METEOROLOGY

Formation of Ice

Airframe Ice

01

Formation of Ice

Airframe ice occurs when supercooled water comes in contact with parts of the airframe that are colder than 0°C.

02

Supercooling

Supercooling is the process of lowering the temperature of a substance below its freezing point without it becoming a solid. This is possible if the liquid is not in contact with a surface (airframe) on which a crystal solid (ice) can form.

03

Amount of Supercooled Water

The severity of airframe icing is dependant on the supercooled water content within a cloud. The greater the liquid content, the more severe the icing will be. Because of their vertical currents, convective clouds contain larger water droplets than stratus type clouds and present a greater icing hazard.

04

Effect of Temperature on Icing Conditions

In convective clouds, the warmer the cloud base, the greater the amount of water that may condense, and therefore the more severe icing will be. By -40°C virtually all water will have frozen into ice crystals and the risk of airframe icing is reduced.

The Freezing Process

Impact of Supercooled Water

When a supercooled droplet of water impacts an airframe it begins to freeze. The freezing process releases latent heat of fusion and slightly warms the remainder of the droplet. The droplet will continue to freeze but now at a reduced rate.

Freezing on Initial Contact

The portion of the droplet that freezes on initial contact is a function of the aircraft skin temperature; the colder it is, the more the water will freeze.

Freezing After Initial Contact

The rate of freezing after impact depends on the airframe skin temperature and the ambient air temperature. The more closely these two approach 0°C, the slower the water will freeze as it spreads downstream from the point of initial contact.

Size and Frequency

If water droplets pile rapidly on on another prior to fully freezing, liquid water may spread further from the point of initial contact. If liquid droplets completely freeze prior to being hit by another droplet, the ice tends to be opaque, brittle and concentrated closely to the original point of impact

Effect of Icing on Aircraft

01	Loss of Lift	Ice will disrupt the smooth laminar air flow over wings causing a decrease in lift and increase in the stalling speed. It will also increase drag and weight.
02	Destructive Vibrations	Uneven shedding from propellers may cause destructive vibrations.
03	Restriction of Control Surfaces	Water can freeze around control surfaces and restrict their movement.
04	Loss of Radios	Antennas may freeze and shear off resulting in a loss of communication and navigation capability.
05	Restriction to Vision	Ice may cover the windscreen and restrict forward vision.