Standard Operating Procedure: Chemiluminescent Oxides of Nitrogen (NOx) Analyzer

Field Calibration, Molybdenum Converter Efficiency, and Gas Dilution Checks

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Lead Specialist / Author:	Kadeem Manning	**Effective Date:**	September 2026
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1. Purpose & Technical Scope

Chemiluminescent NOx analyzers (Thermo 42C/42i, Teledyne API 200E/T500U) measure ambient nitric oxide (NO) and total oxides of nitrogen (NOx = NO + NO2) in air monitoring networks. Nitric oxide reacts with ozone (O_3) produced internally to generate excited NO_2^*, emitting light proportional to NO concentration. This SOP outlines gas dilution calibration, molybdenum converter efficiency testing ($CE \ge 96.0\%$), and ozonator flow audits [11, 49].

2. Required Calibration Standards & Equipment

• **EPA Protocol Gas Standard:** NIST-traceable NO in N_2 cylinder ($50\text{--}100\text{ ppm}$, $\le \pm 1.0\%$ accuracy).
• **Gas Dilution Calibrator:** Multi-gas calibrator with mass flow controllers and internal O_3 generator.
• **Zero Air Generator:** Dry, hydrocarbon-free, NO-free zero air supply ($<0.5\text{ ppb}$ NO).
• **PTFE Sample Tubing:** 1/4" OD FEP/Teflon tubing with particulate filter.

3. Step-by-Step Calibration & Operating Procedure

1. **Shelter Temperature Audit:** Verify shelter climate control (20.0°C to 30.0°C, $\pm 2.0^\circ\text{C}$ stability) and PMT cooler operating at -15.0°C.
2. **Zero Baseline Check:** Introduce zero air into the sample manifold for 15 minutes. Verify NO, NO_2, and NO_x zero responses fall within $0.0 \pm 1.0\text{ ppb}$. Adjust zero offset if required.
3. **Multi-Point Span Calibration:** Dilute NO standard gas to generate 4 span points across the operating range (e.g., 50, 100, 200, 400 ppb). Record NO and NO_x channels; verify linear response slope (1.00 ± 0.05) and correlation coefficient ($r \ge 0.999$).
4. **Molybdenum Converter Efficiency Test (CE):** Perform Gas Phase Titration (GPT) by adding O_3 to the 400 ppb NO stream to convert approximately 80% of NO to NO_2. Calculate converter efficiency:

$$\mathbf{CE = \frac{[NO_2]_{\text{out}}}{[NO]_{\text{orig}} - [NO]_{\text{rem}}} \times 100\%}$$

Verify $CE \ge 96.0\%$. If $CE < 96.0\%$, replace the internal molybdenum converter cartridge (315°C).

FIELD VERIFICATION & APPROVAL SIGN-OFF	
Prepared & Approved By:	**Kadeem Manning** (Lead Field Specialist)
Technician Signature:	*Kadeem Manning*
Verification Date:	September 16, 2026
Calibration Status:	**[X] PASSED & VERIFIED** [ ] REJECTED