EPA Recommends Nationwide Approval of Nafion™ Dryers Upstream of UV-Absorption Ozone Analyzers1

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Challenge:

High humidity during ambient air monitoring increases noise, slows response times, and causes data drift in UV-based ozone analyzers, compromising data accuracy. Conventional setups struggle to mitigate these issues, leading to unreliable ozone trend data. Additionally, analyzers used for EPA compliance must adhere to their original Federal Reference Method (FRM) or Federal Equivalent Method (FEM) designation, and internal modifications require formal redesignation.

Application: (Ambient Ozone Monitoring)

The Clean Air Status and Trends Network (CASTNET) operates rural monitoring stations to track ozone and pollutant trends upwind or downwind of urban areas. Accurate ozone measurements are critical for assessing air quality changes, particularly during rapid humidity fluctuations. When the dew point approaches shelter temperature, UV-based analyzers without humidity mitigation produce noisy and inconsistent data, risking misinterpretation of air quality trends.

Solution:

Perma Pure Nafion™ dryers, installed upstream of ozone analyzers, are recognized by the EPA as an equivalent material under 40 CFR Part 58, Appendix E, for sampling probes. These dryers reduce water vapor in the sampled air, stabilizing measurements during humidity events. With Nafion™ dryers, analyzers exhibit faster response times, reduced signal noise, and minimal data drift, supporting reliable air quality data for regulatory reporting.

Result:

Field tests by CASTNET and other organizations (e.g., North Carolina DEQ, EPA Region 1) demonstrated that Nafion™ dryers eliminate measurable ozone loss and reduce measurement noise from ~10 ppb to ~1 ppb during high-humidity conditions. For example, during a 2016 evaluation period in Gainesville, FL, a Thermo 49i analyzer with a Nafion™ dryer showed stable performance compared to a non-equipped analyzer, which fluctuated significantly when shelter temperatures neared the dew point (see Figure 1). Initially accepted for CASTNET in 2017, the EPA's Office of Research and Development (ORD) now supports nationwide use of Nafion™ dryers upstream of UV-based O_3 analyzers for National Ambient Air Quality Standards (NAAQS) compliance monitoring, as they improve data quality without requiring modification to the analyzer's FEM designation.

1. Halliday, H., Johnson, C., Kleindienst, T., Long, R., Vanderpool, R., & Whitehill, A. (2020). Recommendations for nationwide approval of Nafion™ dryers upstream of UV-absorption ozone analyzers (EPA/600/R-20/390). U.S. Environmental Protection Agency.

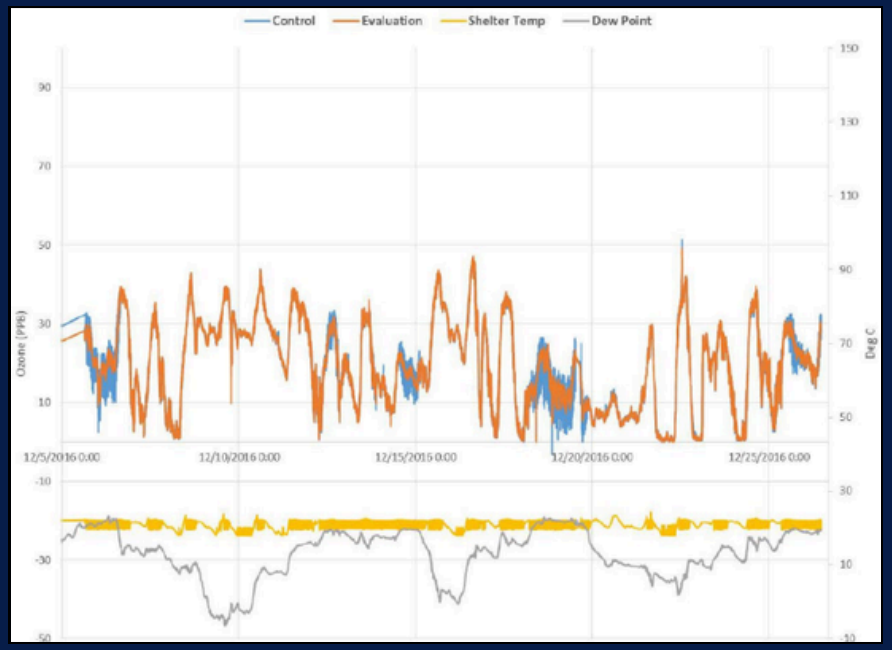

Figure 1: Timeline comparing the performance of two Thermo 49i ozone analyzers during the evaluation period (Dec. 5–26, 2016), with the evaluation analyzer equipped with a Nafion™ dryer showing minimal fluctuations during humid conditions compared to the control analyzer.



Design and operating specifications of CASTNET Nafion™ tubing implementation

Perma Pure's MD-110-48P-4 Dryer with Nafion™ Polymer Specifications:

- Tube Length: 48" (1.2m)
- Purge Air Flow Rate: 1.3 LPM
- Purge to sample flow ratio: Roughly 1:1

Contact us: salaera.com