# Spacecraft AIT (Assembly Integration & Testing) Infrastructure Requirements



UR Rao Satellite Centre Indian Space Research Organisation Department of Space Government of India

### **Revision History**

SI. No.	Baseline	Revision	Date	Description
1	01	00	01-11-2024	Initial Issue

ISRO is involved in building various types of satellites ranging from Nano satellites to I4K satellites. Spacecraft Assembly, Integration and Testing (AIT) is a complex process which include mechanical and electrical integration aspects of various subsystems of the satellite and needs various infrastructure / facilities to do the same.

U R Rao Satellite Centre (URSC), the lead centre of ISRO for realization of various types of satellites, from Nano Satellites (<20kg) to I4K class satellites (~5000kg). These satellite are used in the area of Communication, Navigation, Meteorology, Remote Sensing, Space science and interplanetary explorations. To outsource the activities of Spacecraft AIT at vendor premises, vendor shall have minimum/basic set of infrastructure available at their premises. These infrastructure requirement varies depends on the class and category of the satellite.

This document is a compilation of both mechanical and electrical AIT infrastructure requirements for conducting AIT operations of various types of satellites. The document does not cover satellite test facilities requirement.

This document is neither an Expression of Interest - EoI / RFP or precursor for any future RFPs. This document is just a preliminary infrastructure information / reference document for the potential vendors to plan for establishing infrastructure at their premises, based on present ISRO experience.

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#### **Abbreviations**

- 1. ISRO Indian Space Research Organisation
- 2. URSC U R Rao Satellite Centre
- 3. AIT Assembly Integration and Testing
- 4. INS Indian Nano Satellite
- 5. IMS Indian Mini Satellite
- 6. IRS Indian Remote Sensing Satellite
- 7. NVS Navigation Satellite
- 8. I-1K ISRO 1000 class spacecraft
- 9. I-2K ISRO 2000 class spacecraft
- 10. I-3K ISRO 3000 class spacecraft
- 11. I-4K ISRO 4000 class spacecraft
- 12. S/C Spacecraft
- 13. P/L Payload
- 14. EV Earth View (Panel)
- 15. AEV Anti Earth View (Panel)

- 16. HK House Keeping (Mainframe systems)
- 17. FM Flight Model
- 18. GC Ground Checkout
- 19. DC Direct Current
- 20. RF Radio Frequency
- 21. CR Clean Room
- 22. FS 209E Federal Standard 209E Class Limits
- 23. ESD Electro Static Discharge
- 24. RH Relative Humidity
- 25. HEPA High Efficiency Particulate Absorbers
- 26. CO2 Carbon Di-Oxide
- 27. SO2 Sulphur Di-Oxide
- 28. MgF2 Magnesium Fluoride
- 29. UPS Uninterruptible Power Supply
- 30. AC Air Conditioner

- 31. PC Personal Computer
- 32. CCTV Closed Circuit Television
- 33. MGSE Mechanical Ground Support Equipment
- 34. EGSE Electrical Ground Support Equipment
- 35. SPF Special Purpose Fixture
- 36. VTC Vertical Transportation Container
- 37. MHE Material Handling Equipment
- 38. LM Guide Linear Motion Guide
- 39. SS Stainless Steel
- 40. EOT Electric Overhead Travelling (Crane)
- 41. OH Over Head (Crane)
- 42. RFP Request For Proposal
- 43. Eol Expression of Interest

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# Spacecraft AIT INFRASTRUCTURE REQUIREMENTS

#### **Spacecraft AIT infrastructure requirements**

In this regard the spacecraft's general infrastructure requirements are captured and given for the better understanding of the vendors

Facility Infrastructure for clean room and its related buildings are depicted below



Truck / Lorry space behind Transit area

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#### **Clean Room**

Its 1,00,000 Class Clean room with major features like

- Temperature & RH controlled
- ESD flooring & grounding
- EOT crane
- UPS power
- Ladders, man lift and work tables
- Door for hardware entry and exit to other buildings
- Person entry room with ESD garments & air shower

# Section : 1.2

# Airlock

**Airlock** is the connecting building with clean room for clean room support activities requires

- 1,00,000 Class Clean room, Temperature & RH controlled
- EOT crane
- Ladders, man lift and work tables
- Container and fixtures handling and placement
- Pallet truck
- Door for hardware entry and exit to other area

#### **Other areas**

- Truck / Lorry space behind Airlock
- Spacecraft checkout GC room
  - Glass partition and viewable to S/C clean room
  - Area for GC racks
  - work tables
- **Connecting corridor** for multiple entry and exits
- Electronics Lab and Mechanical fitting lab with the vendor premises

All the above buildings / rooms are essential for the Spacecraft Assembly, Integration & Testing however the sizing of these buildings / rooms / facility depends on the size, shape and mass of the spacecraft

# **Broad Categories of Spacecraft**

#### **Broad category of Spacecraft**

The presently on-going various spacecraft's size, shape and its specific requirements are broadly given in 7 headings / chapters

01	INS	Indian Nano Satellite	
02	IMS-1	Indian Mini Satellite - 1	<u>Im</u>
03	IMS-2	Indian Mini Satellite - 2	<u>Im</u>
04	I-1K/IRS	ISRO 1K / Indian Remote Sensing Satellite	<u>Im</u>
05	I-2K/NVS	ISRO 2K Satellite / Navigation Satellite	<u>Im</u>
06	I-3K/I-4K	ISRO 3K / ISRO 4K class satellites	ſm
07	Scientific	Scientific Satellites	

# Approximate dimensions and mass of satellite of different class

SI. No.	Satellite Class	Mass (Kg)	Dimensions (meters)
01	INS	~20	600 mm x 600 mm x 600 mm
02	IMS-1	100-250	1. 4m x1.2 m x 1.4m
03	IMS-2	250~500	2.5 m x 1.5 m x 3.0 m
04	I-1K/IRS	500-1500	2.7m x 2.3m x 3.7 m
05	I-2K/NVS	1500 - 2500	2.6m x 2m x 3.6 m
06	I-3K/I-4K	3000 - 5000	3.2m x 3.0m x 5.5m
07	Scientific	500-4000	The bus will be chosen based on payload requirements – IMS-2, I-1K, I-2K, I-3K, I-4K as mentioned above.

# **INS** INFRASTRUCTURE REQUIREMENTS

### **INS: OUTLINE**

- Spacecraft views, size and mass
- Cleanroom area and door height requirements
- Cleanroom height requirements
- Airlock area requirements
- Airlock height requirements
- Airlock to Outside door requirements
- Summary of Infrastructure requirements in Cleanroom and Airlock
- MGSE.
- Electrical requirements
- GC requirements
- Clean Room general requirements

#### **INS:** Spacecraft Views, Size And Mass

- The size of the spacecraft is approximately 600mm x 600mm x 600mm and its mass 20 kgs.
- The following view explains the various features of the S/C and Spacecraft views in Stowed and Deployed Configuration with dimensions.



- Spacecraft requires minimum Cleanroom area of 4m x 4m x 3m to carry out Assembly Integration and Testing (AIT).
- Suitable area for testing team may be included.
- Airlock door and Air-shower door dimensions are as shown below:





#### **INS: Cleanroom area requirements (02/03)**

- Spacecraft requires minimum Cleanroom working area of 4m x 4m to carry out Assembly Integration and Testing (AIT).
- In addition to the working area for integration activities, the CR should provide for the following equipment:
- ESD cupboards for package storage
- Surface table
- Mobile crane for satellite handling
- Tool storage area (during integration phase)
- PC/work station area to facilitate testing
- Adjoining separate Air conditioned room for Check-out equipment

- Spacecraft requires the cleanroom height of minimum
  3 meters to carry out Assembly Integration and Testing
  (AIT) operations. Figure substantiating the same is as
  follows:
- The satellite along with handling system and fixture is approx. 2.5 m (with hook) and margin of 500mm provided for MGSE interface and lifting provision



#### **INS:** Airlock requirements (01/03)

• Spacecraft requires minimum Airlock area of 9m x 5m to carry out container loading of the Spacecraft into the vehicle. Figure substantiating the same is as follows:



- Airlock can be only temperature and humidity controlled Area.
- Spacecraft requires minimum height in Airlock area of 4m to carry out loading and unloading of the Spacecraft transportation container onto the trailer.
- ► Handling and lifting activities can be carried out using suitable crane (mobile/EOT)
- Figure substantiating the same is as follows:
  - MGSE height + Container height + Belt height + Safety Margin
  - ~ (850mm + 850mm + 1000 mm + 800)= 3500 mm

Note: shorter belt from crane hook to container belts to be used.



#### **INS:** Airlock requirements – door height (03/03)

- The minimum door height required for Airlock is 2.5 meter width and 2.5 meter height.
- The door height of 2.5 meters is for meeting all MGSE entry and exit requirements



### **INS: Summary of Infrastructure Requirements - Cleanroom**

Cleanroom Requirement (minimum)	Dimensions
Cleanroom Floor Area	4m X 4m
Cleanroom Crane hook height Required	3m
Cleanroom Crane capacity	0.5 Ton
Cleanroom door opening	2.5m height X 1.5m width
Cleanroom equipment area	2.5m X 2.5m

### **INS: Summary of Infrastructure Requirements - (Airlock)**

Airlock Requirements (minimum)	Dimensions
Airlock Area	9m X 5m
Airlock crane hook height	3.5 m
Airlock Crane capacity	1 Ton
Airlock Door Opening	2.5 m height X 2.5 m width

### **INS:** Spacecraft transportation container views





Mass of container: 100 Kg (Empty)

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# **INS:** Spacecraft transportation container Handling





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#### **INS:** Electrical Requirements - Cleanroom

#### **Raw Power requirements :**

✓ Single phase 5A socket for Alignment MGSE

#### **UPS Power Requirements:**

✓ For PCs (2 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), -1kVA, with 5A/15A wall sockets-10 Nos.

✓ Extension boards -03 No's

#### **Other Requirements**

- ✓ ESD Workbenches (1.5m X 1m)– 2 Nos and ESD chairs (04 Nos)
- ✓ ESD safe cupboards or ESD desiccators for on-board material/package storage (1 Nos)

#### **INS: Electrical Requirements - Spacecraft Checkout Lab**

#### **Raw Power requirements :**

• 1kVA

#### **UPS Power Requirements:**

• For PCs, servers and all Spacecraft Checkout System racks (2/4 Nos of 22U rack) – minimum 1kVA with cutler hammer interface, and power extension boards with 15Amp sockets (8Nos).

#### **Other Requirements:**

- Work tables (1.5m X 1m) 4 Nos
- Chairs (8 Nos)
- Book storage cupboards 1 Nos.

#### **INS:** Facility Infrastructure - Clean Room

#### 1,00,000 Class Clean As per FS 209E Environment control with

- Rh 55±5%,
- Temperature 22±2° C
- Particle count measurements on daily twice basis.
- ESD flooring
- Wall mounted grounding copper strips / braid
- Light intensity 700 LUX min
- Site Security, Access Control with CCTV Surveillance system, Integrated smoke detector system and Fire Safety systems
- Work platforms, Weighing scale and Grounding Clips with copper braid

#### Clean room person entry room with

- Air shower
- ESD garments & ESD Slippers

# IMS-1 INFRASTRUCTURE REQUIREMENTS

#### **IMS-1: Outline**

- Spacecraft views, size and mass
- Cleanroom area requirements
- Cleanroom height requirements
- Cleanroom to Airlock door requirement
- Airlock requirements
- Airlock height requirements
- Parking area requirement(with trailer)
- Storage area requirements
- Summary of Infrastructure requirements in Cleanroom and Airlock
- MGSE
- Electrical requirements
- GC requirements
- Clean Room general requirements

#### IMS-1: Spacecraft views, size and mass (01/02)

- The size of the spacecraft is approximately 1.4m x1.2 m x 1.4m and its mass 100 kgs to 250 kgs.
- The following view explains the various features of the S/C and Spacecraft views in Stowed and Deployed Configuration with dimensions.



#### **IMS-1: Spacecraft views, size and mass (02/02)**

• Spacecraft Exploded View with its various constituents are shown below:


### **IMS-1:** Cleanroom area requirements

- Spacecraft requires minimum Cleanroom area of 8m x 6m to carry out Assembly Integration and Testing (AIT). Suitable area for testing team may be included.
- Spacecraft requires minimum height of 5m (Crane Hook Point) to carry out Assembly Integration and Testing (AIT).





Clean room area

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Clean room height

# **IMS-1:** Cleanroom to Airlock door requirements

• Spacecraft requires minimum door size of 3.5m width and 4m height for the passage of Spacecraft on its Dolly Fixture.



### **IMS-1:** Airlock requirements

- Spacecraft requires minimum Airlock area of 8.4m x 7m to carry out containerisation of the Spacecraft. Figure substantiating the same is as follows:



# **IMS-1:** Airlock height requirements

- Spacecraft requires minimum height in Airlock area of 7m to carry out loading and unloading of the Spacecraft into the container.
- Figure substantiating the same is as follows:



• S/C container requires minimum door size of 4m width and 4m height to move the Spacecraft transportation container into the Airlock area.



Section: 4.6

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## **IMS-1:** Parking area requirement(with trailer)

• Parking area for Trailer with container outside airlock to be covered parking, minimum of 15m(length) x 7m (width) to carry out loading and unloading of the Spacecraft transportation container onto the Trailer with suitable movable crane/ fork lift. Figure substantiating the trailer with container as follows:



 Additional storage area requirement with controlled environment is around 4m x 4m for storage of flight hardware, Payloads, payload test equipment's and flight panels.



# **IMS-1:** Summary of Infrastructure Requirements - Cleanroom

Cleanroom Requirement (minimum)	Dimensions
Cleanroom Floor Area	8m X 6m
Cleanroom Crane hook height Required	5m
Cleanroom EOT Crane capacity	2 Ton
Cleanroom door opening	4m height X 3.5m width
Storage area	4m X 4m

# **IMS-1:** Summary of Infrastructure Requirements – Airlock

Airlock Requirements (minimum)	Dimensions
Airlock Area	8.4m X 7m
Airlock crane hook height	7m
Airlock EOT Crane capacity	5 Ton & 10 Ton(Optional)
Airlock Door Opening	4m height X 4m width (with Panel Container)
Covered Parking area (out side Airlock)	15m X 7m

### IMS-1: SPF

- The Special Purpose fixture (SPF) is used to orient the spacecraft to facilitate Assembly Integration and Test operations on Spacecraft. It has provision for vertical translation motion (Z-axis) and rotation about two axes (Axis-1 and Axis-2).
- SPF is required during Solar panel assembly to the S/C and solar panel deployment tests, Payloads assembly.



# **IMS-1: Spacecraft transportation container**

 It provides for safe Vertical positioning of Spacecraft. Mainly it consist of two part Fixture and Frame. Frame is detachable from fixture. Container Fixture required floor area approx. 4mX3m & container Mass is 4000Kg (without S/c).



### **IMS-1:** Electrical Requirements - Cleanroom

#### **Raw Power requirements :**

 3 Phase supply for Special Purpose Fixture (SPF) – 2kVA with Cutler-hammer connectors, Single phase 5A socket for Alignment MGSE

#### **UPS Power Requirements:**

- For PCs (2 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), -1 kVA, with 5A/15A wall sockets- 10 Nos.
- Extension boards -03 No's

#### **Other Requirements:**

- ESD Workbenches (1.5m X 1m)– 2 Nos and ESD chairs (04 Nos)
- ESD safe cupboards or ESD desiccators for on-board material/package storage (1 Nos)

# **IMS-1:** Electrical Requirements - Spacecraft Checkout Lab

#### **Raw Power requirements :**

• 1kVA

#### **UPS Power Requirements:**

• For PCs, servers and all Spacecraft Checkout System racks (2 /4 Nos of 22U rack) – minimum 10kVA with cutler hammer interface, and power extension boards with 15Amp sockets (8Nos).

#### **Other Requirements**

- Work tables (1.5m X 1m) 4 Nos
- Chairs (8 Nos)
- book storage cupboards 1 Nos.

### **IMS-1**: Facility Infrastructure - Clean Room

#### 1,00,000 Class Clean As per FS 209E Environment control with

- Rh 55±5%,
- Temperature 22±2° C
- Particle count measurements on daily twice basis.
- ESD flooring
- Wall mounted grounding copper strips / braid
- Light intensity 700 LUX min
- Site Security, Access Control with CCTV Surveillance system, Integrated smoke detector system and Fire Safety systems
- Work platforms, Weighing scale and Grounding Clips with copper braid

#### Clean room person entry room with

- Air shower
- ESD garments & ESD Slippers

# IMS-2 INFRASTRUCTURE REQUIREMENTS

### **IMS-2: Contents**

- Spacecraft views, size and mass
- Cleanroom area requirements
- Cleanroom height requirements
- Cleanroom to Airlock door requirement
- Airlock requirements (with and without trailer)
- Airlock height requirements
- Airlock to Outside door requirements
- Storage area within Cleanroom requirements
- Summary of Infrastructure requirements in Cleanroom and Airlock
- MGSE.
- Electrical requirements
- GC requirements
- Clean Room general requirements

### IMS-2: Spacecraft Views, Size And Mass (01/02)

• The size of the spacecraft is approximately 2.5 m x 1.5 m x 3.0 m and its mass is approximately 500 kg. The following view explains the various features of the S/c and Spacecraft views in Stowed and Deployed Configuration with dimensions.



### **IMS-2:** Spacecraft Views, Size And Mass (02/02)

• Spacecraft Exploded View with its various elements are shown below:



### **IMS-2: Cleanroom area requirements**

- Spacecraft requires minimum Cleanroom area of 8 m x 9m to carry out Assembly Integration and Testing (AIT). Suitable area for testing team may be included
- Floor area required 8m x 9m (all around 1m considered)
- On one side of SPF area is left for Tilting provision.



# **IMS-2:** Cleanroom height requirements

- Panel Dimensions (1m x0.5m)
- Panel Lifting is subset of Spacecraft Lifting.





- Spacecraft requires minimum height of 7m to carry out Assembly Integration and Testing (AIT). Figure substantiating the same is as follows:
- H = Satellite from ground: Approx. 3.0+1.5+0.5(5m) + Handling system +Crane clearance(2m) = 7m from ground to crane Hook)



# **IMS-2: Cleanroom to Airlock door requirements**



### **IMS-2:** Airlock requirements

• Spacecraft requires minimum Airlock area of 20m x 8.5m to carry out containerization of the Spacecraft. Figure substantiating the same is as follows:



• Spacecraft requires minimum Airlock area of 20m x 8.5m to carry out loading and unloading of the Spacecraft transportation container onto the trailer. Figure substantiating the same is as follows:



# **IMS-2:** Airlock height requirements

• Spacecraft requires minimum height in Airlock area of 8 m to carry out loading and unloading of the Spacecraft transportation container onto the trailer.



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# **IMS-2:** Airlock to Outside door requirements

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• VTC on trailer requires minimum door size of 6m width and 7m height to move the Spacecraft transportation container on the trailer to outside for transportation.



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# **IMS-2:** Storage area requirement within cleanroom

• Additional storage requirement within cleanroom is around 3.5m x 3.5m for storage of flight hardware.

# **IMS-2:** Summary of Infrastructure Requirements - Cleanroom

Cleanroom Requirement (minimum)	Dimensions
Cleanroom Floor Area	8m X 9m
Cleanroom Crane hook height Required	7m
Cleanroom OH Crane capacity	2 Ton
Cleanroom door opening	5.0 m height X 3.5 m width
Cleanroom Storage area	3.5m X3.5m

# **IMS-2:** Summary of Infrastructure Requirements – Airlock

Airlock Requirements (minimum)	Dimensions
Airlock Area	20m X 8.5m
Airlock crane hook height	8m
Airlock OH Crane capacity	5 Ton & 8 Ton
Airlock Door Opening	7m height X 6m width

## IMS-2: SPF

- The Special Purpose fixture (SPF) is used to orient the spacecraft to facilitate Assembly Integration and Test operations on Spacecraft. It has provision for vertical translation motion (Z-axis) and rotation about two axes (Axis-1 and Axis-2).
- It can be moved on the floor (from Airlock to Cleanroom) through wheel Provision.
- Lifting provision is through Crane/Fork-lift.
- Mass: 6.1T

#### **Raw Power requirements :**

• 3 Phase supply for Special Purpose Fixture (SPF) – 2kVA with Cutler-hammer connectors



# **IMS-2:** Panel Integration Fixture

- It provides for safe horizontal/Vertical positioning of panels to perform various package/panel assembly activities. It has provision of up and down motion by LM guide and Wire rope driven by motor and also manual rotation of panels. Mainly it consist of two part Fixture and Frame. Frame is detachable from fixture.
- 3 Panel Integration fixtures are used for 5 panels. Mass of each panel integration fixture (which can hold 2 panels: ~500-600 kg)
- Manual Rotation is planned. Hence No power supply required.



### **IMS-2:** Spacecraft transportation container (01/02)

- In order to offer protection to the spacecraft from these hazards, multiple subsystems such as Shock and Vibration Isolation System, Pressure Equalization and Rapid Decompression System, Passive Thermal Control System, Gaseous Nitrogen Purge System, Passive Dehumidification System, Environmental Control and Monitoring System, Handling Devices and Transit Data Acquisition System are integrated in Vertical Transportation Container (VTC-I). Appropriate grounding and all metallic construction forms the Faraday's cage to protect from electrical hazards. VTC-I is dimensionally optimized for compatibility to accommodate itself within the commercially available low bed trailers, commercially available cargo aircrafts and other constraints posed at assembly, integration and test (AIT) facilities and Material Handling Equipment (MHE). MHEs associated with VTC-I such as lifting devices, crane, mobility devices etc., are also validated before their usage with spacecraft. VTC-I can carry spacecraft in vertical orientation and they are built modular to vary their sizes and enable transportation of spacecraft up to 2900 mm diametric envelope and lengths up to 3.0 m and S/C mass up to 500 kg. VTC-I can be handled using 4-point handling system.
- The bare VTC-1 weight container weight is 6600 kg

### **IMS-2:** Spacecraft transportation container (02/02)



### **IMS-2: Electrical Requirements - Cleanroom**

#### Raw Power requirements :

 3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler-hammer connectors 5 pins, 30A interface for all MGSEs.

#### **UPS Power Requirements:**

• For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets.

#### **Other Requirements**

- ESD Workbenches (1.5m X 1m)- 3 Nos and ESD chairs (06 Nos)
- ESD safe cupboards or ESD desiccators for on-board material/package storage (2 Nos)

### **IMS-2: Electrical Requirements - Spacecraft Checkout Lab**

#### Raw Power requirements :

• Single phase supply for cooling fans and Checkout equipment - 1kVA.

#### **UPS Power Requirements:**

• For PCs, servers and all Spacecraft Checkout System racks (12 Nos) –minimum 10kVA with cutler hammer interface, and power extension boards with 15Amp sockets (15Nos).

#### **Other Requirements**

- Work tables (1.5m X 1m) 6 to 8 Nos
- Chairs (8 to 10 Nos)
- Book storage cupboards 2 Nos.

#### 1,00,000 Class Clean As per FS 209E Environment control with

- Rh 55±5%,
- Temperature 22±2° C
- Particle count measurements on daily twice basis.
- ESD flooring
- Wall mounted grounding copper strips / braid
- Light intensity 700 LUX min
- Site Security, Access Control with CCTV Surveillance system, Integrated smoke detector system and Fire Safety systems
- Work platforms, Weighing scale and Grounding Clips with copper braid

#### Clean room person entry room with

- Air shower
- ESD garments & ESD Slippers

# I-1K Spacecraft / IRS INFRASTRUCTURE REQUIREMENTS
### I-1K/IRS : Contents

- Spacecraft views, size and mass
- Cleanroom area requirements
- Cleanroom height requirements
- Cleanroom to Airlock door requirement
- Airlock requirements (with and without trailer)
- Airlock height requirements
- Airlock to Outside door requirements
- Storage area within Cleanroom requirements
- Summary of Infrastructure requirements in Cleanroom and Airlock
- Electrical requirements
- GC requirements
- Clean Room general requirements

### I-1K/IRS: Spacecraft Views, Size And Mass

- The size of the spacecraft is approximately 2.7m x 2.3m x 3.7 m and its mass 1500 kg.
- The following view explains the various features of the S/C and Spacecraft views in Stowed and Deployed Configuration with dimensions.



# Section: 6.3

### I-1K/IRS: Cleanroom area requirements

Spacecraft requires minimum Cleanroom area of 12m x 10m to carry out Assembly Integration and Testing (AIT). Suitable area for testing team may be included. Figure substantiating the same is as follows:



### I-1K/IRS: Cleanroom height requirements

- Spacecraft requires minimum height of 8m (crane hook point) to carry out Assembly Integration and Testing (AIT) is shown:
- The capacity of the crane : 5 Ton



### I-1K/IRS: Cleanroom to Airlock door requirements

• Spacecraft requires minimum door size of 4m width and 6m height for the passage of Spacecraft on its Special Purpose Fixture (SPF).



### I-1K/IRS: Airlock requirements without trailer

• Spacecraft requires minimum Airlock area of 20m x 8.5m to carry out containerisation of the Spacecraft. Figure substantiating the same is as follows:



### I-1K/IRS: Airlock requirements (with trailer)

• Spacecraft requires minimum Airlock area of 20m x 8.5m to carry out loading and unloading of the Spacecraft transportation container onto the trailer. Figure substantiating the same is as follows:



- Spacecraft requires minimum height in Airlock area of 10m (Crane hook point) to carry out loading and unloading of the Spacecraft transportation container onto the trailer.
- The capacity of the crane : 5 Ton and 10 Ton
- Figure substantiating the same is as follows:



• VTC on trailer requires minimum door size of 6m width and 7m height to move the Spacecraft transportation container on the trailer to outside for transportation.



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### I-1K/IRS: Storage area requirement within cleanroom

• Additional storage requirement within cleanroom is around 5m x 5m for storage of flight hardware and flight panels, P/L test systems, and payloads.



### I-1K/IRS: Summary of Infrastructure Requirements - Cleanroom

Cleanroom Requirement (minimum)	Dimensions
Cleanroom Floor Area	12m X 10m
Cleanroom Crane hook height Required	8m
Cleanroom EOT Crane capacity	5 Ton
Cleanroom door opening	6m height X 4m width
Cleanroom Storage area	5m X 5m

### I-1K/IRS: Summary of Infrastructure Requirements – Airlock

Airlock Requirements (minimum)	Dimensions
Airlock Area	20m X 8.5m
Airlock crane hook height	10m
Airlock EOT Crane capacity	5 Ton & 10 Ton
Airlock Door Opening	7m height X 6m width

### I-1K/IRS: SPF

- The Special Purpose fixture (SPF) is used to orient the spacecraft to facilitate Assembly Integration and Test operations on Spacecrafts. It has provision for vertical translation motion (Zaxis) and rotation about two axes (Axis-1 and Axis-2).
- SPF handling provisions: Fork lift / Crane



### I-1K/IRS: Container with trailer

- Spacecraft Vertical Transportation Container (VTC) on Trailer: The below given are the details of the truck which will be used to bring and send the S/C with container.
- Handling provisions: Crane



### I-1K/IRS: Panel Integration Fixture

- It provides for safe horizontal/Vertical positioning of panels to perform various package/panel assembly activities. Mainly it consist of two part, viz., Fixture and Frame. Frame is detachable from fixture. For IRS-I1K series, four panel integration fixtures are required.
- Fixture handling provisions: Fork lift / Crane



### I-1K/IRS: Payload transportation container

- It provides for safe transportation of payload. It is equipped with safety systems like shock & vibration isolation system, passive thermal control, pressure equalisation system, passive dehumidification System handing and lashing points etc.
- Handling provisions: Fork lift / Crane



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### I-1K/IRS: Spacecraft Transportation Container (01/02)

- In order to offer protection to the spacecraft from these hazards, multiple subsystems such as Shock and Vibration Isolation System, Pressure Equalization and Rapid Decompression System, Passive Thermal Control System, Gaseous Nitrogen Purge System, Passive Dehumidification System, Environmental Control and Monitoring System, Handling Devices and Transit Data Acquisition System are integrated in Vertical Transportation Container (VTC-I). Appropriate grounding and all metallic construction forms the Faraday's cage to protect from electrical hazards. VTC-I is dimensionally optimized for compatibility to accommodate itself within the commercially available low bed trailers, commercially available cargo aircrafts and other constraints posed at assembly, integration and test (AIT) facilities and Material Handling Equipment (MHE). MHEs associated with VTC-I such as lifting devices, crane, mobility devices etc., are also validated before their usage with spacecraft. VTC-I can carry spacecraft in vertical orientation and they are built modular to vary their sizes and enable transportation of spacecraft up to 2900 mm diametric envelope and lengths up to 4.0 m and S/C mass up to 2000 kg. VTC-I can be handled using 4-point handling system.
- The bare VTC-1 weight container weight is 6600 kg. without additional spacer module, 7300 kg. with 600mm spacer module and 8300 kg. with 950 mm space module.

### I-1K/IRS: Spacecraft transportation container views (02/02)



### I-1K/IRS: Electrical Requirements - Cleanroom

#### Raw Power requirements :

 3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler-hammer connectors 5 pins, 30A interface for all MGSEs.

#### **UPS Power Requirements:**

• For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets

#### Other Requirements

- ESD Workbenches (1.5m X 1m)- 3 Nos and ESD chairs (06 Nos)
- ESD safe cupboards or ESD desiccators for on-board material/package storage (2 Nos)

### I-1K/IRS: Electrical Requirements - Spacecraft Checkout Lab

#### Raw Power requirements :

• Single phase supply for cooling fans and Checkout equipment 1kVA.

#### **UPS Power Requirements:**

• For PCs, servers and all Spacecraft Checkout System racks (12 Nos) –minimum 20kVA with cutler hammer interface, and power extension boards with 15Amp sockets (15Nos).

#### **Other Requirements**

- Work tables  $(1.5m \times 1m) 6 \text{ to } 8 \text{ Nos}$
- Chairs (8 to 10 Nos)
- book storage cupboards 2 Nos.

#### 1,00,000 Class Clean As per FS 209E Environment control with

- Rh 55±5%,
- Temperature 22±2° C
- Particle count measurements on daily twice basis.
- ESD flooring
- Wall mounted grounding copper strips / braid
- Light intensity 700 LUX min
- Site Security, Access Control with CCTV Surveillance system, Integrated smoke detector system and Fire Safety systems
- Work platforms, Weighing scale and Grounding Clips with copper braid

#### Clean room person entry room with

- Air shower
- ESD garments & ESD Slippers

## I-2K Spacecraft / NVS INFRASTRUCTURE REQUIREMENTS

### I-2K/NVS: Contents

- Spacecraft views, size and mass
- Cleanroom area requirements
- Cleanroom height requirements
- Cleanroom to Airlock door requirement
- Airlock requirements (with and without trailer)
- Airlock height requirements
- Airlock to Outside door requirements
- Storage area within Cleanroom requirements
- Summary of Infrastructure requirements in Cleanroom and Airlock
- MGSE.
- Electrical requirements
- GC requirements
- Clean Room general requirements

### I-2K/NVS: Spacecraft Views, Size And Mass (01/02)

- The size of the spacecraft is approximately 2.6m x 2m x 3.6 m and its mass 1500 kg to 2500 kg. Mass of NVS Spacecraft is approximately 2250 kg.
- The following view explains the various features of the S/C and Spacecraft views in Stowed and Deployed Configuration with dimensions.



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### I-2K/NVS: Spacecraft Views, Size And Mass (02/02)

• Spacecraft Exploded View with its various constituents are shown below:



• Spacecraft requires minimum Cleanroom area of 12m x 10m to carry out Assembly Integration and Testing (AIT). Suitable area for testing team may be included. Figure substantiating the same is as follows:



### I-2K/NVS: Cleanroom height requirements

• Spacecraft requires minimum height of 8m to carry out Assembly Integration and Testing (AIT). Figure substantiating the same is as follows:



Mass Of SPF- 4.5T(Approx)

### I-2K/NVS: Cleanroom to Airlock door requirements

• Spacecraft requires minimum door size of 4m width and 6m height for the passage of Spacecraft on its Special Purpose Fixture (SPF).



### I-2K/NVS: Airlock requirements

• Spacecraft requires minimum Airlock area of 20m x 8.5m to carry out containerisation of the Spacecraft. Figure substantiating the same is as follows:



### I-2K/NVS: Airlock requirements (with trailer)

• Spacecraft requires minimum Airlock area of 20m x 8.5m to carry out loading and unloading of the Spacecraft transportation container onto the trailer. Figure substantiating the same is as follows:



### I-2K/NVS: Airlock height requirements

- Spacecraft requires minimum height in Airlock area of 10m to carry out loading and unloading of the Spacecraft transportation container onto the trailer.
- Figure substantiating the same is as follows:



### I-2K/NVS: Airlock to outside door requirements

• VTC on trailer requires minimum door size of 6m width and 7m height to move the Spacecraft transportation container on the trailer to outside for transportation.



### I-2K/NVS: Storage area requirement within cleanroom

• Additional storage requirement within cleanroom is around 5m x 5m for storage of flight hardware and flight panels.



### I-2K/NVS: Summary of Infrastructure Requirements - Cleanroom

Cleanroom Requirement (minimum)	Dimensions
Cleanroom Floor Area	12m X 10m
Cleanroom Crane hook height Required	8m
Cleanroom OH Crane capacity	5 Ton
OH Crane height requirements	8m
Cleanroom door opening	6m height X 4m width
Cleanroom Storage area	5m X 5m

### I-2K/NVS: Summary of Infrastructure Requirements – Airlock

Airlock Requirements (minimum)	Dimensions
Airlock Area	20m X 8.5m
Airlock crane hook height	10m
Airlock OH Crane capacity	5 Ton & 10 Ton
OH Crane height requirements	10m
Airlock Door Opening	7m height X 6m width

### I-2K/NVS: SPF

- The Special Purpose fixture (SPF) is used to orient the spacecraft to facilitate Assembly Integration and Test operations on Spacecraft. It has provision for vertical translation motion (Z-axis) and rotation about two axes (Axis-1 and Axis-2).
- SPF handling provisions: Fork lift / Crane


### I-2K/NVS: Container with trailer

- Spacecraft Vertical Transportation Container (VTC) on Trailer: The below given are the details of the truck which will be used to bring and send the S/C with container.
- Handling provisions: Crane



### I-2K/NVS: Panel Integration Fixture

 It provides for safe horizontal/Vertical positioning of panels to perform various package/panel assembly activities. It has provision of up and down motion by LM guide and Wire rope driven by motor and also manual rotation of panels. Mainly it consist of two part Fixture and Frame. Frame is detachable from fixture. For NVS series spacecraft, three panel integration fixture required namely South, North and EV. South and North Fixture required floor area approx 3.5mX2.9m. EV Panel Integration fixture required floor area approx 2.6mX2.7m.

Fixture handling provisions: Fork lift / Crane



# I-2K/NVS: Panel Transportation Container

- It provides for safe transportation of payload. It is equipped with safety systems like shock & vibration isolation system, passive thermal control, pressure equalization system, passive dehumidification System handing and lashing points etc.
- Handling provisions: Fork lift / Crane



## I-2K/NVS: Spacecraft Transportation Container (01/02)

- In order to offer protection to the spacecraft from these hazards, multiple subsystems such as Shock and Vibration Isolation System, Pressure Equalization and Rapid Decompression System, Passive Thermal Control System, Gaseous Nitrogen Purge System, Passive Dehumidification System, Environmental Control and Monitoring System, Handling Devices and Transit Data Acquisition System are integrated in Vertical Transportation Container (VTC-I). Appropriate grounding and all metallic construction forms the Faraday's cage to protect from electrical hazards. VTC-I is dimensionally optimized for compatibility to accommodate itself within the commercially available low bed trailers, commercially available cargo aircrafts and other constraints posed at assembly, integration and test (AIT) facilities and Material Handling Equipment (MHE). MHEs associated with VTC-I such as lifting devices, crane, mobility devices etc., are also validated before their usage with spacecraft. VTC-I can carry spacecraft in vertical orientation and they are built modular to vary their sizes and enable transportation of spacecraft up to 2900 mm diametric envelope and lengths up to 4.0 m and S/C mass up to 2000 kg. VTC-I can be handled using 4-point handling system as well as single point handling system.
- The bare VTC-1 weight container weight is 6600 kg. without additional spacer module, 7300 kg. with 600mm spacer module and 8300 kg. with 950 mm space module.

# I-2K/NVS: Spacecraft transportation container views (02/02)



### I-2K/NVS: Electrical Requirements - Cleanroom

#### Raw Power requirements :

 3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler-hammer connectors 5 pins, 30A interface for all MGSEs.

#### **UPS Power Requirements:**

• For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets

#### **Other Requirements**

- ESD Workbenches (1.5m X 1m)- 3 Nos and ESD chairs (06 Nos)
- ESD safe cupboards or ESD desiccators for onboard material/package storage (2 Nos)

# I-2K/NVS: Electrical Requirements - Spacecraft Checkout Lab

#### Raw Power requirements :

• Single phase supply for cooling fans and Checkout equipments 1kVA.

#### **UPS Power Requirements:**

• For PCs, servers and all Spacecraft Checkout System racks (12 Nos) –minimum 30kVA with cutler hammer interface, and power extension boards with 15Amp sockets (15Nos).

#### **Other Requirements**

- Work tables  $(1.5m \times 1m) 6 \text{ to } 8 \text{ Nos}$
- Chairs (8 to 10 Nos)
- book storage cupboards 2 Nos.

# I-2K/NVS: Facility Infrastructure - Clean Room

#### 1,00,000 Class Clean As per FS 209E Environment control with

- Rh 55±5%,
- Temperature 22±2°C. and
- Particle count measurements on daily twice basis.
- ESD flooring
- Wall mounted grounding copper strips / braid
- Light intensity 700 LUX min
- Site Security, Access Control with CCTV Surveillance system, Integrated smoke detector system and Fire Safety systems
- Work platforms, Weighing scale and Grounding Clips with copper braid

#### Clean room person entry room with

- Air shower
- ESD garments & ESD Slippers

# I-3K/I-4K Spacecraft INFRASTRUCTURE REQUIREMENTS

### I-3K /I-4K-Infrastructure Requirements

- Spacecraft views, size and mass
- Clean room Floor area- Active AIT
- Clean room floor area Passive Storage
- Controlled Environment floor area Passive Storage
- Clean room Crane hook height requirement
- Airlock Floor area requirement
- Airlock Crane hook Height requirement
- Door Sizes
- List of MGSE with Mass/Size
- Summary of Infrastructure requirements in Cleanroom and Airlock
- Electrical requirements
- GC requirements
- Clean Room general requirements

# I-3K/I-4K: Spacecraft Views, Size And Mass (01/02)

- The size of the spacecraft is approximately 3.4m x 3m x 5.6m and its mass 3500 kg to 5000 kg.
- The following view explains the various features of the S/C and Spacecraft views in Stowed and Deployed Configuration with dimensions.



# I-3K/I-4K: Spacecraft Views, Size And Mass(02/02)

• Spacecraft Deployed View with its various constituents are shown below:



# I-3K/I-4K: Cleanroom

- Floor Area (15mX12m)
- Active Area:
  - North/South/EV/HK/Battery Panels & Spacecraft on SPF



• Hook Height Requirements (9m)

Section: 8.3

• Activities: Panel Closure/SC on MGSE/Alignment



# I-3K/I-4K: Cleanroom Floor Area

- Floor Area : 5mX3m Passive/Storage
- Elements
  - Masts
  - Package Storages
  - East/West panel
  - West panels
  - Flight Elements



### I-3K/I-4K: Controlled Environment storage

- Floor Area : 8mX4m Passive/Storage
- Features:
  - AC Environment
  - Temperature & Humidity Controlled area
- Elements in storage
  - Reflectors
  - Smaller MGSE



### I-3K/I-4K: Airlock Floor Area

- Floor Area : 20mX10m
- Activities: Containerization & Movements



# I-3K/I-4K: Airlock Height requirements

- Crane hook Height Requirements (12m)
- Activities: Containerization



### I-3K/I-4K: MGSE (01/02)

• Dimensions/Location/Required Area/Handling



### I-3K/I-4K: MGSE (02/02)

- Dimensions/Location/Required Area/Handling
- All the listed MGSE will be unloaded at Airlock and will be rolled to Cleanroom



# I-3K/I-4K: Infrastructure Summary

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Clean Room - Requirements	
Clean Room Floor Area –Active AIT	15m X 12m
Clean Room Crane hook Height Required	9m
Clean Room Area – Passive Storage	08m X 06m
Controlled Environment floor area- Storage	08m X 04m
Clean Room OH Crane capacity	5 Ton
Clean Room Door opening	8m Height x 7m Wide

Airlock room-Requirements	
Airlock Area – Active AIT	20m X 10m
Airlock Crane hook Height Required	12m
Airlock OH Crane capacity	5 Ton & 20 Ton
Airlock Door opening	7m Height x 7m Wide

### I-3K/I-4K: Electrical Requirements-Cleanroom

#### Raw Power requirements :

 3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler-hammer connectors 5 pins, 30A interface for all MGSEs.

#### **UPS Power Requirements:**

• For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets

#### **Other Requirements**

- ESD Workbenches (1.5m X 1m)– 3 Nos and ESD chairs (06 Nos)
- ESD safe cupboards or ESD desiccators for onboard material/package storage (2 Nos)

# I-3K/I-4K: Electrical Requirements: Spacecraft Checkout Lab

#### Raw Power requirements :

• Single phase supply for cooling fans and Checkout equipments 1kVA.

#### **UPS Power Requirements:**

• For PCs, servers and all Spacecraft Checkout System racks (12 Nos) – minimum 50kVA (Single Phase & Three Phase) with cutler hammer interface, and power extension boards with 15Amp sockets (15Nos).

#### **Other Requirements**

- Work tables (1.5m X 1m) 6 to 8 Nos
- Chairs (8 to 10 Nos)
- Book storage cupboards 2 Nos.

### I-3K/I-4K: Facility Infrastructure - Clean Room

#### 1,00,000 Class Clean As per FS 209E Environment control with

- Rh 55±5%,
- Temperature 22±2°C. and
- Particle count measurements on daily twice basis.
- ESD flooring
- Wall mounted grounding copper strips / braid
- Light intensity 700 LUX min
- Site Security, Access Control with CCTV Surveillance system, Integrated smoke detector system and Fire Safety systems
- Work platforms, Weighing scale and Grounding Clips with copper braid

#### Clean room person entry room with

- Air shower
- ESD garments & ESD Slippers

# Scientific Spacecraft INFRASTRUCTURE REQUIREMENTS

## **Scientific Spacecraft: Contents**

- Spacecraft views, size and mass
- Scientific Spacecraft special requirements
- Cleanroom area requirements
- Cleanroom height requirements
- Cleanroom to Airlock door requirement
- Airlock requirements (with and without trailer)
- Airlock height requirements
- Airlock to Outside door requirements
- Storage area within Cleanroom requirements
- Summary of Infrastructure requirements in Cleanroom and Airlock
- MGSE requirements.
- Electrical requirements
- GC requirements
- Clean Room general requirements

### Scientific Spacecraft: Spacecraft views, size and mass (01/02)

- There is no single defined standard satellite bus for Scientific Spacecraft. Depends on Scientific mission objectives and payloads, the standard satellite bus like IMS-1 or IMS-2 or I1K or I2K or I3K or I4K bus are chosen for Scientific Satellite, described in previous chapters. (Refer Section 2.1.)
- Apart from standard infrastructure requirement, The Scientific Spacecraft requires many special infrastructure requirement depending on Scientific Payload design and storage requirements during S/c realization and testing.
- The size of the Scientific spacecraft and its mass may vary from 500 4000 kg depends on standard satellite bus chosen.
- The following view depicts overall dimensions approximately 2.6m x 2.7 m x 4 m of the Typical medium size Scientific S/C in Stowed Configuration.



S/c in stowed configuration Copyright © URSC, ISRO

### Scientific Spacecraft: Spacecraft views, size and mass (02/02)

• The following view depicts overall dimensions of the S/C in deployed Configuration.



# Scientific Spacecraft: Special Requirements - Contamination free environment

- Scientific Spacecraft carries payloads that are highly sensitive to external environment i.e., contamination. The contamination control plan starts from the very beginning of the project namely
  - a) Selection of the materials
  - b) Process plan to control the contamination during fabrication/assembly/testing phases
  - c) Handling the components
  - d) Storage and transportation.
- > As the AIT activities of Spacecraft and its payloads is carried out in the clean room, it is utmost important to provide a clean/contamination free environment throughout the assembly, integration testing activities of spacecraft and Payloads.
- In order to achieve a clean contamination free environment the following are essential
  - a) 10,000 class clean room,
  - b) 10k class clean air tent,
  - c) 10k class portable clean air modules and
  - d) Clean room special garment requirements
  - e) High pure Nitrogen purging (purity 99.999) requirements
- The purity of the nitrogen gas & traces of SO2, CO2 used for purging will be monitored periodically.
- Molecular contamination around s/c is monitored by MgF2 mirror.

## Scientific Spacecraft: Special Requirements - Clean Air tent

- CLEAN AIR TENT is 10,000 class, capable of maintaining a particulate free area.
- This can be achieved by total removal of Air-Born Particulates by unidirectional clean air streams.
- Capable of accommodating Payloads and Spacecraft mounted on Special Purpose Fixture.
- Working size : L 4000x B 4000x H 5000mm SS grade stainless steel 304 Stand attached with wheel with jack type adjustable. The whole frame system can be moved on 8 wheels on flat floor.
- Particulate Retention : 0.3 micron & above.
- HEPA filters : Micro Fibre Glass Paper, Mini Pleat HEPA filter box type
- Side walls : All side walls are provided with 1mm thick PVC curtains from top to floor level.



10,000 class clean air tent in cleanroom

 10K Clean air modules draw air from class clean room and filters through HEPA (High Efficiency Particulate Absorbing) filters to 10K clean air. Which keeps the near by area well with in 10,000 class clean room. There are many units of 10K Clean air modules are placed near spacecraft.



10,000 class clean air module

## Scientific Spacecraft: Special Requirements - Clean room special garment requirements

ESD Single Piece Bunny Suit Cleanroom Garment, Head cover, Leg cover, Face mask and Hand gloves will be used by all working personnel inside the clean room. And also Powder free Latex hand gloves will be used for all operations. The Clean room air quality will be continuously monitored, regulated and the results logged.





ESD Single Piece Bunny Suit Cleanroom Garment, Head cover, Leg cover, Face mask and Hand gloves



# Scientific Spacecraft: Special Requirements - High purity Nitrogen purging requirements

• There will be number of purging requirements for payloads . The High pure Nitrogen purging ( purity 99.999 % ) only to be used. The purity of the nitrogen gas & traces of SO2, CO2 used for purging will be monitored periodically.

# Scientific Spacecraft: Cleanroom area requirements

- Spacecraft requires minimum Cleanroom area of 16.5 m x 15m to carry out Assembly Integration and Testing (AIT) a typical scientific satellite.
- The Cleanroom for scientific satellite requires one order more stringent contamination control in comparison to remote sensing or communication satellite.
- Additional cleanroom area required for Clean air modules, Clean air tent to meet contamination control requirement.



# Scientific Spacecraft: Clean room height requirements

• Spacecraft requires minimum height of 8m to carry out Assembly Integration and Testing (AIT).



# Scientific Spacecraft: Clean room to Airlock door requirements

Section: 9.6

Spacecraft requires minimum door size of 5m width and 7m height for the passage of Spacecraft on its Special Purpose Fixture (SPF). Clean room to transit area door dimensions


# Scientific Spacecraft: Airlock requirements

• Spacecraft requires minimum Airlock area of 20m x 8.5m to carry out containerisation of the Spacecraft.



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# Scientific Spacecraft: Airlock requirements (with trailer)

• Spacecraft requires minimum Airlock area of 20m x 8.5m to carry out loading and unloading of the Spacecraft transportation container onto the trailer.



# Scientific Spacecraft: Airlock height requirements

Spacecraft requires minimum height in Airlock area of 9 m to carry out loading and unloading of the Spacecraft transportation container onto the trailer.



# Scientific Spacecraft: Airlock to outside door requirements

• VTC on trailer requires minimum door size of 6 m width and 7m height to move the Spacecraft transportation container on the trailer to outside for transportation. Air lock area to outside door dimensions





# Scientific Spacecraft: Summary of Infrastructure Requirements - Cleanroom

Cleanroom Requirement (minimum)	Dimensions
Cleanroom Floor Area	16.5 m X 15m
Cleanroom Crane hook height Required	8m
Cleanroom OH Crane capacity	5 Ton
Cleanroom door opening	7m height X 5m width

# Summary of Infrastructure Requirements – Airlock

Airlock Requirements (minimum)	Dimensions
Airlock Area	20m X 8.5m
Airlock crane hook height	9m
Airlock OH Crane capacity	5 Ton & 10 Ton
Airlock Door Opening	7m height X 6m width

## Scientific Spacecraft: SPF

- The Special Purpose fixture (SPF) is used to orient the spacecraft to facilitate Assembly Integration and Test operations on Spacecrafts. It has provision for vertical translation motion (Z-axis) and rotation about two axes (Axis-1 and Axis-2).
- Power: 1.5 kW, 3 Phase x 415 V,50 Hz



## Scientific Spacecraft: Container with trailer

• Spacecraft Vertical Transportation Container (VTC) on Trailer: The below given are the details of the truck which will be used to bring and send the S/C with container.



# **Scientific Spacecraft: Panel Integration Fixture**

- It provides for safe horizontal/Vertical positioning of panels to perform various package/panel assembly activities. It has provision of up and down motion by LM guide and Wire rope driven by motor and also manual rotation of panels. Mainly it consist of two part Fixture and Frame. Frame is detachable from fixture. For RISAT series, three panel integration fixture are required. Overall dimensions of each fixture is 2400 mm X 2700 mm X 2400 mm.
- Electrical Interface: Cutler Hammer, 415 V three phase, 5 core wired, one ground and one for neutral
- Self weight of fixture: 700 kgs





- In order to offer protection to the spacecraft from hazards, multiple subsystems such as Shock and Vibration Isolation System, Pressure Equalization and Rapid Decompression System, Passive Thermal Control System, Gaseous Nitrogen Purge System, Passive Dehumidification System, Environmental Control and Monitoring System, Handling Devices and Transit Data Acquisition System are integrated in Vertical Transportation Container (VTC-I). Appropriate grounding and all metallic construction forms the Faraday's cage to protect from electrical hazards. VTC-I is dimensionally optimized for compatibility to accommodate itself within the commercially available low bed trailers, commercially available cargo aircrafts and other constraints posed at assembly, integration and test (AIT) facilities and Material Handling Equipment (MHE). MHEs associated with VTC-I such as lifting devices, crane, mobility devices etc., are also validated before their usage with spacecraft. VTC-I can carry spacecraft in vertical orientation and they are built modular to vary their sizes and enable transportation of spacecraft up to 2900 mm diametric envelope and lengths up to 4.0 m and S/C mass up to 2000 kg. VTC-I can be handled using 4-point handling system.
- The bare VTC-1 weight container weight is 6600 kg without additional spacer module, 7300 kg with 600mm spacer module and 8300 kg with 950 mm space module.

## Scientific Spacecraft: Spacecraft transportation container views



3400

950

5,350±50

## Scientific Spacecraft: Electrical Requirements - Cleanroom

#### Raw Power requirements :

 3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler-hammer connectors 5 pins, 30A interface for all MGSEs.

#### **UPS Power Requirements:**

• For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets

#### **Other Requirements**

- ESD Workbenches (1.5m X 1m)– 3 Nos and ESD chairs (06 Nos)
- ESD safe cupboards or ESD desiccators for on-board material/package storage (2 Nos)

# Scientific Spacecraft: Electrical Requirements - Spacecraft Checkout lab

#### Raw Power requirements :

• Single phase supply for cooling fans and Checkout equipment 1kVA.

#### **UPS Power Requirements:**

• For PCs, servers and all Spacecraft Checkout System racks (12 Nos) –minimum 30kVA & 50kVA (for Scientific Spacecraft of I3K & I4K respectively) with cutler hammer interface, and power extension boards with 15Amp sockets (15Nos).

#### **Other Requirements**

- Work tables  $(1.5m \times 1m) 6 \text{ to } 8 \text{ Nos}$
- Chairs (8 to 10 Nos)
- book storage cupboards 2 Nos.

## Scientific Spacecraft: Facility Infrastructure - Clean Room

- 10,000 Class Clean Environment control with
  - ✓ Rh 55±5%,
  - $\checkmark$  Temperature 22±2° C. and
  - $\checkmark$  Particle count measurements on daily twice basis.
  - ✓ESD flooring
  - ✓ Wall mounted grounding copper strips / braid
  - ✓ Light intensity 700 LUX min
  - ✓ Site Security, Access Control with CCTV Surveillance system, Integrated smoke detector system and Fire Safety systems
  - $\checkmark$  Work platforms, Weighing scale and Grounding Clips with copper braid
- Clean room person entry room with
  - $\checkmark$  Air shower
  - ✓ ESD garments & ESD Slippers

# **Consolidated Satellites'** INFRASTRUCTURE REQUIREMENTS

	A	В	C	D	E	F	G	Н		J
	SI.No	Criteria	Spec/dimensions & other details, ref	INS-Nano sats	IMS-1	IMS-2	I1K-IRS	12K NVS	I3K - I4K	Scientific S/C
2		Mass & size of S/C	page numbers	upto 20 kgs	100 to 250 kgs	250 - 500 KGS	500 - 1500 KGS	1500 - 2500 kg	3000 kg- 4800 kg	500-4000 kgs
3				0.6 x 0.6 x 0.6 m	1.4m x1.2 m x 1.4 m	2.5m X 1.5m X 3.0	2.7mx2.3mx3.7m	2.6x2x3.6m	3.2m x 3.0 x 5.5m	2.6m x 2.7m x 4.0 m
4		Payload details								
5	1	Facility Infrastructure								
6		clean room		-						
7	A	Environment control with	As per FS 209E							
,		Rh 55±5%,	ISRO specification	-						
8		temperature 22±2 deg C.								10,000 class clean, room is required
9		measurements on daily twice	SIG handbook URSC	Required	Required	Required	Required	Required	Required	for Scientific spacecrafts
<u>10</u> 11		Possitive pressure shall be maintained. 1.2mm of H2O(12Pa) between clean room and sourrounding area	SIG handbook URSC							
12			1)Resistance to							
14	В	Clean room ESD flooring	ground: < $10^{\circ} \Omega$ as per DIN EN 1081 2)Walk-in-voltage: - 100V to +100V as per DIN IEC 61340-5-1 Standard.	Required	Required	Required	Required	Required	Required	Required
	с	Clean room floor compressive strength	25-50N/mm <sup>2</sup>	Prefered	Prefered	Prefered	Prefered	Prefered	Prefered	Prefered
15		minimum 25-50N/mm <sup>2</sup>	prefered							
16	D	Clean room wall mounted grounding copper strips / braid – Spacecraft and related article disturbance free grounding	With ESD floor gnd and connets to power line common eart25 mm width , 3 mm thickness , copperv stip with sleeves. It has to have dedicated earthing station separate from ESD and body earthing .	Required	Required	Required	Required	Required	Required	Required
19	Е	Clean room static discharge indicator/ facility		Required	Required	Required	Required	Required	Required	Required
Γ	F	Combi Tester (ESD strap & ESD sandal/shoe cover	Make : Stat clean CT01 / Equivalent	Required	Required	Required	Required	Required	Required	Required
20		check at entry) Clean room person entry	Equivalent							
21 22 23 24 25 26	G	room 1 Air shower 2 ESD garments utility racks 3 ESD slippers/ ESD shoe cover 4 Personal shoe rack 5 Person entry register 6 Ester Stickwood	Dressing area to be identified in the entrance of cleanroom for ESD garments and ESD footwear. Entry Air shower 1) Type : Mixed flow 2) Flow rate : 1.5 M3/Sec (approx.) 3) Area : 10 M2 4) Class 100 (capcity : 30 pesron) fresh ESD garments on daily basis.	Required	Required	Required	Required	Required	Required	ESD Single Piece Bunny Suit Cleanroom Garment equired
27		6 Entry Sticky mat								
28 29	н	Clean room size required		4m (L) x 4m (B) x 3m (H)	8m (L) x 6m (B) x 5m (H)	8m (L) x 9m (B) x 7m (H)	12m (L) x 10m (B) x 8m (H)	12m (L) x 10m (B) x 8m (H)	15m (L) x12m (B) x 9m (H)	16.5m (L) x 15m (B) x 8 m (H)
	Т	Clean room EOT ( Electric Overhead Travelling )crane	Crane capacity minimum	0.5 Ton prefered / Gib crane/mobile	2 Ton	2 Ton	5 Ton	5 Ton	5 Ton	5 Ton
30		SWL minimum								
31	J	Clean room entry door with Transit area / airlock room	Width & Height minimum	2.5m x 1.5m	3.5m x 4m	3.5m x 5m	4m x 6m	4m x 6m	7m x 8m	5m x 7m
33	к	Compressed Air supply @ 6 bar g pressure	+ sub micron filter (0.01micron)	Not Required	required	required	required	Required	Required	Required
	1	GN <sub>2</sub> cylinders with movable		Not required	Not required	Not required	Required	Required	Required	High pure Nitrogen purging ( purity
34		trolley	700 1 1 1 1 1 1 1							99.999 ) required
35	м	Clean room light intensity	Prefered	Required	Required	Required	Required	Required	Required	Required
36	N	Surface plate with stand requirement	Flatness 5 micron	0.6 m x 0.6 m x 1 m	1.0 m x 1.0 m x 1 m	1.0 m x 1.0 m x 1 m	1.0 m x 1.0 m x 1m	1.0 m x 1.0 m x 1 m	1.5m x 1.5 m x 1 m	1.0 m x 1.0 m x 1 m
		Electrical power requirement Inside the clean								
<u>37</u> <u>38</u>		room the following are required: UPS power requirement		For PCs (2 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), - 1KVA, with 5A/15A wall sockets- 10 Nos.	For PCs (2 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), - 1 kVA, with 5A/15A wall sockets- 10 Nos. Extension boards-10 nos	For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets.	For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets	For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets	For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets	For PCs (3 Nos), EGSEs like DC power supplies, Standard measuring instruments, RF instruments (Spectrum Analyser, Signal generator), propulsion EGSEs - 4kVA, with 5A/15A wall sockets
40	0	Raw power requirement		Single phase 5A socket for Alignment MGSE Three phase Metal clad with ELMCB(RCBO)(BCH) : 410 VAC, 32 A,50 Hz, 5 Pin - 2	Single phase 5A socket for Alignment MGSE Three phase Metal clad with ELMCB(RCBO)(BCH) :	3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler-hammer connectors 5 pins, 30A interface for all MGSEs. Three phase Metal clad with ELMCB(RCBO)(BCH) : 410 VAC, 32 A,50 Hz, 5 Pin - 2 Nos.(3	3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler- hammer connectors 5 pins, 30A interface for all MGSEs. Three phase Metal clad with ELMCB(RCBO)(BCH) : 410 VAC, 32 A,50 Hz, 5 Pin - 2	3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler-hammer connectors 5 pins, 30A interface for all MGSEs. Three phase Metal clad with ELMCB(RCBO)(BCH) : 410 VAC, 32 A,50 Hz, 5 Pin - 2 Nos.(3	3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler-hammer connectors 5 pins, 30A interface for all MGSEs. Three phase Metal clad with ELMCB(RCBO)(BCH) : 410 VAC, 32 A,50 Hz, 5 Pin - 2	3 Phase supply for MGSEs like Satellite Integration fixture, Panel Integration fixtures, alignment stands, Industrial fans for cooling during payload tests (4 Nos). Minimum capacity required – 3kVA with Cutler- hammer connectors 5 pins, 30A interface for all MGSEs. Three phase Metal clad with ELMCB(RCBO)(BCH): 410 VAC, 32 A,50 Hz, 5 Pin - 2
41		centralised power backup required		Nos.(3 phase) Yes	410 VAC, 32 A,50 Hz, 5 Pin - 2 Nos.(3 phase) Yes	phase) Yes	Nos.(3 phase) Yes	phase) Yes	Nos.(3 phase) Yes	Nos.(3 phase) Yes
42	-									
43	Р	ESD work tables requirement with proper Earthling facility.		2 Nos.	2 Nos.	3 Nos.	3 Nos.	3 Nos.	3 Nos.	3 Nos.
45	Q	ESD Flight Equipment storage system with grounding		1 no	1 no	2 nos	2 nos	2 nos.	2 nos	2 nos
46 47 48 49	R	All areas at clean room / air lock where spacecraft will be handled to be covered with below requirements. • Site Security • Access Control with CCTV Surveillance system • Fire Safety systems		Required	Required	Required	Required	Required	Required	Required
50		detector system								
51	S	RF radiation monitoring	Alternative	Required	Required	Required	Required	Required	Required	Required
6	т	Work platforms / Man lift / Ladders support	Aluminium work platform & Aluminium	To reach 1m to 2.5 m height 2 nos	To reach 1m to 5 m height 2 nos	To reach 1m to 5 m height 2 nos	To reach 1m to 5 m height 2 nos	To reach 1m to 4.5 m height 3 nos	To reach 1m to 6 m height 4 nos	To reach 1m to 8 m height 2 nos

	A	В	С	D	E	F	G	н	I	J
1	SI.No	Criteria	Spec/dimensions & other details, ref	INS-Nano sats	IMS-1	IMS-2	IIK-IRS	12K NVS	I3K - I4K	Scientific S/C
2		Mass & size of S/C	page numbers	upto 20 kgs	100 to 250 kgs	250 - 500 KGS	500 - 1500 KGS	1500 - 2500 kg	3000 kg- 4800 kg	500-4000 kgs
3				0.6 x 0.6 x 0.6 m	1.4m x1.2 m x 1.4 m	2.5m X 1.5m X 3.0	2.7mx2.3mx3.7m	2.6x2x3.6m	3.2m x 3.0 x 5.5m	2.6m x 2.7m x 4.0 m
	U	Weighing scales	Upto 20 kgs 1 no	Upto 20 kgs 1 no Upto 100 kgs 1 no	Upto 20 kgs 1 no Upto 100 kgs 1 no	Upto 20 kgs 1 no Upto 100 kgs 1 no	Upto 20 kgs 1 no Upto 100 kgs 1 no upto 1000 kgs 1 no upto 2000 kgs	Upto 20 kgs 1 no Upto 100 kgs 1 no upto 1000 kgs 1 no upto 2000 kgs 1 no	Upto 20 kgs 1 no Upto 100 kgs 1 no upto 1000 kgs 1 no upto 2000	Upto 20 kgs 1 no Upto 100 kgs 1
53	v	Grounding Clips with copper	opio congo mio	Required	Required	Required	1 no Required	Required	kgs 1 no Required	Required
54		braid	normal extension							
	w	Electrical extension boards	Cutler hammer	2 each	2 each	3 Nos.	4 nos.	4 nos.	4 each	4 each
55			Harness line							
56	х	Cable guards	protection	Required	Required	Required	Required	Required	Required	Required
57										
	2	Transit area / airlock room								
58										
		Transit area / airlock room 1,00,000 Class Clean	As per FS 209E							
59	А	Environment control with		Required	Required	Required	Required	As per std.	Required	Required
60		Rh 55±5%,	ISRO specification							
61		temperature 22±2 deg C.	SIG handbook URSC							
	в	Transit area / airlock EOT ( Electric Overhead Travelling	Crane capacity	1 ton	5 Ton (& 10 ton optional)	5 ton & 8 Ton	5 ton & 10 Ton	5 ton & 10 Ton	5 ton & 20 Ton	5 ton & 10 Ton
62		) crane								
	0	Area & ht required -		0 (l.) (D.) 0 (l.)	8.4 m x 7 m X 7 m HT	20 m x 8.5 m X 8 m HT (TRUCK	20 m x 8.5 m X 10 m HT (TRUCK	20 m x 8.5 m X 10 m HT (TRUCK	20m (L) x 10m (B) x 12m (H)	20 m x 8.5 m X 9 m HT (TRUCK
	C	minimum		9m (L) x 5m (B) x 3.5m (H)	REQUIRED )	ENTRY PROVISION REQUIRED )	ENTRY PROVISION REQUIRED)	ENTRY PROVISION REQUIRED)	REQUIRED)	ENTRY PROVISION REQUIRED)
63										
64	D	Compressed Air supply @ 6 Bar g pressure		Required	Required	Required	Required	Required	Required	Required
	Е	Pallet Truck Requirement		2ton capacity x 1 no	2ton capacity x 1 no	2ton capacity x 1 no	2ton capacity x 1 no	2 Ton. X 2 nos.	5/3 ton capacity x 2 no	5ton capacity x1 no
65		For Unloading / Loading								
66	F	⊏хі door ( transit area to truck loading area )	vviatn & Height minimum	2.5m x 2.5m	4m x 4m	6m x 7m	6m x 7m	6m x 7m	7m x 7m	6m x7m
		Electrical power requirement								
67		Inside the transit area the								
68		tonowing are required:								
		Raw power requirement	TO BE CLEARED BY MID TEAM (LOOKS	Raw : 236V, 15 A, 50 Hz, 3 Pin, switch socket - 2Nos. (Single	Raw : 236V, 15 A, 50 Hz, 3 Pin, switch socket - 2Nos. (	Raw: 236V, 15 A, 50 Hz, 3 Pin, switch	Raw : 236V, 15 A, 50 Hz, 3 Pin,	Raw : 236V, 15 A, 50 Hz, 3 Pin, switch	Raw : 236V, 15 A, 50 Hz, 3 Pin, switch socket - 2Nos. (Single	Raw : 236V, 15 A, 50 Hz, 3 Pin,
			LIKE FOR MGSE)	phase)	Single phase)	socket - Zivos. (Single phase)	switch socket - ZNos. (Single phase)	socket - ZNos. (Single phase)	phase)	switch socket - 2Nos. (Single phase)
69	G									
			TO BE CLEARED BY	Three phase Metal clad with	Three phase Metal clad with	Three phase Metal clad with	Three phase Metal clad with	Three phase Metal clad with	Three phase Metal clad with	Three phase Metal clad with
		32A ELMCB ( Leakage current protector > 100mA)	MID TEAM (LOOKS	ELMCB(RCBO)(BCH) : 410 VAC, 32 A,50 Hz, 5 Pin - 2 Nos.(3	ELMCB(RCBO)(BCH) : 410 VAC, 32 A,50 Hz, 5 Pin - 2	ELMCB(RCBO)(BCH) : 410 VAC, 32 A 50 Hz, 5 Pin - 2 Nos (3 phase)	ELMCB(RCBO)(BCH) : 410 VAC, 32 A 50 Hz, 5 Pin - 2 Nos (3 phase)	ELMCB(RCBO)(BCH) : 410 VAC, 32 A 50 Hz 5 Pin - 2 Nos (3 phase)	ELMCB(RCBO)(BCH) : 410 VAC, 32 A,50 Hz, 5 Pin - 2 Nos.(3	ELMCB(RCBO)(BCH) : 410 VAC, 32 A 50 Hz, 5 Pin - 2 Nos (3 phase)
				phase)	Nos.(3 phase)	A,00 HZ, 0 HIT-2 H03.(0 phase)	A, 30 HZ, 3 HIT-2 H03.(3 phase)	A,00 Hz, 0 Hit - 2 Hos.(0 phase)	phase)	A,50 HZ, 5 HIT - 2 N03.(5 pild36)
70										
71		centralised power backup required		Yes	Yes	Yes	Yes	Yes	Yes	Yes
72	н	Floor strength	50N/mm <sup>2</sup> Prefered	Required	Required	Required	Required	Required	Required	Required
73									open space for truck length 60 m x	
	3	Truck / Lorry space behind	Loading / unloading containers for	open space for truck/Innova	open space for truck length	open space for truck length 20 m x 10	open space for truck length 20 m x	open space for truck length 20 m x 10 m	20 m parking along with suitable coridor width upto exit ( exit area	open space for truck length 20 m x
	0	Transit area	movement to other facility	parking	20 m x 10 m parking	m parking	10 m parking	parking	shall to have provision to unload using higher capacity mobile crane	10 m parking
74 75									)	
76		Spacecraft Checkout								
		GC Lab air-conditioned with								
		glass partician and viewable to S/C clean room. Checkout		Required	Required	Required	Required	Required	Required	Required
77		wall mounted grounding copper strips / braid								
78		Dimensions in L x B x H		6m x 10m x 5m	6m x 10m x 5m	12m x 10m x 5m	12m x 10m x 5m	12m x 10m x 5m	12m x 10m x 5m	12m x 10m x 5m
					1m L v 1m P v 2.0m H. Beske					
		Equipment Racks & work		1m L x 1m B x 2.2m H, Racks & work tables – 4 Nos with cutler	1m L x 1m B x 2.2m H, Racks & work tables – 4 Nos, with	1m L x 1m B x 2.2m H, Racks & work tables – 6 to 8 Nos, cutler hammer	1m L x 1m B x 2.2m H, Racks & work tables – 6 to 8 Nos, cutler hammer	1m L x 1m B x 2.2m H, Racks & work tables – 6 to 8 Nos, with cutler hammer	1m L x 1m B x 2.2m H, Racks & work tables – 6 to 8 Nos with	1m L x 1m B x 2.2m H, Racks & work tables – 6 to 8 Nos, with cutler
		tables requirement		hammer (3Nos) and 15Amp sockets and LAN Routers/Switches	&15Amp sockets and LAN	(8Nos) & 15Amp sockets and LAN Routers/Switches	(10Nos) & 15Amp sockets and LAN Routers/Switches	(12Nos) & 15Amp sockets and LAN Routers/Switches	cutler hammer (15Nos) & 15Amp sockets and LAN Routers/Switches	hammer (12Nos) & 15Amp sockets and LAN Routers/Switches
79					riouters/owneries					
80		Cable ducts between clean room to GC		Required	Required	Required	Required	Required	Required	Required
		Pass box for flight material		Beguired	Required	Deguised	Deguined	Deguierd	Required	Permined
81		between clean room and GC		Required	Required	Required	Required	Kequired	Required	requireu
		Wireless communication between GC and clean room		Required	Required	Required	Required	Required	Required	Required
62		Electrical RAW power	Distributed through	16\/A	16\/A	16//4	161/4	16\/A	16\/A	1K\/A
83		requirement	on the walls		For PCs servers and all					
	4			For PCs, servers and all	Spacecraft Checkout	For PCs, servers and all	For PCs, servers and all	For PCs, servers and all	For PCs, servers and all	For PCs, servers and all Spacecraft Checkout Svstem
		LIPS power		racks (2/4 Nos of 22U rack) –	System racks (2 /4 Nos of 22U rack) – minimum	Spacecraft Checkout System	spacecran Checkout System racks (12 Nos) –minimum	Spacecraft Checkout System racks	racks (12 Nos) –minimum	racks (12 Nos) –minimum
		appropriate distribution		minimum 1kVA with cutler hammer interface, and power	10kVA with cutler hammer interface. and	with cutler hammer interface, and	20kVA with cutler hammer interface, and power extension	cutler hammer interface, and	50kVA (Single Phase & Three Phase) with cutler	Spacecraft of I3K & I4K
				extension boards with 15Amp	power extension boards	power extension boards with 15Amp sockets (15Nos).	boards with 15Amp sockets	power extension boards with 15Amp sockets (15Nos).	hammer interface, and power	hammer interface, and power
					(8Nos).		(10100).		sockets (15Nos).	extension boards with 15Amp sockets (15Nos).
84		Spacecraft Checkout								
85		System:								
		· Standard Test & measuring								
		Instruments - DC Power Supplies, Multimeters,								
86		Oscilloscopes, cuurent probe								
		Computer Server								
<u>87</u>		capacity, 8-core processor, 16GB RAM								
0/		RF Power meter-	1	Prefered	Prefered	prefered	Prefered	prefered	prefered	prefered
		Trequency range from 10 KHz to 18GHz, -70dBm to								
88		TZUGBM								
00		frequency range upto 40GHz								
60		Spectrum Analyzer -	1							
90		frequency range upto 40GHz								
91		Electronics Lab having								
92		work benches								
93		Soldering Station								
۰.	5	Fabrication Tools	SIZE 6m X 5m X 4m	Required	Required	Required	Required	Required	Required	Required
J*4	-	- crimping tool			,					· -
95		· -								
96		- Magnifier tool (10x) -								
9/										

	А	В	C	D	E	F	G	Н	I	J
1	SI.No	Criteria	Spec/dimensions & other details, ref page numbers	INS-Nano sats	IMS-1	IMS-2	I1K-IRS	12K NVS	13K - 14K	Scientific S/C
2		Mass & size of S/C		upto 20 kgs	100 to 250 kgs	250 - 500 KGS	500 - 1500 KGS	1500 - 2500 kg	3000 kg- 4800 kg	500-4000 kgs
З				0.6 x 0.6 x 0.6 m	1.4m x1.2 m x 1.4 m	2.5m X 1.5m X 3.0	2.7mx2.3mx3.7m	2.6x2x3.6m	3.2m x 3.0 x 5.5m	2.6m x 2.7m x 4.0 m
<u>9</u> 10	0 6 1	Mechanical fitting lab with  Bench drilling machine -  Milling machine  Milling tool for reworks.	Hand shearing machine and general tools crib. Size 8mx6mx4m door size 4mx3m	Required	Required	Required	Required	Required	Required	Required
10	3									

### Flight elements storage area

#### **ESD Safe containers:**

- Most of the flight elements are Electrostatic Sensitive Devices (ESD) i.e., they contain static sensitive electronic parts and can be damaged by common static chares which build up on people, tools and other items.
- These flight elements are to be handled, transported and stored in ESD safe storage containers.
- These containers, in addition to meeting their general requirements, are constructed from materials that prevent the build-up and discharge of static electricity.

#### Desiccator

- A desiccator is a sealable enclosure containing desiccants (water absorbing substances) used for preserving moisture sensitive items.
- All general sized flight elements stored inside the cleanroom are to be stored inside ESD safe desiccators.

#### Area inside cleanroom for storing large elements

- The cleanroom space should also account for storing large flight elements (solar panels, antennae, etc.) in a safe manner.
- Appropriate provisions for restricting movement of people around the flight elements kept in storage are to be provided.

Thankyou

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