



ASCENT Project 002

**Understanding Changes in Aviation Emissions due to SAF
with New Combustor Engine Technology.**

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Understanding Changes in Aviation Emissions due to SAF with New Combustor Engine Technology.

Missouri University of Science and Technology

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Cost Share Partners:

GE, Boeing, Gulfstream, Honeywell, P&W, Airbus Americas.

Objective:

Understanding Changes in Aviation Emissions due to SAF with New Combustor Engine Technology.

Project Benefits:

- 1.) Characterize the volatile and non-volatile particulate matter from engines not currently in the ICAO emissions databank for nvPM emissions.
- 2.) Quantify the effects of fuel composition on those emissions by making measurements using a range of SAFs and low sulfur fuels.
- 3.) Compare results obtained from the instruments of other campaign participants (e.g. NASA) with those from the MS&T team instrumentation
- 4.) Compare results with the data from prior emissions research campaigns to characterize how the particle emissions vary as engine combustor technology has evolved.
- 5.) Provide much needed input for improving contrail modeling.
- 6.) Provide the opportunity to acquire in situ monitoring of contrails and the ambient atmosphere.
- 7.) Provide real measurement input for CAEP decision making.

Research Approach:

The ASCENT MS&T team with the guidance of emissions specialists at various OEMs propose to make high priority ground-based field measurement campaigns of nvPM and combustion gas emissions from engines on a commercial widebody transport, a business jet aircraft, and a new technology combustor burning both conventional fuels and candidate sustainable aviation fuels (SAF). These measurements are scheduled to take place in multiple campaigns spanning FY2023 and FY2024 with analysis and results reported throughout 2024. Each campaign will be preceded by test design, planning and preparation, beginning in the second quarter of 2023. The cost to ASCENT will be to support the MS&T team to participate in and manage the emission studies, and, to defray some of the costs incurred for the fuels to conduct both ground-based and in flight emissions testing.

Major Accomplishments (to date):

- Ground-based SAF emissions testing opportunities identified
- Funding for future emissions testing being negotiated
- Preparations for Eco-D 2023 completed
- Deploy to Eco-D scheduled for 10/04/23

Future Work / Schedule:

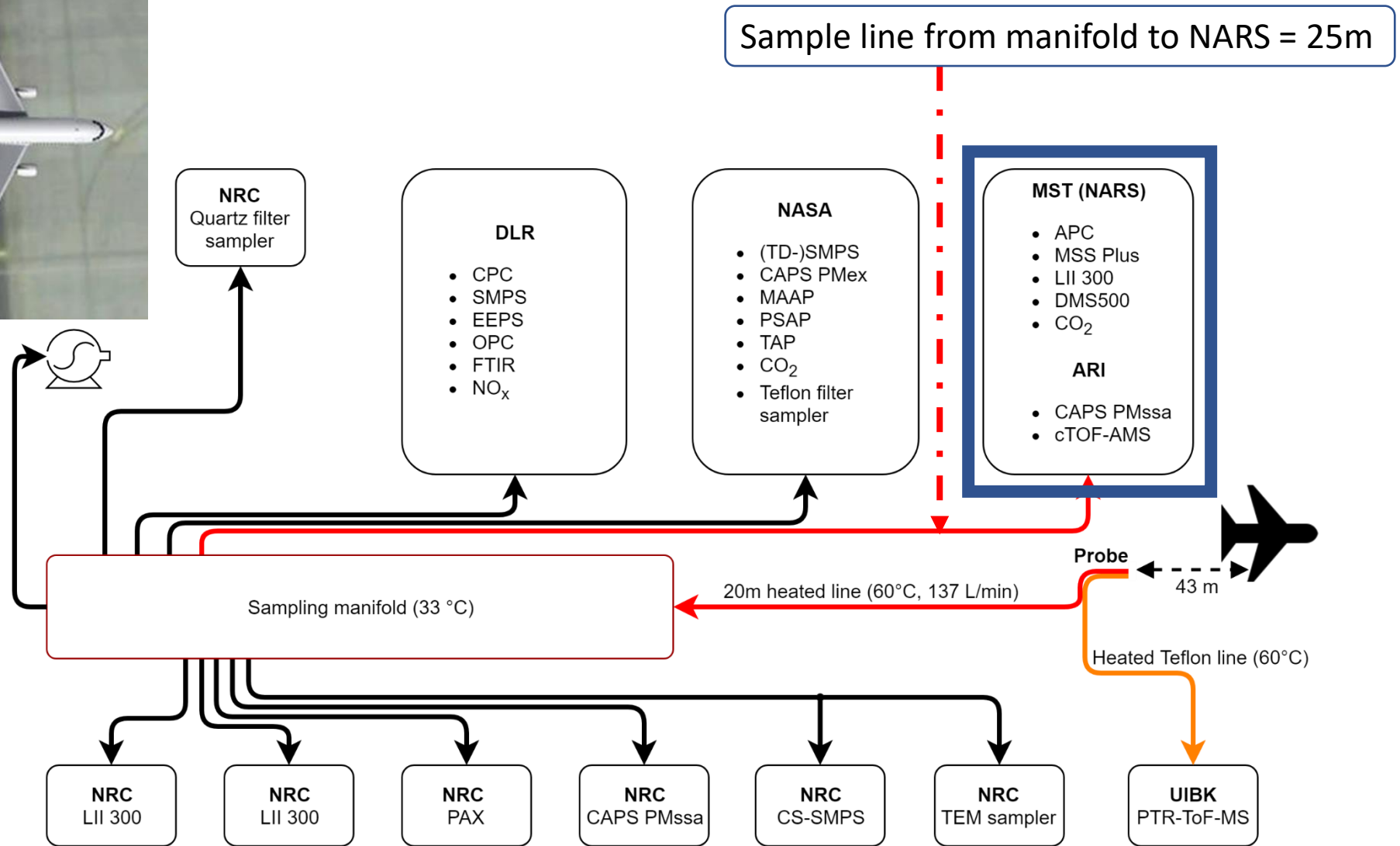
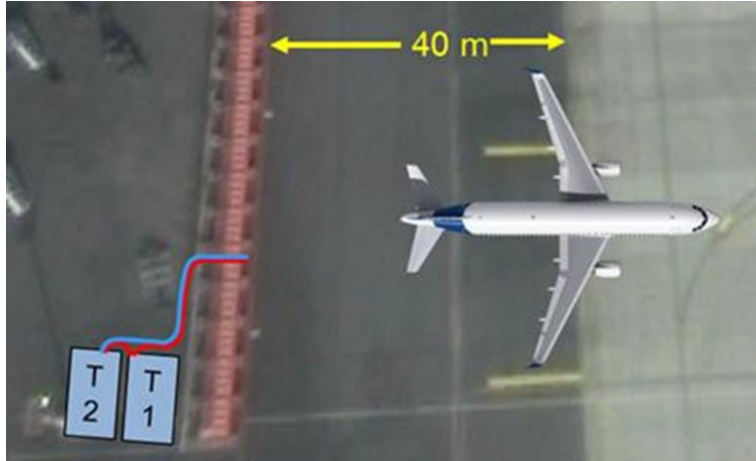
- Fuel sources identified, fuel procured and delivered
- Test planning. Test deployment. Data acquisition
- Test specific data analysis and interpretation

ASCENT 02 Proposed Schedule	2023		2024				2025			
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Boeing Eco-Demonstrator		→								
Honeywell Combustor/Engine with JET A and 3 SAFs				→						
GE Combustor/Engine with JET A and 3 SAFs					→					
P&W Combustor test						→				
Airbus /PW GTF aircraft ground test							→			
Airbus /PW GTF aircraft flight test with associated ground test								→		
Gulfstream flight test with associated ground test 1 - Jet A SAF									→	
Gulfstream flight test with associated ground test 2 - Jet A SAF										→

Research Objectives

- The ASCENT MS&T team with the guidance of emissions specialists at various OEMs will make:
- high priority ground-based measurements of nvPM and combustion gas emissions from engines on:
- a commercial widebody transport, a business jet aircraft, and new technology combustors
- burning both conventional fuels and candidate sustainable aviation fuels (SAF) and blends thereof.
- These measurements are scheduled to take place in multiple campaigns spanning FY2023 and FY2024 with analysis and results reported throughout 2025.
- Each campaign will be preceded by test design, planning and preparation, beginning in the second quarter of 2023.

Ground-based Sampling Schematic



**Line loss methods assessment undertaken for sample line from manifold to NARS and NARS

Goals for ASCENT 002 Studies

- Characterize the volatile and non-volatile particulate matter from engines not currently in the ICAO emissions databank for nvPM emissions.
- Compare SAF emissions with those from conventional Jet A.
- Deconvolve the emission issues potentially encountered through lube oil contamination.
- Quantify the effects of fuel composition on those emissions by making measurements using a range of SAFs and low sulfur fuels.
- Compare results obtained from the instruments of other campaign participants (e.g. NASA) with those from the MS&T team instrumentation
- Compare results with the data from prior emissions research campaigns to characterize how the particle emissions vary as engine combustor technology has evolved.
- Provide much needed input for improving contrail modeling.
- Provide the opportunity to acquire in situ monitoring of contrails and the ambient atmosphere.
- Provide real measurement input for CAEP decision making.

ecoD 2023



- **Boeing has added a United Airlines 737 MAX 10 aircraft to its ecoDemonstrator fleet to test the effects of Sustainable Aviation Fuel (SAF) on contrails and emissions, as well as to reduce the fuel's climate impact.**
- **The program will involve NASA's DC-8 aircraft, which will measure and compare the emissions and contrail ice particles of SAF and conventional jet fuel. NASA satellites will also capture contrail formation during the campaign.**
- **Boeing is partnering with various organizations, including NASA, World Energy, FAA, GE Aerospace, and DLR, to analyze how SAF can reduce emissions and achieve environmental benefits.**

Fuels

- The OEMs with the assistance of the FAA, through this proposed effort will coordinate the procurement, fuel properties analysis, delivery, handling, and loading logistics for various fuels in support of the proposed Emissions Testing.
- This includes the fuel volume required to support testing of the source and chase aircraft.
- By way of example, listed below, are the fuels proposed to be used in the eco-D study
 - Fuel 1 - Low Sulfur Jet-A per ASTM D1655, total percent by mass maximum objective of 0.0001 (max total sulfur target of 1 ppm) ·
 - Fuel 2 - 100% HEFA-SPK

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