Piston Aviation Fuel Initiative

The Piston Aviation Fuel Initiative (PAFI) was established at the request of a broad cross section of the aviation and petroleum industries and consumer representatives to develop a path forward for the identification, evaluation and deployment of the most promising unleaded replacements for 100 low lead aviation gasoline. The mission of PAFI is to evaluate candidate unleaded replacement fuels and identify those fuels best able to technically satisfy the needs of the existing aircraft fleet while also considering the production, distribution, cost, availability, environmental and health impacts of those fuels. Mounting environmental and economic pressure necessitates a transition to unleaded fuel. Unfortunately, the aviation and petroleum marketplace, in concert with existing government regulations and policies, do not support an orderly and economically viable fleet-wide transition to a new fuel or fuels, hence the need for the joint government and industry collaborative initiative known as PAFI.

Aviation gasoline has remained largely unchanged for seventy years and the existing fleet of piston aircraft was designed to be compatible with its chemical and physical properties to achieve superior levels of safety, reliability, durability and performance. The FAA's certification activities and supporting policies have therefore not focused on certifying an existing fleet of aircraft to a new fuel or evaluating the properties and performance of fuels themselves, but rather on ensuring the airworthiness of products operating on known fuels conforming to long-established specifications.

To date, the only paths for approving a new fuel for use in existing products was for the OEM to amend their type certificate (TC), or for a third party to obtain a supplemental type certificate (STC) from the FAA, a process intended to ensure flight safety of an existing aeronautical product when operating on the specific fuel to which it was tested. This approval process requires a separate showing that each aircraft and engine complies with all of the airworthiness standards when operated on the new fuel. This process was identified by industry as being too costly and inefficient to be successful in transitioning the entire existing aircraft fleet to any new fuel, particularly because much of the fleet is no longer supported by an active manufacturer. It was also identified that existing evaluation paths examine the airworthiness of the aeronautical products but are not designed or intended to evaluate the chemistry and properties of the fuel. While there are options available for approved model list supplemental type certificates (AML-STC) that can cover a range of aircraft and engine models, such an approval process can be complex and would not likely result in the orderly fleet-wide transition necessary to maintain the economic viability of the piston aircraft fleet. Other available avenues for approval such as amended type certificates or the issuance of manufacturer service instructions authorizing the use of a new fuel across a range of models pose similar barriers and complications to an orderly and comprehensive transition and do little to address the orphan fleet of aircraft and engines no longer supported by an active manufacturer.

Aviation fuel commercial development and deployment over the past seven decades has relied on industry organizations comprised of a diverse group of industry stakeholders possessing experience and technical knowledge in the areas of powerplant engineering, fuel system design, combustion engineering, chemical engineering, toxicology and emissions, and fuel production and distribution, among others. These industry stakeholders require that a new fuel must both be shown to operate safely across the fleet of existing engines and aircraft, and must be able to be produced and distributed across existing infrastructure safely and efficiently. Thus, it is recognized that significant additional information beyond that required for FAA airworthiness approval is necessary to bring a fuel into actual production and distributed as a commodity in the marketplace.

Fuels move seamlessly around the globe because of broad-based understanding and acceptance of the products, their properties and behaviors, and commonality between production, distribution and testing methods. Such acceptance is necessary to ensure widespread, reliable, and economically viable production, distribution, and usage wherever aviation gasoline is needed. This global acceptance is the result of open consensus-based processes that permit peer review and significant standardization among both the products and their respective testing methods and specifications.

Inherently, existing FAA certification procedures such as STCs, amended TCs and service letters are a closed review process between a fuel developer and the FAA office and/or OEM, relying upon data that is often considered to be proprietary intellectual property. While this may work for FAA airworthiness approval resulting in the ability to burn a particular fuel in a particular aircraft and engine combination or list of combinations, it does little to overcome the barriers to the broad acceptance necessary for fleet-wide implementation by the petroleum, specialty chemical, aviation, and insurance industries as well as the end consumer. FAA certification procedures also do not address the concerns of environmental and health advocacy groups and regulators who have a stake in the emissions and toxicology of any new unleaded fuel. Additional peer review, testing, data collection and the development of industry consensus standards are all necessary steps above and beyond FAA airworthiness approval to bring a fuel to the marketplace as anything other than a specialty proprietary product with limited availability and application.

PAFI was conceived and established to overcome these barriers to entry into the aviation fuel marketplace by creating a process that would evaluate all of the properties and conditions necessary for broad production, distribution and usage of a new unleaded aviation fuel, and expeditiously develop data necessary to support FAA approval of the majority of the existing fleet of piston aircraft to operate on that fuel. Further, PAFI was designed to conduct much of the testing necessary for fuel production and distribution acceptance and fleet approval using common test facilities, procedures and industry consensus standards leading to broad

marketplace acceptance and adoption. In short, the PAFI process is necessary to take the good ideas of a fuel developer and move them beyond FAA approval in limited applications to fleet wide approval and broad based acceptance in the marketplace. It is the mechanism by which a fuel developer can move beyond having a proprietary product with limited application to become a broadly produced and distributed aviation fuel. In effect, the PAFI process is necessary to help enable widespread market acceptance and fleet-wide certification for a candidate unleaded fuel.

The PAFI process involves a two phase testing program. Phase 1 evaluates candidate fuels for potentially show stopping issues in the production, distribution and operation arenas before significant investment is made in gaining FAA design approval. Among these steps is an evaluation of the chemistry of the fuel and fitness for its intended purpose. Because of the substantially differing chemical makeup of various candidate unleaded fuels and their anticipated departure from the chemistry and properties of traditional aviation gasoline, tests necessary to establish a fuels' fitness for purpose under all reasonably envisioned conditions could vary from one fuel to another. The chemistry and performance properties of the fuels will largely determine the required tests and evaluations necessary, which will increase in scope and complexity with increasing deviation from the chemistry and properties of the existing fuels for which the fleet was designed and certificated. The PAFI process is intended to assess the makeup of various fuels and establish credible and peer-reviewed test protocols for ascertaining necessary fit-for-purpose data. Because the PAFI process has broad buy-in across the petroleum and aviation industries and is overseen by an independent, collaborative government/industry body of technical experts with no profit motive or stake in the outcome, results are viewed as objective, helping to ensure broad acceptance in the marketplace of successful candidate fuels that pass through the PAFI process.

Other critical Phase 1 evaluations include; assessing the emissions and toxicology properties and resultant impacts, evaluating whether a fuel can be produced and distributed broadly and economically, and determining that the fuel will perform adequately across its full intended compositional range in the existing fleet of engines and aircraft, effectively ensuring that it will be tested under worst case conditions of fuel composition and operating environment. The PAFI process also endeavors to examine the business case for candidate fuels looking at projected production, availability, and distribution models in an effort to ascertain whether a fuel would be readily producible and available at a manageable cost.

Having proved the technical, environmental and business case merits of proposed unleaded replacements to 100 low lead in Phase 1, fuels determined to be the most promising are approved for entrance into Phase 2. These fuels are ready to be tested now at the engine and aircraft level with an eye toward their adoption across as much of the existing fleet as possible. The PAFI process endeavors to do this by funding the Phase 2 engine and aircraft testing in support of fleet-wide adoption under the oversight of the FAA Technical Center in Atlantic City, New Jersey. The

data collected from this federally-funded test plan would not only lead to acceptance of the fuels but also generate data that can be used to support the fleet wide approval of aircraft and engines including the orphaned fleet no longer supported by a manufacturer. This step is critical to addressing implementation of fuels in the marketplace in an orderly and comprehensive manner. FAA involvement in this step of the process is crucial not only to ensure that the entire fleet is addressed but also to bring the credibility of test methodology and data necessary for the petroleum and aviation industry and consumers to accept and adopt the fuel across the board.

Ultimately, the PAFI process is not intended to be a barrier to entry for proposed fuels but rather is designed to enable the most promising fuels to undergo the necessary independent peer review and data collection necessary to gain broad-based industry, regulatory, and consumer acceptance leading to production and sale across the entire aviation marketplace. History has shown that FAA and/or manufacturer airworthiness approval of a fuel alone does not lead to acceptance by industry and consumers and ultimate production, distribution and sale at airports. Many STCs and manufacturer service instructions have been issued approving fuels that have never been successful in achieving broad production, distribution and user community acceptance. The reasons for this are complex and varied, but in the end the PAFI process is designed and intended to help overcome them. In developing the PAFI process, the petroleum and aviation industries, in cooperation with the FAA and EPA, are applying the lessons learned from past efforts to approve new piston aviation fuels and assist in overcoming the barriers to any new fuel moving from being a good idea to widespread production, distribution and sale in the aviation marketplace. This benefits all parties concerned from the fuel developer to the end consumer and everyone in between.

Ultimately it is everyone's goal that the piston aviation fleet moves efficiently and economically to a viable and safe unleaded future. The PAFI program provides a sound process to ensure that this goal is achieved with a minimum of disruption to the general aviation industry and with the greatest likelihood of marketplace success.