Major Hypersonic Ground Test Facilities

• The following brief summary is taken from “Advanced Hypersonic Test Facilities”, edited by Frank Lu and Dan Marren, AIAA Progress in Astronautics and Aeronautics, v. 198, 2002.


• Best overall description of facility types can be found in Lukasiewicz, “Experimental Methods of Hypersonics”, Marcel-Dekker, 1973. No more recent overall summary at an introductory level.

• Many facilities were closed during the 70’s, 80’s, and 90’s. U.S. industry has closed (nearly) all their facilities.
Major Hypersonic Shock Tunnels

- CUBRC shock tunnels: LENS I, LENS II, LENS-X. Reflected shock tunnels Mach 3-14, nozzle exits to 5-ft dia., vel. to 15 kft/s. LENS-X is a new expansion tunnel, very large, perhaps can achieve high enthalpy with minimal contamination.
- U-12 shock tube at TSNIIIMASH near Moscow. Nozzle with 3 m diameter.
- Detonation-driven shock tunnels at Beijing, Aachen, and UT Arlington.
- Free-piston shock tunnels at Australia (T3 and T4), Caltech (T5), Germany (HEG, 0.44m exit dia., P0 to 900 atm., T0 to 8100K, H0 to 22MJ/kg, Re to 6.7e5/m), and Japan (HIEST, piston to 780 kg, 1 m nozzle, H0 to 25MJ/kg, P0 to 1500 atm.).
Specialized Hypersonic Blowdown Tunnels

- Moscow, TSNIIMASH, piston gasdynamic unit, opposing pistons, P0 to 2500 atm., T0 to 4000K, runtimes to 1 sec.
- Arcjets at AEDC, NASA Ames, SCIROCCO in Naples, Italy, LBK at Cologne in Germany, high enthalpies and long run times, poor flow quality, used to test TPS materials.
- 8-ft high-temperature tunnel at NASA Langley, vitiated air system, used to test scramjet propulsion systems. Burns methane. 8-ft. test section. To 200 atm. at 3000F.
- NASA Glenn hypersonic tunnel at Plum Brook, T0 to 2200K, P0 to 80 atm. Nitrogen with graphite heater.
- French ONERA F4 hot-shot tunnel. Nozzles to 0.9m dia. Arc driven by energy stored in a 15-ton flywheel.
- AEDC Tunnel 9 at White Oak. Nozzles of Mach 7-14, Re to 48 million per foot, P0 to 1000 atm., cold nitrogen with graphite heater.
- Other large blowdown tunnels in Germany, France, Japan, Russia, probably China.
Hypersonic Tracks and Ballistic Ranges

- Test track at Holloman AFB in New Mexico. Speeds to 3 km/s on rails in the desert. Rocket-boosted sleds.
- Ballistic ranges shoot projectiles out of light-gas guns into long tubes with controlled atmospheres:
  - Track G at AEDC in Tullahoma has 8 and 14-in. guns, 1000 ft. of range, roughly 4-7 km/s and seeking 10 km/s.
  - NASA Ames has a smaller range, but this one can fire counterflow into a shock tunnel to increase the relative velocity.
- Ballistic ranges also exist elsewhere, at ISL in France, Eglin AFB in Florida, etc.