Department for Transport

REVIEW OF THE QUOTA COUNT (QC) SYSTEM USED FOR ADMINISTERING THE NIGHT NOISE QUOTAS AT HEATHROW, GATWICK AND STANSTED AIRPORTS

INTRODUCTION

1. In June 1999, following consultation, the Government announced new restrictions on the numbers and types of aircraft permitted to operate at Heathrow, Gatwick and Stansted airports during the night period. Those restrictions came into effect in October 1999 and remain in force.

2. At the same time the Government announced that it would carry out a review of the "Quota Count" (QC) system which forms part of the present night restrictions regime for those airports. The purpose of the Review was to examine whether stronger incentives should be built into the QC system to ensure that it is as effective as possible in encouraging airlines to use quieter aircraft. The Review also examined the methodology used for calculating the classification of arriving aircraft and the weight limit for jet aircraft that may be classified as exempt.

3. It was the intention when the QC system was introduced in 1993 that it should be long lasting and would be reviewed only if an international or EU-wide system of aircraft classification for night restrictions purposes was in prospect. This recognised the need to provide a degree of certainty for airlines in planning their fleets and future acquisitions and a stable reference for aircraft and engine manufacturers due to the long lead times for developing new aircraft.

4. The present QC system is based on a 1991 analysis of aircraft noise completed before the international agreement was reached on the compulsory phase-out of Chapter 2 aircraft. The composition of the airline fleet has changed significantly since 1993 as a result of the accelerated phase out of Chapter 2 aircraft (completed on 31 March 2002) and the introduction of a new generation of long haul aircraft, such as the Airbus 340 and Boeing 777. A section of the turbo prop fleet has also been replaced by the growing family of "regional jets", which includes the Embraer 145RJ, Bombardier-Canadair 700RJ and BAe-AVRO RJ.

5. The QC system generally has worked well since its introduction in 1993. The QC/2 limit[1] on aircraft permitted to be scheduled to land or take off during the night quota period (2330-0600) has become a key design parameter for Airbus and Boeing in their development of long haul aircraft such as the new A380. For this sector of the market the London QC/2 limit sets the *de facto* world-wide noise standard as it is more stringent than the Chapter 4 standard agreed by the ICAO[2].

6. The Review was guided by the following principles:
   - that the likely benefits from any proposals to strengthen incentives to use quieter aircraft should outweigh the benefits of continuity;
   - the quota count should remain proportional to noise energy;
   - the system should be easy to operate, simple to understand and fair;
   - that care should be taken to avoid unintended outcomes.

7. Progress on the Review was reported to and discussed with members of the Aircraft Noise Monitoring Advisory Committee (ANMAC).

The present QC System

8. The central feature of the system is that each aircraft is given a quota count (QC) rating (e.g. QC/0.5, QC/1, QC/2, etc.) according to how much noise it makes. Aircraft are classified separately for landing and take off. The data used are the noise certification data: aircraft are required to possess a noise certificate demonstrating their compliance with the appropriate ICAO noise certification standards (the current standard is Chapter 3 and a Chapter 4 standard for new aircraft types will

[1] The present QC/2 upper limit is applied on a voluntary basis (between 2330 and 0600) by local arrangement between the airlines and the airport operating companies. A decision on whether to incorporate the voluntary scheduling ban on QC/4s into the formal night restrictions set by the Government remains subject to the outcomes of EPNL-QC Study and this Review of the QC system.
[2] International Civil Aviation Organisation. The Chapter 4 standard will come into force for newly certificated aircraft types on 1 Jan. 2006.

come into effect on 1 January 2006). The data is therefore readily available in almost all cases.

9. The metric 'EPNL' *(Effective Perceived Noise Level)* is used for noise certification and it is measured in *Effective Perceived Noise Decibels* (EPNdB). Decibels are logarithmic units and a 3dB difference in noise level corresponds to a two-fold difference in noise energy. So the QC bands increase by multiples of two in step with the 3dB doubling of noise energy principle. The present QC system classifies aircraft into the seven bands:

QC/0 (Exempt)	**Less than 87 EPNdB**, and in the case of jet aircraft, also having a maximum certificated take-off weight not exceeding 11,600kg
QC/0.5	**Less than 90 EPNdB**
QC/1	**90 – 92.9 EPNdB**
QC/2	**93 – 95.9 EPNdB**
QC/4	**96 – 98.9 EPNdB**
QC/8	**99 – 101.9 EPNdB**
QC/16	**More than 101.9 EPNdB**

10. So in principle, an aircraft classified QC/1 is half as noisy as one classified QC/2 and twice as noisy as one classified QC/0.5. However, this is only approximate as an aircraft with noise certification data of say 90**.**1 EPNdB and classified just inside the lower boundary of the QC/1 band is not twice as noisy as one certificated at 89.9 EPNdB and classified just within the upper boundary of the QC/0**.**5 band; in fact the 0**.**2dB difference would not be perceptible to the human ear, whereas for most people a 3dB difference (the width of each band) would be. By the same token, aircraft rated at 90.1 and 95.9 EPNdB would differ by 5.8dB, representing almost a four-fold difference in noise energy.

11. In addition the bottom (QC/0) and top (QC/16) bands are open ended and therefore do not hold true to the 3dB doubling of noise energy principle. However, in practice this does not detract from the proper functioning of the system because all aircraft classified as QC/0 are exempt from the restrictions and those classified QC/8 or QC/16 are not permitted to be scheduled to operate between 2300 and 0700 at all; in effect they are banned.

12. The utility of the QC system is that it allows night flights to be individually counted against a noise quota (in effect a noise budget) according to the QC rating (*i.e.* the noisiness) of the aircraft used. The noisier the aircraft used the higher its QC rating and the fewer that can be operated, thereby also providing a built-in incentive for airlines to use less noisy aircraft where practicable. Airlines are allowed to decide which aircraft to use according to their operational needs, but whether they use for example,

5xQC/2s or 10xQC/1s or 20xQC/0.5s or a combination of these, the sum of the noise energy permitted by the quota remains the same. This does not mean that the numbers of people likely to be disturbed is necessarily the same.

13. Sleep research carried out in this country and abroad shows that the less noisy an aircraft is the lower the chance of an average person being woken up. For example, the 1992 Field Study[3] found, that for:

> **"…outdoor noise levels below 90dBA SEL (80dBA Lmax)[4], average sleep disturbance rates *[all causes]* are unlikely to be affected by aircraft noise. At higher *[noise]* levels, and most of the events upon which these conclusions are based were in the range 90 to 100 dBA SEL (80 to 95 dBA Lmax), the chance of the average person being wakened is about 1 in 75."**

14. That and earlier research shows that several relatively quiet aircraft are likely to disturb fewer people than one much noisier one, which forms part of the rationale for the QC system and in particular for the quietest aircraft (classified QC/0) being exempt from the restrictions.

Aspects of the QC System examined

15. The following aspects of the QC system were examined:
    - The relationship between the movement limits and noise quotas
    - Extension of the QC scale and review of the weight limit for jet aircraft
    - Renumbering the QC bands to whole number values
    - Introducing a maximum passenger limit for exempt aircraft
    - Setting average QC targets
    - An unbanded QC scale
    - Methodology for calculating the QC classification of arriving aircraft

The relationship between the movement limits and noise quotas

16. It would be possible to increase the incentive to use quieter aircraft and to bring about improvements in the night noise climate solely through progressive reductions in the noise quotas phased over a period of 5

[3] Report of a Field Study of Aircraft Noise and Sleep Disturbance, published December 1992.

[4] SEL = sound exposure level, is a one second burst of steady noise containing the same amount of energy as the whole noise event. Lmax is the highest or maximum sound level reached during a noise event. The typical relationship between Lmax and SEL is Lmax+10dB=SEL. There is no simple relationship between SEL and EPNdB used for aircraft certification, but in practice there is a fairly high correlation between the two, of approximately Lmax+13dB=EPNdB. Thus 80 dBA Lmax corresponds approximately to 93 EPNdB, the lower end of the QC/2 band. Therefore an aircraft classified as QC/0 (exempt) having been certificated below 87 EPNdB, is unlikely to exceed a maximum sound level outdoors of about 74dBA Lmax, well below the level of 80 dBA Lmax which the sleep research shows is unlikely to affect the average person's sleep.

years or longer. However, the Review also examined the important relationship between the movement limit and the noise quota, as this can be key factor in incentivising the use of quieter aircraft.

17. When the QC system was devised in the early 1990s it was envisaged that the 'then current' regime of night restrictions consisting solely of movement limits would be replaced by the new regime consisting solely of noise quotas; that is, there would not have been a specified ceiling on movement numbers, although movement numbers would in practice have been limited by the noise quota. This proposal was challenged in the High Court in 1993 by the London Borough of Richmond and others. The Court ruled that it would be outwith the Secretary of State's powers (under section 78 of the Civil Aviation Act 1982) to set restrictions that did not specify a limit on the numbers of movements permitted to operate. The Government therefore reconsulted on modified proposals consisting of movement limits supplemented by noise quotas. It is essentially that regime which is in place today, although changes were made in 1999 to some of the noise quotas and to several other aspects of the regime.

18. However, the Court's requirement that a limit had to be set on the number of movements permitted to operate, together with the Government's decision to proceed with the noise quotas, introduced an important new dynamic; this was the functional relationship between the restored movement limit and the noise quota. The efficiency of the noise quota in incentivising airlines to use the quietest aircraft (in each particular role) depends on this relationship. For this reason the relationship between the movement limit and noise quota was examined for each airport.

19. There are different patterns of night movements at each airport and different types of aircraft predominate. The average QC score per movement at Heathrow fell from a level of 1.8 in 1993-95 to about 1.5 in 1996-98. It rose again to over 1.7 per movement in 1998-99 before briefly falling again to about 1.6 in 2000, but has since risen again to over 1.7 in summer 2002, almost to the same level as 1993-95. At Gatwick the average QC score per movement in 1993-95 was about 1.1 and rose to over 1.2 in 1996-97 before falling to about 0.8 today. At Stansted it was approximately 1.0 in 1993-95, which it remained close to for most of the intervening period but has also fallen to about 0.8 today.

20. There are distinctive operational factors at each airport that contribute to these different outcomes, including the higher proportion (among a relatively small number of movements) of long haul traffic in the night quota period at Heathrow. However, the different functional relationship at each airport between the noise quota and the movement limit is also an important factor. In recent years at Gatwick and Stansted during the

longer summer season[5] (the more important season for charter airlines for obvious reasons), the noise quotas have been the more stringent control measure having most influence on airlines' decision making[6], whereas at Heathrow it has been the movement limit.

Heathrow

21. At Heathrow the winter season movement limit is the component of the package of restrictions that most often comes under pressure *(largely a consequence of differences in the time zone relationship between London and SE Asian cities where daylight saving is not generally operated, unsynchronised adjustments for daylight saving purposes in Europe and North America, as well as some weather related factors)*. The winter season movement limit is virtually always fully used and is sometimes exceeded within the parameters allowed for end of season flexibility (these allow a transfer of up to 5% of the summer season movement limit). The winter season noise quota was also exceeded by 3% in winter 2001/02 (by means of a similar transfer).

22. It is possible that the higher average QC per movement at Heathrow is entirely attributable to the operational factors (including the high proportion of long haul flights), but it is also wholly consistent with the expectation that the incentive to use quieter aircraft would be weaker where the noise quota is less stringent than the movement limit, because airlines have less incentive to reduce the amount of noise quota used per movement.

23. Airlines using the majority of the Heathrow noise quota for early morning arrivals have within their existing fleets 'suitable' long haul aircraft that could reduce the average QC score per movement from the current level of 1.7 to about 1.0. The strong environmental case for using these quieter aircraft is that they would disturb the sleep of fewer people. However, there are also strong economic counter arguments for allowing use of the noisier aircraft which are given added strength by the stringency of the movement limit.

24. The airlines could be obliged to use the less noisy aircraft, first by reducing the noise quotas to the level of use in 2001/02 and then progressively reducing them further to the point where the current movement limit could no longer be fully used if the average QC per

[5] The summer season is normally 217 days (in some years it is 210) and the winter season is normally 148 (in some years it is 155).

[6] British Airways' decision to abandon its twin hub business model and to transfer many of its services from Gatwick to Heathrow contributed to a 20% fall in the use made of the Gatwick noise quota in summer 2002 compared with earlier years. The fall off in consumer confidence and subsequent reductions in capacity after September 11th 2001 was also a factor. Therefore, at the present time neither the noise quota nor the movement limit at Gatwick are functioning as incentivising constraints on the airlines.

movement exceeded 1.0 for example. However, there would be an economic price to pay for doing this; by the airlines, by the users of these important air services and by the economy generally, because the less noisy aircraft also carry fewer passengers and less cargo. The reduced capacity could be expected to lead to business being lost to competing carriers using less restricted airports at Amsterdam, Paris and Frankfurt (*which, are one hour ahead of London and have a local time advantage in the morning, but also a one-hour disadvantage in the evening*).

25. Heathrow is the principal UK hub airport for long haul inter-continental traffic. As most of these services rely on heavy wide body aircraft, the average QC per movement is likely to remain higher than for Gatwick and Stansted. Reductions in the noise quota would need to take account of this difference and care would need to be taken to ensure that there was not a serious impact on the competitiveness of Heathrow as an international hub airport.

26. The Review therefore considered whether there was an alternative which would allow the airlines to use more of their quieter aircraft at night without foregoing capacity.

27. The Boeing 747-400 is the largest long haul passenger aircraft in service today. Although it continues to be manufactured in limited numbers, it is a relatively noisy aircraft based on a 1960s design and it largely accounts for the relatively high average QC score per movement at Heathrow. The B747-400 typically has about 400 seats (depending on airline configuration) and is rated QC/2 on arrival[7]. Many airlines use it in order to maximise the number of seats they can offer on each of the strictly limited number of night movements permitted at Heathrow (*i.e.* compared with movement numbers permitted at Paris, Frankfurt and Amsterdam), and arguably they are also encouraged to do this by the amount of noise quota available per movement. In short, the Heathrow noise quota is not incentivising the use of the quietest suitable aircraft as effectively as it could, and may possibly be doing the opposite due to the present relationship with the more stringent movement limit.

28. Alternative quieter long haul aircraft include the Boeing 777 and the Airbus 340, mostly rated QC/0.5 on arrival. Two of these aircraft typically have a combined capacity of around 660 seats, over 50% more than that of a single B747-400 (depending on airline configuration) and a combined QC on arrival half that of the one B747-400 (rated at QC/2). If the movement limit were raised, airlines could carry more passengers, using more fuel

[7] The larger 555-seat A380, which Airbus expects to enter into service in 2006, is expected to achieve a QC/1 rating on arrival.

efficient aircraft with lower seat operating costs and lower emissions per passenger/km, and at the same time produce significantly less noise and disturb fewer people, as illustrated below.

29. Drawing on the sleep research[8] published in 1992, and applying the findings to the population living within the 90dBA SEL arrival noise footprints of the B747-400[9] and the B777-200, it is estimated that one B747-400 using the most densely populated westerly approach track into Heathrow would wake up about 353 people and the two B777s about 198 people (fewer if the two B777s or A340s landed in close succession).

30. The next major consultation on night restrictions would provide an opportunity to seek views on the possibility of progressively reducing the Heathrow noise quotas, initially to remove surplus quota, followed by further small reductions in step with small increases in the movement limits. It would be necessary to calibrate the changes carefully and also give sufficient notice of changes. The aim would be to bring about at Heathrow a position where the noise quotas also become an effective constraining measure (as they have been to good effect at Gatwick and Stansted in recent years), to increase the incentive for airlines to use quieter aircraft at night (*i.e.* with a lower average QC score per movement) and thereby reduce interference with sleep, but without loss of capacity.

Gatwick

31. As a result of the decisions taken in June 1999 the Gatwick noise quotas have been slowly reducing since 2001 as follows:

Winter	QC points	Summer	QC points
2000-2001	6820	2001	9550
2001-2002	6680 (-2%)	2002	9060 (-5.1%)
2002-2003	6660 (-0.3%)	2003	9030 (-0.3%)
2003-2004	6640 (-0.3%)	2004	9000 (-0.3%)

The Gatwick movement limits and noise quotas are substantially larger than those for Heathrow. The key summer season movement limit is 245% larger, permitting an average of about 51 movements[10] a night compared with an average of about 15 permitted at Heathrow, and the Gatwick summer noise quota (for 2004) is 60% larger than Heathrow's. This does not mean that the noise climate around Gatwick is 1½ or 2½ times worse than around Heathrow. It is also necessary to take into account the average QC score (average noisiness) of night movements at

[8] Field Study of Aircraft Noise and Sleep Disturbance, December 1992.
[9] The B747-400 fitted with RR engines is used as this account for most night movements.
[10] The movement limit is not fully used. In summer 2002 the average operated per night was 45.

Gatwick, which is lower than at Heathrow, and the number of people likely to be disturbed around Gatwick is also a fraction of those around Heathrow. However, for those living directly under the final approach tracks to Gatwick the night noise climate is inferior to that under the final approaches to Heathrow.

32. Until summer 2002 the noise quota was almost fully utilised, but there was a surplus in the movement limit. This has served as a stimulus to the use of quieter aircraft. Because the airport has a high proportion of charter traffic, the winter season noise quotas and movement limits are substantially under-used (typically at around 50-60%) and reduced numbers of 'year-round' scheduled services may lead to even greater under usage this winter (data for the first 13 weeks of the 2002/03 winter season indicates usage will be less than 50% for the full season).

33. The position at Gatwick is in flux following the transfer of some British Airways (BA) services to Heathrow. BA also transferred some B747-400s to Heathrow (to raise seat capacity) and B777s to Gatwick. In summer 2002, partly as a result of the changes by BA and reduced frequencies by some US airlines, there was a 13% reduction in night movements and a 21% reduction in use of the Gatwick noise quota. The present situation does not provide a stable basis for developing or proposing strategic adjustments to the relationship between the noise quotas and movement limits. However, there is presently the scope to continue annual reductions in the noise quotas in the next regime, and possibly in the movement limits as well, to improve the night noise climate.

34. The long term aim should be to maintain and improve upon the present (0.8 QC per movement) positive relationship between the noise quota and movement limit, which in the past has proved effective in incentivising the use of quieter aircraft. When the consultation on the next regime is launched it would be appropriate to explore the principle of progressive noise quota reductions. If proposals were also be brought forward to reduce permitted movement numbers at Gatwick nearer to current levels of use, it would be appropriate to consult on corresponding reductions in the noise quotas to maintain a permitted average QC score per movement of 0.8 or slightly lower.

Stansted

35. Stansted has been recognised in the past as the 'developing airport' among the three. The movement limits and noise quotas were designed to ensure, as it developed, that night movements would be by the quietest types of aircraft to prevent Stansted from becoming a dumping ground for noisy aircraft. The 1999 decision provided for gradual increases in the

noise quotas (shown in the table below) with the movement limits remaining fixed at 5000 in winter and 7000 in summer:

Winter	QC points	Summer	QC points
1999/2000	3110 (+3.6%)	2000	4350 (+3,5%)
2000-2001	3220 (+3.5%)	2001	4500 (+3.4%)
2001-2002	3330 (+3.4%)	2002	4650 (+3.3%)
2002-2003	3440 (+3.3%)	2003	4800 (+3.2%)
2003-2004	3550 (+3.2%)	2004	4950 (+3.1%)

36. The position at Stansted is more stable than at Gatwick and the underlying traffic mix is very different. In the summer season there is a surplus in the movement limit (a little over 20% in 2002) but the noise quota in recent years has been fully used or nearly so. Therefore, the incentive to use quieter aircraft is already a strong one. The average QC permitted by the noise quota and movement limit if both are fully used is 0.66 and probably cannot be reduced to any significant degree in the foreseeable future, given the aircraft that are available.

37. The noise quota is under more pressure (92% used in summer 2002) than the movement limit (75% used). Any proposal to introduce stepped increases in the movement limits (for which there is no clear demand at present) could be linked with increases in the noise quota, with the aim of maintaining the relationship between the two at an average of 0.6 QC per movement. However, there is a real possibility that only the additional noise quota would be used with the result that the average QC per movement would rise towards the 0.8 level at Gatwick.

38. Any changes to the noise quotas or movement limits at Stansted should aim to maintain the value of the present relationship between them.

Extension of the QC scale and review of the weight limit for jet aircraft

39. Under the present regime, only those jet aircraft with a maximum certificated weight of 11,600 kg or less may be classified exempt from the movement limits and noise quotas on the basis of their noise certification data. The weight limit is the only non-noise related element of the QC classification system. It is not consistent with the principle that the quota-count should be related to noisiness of aircraft irrespective of their form of propulsion (and with the 3dB doubling of noise energy principle) and may weaken or even counter the incentive to use quieter aircraft.

40. The weight limit was adopted in 1993 as a control on the potential number of exempt jet movements, but its application to jet aircraft and not to

propeller driven aircraft can serve as a perverse incentive to use noisier turbo props when quieter jet aircraft are available. Many of the faster climbing short haul regional jets can be up to four times quieter than aircraft classified as QC/0.5 on the basis of their noise alone. In terms of incentivising the use of quieter aircraft, it is illogical to classify these small quieter jets as QC/0.5 on the basis of their weight alone when similar or noisier propeller aircraft of an equivalent size and serving in the same role, are classified as exempt. For example, under the present arrangements an AVRO RJ70 on take off is classified QC/0.5 on the basis of its weight (it would be QC/0.25 on the basis of its noise certification) and an ATR-72 turbo-prop is classified QC/0 (exempt), when both make approximately the same amount of noise and serve in the same role.

41. With the exception of small numbers of delayed departures and early arrivals virtually all movements in the night quota period (2330-0600) today now involve aircraft classified QC/2 or quieter (although this could change if quota restrictions were extended into one or both shoulder periods). While the aircraft used are increasingly concentrated towards the bottom end of the QC scale at all three airports, the following tables illustrate that there remain important differences:

Average QC score per movement:
winter 2001/02 and summer 2002

Heathrow		Gatwick		Stansted	
Summer	Winter	Summer	Winter	Summer	Winter
1.72	1.59	0.74	0.90	0.80	0.95

42. Extending the QC scale at the lower end would have little bearing on operations at Heathrow, where most QC/0.5 movements at night are classified as such according the amount of the noise they make. It would be a different matter at Gatwick and Stansted. The proportion of QC/0.5 movements at each airport is:

Proportion of QC/0.5 movements

	Heathrow	Gatwick	Stansted
Winter 2001/02	18%	70%	61%
Summer 2002	19%	73%	68%

43. At Gatwick and Stansted a significant proportion of QC/0.5 arrivals at night (in the region of 30%) and a small number of departures (about 1%) are classified as such on the basis of their weight instead of the amount of noise they make; most of these would be QC/0.25 on the basis of their noise data alone, while only a very small number (about 1%) would be classified as QC/0.125 (a detailed study using aircraft registrations would be necessary to establish more exact figures).

44. The aircraft types in question include:
    - most of the Airbus 320 family on arrival
    - some of the new generation Boeing 737s on arrival
    - some Boeing 757s on arrival
    - the Boeing 717 and MD90 on arrival and departure
    - some other Boeing MD-80 series on arrival
    - some BAe146 and AVRO-RJ on arrival and departure
    - most of the new 'regional jets' on arrival and departure.

45. If the QC scale was extended down by one or possibly two additional bands to include less noisy jet aircraft classified according to their noise certification data alone, it should strengthen the incentives to use the quieter aircraft and provide an opportunity to dispense with the weight limit without allowing a large numbers of exempt movements to operate. The exempt category could then be redefined in the QC system on the basis of noise data alone without discriminating between jets and propeller aircraft.

46. A new QC/0.25 band would include aircraft in the following table (the list identifies significant aircraft and is not intended to be comprehensive):

JETS		PROPS	
ARRIVALS	**DEPARTURES**	**ARRIVALS**	**DEPARTURES**
some BAe 146(70-90)	some BAe146(70-90)	some ATR 72(68)*	some ATR 72(68)*
Some AVRO RJ(70-115)	some Avro RJ(70-90)	some BAe ATP(60)*	Dash 7 & 8(40-75)*
A319(125-145)	some MD80 (150)	some BAe 748(50)*	
Some A320/321(150-180)	some B717(110)	Shorts 360(36)*	
some B757(200)	some bizjets*	Dash 7(40-70)*	
some B737(110-150)			
Some MD80 series(150)			
Some MD90 series(160)			
some Fokker 28(75)			
Embraer 170 RJ(70)			
some bizjets*			

Figures in brackets show typical passenger seat capacity

47. Those aircraft shown in blue* are currently exempt and those in green are jets currently classified as QC/0.5 on the basis of their weight.

48. A QC/0.25 band could be expected to raise the incentive for airlines to use the less noisy types of aircraft and the changes would be consistent with 3dB doubling of noise energy principle which is the foundation of the QC system. Introduction of a QC/0.25 band would mean that some propeller aircraft (e.g. ATR-72s) and some business jets ('bizjets') which are currently exempt from the night restrictions would also become subject to the movement limits and noise quotas for the first time.

49. A new QC/0.125 band would include aircraft in the following table (again the list is not intended to be comprehensive):

JETS		PROPS	
ARRIVALS	**DEPARTURES**	**ARRIVALS**	**DEPARTURES**
some MD80 series(150)	Canadair RJ(40-90)	SAAB SF340(34)*	SAAB SF340(34)*
B717(110)	most bizjets*	some ATR 72(68)*	Shorts 360(36)*
A318(110)		some BAe 748(50)*	some ATR 72(68)*
Embraer 135 RJ(37)			ATR 42(45)*
Embraer 145 RJ(50)			Fokker 27(45)*
Embraer 190 RJ(100)			BAe ATP(60)*
Canadair RJ(40-90)		Figures in brackets show typical passenger seat capacity	
most bizjets*			

50. Extending the scale by two bands (*i.e.* to include new QC/0.25 and QC/0.125 bands) would bring most small business jets and many small propeller aircraft within the scope of the QC system for the first time. It is anticipated that the *ad hoc* operators of these aircraft could face significant difficulties in securing allocations from the noise quotas and movement limits, unless allocations were ring-fenced for them. As smaller alternative aerodromes such as London City, Biggin Hill, Northolt and Farnborough are closed at night, ad hoc operators of business jets could find most of the London airport system closed to them, possibly leaving Luton as the only runway open to them at night. The implications for doing business in London could outweigh any environmental benefits as these small business jets do not cause significant additional disturbance.

51. It should be possible to avoid the unintended consequence of closing London to all ad hoc business jet movements at night by extending the QC scale by one 3dB band only. Larger business jets would still come within a QC/0.25 band, and indeed some are already classified as QC/0.5 on the basis of their noise alone.

52. There is a growing population of new short range regional jets (typically carrying between 50 and 100 passengers) such as the B717, A318, Bombardier/Canadair RJs and Embraer RJs carrying fare-paying passengers on scheduled services. These would be made exempt from restrictions with the addition of just one new band and no weight limit. Given the markets they serve (mainly short haul 'thin' city-pairs such as Birmingham-Edinburgh, Manchester-Dublin, Gatwick-Strasbourg) there is little demand for night operations, and their noise levels would not cause significant additional disturbance. If classified exempt these aircraft could be used to meet a particular niche requirement for overnight mail services to the remoter parts of the UK. However, it would be possible to classify some or all of them to the QC/0.25 band if the 11,600kg weight limit or a higher weight limit was applied. A suitable higher weight limit that would

allow the smaller regional jets to be classified exempt (*i.e.* Bombardier-Canadair and some Embraer) but not the larger B717 or A318, would be one set at 34,000kg. This weight limit is attractive because it is used already in the EU Operating Restrictions Directive (2002/30EC) for other purposes. However, retaining a weight limit would not be consistent with the principle of relating noise quota specifically to the noisiness of aircraft.

53. The consultation on the next night restrictions regime could invite comments on the proposition of removing the weight limit for exempt jet aircraft together with introduction of a new QC/0.25 band, and possibly a new QC/0.125 band, setting out the consequential issues arising in each case, and the supplementary options of retaining a higher 34,000kg weight limit if the QC scale was ended by one band only to QC/0.25.

Renumbering the QC bands to whole number values

54. If the QC system was extended below the current QC/0.5 band to include a QC/0.25 band and perhaps a QC/0.125 band, there are presentational arguments for renumbering the QC system from the bottom up to restore whole number values to all bands. For example, if a QC/0.25 band was introduced, this would be renumbered QC/1, the present QC/0.5 band would be renumbered QC/2 and so on upwards to maintain the principle that a doubling of the QC value corresponds to a doubling of noise energy. However, renumbering could also bring significant presentational and substantive disadvantages:

    a) the present 'London QC/2 limit' is recognised worldwide as the *de facto* design standard for medium and large wide-body aircraft; under this proposal it would become QC/8;
    b) it would be necessary to significantly increase the headline value of the noise quotas to accommodate the same aircraft at their revised QC values, otherwise the effect would be drastically to reduce the noise quotas. This could cause some confusion between the old and new values and could give the misleading impression that the restrictions were being relaxed to allow noisier aircraft to operate.
    c) it would be a cosmetic change only that did not enhance the effectiveness of the QC system.

55. The presentational benefits of renumbering the QC ratings to whole number values would appear to be outweighed by the disadvantages.

Introducing a maximum passenger limit for exempt aircraft

56. An alternative to the weight limit, which would not introduce an obstacle for ad hoc operators of small business jets, would be to control the numbers of movements of other aircraft that could qualify as exempt (on the basis of their noise data) by setting a limit on the passenger capacity of jet aircraft that may be classified exempt. This could be set at a level below the capacity of the smaller regional jets but above the capacity of most business jets; for example at 19 seats. The effect would be that any aircraft classified below the lowest QC band on the basis of its noise data, but above the 19 passenger limit, would be classified at the level of the lowest band and subject to the noise quotas and movement limits.

57. A maximum passenger criterion of 19 passengers (*i.e.* excluding crew) would also be consistent with the EU Operating Restrictions Directive (2002/30EC) where it is used together with a 34,000kg qualifying weight limit for other purposes. However, it would retain an arbitrary non-noise criterion within the QC system and as such would not represent a step forward. It would introduce a new administrative burden, albeit not a significant one. Also, a passenger capacity criterion would not address the use of such aircraft used in a freight carrying role, for example for carrying overnight express mail and packages.

Setting average QC targets

58. As identified above, the QC system can deliver unhelpful incentive signals where there is surplus of noise quota and the movement limit is the constraint having the strongest influence on airline decisions. A possible alternative means of addressing this would be to specify a 'maximum average QC level' per movement as an additional control measure. The aim would be to discourage airlines from switching to a noisier aircraft where the noise quota was not delivering a strong incentive.

59. However, there could also be circumstances in which the average QC level could rise for reasons other than the introduction of noisier aircraft; for example if an airline using a low QC aircraft type withdrew services from an airport entirely. Introducing such targets would also add further complexity to the QC system and could be difficult to administer.

60. The consultation on the next regime might seek views on the introducing average QC targets, at what level those targets should be set (e.g. they could be set so that they gradually became more stringent each year), and seek views on the likely difficulties of administering such a system.

An unbanded QC scale

61. Having 3dB-wide bands (consistent with the doubling of noise energy principle) has worked well since the system was introduced in 1993. It is simple, transparent and easy to administer. There is some evidence of the bands becoming 'design targets' for aircraft manufacturers, and monitoring data indicates that certificated noise levels are beginning to be concentrated near the top of the current bands. This may be the result of manufacturers striving hard to design just below band thresholds or of 'manufacturing up' to band thresholds, or both.

62. The 3dB-wide bands mean that aircraft within the same QC band can have noticeably different noise levels. It is possible for an aircraft to be almost twice as noisy as another within the same QC band, and for two aircraft in adjacent bands, but either side of the band threshold, to make almost the same amount of noise. In each of the foregoing sections the Review examined ways of increasing the incentive for airlines to operate quieter aircraft in lower bands. A more radical approach would be to dispense with the bands altogether and classify aircraft on a continuous scale according to their noise certification data. Such a system is operating at Brussels Airport and a similar system has been proposed by the Commission as the basis for a common EU framework for noise related airport charges.

63. The classification of aircraft according to a single continuous QC scale can be carried out using a relatively simple mathematical formula to convert the noise certification data (measured in EPNdB) into QC values. The table below gives a snapshot of how the formula could be used to assign QC values on an unbanded (or continuous) scale.

Aircraft Type	Engine Type	Certificated Noise EPNdB	Arrival QC rating now	Rating on an unbanded scale
B747-400	PW4056	104.3	**2**	**1.7**
B747-400	RB211-524	103.4	**2**	**1.4**
B747-400	CF6-80C2B1F	103.3	**2**	**1.3**
B767-300	PW4060	100.2	**1**	**0.7**
B767-300	RB211-524	99.1	**1**	**0.5**
B767-300	CF6-80C2B7F	98.5	**0.5**	**0.4**
B777-200	Trent 895	99.5	**1**	**0.6**
B777-200	PW4090	99.1	**1**	**0.5**
B777-200	GE90-85B	97.8	**0.5**	**0.4**
A320-231	V2500-A1	96.6	**0.5**	**0.3**
A320-214	CFM56-5B4	94.6	**0.5**	**0.2**

64. The continuous scale QC formula retains the principle that a doubling in noise energy is reflected in a doubling in QC value by ensuring that at any point on the scale an aircraft would attract half the QC score as one that is

3 decibels noisier. Noise quotas would therefore continue to limit overall noise levels permitted at an airport as they do today.

65. It would be possible to use the system to introduce more specifically targeted operating restrictions. For example, the upper limit on aircraft permitted to be scheduled to operate at night (2300-0700), presently QC/4, need no longer be tied to 3dB-wide band boundaries and could be lowered gradually over time, perhaps in 0.5 or 1dB steps. An unbanded scale can also be calibrated to correspond to the upper limit of the present QC/2 band (for aircraft to be scheduled to operate between 2330-0600), thereby maintaining QC/2 as the *de facto* world-wide noise standard for large aircraft.

66. Operational and other factors mean there is not an exact correlation between certificated and operational noise levels. Therefore, a continuous QC scale might give the misleading impression that the system was more precise than it could be in practice.

67. An unbanded system appears to be working well in Brussels without giving rise to administrative difficulties. Administration of the system would require all operators to provide noise certification data for each individual aircraft, which should not be a problem for regular users of an airport but may give rise to difficulties for ad hoc operators (although such data is required to be carried on board most aircraft).

68. A continuous scale may help to counter any tendency for manufacturers to design aircraft to perform close to the upper limit of the QC bands; but it could equally have the opposite effect if there were no band thresholds to strive for (other than the QC/2 upper limit). The main justification for switching to an unbanded scale would be to incentivise manufacturers to strive for improvements across the range (part of the Commission's rationale for its proposed EU noise charging framework) which under the present banded system might not earn a lower QC rating, but there is no guarantee this would happen in practice.

69. A radical change of this nature would represent a significant break in the continuity of the London QC system and initially may cause confusion and administrative difficulties. It is not clear that the benefits would outweigh the disbenefits. It would be necessary, for the purpose of setting the initial seasonal noise quotas, to examine the traffic mix at each airport in considerable detail.

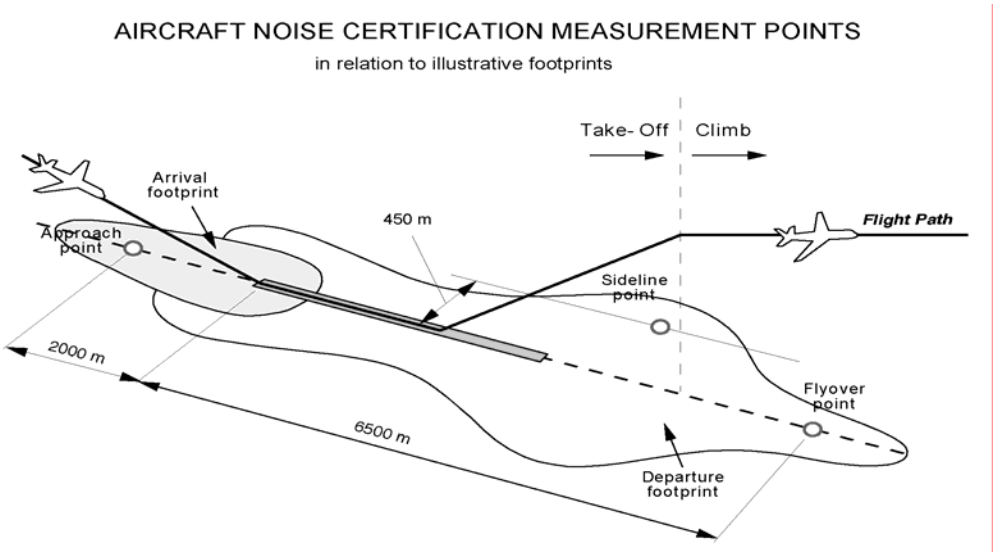
Methodology for calculating the QC classification of arriving aircraft

70. The aims of the current QC system are that airlines should be allowed to choose between operating arrivals or departures at night depending on their operational and commercial priorities, and that the relative environmental impact of the choices they make should be reflected in the QC ratings of the aircraft and therefore the amount of noise quota used. Substituting an arrival for a departure with the same classification, or vice versa, should have no effect on the total noise impact permitted by the noise quota.

71. Arriving aircraft usually contribute significantly less to the total noise impact than departing aircraft for the equivalent certificated noise level. To understand why this is it is necessary to look at the way in which noise impact is measured.

72. Noise impact from an individual overflight, *i.e.* the number of people affected and the noise levels experienced by it[11] is usually measured in terms of a noise footprint. Footprints are lines of constant noise level on the ground. The noisier an aircraft is, the larger its footprint will be and the more people that will be affected. As such, footprints are graphical representations of noise impact. If dwellings were spread uniformly within the noise footprints the numbers of households affected would be directly proportional to the footprint areas.

73. Certificated noise levels are based on noise data collected from three 'reference points', as illustrated in the diagram below.



[11] Impact is the aggregate adverse effect of the noise on people and it is quantified by taking account of noise exposures and the numbers of people affected.

74. The reference point at which the noise is measured on arrival (the approach point) is nearer to the aircraft (i.e. to its position in space) than the reference points at which noise on departure is measured (and for the purpose of calculating departure QC ratings the simple average of the sideline noise level and the flyover noise level is used)[12]. Therefore, for the same level of measured noise at the reference points, an aircraft will have a larger noise impact and a bigger footprint on departure than arrival. In order to adjust for this difference, so that the noise QC classification for arrivals and departures reflects comparable numbers of people affected (as indicated by equivalently sized noise footprint), in the current QC system the arrival noise data is adjusted downwards by 9 EPNdB (As an alternative, it would be possible to adjust the departure noise data, i.e. by adding 9dB to achieve the same outcome.)

75. The size of the 9 EPNdB adjustment was based on an analysis of noise data carried out in 1991 and is a conservative application of that study's finding that the difference between the measured noise impact of arriving and departing aircraft was 11 EPNdB. The value of 9 EPNdB also fitted well with the 3dB-wide bands.

76. Critics of the system have asserted that the 9EPNdB adjustment understates the relative noise impact of approaching aircraft for the following reasons:

    1) the improved climb performance of modern twin-jet aircraft since 1991 (together with the replacement of many 4-jet aircraft by twins), is likely, on average, to shrink departure footprints;

    2) equating the footprint areas ignores the fact that a substantial part of the departure footprint falls on airport land (unlike approach noise) and will therefore have little or no affect on the local population;

    3) and even when their footprint areas are equal in area, noise levels inside the arrival footprints can be greater and the disturbance caused will therefore also be greater.

77. In order to better inform the QC Review, the Department for Transport commissioned the Environmental Research and Consultancy Department of CAA (ERCD) to reanalyse how certificated take-off and landing noise data compare with the noise impact on the local population, and to assess whether a 9 EPNdB adjustment is still appropriate. That assessment has

[12] Compared with arrivals, noise from departing aircraft typically travels between 3 and 5 times as far before reaching the reference points.

been published as ERCD Report 0204 and is available on the CAA's website at: http://www.caa.co.uk/docs/33/ERCD0204.PDF.

78. It has been possible for ERCD to provide a more accurate and up to date picture of the noise impact of arrivals and departures than was feasible in the 1991 study for a number of reasons. Namely:

- it is based on a computer model (ANCON 2) which is more sophisticated and more reliable than its predecessor (ANCON 1);
- noise levels have been determined from official certificated noise levels, not the operational single event levels (as it is certificated levels that are being assessed, this makes the data more reliable);
- the data has been adjusted to exclude noise that falls within the airport boundary and does not therefore impact on the local community; and
- it covers the current aircraft fleet which is very different from the fleet mix analysed in 1991, which was dominated by Chapter 2 types.

Summary of findings

79. The ERCD Report is unavoidably technical. However, the main conclusions can be summarised as follows:

1. The method by which aircraft QC classifications are determined from official certificated noise levels remains appropriate.
2. The areas within which noise levels under the approach path exceed those reached under the departure path are close to the airport and relatively small.
3. The use of operational sound exposure levels in the 1991 analysis (instead of the certificated effective perceived noise levels) distorted the difference between arrivals and departures.
4. The percentage of noise generated which falls on airport land is greater for take-offs than landings. Adjusting the levels of noise impact to account for this reduces the difference between the community impact of arrivals and departures.
5. The effects of 3 and 4 tend to cancel each other out.
6. Improvements in departure noise achieved by modern aircraft have not been matched by equal noise reductions on approach. This closes the gap by around 2 EPNdB.
7. As a consequence of factors 3 – 6 above, the actual difference between the impact of arrivals and departures is now calculated to be equivalent to 9 EPNdB. This is the differential currently used to calculate QC values, but less than the differential of 11 dB measured in the 1991 study.

80. In short ERCD's report shows that the 9 EPNdB adjustment remains appropriate, and indeed is more relevant today than when first adopted in 1993.

Conclusion

81. The Review has shown that there is the potential, through modification of the Quota Count system, to increase the incentives for airlines to use quieter aircraft at night. Some of the ideas explored may be considered too radical to be taken forward in the short term and others may not win sufficiently wide support. The consultation on the next night restrictions regime should offer an opportunity to present to a wider audience the potential benefits and disbenefits of the different options examined in this paper, and to invite views upon them.

February 2003 (amended 2004)