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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.

- Effects of Surface Roughness: When comparing bare wing versus contaminated wing (with no fluid) the results indicate that as the angle of rotation is increased, the difference in the lift coefficient data is also increased. The testing conducted demonstrated varying aerodynamic effects as a result of the type of contamination adhered to the wing section.
- Light Snow Mixed with Light Rain: The Type IV results demonstrated positive results and supported the flat plate testing results recommending the use of light freezing rain holdover times for conditions of mixed light snow and light rain.
- Moderate Snow Mixed with Light Freezing Rain: Although the results were limited, the results indicate a potential for guidance material in mixed light freezing rain and moderate snow conditions.
- Inadequate Anti-Icing Fluid Application: The results indicate that the inadequate fluid application will generate a visually more severe condition following precipitation, however the severity of these scenario is dependant on the type of precipitation, primarily the potential for adhered contamination.
- Frost Fluid Freeze Point Failure: The wind tunnel results supported previous flat plate testing. Although the contamination did not seem to adhere during the plate tests, the wind tunnel tests demonstrated that the contamination was not removed by the time of rotation, and that the level of contamination worsened by the end of the test.
- Low Speed Ramp Testing: The results indicate that increasing the aerodynamic acceptance test speed profile from 67 knots rotation, to 80+ knots rotation could potentially provide better aerodynamic results for Type IV fluids, and potentially allow Type IV fluids to be certified for low speed aircraft.
- Heavy Snow: The results indicate that visually, moderate snow holdover times are not applicable for heavy snow conditions; visual results indicate that it should be approximately half the moderate snow. The results were in accordance with the preliminary results obtained during the 2006-07 wind tunnel tests.
- Future Testing: It is recommended that for future wind tunnel testing, the simulated takeoff profile should target the clean wing stall angle as the maximum angle of attack in order to better quantify the observed lift losses. In addition, during contaminated test runs, a baseline fluid only case should be run immediately before, or after the contaminated test run to provide a direct correlation of the results. It is also recommended that aerodynamic research be conducted to investigate the effects of adhered frozen contamination on a super-critical wing model. Additional research should be conducted to continue the work related to mixed light freezing rain and moderate snow, low speed ramp testing, 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, Light Snow Mixed with Light Rain, Moderate Snow Mixed with Light Freezing Rain, Inadequate Anti-Icing, Frost, Heavy Snow	Limited number of copies available from the Transportation Development Centre

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