Concept Development of the Quiet Supersonic Technology Aircraft

LOCKHEED MARTIN

Peter Iosifidis – Program Manager

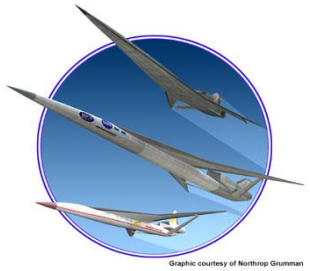
Overview

- Background
- Why Now for a Quiet Supersonic Technology X-plane?
- QueSST Program Objectives
- Schedule
- QueSST X-plane Concept Overview
- Summary

Low Boom History

FAR 91.817 (1960's) -- "No person may operate a civil aircraft . . . at a … flight Mach number greater than 1 . . . unless - {App. B} . . . the flight will not cause a measurable sonic boom overpressure to reach the surface . . ."

Quiet Supersonic Platform 2001-2003



- Supersonic Tech Survey
- 0.3 psf Shock Goal

F-5E Shaped Sonic Boom Demonstration - 2003

- Modified F-5E nose to Shape Front Shock
- 0.8 psf Shock Persisted in All 1300 Measurements

Quiet Supersonic Transport - 2001-2005

- Feasible Low Boom Transportation
- 0.5 psf (24 Pa) Shocks

D-SEND#1 - 2011
D-SEND#2 - 2015

- Dropped Shaped Axi-Bodies and Unpowered Configuration from ~100,000 ft Producing 0.5 psf Shocks

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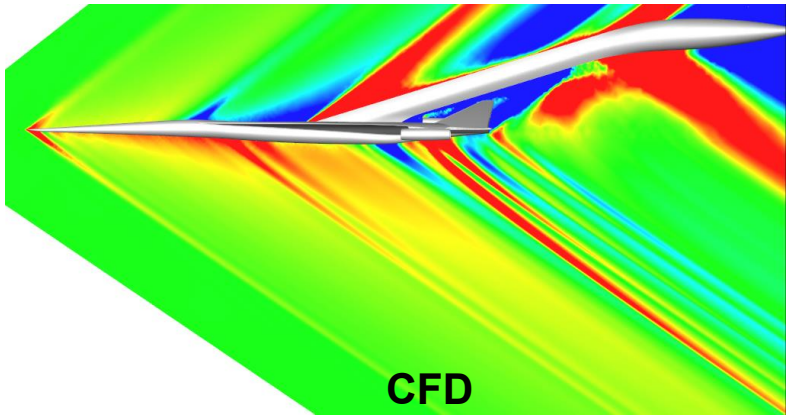
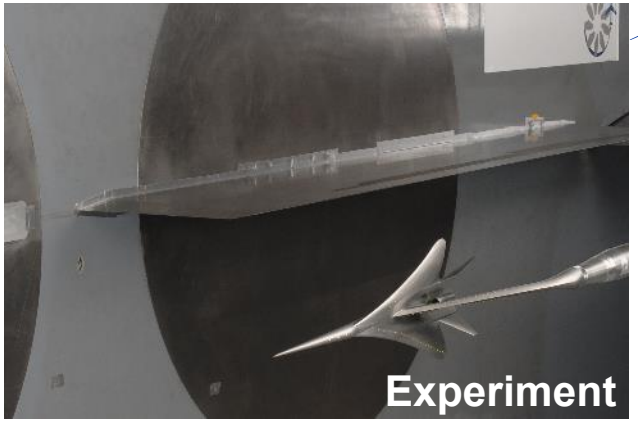
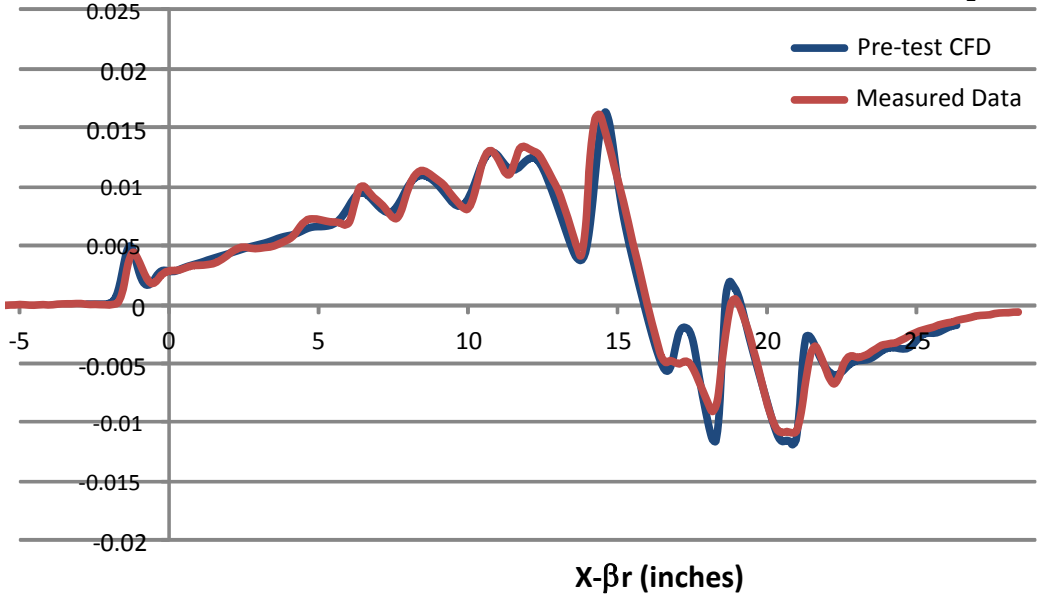
Why Now for the QueSST X-Plane?





Comparison of Pre-test CFD and Wind Tunnel Measurements @ C_L = 0.142



Work Done on N+2 Supersonic Validations Program Showed that Modern Design Tools are Adequate for Shaped Boom Design

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QueSST Program Objectives

- **Develop, build, and flight test a clean-sheet X-plane that can be used to support future regulatory change efforts**
- **Feasibility and soundness of requirements established on now-completed Low Boom Concept Formulation & Refinement Studies**

Requirement	Name	Requirement	C606
MR-1	Boom Traceability	Scaled dP & PLdB	✔
MR-2	Shaped Signature	<75 PLdB, max energy < 10 Hz	74 PLdB, ✔
MR-3	Boom Variability	70-80 PLdB	70-80 PLdB ✔
MR-4	Cruise Deviations	<76 PLdB mean, <1.4 PL RMS	74.5 PLdB, ✔
MR-5	Mach Number	>1.4 for low boom	1.42 ✔
MR-6	Pass Length	2 x 50 nm	✔
MR-7	Flight Rate	3 flights in 9 hours	✔
MR-8	Day/Night Ops.	Equipped	✔
MR-9	Flight Ops.	Day/night VFR, ILS, transit IMC	✔
MR-11	Climb Rate	climb/accelerate cooncurrently	3,000 FPM at top of climb ✔

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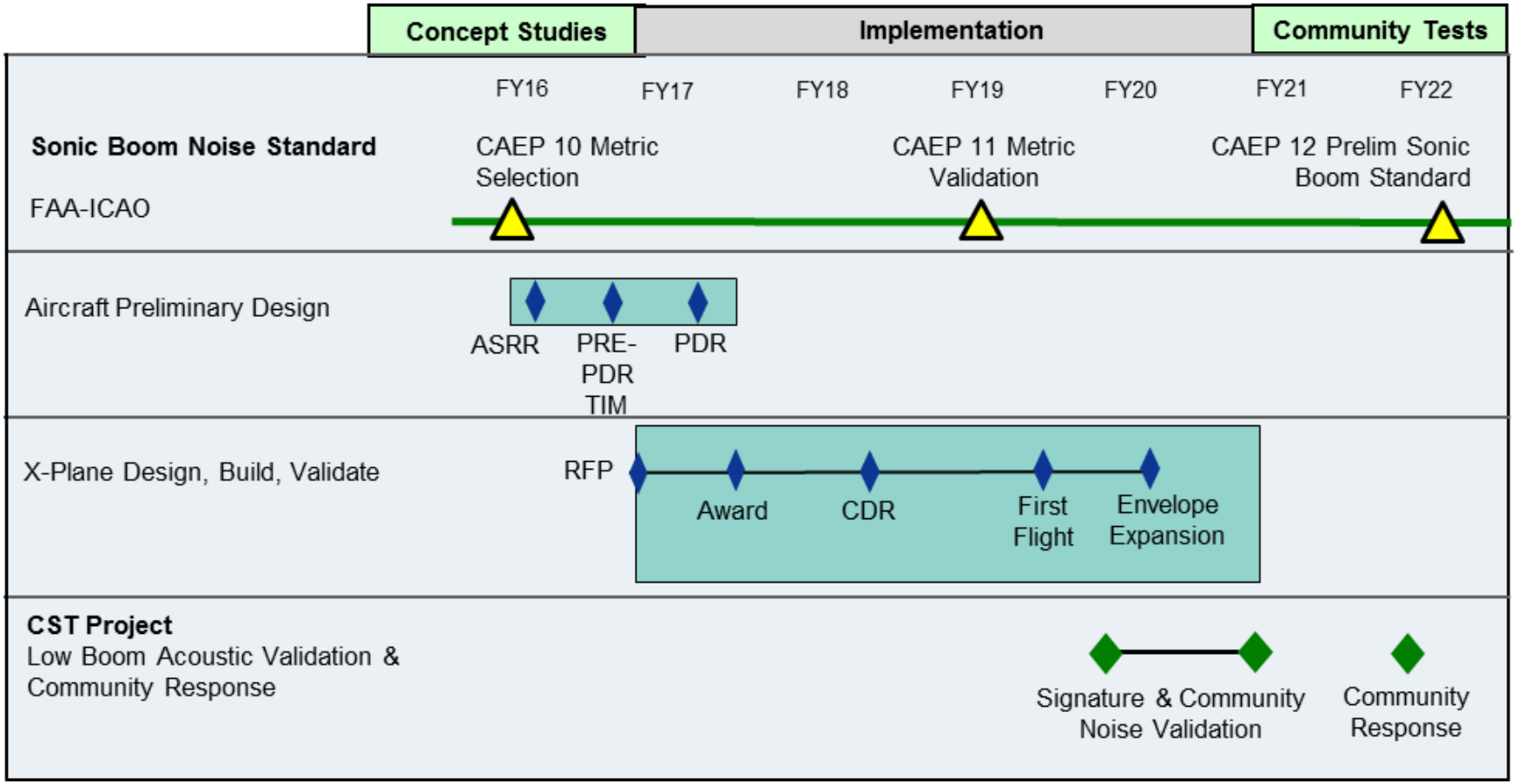
QueSST Program Schedule



QueSST Program Schedule is Responsive to the Timeline Necessary to Support Generation of Community Response Data

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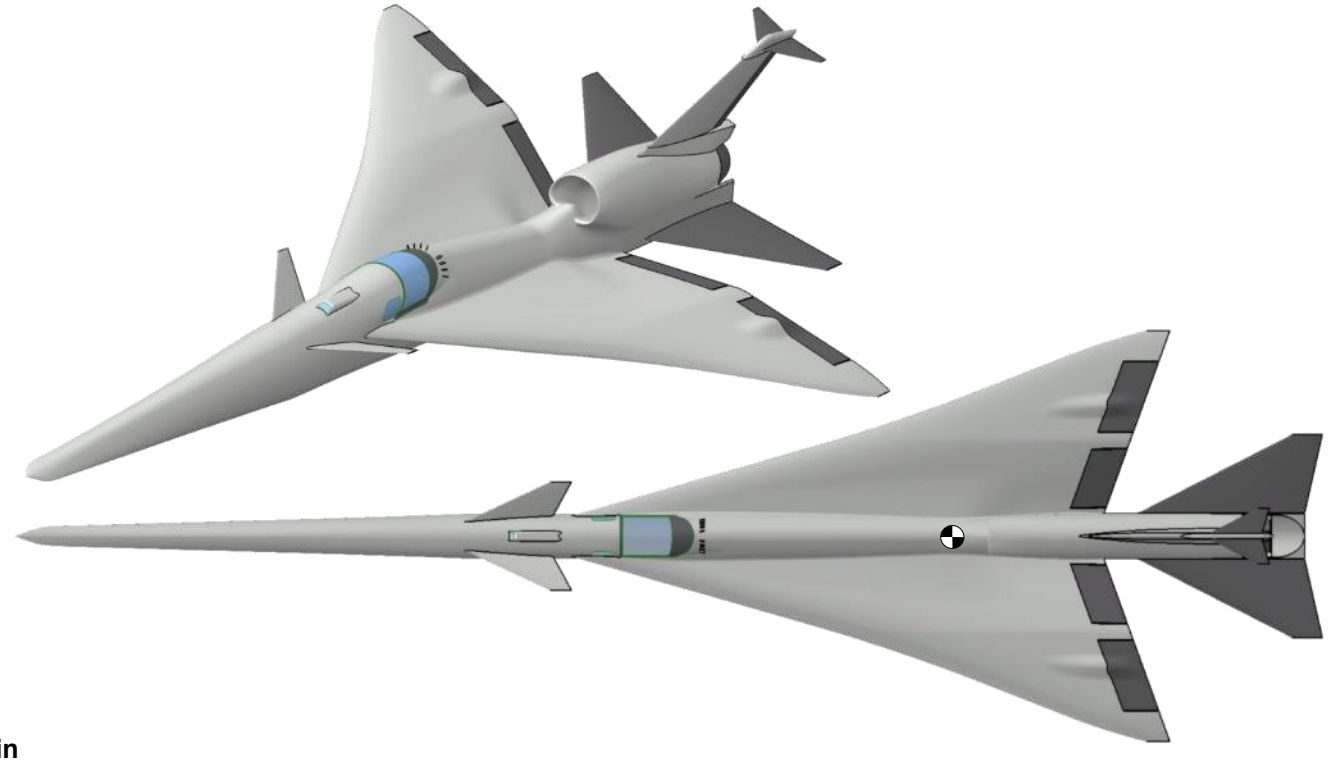
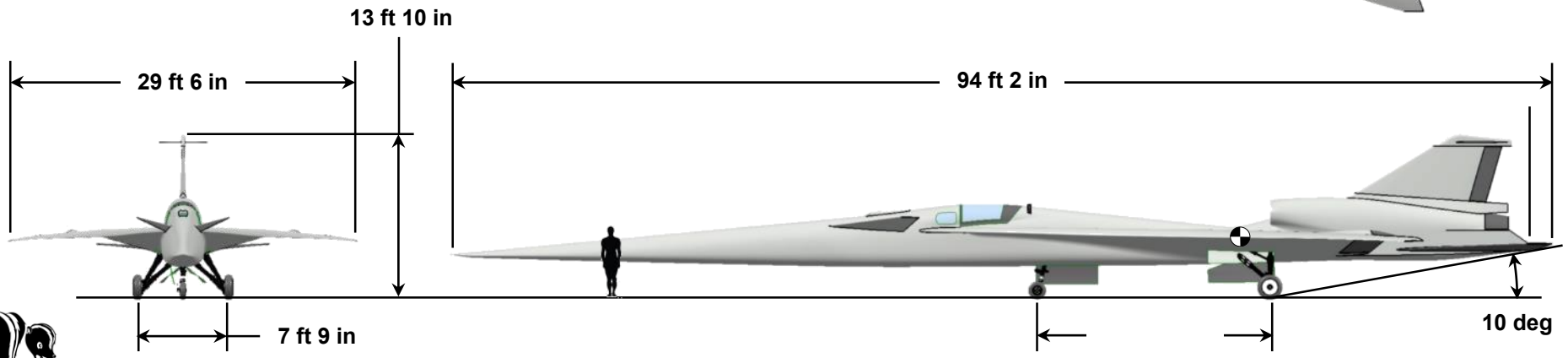
QueSST Configuration C606 Overview

Configuration C606	
MTOW	22,500 lb
Empty Weight	14,000 lb
Maximum Fuel	7,100 lb
Payload	500 lb
S_{ref}	486 sq ft
W/S	46 lb/ft^2
T/W	0.60
Engine	1xGE F404
Design Mach	1.42
Loudness	<75 PLdB





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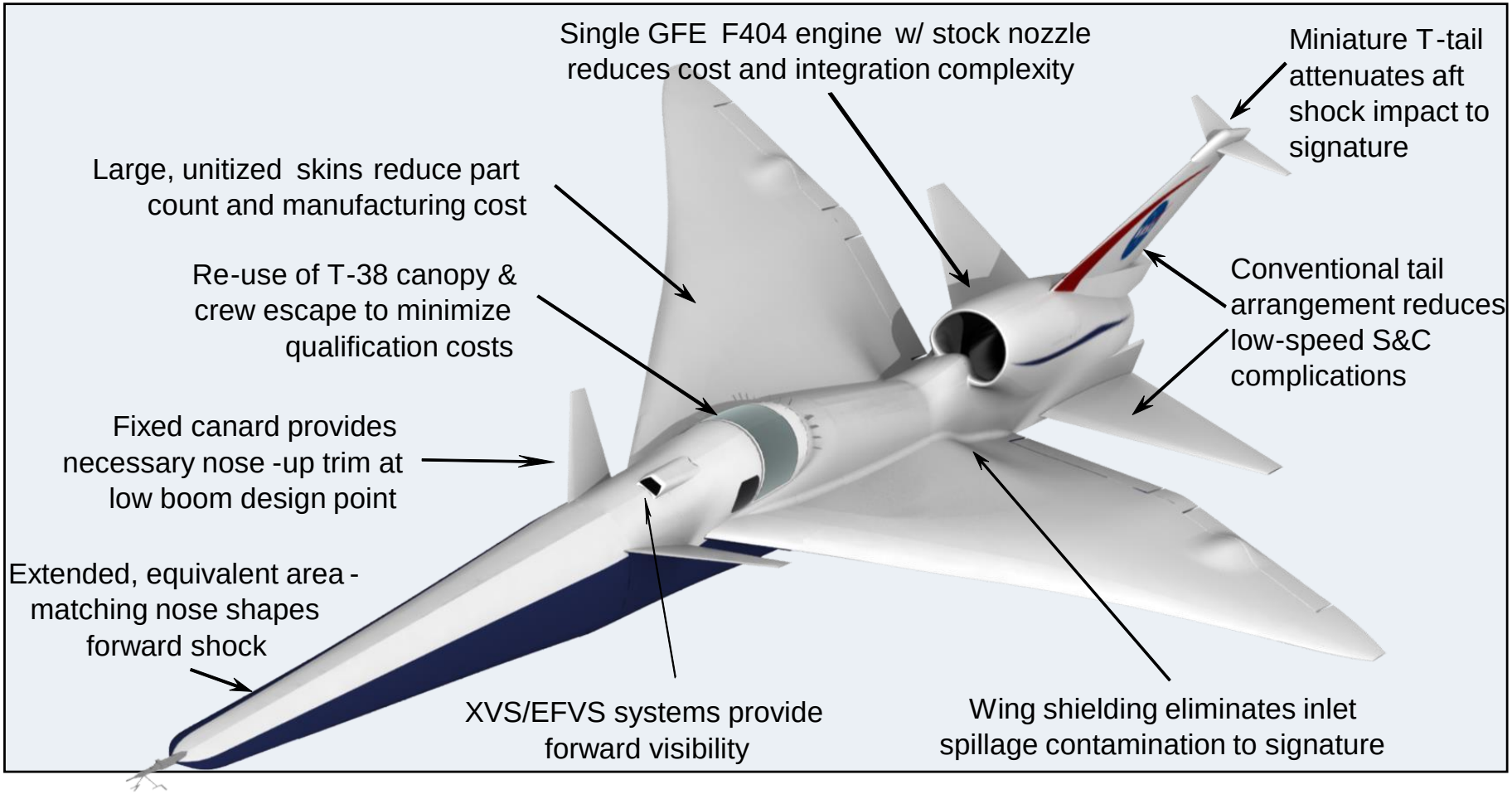
QueSST Design Features



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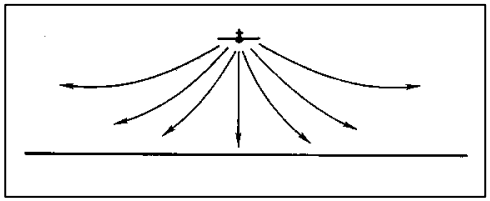
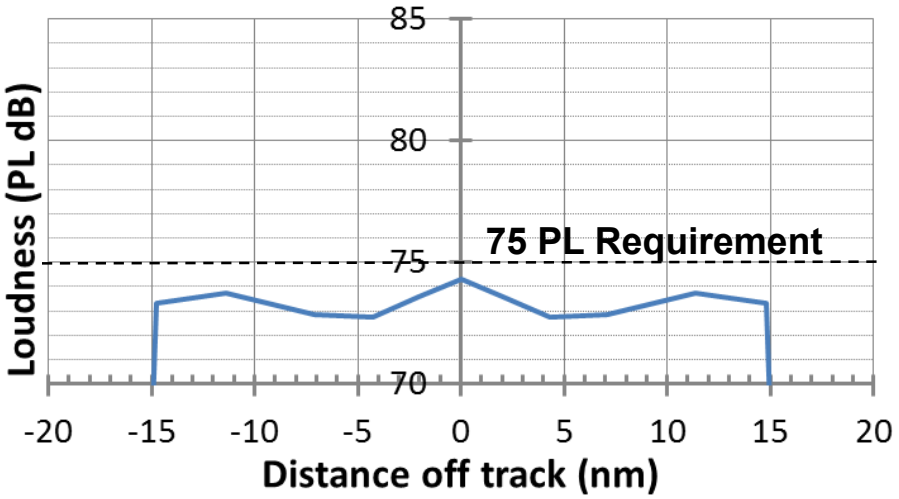
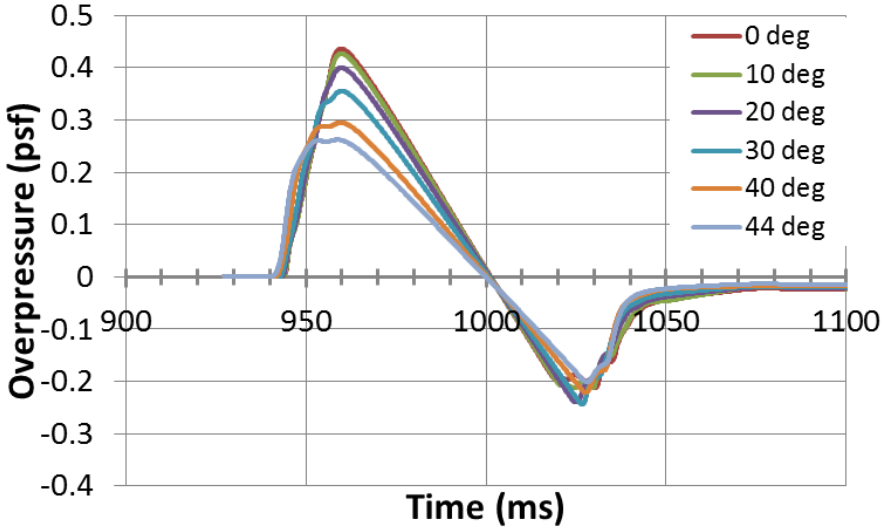
QueSST Shaped Boom Performance



C606 trimmed at Wt=18,800 lb
M1.42 Alt=54,000 ft AOA=1.70 deg CGLOC=844 in PC=122 Tail Incidence=2.60 deg





C606 Meets Sonic Boom Requirements
Over The Entire Carpet with Margin

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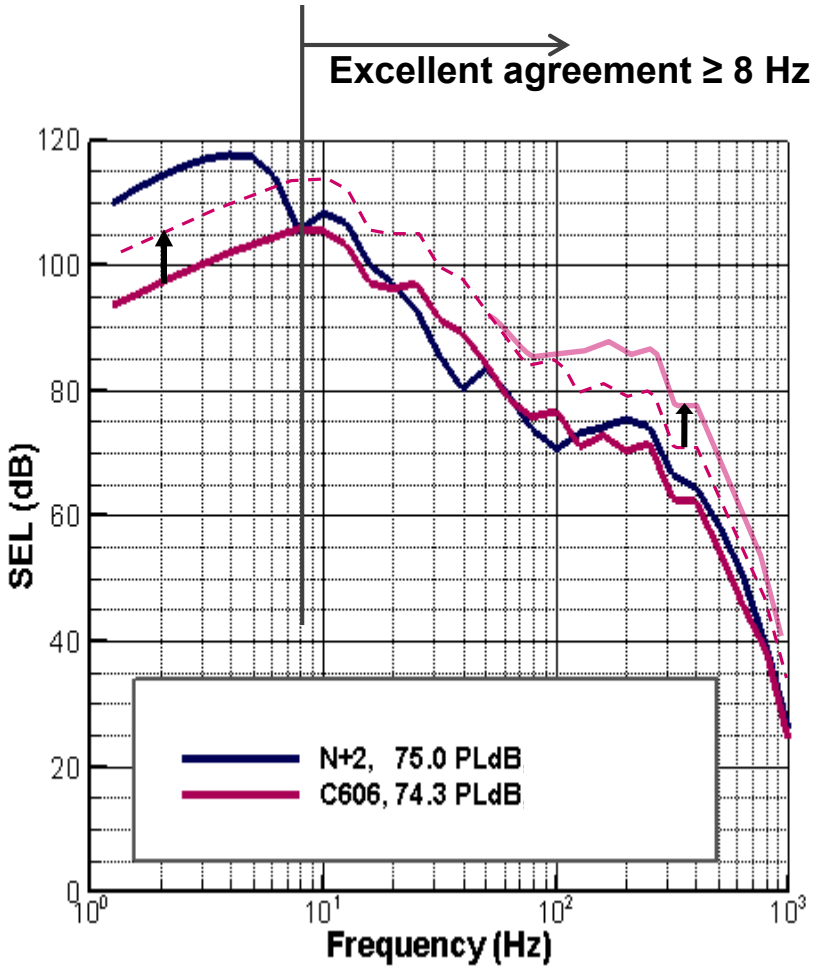
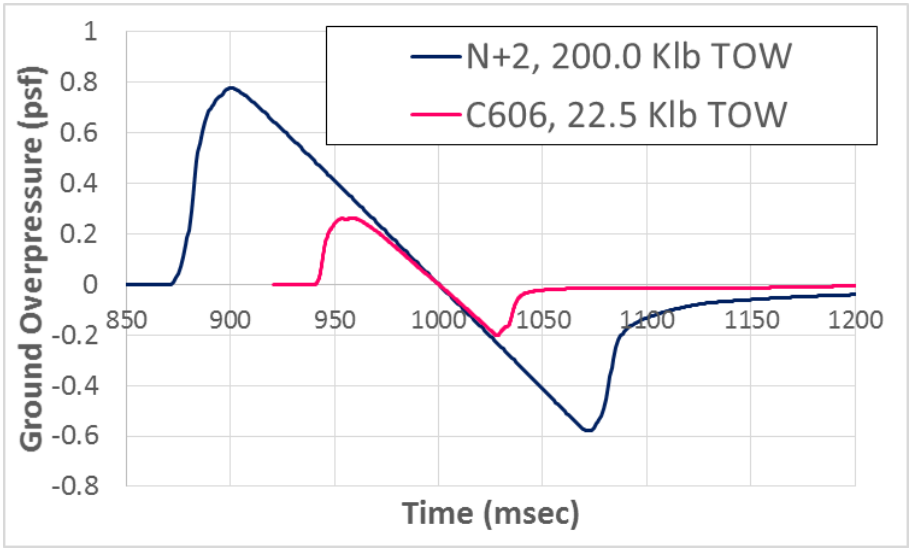
QueSST Signature Traceability



- N+2 sound energy level (SEL) well matched at all frequencies
- SEL can be scaled-up at all frequencies and/or at high frequencies to match a range of possible products



QueSST Sound Energy Variations Provide Excellent Traceability for a Range of Future Commercial Products

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Summary

- **Work on the LBFD Concept Formulation and Refinement Studies established requirements and resulted in a closed airplane configuration capable of generating extremely quiet boom levels**
- **Current work on PDR effort will further mature the X-plane design and lay the foundation for an eventual quiet commercial supersonic aircraft**

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