SATELLITE TESTING

Prepared
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SOLAR PANEL DEPLOYMENT TEST

- Spacecraft operating in the inner solar system rely on the use of solar panel to derive electricity from sunlight.

- In the outer solar system, where the sunlight is too weak to produce sufficient powers, radio isotopes or thermo electric generators are used as a power source.

- Solar Energy is the primary power source for spacecraft, to operate its various sensor's, payload, telemetry, active heating and propulsion systems, therefore deployment of solar panel is mandatory for satellite and its payload operation.

- High power communication satellite needs lot of electricity for its payload operation. It needs to have lot of surface that can be pointed towards sun in order to produce more electricity. These panels are generally folded and make it compact during it launch. Once its reaches its orbit, it gets deployed and pointed towards sun to produce maximum electricity for its operation.

- Low Power satellites like Low earth orbit satellite (student satellite and HAM satellite) needs very less power. So, most of the solar cells are mounted on its body surface to produce electricity.
- It reduces the complex solar panel deployment mechanism.

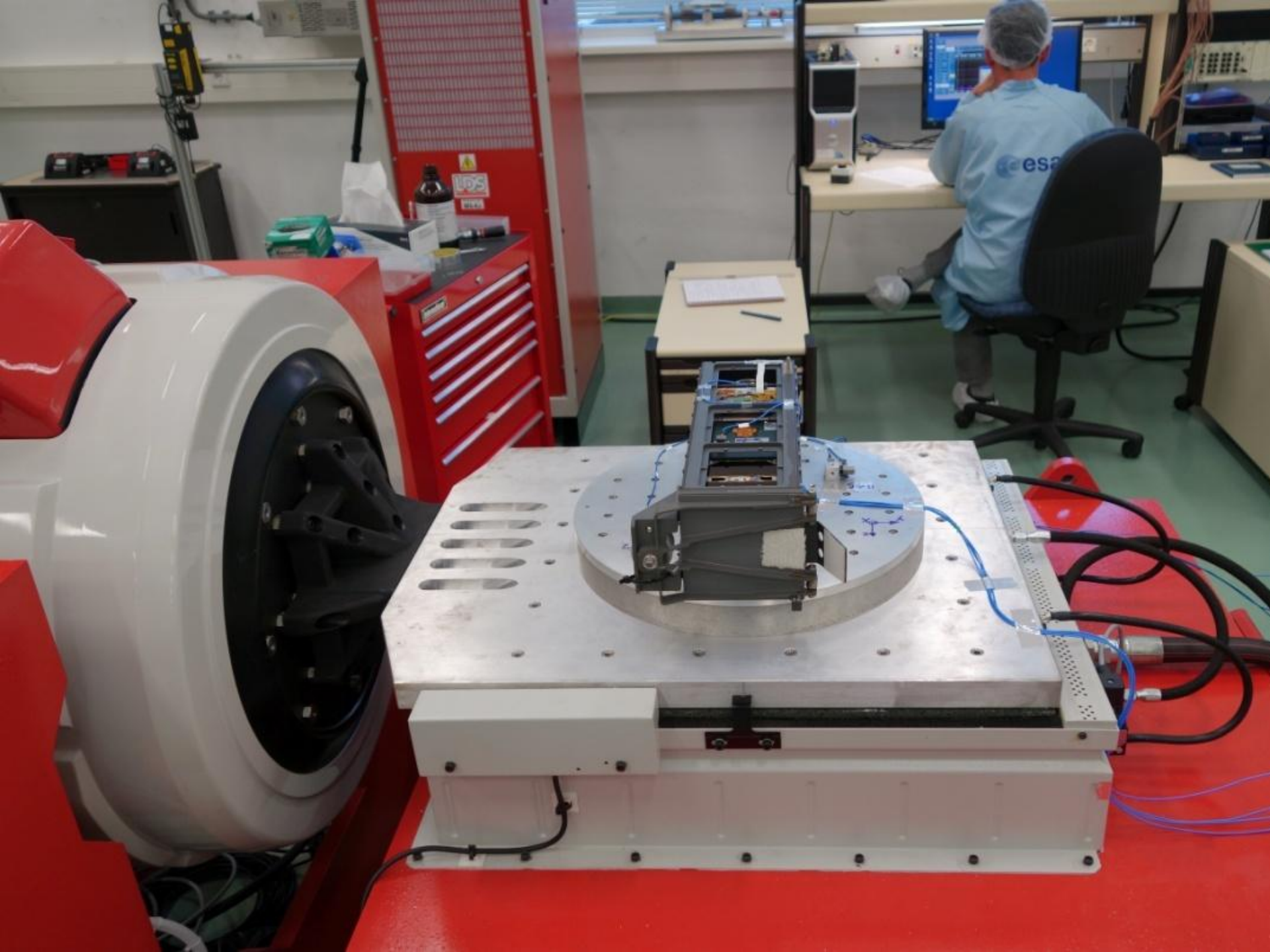
VIBRATION TEST

- Vibration Test Facility is used for simulating the low frequency vibrations caused by a rocket during its launching.

- It helps to verify whether the satellite can function normally after bearing such vibrations, and also helps to verify designs and analysis of the satellite structure meet the vibration requirements.

- To conduct the test, electro dynamic shakers digital vibration control system data acquistion system and sufficient number of accelerometers were used.

- Some times it also equipped with a drop shock machine to carry out high 'g' shock tests on components and small subsystems.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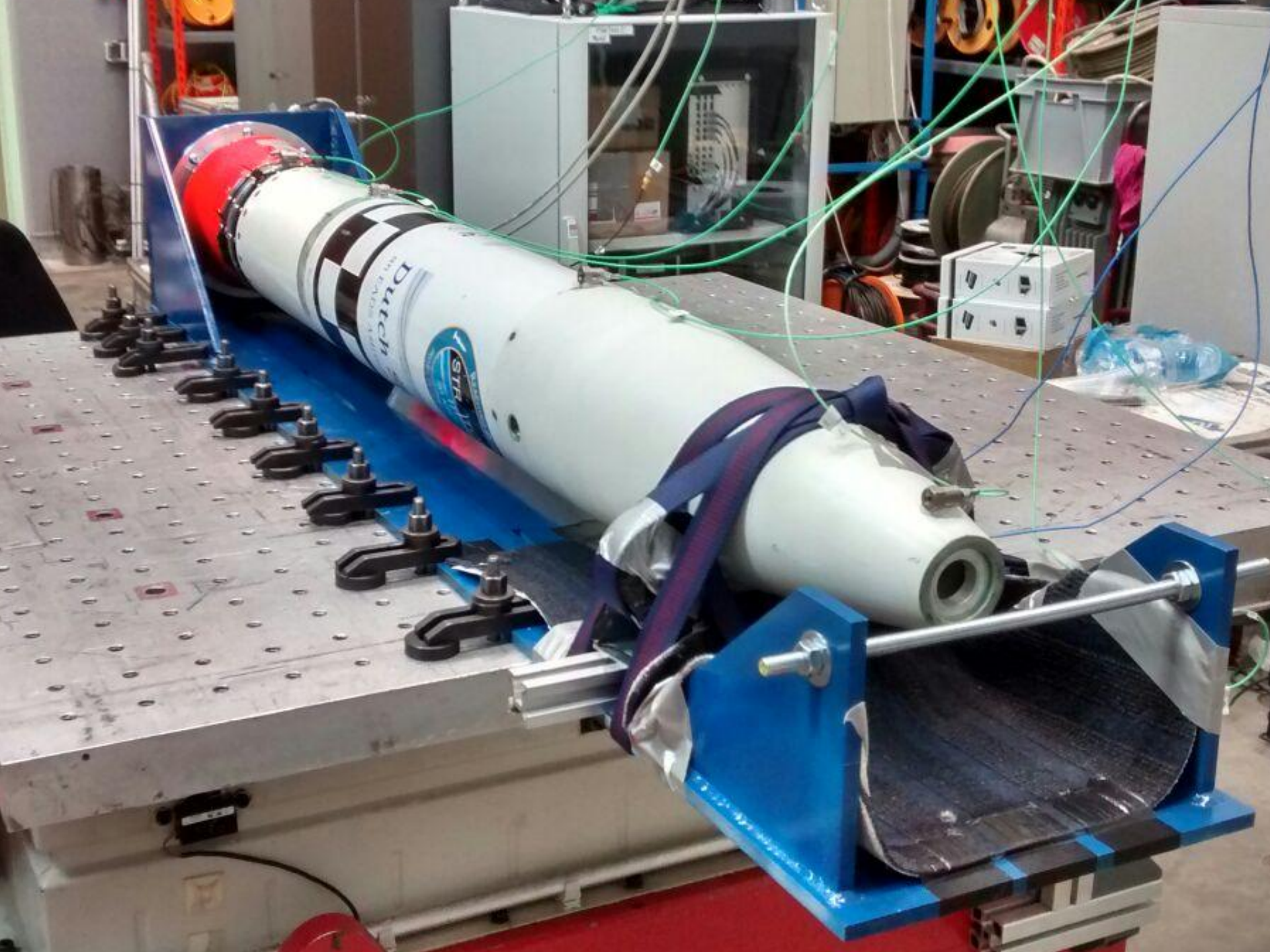


ACOUSTIC TEST

- The acoustic chamber is used for simulating a satellite during the launch process, where a vibration environment is created as a result of noises caused by the rocket during its launch.

- It helps to verify, whether satellite can function normally after bearing such acoustic vibrations, and whether the designs and analysis of the satellite structure meet the acoustic vibration requirements.

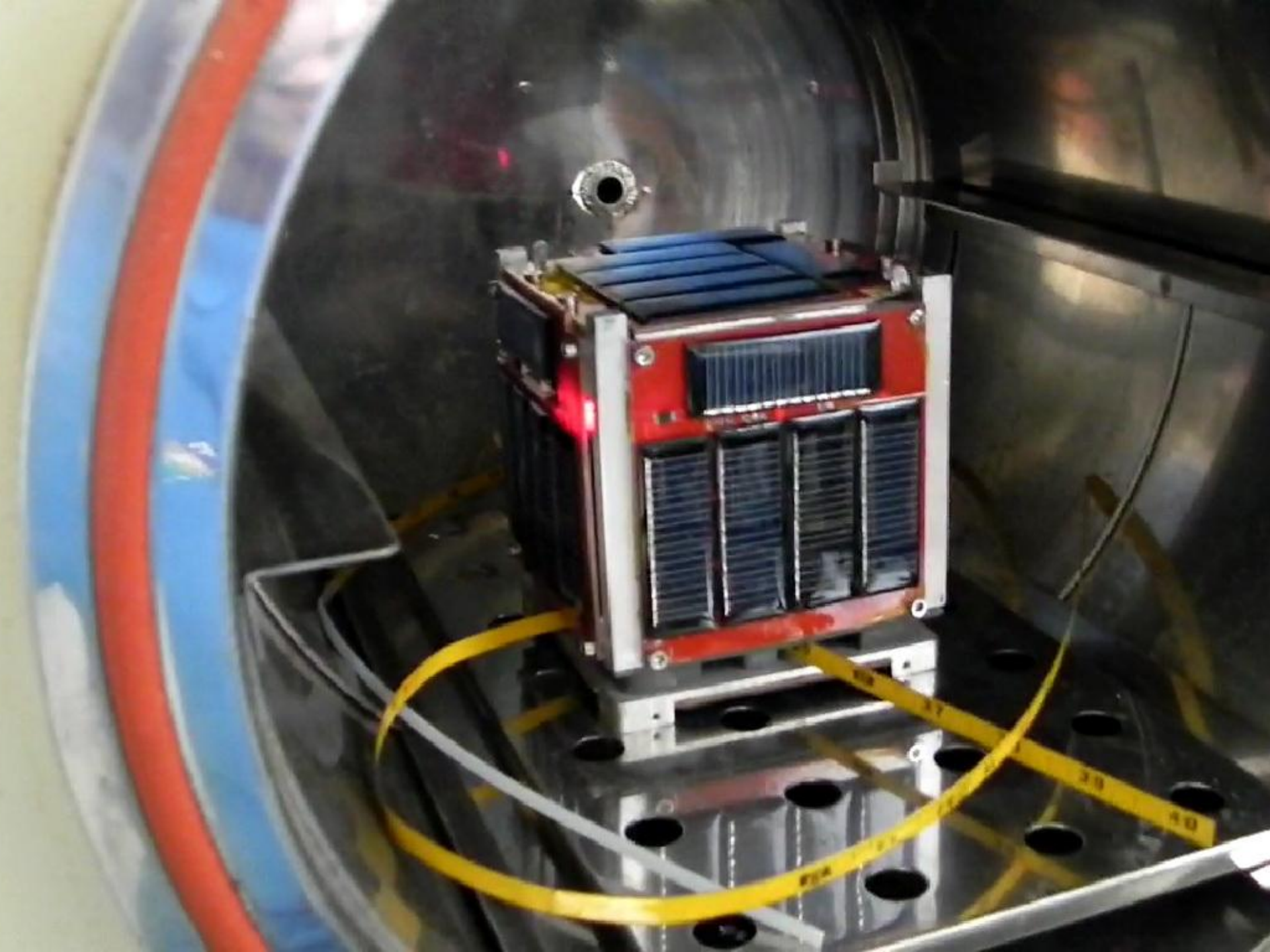
- To conduct the tests, a vaporizer is used to gasify liquid nitrogen which works as source of noise, by adjusting the flow speed with a control equipment, and by the use of a noise producer to transform the kinetic energy into acoustic vibration waves which are then directed into a blare chamber through speakers to test the satellite in the Acoustic Chamber.

THERMAL VACUUM TEST

- Thermal vacuum chambers are used to test satellite's operating performance in space environment (near vacuum with great temperature fluctuation).

- During the test, satellite is securely placed in a chamber, where a pump is used to draw out all the air, while liquid nitrogen and a heater are used to control the environment by radiation.

- Some of the test carried out are thermal vacuum test, thermal circulation test and thermal balance check, to check whether the satellite can operate normally under a vacuum environment and make sure that thermal control analysis performed during the design phase was accurate.



ANTENNA DEPLOYMENT TEST

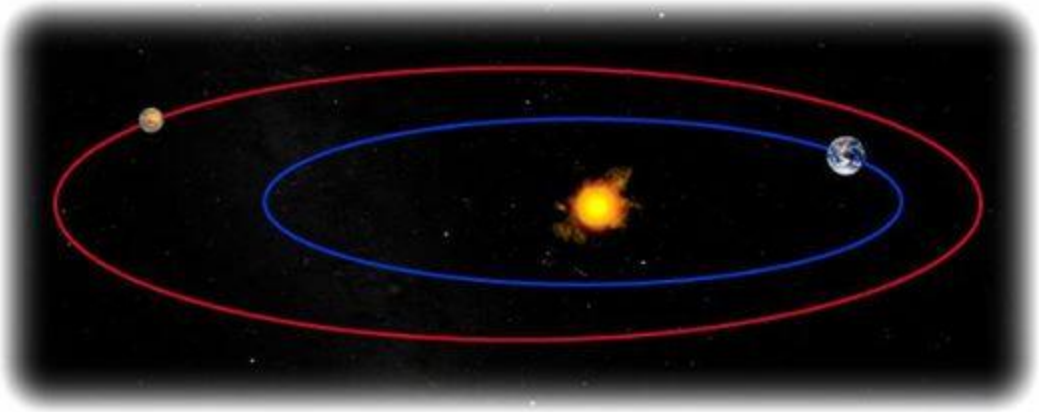
- Antenna deployment test helps to make sure that, successful deployment of satellite antenna in space, before its launch.

- For establishing a reliable communication between ground control station and satellite, antenna deployment is one of the most priority task than other.

- The antenna deployment and solar panel deployment are programmed as an automatic sequence task once the satellite is ejected from its launch vehicle.

- The uplink/downlink commands and telemetry data's are established once the satellite antenna is perfectively deployed in space.

ANTENNA TEST



WHY ATTITUDE CORRECTION IS NEEDED?

- To keep the spacecraft's instruments and antennas aimed in the correct direction.
- To keep the spacecraft solar panel in correct direction to extract maximum power.
- To keep the spacecraft in correct orientation during apogee and perigee motor firing (orbital correction).
- To keep the spacecraft in correct orientation during its interplanetary injection.

MASS PROPERTY

- Mass property measurement facility is used for precisely measuring the centroid of a satellite, moment of inertia and product of inertia, in order to provide for satellite positioning control during orbit insertion and attitude adjustments.

- During a test, a motor is used to slowly move the satellite, with the use of air-bearings to reduce resistance due to friction, to measure the power created (due to the movements) with a sensor.

- The data is then used to calculate the position of the satellite centroid and the moment of inertia by the data processing system.

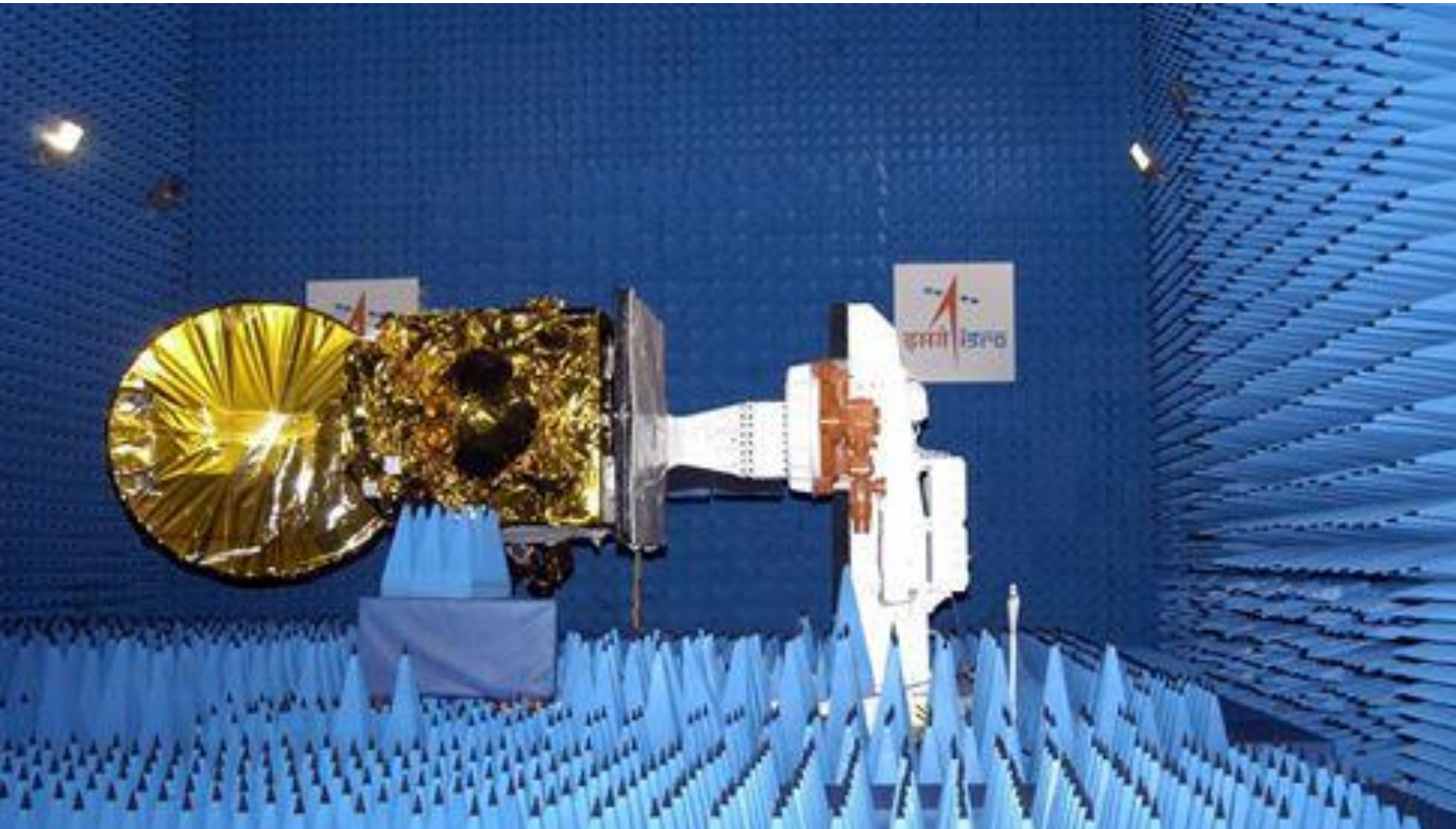
ELECTROMAGNETIC COMPATIBILITY AND ANTENNA TEST

- The electromagnetic interference and compatibility tests are used for assessing whether electromagnetic interference phenomena exist among various satellite subsystems (including payloads).

- The assessments include use of satellite antenna and a probe reader to conduct radiation and transmission tests, in order to understand electromagnetic field response produced by the satellite itself under normal operation, and find out the electromagnetic wave interference limit for which the satellite can tolerate.

- Antenna Measurement System has seven-axial action abilities, and can automatically perform antenna property measurement.

ELECTROMAGNETIC INTERFERENCE / ELECTROMAGNETIC COMPATIBILITY TESTS



ANECHOIC CHAMBER

- It helps to measures radiation patterns and also ensures that there is no degrading impact on the antenna performance as well as payload performance.

- The characterization of antenna performance on ground confirms the conformance to the design specification.

- An anechoic chamber is a room, designed to completely absorb reflections of electromagnetic waves.

- It also insulated from exterior sources of noise.

- The combination of both aspects helps to simulate a quiet open-space of infinite dimension which is ideal for testing communication antennas designed to operate in space.

- High Gain Antenna (HGA): In Mars Orbit, the 2.2 m diameter HGA system is required to transmit/receive the commands, telemetry and data between spacecraft and Indian Deep Space Network.

LOAD TESTING

- Moment of inertia
- Stress strain analysis
- Static and Dynamic load testing-pogo oscillation lead to structural damage

HARDWARE IN-LOOP SIMULATION TEST

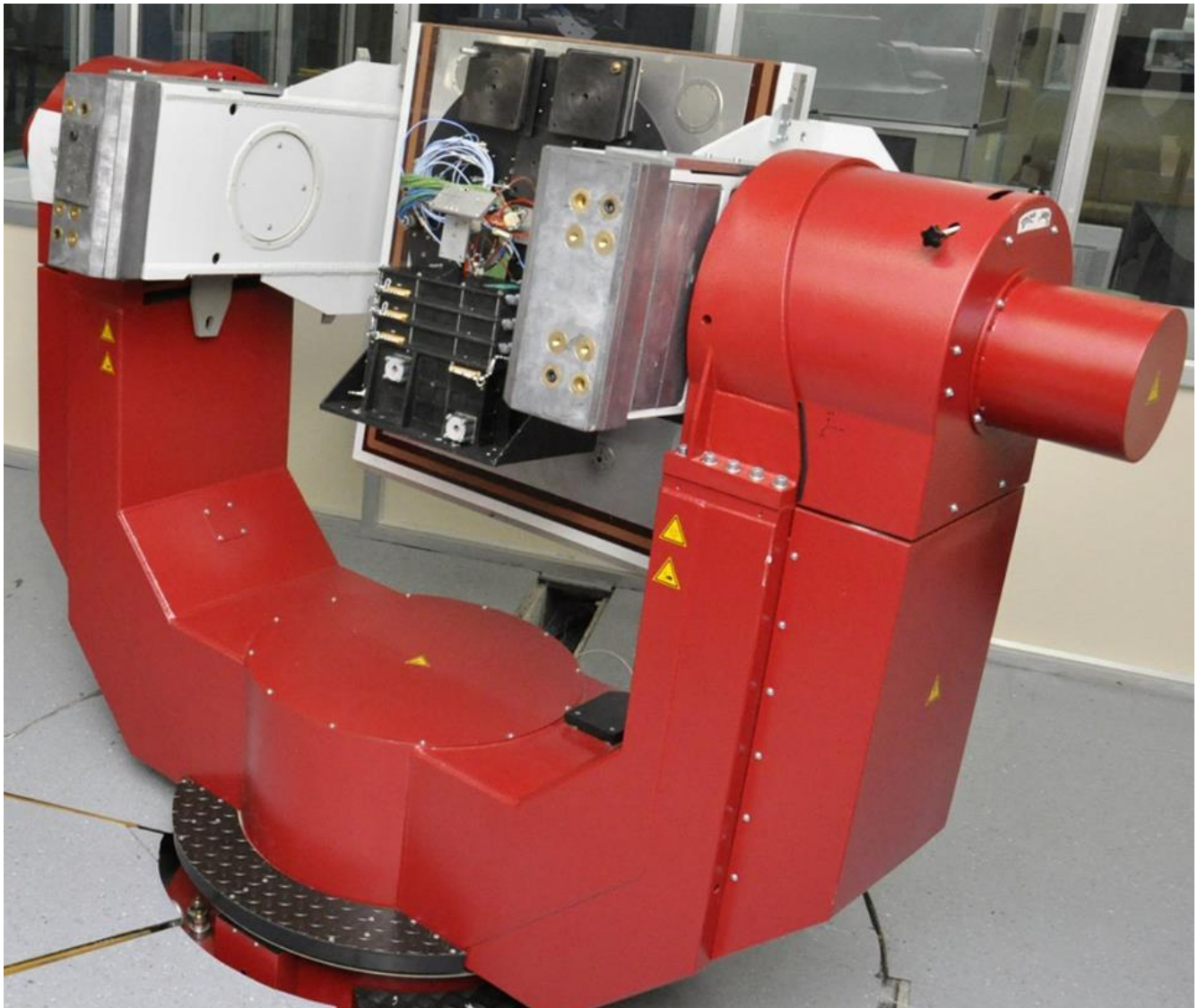
- One of the most complex systems on-board a spacecraft is Attitude Control System, which determines and controls spacecraft's orientation in space.

- A "HILS Facility" is used to test the Attitude and Orbit Control System (AOCS) of satellites in closed loop with all AOCS hardware in-the-loop, catering to the stringent requirements of the spacecraft mission.

- During HILS tests, deficiencies in the spacecraft Hardware, Software, interfaces etc are brought out and are plugged to achieve flawless operation of AOCS in orbit.

- The facility has various key elements which includes 3-axis Motion Simulators, Earth Simulators, Sun Simulators & Star Simulators to stimulate optical sensors, computing workstations, closed loop dynamics software, data acquisition and related display and plotting software.

HARDWARE IN-LOOP SIMULATION TEST



SUBSYSTEM TESTING

- Battery voltage and Bus voltage testing
- Primary & Secondary battery voltage testing
- Solar panel voltage checking
- Actuator and sensors testing
- Momentum wheel Testing
- Magnetic voltage
- Sun sensor testing
  - Indoor
  - Outdoor testing

- RF emission testing
- Pressure checking
  - Fuel tank
  - Oxidizer tank
- Solenoid valve checking.
- Travelling Wave Tube power amplifier- over gain saturation protection and its testing.

MOM team busy with mission operations at the Control Centre

THANK YOU

Drop your Query@ isrokavi@gmail.com