FAA Aircraft Icing Research at the FAA Tech Center, AJP-6350

Friends/Partner in Aviation Weather Forum

NBAA Convention, Atlanta, GA

Presented to:  Progress in Icing & Winter Wx Information
By: Jim Riley, FAA Aircraft Icing Research Lead
Date:  Sept. 27, 2007
Overview of FAA Aircraft Icing Research

• **In-Flight - Primarily in support of Certification Service**
  – Characterization of Atmospheric Icing Conditions
  – Simulation of Aircraft Icing Conditions
  – Determination of Critical Ice Shapes

• **Ground Operations in Icing Conditions – Primarily in support of Flight Standards Service**
  – Methods for determination of holdover times
  – Allowance times
  – Assess/develop new technology

• **Weather Information for Ground Operations in Icing Conditions**
Holdover and allowance times based on current weather conditions

• **Examples of Holdover Time (HOT), undiluted Type IV fluid**
  - Temperature = 25°F
  - Snow
    • Light -> HOT = 40 minutes
    • Moderate -> HOT = 20 minutes

• **Examples of Allowance Time (AT), undiluted Type IV fluid**
  - Temperature = 20°F
  - Ice pellets
    • Light -> AT = 30 minutes
    • Moderate -> AT = 10 minutes
Precipitation Intensity

- Intensities for fluid endurance time testing are based on liquid water equivalent (LWE) rates measured using glycol pans (ref.: SAE ARP 5485)
- In operations, airlines rely on reported visibility and intensity tables
  - **NWS:** .25 mi .50 mi
  - **FAA:** Thresholds vary with temperature (above or below 30°F) and light (day/night)
Ground Icing Weather Information Project

- NCAR
- FAA Icing Research Program, AJP-6350
- FAA Flight Standards, AFS-200
- Provide precipitation type and intensities based on LWE rates in operations for more accurate use of holdover and allowance times
- Current conditions, nowcasting, forecasting
Winter 2007-2008

- Focus on Snow
- 4 airports
  - Pittsburgh
  - Denver
  - Minneapolis/St. Paul
  - Chicago O’Hare
If EF is used for LWE rates from GEODFIR, what is effect on results?

• **EF = Wind Efficiency Factor**

• **Analysis is done for three cases**
  - No EF (Just presented)
  - EF with Terminal Velocity (Vt) = 1.5 m/s
  - EF with Terminal Velocity (Vt) = 1.0 m/s
Wind Enhancement Factor (E.F.)

- \( E.F. = \cos(\theta) + \sin(\theta) \times (Hwspd/VT) \)
  - \( \theta \) = angle of inclination = 10 deg
  - \( Hwspd = \) Horizontal Wind Speed
    - Measured operationally
  - \( VT = \) Terminal Velocity of Snow Flakes
    - Must be assumed

- Presented in paper by Rasmussen, et. al., 2000
Wind Enhancement Factor (E.F.)

Wind speed (m/s) vs. Snowfall Rate Enhancement Factor for 10 degree slope

- Term. Vel. = 0.5 m/s
- Term. Vel. = 1.0 m/s
- Term. Vel. = 1.5 m/s

Federal Aviation Administration
September 27, 2007
Effect of use of EF -
Rest of presentation involves:

• Fax, pp. 6 & 7.
• IntensitySmry2.xls
• Jan5I3T4E0C.xls - No EF
• Jan5I3T4E1C.xls - EF for Vt = 1.5 m/s
• Jan5I3T4E2C.xls - EF for Vt = 1.0 m/s
• Need to have all 4 files open, will be some jumping around
Effect of use of EF on conclusions for NWS Visibility Table

• 1. No EF
  – Does not agree well with GEODFIR.
  – Strongly non-conservative.

• 2. EF for \( V_t = 1.5 \text{ m/s} \)
  – Agreement worse
  – More non-conservative.

• 3. EF for \( V_t = 1.0 \text{ m/s} \)
  – Agreement: about same as 2.
  – Non-conservative: about same as 2.
Effect of use of EF on conclusions for NWS Visibility Table

• **1. No EF**
  – Does not agree well with GEODFIR.
  – Strongly non-conservative.

• **2. EF for Vt = 1.5 m/s**
  – Agreement worse
  – More non-conservative.

• **3. EF for Vt = 1.0 m/s**
  – Agreement: about same as 2.
  – Non-conservative: about same as 2.

Based on totals. Can differ in some respects for a particular day, e.g., Jan 5, 2007.
Effect of use of EF on conclusions for FAA Visibility Table

• 1. No EF
  – Does not agree well with GEODFIR.
  – Strongly conservative.

• 2. EF for Vt = 1.5 m/s
  – Agreement improves.
  – About equally conservative/non-conservative.

• 3. EF for Vt = 1.0 m/s
  – Agreement: about same as 2.
  – Non-conservative: about same as 2.
Concluding Remarks

• Need pan data from Marshall site to further examine validity of EF.