

**Bay Area Air Quality Management District**

**MANUAL OF PROCEDURES**

**VOLUME II**

**ENGINEERING PERMITTING PROCEDURES**

**PART 5**

**REFINERY HEATER EMISSION RATE  
VERIFICATION PROCEDURES**



**MANUAL OF PROCEDURES**

**VOLUME II – Engineering Permitting Procedures**

**PART 5 - Refinery Heater Emission Rate Verification Procedures**

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**VOLUME II**  
**ENGINEERING PERMITTING PROCEDURES**

**PART 5**  
**Refinery Heater Emission Rate Procedures**

REF: BAAQMD Regulation 9, Rule 10

**1. Introduction**

Regulation 9-10-506 authorizes the use of an Emission Rate Verification Procedure as a monitoring alternative to the use of a continuous emission monitoring system (CEMS) for compliance monitoring of NO<sub>x</sub> and CO emissions at certain heaters that are subject to Regulation 9, Rule 10. This chapter of the Manual of Procedures specifies which heaters must be monitored with CEMS and/or parametric monitors, and provides the requirements for Emission Rate Verification Procedures for NO<sub>x</sub> and CO for heaters that are not required to use CEMS.

**1.1 CO Emission Monitoring**

Regulation 9, Rule 10 includes a daily average CO limit of 400 ppmv at 3% oxygen. When a heater is monitored with a CO CEMS, compliance with this limit is based on CEMS emission data expressed in units of “ppmv CO at 3% oxygen”. For certain heaters, this chapter allows compliance with the daily average CO limit to be verified with periodic CO source tests, as an alternative to CEMS.

**1.2 NO<sub>x</sub> Emission Monitoring**

Regulation 9, Rule 10 includes a refinery-wide, daily average NO<sub>x</sub> limit of 0.033 pounds NO<sub>x</sub> per million BTU heat input at most heaters that are not CO boilers. For those averaged heaters that are monitored with NO<sub>x</sub> CEMS, the daily NO<sub>x</sub> mass contribution from those heaters is taken from the CEMS. For certain heaters, this chapter allows the daily NO<sub>x</sub> mass contribution to be estimated by multiplying a heater-specific, Conservative Emission Factor (expressed in units of “pounds of NO<sub>x</sub> per million BTU heat input”) by the daily heat input for that heater, as an alternative to CEMS. Compliance with the refinery-wide NO<sub>x</sub> limit is verified by dividing the total daily NO<sub>x</sub> mass emissions from the averaged heaters (either from CEMS data or derived from one or more Conservative Emission Factors) by the total daily heat input at the averaged heaters.

**1.3 Effective Date**

Prior to the 2010 amendment of Regulation 9, Rule 10, monitoring alternatives to NO<sub>x</sub> and CO CEMS, as allowed by Regulation 9-10-502.1, were included in the permit conditions for each refinery. Per Regulation

9-10-506 (added in 2010), effective January 1, 2011, this MOP chapter will supersede those provisions of the permit conditions, although Conservative Emission Factor and Allowable Operating Range data already approved by the District (as "NOx Box" parameters) may continue to be used until modified as allowed or required by this chapter, as provided in Section 3.

#### **1.4 Violations**

Failure to follow the procedure in this chapter as of the effective date in Section 1.3 shall constitute a violation of Regulation 9-10-506 for either NOx or CO emissions, as applicable, in addition to constituting a possible violation of either the NOx or CO limits in Regulation 9-10, if those are found to have occurred.

## **2. Heaters Required To Operate CEMS and/or Parametric Monitors**

The installation and operation of CEMS required by this chapter shall conform to the District's Manual of Procedures, Volume V: *Continuous Emission Monitoring*.

### **2.1 Heaters That Must Be Monitored With NOx CEMS:**

Heaters that meet any of the following conditions must be monitored with NOx CEMS:

- 1.1 Heaters required to be monitored with a NOx CEMS on the effective date in Section 1.3.
- 1.2 Heaters abated by selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) systems.
- 1.3 Heaters with a maximum rated heat capacity (MRHC)  $\geq 200$  million BTU/hr.
- 1.4 Heaters that trigger a NOx CEMS requirement in Regulation 9-10-506.1.
- 1.5 Heaters that do not use an Emission Rate Verification Procedure for NOx as described in Section 3 of this chapter.

### **2.2 Heaters That Must Be Monitored With CO CEMS:**

Heaters that meet any of the following conditions must be monitored with CO CEMS:

- 2.1 Heaters required to be monitored with a CO CEMS on the effective date in Section 1.3.
- 2.2 Heaters with a maximum rated heat capacity (MRHC)  $\geq 25$  million BTU/hr and with two District-approved source tests within a continuous 5 year period that measure CO  $\geq 200$  ppmv @ 3% O<sub>2</sub>.

### **2.3 Heaters That Must Be Monitored With O<sub>2</sub> CEMS:**

Heaters that meet any of the following conditions must be monitored with oxygen (O<sub>2</sub>) CEMS:

- 3.1 Heaters required to be monitored with O<sub>2</sub> CEMS on the effective date in Section 1.3.
- 3.2 Heaters that are required to be monitored with either a NO<sub>x</sub> or CO CEMS must also be monitored with an O<sub>2</sub> CEMS.

### **2.4 Heaters That Must Be Monitored With O<sub>2</sub> Parametric Monitor and Recorder:**

The following heaters must be monitored with oxygen (O<sub>2</sub>) parametric monitors and recorders:

- 4.1 Heaters required to be monitored with O<sub>2</sub> parametric monitors and recorders on the effective date in Section 1.3.
- 4.2 All heaters subject to a NO<sub>x</sub> or CO emission limit in Regulation 9, Rule 10 that are not monitored with an O<sub>2</sub> CEMS must be monitored with an O<sub>2</sub> parametric monitor and recorder.
- 4.3 In addition to the other requirements of Regulation 1-523, the accuracy of the O<sub>2</sub> parametric monitor shall be verified on an annual basis.

## **3. Conservative Emission Factor, Allowed Operating Range**

The operator of a heater that is not monitored with a NO<sub>x</sub> CEMS, but that is subject to the refinery-wide, daily average NO<sub>x</sub> limit in Regulation 9-10-301, shall establish a Conservative Emission Factor for NO<sub>x</sub> (expressed in units of "pounds of NO<sub>x</sub> per million BTU heat input") and one or two Allowed Operating Ranges for that heater. Each Allowed Operating Range is defined by a range of firing rate, oxygen content, and flue gas recirculation (FGR) recirculation rates, if applicable, to which a single Conservative Emission Factor is applied. The Conservative Emission Factor multiplied by the daily heat input at the heater shall be used as the daily NO<sub>x</sub> mass emission contribution for that heater in the daily verification of compliance with the refinery-wide, daily average NO<sub>x</sub> limit.

For heaters where operators had already established a Conservative Emission Factor and Allowed Operating Range (referred to as a "NO<sub>x</sub> Box") in accordance with District permit conditions prior to the effective date in Section 1.3, these data shall continue to be used until modified as allowed or required by this chapter.

A heater with an Allowed Operating Range shall operate within the boundaries of the Allowed Operating Range, except whenever the heater operates at a firing rate  $\leq 20\%$  of maximum rated heat capacity (MRHC), during periods of curtailed operation (e.g., during heater idling or

refractory dryout) lasting 5 days or less (notwithstanding the longer time allowance in Regulation 9-10-301.2), or during a source test (except for tests required in Section 4.1 of this chapter). During these conditions, the refinery-wide, daily average NO<sub>x</sub> limit shall still apply and compliance with such limit shall continue to be verified using the Conservative Emission Factor.

### **3.1 Establish Conservative Emission Factor, Allowed Operating Range**

The following procedure shall be used to establish a Conservative Emission Factor and Allowed Operating Range for heaters that previously were exempt from the refinery-wide, daily average NO<sub>x</sub> limit, or when the operator desires or is required to establish a new Conservative Emission Factor or desires or is required to expand the Allowed Operating Range for a heater. New and amended Conservative Emission Factors and Allowed Operating Ranges require approval by the District's Air Pollution Control Officer (APCO) through the District's permit application process.

- 1.1 Perform District-approved source tests for NO<sub>x</sub> and CO, while varying the firing rate, oxygen concentration and FGR rate (if applicable) over the desired operating ranges for the heater.
- 1.2 Determine the minimum and maximum firing rate, oxygen concentration and FGR rate (if applicable) for the desired operating ranges. Minimum O<sub>2</sub> at low-fire may be different than the minimum O<sub>2</sub> at high-fire. The same is true for the maximum O<sub>2</sub>.
- 1.3 Determine the Conservative Emission Factor, which is the highest NO<sub>x</sub> emission factor (expressed in units of "pounds of NO<sub>x</sub> per million BTU heat input") measured over the operating ranges while maintaining CO concentration below 200 ppmv. The operator may choose to use a higher NO<sub>x</sub> emission factor than the highest measured factor.
- 1.4 Plot the points representing the Allowed Operating Range on a graph. The Allowed Operating Range for each emission factor can be represented either as a 4- or 5-sided polygon. The Allowed Operating Range is the area within the polygon formed by connecting the parameters that lie about the perimeter of the range of operating parameters measured during approved source tests. Upon establishment of each Allowed Operating Range, the operator shall prepare a graphical representation of the range.
- 1.5 For heaters with a MRHC <25MM BTU/hr, the Conservative Emission Factor and Allowed Operating Range shall be established as follows: High-fire shall be the maximum rated capacity. Low-fire shall be 20% of the maximum rated capacity. There shall be no maximum or minimum O<sub>2</sub>.



### 3.2 Operation Outside Allowed Operating Range

- 2.1 For no more than 30 days in a year, a heater may be operated outside the Allowed Operating Range if no defining parameter (firing rate, oxygen concentration or FGR rate) is exceeded by more than 20%. When this occurs, a rebuttable presumption shall be made by the District that a violation of Regulation 9-10-301 has occurred, and the operator shall perform an assessment, for all days that operation outside the Allowed Operating Range occurred, of compliance with Regulation 9-10-301. If the assessment shows that a violation of Regulation 9-10-301 did not occur, then the operator shall be deemed to be in compliance. If the assessment shows that a violation of Regulation 9-10-301 did occur, then the operator shall be found to be in violation for operation of the subject heater for each day the facility was operated in excess of the refinery-wide average NOx limit. The assessment shall be submitted to the APCO within 30 days of operation outside the Allowed Operating Range. After 30 days in a year where a heater operates outside the Allowed Operating range where no defining parameter is exceeded by more than 20%, the heater shall be treated as if at least one defining parameter had been exceeded by more than 20% (Section 3.2.2).
- 2.2 A heater may not be operated outside the Allowed Operating Range such that any defining parameter (firing rate, oxygen concentration or FGR rate) is exceeded by more than 20%. If this occurs, the operator shall be considered to have operated the heater in violation of Regulation 9-10-506 for any additional days in the same year where this occurs, and the operator shall conduct a District-approved source test which reasonably replicates the past operation outside of the Allowed Operating Range to verify that the Conservative Emission Factor was not exceeded.

The source test representing the new conditions shall be conducted within 45 days of operation outside the Allowable Operating Range. A source test report shall be submitted to the District source test manager within 45 days of the test. The operator may request, and the APCO may grant, an extension of up to 45 days for performance of the source test and up to 15 days for submittal of test results.

If the results of this source test do not show that a heater has operated at a NOx emission rate that exceeds the Conservative Emission Factor, then the operator may submit an accelerated permit program permit application to request an administrative change of the permit condition to adjust the Allowed Operating Range, based on the new test data.

If a District-approved source test shows that a heater has operated at a NOx emission rate that exceeds the Conservative Emission Factor, then the operator shall perform an assessment, retroactive to the date of the previous satisfactory source test, of compliance with Regulation 9-10-301. The heater will be considered to have been in violation of Regulation 9-10-301 for each day the facility was operated in excess of the refinery-wide average NOx limit. The operator may submit a permit application to request an alteration of the permit condition to change the Conservative Emission Factor and/or adjust the Allowed Operating Range, based on the new test data. If the operator chooses not to submit an application to revise the Conservative Emission Factor, the operator shall conduct another source test, at the same conditions as the initial test that showed an exceedance of the Conservative Emission Factor, to verify operation at or below that factor. This re-test shall be conducted within 90 days of the initial test.

#### **4. Periodic Source Test Requirements**

Source tests shall be performed under as-found conditions that are representative of normal operation. For each required source test, a source test report shall be submitted to the District source test manager within 45 days of the test. The operator may request, and the APCO may grant, an extension of 15 days for submittal of test results.

District-conducted and approved source tests, including those associated with CEMS field accuracy tests, may be used to satisfy source test requirements in this chapter, provided the test otherwise satisfies the specific requirements in this chapter.

##### **4.1 Emission Rate Verification Procedure (Source Testing) For Heaters Not Monitored With NOx CEMS**

The operator shall perform periodic NOx source tests to verify that the Conservative Emission Factor is not exceeded, according to the schedule in Sections 4.1.1 and 4.1.2. If a District-approved source test shows that a heater has operated at a NOx emission rate that exceeds the Conservative Emission Factor, then the operator shall perform an assessment of compliance with Regulation 9-10-301, retroactive to the date of the previous source test that showed operation at a NOx emission rate no higher than the Conservative Emission Factor. The heater will be considered to have been in violation of Regulation 9-10-301 for each day the facility was operated in excess of the refinery-wide average NOx limit. The operator may submit a permit application to request an alteration of the permit condition to change the Conservative Emission Factor and/or adjust the Allowed Operating Range, based on the new test data. If the operator chooses not to submit an application to revise the Conservative Emission Factor, the operator shall conduct

another source test, at the same conditions as the initial test that showed an exceedance of the Conservative Emission Factor, to verify operation at or below that factor. This re-test shall be conducted within 90 days of the initial test.

- 1.1 For a heater with a MRHC <25 million BTU/hr, a NO<sub>x</sub> source test shall be performed once per consecutive 12 month period. The time interval between source tests shall not exceed 16 months. For a heater that has been shutdown longer than the allowed testing interval shall be conducted within 30 days of startup.
- 1.2 For a heater with a MRHC ≥25 million BTU/hr, two NO<sub>x</sub> source tests shall be performed per consecutive 12 month period. The time interval between source tests shall not exceed 8 months and shall not be less than 5 months. For a heater that has been shutdown longer than the allowed testing interval shall be conducted within 30 days of startup.

#### **4.2 Emission Rate Verification Procedure (Source Testing) For Heaters Not Monitored With CO CEMS**

The operator shall perform periodic CO source tests to verify that the Regulation 9, Rule 10 CO limit is not exceeded.

- 2.1 For a heater with a MRHC <25 million BTU/hr, and for a heater with a MRHC ≥25 million BTU/hr that is not monitored with a NO<sub>x</sub> CEMS, a CO source test shall be conducted in conjunction with all required NO<sub>x</sub> source tests.
- 2.2 For a heater with a MRHC ≥25 million BTU/hr that is monitored with a NO<sub>x</sub> CEMS, a CO source test shall be conducted on a semi-annual basis at intervals that do not exceed 8 months between tests.

### **5. Records And Reporting**

#### **5.1 Records**

Final reports for all source tests required by this chapter shall be retained for at least 5 years from the date of the source test and shall be made available to the District's Air Pollution Control Officer (APCO) upon request.

#### **5.2 Reporting**

The operator shall report heater operation outside of the Allowed Operating range within 96 hours of occurrence.

### **6. References**

District Regulation 9, Rule 10: *Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators and Process Heaters in Petroleum Refineries*

District Manual of Procedures, Volume V: *Continuous Emission Monitoring*

## 7. Glossary

### **Allowed Operating Range**

For a heater that is not monitored with a NO<sub>x</sub> CEMS, but that is subject to the refinery-wide, daily average NO<sub>x</sub> limit, the Allowed Operating Range is the range (defined by firing rate, oxygen content, and FGR recirculation rate if applicable) where the emission rate has been demonstrated to be no higher than the Conservative Emission Factor for that heater.

### **APCO**

The District's Air Pollution Control Officer or designee.

### **Conservative Emission Factor**

For a heater that is not monitored with a NO<sub>x</sub> CEMS, but that is subject to the refinery-wide, daily average NO<sub>x</sub> limit, the Conservative Emission Factor is a NO<sub>x</sub> emission rate expressed in units of "pounds of NO<sub>x</sub> per million BTU heat input". The Conservative Emission Factor is used to calculate the daily NO<sub>x</sub> mass contribution from that heater when it operates within the Allowed Operating Range by multiplying the Conservative Emission Factor by the daily heat input at the heater".

### **Continuous Emission Monitoring System (CEMS)**

A monitoring system that meets the requirements of District Regulation 1-522 and the District's Manual of Procedures, Volume V.

### **Flue Gas Recirculation (FGR)**

Flue gas recirculation is a technique used to reduce heater combustion temperature and oxygen concentrations by taking combustion gases from the heater firebox or exhaust and adding it to either the combustion air or to the burner inlet, in order to reduce the formation of NO<sub>x</sub>. The FGR rate is the volume percentage of total flue gas flow that is recirculated in this way.

### **Heater**

A heater is any boiler, steam generator or process heater that is subject to a NO<sub>x</sub> or CO emission limit in Regulation 9, Rule 10.

### **Maximum Rated Heat Capacity (MRHC)**

For heaters with a combined stack, the maximum rated heat capacity is the total maximum rated heat capacity for these heaters. However, if the District Source Test Manager and the District Engineering NSR Manager

approve a finding that individual heaters with a combined stack may be accurately tested individual heaters, then the maximum rated heat capacity is the individual heater maximum rated heat capacity.

**Manual of Procedures (MOP)**

The District's Manual of Procedures

**Parametric Monitor**

A monitoring system that meets the requirements of District Regulation 1-523.