

Ground Ops in Icing Conditions ...an Engine Perspective



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Agenda

- Introduction
- The Preflight
- Ground Ice Shed Procedure
- Other Considerations
- Summary

Introduction

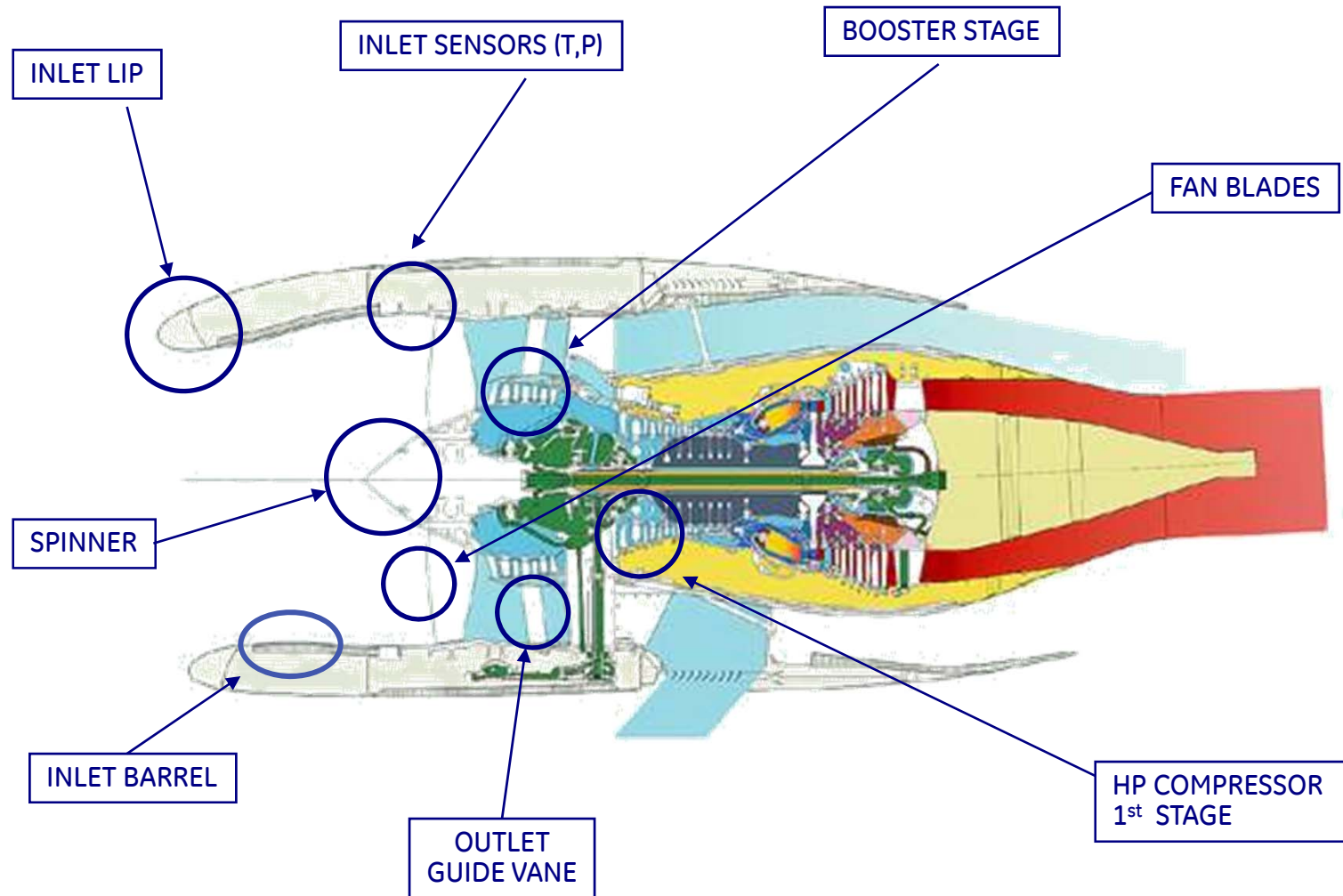
Ground ops in icing conditions ranks as one of the most challenging of all Winter operations for airlines

Engine operations from the flight crew perspective is the focus of this presentation

Information, opinions and recommendations presented are those of the engine manufacturer and the airplane manufacturers' and airlines policies, documents, and operating procedures take precedence

The Preflight

Engine ice accumulation areas



The Preflight - Continued

Walk-around inspection:

- Ground maintenance crews typically accomplish engine deicing as required per airline SOP and/or AMM
- ...but the flight crew should verify:
 - Engine cowl and inlet – clear of ice & snow
 - Fan rotates freely
- Failure to comply may result... ➡



The Preflight - Continued

“How much fan and spinner ice build up is acceptable before de-icing the engine?”



The Preflight - Continued

Unfortunately, there is no one-size fits all recommendation

- Environmental variations
- Airport operations
- Airline policies & procedures

A conservative approach is recommend, but may not always be practical

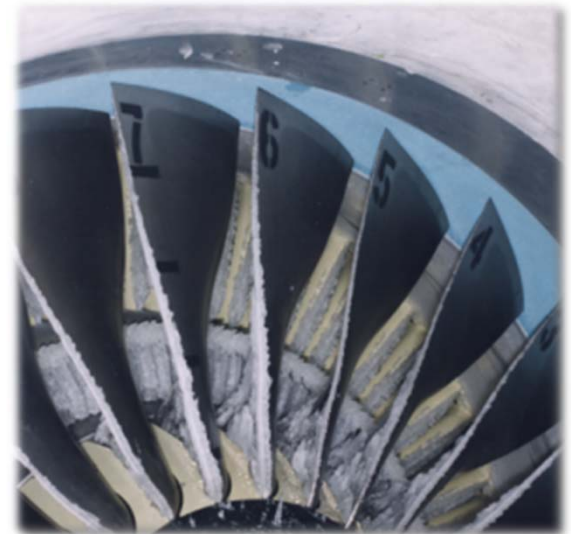
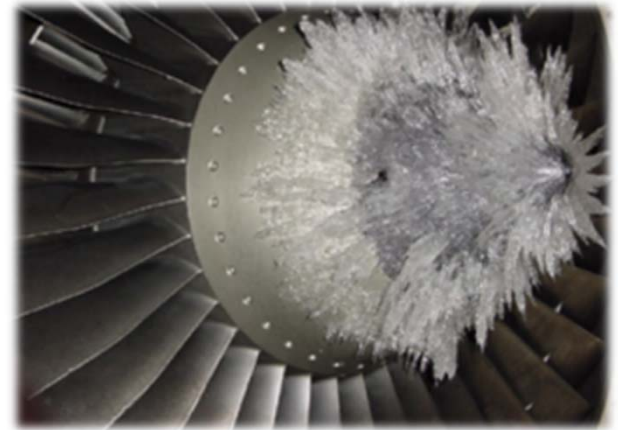
- De-icing equipment availability
- Maintenance crew availability
- Schedule constraints



The Preflight - Continued

General guidelines:

- Spinner ice/snow with no or thin layer of ice/snow visible on fan blades and booster area
 - Accomplish the ground ice shed procedure per the SOP/FCOM
- Ice/snow covered spinner with heavy accumulation on fan blades and booster area
 - Discuss with maintenance prior to push back
- Engine deicing not an option...accomplish the ice shed procedure early on taxi-out
- Spraying aircraft deicing fluid into the engine...**NOT** approved
 - Reduces engine efficiency
 - Hardware corrosion



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Ground Ice Shed Procedure

Ground ice shed procedure based on operation in simulated ground freezing fog conditions specified by FAR 33 and JAR-E/CS-E requirements

Testing consists of:

- Minimum ground idle operation in the icing cloud for predetermined time period
- Perform the ice shed procedure
- Accelerate the engine to takeoff thrust

Criteria for success:

- No engine limit exceedance or operability issues
- No unacceptable performance deterioration or mechanical distress



Ground Ice Shed Procedure - Continued

Ground ice shed procedures typically contain two elements:

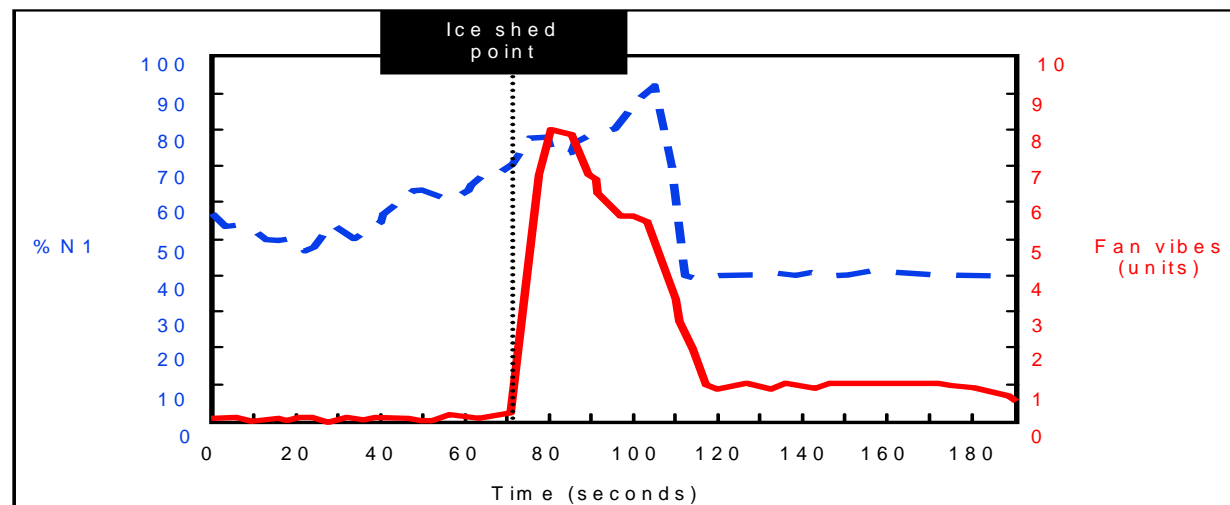
- Acceleration to a minimum thrust setting
- Dwell time at the thrust setting

Acceleration increases centrifugal forces and slightly flexes the fan blade resulting in mechanical shedding of ice

Dwell time contributes to thermomechanical ice shedding of rotating and static hardware resulting from increased fan airflow temperatures and pressures

Ground Ice Shed Procedure - Continued

Asymmetric fan ice shedding may cause momentary increase in perceived and indicated engine vibration



Fan vibration levels should return to normal levels as fan ice sheds

Ground Ice Shed Procedure - Continued

Indicated vibration may exceed advisory levels ...engine integrity not affected

Economic engine damage possible during a high thrust ice shed event



Severe icing conditions; freezing (fog, rain, drizzle) or heavy snow

- Repeating the ice shed procedure facilitates achieving normal fan vibration
- Momentary run-ups at 10 min intervals may reduce fan ice accumulation on some installations

Other Considerations

Avoid ice shed procedure and run-ups in areas with loose ice and snow...minimize FOD potential

Perform ice shed procedure or run-ups during taxi-in if delayed engine shutdown anticipated

Inform outbound flight crew of:

- Airport conditions
- Taxi-in time in icing conditions
- Time since last ice shed procedure or run-up



Summary

Winter ground operations are challenging, but manageable from an engine ground ops perspective

Ground ice shed procedure effectiveness relies on achieving both recommended thrust setting and dwell time

Compliance with ice shed procedures along with good airmanship ensures

- Safe and efficient engine operations
- Minimizes potential engine damage from ice shed events



Thanks For Your Attention



Questions / Discussion



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