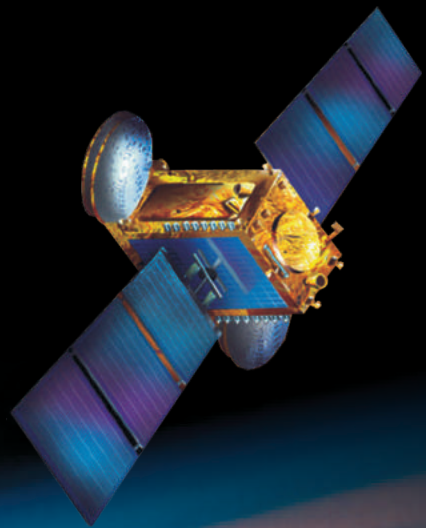




Space Sector



Innovating Technology

www.avasarala.com



Avasarala Technologies Limited

Avasarala was founded in the year 1985 with a primary objective to excel in the high technology areas of engineering requirements.

During the year 1986, capital machinery manufacturing activities were started with an objective of indigenously designing and manufacturing Special Purpose Process Machinery and Automation Systems for the electronics industry.

Avasarala has come a long way as an engineering technology company in fulfilling the requirements of high technology engineering products and services for the Factory Automation, Nuclear Power, Space, Aerospace, Defense and R&D Labs.

In 2001, ATL advanced in to Space industry with the successful manufacturing of Heat pipes for the satellites.

With the research and development work on heat pipes, ATL has received numerous accolades and recognition and have been associated with various satellite programs of ISRO (Indian Space Research Organisation).

Armed with a wealth of industry knowledge and experience, Avasarala is on the cutting edge of technology and development.

Avasarala has carved itself as a premier supplier in the business areas of:

- Nuclear Power
- Factory Automation
- Engineering Construction
- Space, Aerospace, Defense and R&D Labs



Space Sector

The product portfolio for Space sector comprises of Equipment, Products and Services.

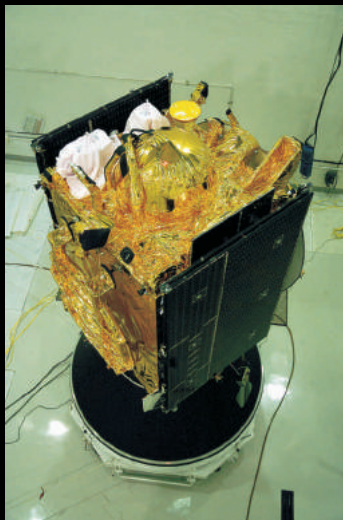
Background:

The Avasarala space unit was started in the year 2001 with an objective to cater exclusively to Specific requirements of the critical space industry, with adequate backing from the core engineering resources of the group.

The facility is located in Bommasandra Industrial Area, Bangalore with a well established and stabilized manufacturing set-up. The space quality dual core Aluminium Ammonia Heat Pipes of different types, sizes and shapes and configuration are manufactured and supplied successfully to various space programs, These heat pipes are embedded in Honeycomb panels of the satellite.

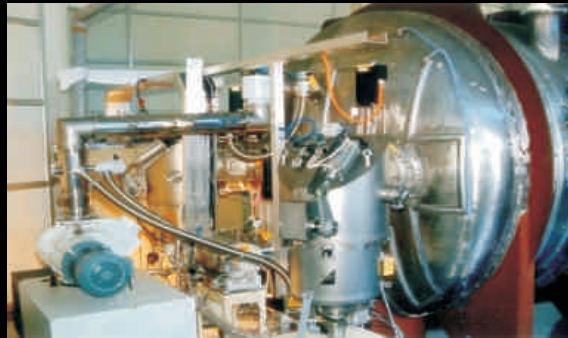
Critical heat pipes have been supplied with participation in various satellite programs of ISRO such as:

1. GSAT-3 (Edusat)
2. INSAT-4A
3. INSAT-4B
4. INSAT-4CR
5. CARTOSAT-2A
6. CHANDRAYAAN
7. EADS - Eutelsat-W2M
8. AVANTI HYLAS
9. GSAT-4
10. OCEANSAT-2
11. RISAT
12. GSAT-5
13. GSAT-5/3E
14. GSAT-8
15. ASTROSAT
16. GSAT-12
17. SS Loral



In addition to the above programs, complete thermal system services have been rendered to - INSAT-3A, GSAT-2, INSAT-3E, RESOURCESAT-1, HAMSAT, CARTOSAT-1, SRE-1, CARTOSAT-2, TWSAT, ANUSAT, INSAT-3D, CARTOSAT-2B programs of ISRO.





The facility has dedicated and trained technical resources to develop and manufacture heat pipes of various configurations and thermal systems.

Manufacturing Facilities:

Heat pipes are manufactured in a stringent controlled processes such as Cleaning, Pressure Test, Media Charging, Thermal Cycling, Thermal Performance Testing, etc.,

Manufacturing Capabilities:

- Heat Treatment
- Precision Forming
- A1 TIG Welding
- High Pressure Test Facility
- X-Ray Facility
- Environmental Test Chamber
- Machining Capability
- Vacuum Systems
- Heat Transfer Checking
- Cryogenic Cooling Facility
- Data Logging



Chemical Cleaning



Thermal Test Chamber



Finishing Set up



Pressure Test



Testing

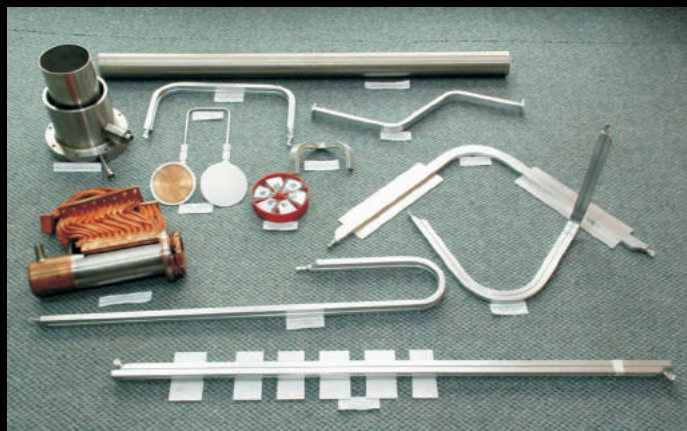


Products

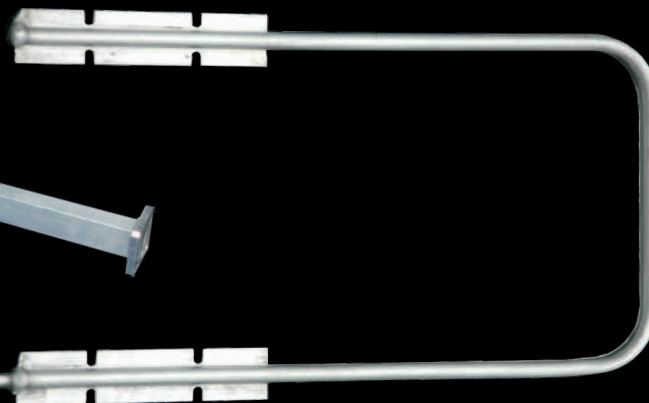
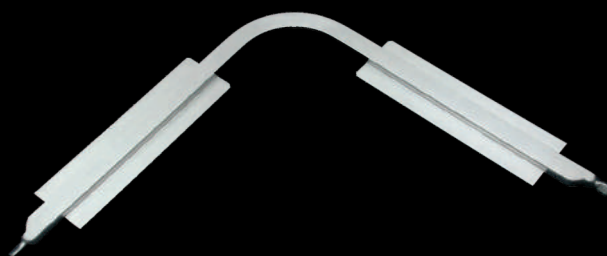
Heat Pipes:

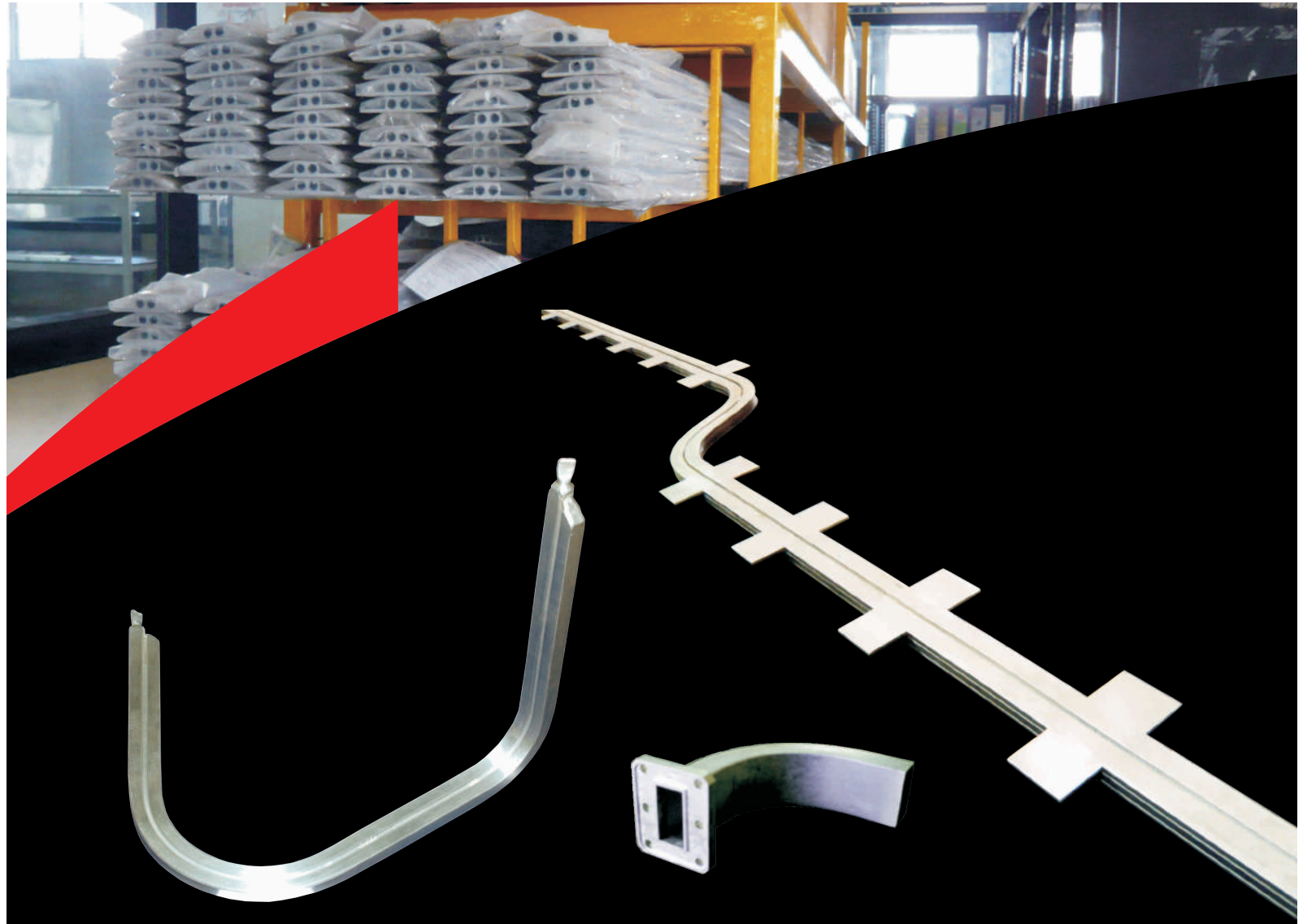
Heat pipes typically provide a quick mechanism to transport heat from the spacecraft electronics and instruments to its radiators. These are two phase heat transfer devices circulating a working fluid, such as ammonia, that evaporates and condenses to transport heat. Heat pipes provide a highly energy efficient means to transport hundreds of watts of thermal energy across several metres.

Heat pipes can be embedded within a honeycomb panel and bonded to the inner surface of the face sheets to achieve highly efficient heat removal. Surface mountable heat pipes with flanges attach to heat pipe panels to transfer heat from internal equipment to external radiator panels.



A heat pipe is generally, a closed pipe structure having an internal capillary which is filled with the working fluid or media. The heat input causes the media to evaporate quickly, thereby carrying the heat towards the colder heat dissipation section, where it condenses back in to liquid form. The condensed liquid flows back in to the hot zone by capillary forces to complete the cycle. Due to its high reliability and simplicity, heat pipes have gained a position as a standard device for thermal control on spacecrafts and instruments.





Thermal Specifications:

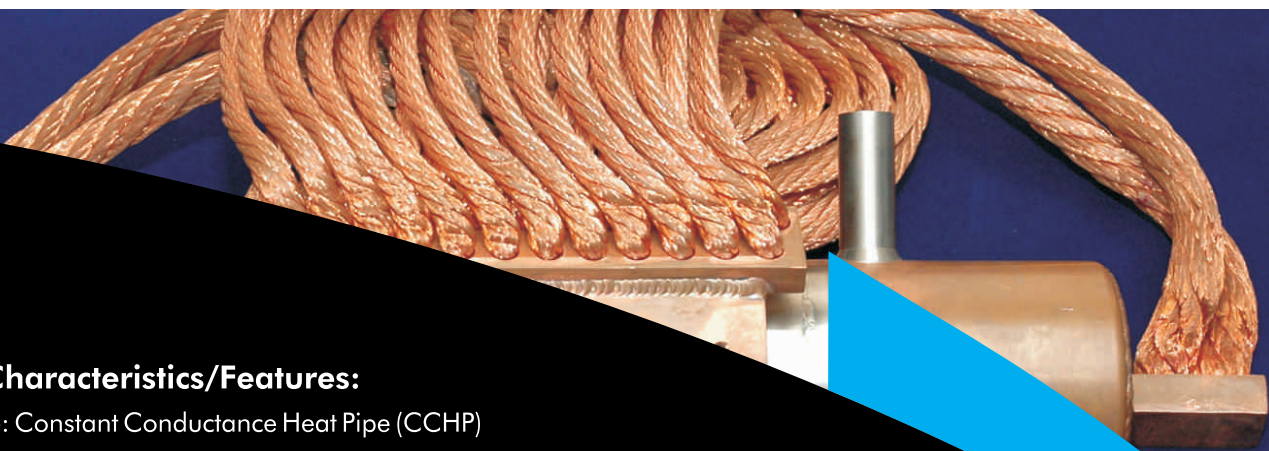
Type of heat pipe	Dual core constant conductance heat pipe
Operating Temperature range	-40°C to +60°C
Heat Transport Capability of each core	Straight Heat Pipe : >150 Wm. @ 20°C and >120 Wm. at +60°C with temperature gradient less than 5°C for an input/output heat flux of 1.5W/cm2 in horizontal condition (i.e. under near 0-g condition) Bent Heat Pipe : The performance degradation should not be more than 5% per bend of the straight pipe for bend radius of 50 mm & bend angle of 90°
Non Condensable Gas Plug length	Less than 15mm @ -40°C Heat pipe temperature

Mechanical Specification

Dimensional control details and finish	Flatness : 0.10mm per 300mm and 0.20mm per full length Roughness : 0.008mm Parallelism : 0.20mm per 1000mm Straightness: 0.50mm per 1000mm Visual defects: scratches, digs and dents (not deeper than 0.08mm)
Proof Pressure Test	189 kg/cm ² at room temperature
Burst Pressure Test	255 kg/cm ² min. (Destructive test on sample basis)
Shape	As per customer requirement (eg. Straight, L-Bend, Multi Bend, S-Bend & two plane bend etc)

Material & Working Fluid

Envelope tube material	Aluminum alloy 6063-T6 or equivalent
Wicking system	Axial grooves (extruded type)
Welding	Tungsten Inert Gas welding
Helium Leak Test	Less than 1x10 ⁻⁸ SCC/sec
Working Fluid	>99.999% purity(Anhydrous Ammonia with water vapour content < 0.3 PPM)
Leak rate for Ammonia	Less than 1 x10 ⁻⁷ scc/ sec at envelope Less than 1 x 10 ⁻⁶ scc/sec between two vapour cores



Technical Characteristics/Features:

Heat Pipe Type: Constant Conductance Heat Pipe (CCHP)

Construction: Axially grooved precision Aluminium Alloy Extrusions

Working Fluid: Ultra high purity Ammonia

Heat Input: Up to 10 W/cm^2

Profile Geometry: length up to 4 metres,

Main Features: Straight Heat Pipes, Bent Heat Pipes, Embedded Heat Pipes, Profiles single core and dual core

Key Benefits: High performance, Low mass, Flight qualification, Possibility to develop new profiles upon customer requirements

Qualified manufacturing process

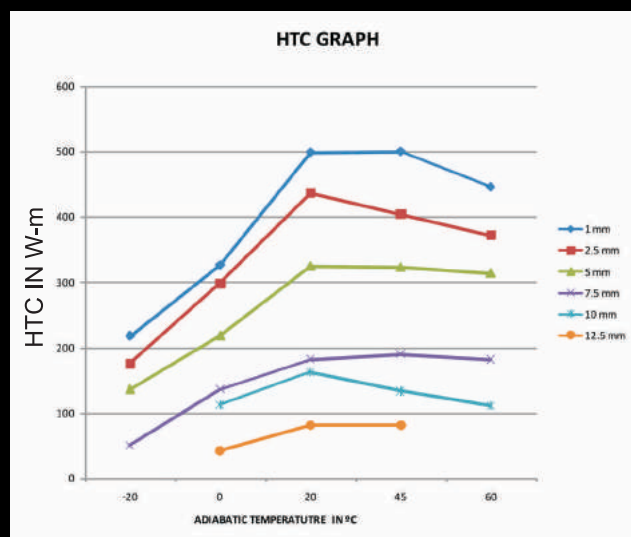
Computer assisted manufacturing and test facilities

Ammonia Heat Pipe Performance

Power Wm Vs Temperature Graph

Qualification: On ground qualification as well as in flight qualification done as per ISRO standards

Qualification for 20 year on orbit operation.

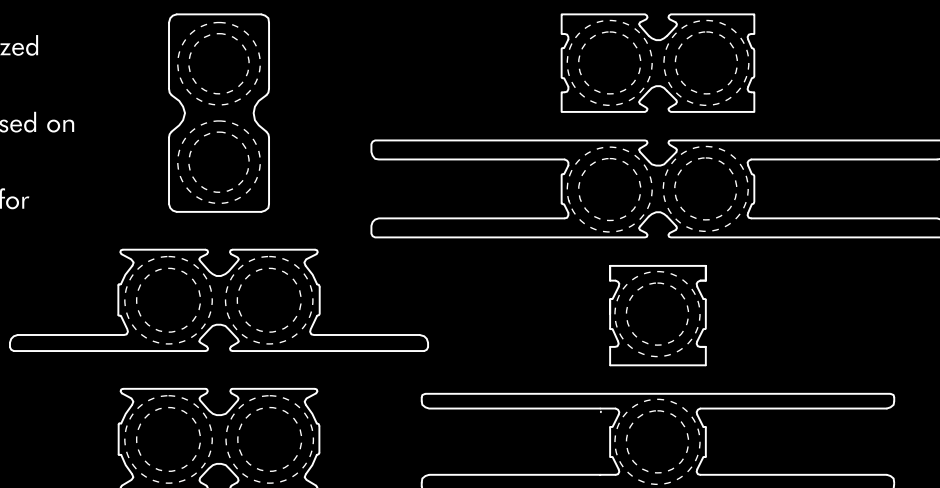


Wave Guides

- Avasarala offers critical space grade Al section waveguides with critical dimensioning, shapes, with dip brazed flanges and silver plated internals.
- Products will be made available based on custom requirements
- The products have been approved for space applications



Typical Cross Section of Heat Pipes



Services

Thermal System Services:

Avasarala provides onsite thermal system services for satellite integration and assembly in clean room environment. The highly skilled thermal system team provides the following services :

- OSR Bonding
- Multi-Layer Insulation - MLI Fab & Implementation
- Tape Heater
- Foil Heater
- PRT/Thermistor
- Thermal Control Tape
- Thermal Painting
- Thermal Grease Application
- Thermal Properties Measurement and Testing Services

Avasarala's Space group skill sets :

- Copper - Copper welding in an inert atmosphere enclosure.
- Aluminium - Aluminium Welding using TIG technology for high pressure application conforming to level 2
- Stainless steel - Stainless Steel FUSION welding
- Dip Brazing for Aluminium joints formation (space grade reliability approved)
- Manufacture of high precision components with surface treatment such as Chromatising, hard anodising, etc.,

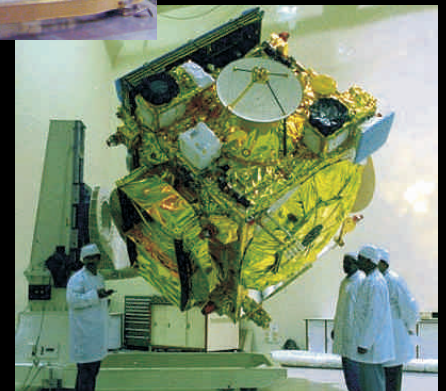
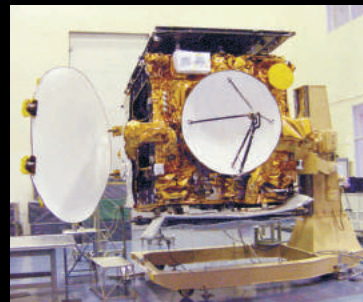
Application areas : Aeronautical, Space, Medical, R&D

Services Capabilities

- Electrolyzing: A process of Hard Chrome plating, hardness achieved is in the range of 65 min HRC to 71 HRC; Thickness: 10 microns to 25 microns.
- Nickel Forming: A highly specialised capability to produce extremely thick Nickel surfaces required for critical applications. A nickel coating of 2000 microns with in a tolerance limit of 20 microns with hardness in the range of 135 VHN.
- Copper to Copper Welding: A special capability to weld copper to copper parts in a precise way, using TIG welding facility and in an enclosed atmosphere.

Typical Application: Thermal heavy duty connections for power devices.

- SS Welding: Using TIG welding facilities.



Equipment

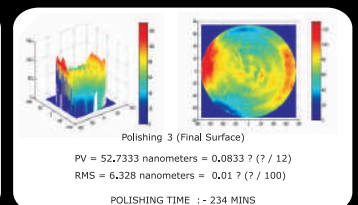
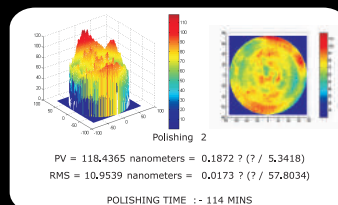
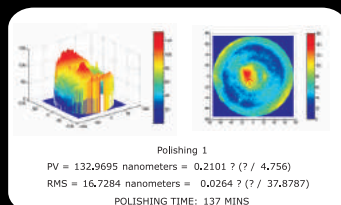
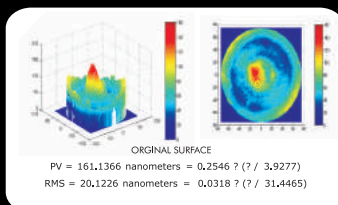
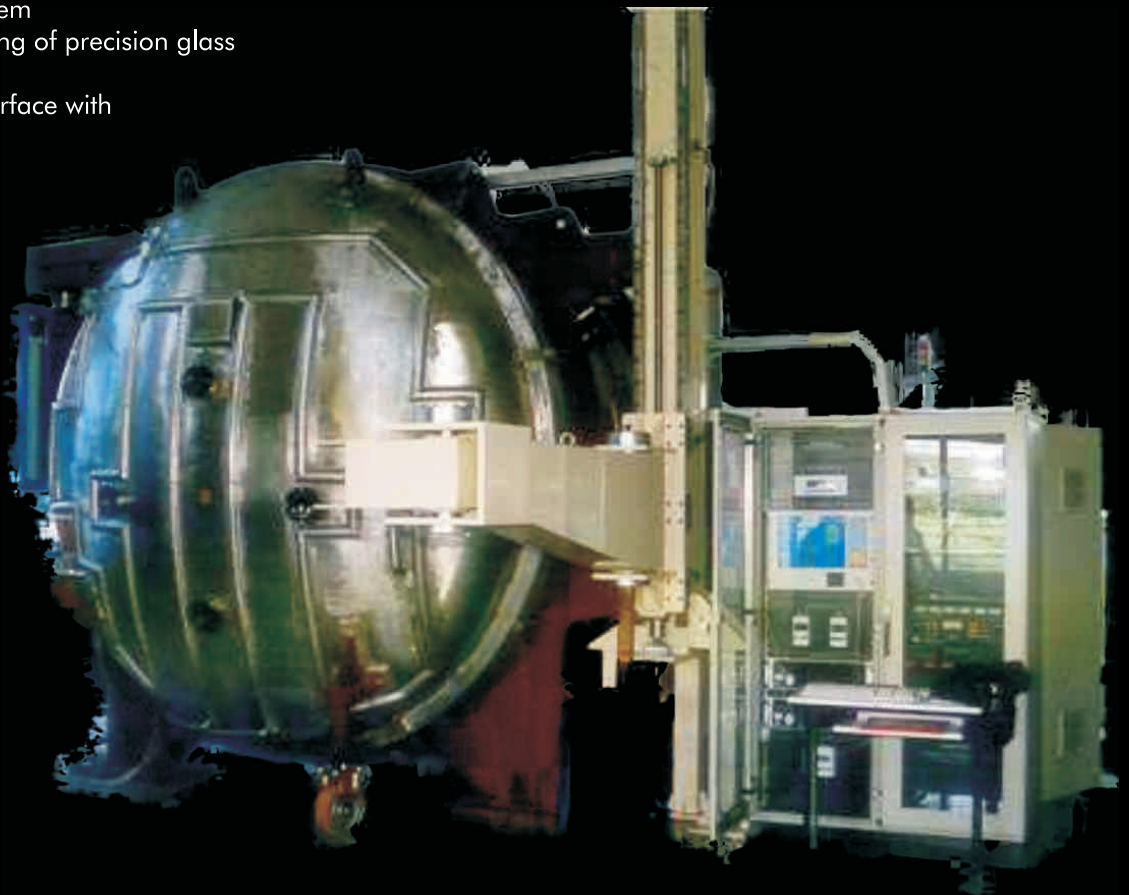
Avasara has been a pioneer in providing various critical ground equipments to space industry. Starting from developing critical thin film burr free punching to ion beam polishing systems have been designed, developed and successfully delivered.

Ion Beam Polishing:

Polishing of large diameter Mirrors - 1Mtr to a Surface Finish of 10 Nanometres.

Features :

- SS-304L Chamber: 3.2m dia / 2m long
- Vacuum: 1×10^{-6} mbar
- Ion Guns: 16 cm
- Vacuum compatible 5 axes Movement
- Software for Laser Interferometer output
- Data Acquisition System
- Non contact machining of precision glass & silicon carbide
- CNC Controls to Interface with interferometer output

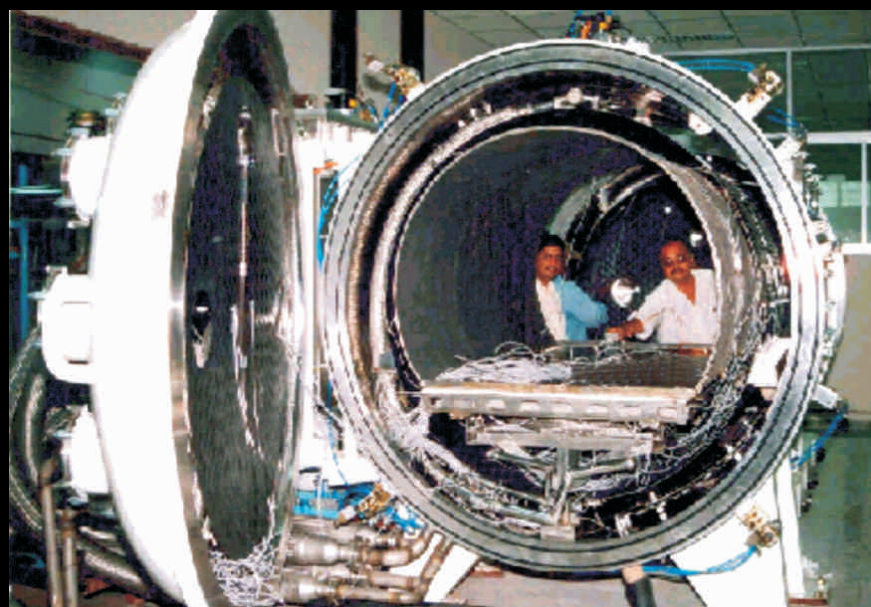


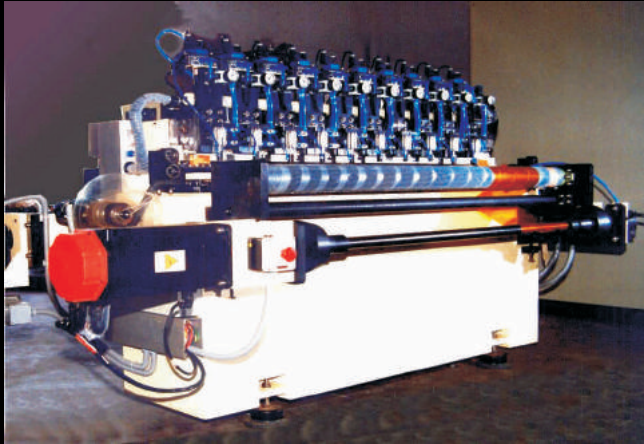


○ Conformal Coating System to VSSC

Thermovac Chamber

- Application: Multipactor RF Testing of Satellite Packages
- Features: Test facility with active / passive shrouds & RF Shield (Eccosorb) barriers at 1×10^{-7} m bar
- Thermal Cycling: -100°C to $+100^{\circ}\text{C}$
- Chamber: Dia 1.68 m X 2.2 m





CNC Perforating Machine

- Perforation in 6 micron Kapton & Mylar Sheets
- Features: Burr free & Slug free Perforation
- Supplied to ISAC Bangalore



- Gimbal Assembly



- Thin Film Coating System

Supplied to LEOS Bangalore

Quality Certifications:
Certified for QMS, EMS OHSAS & Aerospace



ISO 9001 : 2008



ISO 14001: 2004



OHSAS 18001 : 2007



AS 9100

ASME and N-Stamp Certifications under process



Equipments for S 200 Motor (Mark III Project) Launch Vehicle. Design, Manufacture, Supply, Erection & Commission at Sriharikota

- ▶ Spill Collection System
- ▶ Hardware Surface Preparation System
- ▶ Casting Facility
- ▶ NDT Equipments
- ▶ Bowl Cleaning Machines
- ▶ Mixing Instrumentation Package



Manufacture of Suspension frame and re-furbishment of W2M transport container



○ Suspension Frame



○ Container before Re-furbishment



○ Container after Re-furbishment

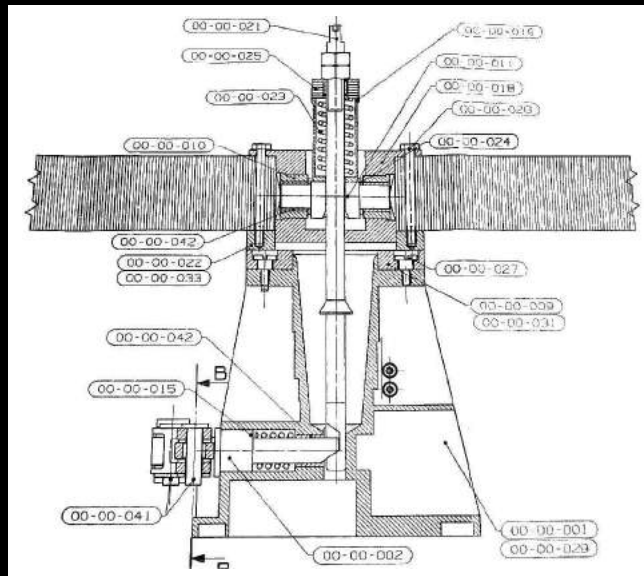
Oxidation Tank

- Size of the tank:
Inner Dia 2500mm x Height: 2908 x Wt: 5mm
- Material Of Construction: IS 2062 Gr. B
- Corrosion Resistance Coating: Fibre-Reinforced Plastic (FRP) of 3 mm
- Supplied to LPSC Mahendragiri



○ Oxidation Tank

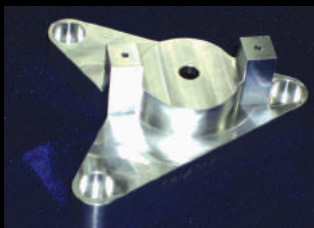
Solar array Deployment Mechanism and sub-assemblies



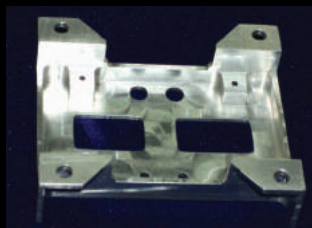
Fork end bracket



Hinge bracket



Corner pulley bracket



Pyro cutter mount bracket



Eye end bracket



CCI Bracket

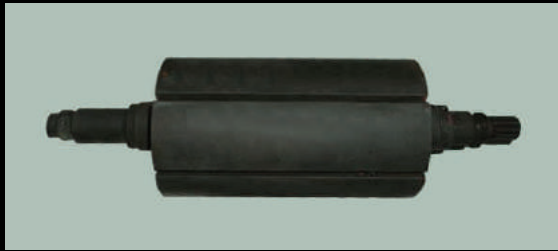


Base A



Critical Components to Space Units

Actuator components to VSSC



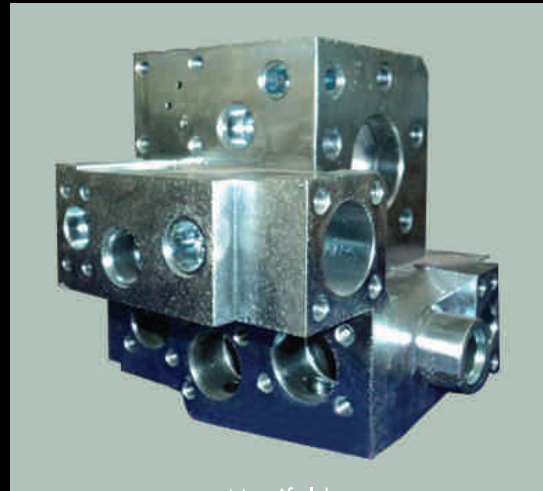
Rotor



Spool & Piston



Cylinder



Manifold

Injector elements to LPSC





Somanahalli, Bangalore



Raghuvanahalli, Bangalore



Bommasandra, Bangalore

FACILITIES



Corporate Centre, Bangalore



Avasarala Technologies Limited

Corporate Centre

47, 36th Main, BTM 1st Stage, Dollar Scheme, Bangalore - 560 068. INDIA Tel.: +91 80 2668 3860 Fax : +91 80 2668 3935
e-mail : info@avasara.com website : www.avasara.com

WORKS

ATLB

#61A, KIADB Industrial Area,
Hosur Road, Bommasandra
Bangalore 560099, INDIA

Tel: +91 (80) 2783 4213
Fax: +91 (80) 2783 5909

ATLR

#14/2, Raghuvanahalli, 14th KM,
Kanakapura Road,
Bangalore 560062, INDIA

Tel: +91 (80) 2608 3000
Fax: +91 (80) 2843 5207

ATLS

#60, K.Choodahalli, Somanahalli Gate,
27th KM, Kanakapura Road,
Bangalore 560082, INDIA

Tel: +91 (80) 2608 3300
Fax: +91 (80) 2608 3301