Commercial Airplanes

Quieter Airplanes and Flight Operations – A Boeing Perspective

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Significant Reduction in Community Noise
Seattle-Tacoma International Airport – 85 dBA
Global Aviation Brings Together People, Countries and Cultures

38.2M annual global flights. Every day...
- 9.8 million passengers
- 104,000 flights

Supports 62.7M jobs globally

$2.7T in global economic impact, 3.5% of global GDP

~ 41,000 new airplanes over next 20 years
  - 71% of these will be single aisle aircraft

Source: ATAG Aviation Benefits Beyond Borders
Sustainable Solutions
Collaboration Is Key

Airlines | Pilots
Airplanes
Airspace | ANSP's
Airports | Communities
Regulators
Balanced Approach to Community Noise Reduction
Four concepts for a balanced approach

Source Noise Reduction

Low Noise – Operational Procedures

Operational Restrictions

Land Use Planning
Aircraft Noise Valuation
Source Noise Reduction

Certification Levels - EPNL

<table>
<thead>
<tr>
<th>Airplane</th>
<th>737-800</th>
<th>737-8</th>
</tr>
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<tbody>
<tr>
<td>Cumulative Margin</td>
<td>11.5</td>
<td>24.9</td>
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Change the Airplane’s Design
Aircraft Noise Valuation
Low - Noise Operational Procedures

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle.

Aircraft Take Off Airport Monitor Levels

San Francisco Trial
Typical Short Vector Route
Estimated Population: 329,600 to 55dBA
SFO GLS R RWY 19R
Estimated Population: 47,300 to 55dBA

Greener Skies over Seattle
RNAV (RNP) Z RWY 16R

Portland, Oregon
RNAV (RNP) Z RWY 10R

Change how the airplane is flown

- Identify/implement low noise procedures
- Enable airplane to be flown to:
  - limit variation – NextGen, Automation
  - bias procedures toward lower noise levels
    – employ data analytics to identify opportunities

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Low Noise Operations Opportunity
Evolution of ATM Advances

- Instrument Landing System (ILS) 1950s
- VHF omnidirectional range (VOR) 1930 to 1940
- Non-Directional Beacon (NDB) 1940
- Required Navigation Performance (RNP) 1990s
- Localizer Performance with Vertical Guidance (LPV) 2010s
- Global Navigation Satellite Landing Systems (GLS) 2020s
- Next Generation GNSS 2020s
Sustainable Solutions
Collaboration Is Key

Boeing will continue to seek opportunities and collaborations to:

✦ pursue additional source noise reduction.
✦ Identify ways for airplanes to be flown quieter
Creating a Better Future Together

Thank You!