An In-Flight PAN Calibration System for High-Altitude Studies

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High-altitude measurements of peroxyacetyl nitrate (PAN) will be carried out using our recently developed PAN and other Trace Hydrohalocarbons Experiment (PANTHER) instrument. Measurements of PAN require in-flight calibration. There are two things that make this calibration task more difficult that those normally used for in-flight PAN calibration: (1) space and weight restrictions severely limit the number and size of components, and (2) the low levels (0-50 ppt) of PAN expected at high altitudes push the limits of the measurement and calibration techniques. This means that it would be difficult for us to generate a suitable PAN source using typical dynamic dilution methods (Figure 1a). To study these issues two calibrations units were developed. One for laboratory use (typical method) and one for in-flight use (modification of the typical method). Both rely on the photo-oxidation of acetone in the presence of nitric oxide and oxygen to produce PAN. Because we cannot readily measure NO, CFC-11 was added to the NO mixture to serve as a dilution tracer. Several experiments were performed to verify the stability of the calibration system, test for artifacts, and ensure that the system would work as designed in-flight. During the testing phase, issues such as the stability of NO in compressed gas cylinders, contamination of the reaction cell, and optimum operating conditions were investigated. For example, we were concerned about the stability of NO in the in-flight calibration mixture (NO, acetone, CO, and CFC-11 in air). Nitric acid loss rates of about 2% day^{-1} at 2 ppb NO and 1500 psi were inferred from PAN measurements. This means that losses of NO will be small over the course of a 1-2 day flight period.

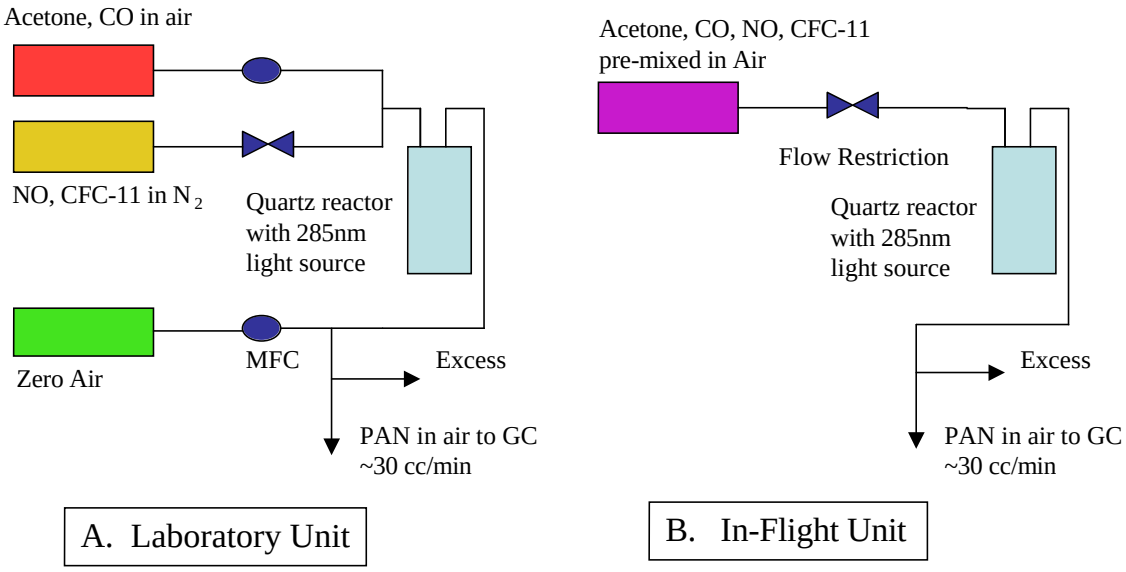

Figure 1. Flow schematics for two PAN calibration systems.