3. Noise Reduction

(1) Environmental Approaches to Noise by the JAL Group

Following are noise impacts by JAL Group operations on the environment around the airports.

A. Aircraft noise such as engine noise at take-off and landing
B. Noise caused by aircraft engine run-up on ground, use of APU, GPU, and ground vehicles in and around the airports.

(2) Improvement of Aircraft Noise Level and Ever Stricter Noise Standards

A. Improvement of jet engine noise level

Thanks to technological advancement, the jet engine noise level has greatly improved: The noise level of Boeing 767, which has a similar fuselage in size as DC-8 or Boeing 707 in the early 1960’s, has decreased, and the annoyance sensed by humans has decreased to about 1/4 from before.

B. Noise standards of International Civil Aviation Organization (ICAO) (applicable to Chapter 2 compliant aircraft)

<1> Agreed by member nations in 1990.
<2> Phased retirement after April 1, 1995
<3> Complete ban on operation after April 1, 2002

Note: There are noise standards for take-off, sideline, and approach for Chapter 2 and Chapter 3 aircraft. Standards vary by maximum take-off weight and number of installed engines. Shown below is a sample chart of take-off noise standards.

Side Measuring Line

Measuring Points of ICAO Noise Standard

6,500 m from Brake Release
Take-off
Approach
Measuring Point
A

Noise Certification Requirements - Takeoff

<table>
<thead>
<tr>
<th>Max. Takeoff Weight</th>
<th>EPNL (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000 lbs</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td></td>
</tr>
<tr>
<td>95</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
<tr>
<td>105</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>

4 Engine
3 Engine
2 Engine

Chapter 2
Chapter 3

C. New ICAO aircraft noise standards (Chapter 4)

In June 2001, ICAO Council adopted the following new Chapter 4 noise standards.

<1> At least 10 dB in cumulative margin for current Chapter 3 noise limits at three measuring points.
<2> The sum of improvement at any two measuring points must be at least 2 dB with respect to current Chapter 3 noise limits.
<3> No trade-offs.

The new standards will be applicable to newly certified aircraft after Jan. 1, 2006.

D. Noise standards in Japan

The Japanese Civil Aeronautics Law establishes noise standards, and all aircrafts are inspected to meet:

- B747 (4-engine)
- B777 (2-engine)
- DC10 (3-engine)
- B737 (2-engine)
- Chapter 3 (3-engine)
- Chapter 2
- B747-400 (4-engine)
- B767 (2-engine)
- MD 11 (3-engine)
- Chapter 3 (2-engine)
- Chapter 3 (4-engine)
these standards at the time of airworthiness inspection on delivery.

(3) Measures by the JAL Group
A. Aircraft operation noise reduction
   <1> Introduction of Chapter 3 aircraft
   The JAL Group fleet is now fully compliant with Chapter 3 standards by either retiring or changing the maximum take-off weight of Chapter 2 aircraft, restricted after April 2002 because of their age and noise.

   <2> Noise reduction flight operational measures
   Regarding flight operational measures at Japanese airports, based on the study result by Committee on Promotion of Noise Reduction Flight Operational Measures, cooperatively established by the government authorities and airlines in 1975, noise reduction flight operational measures were introduced. Improvements such as technical implementation in operation, noise reduction flight operational measures, and compliance with airport operation hours were executed. These measures have been constantly improved on to decrease noise levels in airport surroundings.

   Low Noise Aircraft MD-90
   Noise Reduction Flight Operational Measures

<table>
<thead>
<tr>
<th>Operational Measure</th>
<th>Procedure</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steepest climb</td>
<td>After reaching a certain altitude, climb at maximum climb angle with restraining normal climb power.</td>
<td>Very effective</td>
</tr>
<tr>
<td>Thrust cutback climb</td>
<td>After reaching a certain altitude, reduce thrust to lower noise level over noise sensitive areas, and reapply thrust and make a normal climb after passing those areas.</td>
<td>5 to 10 dB(A) reduction in case of B737</td>
</tr>
<tr>
<td>Reduced flap setting</td>
<td>Landing is made with a shallow flap angle, used only where there is sufficient runway length. Ground noise level is reduced in proportion to thrust decrease due to reduction of aerodynamic drag.</td>
<td>2 to 3 dB(A) reduction</td>
</tr>
<tr>
<td>Delayed flap approach</td>
<td>Delay operation timing of flap down. Similar effect as the reduced flap setting procedure.</td>
<td>2 to 3 dB(A) reduction</td>
</tr>
</tbody>
</table>

B. Ground noise reduction measures
   <1> Aircraft noise during parking at airport
   We are making efforts to reduce aircraft noise during parking at airport by using the Ground Power Unit (GPU) in stead of APU, the noise level of which is 85 to 98 dB(A) in case of B747 aircraft. The GPU can control the noise level within 55 to 59 dB(A), which is less than background noise level. (Refer to page 18 for GPU)

   <2> Construction of noise reduction hangar for engine run-up
   As a controlling measure against noise source of aircraft engine run-up at Narita airport, we built a noise reduction hangar with the Narita airport authority and other airline, and it has been in use from April 2001. Owing to this, the engine run-up became possible regardless of hours and wind direction.