

An Overview of Recent Phased Array Measurements at NASA Glenn

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Acoustics Technical Working Group September 23 - 24, 2008

Abstract

A review of measurements made at the NASA Glenn Research Center using an OptiNAV Array 48 phased array system is provided. Data were acquired on a series of round convergent and convergent-divergent nozzles using the Small Hot Jet Acoustic Rig. Tests were conducted over a range of jet operating conditions, including subsonic and supersonic and cold and hot jets. Phased array measurements were also acquired on a Williams International FJ44 engine. These measurements show how the noise generated by the engine is split between the inlet-radiated and exhaust-radiated components. The data also show inlet noise being reflected off of the inflow control device used during the test.



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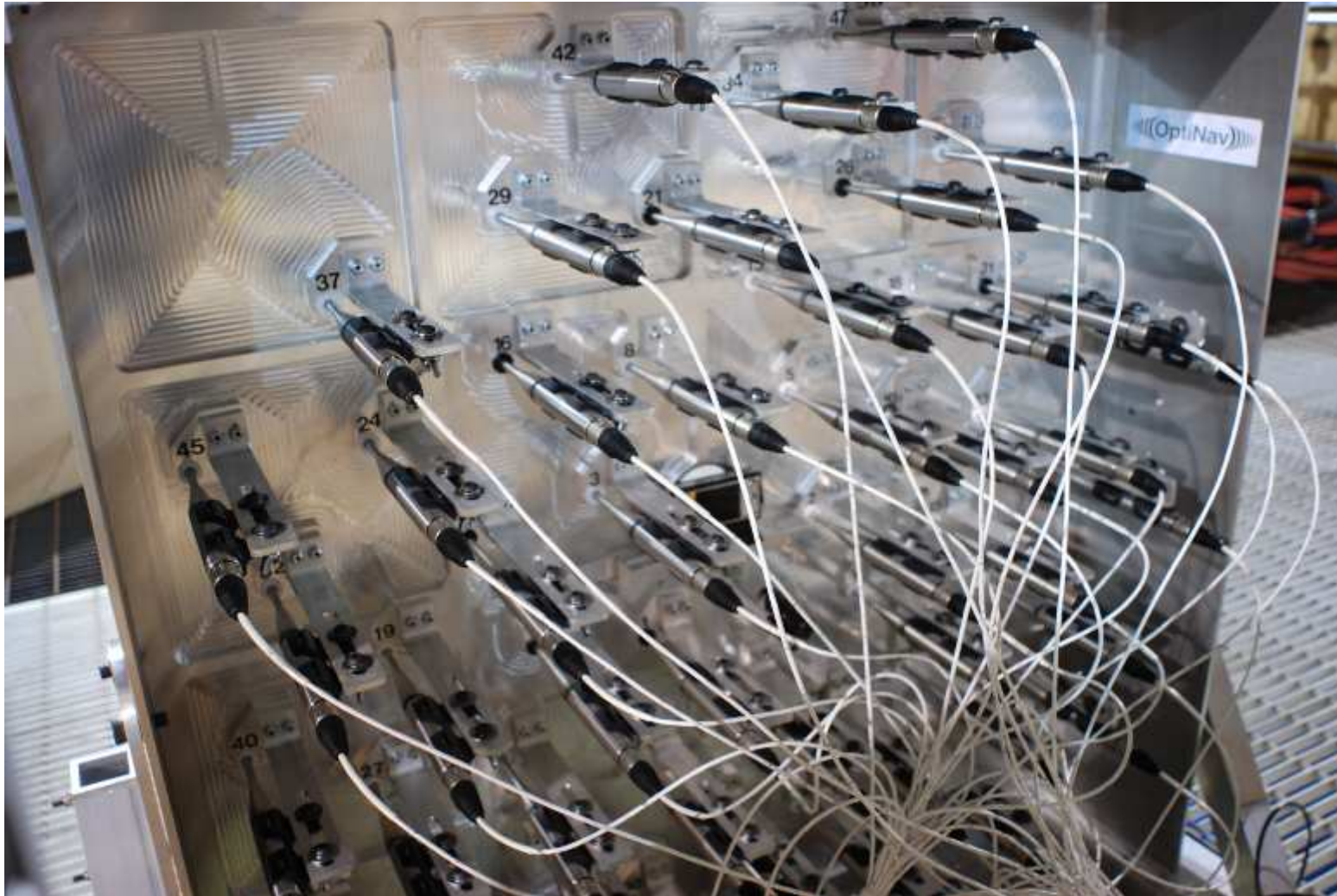


Introduction





Photo of the Back of Array 48





Array 48 Microphones



Earthworks M30

\$500, 48V XLR , 5 Hz - 30 kHz, 150 dB



Array 48 Electronics





December 2007 SHJAR Test

- Determine How Well Array48 Works with Jet Flows





May 2008 SHJAR Test

- Obtain Data in Support of Dougherty NRA



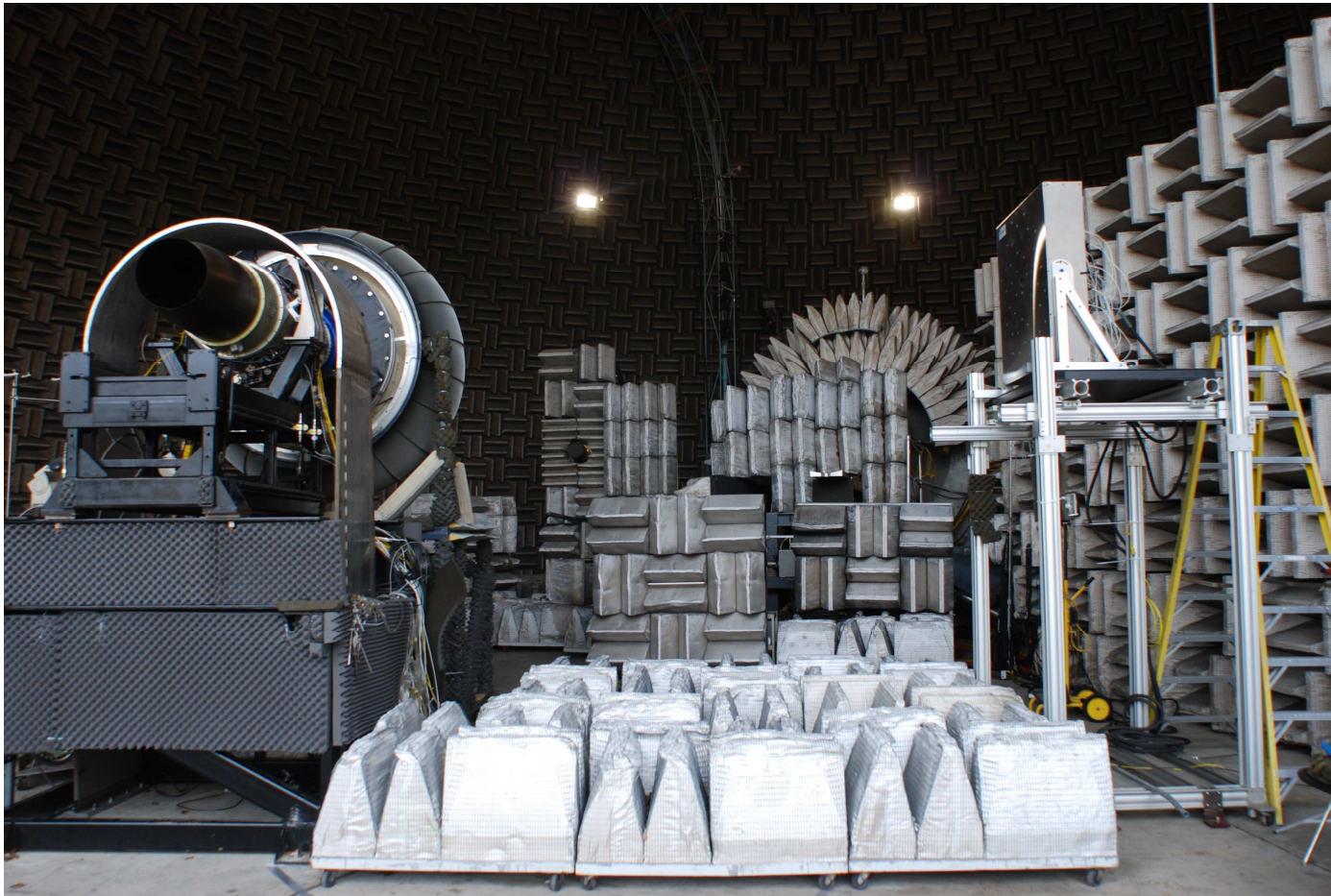


June 2008 Williams International FJ44 Test



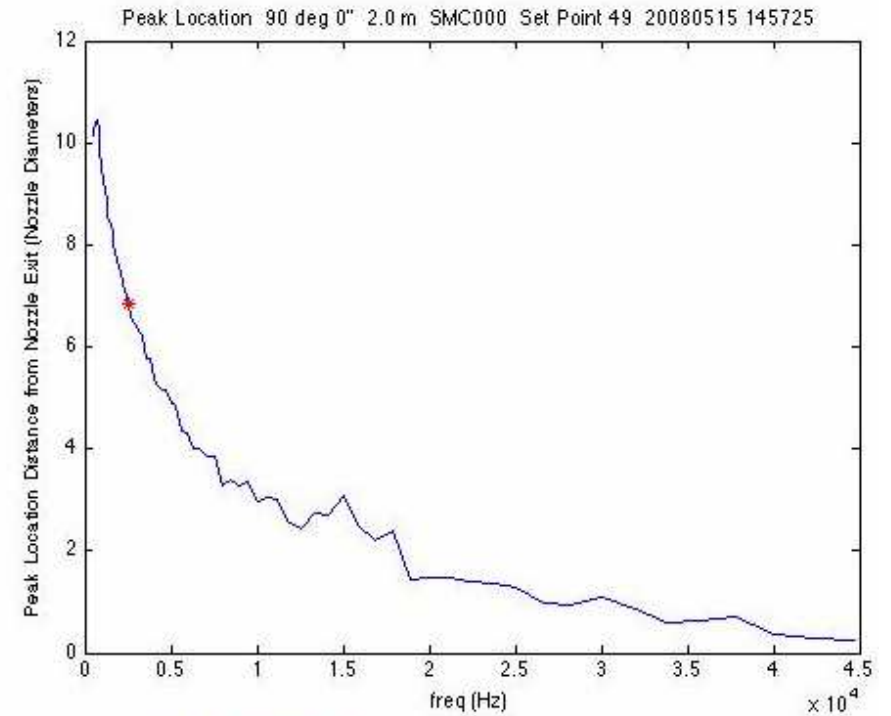
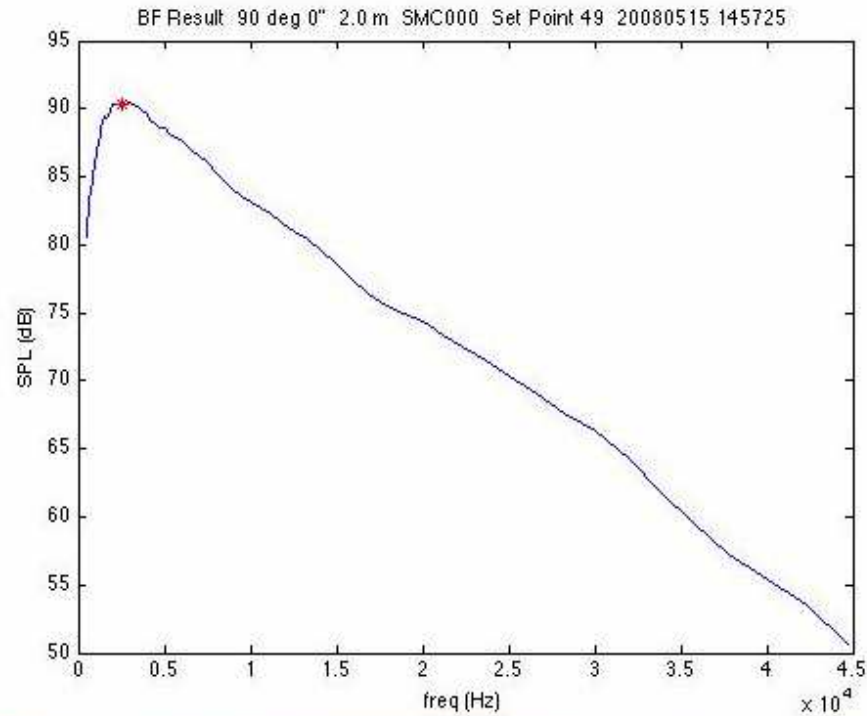


June 2008 Williams International FJ44 Test





Hot, M=0.9 Jet from Round Convergent Nozzle

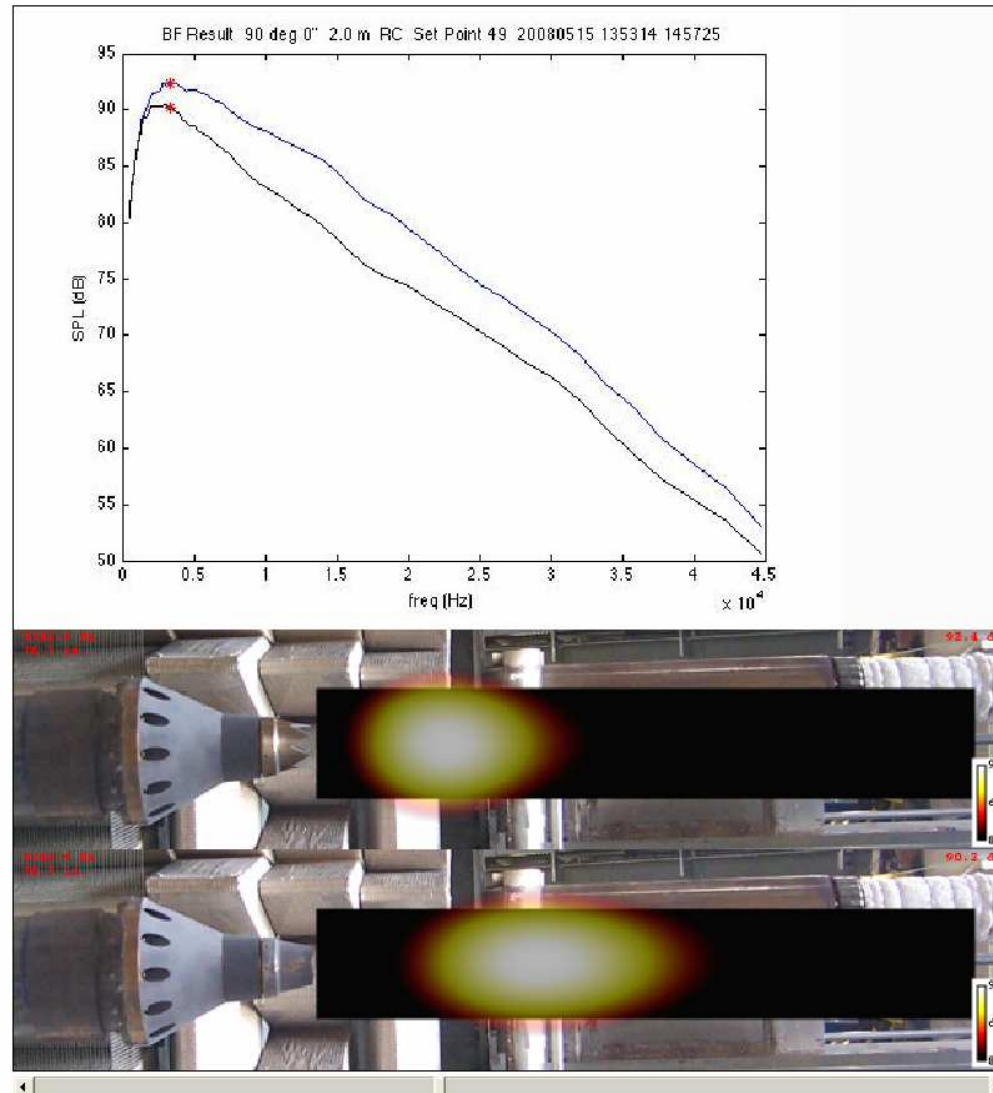


Stack 1



RC / Chevron Comparison

Hot, M=0.9 Jet



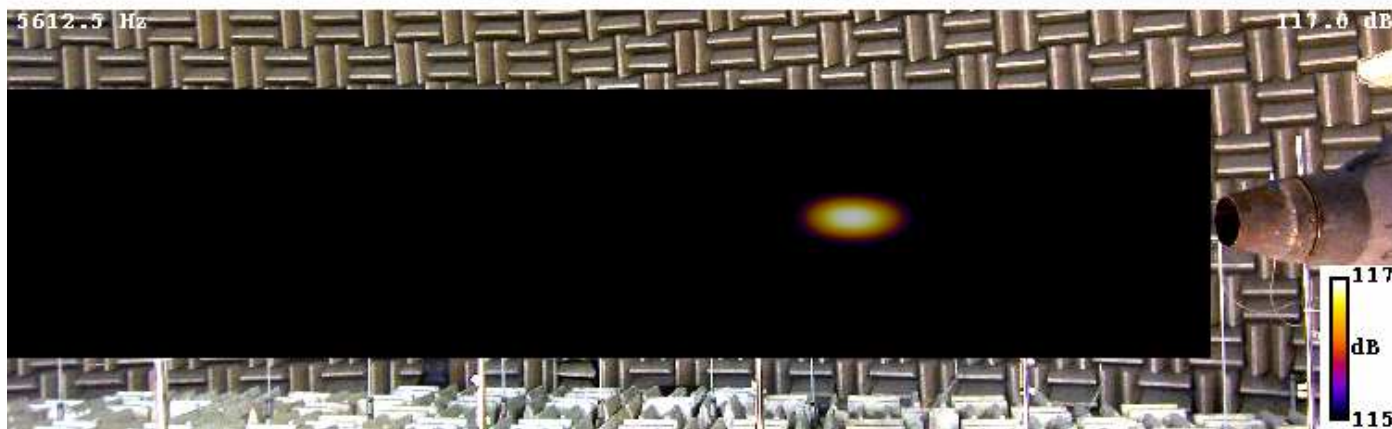
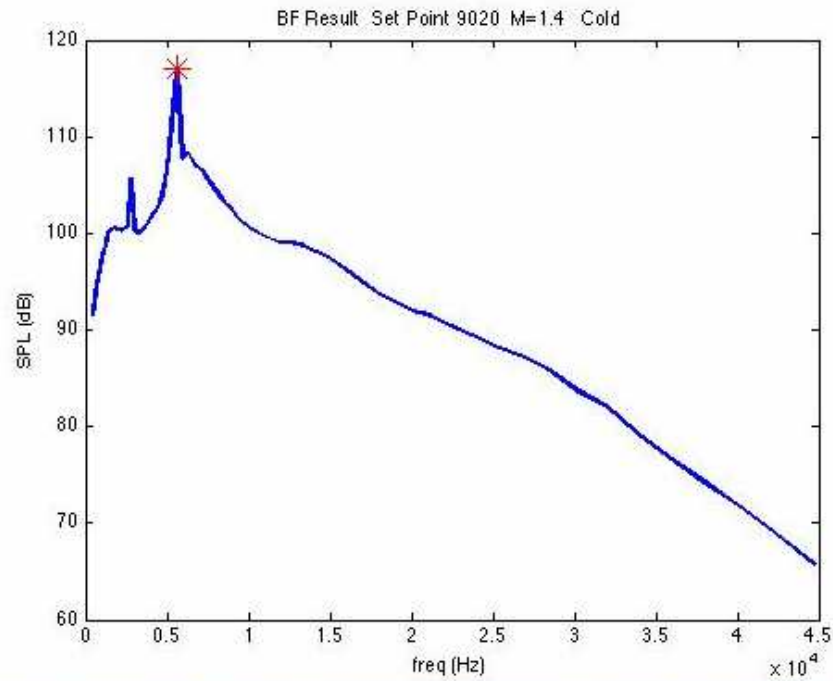
Stack 2



RC Nozzle

Underexpanded

Cold, M=1.4 Jet



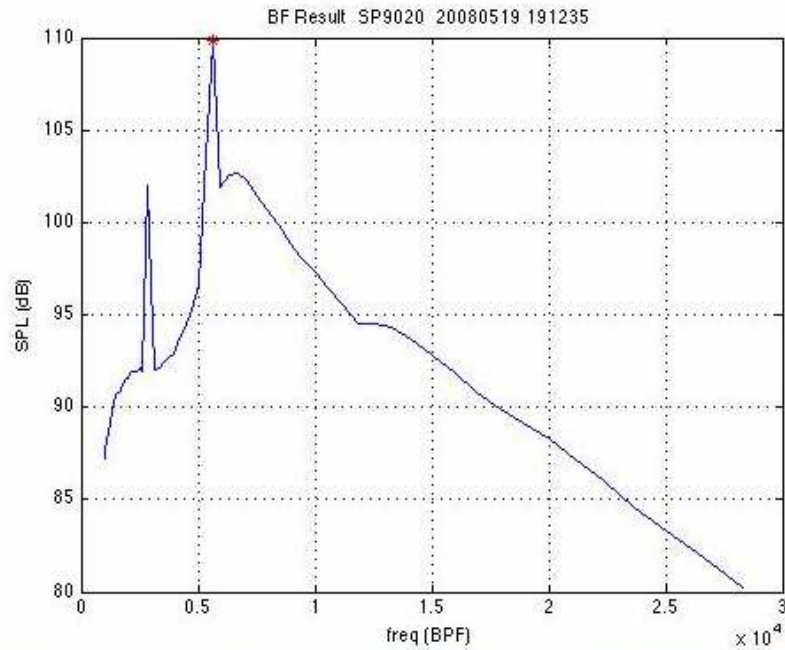
Stack 3



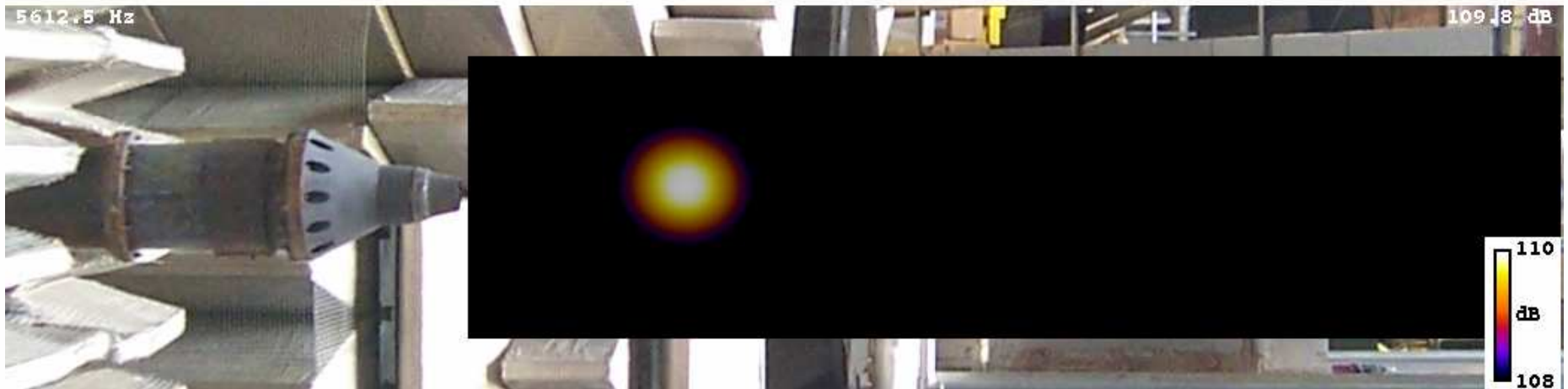
RC Nozzle

Underexpanded

Different Array Location



Stack 4





RC Nozzle

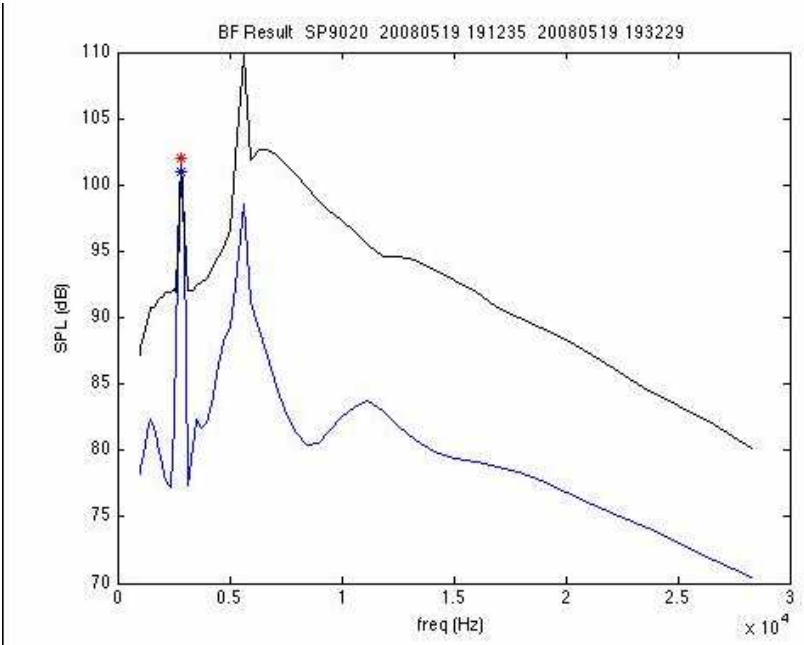
Wedges Blocking Jet Noise





RC Nozzle

Wedges Blocking Jet Noise



Stack 5





Williams Engine Test

Array at the Side of the Engine

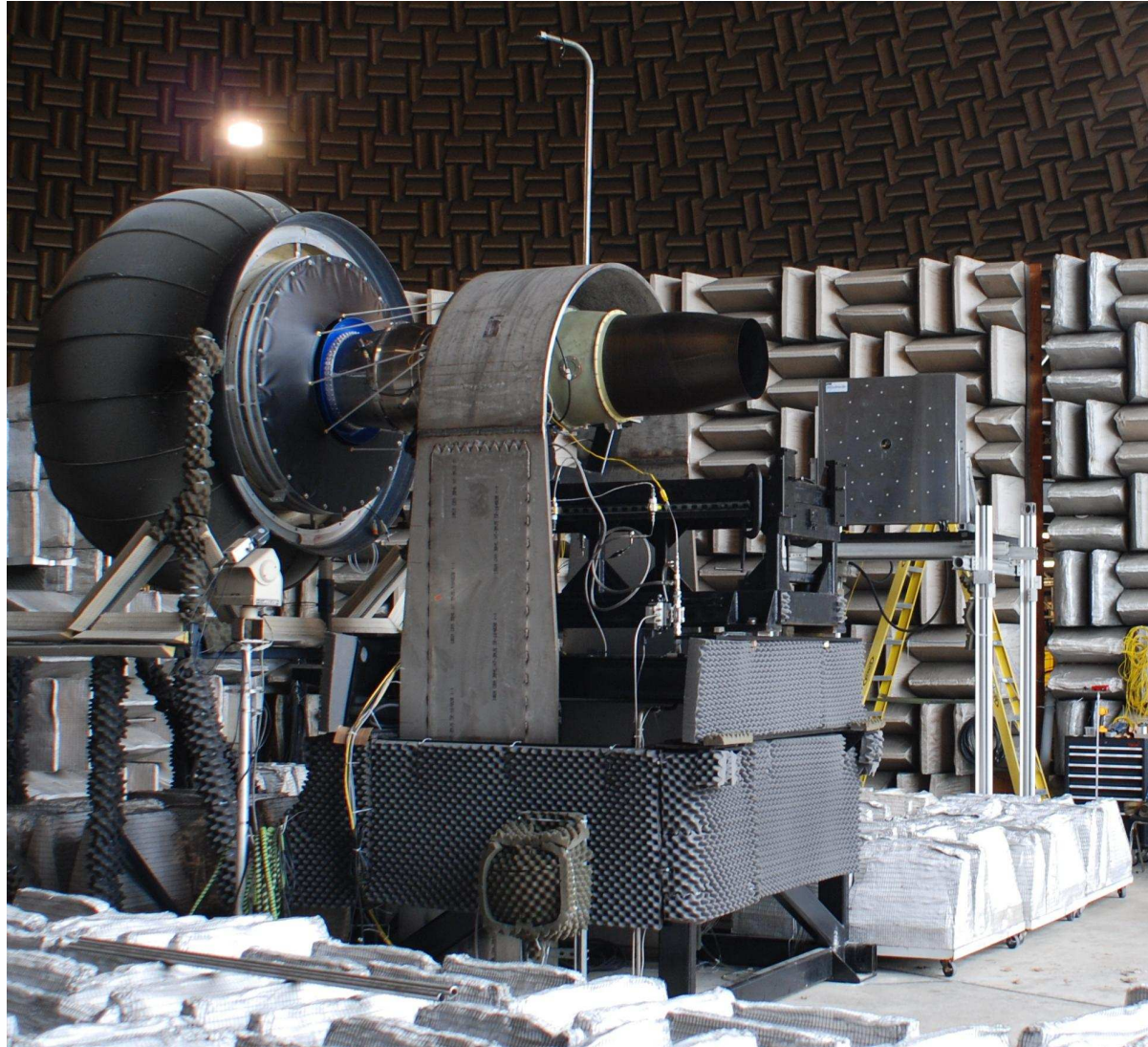
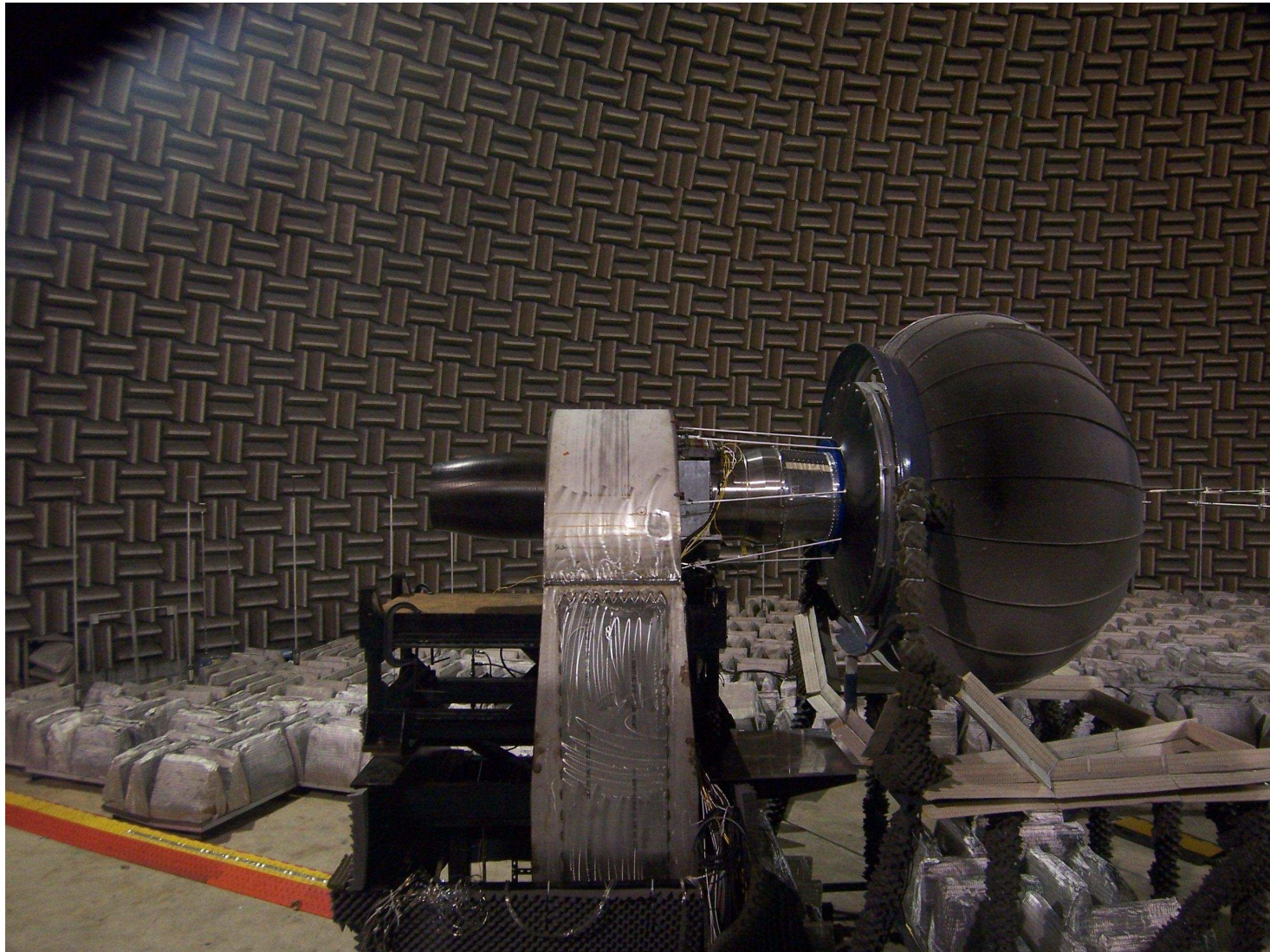




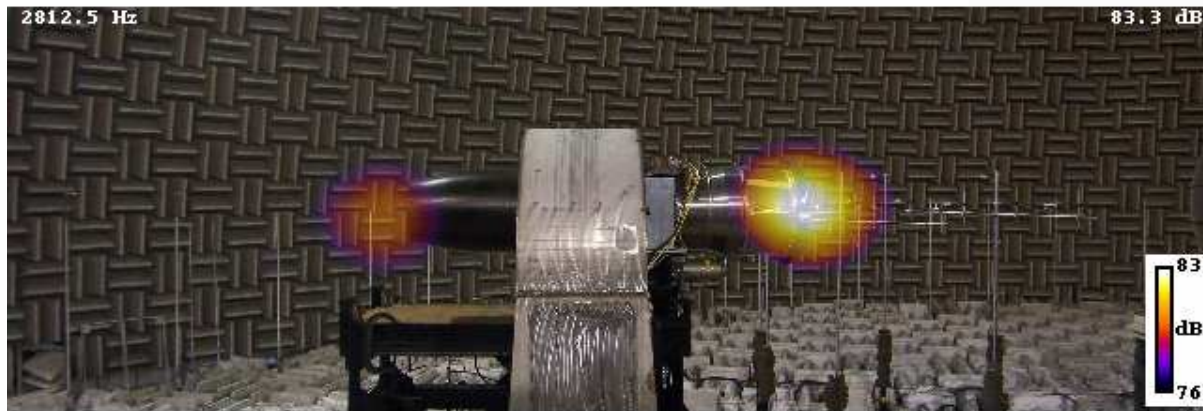
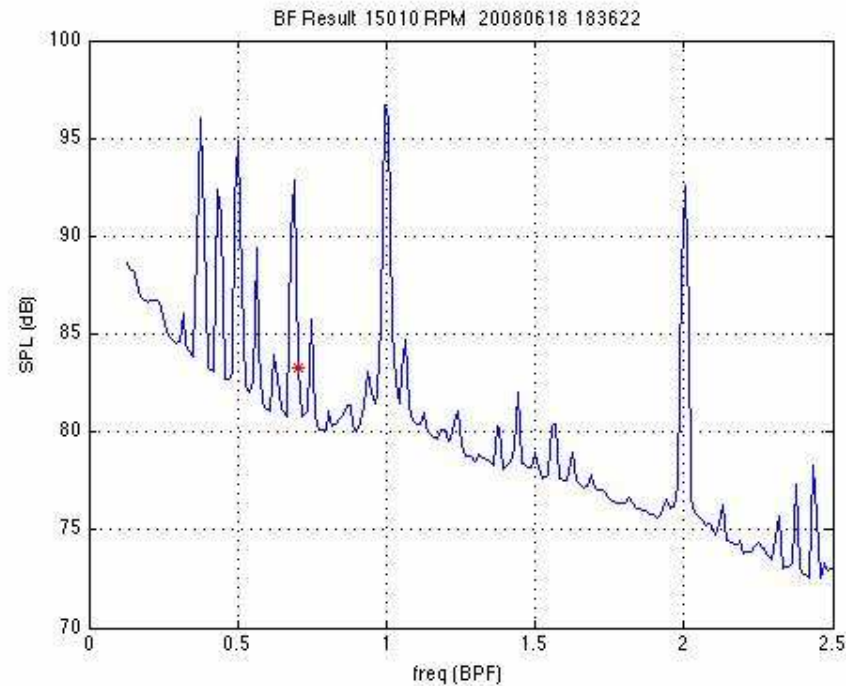
Photo Showing Tested Configuration





Williams Engine Test Data

Array at the Side of the Engine

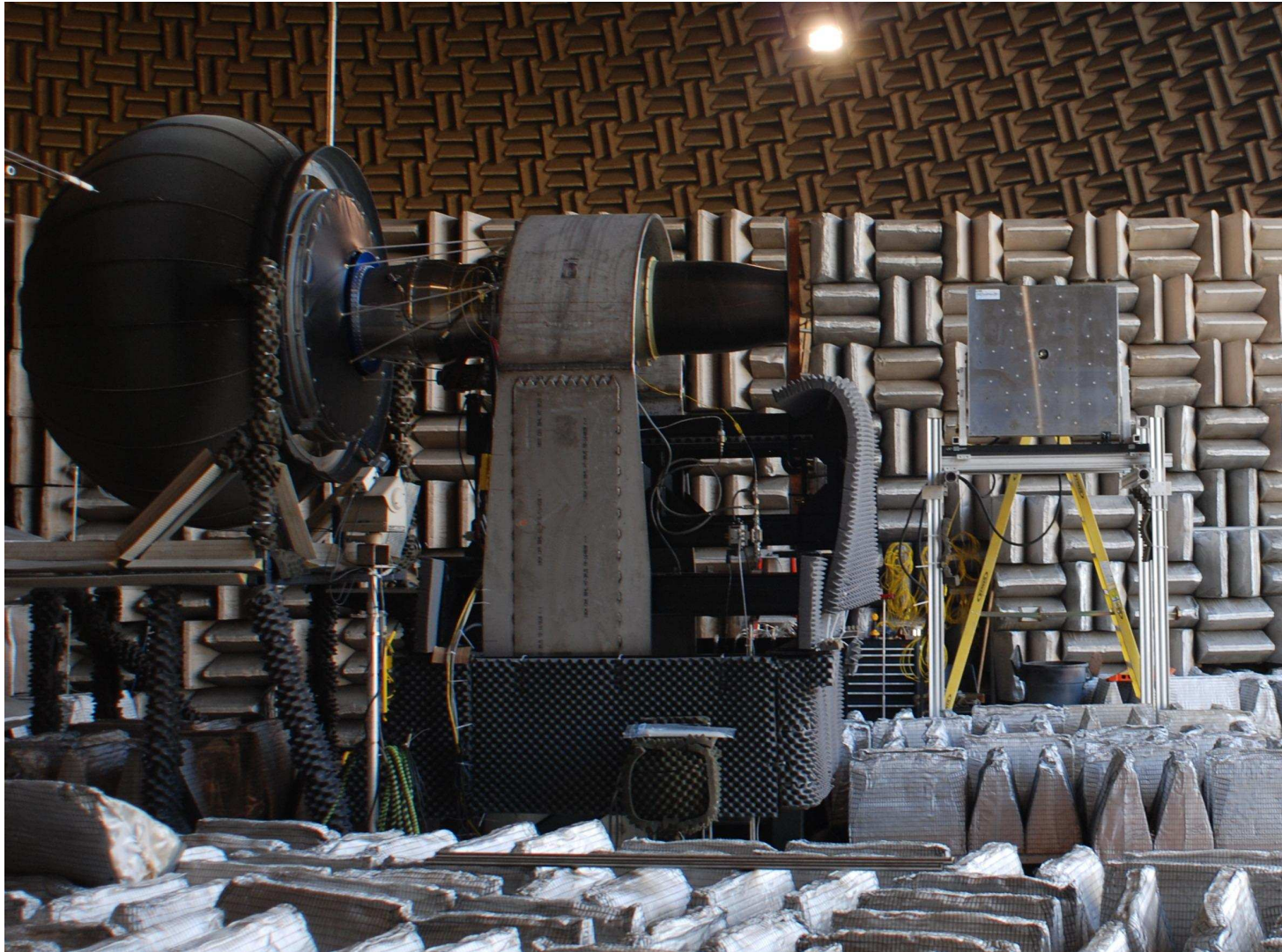


Stack 6



Williams Engine Test

Array Focused on Nozzle Flow

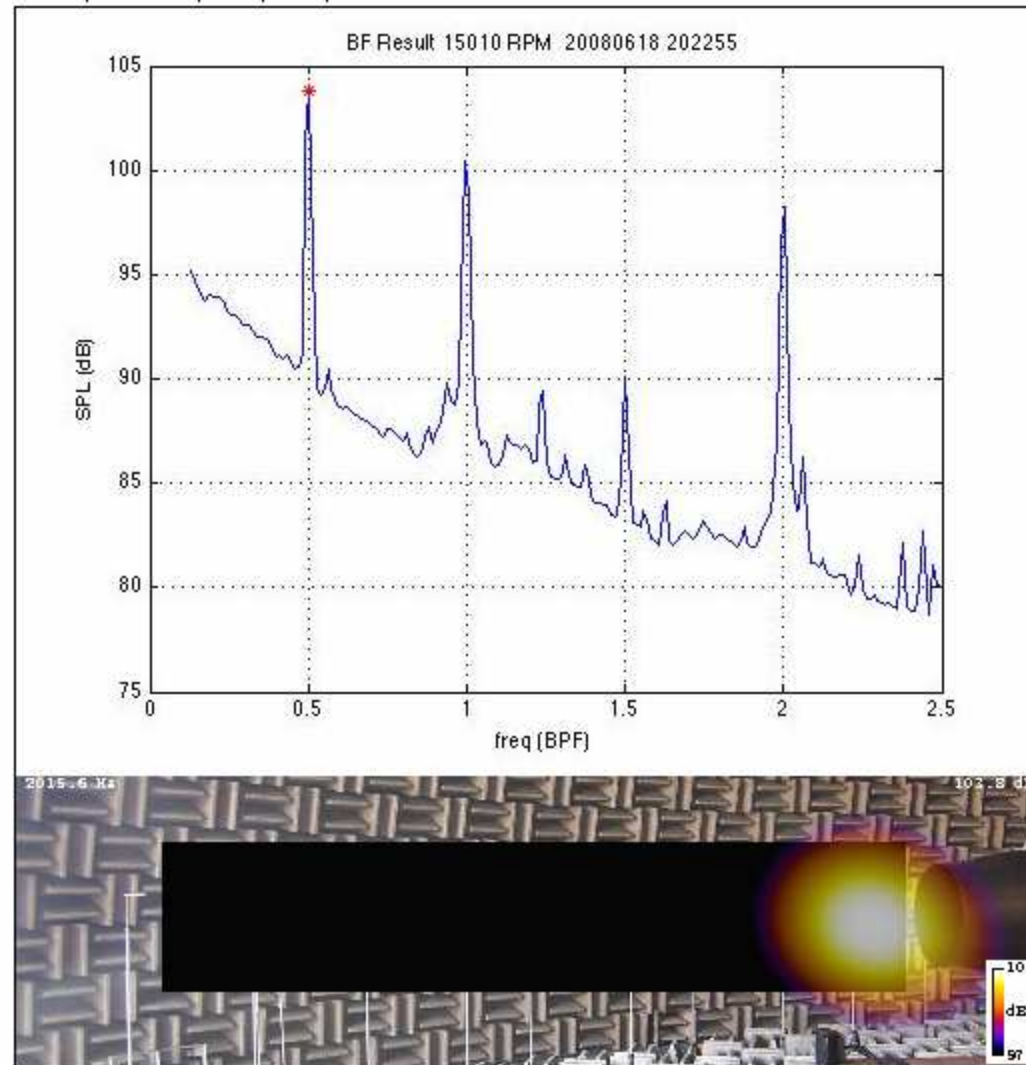




Williams Engine Test

Array Focused on Nozzle Flow





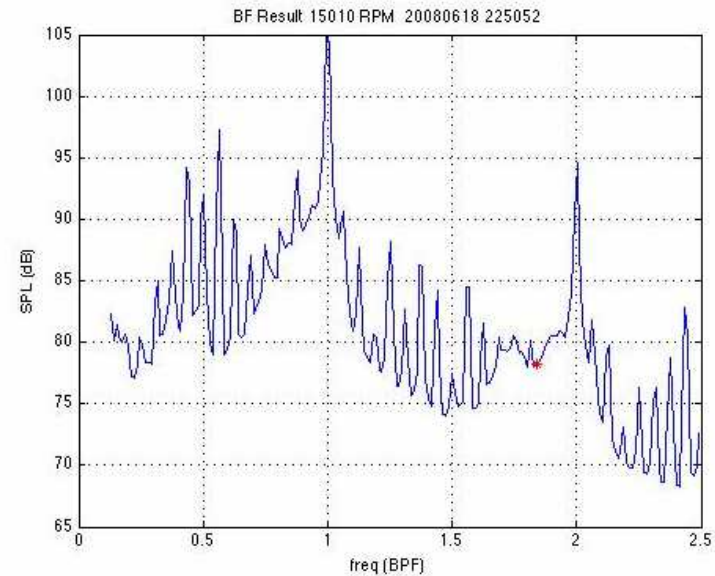
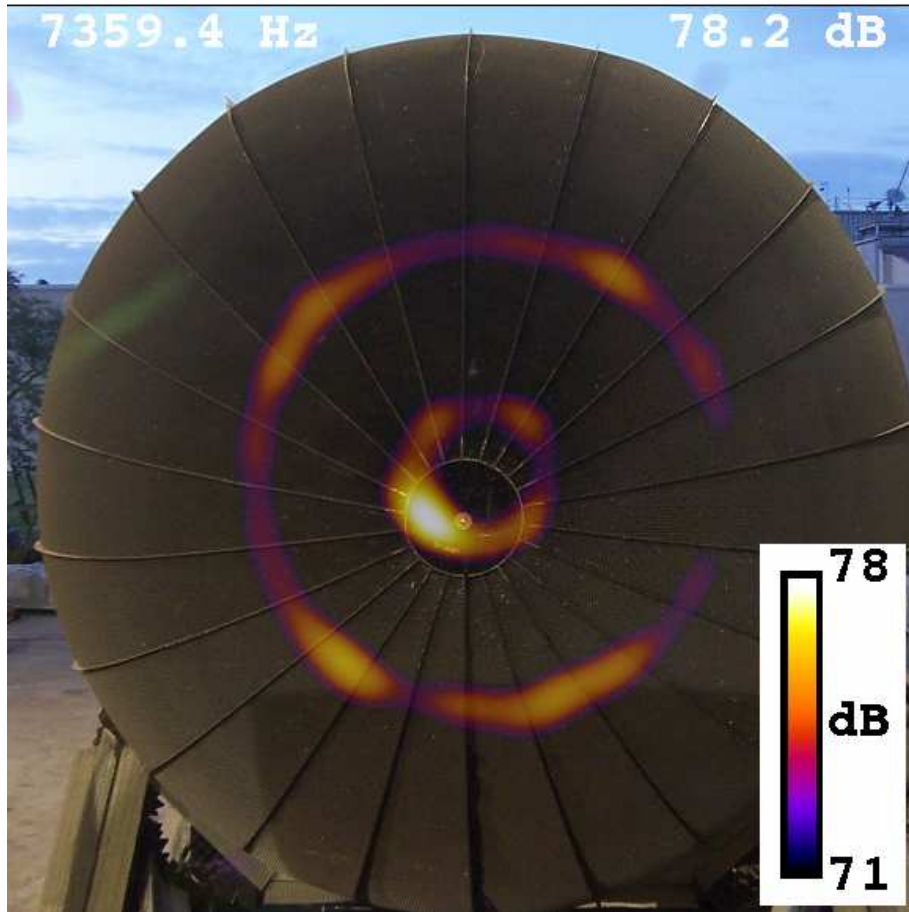
Stack 7



Williams Engine Test

Array In Front of the Engine





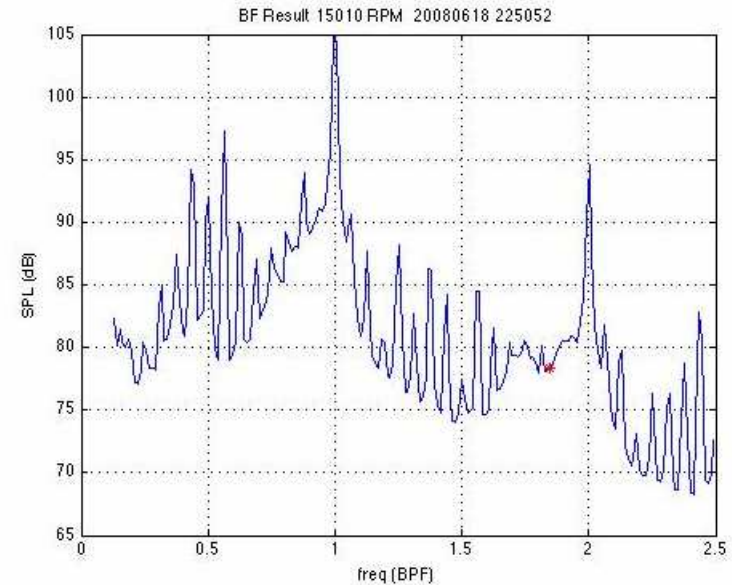
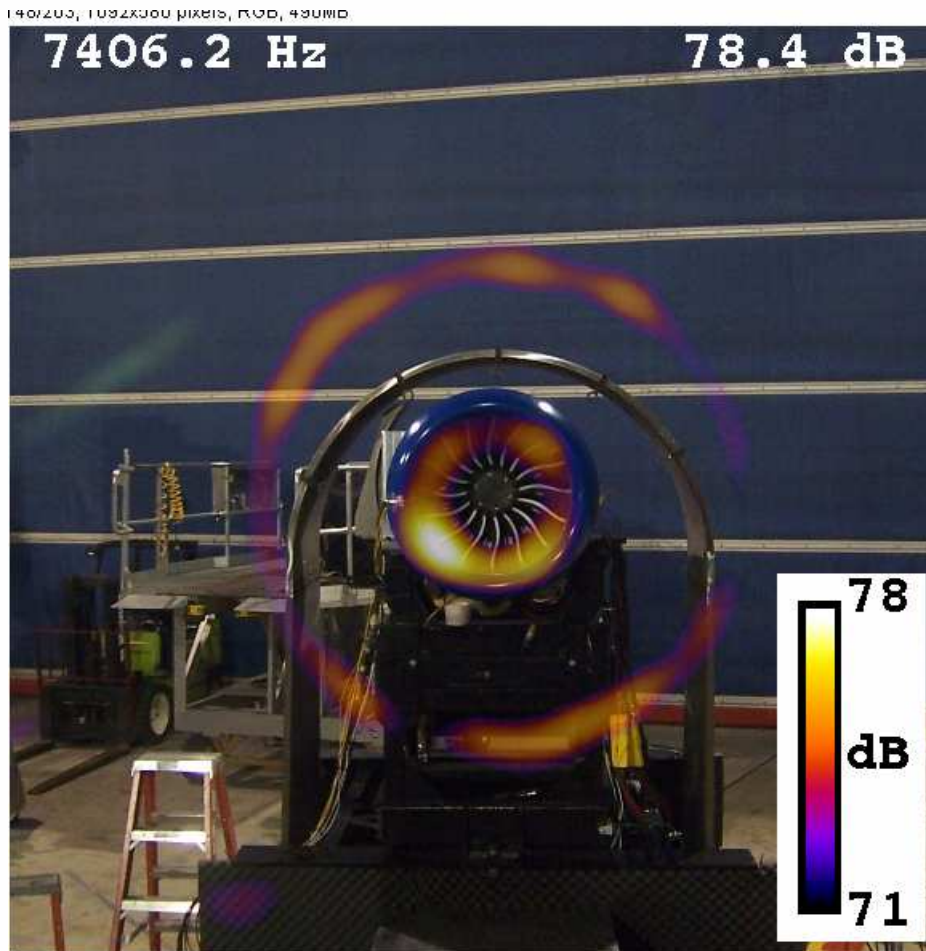
High Frequency Broadband Noise Appears in 2 Rings

Stack 8



Williams Engine Test Data

Array In Front of the Engine



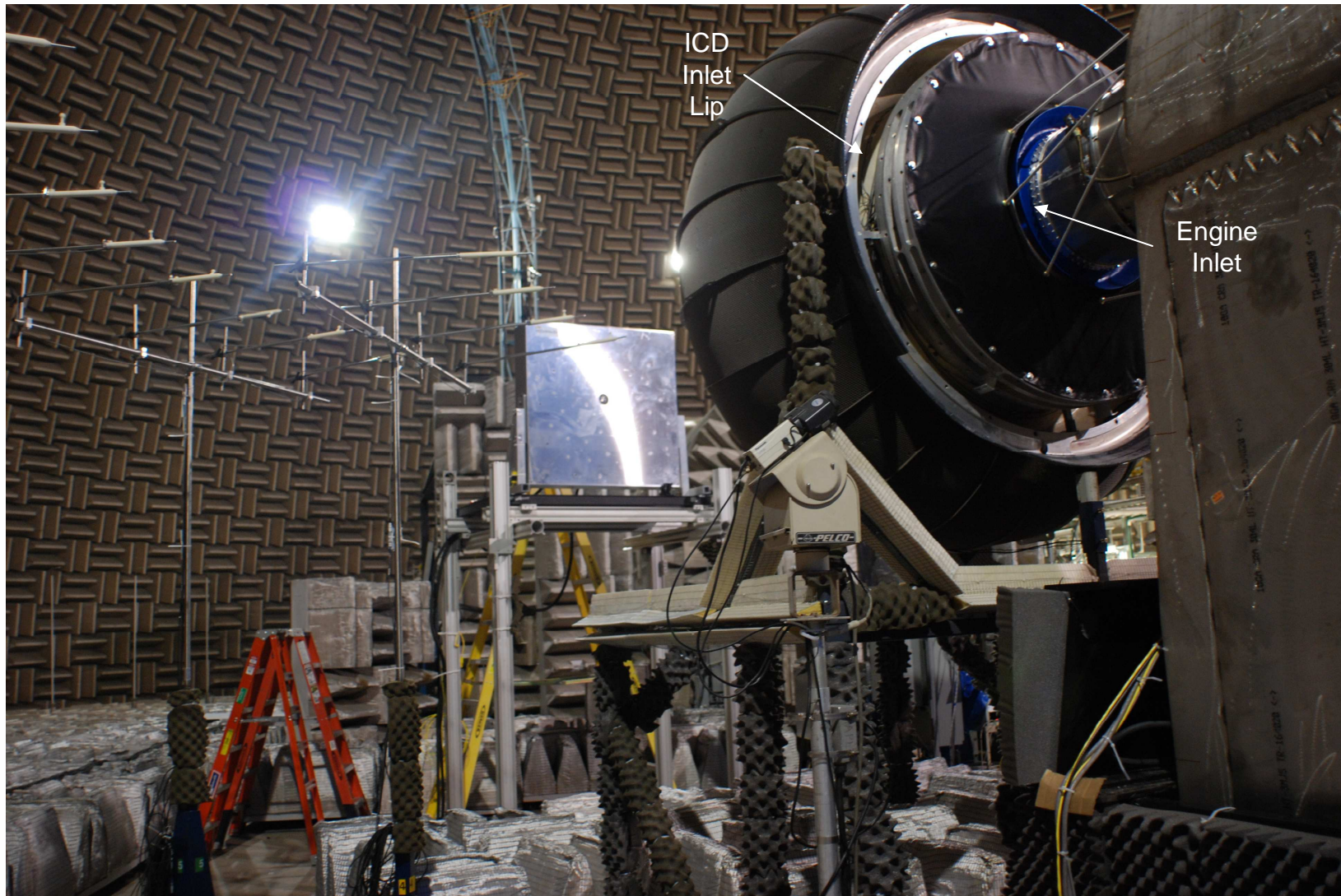
Outer Ring is Noise Reflected From the ICD

Stack 9



Williams Engine Test

ICD





June 2008 Williams International FJ44 Test





Summary

- Array48 phased array system was used to acquire data on both RC and CD nozzles over a range of operating conditions (cold/hot, subsonic/supersonic). The data shows how the location of the peak noise in the jet varies with frequency. The data indicates that some of the screech noise measured at SHJAR comes from upstream of the nozzle exit.
- Array48 was also used to acquire data on a Williams International FJ44 engine. Data were acquired with the array at three different locations relative to the engine at 11 fan rotor speeds ranging from engine idle to max speed. The data show the split between inlet and exhaust noise as a function of frequency. The data also show broadband noise reflecting off the ICD, and the location of the inlet temperature probe as a noise “hot spot.”