SESSION 7: WEATHER HAZARDS — ICING: TYPES, FORMATION, AND RISK ASSESSMENT

1. Structural icing requires which two conditions to be present simultaneously?

A. Stable air and a temperature inversion

B. High humidity and calm winds

C. Cumuliform clouds and turbulence

D. Visible moisture and temperatures at or below 0°C

2. Clear ice forms when an aircraft encounters:

A. Small supercooled droplets that freeze instantly on contact

B. Frost deposited from water vapor on a cold surface

C. Dry snow that adheres to the leading edges

D. Large supercooled droplets that spread before freezing

3. Rime ice is characterized by:

A. A rough, opaque, milky-white appearance from small droplets freezing on contact

B. A smooth, clear, dense layer that spreads aft of the leading edge

C. A combination of smooth and rough textures in unpredictable patterns

D. Crystalline deposits forming before the aircraft is airborne

4. The most intense structural icing typically occurs in which temperature band?

A. 0°C to +10°C

B. 0°C to -20°C

C. -20°C to -40°C

D. Below -40°C

5. Why is clear ice considered the most hazardous form of structural icing?

A. It is easily removed by de-icing boots

B. It is dense, adheres strongly, and severely disrupts the wing's aerodynamics

C. It forms only at very high altitudes above icing concern

D. It sublimates quickly without performance effect

6. Below approximately -40°C, structural icing is rare because:

A. Aircraft cannot fly at those temperatures

B. Clouds cannot form at such low temperatures

C. The air is too turbulent for droplets to adhere

D. Water droplets freeze spontaneously, leaving little supercooled liquid water

7. Freezing rain (FZRA) is particularly hazardous because the supercooled large droplets:

A. Freeze instantly with no aerodynamic effect

B. Are too small to accumulate meaningfully

C. Can flow aft of leading-edge protection onto unprotected surfaces

D. Only occur above the aircraft's service ceiling

8. Mixed ice forms when conditions:

A. Remain constant in a single droplet-size environment

B. Cycle between large and small droplet environments

C. Produce only frost on parked aircraft

D. Are above freezing throughout the cloud layer

9. The freezing level is defined as the altitude at which:

A. Clouds first become visible to the pilot

B. Precipitation transitions from rain to snow

C. The ambient temperature is 0°C

D. The aircraft enters instrument meteorological conditions

10. A relatively thin layer of clear ice on the wing can increase the stall speed by approximately:

A. Less than 5%

B. About 10% at most

C. 30% or more

D. It has no measurable effect on stall speed

11. Operating a non-FIKI aircraft in known icing conditions:

A. Is permitted if the pilot exits the icing within five minutes

B. Is allowed below 6,000 feet only

C. Is acceptable as long as pitot heat is activated

D. Is a regulatory violation under §91.9 and §91.13

12. The primary escape strategy when icing is encountered, terrain permitting, is to:

A. Descend to warmer air below the freezing level

B. Increase airspeed to shed the accumulating ice

C. Maintain altitude and wait for the icing to dissipate

D. Reduce power to slow the rate of accumulation

13. Stratiform cloud layers between 0°C and -20°C with significant vertical depth represent:

A. A negligible icing threat due to low liquid water content

B. The highest sustained icing threat for non-convective flight

C. An icing risk only for FIKI-certified aircraft

D. Conditions where only rime ice can form

14. Why is the pitot-blocked-with-sealed-drain failure especially associated with icing?

A. Icing only affects the static ports, never the pitot tube

B. Ice can seal both the pitot opening and the drain hole if pitot heat is off

C. Icing has no relationship to pitot-static failures

D. The pitot tube is immune to icing in all conditions

15. Supercooled water droplets are defined as:

A. Liquid water cooled below 0°C that has not yet frozen

B. Ice crystals that have begun to melt

C. Water vapor at temperatures above freezing

D. Frozen precipitation falling through warm air

16. Cumuliform clouds, compared to stratiform clouds, tend to produce icing that is:

A. More intense but shorter in duration

B. Less intense but longer in duration

C. Identical in intensity and duration

D. Limited to clear ice only

17. When neither descent below the freezing level nor climb above the cloud tops is viable, the appropriate icing response is:

A. Continue at the current altitude and monitor accumulation

B. Divert to an alternate route or airport

C. Increase the airspeed to maximum cruise

D. Lower the landing gear to disrupt the airflow

18. Anti-icing systems differ from de-icing systems in that anti-icing systems:

A. Remove ice only after it has accumulated to a minimum thickness

B. Prevent ice from forming in the first place

C. Function only on the propeller and intake

D. Are limited to turbine aircraft exclusively

19. Pneumatic de-icing boots should be activated:

A. Continuously before entering any visible moisture

B. Only after landing to clear residual ice

C. After ice has accumulated to the minimum effective thickness

D. Only when the windscreen begins to ice over

20. Why must pitot heat be activated before entering visible moisture near freezing, rather than after?

A. Pitot heat draws too much current to use preemptively

B. Activating it early causes erroneous airspeed readings

C. The pitot tube cannot ice over while the aircraft is moving

D. The indication of a blocked pitot means the blockage has already occurred

21. The rate of structural ice accumulation depends on which combination of factors?

A. Only the ambient temperature

B. Only the aircraft's airspeed

C. The wind direction and barometric pressure

D. Liquid water content, droplet size, airspeed, and surface temperature

22. A pilot encounters icing and notices the airspeed gradually decreasing at constant power and pitch. This most likely indicates:

A. Ice accumulation is degrading aircraft performance

B. The pitot tube has become completely blocked

C. The static port has frozen over

D. The altimeter setting is incorrect

23. TKS weeping wing systems prevent or remove ice by:

A. Dispensing a glycol-based fluid that lowers the freezing point on protected surfaces

B. Inflating rubber boots to crack accumulated ice

C. Heating the leading edges with engine bleed air

D. Vibrating the wing surface to shed ice mechanically

24. The decision to escape an icing encounter should be made:

A. Only after significant accumulation degrades climb performance

B. After consulting ATC for permission to deviate

C. Early and decisively, at the first recognition of icing

D. Only if the aircraft is FIKI certified

25. A pilot's icing decision-making should fundamentally begin during:

A. The climb to cruise altitude

B. The descent into the terminal area

C. Preflight planning, by evaluating icing AIRMETs, freezing levels, and PIREPs

D. The approach briefing at the destination

ANSWER KEY & EXPLANATIONS — SESSION 7

1. D. Moisture + ≤0°C — Structural icing requires visible moisture and temperatures at or below 0°C simultaneously.

2. D. Large droplets spread — Clear ice forms from large supercooled droplets that spread across the surface before freezing.

3. A. Rough/opaque/white — Rime ice has a rough, opaque, milky-white appearance from small droplets freezing on contact.

4. B. 0°C to -20°C — The most intense icing occurs between 0°C and -20°C, where supercooled liquid water is abundant.

5. B. Dense/adhesive/disruptive — Clear ice is dense, adheres strongly, and severely disrupts the wing's aerodynamic profile.

6. D. Spontaneous freezing — Below about -40°C, droplets freeze spontaneously, leaving little supercooled liquid water.

7. C. Flows aft of protection — Freezing rain's supercooled large droplets can flow aft of leading-edge protection onto unprotected surfaces.

8. B. Cycling droplet sizes — Mixed ice forms when conditions cycle between large and small droplet environments.

9. C. Temperature is 0°C — The freezing level is the altitude at which the ambient temperature is 0°C.

10. C. 30% or more — A thin layer of clear ice can increase stall speed by 30% or more.

11. D. Regulatory violation — Operating a non-FIKI aircraft in known icing violates §91.9 and §91.13.

12. A. Descend to warmer air — Descending below the freezing level (terrain permitting) is the primary escape strategy.

13. B. Highest sustained threat — Deep stratiform layers between 0°C and -20°C represent the highest sustained non-convective icing threat.

14. B. Ice seals both openings — Without pitot heat, ice can seal both the pitot opening and drain hole, producing the dangerous trapped-pressure failure.

15. A. Liquid below 0°C — Supercooled water droplets are liquid water cooled below 0°C that has not yet frozen.

16. A. Intense but brief — Cumuliform clouds produce more intense but shorter-duration icing than stratiform clouds.

17. B. Divert — When neither descent nor climb escape is viable, diversion to an alternate route or airport is appropriate.

18. B. Prevent formation — Anti-icing systems prevent ice from forming, unlike de-icing systems that remove ice after it forms.

19. C. After minimum thickness — Pneumatic boots are activated after ice reaches the minimum effective thickness; activating too early risks ice bridging.

20. D. Blockage already occurred — The indication of a blocked pitot means blockage has already happened; pitot heat must be preventive.

21. D. Multiple factors — Accumulation rate depends on liquid water content, droplet size, airspeed, and surface temperature.

22. A. Performance degradation — Gradual airspeed loss at constant power and pitch indicates ice accumulation degrading performance.

23. A. Glycol fluid — TKS weeping wing systems dispense glycol-based fluid that lowers the freezing point on protected surfaces.

24. C. Early and decisively — The escape decision must be made early and decisively at first recognition, before accumulation degrades performance.

25. C. Preflight planning — Icing decision-making begins in preflight planning by evaluating icing AIRMETs, freezing levels, and PIREPs.