UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

February 19, 2021

MEMORANDUM

SUBJECT: Use of Nafion Dryers for Ultraviolet (UV) Ozone Analyzers

FROM: Kristen Benedict, Group Leader
Air Quality Assessment Divison, Ambient Air Monitoring Group

TO: EPA Regional Air Monitoring Contacts

In 2017, the Ambient Air Monitoring Group (AAMG) of the Office of Air Quality Planning and Standards (OAQPS) approved a request to add Nafion™ dryers to the ozone sampling lines at select Clean Air Status and Trends Network (CASTNET) sites. EPA's 2017 approval applied only to the CASTNET network and the addition of a Nafion™ dryer upstream of the ozone analyzer inside the monitoring station. The request was made because analyzer noise and slowed response was observed. The CASTNET ozone network uses ultraviolet (UV)-based ozone analyzers that do not include a dryer for humidity control as part of the Federal Equivalent Method (FEM) approval.

EPA has received additional inquiries from other monitoring agencies seeking the approved use of Nafion™ dryers as a means of addressing UV-based ozone measurement issues due to the presence of water vapor. In considering the request, the Office of Research and Development (ORD) and the AAMG have determined that this is not a request for modification to UV-based FEM designations, but a decision regarding the use of acceptable sampling probe material as discussed in 40 CFR part 58 Appendix E. The EPA has concluded that the addition of Nafion™ as part of the sampling line represents a suitable "equivalent" material per Section 9 of Part 58, Appendix E and that there is no evidence of significant loss of ozone in Nafion™ systems. Nafion™ has been shown to significantly reduce measurement noise, biases, and slow analyzer response times. The use of the Nafion™ may also provide the added advantage of increasing the ozone analyzer's scrubber service life.

EPA is providing this memo on the implementation of a Nafion™ dryer upstream of UV-based ozone FEMs (that do not have an internal Nafion™ dryer) on a nationwide basis.

This not a requirement, but an option for monitoring agencies to gain subsequent approval on the use of Nafion™ by the EPA Regions through review and approval of the monitoring agency's Quality Assurance Project Plan (QAPP) and Standard Operating Procedures (SOPs).

ORD's recommendations for nationwide use of Nafion™ upstream of UV-based ozone analyzers is provided in EPA report EPA/600/R-20/390, 2020 located here: https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=350170&Lab=CEMM
The document provides an overview of:

- the operating principle of UV-based ozone photometers and interferences;
- characteristics of Nafion™, including 2B Technologies' Dewline™;
- EPA's review and 2017 approval of CASTNET's request, including the Nafion™ assembly;
- Nafion™ dryer issues since the 2017 CASTNET approval; and
- summary and conclusions.

Regarding implementation of a Nafion™ system, EPA recommends that:

- the Nafion™ system be based on CASTNET's operating and design specifications which are provided in Table 1 and Figure 5 from the attached document and included below, with a minor modification to increase the Nafion™ tubing length from 48 inches to 72 inches;
- ozone calibration gases be introduced at the inlet to the Nafion™ system rather than directly into the ozone analyzer; and
- the Nafion™ dryer and analyzer's scrubber be replaced annually.

It is important to note that the specifications in Table 1 are not specific to the Thermo 49i and can be applied to other UV-based ozone photometer analyzers if needed.

For questions, you may contact Joann Rice at rice.joann@epa.gov.

Table 1. Design and operating specifications of CASTNET's Nafion™ Dryer

Parameter	**Specification**
Tested UV-based ozone analyzer	Thermo 49i FEM (EPA designation EQOA-0880-047)
49i sample flow rate	1.3 Lpm
Nafion™ tube	Perma Pure, Model # MD-110-48P-4
Nafion™ tube length	48 inches (1.2 m)
Nafion™ sample air tube's ID	0.086" (0.218 cm)
Nafion™ sample air residence time	2.1 seconds
Purge air flow rate	1.3 Lpm (nominal)
Purge air to sample air flow ratio	Approx. 1:1
Purge air inlet filter	Parker – Balston, #9933-05-DQ
Purge air flow control orifice	McMaster-Carr, size 0.010", Model #6349T42
Vacuum pump	Thomas, Model # 107CA18

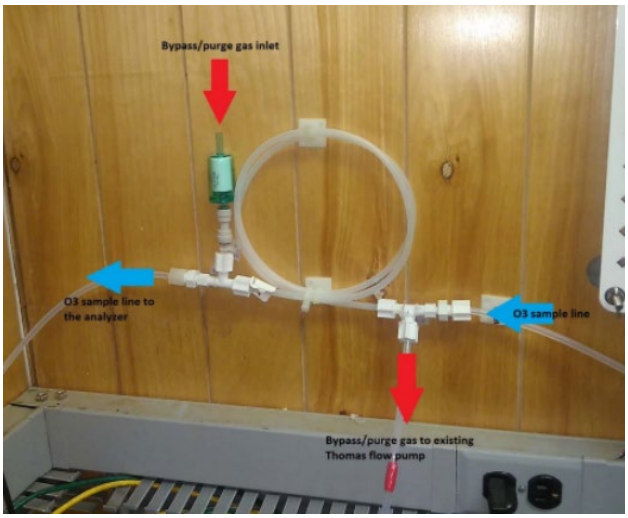

Figure 1. Photograph of CASTNET's Nafion™ assembly showing sample and purge air paths.