Commission Directive (EU) 2015/996 of 19 May 2015 establishing common noise assessment methods according to Directive 2002/49/EC of the European Parliament and of the Council (Text with EEA relevance)

ANNEX

Appendix B

Flight performance calculations

B7 POWER CUTBACK (TRANSITION SEGMENT)

Power is reduced, or *cut back*, from take-off setting at some point after takeoff 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 B6**) or an acceleration segment (**Section B8**). As it is a relatively brief process, typically of only 3-5 seconds′ duration, is it modelled by adding a 'transition segment' to the primary segment. This is usually taken to cover a horizontal ground distance of 1 000 ft (305 m).

Amount of thrust reduction

In normal operation 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 B-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[1] to an amount determined by the performance of the aeroplane and the number of engines.

The minimum 'reduced-thrust' level is sometimes referred to as the engine-out 'reduced thrust':

$$(F_n / \delta)_{engine\,out} = \frac{(W/\delta_2)}{(N-1)} \times \left[\frac{\sin(\arctan(0{,}01 \times G'))}{K} + \frac{R}{\cos\varepsilon}\right] \quad \text{(B-16)}$$

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 2-engine aeroplane

= 1,5 % for 3-engine aeroplane

= 1,7 % for 4-engine aeroplane

Constant speed climb segment with cutback

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

Figure B-2

Constant speed climb segment with cutback (illustration — not to scale)

Track No	001
Track designation	Dep 01 — 09L
From runway	09L
Type of track	Departure
Displacement from start of roll	0 m
Number of subtracks:	7

Backbone track description

Segment No	Straight [m]	Curve			Standard deviation for lateral dispersion at segment end [m]
		L/R	Heading change [°]	Radius [m]	
1	10 000				2 000
3		R	90,00	3 000	2 500
4	20 000				3 000

The first sub-segment is assigned a 1 000 ft (304 m) ground distance, and the corrected net thrust per engine at the end of 1 000 ft is set equal to the cutback value. (If the original horizontal distance is less than 2 000 ft, one half of the segment is used to cutback thrust.) The final thrust on the second sub-segment is also set equal to the cutback thrust. Thus, the second sub-segment is flown at constant thrust.

(**1**) 'Noise Abatement Procedures', ICAO Document 8168 'PANS-OPS' Vol.1 Part V, Chapter 3, ICAO 2004.