ASCENT Project 59B
JET NOISE MODELING AND MEASUREMENTS TO SUPPORT REDUCED LTO NOISE OF SUPERSONIC AIRCRAFT TECHNOLOGY DEVELOPMENT

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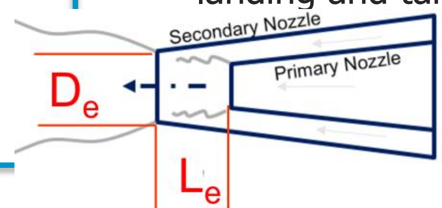
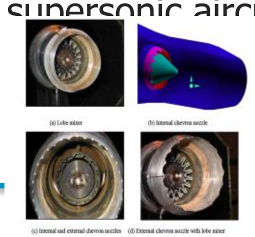
Objective:

To acquire acoustic and flow measurements to be used by Project 59 jet noise modelers for the validation of low, medium, and high-fidelity jet noise prediction methods for supersonic transport applications (SST).

Project Benefits:

The validation of these prediction codes will give confidence in the noise prediction, which will aid in the design of low noise engines for reduced landing and takeoff noise of supersonic aircraft





Research Approach:

- Design and fabricate a simple model-scale test nozzle made of a round core primary nozzle buried in a coaxial secondary flow with the mixed flow exhausting some distance downstream of the primary nozzle exit.
  - Geometry was designed as a scaled model of a paper engine design
- Acquire acoustic and related flow measurements as a function of mixing distance between the primary nozzle exit and the final exhaust nozzle exit
- Provide the measured data to modeling teams for validation of prediction codes

Major Accomplishments (to date):

- The test nozzle designed and fabricated
- The model design shared with the modelers
- Acoustic data acquisition is in progress and initial data shared with the modelers

Future Work / Schedule:

- Complete the acoustic and flow measurement acquisition (5-15-2021)
- Share all data with modelers and be available for interactions (present through (5-28-2021)
- Select a mixer design for the Year 2 effort (5-28-2021)

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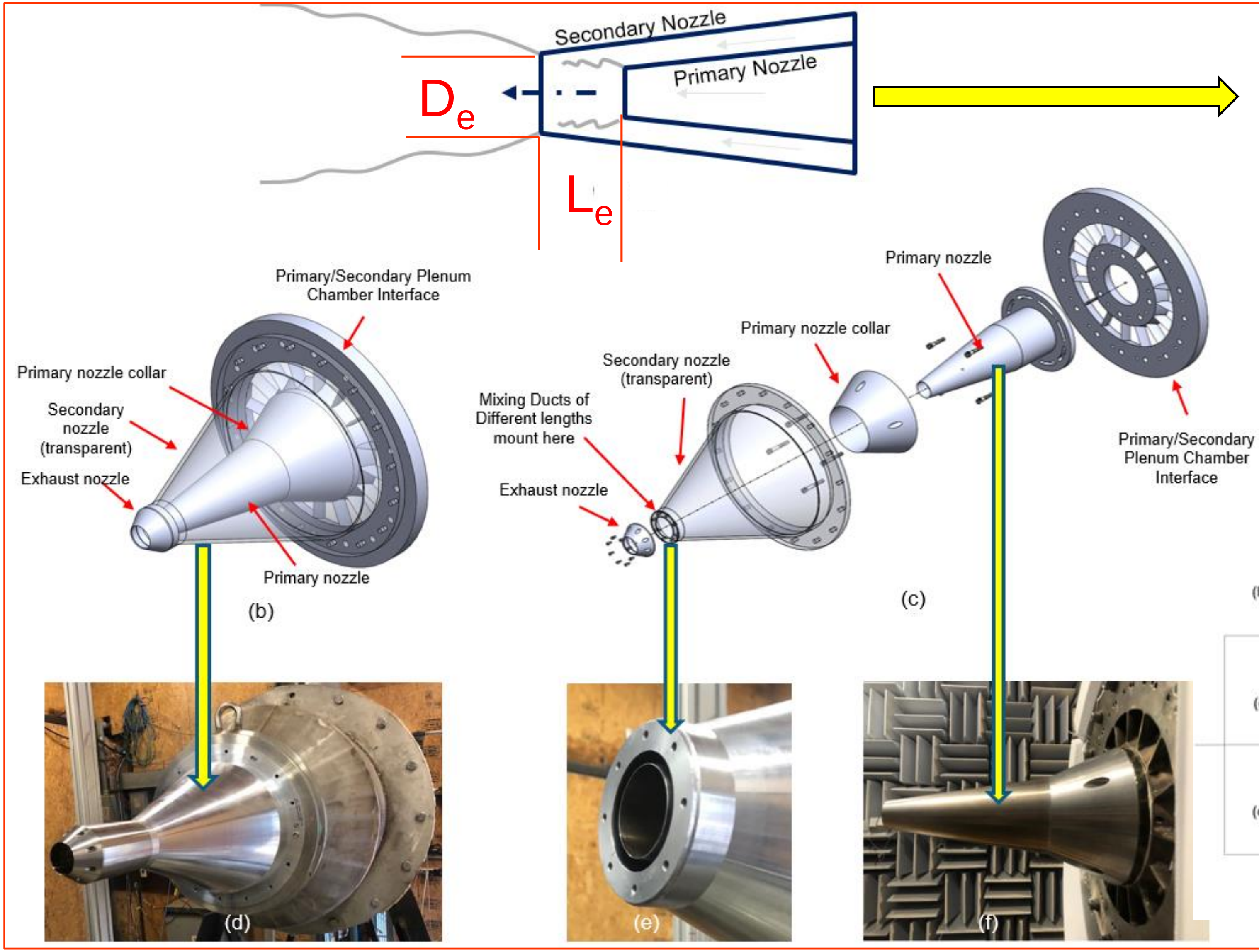
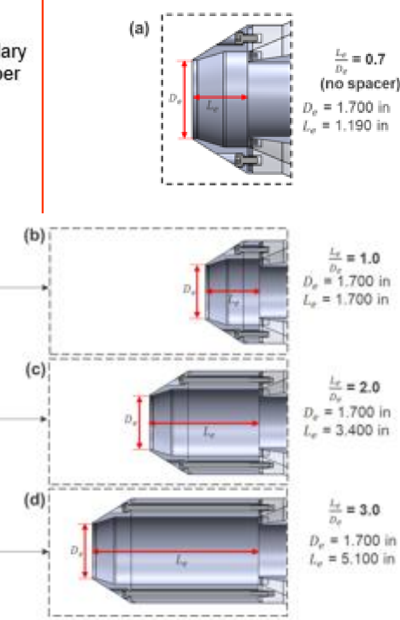
Experimental Model



The mixing length/exhaust nozzle exit diameter (L_e/D_e): 0, 0.7, 1, 2, and 3

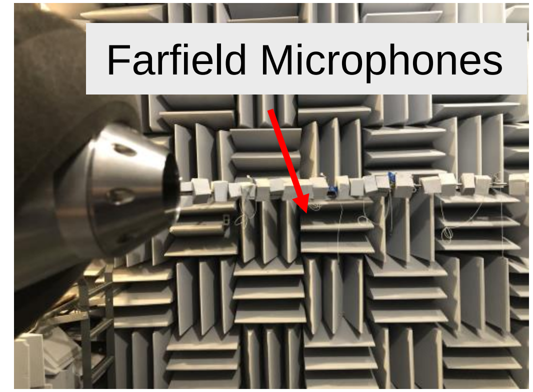


The GTRI Model is a 0.045 scale of the paper engine

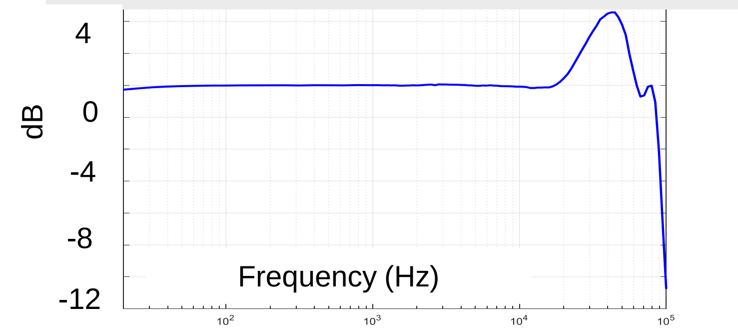
Farfield Acoustic Measurements

- 10 microphones mounted in the GTRI Anechoic Jet-Facility in a circular arc
  - Polar angles 30° - 120°
- Acoustic Pressure time histories are sampled at 204.8 kHz
- Processed into averaged power spectra using the following parameters:
  - Window Length: 6400 samples
  - Windowing Function: Hanning
  - 50% overlap
  - Δf = 32 Hz
- Corrections to render measured data lossless:
  - Freefield response → provided by microphone manufacturer
  - Windsock correction → experimentally determined
  - Atmospheric Attenuation → using ANSI S1.26-1995 (Tone based)
  - Distance correction → $1/R^2$ law
    - Corrected to common distance of 12 ft

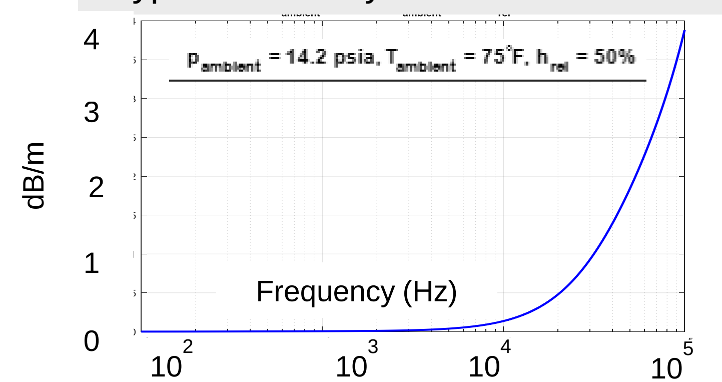
Farfield Microphones



Typical Freefield Microphone Response



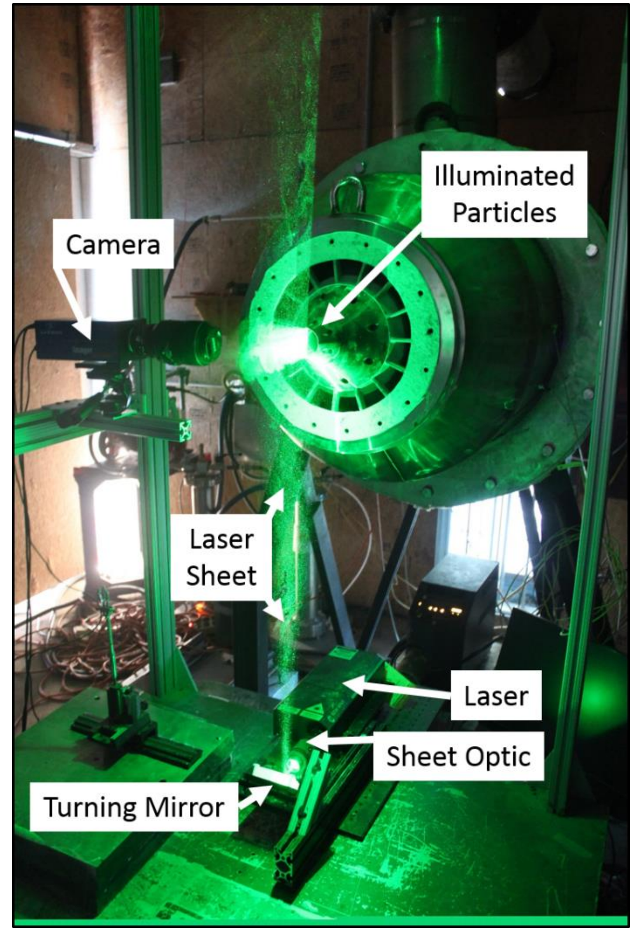
Typical Humidity Attenuation at 12 ft



Flow Measurements

- Alongside the acoustic measurement the following measurements being acquired in the GTRI Static Anechoic Jet-Facility
  - Ambient temperature, pressure, and relative humidity
  - Upstream primary and secondary total pressure and temperature
  - Primary and secondary mass flow rate
- PIV being setup to measure the downstream flow field

PIV System



- Will also acquire limited high-speed flow visualization data as well as source-location data with a phased array

Example Acoustic/flow Measurements