
Subject: Updated 757 Ice Crystal Icing Operation

Note: This FB supersedes FB 15-06: 757 Ice Crystal Icing Operation, and contains revised operation procedures.

Introduction

Delta, Boeing, and Pratt & Whitney recently concluded discussions aimed at simplifying pilot procedures and expanding Ice Crystal Icing (ICI) worldwide operations for Delta's 757 fleet. The result was to eliminate the use of selecting engine start selectors to FLT and utilize engine anti-ice (A/I). Current engine A/I operating procedures allow an exception during climb and cruise below -40°C. Boeing has removed the exception and now requires engine A/I to be selected ON for all operations in visible moisture and TAT is +10°C or below.

Use of engine anti-ice will:

- Ensure continuous igniter operation for potential ICI conditions,
- Improve engine stall margin, and
- Simplify worldwide ICI procedures.

757 Operating Procedures

Operate engine A/I ON when in visible moisture and TAT is +10°C or below. No exceptions.

CAUTION: Awareness of entering an area of IMC at night requires careful monitoring of external meteorological conditions. Forward facing landing lights can be used to assist pilots in determining IMC conditions and should be used to verify in-flight cloud conditions. If any doubt exists, operate with engine A/I ON if TAT is +10°C or below.

Suspected Ice Crystal Icing

Exit the ice crystal icing conditions. Request a route change to minimize the time above red and amber radar returns.

Accomplish the Ice Crystal Icing checklist, QRH, NNC.3.

Background

The following is a synopsis of information concerning ICI that will be incorporated in applicable publications during the next revision cycle:

- Description of the problem.
- Recommendations on how to avoid potential ICI conditions.
- Importance of preflight planning and in-flight situational awareness.
- Key indicators of ICI.
- Utilization of High Ice Water Content (HIWC) mapping for preflight planning and in-flight adjustments to avoid potential ICI conditions.
- Accomplishment of the QRH ICI NNC when actual ICI conditions are encountered.

Delta has instituted the following company initiatives:

- Meteorology has incorporated the Boeing HIWC mapping product into Delta's Turbulence Management System to help forecasters develop special thunderstorm TPs that highlight ICI risk, for use by dispatchers and pilots.
- MDM engine igniter MELs now incorporate changes to ensure that only a single igniter may be inoperative on any 757 operating in areas of TRWs or hazardous weather conditions.
- TechOps has refreshed the igniters on the entire Pacific 757 ETOPS fleet and has developed an igniter replacement program to ensure igniter reliability. Igniter failure will be tracked to validate the new replacement cycle.

Ice Crystal Icing (ICI)

Particular attention should be exercised when operating in areas with very warm tropical conditions. At Delta, 83% of ICI incidents have occurred in Pacific theater beach markets.

At temperatures below freezing, near convective weather, the airplane can encounter visible moisture made up of high concentrations of small ice crystals. Ice crystals can accumulate aft of the engine fan, in the engine core. Ice shedding can cause engine vibration, power loss, and damage.

PW2000 series engines have experienced several flame out events resulting from ice accumulation in the low pressure compressor. Ice crystal icing is difficult to detect because ice crystals do not cause significant weather radar returns. They are often found in high concentrations above and near regions of heavy precipitation. Ice crystals do not stick to cold aircraft surfaces.

Avoid ICI conditions. Flight in clouds containing high concentrations of ice crystals has been associated with engine vibration, power loss, and damage.

Because these conditions can be difficult to recognize, careful preflight planning is a key component of in-flight situational awareness. When ICI is encountered or suspected, accomplish the Ice Crystal Icing checklist, QRH, NNC.3 to mitigate the effect on the flight.

Areas with a higher risk of HIWC are identified and mapped by Boeing. In these areas, ICI should be suspected while operating in IMC. Use of this type of HIWC information is recommended for preflight planning and in-flight adjustments.

Meteorology has incorporated the Boeing HIWC mapping product into Delta's Turbulence Management System to help forecasters develop special ICI TPs for use by dispatchers and pilots. This improves Delta's ability to identify potential areas of ICI and enhances pilot situational awareness.

Review all TPs listed on the flight plan and note any with a remark indicating potential ICI. If desired, the approximate location of these areas may be added to the Howgozit section of the flight plan. This will enhance crew awareness, particularly during night operations.

If time permits, pilots may also reference the Upper Air Weather Depiction chart located on the Meteorology web page to locate areas of forecasted convective activity. These areas may develop during flight generating a thunderstorm TP with an ICI remark. TPs issued after departure will be uplinked to the aircraft. Review all uplinked TPs carefully and note any with an ICI remark. The graphic below is a TP reporting current thunderstorm activity and ICI risk.

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TP AI25 231450Z
1. IW OA
2. * ALERT *
HAZ : TSTMS
SOURCE : SATELLITE
AREA : 22N132E 24N138E
      21N140E 21N135E
CVRG : SCT
TOPS : FL450
TREND : NC
MVG FROM : CELLS 27012
INFO : RISK ICE CRYSTAL
ICING-B757 ACTION
RQRD
3. VALID 231450Z/231750Z
4. CANCEL AI21
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Recognizing Ice Crystal Icing

Ice crystals are most frequently found in areas of visible moisture and above altitudes normally associated with icing conditions. Their presence can be indicated by one or more of the following:

- Appearance of rain on the windshield at temperatures too cold for liquid water to exist. This is due to ice crystals melting on the heated windows (sounds different than rain).
- Areas of light to moderate turbulence.
- In IMC with:
 - No significant airframe icing, and
 - No significant radar returns at airplane altitude, and
 - Heavy precipitation below the airplane, identified by amber and red radar returns on weather radar.
- Cloud tops above typical cruise levels (above the tropopause).
- Smell of ozone or sulfur.
- Humidity increase.
- Static discharge around the windshield (St. Elmo's fire).

602-690, 692-699, 6700-6717 (Ice Detection System Installed)

Note: The ice detection system does not detect ice crystal icing. It is designed to detect supercooled water only.

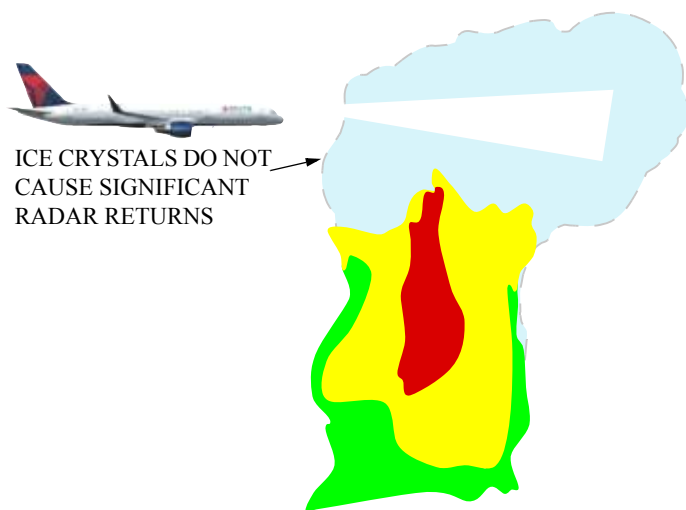
Avoiding Ice Crystal Icing

During flight in IMC, avoid flying directly over significant amber or red radar returns, even if there are no returns at airplane altitude.

Ice Crystal Icing areas do not cause significant radar returns.

Note: Additional down tilt is necessary to avoid flying over heavy convective activity below the flight path.

The graphic below illustrates that radar is ineffective for display of ice crystals.



For operations at or above 30,000 feet pressure altitude, when approaching convective activity, in IMC or visual moisture:

- Operate radar with gain in maximum and set tilt between -1 and -3.

If areas of green, amber, or red radar returns are observed along the flight path:

- Vary the tilt between -3 and -5 degrees to determine if amber or red returns are present below the airplane's flight path.
- Avoid flying over areas of amber or red radar returns that are displayed below the airplane's flight path.

Refer to weather radar operating instructions for additional information.

Summary

By providing relight capability, use of engine A/I has proven to be an effective counter measure for in-flight engine failure as a result of ICI. Of the in-flight shutdown ICI events experienced at Delta, two events occurred with engine A/I ON. In both cases, the engines relit and were operated throughout the remainder of the flight. Delta will continue to track these events. If an in-flight engine surge occurs, a detailed write-up in the aircraft logbook must be accomplished. If ICI is the suspected cause of the surge, it should be noted in the logbook write-up. This will document the event and assist maintenance with troubleshooting.

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