National Aeronautics and
Space Administration

Atmospheric Reentry

Johnson Space Center (JSC) offers expertise and facilities for the simulation and testing of the aerothermal heating experienced by spacecraft as they enter planetary atmospheres. The 13 Megawatt Arc Tunnel provides capability to perform aerothermal heating environment tests necessary for the screening, development, and certification of manned and unmanned spacecraft thermal protection systems. This facility is a high altitude, hypersonic wind tunnel facility that uses electric power to heat and accelerate air to simulate convective heating conditions experienced by spacecraft during reentry. The Radiant Heating Test facility provides capability of performing multizone, high-temperature, radiant heat testing of large spacecraft thermal protection systems and associated structures in a controlled pressure environment to simulate reentry thermal profiles, thermal gradient, and pressure.

Services Provided

- Earth (air test gas), Mars, and Venus planetary entry testing (carbon dioxide test gas)
- Basic material testing and screening
- Development testing – gaps, seals, and attachments
- Clipped hardware – RCS nozzles, antennas, instrument penetration, windows, and hatches
- Sustaining Engineering
  - Orbital debris
  - Design changes
  - Recertification of materials
- Simulation
  - Ascent heating and pressure decay
  - On-orbit cold soak
  - Reentry heating and pressure
- Large scale system tests
  - Nose cap
  - Wing leading edge
- Small scale tests
  - Materials screening
  - Conductivity testing
  - Advanced materials

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Atmospheric Reentry Materials and Structures Evaluation Facility

Parameter	Conical Nozzle		Channel Nozzle
Gas	N_2 + O_2 (0 – 50% O_2), CO_2		N_2 + O_2 (0 – 50% O_2), CO_2
Input power	0.5 – 13 MW		0.5 – 13 MW
Nozzle exit (inches)	3.5, 5, 7.5, 10, 12, 15, 18, 20, 25, 30, 35 and 40		2 x 10, 2 x 18, 2 x 30 Height x width @ test article center
Bulk enthalpy (BTU/lbm)	1,500 – 20,000		1,500 – 20,000
Type of test article	Stagnation	Wedge	Flat panel
Sample size (inches)	27 Dia. Max.	3 x 3, 4.5 x 5, 6 x 6, 12 x 12, 24.5 x 24.5	4 x 4, 12 x 12, 24 x 24, 8 x 10
Convective heating rate (BTU/ft^2 – Sec)	0.5 – 1300	0.5 – 234	12” x 12” 2 – 78 24” x 24” 2 – 45
Surface pressure (psf)	2 – 1000		4 – 110
Surface temperature	400 – 5,500 °F*		1, 000 – 3,100 °F*

* Maximum temperature is dependent on material

Preparing sample inside Arcjet

Radiant Heat Test Facility

Parameter	Radiant Heat 1	Radiant Heat 2
Chamber dimensions	10’ x 18’	92” x 92”
Article size	72” x 110”	24” x 24”
Gas	Air, N_2	
Pressure range	0.1 – 760 torr	
Tempera-ture range	300 °F – 3200 °F	
Radiative heating rate	0 to 90 BTU/ft^2 – sec entry profile, 22 zones	0 to 90 BTU/ft^2 Entry profile, 1 zone
Test article type	Flat, radically curved	Flat, small curvature
Heater	1 – 5 MW	

We have developed customer-friendly agreements to streamline business relationships and are eager to share our unique facilities and expertise with new customers. We invite your inquiries regarding application or adaptation of our capabilities to satisfy your special requirements. Briefings on general or specific subjects of mutual interest can be arranged at JSC or at your business site.

Facility Testing Information
http://jsceng.nasa.gov

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