

The period of occupying the reverberation chamber to pursue the series of work for a test is about three days for a subsystem and five days for a system, even though it depends on the size of a TS, etc.

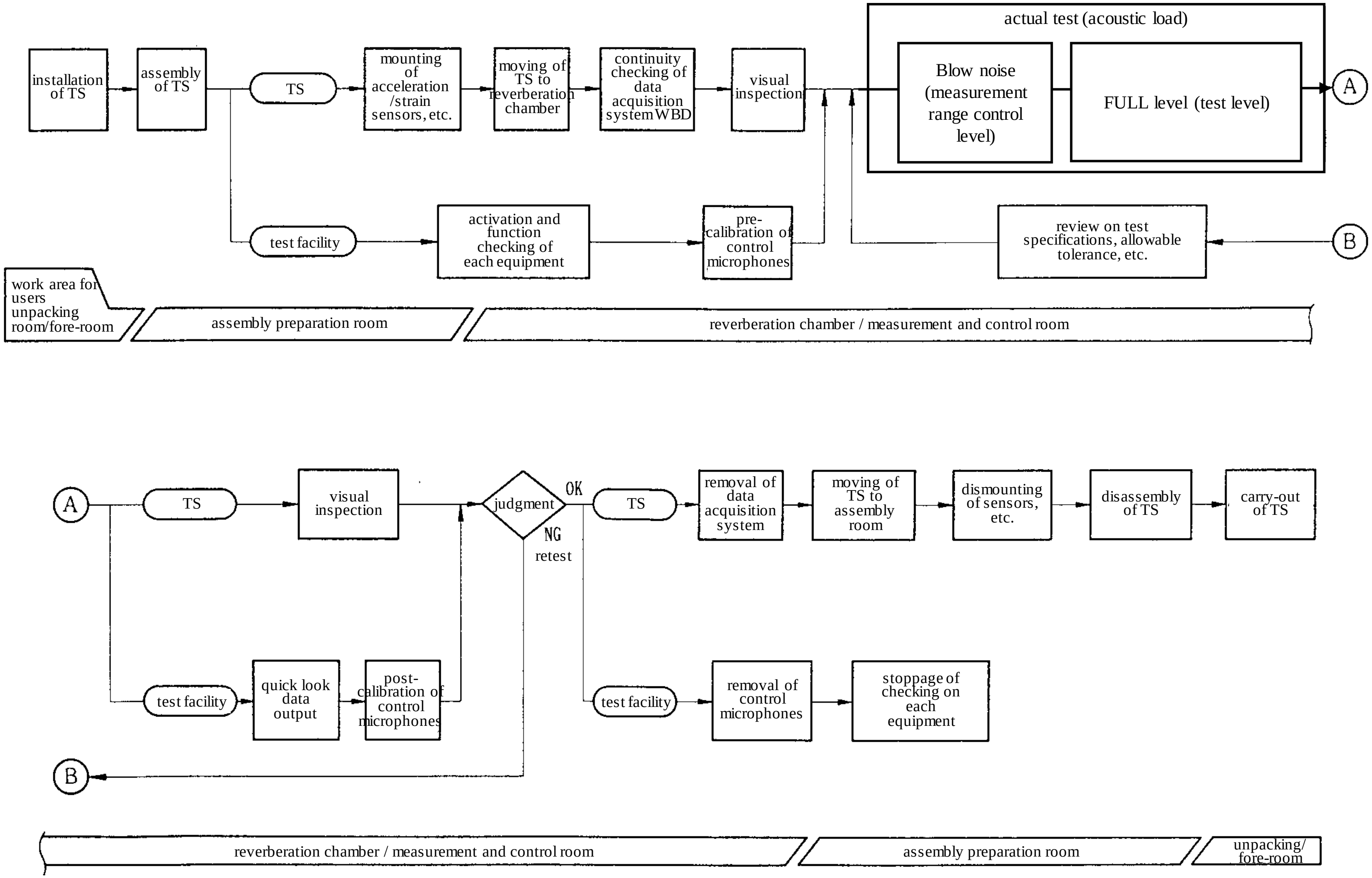


Figure 4-1 Test-related Work Flow

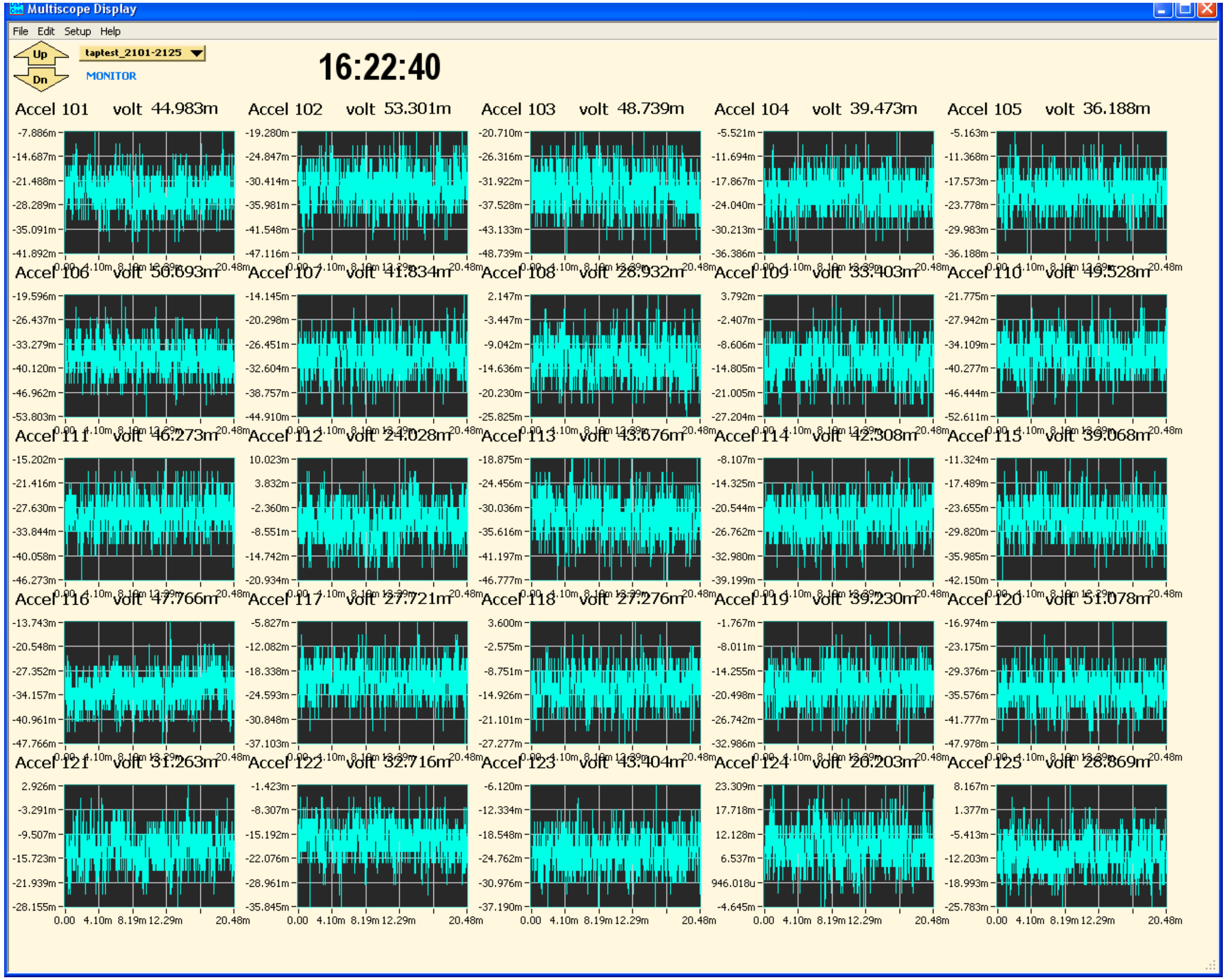


Figure 4-2 Example of Screen Display for Oscilloscope Function (Multi Scope Display Function)

4.2 Designation of Test Conditions

Users are to submit the test conditions requisition sheet shown below so that an acoustic test can be carried out smoothly without errors. Its format is in Appendix C.

(1) Test conditions requisition sheet

(a) Fill in the “test conditions requisition sheet” with test/analysis conditions, and submit it to us before a kickoff meeting. Its format and fill-out guidelines are shown in Appendix C.

(b) Examples of analysis output are shown in Figure 4-3 (1/2)(2/2).

(c) All the measured test data (binary data) are written and saved in a DVD along with a sensor database list (cf. (2) below.) The analyzed test data can not only be printed out but saved in a CD-R in csv format, etc. An output example is shown in Appendix E.

(d) The types of applicable analyses are different depending on facilities (cf. “main specifications” in section 2.2.)

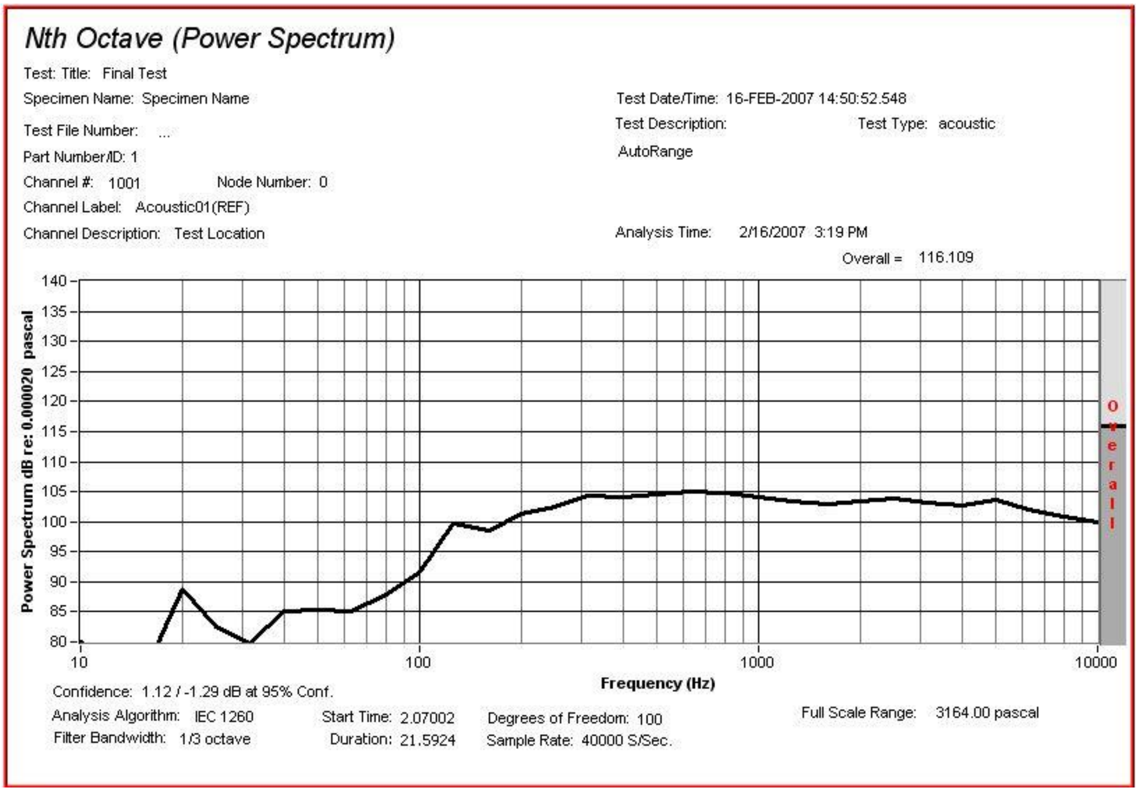
(2) Sensor database list

(a) Fill in the sensor database list with the measurement conditions for measurement points (the sensitivity information, ID, etc., of the sensor mounted on each measurement point), and submit it to us before starting a test.

(b) A sensor database list is to be created in a Microsoft Excel file (Office 2000 or later version.) following the specified format. The guidelines for creating a sensor database are shown in Appendix D.

(c) By creating the random vibration conditions for mounted equipment in the designated format, the random vibration environmental conditions can be superimposed on the PSD analysis results of each measurement point. Examples of superimposing are shown in Figure 4-3 (2/2.) The guidelines for filling out the designated format are shown in Appendix D.

Note) While we require a sensor database list to be created in an Excel file, please do not use the LINK function of the cells.



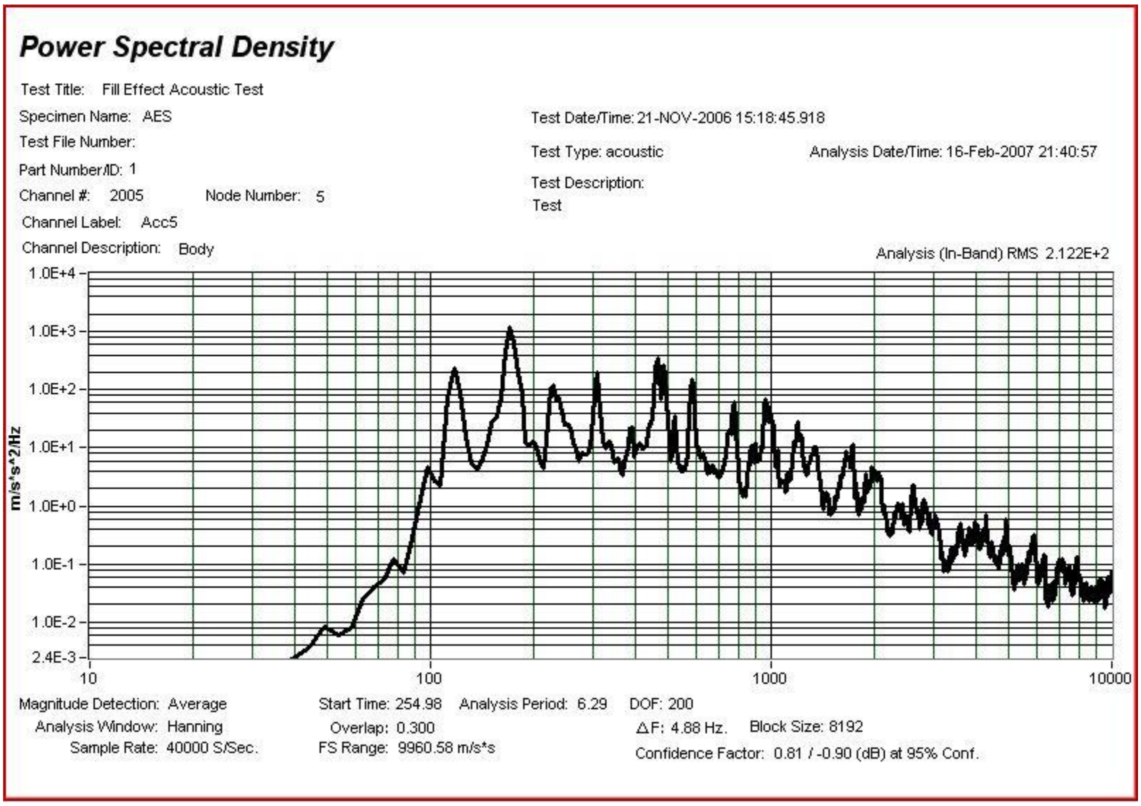


Figure 4-3 (1/2) Example of Analysis Output Results

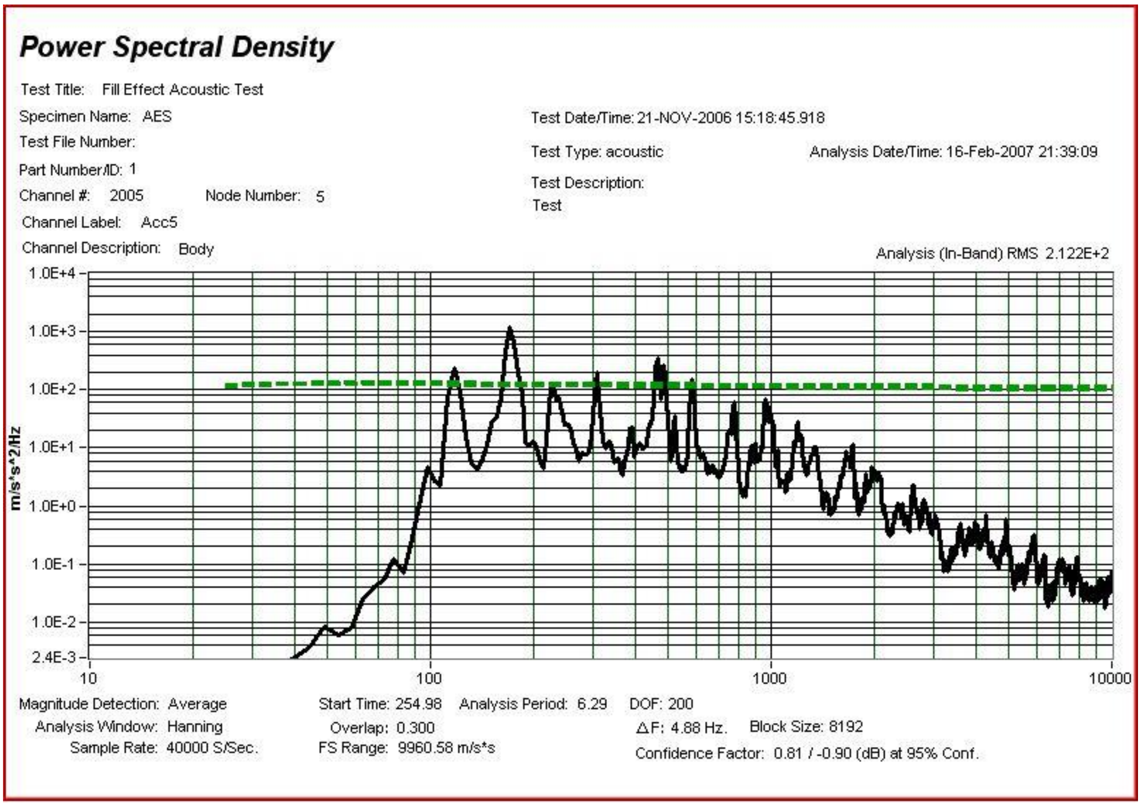


Figure 4-3 (2/2) Example of Analysis Output Results

4.3 Special Notes

4.3.1 Restrictions for Tests

(1) Up to three tests can be performed per a day.

(2) A two-hour interval is required between tests.

4.3.2 Check on Measurement Lines

The measurement lines including those of sensors are to be checked thoroughly by tapping, etc., during the preparatory work.

The checking after the start of a test sequence is to be avoided as much as possible for the sake of reducing LN_2 consumption. In case it is necessary to check measurement lines during a test sequence, use the oscilloscope function (multi scope display function) of the data acquisition system to complete the task in a shortest time possible. Meanwhile, please refrain from checking measurement lines during a pre-level test, with regard to the protection of a TS and smooth advancement of a test sequence.

4.3.3 Acoustic Test Conditions for Large TS

When performing an acoustic test on a large TS, the difference of acoustic properties between the cases of an empty sound field and the actual test is to be taken into account for setting the control target level or the abort level (especially in the low-frequency band.) Furthermore, the difference between TS models can result in the error of over 2dB in the controlled results, depending on the target frequency bands of sound pressure controlling. To avoid overload on a flight model due to such errors, a low-level preliminary test is to be performed on it to check for the difference(s) from a structural model.

4.3.4 Wearing a Helmet

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

4.3.5 Cleanliness Control

The cleanliness in the test room is controlled to keep ISO class 8 (class 100,000) level. Users are to wear a clean garment (to be prepared by users) when entering the test room.

4.3.6 Security Verification

The external recording media to be used for giving/receiving data, e. g., a sensor database list, to/from this facility, are to be put through virus checking using software for that purpose before application.

Appendix A Details of Distribution Board

Table A-1 Distribution Board Specifications (1/2)

name		PA-1-B		
location		chamber side room		
breaker signs	source resultant pulse number	voltage [V]	breaker rating	notes
APM311 I, J, K, L	3	200	MCB 3P 50/50AT	
APL103 Ⓓ	1	100	MCB 2P 50/30AT	
APL103 Ⓔ, Ⓕ	1	100	MCB 2P 50/20AT	
APL103 Ⓖ	1	100	MCB 2P 50/50AT	
APL103 Ⓗ, Ⓘ, Ⓙ Ⓚ, Ⓛ	1	100	MCB 2P 50/20AT	
APL103 Ⓜ, Ⓝ	1	100	MCB 2P 50/50AT	

Table A-1 Distribution Board Specifications (2/2)

name		PA-1-C		
location		satellite path		
breaker signs	source resultant pulse number	voltage [V]	breaker rating	notes
APM312 $\boxed{A}$	1	200	MCB 2P 50/50AT	
APM312 $\boxed{B}$, $\boxed{C}$, $\boxed{D}$	3	200	MCB 3P 50/50AT	
APL104 Ⓐ	1	100	MCB 2P 50/30AT	*
APL104 Ⓑ, Ⓒ	1	100	MCB 2P 50/20AT	
APL104 Ⓓ	1	100	MCB 2P 50/50AT	*
APL104 Ⓔ, Ⓕ, Ⓖ Ⓗ, Ⓘ	1	100	MCB 2P 50/20AT	
APL104 Ⓙ	1	100	MCB 2P 50/50AT	*

* When using the measurement rack(s) of the large-scale separation shock test facility as additional rack(s) to the data acquisition system, that will occupy up to 3 terminals of breakers with the rating of 30A or more on the distribution board PA-1-C. For further information, contact the Environmental Test Technology Unit.

Appendix B Example of Data Output

＊＊＊ Test Specification Data List ＊＊＊

＊＊ Test Specification - 1 ＊＊

① Date of test	[March 25th, 2007]
② Name of test	[ABC-X SMD-D TEST No.2]
③ Name of test specimen	[PX]
④ Test number	[001]
⑤ Test type	[test]
⑥ Test spectrum	[1/1] OCT
⑦ Name of option parameter file	[TEST]
⑧ Name of control parameter file	[H2QT]
⑨ Test time (Max. 600 sec. in total)	
・ FULL LEVEL	[60] sec.
⑩ Control on jet nozzle	[23]

＊＊＊ Test Condition and Control Parameter List ＊＊＊

＊＊ Test Specification - 2 ＊＊

Date of Test: March 25th, 2007

(FULL LEVEL)

band number	frequency	reference level	tolerance upper / lower	abort upper / lower
1	31.5	138.0	+5.0 / -10.0	+10.0 / -10.0
2	63	143.5	+5.0 / -10.0	+10.0 / -10.0
3	125	144.0	+5.0 / -10.0	+10.0 / -10.0
4	250	146.0	+5.0 / -10.0	+10.0 / -10.0
5	500	142.5	+5.0 / -10.0	+10.0 / -10.0
6	1000	140.0	+5.0 / -10.0	+10.0 / -10.0
7	2000	134.0	+5.0 / -10.0	+10.0 / -10.0
8	4000	125.0	+5.0 / -10.0	+10.0 / -10.0
9	8000	122.0	+5.0 / -10.0	+10.0 / -10.0
10	OA	138.0	+5.0 / -10.0	+10.0 / -10.0

＊＊＊　クイックルックデータ　＊＊＊
(平均スペクトラム一覧リスト)

試験名：JN_para_AES
供試体名：PX
試験日：2007年03月22日
試験番号：001

データサンプル数：　60　　　解析時間：13:53:05～13:53:35
マイクロフォン：平均

		1／3オクターブ					1／1オクターブ				
バンド番号	周波数	平均値	目標値	偏差	トレランス上限	トレランス下限	平均値	目標値	偏差	トレランス上限	トレランス下限
1	25	122.5	122.7	-0.3	+5.0	-10.0					
2	31.5	122.4	123.2	-0.8	+5.0	-10.0	127.4	128.0	-0.6	+5.0	-10.0
3	40	123.0	123.7	-0.7	+5.0	-10.0					
4	50	123.9	123.8	0.1	+3.0	-3.0					
5	63	124.3	124.3	-0.0	+3.0	-3.0	129.5	129.5	0.0	+3.0	-3.0
6	80	125.8	125.8	0.0	+3.0	-3.0					
7	100	127.9	127.9	-0.0	+1.0	-1.0					
8	125	129.4	129.4	-0.1	+1.0	-1.0	134.0	134.0	-0.0	+1.0	-1.0
9	160	130.0	130.1	-0.0	+1.0	-1.0					
10	200	131.1	131.2	-0.2	+1.0	-1.0					
11	250	131.2	131.2	-0.0	+1.0	-1.0	135.9	136.0	-0.1	+1.0	-1.0
12	315	131.2	131.2	-0.0	+1.0	-1.0					
13	400	127.9	128.0	-0.1	+1.0	-1.0					
14	500	126.4	126.5	-0.1	+1.0	-1.0	131.4	131.5	-0.1	+1.0	-1.0
15	630	125.2	125.3	-0.1	+1.0	-1.0					
16	800	124.3	124.4	-0.1	+1.0	-1.0					
17	1000	123.2	123.2	-0.1	+1.0	-1.0	127.9	128.0	-0.1	+1.0	-1.0
18	1250	121.4	121.6	-0.1	+1.0	-1.0					
19	1600	119.5	119.7	-0.2	+3.0	-3.0					
20	2000	117.8	118.0	-0.2	+3.0	-3.0	122.8	123.0	-0.2	+3.0	-3.0
21	2500	116.2	116.4	-0.1	+3.0	-3.0					
22	3150	113.4	114.4	-1.0	+3.0	-3.0					
23	4000	112.8	112.8	-0.0	+3.0	-3.0	117.7	118.0	-0.3	+3.0	-3.0
24	5000	112.6	112.1	0.5	+3.0	-3.0					
25	6300	112.2	111.9	0.4	+3.0	-3.0					
26	8000	110.7	111.2	-0.5	+3.0	-3.0	115.5	116.0	-0.5	+3.0	-3.0
27	10K	108.3	110.5	-2.2	+3.0	-3.0					
28	OA	140.1	140.5	-0.4	+2.0	-2.0	140.1	140.5	-0.4	+2.0	-2.0

Figure B-1 Numerical List of Sound Pressure Spectrum Levels

This may not be the latest edition.

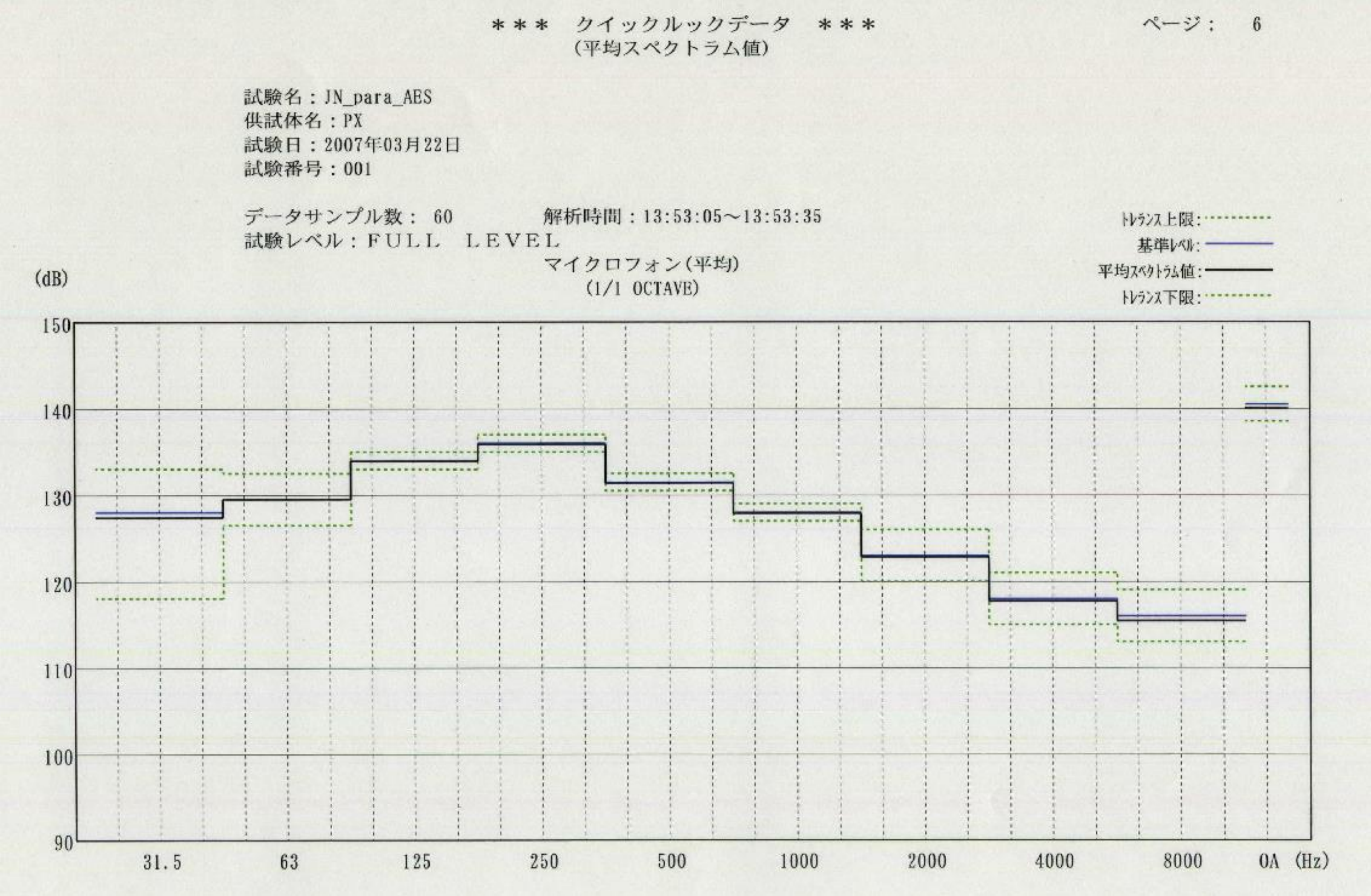


Figure B-2 1/1 Octave Band Sound Pressure Spectrum Levels (Microphone Average)

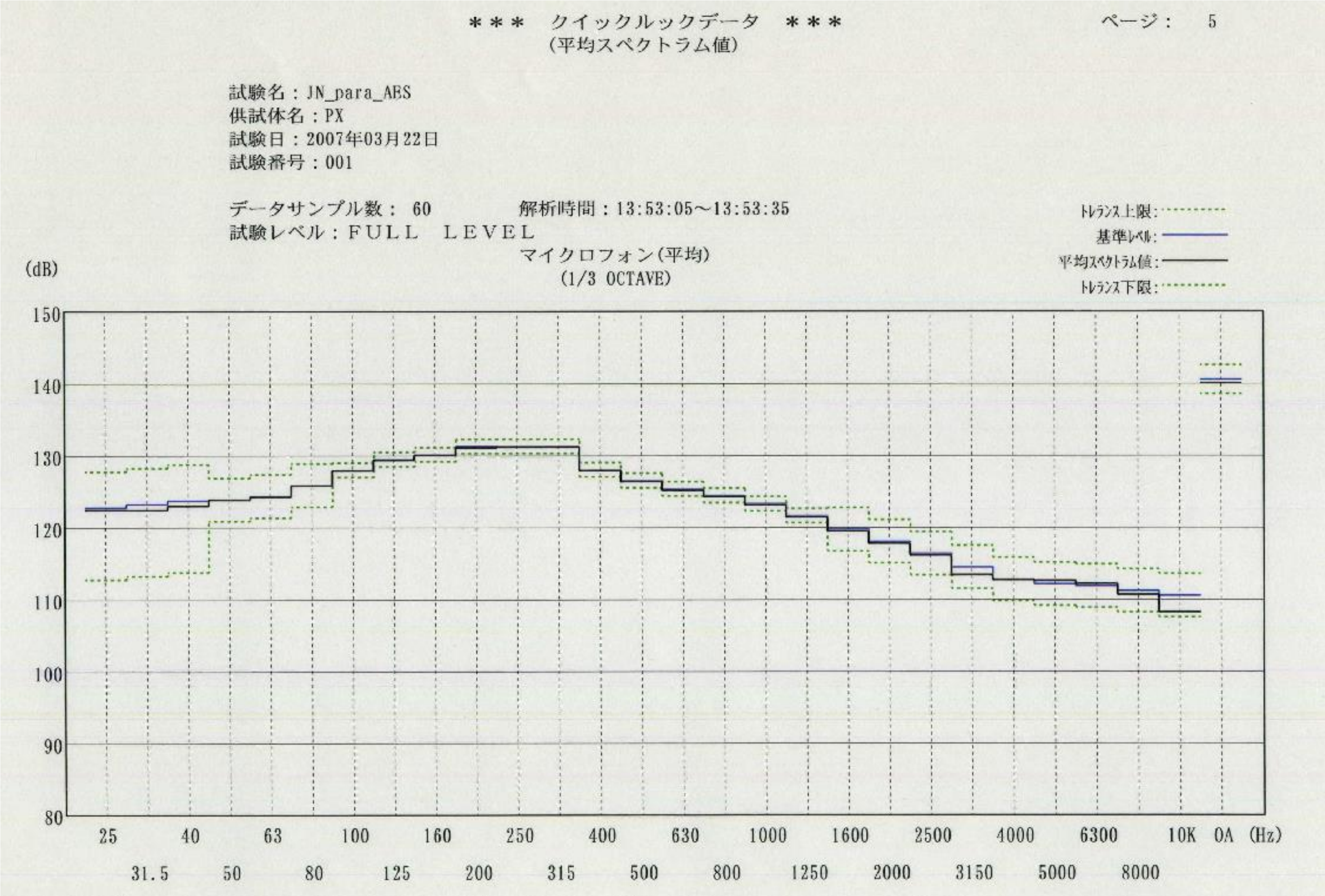


Figure B-3 1/3 Octave Band Sound Pressure Spectrum Levels (Microphone Average)

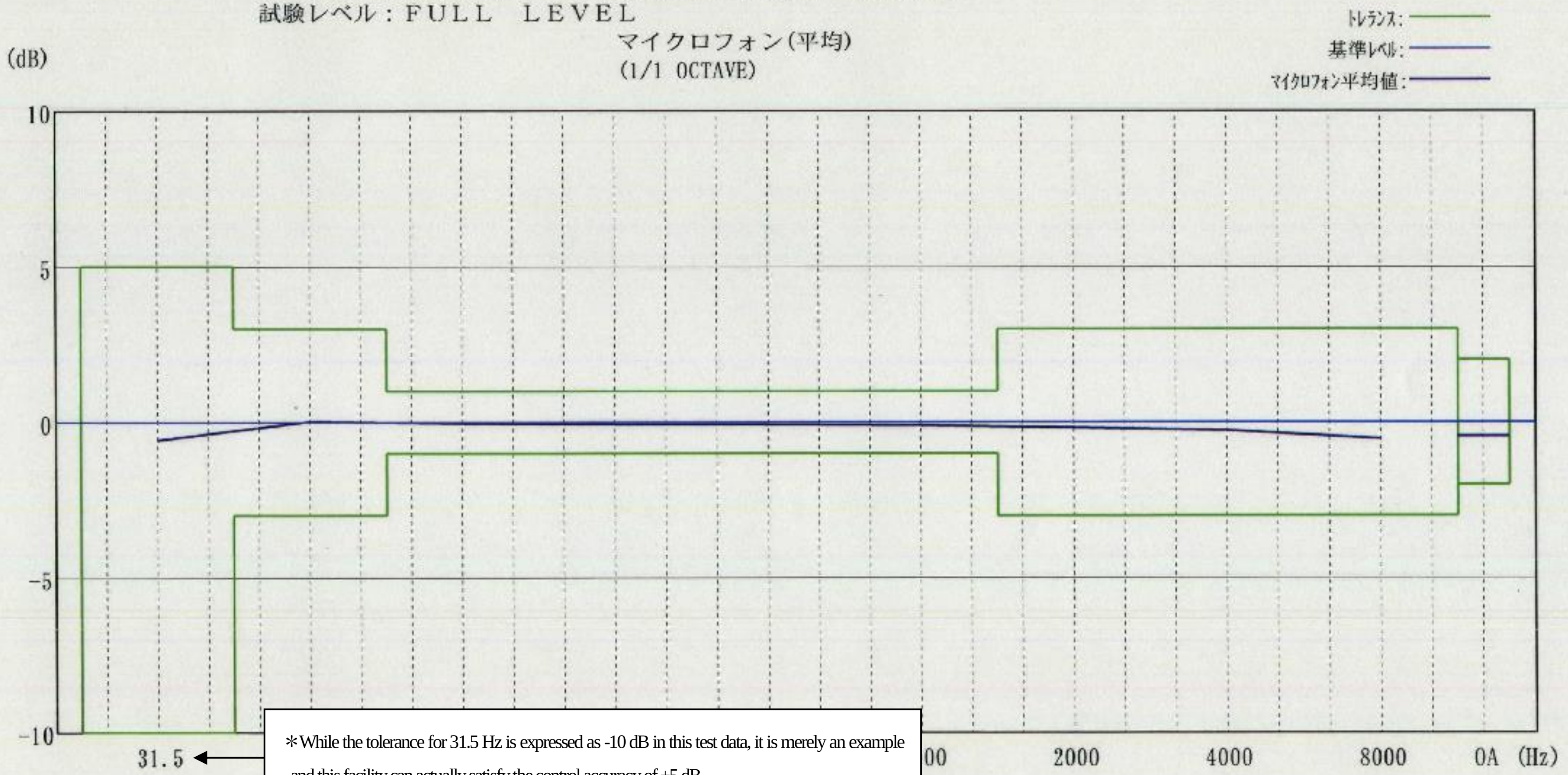
＊＊＊　クイックルックデータ　＊＊＊　　ページ：　12

（平均スペクトラム偏差）

試験名：JN_para_AES
供試体名：PX
試験日：2007年03月22日
試験番号：001

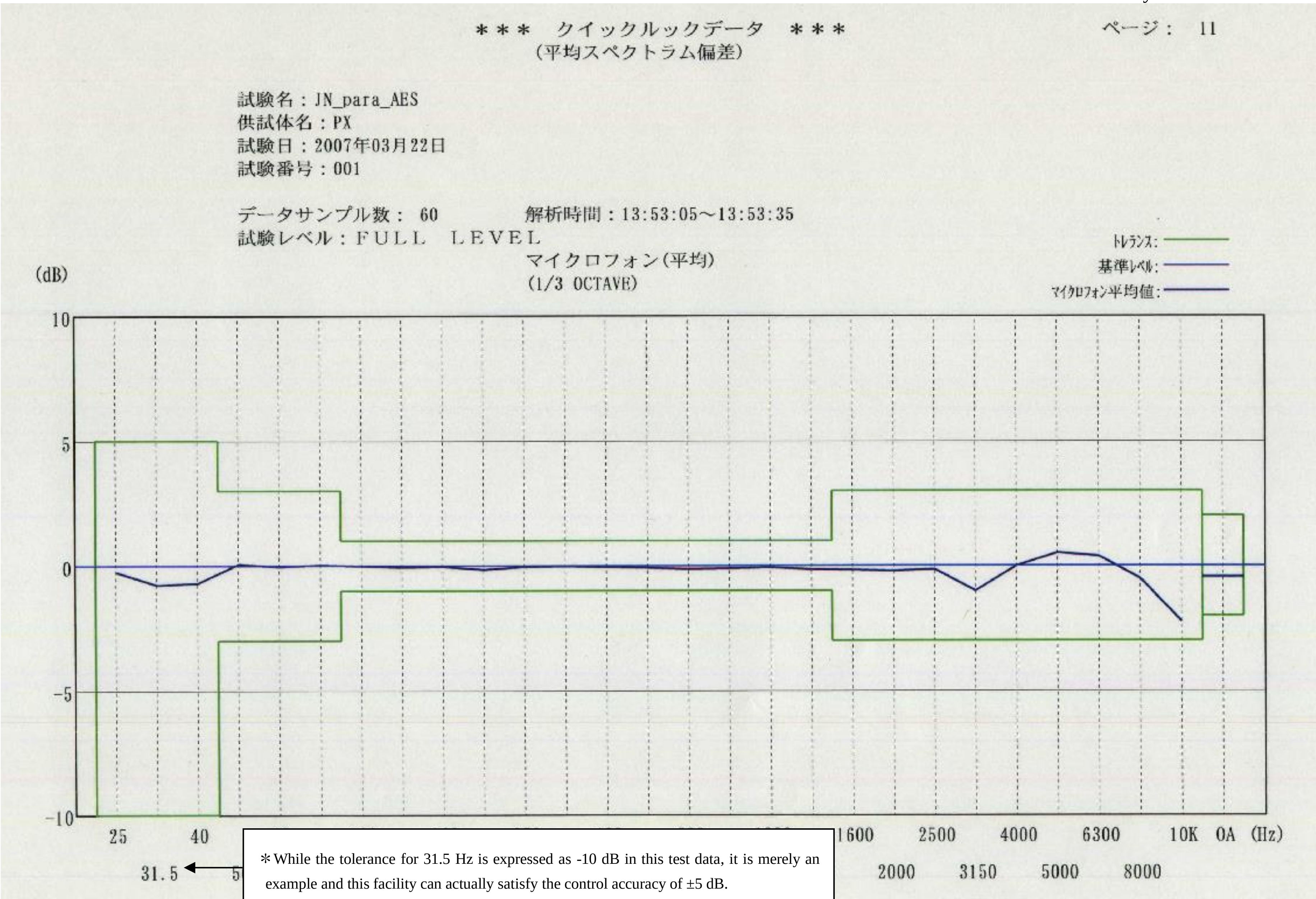
データサンプル数：　60　　　解析時間：13:53:05～13:53:35
試験レベル：ＦＵＬＬ　ＬＥＶＥＬ

マイクロフォン(平均)
(1/1 OCTAVE)



＊While the tolerance for 31.5 Hz is expressed as -10 dB in this test data, it is merely an example and this facility can actually satisfy the control accuracy of ±5 dB.

Figure B-4 1/1 Octave Band Sound Pressure Spectrum Deviation (Microphone Average)



＊While the tolerance for 31.5 Hz is expressed as -10 dB in this test data, it is merely an example and this facility can actually satisfy the control accuracy of ±5 dB.

Figure B-5 1/3 Octave Band Sound Pressure Spectrum Deviation (Microphone Average)

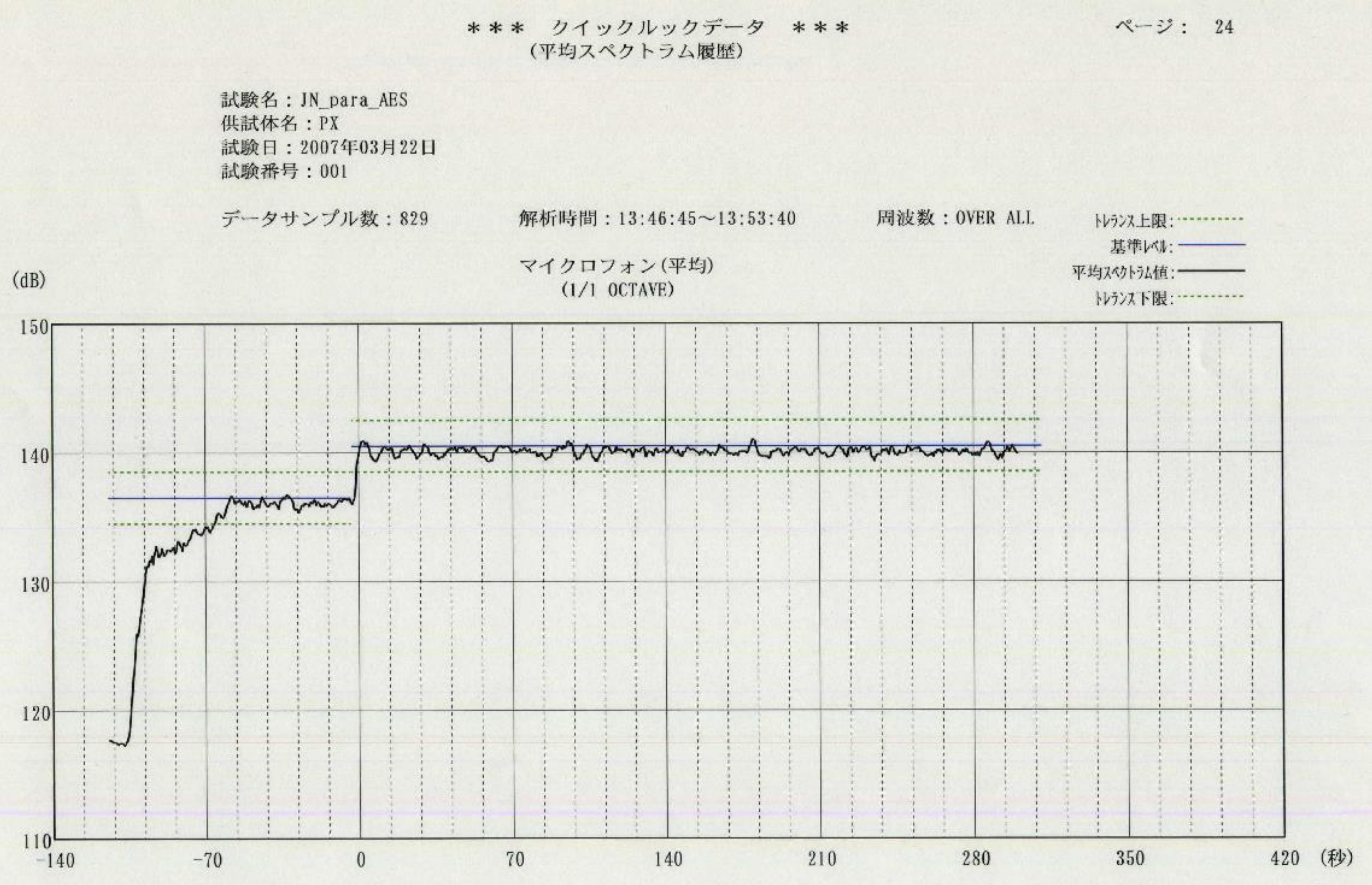


Figure B-6 Time History (Overall Values, Microphone Average)

Appendix C Test Conditions Requisition Sheet

document number	

1600m^3 Acoustic Test Facility
Test Conditions Requisition Sheet

Name of Test : Acoustic Test

Facility User :

◆Test Conditions (1/2)

Date of Test 〔 month _______ date _______ year _______ 〕

Name of Test 〔 ______________________ 〕 (within 40 alphanumeric characters)

Name of TS 〔 ____________ 〕 (within 10 alphanumeric characters)

Test Number 〔 ____ 〕 (4 digit numbers: leave it blank if not necessary)

Test Spectrum 〔 □1/1 ・ □1/3 〕 OCT

Test Time 〔 _____ 〕 sec. (tolerance: + 〔 ____ 〕 sec., － 〔 ____ 〕 sec.)

PRE LEVEL 〔 □planned / □not planned 〕
test level: FULL LEVEL － [___] dB
test time: 〔 ___ 〕 sec. (tolerance: + 〔 ____ 〕 sec., － 〔 ____ 〕 sec.)

INI LEVEL 〔 □planned / □not planned 〕
test level: FULL LEVEL － [___] dB
test time: Max. 600 sec. – (PRE LEVEL + FULL LEVEL)

*****************The following blanks are to be filled in by the facility-side personnel. *****************

Name of option parameter file 〔 ______________________ 〕

Name of control parameter file 〔 ______________________ 〕

Information of control microphones

	serial #	full range
No.1	〔 ______ 〕	〔 ______ 〕
No.2	〔 ______ 〕	〔 ______ 〕
No.3	〔 ______ 〕	〔 ______ 〕
No.4	〔 ______ 〕	〔 ______ 〕
No.5	〔 ______ 〕	〔 ______ 〕
No.6	〔 ______ 〕	〔 ______ 〕

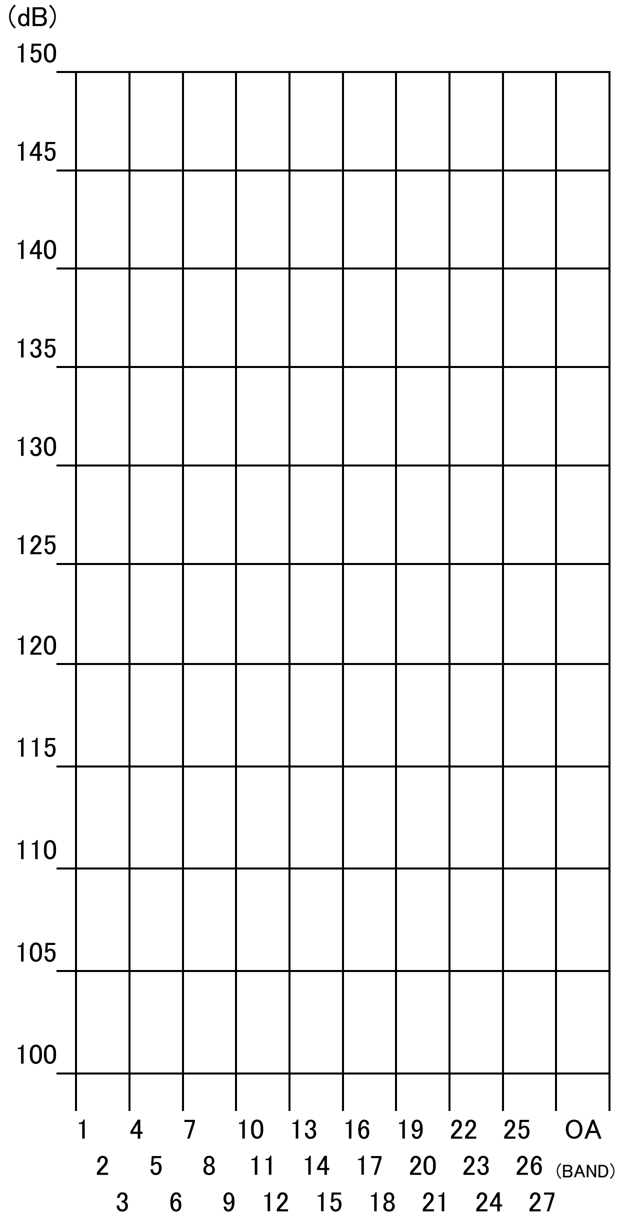
Jet nozzle control band number
PRE LEVEL 〔 _______ 〕
FULL LEVEL 〔 _______ 〕

****

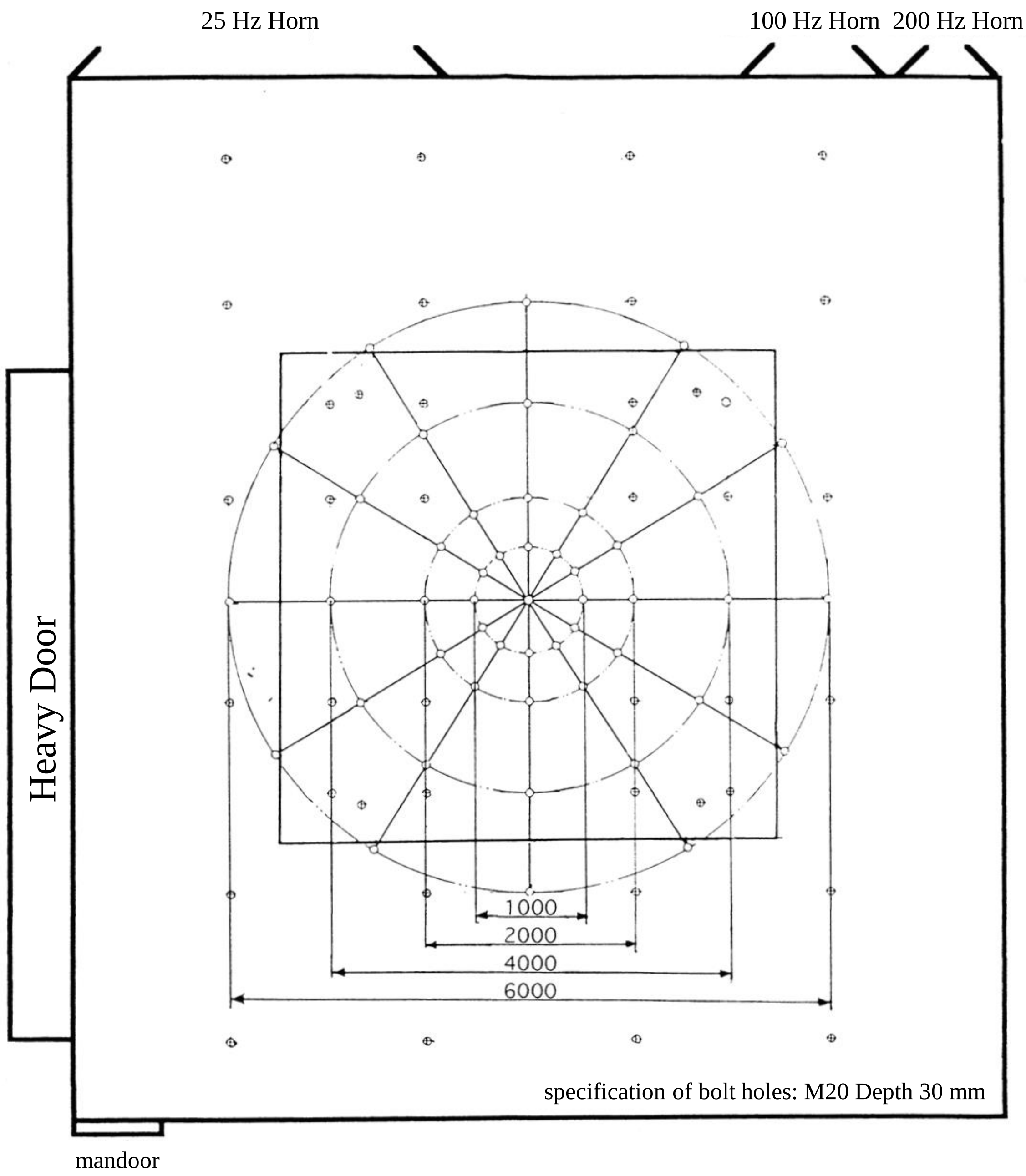
◆Test Conditions (1/2)

Test Spectrum Conditions

No.	−Hz−	−SPC−	−−TLR−− UP	LO	−−ABT−− UP	LO
1	25					
2	31.5					
3	40					
4	50					
5	63					
6	80					
7	100					
8	125					
9	160					
10	200					
11	250					
12	315					
13	400					
14	500					
15	630					
16	800					
17	1000					
18	1250					
19	1600					
20	2000					
21	2500					
22	3150					
23	4000					
24	5000					
25	6300					
26	8000					
27	10k					
28	OA					

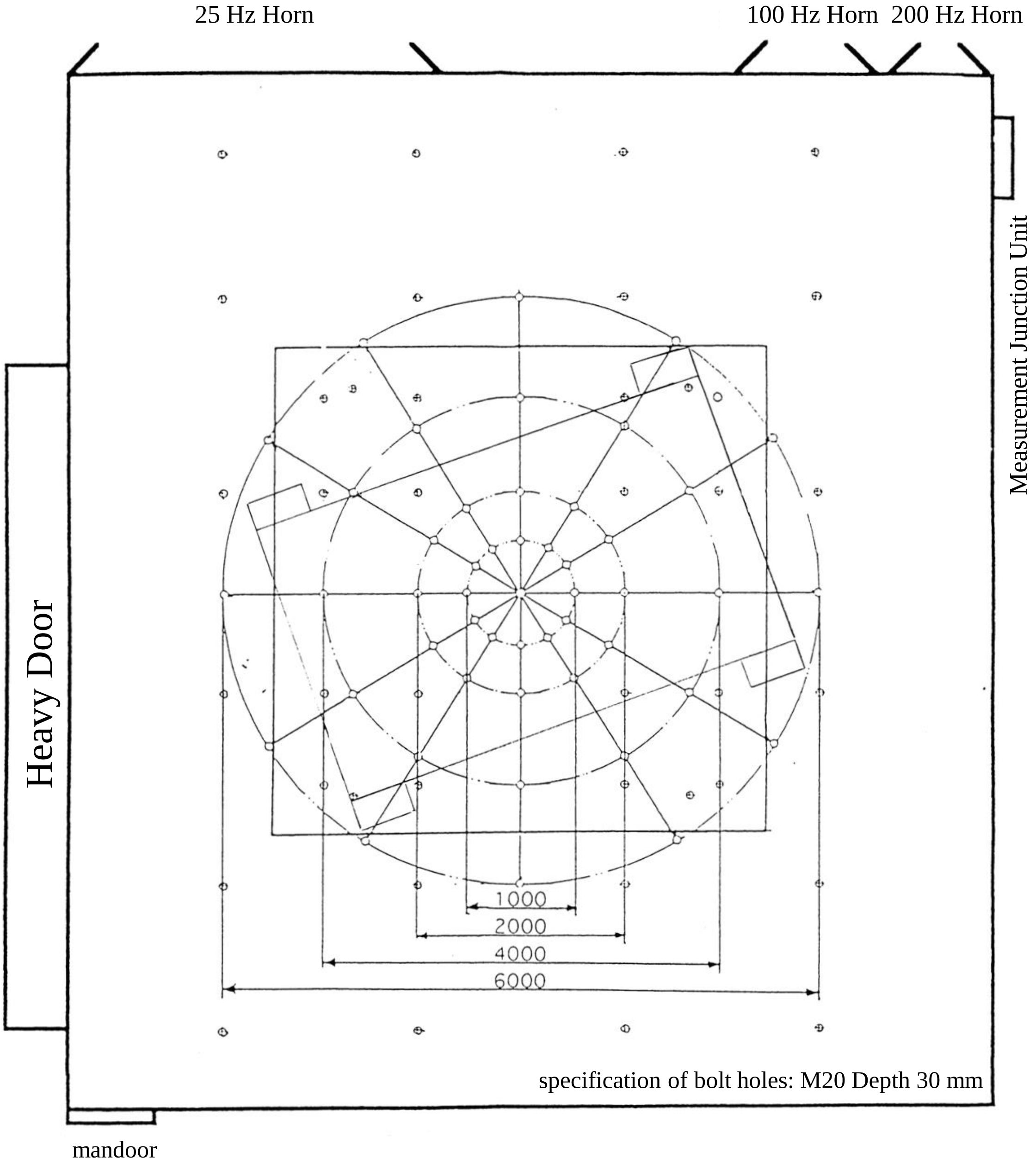


◆Locations of Microphones① (when a TS dolly is not used.)



control microphones	channel # (1001 ~ 1036)	located height (mm)	locations
No.1			Indicate locations in the figure above
No.2			
No.3			
No.4			
No.5			
No.6			

◆Locations of Microphones② (when a TS dolly is used.)



control microphones	channel # (1001 ~ 1036)	located height (mm)	locations
No.1			Indicate locations in the figure above
No.2			
No.3			
No.4			
No.5			
No.6			

◆Quick Look Data Output Conditions

Note) When the output time of the sound pressure spectrum or the sound pressure spectrum deviation is specified as "30 seconds in the stable part", while the test time turns out less than 30 seconds, the stable part in the test time is targeted for outputting.

1. PRE TEST (Fill in the blanks only when PRE TEST is performed.)

□ Sound pressure spectrum (□average of 6 microphones □each microphone)

Output time: □30 sec. in the stable part

□designation [~]

□ Sound pressure spectrum deviation (□average of 6 microphones □each microphone)

Output time: □30 sec. in the stable part

□designation [~]

2. FULL TEST

□ Sound pressure spectrum (□average of 6 microphones □each microphone)

Output time: □30 sec. in the stable part

□designation [~]

□ Sound pressure spectrum deviation (□average of 6 microphones □each microphone)

Output time: □30 sec. in the stable part

□designation [~]

3. TIME HISTORY (□average of 6 microphones □each microphone)

Output time: □BLOW NOISE ~ end of FULL LEVEL

□designation [~]

Range: □automatic setting (default state)

□designation [dB~ dB]

Frequency band: □OVER ALL only

□entire frequency band (including OVER ALL)

band: □ 1/3 OCT

□ 1/1 OCT

□designation for frequency band [Hz~ Hz]

band: □ 1/3 OCT

□ 1/1 OCT

◆Data Measurement Conditions

1. Auto range function

The optimum range is automatically set during the Blow Noise phase using the following equation.Specify the factor C.

The data acquisition system on the measurement rack of the large-scale separation shock test facility does not possess an auto range function. (cf. section 3.2.2)

C (factor): □ 5.0 □designation [______]

$$FULL\_Peak = C \times BlowNoise\_rms \times \alpha$$

$$\alpha = 10^{(FULL\_OA-Blownoise\_OA)/20}$$

BlowNoise_RMS: response RMS in an auto-ranging phase (automatically measured during that phase)
BlowNoise_O.A.: sound pressure level (dB) in a Blow Noise phase.
(automatically measured during that phase)
FULL_OA: (O. A. levels in a Full Level phase.)

2. Sensor database

A sensor database is to be created in the specified format, and submitted.

3. Random vibration environmental conditions

Random vibration environmental conditions are to be documented in the specified format, and submitted.

◆Data Acquisition/Analysis Conditions Sheet① (/)

The conditions sheets ① and ② are to be filled in for each analysis method, and submitted.

1. Analysis method : [______] *Note) specify it by the number below.*

(1) Octave analysis (/ Oct)	(2) PSD analysis
(3) Waveform display	(4) Histogram analysis
(5) AL-SPL analysis	(6) Cross spectrum analysis
(7) Transfer function analysis	(8) Coherence analysis
(9) Crosscorrelation function analysis	(10) Autocorrelation function analysis
(11) RRS analysis	

Note) The choice of “(11) RRS analysis” always accompanies “(2) PSD analysis.”

2. Analysis time

Start: from [_______] sec. after □pre □full / □start □complete □end
End: to [_______] sec. after □pre □full / □start □complete □end
Start: from [_______] sec. after □pre □full / □start □complete □end
End: to [_______] sec. after □pre □full / □start □complete □end

3. Analysis channel

Sound pressure	(1001 ~ 1036) □all	□designation	[______________________]
Acceleration	(2001 ~ 2200) □all	□designation	[______________________]
Strain	(3001 ~ 3020) □all	□designation	[______________________]

4. Analysis frequency range

Sound pressure	□20Hz ~ 8000Hz	□designation	[_________Hz ~ _________Hz]
Acceleration	□20Hz ~ 2000Hz	□designation	[_________Hz ~ _________Hz]
Strain	□20Hz ~ 2000Hz	□designation	[_________Hz ~ _________Hz]

5. Electronic data (CSV file) output □planned □not planned

Note) For outputting electronic data (CSV file), CD-R, USB memory stick, etc. are necessary.

◆Data Acquisition/Analysis Conditions Sheet② (　/　)

<Designation for PSD analysis>

1. Hanning window □on □off
2. Frequency resolution □choice 7.8 Hz or lower □designation Hz
3. Overlap factor [______] % Note) write in the ratio of overlapping.
4. Number of average operations □Max. □designation [________] times

<Designation for octave analysis>

1. 0dB level of sound pressure □ 20 μPa □designation [____________] Pa
2. 0dB level of acceleration □ 1.0 × 9.8 m/s^2 □designation [____________] m/s^2

<Designation for PSD/octave analyses>

Confidence □50% □80% □90% □95% □99%

<Designation for transfer function/cross spectrum/coherence/crosscorrelation function analyses>

1. Reference channel # [___________________________]
2. Hanning window □on □off
3. Frequency resolution [________] Hz or lower
4. Overlap factor [________] % Note) write in the ratio of overlapping
5. Number of average operations □Max. □designation [________] times

<Designation for AL-SPL analysis>

1. Data type □1/1 oct □1/3 oct
2. 0 dB level of sound pressure □20 μPa □designation [____________] Pa
3. 0 dB level of acceleration □1.0 × 9.8 m/s^2 □designation [____________] m/s^2

<Designation for RRS analysis>

Quality factor [_________]

Note) RRS analysis requires PSD analysis results for its input, that is, PSD analysis conditions have an impact on RRS analysis.

— Examples of filled out conditions requisition sheets —

◆Test Conditions (1/2)

Date of Test [month date year]
(Write in the date of the test)

Name of Test [______________________________] (within 40 alphanumeric characters)
(Write in the name of the test within 40 alphanumeric characters.)

Name of TS [________________] (within 10 alphanumeric characters)
(Write in the name of the test specimen within 10 alphanumeric characters.)

Test Number [_____] (4 digit numbers: leave it blank if not necessary)
(Write in the test number within 4 digit numbers.)

Test Spectrum [☐1/1 ・ ☐1/3] OCT
(Choose a test spectrum from either 1/1 or 1/3)

Test Time [______] sec. (tolerance: + [_____] sec., − [_____] sec.)
(Write in the Full Level load time)

PRE LEVEL [☐planned / ☐not planned]
test level: FULL LEVEL − [____] dB
test time: [_____] sec. (tolerance: + [_____] sec., − [_____] sec.)
(Write in whether or not a PRE LEVEL test is performed; if planned, its test level and time.)

INI LEVEL [☐planned / ☐not planned]
test level: FULL LEVEL − [____] dB
test time: Max. 600 sec. – (PRE LEVEL + FULL LEVEL)
(Write in whether or not an INI LEVEL test is performed; if planned, its test level.)

***************** The following blanks are to be filled in by the facility-side personnel. *****************

Name of option parameter file [______________________________]

Name of control parameter file [______________________________]

Information of control microphones

	serial #	full range
No.1	[________]	[________]
No.2	[________]	[________]
No.3	[________]	[________]
No.4	[________]	[________]
No.5	[________]	[________]
No.6	[________]	[________]

Jet nozzle control band number
PRE LEVEL [__________]
FULL LEVEL [__________]

****

◆Test Conditions (1/2)

Test Spectrum Conditions

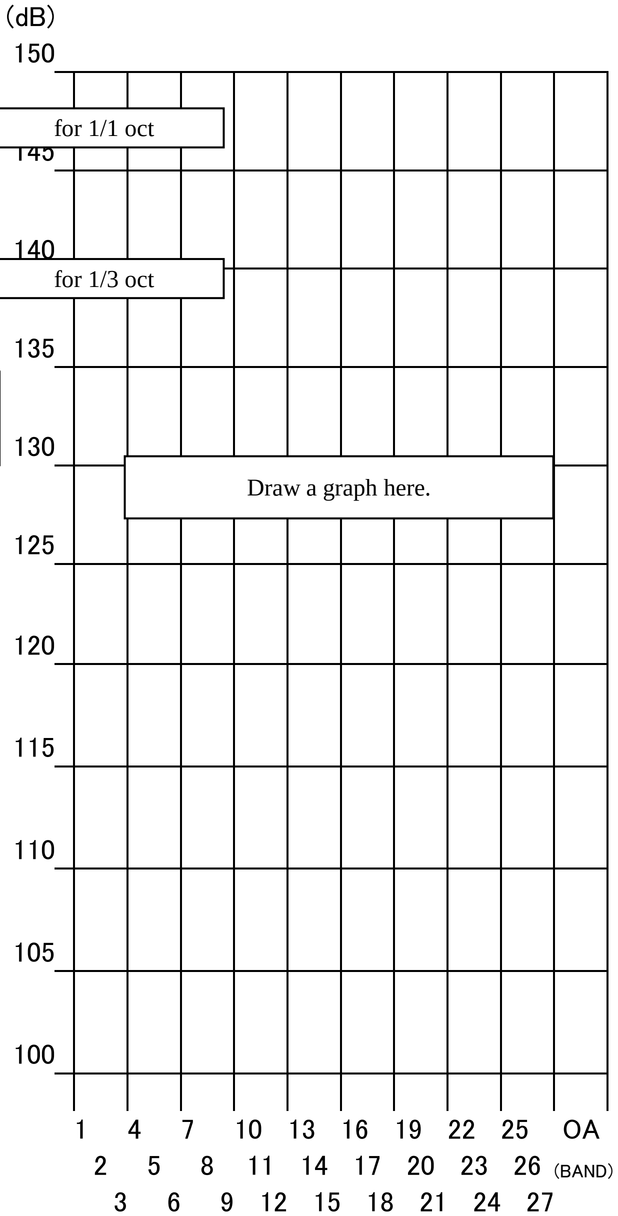
No.	-Hz-	-SPC-	--TLR-- UP	--TLR-- LO	--ABT-- UP	--ABT-- LO
1	25					
2	31.5	129.0	5	5	10	10
3	40					
4	50	124.3	5	5	10	12
5	63	126.4	5	5	10	12
6	80	127.6	5	5	10	12
7	100					
8	125					
9	160					
10	200					
11	250					
12	315					
13	400					
14	500					
15	630					
16	800					
17	1000					
18	1250					
19	1600					
20	2000					
21	2500					
22	3150					
23	4000					
24	5000					
25	6300					
26	8000					
27	10k					
28	OA					

for 1/1 oct

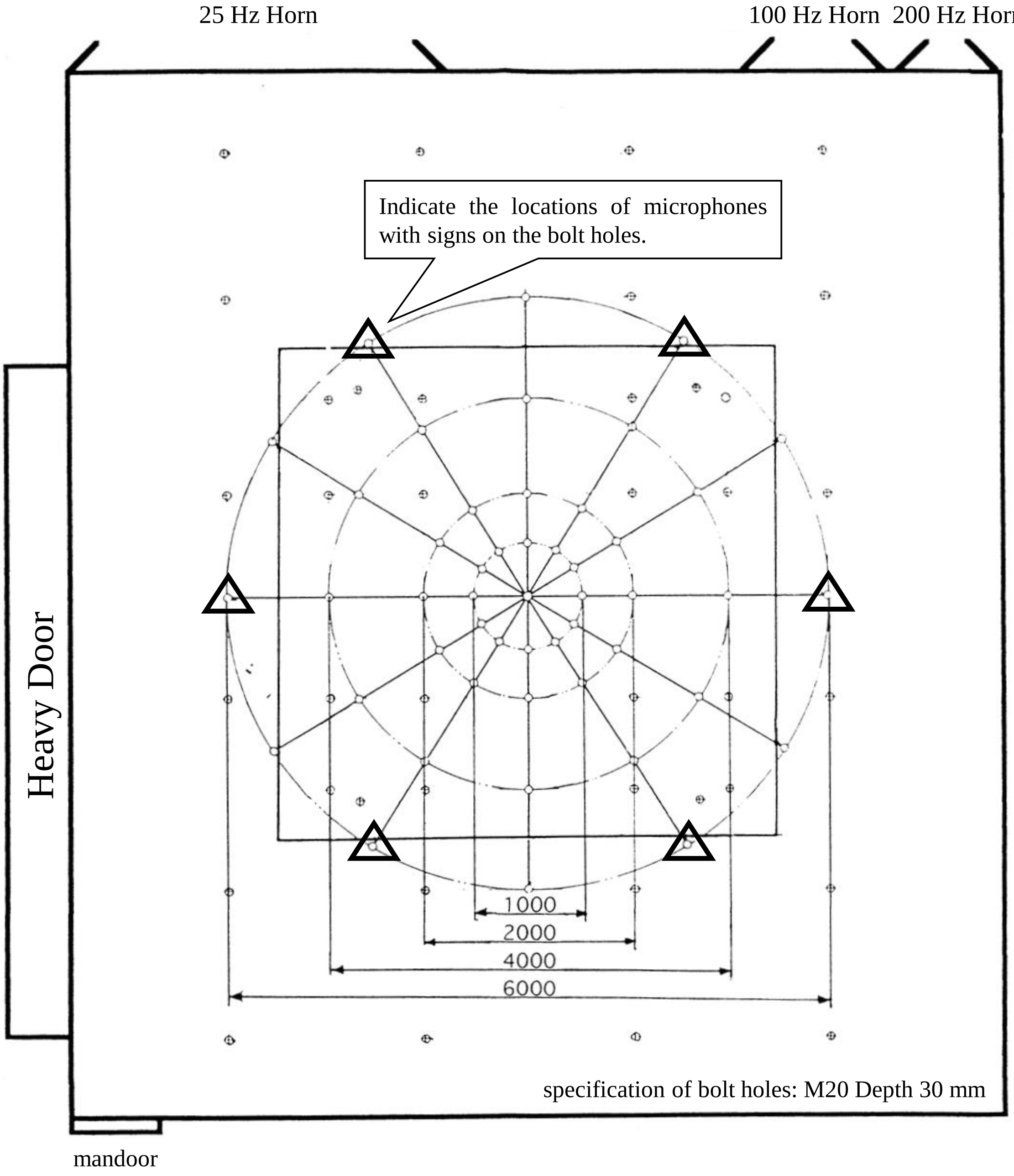
for 1/3 oct

within 5 digits

+/— not necessary, decimals not acceptable



◆Locations of Microphones① (used only when a TS dolly is not used.)



control microphones	channel # (1001 ~ 1036)	located height (mm)	locations
No.1	1001	2300	Indicate locations in the figure above
No.2	1002	2300	
No.3	1003	2300	
No.4	1004	2300	
No.5	1005	2300	
No.6	1006	2300	

◆Quick Look Data Output Conditions

Note) When the output time of the sound pressure spectrum or the sound pressure spectrum deviation is specified as “30 seconds in the stable part”, while the test time turns out less than 30 seconds, the stable part in the test time is targeted for outputting.

1. PRE TEST (Fill in the blanks only when PRE TEST is performed.)

□ Sound pressure spectrum (☑average of 6 microphones □each microphone)

Output time: ☑30 sec. in the stable part

□designation [~]

□ Sound pressure spectrum deviation (☑average of 6 microphones □each microphone)

Output time: ☑30 sec. in the stable part

□designation [~]

2. FULL TEST

□ Sound pressure spectrum (☑average of 6 microphones □each microphone)

Output time: ☑30 sec. in the stable part

□designation [~]

□ Sound pressure spectrum deviation (□average of 6 microphones □each microphone)

Output time: □30 sec. in the stable part

□designation [~]

3. TIME HISTORY (☑average of 6 microphones □each microphone)

Output time: ☑BLOW NOISE ~ end of FULL LEVEL

□designation [~]

Range: ☑automatic setting (default state)

□designation [dB~ dB]

Frequency band: □OVER ALL only

☑entire frequency band (including OVER ALL)

band: □ 1/3 OCT

☑ 1/1 OCT

□designation for frequency band [Hz~ Hz]

band: □ 1/3 OCT

□ 1/1 OCT

Check the □ that corresponds to the designated conditions.

◆Data Acquisition Conditions

1. Auto range function

The optimum range is automatically set during the Blow Noise phase using the following equation.Specify the factor C.

The data acquisition system on the measurement rack of the large-scale separation shock test facility does not possess an auto range function. (cf. section 3.2.2.)

C (factor): ☑ 5.0 □designation [______]

$$FULL\_Peak = C \times BlowNoise\_rms \times \alpha$$

$$\alpha = 10^{(FULL\_OA - Blownoise\_OA)/20}$$

BlowNoise_RMS: response RMS in an auto-ranging phase (automatically measured during that phase)
BlowNoise_O.A.: sound pressure level (dB) in a Blow Noise phase.
(automatically measured during that phase)
FULL_OA: (O. A. levels in a Full Level phase.)

2. Sensor database

A sensor database is to be created in the specified format, and submitted.
(The guidelines are shown in Appendix D.)

3. Random vibration environmental conditions

Random vibration environmental conditions are to be documented in the specified format, and submitted.
(The guidelines are shown in Appendix D.)

◆Data Acquisition/Analysis Conditions Sheet① (1/2)

The conditions sheets ① and ② are to be filled in for each analysis method, and submitted.

1. Analysis method : [(1) (2)] *Note) specify it by the number below.*

(1) Octave analysis (1/1 Oct)	(2) PSD analysis
(3) Waveform display	(4) Histogram analysis
(5) AL-SPL analysis	(6) Cross spectrum analysis
(7) Transfer function analysis	(8) Coherence analysis
(9) Crosscorrelation function analysis	(10) Autocorrelation function analysis
(11) RRS analysis	

Note) The choice of "(11) RRS analysis" always accompanies "(2) PSD analysis."

2. Analysis time

Start: from [15] sec. after ☑pre □full / □start ☑complete □end
End: to [25] sec. after ☑pre □full / □start ☑complete □end
Start: from [15] sec. after □pre ☑full / □start ☑complete □end
End: to [25] sec. after □pre ☑full / □start ☑complete □end

3. Analysis channel

Sound pressure (1001 ~ 1036) ☑all □designation [ ]
Acceleration (2001 ~ 2200) ☑all □designation [ ]
Strain (3001 ~ 3020) □all □designation [ ]

4. Analysis frequency range

Sound pressure ☑20 Hz ~ 8000 Hz □designation [Hz ~ Hz]
Acceleration ☑20 Hz ~ 2000 Hz □designation [Hz ~ Hz]
Strain □20 Hz ~ 2000 Hz □designation [Hz ~ Hz]

5. Electronic data (CSV file) output ☑planned □not planned

Note) For outputting electronic data (CSV file), CD-R, USB memory stick, etc. are necessary.

◆Data Acquisition/Analysis Conditions Sheet② (　/　)

<Designation for PSD analysis>

1. Hanning window　☑on　□off
2. Frequency resolution　☑choice　7.8 Hz or lower　□designation　Hz
3. Overlap factor　〔 50 〕%　Note) write in the ratio of overlapping.
4. Number of average operations　□Max.　□designation 〔 ______ 〕 times

<Designation for octave analysis>

1. 0 dB level of sound pressure　☑ 20 μPa　□designation 〔 ______ 〕 Pa
2. 0 dB level of acceleration　☑ 1.0×9.8 m/s^2　□designation 〔 ______ 〕 m/s^2

<Designation for PSD/octave analyses>

Confidence　□50%　□80%　□90%　□95%　☑99%

<Designation for transfer function/cross spectrum/coherence/crosscorrelation function analyses>

1. Reference channel #　〔 ______ 〕
2. Hanning window　□on　□off
3. Frequency resolution　〔 ______ 〕 Hz or lower
4. Overlap factor　〔 ______ 〕% Note) write in the ratio of overlapping.
5. Number of average operations　□Max.　□designation 〔 ______ 〕 times

<Designation for AL-SPL analysis>

1. Data type　□1/1 oct　□1/3oct
2. 0 dB level of sound pressure　□20 μPa　□designation 〔 ______ 〕 Pa
3. 0 dB level of acceleration　□1.0×9.8 m/s^2　□designation 〔 ______ 〕 m/s^2

<Designation for RRS analysis>

Quality factor　〔 ______ 〕

Note) RRS analysis requires PSD analysis results for its input, that is, PSD analysis conditions have an impact on RRS analysis.

Appendix D Data Acquisition Database

Please fill out the Excel charts in the separate file “GCA-02010F_1600m^3 Acoustic Test Facility Users’ Manual_Data Acquisition Database Sheet” following the examples and instructions in this Appendix, and submit it to us prior to the execution of the test.

1. Example of Creating Sensor Database

- Sheet Contents of Sensor Database File (SDIF)
  - Acoustic Channels
  - **Acceleration Channels**
  - **Strain Channels**
  - *RESERVED SHEET (not displayed)*
  - *Reserved Sheet 2 (not displayed)*
  - *General Test Sheet (not displayed)*

Note 1) RESERVED SHEET, Reserved Sheet 2, and General Test Sheet are used by the facility-side personnel to read into the facility, and are therefore to be left untouched.

Note 2) A sensor database file is to be created in Microsoft Excel (Office 2000 or later version.)

Note 3) Only alphanumeric characters are to be used to fill in a sensor database file.

Note 4) For measurements of sound pressure, acceleration, and strain, fill out the Acoustic Channels Sheet, the Acceleration Channels Sheet, and the Strain Channels Sheet, respectively.

Note 5) The guidelines for filling out the sheets of Acoustic Channels, Acceleration Channels, and Strain Channels are shown below. The blank columns that are not guided can be left blank, unless they are needed.

Example of Acoustic Channels Sheet

Acoustic Channels

[SENSOR/CHANNEL INFORMATION]

A/D Channel #	Location Name or Remark	Sample Rate	Measuring Position	Channel Label	Acquisition Status	Channel Limits File	High Resolution FFT Scaling	OASIS Model Number	Michrophon Model Number	Sensitivity (mV/EU or mV/Pa)
1001		40000	M1	Acoustic01 (REF)	True		Peak	Oasis 428		1
1002		40000	M2	Acoustic02 (REF)	True		Peak	Oasis 428		1
1003		40000	M3	Acoustic03 (REF)	True		Peak	Oasis 428		1
1004		40000	M4	Acoustic04 (REF)	True		Peak	Oasis 4		1
[illegible]		40000	M5	Acoustic05 (REF)	True		Peak	Oasis 4		1
[illegible]		40000	M6	Acou c06 (REF)	True		Peak	Oasis 4		1
[illegible]		40000	M7	Aco 07	False		Peak	Oasis 428		
[illegible]		40000	M8	Ac	False		Peak	Oasis 428		
[illegible]		40000	M9	A	False		[illegible]	is 428		
[illegible]		4000	[illegible]	[illegible]	False		[illegible]	is 428		
[illegible]		4000	[illegible]	[illegible]	False		[illegible]	is 428		
[illegible]		4000	[illegible]	[illegible]	False		[illegible]	is 428		
[illegible]		4000	[illegible]	[illegible]	False		[illegible]	is 428		
[illegible]		4000	[illegible]	[illegible]	False		Peak	Oasis 428		
[illegible]		4000	[illegible]	[illegible]	False		Peak	Oasis 428		
1016		4000	[illegible]	[illegible]	False		Peak	Oasis 428		
1017		40000	M17	Acoustic17	False		Peak	Oasis 428		

Choose sample rate from pulldown menu.
Sample rate can be changed every 32 ch for measurement.

(pulldown menu)
64kHz、32kHz、16kHz、8kHz、4kHz、2kHz

＊＊Channels indicated with (REF) mean sound pressure control microphones.
(normally 1001 ～ 1006 ch)
Please leave them as they are.

Choose True for measurement channels and False for the rest.

Write in the sensitivity.
unit (mV/Pa)

Fill only in the columns that are marked with a red circle.

Blank columns can be left with no information. They can be used if necessary.

Serial Number	Transducer Type	Pre Amp Model	Response Units	Input Connection	Input Coupling	Accelerometer Full Scale Input Range	Filter In/Out	Transducer Excitation Level (mA)	Effective Gain
	Voltage		pascal	Single-ended	AC	1000	Enabled		10
	Voltage		pascal	Single-ended	AC	1000	Enabled		10
	Voltage		pascal	Single-ended	AC	1000	Enabled		10
	V		pascal	Single-ended	AC	1000	Enabled		10
	V		pascal	Single-ended	AC	1000	Enabled		10
	V		pascal	Single-ended	AC	1000	Enabled		10
	V		pascal	Single-en	[illegible]	[illegible]	Enabled		#DIV/0!
	V		pascal	Single-en	[illegible]	[illegible]	Enabled		#DIV/0!
	Voltage		pascal	Single-en	[illegible]	[illegible]	Enabled		#DIV/0!
	Voltage		pascal	Single-en	[illegible]	[illegible]	Enabled		#DIV/0!
	Voltage		pascal	Single-en	[illegible]	[illegible]	Enabled		#DIV/0!
	Voltage		pascal	Single-en	[illegible]	[illegible]	Enabled		#DIV/0!
	Voltage		pascal	Single-en	[illegible]	[illegible]	Enabled		#DIV/0!
	Voltage		pascal	Single-en	[illegible]	[illegible]	Enabled		#DIV/0!
	Voltage		pascal	Single-ended	AC		Enabled		#DIV/0!
	Voltage		pascal	Single-ended	AC		Enabled		#DIV/0!
	Voltage		pascal	Single-ended	AC		Enabled		#DIV/0!

Choose the same unit as the one chosen for "sensitivity."

Write in the Max. level in measurement range. Use the same unit as the one chosen for "sensitivity."

This may not be the latest edition.

Example of Acceleration Channels Sheet

Accelerometer Channels

[SENSOR/CHANNEL INFORMATION]

A/D Channel #	Location Name or Remark	Sample Rate	Measuring Position	Channel Label	Acquisition Status	Channel Limits File	High Resolution FFT Scaling	OASIS Model Number	Accelerometer Model Number	Sensitivity (mV/EU)
2001		10000			True		Peak	Oasis 428		1
2002		10000			True	LimitsC.txt	Peak	Oasis 428		1
2003		10000			False		Peak	Oasis 428		
2004		10000			False		[illegible]	[illegible]		
[illegible]	[illegible]	10000			False		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	10000			False		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	10000			False		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	False		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	False		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	False		Peak	Oasis 428		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Oasis 428		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Oasis 428		
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	Oasis 428		
[illegible]	[illegible]	10000			[illegible]	[illegible]	[illegible]	Oasis 428		
[illegible]	[illegible]	10000			[illegible]	[illegible]	[illegible]	Oasis 428		
2016		10000			False		Peak	Oasis 428		
2017		10000			False		Peak	Oasis 428		

Choose sample rate from pulldown menu.
Sample rate can be changed every 32 ch for measurement.

(pulldown menu)
64kHz、32kHz、16kHz、8kHz、4kHz、2kHz

It shows up on multi scope screen and analysis results.
Therefore, pick an easy name to understand. (alphanumeric letters)

Choose True for measurement channels and False for the rest.

For the channels whose analysis results are superimposed with random vibration environmental conditions, write in the file name of the environmental conditions.

Write in the sensitivity.
unit（pc/（m/s ²）or（pc/G））

Fill only in the columns that are marked with a red circle.

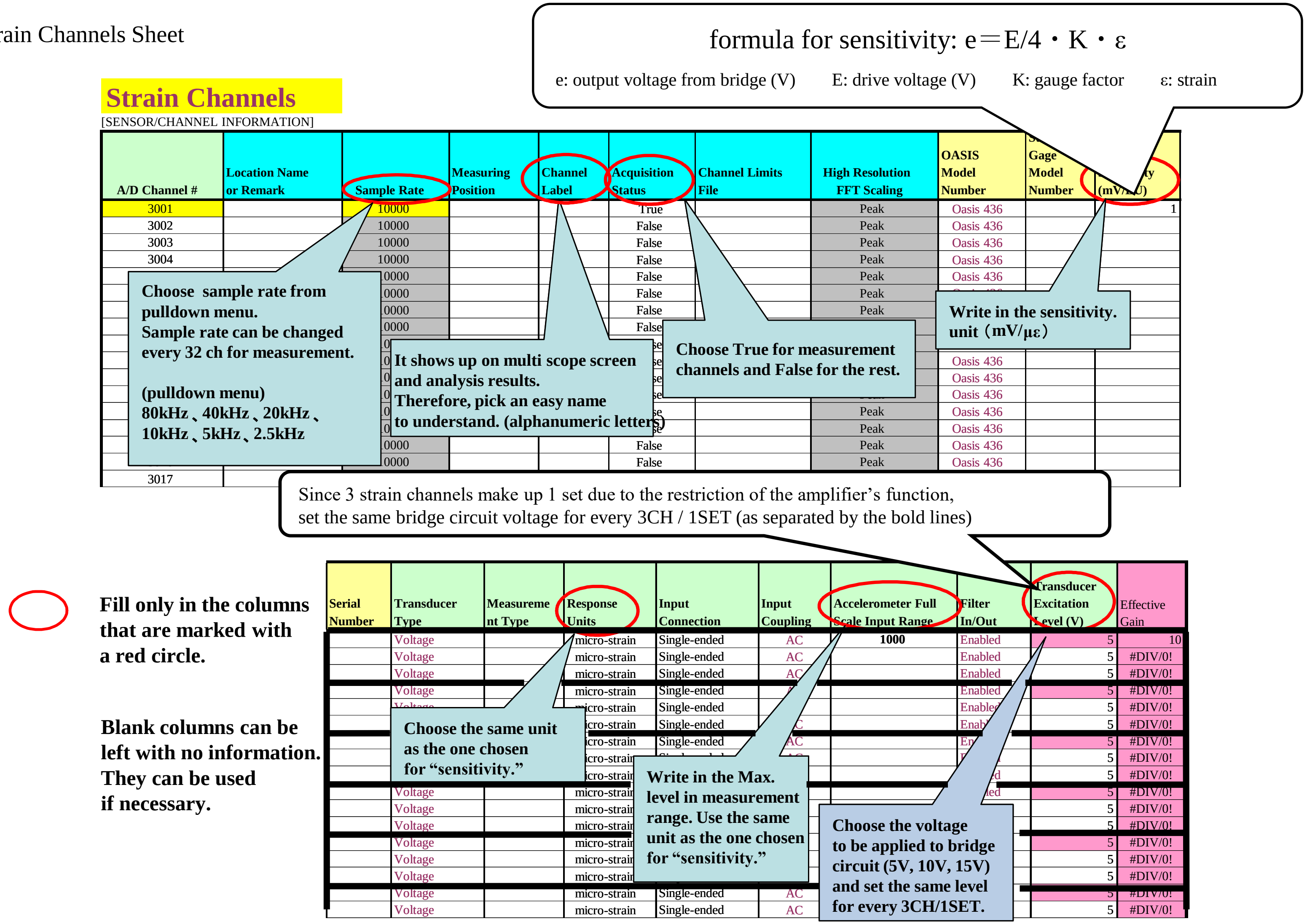
Blank columns can be left with no information. They can be used if necessary.

Serial Number	Transducer Type	Measurement Type	Response Units	Input Connection	Input Coupling	Accelerometer Full Scale Input Range	Filter In/Out	Transducer Excitation Level (mA)	Effective Gain
	Charge		m/s*s	Single-ended	AC	100	Enabled		100
	Charge		m/s*s	Single-ended	AC	1000	Enabled		10
	Charge		m/s*s	Single-ended	AC		Enabled		#DIV/0!
	Charge		m/s*s	Single-ended	AC		Enabled		#DIV/0!
	[illegible]	[illegible]	[illegible]	Single-ended	AC		Enabled		#DIV/0!
	[illegible]	[illegible]	[illegible]	Single-ended	AC		Enabled		#DIV/0!
	[illegible]	[illegible]	[illegible]	Single-ended	[illegible]	[illegible]	Enabled		#DIV/0!
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Enabled		#DIV/0!
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Enabled		#DIV/0!
	Charge		m/s*s	[illegible]	[illegible]	[illegible]	Enabled		#DIV/0!
	Charge		m/s*s	[illegible]	[illegible]	[illegible]	Enabled		#DIV/0!
	Charge		m/s*s	[illegible]	[illegible]	[illegible]	Enabled		#DIV/0!
	Charge		m/s*s	[illegible]	[illegible]	[illegible]	Enabled		#DIV/0!
	Charge		m/s*s	[illegible]	[illegible]	[illegible]	Enabled		#DIV/0!
	Charge		m/s*s	[illegible]	[illegible]		Enabled		#DIV/0!
	Charge		m/s*s	Single-ended	AC		Enabled		#DIV/0!

Choose the same unit as the one chosen for “sensitivity.”

Write in the Max. level in measurement range. Use the same unit as the one chosen for “sensitivity.”

Example of Strain Channels Sheet



2. Example of Creating Random Vibration Environmental Conditions File

- File format text file
- File name alphanumeric characters

  Note) Write in the file name (including .txt) in the designated space (viz. the column under "Channel Limits File") of the sensor database file (SDIF.)
- Format

  The both ends of a random vibration environmental condition, and the coordinates of breakpoints, are to be written in the following order (in alphanumeric characters.)

[limits]
Frequency [Hz], PSD level [$(m/s^2)^2$/Hz],0,0
Frequency [Hz], PSD level [$(m/s^2)^2$/Hz],0,0
Frequency [Hz], PSD level [$(m/s^2)^2$/Hz],0,0
Frequency [Hz], PSD level [$(m/s^2)^2$/Hz],0,0
Frequency [Hz], PSD level [$(m/s^2)^2$/Hz],0,0
Frequency [Hz], PSD level [$(m/s^2)^2$/Hz],0,0
[limits_end]

both ends

breakpoints
(where a graph bents)

【Example】
[limits]
20,0.1,0,0
100,1,0,0
300,1,0,0
500,5,0,0
1000,5,0,0
2000,0.5,0,0
[limits_end]

Appendix E Example of Output Test Data in CSV Format

Narrowband Analysis
Data File Name: D:¥fy18 kaihatu¥data 070315¥h2a_5¥Dedicated-20070315-143238.cats_index
Test Title: PANEL#8 #9
Specimen: Specimen Name
Test File#: ...
Part #/ID: 1
Test Type: acoustic
Test Date/Time: 15-MAR-2007 14:32:40.932
Analysis Start Time: 78.070000
Analysis Period: 20.096000
Sample Rate: 6.40000000000E+004
Analysis Date / Time: 15-Mar-2007 16:47:56
Degree of Confidence:1.09 / -1.21 (dB) at 99.9% Conf.
Bandwidth:...
Magnitude Detection: Average
Number of Ensembles: 156
Degrees of Freedom: 312
Analysis Window: Hanning
Delta F: 3.91 Hz.
Block Size: 16384

Channel>	2101	2102	2103	2104	2105	2106	2107
Function>	PSD	PSD	PSD	PSD	PSD	PSD	PSD
Frequency/Label	pane4 AA	pane4 BB	pane4 CC	pane4 DD	pane4 EE	pane4 FF	pane7 AA
7.812	1.71E-06	2.27E-06	1.15E-06	9.85E-07	1.87E-06	1.98E-06	7.52E-07
11.719	9.09E-07	1.50E-06	3.57E-07	4.82E-07	8.68E-07	9.52E-07	3.45E-07
15.625	6.13E-07	1.25E-06	2.85E-07	3.46E-07	5.79E-07	7.92E-07	2.09E-07
19.531	1.24E-06	1.61E-06	3.06E-07	2.85E-07	1.10E-06	6.32E-07	1.73E-07
23.437	7.95E-06	4.20E-06	9.18E-07	3.65E-07	5.45E-06	1.25E-06	1.80E-07
27.344	4.81E-06	3.65E-06	5.64E-07	3.55E-07	3.56E-06	1.56E-06	2.44E-07
31.25	1.08E-06	1.50E-06	2.01E-07	2.77E-07	9.98E-07	7.22E-07	2.24E-07
35.156	8.60E-07	1.46E-06	1.68E-07	2.18E-07	9.61E-07	5.55E-07	1.92E-07
39.062	8.40E-07	1.79E-06	1.71E-07	2.08E-07	1.21E-06	7.49E-07	1.62E-07
42.969	1.70E-06	2.55E-06	2.43E-07	2.34E-07	2.59E-06	1.57E-06	1.73E-07
46.875	1.67E-06	4.50E-06	3.40E-07	2.89E-07	1.73E-06	1.87E-06	1.55E-07
50.781	2.40E-06	1.18E-05	3.65E-07	2.69E-07	7.40E-07	2.69E-06	2.05E-07
54.687	3.17E-06	1.87E-05	3.42E-07	1.98E-07	1.08E-06	2.92E-06	2.94E-07
58.594	1.35E-06	8.01E-06	2.58E-07	1.82E-07	9.18E-07	1.18E-06	1.99E-07
62.5	8.84E-07	3.76E-06	2.04E-07	2.27E-07	8.52E-07	7.45E-07	1.37E-07
66.406	8.49E-07	3.45E-06	2.08E-07	2.50E-07	7.78E-07	6.95E-07	1.16E-07
70.312	7.47E-07	2.45E-06	1.87E-07	1.94E-07	1.09E-06	7.32E-07	1.39E-07
74.219	1.46E-06	4.70E-06	1.84E-07	1.90E-07	1.15E-06	8.12E-07	1.55E-07
78.125	1.19E-06	3.43E-06	2.29E-07	1.96E-07	1.01E-06	7.27E-07	1.08E-07
82.031	3.17E-06	3.08E-06	2.16E-07	1.72E-07	1.36E-06	7.22E-07	1.30E-07
85.937	7.41E-06	4.27E-06	1.70E-07	1.93E-07	1.79E-06	6.92E-07	2.11E-07

Figure D-1 Example of Output Test Data in CSV Format (PSD analysis)