Aircraft Systems Field Exam

Consider the problem of aircraft icing on a small single engine propeller aircraft such as the PA-28R shown in Figure 1. The Maximum Takeoff Weight is 2750 lbs, Empty Weight is 1630 lbs, the usable fuel is 72 gal (432 lbs), the wing span is 35.5 ft and the mean chord is 4.8 ft, the tail span is 10 ft and the mean chord of the tail is 2.5 ft.

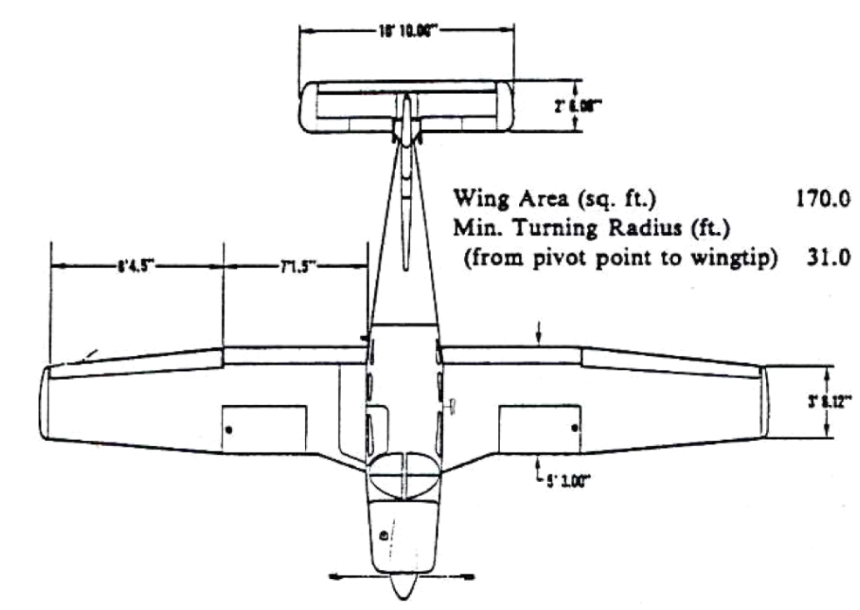

Figure 1. PA-28R Top View

1. Using the Breguet Range Equation, discuss the different ways in which icing could impact aircraft range. You can assume a density of ice of 0.92 g/m^3 if you need it. Make sure that you consider all the mechanisms.

2. Based on the considerations in 1, make a *very rough* estimate of the percent reduction in range if the aircraft was heavily iced. You can use the typical effects of ice accretion on airfoil C_L and C_D in Figures 2 and 3 and assume cruise C_L for the wing is 0.3.

3. Discuss the potential impacts and mechanisms by which icing can degrade longitudinal control.

4. Given a requirement that an aircraft be able to operate in icing conditions. Discuss the development of the aircraft and ice protection systems in the context of the system engineering V chart. What are some of the ice protection systems you might consider.

5. If you have time, discuss potential impacts of icing on take off performance.

6. If you have time, discuss potential impacts of icing on instrumentation systems and human factors.

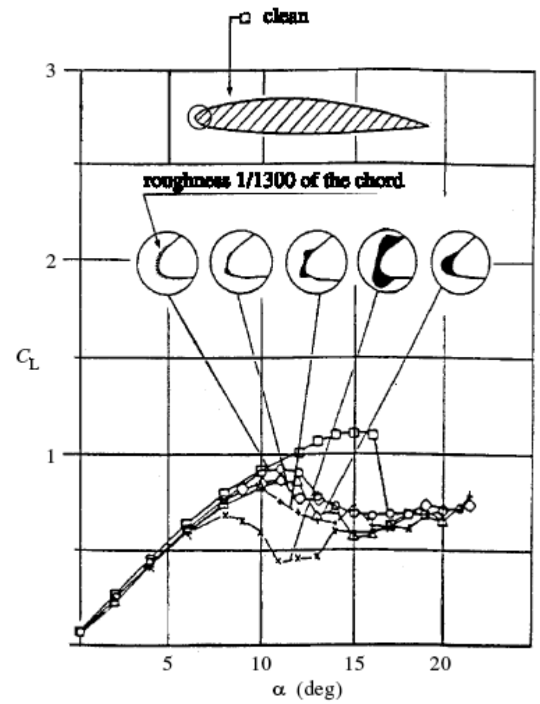

Figure 2. Typical effect of ice accretion on aerofoil lift.

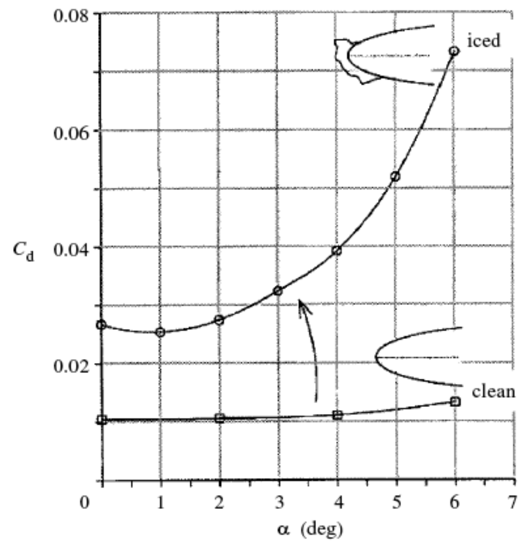

Figure 3. Typical effect of ice accretion on aerofoil drag.

For reference, figures 2 and 3 represent typical effects of ice accretion on airfoil C_L and C_D from Gent, Dart & Cansdale, "Aircraft Icing", Philosophical Transactions of the Royal Society A, London, 358, 2000