

South Coast Air Quality Management District
Science and Technology Advancement

Monitoring and Analysis Division
Atmospheric Measurements Branch



STANDARD OPERATING PROCEDURE

FOR

Operations of API/Teledyne
200E NO/NOX/NO2

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PREPARATION, REVIEWS AND APPROVALS
Standard Operating Procedure for API 200E NO/NOX/NO2 Instrument

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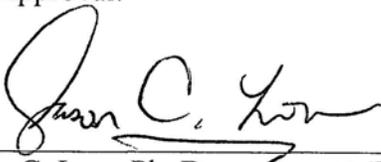
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Standard Operating Procedure for API 200E NO/NO_x/NO₂ Instrument

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1 General:

1.1 Purpose

The purpose of this Standard Operating Procedure (SOP) is to provide a set of written instructions that document routine maintenance and operation procedures for measurement of the Advanced Pollution Instrumentation, Inc. (API) Model 200E Nitrogen Oxides Analyzer

- ☞ The AQIS Operator is ultimately responsible for the Air Monitoring Site data quality. If a critical failure is being reported or the analyzer is over the "Validation Tolerance" the **AQIS Operator shall "Disable" the onsite Datalogger immediately.** Consultation with the Senior AQIS can be made after the fact.

1.2 Safety

Air Monitoring Stations have a great many reasons for safety concerns. Please see "Station Safety Manual", SOP's for Specific Instrumentation and Manufacture's Instrument Manuals and Recommendations.

1.3 References

- Teledyne - API MODEL 200E NITROGEN OXIDES ANALYZER, Instruction Manual
- "SOP for General Air Monitoring Station Operations"

1.4 General Description

Advanced Pollution Instrumentation, Inc. (API) Model 200E NO/NO_x Analyzer is designated as Reference Method Number RFNA-1194-099 (same designation as model M200A) as per 40 CFR Part 53 when operated under the following conditions:

1. Range: Any full-scale range between 0-0.05 and 0-1.0 ppm (parts per million).
2. Ambient temperature range of 5 to 40 oC.
3. Line voltage range of 105-125 VAC or 220-240 VAC, at 50 or 60 Hz.
4. Equipped with PTFE filter element in the internal filter assembly.
5. Equipped with ozone supply air filter
6. External vacuum pump capable of 10 in-Hg-A at 2 standard liters per minute (slpm) or better.
7. Software settings:
 - A. Dynamic span OFF
 - B. Dynamic zero OFF
 - C. Cal-on-NO₂ OFF

D. Dilution factor	OFF
E. Temp/Pressure compensation	ON
F. Auto Cal	ON or OFF
G. Independent range	ON or OFF
H. Auto-range	ON or OFF
I. Converter Efficiency	Acceptable values of 0.96 to 1.02

1.5 Principal Of Operation

The M200E Nitrogen Oxides Analyzer is a microprocessor controlled instrument that determines the concentration of nitric oxide (NO), total nitrogen oxides (NO_x, the sum of NO and NO₂) and nitrogen dioxide (NO₂) in a sample gas drawn through the instrument. It requires that sample and calibration gases are supplied at ambient atmospheric pressure in order to establish a constant gas flow through the reaction cell where the sample gas is exposed to ozone (O₃), initiating a chemical reaction that gives off light (chemiluminescence).

The instrument measures the amount of chemiluminescence to determine the amount of NO in the sample gas. A catalytic-reactive converter converts any NO₂ in the sample gas to NO, which is then - including the NO in the sample gas - is then reported as NO_x. NO₂ is calculated as the difference between NO_x and NO. (For more on the theory of operation and chemiluminescence please see API Model 200E Instrument Manual 10.0.0

2 Siting and Installation

2.1 Initial Setup and Installation: Station Operations

- Verify Correct Instrument Installation
- Verify Receipt of Current Instrument Manual
- Verify Receipt of all Instrument Log Books
- Verify Receipt of Instrument Specific Maintenance Sheet

2.2 Physical Instrument Inspection: Station Operations Verify the Following

- Ventilation Clearance:
Whether the analyzer is set up on a bench or installed into an instrument rack, be sure to leave sufficient ventilation clearance.
Minimum Clearance Area Required
 - Back of the instrument 4 in.
 - Sides of the instrument 1 in.
 - Above and below the instrument 1 in.
- Electrical Connections:

Verify Clean and professional installation, check for loose wires and connections and proper clearance for instrument inspection and maintenance (API Model 200E Manual – Section 3.1 & 3.4)

- **Pneumatic Connections:**
 Verify correct tubing and connection installation, check for clearance and damaged tubing, verify correct inlet/outlet (exhaust) connections (API Model 200E Manual – Section 3.3 Figure 3-3)
- **Initial Startup:**
 Verify Initial startup procedure corresponds with factory firmware and calibration (API Model 200E Manual – Section 3.5.1 – 3.5.4)
- **Initial Calibration:**
 Verify multi-point calibration; verify documentation of calibration in Station Logbook, Instrument Logbook & Monthly Maintenance Sheet (API Model 200E Manual – Section 3.6 & 7.0)

3 Routine Servicing

3.1 General Information

Perform the following checks at the intervals specified in the service schedule. The checks may be preformed more frequently but should be preformed at least at the prescribed intervals. Be sure to document all results of maintenance and downtime on the monthly maintenance sheet and downtime log. The Downtime Log, Monthly Maintenance sheet and Maintenance Summary Table are included as attachments.

3.2 Data Validation

NO ₂ Validation Template			
Requirement	Frequency	Acceptance Criteria	Information /Action
CRITICAL CRITERIA- NO₂			
One Point QC Check Single analyzer	1/2 weeks	≤ ±10% (percent difference)	0.01 - 0.10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/2 weeks	Zero drift ± 3% of full scale Span drift ± 10 %	

- ☞ **One Point QC Check - Daily - Required every 2 Weeks**
 ±10 % = Out of Tolerance - Disable - Report
 ±07 % = Out of Tolerance Warning - Report

AQIS Operator shall record the current Span readings from the Chessell Video Recorder on the PC/SPAN maintenance sheet. Verify that the readings are within the Acceptance Criteria Range.

Data Validation can be an issue if the Data is outside this range. Perform

a visual inspection of all instruments to ensure that they are not damaged and are functioning correctly.

Review the Chessell Video Recorder data for the preceding week to ensure that data appears to follow normal patterns and check appropriate box to indicate whether traces are normal on maintenance sheets.

3.3 AM Work Orders

The AQIS Operator shall in the course of duties utilize as explained in the "SOP for General Air Monitoring Station Operations" the "AM Work Order" Procedure.

If a critical failure is being reported or the analyzer is over the "Validation Tolerance" the **AQIS Operator shall "Disable" the on-site Datalogger immediately**. Consultation with the Senior AQIS can be made after the fact.

3.4 Daily* Tasks: Station Operations API 200E NO/NO_x Instrument

*on the days that the operator services the station

- Check NO/NO_x Instrument Status on Chessell
- Check that instruments in Sample mode
- Check for LED Status
(Sample-Green: Cal-Off: Fault-Off: Record in Station Logbook, Instrument Logbook & Monthly Maintenance Sheet & Notify Senior if unable to resolve Fill out Downtime log if necessary (fig...))
- Record any problems or changes in Station Logbook, Instrument Logbook & Monthly Maintenance Sheet
- Check Sample Instrument Flow & O₃ Flow are within parameters
(Sample Flow 500±50cc/min; O₃ Flow 60-90cc/min)

3.5 Weekly Tasks: Station Operations API 200E NO/NO_x Instrument

- *All Checks to be run with Zero Air through gas calibrator for a minimum of 15 minutes: Record downtime in downtime log.*
 - Change Filter 5um (Minimum Every Week) (see detailed Maintenance & Adjustment)
 - Check Clock to ESC (±5 Min)
 - Complete Monthly Maintenance Sheet (Test Keys <>)
 1. Record LED Status (Sample-Green: Cal-Off: Fault-Off: If LED Status Is Other, Record in Station Logbook, Instrument Logbook & Monthly Maintenance Sheet & Notify Senior if unable to resolve Fill out Downtime log if necessary)

2. Record O₃ Flow (80 ±15 cc/min)
 3. Record Sample Flow (500 ± 50 cc/min)
 4. Record RCEL Pressure (4 – 10 inHg)
 5. Record Moly Temperature (315°C ± 5)
 6. Record PMT Temperature (7°C ± 1)
- Check Calibration Factors – NO/NO_x Offset (Zero) & NO/NO_x Slope (Span) with those recorded in the Instrument Logbook & record on monthly maintenance sheet

3.6 Monthly Tasks: Station Operations API 200E NO/NO_x Instrument

- Perform Analog Output Test & Record Values on Monthly maintenance sheet (±1% Full Scale) (API Model 200E Manual - Section 6.7.2)
- Zero Span Check for NO_x/NO

Parameters	Response
> or < than +/- 15 PPB	Invalid Data Call in work order
-15 to -5 PPB or 5 to 15 PPB	Perform Manual Zero Adjustment
-5 to 0 PPB or 0 to 5 PPB	No Adjustment Needed

(See Detailed Maintenance & Adjustment Zero Span for procedure on Manual Zero adjustment)

3.7 Quarterly Tasks: API 200E NO/NO_x Instrument

3.7.1 Station Operator

Verify multi-point calibration & NO₂ Converter Efficiency check; verify documentation of calibration in Station Logbook, Instrument Logbook & Monthly Maintenance Sheet

3.7.2 Support Group:

Multi-Point Calibration & NO₂ Converter Efficiency
(API Model 200E Manual - Section 7.0.0)

3.8 Semi-Annual Tasks: API 200E NO_x Instruments

3.8.1 Station Operator:

Clean Manifold, Probe Inlet and Instrument lines

3.9 Annual Tasks: API 200E NOX Instruments

3.9.1 Station Operator:

Verify the Completion and Documentation of the following

3.9.2 Support Group:

- Replace: Ozone Filter (API Model 200E Manual – Sections 9.3.3)
- Inspect & Clean Reaction Cell Window (API Model 400E Manual – Sections 9.3.9)
- Examine Pneumatic Lines & Check for Leaks (API Model 200E Manual – Sections 11.5.1 & 11.5.2)
- Replace Sintered filter and O-rings (API Model 200E Manual - Section 9.3.10)
- Check RCEL Pressure and repair or replace pump as necessary (API Model 200E Manual - Section 9.3.4)
- Replace the O₃ Dryer Particulate Filter

3.10 Every Three Years Tasks:

3.10.1 Station Operator

Verify the Completion and Documentation of the following

3.10.2 Support Group:

Replace NO₂ Converter (API Model 200E Manual – Sections 9.3.8)

4 Documentation:

4.1 Station & Instrument Logbooks

The AQIS Operator shall maintain as explained in the “SOP for General Air Monitoring Station Operations” the Station and Instrument Logbooks.

4.2 Monthly Downtime Log

Complete the Monthly Downtime Log as per instructions in the “SOP for General Air Monitoring Station Operations” Section.4.5 and submit as described.

4.3 Maintenance Sheets

Complete and submit the API 200E NO/NO_x Monthly Maintenance sheet to the Senior AQIS for review. Once reviewed, the Senior AQIS submits the maintenance sheet to Data Validation for review

5 Troubleshooting:

Before starting any troubleshooting procedure, refer to API Model 200E Manual – Section 11 for more on specific information.

Check for Leaks at all obvious connections

Check all electrical connections, specifically those at the ESC & Chessel connection, check for proper grounding

5.1 Detailed Maintenance & Adjustment

5.1.1 Replacing Particulate Filter

(API Model 200E Manual – Section 9.3.1)

The particulate filter should be inspected often for signs of plugging or excess dirt. It should be replaced according to the service interval in API Model 200E Manual Table 9-1 even without obvious signs of dirt. Filters with 1 and 5 μm pore size can clog up while retaining a clean look. It is recommend to handle the filter and the wetted surfaces of the filter housing with gloves and tweezers. It is recommend not to touch any part of the housing, filter element, PTFE retaining ring, glass cover and the O-ring with bare hands as this may cause the pores to clog quicker and surfaces to become dirty due to possible oils from your hands.

Figure 1: Sample Particulate Filter Assembly



To change the filter, follow this procedure:

1. Remove the CE Mark locking screw in the center of the front panel and open the hinged front panel and unscrew the knurled retaining ring of the filter assembly.
2. Carefully remove the retaining ring, glass window, PTFE O-ring and filter element.
3. It is recommend to clean the glass and O-rings at least once monthly, weekly in very polluted areas.
4. Install a new filter element, carefully centering it in the bottom of the holder.
5. Re-install the PTFE O-ring with the notches facing up (important!), the glass cover, then screw on the hold-down ring and hand-tighten the assembly.
6. Inspect the (visible) seal between the edge of the glass window and the O-ring to assure proper gas tightness.

5.1.2 Zero Check Procedure: General

The zero and span check procedure is preformed at the air monitoring site. When completing this procedure the operator will comply with instruction from the manufacturer's operation manual.

(API Model 200E NO/NO_x Manual – Section 7.2.3 Zero Air **only**)

To complete the procedure the operator may examine the nightly span/precision values to verify zero values or the operator use the gas dilution system to zero/span the criteria pollutant analyzers. During the procedure verify the analyzer is in normal operation mode.

- Initiate the flow of zero air through the analyzer until it stabilizes; approximately 15 minutes
- Compare the values from the Chessell or ESC data logger to the table and determine if adjustments are required
- If adjustments are required note the old calibration factors both in the logbook and on the maintenance sheet.
- While running zero air, place the instrument in the calibration mode and run for at least 15 additional minutes.
- Press the “zero mode” function
- Press the “enter button”
- The instrument should now have a new “zero” or “intercept “value”
- Record these new values both in the log book and on the maintenance sheet.

Please be sure to note any additional information regarding erratic instrument behavior

**5.1.3 Zero Span Calibration
 (API Model 200E NO/NO_x Manual section 7.2.3 Zero Air Only)**

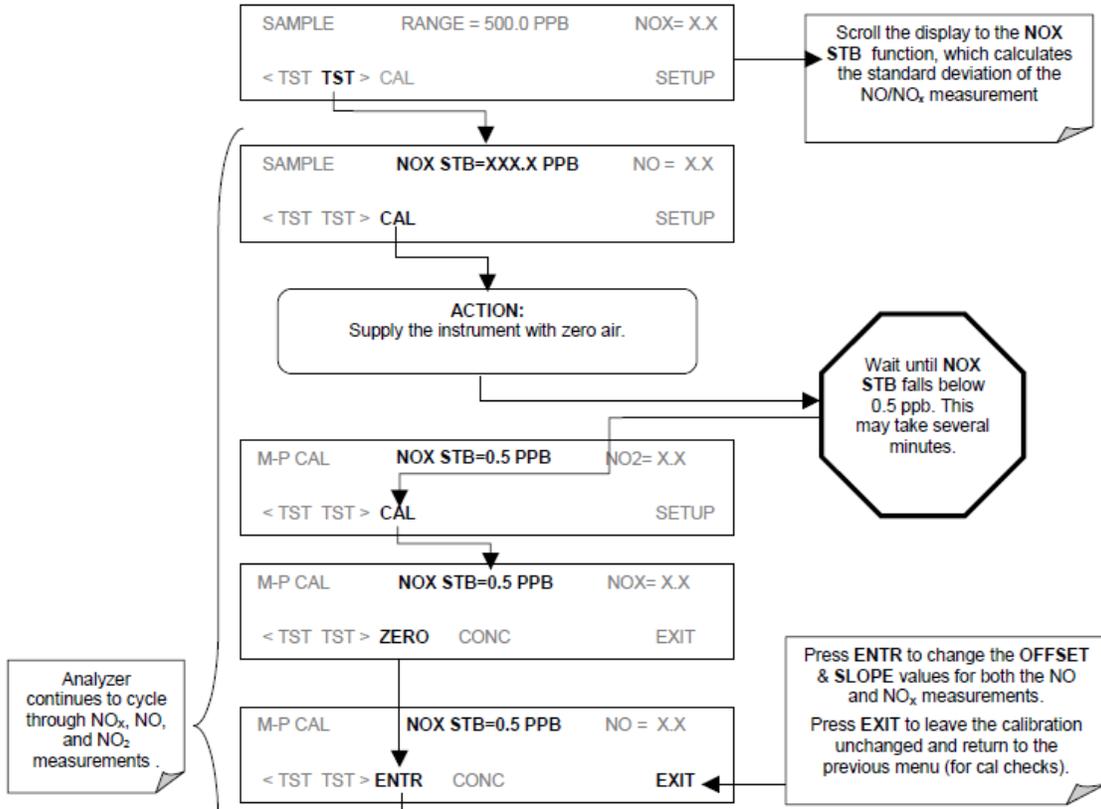


Figure 2: Front Panel

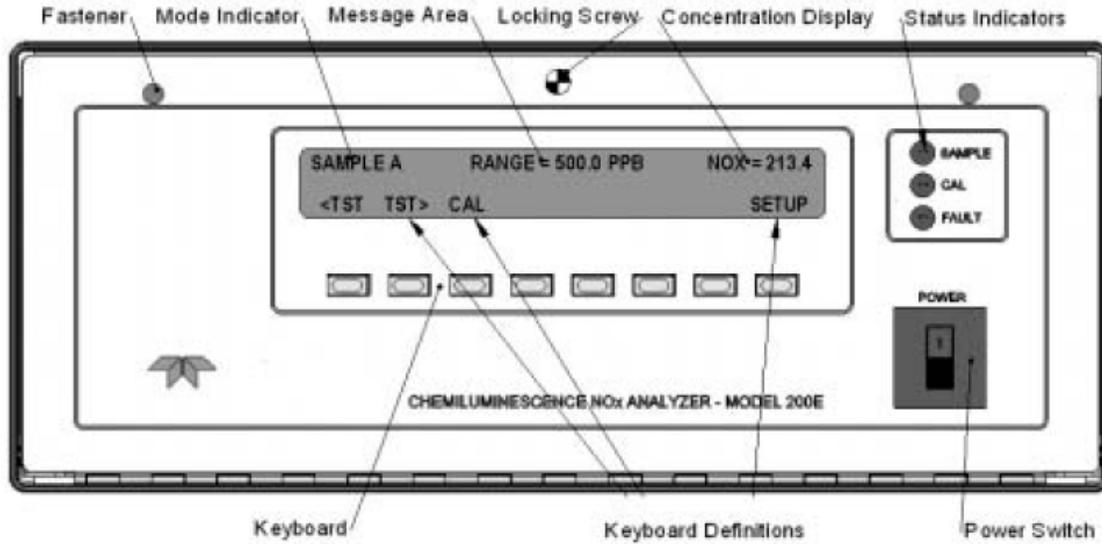


Figure 3: Back Panel

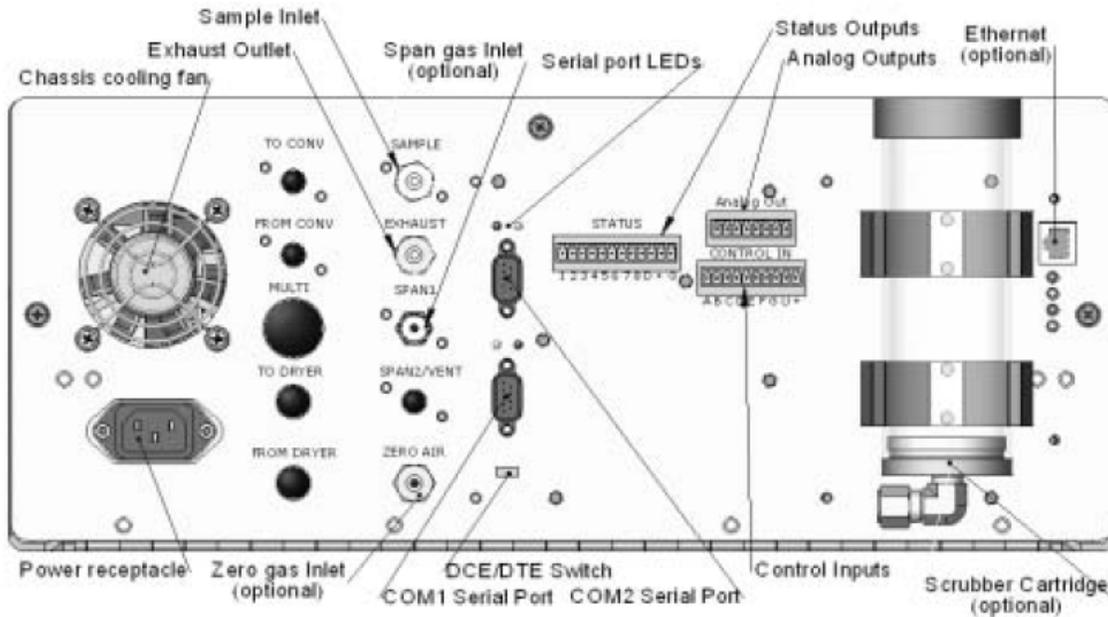


Table 1: Maintenance Interval

(API Model 200E NO/NO_x Technical Manual – Section 9.1

Daily	Review all data collected from the previous day for all sites by viewing data remotely or Chessel strip chart. Data should be compared to the previous day for consistency. Perform a visual inspection of all instruments to ensure that they are not damaged and are functioning correctly. Notify Senior if otherwise	Station Operator
Weekly	Complete all weekly maintenance sheet tasks. Record the current readings from the Chessell strip chart recorder and data logger in the appropriate columns on the PC/SPAN maintenance sheet. Perform a visual inspection of all instruments to ensure that they are not damaged and are functioning correctly. Review the Chessell strip chart data for the preceding week to ensure that data appears to follow normal patters and check appropriate box to indicate whether traces are normal on maintenance sheets. Notify Senior if otherwise	Station Operator
Monthly	Perform Analog Output Test for Zero & Full Scale, Zero Span Check	Station Operator
Quarterly	Verify multi-point calibration & NO ₂ Converter Efficiency check; verify documentation of calibration in Station Logbook, Instrument Logbook & Monthly Maintenance Sheet	Station Operator
	Multi-Point Calibration & NO ₂ Converter Efficiency	Repair/Calibration Technician
Semi - Annually	Clean Manifold, Probe Inlet, & Instrument tubing/lines	Station Operator
Annually	Verify the Completion and Documentation of the following	Station Operator
	Replace the Ozone Filter, Inspect & Clean the Reaction Cell Window, Replace the Sintered filter and O-rings, Clean & Examine Pneumatic lines, Leak Check Check RCEL Pressure and repair or replace pump, Replace the O ₃ Dryer Particulate Filter	Repair/Calibration Technician
Every 3 Years	Verify the Completion and Documentation of the following	Station Operator
	Replace NO ₂ Converter	Repair/Calibration Technician

Appendix A: API 200E Maintenance Sheet

South Coast Air Quality Management District
 Monthly Maintenance Report
 API/Teledyne 200E NO/NO₂/NO_x

See SOP for Maintenance Sheet Instructions

Location:	Month & Year:
Station #	Technician:
Instrument Serial #	AQMD Property #

DATE:					
TIME:					
Change Filter					
LED Status Sample					
LED Status CAL					
LED Status Fault					
Sample Flow (500 ± 50cc/m)					
O ₃ Flow (80 ± 15 cc/min)					
PMT Temp (7°C ± 1)					
RCEL Pressure (4 - 10inHg)					
Moly Temp (315°C ± 5)					
NO _x Slope (Span)					
NO _x Offset (Zero)					
NO Slope (Span)					
NO Offset (Zero)					

Monthly: Perform Analog Output Test (± 1% Full Scale)

DATE:		TELEMETRY	CHESSEL		
<input style="width: 100%;" type="text"/>		ZERO	SPAN	ZERO	SPAN
	NO				
	NO _x				

Comments: _____

Calibration Date: _____ Reviewed BY: _____