

Appendix A.

Technical Specifications – Satellite Assembly, Integration
and Test equipment.

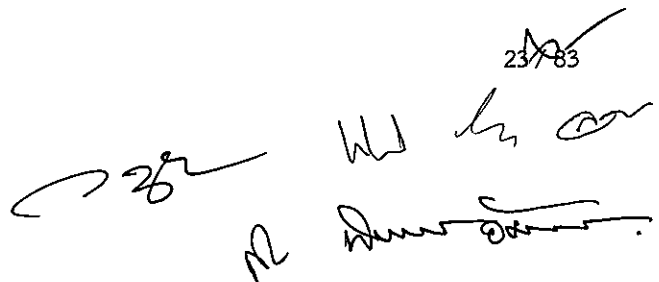
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Appendix A - Technical Specifications – Satellite Assembly, Integration and Test equipment.

1. Vibration Test equipment (1 set)

- 1.1 Must be able to produce Sine vibration force greater than or equal to 160 kN with an amplitude error not exceeding $\pm 10\%$ and frequency error not exceeding $\pm 2\%$ with reference to the GEVS documentation.
- 1.2 Must be able to produce Random vibration force greater than or equal to 160 kN with RMS error not exceeding $\pm 10\%$ and Acceleration Spectral Density not exceeding $\pm 2\%$ with reference to the GEVS documentation.
- 1.3 Random vibration force delivery must be in accordance with ISO 5344 standard or equivalent.
- 1.4 Shock vibration force must be greater than or equal to 300 kN
- 1.5 Must supports both Vertical and Horizontal Testing
- 1.6 The Maximum Displacement must be greater than or equal to 30 mm (peak-to-peak)
- 1.7 The Maximum load capacity specified for Equipment Under Test (EUT) must greater than or equal to 500 kg.
- 1.8 The equipment must support test with the minimum vibration frequency less than or equal to 5 Hz and maximum vibration frequency more than or equal to 2,000 Hz
- 1.9 The Base plate must be no less than 1.2 meters wide and no less than 1.2 meters long. Vertical and Horizontal testing performance is as follows.
 - Vertical table vibration frequency must be more than or equal to 1,500 Hz.
 - Horizontal table vibration frequency must be more than or equal to 1,000 Hz.
- 1.10 There must be a control and monitoring system as part of the deliverables. The controller system should be able to configured at least 12 channels.
- 1.11 Sensors for data acquisition must be accelerometer, piezo or better sensors which are suitable for use with vibration test equipment. The number of channels must be no

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less or equal to 64 channels and must have sensors which support 3-axis measurement at least 12 channels at no less than 51 kHz sampling rate.

1.12 The system must be able to support test profile at least according to Table 1 for Random Vibration with reference to the GEVS documentation.

1.13 The Vibration Test equipment must be manufactured from an ISO 9001 certified factory.

Table 1: Sample Random Vibration Test

Frequency (Hz)	Acceleration Spectral Density (G ² /Hz)
20	0.0016
20-300	+4dB/oct
300-700	0.06
700-2000	-3dB/oct
2000	0.021
Overall	8.7 Grms

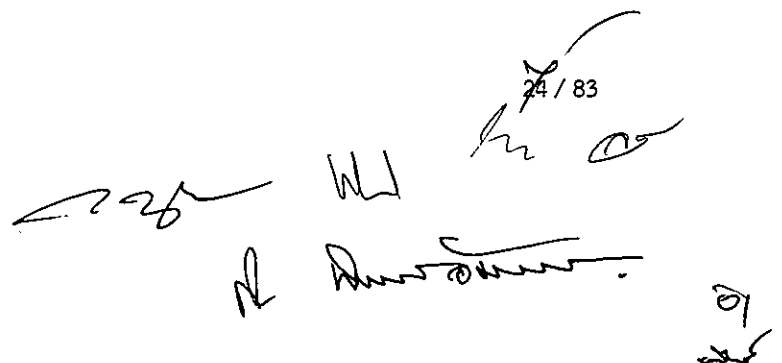
1.14 The equipment must have the Natural frequency detection at any position on equipment under test

1.15 The equipment must have control, protection and automatic cut off system in case of emergency or error and including force overload (Force limiting) and resonance with equipment under test (Notching) for protection damaging at vibration test itself, equipment under test and operator.

1.16 The equipment must be able to be installed in an area of 10 meters in length, 10 meters in width and 2.7 meters in depth with the floor load of 5,000 kg / sq. m. The working area shall be level with the adjacent surface according to Figure 1 and the depth shall be no more than 2.7 m. The installation of the vibration test equipment must be done to ensure there is no vibration to the building when the equipment is in use.

1.17 The electrical wiring and control cables must be routed to the control room or designated office for the vibration test simulation and the wiring must be routed neatly

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and should not create an obstacle to the working of the equipment or the people in the AIT center.

- 1.18 There must be warning sticker or label or sign which are clearly visible all around the equipment to increase caution while near or operating the equipment.

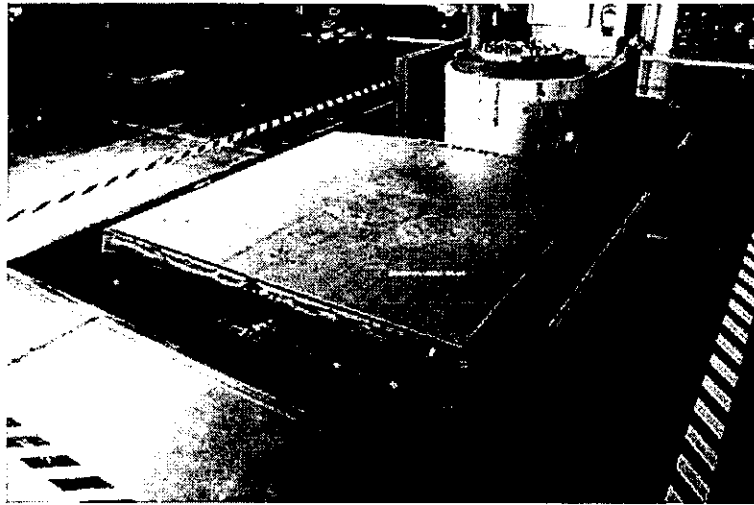


Figure 1: Example of Vibration Test equipment installation*

2. Thermal Vacuum Chamber (1 set)

- 2.1 The diameter of the internal space for testing must be more than or equal to 1.8 meters and the depth of the test area must be more than or equal to 1.5 meters. (Cylinder)
- 2.2 The lowest Test temperature must be lower or equal to -150 degrees Celsius
- 2.3 The highest test temperature must be higher than or equal to +150 degrees Celsius
- 2.4 The Temperature Ramping Rate must be greater than or equal to 2.0 °C / min.
- 2.5 The Cool Down Rate must be greater than or equal to 2.0 °C / min.
- 2.6 The Vacuum pressure must be less than or equal to 10^{-6} mbar
- 2.7 The Chiller system must be at least 25,000 kg
- 2.8 The equipment must have a Liquid Nitrogen System (LN2)
- 2.9 There is a glass for IR box to inspect the Equipment under Test while testing.

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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- 2.10 The delivery must include Installation of the computer and program for monitoring and control.
- 2.11 There must be more than 128 channels of data acquisition and display in real time with Thermocouple
- 2.12 The system must be able to support test profile.
- 2.13 The equipment must have an automatic cut off in case of emergency or error.
- 2.14 The equipment must be able to be installed in a room of 15 meters in width and 15 meters in length.
- 2.15 The installation shall be carried out in such a way that the door of the equipment which is the entry point of the test piece must be in the clean room area and the other part of the test equipment must be integrated into the wall of the room as shown in Figure 2.
- 2.16 The door or access to the Thermal Vacuum Chamber must have a system to help with opening and closing such as a wheel system or sliding rail system, etc.

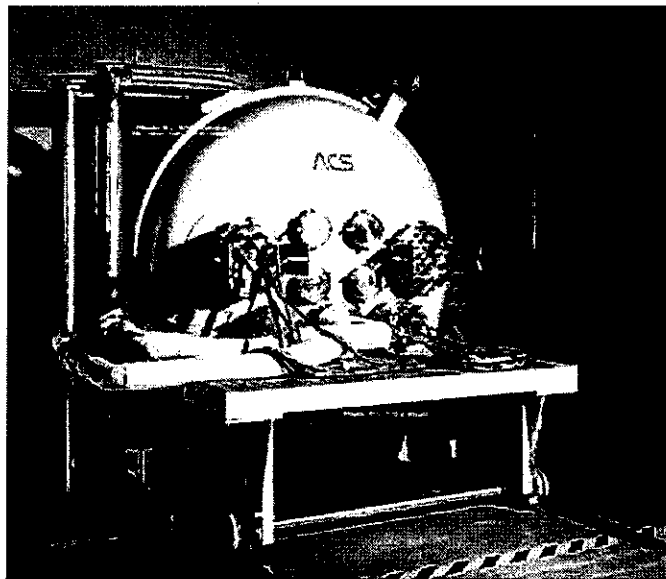


Figure 2: Example of Vacuum Test Chamber Installation*

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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3. Thermal Cycling Chamber (1 set)

- 3.1 The test area must have the length be greater than or equal to 1.5 m, the width be more than or equal to 1.5 m and the depth be more than or equal to 1.5 m.
- 3.2 The Minimum test temperature must be less than or equal to -70 °C
- 3.3 The Maximum test temperature must be more than or equal to +150 °C
- 3.4 The humidity in the chamber must be in the range of 20 - 98% RH
- 3.5 The average of Heating up rate must be greater than or equal to 3 °C / min, as specified by IEC 60068-3-5.
- 3.6 The average of Cool down rate must be greater than or equal to 1.5 °C / min as specified by IEC 60068-3-5.

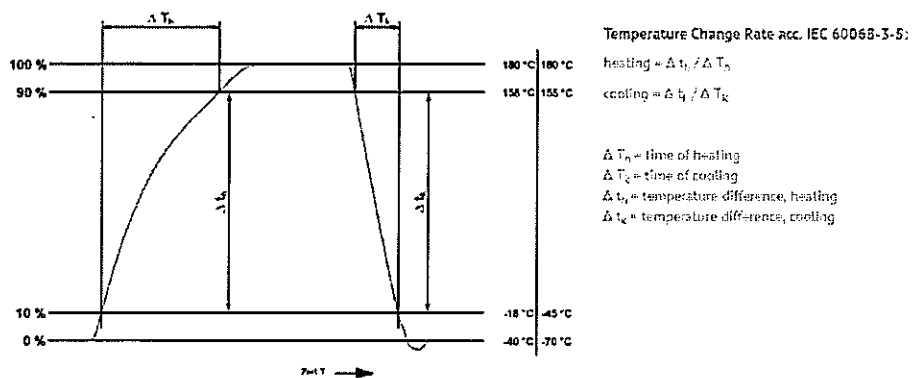


Figure 3 Test standard IEC 60068-3-5

- 3.7 The delivery must include Installation of the computer and program for monitoring and control.
- 3.8 There must be Sensor at least 128 channels to measure data or acquisition of data.
- 3.9 The system must be able to support test profile.
- 3.10 The equipment must have an automatic cut off in case of emergency or error.

4. Mass properties measurement equipment (1 set).

- 4.1 The equipment must be able to test the Equipment Under Test with the mass of no less than 500 kg in vertical measurement.

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- 4.2 The equipment must be able to test the Equipment Under Test with the mass of no less than 500 kg in horizontal measurement (after excluding the weight of L shape steel frame)
- 4.3 The delivery must include a Horizontal L-shape adapter which the dimension is width must not be less than 900 mm, the maximum length must not be less than 4800 mm (be able to slide mounting base from the maximum length to the middle of L-shape by motor at least 1500mm.) and the height must not be less than 1500 mm. The base for installation of the work piece must have a diameter not less than 900 mm.
- 4.4 The Spin rate for testing the satellite must be less than or equal to 30rpm and it must be able to support spin rate up to at least 250 rpm.
- 4.5 The acceptable Total dynamic unbalance measurement error is in range of less than +5% and more than -5%, ($\pm 5\%$.)
- 4.6 The Static CG accuracy must be less than +0.1% of measured moment value
- 4.7 The Moment of Inertia accuracy must be less than +0.1% and more than -0.1%, ($\pm 0.1\%$) of the measured value.
- 4.8 The delivery must include Installation of the computer and program for monitoring and control.
- 4.9 The system must be able to support test profile.
- 4.10 The equipment must have an automatic cut off in case of emergency or error.
- 4.11 The equipment must be able to be installed and operate in a class 100000 clean room.
- 4.12 The equipment must be able to be installed in an area of 8 meters wide by 8 meters long and 1.5 meters deep with a load floor of 5,000 kg per square meter. The working area shall be level with the adjacent surfaces and adequate for operation with the L-shape adapter. (the depth shall be no more than 1.5 m.)
- 4.13 The electrical wiring and control cables must be routed neatly and should not create an obstacle to the working of the equipment or the people in the AIT center.

5. Theodolite (3 units)

- 5.1 Telescope System

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- (1) Must have a magnification greater than or equal to 30 times
- (2) The width of the lens is must be greater than or equal to 45 mm
- (3) Vertical image at a distance of 1 km over or must be equal to 26 meters or 1 degree 20 arcminute
- (4) Must have a laser pointing system for easy aiming.
- (5) Must have a Laser Plummet which can adjust the focus of light or camera peg.
- (6) The Optical Plummet must have a magnification more than or equal to 3 times and can be focused

5.2 Distance Measurement

- (1) Must be able to measure distance without using a prism (reflectiveness) at a distance greater than or equal to 500 meters.
- (2) Must be able to measure distance up to 3,000 meters using a single prism.
- (3) The mean square error must be within $\pm 2\text{mm} + 2\text{ppm} \cdot \text{xD}$

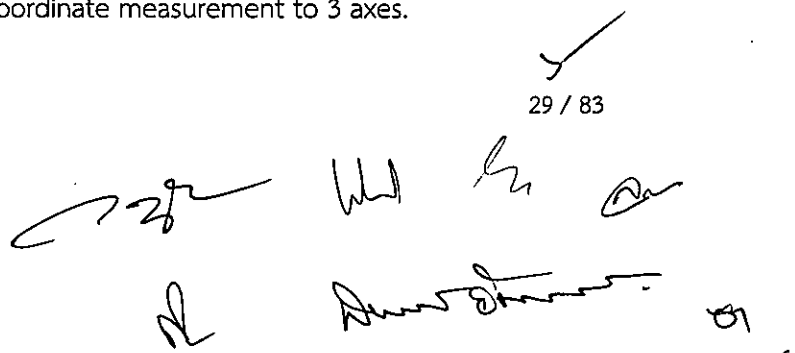
5.3 Angle Measurement

- (1) Must be able to read the horizontal and vertical angle up to 1 arc second/ 5 arc second.
- (2) The Standard deviation of horizontal and vertical angles must not exceed 5 arc second.
- (3) Must use an Absolute rotary encoder angle measurement system

5.4 Data logging and programming

- (1) Must be able to record the data inside the camera more than or equal to 2GB / 528MHZ.
- (2) Must be able to transfer data to computer using data cable, mini USB, Flash Drive, Bluetooth (class2)
- (3) Must be able to perform the following functions:

- Set the azimuth and coordinate measurement to 3 axes.

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- Must be able to perform remote elevation measurement
- Must be able to support Stake Out function
- Must be able to distance of an obstacle or remote distance Measurement
- Must be able to pinpoint the location of the camera (Free Station)
- Road Design Program

5.5 General

- (1) Must have Microsoft Window operating system
- (2) Must have a Touch Screen with which one can enter numbers and letters directly.
- (3) Must be resistant to environmental conditions and water resistant according to IP55 standard.
- (4) The spirit level at the base of the camera must have an accuracy 8 arcminute 2 millisecond or better.
- (5) The battery must work for at least 8 hours.

5.6 Accessories:

- (1) 1 set of prism with aluminum tripod
- (2) 1 set of prism with range pole of length of 2 meters
- (3) Aluminum tripod with height adjustment mechanism
- (4) Rechargeable battery.
- (5) Charger
- (6) Camera bag and correction set
- (7) Data cable
- (8) Instruction Manual
- (9) Software and programs

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Appendix B.

Technical Specifications – Facility and laboratory tools.

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Appendix B - Technical Specifications – Facility and laboratory tools.

1. Setup and installation of class 100000 cleanroom (3 rooms)

- 1.1 Setup and installation of three class 100000 cleanroom. The first clean room is 30 meters wide, 50 meters high, 12 meters high (AIT high bay) and the second and third clean room are 10 meters wide, 15 meters high, 12 meters (Storage room and Loading room). Room details as shown in picture 3.

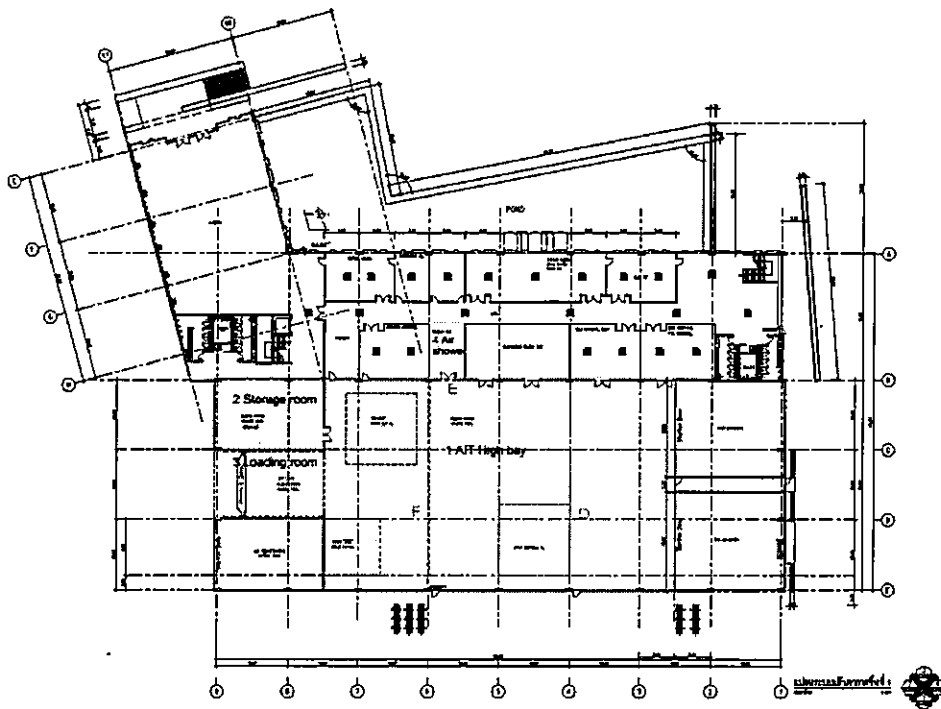


Figure 4: Layout of clean room and air shower

- 1.2 The Clean rooms must be temperature controlled within the range of $22^{\circ}\text{C} \pm 3^{\circ}\text{C}$
- 1.3 The Clean rooms must be humidity controlled within the range of $55\% \pm 10\% \text{RH}$
- 1.4 The Clean rooms must have at least 3 mm thick Epoxy floor with grounding system installed.
- 1.5 The Clean rooms must be ISO 14644 standard or equivalent where class 100000 is equal to ISO 8, which allows 3,520,000 particles per cubic meter of 0.5-micron dust particles 29,300 particles per cubic meter of 5.0-micron dust particles.

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- 1.6 The Clean rooms walls must have Isowall insulation with grooved joints or glass to prevent dust retention.
- 1.7 The Clean rooms must be installed with electrical shutter door for the class 100000 clean room. This include installation for the room which are 8 meters wide and 6 meters high (2 rooms) and for the EMC room which 5 meters wide, 6 meters high. An example can be seen in Figure 4.

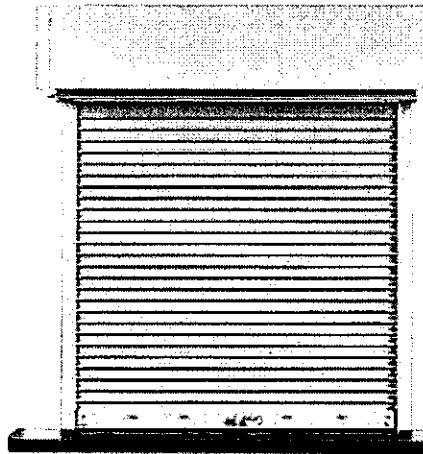


Figure 5: Example of shutter door*

- 1.8 There must be a pass box for loading in and out of the storage room which is a class 100000 clean room.
- 1.9 There must be an installation of an at least 1 set of air shower room or air shower equipment in area as depicted in figure 3. The area must be 5 meters in width and 8 meters in length and must include an area for locker, luggage storage facility and closet for grounding coat for prior to entering the clean room.
- 1.10 There must be lockers, luggage storage facility and closet for grounding coat before entering the clean room.
- 1.11 There must be an installation of dust trap floor mat (clean room mat) before entering clean room.

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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- 1.12 Must deliver at least 500 sets of ground coats, clean room shoes, cleanroom gloves and hair caps.
- 1.13 Must deliver at least 50 sets of safety goggles and earplugs.
- 1.14 There must be a Fire alarm system for the Clean rooms with the following characteristics:
- (1) Photoelectric smoke detector or fire detection device at a height of 12 meters and must be able to work in a class 100000 clean room according to the standards of the Ministry of Industry or its equivalent.
 - (2) There must be installations of CO2 fire extinguisher or sprinkler or fire horse or handheld fire extinguisher according to the standards of the Ministry of Industry or its equivalent.
 - (3) There must be an audible alarm.
 - (4) There must be a control unit system for controlling all devices as shown in figure 5. The flow of the system is shown in the figure.

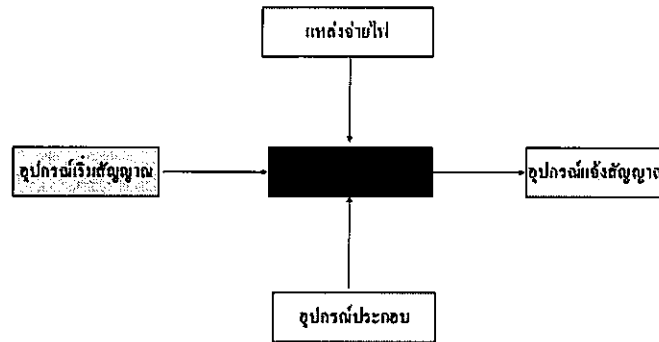


Figure 6: Diagram showing the control of Fire safety system

- 1.15 There must be an installation of Eyewashes and Showers

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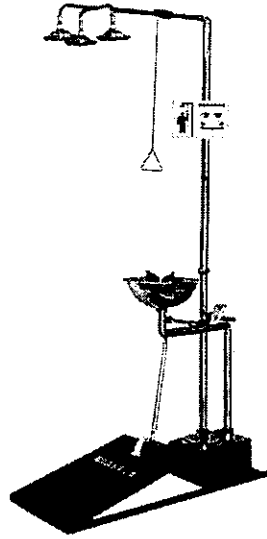


Figure 7: Example of Eyewashes and Showers*

- 1.16 The clean rooms must have lighting that have illuminance within 500-800 lux.
- 1.17 Upon completion of installation, the bidder must perform a certification of the clean room according to ISO 14644 (ISO 8) and a certificate of compliance must be provided the certifications must be done by a reliable institute.
2. **Class 100 Clean room tent (1 set)**
 - 2.1 There must be an installation of a tent with class 100 clean room system which is 10 meters wide, 20 meters long and a height of at least 6 meters.
 - 2.2 The clean room tent must be installed in the AIT high bay.
 - 2.3 The clean room tent must meet ISO 14644 standard or equivalent with class 100 equivalent to ISO 5 which allows no more than 4 particles per cubic meter of 0.5-micron dust particles.
 - 2.4 Upon completion of installation, the bidder must perform a certification of the clean room according to ISO 14644 (ISO 2) and a certificate of compliance must be provided the certifications must be done by a reliable institute.

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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3. Foundation Isolator (1 set)

- 3.1 Installation of a concrete block structure for a 10m wide, 10 m deep and 3 m deep hole.
- 3.2 There must be an installation of a concrete structure with an area no less than 64 sqm. with the thickness of 1 meter and it must be supported by vibration isolation equipment or materials such as pads (neoprene, fiberglass, felt, cork or other similar compressive material) or spring or air spring.
- 3.3 In case of installation which requires maintenance area (according to Figure 7), a removable walking platform must be installed when there is no need for access to maintenance area. However, such installation may be different to Figure 7 if it is more appropriate or effective.
- 3.4 After installing Seismic concrete, the top surface level shall be equal to the adjacent surface
- 3.5 The equipment or material supporting the seismic block must have a natural frequency not equal to disturbed frequency or ambient frequency which is from system of building.
- 3.6 The Foundation Isolator must have isolation efficiency no less than 90%.
- 3.7 The Foundation Isolator must be able to be installed in a class 100000 clean room.

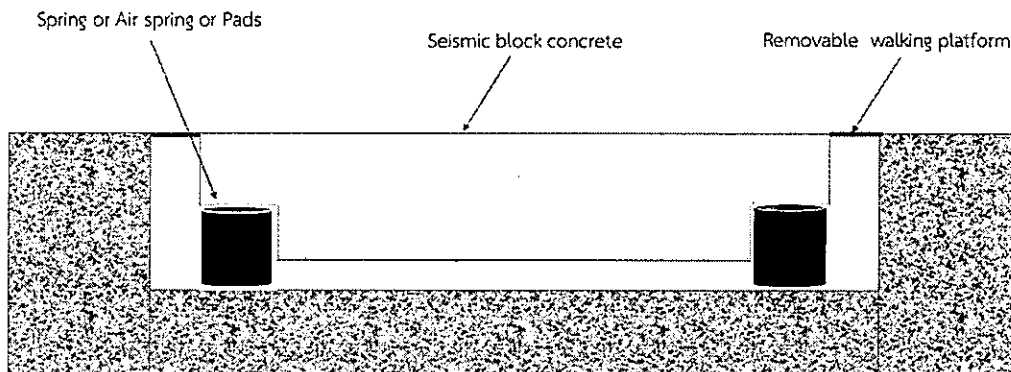


Figure 8: Example of an installation of Foundation Isolator

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4. Furniture for the clean rooms.

The equipment to be used in the clean room must be in compliance with ISO Class 8 or FED-STD-209D (Federal Standard) class 100000 and ESD-Safe standard (Electro Static Discharged), that is it prevents electrostatic discharge which prevent rapid electrical discharge and affect electronic components.

- 4.1 Stainless steel working table for clean room with ESD-Safe standard with anti-static mats (10 sets).

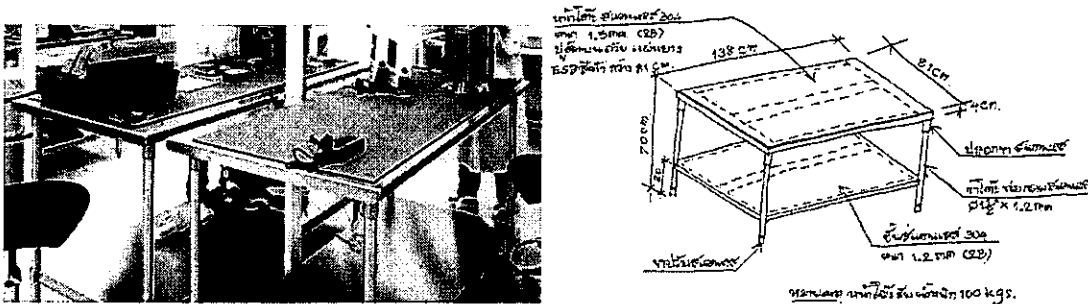


Figure 9: Example of stainless steel working table for clean room*

Unique features:

- (1) The table must have a dimension greater than or equal to 0.81 meters long x 1.38 meters wide x 0.7 meter high
- (2) The structure must be made from stainless steel. The surface of the table must be more than or equal to 4 mm thick. The top surface of the table must be covered with anti-static mats (ESD Table Mats) with a thickness of more than or equal to 1.5 mm.
- (3) There must be a second tier of stainless steel surface with the thickness of more than or equal to 1.2 millimeters which is 20 centimeters of higher from the floor.

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product)

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- (4) The table legs must be made from stainless steel and the height of the table must be adjustable.
- (5) The structure of the table must be able to support more than or equal to 100 kg of load.
- (6) There must be a Ground Cord which is connected from the connective plate on the antistatic rubber sheet to the ground.

4.2 Table for holding satellite in class 100000 clean room class in accordance to ESD-Safe standard (Electro Static Discharged) with anti-static mats (2 sets)

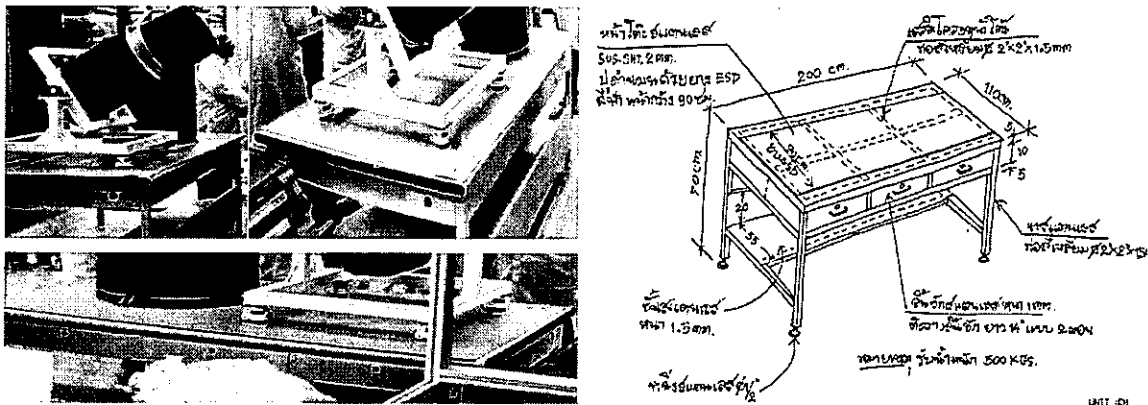


Figure 10: Example of table for holding satellite *

Unique features

- (1) The table must have the dimensions greater than or equal to 1.1 meters long x 2 meters wide x 0.7 meters high
- (2) The structure must be made from stainless steel. The top surface of the table must be covered with anti-static mats (ESD Table Mats).
- (3) The table must have 3 drawers for tool storage with lock and keys.
- (4) The structure of the table must be able to support more than or equal to 500 kg of load.

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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(5) There must be a Ground Cord which is connected from the connective plate on the antistatic rubber sheet to the ground.

4.3 Chair with ESD-Safe standard (Electro Static Discharged) to be used in class 100000 clean rooms (20 sets).

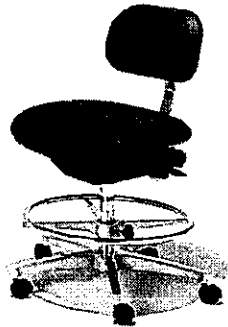


Figure 11: Example of Chair with ESD safe standards *

Unique features

- (1) Soft surface with pneumatic height control.
- (2) Ergonomics Design
- (3) Static-safe model features dissipative Micron nylon
- (4) The structure and base of the chair must be made of polished aluminum.

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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4.4 ESD-Safe Parts Storage Cabinets with Drawers (6 sets - 3 large cabinets and 3 small cabinets)

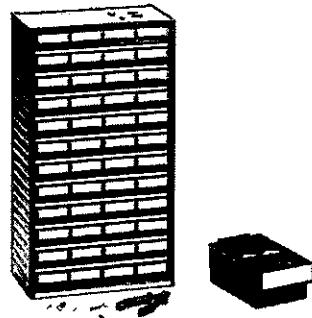


Figure 12: Example of Parts storage cabinets with drawers*

4.4.1 Large ESD-Safe Parts Cabinet (3 sets)

Unique features:

- (1) The number of drawers must be more than or equal to 16 drawers.
- (2) The dimensions of the drawers must be more than or equal to 15 inches long x 15 inches wide x 15 inches high
- (3) The structure must be made with antistatic plastic material.

4.4.2 Small ESD-Safe Small Parts Cabinet (3 sets)

Unique features:

- (1) The number of drawers must be more than or equal to 40 drawers.
- (2) The dimensions of the drawers must be more than or equal to 7 inches long x 12 inches wide x 21 inches high
- (3) The structure must be made with antistatic plastic material.

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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4.5 Size 48" Standard Tool Storage Cupboard with more than 170 Conductive Bins (4 sets)

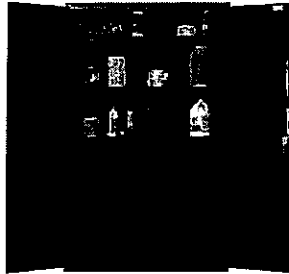


Figure 13: Example of ESD-Safe standard tool storage cupboard*

Unique features

- (1) The dimensions must be more than or equal to 24 inches long x 48 inches wide x 78 inches high

4.6 Corrosive Safety Cabinet for clean room (1 set)

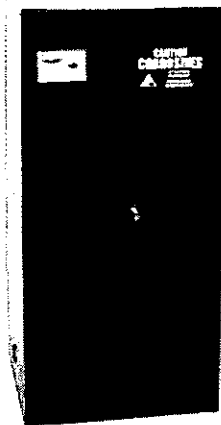


Figure 14: Example of Corrosive Safety cabinet*

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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Unique features

- (1) The dimensions must be more than or equal to 18 inches long x 43 inches wide x 44 inches high

5. Materials Handling Equipment

- 5.1 ESD-Safe Stackable Super Tek-Trays with Foam made with High Impact Polypropylene having the dimensions 18 "x11-3/8" x1-3/4" (10 sets) and 22-3/4"x17-1/2" x2-1/2" (10 sets)

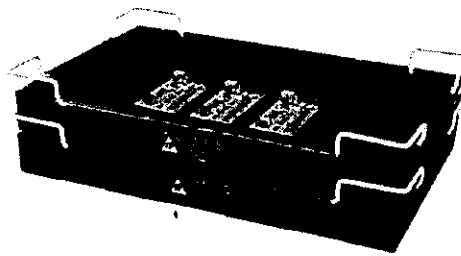


Figure 15: Example of ESD-Safe Trays *

- 5.2 ESD-Safe Steel mobile shelving system (5 tiers) with adjustable height with dimension more than or equal to 60 cm long x 150 cm wide x 170 cm high (4 sets)

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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