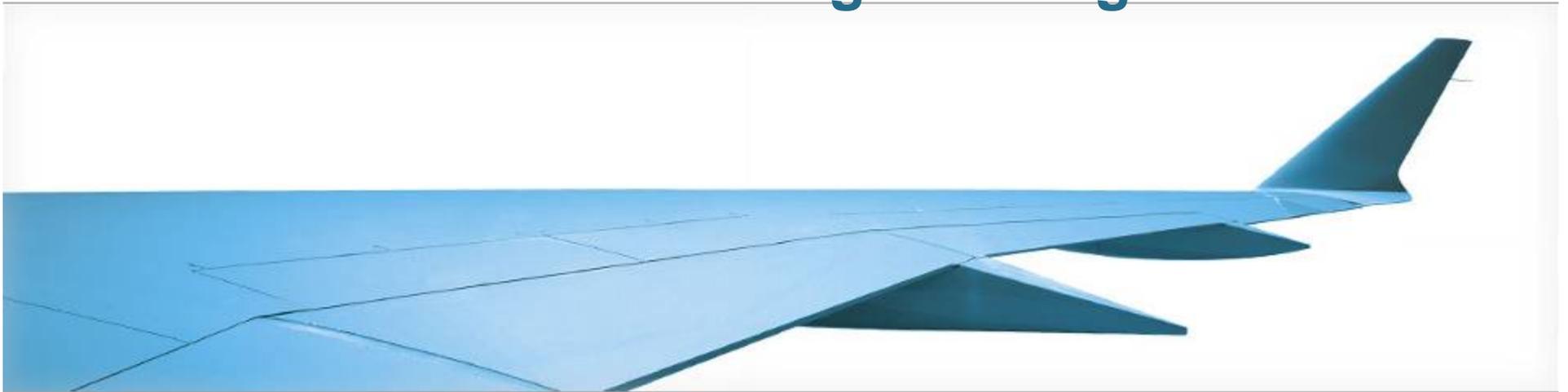


**AVIATION OPERATIONAL MEASURES FOR FUEL  
AND EMISSIONS REDUCTION WORKSHOP**  
**Weight Management**



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**C Series Aircraft Configuration**

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# **AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP**

To reduce fuel consumption, Mass Properties Discipline can help on two parameters.

- **Weight**

- Reduce aircraft weight

- **Center of Gravity**

- Optimised Center of Gravity (CG) position to reduce trim drag to minimum.

# **AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP**

## **Reduced fuel consumption**

- **Aircraft are designed to be safe, satisfy certification requirements and meet mission performance requirements.**
- **To be competitive this requires low weight and optimized C. G. to ensure aircraft operating costs are kept to a minimum and this is principally achieved by low mission fuel burn.**
- **Weight minimization , aircraft drag reduction and engine fuel burn are areas that are continuously challenged throughout an aircraft development program.**

# **AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP**

**Rule of thumb, for regional jets and business applications:**

- **additional fuel requirement: approx 2.6 % of OWE weight increase x hours flown**
  - e.g. extra weight = 500 kg
  - flight time = 1.5 hours ~ 500 nm.
  - extra fuel burn = 30 - 50 kg
  - extra CO<sub>2</sub> = 100 - 160 kg
- **For Every Flight!**

# **AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP**

**Rule of thumb, for regional jets and business applications:**

- **assuming 3,000 hours/year**
  - extra fuel burn = 60 000 – 100 000 kg
  - extra CO<sub>2</sub> = 190 000-315 000 kg
  - extra cost = \$ 41 000 – 69 000 \$US / years / aircraft (@ 2.10\$US /Gallon)
    - **and that's just the extra-cost due to fuel, per aircraft!**
- **Weight control is important**

# AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP



## Weight Saving Opportunities.

- Usage of ‘fly by wire’ (load alleviation) (up to -600 lbs)
- Use of new technology material
  - (composites, AL-LI, titanium, plastic, etc.)(up to -3000 lbs)
- **Integrated Avionics / Utilities** (merge multiple avionic boxes together) (up to -250 lbs)
- **System Integration** (more electric aircraft, electrical generators imbedded within the engine, starter generators, (up to -1000 lbs)
- **Composite wiring & connectors** (up to -120 lbs)
- Usage of light carpet (up to -125 lbs)
- Usage of Chromate free paint (up to -150 lbs)

# AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP



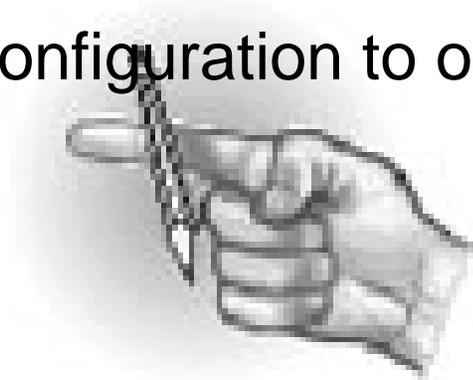
## Weight Saving Opportunities.

- Windshield wipers replacement with rain repellent windshield coating
  - aircraft weight reduction by approximately 24lb as well as aircraft drag;
  - Can be achieved if regulators amend 121.313 to allow use of equivalent means for rain dispersal.
- Minimize operating items to minimum (Flt Ops)
  - (no extra water, paperless cockpit, consumables for 1 flight only, over water kit only if required, etc.)
- Take advantages of summer vs winter passenger weight. (Flt Ops)

# AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP

## Center of Gravity Optimization.

- Flight with an aft center of gravity help to minimized trim drag.
  - Design flight envelope to minimized trim drag.
  - Move heavy equipment at the back of the A/C.
  - Develop fuel burn sequences between fuel tanks to control CG.
  - Optimized climb profile to minimize fuel burn
  - Manage passenger seating configuration to optimized CG position. (Flt Ops)



# AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP

## Center of Gravity Optimization.

- Fuel trim tank in empennage can help to control the CG at optimum point.



# AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP

## Center of Gravity Optimization.

- Wing position and interior arrangement also influences CG position.



# AVIATION OPERATIONAL MEASURES FOR FUEL AND EMISSIONS REDUCTION WORKSHOP

## Weight Management - Summary

- Weight management is an issue to be addressed by both the aircraft manufacturer and the operator.
- The manufacturer
  - To be competitive, provides lowest weight aircraft possible, meeting mission requirements.
  - Is well aware of the compounded effect of additional empty weight needing more fuel to complete mission
- The operator
  - Manages passenger loads, c.g., aircraft / engine maintenance and mission fuel reserves to minimize operating costs
  - Is well aware that mission fuel is biggest contributor to the variable operating costs (approx 1/3 of costs, considering crew, aircraft & engine maintenance, navigation & landing fees)

**AVIATION OPERATIONAL MEASURES FOR FUEL AND  
EMISSIONS REDUCTION WORKSHOP**

**Thank you !**