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Section 6. Induction System

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SUBPART E - POWERPLANT

Section 6. Induction System

Section 25.1091 Air induction.

a. **Rule Text.**

(a) The air induction system for each engine and auxiliary power unit must supply --

(1) The air required by that engine and auxiliary power unit under each operating condition for which certification is requested; and

(2) The air for proper fuel metering and mixture distribution with the induction system valves in any position.

(b) Each reciprocating engine must have an alternate air source that prevents the entry of rain, ice, or any other foreign matter.

(c) Air intakes may not open within the cowling, unless-

(1) That part of the cowling is isolated from the engine accessory section by means of a fireproof diaphragm; or

(2) For reciprocating engines, there are means to prevent the emergence of backfire flames.

(d) For turbine engine powered airplanes and airplanes incorporating auxiliary power units-

(1) There must be means to prevent hazardous quantities of fuel leakage or overflow from drains, vents, or other components of flammable fluid systems from entering the engine or auxiliary power unit intake system; and

(2) The airplane must be designed to prevent water or slush on the runway, taxiway, or other airport operating surfaces from being directed into the engine or auxiliary power unit air inlet ducts in hazardous quantities, and the air inlet ducts must be located or protected so as to minimize the ingestion of foreign matter during takeoff, landing, and taxing.

(e) If the engine induction system contains parts or components that could be damaged by foreign objects entering the air inlet, it must be shown by tests or, if appropriate, by analysis that the induction system design can withstand the foreign object ingestion test conditions of

§ 33.77 of this chapter without failure of parts or components that could create a hazard.

(Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-38, 41 FR 55467, Dec. 20, 1976; Amdt. 25-40, 42 FR 15043, March 17, 1977; Amdt. 25-57, 49 FR 6849, Feb. 23, 1984)

b. **Intent of Rule.** The intent of this rule is to assure safe inlet design and function and preclude foreign object ingestion, in engines and auxiliary power units, which could result in engine/APU failure or malfunction, and airframe damage.

c. **Background.**

(1) The regulatory history dates back to Civil Air Regulation (CAR) Part 4b, dated January, 1958. Amendment 25-AD was published in the Federal Register on December 24, 1964 (29 FR 18289), which added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b without any substantive changes.

(2) Amendment 25-38 (41 FR 55454, December 20, 1976) added the provisions of § 25.1091(c)(2). This addition was intended only to clarify the pre-existing § 25.1091 requirements.

(3) Amendment 25-40 (42 FR 15034, March 17, 1977): revised § 25.1091 by

- Revising the requirements of § 25.1091(a) and (b) to make those provisions applicable to auxiliary power units; and to ensure an adequate supply of inlet air to the APU and protect it from the intake of flammable fluids and of water, slush, or other foreign objects.
- Adding § 25.1091(e) to require that turbine powerplant installation induction system designs comply with the foreign object ingestion requirements of § 33.77 ("Foreign object ingestion") that currently applied to turbine engines. As it was worded by Amendment 25-40, § 25.1091(e) requires compliance with § 33.77, unless compliance is shown during engine certification testing. Since the wording of this new requirement pertained only to engines, but not to aircraft induction systems, it was moved to § 25.903(a) ("Engines"). Further, the § 25.1091(e) requires that the foreign object ingestion criteria of § 33.77 be applied to portions of the induction system, such as inlet splitters and acoustic liners, to ensure that they withstand impact with birds, hailstones, ice, and water.

The preamble to Amendment 25-40 contained a discussion of the following relevant comments:

> One commenter [who submitted comments to the proposal] states that incorporating APU requirements into the propulsion engine requirements is confusing and unnecessary. This commenter also states that each APU would have to meet the propulsion engine foreign object ingestion test requirements for takeoff, flight idle, and cruise conditions, although APU's do not undergo these conditions. The FAA agrees that foreign object ingestion by APU's is not considered to be a significant problem; however, the FAA considers that applicability of the other requirements to APU's is necessary for the reasons stated in the explanation for the proposal.
>
> The same commenter also believes that, in order to comply with proposed paragraph (e), an applicant would have to repeat the ingestion test requirements of § 33.77 on the installed engine. The FAA replies that it did not intend to require that the ingestion test required by § 33.77 during engine type certification adequately account for the effects of inlet ingestion on the powerplant installation. The FAA revised the wording that appeared in proposed § 25.1091(e) to clarify that it applies only to turbine engines, and to include only those engines that had not been shown to comply with § 33.77 during type certification.

(4) Amendment 25-57 (49 FR 6832 February 23, 1984) revised the provisions of § 25.1091(e). It required:

> If the engine induction system contains parts or components that could be damaged by foreign objects entering the air inlet, it must be shown by tests or, if appropriate, by analysis that the induction system design can withstand the foreign object ingestion test conditions of § 33.77, without failure of parts or components that could create a hazard..

d. <u>Policy/Compliance Methods.</u> The following is excerpted from internal FAA material (dated 1982) and provides design guidance information on methods of improving the reliability of reciprocating engine induction air components and their installation:

> *<u>Re: § 25.1091, paragraph(a)(2) and (b), Reciprocating Engine Induction Air Filters</u> -*
>
> Service history on reciprocating engine induction air filters, and subsequent Airworthiness Directive action on one specific filter installation, indicates that good design practices were not always being followed, and potentially harmful environmental factors were not being considered in the design and installation of air filters and associated hardware.
>
> During a 5-year period, approximately 158 reports of accidents, incidents, or malfunctions of induction air filters and filter gaskets have been reported to the Federal Aviation Administration. Analysis of these reports indicated that the durability of some materials and the design of some filters are inadequate to withstand the normal service environment to which they were exposed. Consequently, these installations fail or malfunction in a manner that affects the

engine's ability to produce adequate power and operational incidents and accidents resulted. The most critical failures occurring were those that allowed some portion of the filter material or gasket to separate and migrate to the carburetor. These pieces often blocked the carburetor metering passages and disrupted metering to the extent that engine power failure occurred.

Air filters are simple components that can be designed to reduce the probability of failure without significantly increasing the cost or complexity of the components. Although the data available is insufficient in detail and completeness to pinpoint poor or inadequate design features on each specific component involved, it does establish general areas in which existing designs are not always meeting the conditions imposed on the components in service.

The following should be considered on reciprocating engine induction air component designs and installations:

(1) The air filter material, gasket material and adhesives should be resistant to fuels, oils, water, and cleaning materials to which they way be exposed in the powerplant environment and during maintenance. In addition, the material should be flame resistant.

(2) The aging and deterioration of any filter and gasket material should not be accelerated by exposure to temperatures imposed during powerplant operation and cool-down cycles, including inlet heat applications.

(3) Filter materials or gaskets subject to failure where pieces of sufficient size to interfere with the function of fuel metering components downstream should have screens or restraints downstream of the filter to prevent pieces of failed filter material from moving downstream and blocking these components. Alternatively, a different material should be selected which does not exhibit the undesirable failure characteristics. If screens or restraints are used, their icing characteristics should be thoroughly investigated.

(4) Exposure to high humidities or absorption of water, fuel, or oil should not result in a significant pressure drop across the filter, whether the filter is clean or dirty.

(5) Instructions for servicing or replacement of the filter should be prominently located on the filter. In addition, if the filter media is susceptible to damage or disintegration during airbox fires or severe backfires, appropriate inspection procedures for allowable damage should be included. Criteria for routine filter structural inspection should be included in the maintenance procedures.

(6) Attachment means should firmly secure the filter and gasket to the airbox. It should prevent relative motion between the components and the mounting flanges during the vibration conditions to which they will be exposed. Consideration should be given to the maximum gasket set, adverse manufacturing tolerance accumulation of the filter, hardware, and mounting flange. The filter frame should have sufficient strength to withstand the clamping forces imposed by the installation including the vibration loads from the engine.

(7) The filter and its supports should be stressed for the maximum pressures resulting from likely filter blockage. Restraints designed to catch filter fragments should be stressed to contain the largest expected fragments.

Re: § 25.1091(d), Engine Foreign Object Ingestion (FOI) -

The engine installation must be shown to minimize the possibility of foreign object ingestion.

The foreign matter referred to in this case includes, but is not limited to, ice, slush on the ground or aircraft surfaces, water, tire fragments, birds, rodents, gravel, etc. A new engine location, larger inlet area, different airflow characteristics, and ground clearance will all affect the FOI characteristics of the airplane.

Compliance with § 25.1091(d), particularly that portion which relates to the ingestion of foreign matter (objects) during takeoff, landing, and taxing, should be evaluated as a Type Inspection Authorization (TIA) item during the FAA certification flight demonstrations. Both Advisory Circular (AC) 20-124, "Water Ingestion Testing For Turbine Powered Airplanes", dated September 30, 1985; and SAE AIR 1904, "Tire Spray Suppression - Airplane Consideration and Testing For", dated December, 1985; provide guidance for water ingestion test techniques and airplane design considerations.

e. **References.**

(1) Civil Air Regulation (CAR) Part 4b, dated January, 1958.

(2) Amendment 25-AD (29 FR 18289, December 24, 1964).

(3) Amendment 25-38 (41 FR 55454, December 20, 1976).

(4) Amendment 25-40 (42 FR 15034, March 17, 1977).

(5) Amendment 25-57 (49 FR 6832, February 23, 1984).

(6) Advisory Circular (AC) 20-124, "Water Ingestion Testing For Turbine Powered Airplanes," dated September 30, 1985.

(7) Society of Aeronautical Engineers (SAE) AIR 1904, "Tire Spray Suppression - Airplane Consideration and Testing For," dated December, 1985.

Section 25.1093 Induction system icing protection.

a. **Rule Text.**

(a) Reciprocating engines. Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of 30°F., each airplane with altitude engines using --

(1) Conventional venturi carburetors have a preheater that can provide a heat rise of 120°F. with the engine at 60 percent of maximum continuous power; or

(2) Carburetors tending to reduce the probability of ice formation, has a preheater that can provide a heat rise of 100°F. with the engine at 60 percent of maximum continuous power.

(b) Turbine engines.

(1) Each turbine engine must operate throughout the flight power range of the engine (including idling), without the accumulation of ice on the engine, inlet system components, or airframe components that would adversely affect engine operation or cause a serious loss of power or thrust --

(i) Under the icing conditions specified in appendix C; and

(ii) In falling and blowing snow within the limitations established for the airplane for such operation.

(2) Each turbine engine must idle for 30 minutes on the ground, with the air bleed available for engine icing protection at its critical condition, without adverse effect, in an atmosphere that is at a temperature between 15°and 30°F (between –9°and –1°C) and has a liquid water content not less than 0.3 grams per cubic meter in the form of drops having a mean effective diameter not less than 20 microns, followed by momentary operation at takeoff power or thrust. During the 30 minutes of idle operation, the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator.

(c) Supercharged reciprocating engines. For each engine having a supercharger to pressurize the air before it enters the carburetor, the heat rise in the air caused by that supercharging at any altitude may be utilized in determining compliance with paragraph (a) of this section if the heat rise utilized is that which will be available, automatically, for the applicable altitude and operating condition because of supercharging.

(Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-38, 41 FR 55467, Dec. 20, 1976; Amdt. 25-40, 42 FR 15043, March. 17, 1977; Amdt. 25-57, 49 FR 6849, Feb. 23, 1984; Amdt. 25-72, 55 FR 29785, July 20, 1990)

b. **Intent of Rule.** The intent of this rule is to ensure that no accumulation of ice on the engine, inlet/air induction system and its components, or airframe components would adversely affect engine operation or result in a serious loss of power or thrust.

c. **Background.**

(1) Notice of Proposed Rulemaking 71-12 (36 FR 8383, May 5, 1971) introduced paragraph § 25.1093(b). The explanation given was as follows:

> This proposal is considered appropriate in order to require the applicant to provide ice protection with the engine idling. It would also provide protection in both falling and blowing snow. In addition, the indicator requirement in present § 25.1093 would be moved to § 25.1305 which covers instruments.

(2) Amendment 25-36 (39 FR 35452, October 1, 1974) followed Notice 71-12. The following discussion of the comments that were submitted is excerpted from the preamble to this amendment:

> Several commenters object to the requirement in proposed § 25.1093 for operation in falling and blowing snow on the basis that no standard is specified as to the intensity or the amount of falling snow or the degree of blowing involved. They further point out that no uniform means were provided for demonstrating compliance with the section, and that a small or even minute amount of snow might satisfy the letter of the law of this section. One commenter offered detailed standards that could be adopted. However, it was not the FAA's intent that specifications for all possible conditions be included in the regulation, but, rather, that an applicant select the limitations desired for its airplane and then demonstrate the ability to operate within those limitations.
>
> Several commenters assert that the specified liquid water content of 2 grams per cubic meter (as proposed in the Notice) was not representative of actual conditions, and would result in more stringent requirements for ground operation than for flight. Another commenter suggests that the requirement for icing protection at idle should be applicable "on the ground" rather than at sea level. Upon further consideration, the FAA agrees that a reduction of 0.6 grams would provide adequate and safe standard for icing protection at idle conditions on the ground and has specified this requirement in the finalized amendment.
>
> One commenter objects to the requirement for icing protection for 30 minutes at idle, stating that there is insufficient bleed air to adequately meet the requirement for this period of time. However, the FAA points out that experience has demonstrated that it is practical and necessary for safety of flight, and that protection for the engine during prolonged idle prior to takeoff is essential to safety of operation. The proposal, as it was worded, would not restrict the means for icing protection to engine bleed air, as suggested by the commenter, but allows any means or combination of means that the applicant may choose. With respect to bleed air, the intent of the requirement is that icing protection at

> idle be provided when the bleed air available for icing protection is at its critical condition. This section has been reworded in the amendment to make this clear.

(3) Notice of Proposed Rulemaking 75-19 (40 FR 21866, May 19, 1975) explained the incorporation of the requirement to consider ice build-up of inlet components, such as noise attenuation rings, vortex generators, and splitters, that could have an adverse effect on engine operation. The intent of the proposal was to make it clear that the effect of ice accumulation on components of the inlet system, as well as the engine control system, must be considered.

(4) Amendment 25-40 (42 FR 15034, March 17, 1977) followed Notice 75-19. In its preamble, relevant comments from the "Airworthiness Review Program -- Amendment No. 4, Powerplant" were discussed. Specifically:

> The proposal 3-31 proposed only a minor change to make it clear that the requirements of paragraph (b), concerning ice accumulation caused by the ice and snow expected within the approved flight envelope, cover air inlet system components.

(5) Notice of Proposed Rulemaking 84-21 (49 FR 47358, December 3, 1984) proposed clarification of the change to paragraph (b) made by Amendment 25-40. The explanation for this proposal is as follows:

> Historically, turbine engine induction systems, as well as analogous reciprocating engine carburetor heat rise systems, have been required to meet specified standards regardless of whether the airplane is approved for operation in icing conditions. An airplane may inadvertently enter unforeseen icing condition, and any difficulty experienced due to the accumulation of ice on the airframe must not be compounded due to a loss of power or thrust caused by engine icing. Due to an editorial error introduced with Amendment 25-40, the phrase "within the limitations established for the airplane" implies that an operational limitation may be accepted in lieu of providing the capability to operate the engines safely in icing conditions. The proposed change would correct this editorial error by clarifying that the phrase "within the limitation established for the airplane" applies only to operation in snow. Due to the difference in the standard of ice protection required for the engines and that required by § 25.1419 for the airplane in general, the term "inlet system components" is interpreted to include any portion of the airframe from which accumulated ice could be ingested. Section 25.1093(b)(1) would be amended to ensure that such airframe components are not overlooked during the evaluation of the engine installation.

(6) Amendment 25-72 (55 FR 29756, July 20, 1990) provided clarification of § 25.1093(b) so that the evaluation would include any portion of the airframe from which ice or snow could be shed and then be ingested into the engine. This rule clarification was precipitated by several incidents of engine flameout and/or damage following ice shedding from airframe surfaces (i.e., radome, wing, fuselage, etc.)

d. **Policy/Compliance Methods.** It should be remembered that the requirements of this section apply regardless of whether certification of the airplane in icing conditions is requested. Section § 25.1093(b)(1) states that

> *"Each turbine engine must operate throughout the flight power range of the engine (including idling), without the accumulation of ice on the engine, inlet system components, or airframe components that would adversely affect engine operation or cause a serious loss of power or thrust."*

FAA clarification of the policy and background of the terms "including idling" and "airframe component" are presented below.

(1) The following excerpt, from the Engine Icing Generic Issue Paper, concerns the term "including idling."

> Engine ice protection at the engine's idle power-setting has been required since Amendment 25-36 (39 FR 35452, October 1, 1974). Initially, many airframe manufactures complied with this rule by redefining inflight idle when the engine anti-ice was turned on. Crew procedure was relied upon to reset the throttles to a higher engine idle speed where adequate air bleed could be supplied to the ice protection system. Following numerous single and multiengine power loss incidents in icing conditions due to inappropriate crew throttle procedure, the FAA required that engine ice protection should be automatic once the atmospheric condition is recognized and the system activated by the flight crew. From this point on, the term "operate throughout the flight power range of the engine (including idling)", as stated in § 25.1093(b)(1) was interpreted by the FAA to mean the engine must be protected from ice with the throttle against the idle stop. Most airplanes certified since the late 1970's have engine cowl anti-ice designs that automatically increase power (thrust) when the system is activated.
>
> The term "airframe components" is interpreted to include any portion of the airframe from which accumulated ice could be ingested into the engine. Recognizing that some ice may form under certain icing conditions on the wing (leading edge and runback ice), fuselage, radome, antennas, etc. , it is the airframe manufacturer's responsibility in showing compliance with § 25.1093(b)(1) to review these potential airframe ice accumulation sites relative to ingestion into the engine. If the airframe cannot be shown to be free of ice under all Appendix C icing conditions, then the airframe manufacturer should evaluate the maximum airframe ice slab against the engine's Part 33 engine ice slab ingestion test. The FAA clarified this interpretation of airframe components in a 1984 NPRM preceding Amendment 25-72 (55 FR 29756), July 20, 1990. This clarification was due to multiple engine damage events caused by ice slab damage. Although some of these events were caused by the delayed activation of the engine ice protection, many more were caused by ice slabs being released from ice accumulation sites other than the engine inlet cowl.
>
> For airplanes with aft fuselage mounted engines, the inboard sections of the wing should be treated as part of the engine's inlet system. Typically, two compliance methodologies may be taken to address this issue:
>
> (i) Show that whatever ice (including runback ice) accumulates on the wing with the engine at idle, either sheds and misses the engine or breaks into small enough slabs such that engine damage or power loss does not occur.

(ii) Show that the anti-ice system for the inboard section of the wing operates hot enough that it vaporizes all moisture (thus very little or no runback) with the engine at flight idle.

With some airplane configurations, ice shed from the wing only enters the engine at higher airplane angle of attacks. Additionally, the airplane operating procedure for turning on the airframe and engine ice protection systems may significantly differ (i.e., anti-ice versus de-ice systems), thereby adding further complexity to the problem of defining critical conditions. Typically, procedures for turning on engine anti-ice involve visible moisture and a total air temperature of +10 degrees Celsius or colder. The intent of these engine anti-ice procedures is to prevent any ice accumulation on the inlet cowl. For airframe (mainly wing) anti -ice or de-ice, the activation procedure may vary from that of the engine anti-ice system. This may lead to a situation where the wing ice inadvertently is shed into the engine following late airframe anti-ice activation or because of differences in anti-ice activation procedures.

To summarize the above policy, the airplane must comply with § 25.1093(b)(1) at all engine power settings. This analysis should include the inflight idle condition with the power levers against the minimum stop. Icing exposure times associated with these power settings should be appropriate for the horizontal extent factors in Appendix C as well as the likely airplane operational exposure (i.e., holding, climb, descent, etc.). For the inflight idle condition, the exposure time should be developed from the worst case airplane descent profile (longest time exposure with both engines at idle). Included in this evaluation should be any portion of the airframe from which accumulated ice could be ingested into the engine. Special compliance emphasis should be given to the inboard section of wing relative to the engine inlet.

Aircraft certification under § 25.1093(b)(1)(i), relative to the Part 25 Appendix C icing envelope, must require demonstration of adequate anti-ice or de-ice procedures and an adequate icing condition “cue” for the aircraft, engine, and flight idle limit to allow flight into icing conditions. Service history must show that there have been no incidents of engine core ice (anomaly that has affected some engine models) causing engine operating difficulty or a reduction in engine performance.

Icing conditions may exist when the OAT on the ground and for takeoff, or the TAT in flight, is 10°C or below, and visible moisture in any form is present (such as clouds, fog with visibility of one mile or less, rain, snow, sleet, and ice crystals). Icing conditions also exist when the OAT on the ground and for takeoff is 10°C or below when operating on ramps, taxiways or runways where surface snow, ice, standing water, or slush may be ingested by the engines or freeze on engines, nacelles or engine sensor probes.

(2) The following excerpt is from a1996 FAA Issue Paper on icing:

Based on multiple engine natural ice damage and operability events on flight test and in-service airplanes, the FAA has recently required natural ice encounters for the purpose of showing compliance with § 25.1093(b)(1). Aside from the obvious benefit of validating the engine inlet icing analysis model, there are several other key issues that the natural ice encounter addresses.

These evaluations include:

(i) the adequacy of the flight crew procedures for operation in icing conditions

(ii) the acceptability of tactile inputs to the flight crew as the airplane responds to engine fan blade ice shedding during a variety of airplane operating conditions

(iii) the performance of the engine vibration indication system as well as other engine indication systems, and

(iv) the confirmation that the powerplant installation as a whole (engine, inlet, anti-ice system, etc.) performs satisfactorily while in icing conditions.

Compliance with the natural ice encounter criteria should be proposed by the applicant and agreed to by the FAA prior to the test. However, typically an adequate test sequence includes three natural fan ice shed cycles at each of the following conditions (with inlet anti-ice turned “on”); descent (flight-idle), holding (power necessary to maintain level flight), and maximum climb, unless a more critical engine power setting exists. These encounters should be conducted at a steady state engine thrust level and although not preferred, sometimes have involved flying through the same icing cloud multiple times (lapping) in order for the fan to accumulate enough ice for a shed cycle to occur. These fan shed cycles should be due to natural ice accumulation and not induced or forced by throttle bodies during each condition. It is has also been allowed for the airplane to exit the icing conditions between each fan shed cycle for the purpose of clearing any other unprotected airplane surfaces from ice. Lastly, based on past experience, it is advisable that the applicant establish and gain concurrence with the FAA for engine damage criteria prior to conducting the natural ice encounter test.

Relative to the issue of compliance with the ground fog requirements of § 25.1093(b)(2), the FAA intends to add this requirement to airplane’s certification basis. As the uninstalled engine has likely already met this requirement by complying with the ground fog requirement of § 33.68(b), compliance with the installed engine requirement of § 25.1093(b)(2) should only involve evaluation of the engine inlet anti-ice system performance under these conditions. Furthermore, it is imperative that any engine ground power increase and associated time interval (i.e., engine power run-ups to 45% N1 every ten minutes) that was necessary for the engine to comply with the § 33.68(b) ground icing condition become a limitation for ground operation in the Airplane Flight Manual (AFM)

A March 16, 1984, FAA Policy memorandum clarified the applicability of icing horizontal extent factors [from Appendix C and Advisory Circular (AC) 20-73, “Aircraft Ice Protection”] to installed engines during airplane holding conditions. The 45-minute hold was originally developed as a criterion to judge the acceptability of eliminating ice protection on airframe components (ADS-4, titled “Engineering Summary of Airframe Icing Technical Data, page 4.2-29). It was conceived as a 15 minute departure hold and 30-minute destination hold. The climb and descent holds have been lumped into one for ease of evaluation. AC 20-73 recommends that tests include a continuous exposure for at least 45 minutes.

ADS-4 and AC 20-73 address the engine inlet so remarks concerning the hold condition also apply to ice consideration for the engine inlet. Report FAA-RD-

77-76 does not contribute much in our review since it does not address the inlet, nor does it address the “race track” type hold condition for analyzing the inlet.

The typical hold speeds and altitudes for an airplane type are specified in FAA Order 7130.3, “Holding Pattern Criteria Handbook.” Speeds and configuration selected by the manufacturer may be more appropriate. Following the example, pg. 6-19 of ADS-4, which in turn refers to section 4.1.3 and 4, liquid water contents are selected from Figure 1 of Appendix C typically for a 20 micron drop diameter for the most probable icing temperature (Figure 1-16, ADS-4) at each hold altitude under investigation. The other continuous maximum conditions should be investigated also (AC 20-73, pg. 4 and pg. 6) to establish the most severe conditions using a cloud extent factor of one. The ice shape or ice accretion is then evaluated based on the airplane being exposed at least 45 minutes “continuously” to the most critical icing hold condition. Keep in mind this condition is only a design criterion. This criterion provides a condition in lieu of scenarios of mixed continuous or intermittent atmospheric conditions that may be more or less severe.

The straight line flight (cruise, diversion to alternate airport, etc.) evaluation should also be investigated using Appendix C, including the use of the extent factor. If the inlet is evaporative under continuous maximum icing conditions, straight-line (factored), or hold (unfactored); and is running wet under intermittent maximum conditions; then the design is satisfactory, provided acceptable precautions can be taken to prevent hazardous accumulations of runback ice (AC 20-73, pg. 15).

We note the applicant’s design analyses predicts runback ice forming under some descent and holding conditions (straight line evaluation) for the continuous maximum atmospheric envelope or Appendix C. As the accepted criteria of AC 20-73 has not been met, we question the capability of the design to handle real world varying icing conditions. To resolve this question we suggest the applicant determine the critical accretion ice conditions for the continuous maximum 17.4 nautical mile cloud using a horizontal extent factor of one. Apply those critical conditions to the inlet for at least 45 minutes (Criteria of ADS-4 and AC 20-73). If the bulk of the continuous maximum icing envelope is evaporative, then the applicant should establish by analysis or test, for the 45-minute critical running wet condition that runback ice will not accumulate.

If ice does form during the continuous atmospheric running wet condition, then the applicant should calculate the amount of ice that would accumulate in 4 hours on the engine cowlings. This calculated quantity of ice should be added to ice that may be ingested in the engine from any other source, and the total should be less than the amount of ice the engine has been satisfactorily demonstrated to ingest during engine certification. This criteria should provide a conservatism to achieve a level of safety equivalent to the continuous maximum full evaporative criteria that has been accepted in demonstration of compliance to FAR 25.l093 (14 CFR 25.1093). This latest criteria was recently accepted for the certification of another part 25 airplane, and it seems reasonable.

Also, if for the straight line case, the inlet is running wet in continuous maximum conditions, the exposure should be followed by an embedded intermittent condition and an unsafe condition should not develop. (AC 20-73, pg., 11, paragraph 19b).

Appendix C contains design envelopes that are not representative of the possible cloud combinations, altitudes, or extents that can exist. Using those

envelopes evaluated in accordance with the accepted criteria of AC 20-73, and by the methods of ADS-4, have provided acceptable service experience. Also, when the airplane is evaluated under Appendix C, the criteria of AC 20-73, and by the methods of ADS-4, the airplane is acceptable for use in icing conditions above and below the design altitude limits of Appendix C. The criteria discussed above is not considered the worst possible condition (considering runback ice or ice shapes) that may be encountered, as combination atmospheric conditions may be worse. However, the criteria have provided acceptable design conditions for current anti-icing protection systems. For that reason we do not recommend lesser criteria than the above. Accepting some other would mean accepting an icing scenario, which in reality could be infinite combinations. In addition, the approval relative to service experience would be unknown.

For FAA policy on ice detector systems, refer to the § 25.1419 of the Mechanical Systems Mega AC. This policy noted above covers acceptable compliance methods for both primary and advisory ice detection systems.

(3) In an August 3, 1992, internal FAA policy memo, the Transport Airplane Directorate responded to questions concerning the falling and blowing snow provisions of § 25.1093(b)(1)(ii):

Concerning Airplane Flight Manual (AFM) limitations for operation of turbine engines in snow conditions, Section 25.1093(b)(1)(ii) states, *"In falling and blowing snow within the limitations established for the airplane for such operation."* Historically, Part 25 airplanes have not been certified with AFM limitations restricting the airplane from snow operation. This is consistent with other FAA policy concerning airplane operation in unavoidable meteorological hazards such as rain, ice, hail, and lightning. With respect to the wording of the rule, the only plausible AFM limitation which the FAA may consider for a Part 25 airplane would be a restriction against taxi and takeoff in falling or blowing snow. However, once the airplane is inflight, it is the FAA's position that snow is unavoidable and all Part 25 airplanes shall have full flight clearance to operate in snow. Additionally, visibility or time restrictions that may allow limited airplane dispatch in certain snow conditions are not acceptable.

Pertaining to the definition of falling and blowing snow for Part 25 airplanes, later editions of the FAA Airman's Information Manual defines heavy snow intensity as "Visibility less than 5/16 statute mile." Consistent with this definition, the following airplane test criteria has been derived from past rotorcraft and airplane certification experience combined with data from multiple research publications.

(i) *Visibility* - A maximum of 1/4 mile test visibility (or less) as limited by snow (not snow and fog).

(ii) *Temperature* - The applicant is responsible for defining the critical ambient temperatures, which will vary for each airframe and engine inlet configuration. Typically, a temperature range between 25 and 34 degrees Fahrenheit has been found conducive to the heavy snow environment and to providing the "wet sticky snow" which may accumulate on unheated surfaces (airframe and engine) subject to impingement.

It should be noted that colder temperatures may be critical to some configurations. In these cases, colder exterior surfaces may be bypassed, and the snow crystals may stick to partially heated interior inlet surface where melting and refreezing may occur. In all cases, the applicant must identify and evaluate the critical temperature for the configuration proposed.

With respect to acceptable test methods for showing compliance to the requirement, historically the FAA has only required compliance by actual test on those inlets/airframes where, by evaluation, potentially hazardous snow accumulation sites could be identified. Thus, airplanes with turbine engine inlets that have plenum chambers, screens, particle separators, variable geometry, or any other feature (such as an oil cooler) which may provide a hazardous accumulation site for snow, should be tested. This group includes most turboprop inlets as well as inlets on essential auxiliary power units (APU). For most turbojet and turbofan engines with traditional pitot (straight duct) type inlets, icing tests have been found to be a more critical case than snow. Thus, actual testing for falling and blowing snow has been relaxed in lieu of stringent icing test and analysis.

Additionally, in 1990, Amendment 25-72 provided clarification of § 25.1093(b) so that the evaluation would include any portion of the airframe from which ice or snow could be shed and then be ingested into the engine. This rule clarification was precipitated by several incidents of engine flameout and/or damage following ice shedding from airframe surfaces (i.e., radome, wing, fuselage etc.)

Once it has been determined that actual testing for falling and blowing snow is necessary, compliance must be shown for both ground and flight conditions within the critical snow criteria listed above. Ground conditions should include static operation at variable engine power settings, taxi at constant speed (15 to 30 miles per hour) to simulate blowing snow, and taxi/hold conditions to simulate typical ground holding conditions prior to takeoff. The flight conditions should include takeoff, cruise, holding, descent, and landing. These conditions should be evaluated at variable airspeeds and in all critical airplane configurations (i.e., flap angles, gear position, etc.) for which the applicant requests certification.

The applicant should maximize the number of actual airplane tests conducted within the critical snow and temperature environment. Recognizing, however, that these snow and temperature conditions are sometimes difficult to find for test purposes, some of the conditions above may be substantiated by analysis. This methodology assumes that the analysis is substantiated by actual temperature survey data from the engine inlet and any other potentially hazardous airframe accretion sites on the aircraft. It is worth noting that the test article must be in production configuration with respect to surface finish, texture, and material type to assure the test conditions adequately represent those expected in service. Prototype or modified hardware (including painting) should not be used for compliance testing.

e. **References.**

(1) Notice of Proposed Rulemaking 71-12 (36 FR 8383, May 5, 1971).

(2) Amendment 25-36 (39 FR 35452, October 1, 1974).

(3) Notice of Proposed Rulemaking 75-19 (40 FR 21866, May 19, 1975).

(4) Amendment 25-40 (42 FR 15034, March 17, 1977).

(5) Notice of Proposed Rulemaking 84-21 (49 FR 47358, December 3, 1984).

(6) Amendment 25-72 (55 FR 29756, July 20, 1990)

(7) FAA Order 7130.3, “Holding Pattern Criteria Handbook.”

(8) Advisory Circular 20-73, “Aircraft Ice Protection,” April 21, 1973.

(9) Advisory Circular 20-XX, “Turbine Engine Induction System Icing,” 1982 Unreleased Draft

Section 25.1101 Carburetor air preheater design.

a. **Rule Text.**

Each carburetor air preheater must be designed and constructed to --

(a) Ensure ventilation of the preheater when the engine is operated in cold air;

(b) Allow inspection of the exhaust manifold parts that it surrounds; and

(c) Allow inspection of critical parts of the preheater itself.

b. **Intent of Rule.** The intent of this rule is self-evident.

c. **Background.** The regulatory history shows that this requirement originated from section 4b.462 of the Civil Air Regulations (CAR) 4b, December 31, 1953. This rule was recodified from CAR 4b.462 without any substantive changes. No amendments have been issued.

d. **Policy/Compliance Methods.**

(1) The following excerpt from Advisory Circular 29-2B, "Certification of Transport Category Rotorcraft," provides guidance for transport rotorcraft, but may also provide insight into acceptable compliance methodology useful for other category aircraft.

Carburetor Air Preheater Design.

Procedures. Although carburetors of some design and fuel injections are free from icing difficulties, the most common remedy is to preheat the air supply entering the carburetor. In this way, sufficient heat is added to replace the heat lost due to vaporization of fuel, and the mixing chamber temperature cannot drop to the freezing point of water. The air preheater is essentially a tube or jacket through which the exhaust of one or more cylinders is passed with the air flowing over the heated surface raised to the required temperature before entering the carburetor. A control for adjusting the preheater valve is installed in the cockpit so that heat may be applied only when actually required to prevent ice formation.

d. **References.**

(1) Civil Air Regulations (CAR) 4b, December 31, 1953.

(2) Advisory Circular 29-2B, "Certification of Transport Category Rotorcraft," July 30, 1997.

Section 25.1103 Induction system ducts and air duct systems.

a. **Rule Text.**

(a) Each induction system duct upstream of the first stage of the engine supercharger and of the auxiliary power unit compressor must have a drain to prevent the hazardous accumulation of fuel and moisture in the ground attitude. No drain may discharge where it might cause a fire hazard.

(b) Each induction system duct must be --

(1) Strong enough to prevent induction system failures resulting from normal backfire conditions; and

(2) Fire-resistant if it is in any fire zone for which a fire-extinguishing system is required, except that ducts for auxiliary power units must be fireproof within the auxiliary power unit fire zone.

(c) Each duct connected to components between which relative motion could exist must have means for flexibility.

(d) For turbine engine and auxiliary power unit bleed air duct systems, no hazard may result if a duct failure occurs at any point between the air duct source and the airplane unit served by the air.

(e) Each auxiliary power unit induction system duct must be fireproof for a sufficient distance upstream of the auxiliary power unit compartment to prevent hot gas reverse flow from burning through auxiliary power unit ducts and entering any other compartment or area of the airplane in which a hazard would be created resulting from the entry of hot gases. The materials used to form the remainder of the induction system duct and plenum chamber of the auxiliary power unit must be capable of resisting the maximum heat conditions likely to occur.

(f) Each auxiliary power unit induction system duct must be constructed of materials that will not absorb or trap hazardous quantities of flammable fluids that could be ignited in the event of a surge or reverse flow condition.

(Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-46, 43 FR 50597, Oct. 30, 1978)

b. **Intent of Rule.** The intent of this rule is to ensure that no hazard will result due to induction system and bleed air ducts in reciprocating and turbine engines, and in auxiliary power units (APU).

c. **Background.**

(1) The regulatory history shows that paragraphs (a), (b), and (c) originated from the requirements of recodified CAR 4b.463, which included only induction system ducts. Amendment 25-23 (35 FR 5665, April 8, 1970) added paragraph (d) to require that no hazard would result from bleed duct failures.

(2) Notice of Proposed Rulemaking 68-18 (33 FR 11913, August 22, 1968) contained the following discussion of the proposal in its preamble:

> The induction system ducts requirements of § 25.1103 do not specifically cover turbine engine bleed air system failures. Engine bleed air is used for airplane services and failures of hot pipes have resulted in over-pressure and over-temperature conditions in the compartment where the failures occurred. Bleed air can be at pressures as high as 338 psi and at temperatures up to 1000°F. Hot pipe failures have occurred in service, and the proposal would require that no hazard to the airplane will result if a duct rupture occurs at any point between the engine port and the airplane bleed service.

(3) The 1974-75 Airworthiness Review Program resulted in Amendment 25-46 (43 FR 50578, October 30, 1978). That amendment revised subparagraphs (a), (b)(2), and (d), and added new subparagraphs (e) and (f).

(4) Notice of Proposed Rulemaking 75-31 (40 FR 29410, July 11, 1975) resulted from the Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals. Its preamble contained a discussion of the proposal as follows:

> The proposal would revise § 25.1103 to provide more comprehensive standards for APU induction system ducts. Similar standards have been applied in the past.

The preamble also discussed comments to the proposal as follows:

> One commenter . . . suggests that the proposed revision to § 25.1103(d), concerning ducts other than induction system ducts, be placed in a separate section of Part 25. The FAA [does not agree, and] believes that it is more appropriate to include the requirement in § 25.1103 and to expand the heading of that section to include a reference to air duct systems.
>
> Several commenters suggest that it would be difficult to establish the “sufficient distance upstream of the auxiliary power unit compartment” specified in proposed § 25.1103(e). The FAA believes that the proposed standard is appropriate. In this instance, a more definitive standard, taking into account all of the factors that might be involved, would tend to restrict design flexibility unnecessarily.
>
> One commenter objects to proposed § 25.1103(e), contending that its language precludes the use of methods to prevent hot gas reverse flow, which would provide at least an equivalent level of safety. The FAA knows of no practical method other than fireproofing to prevent hot gas reverse flow in induction

system ducts. If such a method were developed, the applicant could apply for its approval under the "equivalent safety" provisions of § 21.21(b)(1).

This commenter also contends that, if proposed § 25.1103(f) is met, it is unrealistic to consider a fire caused by hot gas reverse flow burning in the air induction system. The commenter suggests, instead, a requirement to determine the maximum intake duct temperature that could occur under hot gas reverse flow conditions and to use a duct material that can resist these temperatures. The commenter apparently misinterpreted the proposal. Proposed § 25.1103(e) requires that certain portions of each auxiliary power unit induction system duct be fireproof, and proposed § 25.1103(f) states heat tolerance requirements for those portions of the induction system other than those which are specifically required to be fireproof. However, the FAA believes the proposed language may be unclear. Therefore, that portion of § 25.1103(f) which states requirements for the heat tolerance of materials is revised to clarify the applicability and is moved to § 25.1103(e).

d. **Policy/Compliance Methods**.

(1) ***Duct Fire Resistance.*** Section 25.1103 addresses turbine engine, reciprocating engine, and auxiliary power unit (APU) inlet ducts. It specifically requires that:

- the engine inlet duct be fire-resistant when it is located in a fire zone that has fire extinguishing, and
- ducts for APU's be fireproof within their fire zone.

The intent of the rule is that, if a fire were to start in the fire zone surrounding the inlet duct, then the fire protection features within the fire zone (detection, isolation of combustibles, fire extinguishing) would allow control of the fire before the fire could escape the zone through the inlet duct. Compliance of an engine installation with these regulations would also require consideration of the design-specific fire protection features. For example, if the engine inlet were to 1) form part of a firewall or 2) be part of the nacelle skin where escape of flame from the fire zone could result in a hazard to the airframe, the inlet duct would be required to be fireproof.

Clarification regarding compliance with § 25.1103(e) with respect to the rule allowances for sufficient distance and the maximum heat conditions likely to occur is needed. Questions have been raised concerning the situation where flame penetration at the APU inlet door seal location should be acceptable for compliance with § 25.1103(e), in consideration of these rule allowances. The rule requires that the APU inlet duct be fireproof a sufficient distance upstream of the APU compartment and the remainder of the inlet duct to be capable of resisting the maximum heat conditions likely to occur during an APU reverse flow condition.

The "sufficient distance" has been reviewed with respect to APU installation location from the standpoint that flame and hot gas reverse flow egress into the airplane cavity surrounding the APU inlet is an unsafe condition. This area of the airplane normally is a flammable leakage zone, but void of ignition sources. The addition of the APU burn-

through flame or hot gas reverse flow would be hazardous to the airplane. Therefore, in this case the sufficient distance for the APU inlet duct to be fireproof extends to the APU inlet door. However, no set distance or other simple criterion is foreseen which could be universally used for defining "sufficient distance" for compliance with this requirement. Therefore, there will still be no substitute for early coordination with the FAA certification team responsible for the specific certification project.

With respect to withstanding the maximum heat conditions likely to occur, it is considered that the demonstrated flame penetration at the inlet door seal precludes meeting this criteria. Consideration should not be given for the differences in seal temperatures experienced during the fire test and that predicted for an actual reverse flow condition. Actual reverse flow data for the APU installation should be provided along with seal temperatures recorded during the fire test. The door seal is normally located at the opposite end of the duct from where the burner flame is applied and, therefore, is subject to temperatures substantially below that of the burner flame. The temperatures experienced during this test should be considered representative of those associated with reverse flow conditions for the APU installation. Therefore, if the seal failed in such a way as to allow the passage of flame, test evidence would demonstrate that the seal did not withstand the heat conditions likely to occur during a fire/reverse flow situation.

(2) *Equivalent Means of Compliance to Fire-resistant Requirements***:** The following policy information has been extracted from an FAA Issue Paper, dated July 28, 1982, concerning APU inlet duct installation and automatic features of the APU control system, and the proposed compliance by equivalent safety means:

> The applicant intends to demonstrate compliance with certain regulations forming the basis of certification for the APU installation by equivalent methods of compliance. In lieu of specific compliance with Section 25.1103(e) requiring fireproof inlet duct construction, the applicant has installed a load compressor inlet temperature (LCIT) sensor as part of a system which is intended to prevent reverse flow into the APU inlet when inlet air temperature exceeds a safe value. The proposal is dependent on automatic features of the APU control system and is designed to prevent an unsafe condition from occurring rather than assuring continued operation as a source of bleed air or horsepower.
>
> The LCIT control system design and test were reviewed and the design is considered acceptable as supporting the proposed APU inlet fireproof construction based on the demonstrated failsafe and checkable features of the LCIT control system. However, final approval is dependent on review and acceptance of the test results and a complete system description and analysis. The APU reverse flow protection system is designed such that if the load compressor inlet temperature (LCIT) exceeds 210°F for 0.100 seconds or rises 60°F in 1.1 seconds, the APU is automatically shutdown by the ECU. This feature in the control system precludes sustained hot gas reverse flow. The APU reverse flow protective shutdown system complies with the requirements in FAR 25.1103(e), (f).

(3) *Denial of Equivalent Safety Finding to Section 25.1103(e) - Proposed Use of Temperature Sensor*. The following policy information has been extracted from an FAA Issue Paper, dated June 14, 1989, concerning certification of the APU inlet duct installation:

> The applicant intends to demonstrate compliance with certain regulations forming the basis of certification for the APU installation by equivalent methods of compliance.
>
> In view of the specific compliance with Section 25.1103(e) requiring fireproof inlet duct construction, the applicant has installed an inlet temperature (LCT) sensor as part of a system which is intended to prevent reverse flow into the APU inlet when the inlet air temperature exceeds a safe value. As this system is used, the applicant contends that the APU inlet duct does not have to be fireproof.
>
> If the applicant wishes to pursue an equivalent safety finding, data requesting and supporting such a finding should be submitted through the local regulatory agency. The FAA would consider the request to determine if an equivalent safety finding can be made.
>
> The FAA reviewed the APU data package submitted and, as identified in meetings with the applicant, there is no monitor or checkability feature of the inlet temperature sensor system.
>
> In addition, the indication of overtemperature is “Bleed X” which, per the Aircraft Operating Manual (AOM), is a pneumatic duct overtemp and resultant action is to cycle the bleed on/off. If the light persists - shutdown the bleed. There is no specific information to the crew of an APU fire/overheat in the inlet.
>
> The applicant’s additional position with respect to distance and temperature do not relate to a proposed requirement (2,000°F) for a distance upstream of the compartment. The aluminum duct is attached to the APU compartment bulkhead and the temperature sensor is immediately upstream in the aluminum duct. Also, the FAA does not accept a probability as equivalent to a physical requirement (fireproof) and the fire condition may not be just a reverse flow but could, for example, be a failed shaft and a fuel fed fire in the inlet ducting. Upon further review, the FAA does not accept that the installation of a temperature sensor can replace the required fireproof duct and, therefore, equivalency cannot be found.

(4) *Inlet Duct Fire/Combustion Integrity Policy*. The following policy information is an extraction from a FAA memorandum entitled, “Inlet Duct Fire/Combustion Integrity Policy,” dated June 16, 1983:

> This office has been involved with an applicant and their vendors in establishing the fire characteristics of their composite inlet ducting for the airplane. The applicant forwarded a six foot inlet duct (fire seal, forward and aft sections) to the vendor for fire testing per FAA approved procedures. The test objective was to establish the fireproof integrity of the seal as installed with the duct.

During testing, after the application of the burner to the fire seal, the forward duct section (forward of the seal) ignited 45 seconds after the start of the test and burned vigorously and emitted dense black smoke. With the burner removed from the test duct four or five attempts were made to extinguish the fire with a CO_2 extinguisher, but all attempts were unsuccessful because of repeated re-ignition of the material. Finally, the fire was extinguished at seven minutes from the start of test using a water pressure hose after much of the forward duct had already been consumed. The inlet/firewall seal was intact and was not destroyed and the aft & center portion of duct indicated normal integrity. (The aft portion of the duct did not ignite as this portion was shown to be fireproof during earlier FAA tests.) The aft portion of the duct is fabricated from numerous types of material layers, some of which are: Kevlar, graphite, epoxy primer, intumescent paint, polyurethane, fiberglass, and resin. The forward inlet duct is fabricated from Kevlar, epoxy primer, polyurethane, and resin. This portion of the duct failed to maintain integrity possibly from the lack of use of graphite and intumescent paint materials. In addition, the forward inlet duct may have failed because the test specimen was not fabricated with the firewall bulkhead attached, which would tend to protect the forward section from external flame impingement during testing.

This office discussed the test results with the applicant. Although it was known after the test that the test duct delivered to the vendor did not have a firewall bulkhead attached, the FAA nevertheless advised them that the materials for the forward portion of the duct were not appropriate powerplant materials for this application.

The basis for this conclusion was derived predicated on the following considerations:

(i) When the Federal Aviation Regulations (FAR) were derived for induction systems, conventional materials were aluminum and fiberglass -- materials that do not support combustion. The characteristics of combustion of certain composites were neither known nor foreseen at that time.

(ii) Entry of flammable fluids or combustibles into an inlet duct is not acceptable.

(iii) It is considered that inlet duct materials which, when ignited and cannot be extinguished by normal means, do not meet crashworthiness or “wicking” philosophy.

(5) *Compliance with Section 25.1103(d), Duct Failure Criteria.* Compliance with the provisions of this subparagraph requires demonstration that no hazard will result due to failure of turbine engine and auxiliary power unit bleed air duct systems. This may require incorporation of pressure relief provisions (such as pressure relief doors) into the engine nacelle, APU enclosure and other areas of the airplane that contain high pressure air sources. Substantiation of compliance utilizing pressure relief analysis is acceptable. The duct burst analysis should include evaluation of the effects of the initial pressure increase and associated effects of high temperature air on critical components or systems. This rule has been interpreted to include consideration of

hazardous effects of failure of ducting within the engine nacelle such as nacelle anti-ice ducting and surge bleed valves.

e. **References.**

(1) Notice of Proposed Rulemaking 68-18 (33 FR 11913, August 22, 1968).

(2) Amendment 25-23 (35 FR 5665, April 8, 1970).

(3) Amendment 25-46 (43 FR 50578, October 30, 1978).

(4) Notice of Proposed Rulemaking 75-31 (40 FR 29410, July 11, 1975),

(5) AC 20-135, "Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards, and Criteria."

(6) FAA Issue Paper, "Equivalent Means of Compliance to Fire-resistant Requirements," dated July 28, 1982.

(7) FAA Issue Paper, "Denial of Equivalent Safety Finding to Section 25.1103(e) - Proposed use of Temperature Sensor," dated June 14, 1989.

(8) FAA internal memorandum, "Inlet Duct Fire/Combustion Integrity Policy," dated June 16, 1983.

Section 25.1105 Induction system screens.

a. **Rule Text.**

If induction system screens are used-

(a) Each screen must be upstream of the carburetor;

(b) No screen may be in any part of the induction system that is the only passage through which air can reach the engine, unless it can be deiced by heated air;

(c) No screen may be deiced by alcohol alone; and

(d) It must be impossible for fuel to strike any screen.

b. **Intent of Rule**. The intent of this rule is self-evident.

c. **Background.** The regulatory history shows that the requirement originated from Section 464 of the Civil Air Regulations (CAR) 4b, December 31, 1953. Amendment 25-AD (29 FR 18289, December 24, 1964) added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b without any substantive changes. No amendments have been issued.

d. **Policy/Compliance Methods.** No policy is currently available.

e. **References.**

(1) Civil Air Regulations (CAR) 4b, December 31, 1953.

(2) Amendment 25-AD (29 FR 18289, December 24, 1964).

Section 25.1107 Inter-coolers and after-coolers.

a. **Rule Text.**

Each inter-cooler and after-cooler must be able to withstand any vibration, inertia, and air pressure load to which it would be subjected in operation.

b. **Intent of Rule.** The intent of this rule is self-evident.

c. **Background.** The regulatory history shows that the requirement originated from Section 466 of the Civil Air Regulations (CAR) 4b, December 31, 1953. Amendment 25-AD (29 FR 18289, December 24, 1964) added Part 25 [New] to the Federal Aviation Regulations and replaced Part 4b of the Civil Air Regulations. It was part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 FR 10698). Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 FR 7169), and given further distribution as Notice No. 64-28. This rule was recodified from CAR 4b without any substantive changes. No amendments have been issued.

d. **Policy/Compliance Methods.** No guidance is currently available.

e. **References.**

(1) Civil Air Regulations (CAR) 4b, December 31, 1953.

(2) Amendment 25-AD (29 FR 18289, December 24, 1964).