

(Add a short summary of the concepts you are using to solve the problem)

Problem T20

The MIT-CU *Silent Aircraft Initiative* (SAI) has developed a conceptual aircraft sufficiently quiet that outside the airport perimeter aircraft noise is less than the background noise of a well populated area. A flying wing type airframe was considered (see illustration below) due to acoustic advantages. This “silent aircraft” will need some way to prevent ice from forming on its exterior. One solution would be to install electric resistance heating elements under the skin near the leading edge of the flying wing. You are asked to evaluate this proposal. You can assume that the silent aircraft is in steady level flight and that ice will not form near the leading edge when the surface temperature is kept at $T_s = 5^\circ C$.



Silent Aircraft eXperimental design SAX-40

The following data is available:

Body surface area (wetted):	$A = 800 \text{ m}^2$
Total cruise thrust (3 engine clusters):	$F = 70,000 \text{ N}$
Cruise Mach:	$M = 0.8$
Cruise conditions:	$p_\infty = 18,754 \text{ Pa}$
	$T_\infty = 217 \text{ K}$

- If the wing was adiabatic, what is the adiabatic wall temperature at cruise? Is heating of the wing surface required to avoid the formation of ice?
- Estimate the electrical power needed to maintain a surface temperature of $T_s = 5^\circ C$ near the leading edge of area $A_{LE} = 20 \text{ m}^2$. You can assume that the total drag is only due to friction on the flying wing of wetted area A .