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THE REDUCTION OF AIRCRAFT NOISE ZONES AROUND AIRPORTS BY INCREASING THE PROPORTION OF LOW NOISE AIRCRAFT

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INTRODUCTION

By order of the Austrian ministry of transportation a study was carried out to

- define noise emission data for aircraft according to ICAO Annex 16-Chapter 3 (in Austria represented by DC-9-80) similar to the data already existing for other types of aircraft in the German aircraft-noise-act (deutsches Fluglärmgesetz) and the related regulations
- to calculate the area of the zones around an airport where $L_{eq,A} \geq 60$, 65, 70 dB, for a hypothetic airport with 100 take off's and 100 landings per day (in straight routes parallel to the runway) with different fleet mixture (proportion of Chap.3 aircraft).

NOISE DATA AND CALCULATIONS

The noise emission data of DC-9-80 (maximum A-level versus distance) were taken from the report 4440, Project 09611 from Bolt, Beranek and Newman Inc. "Civil Aircraft Noise Data for Computation of Aircraft Noise Contours" by D.E. Bishop and J.M. Beckmann. The noise emission data for the airbus A 300 are very similar to these of DC-9-80. All other data were taken according to the German aircraft noise act (noise emission and performance data).

The noise aircraft zones $L_{eq,A}$ = 60, 65, 70 dB around an airport were calculated with

$$L_{eq,A} = 10 \lg \frac{1}{T} \sum_{i=1}^{n} t_i \cdot 10^{L_i/10} \qquad (1)$$

with

$L_{eq,A}$ A-weighted equivalent sound level of the aircraft noise in dB

n number of flights during daytime or nighttime

t_i duration of the i-th flight in sec [1]

L_i maximum A-weighted sound level of the i-th flight in dB

T time interval in sec, for which the calculation is done: daytime 6-22 (57600 sec), nighttime 22-6 (28800 sec)

The calculations were done for 100 take off's and 100 landings per day on a runway with 3,6 km length for 12 different fleet mixtures.
The area, surrounded by the contours $L_{eq,A}$ = 60, 65, 70 dB was calculated by measures of numerical integration.

RESULTS

The noise zones were drawn 1:100 000 and the areas are given below.

	fleet mixture percentage			area (ha) of zone with $L_{eq,A}$		
	S 1 [2]	S 4 [2]	DC-9-80	≥ 60	≥ 65	≥ 70
a	100	-	-	11 349	3 468	1 114
a'	95	5	-	12 433	3 838	1 223
a"	98	2	-	11 800	3 613	1 141
b	80	-	20	9 448	2 851	956,60
b'	75	5	20	10 577	3 241	1 057
b"	78	2	20	9 911	3 011	997,10
c	50	-	50	6 461	1 930	696,70
c'	45	5	50	7 635	2 318	808,60
c"	48	2	50	6 950	2 086	746,40
d	20	-	80	3 591	1 172	440,90
d'	15	5	80	4 733	1 472	558,70
d"	18	2	80	4 049	1 312	465,90 [3]

1) The duration is defined with $t_i = \frac{1{,}5 \cdot s}{v + \frac{s}{50}}$ with
v speed in m/sec, s distance in m

2) S 1 are jets ≤100 t, according to ICAO Annex 16; S 4 are jets > 100 t not according to ICAO Annex 16; noise data laid down in the German aircraft noise act.

3) inaccurate because of the very small area

In fig. 1 the area of the zones versus the percentage of low noise aircraft is drawn. It can be seen, that by increased use of Chapter 3-aircraft a considerable diminuation of the aircraft noise zones may be expected. With 80 % Chapter 3-aircraft the zone exposed to $L_{eq,A} \geq 60$ dB is only as large as the zone exposed to $L_{eq,A} \geq 65$ dB with 0 % Chapter 3-aircraft. However with the noisy S 4-type aircraft still in use the zones remain considerably larger; e.g. the zone $L_{eq,A} \geq 60$ dB is for 80 % Chapter 3-aircraft and 5 % S 4 as large as the zone with 65 % DC-9-80 without S 4.

The values for $L_{eq,A}$ at 12 sites alongside the runway for the different fleet mixtures were compared and the relevant sound level reduction by increasing the percentage of DC-9-80 calculated.
It can be seen that in all sites, where the sound level is caused by the take off the reduction is about the same, also it is the same at all sites, where the landing aircraft causes the noise level, however somewhat smaller. The average sound level reduction is given below:

	fleet mixture percentage			average reduction of $L_{eq,A}$ (dB)	
	S 1	S 4	DC-9-80	landing	take off
b	80	0	20	0,8	0,8
b'	75	5	20	0,5	0,7
b"	78	2	20	0,6	0,7
c	50	-	50	2,1	2,2
c'	45	5	50	1,3	2,1
c"	48	2	50	1,7	2,2
d	20	-	80	4,2	4,6
d'	15	5	80	2,3	3,9
d"	18	2	80	3,1	4,4
e	0	0	100	6,4	7,3

A noticable noise reduction around airports is therefore only to be expected, if the percentage of the low noise Chapter 3-aircraft is > 50 % and a considerable noise reduction, if the percentage is > 80 %. The noise reduction gets less, if still S 4-type aircraft (not according to ICAO Annex 16) are allowed to operate.

Figure 1: Area of aircraft noise zones with different proportion of low noise aircraft in the fleet mixture