AOS developed the New Generation Flask Technology, NGFT, as a tool to sample atmospheric gases using an Unmanned Aircraft System (UAS) as the base, and 100 replaceable flasks, overcoming 2 existing biases of current technology. DOE/ARM/ACME has weather covariance bias necessitated by the requirement to operate its manned aircraft by Visual Flight Rules mostly during fair weather. UAS deployments have far less of this restriction, making NGFT a better choice for reducing this fair weather bias. After years of use, the NOAA/GMD flask technology has developed bias beyond its original storage value of up to 1 ppm for individual flasks. The NOAA/GMD technology does not have an internal validation mechanism, in part because it has too few flasks to sacrifice one for internal validation. The NGFT has 100 flasks, and a small number, selected randomly for each mission, can be filled with wetted reference gas as the means to track performance and possible aging effects. If such effects appear at the 0.1 ppm level, the NGFT is inexpensive and simple enough to be refurbished by chemical treatment or discarded entirely. By contrast, the NOAA/GMD technology has a very complicated structure, consisting of four major sub-systems (compressor, two floating valve actuators per flask, glass flasks, entrance manifold), accumulating to a large expense per air sample ($1,250) and necessitating a complicated process of refurbishment. The NGFT can also be used to validate continuous analyzer payloads of the small UAS, but now there is an order of magnitude higher spatial density of sampling than is possible for the NOAA/GMD technology.

The prototype analysis station was built and used to test the NGFT for acquisition of the sample gases and fidelity of storage. The tests were successful at the expected level of noise and analyzer performance.

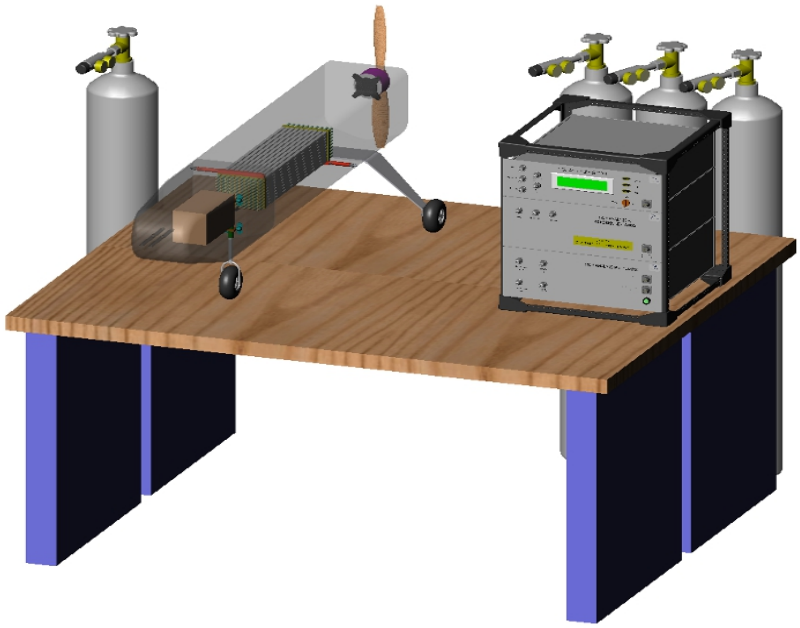

Figure 1

Figure 1 illustrates automated analysis station of the NGFT. The airframe has the prototype form. The wings have been removed, and the fuselage with the permanently installed NGFT is connected to the analysis station. A dry reference gas was chosen, with dry mole fraction ([CO2]~340 ppm) connected to the exhaust manifold as the means to replace atmospheric sample drawn from the flasks by the analyzer. Detection of that level signals the transition from atmospheric sample to laboratory standard and the end of analysis. The analyzer in this case has the ability to quantify concentrations of the two most important greenhouse gases of the Arctic, CO2 and CH4. {Note: As the means to implement internal validation of the observational program, the NGFT controller can be programmed to make random selection of individual flasks to be filled with reference gas. Information from the controller, including those selections, timing and GPS coordinates of the sampling, is passed along to the controller of the analysis station when sample is expended through the analyzer.}

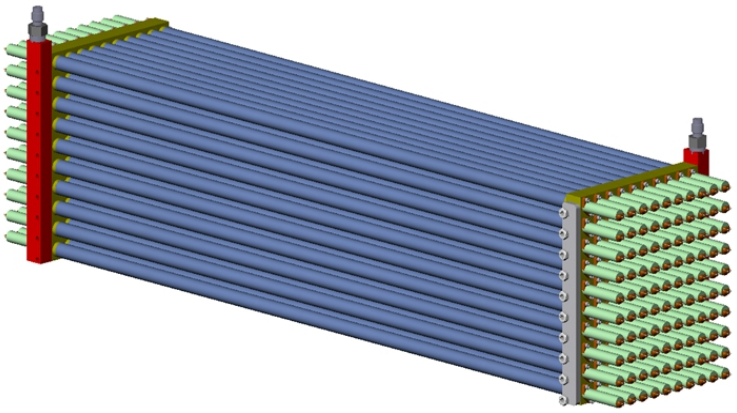

Figure 2

NGFT (Figure 2) can function as both a high density package of individual flasks or as an AirCore (continuous sample). In both cases, sample is to be analyzed by a multi-species laser spectrometer requiring small sample of 12.5 scc per set of data (CH4, CO2). This happens to be somewhat smaller than the capacity (14.3 cm^3) of a 50 cm long stainless steel tube with 0.006" walls, the form of the individual flasks of the NGFT. The alternative form, the AirCore, consists of the same tubing segments, but they are connected by open pathways instead of being isolated by discrete valves.

Deployment of the NGFT starts out the same for both forms. In preparation for an airborne mission with the NGFT installed permanently inside the UAS, the outlet valves are opened, enabling connection to a vacuum pump. The full length, typically 50 m, is evacuated to low pressure much less than 1 mBar or < 1‰ of its eventual mass when it is filled. Then, the vacuum pump is disconnected and the NGFT is left connected to a passive air getter as insurance until just before deployment. At deployment, all valves are closed. During the airborne missions, valves are opened to build sample into either the individual flasks or the full length of the AirCore. Action of the valves is recorded along with GPS coordinates and timing to be used by the analysis station.