



**Future Rulemaking –  
Ice Protection Harmonization  
Working Group –  
Update**

Presented by

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# History

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- In 1990's, icing related airplane design and operation was under review -
  - FAA Icing Plan developed
  - FAA Airplane Icing Conferences (2)
  - NTSB ( USA ) safety recommendations
  - FAA AD's related to severe icing
  - FAA tasked ARAC -
    - FTHWG – 1994 – Flight Characteristics in Icing Conditions
    - IPHWG – 1997 – Icing Conditions

# History

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- In 2000's – some results –
  - icing related airplane design and operation rulemaking proposals
  - improvements to design standards and operations rules - safety in icing conditions
  - harmonization – FAA and EASA / JAA and other CAA's
  - FTHWG – Final Rule – 3<sup>rd</sup> Qtr 2007-
    - flight characteristics in icing conditions
    - relating to Part 25 and Appendix C
  - IPHWG - NPRM - Activation of Ice Protection

# IPHWG Tasks

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## ➤ Task 1

- Activation of ice protection systems
  - Part 121 and Part 25
- Exit icing conditions
  - Part 121

## ➤ Task 2

- Develop SLD icing environment & design requirements

## ➤ Task 3 – 6

- Harmonize various certification standards

## ➤ Task 7

- Develop / harmonize advisory material

# IPHWG - Task 1 – first part

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- Consider the need for a regulation that requires installation of ice detectors, aerodynamic performance monitors, or another acceptable means to warn flight crews of ice accumulation on critical surfaces requiring crew action (regardless of whether the icing conditions are inside or outside of Appendix C of 14 CFR Part 25).

# IPHWG – Task 1 – first part

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- Proposed Part 121 Operating Rule –
  - applicable to limited airplane types – less than 60000 lbs MTOW and approved for icing
  - Activation of Ice Protection
    - primary ice detection system; or
    - visual cues with an advisory ice detection system; or
    - temperature and visible moisture in flight
  - Exit Icing Conditions
    - visual cues or alerts for flight crew to exit all icing conditions
- with FAA for processing

# IPHWG – Task 1 – first part

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- Proposed 25.1419 (e) thru (h) changes -
  - Applicable to all new type certificate applicants
  - Activation of Ice Protection
    - primary ice detection system; or
    - visual cues with advisory ice detection system; or
    - temperature and visible moisture in flight
  - FAA NPRM issued - April 26, 2007
  - Comments closed - July 25, 2007
  - Comments under Docket Number - 27654
- with FAA - Final Rule - end of 2008

# IPHWG - Task 1 – second part

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- Consider the need for a Technical Standard Order (TSO) for design and/or minimum performance specifications for an ice detector and aerodynamic performance monitors.
- Develop the appropriate regulation and applicable standards and advisory material if a consensus on the need for such devices is reached.

# IPHWG - Task 1 – second part

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## ➤ Need for TSO

- not in proposals for Part 121 or Part 25 rules
- TAEIG Meeting - Nov 2006 -
  - advised of EASA E-TSO's - ice detection systems
  - similar to FAA AC's
  - IPHWG - August 2006 - TSO not recommended

## ➤ with FAA for processing

## ➤ Task 1 NPRM's and AC's developed

## Task 2

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- Review National Transportation Safety Board recommendations A-96-54, A-96-56, and A-96-58, and advances in ice protection state-of-the-art.

In light of this review, define an icing environment that includes **supercooled large droplets (SLD)**, and devise requirements to assess the ability of aircraft to safely operate either for the period of time to exit or to operate without restriction in SLD aloft, in SLD at or near the surface, and in **mixed phase conditions** if such conditions are determined to be more hazardous than the liquid phase icing environment containing supercooled water droplets.  
- continued -

## Task 2

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Task 2 - continued -

Consider the effects of icing requirement changes on 14 CFR part 25 and revise the regulations if necessary.

In addition, consider the need for a regulation that requires installation of a means to discriminate between conditions within and outside the certification envelope.

## Task 2

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- Review National Transportation Safety Board recommendations A-96-54, A-96-56, and A-96-58, and advances in ice protection state-of-the-art.
  - NTSB safety recommendations from the ATR 72 accident which occurred on October 31, 1994
  - NTSB concluded the airplane had encountered icing conditions outside of the certification icing conditions of Part 25 - Appendix C

## Task 2

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- IPHWG proposes new design standards
  - Appendix X – SLD icing conditions to address freezing drizzle and freezing rain
  - Appendix D – extended icing conditions to address SLD, mixed phase, and glaciated conditions for engines
  - 25.1420 proposed to address Appendix X icing conditions
  - 25.1420 required in addition to 25.1419

## Task 2

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- Proposed 25.1420(a) provides options to operate safely -
  - detect Appendix X icing conditions and exit all icing conditions, or
  - detect a defined portion of Appendix X icing conditions and exit all icing conditions, or
  - operate in Appendix X icing conditions.

## Task 2

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- Proposed 25.1420(b) sets out methods of compliance
  - analysis supported by tests
  - tests - “one, or more as found necessary,”
  - simulated or natural icing conditions – flight tests - “measured as required”
  
- Draft AC - interim means of compliance
  
- Proposals co-ordinated with other ARAC WG's - FTHWG , PPIHWG & EHWG

# Task 2

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## ➤ Appendix X SLD Icing Conditions

- developed from recent atmospheric research data measured in-flight
- mostly North American continent data
- data reviewed by IPHWG Meteorological subgroup
- conclusion - large variation in droplet spectra
- could approximate bi-modal mass distributions

# Task 2

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## ➤ Appendix C

- maximum drop size – 100 um

## ➤ Appendix X

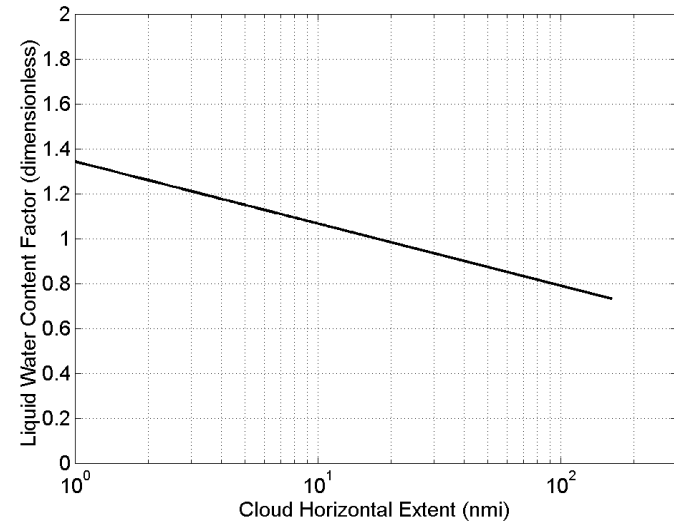
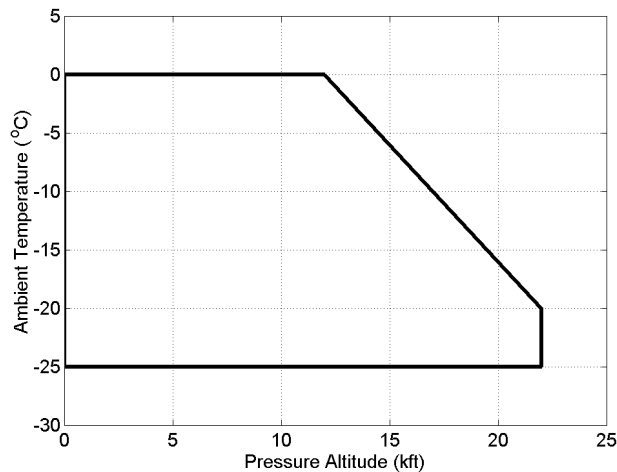
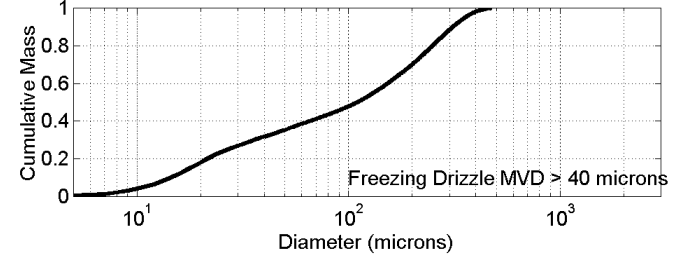
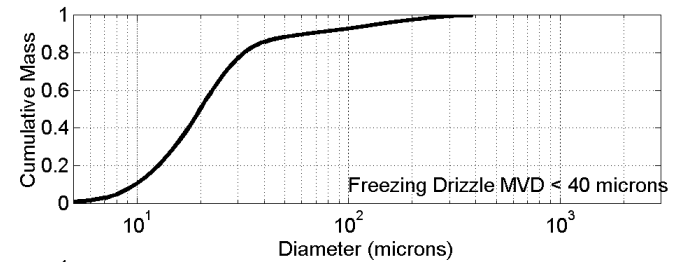
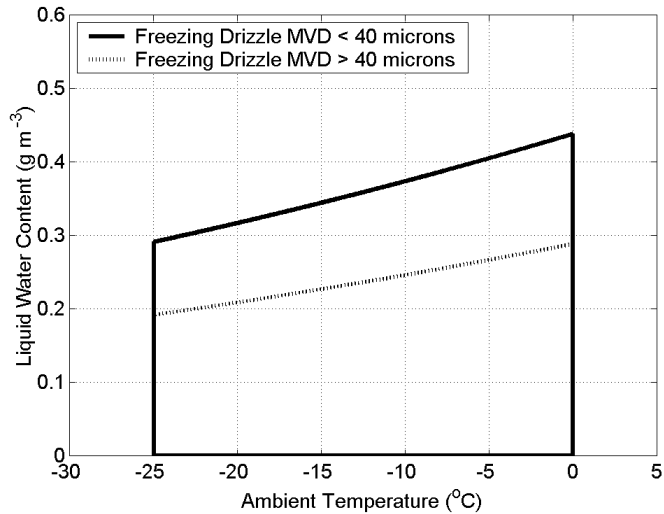
- Freezing Drizzle

- drop size - 100 – 500 um
- # 1 - MVD less than 40 um, or
- # 2 - MVD greater than 40 um

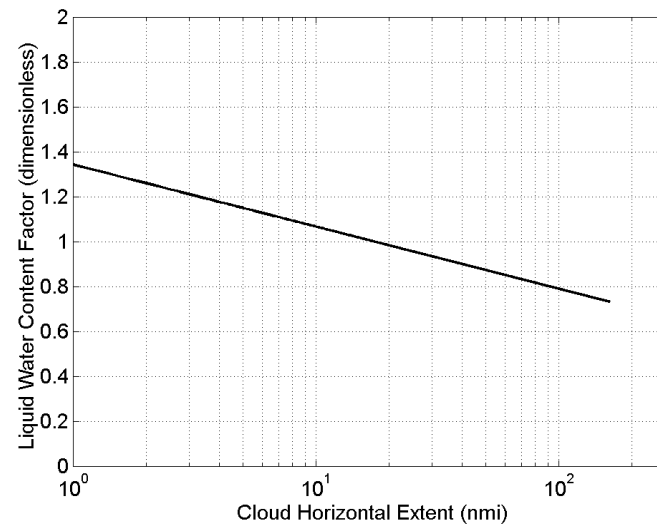
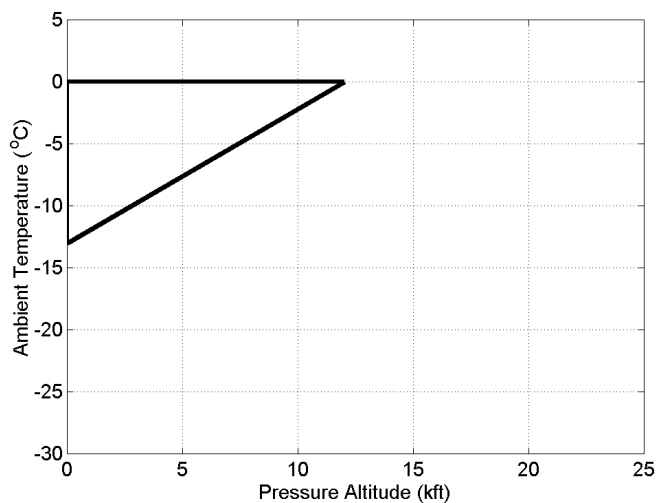
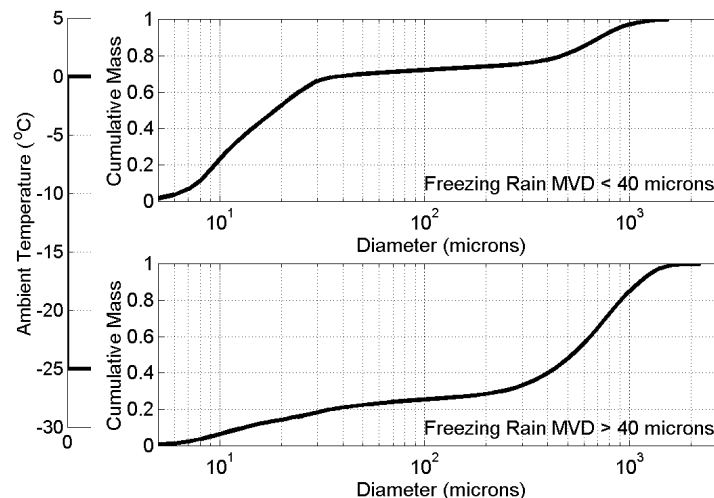
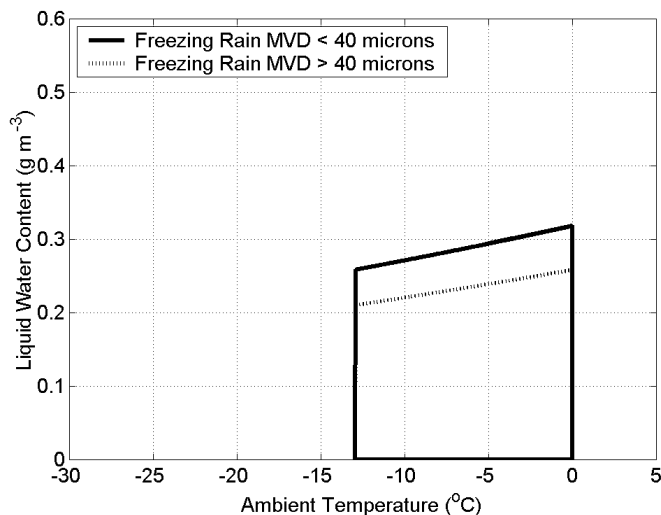
- Freezing Rain

- Maximum drop size – greater than 500 um
- # 1 - MVD less than 40 um, or
- # 2 - MVD greater than 40 um

# Task 2 - Freezing Drizzle Proposal



# Task 2 - Freezing Rain Proposal



## Task 2

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- FTHWG support to IPHWG -
  - design standard and AC development
  - IPHWG focused on systems aspects
  - FTHWG developed
    - Part 25 sub-part B aspects
    - critical ice shapes, performance, and handling related to Appendix X
    - FTHWG proposed requirements include Appendix C and X icing conditions

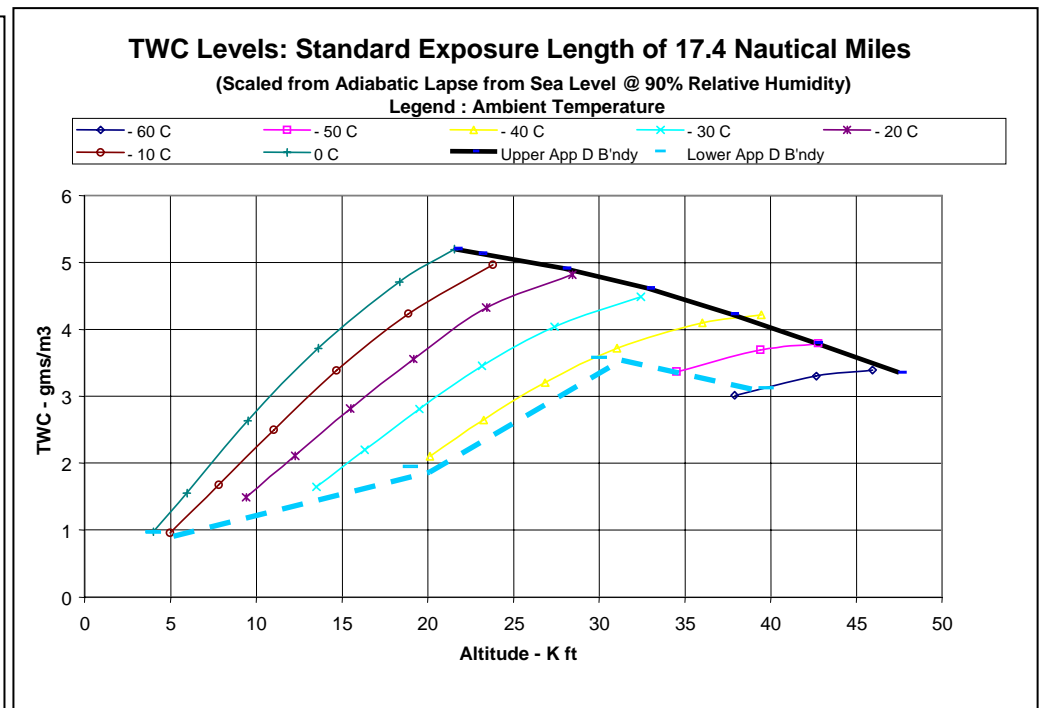
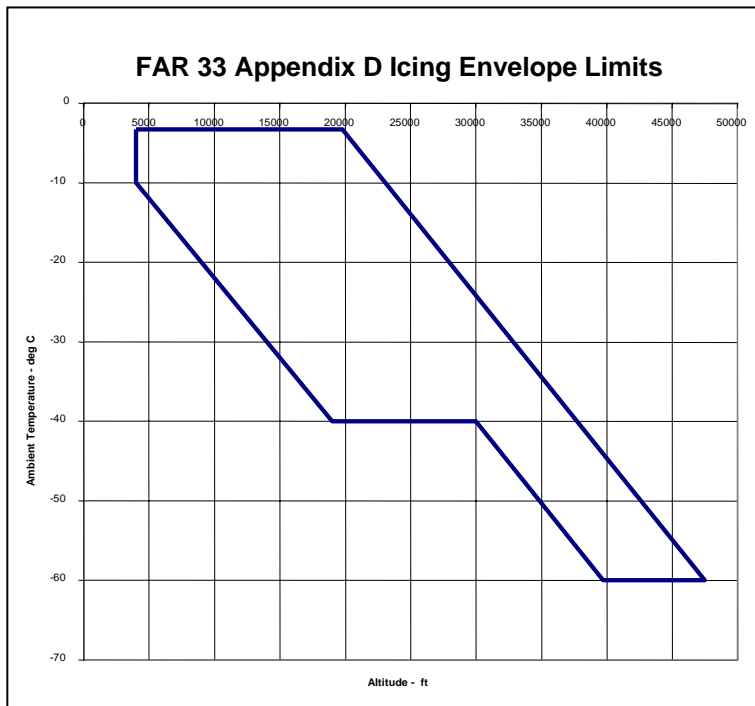
## Task 2

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- EHWG & PPIHWG support to IPHWG -
  - design standard and AC development
  - IPHWG focused on systems aspects
  - EHWG & PPHIHWG developed –
    - SLD and mixed phase / glaciated icing applications
    - addressed Part 33, 25.929, and 25.1093
    - slab ingestion test - FAR 33.77
    - induction system icing - FAR 33.68 / 25.1093
    - sub-groups address specific areas – designs, analysis methods, test techniques

# Task 2 – Engine Icing Proposal

## Appendix D proposal -



## Task 2 - Engineering Tools

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- Interim means of compliance for SLD and mixed phase/ice crystal conditions
  - updated IPHWG & EHWG Engineering Tool Roadmaps to TAEIG
  - further research by NASA and international partners to develop tools
  - TAEIG strongly recommends continued funds to develop / validate simulation methods (analytical and testing)
  
- with FAA for processing

## Task 2 - Research

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- Engine Icing in High Ice Water Content Environments -
  - collaborative effort with NASA, EC, NRC, Industry, and others
  - planned field studies – 2006 - 2010
  - physics of ice accretion in engine core
- NASA Workshops -
  - 2006 - SLD CFD Methods Development
  - 2004 - SLD Tools Roadmap Development

## Task 3

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- Propose changes to make the requirements of 14 CFR 23.1419 and 25.1419 the same
  - FAA Letter to TAEIG - September, 1999
  - IPHWG mandate did not include Part 23
  - IPHWG recommended task returned to FAA
  - FAA accepted the return of Task 3
  - No IPHWG further action required
- Task 3 is closed by FAA

## Task 4

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- Harmonize 14 CFR 23.1419, 25.1419, 25.929, and 25.1093, and JAR 23.1419, 25.1419, 25.929, and 25.1093.
  - November 1999 – FAA changes Task 4
  - Part 23 - not in IPHWG mandate
  - harmonize FAR 25.1419 and JAR 25.1419 where possible
  - PPIHWG - review 25.929 and 25.1093
  - completed with Task 2
  
- with FAA for processing

# Task 5

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- Consider the effects icing requirement changes may have on 14 CFR 25.773(b)(1)(ii), 25.1323(e), 25.1325(b). Revise and harmonize the certification standards if necessary.
  - Appendix X – SLD – icing conditions from Task 2 added to each requirement
  - also address mixed phase and ice crystal conditions
  - harmonize with EASA standard where possible
- with FAA for processing

# Task 5

## ➤ Proposed 25.1323(i) -

- Appendix C and Appendix X
- mixed phase and ice crystal conditions – similar to EASA requirements -

Air Temperature	Altitude Range		Ice Water Content	Liquid Water Content	Horizontal Extent		Ice Median Mass Dimension	Liquid Water MVD
	(°C)	(ft)			(m)	(km)		
0 to -20	10 000 to 30 000	3000 to 9000	4	1	5	3	100 to 1000	20
			1	1	100	50		
			0.5	0.5	500	300		
-20 to -40	15 000 to 40 000	4500 to 12 000	5	0	5	3		
			2	0	20	10		
			1	0	100	50		
			0.5	0	500	300		

# Task 6

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- Consider the need for a regulation on ice protection of angle of attack probes
  - icing adverse affects on air data probes / sensors – Appendices C and X, and mixed phase and ice crystal condition as proposed in 25.1323
  - criticality of functions to operations in icing conditions
  - inherent in current regulations, such as 25.1309
  - 25.13xx - new standard to address icing conditions
- with the FAA for processing

# Task 7

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- Develop or update advisory material pertinent to Task 1 through Task 6
  - AC's drafted for Task 1 and 2
  - No AC required for Task 3
  - AC for Task 4 combined with other Tasks
  - AC's drafted for Task 5 and 6
  
- with FAA for processing - scheduled with each Task

# Task 8

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- Modification to Task 2
  - IPHWG identified scope would affect Part 33
  - original tasking to IPHWG was Part 25 only
  - IPHWG requested TAEIG / FAA to add Part 33 to Task 2
  - TAEIG / FAA agreed
- Task 8 is closed – Part 33 added to Task 2

# Summary

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## ➤ IPHWG Status:

- Task 1 - Part 25 – FAA NPRM – April 2007  
( FAA - Final Rule - end of 2008 )
- Task 1 – Part 121 – with FAA
- Task 2 - Part 25 and 33 - with FAA
- Task 3 - closed
- Task 4 – with Task 1 & 2 – with FAA
- Task 5 & 6 – with FAA
- Task 7 – as required
- Task 8 - closed

# IPHWG Reports

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## ➤ IPHWG Task Reports

- available on FAA web site at [faa.gov](http://faa.gov)
- listed under Regulations and Policies / Rulemaking / Advisory / ARAC / TAIEG / IPHWG
- [FAA - Aviation Rulemaking Advisory Committee-Transport Airplane and Engine Issue Area](#)

## ➤ IPHWG Task 1 – NPRM & Comments

- <http://dms.dot.gov/searchFormSimple.cfm>
- Docket Number - 27654

# Questions

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and Thank You

# Appendix

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- Acronyms used in this presentation -
  - AC – Advisory Circular – FAA AC
  - ARAC – Aviation Rulemaking Advisory Committee to the FAA
  - EC – Environment Canada
  - EHWG – Engine Harmonization Working Group FAA – Federal Aviation Administration (USA)
  - FTHWG – Flight Test Harmonization Working Group
  - IPHWG – Ice Protection Harmonization Group
  - NASA – National Aeronautics and Space Administration
  - NRC – National Research Council of Canada
  - PPIHWG – Power Plant Installation Harmonization Working Group
  - TAEIG – Transport Airplane and Engine Issues Group under ARAC