Take-off profiles – an introduction

Captain Dean Plumb

08th July 2015

Airline Perspective on Noise

- Aim to:
  - Buy the safest, quietest, lowest emission aircraft we can afford,
  - Fly aircraft in safest, quietest, most environmentally efficient way.

- This creates trade-offs as some objectives compete:
  - Some noise saving techniques / designs could lead to larger NOx or CO2 emissions,
  - Some operational techniques could reduce noise further but at the cost of a safe, stable and sensible flight path.
  - Airlines operate to hundreds of airports, procedures must be as standardised as possible.

4 things about aircraft engines….

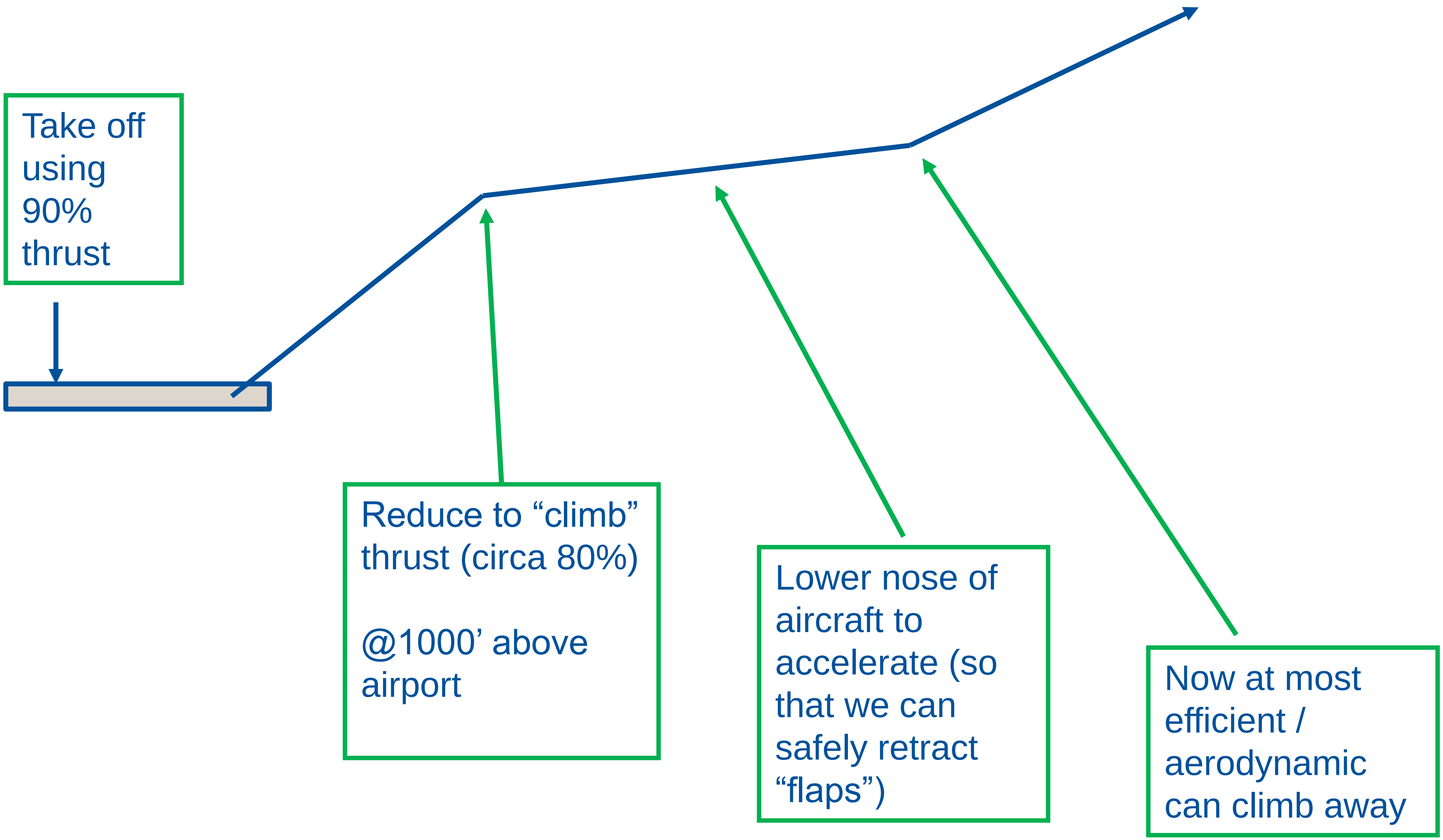
- Just like a car engine, they are not designed to be used at maximum rev's (full thrust) all the time.

- For many decades the normal practise has been to minimise thrust on take-off in order to protect the engine and reduce wear and tear.

- By taking care of the engines we reduce the amount of component wear, increase the time between servicing and minimise risk of unexpected engine failure.

- When an aircraft and engine are first certified the maximum reduction in thrust is set (between 25% and 40%)

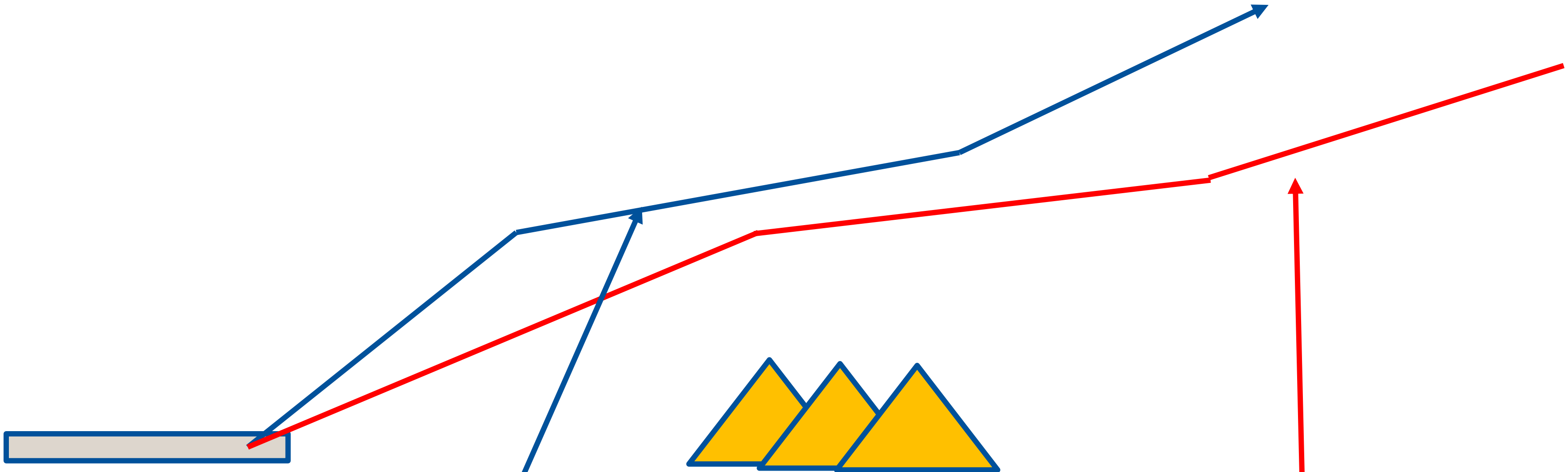
Normal Take-off (example only):



What effects climb rates

- Aircraft weight:
  - The longer the flight the more fuel it needs this can be over 100 tonnes of fuel and greatly affects aircraft performance;
  - More passengers = more weight;
  - More cargo in belly of aircraft = more weight.
- Weather – e.g very hot days reduce aircraft performance.
- Other effects – wind / atmospheric pressure……

Effect of weight:



"Lightest weight" take-off:

1. Lower thrust setting so less engine noise;

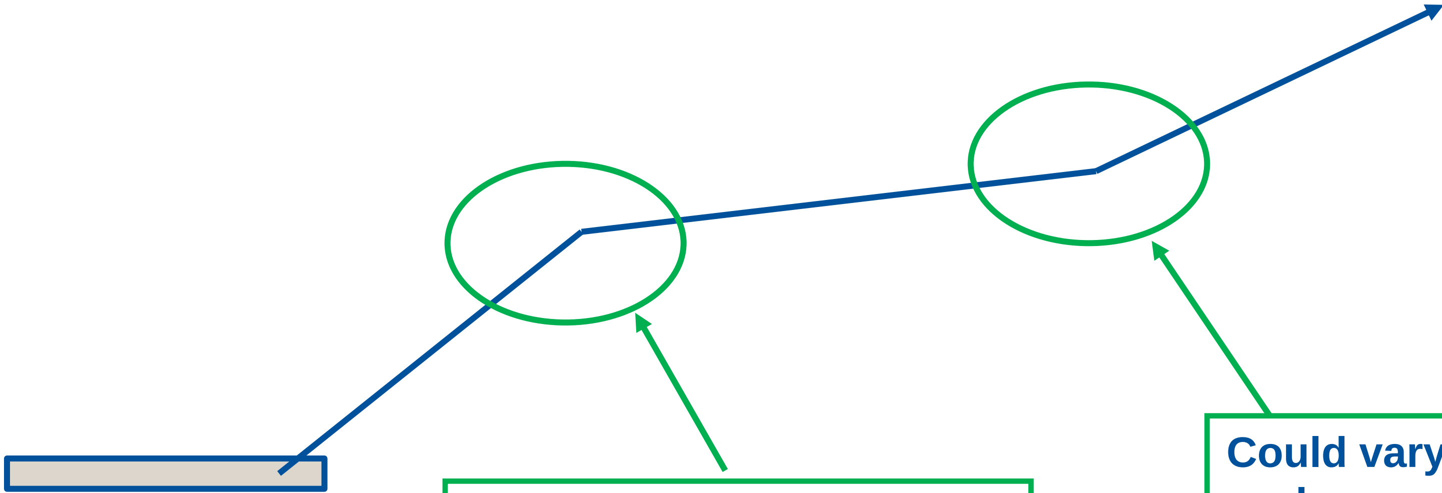
2. Would expect to be higher – especially if still has spare "performance" despite maximum reduction in take-off thrust

Heavy weight take-off:

1. Closer to maximum thrust required to stay above obstacles.

2. Lower altitude.

Items we can vary:



Could vary the thrust reduction altitude:

Early = aircraft lower but less engine noise

Later = aircraft higher but more engine noise

Could vary point at which we lower nose to accelerate:

Delay = higher closer to airport but lower than would normally be further away from the airport i.e. rob Peter to pay Paul…

Factors Affecting Thrust Setting on Each Take-off

Thrust	Pro	Con
Full thrust	Uses less fuel.	Creates more noise
		Produces more NOx
Reduced thrust	Produces less NOx	
	Less wear on engines	
	Can be quieter – depending on when thrust reduced	Probably lower than if full thrust used (but noise not louder at ground level)

Conclusions

- As an industry we once thought “higher was better”…but:

  - Recent noise analysis has shown that 1000’ “thrust reduction and acceleration” has some noise benefits,
  - Recent A380 “optimised” low noise departure flights showed engine thrust is even more important than height of aircraft.

- Many variations can be tested – but need to be mindful of time it takes to develop best profile so need:

  - Clear guidance on which areas we are trying to reduce noise over (can’t simply reduce noise everywhere - but can refine procedures to maximise benefits)
  - Recognition of trade-offs with other safety / environmental needs.

BRITISH AIRWAYS

oneworld

A380 Departure noise footprint at LHR

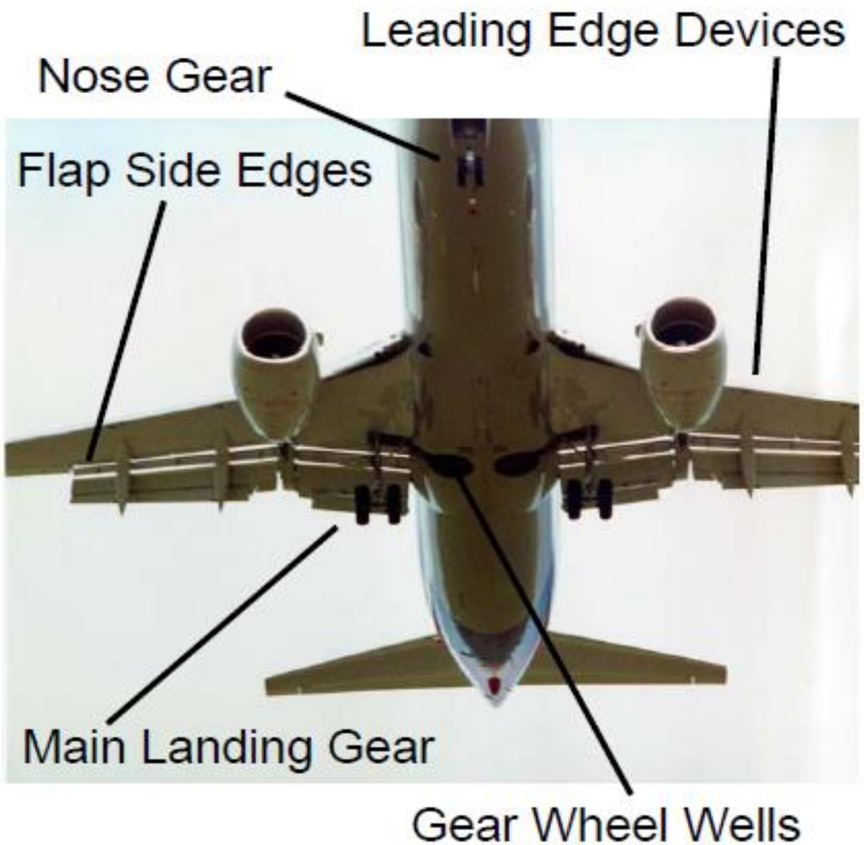
85 dbA contour at London Heathrow – 5,000 nm mission

A380… half the noise footprint on departure with 40% more passengers

© AIRBUS S.A.S. All rights reserved. Confidential and proprietary document.

Sources of Aircraft Noise

Airframe Noise Sources



Engine Noise Sources