THE EMB-120 BRASILIA IN SLD CONDITIONS & EMBRAER FLIGHT OPERATIONS SUPPORT FOR WINTER OPS

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October 2011

Background

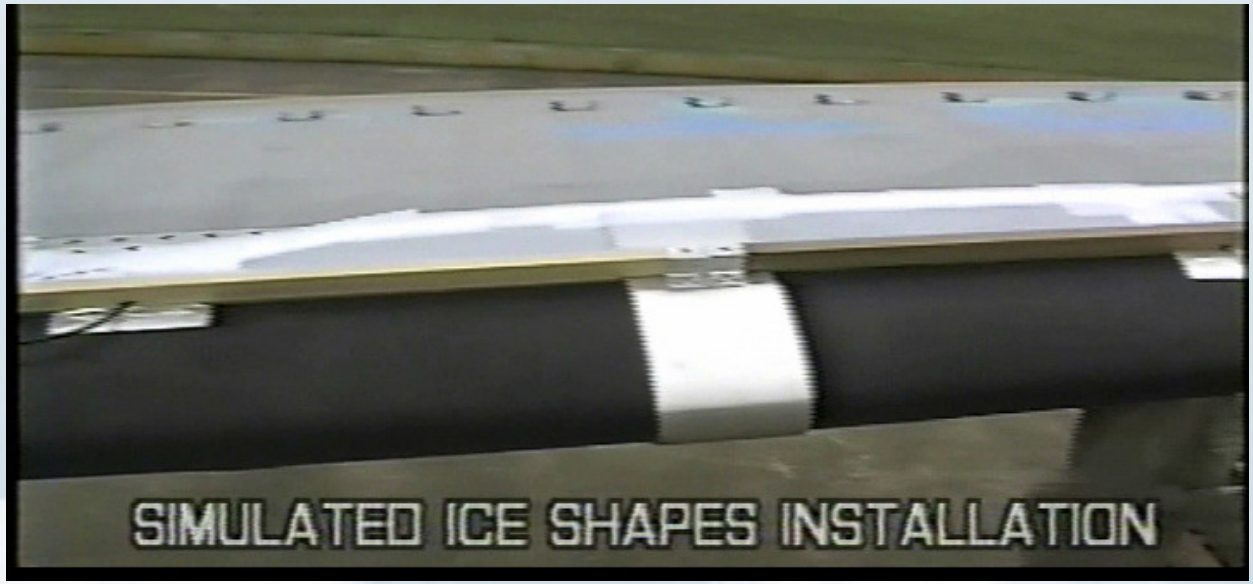
Background Information

- **ATR-72 accident at Roselawn**, in October 1994, which resulted in an in-flight loss of control and subsequent dive until collision with the ground.
- The weather at the time of the accident involved atmospheric conditions outside of the FAA part 25 Appendix C, and involved **freezing rain** and **freezing drizzle**.
- At that time, no aircraft was required to demonstrate the capability of flying in severe icing conditions (SLD).
- Ice is a surprising phenomena -> loss of a turboprop at Los Menucos (Argentina) on May 2011, possibly involving severe icing, stall and loss of control.
- Embraer was required by certification authorities to assess the roll characteristics of the EMB-120 in SLD conditions.

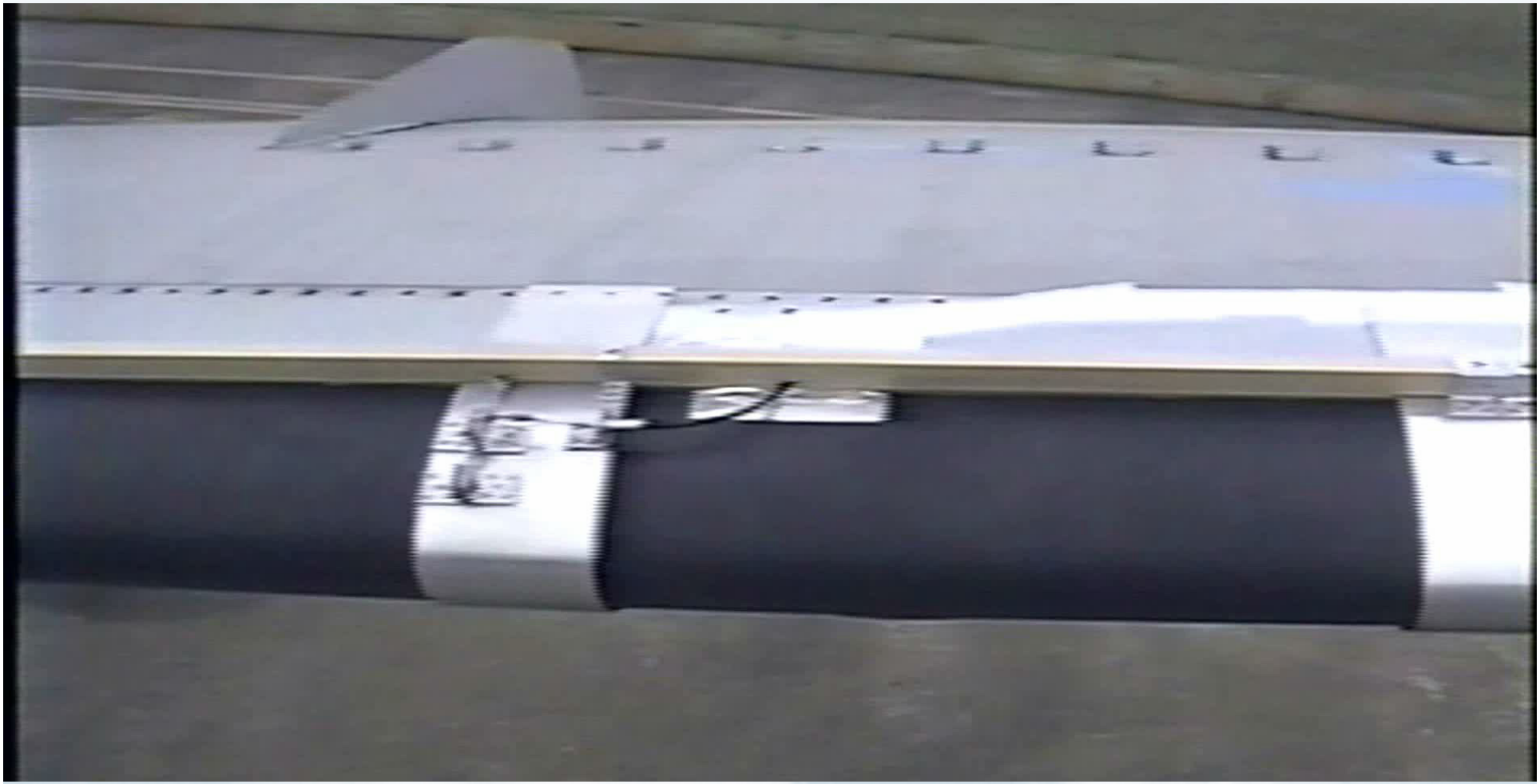
FLIGHT TEST PREPARATION

BEFORE CARRYING OUT FLIGHT TESTS

- Wind tunnel tests with artificial ice shapes to measure the effect on the aileron hinge moment.
- 1 and ½ inch have been evaluated for various aileron displacements.
- Hinge moment, loss of lift, drag increase, and rolling moments were introduced in the simulator model and flown.
- Results: after **successful** simulator flights, it was decided that a 1 and ½ inch wooden quarter molding should be positioned at the end of the last boot inflatable tube and proceed to real flights.



FLIGHT TEST PREPARATION



FLIGHT TEST WITH ARTIFICIAL ICE

TO TAKEOFF SAFELY (SAFETY FIRST, NO SECRET)

- High speed taxi and operation of the jettison device.
- Flight with a molding covering 1/3 of the aileron span, first ½ inch molding, then 1 inch molding on both wings.
- Flight with the molding covering 2/3 of the aileron span on both wings.
- Flight with the molding covering full aileron span length. Artificial ice shapes released asymmetrically in flight.

FLIGHT TEST RESULTS

- The aircraft was considered fully controllable.
- (Despite of) Simulated ice shape much more critical than a real SLD.
- (Despite of) Highly conservative test condition.

FLIGHT TEST WITH ARTIFICIAL ICE

ICING TANKER TESTS

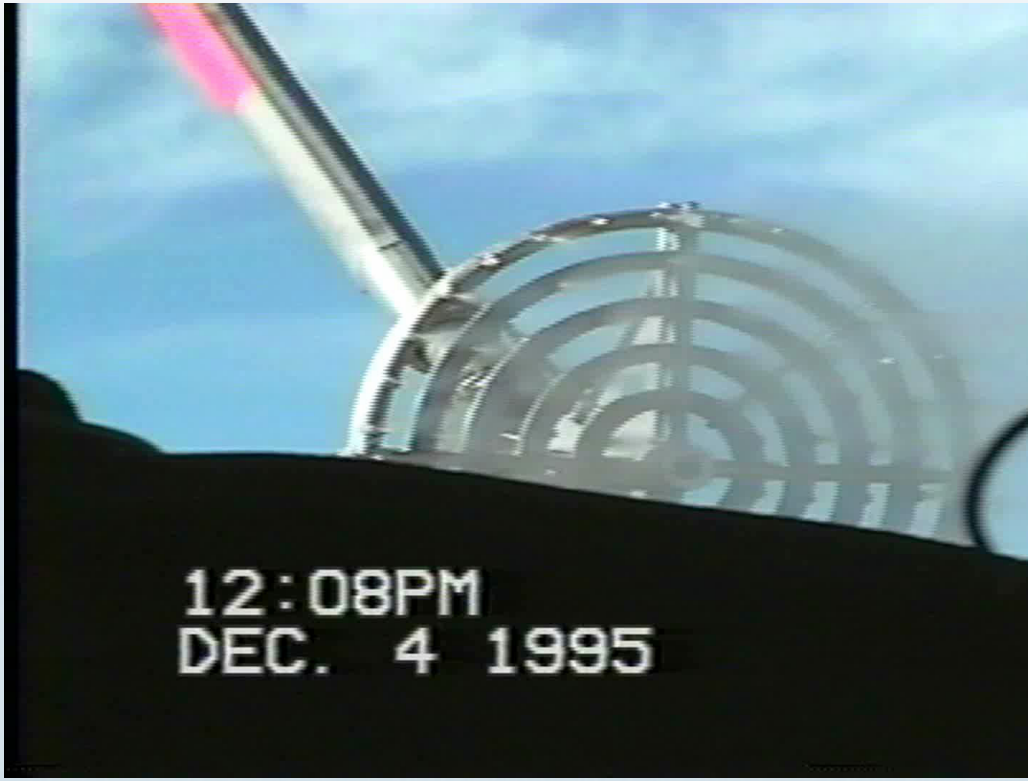
Purpose

- ...to determine the shape of the ice accumulated during freezing rain/freezing drizzle.
- ...to determine the visual cues to allow pilots to recognize when they are flying in SLD conditions.

ICING TANKER TESTS

The Icing Tanker and Chase Plane (cameras everywhere)

- A USAF KC-135 with boom-mounted water nozzle array.
- Capable of producing an icing “cloud” with the correct droplet size and water content.
- A Learjet was used as chase plane, with proper equipment to calibrate the water spray.



ICING TANKER TESTS

ICING TANKER TESTS

The Emb-120 Aircraft

- s/n 120.038, normal deicing boots with no surface treatment, very representative of the fleet.
- Total test time: 5,7 hours
- Airspeed: 160 and 175 kt
- Temperature: -1 < t < +5 deg C
- MVD: 40 **µ** and 170 **µ**
- LWC: 0,5 g/m^3 and 0,65 g/m^3

ICING TANKER TESTS

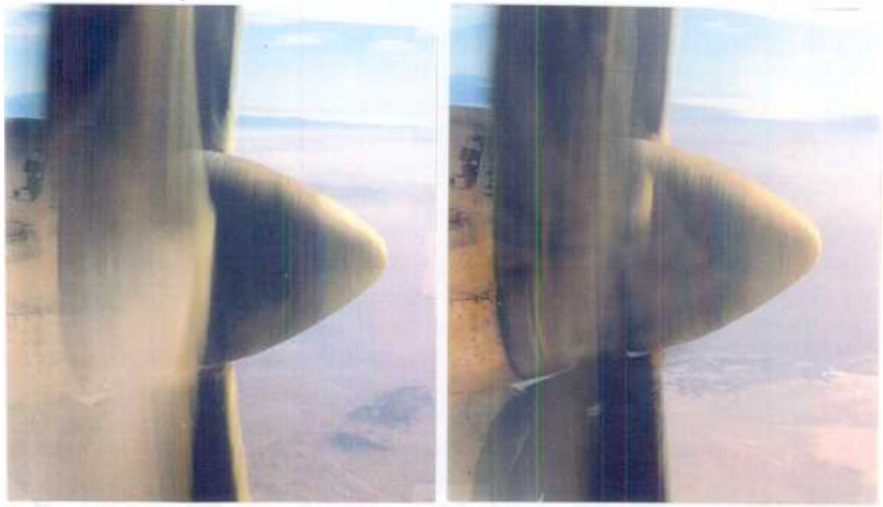
ICING TANKER TESTS

Flight Test Results

- Wing and engine air inlet boots, propeller, windshield and pitot-static tubes (elec anti-ice) exposed to SLD. All operated normally.
- Systems activated according to the AFM procedures.
- Flying qualities, handling and controllability remained unchanged.
- Ice indicator close to the pilot's side window is not effective.
- Ice on the windshield and propeller blades did not reveal any SLD cue.
- SLD ice on the wing and spinner revealed different accumulation patterns from normal icing, and were declared AFM appropriate visual cues.

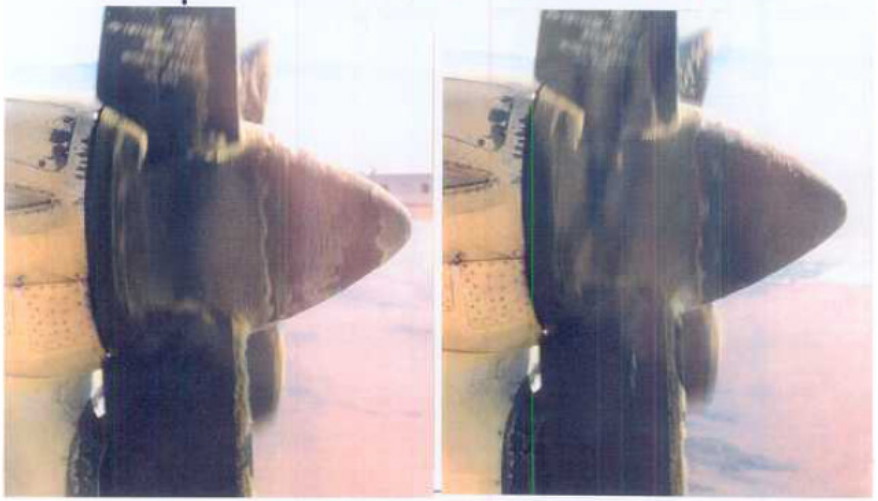
ICING TANKER TESTS

40 μ SPRAY ON THE SPINNER



Normal ice spray on the spinner shows ice accumulation concentrated on forward half.

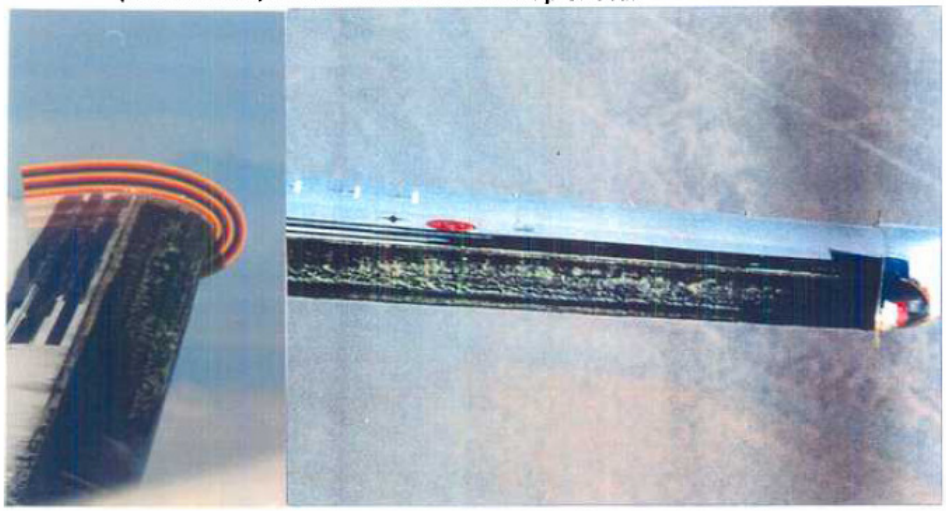
170 μ SPRAY ON THE SPINNER



ICING TANKER TESTS

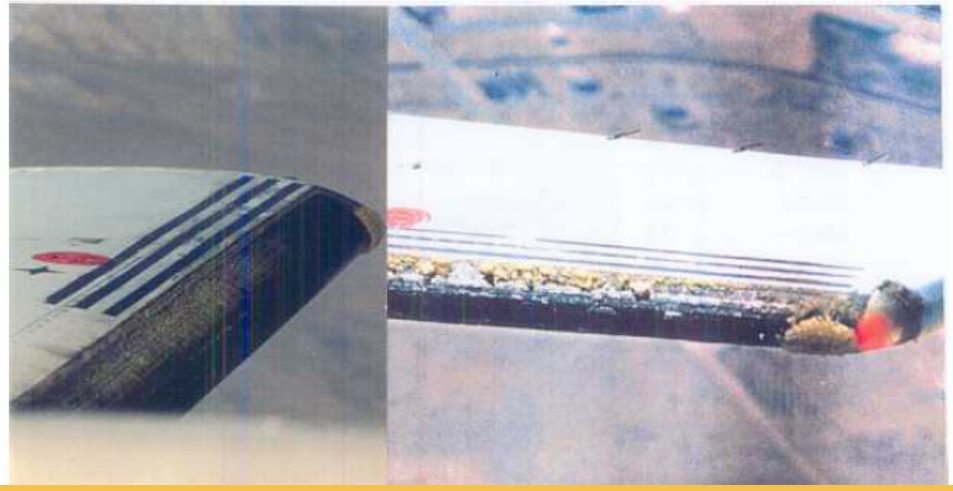
40 μ SPRAY ON THE WING

These photos show normal icing in which ice begins forming on the protected area, where the inflation tubes are provided.



170 μ SPRAY ON THE WING

SLD ice spray on the wing shows ice accumulating on the de-icer aft of the last inflatable rib.



ICING TANKER TESTS

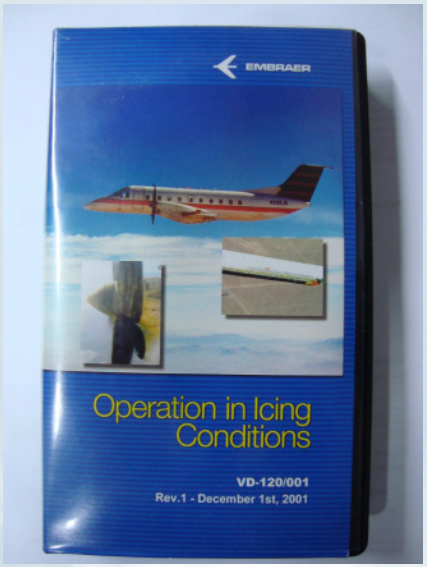
ICING TANKER TESTS

PROCEDURES RESULTING FROM THE TESTS OR REQUIRED BY CERTIFICATION

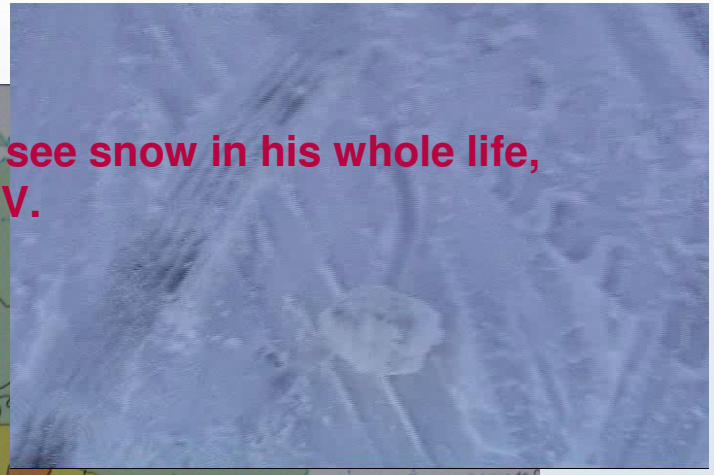
- Turn boots immediately after recognizing icing conditions
- Turn AP off in icing (later authorized if installing the low speed alarm)
- AP off when flying SLD conditions
- Specific information regarding AP disengage, flaps operation, speeds to use etc
- Extensive revision to the AFM and issue of a special OPERATIONAL BULLETIN
- * Distribution of a dedicated video covering all aspects regarding winter ops (Embraer Flt Ops initiative)!

ADDITIONAL AIRCRAFT MODIFICATIONS:

- Installation of the LOW SPEED ALARM for icing conditions (IAS < 160 kt)
- Installation of the ice detection system.
- Operation with only the fastest boot inflation cycle
- ... no boots size change



HOW DOES EMBRAER FLT OPS SUPPORT ICE?



99.9% of the native Brazilians will never see snow in his whole life, except on the TV.

WHERE ARE YOU LIKELY TO FIND "GOOD" ICE IN BRAZIL?

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

1. EARLY INVOLVEMENT
2. GLOBAL AWARENESS
3. CONTINUOUS CARE WITH ALL FLEETS
4. KEEP FLYING
5. SHARE KNOWLEDGE

Embraer 145 Type II application at Kemi, Finland

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

EARLY INVOLVEMENT

- Presentations to design engineers of ice-related lessons-learned
- Specific inputs during new aircraft development and follow-up of system design
- Test proposal discussion
- Fight/ground tests personnel participation: cold soak (Eglin – Alaska – Russia), in-flight real icing tests
- Sharing of flight/ground test results.

Embraer 190 at Fairbanks, Alaska

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

GLOBAL AWARENESS

- PARTICIPATION IN SAE G-12
  - 2 engineers continuous follow-up
- WINTER OPS CONGRESSES – CANADA, EUROPE, USA
  - 6 + engineers at the last Chicago Congress
- SAFETY ISSUES: Keep tracking of ice-related incidents and accident reports.
- PUBLICATIONS (FAA, EASA, TCAG, AEA, SAE): ARPs, SAFOs, ACs, ADs, SIBs, _____, _____,_____ etc

Embraer 145 at Boston, USA

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

CONTINUOUS CARE OF ALL FLEETS

- How does a new issue affect ALL Embraer aircraft?
- How is the fleet performing with regard to new technologies?
- How is the current airframe performing with regard to existing technologies?
- What can be done to solve a new issue? Will the airlines get it?

Phenom 300 at Duluth, MN - USA

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

KEEP FLYING

- Continuous contact with flight crews.
- Continuous research in Airline Flight Standards.
- Go to ice, wherever it is.

Embraer 190 landing in Alaska - USA

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

SHARE KNOWLEDGE/EXPERIENCE

- FOR AFM/CERTIFICATION PURPOSES
- FOR STANDARD PROCEDURES AND OPERATIONS MANUAIS
- FOR MAINTENANCE PROCEDURES
- FOR CONSISTENCY OF INFORMATION BETWEEN EMBRAER INTERNAL AREAS
- FOR DESIGN SUPPORT
- FOR SAFETY PURPOSES
- FOR PRODUCING SPECIFIC TRAINING MATERIAL

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

EMBRAER

Operational Videos EMB 120

Operational Video Download

EMB 120

VD 120001
Operation In Icing Conditions
- **Part 1** [23900 kb]
- **Part 2** [21100 kb]
- **Part 3** [30200 kb]
- **Part 4** [29200 kb]

VD 120003 - EMB-120
Upset Recovery
- **Part 1** [23900 kb]
- **Part 2** [21100 kb]
- **Part 3** [30200 kb]
- **Part 4** [29200 kb]

VD 120004 - EMB-120
Recuperação de Upset
- **Part 1** [27500 kb]
- **Part 2** [20800 kb]
- **Part 3** [19100 kb]
- **Part 4** [20300 kb]

VD 120005 - EMB-120
Evacuações de Emergência
- **Part 1** [25600 kb]
- **Part 2** [21000 kb]
- **Part 3** [18600 kb]
- **Part 4** [27300 kb]

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

Operational Videos

Operational Video Download

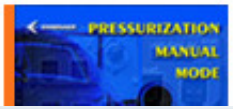
ERJ 145

OV 145001 (MAY/2001)
New Gust Lock System
Download [7420 kb](00:03:23)

VD 145001 (MAY/2001)
Jet Transition
Part 1 [17700 kb](00:10:01)
Part 2 [14700 kb](00:09:17)
Part 3 [16500 kb](00:09:44)
Part 4 [16100 kb](00:09:31)
Part 5 [10500 kb](00:07:14)

OV 145002 (JAN/2001)
Pitch Trim Operation
Download [17100 kb](00:07:09)

VD 145002 (OCT/2001)
Regional Jets Operation In Icing Conditions
Part 1 [19300 kb](00:11:32)
Part 2 [20600 kb](00:11:16)
Part 3 [15600 kb](00:08:24)
Part 4 [12300 kb](00:06:35)
Part 5 [24200 kb](00:12:45)



OV 145003 (NOV/2001)
Pressurization Manual Mode
Download [21100 kb](00:11:16)

VD 145003 (MAY/2002)
Head-up Guidance System
Part 1 [18100 kb](00:09:38)

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

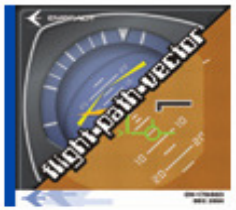
Operational Videos EMBRAER 170/175/190/195

Operational Video Download

EMBRAER 170/175/190/195

OV 170001 - REV 1 (OCT/2005)
EMBRAER 170 Operation In Icing Conditions
- **Part 1** [23900 kb](00:13:14)
- **Part 2** [21100 kb](00:16:23)
- **Part 3** [30200 kb](00:16:09)

OV 170002 - REV1 (AUG/2006)
EMBRAER 170 / 190 Upset Recovery
- **Part 1** [20452 kb](00:10:25)
- **Part 2** [49146 kb](00:15:41)
- **Part 3** [31789 kb](00:12:53)



OV 170003 (DEC/2004)
Fligh Path Vector
- **Part 1** [18900 kb](00:10:06)
- **Part 2** [24700 kb](00:12:03)

OV 170004 - REV 1 (JUN/2005)
Vertical Navigation VNAV
- **Part 1** [20700 kb](00:11:44)
- **Part 2** [19700 kb](00:11:50)
- **Part 3** [20800 kb](00:11:47)

OV 170005 - REV 1 (MAR/2009)
EMBRAER 170 / 190 Power Up and Power Down Procedures
- **Download** [15297 kb](00:07:34)

OV 170006 - REV 2 (MAR/2009)
EMBRAER 170 / 190 Doors Operation
- **Download** [30375 kb](00:14:36)

HOW DOES EMBRAER FLT OPS SUPPORT ICE?

Operational Video Download

Phenom 100/300

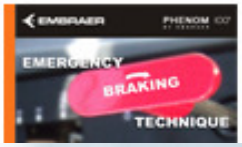
OV-500/001
Single Pilot Operation
- **Part 1** [153792 kb]
- **Part 2** [251464 kb]

OV-500/002
Adverse Weather Operation
- **Part 1** [15345 kb]
- **Part 2** [35495 kb]

OV-500/003
Fluid Application
- **Part 1** [10820 kb]
- **Part 2** [4513 kb]
- **Part 3** [6090 kb]
- **Part 4** [6991 kb]
- **Part 5** [5404 kb]
- **Part 6** [4016 kb]

OV-500/004
Jet Transition
- **Part 1** [47814 kb]
- **Part 2** [37188 kb]

OV-500005
Runway Overrun Prevention
- **Part 1** [15031 kb](00:04:58)
- **Part 2** [15426 kb](00:04:25)



OV-500/006
Emergency Braking Technique
- **Part 1** [37730 kb](00:05:26)
- **Part 2** [18498 kb](00:02:29)

THANK YOU

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