NASA Ames Sonic Boom Testing

Review of Ames/Gulfstream Sonic Boom Test in the Ames 9-by 7-Foot Supersonic Wind Tunnel (Sept. 2008)

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Outline – *will be updated as charts progress…*

- Sonic Boom Testing
- Facility
- Models
- Probes
- Results
- Lessons Learned

Include graphic of model, tunnel, and signature lines
Also show plot of shocks propagating to ground

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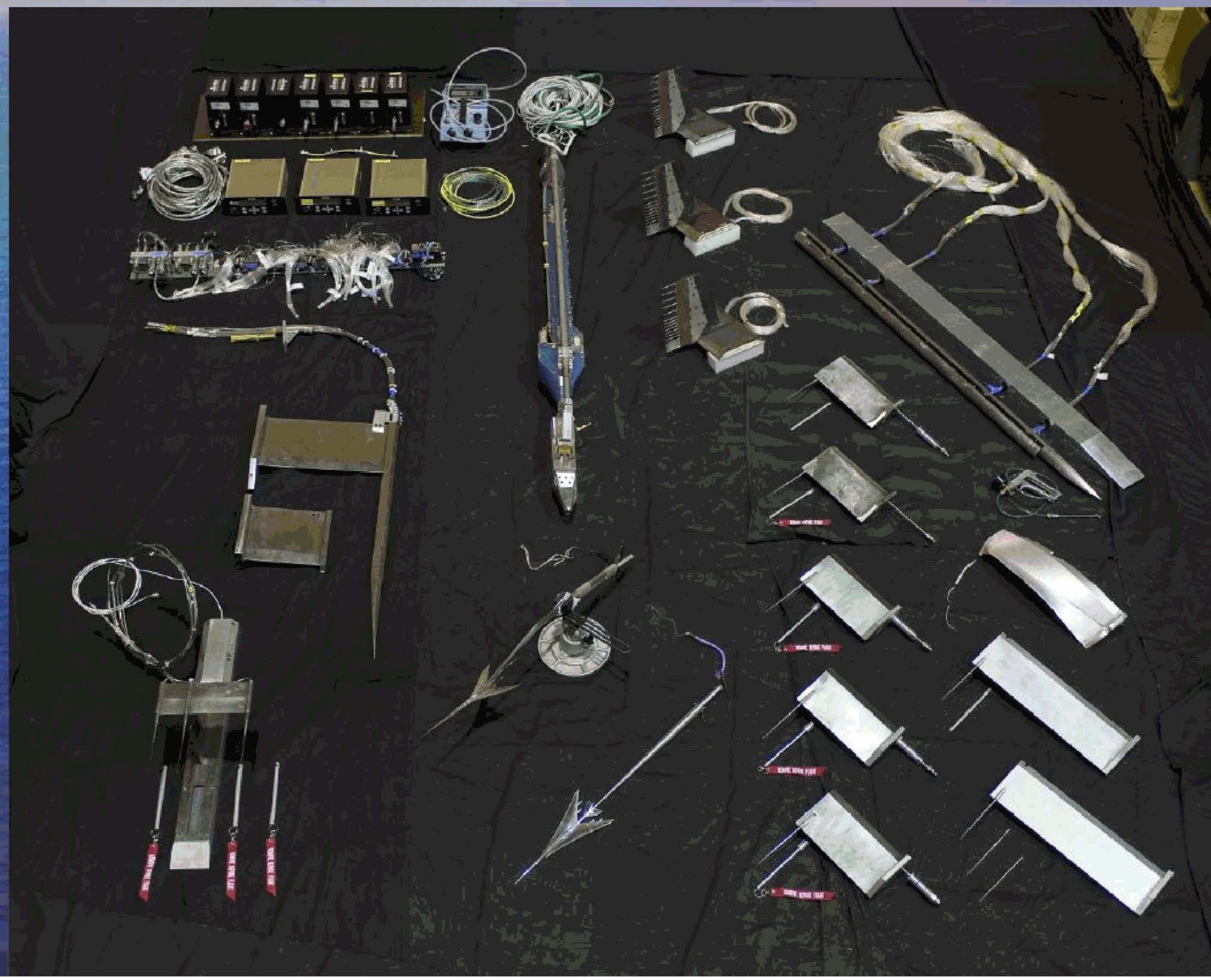
Sonic Boom Testing in a Nutshell

- Acquire pressure “signatures” in flow field surrounding model
  - Line of static pressure variation parallel to the freestream
- Measure pressures along a line directly below model (as along a ground track)
  - Measurements at other angles relative to the model are also commonly taken for determination of off-ground-track boom loudness
- (post-test) Extrapolate signature to ground to determine merging of shocks as boom propagates and sound pressure levels at ground

So what does it take to do a Sonic Boom Test?

Just a few parts…



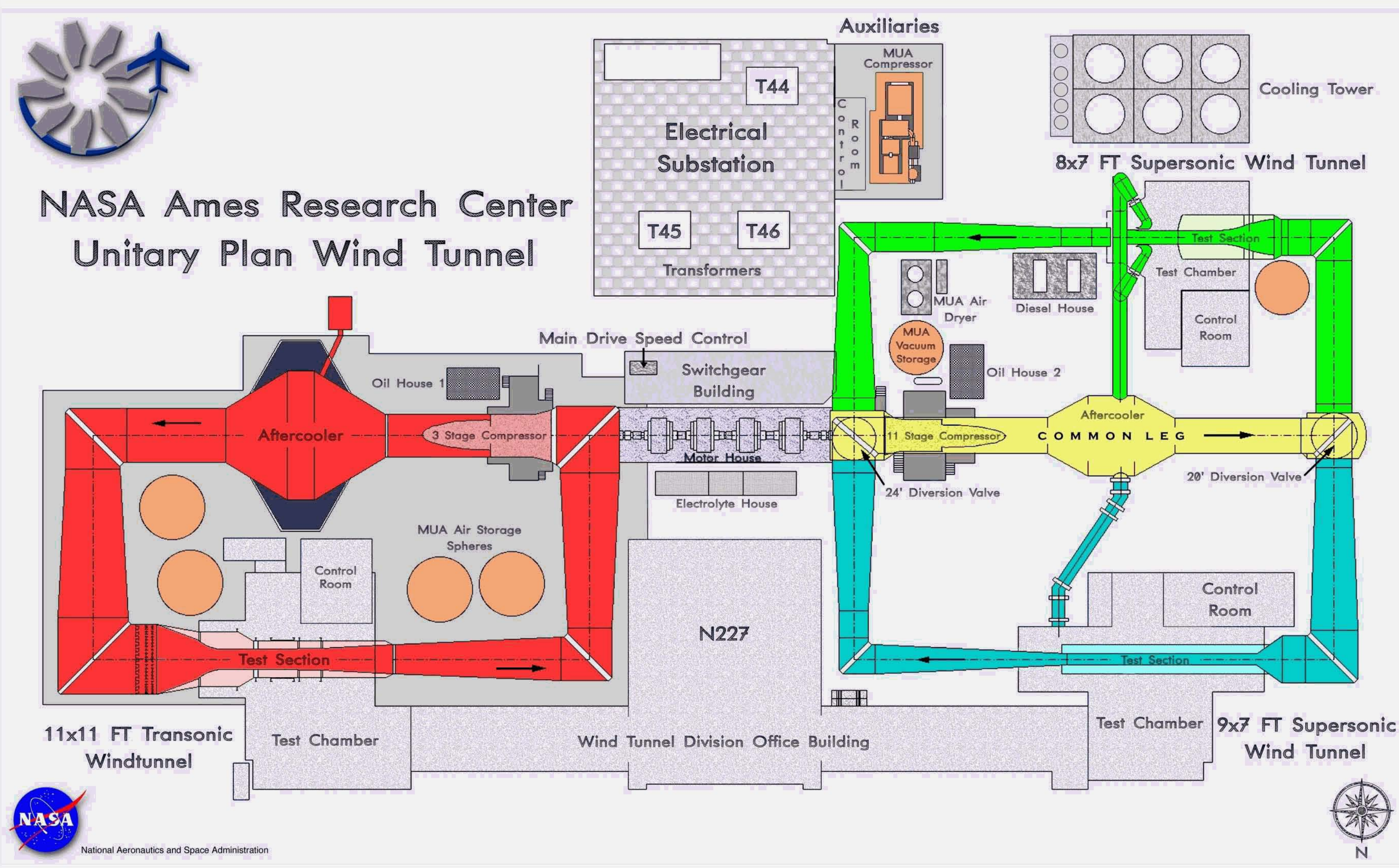
The Most Important Parts: Model & Probes

- Small model (typically 10 - 20 inches in length) to allow for high h/L (number of body lengths from probe)
- Probe(s) mounted on wall out of tunnel boundary layer
- 3 ways to get signature along length of model:
  1. Move model relative to probes
  2. Move probes relative to model
  3. Use probe rail: many orifices over long length, model & rail remain stationary (or small model movements to cover orifice gaps)

Particular Objectives for Ames 9x7 Test

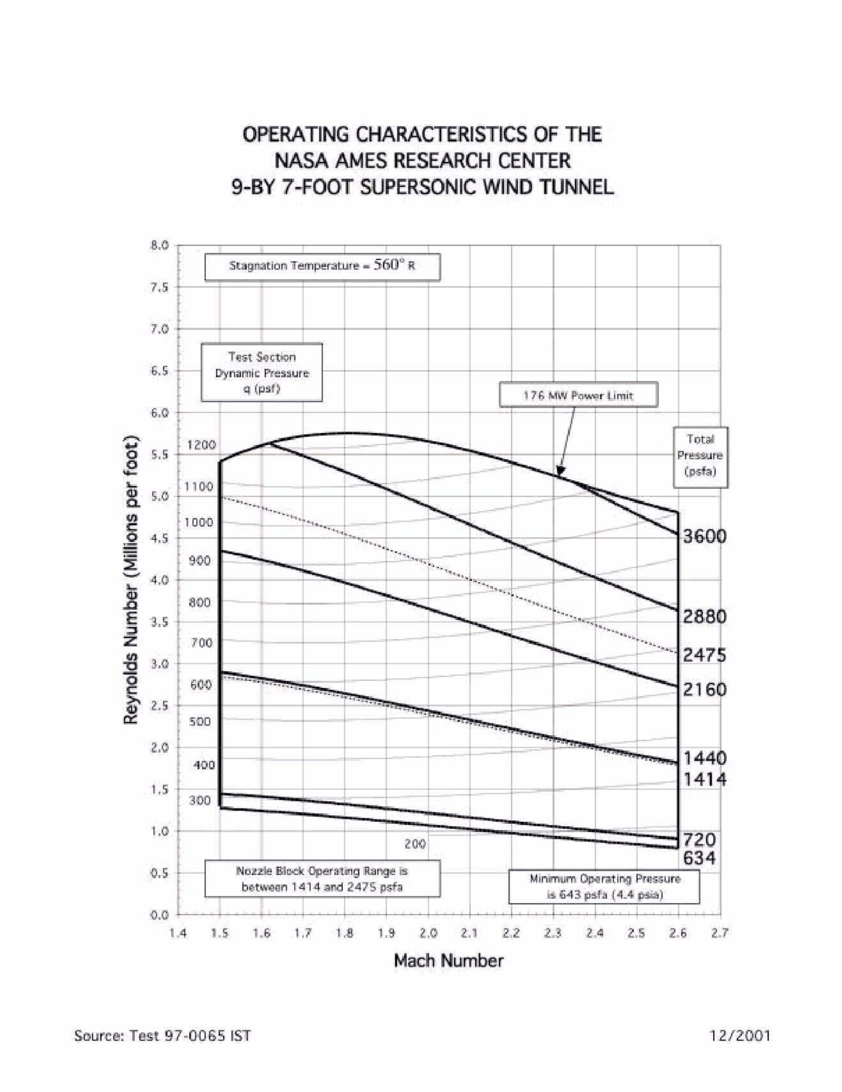
- Re-establish sonic boom testing in the Ames 9x7
- Acquire higher-fidelity signatures with the better instrumentation of today Better pressure xducers?
- Ames model
  - Compare new and old data for Ames model to verify test techniques and hardware
- Gulfstream model
  - Make tunnel-to-tunnel test comparisons (Ames 9x7 to Langley 4x4) for a Gulfstream model
  - Acquire data at larger distances for the Gulfstream model than was possible in the 4x4 WT

NASA Ames Unitary Plan Wind Tunnel



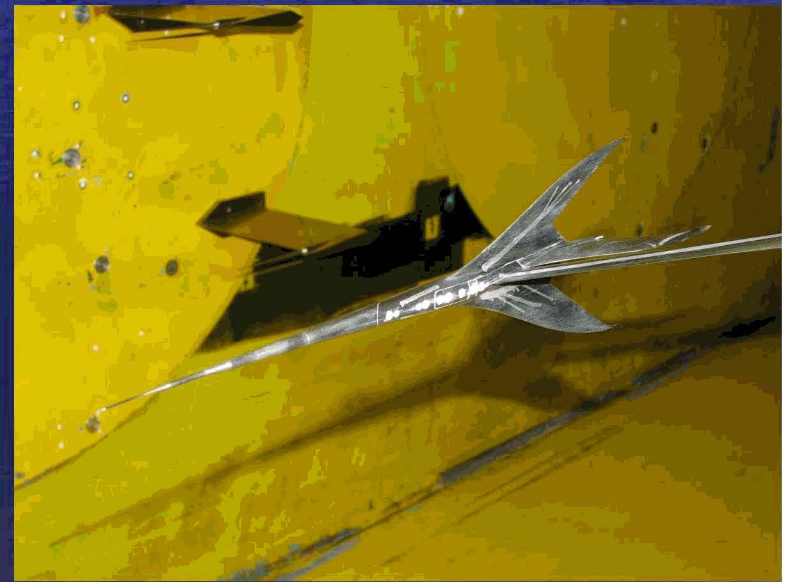
9-by 7-Foot SWT Characteristics

- Complete automation of tunnel and model support systems
- Excellent optical access
- Sting mount model support system
- Modern control room
- Contoured sliding block nozzle
- 11-stage compressor with stainless steel blades
- The Standard Data System (SDS) is a multi-tasking, multi-user steady-state data system
- Precision Instrumentation, Flow Visualization, a Balance Alarm System (BLAMS), and modern Video Systems
- 3000 psia heated High Pressure Air available



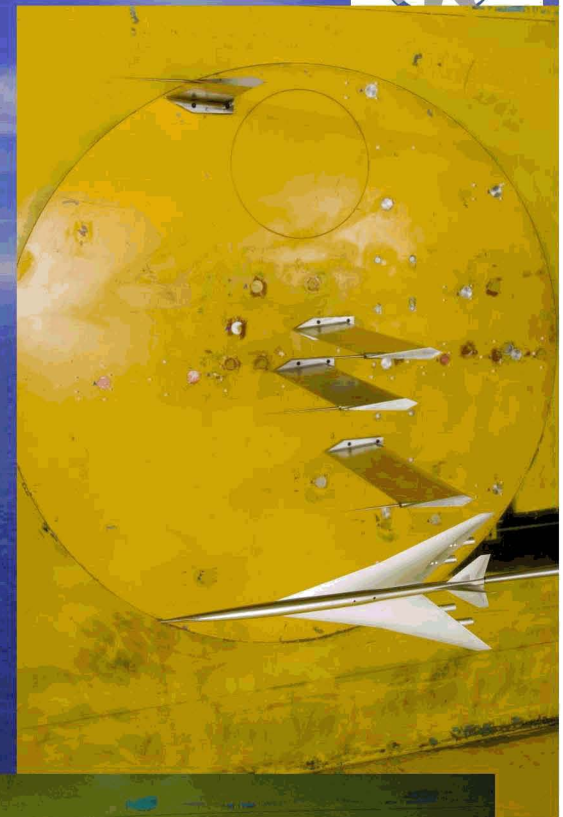
Models

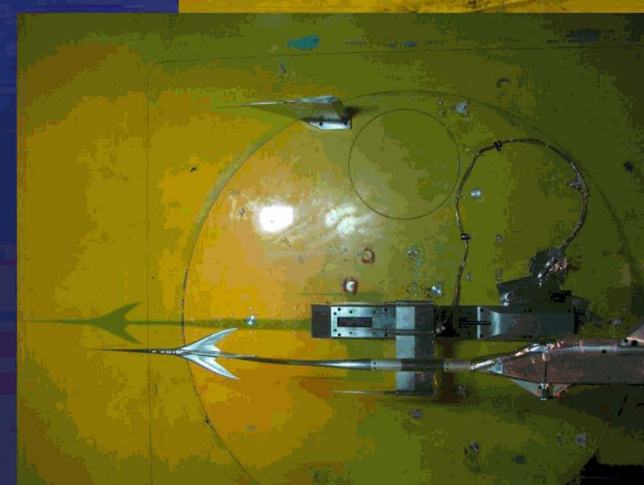
- Both designed for low boom
- Ames 1990 wing-tail model
  - 0.3% scale, 12” long
  - Various nacelle positions on wing & tail
  - Sting-mounted
- Gulfstream
  - 1% scale, 16” long
  - No nacelle simulation
  - Blade-strut mounted for clean aft end of model



Probes

- pictures of probe rails to come…





Results

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Lessons Learned / Conclusions

- Supersonic Test hardware review
  - Review all test hardware as if it were installed for the first time
  - Relative placement of rake hardware was an important variable

Things to highlight
(brainstorming slide – delete after making slides)

- How sonic boom testing is done
  - techniques
  - how the data are used
- Probe failure
  - what happened and why
  - analyses done
  - lessons learned
- Probe rails vs. single probes
  - concept of operation
  - productivity gains
  - data quality comparisons
- Value of large tunnels for SB testing
  - higher h/L's