An Overview of the Gulfstream Supersonic Technology Program

Gulfstream Aerospace Corporation
UC Davis Aviation Noise & Air Quality Symposium
“Revolution in Aviation”
March 1, 2009 / Palm Springs, CA
Civil Supersonics / Concorde is Gone – What Now?

- **Gulfstream Perspective…**
  - Quiet Supersonic Jet (QSJ)
    - Different Market
      - Business Jet: Speed is Important & Affordable
    - Different Requirements
      - High Speed Civil Transport: Mach 2.4, 600K airliner
      - Quiet Supersonic Jet: Mach 1.8, 100K transport
  - Advantages
    - Smaller Aircraft → Reduced Sonic Boom
    - Lower Speed → Less Complexity (Inlets, Materials, Etc.)

Better Chance at Enabling Acceptable Supersonic Civil Aircraft
Redefining the Speed Envelope

Today’s Reality

Cruise Speed: 0.85 M

Tomorrow’s Vision

Cruise Speed: 1.80 M

Environmental Considerations

- Boom Overpressure: Acceptable for Overland SS Flight
- Takeoff Emissions: ICAO with Margin
- Cruise Emissions: Minimum Impact
- Airport Noise: Stage 4 with 10dB Margin

Manage Environmental Impacts Through Design Requirements
Supersonic Technology Development

Conduct basic research into reducing the impact of sonic boom on people and the environment to enable regulatory change for supersonic flight overland, domestically and internationally.
Sonic Boom Suppression

- **Gulfstream Quiet Spike™**
  - Extendable Nose Spike
  - Generate Series Of Weak Shocks
  - Propagate Parallel To Each Other
  - Transform Sharp Crack Into Quiet Whisper

![Graph showing Delta Pressure vs Time with different curves for Concorde, SBJ w/ No Shaping, and QSJ w/ Quiet Spike.](image)

![Images of a spike configuration with and without spike.](image)
Quiet Spike™ Flight Test

Comparison of CFD-Predicted vs. Measured Near-field Signature

Excellent Correlation & Validation of Sonic Boom Suppression

Photo: NASA Dryden Flight Research Center
Preliminary Outdoor Acceptability Results

NASA F-18 Low Boom Flight Test – October 2005

Flight test results validated independently via SASSII outdoor simulator testing.

Acceptability Levels:
- Absolutely Not Allowable
- Not Acceptable
- Marginal
- Acceptable Day Time
- Acceptable 24/7

Boom Sound Levels:
- HSCT Concorde SBJ
- QSJ shaped
- advanced
- advanced+

PLdB Levels:
- Linear (50% Acceptance)
  - $y = 8.7209x + 51.731$
  - $R^2 = 0.7576$
  - 50% Acceptance
- Linear (95% Acceptance)
  - $y = 5.7889x + 54.646$
  - $R^2 = 0.3195$
  - 95% Acceptance

Noise Reduction:
- >35dB Reduction
Global Impact Assessment

Low Boom Signature
Robust in Non-Standard
Atmosphere

Concorde, Std. Atm.: >105 PLdB
QSJ, Std. Atm.: <70 PLdB

St. Helena Island (summ)  58.6 PL(dB)
Oimakon, Russia (wint)     69.5 PL(dB)
Std. Atm.                                66.8 PL(dB)
Summary

• Continued Market / Industry Interest in Future Supersonic Concepts
  – Supersonic Overland Flight is Required
  – Manage Environmental Design Requirements for Success

• Promising Research Results in Sonic Boom Suppression
  – Validated Quiet Spike Technology
  – Acceptable Noise Level Achieved Through Low Boom Shaping

Quiet Spike Video
Questions?

SUPERSONIC ACOUSTIC SIGNATURE SIMULATOR II
(SASS II)

Listening Area
Looking toward the Speaker

Operator’s Station

Listening Area
Looking toward the Bass Trap

A MOBILE FACILITY FOR ASSESSING SIGNATURE ACCEPTABILITY