Aviation Fuel Standard Takes Flight

D7566 Revision Adds Bioderived Components

BY CICELY ENRIGHT

The recent revision to ASTM D7566 allows new components to be manufactured from jatropha, camelina, and fats and combined with conventional aviation jet fuel.

Powered in part by a 50 percent jatropha-derived jet fuel, the first experimental demonstration flight (non-passenger) using this bioderived fuel component took off from Auckland, New Zealand, in December 2008.

Less than three years later, the first regular scheduled commercial route from Hamburg to Frankfurt, Germany, started a six-month trial and took flight with one engine operating on a 50 percent biofuel component consisting of jatropha, camelina and animal fats.

Helping to make commercial flight with bioderived fuel components a reality is the recently approved revision to an ASTM International standard, D7566, Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons. The standard, first published in 2009, now includes an annex with requirements for synthetic fuel components manufactured from hydroprocessed esters and fatty acids (HEFA), produced from various renewable sources. ASTM International published D7566-11 on July 1, 2011.

"This is a significant step toward a new era of greener and more energy-independent air travel," noted Federal Aviation Administration Administrator Randy Babbitt in a recent statement about D7566.

The standard, developed by a task force in Subcommittee D02.J0 on Aviation Fuels, part of ASTM International Committee D02 on Petroleum Products and Lubricants, represents a collaboration across the fuel supply chain, with HEFA fuel producers, aircraft and engine manufacturers, and regulatory agency and airline representatives who were involved in the specification revision as well as its development.

BIODERIVED FUEL BENEFITS

"The challenge [to revising D7566] really was the need to balance safety along with the need of the industry to introduce a renewable fuel and an alternative supply of aviation fuel," says Mark Rumizen, who helped lead the work to revise D7566. Rumizen heads the certification-qualification group for the Commercial Aviation Alternative Fuels Initiative, a coalition that seeks to enhance sustainability for aviation by promoting the use of alternative jet fuels.

D7566-11 enables the use of such fuel components without compromising safety. Rob Midgley, technology manager, aviation fuels, for Shell Aviation, Cheshire, Great Britain, and a D02 member who worked on the D7566 revision, says, "The approval of HEFA as a blending component in jet fuel builds on the great efforts expended by ASTM on approving Fischer-Tropsch components in 2009 and shows that, as a consensus group, ASTM can make great strides while still maintaining the safety levels demanded by the aviation sector."

The results are clear, according to Rumizen. "The revision combined the highly skilled talents of the technical people involved, along with an understanding of the need to address the global warming effects of aviation along with the issue of concerns with providing an alternative supply of aviation fuel," he says.

Jim Rekoske, vice president and general manager of renewable energy and chemicals for Honeywell's UOP, notes that benefits to the environment should arise from the use of bioderived fuels. Rekoske says that aviation biofuels should help to decrease the industry's carbon footprint: "Our life cycle analysis testing shows that fuels made from camelina, jatropha and algae can offer as much as an 85 percent reduction in net carbon emissions compared to petroleum fuels."

The D7566 revision also responds to evolving environment-related regulations and policies in Europe and the United States. In the European Union, under its Climate Action policy requirements that next year will begin to include airlines in its emissions trading system, greenhouse gas emissions need to be calculated and reduced to avoid additional fees or taxes. In the United States, for example, through the military's operational energy strategy, the Department of Defense plans to diversify its energy sources, among other goals, and continue to invest in research and development, testing, evaluation and ultimately the use of


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alternative fuels with greenhouse gas emissions less than or equal to emissions from conventional fuel. In both areas, D7566 supports such approaches.

"The requirements also ensure that fuel from natural oils and fats meets all of the quality and performance standards of petroleum-based fuels," says Rekoske. "By establishing D7566 and making sure fuels meet these specifications, users can be certain the fuel is safe for use."

THE D7566 AND D1655 CONNECTION

The D7566 specification addresses aviation turbine fuel containing synthesized hydrocarbon, and it meshes with the time-tested ASTM D1655, Specification for Aviation Turbine Fuels, a globally used aviation fuel specification first approved in 1959.

The new edition of D7566 prescribes performance requirements for HEFA aviation fuel blending components, which can be manufactured from a variety of feedstocks such as the inedible plants camelina and jatropha, algae, coconut or vegetable or other oils, chicken fat and more. The standard already specified blend components produced through Fischer-Tropsch synthesis.

According to the new edition of D7566, criteria for the bioderived or HEFA component consist of more demanding thermal stability, distillation control and trace material requirements, notes Rumizen, as well as additional requirements for lubricity, distillation and composition after blending.

The standard specifies that no more than 50 percent of a fuel can be the synthetic portion; at least 50 percent must be conventional commercial jet fuel, or Jet A and Jet A-1.

"HEFA is a pure hydrocarbon fuel," Rumizen says, "It is essentially identical to conventional jet fuel, meaning there are no performance or operability differences at all."

In order to be used on an airplane, fuel needs to meet the requirements of the airplane equipment certification, explains Stanford Seto, chairman of Subcommittee D02.J0 and a contractor in Cincinnati, Ohio, for Belcan Engineering Corp., a firm that provides services to aviation equipment manufacturers worldwide. So that the D7566-11 blend components can be used on certificated aviation engines calling for fuel meeting requirements of ASTM D1655, the D7566 standard states that "Aviation turbine fuel manufactured, certified and released to all the requirements of this specification meets the requirements of specification D1655 and shall be regarded as specification D1655 turbine fuel." Seto says, "This allows these new D7566 fuels to be seamlessly integrated into the distribution infrastructure and onto certificated aircraft as D1655 fuels."

D02.J0 AND ALTERNATIVE AVIATION FUELS

ASTM Committee D02 first focused on alternative aviation fuels in the early 1990s when representatives of global energy company Sasol attended D02 and D02.J0 meetings in connection with their manufacture of a synthetic fuel component —

an isoparaffinic kerosene (IPK) — in South Africa using the Fischer-Tropsch process. At the time, Sasol company helicopters flew with the blendstock, and needed both specifications and test methods that would cover their plan to use the fuel to extend the available Jet A-1 fuel supply at what was then the Johannesburg International Airport.

"That was the very initiation of synthetic components being used in jet fuel," Seto says. Research work commenced to study and determine the needed properties for the blendstock, and IPK became part of a United Kingdom standard: Ministry of Defence Standard 91-91 Turbine Fuel, Aviation Kerosine Type, Jet A-1. The IPK approval process also became part of ASTM D4054, Practice for Qualification and Approval of New Aviation Turbine Fuels and Fuel Additives, which had been first approved in 1981 and significantly modified in 2009. D4054 provides a framework to qualify and approve new fuels and new fuel additives for both commercial and military aviation gas turbine engines.

Then, in early 2007, ASTM D02.J0.06 on Emerging Turbine Fuels organized in D02.J0 to address this up-and-coming aviation fuel arena and consider additional standards for aviation fuels with nonpetroleum material components. The emerging fuels group, charged with developing a specification for jet fuel from synthetic sources, began with the Fischer-Tropsch process and developed the first edition of D7566, approved and published in 2009.

The Fischer-Tropsch process can be used to produce blending components from renewable feedstocks or from fossil fuel sources. A refiner uses Fischer-Tropsch to break down the feedstock, whether a biomaterial or coal or natural gas, into elemental constituents, extracting carbon monoxide and hydrogen, to synthesize into a petroleum wax that can be made into an aviation fuel component.

WHAT'S AHEAD

The D7566 specification lays out a framework for the aviation industry to make use of HEFA- and Fischer-Tropsch-processed blendstocks, and other potential synthetic fuel components that may become part of D7566 in the future.

Oil companies, refiners and producers of aviation turbine fuel and new alternative fuel producers will use the new specification in their operations to manufacture the fuel. These fuels are recertified, usually by the refinery or transportation company, as D1655 fuels as they move into the distribution infrastructure that moves aviation turbine fuel from producers to end users. "The airline has ultimate responsibility for ensuring the fuel meets the specification before loading it on the aircraft," says Rumizen.

Now the biggest challenge facing the industry is the investment required to scale up production and produce the quantities of fuel needed to make an impact in the industry.

"It's true that it will take some time to ramp up feedstock production and refining capacity, but we believe that biofuels could make up anywhere from 5 to 15 percent of the total aviation fuel supply by 2020," says Rekoske.

Seto notes that the cost still needs to be considered as synthetic fuel components are significantly more expensive currently than conventional aviation jet fuel. He adds that price will come down as more feedstock becomes available and that quality control will be critical to fuel quality and safety during production and use.

However, the first key step to changing the situation — and to such blend component manufacture and use — is an agreed upon specification, and that has happened with the revision to D7566.

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