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15. Supplementary Notes (Funding programs, titles of related publications, etc.)

Several research reports for testing of de/anti-icing technologies were produced for previous winters on behalf of Transport Canada. These are available from the Transportation Development Centre (TDC). Several reports were produced as part of this winter's research program. Their subject matter is outlined in the preface. The work described in this report was, in part, co-sponsored by the Federal Aviation Administration (FAA).

16. Abstract

This objective was met by conducting a series of full-scale tests using the NRC open circuit wind tunnel to examine the flow-off properties of anti-icing fluids contaminated with various forms of simulated freezing precipitation to investigate several recent industry operational concerns; this work was completed in conjunction with the ice pellet research being conducted at the NRC PIWT.

- Type III Ice Pellet Allowance Times: A viscosity issue was discovered with the Type III 1000L fluid tote sample received for testing, therefore the data collected was dismissed and testing with the Type III fluid was stopped. A new quality control protocol was put into place by APS to prevent this occurrence during future tests.
- Effects of Wing Surface Roughness: The aerodynamic performance improved as the wing section became increasingly clean, however, the stall angle data demonstrated results that were counter-intuitive, whereby the wing seemed to stall at a higher angle when contaminated as compared to the clean wing.
- Effects of a Contaminated Flap: A contaminated flap section can have significant impacts on aerodynamic performance. The most severe lift losses were observed when the leading edge section and stagnation point of the flap was contaminated.
- Effect of Applying Excessive Amounts of Anti-Icing Fluid: The lift data for both comparative tests were comparable indicating no aerodynamic difference between a standard application, and an excessive application of anti-icing fluid.
- Low Speed Ramp Testing: The results indicated that the aerodynamic performance will significantly improve as the speed is increased.
- Light Freezing Rain Mixed with Moderate Snow Conditions: The Type I fluid results indicated that the added snow contamination (compared to light freezing rain alone) significantly affected the aerodynamic performance when the wing section was severely contaminated.
- Effects of Snow on an Un-Protected Wing: The results from this testing indicated that a takeoff with dry loose snow on the wings may be feasible at colder temperatures, however, it is not recommended at warmer temperatures where the risk of melting and refreezing is high.
- Degraded Anti-Icing Fluid Performance Following Contamination with Runway Deicing Fluid: The degradation effect of runway deicer fluid on anti-icing fluid protection time was more apparent following the Type IV application when higher concentrations of runway deicer fluid were used
- Heavy Snow: The results obtained using Type III, Type IV EG, and Type IV PG fluid indicated that using half the moderate snow HOT for heavy snow conditions could be a viable approach for providing guidance in heavy snow conditions.
- Future Testing: In order to ensure fluid quality for large shipments (i.e. large 1000L fluid totes) during future wind tunnel tests, it is recommended that fluid sampling for viscosity testing should be done before testing begins by extracting fluid from several layers in the tote, i.e. the bottom, the top, and the middle. Additional research should be conducted to continue the work related to Type III Ice Pellet Allowance Times, Effects of Surface Roughness, Low Speed Ramp Testing, Light Freezing Rain Mixed with Moderate Snow Conditions, Effects of Snow on an Un-Protected Wing, Degraded Anti-Icing Fluid Performance Following Contamination with Runway Deicing Fluid, and Heavy Snow

17. Key Words	18. Distribution Statement
Ice Pellet, Allowance Time, High Speed Rotation, Low Speed Rotation, Fluid Adherence, Fluid Flow-Off, Wind Tunnel, Surface Roughness, Contaminated Flap, Excessive Anti-Icing Applciation, Light Freezing Rain Mixed With Moderate Snow, , Snow on an Un-Protected Wing, Runway Deicing Fluid, Heavy Snow	Limited number of copies available from the Transportation Development Centre

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