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Understanding Takeoff Thrust Setting Technique

Sharing in-service events

AIRBUS

Contents

- Standard Operating Procedures - Takeoff
- Typical turbofan engine behavior
- Lines-of-defense
- In-service events
- Prevention strategies

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Standard Operating Procedures - Takeoff

Recommended technique:

- Extract from A318/A319/A320/A321 FCOM:

· PF progressively adjusts engine thrust in two steps :
– from idle to about 50 % N1 (1.05 EPR).
– from both engines at similar N1 to takeoff thrust.

- Extract from A300-600 FCOM (GE engines):

– Slightly advance throttles and monitor spool-up, until both engine are above idle (approx. 40% N1).

– **GO-LEVERS . . . . . TRIGGER**

Why are two steps required, whatever the engine type?

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Typical turbofan engine behavior

Common to all engines:

- Engine acceleration depends on acceleration schedule (FF vs N2) and throttle movement
- Two types of acceleration:
  - Slow throttle movement "behind" the engine acceleration schedule:
    - Thrust is function of throttle position
  - Fast/normal throttle movement "ahead of" the engine acceleration schedule:
    - Thrust is function of the max acceleration schedule capability

Typical turbofan engine behavior

Common to all engines:

- The time to accelerate the engine up to the takeoff power depends on the initial power level
  - Acceleration from min ground idle is slow
  - Acceleration from intermediate thrust is fast
- At low power setting, engines may have different acceleration profile
- Same acceleration profiles for both engines is reached from a certain amount of thrust

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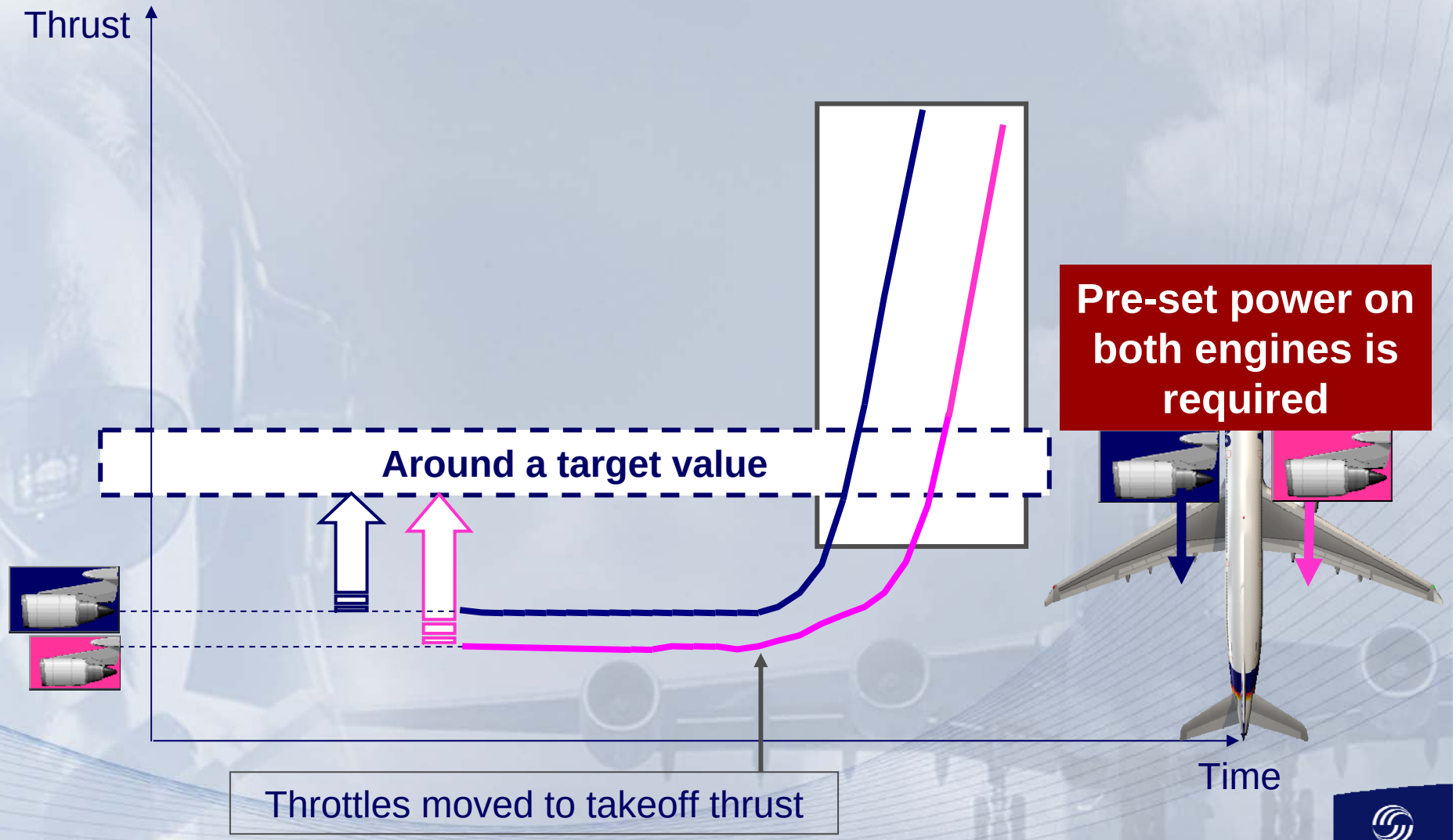
Lines-of-defense

SOP

Before moving throttles to takeoff thrust:



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In-service events

Threats:

- ATC pressure (expedite takeoff)
- Airport layout (taxiway/runway entry)
- Contaminated taxiway/runway

Errors:

- Thrust levers misaligned at low power
- Takeoff thrust set without pre-set power and from different low power setting

In-service events

Management:

- Rejected takeoff but too late to prevent runway excursion

A300-600 event

A320 event

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- In-service events
- **Prevention strategies**

Prevention strategies

Regular communication to pilots

- Emphasize the understanding of engine response at takeoff thrust setting, particularly the requirement of setting a minimum similar N1 (or EPR) on both engines at same time, prior to setting the takeoff thrust
  - Type rating
  - Recurrent training
  - Lessons-learned shared through Airline's bulletin to all pilots, if needed

Prevention strategies

Operational and training documentation

- Possible wording enhancements:
  - A300/A310/A300-600 FCOM - Takeoff SOP (Example for GE engines):

PF progressively adjusts engine thrust in two steps:
- from idle to about 40% N1
- from both engines at similar N1 to takeoff thrust, by triggering the go-levers

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Note:
If this procedure is not properly applied, it may lead to asymmetrical thrust increase and, consequently, to severe directional control problem.

  - SA and LR FCTM:

Conclusion

- ✓ Whatever the engine type (FADEC or MEC), the differential thrust resulting from acceleration to takeoff power when both engines are initially at different pre-set power can be very high
- ✓ At low speed, this high differential thrust significantly affects aircraft lateral control capability
- ✓ Acceleration to pre-set N1 (EPR) is required prior setting the takeoff thrust
- ✓ Runway excursion may be the consequence of high differential thrust at low speed

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