Rolls-Royce CLEEN II Sustainable Aviation Fuels

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Jurisdiction	Export Control Classification (Rating)	Date
US	No Technical Data	10-15-2018 EBW

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CLEEN Technologies

CLEEN Technology Name	Goal Impact	Benefits and Application
Alternative Jet Fuel Test and Evaluation (Area A)	Alternative Fuels	Promotes the development and introduction of viable, renewable alternative fuels to achieve the NextGen Air Transportation System goals. Data will be shared with the ASTM Aviation Fuel Community to support international approval of a fully synthetic jet fuel.

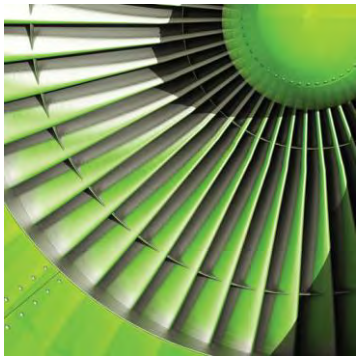
Rolls-Royce
Sustainable Aviation
Fuel Program

Elevator Speech

The Rolls-Royce Sustainable Aviation Fuel Program is promoting alternative jet fuel development, approval & deployment, which contributes to the attainment of FAA NextGen Air Transportation System goals. This robust evaluation program is characterizing a novel fully synthetic fuel's performance under representative engine conditions. This goal is being accomplished through a series of "back-to-back" rig tests with conventional Jet A fuel, to assess the fuels' impact on combustor performance and emissions. Elastomeric seal performance is also being assessed using the innovative Elastocon rig capability developed and demonstrated under CLEEN I. The data generated will be compared to prior work, assessed and shared with the ASTM Aviation Fuel Community to support the International approval of a fully synthetic jet fuel.

No Technical Data

Rolls-Royce Sustainable Aviation Fuel Program



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Program Scope

- Promotes the development and introduction of viable renewable alternative fuels to meet NextGen Air Transportation system goals
- A robust evaluation program that is characterizing a fully synthetic fuel's performance under representative engine conditions
- Accomplished through a series of "back to back" rig tests with conventional Jet A fuel
- Fuel chemistry/properties relationship upon fuel spray, combustor performance, operability and emissions
- Elastomeric seal performance due to cyclic fuel switching under more realistic engine conditions
- Data generated can be shared with ASTM Aviation Fuel Community and aid in fuel certification process

No Technical Data

Rolls-Royce Sustainable Aviation Fuel Program

Benefits

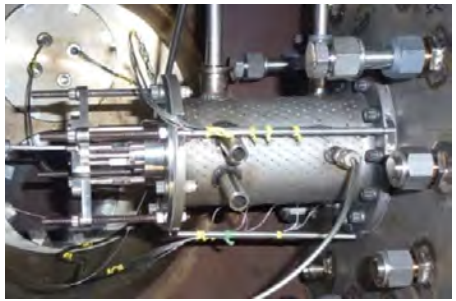
- The data generated will support the International approval of a fully synthetic jet fuel
- Enhanced methods for predicting fuel performance on engine systems to support reduced cost and timescale of approvals
- Greater data and test capability to support environmental benefits (i.e. local air quality, increasing regulations)
- Renewable, synthetic alternative jet fuel for aerospace gas turbine engine applications will provide reduced aerospace environmental impact and increased energy security

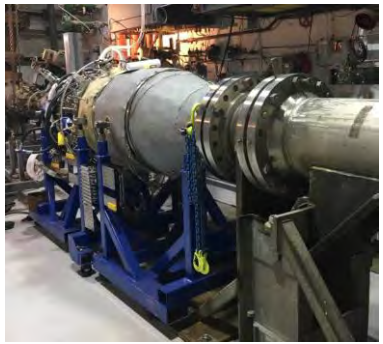
No Technical Data

The purpose of the test program is to ensure that the candidate fuel will have no negative impact on engine safety, durability, or performance.

Approach

- Proven sequential test program (“back-to-back” with Jet A)
  - Fuel requirements: 4,100 gallons
  - Conduct laboratory and fit-for-purpose evaluation
  - Characterize fuel spray behavior
  - Utilize combustion rigs to assess fuel impact upon performance, operability and emissions
  - Assess elastomeric seal performance using the innovative Elastocon rig
- Data generated will be compared to prior work, assessed and reported to ASTM Aviation Fuel Community





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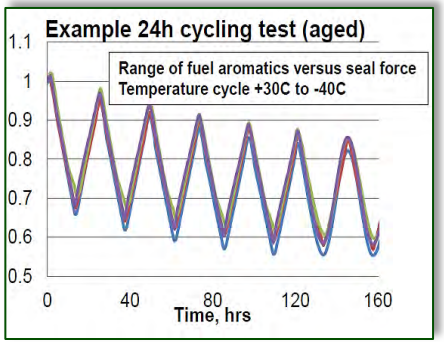


Summary of ATJ-SKA Test Results

- Laboratory characterization:
  - Primarily iso-paraffinic composition
  - Acceptable volatility, fluidity and thermal stability
- Overall spray performance similar to Jet A fuel, with only minor differences noted.
- Combustion Flame tube:
  - Lean stability deteriorated slightly
  - Emissions- NOx similar, but CO and UHC emissions are higher at certain conditions, leading to lower combustion efficiency
  - Combustion liner Wall temperatures are similar

No Technical Data

Sustainable Aviation Fuel Program

Achievements

- **Complete**: Laboratory fit for purpose, spray characterization and flame tube testing
- **Ongoing:** Elastocon rig modification complete, generating compression stress relaxation data for 5 seals
- **Planned:** FANN rig test 1Q2019
- 2200 gallons of ATJ-SKA fuel ordered for the FANN rig test

Program on track to deliver objectives

No Technical Data

Schedule

CLEEN II Sustainable Aviation Fuel Schedule

Rolls-Royce Sustainable Aviation Fuel Program		2016				2017				2018				2019			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Fuel Selection																	
Test Program																	
Draft Final Report																	

Program on track and on schedule

No Technical Data

Program Plans for Year 4

Sustainable Aviation Fuel Program

- Launch FANN rig test
- Complete Elastocon work at Sheffield University
- Assess test results and provide preliminary results
- Deliver full draft technical report

No Technical Data

Sustainable Aviation Fuel Test and Evaluation

Quad Chart

Benefits:

- The data generated will support the International approval of a fully synthetic jet fuel
- Enhanced methods for predicting fuel performance on engine systems to support reduced cost and timescale of approvals
- Greater data and test capability to support environmental benefits (i.e. local air quality, increasing regulations)
- Renewable, synthetic alternative jet fuel for aerospace gas turbine engine applications will provide reduced aerospace environmental impact and increased energy security

Objectives:

- Promote the development and introduction of viable renewable alternative fuels - NextGen Air Transportation systems goals
- Improved tools for predicting fuel performance and scientific understanding
- Data generated will aid in ASTM fuel certification process

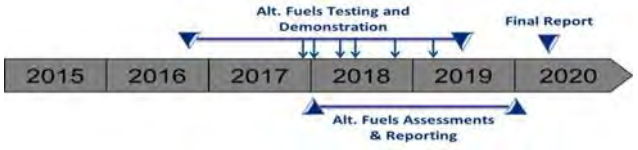
Work Statement:

- Assess a fully synthetic jet fuel using low NOx combustion systems to determine fuel impact on performance, operability and emissions
- Assess elastomeric seal performance using the innovative Elastocon rig

Accomplishments/Milestones:

- Complete: Laboratory fit for purpose, spray characterization and flame tube testing
- Ongoing: Elastocon rig modification complete, generating compression stress relaxation data for 5 seals
- Planned: FANN rig test 1Q2019
- 2200 gallons of ATJ-SKA fuel ordered for the FANN rig test

Schedule:

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