

computed (using modern software) for a given icing condition. This new feature is a major improvement because it will allow icing forecasts to be tailored to individual airplane makes and models, to the degree that the relevant variables are known. AIAA-98-0094 contains information on how the new definitions will permit this to be achieved.

(e) The only way for accretion-based intensities to be useful for forecasting is to have every airplane carry a small ice accretion probe and base icing (PIREP) reports on that.

The FAA partially concurs. Having a common ice accretion probe on all aircraft for reporting icing conditions would be advantageous, however, the FAA does not currently plan to mandate such a probe. The choice of the reference surface coupled with the aircraft model and estimated accretion rate provides useful information for forecasting.

There are two ways to categorize icing conditions—describe the atmospheric conditions themselves, or describe their effects on the aircraft. The former would include liquid water concentration, static air temperature, and perhaps a representative droplet size in the clouds. But these are meaningless to pilots unless they are translated into effects on the aircraft. The effects may be qualitative or quantitative.

Qualitative definitions focus on perceivable effects on the aircraft and are not quantifiable. The present icing intensity definitions are ultra-qualitative, using terms like occasional or frequent need to deice, and vague warnings that the icing may create a problem or is potentially hazardous, for example. (In comparison, see the AIM for definitions of turbulence intensities which, although qualitative, are much easier to characterize and distinguish).

Quantitative definitions would specify ice accretion rates on components of concern or would list graduated intervals of speed loss, compensatory power increase, or other measurable effects of ice accretion. (A graduated table of operational effects was developed and will be submitted as a recommended change to the PIREP format.)

The situation is complicated by the presence of functioning ice protection equipment. When the equipment is operating, it may be difficult or impossible to observe, estimate, or measure any ice accretion on the protected surfaces. For heated wings there should be no ice accretion to report anyway. For booted wings operated on automatic cycle intervals, the crew would have to estimate the rate of buildup between cycles. Newer boot

models with embedded icing rate sensors may be useful here.

Otherwise, an icing rate meter (not located on a critical surface) is a useful surrogate for quantitative measurements of both the icing atmospheric variables and the ice accretion on the aircraft components of concern. To a certain extent, it can be related quantitatively to both. By taking into account the differences in the droplet collection efficiency of the probe compared to the aircraft component, rates measured by the probe can be converted to proportional rates on the component.

In a similar way and to a certain extent, icing rates measured by a probe on one airplane can be converted to expected accretion rates on components of other airplanes too, as long as the airspeeds are known. The new, quantitative definitions also take advantage of this fact and allow these measured icing rates to be converted to equivalent icing rates on the wings or tailplane of the reporting airplane and on any other make and model that may fly through the same icing conditions. (For a good explanation, see the technical paper "A Workable, Aircraft-Specific Icing Severity Scheme", AIAA-98-0094 (Jan. 1998) by R. Jeck.)

It must be understood that the indicated icing rates are those to be expected on an unheated component.

Gradually more and more airplanes may install icing rates probes that are already commercially available. Through icing PIREPS, this would greatly help the icing forecasters and, by means of conversion tables, could help even those airplanes without the probes.

(f) There is no need to re-define something that well-trained pilots have known about for 30 years or more.

The FAA does not concur. Concerns have been expressed about the ambiguities of the existing definitions. The existing definitions are outmoded in view of technological advances. The existing definition were formulated at a time when no suitable icing rate meters were available, and when computing icing rates on an airfoil was prohibitively difficult due to lack of computing power and to lack of the necessary experimental data on most airfoils. The FAA wishes to modernize the definitions consistent with current and anticipated technology.

(g) Except for severe icing conditions, airplanes certificated for flight in icing conditions are supposed to be protected enough to allow safe transition out of icing, or to lesser icing intensities. Therefore, the changes in definitions are neither helpful nor necessary nor increase safety.

The FAA does not concur. Even for icing-certificated airplanes, reported icing intensities are helpful for planning, forecasting of icing conditions, situational awareness, and compliance with operating rules and associated limitations (14 CFR parts 91.527, 121.341, 125.221, and 135.227). The definition of severe icing conditions is being changed to be airplane-specific. Thus, reported less-than-severe icing conditions for one aircraft may indicate severe icing for other types of aircraft.

(h) The new definitions endanger safety and introduce new ambiguities.

The FAA does not concur. In light of the explanations given above, current ambiguities will be reduced for all users because of better, more versatile definitions of the icing intensities.

### *3. Revise Definitions of Light and Moderate Icing To Make Them Consistent With the ADs on the Operation of Pneumatic Boots*

One commenter requested that the FAA revise definitions of light and moderate icing to make them consistent with the ADs issued by the FAA in December 1999 on the operation of pneumatic boots.

The FAA concurs. Therefore, the word "use" has been replaced by "cycling" so as not to imply delayed activation of ice protection systems.

### *4. Include Characterization of Hazard to Aircraft in Icing Intensity Definitions*

Include characterization of hazard to aircraft in icing intensity definitions. (One commenter suggests that these be related to loss in indicated airspeed of percentage increase in power.)

The FAA partially concurs. The definitions were modified to include characterization of the hazard, however, the aerodynamic effects of icing are aircraft-specific. Therefore, the PIREP icing report format currently contained in the AIM in being revised to include the characterization of the hazard being experienced by the reporting pilot.

### *5. Remove Footnotes*

The FAA does not concur. Although the footnotes have been removed, the information contained in them has been corrected and retained within the definitions themselves.

### *6. Correct Errors in Footnotes*

Several commenters noted that there were typographical errors in the footnotes.

The FAA concurs. Typographical errors in the footnotes have been corrected and the information has been inserted in the definitions.