

## RULE 1157

### Boilers and Process Heaters

#### (A) General

##### (1) Purpose:

- (a) To limit Oxides of Nitrogen (NO<sub>x</sub>) and Carbon Monoxide (CO) emissions from industrial, institutional, and commercial Boilers, Steam Generators, and Process Heaters.

##### (2) Applicability:

- (a) This rule applies to new and existing Boilers, Steam Generators, and Process Heaters located within the Federal Ozone Non-Attainment Area with Rated Heat Inputs of greater than or equal to 5 million Btu per hour (MMBtu/hr) which are used in all industrial, institutional, and commercial operations, including permit units used by Independent Power Producer or a Cogeneration Facility.
- (b) This rule does not apply to permit units whose sole purpose is the production of steam for electrical power generating equipment when the permit unit is located at a facility directly regulated by a Public Utilities Commission.

- (3) Compliance with this rule does not exempt a person from complying with any other applicable State, federal or local law, statute, code, ordinance, rule, or regulation.

#### (B) Definitions

- (1) The definitions contained in District Rule 102 – *Definition of Terms* shall apply unless the term is otherwise defined herein:

- (a) "Annual Heat Input" - The total heat input of fuels, in Btu, burned by a permit unit in a calendar year, as determined from the higher heating value and cumulative annual usage of each fuel.
- (b) "Cogeneration Facility" – A facility which produces:
  - (i) electric energy; and
  - (ii) steam or forms of useful energy (such as heat) which are used for industrial or commercial heating or cooling purposes.

- (c) "Emissions Control Plan" - A document which outlines how an existing facility will comply with the requirements of this rule. The plan shall contain the following:
  - (i) a list of all permit units with their Rated Heat Inputs and estimated Annual Heat Inputs; and
  - (ii) for permit units subject to subsection (C)(3)(a) or (C)(4)(a), for each permit unit listed, the selected method of achieving the applicable standard or standards of subsection (C)(3)(a) or (C)(4)(a); and
  - (iii) for permit units subject to subsection (C)(3)(b) or (C)(4)(b), for each permit unit listed, a selection of one of the four options specified in subsection (C)(3)(b) or (C)(4)(b) to achieve compliance with this rule.
- (d) "Gaseous Fuel" - Natural gas, digester gas, landfill gas, methane, ethane, propane, butane, or any gas stored as a liquid at high pressure such as liquefied petroleum gas.
- (e) "High Annual Heat Input Permit Unit" - A permit unit with an annual heat input greater than or equal to 50,000 million Btu (MMBtu).
- (f) "Independent Power Producer" - A power plant which is not directly regulated by a Public Utilities Commission, which provides power to an electric utility rather than directly to rate-payers, and which is a Qualifying Small Power Production Facility per Public Utility Regulatory Policies Act regulations (18 CFR Ch.1, Subpart B).
- (g) "Liquid Fuel" - Any fuel which is a liquid at standard conditions including but not limited to distillate oils, kerosene and jet fuel. Liquefied Gaseous Fuels are not Liquid Fuels.
- (h) "Low Annual Heat Input Permit Unit" - A permit unit with an annual heat input less than 50,000 million Btu (MMBtu).
- (i) "NO<sub>x</sub> Emissions" (NO<sub>x</sub>) - The sum of any oxides of nitrogen which can be measured in the flue gas.
- (j) "Process Heater" - Any combustion equipment fired with any fuel, which transfers heat from combustion gases to water or process streams. Process Heaters do not include any dryers in which the material being dried is in direct contact with the products of combustion, such as: cement or lime kilns, glass melting furnaces, or smelters.
- (k) "Solar Power Production Facility" - An independent power producer which is a Solar Thermal Powerplant in which 75 percent (75%) or more of the total energy output is from solar energy and the use of backup fuels, such as oil, natural gas, and coal, does not, in the aggregate, exceed 25 percent (25%) of the total energy input of the facility during any calendar year period per Public Resources Code §25140.

(C) Requirements

- (1) RACT standards shall apply to all permit units, unless BARCT standards are applicable to the particular existing permit unit. BARCT standards shall apply to any existing permit units currently permitted to emit more than five tons per day or more than 250 tons per year of NO<sub>x</sub>.
- (2) An Owner/Operator of any permit unit(s) subject to subsection (C)(3)(a) or (C)(4)(a) below shall have the option of complying with either the ppmv or pounds per million Btu (lbs/MMBtu) NO<sub>x</sub> emission limits.
- (3) RACT Standards:
  - (a) High Annual Heat Input permit units, shall not emit:
    - (i) carbon monoxide in excess of 400 ppmv; and
    - (ii) NO<sub>x</sub> in excess of 30 ppmv, and/or 0.036 lbs/MMBtu of heat input, when operated on Gaseous Fuel; and
    - (iii) NO<sub>x</sub> in excess of 40 ppmv, and/or 0.052 lbs/MMBtu of heat input, when operated on Liquid Fuels; and
    - (iv) NO<sub>x</sub> in excess of the heat-input weighted average of the limits specified in (C)(3)(a)(ii) and (C)(3)(a)(iii), above, when operated on combinations of Gaseous and/or Liquid Fuels.

Sample calculation:

$$Emission\ Limit = \frac{(40\ ppmv * x) + (70\ ppmv * y)}{x + y}$$

Where:

x	=	Annual Heat Input from Gaseous Fuel
y	=	Annual Heat Input from Liquid Fuel

- (b) Low Annual Heat Input permit units shall:
  - (i) be operated in a manner that maintains stack-gas oxygen (O<sub>2</sub>) concentrations at less than or equal to 3.0 percent by volume on a dry basis; or
  - (ii) be operated with a stack-gas oxygen trim system set at 3.00±0.15 percent oxygen by volume on a dry basis; or
  - (iii) be tuned at least annually in accordance with the procedure described in Section (I), a modification of the tuning procedure described in Section (I) as approved by the APCO, CARB and USEPA, or the permit unit manufacturer's specified tune-up procedure; or
  - (iv) be operated in compliance with the applicable emission levels specified in subsection (C)(3)(a).

(4) BARCT Standards:

- (a) High Annual Heat Input permit units, as defined in Section (B), shall not emit:
- (i) carbon monoxide in excess of 400 ppmv; and
  - (ii) NOx in excess of 30 ppmv, and/or 0.036 lbs/MMBtu of heat input, when operated on Gaseous Fuel; and
  - (iii) NOx in excess of 40 ppmv, and/or 0.052 lbs/MMBtu of heat input, when operated on Liquid fuels ; and
  - (iv) NOx in excess of the heat-input weighted average of the limits specified in (C)(4)(a)(ii) and (C)(4)(a)(iii), above, when operated on combinations of Gaseous and/or Liquid fuels.

Sample calculation:

$$\text{Emission Limit} = \frac{(30 \text{ ppmv} * x) + (40 \text{ ppmv} * y)}{x + y}$$

Where:

x	=	Annual Heat Input from Gaseous Fuel
y	=	Annual Heat Input from Liquid Fuel

- (b) Low Annual Heat Input permit units, as defined in Section (B), shall:
- (i) be operated in a manner that maintains stack-gas oxygen concentration at less than or equal to 3.0 percent by volume on a dry basis; or
  - (ii) be operated with a stack-gas oxygen trim system set at 3.00±0.15 percent oxygen by volume on a dry basis; or
  - (iii) be tuned at least annually in accordance with the procedure described in Section (I), a modification of the tuning procedure described in Section (I) as approved by the APCO, CARB and USEPA, or the permit unit manufacturer's specified tune-up procedure; or
  - (iv) be operated in compliance with the applicable emission levels specified in subsection (C)(4)(a).

(5) General Equipment Requirements:

- (a) Owner/Operators of permit units which simultaneously fire combinations of different fuels, and are subject to the requirements of subsection (C)(3)(a) or (C)(4)(a), shall:
- (i) install mass flow rate meters in each fuel line; or

- (ii) install volumetric flow rate meters in conjunction with temperature and pressure probes in each fuel line; or
  - (iii) maintain a fuel log.
- (b) Owner/Operators of permit units which employ flue-gas NO<sub>x</sub> reduction technology, and are subject to the requirements of subsection (C)(3)(a) or (C)(4)(a), shall:
- (i) install meters as applicable to allow instantaneous monitoring of the operational characteristics of the NO<sub>x</sub> reduction equipment; or
  - (ii) maintain a log of NO<sub>x</sub> reduction equipment operational characteristics.
- (c) Owner/Operators of permit units which are subject to (C)(3)(b) or (C)(4)(b) and choose to comply with (C)(3)(b)(ii) or (C)(4)(b)(ii), respectively, shall install a stack-gas oxygen trim system.

#### (D) Exemptions

- (1) During periods of unexpected curtailment of normal Gaseous Fuels, permit units subject to the requirements of subsection (C)(3)(a) or (C)(4)(a) which normally burn only Gaseous Fuel shall comply with a NO<sub>x</sub> emission limit of either 150 ppmv or 0.215 pound per million Btu of heat input when burning Liquid Fuel. (This exemption shall not exceed the period of natural gas curtailment, and specifically includes equipment and emission testing time not exceeding 48 hours per calendar year).
- (2) Permit units which are located at Solar Power Production Facilities and are subject to the requirements of subsection (C)(3)(a) shall comply with the following NO<sub>x</sub> emission limits in lieu of complying with subsection (C)(3)(a):
- (a) 125 ppmv, when the permit unit is located at SEGS VI or SEGS VII in Kramer Junction and is operating at 40% or less of Rated Heat Input; and
  - (b) 70 ppmv, when the permit unit is located at SEGS VI or SEGS VII in Kramer Junction and is operating at more than 40% of Rated Heat Input, or when the permit unit is located at SEGS III, IV, V in Kramer Junction or SEGS VIII or IX in Harper Lake under all operating conditions; and,
  - (c) those limits specified in (C)(3)(a), for all other such permit units and operating conditions.
- (3) The provisions of Section (C) of this rule shall not apply to permit units which have no Annual Heat Input (Annual Heat Input equals zero). The Owner/Operator of any permit unit who wishes to claim an exemption pursuant to this subsection shall meet the record keeping requirements of this rule so as to be able to prove the exemption status.
- (4) Units which are subject to District Rules 1158 or 1161 are exempt from this rule.

- (5) Units located outside of the Federal Ozone Non-Attainment Area (FONA) are exempt from this rule.

(E) Monitoring and Records

(1) Emissions Compliance Testing:

- (a) Frequency: All permit units covered under subsections (C)(3) and (C)(4) shall demonstrate compliance through emission compliance testing not less than once every 12 months, except that permit units complying with subsection (C)(3)(b)(iii) or (C)(4)(b)(iii) shall be tuned not less than once every 12 months, and permit units claiming an exemption pursuant to subsection (D)(1) which burn a secondary fuel for less than 720 cumulative hours in the twelve month consecutive period prior to testing shall not be required to perform compliance testing for that fuel.
- (b) Procedures:
- (i) Compliance testing required by this rule shall follow the administrative procedures outlined in the District's Compliance Test Procedural Manual. All emission determinations shall be made as stipulated in the test protocol accepted by the District.
  - (ii) Emission determinations shall include, at a minimum, one emission compliance test conducted at 90% of the maximum firing rate allowed by the District permit or at normal operating conditions.
  - (iii) No compliance determination shall be established based on data obtained from compliance testing, including integrated sampling methods, during a start-up period or shut-down period.
  - (iv) All ppmv emission limits specified in subsections (C)(3)(a), (C)(4)(a) and (D)(1) are referenced at dry stack-gas conditions and 3.0 percent by volume stack-gas oxygen.
  - (v) All lbs/MMBtu NO<sub>x</sub> emission rates shall be calculated as pounds of nitrogen dioxide per MMBtu of heat input.
  - (vi) All emission concentrations and emission rates shall be based on hourly averages.

(2) Records and Reporting

- (a) For all permit units subject to this rule, the Owner/Operators shall monitor and record for each permit unit the High Heat Value and cumulative annual usage of each fuel. The cumulative annual usage of each fuel shall be monitored from utility service meters, purchase or tank fill records. A statement of the heat input for the previous calendar year shall be submitted to the District by March 1 each year.
- (b) For permit units exempt from subsection (C)(3)(a) or (C)(4)(a) in accordance with subsection (D)(1), the Owner/Operators shall monitor and

record for each permit unit the cumulative annual hours of operation on each Liquid Fuel.

- (c) All data shall be kept current and on site for a minimum of five years, and provided to District or state personnel on request.
- (d) The Owner/Operators of permit units subject to this rule shall submit all required compliance test reports to the District.
- (e) For each permit unit complying with subsection (C)(3)(b)(iii) or (C)(4)(b)(iii), records verifying that the tune-up has been performed for each fuel burned shall be maintained on site for five years. If a different tune-up procedure from that described in Section (I) is used, then a copy of this procedure shall be kept on site for five years. Such records shall be provided on request by the APCO.
- (f) Test reports shall include the operational characteristics of all flue-gas NOx reduction equipment.

#### (F) Test Methods

- (1) Compliance with the NOx, carbon monoxide and oxygen requirements of Section C shall be determined using the following test methods:
  - (a) Oxides of Nitrogen - EPA Method 7E or ARB Method 100
  - (b) Carbon Monoxide - EPA Method 10 or ARB Method 100
  - (c) Stack Gas Oxygen - EPA Method 3 or 3A or ARB Method 100 (d) NOx Emission Rate (Heat Input Basis) - EPA Method 19
- (2) HHV determination shall be by one of the following test methods:
  - (a) ASTM D 240-87 or ASTM D 2382-88 for liquid hydrocarbon fuels; or
  - (b) ASTM D 1826-88, or ASTM D 1945-81 in conjunction with ASTM D 3588-89 for Gaseous Fuels.

#### (G) Compliance Schedule

- (1) The Owner/Operator of a permit unit which becomes subject to the requirements of subsection (C)(3)(a) or (C)(4)(a) by exceeding the Annual Heat Input thresholds in subsection (B)(1)(h) for a calendar year, or by operating the permit unit so that an exemption pursuant to (D)(3) no longer applies, shall fulfill the following increments of progress:
  - (a) On or before December 31 of the calendar year immediately following the year that the Annual Heat Input threshold was exceeded or the permit unit commenced operation, submit an Emissions Control Plan containing the information outlined in subsection (B)(1)(e).

- (b) No later than three calendar years following the submission of the Emissions Control Plan, demonstrate final compliance with all applicable standards and requirements of the rule.
- (2) Failure to perform interim measures as set forth in a submitted Emissions Control Plan shall constitute a violation of this rule.

#### (H) Severability of Portions of this Rule

If any portion of this rule is found to be invalid or unenforceable, such finding shall have no effect on the validity and enforceability of the remaining portions of the rule, which are severable and shall continue to be in full force and effect.

#### (I) Tuning Procedure

- (1) Nothing in these Tuning Procedures shall be construed to require any act or omission that would result in unsafe conditions or would be in violation of any regulation or requirement established by Factory Mutual, Industrial Risk Insurers, National Fire Prevention Association, the California Department of Industrial Relations (Occupational Safety and Health Division), the Federal Occupational Safety and Health Administration, or other relevant regulations and requirements.
- (2) Tuning Procedure for Forced-Draft Permit units<sup>1</sup>
  - (a) Operate the permit unit at the firing rate most typical of normal operation. If the permit unit experiences significant load variations, operate it at its average firing rate.
  - (b) At this firing rate, record stack gas temperature, oxygen concentration, and CO concentration (for Gaseous Fuels) or smoke-spot number<sup>2</sup> (for Liquid Fuels), and observe flame conditions after permit unit operation stabilizes at the firing rate selected. If the excess oxygen in the stack gas is at the lower end of the range of typical minimum values,<sup>3</sup> and if the CO emissions are low and there is no smoke, the permit unit is probably operating at near optimum efficiency - at this particular firing rate. However, complete the remaining portion of this procedure to determine whether still lower oxygen levels are practical.
  - (c) Increase combustion air flow to the furnace until stack gas oxygen levels increase by one to two percent over the level measured in subsection (I)(2)(b). As in (I)(2)(b), record the stack gas temperature, CO concentration (for Gaseous Fuels), or smoke-spot number (for Liquid

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<sup>1</sup> This tuning procedure is based on a tune-up procedure developed by KVB, Inc. for the USEPA.

<sup>2</sup> The smoke-spot number can be determined with ASTM test method D-2156 or with the Bacharach method.

<sup>3</sup> Typical minimum oxygen levels for boilers at high firing rates are: For natural gas: 0.5 - 3%; 2. For Liquid Fuels: 2 - 4%



Fuels), and observe flame conditions for these higher oxygen levels after Boiler operation stabilizes.

- (d) Decrease combustion air flow until the stack gas oxygen concentration is at the level measured in (I)(2)(b). From this level gradually reduce the combustion air flow, in small increments. After each increment, record the stack gas temperature, oxygen concentration, CO concentration (for Gaseous Fuels) and smoke-spot number (for Liquid Fuels). Also, observe the flame and record any changes in its condition.
- (e) Continue to reduce combustion air flow stepwise, until one of these limits is reached:
  - (i) Unacceptable flame conditions - such as flame impingement on furnace walls or burner parts, excessive flame carryover, or flame instability.
  - (ii) Stack gas CO concentrations greater than 400 ppmv.
  - (iii) Smoking at the stack.
  - (iv) Equipment-related limitations - such as low windbox/furnace pressure differential, built in air-flow limits, etc.
- (f) Develop an O<sub>2</sub>/CO curve (for Gaseous Fuels) or O<sub>2</sub>/smoke curve (for Liquid Fuels) using the excess oxygen and CO or smoke-spot number data obtained at each combustion air flow setting.
- (g) From the curves prepared in (I)(2)(f), find the stack gas oxygen levels where the CO emissions or smoke-spot number equal the following values:

Fuel	Measurement	Value
Gaseous	CO Emissions	400 ppmv
#1 and #2 oils	smoke-spot number	number 1
# 4 Oil	smoke-spot number	number 2
# 5 Oil	smoke-spot number	number 3
Other oils	smoke-spot number	number 4

The above conditions are referred to as the CO or smoke thresholds, or as the minimum excess oxygen levels.

Compare this minimum value of excess oxygen to the expected value provided by the combustion permit unit manufacturer. If the minimum level found is substantially higher than the value provided by the combustion permit unit manufacturer, burner adjustments can probably be made to improve fuel and air mix, thereby allowing operations with less air.

- (h) Add 0.5 to 2.0 percent to the minimum excess oxygen level found in (I)(2)(g) and reset burner controls to operate automatically at this higher stack gas oxygen level. This margin above the minimum oxygen level accounts for fuel variations, variations in atmospheric conditions, load changes, and nonrepeatability or play in automatic controls.
  - (i) If the load of the combustion permit unit varies significantly during normal operation, repeat (I)(2)(a) through (h) for firing rates that represent the upper and lower limits of the range of the load. Because control adjustments at one firing rate may affect conditions at other firing rates, it may not be possible to establish the optimum excess oxygen level at all firing rates. If this is the case, choose the burner control settings that give the best performance over the range of firing rates. If one firing rate predominates, setting should optimize conditions at the rate.
  - (j) Verify that the new settings can accommodate the sudden load changes that may occur in daily operation without adverse effects. Do this by increasing and decreasing load rapidly while observing the flame and stack. If any of the conditions in (I)(2)(e) result, reset the combustion controls to provide a slightly higher level of excess oxygen at the affected firing rates. Next, verify these new settings in a similar fashion. Then make sure that the final control settings are recorded at steady-state operating conditions for future reference.
  - (k) When the above checks and adjustments have been made, record data and attach combustion analysis to permit unit records. Indicate the name and title of the person performing the tune-up, the date the tune-up was performed, and sign the record.
- (3) Equipment Tuning Procedure for Natural Draft Fired Permit units
- (a) Preliminary Analysis
    - (i) **CHECK THE OPERATING PRESSURE OR TEMPERATURE.** Operate the permit unit at the lowest acceptable pressure or radiation losses. Determine the pressure or temperature that will be used as a basis for comparative combustion analysis before and after tune-up.
    - (ii) **COMBUSTION ANALYSIS.** Perform an "as is" combustion analysis (CO<sub>2</sub>, O<sub>2</sub>, etc.) with a warmed up permit unit at high and low fire, if possible. In addition to data obtained from combustion analysis, also record the following:
      - a. Inlet fuel pressure at burner (at high & low fire); and
      - b. Draft above draft hood or barometric damper (at high, medium, and low settings); and
      - c. Steam pressure, water temperature, or process fluid pressure or temperature entering and leaving the permit unit.

- d. Permit unit rate if meter is available.
- (b) Adjustments: while taking combustion readings with a warmed up permit unit operated at the Rated Heat Input, perform checks and adjustments as follows:
- (i) Adjust permit unit to fire at rate; record fuel manifold pressure.
  - (ii) Adjust draft and/or fuel pressure to obtain acceptable, clean combustion at high, medium and low firing rates. The CO value should always be below 400 ppmv at 3% O<sub>2</sub>. If CO is high make necessary adjustments.
  - (iii) Check to ensure permit unit light offs are smooth and safe. A reduced fuel pressure test at both high and low fire should be conducted in accordance with the manufacturer's instructions and maintenance manuals.
  - (iv) Check and adjust operations of modulation controller. Ensure proper, efficient and clean combustion through the range of firing rates.
  - (v) When above adjustments and corrections have been made, record all data.
- (c) Final Test: Perform a final combustion analysis with a warmed up permit unit at high, medium and low firing rates, whenever possible. In addition to data from combustion analysis, also check and record:
- (i) fuel pressure at burner (at high, medium and low settings); and
  - (ii) draft above draft hood or barometric damper (at high, medium, and low settings); and
  - (iii) steam pressure, water temperature, or process fluid pressure or temperature entering and leaving the permit unit; and
  - (iv) permit unit rate if meter is available.

When the above checks and adjustments have been made, record data and attach combustion analysis to permit unit records. Indicate the name and title of the person performing the tune-up, the date the tune-up was performed, and sign the record.

See SIP Table at <http://www.mdaqmd.ca.gov/>