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WORKING PAPER

CONFERENCE ON AVIATION AND ALTERNATIVE FUELS

Rio de Janeiro, Brazil, 16 to 18 November 2009

Agenda Item 3: Measures to support development and use

ENGINE AND AIRCRAFT CERTIFICATION FOR USE WITH ETHANOL

(Presented by Brazil)

SUMMARY

Ethanol is a compelling alternative fuel for piston engine aircraft in use in the agricultural sector in Brazil; ethanol can be produced cheaper than aviation gasoline, is independent of world oil prices, and can be used in piston engines with lower emissions than current fuels.

A certification process is in place to allow engines and their associated aircraft to be modified to use ethanol. As part of certification, a number of tests must be conducted to demonstrate materials of construction, operating performance, and similar factors for both engines and aircraft are satisfactory. Regulatory review determines additional requirements that must be met.

Separate compliance certificates are issued for the engine and the airframe as part of final approval.

The conference is invited to approve the conclusions in paragraph 4 and the recommendations in paragraph 5.

1. INTRODUCTION

1.1 Brazilian aviation development is significantly affected by the dependence of the price of aviation gasoline (avgas) on world oil prices. In this context, ethanol appears to be an attractive alternative to Avgas.

1.2 Ethanol, as defined by the "REGULAMENTO TÉCNICO ANP Nº 7/2005"[1] specification, is an energy resource for which the production chain is totally developed and integrated within the Brazilian national territory, contributing to employment generation and wealth in various

[1] The National Agency of Petroleum, Natural Gas and Biofuels (ANP) is responsible for the specification of Anhydrous Ethanol Fuel (AEAC) and Hydrous Ethanol Fuel (AEHC). The discussion over here refers to the latter, which is the ethanol fuel available at gas stations in Brazil.

sectors of the Brazilian economy. Another aspect of the utilization of ethanol in aviation is the opportunity for technological innovation in terms of engine efficiency. Agricultural aviation has a relevant role for the country's economy because it is recognized for its modern, fast, and efficient handling technique. Agricultural aviation improves the national agro industry productivity index and reduces cost, assuring the competitiveness of Brazilian agricultural products in world markets. Additionally, ethanol is an important alternative fuel whose use in agriculture has positive environmental aspects as a result of its reduced life-cycle and direct emissions compared to avgas.

1.3 Ethanol has a low price compared to Avgas, and technology is already available in the automotive industry for using this kind of fuel in reciprocating aircraft engines. This has raised operators' interest in using ethanol as an avgas replacement, especially in the agricultural aviation services.

1.4 Changing a fuel to be used in an aircraft engine and in its respective aircraft is considered a major modification to the original design according to "Regulamento Brasileiro de Homologação Aeronáutica" (RBHA) 21.93 - Classification of changes in type design. Because of this, ethanol use must be approved according to internationally recognized standards legally adopted in Brazil, as required in RBHA 21.97 - Approval of major changes in type design.

1.5 This working paper gives a generic overview of Brazilian certification process for engine and aircraft modified to use ethanol. Specific details of the process are usually determined on a case-by-case basis.

2. CERTIFICATION PROCESS

2.1 The certification process depends on the determination of which requirements of the product certification basis are affected by the modification. The applicant is responsible for the elaboration of a preliminary list of these affected requirements, as well as the method intended to demonstrate compliance with those requirements.

2.2 It must be emphasized that it is applicant's duty to perform all of the inspections and tests necessary to demonstrate compliance with the applicable requirements. The certification authority is responsible to evaluate and determine the requirements affected by the modification.

2.3 The certification basis of any major modification of an engine or an aircraft is determined by RBHA 21.101. According to FAA AC 21.101-1, accepted by ANAC as an interpretation guideline of RBHA 21.101, the utilization of a different fuel than specified for an engine or aircraft is considered a non-significant change, therefore, it does not require compliance with all requirements prior to the date of application for the change approval. The analysis of requirements affected by the change considers the influence of physical and chemical properties of ethanol on the entire fuel system, including engine and aircraft.

2.4 The list of affected requirements plus the respective methods for demonstrating compliance form the Compliance Checklist. This list becomes part of another document, called the Certification Plan, which has to be elaborated individually for both the modified engine and the aircraft.

2.4.1 For engine modification approval, the main aspects to be assessed are material compatibility, ignition properties, power increase, corrosion, cold start, and endurance.

2.4.2 For aircraft modification approval, the main aspects to be assessed are material compatibility, structure and components corrosion, high and low temperature operation, engine overcooling, ice protection, flight characteristics, and operating limitations.

2.5 ANAC eventually determines the need for compliance with additional requirements or complementary tests, envisaging flight safety and continued airworthiness. e.g. engine behavior with various degrees of water content in ethanol and the influence of different ignition setting points in the engine performance.

3. APPROVAL

3.1 For each certification process there is a respective certificate issued. However, the issuance of the aircraft approval certificate depends on the conclusion of the process related to the engine compliance requirements. Without the engine certification for the modification, the aircraft certification would not be possible.

4. CONCLUSION

4.1 The conference is invited to conclude:

a) Ethanol presents several environmental and cost advantages over aviation gasoline;

b) Brazil has identified a procedure for gaining approval of ethanol for use in piston engine aircraft; and

c) Ethanol is a compelling alternative fuel for piston engine aircraft.

5. RECOMMENDATION

5.1 The conference is invited to:

a) Recommend that States define an appropriate regulatory process for approving the use of ethanol in piston engine aircraft;

b) Recommend that States consider ethanol for piston engine aircraft as an alternative to aviation gasoline.

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