Noise from Arriving Aircraft

An Industry Code of Practice

2nd Edition – November 2006

Executive Summary

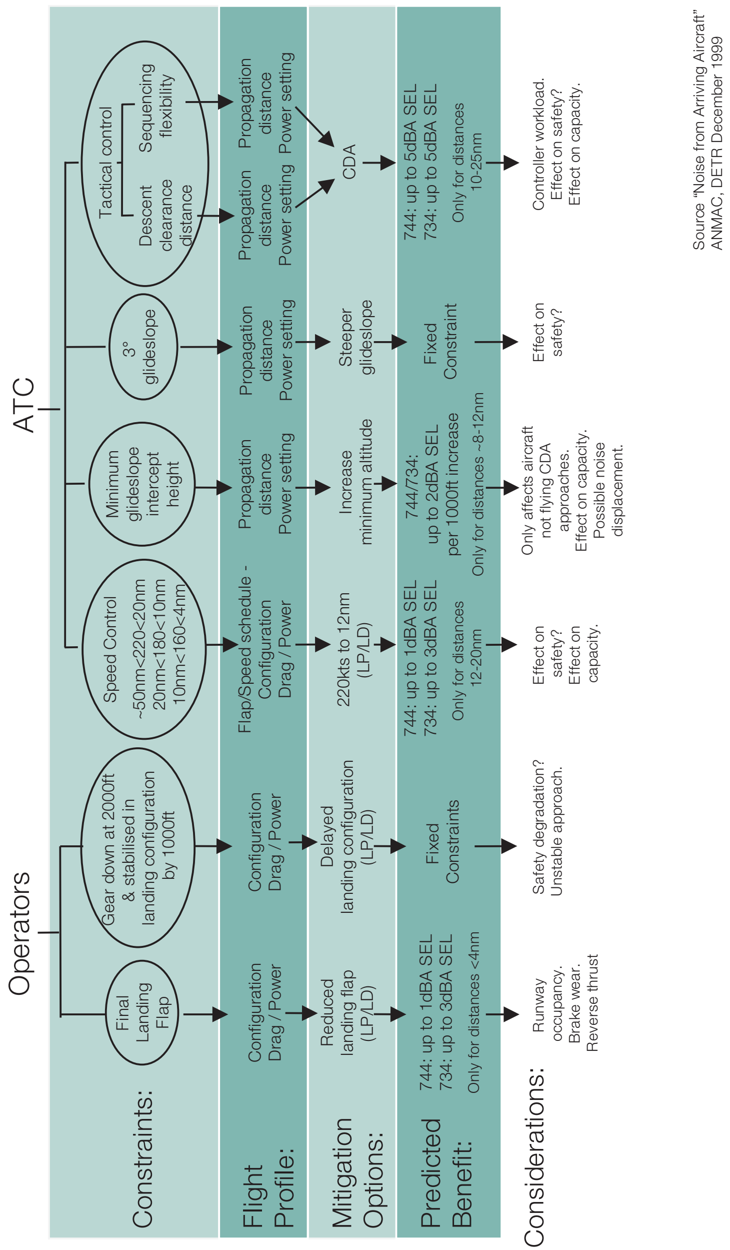
This voluntary Code of Practice has been compiled by a group representing airlines, air traffic control, airports, the Civil Aviation Authority (CAA) and the Department for Transport (DfT). It is primarily concerned with Heathrow, Gatwick and Stansted airports, although much of the content is equally applicable to other airports in the UK and worldwide. Recent successes are noted and practical steps are set out along with longer-term advice concerning measures to reduce noise from arriving aircraft.

The key factor identified is the noise benefit that can be obtained from greater achievement of continuous descent approaches (CDAs as defined in this document).

Introduction

1. During the period 1994-99 Government considered the feasibility of setting noise limits for arriving aircraft through the then Department for Transport, Local Government and the Regions' (now DfT) Aircraft Noise Monitoring Advisory Committee (ANMAC). This was considered in some depth, including the formation of a technical working group whose work was published in the report 'Noise from Arriving Aircraft: Final Report of the ANMAC Technical Working Group' in December 1999. This considered all aspects of variability of noise from arriving aircraft in great detail. The study summarised the causes of variability of noise heard under the path of arriving aircraft – illustrated in Fig 1.

Figure 1 - Aspects of variability in Approach noise



2. In the light of the ANMAC findings, the then Aviation Minister decided against imposing operational noise limits for arriving aircraft. On 10 February 2000 he announced that a Code of Practice should be established to address this issue. Representatives of the DTLR, NATS, BAA, British Airways, Airtours (now operating as My Travel) and CAA/ERCD compiled the original version of the Code which was published in February 2002.

3. A review of the Code was undertaken by a similar group (now including EasyJet and Virgin Atlantic Airways) in 2003/4. The detailed results of the review were presented to ANMAC. The review, this document and a condensed version of this document can be found on-line at www.dft.gov.uk/aviation

4. Notwithstanding the success of the Code to date the review group also agreed a number of recommendations which are outlined throughout this document. Ten key factors that could lead to further improvements are summarised at the end of this document.

Scope

5. Using the experience and knowledge of all participants, this 2nd edition of the Code of Practice has been produced to identify steps which could reduce the noise generated by arriving aircraft. As a result the Code is a technical document which is primarily written for pilots and air traffic controllers, but it also includes advice to relevant parties such as airports and the regulators.

6. This work has concentrated on Heathrow, Gatwick and Stansted although it is recognised that much of the Code is potentially relevant to other airports internationally. It should be noted that CDA arrival procedures are not possible under normal operations for approaches to runway 05 at Stansted due to

airspace constraints (although such approaches at night are monitored for CDA achievement). To a lesser extent there are also restrictions on the application of CDA due to airspace constraints at Gatwick. Any change to the airspace around Stansted would seek where possible to facilitate CDAs to runway 05.

7. **Nothing in this Code shall take precedence over the requirement for safe operation and control of aircraft at all times. For the avoidance of doubt, all recommendations are to be read as being "subject to the requirements of safety".**

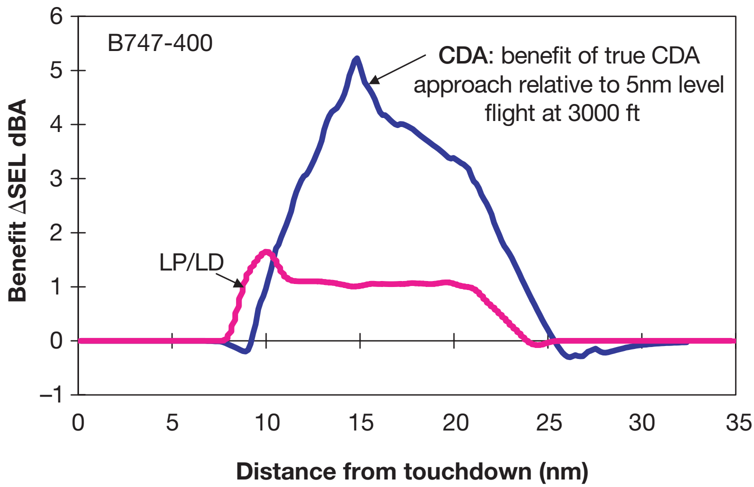
Background

8. Approach noise is a specific measurement in the International Civil Aviation Organization (ICAO) noise certification process whereby aircraft types are assessed and certificated. For fixed wing aircraft the approach noise certification measurement point is very close in to the airport (2 km from threshold), where configuration and flight conditions are very tightly defined. The ANMAC Technical Working Group report showed that further away from the airport there is significant variability in arrivals noise levels for a given aircraft type. The study identified the many factors which caused this variability, and determined what measures could best mitigate the higher noise levels for aircraft type (i.e. those at the upper end of the range of variability). It was recognised however that the safety requirements of the industry, especially ATC procedures and operations in poor weather, place constraints on which factors can be modified to reduce noise. Within these constraints, this Code identifies measures that can deliver reductions in arrivals noise.

9. The report highlighted CDA, in descent from 6000ft to establishment on the final approach glideslope, as the leading technique for reducing arrivals noise (this is illustrated at Fig 2).

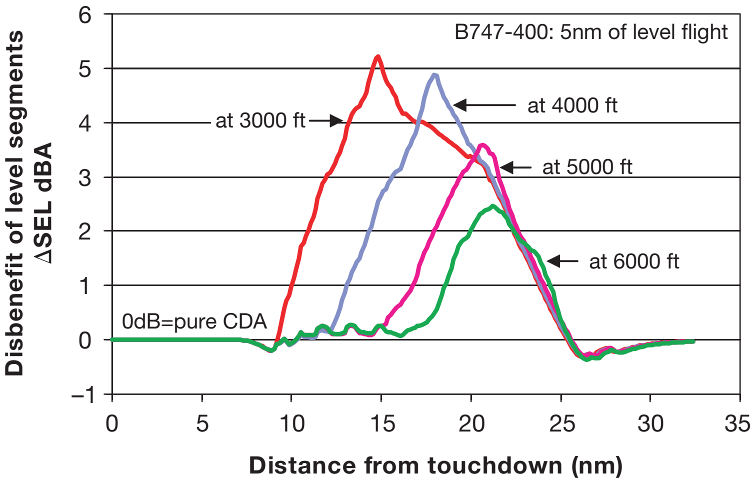
This Code of Practice therefore strongly emphasises measures intended to improve achievement of CDA.

Figure 2: Benefits of approach noise mitigation procedures



10. It is important to note that, for modern jet aircraft (high by-pass ratio turbofans), the benefits of increased altitude typically outweigh those gained from a low power/low drag technique (see paragraph 16) prior to joining final approach, where there is to some extent a choice or trade-off between the two. Controllers and pilots should therefore seek to facilitate/achieve CDA wherever possible. In general a level segment of a given length will result in less noise at ground level the higher it is flown. For example a level segment at say 2500ft is likely to result in a noise level of the order of 8dB greater than if it were flown at 5,000ft. It is acknowledged that controllers and pilots are not typically confronted by a simple choice of this sort for individual flights, but it is important that the broad principle should be widely understood and applied wherever possible. This is further illustrated in Fig 3.

Figure 3: Disbenefit of level intercepts relative to 'pure' CDA approach



11. In addition to the noise benefit, the use of CDA techniques also reduces fuel burn and hence emissions thereby producing both an overall environmental benefit plus cost savings to airline operators.

12. ICAO Circular 303 notes that: 'Descent profile optimization and the use of continuous descent approaches can offer significant potential fuel-saving benefits', and that 'reductions of between 200 kg and 400 kg per flight, depending on aircraft size, are possible.'

Definition of CDA

13. In the first edition of the code it was strongly recommended that detailed CDA requirements be published in the UK AIP. This has been achieved, a definition of CDA is published in the UK Aeronautical Information Package (AIP) at GEN 1.7 Table 1.7.2 'UK Definitions for Terms Used by ICAO'.

What is a CDA?

A noise abatement technique for arriving aircraft in which the pilot, when given descent clearance below Transition Altitude by ATC, will descend at the rate best suited to the achievement of continuous descent, whilst meeting the ATC speed control requirements, the objective being to join the glide-path at the appropriate height for the distance without recourse to level flight.

Specific conditions for Heathrow, Gatwick and Stansted are detailed in paragraph 15.

14. The use of CDA and LP/LD approach techniques, subject to compliance with ATC requirements, is outlined at UK AIP ENR 1.1.3 paragraph 2.3.1.

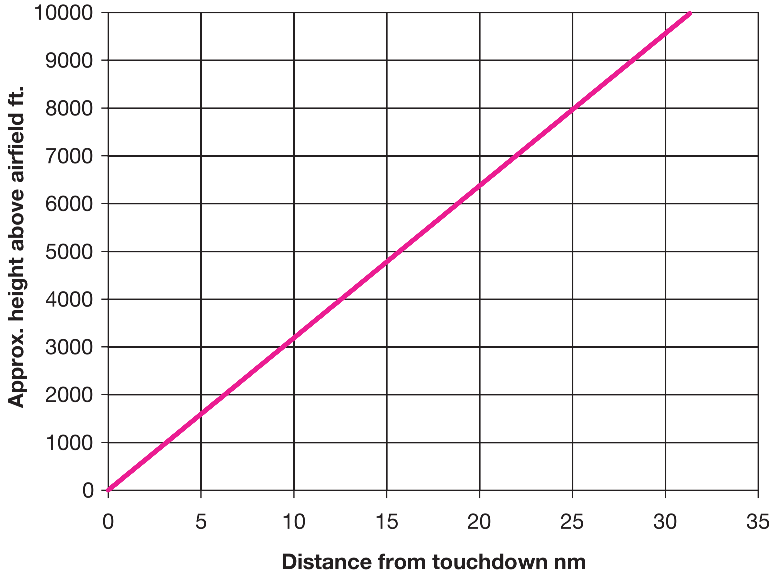
15. The theoretical "ideal" CDA profile for Heathrow, Gatwick and Stansted is a descent at 3° from 6000ft, as illustrated in Fig 4. A number of factors need to be taken into account in defining CDA:

- ICAO Doc 8168 PANS-OPS Vol II Pt III, paragraph 5.6 requires that, on the intermediate approach segment, "…a horizontal segment with a minimum length of 2.8km (1.5nm) should be provided prior to the final approach for Category C and Category D aircraft …";
- the standard ICAO safety requirement of intercepting the final approach glideslope from below;
- at a given altitude, a level segment used to decelerate an aircraft, at or near thrust-idle, will tend to generate less noise than an extended level segment at or near a constant airspeed;

- the monitoring capabilities of the Noise and Track (NTK) system in use at Heathrow, Gatwick and Stansted, including altimeter and radar tolerances, software interpolation, etc;
- the distance required by modern jet transport aircraft to decelerate in level flight; this is reflected in the choice of 2.5nm for the maximum level segment length at the three airports;
- CDA should start from as high a level as possible given the constraints of the airspace. In the London TMA it is recognised that the highest practicable level a CDA can commence for Heathrow, Gatwick and Stansted is 6000ft.

Figure 4 – Height vs Distance for a 3 degree Glideslope

Distance from touchdown nm	Approx. height above airfield ft	Distance from touchdown nm	Approx. height above airfield ft
0	0	20	6370
1	320	21	6690
2	640	22	7010
3	960	23	7330
4	1270	24	7650
5	1590	25	7970
6	1910	26	8280
7	2230	27	8600
8	2550	28	8920
9	2870	29	9240
10	3190	30	9560
11	3510	31	9880
12	3820	32	10200
13	4140	33	10520
14	4460	34	10830
15	4780	35	11150
16	5100		
17	5420		
18	5740		
19	6050		



For practical purposes a working definition of CDA as defined in AIP for Heathrow, Gatwick and Stansted is as follows: an arrival is classified as a CDA if it contains, below an altitude of 6000ft:

*– **no level flight**; or*

*– **one phase of level flight not longer than 2.5nm***

For monitoring purposes, due to the constraints of the NTK system and the different elevations of airports, CDA achievement is monitored below a height of 5,500ft above aerodrome level (aal) at Heathrow, Gatwick and Stansted airports.

'Level flight' is interpreted as any segment of flight having a height change of not more than 50ft over a track distance of 2nm or more, as recorded in the airport NTK system.

Definition of Low Power/Low Drag (LP/LD)

16. A definition of Low Power/Low Drag is published in the UK Aeronautical Information Package (AIP) at GEN 1.7 Table 1.7.2 'UK Definitions for Terms Used by ICAO'.

What Is Low Power/Low Drag?

"A noise abatement technique for arriving aircraft in which the pilot delays the extension of wing flaps and undercarriage until the final stages of the approach, subject to compliance with ATC speed control requirements and the safe operation of the aircraft."

17. This broadly means the aircraft being in as 'clean' a configuration as possible, for as long as possible. During the intermediate approach, including the closing heading, and on final approach, thrust reductions should be achieved where

possible by maintaining a 'clean' aircraft configuration and by landing with reduced flap. In practice at Heathrow, Gatwick and Stansted this is broadly interpreted to mean the minimum drag configuration (flaps and undercarriage) consistent with ATC speed controls. In turn ATC speed controls are specified to be broadly compatible with LP/LD for most types of aircraft.

Operational Issues for Air Traffic Controllers

Continuous Descent Approach Procedure

18. From an Air Traffic Control perspective the aim of a CDA is to provide pilots with the ATC assistance necessary for them to achieve a continuous descent during intermediate and final approach, at speeds which require minimum use of flaps etc. This has significant benefits in terms of noise produced beneath the approach area, and in reduction of fuel used.

19. CDA procedures requires ATC to apply specific or minimum speeds to inbound aircraft and to pass adequate "range from touchdown" information.

20. Except in exceptional circumstances, CDAs are to be employed at all times for aircraft inbound to Heathrow, Gatwick and Stansted. (Note: CDAs for runway 05 at Stansted are still not routinely possible due to conflicting airspace considerations.)

21. During the night quota period (2330-0600) all inbounds to Heathrow, Gatwick and Stansted, irrespective of weight or type of approach, are to be given descent clearance from Minimum Stack level at a distance from touchdown which ensures that inbounds are no lower than 6000ft when 20 track miles from touchdown.

22. In accordance with existing procedures, aircraft are then to be vectored onto a closing heading that will position the aircraft to intercept the extended runway centreline no closer than 10nm from touchdown. Descent clearance below 3000ft is not to be given until the aircraft is 10nm from touchdown.

23. During daytime operations the minimum joining point and height are less than the night time criteria. Although absolute minima are defined in the UK AIP, controllers should endeavour to keep arrivals as high as possible for as long as possible and not join the final approach lower than necessary, for minimum noise impact reasons.

24. Previously aircraft were given ATC clearance to intercept the ILS in two steps. At times this led to level segments before the second clearance was given. One of these steps has been eliminated, reducing the incidence of a level segment as the aircraft intercepts the ILS.

ATC Phraseology

Phraseology now approved is: ***'(callsign) when established on the localiser, descend on the ILS'****.*

25. NATS currently operate a scheme at the London airports where a small randomly selected sample of night-time arrivals tracks are analysed with a view to improving the accuracy of the track distance given and pilot compliance.

Speed Control

26. The speeds to be flown during the approach phase are to be specified by the controller, and will depend on the traffic situation at the time. Standard speeds are published in the UK AIP and should be adhered to whenever possible.

27. If the traffic conditions permit, a pilot may be requested to maintain a higher than normal speed, or be advised that there is “no ATC speed restriction”. The terms “keep your speed up” and “maintain your speed” should be avoided except when necessary for ATC separation purposes. The use of such instructions may put a pilot into such a position that they may have difficulty in achieving a reasonable approach because of height/speed/range problems.

28. The standard speeds to be employed are as follows:

- During intermediate approach, i.e. after leaving the holding facility to base leg approximately 6 miles prior to ILS intercept: 210kt.

  Note: Pilots of some modern jet aircraft may request the use of their “minimum clean” speed during this phase of flight; commonly 220/230kts. Where possible, and subject to separation requirements, this should be approved.

- Thereafter, and until established on final approach, the highest possible speed between 160-180kt as required to ensure accuracy of spacing;

- Established on final approach, until 4nm DME: 160kt

29. Instructed speeds are not subject to tolerance, and pilots will fly them as accurately as possible.

Ranges from Touchdown

30. To assist pilots in the management of their descent, ranges from touchdown are to be passed as follows:

- When first issuing descent clearance from stack level (a best estimate only is required at this stage)

- As soon as possible after contact with final director
- At any time if a previous estimate has become invalid, e.g. following a change in landing sequence, or if the controller considers that a range check would assist a pilot with descent management.

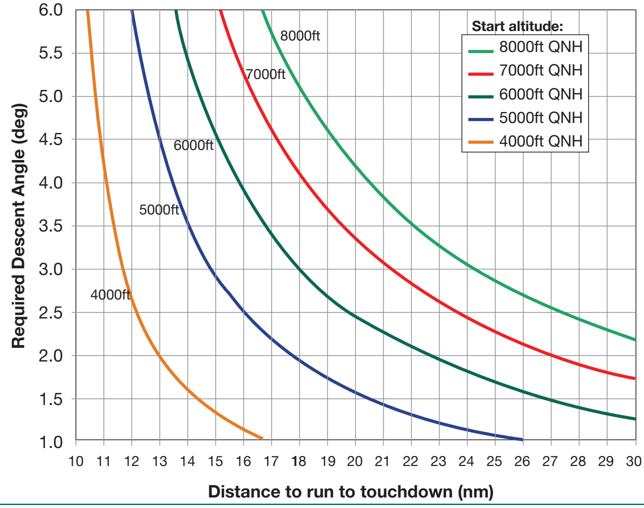
31. If the DME is unserviceable, radar ranges should be passed on the intercept heading to the ILS (these ranges should be as accurate as possible).

Operational Issues for Flight Crew

32. All aircrew are encouraged to use all available data to assist in the achievement of CDA.

33. CDA guidance detailing flight path angle/vertical speed for pilots should be available to the pilot on the flight deck to enable the planning and execution of a CDA approach. This could be either within the FMC system or as charts/printed material. Charts are provided in Figures 5 and 6, and the corresponding numerical information is given in Tables 1 and 2. The CAA intends to disseminate these charts by publication either in the UK AIP or through an Aeronautical Information Circular (AIC).

Figure 5 – Flight Path Angles for CDA



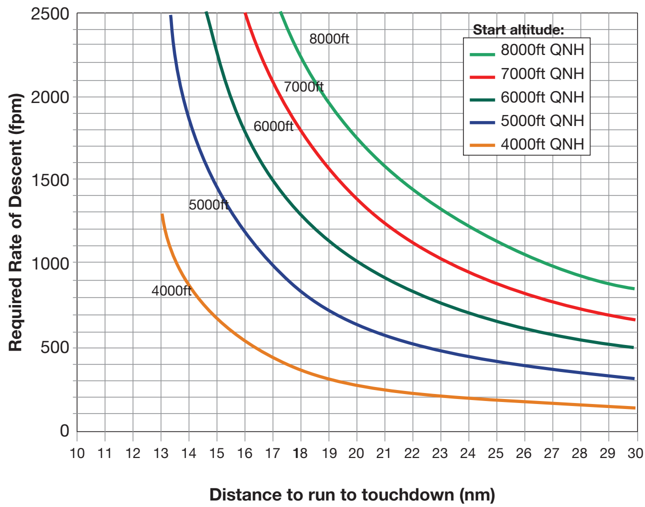
Assumptions

1. Calculation assumes 20sec of level flight (at 210kt zero wind) before descent commences.

2. Assumes ILS glideslope is intercepted at 10nm.

3. Assumes zero wind, sea level airfield.

Figure 6 – Vertical Speed for CDA



Assumptions:

1. Calculation assumes 20sec of level flight (at 210kt zero wind) before descent commences.

2. Assumes 210kt initially, 190kt on base leg (max 6nm), and 170kt for last 2nm before joining ILS glideslope at 10nm.

3. Assumes zero wind, sea level airfield.

Table 1 Flight Path Angles for CDA

		Flight path angle (deg)						NOTE: Flight path angles greater than 6 deg or less than 1 deg are not shown.													
Start altitude QNH	Distance to run (nm) ->	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
8000 ft		-	-	-	-	-	-	5.8	5.1	4.6	4.2	3.8	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.3	2.2
7000 ft		-	-	-	-	-	5.3	4.6	4.1	3.7	3.3	3.0	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.7
6000 ft		-	-	-	5.5	4.5	3.9	3.4	3.0	2.7	2.4	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.3
5000 ft		-	6.0	4.4	3.5	3.0	2.5	2.2	1.9	1.7	1.6	1.5	1.3	1.2	1.2	1.1	1.0	-	-	-	-
4000 ft		4.2	2.7	2.0	1.6	1.3	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2 Vertical Speed for CDA

		Required Rate of Descent (fpm)						NOTE: Vertical speeds greater than 2500 fpm are not shown. Values are shown to nearest 50 fpm.													
Start altitude QNH	Distance to run (nm) ->	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
8000 ft		-	-	-	-	-	-	-	2250	1950	1750	1600	1450	1300	1200	1150	1050	1000	950	900	850
7000 ft		-	-	-	-	-	2450	2050	1800	1550	1400	1250	1150	1050	950	900	850	800	750	700	650
6000 ft		-	-	-	-	2250	1800	1500	1300	1150	1000	900	850	750	700	650	600	600	550	500	500
5000 ft		-	-	-	1900	1450	1150	1000	850	750	650	600	550	500	450	450	400	400	350	350	300
4000 ft		-	-	1300	850	650	550	450	400	350	300	250	250	200	200	200	200	150	150	150	150

Assumptions:

1. Calculation assumes 20sec of level flight (at 210kt zero wind) before descent commences.
2. Assumes ILS glideslope is intercepted at 10nm.
3. Assumes zero wind, sea level airfield.

Source ERCD/CAA

34. A minimum rate of descent of 500 fpm is applicable for ATC purposes for aircraft above the Transition Altitude following STARs (this is a unique UK requirement). Although this requirement does not continue into the approach phase of flight, some pilots have in the past continued to descend at a higher rate than necessary. To avoid confusion the UK AIP now clarifies that the 500 fpm minimum ROD requirement does not apply below Transition Altitude.

35. Depending on aircraft type and operators' standard operating procedures, it is recommended that descent should be controlled by VNAV or Flight Path Angle (or Vertical Speed) rather than FLCH or Open Descent.

36. Aircraft separation is achieved by vertical separation and accurate vectoring supported by the use of accurate speed control. It is important that ATC heading and speed instructions are accurately and promptly adhered to. Descent using Vertical Speed control may require the use of speedbrake or thrust to maintain the correct speed.

37. Commensurate with safety and establishing a stabilised approach, crews are encouraged to use the minimum flap setting required for the requested ATC speed restriction and to avoid the early lowering of the undercarriage.

38. Research shows that noise is kept to a minimum by operating the aircraft on a CDA and in as clean a configuration for as long as possible.

39. PANS-OPS (Vol 1 Pt V, 3.2.1) provides that "in noise abatement approach procedures ... the aeroplane shall not be required to be in any configuration other than the final landing configuration at any point after passing ...5nm" from the threshold; this corresponds to approximately 1500ft aal.

40. Therefore, if possible do not lower the landing gear earlier than required to satisfy company requirements for a stabilised approach. This would not normally be until passing or below 2000ft (aal) depending on aircraft type.

41. Operators should ensure that operating procedures encourage the use of CDA techniques whenever possible especially in preference to any descent followed by an extended level segment. Pilots should comply with noise abatement procedures detailed in flight-deck documentation.

42. In the interests of noise abatement, to minimise disturbance in areas adjacent to the aerodrome commanders of aircraft are encouraged to avoid the use of reverse thrust after landing, consistent with the safe and practical operation of the aircraft, for example by selecting reverse idle.

Training

43. The NATS College of Air Traffic Control has introduced a module that addresses the training issue for Student ATCOs (Air Traffic Control Officers). During the initial weeks of their Approach Radar course, Student ATCOs receive a presentation on the principles and application of CDAs in the approach environment. This is then put into practice on all subsequent simulator training runs. This enables the student to be prepared to apply the principles and application of CDA in the field.

44. As part of ongoing programmes within NATS, presentations are given to operational staff on the benefits of CDAs. In addition, the UK Sustainable Aviation Initiative commits signatories to “completing a CDA outreach programme at all main airports by end 2006”. This programme is aimed at Air Traffic Control staff as well as airport and airline staff.

45. The major UK based airlines operating into the three London airports routinely train their pilots in CDA techniques. This is regarded as best practice and other airlines operating into the airports are encouraged to introduce similar training initiatives.

Operational Issues For Airports

46. Runway exit points should be designed and located to help minimise the use of reverse thrust and runway occupancy times thus reducing the likelihood of go-arounds.

47. Airports should, where practicable, consider evaluating the costs and benefits of potential design enhancements, such as displaced thresholds.

48. Successful CDA is significantly assisted by the installation of an ILS or equivalent, so airports are encouraged to provide ILS to all approaches where CDA is expected. When the ILS is unserviceable or is not provided, the request to achieve CDA is not negated. Consideration should be given to the establishment of P-RNAV APVs (Approach procedures with vertical guidance) as the primary back up to ILS/MLS failure in preference to reliance on SRA, NDB or visual approaches. In situations when the ILS/MLS is not available, which are rare, a greater achievement of CDA is likely if P-RNAV APV procedures are in place.

49. Regular and timely feedback to all parties involved is essential for understanding and improving performance against this Code. In particular, use of NTK systems to analyse CDA performance will enable each airport company to monitor and discuss progress with pilots and ATC representatives at the Company's appropriate technical group (e.g. BAA Gatwick's Flight Operations Performance Committee). Each airport's data is available for referral to individual airlines, and is routinely

sent to NATS, for their own internal review. Data on CDA performance is considered at each airport's Consultative Committee. Working groups of these committees currently review monthly CDA performance data. This will continue for the foreseeable future and input to these groups, reporting on progress against this Code, will continue to be sought from pilots and ATC.

Non-Operational Factors to Mitigate Approach Noise

50. The Code of Practice review group identified the following areas that could be considered in order to further mitigate approach noise:

    - The approach procedures published in the UK AIP should clearly state the fact that the 500 fpm rate of descent does not apply below Transition Altitude. Consideration should also be given to stating “Continuous Descent Approaches in effect” on the ATIS to remind crews not familiar with the London airports.
    - Minimum joining altitudes for ILS approaches should be kept under review.
    - Use of standardised approach procedures including P-RNAV approaches should be evaluated for potential noise benefits, bearing in mind safety and capacity issues.
    - ATC should continue to evaluate optimum speeds for intermediate and final approach.
    - The industry should continue to evaluate the benefits of steeper approaches in both the intermediate and final stages of approach.

- Aircraft manufacturers should evaluate the feasibility of designing aircraft and FMS systems in such a way as to make it straightforward for the pilot to be able to set and monitor progress against a CDA profile.

- Guidance should be available to ATC to assist them in identifying accurately the predicted distance to run for arriving aircraft.

51. All organisations involved in writing the Code (and other organisations who are implementing it) are encouraged to continue reporting progress in their respective Annual Environmental Reports, or similar, and to exchange best practice with other organisations around the world.

52. DfT and CAA are encouraged to continue to promote and disseminate, through their regulatory functions and through participation in ICAO and other international fora, the use of CDA where feasible at airports in the UK and abroad.

53. Further reviews of the Code will be undertaken when considered necessary.

54. 'The Future of Air Transport White Paper', published in December 2003 set out a plan for delivery of increased capacity to cope with future demand (see box).

> ***Environment in the Air Transport White Paper***
>
> *Chapter 12 of The Future of Air Transport White Paper states that 'environmental impacts must be taken into account when increases in airspace capacity are made to allow effective use of the additional airport capacity that would result from the White Paper's proposals'.*

55. In order to respond to these challenges, NATS may need to redesign airspace in the London TMA. In doing so NATS will

take into account a number of requirements set out by DfT and CAA/DAP (see box below).

56. Any such revisions may need to take into account positioning of holding patterns, standard arrival routes as well as standard instrument departure routes (due to the interaction of arriving and departing traffic in the London TMA).

Environmental Considerations in Airspace Design

DfT issued 'Guidance to the Civil Aviation Authority on Environmental Objectives Relating to the Exercise of its Air Navigation Functions' in 2002. Under section 70(2)(d) of the Transport Act 2000 the CAA is required to take account of any such guidance in carrying out its air navigation functions.

Section E (paragraphs 47 to 50) of the 2002 guidance deals with factors relevant to arriving aircraft.

Paragraph 48 states:
'The Government's aim is that radar manoeuvring areas and the positions of stacks are designed and managed in ways that will assist and promote the consistent use of "continuous descent approach" (CDA) and "low power/low drag" (LP/LD) operating procedures.'

Paragraphs 49 and 50 state:
'the CAA's Directorate of Airspace Policy (DAP) should ensure that consideration is given to how the use of CDA and LP/LD procedures can be promoted in the course of developing new procedures and when considering proposals for changes to existing airspace arrangements. Both procedures should be regarded as "best practice" for use at all airports where local circumstances (such as terrain clearance) do not preclude it. The procedures also reduce fuel consumption and emissions.'

57. In a complex TMA environment, safety and operational efficiency are key factors in airspace design. These factors need to be optimised with the environmental impact of the proposed operations. In accordance with the guidance to the CAA and to proposers of airspace change, the design of airspace to enable CDA operations is core to the design process.

58. Mindful of the need to optimise the environmental performance of airspace designs where possible, NATS has implemented an environmental assessment process that enables the analysis of noise, emissions and population exposure for airspace design options. This analysis capability will form an integral part of the ongoing airspace design work NATS undertakes in response to the challenges set out in the Air Transport White Paper.

Other factors

59. External factors can mean that achievement of CDA is more difficult in certain circumstances, for example periods of adverse weather or aircraft emergencies. The review document highlighted seasonal variations in CDA achievement, with achievement in winter months typically lower than in summer. The reasons for this variation are unclear at present but will be subject to further review.

60. Positioning flights between airports in and around the London TMA are usually flown at altitudes below 6000ft. Such flights will be registered by the NTK system as non-CDA approaches. There are, however, relatively few of these movements. It is also recognised and accepted that it is not practical to instruct go-arounds to climb to an altitude of 6000ft, and therefore these will register as non-CDA on subsequent re-approach to the airfield. Again these are relatively few in number.

Successes

61. In compiling the first edition of the Code of Practice early in 2002, a number of initiatives were identified and implemented that have led to an increase in the number of flights using CDA techniques, ultimately resulting in aircraft remaining higher for longer. Some of the successes are outlined below.

62. The phraseology used by ATC to permit aircraft to descend on the glidepath was reviewed and this has to some extent reduced the need for level segments to be flown as aircraft join the ILS.

63. There has been clarification in the AIP of the applicability of the 500fpm minimum ROD requirement, removing a potential source of confusion.

64. In the first edition of the code, it was strongly recommended that typical approach paths from each holding stack be published to enable pilots of suitably equipped aircraft to use the automatic vertical guidance features of the autopilot to improve CDA achievement, when operating in a radar vectored environment. Initial Approach Procedures showing flight paths from the holding stacks to the ILS intercept points have been published in the UK AIP. Approximate distances to touchdown are indicated on the Heathrow procedure diagrams to assist pilots in achieving a CDA.

65. There is now an increased emphasis on training of pilots and ATCOs with regard to arrivals noise mitigation.

66. The Code of Practice has raised the profile of arrivals noise mitigation and in particular CDA worldwide, and has sparked further work in the UK and internationally which is continuing, involving various sectors of the aviation industry. Some examples of initiatives with which representatives of the

Arrivals Code of Practice group have been involved are;

- Key Stakeholders in the Eurocontrol CDA focus group
- Advice and guidance on implementation of CDAs at UK and European International airports
- Input to a US-funded, NASA/Boeing run CDA arrivals study at Louisville, Kentucky airport
- Advice and guidance to Cambridge University on the Silent Aircraft Initiative

67. CDA performance has improved since the introduction of the first edition of the Code of Practice. Figures 7 and 8 show the increases in overall achievement of CDA across the three designated London airports. It can be seen that in the night quota period (2330-0600) a 13% increase in the use of CDA has been achieved against a 5% growth in the number of arrivals movements. An increase of 9% is evident in the Day + night shoulder period (0601-2329) against a growth in arrivals movements at 6.5%.

Figure 7: CDA Achievement Night Quota Period (2330-0600) at Designated London Airports

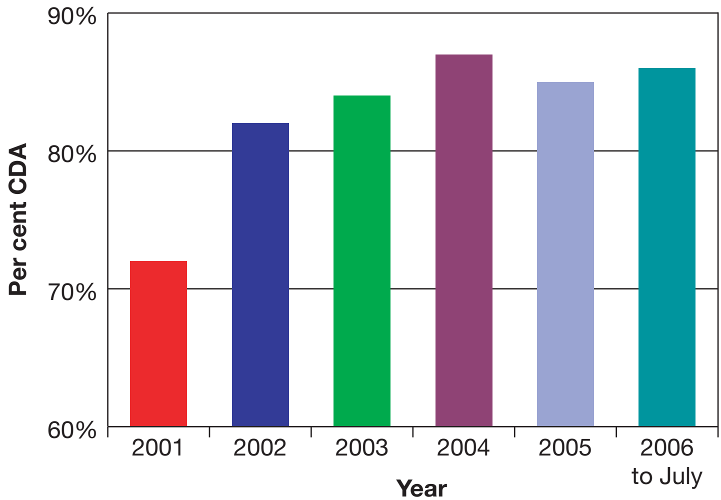
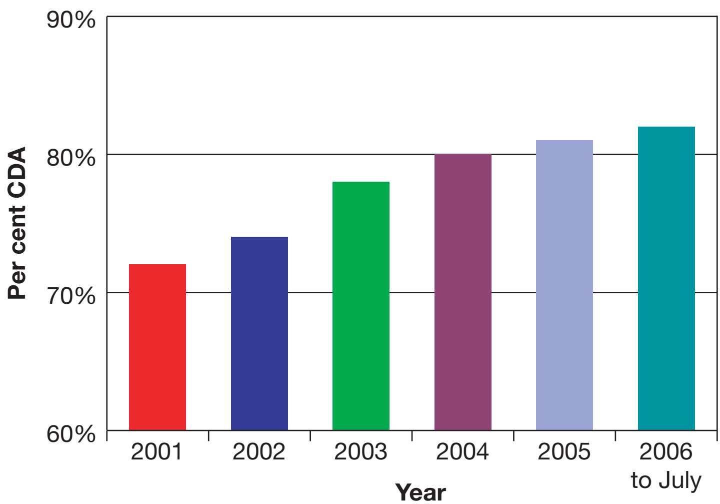


Figure 8: CDA Achievement Day + Night Shoulder Period (0601-2329) at Designated London Airports



Note: figures do not include arrivals to Stansted runway 05

68. In addition to the traditional CDA more sophisticated techniques have been developed, often referred to as Advanced CDAs. These call for the vertical profile to be an integrated part of published arrival procedures.

69. The vertical profile is specified by means of Flight Level or Altitude constraints at waypoints that are used to define the procedure. The waypoints specify the lateral profile, whilst the constraints published at the waypoints specify the vertical profile, and the speed profile, if applicable.

70. The procedure is designed with the intention that it is flown using an automated method of operation, whereby the avionics interpret the coded procedure and calculate the optimum vertical profile given the constraints published at the waypoints.

71. Advanced CDAs have been on trial at both Heathrow and Gatwick during recent years. The Heathrow trial has only been available to traffic arriving from the East during the night period. The current trial procedures include a CDA that commences at 25,000 feet and terminates at the point of ILS intercept.

72. The Gatwick trial is available on a 24-hour basis during times of quiet traffic. At present, due to variability in the way in which different avionics platforms interpret the speed profiles, it is necessary to provide increased spacing requirements between successive aircraft. This would result in a capacity decrease during busy times. The Advanced CDAs are therefore not utilised during busy traffic, when radar vectors continue to be used.

73. Procedures providing the vertical profile, enabling a CDA, are based on Precision Area Navigation (P-RNAV). This technology also permits the flexible placement of routes, enabling the avoidance of noise sensitive areas.

74. It is anticipated that the trial procedures will become permanent in due course. Dialogue with the ATS regulators is currently underway to determine the process to be followed in order to introduce these procedures on a permanent basis.

Arrivals Code of Practice Group Membership

BAA Gatwick

BAA Heathrow

BAA Stansted

British Airways

CAA, Directorate of Airspace Policy

CAA, Environmental Research and Consultancy Department

DfT, Aviation Environmental Division

EasyJet

My Travel

NATS

Virgin Atlantic

Useful Arrivals Noise weblinks

www.dft.gov.uk

www.airbus.com

www.ba.com

www.baa.com

www.boeing.com

www.caa.co.uk/dap/environment

www.cambridge-mit.org

www.eurocontrol.int

www.icao.int

www.nats.co.uk

www.sustainableaviation.co.uk

References

Noise from Arriving Aircraft; Final Report of the ANMAC Technical Working Group Dec 1999 DETR

Noise From Arriving Aircraft; First Progress Review

The Future of Air Transport – White Paper; December 2003

UK Aeronautical Information Publication

ICAO Circular 303: Operational opportunities for minimising fuel burn

ICAO Document 8168 Vol I and II: Procedures for Air Navigation Services: Operations (PANS-OPS)

GLOSSARY OF TERMS

Note that in some cases a simplified, more descriptive explanation of terms is given here, rather than the "official" technical definition, in order to assist the lay reader better to understand the terms used.

aal	Aircraft height above aerodrome level (runway datum).
AIP	UK Aeronautical Information Publication; colloquially known as the 'Air Pilot', published by the Civil Aviation Authority.
Altitude	The vertical displacement of an aircraft measured above mean sea level (the altimeter pressure setting is known as QNH). NB all ATC radar vectoring operations below the minimum stack level are conducted with reference to altitude. Most aircraft operators use altitude throughout the approach.
ANMAC	DfT's Aircraft Noise Monitoring Advisory Committee.
ATC	Air Traffic Control.
ATCOs	Air Traffic Control Officers.
ATIS	Aerodrome Terminal Information Service.
CAA	Civil Aviation Authority.
CAT II	An approach in visibility less than 550m runway visual range.
CAT III	An approach in visibility less than 200m runway visual range.

Category C & Category D	ICAO PANS-OPS (Doc 8168) Speed Related aircraft Category: Aircraft are divided into five speed categories. These are based on a nominal threshold speed defined as 1.3 times the stalling speed in the landing configuration at Maximum Certified Landing Weight. The five categories are: A – <91 kts (e.g. DHC 6 Twin Otter) B – 91 kts < 120 kts (e.g. ATR 42/72, BAe 146, Fokker 50/100) C – 121 kts to 140 kts (B737, A320, B757) D – 141 kts to 165 kts (B777, B747, A340, MD11) E – >165 kts. (no current civil aircraft type examples)
CDA	Continuous Descent Approach.
dB	Decibel, a unit used for quantifying sound level, calculated as 10 times the logarithm (base 10) of a sound energy ratio.
dBA	dBA is used to denote levels of sound measured on a decibel scale using a frequency weighting that approximates the characteristics of human hearing. These are referred to as A-weighted sound levels; they are widely used for noise assessment purposes.
Designated London Airports	Heathrow, Gatwick and Stansted – these airports have been ‘designated’ by the Secretary of State under Section 78 of the Civil Aviation Act 1982, leading to the DfT taking responsibility for policy on most aspects of airport noise.
DfT	Department for Transport.
DME	Distance Measuring Equipment.

DTLR	Department of Transport, Local Government and the Regions.
ERCD	Environment Research and Consultancy Department, CAA.
Eurocontrol	European Organisation for the Safety of Air Navigation.
FLCH	Flight Level Change – a control logic with set thrust and the aircraft speed controlled by the elevator.
Flight Level	A surface of constant atmosphere pressure, which is related to a specific pressure datum, 1013.2mb and is separated from other surfaces by specific pressure intervals (ICAO).
FMC/FMGC	Flight Management Computer/Flight Management Guidance Control.
FMS	Flight Management System.
fpm	feet per minute.
Glideslope	The ILS vertical guidance, set at the London airports for a nominal 3° descent angle.
Height	The vertical displacement of an aircraft measured above a specified datum, normally the elevation of an aerodrome (aal) (the altimeter pressure setting is known as QFE) or above ground level (agl). In this Code all heights are aal.
ICAO	International Civil Aviation Organization.
ILS	Instrument Landing System.

Initial Approach and Intermediate Approach	Technical terms used in Instrument Approach procedure design and related to obstacle clearance requirements. The Intermediate Approach segment blends the Initial Approach into the Final Approach and is normally aligned with, or not more than 30° offset from, the final approach track. For the purposes of this Code, both relate to the parts of the approach where radar directed marshalling and sequencing of traffic takes place between the Terminal Holding Point and the lowest (obstacle clearance) altitude at which an aircraft must be fully established on both the Localiser and the Glideslope (2500 ft at Heathrow and Stansted, and at Gatwick 3000 ft for runway 08R and 2000 ft for runway 26L).
Localiser	The ILS azimuth guidance, coinciding with the extended runway centreline.
LP/LD	Lower Power Low Drag approach procedure.
MLS	Microwave Landing System.
Nautical Mile (nm)	A distance defined by 1 minute of arc at the Equator, equal to 6076 ft (i.e. 1.151 statute miles, or 1.852 km).
NDB	Non-Directional Beacon.
NTK	Noise and Track Keeping monitoring system; this is a system that integrates noise data from a number of microphones, the airport's Flight Information System, and the NATS Secondary Surveillance Radar and flight identification. Heathrow, Gatwick and Stansted each have similar systems, as does ERCD (which receives data from the three airports' systems).
Open descent	A control logic with idle thrust and the aircraft speed controlled by the elevator.

PANS-OPS	ICAO Procedures for Air Navigation Services: Operations.
P-RNAV	Precision Area Navigation.
QFE	Atmospheric pressure at aerodrome level (or at runway threshold) (i.e. the altimeter reads zero feet on the ground).
QNH	Altimeter sub-scale setting to obtain airfield elevation when on the ground (i.e. the altimeter reads the aircraft's altitude Above Mean Sea Level).
ROD	Rate of descent.
SEL	The single event Sound Exposure Level is the sound level in dBA which, if maintained for a period of one second, would cause the same A–weighted sound energy to be received as is actually received from a given sound event.
SRA	Surveillance Radar Approach.
STAR	Standard Arrival Route.
TMA	Terminal Manoeuvring Area.
Transition Altitude	The altitude at or below which the vertical position of an aircraft is normally controlled by reference to altitude.
VNAV	Vertical Navigation.

Key Messages

1. *Use of Continuous Descent Approach (CDA) is encouraged wherever possible to realise the benefits of reduced noise, fuel burn and emissions.*
2. *From Transition Altitude, an arrival containing no level flight or one phase of level flight not longer than 2.5nm is classified as a CDA.*
3. *The minimum rate of descent of 500fpm does not apply below Transition Altitude. Airlines should ensure that ROD requirements are refreshed during line training.*
4. *Database suppliers should be encouraged to understand the Code and ensure that the CDA requirements are included on noise abatement pages.*
5. *The industry and regulators should keep the possibility of steeper glideslope capability under consideration in the design of new generation aircraft.*
6. *Advances in technology which would provide key information in relation to CDA achievement should be kept under consideration.*
7. *Operators should review their Standard Operating Procedures regarding lowering of landing gear and flaps to minimise drag and noise on arrival.*
8. *Airports should consider the benefits, costs and practical implications of introducing displaced thresholds.*
9. *The industry shall continually seek opportunities to improve the arrival procedures in order to minimise the environmental impact. Any new initiatives to reduce noise must take account of the impact on air quality. CDA is win-win!*
10. *A CDA means HIGHER FOR LONGER!*