7.3 The distance that the aeroplane traverses along the ground track, Δs, while climbing at angle γ_w, from an initial altitude h_1 to a final altitude h_2 is given by

$$\Delta s = \frac{(h_2 - h_1)}{\tan \gamma_w} \tag{C-14}$$

7.4 As a rule, two distinct phases of a departure profile involve climb at constant airspeed. The first, sometimes referred to as the initial climb segment is immediately after lift-off, where safety requirements dictate that the aeroplane is flown at a minimum airspeed of at least the take-off safety speed. This is a regulated speed and should be achieved by 35 ft above the runway during normal operation. However, it is common practice to maintain an initial climb speed slightly beyond the take-off safety speed, usually by 10-20 kt, as this tends to improve the initial climb gradient. The second is after flap retraction and initial acceleration, referred to as continuing climb.

During the initial climb, the airspeed is dependent on the take-off flap setting and the aeroplane gross weight. The calibrated initial climb speed V_{CTO} is calculated using the first order approximation:

$$V_{CTO} = C \cdot \sqrt{W} \tag{C-15}$$

where C is a coefficient appropriate to the flap setting (kt/√lbf), taken from the ANP database.

7.5 For continuing climb after acceleration, the calibrated airspeed is a user input parameter.

8. POWER CUTBACK (TRANSITION SEGMENT)

8.1 Power is reduced, or cut back, from take-off setting at some point after take-off in order to extend engine life and often to reduce noise in certain areas. Thrust is normally cut back during either a constant speed climb segment (section 6) or an acceleration segment (section 9). As it is a relatively brief process, typically of only 3 to 5 seconds duration, is it modelled by adding a “transition segment” to the primary segment. This usually covers a horizontal ground distance of 1 000 ft (305 m).

8.2 Amount of thrust reduction

8.2.1 During normal operations, the engine thrust is reduced to the maximum climb thrust setting. Unlike the take-off thrust, climb thrust can be sustained indefinitely, usually in practice until the aeroplane has reached its initial cruise altitude. The maximum climb thrust level is determined with equation C-1 using the manufacturer-supplied maximum thrust coefficients. However, noise abatement requirements may call for additional thrust reduction, sometimes referred to as a deep cutback. For safety purposes, the maximum thrust reduction is limited [ref. 20] to an amount determined by the performance of the aeroplane and the number of engines.

8.2.2 The minimum “reduced-thrust” level is sometimes referred to as the engine-out “reduced thrust”:

$$(F_n / \delta)_{engine-out} = \frac{W / \delta_2}{(N-1)} \cdot \left[\frac{\sin(\tan{-1}(0.01 \cdot G'))}{K} + \frac{R}{\cos \varepsilon} \right] \tag{C-16}$$

where

δ_2 is the pressure ratio at altitude h_2

G' is the engine-out percentage climb gradient:
= 0% for aeroplanes with automatic thrust restoration systems; otherwise,

= 1.2% for a 2-engine aeroplane

= 1.5% for a 3-engine aeroplane

= 1.7% for a 4-engine aeroplane.

8.3 Constant speed climb segment with cutback

8.3.1 The climb segment gradient is calculated using equation C-12, with thrust calculated using either equation C-1 with maximum climb coefficients, or equation C-16 for reduced thrust. The climb segment is then broken into two subsegments, both having the same climb angle. This is illustrated in Figure C-2.

8.3.2 The first subsegment is assigned a 305 m (1 000 ft) ground distance, and the corrected net thrust per engine at the end of 305 m (1 000 ft) is set equal to the cutback value. (If the original horizontal distance is less than 610 m (2 000 ft), one half of the segment is used to cutback thrust.) The final thrust on the second subsegment is also set equal to the cutback thrust. Thus, the second subsegment is flown at constant thrust.

9. ACCELERATING CLIMB AND FLAP RETRACTION

9.1 This usually follows the initial climb. As for all flight segments, the start-point altitude h_1, true airspeed V_{T1}, and thrust $(F_n/\delta)_1$ are those from the end of the preceding segment. The end point calibrated airspeed V_{C2} and the average climb rate (ROC) are user inputs (bank angle ε is a function of speed and radius of turn). As they are interdependent, the end-altitude h_2, end-true airspeed V_{T2}, end-thrust $(F_n/\delta)_2$ and segment track length Δs have to be calculated by iteration; the end-altitude h_2 is guessed initially and then recalculated repeatedly using equations C-16 and C-17 until the difference between successive estimates is less than a specified tolerance, e.g. one foot. A practical initial estimate is $h_2 = h_1 + 250$ ft.

9.2 The segment track length (horizontal distance covered) is estimated as:

$$S_{seg} = 0.95 \cdot k \cdot k^2 \cdot (V_{T2}^2 - V_{T1}^2) / 2(a_{max} - G \cdot g) \tag{C-17}$$

where

0.95 is a factor to account for the effect of an 8 kt headwind when climbing at 160 kt

k is a constant to convert kt to ft/sec = 1.688 ft/s per kt

V_{T2} = true airspeed at segment end, kt: $V_{T2} = V_{C2} / \sqrt{\sigma_2}$

where σ_2 = air density ratio at end-altitude h_2

a_{max} = maximum acceleration in level flight (ft/s^2) = $g\left[N \cdot \overline{F_n/\delta} / (\overline{W/\delta}) - R / \cos\varepsilon\right]$

G = climb gradient $\approx \dfrac{ROC}{60 \cdot k \cdot \overline{V_T}}$

where ROC = climb rate, ft/min

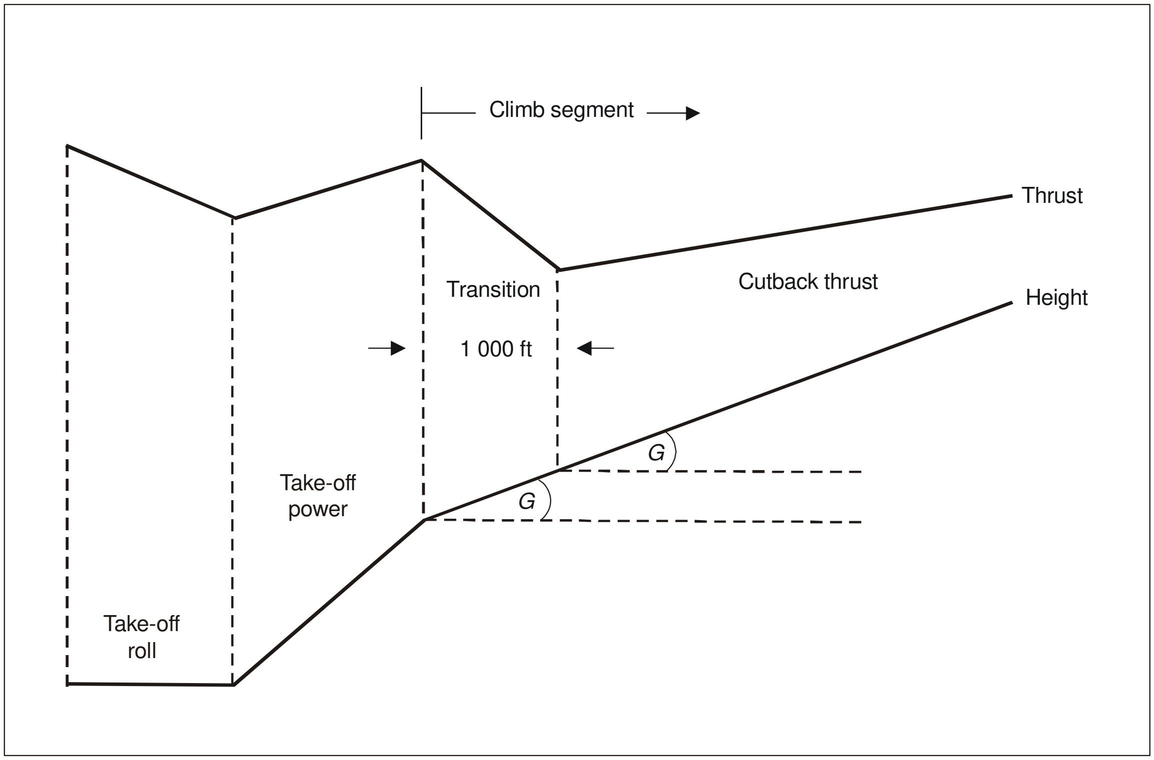

Figure C-2. Constant speed climb segment with cutback (illustration — not to scale)

9.3 Using this estimate of Δs, the end-altitude h_2' is then re-estimated using:

$$h_2' = h_1 + s \cdot G / 0.95 \quad \text{(C-18)}$$

9.4 As long as the error $|h_2' - h_2|$ is outside the specified tolerance, the steps in equations C-17 and C-18 are repeated using the current iteration segment-end values of altitude h_2, true airspeed V_{T2}, corrected net thrust per engine $(F_n/\delta)_2$. When the error is within the tolerance, the iterative cycle is terminated and the acceleration segment is defined by the final segment-end values.

Note.— If during the iteration process (α_{max} – $G \cdot g$) < 0.02g, the acceleration may be too small to achieve the desired V_{C2} in a reasonable distance. In this case, the climb gradient can be limited to $G = \alpha_{max}\, g$ – 0.02, in effect reducing the desired climb rate in order to maintain acceptable acceleration. If G < 0.01 it should be concluded that there is not enough thrust to achieve the acceleration and climb specified; the calculation should be terminated and the procedure steps revised[4].

9.5 The acceleration segment length is corrected for headwind *w* by using:

$$\Delta s_w = \Delta s \cdot \frac{(V_T - w)}{(V_T - 8)} \quad \text{(C-19)}$$

4. In either case, the computer model should be programmed to inform the user of the inconsistency.

9.6 Accelerating segment with cutback

Thrust cutback is inserted into an acceleration segment in the same way as for a constant speed segment — by turning its first part into a transition segment. The cutback thrust level is calculated as for the constant-speed cutback thrust procedure, using equation C-1 only. Note it is not generally possible to accelerate and climb while maintaining the minimum engine-out thrust setting. The thrust transition is assigned a 305 m (1 000 ft) ground distance, and the corrected net thrust per engine at the end of 305 m (1 000 ft) is set equal to the cutback value. The speed at the end of the segment is determined by iteration for a segment length of 305 m (1 000 ft). (If the original horizontal distance is less than 610 m (2 000 ft), one half of the segment is used for thrust change.) The final thrust on the second subsegment is also set equal to the cutback thrust. Thus, the second subsegment is flown at constant thrust.

10. ADDITIONAL CLIMB AND ACCELERATION SEGMENTS AFTER FLAP RETRACTION

If additional acceleration segments are included in the climb-out flight path, equations C-12 to C-19 should be used again to calculate the ground track distance, average climb angle, and height gain for each, and the final segment height must be estimated by iteration.

11. DESCENT AND DECELERATION

11.1 Approach flight normally requires the aeroplane to descend and decelerate in preparation for the final approach segment where the aeroplane is configured with the approach flap and gear down. The flight mechanics are unchanged from the departure case; the main difference is that the height and speed profile is generally known, and it is the engine thrust levels that must be estimated for each segment. The basic force balance equation is:

$$F_n/\delta = W \cdot \frac{R \cdot \cos\gamma + \sin\gamma + a/g}{N \cdot \delta} \qquad \text{(C-20)}$$

11.2 Equation C-20 may be used in two distinct ways. First, the aeroplane speeds at the start and end of a segment may be defined, along with a descent angle (or level segment distance) and initial and final segment altitudes. In this case, the deceleration may be calculated using:

$$a = \frac{(V_2/\cos\gamma)^2 - (V_1/\cos\gamma)^2}{(2 \cdot \Delta s/\cos\gamma)} \qquad \text{(C-21)}$$

where Δs is the ground distance covered and V_1 and V_2 are the initial and final ground speeds calculated using

$$V = \frac{V_C \cdot \cos\gamma}{\sqrt{\sigma}} \qquad \text{(C-22)}$$

11.3 Equations C-20, C-21 and C-22 confirm that while decelerating over a specified distance at a constant rate of descent, a stronger headwind will result in more thrust being required to maintain the same deceleration, while a tailwind will require less thrust to maintain the same deceleration. The most commonly practiced are decelerations during approach flight performed at idle thrust. Thus, for the second application of equation C-20, thrust is defined at an idle setting and the equation is solved iteratively to determine (1) the deceleration, and (2) the height at the end of the deceleration segment — in a similar manner to the departure acceleration segments. In this case, the deceleration distance can be very different with headwinds and tailwinds; it is sometimes necessary to reduce the descent angle in order to obtain reasonable results.

11.4 For most aeroplanes, idle thrust is not zero and, for many, it is also a function of flight speed. Thus, equation C-20 is solved for the deceleration by inputting an idle thrust; the idle thrust is calculated using an equation of the form:

$$(F_n / \delta)_{idle} = E_{idle} + F_{idle} \cdot V_C + G_{A,idle} \cdot h + G_{B,idle} \cdot h^2 + H_{idle} \cdot T \qquad \text{(C-23)}$$

where (E_{idle}, F_{idle}, $G_{A,idle}$, $G_{B,idle}$ and H_{idle}) are idle thrust engine coefficients available in the ANP database.

12. LANDING APPROACH

12.1 The landing approach calibrated airspeed, V_{CA}, is related to the landing gross weight by an equation of the same form as equation C-11, namely

$$VCA \approx D \cdot \sqrt{W} \qquad \text{(C-24)}$$

where the coefficient *D* (kt/√lbf) corresponds to the landing flap setting.

12.2 The corrected net thrust per engine during descent along the approach glideslope is calculated by solving equation C-12 for the landing weight *W* and a drag-to-lift ratio *R* appropriate for the flap setting with landing gear extended. The flap setting should be that typically used in actual operations. During landing approach, the glideslope descent angle γ may be assumed constant. For jet-powered and multi-engine propeller aeroplanes, γ is typically –3°. For single-engine, propeller-powered aeroplanes, γ is typically –5°.

12.3 The average corrected net thrust is calculated by inverting equation C-12 using K=1.03 to account for the deceleration inherent in flying a descending flight path into an 8-knot reference headwind at the constant calibrated airspeed given by equation C-24, i.e.

$$\overline{F_n / \delta} = \frac{\overline{W / \delta}}{N} \cdot \left(R + \frac{\sin\gamma}{1.03} \right) \qquad \text{(C-25)}$$

For headwinds other than 8 kt, average corrected net thrust becomes

$$\left(\overline{F_n / \delta}\right)_w = \overline{F_n / \delta} + 1.03 \cdot \overline{W / \delta} \cdot \frac{\sin\gamma \cdot (w-8)}{N \cdot V_{CA}} \qquad \text{(C-26)}$$

The horizontal distance covered is calculated by

$$\Delta s = \frac{(h_2 - h_1)}{\tan\gamma} \qquad \text{(C-27)}$$

(positive since $h_1 > h_2$ and γ is negative).

13. EXAMPLES

13.1 The following examples for the Boeing 737-300 illustrate how the various equations are used with parameters defining aeroplane departure and approach “procedures” to construct flight profiles together with power settings.

13.2 Departure profile

13.2.1 This example is for a Boeing 737-300 departure: take-off mass of 53 968 kg (119 000 lb), ISA conditions at sea level, headwind component 8 kt.

13.2.2 The procedural steps are:

1. Take-off, flap 5, full take-off thrust.
2. Maintain take-off power, climb at V_2 + 10 kt to 1 000 ft.
3. Maintain take-off power, accelerate to 185 kt CAS, climbing at 1 544 ft/min.
4. Maintain take-off power, select flap 1, accelerate to 190 kt CAS, climbing at 1 544 ft/min.
5. Reduce thrust to maximum climb thrust, select zero flap, accelerate to 220 kt CAS, climbing at 1 000 ft/min.
6. Maintain maximum climb thrust, 220 kt CAS, zero flap and climb to 3 000 ft.
7. Maintain maximum climb thrust, accelerate to 250 kt CAS, climbing at 1 000 ft/min.
8. Maintain maximum climb thrust and 250 kt CAS, zero flap and climb to 5 500 ft.
9. Maintain maximum climb thrust, 250 kt CAS, zero flap and climb to 7 500 ft[5].
10. Maintain maximum climb thrust, 250 kt CAS, zero flap and climb to 10 000 ft.

13.2.3 The calculation steps and results are shown in Table C-1. Note that step 5 is split into two parts, the initial part including a 1 000-ft long segment to account for thrust reduction. The length of the segment following acceleration at the specified climb rate determines the end-speed for this segment.

13.3 Approach profile

13.3.1 This example is for a Boeing 737-300 on a relatively conventional approach with a long decelerating segment in level flight: landing mass 46 636 kg (102 600 lb), ISA conditions at sea level, 8 kt headwind.

13.3.2 The procedural steps are:

1. Descend from 6 000 ft to 3 000 ft with a descent angle of 3°, while maintaining 250 kt CAS, flap code zero.
2. At 3 000 ft, level off, select flap code 5 and decelerate to 170 kt CAS over a distance of 21 000 ft.
3. Maintain altitude of 3 000 ft, flap code 5 and decelerate to 148.6 kt CAS over a distance of 5 000 ft.

5. Although apparently redundant as step 10 supplants it, step 9, like much ANP content, dates from a time when models had to be less sophisticated. In this particular case, the original need was to reduce the risk of using excessively long segments. Modern tools designed for more capable computers can be designed to warn of such risks automatically.

4. Descend at 3°, select flap code D-15 and decelerate to 139 kt CAS by an altitude of 2 500 ft.
5. Descend at 3°, select flap code D-30 and maintain 139 kt (reference landing speed).

6. Touchdown roll out for 294 ft, decelerate to 132.1 kt.

7. Touchdown roll for 2 940 ft, thrust at 60% maximum.

8. End of procedure, speed at 30 kt, thrust at 10% maximum.

Note.— The approach example features a level flight segment at 3 000 ft along which speed is reduced and illustrates how the improved methodology may be applied. However, the specified "procedural steps" are not at present tabulated in the ANP database[6]. Data for the Boeing 737-300 were generated some years ago when the SAE data specifications called only for a continuous 3° descent from 6 000 ft to touchdown, while continuously decelerating. Such a flight profile is rarely typical of operations at most airports. Although the aerodynamic coefficients necessary to calculate more realistic approach profiles have still not been provided, more recent data entries remedy the problem via tabulations of "profile points" data for an approach with a 3 000 ft level flight segment. (A remaining difficulty with "profile points" is that they are fixed; alternative profiles cannot be created.) In future, the methodology described in section 9, will enable the provision of "procedural steps" data for profiles incorporating level flight segments and deceleration.

Table C-1. Example departure profile

Segment		Start of roll	Take-off ground roll	Climb to 1 000 ft	Accelerate to 185 kt	Accelerate to 190 kt	Thrust cutback	Accelerate to 220 kt	Climb to 3 000 ft	Accelerate to 250 kt	Climb to 5 500 ft	Climb to 7 500 ft	Climb to 10 000 ft
							(Accelerate to 220 kt)						
Start-speed (CAS)	(kt)		0	164.6	164.6	185.0	190.0	196.7	220.0	220.0	250.0	250.0	250.0
End-speed (CAS)	(kt)		164.6	164.6	185.0	190.0	196.7	220.0	220.0	250.0	250.0	250.0	250.0
Start-height	(ft)		–	–	–	–	–	–	–	–	–	–	–
End-height	(ft)		–	1 000	1 331	1 408	1 461	1 646	3 000	3 268	5 500	7 500	10 000
Input climb rate	(ft/min)		–	–	1 544	1 544	1 000	1 000	–	1 000	–	–	–
Flap	(°)		5	5	5	1	zero	zero	zero	zero	zero	zero	zero
Thrust rating	(-)		Max take-off	Max take-off	Max take-off	Max take-off	Max climb	Max climb	Max climb	Max climb	Max climb	Max climb	Max climb
Start FN/δ	(lb/eng)	18 745	18 745	15 433	15 837	15 561	14 376	14 269	13 894	14 105	13 627	13 974	14 286
End FN/δ	(lb/eng)	–	15 433	15 837	15 561	15 492	14 269	13 894	14 105	13 627	13 974	14 286	14 675
Start θ	(-)	1.000	1.000	1.000	0.993	0.991	0.990	0.990	0.989	0.979	0.978	0.962	0.948
End θ	(-)	1.000	1.000	0.993	0.991	0.990	0.990	0.989	0.979	0.978	0.962	0.948	0.931
Start δ	(-)	1.000	1.000	1.000	0.964	0.953	0.950	0.948	0.942	0.896	0.887	0.817	0.757
End δ	(-)	1.000	1.000	0.964	0.953	0.950	0.948	0.942	0.896	0.887	0.817	0.757	0.688
Start σ	(-)	1.000	1.000	1.000	0.971	0.962	0.959	0.958	0.953	0.915	0.908	0.849	0.798
End σ	(-)	1.000	1.000	0.971	0.962	0.959	0.958	0.953	0.915	0.908	0.849	0.798	0.738
Weight/δ (mean)	(lb)	119 000	119 000	121 173	124 140	125 067	125 365	125 910	129 509	133 435	139 768	151 324	164 882
Climb factor	(-)	–	–	1.01	1.01	1.01	1.01	0.95	0.95	0.95	0.95	0.95	0.95
Climb gradient	(-)	–	–	0.1817	0.1765	0.1748	0.1690	0.1542	0.1470	0.1390	0.1291	0.1188	0.1082

6. However, it is consistent with the current ANP database "procedural steps" to the extent that the flap deployment has been sequenced based on the same speeds.

Segment		Start of roll	Take-off ground roll	Climb to 1 000 ft	Accelerate to 185 kt	Accelerate to 190 kt	Thrust cutback	Accelerate to 220 kt	Climb to 3 000 ft	Accelerate to 250 kt	Climb to 5 500 ft	Climb to 7 500 ft	Climb to 10 000 ft
							(Accelerate to 220 kt)						
Wind adjustment	(-)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Eq. take-off distance	(ft)	–	5 506	–	–	–	–	–	–	–	–	–	–
Start VTAS	(kt)	0.0	0.0	164.6	167.1	188.7	194.0	201.0	225.4	230.0	262.4	271.4	279.8
End VTAS	(kt)	–	164.6	167.1	188.7	194.0	201.0	225.4	230.0	262.4	271.4	279.8	290.9
Sector distance gain	(ft)	0	5 506	5 441	3 671	926	999	3 801	9 143	6 357	17 197	16 757	23 021
Sector height gain	(ft)	0	0	1 000	331	78	53	185	1 354	268	2 232	2 000	2 500
Total distance gain	(ft)	0	5 506	10 947	14 618	15 544	16 543	20 344	29 487	35 844	53 041	69 798	92 818
Total height gain	(ft)	0	0	1 000	1 331	1 408	1 461	1 646	3 000	3 268	5 500	7 500	10 000

Table C-2. Example approach profile[7]

	Units	Step 1	Step 2		Step 3		Step 4		Step 5		Step 6	Step 7	Step 8
Flap code		zero	5	5	5	5	D-15	D-15	D-15	D-30	D-30	D-30	D-30
D		0	0	0	0	0	0	0	0	0.434	0.434	0.434	0.434
R		0.062	0.0791	0.0791	0.0791	0.0791	0.1103	0.1103	0.1103	0.1247	0.1247	0.1247	0.1247
Segment:		Descend	Level	Level	Level	Level	Descend	Descend	Descend	Descend	Land	Decelerate	Decelerate
Descent angle	(°)	–3	–	–	–	–	–3	–3	–3	–3	–3	–	–
Distance	(ft)		1 000	20 000	1 000	4 000	–	–	–	–	294	2 940	0
Ground thrust	(%)	–	–	–	–	–	–	–	–	–	–	60	10
Start:													
CAS	(kt)	250.0	250.0	246.2	170.0	165.7	148.6	147.6	139.0	139.0	139.0	132.1	30.0
Altitude (h)	(ft)	6 000	3 000	3 000	3 000	3 000	3 000	2 948	2 500	2 448	0	0	0
Δ h	(ft)	3 000	0	0	0	0	52.4	447.6	52.4	2 447.6	0	0	0
θ	(-)	0.959	0.979	0.979	0.979	0.979	0.979	0.980	0.983	0.983	1.000	1.000	1.000
δ	(-)	0.801	0.896	0.896	0.896	0.896	0.896	0.898	0.913	0.915	1.000	1.000	1.000
σ	(-)	0.836	0.915	0.915	0.915	0.915	0.915	0.917	0.929	0.930	1.000	1.000	1.000
TAS	(kt)	273.4	261.3	257.4	177.7	173.2	155.3	154.2	144.2	144.1	139.0	132.1	30.0
GSP	(kt)	265.5	253.3	249.4	169.7	165.2	147.3	146.2	136.2	136.1	131.0	0.0	0.0
RoD (ft/min)	(ft/min)	–1 258.6	0.0	0.0	0.0	0.0	–745.6	–721.4	–699.8	–699.8	0.0	0.0	0.0
Mid-values:													
θ	(-)	0.969	0.979	0.979	0.979	0.979	0.980	0.981	0.983	0.992	1.000	1.000	1.000
δ	(-)	0.849	0.896	0.896	0.896	0.896	0.897	0.905	0.914	0.957	1.000	1.000	1.000
σ	(-)	0.875	0.915	0.915	0.915	0.915	0.916	0.923	0.930	0.965	1.000	1.000	1.000
Calculation:													
Segment length (ft)	(ft)	57 243	1 000	20 000	1 000	4 000	1 000	8 541	1 000	46 703	–294	–2 940	0
Deceleration (m/s²)	(m/s²)	–0.048	–0.731	–0.731	–0.731	–0.615	0.000	–0.143	–0.143	0.000	–	–	–
Track distance	(ft)	140 487	83 243	82 243	62 243	61 243	57 243	56 243	47 703	46 703	0	–294	–3 234
FN/δ	(lb/eng)	302.1	260.8	260.8	260.8	936.5	936.5	2 467.6	2 427.3	4 144.0	3 790.4	8 000.0	2 000.0

7. Underlined figures are input procedural step values, other numbers are calculated.

Appendix D

MODELLING OF LATERAL GROUND TRACK SPREADING

1. It is recommended that, in the absence of radar data, lateral ground track dispersion be modelled on the assumption that the spread of tracks perpendicular to the backbone track follows a Gaussian normal distribution. Experience has shown that this assumption is reasonable in most cases.

2. Assuming a Gaussian distribution with a standard deviation S, illustrated in Figure D-1, about 98.8 per cent of all movements fall within boundaries of $\pm 2.5 \cdot S$ (i.e. within a swathe of width of $5 \cdot S$).

3. A Gaussian distribution can normally be modelled adequately using seven discrete sub-tracks evenly spaced between the $\pm 2.5 \cdot S$ boundaries of the swathe as shown in Figure D-1.

4. However, the adequacy of the approximation depends on the relationship of the sub-track track separation to the heights of the aeroplanes above. There may be situations (very tight or very dispersed tracks) where a different number of sub-tracks is more appropriate. Too few sub-tracks cause "fingers" to appear in the contour. Tables D-1 and D-2 show the parameters for a subdivision into between 5 and 13 sub-tracks. Table D-1 shows the location of the particular sub-tracks and Table D-2 shows the corresponding percentage of movements on each sub-track.

Table D-1. Location of 5, 7, 9, 11 or 13 sub-tracks (containing 98% of all movements)

	Location of sub-tracks for subdivision into				
Sub-track number	**5 sub-tracks**	**7 sub-tracks**	**9 sub-tracks**	**11 sub-tracks**	**13 sub-tracks**
12 / 13					$\pm 2.31 \cdot S$
10 / 11				$\pm 2.27 \cdot S$	$\pm 1.92 \cdot S$
8 / 9			$\pm 2.22 \cdot S$	$\pm 1.82 \cdot S$	$\pm 1.54 \cdot S$
6 / 7		$\pm 2.14 \cdot S$	$\pm 1.67 \cdot S$	$\pm 1.36 \cdot S$	$\pm 1.15 \cdot S$
4 / 5	$\pm 2.00 \cdot S$	$\pm 1.43 \cdot S$	$\pm 1.11 \cdot S$	$\pm 0.91 \cdot S$	$\pm 0.77 \cdot S$
2 / 3	$\pm 1.00 \cdot S$	$\pm 0.71 \cdot S$	$\pm 0.56 \cdot S$	$\pm 0.45 \cdot S$	$\pm 0.38 \cdot S$
1	0	0	0	0	0