Docket No. SA-533

Exhibit No. 13B

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

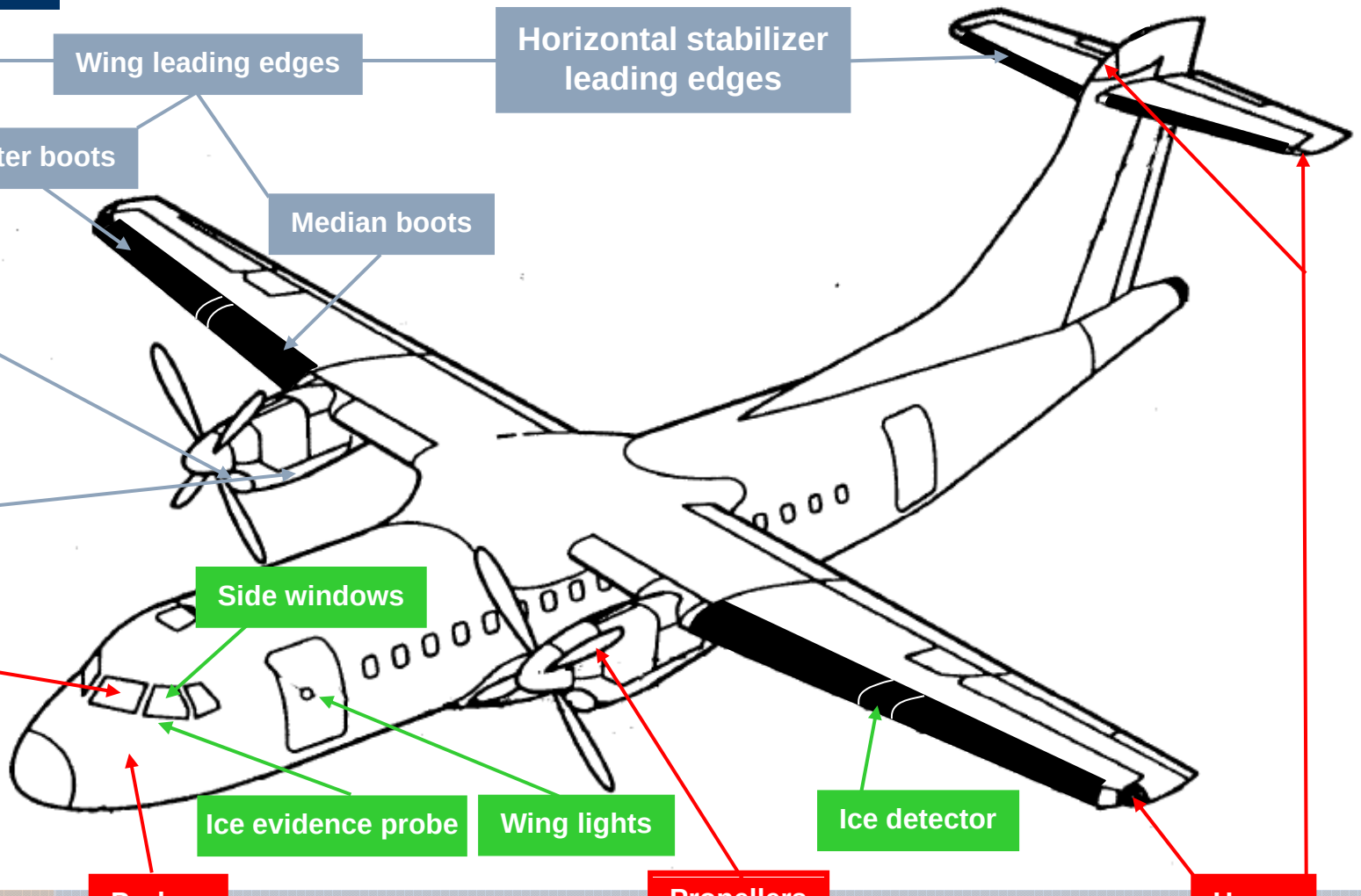
ATR Presentation – ATR-42 Icing Systems and Design Changes Since Roselawn

(17 Pages)

ATR42-320 Ice Protection Systems

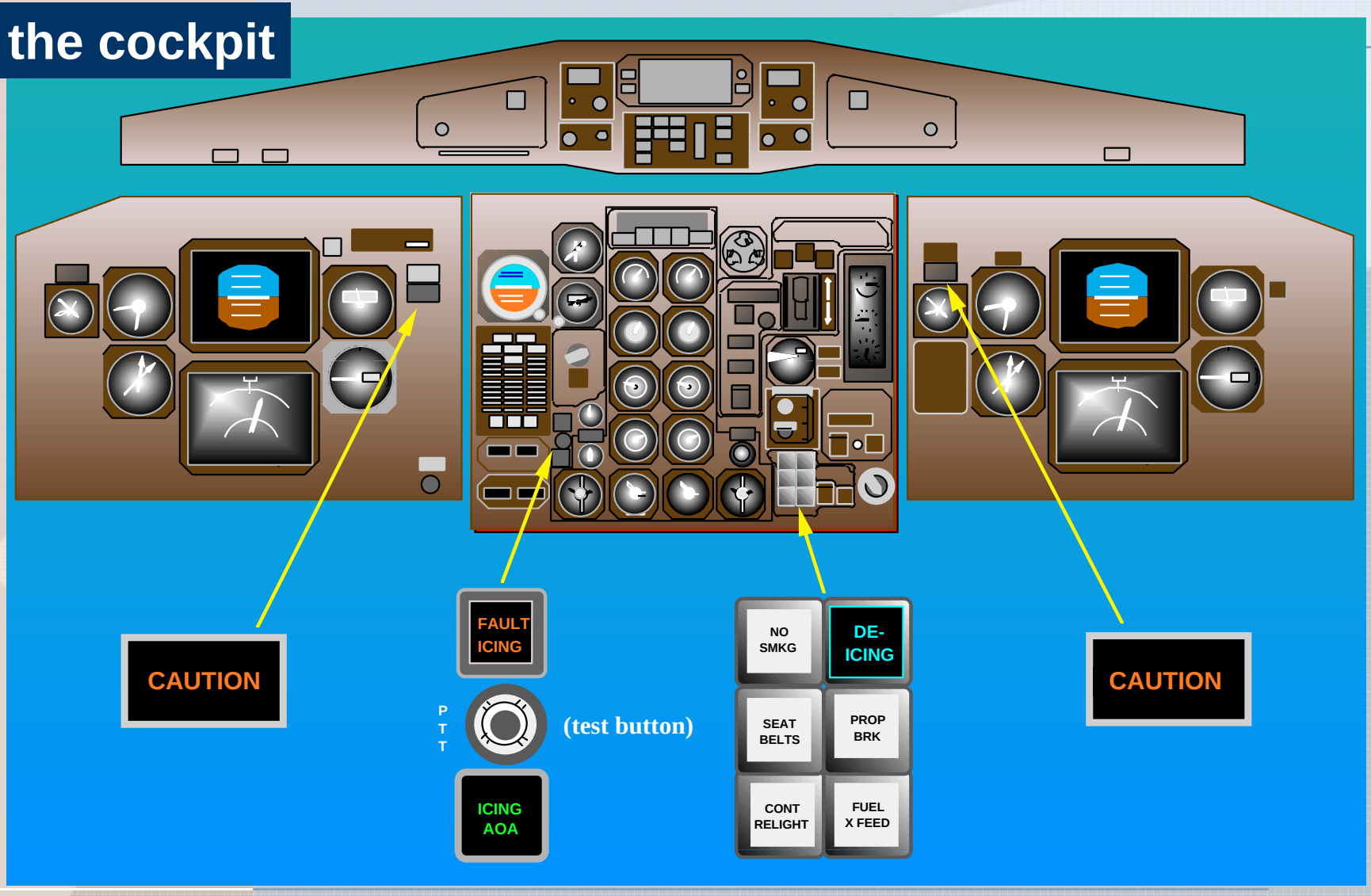
ATR42-320 Ice Protection Systems

System locations



ATR42-320 Ice Protection Systems

AAS in the cockpit



ATR42-320 Ice Protection Systems

Overall Certification

Main certification tasks (JAR25.1419 and appendix C)

- Icing wind tunnel test
- Ice shape computations
- Flight tests in dry air conditions with simulated ice shapes
- Flight tests under natural and measured icing conditions

To establish that operations in Appendix C icing conditions are safe

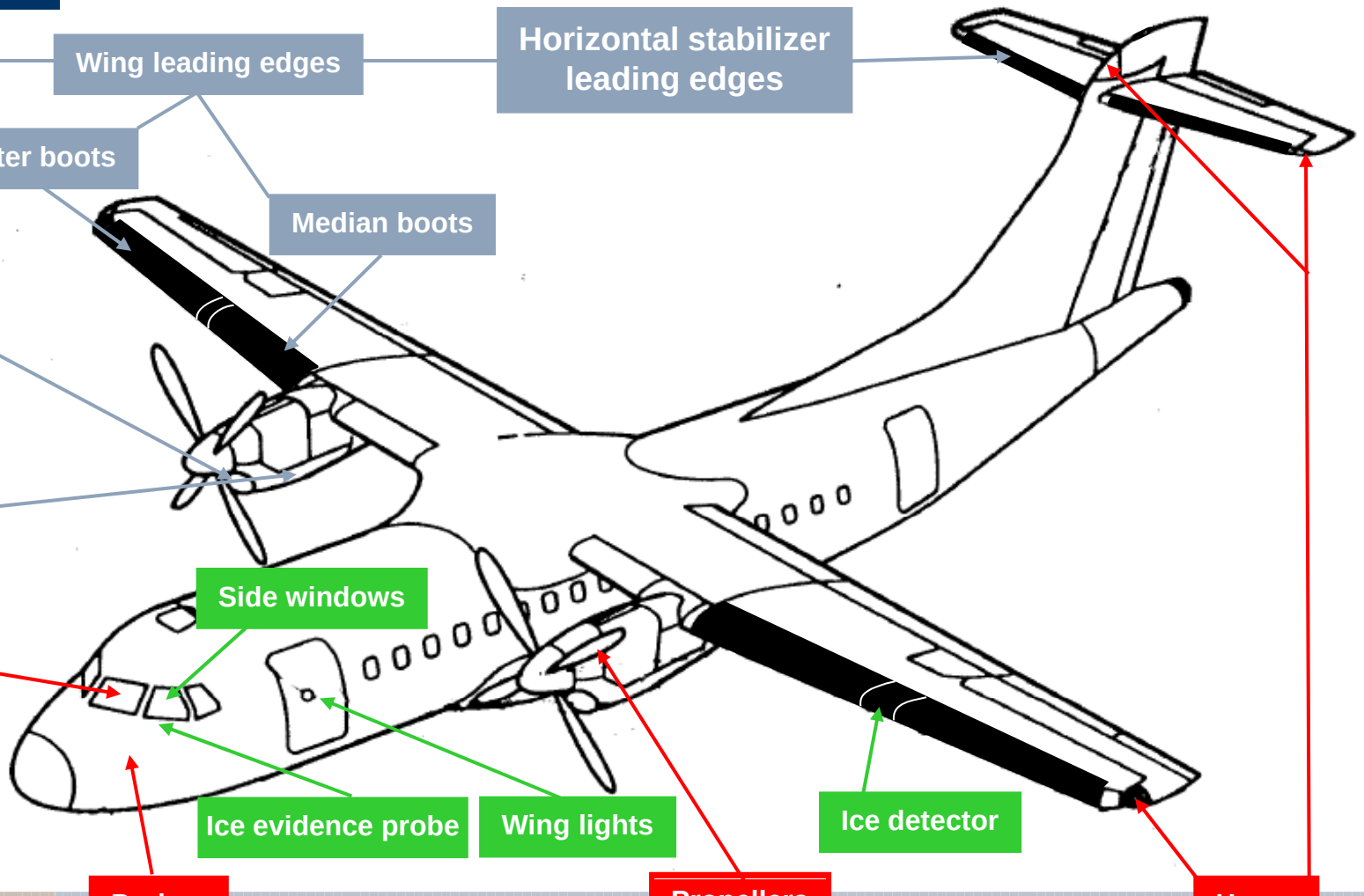
- Minimum speeds while in icing
- Stall protection (SW and SP)
- Procedures in ops documentation

Adequacy of ice protection systems

- Operating mode (cycles/SAT)

ATR42-320 Ice Protection Systems

System locations

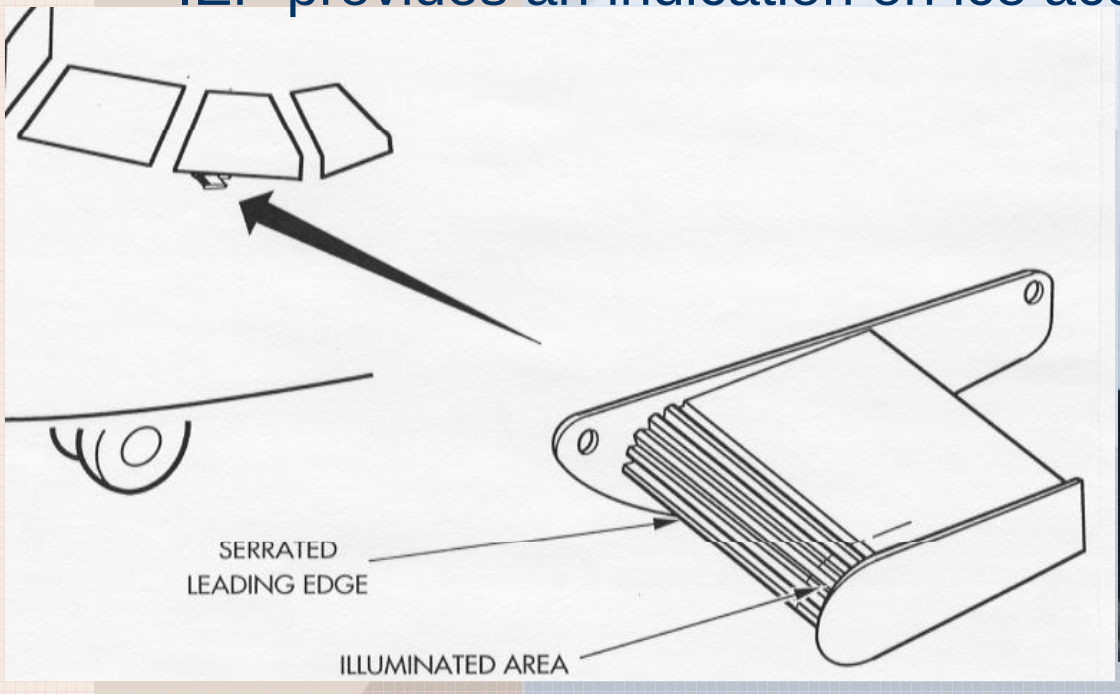


ATR42-320 Ice Protection Systems

Ice Evidence Probe: IEP

IEP visible by both pilots (propeller spinner if not installed)

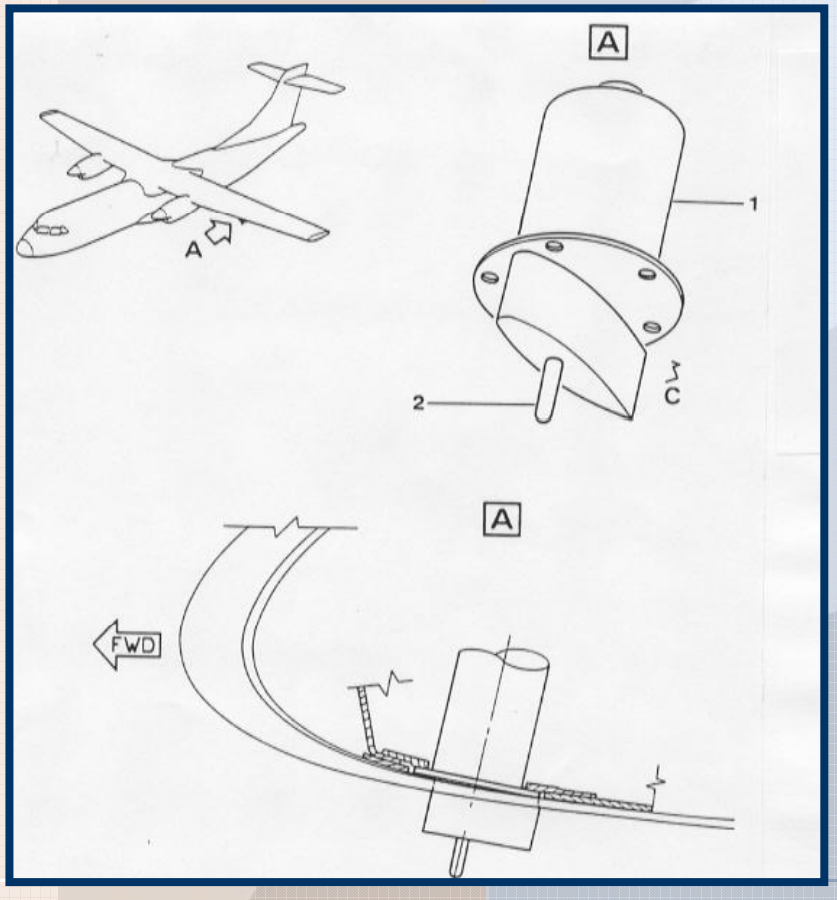
- When clean ⇒ critical surfaces are free of ice
- IEP provides an indication on ice accretion rate



ATR42-320 Ice Protection Systems

Ice Detector part of the Advisory Anti-icing System

Ice detector (BFG) ⇒ Icing signal (amber light + Single Chime)



ATR42-320 Ice Protection Systems

Design Evolutions since Roselawn Accident

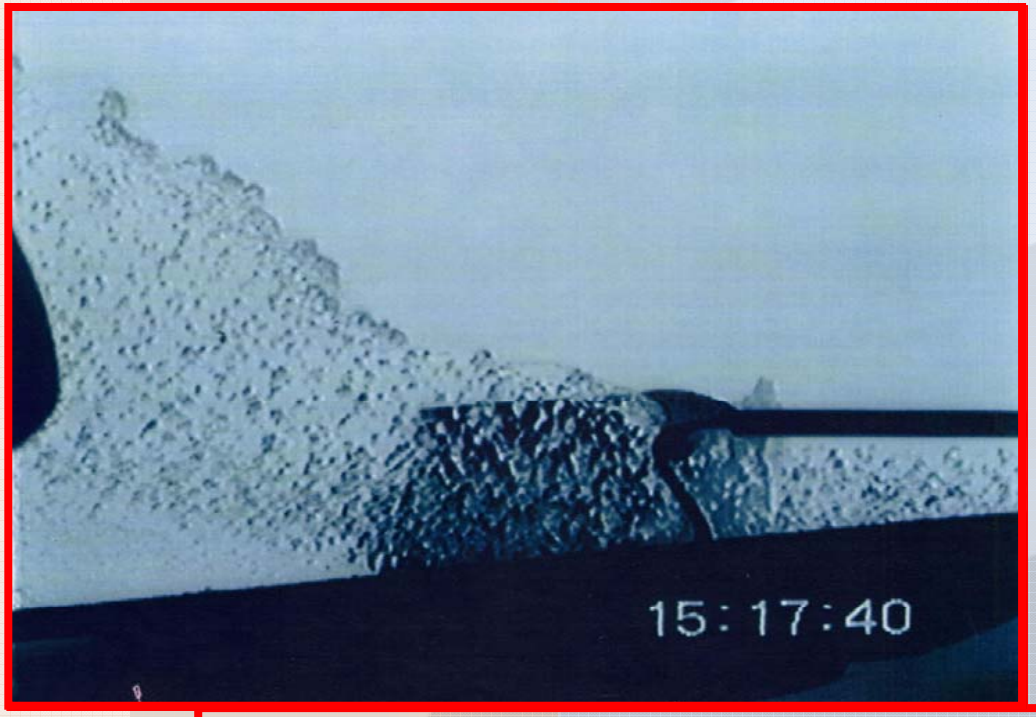
Intent: Address inadvertent Severe Icing encounter and improve crew awareness (1995)

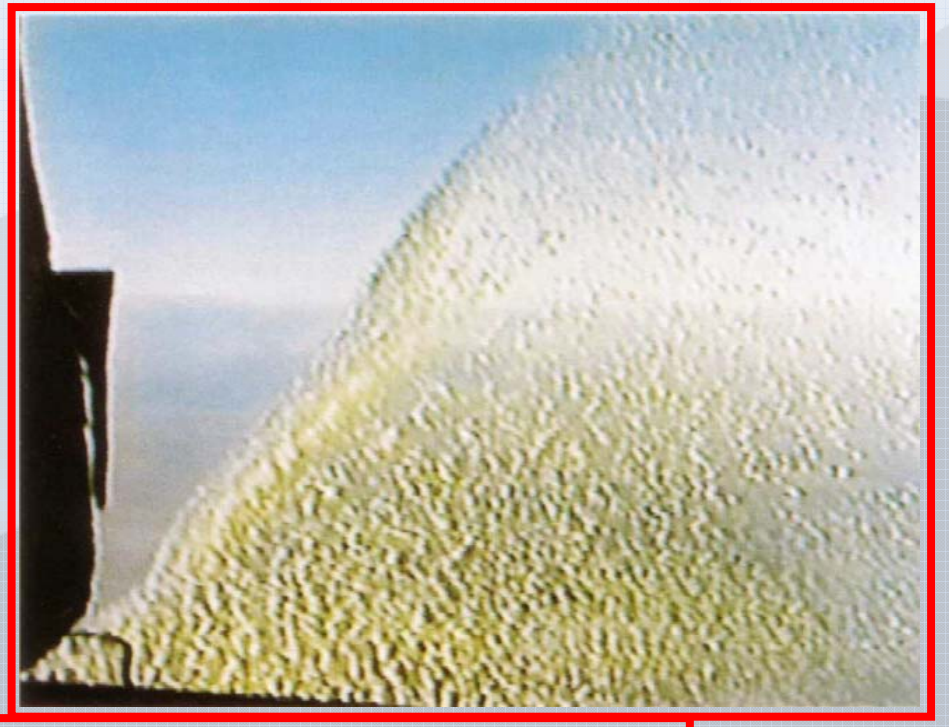
- **External wing boots extension up to 12.5% chord on upper surface**
  - **2 flight test campaigns at Edwards AFB behind a tanker**
  - **Flight test to find natural SLD icing conditions**
  - **Icing wind tunnel tests under SLD conditions**
- **Means to positively recognize SLD conditions: *Side window cues***
  - **Identified during the tanker tests**
  - **Validated during several flight test under natural SLD conditions**
  - **Further validated during FAA/RAA Unusual Icing Reports (Oct95 to Jan97)**
  - **Secondary means also provided**
- **Procedures to exit safely severe icing environment**
  - **Update of Limitation and Emergency Sections of the AFM**
- **Training materials for the flight crews**
  - **Update of the All Weather Operations brochure to include severe icing and SLD**
  - **Severe Icing Module added in the data packages for flight simulators**

ATR42-320 Ice Protection Systems

Severe Icing Cues

Side Window icing



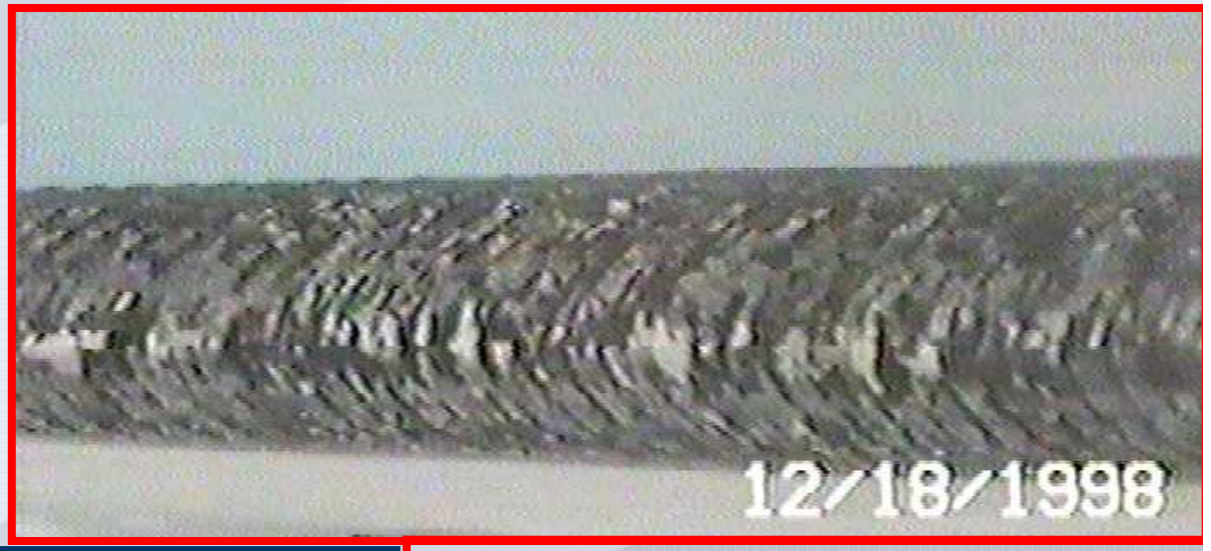


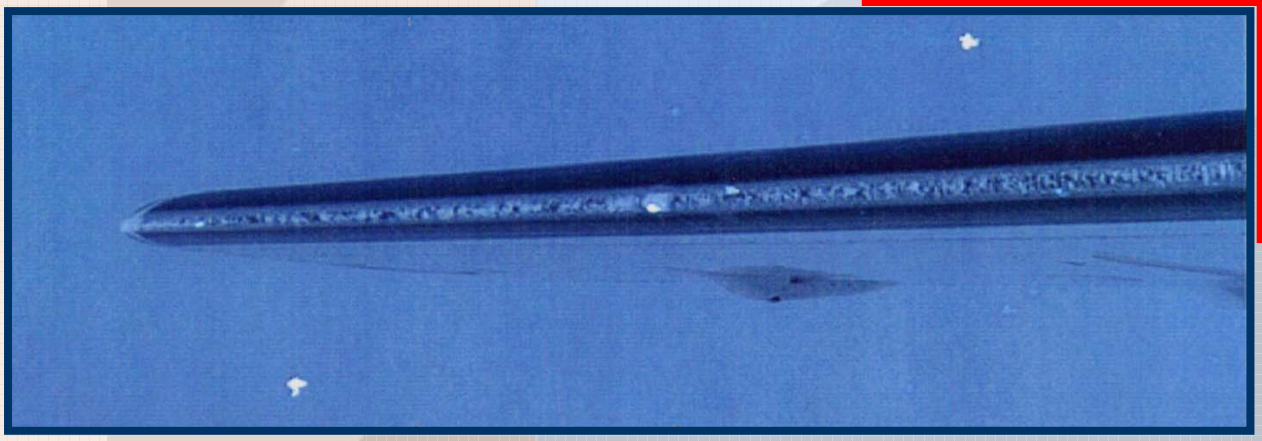
Partial or total coverage of the unheated part of side Windows

ATR42-320 Ice Protection Systems

Severe Icing Cues

Wing leading edge



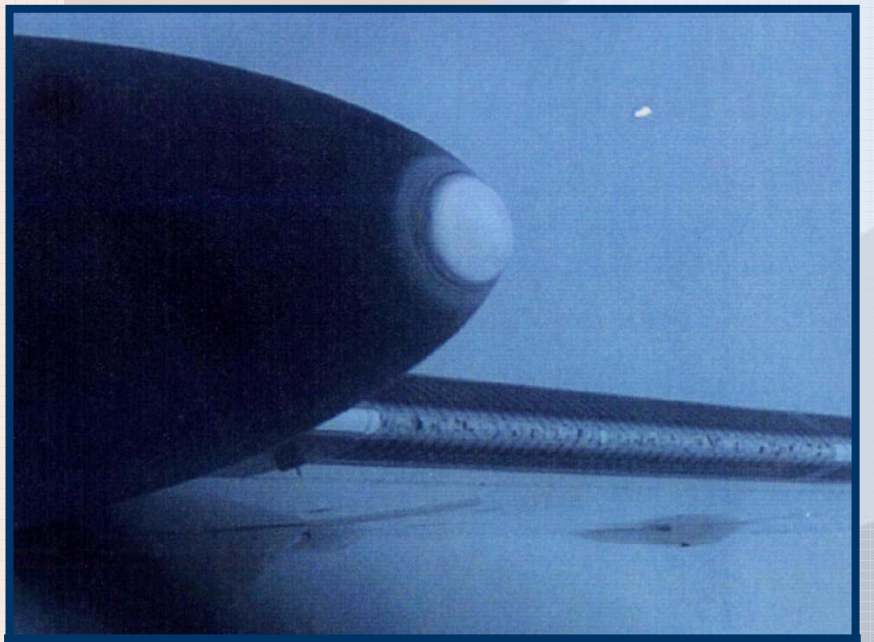


Residual ice on the whole chordwise extent of the boots

ATR42-320 Ice Protection Systems

Severe Icing Cues

Propeller spinner

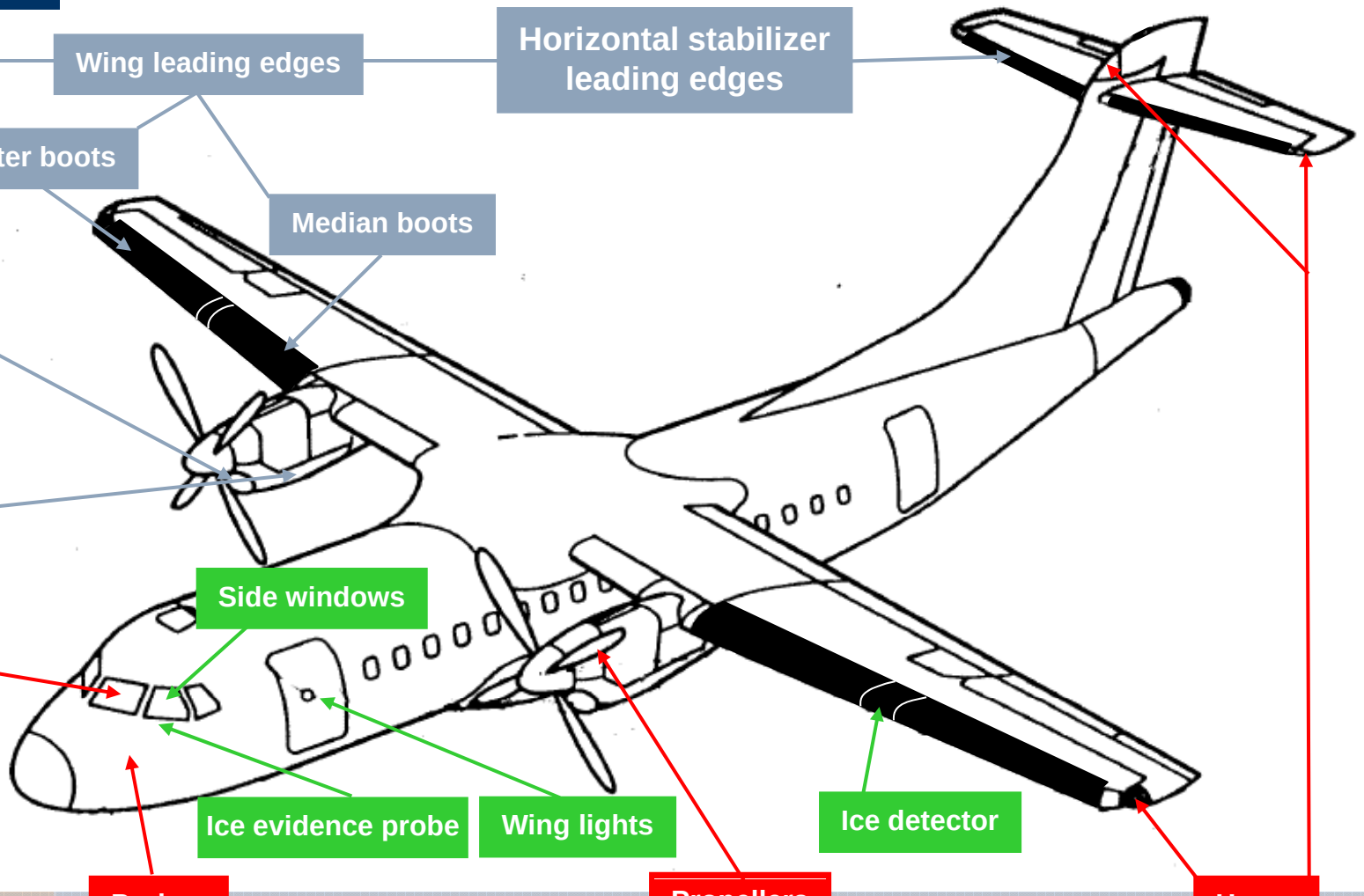


Appendix C ice accretion on the spinner

Ice accretion on the spinner under SLD's

ATR42-320 Ice Protection Systems

System locations



ATR42-320 Ice Protection Systems

Design Evolutions since Roselawn Accident

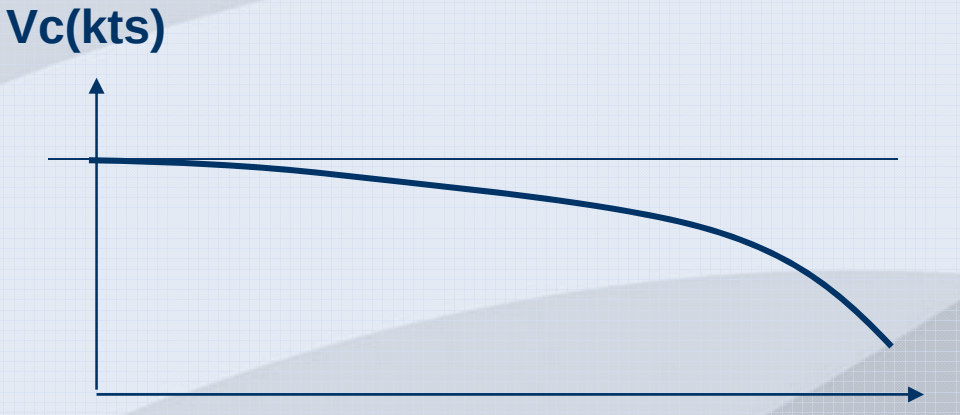
Intent: Prevent any handling anomaly to occur before the stall warning during inadvertent SLD encounters (1999)

- **Median wing boots extension up to 12.5% chord on upper surface**
  - **Flight and ground tests to check the boots inflation/deflation time**
- **Crew awareness enhancement**
  - **Icing light flashing when icing and level 3 not engaged**
- **Minimum speed defined for severe icing encounter**
  - **Minimum Severe Icing Speed (MSIS) = Minimum Icing Speed + 10kts**
  - **Emergency section of the AFM updated to account for MSIS**
- **Definition of Severe Icing Cues updated**
  - **Speed decay and Rate of Climb decrease also considered as means to identify severe icing encounters**
  - **Update of Limitation Sections of the AFM**

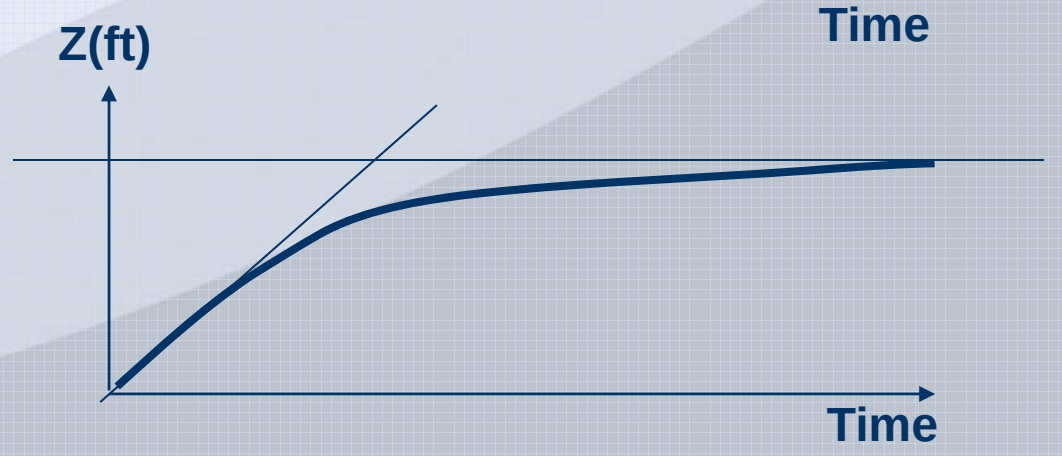
ATR42-320 Ice Protection Systems

Severe Icing Cues

- Speed decay in climb or level flight



- Rate of Climb decrease



- Attitude (pitch) increase in level flight
- Instability in roll

ATR42-320 Ice Protection Systems

Design Evolutions since Roselawn Accident

Intent: Compliance with FAA generic AD on de-icing boots operation (1999)

- **Update of the AFM normal procedure section**
  - **Activation of the wing ice protection as long as icing conditions exist.**
  - **Note: All ATR AFM already included activation of boots at first sign of ice accretion.**

ATR42-320 Ice Protection Systems

Proactive actions

- Crew awareness in icing
  - IEP kits distributed free of charge to all ATR42 operators (1995)
  - “Be Prepared for Icing” brochures and CD distributed FoC to all ATR customers upon request.
  - Icing updates provided to each ATR operators and Flight Ops conferences.
- Share our experience with worldwide working groups:
  - French Icing Committee (1995-1998)
  - FAA Icing Plan (1996-1998)
  - EURICE (European Union Research Project 1997-1998)
  - EUROCAE WG54 on Ice Detection Systems (1998-2000)
  - ARAC IPHWG (1998-2004)
- Flight testing of various SLD ice detection system technologies
  - Flush mounted piezoelectric sensor (1995)
  - Flush mounted ultrasonic sensor (1995)
  - Aerodynamic Performance Monitor (1996-1998)

ATR42-320 Ice Protection Systems

ATR and Severe Icing

- **Adequacy of design and procedures**
  - **Validated severe icing cues were present during all severe icing incidents experienced since Roselawn. Timely application of the procedures would have prevented these events from occurring.**
  - **Severe icing encounters were uneventful every time the flight crew applied the relevant Emergency Procedures of the AFM**

ATR aircraft can safely operate in icing conditions as long as the AFM limitations and procedures are followed.

- **Crew Awareness enhancement**
  - **Benefit from our Severe Icing knowledge : It is more appropriate to detect the effects rather than the conditions.**
  - **The Aircraft Performance Monitoring only provides ADVISORY signals but appeared to be a good decision-making aid for the flight crews**