

AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP

Aircraft Operating Procedures to Reduce Airport Ground Emissions

Captain Richard Sowden

Project Pilot Air Canada Flight Operations

Technical Group





Objectives



- »Describe aircraft operating techniques to reduce aircraft noise and engine emissions for phases of flight below 3,000 ft. AGL
- »Review strategies to ensure success
- »Outline means to measure success
- »Discuss conflicting environmental objectives
- »Discuss the collective industry effort required to achieve the greatest enhancements in efficiency







Efficiency Assumptions



- »A320 aircraft
- »100 aircraft in fleet
- »15,000 sectors/month or 180,000 sectors/year
- »Every 100 litres of fuel burned releases the following combustion by-products

$$-CO_2 - 233 \text{ kg}$$

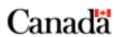
$$-CH_4 - 219 g$$

$$-NO_x - 23 g$$











Pre-departure

»Minimize APU use

- -Start APU 10 minutes before scheduled departure time
 - •Reducing APU use by 2 minutes per sector saves 780,000 litres of fuel annually
- -APU vs. Ground Support equipment
 - •APU burns 6 times as much fuel per hour as mobile ground support equipment (B744 20X)
- -Requires precise procedures & dedicated effort by ground handling teams













Engine Start & Taxi









- »Single engine taxi should be the normal departure procedure unless conditions preclude it
 - -1 minute of single engine taxi-out per sector saves 430,000 litres of fuel annually
- »Five key areas to focus on in Standard Operating Procedures (SOP's)
 - –Limiting weight
- Engine start sequence
- –Limiting thrust
- Stabilization times

-Checklists





Takeoff



- "Flex Thrust" normal operating procedure
 - -Reduces noise
 - -Reduces overall sector fuel consumption
 - Reduces gas path wear & maintenance costs
 - -Currently 85% of A320 family departures are "Flex Thrust"
- »Depart in direction of flight
 - Airborne fuel flow is 6 times higher than
 ground idle 18 min. taxi = 3 minutes airborne







Initial Climb



- »Climb profile tailored to direction of flight for turns limited by altitude due to noise abatement requirements
 - -Use V_2 + 10 to 3,000 ft AGL for altitude restricted SID's when departure runway is more than 90° from direction of flight
 - -Used on 1/3 of departures saves 3.2 million litres of fuel annually





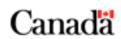


Approach



- »RNAV arrivals
 - -Enhanced traffic & energy management
 - Reducing IFR arrival distance by 4 miles saves 50 litres of fuel
- »Decelerated approaches as normal SOP
 - Flap/gear selection defined by altitudes
 - -Used on 1/3 of arrivals saves 4.5 million litres of fuel per year







Landing



- –Quieter approaches
- Used on 1/3 of landings saves 3 million litres per year of fuel
- »Idle reverse as normal SOP
 - –Quieter & can improve carbon brake wear
 - Reduced gas path wear & maintenance costs
 - Used on 1/3 of landings saves 1.2 million litres of fuel per year















Taxi-in



- »Single engine taxi should be the normal arrival procedure unless conditions preclude it
 - -1 minute of single engine taxi-in per sector saves 430,000 litres of fuel annually







Gate Arrival



- »Minimize APU use with full ground support on arrival at gate
 - -Start APU 10 minutes before scheduled departure time
 - Reducing APU use by 2 minutes per sector saves 780,000 litres of fuel annually
 - -APU vs. Ground Support equipment
 - •APU burns 6 times as much fuel per hour as mobile ground support equipment (B744 20X)
 - Requires precise procedures & dedicated effort by ground handling teams



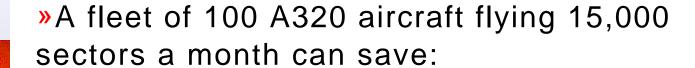






Transports Canada

Achievable Fuel Savings





Taxi-out 430,000 litres

Initial climb 3,200,000 litres

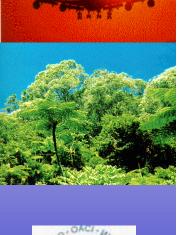
Approach 4,500,000 litres

Landing 3,000,000 litres

Taxi-in 430,000 litres

Gate arrival 780,000 litres

Total 13,120,000 litres (1.25%)











Fuel Savings Impact

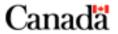








- »Operating cost reduction through reduced fuel consumption
 - -\$3.25 million US
- »Emission reductions through reduced fuel consumption
 - $-CO_2$ –12.2 million kg
 - $-CH_4 11,500 \text{ kg}$
 - $-NO_{x} 1200 \text{ kg}$

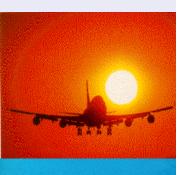




Strategies for Success



- -Top down management support
- Policy to define fuel efficiency as a corporate objective, but not at the expense of safety
- -Procedures that:
 - Establish fuel efficient procedures as the norm
 - Recognize conservative, safety oriented pilot culture
- -Education & awareness material to explain "why"
- -Training to teach the SOP
- -Checking to reinforce the SOP















Measuring Success



- Capture flight plan and actual aircraft operating fuel values
- –Validate policy & systems
- »Flight Operations Quality Assurance (FOQA)
 - Capture aircraft flight profiles
 - Validate procedures and compliance rates
- »Maintenance QAR & ACARS data
 - -Trending information pending introduction of FOQA
- »Clear employee non-judgmental clauses required













Conflicting Environmental Objectives



- Reduce glycol contamination
- Incur significant taxi-out delays
 thereby increasing engine emissions
- -30 minute deicing taxi event burns
 - -A320 400 litres
 - -B747-400 3300 litres













Conflicting Environmental Objectives...2



- -Preferential runways and arrival/departure procedures are:
 - Based on track/altitude monitoring
 - Do not reflect actual aircraft noise or promote noise and fuel efficiency
 - -Have not been revisited for years
 - Are not based on reasoned scientific and engineering analysis or evolution of aircraft technology

















An Industry Integrated Approach to Fuel Efficiency



»





»Airlines

Develop and implement fuel efficient SOP's

»ANS Providers

Develop and implement fuel efficient arrival and departure paths

»Airports

- –Maximize on-gate de-icing & minimize CDF delays
- -Facilitate departures in direction of flight
- Ensure noise abatement procedures minimize adverse affect on fuel burns

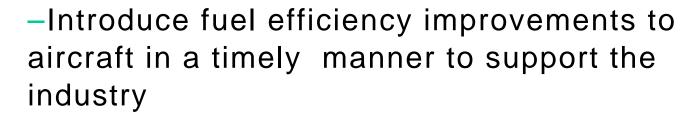






An Integrated Approach to Fuel Efficiency (cont'd)





- -Examples of needed aircraft modifications:
 - 1.A320 family aircraft approach idle change to Flap 3 or gear down from Flap 1 would save 12 litres of fuel per approach
 - 2.Bombardier Regional Jet Flap 30 landing instead of Flap 45 would save 18 litres of fuel per approach











AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP

Thank you!

Contact: richard.sowden@aircanada.ca



