ACI Aircraft Noise Rating Index (Update 2010)

Introduction

Air transport brings very significant economic and social benefits to the communities and countries served by airports. Aircraft noise is the single major cause of community opposition to current operations and to airport capacity development to meet future traffic growth. At many noise sensitive airports, quieter aircraft are the key to offsetting the impact of aircraft noise and ensuring the sustainable future growth of airport capacity and air transport under increasing environmental constraints, for the benefit of the traveling public, airlines, airports and their neighboring communities.

ICAO' Committee on Aviation Environmental Protection (CAEP) is the competent ICAO body for developing and revising ICAO's Annex 16 aircraft noise and engine emissions international certification standards for application by ICAO's Contracting States.

The Chapter 4 noise standard was approved in 2001 and came into force in 2006. It introduced a cumulative reduction of 10 dB relative to Chapter 3, which is much less stringent than three individual and separate stringencies at each noise certification measurement point. Furthermore, Chapter 4 requires that the sum of reductions relative to Chapter 3 at any two measurement points is at least 2 dB, thus leaving the possibility of no reduction at one of the measurement points. The combination of the two criteria in Chapter 4 brought little noise relief for airports.

In April 2002, ACI's Governing Board directed ACI's Environment Standing Committee to draw up a tool for rating aircraft noise for practical applications at airports. The following issues and choices involved in the drawing up of this Index, and the pros and cons of each one were discussed by the Standing Committee:

- Whether the Index should reflect noise values relative to ICAO Chapter 3 standard or absolute noise values;
- Whether the Index should reflect separate noise reductions at each of the three noise measurement points (Approach, Sideline and Flyover), or a cumulative noise reduction;
- Whether the Index should be linked to the ICAO system or be separate from it; and
- The possible uses of such an Index by airports.

ACI Aircraft Noise Rating Index (2002)

In October 2002, the original ACI Aircraft Noise Rating Index was adopted by ACI's Governing Board (see table 1). The Index was designed to achieve the following objectives:

- Encourage global consistency in the implementation of effective airport noise management programs;
- Enable airports to communicate effectively with communities and governments about noise issues;
- Provide an effective tool that is compatible with the ICAO system of noise certification standards;
- Provide a consistent reference point to encourage manufacturers to develop and market the quietest possible aircraft and encourage airlines to upgrade their fleets as rapidly as possible.

The Index combined cumulative reductions with reductions at the three measurement points. The Index thus matched current trends and technologies and remained simple, while at the same time it reflected more faithfully the specific situation at each individual airport and was therefore of greater use for noise management policies.

The Index applied to aircraft certificated under ICAO Annex 16 Chapters 2, 3, 4 and 5, using the corresponding noise certification data. The Index placed aircraft into six categories of noise performance, ranging from A to F. An aircraft is required to meet both criteria concurrently in order to qualify for the corresponding noise category.

Table 1: Original ACI Aircraft Noise Rating Index (2002)

Criteria to be met concurrently	**Categories**					
	F	**E**	**D**	**C**	**B**	**A**
Cumulative EPNdB reduction from ICAO Chapter 3 standard of at least:	Less than 0	0 or more	5 or more	10 or more	15 or more	20 or more
Individual EPNdB reduction from ICAO Chapter 3 Standard at each noise measurement point of at least:	Not applicable	0	1	2	3	4

NRI Extension for New Aircraft

In recent years, some new aircraft types are being certified with cumulative noise margins better than 25 EPNdB relative to the Chapter 3 Standard. Under the original NRI system, however, the best category that an aircraft can achieve was Category A, which as a cumulative margin of only 20 dB. In November 2009, the World Governing Board approved a modification of the NRI in order to give recognition to the clearly superior performance of these new aircraft.

The agreed solution was to

1. extend the system beyond former Category A with 2 new categories and
2. create an open ended labelling system starting with R1, the former Category F, through to R8, as shown in Table 2 below.

Table 2: The Modified ACI Noise Rating Index (2010)

Criteria to be met concurrently	**Categories** (and Former Categories)							
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**
	(F)	(E)	(D)	(C)	(B)	(A)		
Cumulative EPNdB reduction from ICAO Chapter 3 standard of at least:	Less than 0	0 or more	5 or more	10 or more	15 or more	20 or more	25 or more	30 or more
Individual EPNdB reduction from ICAO Chapter 3 Standard at each noise measurement point of at least:	Not applicable	0	1	2	3	4	5	6

The open ended system will allow new, better categories to be added at any time. The original 6 categories (F through A) changed only in name (R1 through R6).

Table 3 below shows some of the aircraft that would qualify for the new R7 category. Each has a cumulative margin of at least 25 EPNdB better than the Chapter 3 Standard and all individual margins are at least 5 better than Chapter 3. There are no current aircraft that would fall in the new R8 category.

Table 3: Category R7 Aircraft

Manufacturer	Type	Version	MTOM(kg)	MLM(kg)	Engine	Flyover Margin	Lateral Margin	Approach Margin	CUM Margin
AIRBUS	A380	841	569000	391000	TRENT 970	11.2	8.1	7	26.3
AIRBUS	A380	842	569000	391000	TRENT 972	11.7	7.7	7	26.4
AIRBUS	A340	541	305000	220000	TRENT 553EP	16.2	5.9	5.9	28
BOEING	777	200	229500		GE60-76B	11.3	7.7	6.7	25.7
BOMBARDIER	CRJ	200	24000		CF-34-3B1	10.3	11.6	5.9	27.8
SAAB	2000		22999	22000	AE2100A	9.9	7.1	10.1	27.1

Purpose and uses of the Index

The Index still provides airports with a common tool to rate all aircraft which operate into an airport, on the basis of the certificated noise levels relative to the Chapter 3 standards.

The Index uses the margins relative to the Chapter 3 limits at the three measurement points of ICAO Annex 16 Chapter 3. These limits are based on the maximum takeoff mass of an aircraft. Therefore the Index does not provide information about the absolute noise levels that people hear in the surroundings of an airport. It does give information about the status of an aircraft relative to the state of the art in noise reduction technology for aircraft with comparable takeoff mass.

The Index can therefore be used to encourage airlines to use quieter aircraft and as an incentive to manufacturers to develop and market the quietest possible aircraft in each weight range.

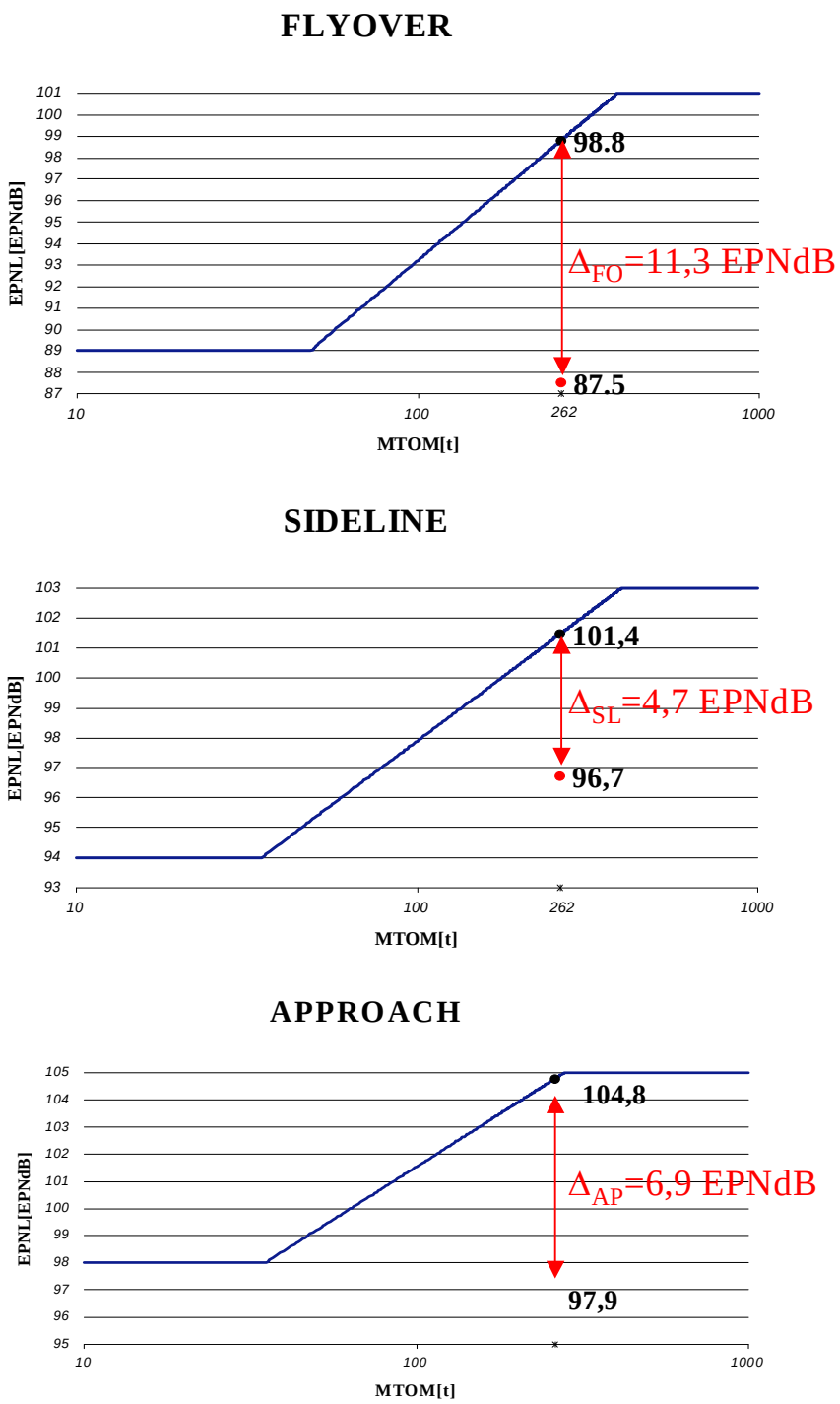
Airports can make use of the Index for the following purposes:

- Airport fleet analysis by evaluating the percentage of aircraft operations falling into the categories R1 to R8;
- Airline fleet analysis and comparison of each airline's contribution to overall noise levels at an airport;
- Worldwide airport and airline noise performance statistics;
- Communication with neighboring communities, local authorities, regulators and business partners;
- Slot allocation;
- Noise related operational restrictions for instance night flying restrictions, preferential runway usage etc; and
- Noise related charges.

How to calculate the ACI Index noise ratings

Figure 1 shows the certification data of a B777-200 relative to Chapter 3 limits as an example. The certification data of the aircraft can be taken from the noise certification documentation (noise certificate) on board of the aircraft, or from the national certification authority, or from reports such as the FAA Advisory Circular 36-1H.

Figure 1: Noise Certification Values for B777-200 according to ICAO Annex 16, Volume I, Chapter 3



Chapter 3 limits for the three measurement points of Flyover (FO), Sideline (SL) and Approach (AP) noise can be calculated from the formulas contained in ICAO Annex 16 Volume I.

The margins relative to Chapter 3 then can be calculated as the differences between the Chapter 3 limits and the certificated data for the three measurement points (see Figure 1). The cumulative margin relative to Chapter 3 is the sum of the three single margins.

For the B777-200 in Figure 1, the FO, SL and AP margins relative to Chapter 3 are respectively: 11.3, 4.7, and 6.9 EPNdB.

And the cumulative margin relative to Chapter 3 is: 11.3 + 4.7 + 6.9 = 22.9 EPNdB.

For this aircraft, the cumulative margin relative to Chapter 3 is more than 20 EPNdB. Concurrently, at each of the three measuring points, the individual margin relative to Chapter 3 limits is more than 4 EPNdB. As a result, this aircraft is rated as Category R6 aircraft.

This procedure can be followed for all aircraft operating into an airport, and a general picture of the airport fleet and airline fleet noise can be obtained.

Table 4 provides other examples showing the resulting aircraft ratings. It is important to note that different airframe-engine combinations may result in different rankings, even though they may have the same MTOM. Examples for this in Table 4 include: Airbus A330-200 and A320-200, Boeing B747-400, B767-300, B767-300ER, B777-200, B777-200ER and B777-300. It is also important to note that the aircraft in Table 4 are just examples, not a general classification.

Table 4: Application of the Index to a sample of aircraft

Aircraft Type		Rating Index	MTOM (tons)	Engine	Margin Levels (EPNdB) FO	SL	AP	CUM
A-300	B4	R2	165.0	CF6-50-C2	2.1	2.8	0.8	5.7
A-300	600R	R3	174.8	CF6-80C2A5F	5.0	1.5	3.4	9.9
A-300	600R	R3	174.6	PW-4158	3.4	2.1	1.5	7.0
A-310	200	R4	138.6	JT9D-7R4D1	4.6	4.3	2.0	10.9
A-310	300	R4	160.0	CF6-80C2A2	3.1	3.6	4.3	11.0
A-310	300	R3	150.0	PW-4152	5.0	2.2	2.7	9.9
A-319	100	R4	74.0	CFM56-5A5	4.7	2.6	5.7	13.0
A-320	200	R4	68.0	CFM56-5A1	5.7	2.1	3.8	11.6
A-320	200	R2	60.0	CFM56-5B4/P	11.5	0.8	4.3	16.6
A-321	200	R4	93.0	V2533A5	4.6	2.4	5.5	12.5
A-330	200	R5	230.0	TRENT772	7.7	3.6	7.6	18.9
A-330	200	R4	230.0	PW4168A	5.6	2.0	6.3	13.9
A-330	300	R4	230.0	CF6-80E1A2	3.8	3.8	5.6	13.2

A-330	300	R4	230.0	PW4168	3.7	2.7	6.3	12.7
A-330	300	R5	217.0	TRENT768	8.0	4.3	7.3	19.6
A-330	300	R5	217.0	TRENT772	8.6	3.2	7.3	19.1
A-330	300	R5	233.0	TRENT772B	7.4	3.6	7.6	18.6
A-340	200	R6	270.0	CFM56-5C3	7.9	6.2	7.7	21.8
A-340	300	R6	270.0	CFM56-5C3	7.8	6.3	7.7	21.8
A-340	600	R6	368.0	TRENT556	12.0	7.2	5.1	24.3
AN-124-100		R2	392.0	D-18T	0.0	0.2	0.4	0.6
B-737	300	R1	63.3	CFM56-3B-2	5.0	4.3	-0.1	9.2
B-737	300	R3	63.3	CFM56-3-w/HWFAP	6.8	5.3	1.4	13.5
B-737	500	R2	52.4	CFM56-3-B1	6.9	4.7	0.0	11.6
B-737	600	R5	65.1	CFM56-7B22	6.4	4.1	4.6	15.1
B-737	700	R4	70.1	CFM56-7B24	5.4	3.6	4.5	13.5
B-737	800	R4	79.0	CFM56-7B24	3.3	5.0	4.3	12.6
B-747	100	R1	332.9	JT9D-7A	0.9	-0.3	-0.5	0.1
B-747	200	R1	377.8	CF6-50E2	3.3	1.1	-1.5	2.9
B-747	200	R1	332.9	JT9D-7A	1.7	1.1	-1.9	0.9
B-747	200	R1	340.2	JT9D-7F	1.8	0.4	-1.9	0.3
B-747	200	R1	349.3	JT9D-7J	1.9	-0.5	-1.0	0.4
B-747	200	R1	377.8	JT9D-7Q	2.7	-0.7	-1.6	0.4
B-747	200	R2	377.8	RB211-524D4	2.0	3.1	0.1	5.2
B-747	300	R1	377.8	CF6-80C2B1	6.9	4.6	-0.2	11.3
B-747	300	R1	377.8	JT9D-7R4G2	3.5	1.5	-1.6	3.4
B-747	SP	R1	299.4	JT9D-7F	5.9	-0.3	1.2	6.8
B-747	SP	R3	315.7	RB211-524B2	5.4	2.3	1.8	9.5
B-747	400	R3	396.9	CF6-80C2B1F	6.2	4.8	1.2	12.2
B-747	400	R2	396.9	PW4056	4.4	3.3	0.3	8.0
B-747	400	R3	396.9	PW4056 PH3(FB2B)	6.3	4.4	1.4	12.1
B-747	400	R4	396.9	PW4056 H3(FB2C)NR	8.6	4.9	2.9	16.4
B-747	400	R3	396.9	RB211-524G	6.8	5.0	1.2	13.0
B-747	400	R3	394.6	RB211-524H	8.2	4.2	1.2	13.6
B-757	200	R5	115.9	RB211-535-E4	8.4	4.3	6.8	19.5
B-767	200	R2	127.9	JT9D-7R4E	7.2	2.0	0.5	9.7
B-767	200ER	R2	163.3	JT9D-7R4E	0.7	3.5	0.6	4.8
B-767	200ER	R3	159.2	PW4052	5.0	4.7	4.9	14.6
B-767	300	R6	131.0	CF6-80C2B2	11.7	4.6	5.9	22.2
B-767	300	R2	136.1	JT9D-7R4D(B)	4.0	3.4	0.3	7.7
B-767	300	R4	172.4	PW4056	4.4	3.9	4.6	12.9
B-767	300ER	R4	133.8	PW4060PH3(FB2C)NR	13.4	2.4	5.9	21.7

B-767	300ER	R3	156.5	PW4062PH3(FB2C)NR	11.2	1.6	6.4	19.2
B-767	300ER	R5	184.6	CF6-80C2B6F	5.9	4.2	5.1	15.2
B-767	400ER	R5	204.1	CF6-80C2B8F	6.2	3.7	5.2	15.1
B-777	200	R6	229.5	GE90-76B	11.3	7.7	6.7	25.7
B-777	200	R6	201.9	PW4077	12.4	4.3	5.0	21.7
B-777	200	R5	207.8	RR TRENT875	10.4	4.5	4.8	19.7
B-777	200	R5	207.8	RR TRENT877	10.8	4.1	4.8	19.7
B-777	200ER	R6	297.6	GE90-90B	8.2	6.9	7.2	22.3
B-777	200ER	R6	297.6	GE90-94B (BLK IV)	8.4	5.5	6.7	20.6
B-777	200ER	R5	297.6	PW4090	5.6	3.7	5.8	15.1
B-777	200ER	R5	286.9	RR TRENT884	5.0	4.9	5.5	15.4
B-777	200ER	R5	297.6	RR TRENT892	5.5	4.2	5.5	15.2
B-777	200ER	R5	297.6	RR TRENT895	6.1	3.6	5.5	15.2
B-777	300	R4	299.4	PW4090	5.2	4.7	5.1	15.0
B-777	300	R4	299.4	PW4098	6.5	3.5	3.9	13.9
B-777	300	R4	299.4	RR TRENT884	3.4	6.1	4.6	14.1
B-777	300	R5	299.4	RR TRENT892	5.4	5.1	4.6	15.1
DC-10	30	R1	267.6	CF6-50C2	2.9	3.8	-1.6	5.1
DC-10	40	R1	251.7	JT9D-59A	0.2	3.3	-1.8	1.7
MD-11		R3	273.3	CF6-80C2D1F	9.2	5.3	1.3	15.8
MD-11		R2	286.0	PW4460	6.5	5.7	0.6	12.8
CRJ	100	R6	24.0	CF-34-3A1	9.2	11.8	5.9	26.9
CRJ	200	R6	24.0	CF-34-3B1	10.3	11.6	5.9	27.8