



WORKING PAPER

CONFERENCE ON AVIATION AND ALTERNATIVE FUELS

Mexico City, Mexico, 11 to 13 October 2017

Agenda Item 1: Developments in research and certification of aviation alternative fuels

**ALTERNATIVE FUELS CERTIFICATION PROCESS ACCOMPLISHMENTS
AND CHALLENGES**

(Presented by the United States of America)

SUMMARY

Since the First Conference on Aviation and Alternative Fuels (CAAF1), the alternative fuel airworthiness certification approval process has evolved to a greater level of maturity. The United States Federal Aviation Administration (FAA) has introduced procedures along with control and funding mechanisms that have added structure to the overall process and facilitated the progress of new alternative fuel pathways towards ultimate approval. This has led to the approval of five alternative fuel pathways, with several more approaching approval. The FAA has recently established the D4054 Clearinghouse to further improve the process with a single primary focal point to manage the evaluation and approval of new alternative fuel pathways. This WP describes the current fuel approval process and the D4054 Clearinghouse concept being utilized by the aviation industry in the United States to qualify and certify new classes of aviation fuels. The concepts presented here should be applicable to other CAAs and fuel specification-writing organizations.

Action by the Conference is in paragraph 4.

1. INTRODUCTION

1.1 The alternative aviation fuel approval process utilizes the ASTM International Aviation Fuel Subcommittee (Subcommittee J) to coordinate the evaluation of fuel test data and the establishment of specification criteria for candidate alternative aviation fuels. Subcommittee J has issued two standards to facilitate this process; ASTM D4054 – “Standard Practice for Qualification and Approval of New Aviation Turbine Fuels and Fuel Additives”, and ASTM D7566 – “Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons”.

1.2 The paper below provides progress to date and ongoing efforts related to the ASTM International process. Additional details on the ASTM process and the efforts outlined below were

presented at the February 2017 ICAO Seminar on Alternative Fuels, which can be viewed in Appendix A below.

2. PROGRESS TO DATE

2.1 ASTM D7566 was issued in September, 2009. The specification is structured with annexes that define property and compositional requirements for synthetic blending components that can be mixed with conventional, petroleum-derived jet fuel at specified volumes. D7566 includes a provision to allow fuels meeting this specification to be re-identified as conventional fuels when they enter the distribution infrastructure. ASTM International Standard D1655, ‘Standard Specification for Aviation Turbine Fuels, defines the requirements for petroleum derived, conventional jet fuel. This re-identification provision allows the drop-in fuels listed in D7566 to be seamlessly integrated into the infrastructure and on to the aircraft without the need for separate tracking or regulatory approval. This is because the infrastructure is already designed to support D1655 jet fuel, and virtually all civil aircraft are certified to operate with jet fuel meeting specification D1655. So, once a new, alternative jet fuel is added as an annex to D7566, it is approved for use on all civil aircraft certified to operate with Jet A fuel.

2.2 ASTM D4054 was developed to provide the producer of an alternative jet fuel with guidance regarding testing and property targets necessary to evaluate a candidate alternative jet fuel. D4054 is an iterative process, which requires the candidate fuel developer to test samples of fuel to measure properties, composition, and performance. The testing covers basic specification properties, expanded properties called fit-for-purpose (FFP) properties, engine rig and component testing, and if necessary, full-scale engine testing. This is a rigorous process that requires participation and input from many of the stakeholders at ASTM.

2.3 The FAA has issued Special Airworthiness Information Bulletin (SAIB) NE-11-56R21 to communicate that jet fuel made from synthetic blending components that meet the requirements of ASTM International Standard D7566 are acceptable for use on aircraft and engines certificated for operation with Jet A or Jet A-1 jet fuel. This SAIB lists the five alternative aviation fuels that have been incorporated in ASTM D7566:

- a) Fischer Tropsch synthesized isoparaffinic kerosene (FT-SPK) was approved by ASTM for incorporation into ASTM D7566 in September, 2009. In the FT-SPK process, coal, natural gas, or biomass feed stocks are gasified into a syngas comprised of hydrogen and carbon monoxide. This syngas is then catalytically converted to a liquid hydrocarbon fuel blending component in the FT reactor.
- b) Hydroprocessed fatty acid esters and fatty acids (HEFA) was approved by ASTM for incorporation into ASTM D7566 in June, 2011. In the HEFA process, lipid feedstocks such as plant or algae oils, tallow (animal fats), or waste greases such as cooking oils are deoxygenated and then hydroprocessed to produce a pure hydrocarbon fuel blending component.
- c) Synthesized isoparaffins (SIP) was approved by ASTM for incorporation into ASTM D7566 in July, 2014. The SIP process utilizes a fermentation to convert a sugar feed stock into a hydrocarbon molecule that can be blended into conventional jet fuel.

¹ [http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSAIB.nsf/0/db5a49761fe02e8b86257fb8006c963b/\\$FILE/NE-11-56R2.pdf](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSAIB.nsf/0/db5a49761fe02e8b86257fb8006c963b/$FILE/NE-11-56R2.pdf)

- d) Fischer Tropsch synthesized kerosene with aromatics (FT-SPK/A) was approved by ASTM for incorporation into ASTM D7566 in November, 2015. FT-SPK/A is a variation of the FT process where a fully-synthetic alternative aviation fuel containing aromatics is produced.
- e) Alcohol to jet (ATJ) was approved by ASTM for incorporation into ASTM D7566 in April 2016. The ATJ process utilizes dehydration, oligomerization, and hydroprocessing to convert alcohol feed stocks to a pure hydrocarbon fuel blending component. The ATJ process is currently limited to isobutanol alcohol feed stocks, but is in process of being expanded to include ethanol feed stocks.

3. **CURRENT EFFORTS**

3.1 The FAA has established a framework with engine and aircraft original equipment manufacturers (OEMs) to guide and monitor each step in the iterative D4054 review process. This framework is called the OEM Review Process.

3.2 The Federal Aviation Administration (FAA) established the D4054 Clearinghouse under its Center of Excellence for Alternative Jet Fuels and Environment (ASCENT) program to guide candidate fuel producers through this OEM Review Process. The FAA has written a D4054 Clearinghouse Guide that describes the roles and responsibilities of the Clearinghouse.

3.3 The D4054 Clearinghouse project is being managed by the University of Dayton Research Institute (UDRI). The FAA has provided a level of funding intended to establish the clearinghouse and support a limited amount of fuel testing and review. It is anticipated that other sources of funding or in-kind resources will be required from industry, academia, or other Government agencies to fully support the complete scope of testing for future candidate alternative jet fuel projects.

3.4 Work is also underway to develop what is being called a “Generic Annex” to D7566 that would permit the use at a nominal blend level of any fuel that comes from pathways that meet specific compositional and quality control criteria. In concept, the Generic Annex would not be limited to a specific conversion process or feedstock, and a fuel producer would not need to negotiate the D4054 process. This “commodity” specification concept is under consideration by ASTM International and if successful would open the door to low level blending (e.g. less than 10%) of multiple new processes with petroleum jet fuel. This would likely enable earlier commercialization for many fuel producers. However, improved methods for testing fuels and tracking producers might be required for this approach to work. A graphical representation of the Generic Annex can be viewed in Appendix B below.

4. **ACTION BY THE CAAF2**

4.1 The CAAF2 is invited to:

- a) communicate the drop-in AJF certification concept as described in FAA SAIB NE-11-56R2 to domestic aviation regulatory agencies and recommend that they issue similar communications to their domestic aviation community;
- b) encourage the collaboration of States and industry with the D4054 Clearinghouse to support the evaluation and approval of alternative aviation fuels;

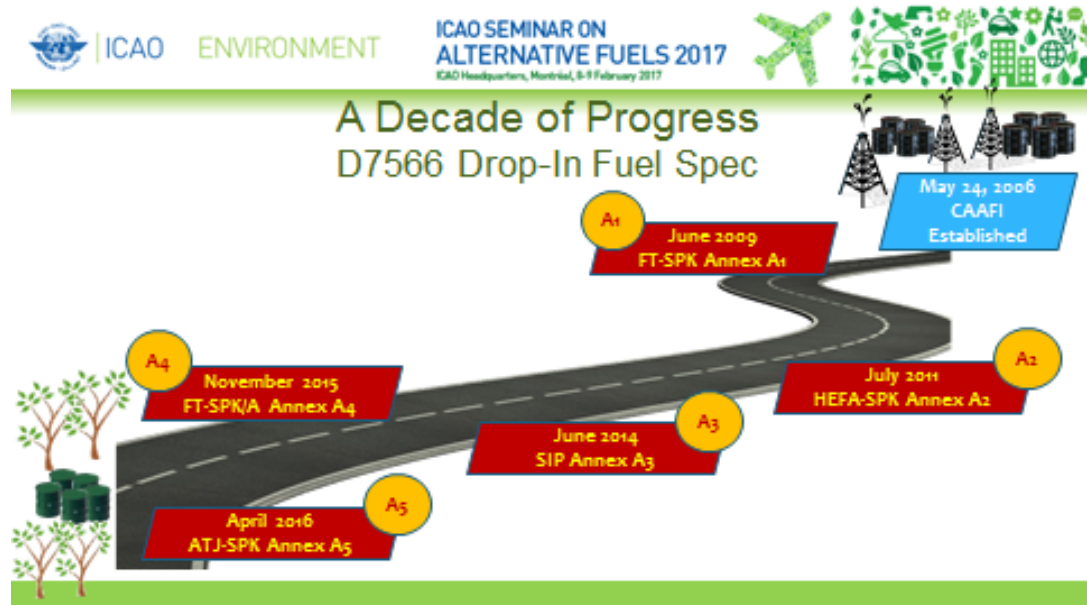
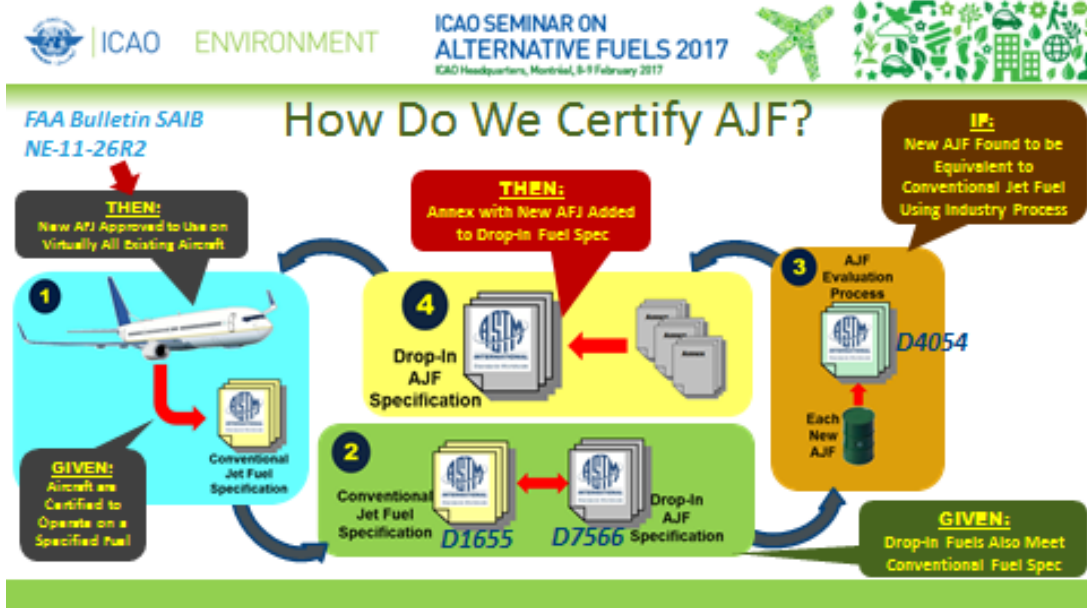
- c) encourage the testing and evaluation of candidate alternative jet fuels; and
- d) encourage States to direct candidate AJF producers to ASTM and support their qualification effort at ASTM.

APPENDIX A

PRESENTATION ON ALTERNATIVE JET FUEL (AJF) CERTIFICATION

1.1 Presentation on Alternative Jet Fuel (AJF) Certification given by Mark Rumizen at the ICAO Seminar on Alternative Fuels 2017. This presentation can be downloaded from: <https://www.icao.int/Meetings/altfuels17/Documents/Mark%20Rumizen%20-%20FAA.pdf>





The Current Challenge



D4054 Qualification Process







ICAO SEMINAR ON
ALTERNATIVE FUELS 2017
ICAO Headquarters, Montreal, 8-9 February 2017



Policy Requests

1. Direct R&D resources and funding to the D4054 Clearinghouse to support the testing and evaluation of candidate alternative jet fuels.
2. Direct state-domestic candidate AJF producers to ASTM and support their qualification effort at ASTM.
3. Communicate the drop-in AJF certification concept as described in FAA SAIB NE-11-56R2 to domestic aviation regulatory agencies and issue similar communications to domestic aviation community.



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APPENDIX B

GRAPHICAL REPRESENTATION OF THE D7566 GENERIC ANNEX CONCEPT

D7566 Generic Annex

