AAPCA THE ASSOCIATION OF AIR POLLUTION CONTROL AGENCIES

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Mr. Edwin Roks
Chief Executive Officer
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Thousand Oaks, CA 91360

Mr. Michael S. Regan
Administrator
U.S. Environmental Protection Agency (EPA)
1200 Pennsylvania Ave NW
Washington, D.C. 20460

Dear Mr. Roks and Mr. Regan:

This letter is to transmit from the Association of Air Pollution Control Agencies (AAPCA)[1] considerations for improving data comparability between federal reference methods (FRM) and federal equivalent methods (FEM)[2] for ambient air monitoring of particulate matter (PM). State and local air agencies are co-regulators under the federal Clean Air Act (CAA) with important on-the-ground expertise, including serving as primary monitoring entities for the National Ambient Air Quality Standards (NAAQS). The U.S. Environmental Protection Agency (EPA) Office of Air Quality Planning & Standards (OAQPS) and Teledyne Technologies Incorporated acknowledge the need to address comparability issues between FRMs and FEMs, and AAPCA provides this expert technical input to that aim.[3]

Teledyne T640/T640X PM Mass Monitors received FEM designation from the U.S. EPA Office of Research & Development (ORD) in July 2016 and are widely used for continuous monitoring of ambient fine particulate matter ($PM_{2.5}$) by state and local air agencies throughout the nation.[4] These instruments have the advantage of instantly providing high temporal resolution $PM_{2.5}$ concentrations at a lower overall cost compared to FRM monitors. State and local agencies rely on U.S. EPA ORD designation of an instrument as "equivalent" to an FRM, which is generally the sole assurance of comparable performance.[5] Meeting data quality objectives is critical for collecting

[1] AAPCA is a national, non-profit, consensus-driven organization focused on assisting state and local air quality agencies and personnel with implementation and technical issues associated with the federal Clean Air Act. Created in 2012, AAPCA represents 53 state and local air pollution control agencies, and senior officials from 21 state environmental agencies currently sit on the AAPCA Board of Directors. AAPCA is housed in Lexington, Kentucky as an affiliate of The Council of State Governments. More about AAPCA is at: www.cleanairact.org.

[2] Methods for measuring ambient concentrations of specified air pollutants have been designated as "reference methods" or "equivalent methods" in accordance with 40 CFR Part 53. See U.S. EPA, "List of Designated Reference and Equivalent Methods," June 15, 2024.

[3] See also AAPCA's letter to U.S. EPA OAQPS addressing particulate matter monitoring method comparability (November 23, 2022).

[4] See U.S. EPA's Supplemental Information on the EPA's Update of $PM_{2.5}$ Data from T640/T640X PM Mass Monitors (May 13, 2024). State and local agencies were "reporting data for about 400 T640 and T640X $PM_{2.5}$ FEMs in 2023."

[5] See 40 CFR Part 53 Subpart C – Procedures for Determining Comparability Between Candidate Methods and Reference Methods.

defensible ambient air data that will have important implications for implementing the 2024 revised primary annual $PM_{2.5}$ NAAQS,[6] including for attainment/nonattainment designations, state implementation plans (SIPs), exceptional events demonstrations, and permitting.

AAPCA's state and local air agency members are concerned that the Teledyne T640/X FEM instruments have a significantly high bias compared to FRM instruments. AAPCA appreciates Teledyne Technologies and U.S. EPA's efforts to correct the bias in the Teledyne T640/X FEM.[7] However, the bias adjustment algorithm that was developed by Teledyne, approved by U.S. EPA, and applied to AQS data[8] does not adequately reduce the bias in the Teledyne T640/X $PM_{2.5}$ concentrations, resulting in annual $PM_{2.5}$ concentrations that are significantly higher compared to annual $PM_{2.5}$ concentrations measured with FRM monitors. This can lead to areas being designated nonattainment based on measured Teledyne T640/X $PM_{2.5}$ concentrations, when the area would have been designated attainment based on measured FRM $PM_{2.5}$ concentrations. As a result, many state and local air monitoring programs are in the process of invalidating the Teledyne T640/X measurements and moving away from the Teledyne T640/X instruments.

Currently, there are over 200 sites nationwide that have FRM monitors collocated with Teledyne T640/X instruments. The Georgia Environmental Protection Division (EPD) evaluated the performance of the Teledyne T640/X instruments by calculating the normalized mean bias (NMB)[9] at collocated FRM/FEM sites. The NMB statistics were based on 24-hour $PM_{2.5}$ measurements at 217 FRM sites across the United States from 2018 through 2023. The dataset included more than 68,000 FRM/FEM 24-hour $PM_{2.5}$ concentration data pairs. Details of Georgia EPD's evaluation are contained in Attachment A (slides 23 – 34) and Attachment B.

Prior to the implementation of the Teledyne bias adjustment algorithm, the multiyear average bias of the T640/X instruments was as much as 9.0 micrograms per cubic meter, or $\mu g/m^3$, (65.3 percent) higher as compared to FRM data. Also, 189 monitoring locations (87 percent) had a bias greater than ±10 percent while only 28 monitoring locations (13 percent) had a bias less than ±10 percent. The overall NMB was 20.1 percent. The Teledyne bias adjustment algorithm made adjustments based on the hourly ambient temperature and hourly measured FEM concentration. After implementation of the Teledyne bias adjustment algorithm, the multiyear average bias of the T640/X instruments was up to 7.9 $\mu g/m^3$ (57.6 percent) higher as compared to the FRM data. Also, 68 monitoring locations (31 percent) had a bias greater than ±10 percent while 149 monitoring locations (69 percent) had a bias less than ±10 percent. The overall NMB was 6.4 percent. While this is a significant improvement in the bias compared to the uncorrected measurements, it still does not adequately reduce the bias in the Teledyne T640/X $PM_{2.5}$ concentrations to an acceptable level.

The main concern with the current Teledyne algorithm is that it applies a constant adjustment value of 0.925 $\mu g/m^3$ to all values over 5.0 $\mu g/m^3$ (when the hourly temperature is greater than 20°C) and a constant adjustment value of 1.861 $\mu g/m^3$ to all values over 10.0 $\mu g/m^3$ (when the hourly temperature is less than or equal to 20°C). However, the FRM/FEM comparison clearly demonstrates that this approach does not match the data at higher $PM_{2.5}$ concentrations and that the bias adjustment needs to increase as the Teledyne FEM $PM_{2.5}$ concentrations

[6] 89 Fed. Reg. 16202 (March 6, 2024).
[7] See AAPCA comments on U.S. EPA's Docket ID No. EPA-HQ-OAR-2023-0642; Proposed Update of $PM_{2.5}$ Data From T640/T640X PM Mass Monitors (March 15, 2024).
[8] 89 Fed. Reg. 42874 (May 16, 2024).
[9] Normalized Mean Bias (NMB) = [(Average FEM Conc.) - (Average FRM Conc.)]/(Average FRM Conc)

increase.[10] Therefore, the application of a constant adjustment value (e.g., 0.925 or 1.861 µg/m^3) is inappropriate and should be replaced with an adjustment based on a percent reduction in Teledyne FEM $PM_{2.5}$ concentration for all concentrations and temperatures. As an example of an alternative bias adjustment approach, Georgia EPD implemented a simple update to the Teledyne bias adjustment algorithm. The alternative approach multiplies the T640/X raw PM value by 0.813233 for all hourly $PM_{2.5}$ concentrations regardless of concentration and temperature. Application of the Georgia EPD bias adjustment algorithm to the T640/X data resulted in a multiyear average bias of up to 4.7 µg/m^3 (34.4 percent) higher as compared to the FRM data. Also, only 45 monitoring locations (21 percent) had a bias greater than ±10 percent while 172 monitoring locations (79 percent) had a bias less than ±10 percent. The overall NMB was -2.3 percent. Table 1 below summarizes the T640/T640X instrument bias before and after Teledyne adjustment and Georgia EPD adjustment for 217 collocated FRM/FEM sites from 2018 – 2023.

Table 1. Summary of T640/T640X instrument bias before and after Teledyne adjustment and Georgia EPD adjustment for 217 collocated FRM/FEM sites from 2018-2023.

	Before Teledyne Bias Adjustment Algorithm	After Teledyne Bias Adjustment Algorithm	After Georgia EPD Bias Adjustment Algorithm
Maximum multi-year average bias	9.0 µg/m^3 (65.3%)	7.9 µg/m^3 (57.6%)	4.7 µg/m^3 (34.4%)
# of Sites > ±10% NMB	189 (87%)	68 (31%)	45 (21%)
# of Sites < ±10% NMB	28 (13%)	149 (69%)	172 (79%)
Overall NMB	**20.1%**	**6.4%**	**-2.3%**

Although the Georgia EPD analysis was performed for the entire United States, it should be noted that some areas of the country performed better than others, while others performed worse. Below are additional examples of analyses and actions undertaken by AAPCA member agencies:

- Georgia EPD evaluated collocated FRM/FEM instruments across 11 collocated sites in Georgia from January 1, 2021, to July 31, 2023. The Teledyne bias adjustment algorithm resulted in an overall normalized mean bias of 9.59 percent (with 6 of 11 sites having greater than ±10 percent bias). Applying a single bias adjustment multiplier of 0.813233 for all $PM_{2.5}$ concentrations regardless of concentration and temperature reduces the overall normalized mean bias in Georgia to -0.24 percent (all Georgia sites have less than ±10 percent bias and 9 of 11 sites have less than ±5 percent bias). Details can be found in Attachment C. As a result of the poor Teledyne T640/X performance in Georgia, Georgia EPD recently purchased 16 new FRM instruments to deploy at locations only running T640/X FEM instruments. For many of these sites, the FRM instruments will collect daily filter samples at an additional cost of approximately $300,000/year for filters, analysis, and additional full-time employees. Georgia EPD has requested NAAQS exclusion for a number of Teledyne T640/X $PM_{2.5}$ monitors based on the poor comparison to collocated FRMs using the U.S. EPA FEM Comparability Assessment Tool.[11]
- Oklahoma Department of Environmental Quality (ODEQ) uses both T640 and T640X samplers, and has found that, following U.S. EPA's implementation of Teledyne's correction factor, a 10 – 22 percent high bias still exists at all three sites collocated with FRM samplers. This level of bias throughout the state results in regions within Oklahoma now inaccurately showing annual design values at or near the newly revised annual primary NAAQS for $PM_{2.5}$. The risk of being designated nonattainment due to biased data rather than true NAAQS exceedances is not a risk ODEQ can continue to take. As such, ODEQ Ambient Air Monitoring staff are

[10] See Attachment A, slides 27 – 28.
[11] See U.S. EPA technical note "$PM_{2.5}$ Continuous Monitor Comparability Assessment" (updated May 18, 2018).

currently not purchasing T640 or T640X analyzers, replacement parts, or factory repairs for these devices, and are evaluating options to transition Oklahoma's entire continuous $PM_{2.5}$ Monitoring network towards alternative FEM samplers.

- Texas Commission on Environmental Quality (TCEQ) continues to evaluate data from sites where it has an FRM collocated with a Teledyne T640X. The data reviewed to date indicates a general high bias in the Teledyne T640X data when compared to the FRM data. This high bias ranges from +8 percent to +37 percent across six monitoring sites in the TCEQ network. In addition to the high bias, known problems with poor build quality in the sample inlets have affected sampler operations, making it difficult to compare data across multiple instruments and methods. Currently, TCEQ has no plans to purchase or deploy additional Teledyne T640X samplers in its network and is evaluating options to replace or redesignate Teledyne T640X samplers already being used.
- West Virginia Department of Environmental Protection (WVDEP) provided comments to U.S. EPA responding to the Agency's update of $PM_{2.5}$ data from T640/T640x PM Mass Monitors to indicate remaining concern that the applied adjustment does not adequately correct WVDEP's data compared with FRM data at the same locations. Using 2023 data at the Moundsville, WV, monitoring site as an example, the historical uncorrected T640X FEM (31.44 percent above FRM) was corrected using the alignment factor, however, the corrected data (22.46 percent above FRM) does not sufficiently align the FEM data to within 5 – 10 percent of the FRM data as expected. Furthermore, using Georgia EPD's alternate alignment factor on 2023 data at Moundsville would result in an average of the FEM running 8.33 percent higher than the FRM.[12]

AAPCA requests that Teledyne Technologies re-evaluate the bias adjustment algorithm implemented on the Teledyne T640/X instruments such that the comparability with the collocated FRM measurements result in an overall bias much closer to zero. Without an updated bias adjustment algorithm, state and local air agencies are likely to continue to invalidate the Teledyne T640/X measurements and look for alternatives to the Teledyne T640/X instruments.

AAPCA also urges U.S. EPA to revisit retroactively correcting particulate matter with a diameter of 10 microns or smaller (PM_{10}) data. Teledyne's Network Data Alignment is applicable to PM_{10} measurements moving forward, and despite being potentially diminutive,[13] correcting the bias associated with PM_{10} data is important to some states and provides a more accurate dataset for regulatory, scientific, and public use. We agree with the Agency's prioritization of implementing the Network Data Alignment for $PM_{2.5}$ given approaching implementation deadlines for the 2024 revised annual $PM_{2.5}$ NAAQS; however, U.S. EPA should begin working with air agencies to implement the alignment, as appropriate, for PM_{10} data as well. Developing and implementing the bias adjustment was a time- and resource-intensive process that resulted in the delayed release of 2023 $PM_{2.5}$ design values.[14] Transparent, early engagement with state and local co-regulators is critical as U.S. EPA continues to further evaluate and improve the performance of FEMs operating in the national regulatory monitoring network.

Thank you for considering the Association's comments on improving PM monitoring method comparability between FRMs and the Teledyne T640/T640X PM Mass Monitor FEM. If you have any questions, please contact

[12] See Attachment D.
[13] See U.S. EPA's "Supplemental Information on the EPA's Update of $PM_{2.5}$ Data from T640/T640X PM Mass Monitors" (May 13, 2024).
[14] U.S. EPA released 2023 $PM_{2.5}$ Design Values on August 9, 2024, while design value reports for all other criteria pollutants were made available on June 12, 2024.

Ms. Morgan Dickie, Executive Director, at mdickie@csg.org or (859) 244-8042.

Sincerely,

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Executive Director, AAPCA

cc: Mr. Kirk Lovewell, Teledyne Technologies Inc.
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