E230 Aircraft Systems

Frozen in the Air

6th Presentation

School Of Engineering

Conditions for ice to form

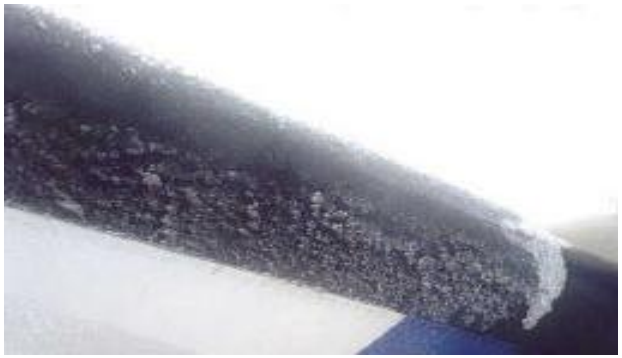
- Water is present e.g. in clouds, snow, rain, fog
- Temperature around 0°C
- Condensation nuclei

Aircraft parts susceptible to icing

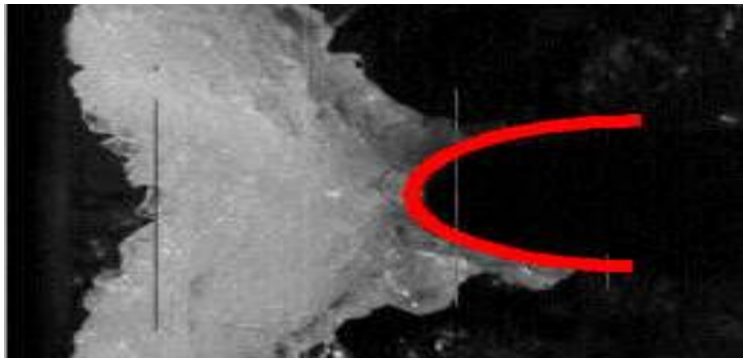
- Wings
- Tail
- Leading edges
- Slats
- Probes (Pitot, TAT, AOA etc)
- Antennae

Types of Icing

Rime Ice on leading edge



Hoar Frost on an leading edge



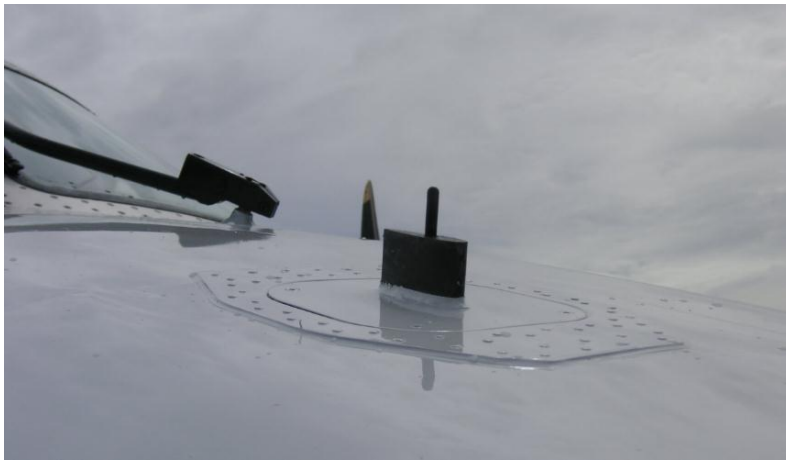
Glaze Ice or Clear Ice

Effects of icing on aircraft

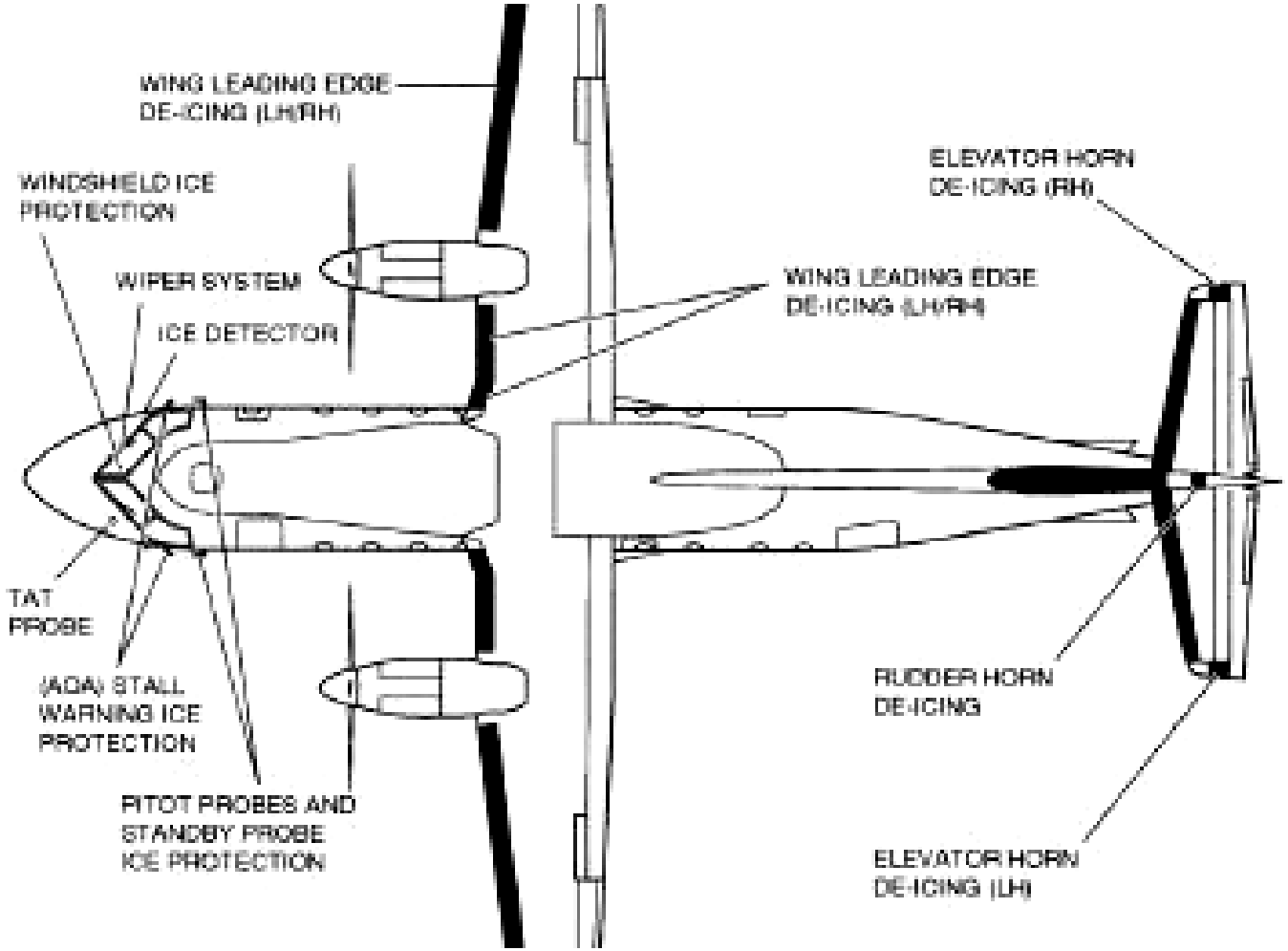
- Destroy lift
- Increase drag
- Increase weight and stall speed
- Air data collection affected if probes are blocked
- Propeller efficiency decreases
- Airflow into turbine engines disrupted

Ice Detection System

- Visual inspection by flight crew on windshield and leading edge of wings
- Vibrating probe – vibration frequency will decrease if there is ice formed
- Optical probe that measures thickness of ice



Location of Ice and Rain protection system



Anti-icing and De-icing

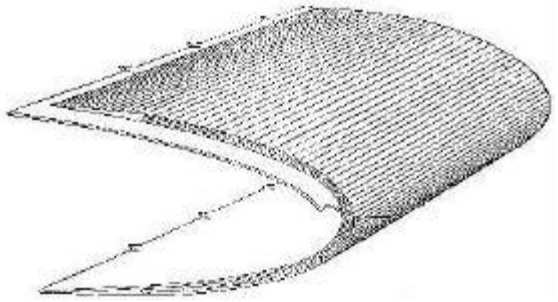
- Anti-icing system
  - Used to prevent ice from forming
  - Activated before ice has formed
- De-icing system
  - Used to remove ice after it has formed
  - Activated after ice has formed

Thermal Anti-icing Systems

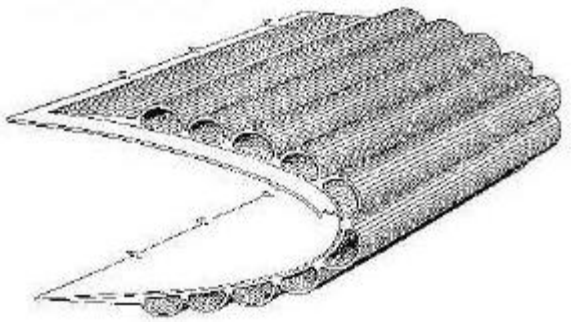
- Heats up aircraft components to prevent ice from forming
- Heat can come from
  - Engine bleed air
  - Electrical heating elements

Types of De-icing Systems

- Thermal system
  - Uses heat to melt ice
- Fluid system
  - Uses de-icing fluid to lower freezing point of water
- Pneumatic system
  - Uses air to expand rubber tubes (boots) that are mounted on aircraft surfaces



Deflated de-icing boot



Inflated de-icing boot

De-icing by inflating rubber boots

- Rubber boots are inflated by bleed air from engine or by electromagnetic power
- Advantages
  - Simple design, easy to maintain
  - Low energy consumption
- Disadvantages
  - Rubber boots are fragile

Windshield Ice and Rain protection

- Ice and rain cannot accumulate on windshield because pilot visibility must be guaranteed at all phases of flight
- Electrical heating or bleed air heating remove ice build-up.
- Wipers or air blast remove rain from the wind shield.

Carburettor Icing

- Ice may form in carburettor venturi even if outside air temperature is around 20°C
- Once ice is formed, airflow into engine will be restricted.
- Engine might stop in severe cases

Learning Objectives

- Discuss the effects of icing on the performance of aircrafts
- Describe the different types of icing conditions
- Explain how different types of anti-icing and de-icing systems work
- Identify parts of aircraft that are ice- and rain-protected