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A Computational Study of Icing Effects on the Performance of S-Duct Inlets

The effects of a typical glaze ice accretion shape on the performance of the M2129 S-duct inlets are computationally investigated using the steady-state RANS solution. The glaze ice accreted on the inlet lip causes a significant degradation in the inlet performance, and the degradation is enhanced as free-stream Mach numbers increase. With increasing freestream Mach numbers from M =0.13 to 0.85, total pressure recovery decreases from 0.985 to 0.61. And the level of the mass flow rate with the glaze ice accretion is 73 percent of that in the ice-free condition at M =0.13; however, it decreases to 67 percent at M =0.475. In addition, compared to the symmetrical glaze ice shape in the circumferential direction of the inlet lip, an asymmetrical glaze ice on the top (= 315~45°) or bottom (= 135~225°) side of the inlet lip produces less significant effect on the inlet performance due to the relatively smaller blocking area to the in-flow by the asymmetrical ice accretion. At M = 0.475, total pressure recoveries of the top- and bottom-ice case are 0.924 and 0.922, respectively, while that of the symmetrical case is 0.836. Also, the bottom-glaze ice produces slightly more degradation in the inlet performance than the top-glaze ice due to the influence of thecurvature shape of the S-duct.

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