Project 101 Sustainable Aviation Fuel Repository

Washington State University

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- P.I.: Dr. Joshua Heyne
- FAA Award Number: 13-C-AJFE-WaSU-043
- Period of Performance: March 15, 2025, to September 30, 2025
- Tasks:
  1. Investigating detailed needs and requirements of a sustainable aviation fuel (SAF) Repository
  2. Procuring SAF and conventional fuel samples for testing
  3. Testing procured samples for reference data to be leveraged by other partners
  4. Developing a data management protocol for sharing and distributing data
  5. Distributing fuel samples and data to partners per Federal Aviation Administration (FAA) prioritization

Project Funding Level

The ASCENT Project 101 received $2,000,000 from the FAA and cost sharing funding. In-kind cost share funding has been provided by Trinity College Dublin ($1,965,000), Woodward ($35,000), and the state of Washington ($1,200,000).

Investigation Team

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Project Overview

This project will serve to acquire, distribute, test, and document SAF and other reference conventional fuel samples. At present, accessing SAF samples is costly for the FAA and difficult for many research groups. Private, federal, and public research entities have issues collecting relevant SAF samples for testing. The lack of access inhibits progress in SAF research. Concurrently, procuring SAF materials is costlier for the FAA as samples are charged the full overhead rates, and individual acquisitions do not benefit from economies of scale. Fuel samples after acquisition will be tested for critical properties and then distributed to labs, per the preference of the FAA. A small portion of the acquired fuels will be retained for posterity and additional testing if anomalous observations are made.

Task 1 – Investigating Detailed Needs and Requirements of a SAF Repository

Washington State University

Objective

The objective of this task is to investigate detailed needs and requirements of a SAF Repository. SAF is currently produced using novel feedstocks and conversion technologies. The combination of these novel feedstocks and conversion technologies results in unique chemical compositions and physical properties in sustainable aviation fuel. As a result, the blend ratios for approved sustainable aviation fuel pathways vary between 5% and 50% as of October 30, 2025, and work is on-going to qualify SAF pathways at 100%. However, now, the limited blend ratios are the result of the unique properties and compositions of SAF relative to fossil fuel. For example, ASTM D7566 (ASTM International, 2024), the standard for synthetic aviation turbine fuel blend components, includes several annexes that have no aromatic content in the final product. The lack of aromatic content in the final product means that certain properties, such as seal swelling and dielectric constant, are outside of the experience range of 100% fossil fuels. This deviation is pronounced in the case of aromatics, but other more subtle deviations can also occur. For example, SAFs may be composed of only one or two molecules, as in the case of the iso-butanol to jet and Annex A3 in ASTM D7566. These compositions are very different from fossil jet fuel and, as a result, are not considered anything close to a conventional petroleum fuel and hence required blending with conventional petroleum jet fuel before use.

Subtle and dramatic differences in composition can have substantial impacts on many safety and operability aspects. For example, changes in isomeric structure can impact a wide range of properties relevant to aviation. Properties like viscosity, for instance, can be increased substantially with changes in catalyst technologies, which is allowed under current ASTM D7566 definitions. While there are no known issues with allowable blends or the current regulatory framework, it is critical to understand the scientific underpinnings of the impact of compositional variance on all aspects related to aviation fuel impacts on engines, infrastructure, aircraft, humans, and the environment. This task, investigating detailed needs and requirements of a sustainable aviation fuel repository, aims to identify the following characteristics required to assist in understanding the following compositional impacts:

- Types of fuels or synthetic blend components needed
- Volumes of each needed fossil-synthetic blend component
- Number and type of fossil jet fuels for use as reference materials
- Number of entities that are needed to support this project
- Facilities needed to support activities SAF testing and research
- Forecasting future fuels and requirements several years in advance

Research Approach

Types of Fuels or Synthetic Blend Components Needed

There are three categories of fuels or synthetic blend components needed. The first category is benchmark conventional fuels. Conventional or petroleum-based fuels are needed to establish baseline experience ranges in various experimental architectures. Current aviation systems operate effectively, safely, and consistently on conventional fuels. However, all petroleum-based aviation fuels are not all the same. There are deviations across petroleum-based fuels in terms of their densities, viscosities, compositions, contaminants, etc. As a result, it is important to acquire several different petroleum-based fuels for testing in relevant architecture and configurations. Historically, three main petroleum-based fuels have been used for baselining. Under the National Jet Fuels Combustion Program (NJFCP) (Colket & Heyne, 2021), these fuels were defined as Category A fuels: Jet A-1, A-2, and A-3. These three fuels were selected based on their combustor operability characteristics, namely their ability to resist or trigger lean blowout and ignite under altitude conditions. Jet A-1 fuel was selected to be the easiest to ignite and have the lowest lean blowout limit, making it a best-case fuel. Jet A-2 fuel was selected to be an "average" fuel, with properties similar to the average fossil fuel that aircraft in the United States (U.S.) were burning in 2014. The third fuel, Jet A-3, was selected to be a "worst-case" fuel, with the poorest ignition and lean blowout characteristics relative to most conventional fuels used in the U.S. Under this funded activity, the team has sought to acquire these Category A fuels from the U.S. Air Force Research Lab and gather additional fuels from other refineries in the U.S. To the investigation team's knowledge, there are still some volumes of Category A fuels remaining; however, the available quantity of these fuels is not sufficient to meet the needs of the FAA SAF repository project. The team will therefore need to identify and acquire a new batch of reference fuel with properties matched as closely as practical with those acquired during the NJFCP.

The second category of reference fuels sought under the SAF repository project are approved or candidate synthetic blend components. Currently, there are eight annexes under ASTM D7566 that detail the quality control requirements of these materials. Some annexes, e.g., Annex A2, pertain to a product (hydro-processed esters and fatty acids [HEFA]) made by multiple producers. For example, Montana Renewables in Great Falls, Montana, and Neste in Porvoo, Finland, both produce synthetic blend components leveraging the ASTM D7566 Annex A2 pathway. Annex A5 pertains to the production of SAF from alcohols through dehydration, oligomerization, hydrogenation, and fractionation. Lanzajet produces and sells products leveraging this pathway. Several other annexes, A3, A6, A7, and A8 are not currently leveraged by any commercial activity, while annexes A1 and A4 pertain to a Fischer-Tropsch process that usually employs coal as a feedstock. In addition to these eight approved pathways, there are many SAF candidate pathways that are currently undergoing ASTM qualification or working towards entering the ASTM qualification process, ASTM D4054 (ASTM International, 2022). The investigators have identified several institutions and products from these synthetic fuel routes.

The last broad category of synthetic blend components this program has sought to procure are solvents or other hydrocarbon materials that are not currently used as commercial fuels or being produced as an approved ASTM D7566 pathway. Historically, programs have leveraged aromatic solvents such as aromatic (ARO) 100 and ARO 150. Furthermore, there are other solvents, such as NORPAR™ and ISOPAR®, which can be prepared to develop critical blends for testing various features or properties of aviation hardware.

Finally, under the NJFCP, combinations of all these categories were at times blended together to form mixtures that would stress-test various theories related to aircraft operability. These blends were collectively referred to as Category C fuels. Table 1 documents a range of fuels that have been selected based on the criteria above for inclusion in the repository.

Table 1. List of high interest materials for procurement under the repository project.

Category and motivation	Fuel description	Notes	POSF ID	Reason for Inclusion
SAF, emissions	HEFA (ASTM D7566 Annex A2)	Current producers: World Energy,® Montana Renewables, and Neste®	-	-
SAF	ATJ (ethanol) (ASTM D7566 Annex A5)	Lanzatech Global, Inc.	-	-
SAF	ATJ (isobutanol) (NJFCP C-1) (ASTM D7566 Annex A5)	Gevo® or Global Bioenergies	Gevo: 11498 etc.	Historical, low cetane, narrow boiling
SAF	Power to liquids (Air Company)	In development toward ASTM D4054	-	-
Petroleum, operability	NJFCP A-2 "average" jet fuel, also used for blending	-	10325, Jet A (also 4658)	Baseline for combustor operability testing
Petroleum, operability	NJFCP A-3 worst case jet fuel	-	10289, JP-5	High viscosity, high flash
Petroleum, operability	NJFCP A-1 best case jet fuel	-	10264, JP-8	Low viscosity, low (but >38°C) flash
Petroleum, operability	New average Jet A fuel, also used for blending	-	-	-
Petroleum, operability	High flash JP-5 POSF 10370?	-	10376	70°C flash

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Category and motivation	Fuel description	Notes	POSF ID	Reason for Inclusion
SAF, emissions	Virent, Inc.,® SAK	Single-ring aromatics	12924, 13349, 13350	General Electric CLEEN II, 100% SAF flights by United and Virgin Atlantic
SAF	CleanJoule LLC,® CycloSAF	1,4 dimethyloctane	-	-
SAF	Alder® Renewables pyrolysis pathways to Alder Renewable Crude (ARC) and Alder Pyrolytic Sugars (APS)	In development toward ASTM D4054	-	-
SAF	Visolis, Inc.	In development toward ASTM D4054		-
SAF historical	Amyris, Inc.,® fully synthetic	Contains farnesane, limonane, isopropyl methyl benzene	-	-
Operability	NJFCP C-8 (JRF-3)	-	12936	25% aromatic, maximum sulfur
SAF historical	Swedish Biofuels® ATJ SKA	ASTM D7566 Annex A8	12924, 7691	-
"SAF" historical	Sasol Ltd. IPK CTL	31 DCN, in production (coal)	7629	Baseline property data
"SAF" historical	Syntroleum Corp. S-8 or Rentech, Inc., GTL	GTL, a typical F-T product similar to HEFA	5018	Baseline property data
SAF historical	KiOR, Inc., HDCJ	Lignocellulosic pyrolysis, aromatic blend component (dormant)	-	-
SAF historical	Applied Research Associates CHJ	Aromatic-containing SAF, ASTM D7566 Annex A6	8455, 13676	-
SAF historical	IHI Corp. Bio-SPK	ASTM D7566 Annex A7	-	-
SAF historical	Shell International Ltd. CPK-0	High cyclo, on hold	-	-
SAF historical	Virent, Inc., HDO SK	High cyclo, on hold	8535	-
SAF historical	Honeywell International, Inc., UOP camelina HEFA	-	10301	-
SAF historical	Dynamic Fuels LLC, HEFA mixed fats	-	7635	-
SAF historical	Amyris, Inc., farnesane (DSH-76)	Trimethyl dodecane	12398	-
Operability	NJFCP C-2	-	12223, 11813	Asymmetric boiling range

Category and motivation	Fuel description	Notes	POSF ID	Reason for Inclusion
Operability	NJFCP C-3	-	12341, 12363	Maximum viscosity
Operability	NJFCP C-4	-	12344, 12489	Low cetane, broad boiling
Operability	NJFCP C-5	-	12345, 12713, 12789, 12816	Flat/narrow boiling range
Operability	NJFCP C-7	-	12925, 12969, 12973	Maximum cycloparaffins
Operability	NJFCP C-9	-	12933, 12968	Maximum cetane

ATJ = alcohol-to-jet
CHJ = Catalytic Hydrothermolysis jet
CLEEN = continuous lower energy, emissions and noise
CPK-0 = cycloparaffinic Kerosene
CTL = coal-to-liquids
DCN = derived cetane number
DSH = direct sugar to hydrocarbon
GTL = gas-to-liquids
HDCJ = hydroprocessed depolymerized cellulosic jet
HDO = hydrodeoxygenation
HEFA = hydroprocessed esters and fatty acids
IPK = iso-paraffinic kerosene
JRF = jet reference fluid
NJFCP = National Jet Fuels Combustion Program
UOP = Universal Oil Products
POSF = U.S. Air Force Research Laboratory fuel identification number prefix
SAF = sustainable aviation fuel
SAK = synthesized aromatic kerosene
SKA = synthetic kerosene with aromatics
SK = synthetic kerosene
SPK = synthetic paraffinic kerosene

ASTM International. (2022). *ASTM D7566-22: Standard specification for aviation turbine fuel containing synthesized hydrocarbons.* https://www.astm.org/d7566-22.html
ASTM International. (2022). *ASTM D4054-22: Standard practice for evaluation of new aviation turbine fuels and fuel additives.* https://www.astm.org/d7566-22.html

Facilities and Volumes of Each Needed Petroleum and Synthetic Blend Component

The volumes of each desired synthetic blend component were investigated based on the product availability, research needs, and storage availability. Two storage facilities have been identified to support the SAF repository project. One facility on campus at WSU is able to store 55-gal drum containers. The second facility, which is under development at Seattle Paine Field International Airport (hereinafter called Paine Field) in Snohomish County, Washington, can store tens of thousands of gallons of material. Finally, volumes needed for short-term distribution and use, have also been investigated and leveraged as will be reported later. Plans are underway to procure up to 55 gal of each of the materials reported in Table 1. Ideally, the facility at WSU would be able to accommodate all of these procurements. Material volumes to be stored at Paine Field have emphasized large volumes with relatively limited number of samples. Nine above-ground fuel tanks with a combined capacity of 50,000 gallons are in the process of being specified for request for bid to be sent out by Snohomish county. The volume stored at Paine Field would be able to support ASCENT projects and other global efforts in a manner that is substantial, and beyond current capabilities anywhere else in the world.

Number and Type of Petroleum Jet Fuels for Use as Reference Materials
After consideration, there are additional motivations to procure new reference materials composed of fossil hydrocarbons (beyond NJFCP A-1, A-2, and A-3) for this project. A key motivation for procuring new petroleum-based reference fuels is that the existing Category A fuels—originally obtained over a decade ago—are nearly depleted. Replacing these diminishing stocks with updated standards is essential for ongoing and future research needs. Towards this end, several fuel suppliers have been contacted to source additional reference petroleum fuels. To date no additional fuels have been identified with certainty, this remains an ongoing subtask. Upon installation of the above-ground tanks at Paine Field, it is anticipated that selection of the supplier for reference petroleum jet fuel will be completed within a few weeks.

Number of Entities that Could be Supported Under this Project
Domestic and international entities have been identified as potential users or entities that could be supported as a result of this project. Domestically, 16 ASCENT universities/principal investigators and 36 total entities or principal investigators have been identified as potential users of the repository project. Internationally, entities have queried for samples to be purchased and shipped to their locations. The major benefit of the repository project is that many experiments can study and explore the same fuel composition producing a key uncertainty in comparing results from numerous studies.

The facilities mentioned herein are sufficient to support the vast majority of programs domestically and internationally researching the compositional the property impacts of novel synthetic blend components on operability, emissions, various forms of compatibility, human health, and the environment. Unfortunately, current forecasts for large-scale flight and emissions campaigns, which require tens of thousands of gallons per campaign, are outside the scope of possibility for the two currently pursued facilities. This means that while many lower volume tests performed at ASCENT universities routinely can be supported sufficiently, years-long investigations on the impacts of composition on emissions and the environment will not be able to be supported by the size of facilities envisioned at present.

Milestones

- Developed a short list of candidate materials for storage in the SAF repository.
- Worked with ASCENT stakeholders to identify compositional and volume interests for testing.

Major Accomplishments

- Developed a short list of candidate materials for storage in the SAF repository.
  - Candidate materials identified sought in the next federal fiscal year.
- Worked with ASCENT stakeholders to identify compositional and volume interests for testing.
  - Materials will be distributed more broadly once they are acquired in sufficient volumes quality.

Publications

None.

Outreach Efforts

In support of defining the repository's technical and capacity requirements, the ASCENT Project 101 team engaged multiple ASCENT principal investigators to learn about their specific demands for fuel volumes, compositional preferences, and testing frequencies. Our team also collaborated closely with original equipment manufacturer (OEM) partners—such as Gulfstream,® Airbus,® Pratt & Whitney,® World Energy®, Montana Renewables™, and CleanJoule®—to align the repository's capabilities with industry goals. These interactions, along with presentations at the Coordinating Research Council (CRC) aviation fuels meeting and the Commercial Aviation Alternative Fuels Initiative (CAAFI) webinar, helped refine our understanding of what a comprehensive SAF repository should encompass.

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Awards
Joshua Steven Heyne, American Chemical Society (ACS) Energy & Fuels, Rising Star

Student Involvement
None.

Plans for Next Period
Continue to add additional details and solicit feedback from stakeholders.

References

ASTM International. (2022). *ASTM D4054-22: Standard practice for evaluation of new aviation turbine fuels and fuel additives*. https://doi.org/10.1520/D4054-22

ASTM International. (2024). *ASTM D7566-24: Standard specification for aviation turbine fuel containing synthesized hydrocarbons*. https://doi.org/10.1520/D7566-24

Colket, M., & Heyne, J. (2021). *Fuel Effects on Operability of Aircraft Gas Turbine Combustors: Progress in Astronautics and Aeronautics*. The American Institute of Aeronautics and Astronautics, Inc. https://doi.org/10.2514/4.10604

Task 2 – Procuring SAF and Conventional Fuel Samples for Testing
Washington State University

Objective
The objective of this task is to procure SAF and conventional fuel samples for testing under various ASCENT projects. Given the wide array of petroleum jet fuel producers, approved SAF producers, novel SAF producers, and manufacturers of relevant solvents for blend studies, it's essential to continually monitor the availability and changes in properties and compositions these producers offer. These variations can occur even over time at a given facility due to changes in production technology or feedstock.

To ensure quality and consistency, our team aims to:

- Gather certificates of analysis from various producers at different points in time to verify that the materials are consistent and are suitable for our research needs.
- Balance costs, availability, and desirability in terms of properties and compositions when procuring samples, ensuring we obtain high-quality materials within budget constraints.
- Identify cost-effective alternatives, such as contracting with petroleum fuel producers or solvent vendors who can provide products similar to expected SAF products.
- Monitor availability and property changes in producers' offerings on an annual or more frequent basis to support critical ASCENT projects.

Research Approach
Our approach involves collaborating with producers of sustainable fuels, conventional fuels, and solvent manufacturers to purchase and distribute the necessary materials. Our team will work closely with these suppliers to identify sources that meet the specific property and composition requirements for our research. This includes reviewing certificates of analysis and assessing the consistency of their products over time. By maintaining relationships with multiple producers, we ensure a reliable supply of samples for testing and blend studies.

Milestones
- Acquired reference HEFA fuel from Montana Renewables.
- Sampled and analyzed fuel that is planned for a test campaign; now postponed to commence in spring 2026.

Major Accomplishments
- Procured test volumes and distributed them to a research partner's test location for evaluation, ensuring that the necessary materials were available for timely testing.
- Established a procurement process that balances cost, availability, and quality, allowing for the acquisition of samples that meet research requirements without exceeding budget constraints.

- Supported for research initiatives enabling researchers to conduct fuel blend studies and other tests by providing appropriate samples sourced from various producers, thereby supporting the overall objectives of the ASCENT projects.

Publications
None.

Outreach Efforts
To streamline the procurement of various SAF and conventional fuel samples, our team proactively contacted ASCENT principal investigators to ascertain their project-specific requirements around fuel volumes, composition, and testing schedules. We also worked with the U.S. Navy, U.S. Air Force, and OEMs, such as Gulfstream, Airbus, Pratt & Whitney, World Energy, Montana Renewables, Monument Chemical,® CleanJoule, and World Kinect® (World Fuel Services) to ensure the correct types of fuel were sourced and supplied for research or operational needs. Our team presented at the CRC aviation fuels meeting and other technical conferences with a spotlight on sustainable aviation, further facilitating the sharing of procurement insights and best practices with a broader community.

Awards
None.

Student Involvement
None.

Plans for Next Period
- Support similar emissions campaign measurements.
- Procure additional materials for storage and distribution within the repository at WSU and Paine Field.

Task 3 – Testing Procured Samples for Reference Data to be Leveraged by Other Partners

Washington State University

Objectives
The objectives of this task are to (1) measure and disseminate standard reference data on materials associated with the repository project, (2) establish the extent of contamination from residual conventional fuels mixing with SAF in fuel storage tanks, and (3) provide reference test data to research partners to understand the variance in SAFs, specifically regarding sulfur content.

The success of the repository project critically depends on accurately measuring and disseminating standard reference data on materials associated with SAFs, reference petroleum fuels, hydrocarbon solvents, and blends of all these materials. SAFs can exhibit substantial variance in properties and compositions—from one ASTM D7566 (ASTM International, 2024) annex to another, and even within the same feedstock and process due to catalyst aging. For example, sulfur content plays a significant role in catalyzing contrail formation and persistent aviation-induced cloudiness, which contribute to the radiative forcing associated with aviation. Therefore, providing reliable data on sulfur content and other properties is essential for research partners and the broader scientific community.

Research Approach
Recognizing that sulfur is a key component that catalyzes contrail formation and persistent aviation-induced cloudiness, we aimed to understand how even minimal sulfur levels could have a significant environmental impact. During this period of performance, this task has focused on furtherance of sulfur measurement capabilities, advancing the limit of quantification to levels near 1 ppm. Our efforts are centered around cross-method validation including ultraviolet fluorescence (ASTM D5453 [ASTM International, 2025a]), inductively coupled plasma – optical emission spectroscopy

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(ASTM D7111 [ASTM International, 2025b]), and especially, combustion ion chromatography (ASTM D7359 basis [ASTM International, 2023]).

Concurrently, we continue to document other important properties such as dielectric constant and seal swell to fill critical needs as indicated by OEM stakeholders. Further tests were performed by distributing HEFA material to Stanford University and the University of Dayton Research Institute for ASCENT-funded research. Under all these programs, our team also measured standard reference properties for the HEFA materials. These data are being prepared for public dissemination in accordance with FAA guidance.

Milestones

- Received and analyzed dozens of HEFA samples for sulfur content, establishing a thorough sampling process across the supply chain to trace sulfur introduction.
- Fostered collaborations with key partners, including Gulfstream, University of Dayton Research Institute, and Stanford University.

Major Accomplishments

- Procured and distributed HEFA samples with the necessary cleanliness to validate low-sulfur concentration measurements.
- Prepared data for public dissemination per FAA guidance, contributing to broader industry knowledge and efforts to mitigate environmental impacts.

Publications

None.

Outreach Efforts

To optimize our testing protocols and capture critical reference data, the ASCENT Project 101 team reached out to ASCENT principal investigators, confirming the volumes and compositional attributes they require for meaningful analysis. Our team also coordinated with OEMs—Gulfstream, Airbus, Pratt & Whitney, World Energy, Montana Renewables, Monument Chemicals, CleanJoule, and World Kinect (World Fuel Services) —to integrate feedback on how test results could support engine performance and emissions evaluations.

Our work on low sulfur measurement capabilities has been presented at conferences including International Conference on Sustainable Aviation Research, SAF End-User Meeting hosted by Sandia National Laboratory, and we are in the process of preparing a journal article for scholarly review.

In parallel, our team engaged with Aerodyne® and other FAA program managers to clarify property measurement requirements that benefit broader SAF repository projects. For example, we discussed detection limits for total sulfur in HEFA blends—a key parameter for understanding contrail formation—and identified additional property measurements needed to address emerging research questions. By showcasing our testing objectives and methodologies at CRC aviation fuels meetings and other technical conferences (mentioned above), we fostered open discussion on these measurement needs, ensuring our approach remains aligned with the latest stakeholder and industry requirements.

Awards

- Joshua Steven Heyne - ACS Energy & Fuels, Rising Star

Student Involvement

- Conor Faulhaber is leading the effort to publish our work on low sulfur quantification methodology.
- Patricia Garcia-Alfaro is assisting with our lab's commissioning and standardization of the combustion ion chromatography method.
- Kaamel Sidiqi is assisting with ultraviolet fluorescence (UVF) sulfur data collection and organization.

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Plans for Next Period

- Support similar research activities with other partners. Specifically, our team is looking to support a greater number of low-volume SAF requirements at partner institutions as well as at least two large-scale emissions campaigns.
- Publish journal article on low sulfur measurement capabilities.

References

ASTM International. (2023). *ASTM D7359-18: Standard Test Method for Total Fluorine, Chlorine and Sulfur in Aromatic Hydrocarbons and Their Mixtures by Oxidative Pyrohydrolytic Combustion followed by Ion Chromatography Detection (Combustion Ion Chromatography-CIC).* https://doi.org/10.1520/D7359-18

ASTM International. (2024). *ASTM D7566-24: Standard specification for aviation turbine fuel containing synthesized hydrocarbons.* https://dol.org/10.1520/D7566-24

ASTM International. (2025a). *ASTM D5453-24: Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence.* https://doi.org/10.1520/D5453-24

ASTM International. (2025b). *ASTM D7111-16: Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES).* https://doi.org/10.1520/D7111-16R21

Task 4 – Developing a Data Management Protocol for Sharing and Distributing Data

Washington State University

Objectives

Building upon the experience gained from ASCENT Project 065A the ASCENT Project 101 team aims to enhance our processes for the SAF repository project. The objectives for this task are to:

- Develop a Comprehensive Suite of Tests: Create and document a suite of tests specific to the SAF repository project, tailored to support airframers and engine companies in designing experiments for large-scale emissions tests.
- Collect and Database Property Data: Gather and systematically record property data and compositional information for all materials received under the repository project.
- Leverage U.S. Department of Transportation (DOT) Resources: Collaborate with the developing resource within DOT, as recommended by the FAA, to enhance our data collection and analysis capabilities.
- Support Critical Research Needs: Focus on properties like sulfur content, trace metals, thermal stability, and other critical measurements not commonly emphasized in previous projects.

Research Approach

The ASCENT Project 101 team is leveraging the robust, consistent, and streamlined processes established under ASCENT Project 065A for collecting and documenting relevant properties and compositions of aviation fuels. This existing system has been effectively utilized for materials processed under the repository project, including samples from Pratt & Whitney, Montana Renewables, and those distributed to Stanford University and the University of Dayton Research Institute.

Recognizing the different requirements of the SAF repository project, our team is developing a new suite of tests that may differ from those used in ASCENT Project 065A. Specifically, we are incorporating tests for properties such as sulfur content—which is of high importance for the repository project but not commonly measured under ASCENT Project 065A. Additional tests include, but are not limited to:

- Trace metals analysis
- Thermal stability (JFTOT®) tests
- Heat capacity measurements
- Dielectric constant measurements

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These tests are critical for supporting airframers and engine companies as they design experiments for large-scale emissions tests. A comprehensive list of properties that has begun to be documented will be included for each material received.

Moving forward, our team plans to leverage the developing resource within DOT, as suggested by the FAA, during the next period of performance. This collaboration will enhance our ability to collect, analyze, and disseminate critical fuel property data.

Milestones

- Collected and databased property data and compositional information for all materials received under the repository project.
- Began developing and documenting a full list of properties and tests specific to the SAF repository project.
- Applied the established processes from ASCENT Project 065A to streamline data collection and documentation efforts for the repository project.
- Initiated plans to collaborate with DOT's developing resource, setting the stage for enhanced capabilities in the next performance period.

Major Accomplishments

- Established a robust and streamlined process for gathering and documenting aviation fuel properties, tailored to the needs of the SAF repository project.
- Developed a suite of tests focusing on critical properties such as sulfur content, trace metals, and thermal stability, which are essential for large-scale emissions testing.
- Provided vital property data to support airframers and engine companies in designing experiments, thereby facilitating advancements in emissions testing and environmental impact assessments.
- Positioned the project to leverage new tools and methodologies by preparing to collaborate with DOT's developing resource, as recommended by the FAA.

Publications

None.

Outreach Efforts

In designing our data management framework, the ASCENT Project 101 team consulted multiple ASCENT principal investigators to gauge the types of data they collect (e.g., compositional or performance) and how frequently they need updates. This feedback, along with guidance from OEM partners ensured the protocol would support both research and operational analytics. Our team presented at conferences including International Conference on Sustainable Aviation Research (ICSAR), CRC Aviation Fuels meeting, and SAF End-User Meeting hosted by Sandia National Laboratory and we participated in OEM-led task forces and meetings on drop-in fully synthetic aviation fuel and 100% paraffinic aviation fuel. These engagements allowed us to share draft data standards and solicit feedback for a more robust, user-oriented database system.

Awards

- Joshua Steven Heyne, ACS Energy & Fuels, Rising Star

Student Involvement

- Conor Faulhaber supported database upkeep and development and presented research findings pertaining to dielectric constant at ICSAR.
- Patricia Garcia-Alfaro is helping to measure fuel and other hydrocarbon fluids lubricity.
- Kaamel Sidiq is helping with JFTOT thermal stability measurements.

Plans for Next Period

- Await FAA guidance to enable our team to put our research data into databases.

Task 5 – Distributing Fuel Samples and Data to Partners per FAA Prioritization

Washington State University

Objectives

Distributing fuel samples is one of the most critical steps in the FAA SAF Repository project. The objectives of this task are to:

- Provide Appropriate Fuel Samples: Distribute relevant fuel samples—including neat SAFs, SAF candidates, reference fossil fuel materials, solvent materials, and blends—to partner institutions per the FAA's priority.
- Support Diverse Research Needs: Enable testing for operability, compatibility, emissions, human health impacts, and environmental impacts by ensuring that partner institutions receive fuel samples suited to their specific experimental hardware and testing motivations.
- Enhance Collaboration: Facilitate effective collaboration by matching partner institutions with the correct SAF repository materials, both within and outside of the ASCENT program.

Research Approach

Introduction

Distributing fuel samples is a critical component of the FAA SAF Repository project. The effectiveness of this task depends on matching partner institutions with fuel samples that meet their specific research needs. Partner institutions, both within and outside of the ASCENT program, receive reference materials from the repository. These materials may include neat SAFs, SAF candidates, reference fossil fuel materials, solvent materials, and blends of these hydrocarbon mixtures. These test materials enable experiments related to operability, compatibility, emissions, human health impacts, and environmental impacts.

Research Partner Material Requirements

The materials distributed need to align with partner experimental hardware and testing objectives. For example:

- Operability Testing: Institutions focusing on fuel operability in different hardware require fuel samples that reflect the operational conditions and stresses their equipment might encounter.
- Emissions and Environmental Impact Studies: Researchers examining emissions or performance metrics related to human health and the environment may require fuels with specific combustion characteristics or constituents.
- Flight Condition Testing: Facilities conducting tests under flight conditions require fuels that perform reliably and safely in those environments.

By understanding these specific needs, candidate materials are paired to the institution with the appropriate SAF repository material.

Material Selection and Preparation

Based on the needs assessment, our team selects and prepares the fuel samples for distribution. This process includes:

- Reviewing Repository Inventory: Evaluating available materials in the repository, including their properties, compositions, and suitability for the intended research.
- Custom Blending: Creating blends of fuels or adding specific additives when necessary to meet the precise needs of the partner institution.
- Quality Assurance: Verifying that all fuel samples meet the required quality standards and specifications before distribution.

Distribution Process

The distribution process is managed to comply with safety regulations and to maintain the integrity of the fuel samples. Materials are shipped with qualified hazardous material distribution entities such as FedEx,® UPS,®,and World Kinect. Steps of the distribution process include:

- Documentation: Preparing detailed documentation for each fuel sample, including certificates of analysis, safety data sheets, and handling instructions.

® FedEx is a registered trademark of Federal Express Corporation, Memphis, Tennessee.
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- Packaging: Using appropriate containers and packaging materials to protect the fuel samples during transit.
- Logistics Coordination: Arranging transportation while adhering to all relevant regulations concerning the shipment of hazardous materials.

Distribution Recipients

Over this period of performance, materials were distributed to the following institutions:

- Standford University
- University of Dayton Research Institute

Data Sharing

In addition to physical fuel samples, our team provides data packages that include:

- Property Measurements: Information on fuel properties such as density, viscosity, sulfur content, and more.
- Compositional Analysis: Data on the chemical makeup of the fuels to assist partners in their analyses.

Conclusion

By assessing partner needs, selecting suitable materials, and managing the distribution process, our team has aimed to ensure that each research institution receives fuel samples appropriate for their specific projects. This approach supports the objectives of the SAF Repository project, facilitates research across multiple domains, and aligns with the FAA's priorities to advance the understanding and adoption of sustainable aviation fuels.

Milestones

- Distributed samples to support two research projects; One led by Standford University, the other led by the University of Dayton Research Institute.
- Coordinated with producers by requesting additional materials to expand the repository's offerings and better meet partner needs.

Major Accomplishments

- Enabled critical research to occur at the University of Dayton Research Institute and Stanford University.

Publications

None.

Outreach Efforts

To efficiently supply partners with the fuels and data they need, the ASCENT Project 101 team contacted a range of ASCENT principal investigators to ascertain their project timelines, fuel needs, and preferred reporting formats. We continued collaborating with OEMs such as Gulfstream, Airbus, Pratt & Whitney, World Energy, Montana Renewables, Monument Chemicals, and CleanJoule to align sample distribution with ongoing testing programs. By participating in the International Conference on Sustainable Aviation Research, the CRC Aviation Fuels meeting, task forces and meetings on drop-in fully synthetic aviation fuel and 100% paraffinic aviation fuel, we demonstrated the distribution processes, addressed questions about sample integrity, and highlighted the broader benefits of a centralized, FAA-prioritized repository.

Awards

- Joshua Steven Heyne - ACS Energy & Fuels, Rising Star

Student Involvement

- Conor Faulhaber distributed, analyzed, and provided experimental context for thermal stability and UVF sulfur data.

Plans for Next Period

- Expand Sample Distribution to Additional Partners: Engage with more partner institutions, both within and outside of ASCENT per FAA guidance, to assess their specific fuel sample needs. We aim to provide appropriate materials from the repository to support their research projects.

- Process and Distribute New Materials: Upon receiving additional materials from various producers, we will incorporate these fuels into the repository. These new materials will be made available to partner institutions whose research requires specific fuel properties.