

Sonic Boom Technologies and Challenges

FAA Civil Supersonic Aircraft Workshop

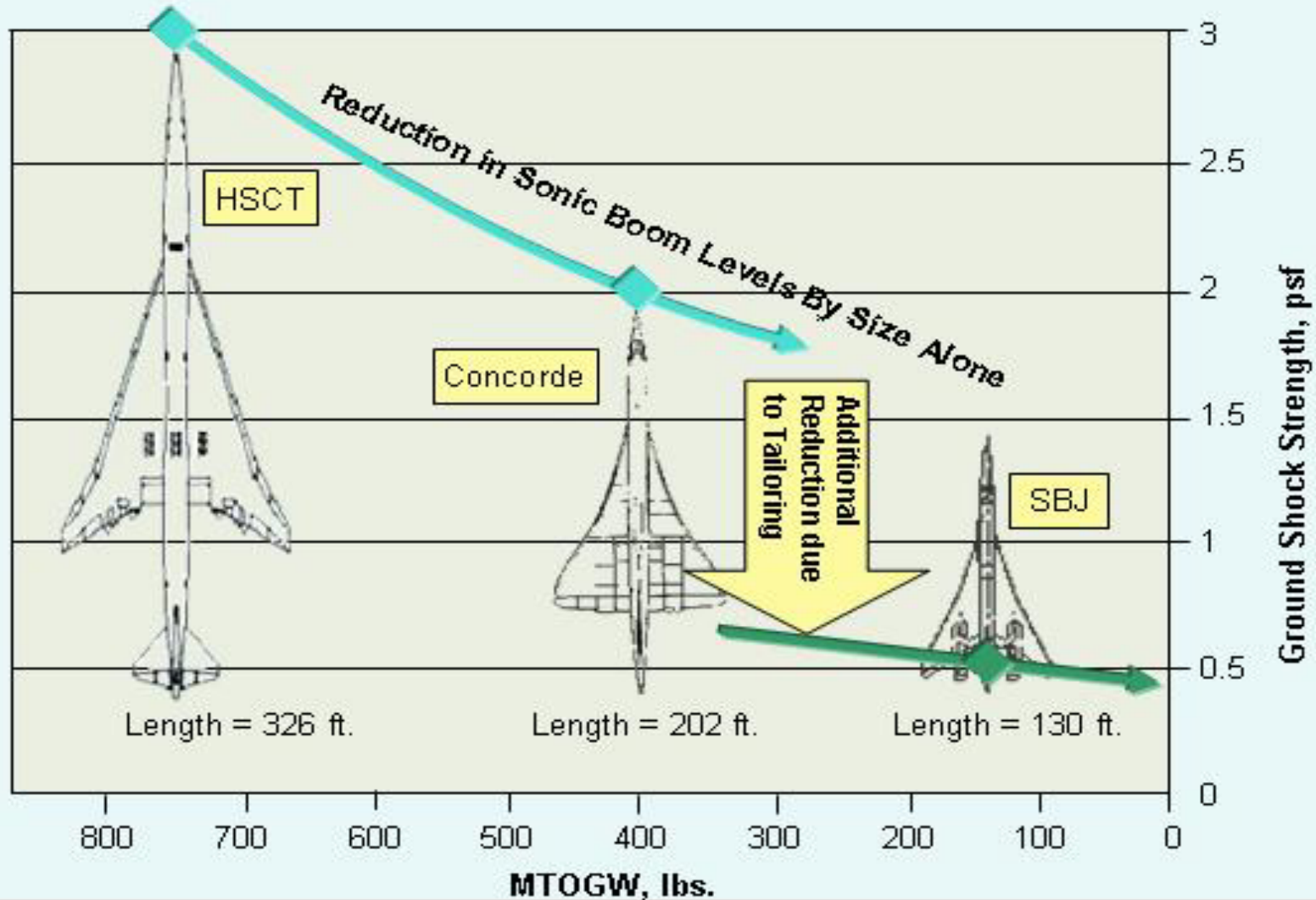
***Lockheed Martin Aeronautics Company
Advanced Development Programs***

November 13, 2003

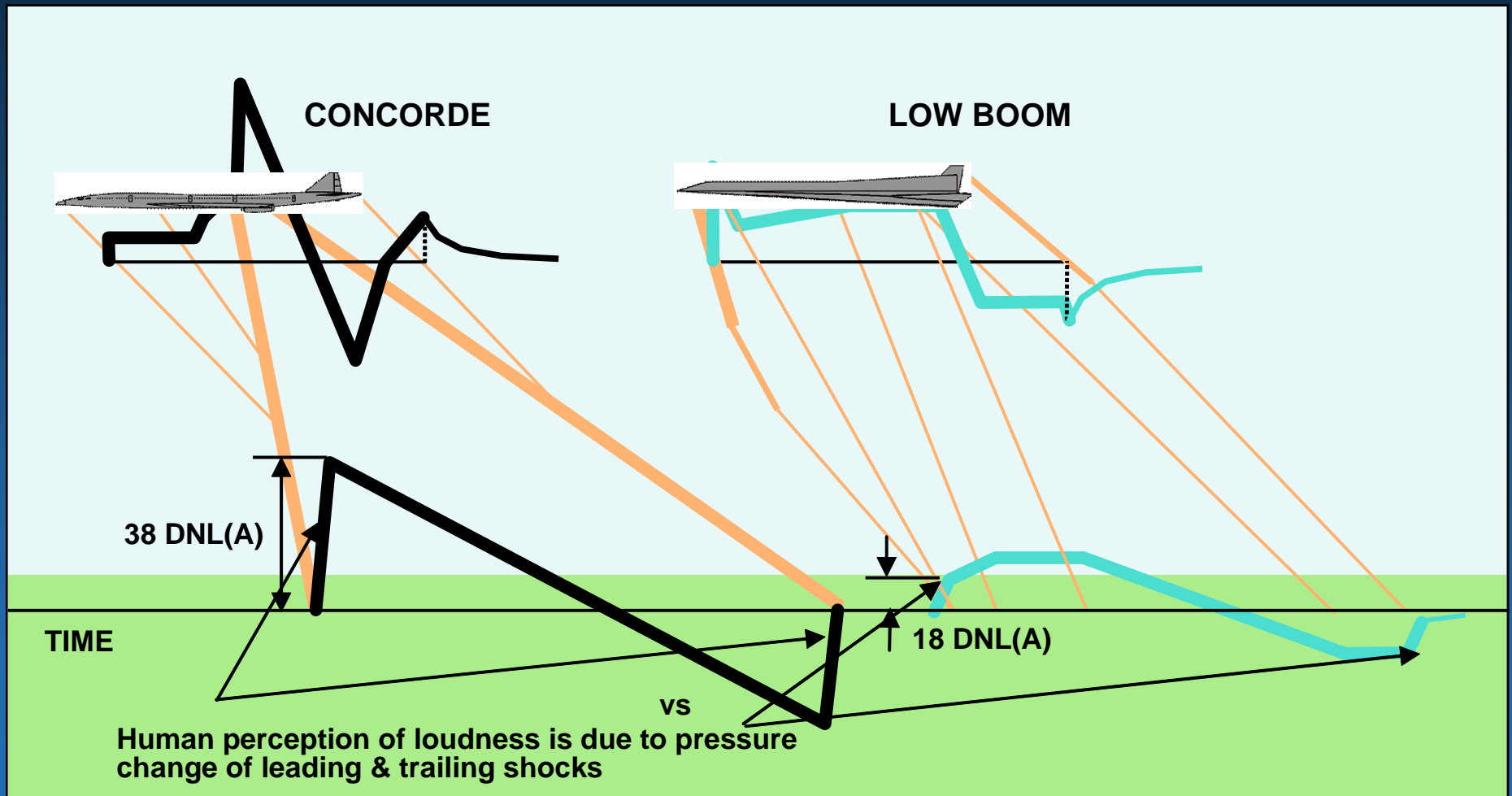
Key Steps to Supersonic Flight Overland



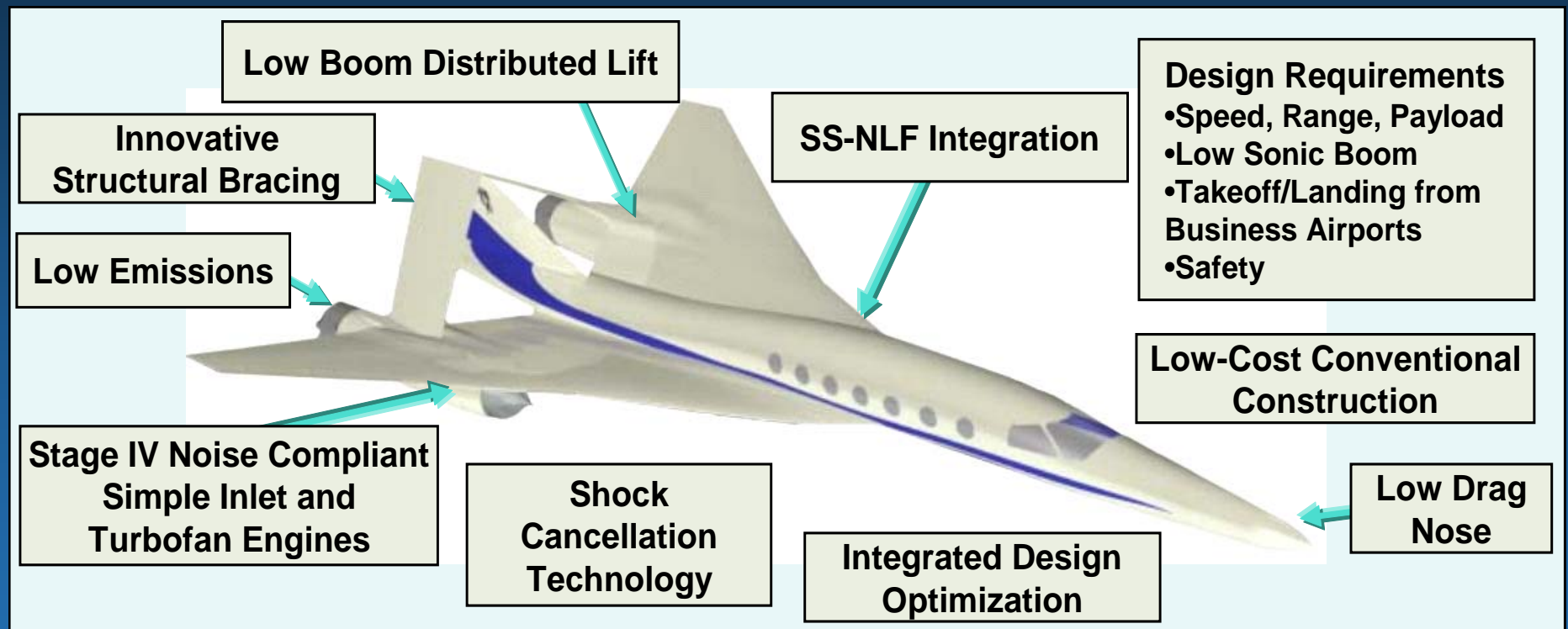
Sonic Boom Reduction Techniques



Low Sonic Boom Methodology



New Low Boom Technologies



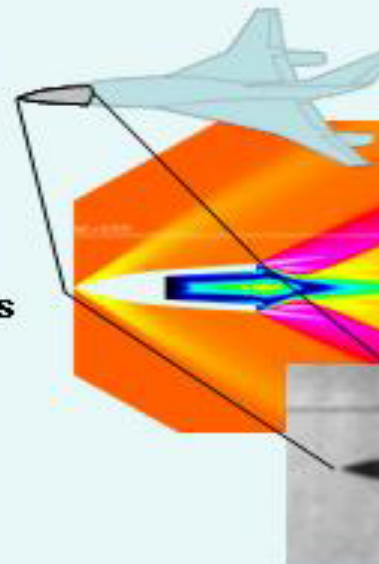
Low Sonic Boom Validation



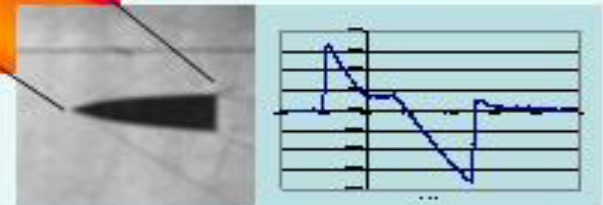
- Wind tunnel tests of lift/area minimized designs
- Sonic boom less than 0.5 psf predicted from tunnel measurements



- DARPA QSP modified F-5 for shaped sonic boom
- First flight test validation of non -"N wave" sonic boom



- Refined low drag / low boom nose
- CFD prediction & NASA Ames ballistic range measurements
- Schlieren photo and measurement confirms low boom



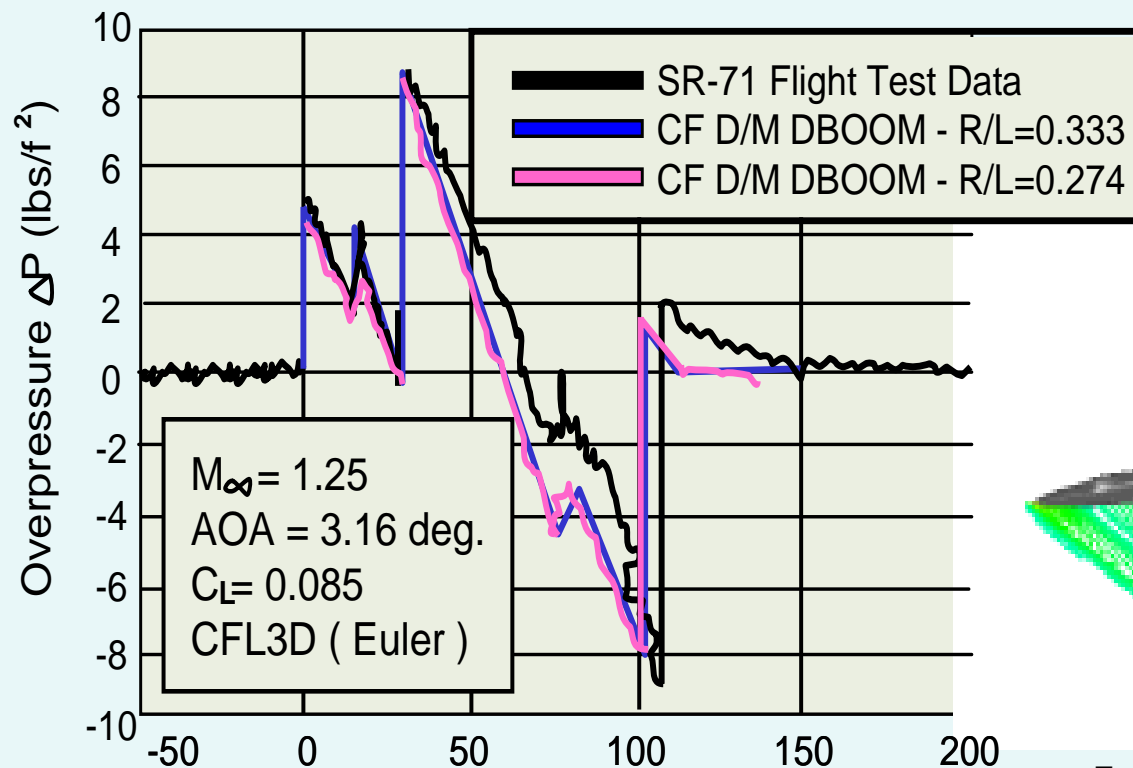
- LM Sonic Boom Simulator improves low boom shaping

- Supersonic natural laminar flow for low drag
- NASA Dryden flight test demonstrates full chord SS-NLF

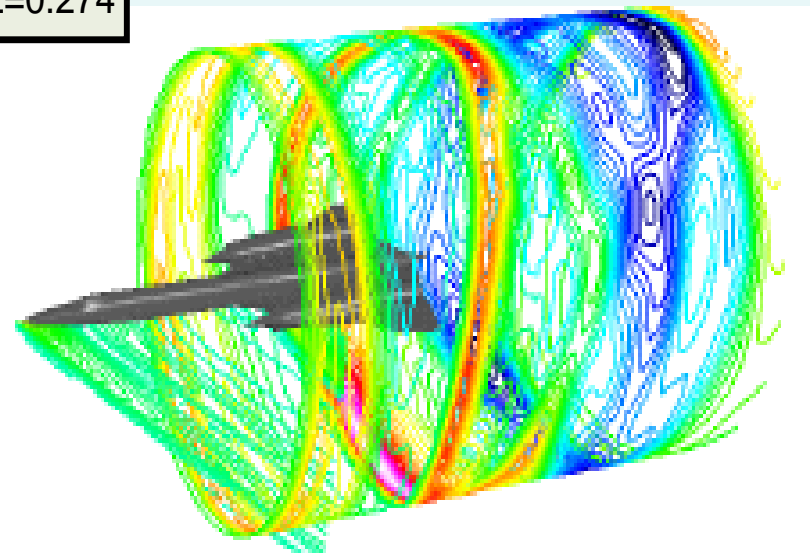
Sonic Boom Analysis Methodology Validation



Track Signatures at ~8 Fuselage Lengths off the SR-71

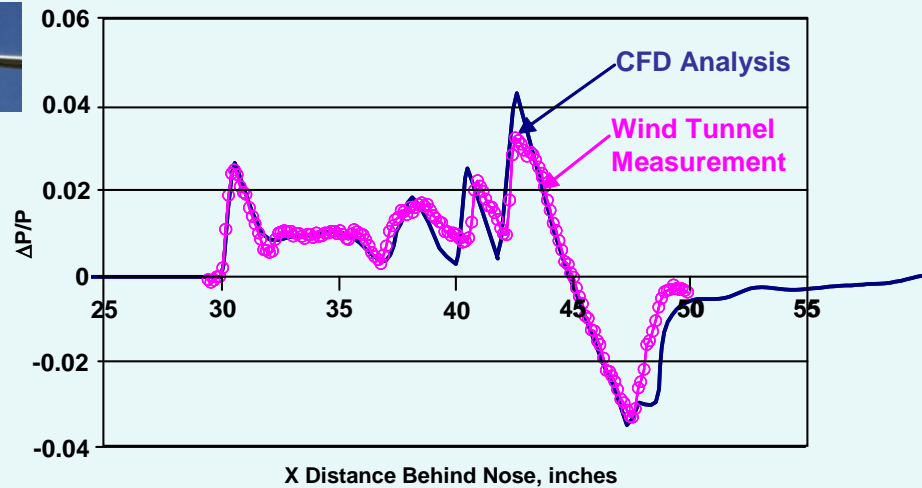


- CFD matches flight test measurements of near field pressure data



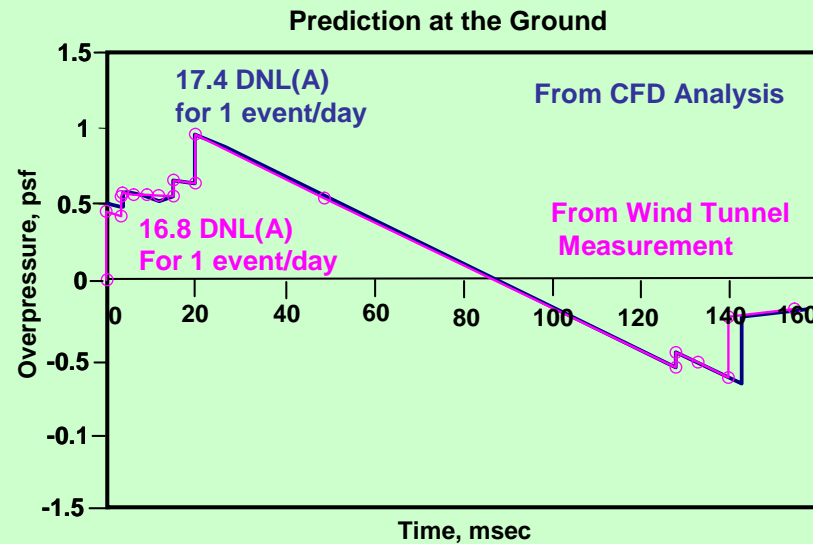
From AIAA 556-2003; Peter Hartwich, et. Al.

Sonic Boom Analysis Methodology Validation



- CFD analysis matches wind tunnel measurements

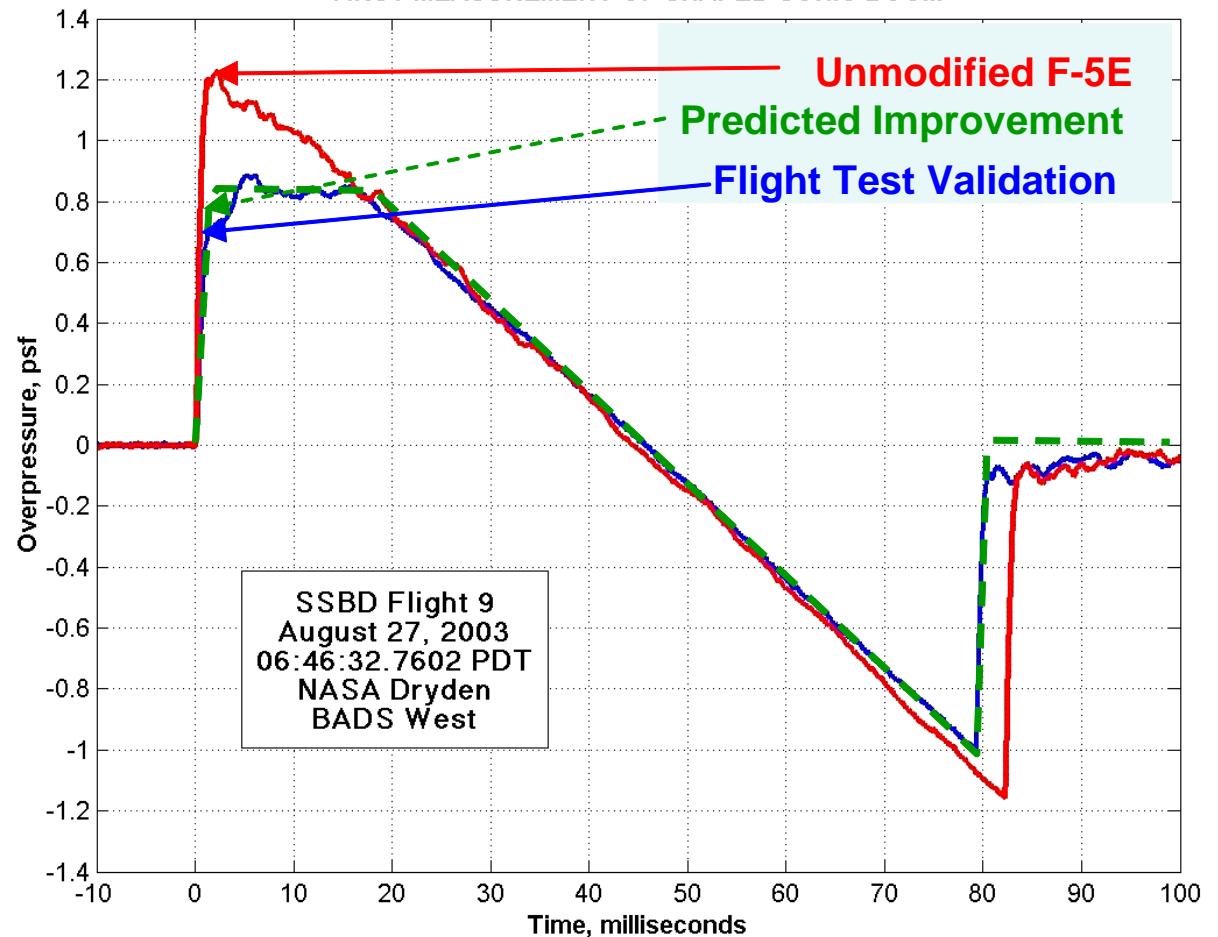
- Wind tunnel & CFD data propagated to ground demonstrates acceptably low boom levels



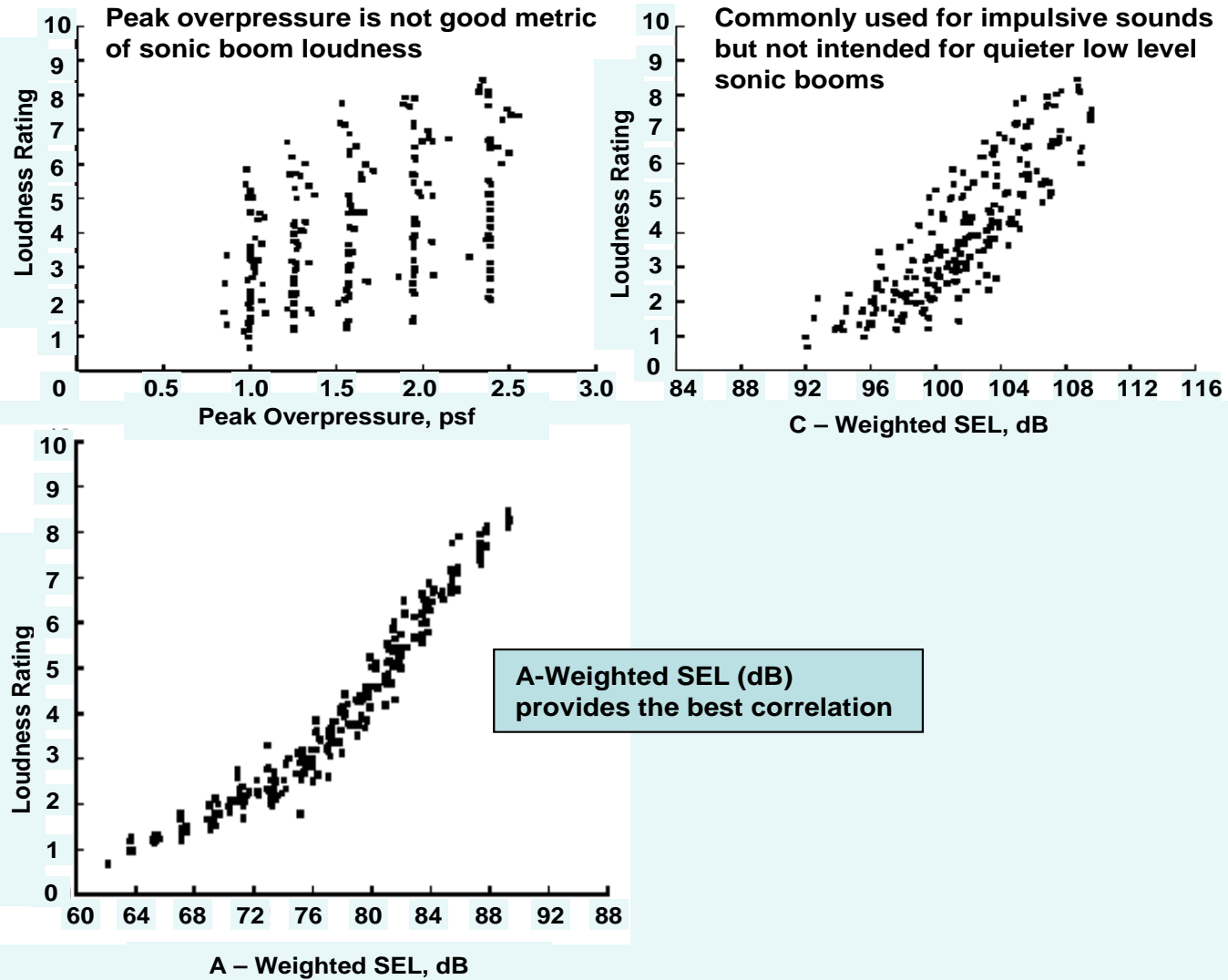
Flight Test Validation of Predicted Sonic Boom



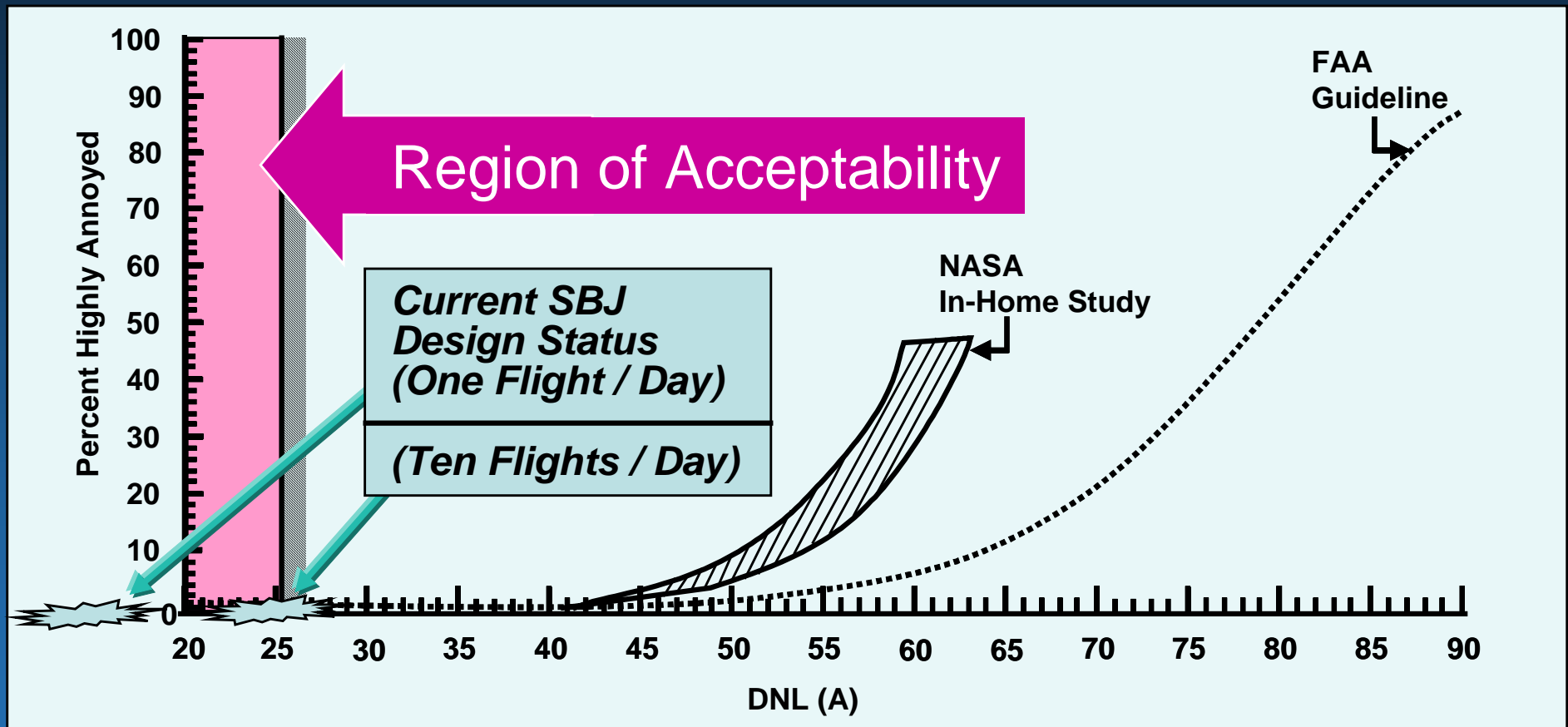
- DARPA QSP tested modified F-5 aircraft with tailored fuselage fairing to demonstrate front shock boom reduction
- Results confirm that Lift/Area Tailoring can produce shaped sonic boom on the ground



Sonic Boom Measurement Metrics



Sonic Boom Acceptability Metrics



Recommendations



- **Establish rulemaking project to amend FAR 91 to replace current prohibition on overland sonic boom with objective criteria for supersonic flight**
 - *If necessary, Conduct further low boom human reaction studies using simulators*
- **Alternatively,**
- **Amend FAR 91 Appendix B to broaden conditions for approval of Authorizations to Exceed Mach 1**
 - *Incremental approach with evolution based on experience*
- **Lead efforts to establish international criteria through ICAO Committee on Aviation Environmental Protection (CAEP)**