RULE 69.2. INDUSTRIAL AND COMMERCIAL BOILERS, PROCESS HEATERS AND STEAM GENERATORS

(Adopted and Effective 9/27/94)

(a) APPLICABILITY

This rule shall apply to any boiler, process heater, or steam generator with a heat input rating of 5 million Btu per hour or more.

(b) EXEMPTIONS

(1) The provisions of this rule shall not apply to the following:

(i) Electricity-generating steam boilers with a heat input rating of 100 million Btu per hour or more including auxiliary boilers used in conjunction with such boilers.

(ii) Waste heat recovery boilers that are used to recover heat from the exhaust of gas turbines or internal combustion engines.

(iii) Furnaces, kilns, and any combustion equipment where the material being heated is in direct contact with the products of combustion.

(iv) Thermal oxidizers and associated waste heat recovery equipment.

(v) Boilers, process heaters and steam generators used exclusively in connection with a structure that is designed for and used exclusively as a dwelling for not more than four families.

(vi) Boilers, process heaters and steam generators used in agricultural operations in the growing of crops or the raising of fowl or animals.

(2) The provisions of Subsection (d)(1)(ii) and (e)(1) shall not apply to any unit which burns liquid fuel only during periods of natural gas curtailment, during emergencies, or during equipment testing for the purpose of maintaining the fuel oil back-up system, provided that both of the following conditions are met:

(i) Total cumulative operation during curtailment periods or emergencies shall not exceed 168 hours per calendar year. It is the responsibility of any person claiming this exemption to keep records in accordance with Subsection (e)(4) of this rule.

(ii) Liquid fuel firing for equipment testing shall not exceed 48 hours per calendar year. It is the responsibility of any person claiming this exemption to keep records in accordance with Subsection (e)(5) of this rule.

(3) The provisions of Subsections (d)(2)(iii) and (g)(4) shall not require the firing of liquid fuel for any unit which otherwise burns liquid fuel only during periods of natural gas curtailment, during emergencies, or during equipment testing for the purpose of maintaining the fuel oil back-up system, provided that operation on liquid fuel complies with Subsections (b)(2)(i) and (ii).

(c) **DEFINITIONS**

For the purposes of this rule, the following definitions shall apply:

(1) **"Annual Capacity Factor"** means the ratio of the amount of fuel burned by a unit in a calendar year to the amount of fuel it could have burned if it had operated at the heat input rating for 8,760 hours during the calendar year.

(2) **"Annual Heat Input"** means the actual, total heat input of fuels burned by a unit in a calendar year, as determined from the higher heating value and cumulative annual usage of each fuel. Annual heat input shall not include the heat input from fuels used during natural gas curtailment, during an emergency, or during equipment testing for the purpose of maintaining the fuel oil back-up sytem.

(3) **"Boiler" or "Steam Generator"** means any combustion equipment fired with gaseous and/or liquid fuel and used to produce steam or to heat water. "Boiler" or "Steam Generator" shall not include waste heat recovery boilers that are used to recover heat from the exhaust of gas turbines or internal combustion engines, or any unfired waste heat recovery boiler that is used to recover sensible heat from the exhaust of any combustion equipment.

(4) **"Btu"** means British thermal unit.

(5) **"Emergency"** means an unforeseen disruption or interruption in the supply of gaseous fuel to the unit.

(6) **"Existing Unit"** means any unit which was installed and operating on or before September 27, 1994.

(7) **"Heat Input"** means the heat derived from combustion of a fuel in a unit, calculated using the higher heating value, excluding the heat input from preheated combustion air, recirculated flue gases, or exhaust gases from other sources, including but not limited to, gas turbines, internal combustion engines and kilns.

(8) **"Heat Input Rating"** means the maximum steady state heat input capacity of a unit, in Btu per hour, as specified by the manufacturer, or as limited by a District Authority to Construct or a Permit to Operate.

(9) **"Higher Heating Value"** means the total heat liberated, including the heat of condensation of water, per mass of fuel burned (Btu per pound) when fuel and dry air at standard conditions undergo complete combustion and all resultant products are brought to standard conditions.

(10) **"Major Stationary Source"** means a stationary source that emits or has the potential to emit 25 tons or more of oxides of nitrogen (NOx) per year. If the San Diego County Air Pollution Control District is reclassified to a "serious" ozone non-attainment area by the federal Environmental Protection Agency (EPA), then a major stationary source of NOx will mean a stationary source that emits or has the potential to emit 50 tons or more of NOx per year.

(11) **"Natural Gas Curtailment"** means a shortage in the supply of natural gas, due solely to limitations or restrictions in distribution pipelines by the utility supplying the gas, and not due to the cost of natural gas.

(12) **"New Unit"** means a unit installed after September 27, 1994.

(13) **"Process Heater"** means any combustion equipment fired with liquid and/or gaseous fuel and which transfers heat from the combustion gases to water or process streams. Heaters used for swimming pools, spas and/or therapy pools shall be considered process heaters. "Process Heater" shall not include any combustion equipment where the material being heated is in direct contact with the products of combustion, such as furnaces or kilns, or any unfired waste heat recovery heater that is used to recover sensible heat from the exhaust of any combustion equipment.

(14) **"Stack-Gas Oxygen Trim System"** means a system of monitors that is used to maintain excess air at the desired level. A typical system consists of a flue gas oxygen and/or carbon monoxide monitor that automatically provides a feedback signal to the combustion air controller.

(15) **"Stationary Source"** means the same as is defined in Rule 20.1.

(16) **"Therm"** means 100,000 Btu.

(17) **"Thermal Oxidizer"** means combustion equipment fired with gaseous fuel and used to control emissions of air contaminants from industrial or commercial processes.

(18) **"Unit"** means any boiler, steam generator or process heater.

(d) **STANDARDS**

(1) For any unit with a heat input rating less than or equal to 50 million Btu/hr and an annual heat input of 220,000 therms or more, or for any unit with a heat input rating greater than 50 million Btu/hr and an annual capacity factor 10% or greater, emissions of oxides of nitrogen, calculated as nitrogen dioxide at 3% oxygen on a dry basis, shall not exceed the following levels:

(i) 30 parts per million by volume when operated on a gaseous fuel.

(ii) 40 parts per million by volume when operated on a liquid fuel.

(iii) The heat-input weighted average of the limits specified in Subsections (d)(1)(i) and (d)(1)(ii) when operated on combinations of a gaseous and a liquid fuel. The heat-input weighted average is calculated using the following equation:

Heat-input weighted average, ppmv = $\{(H_g)\ (30\ \text{ppmv}) + (H_l)\ (40\ \text{ppmv})\}/(H_g + H_l)$

where:

H_g = the actual heat input of gaseous fuel to a unit, in Btu per hour.

H_l = the actual heat input of liquid fuel to a unit, in Btu per hour.

(2) Any unit with a heat input rating less than or equal to 50 million Btu/hr and an annual heat input of less than 220,000 therms, or any unit with a heat input rating greater than 50 million Btu/hr and an annual capacity factor less than 10%, shall comply with one of the following provisions:

(i) The unit shall be operated in a manner to maintain stack-gas oxygen concentration at less than or equal to 3.00 percent by volume on a dry basis; or

(ii) The unit shall be operated with a stack-gas oxygen trim system to maintain stack-gas oxygen concentration at 3.00 ± 0.15 percent by volume on a dry basis; or

(iii) The unit shall be tuned at least once per year in accordance with the tuning procedure in Section (j), or in accordance with the manufacturer's recommended tuning procedure, provided such procedure has been approved in advance by the Air Pollution Control Officer; or

(iv) The unit shall be operated in compliance with the applicable emission standards of Subsections (d)(1) and (d)(3).

(3) For any unit with a heat input rating less than or equal to 50 million Btu/hr and an annual heat input of 220,000 therms or more, or for any unit with a heat input rating greater than 50 million Btu/hr and an annual capacity factor 10% or greater, emissions of carbon monoxide shall not exceed 400 parts per million by volume, calculated at 3% oxygen on a dry basis.

(e) **MONITORING AND RECORDKEEPING REQUIREMENTS**

(1) An owner or operator of a unit which is capable of burning both gaseous and liquid fuel and is subject to the requirements of Subsection (d)(1) except as specified in Subsection (b)(2), and an owner or operator of a unit which is subject to the requirements of Subsection (d)(2) shall install one of the following:

(i) A non-resettable, totalizing meter in each fuel line to measure the mass flow rate of each fuel to the unit; or

(ii) A non-resettable, totalizing meter in each fuel line to measure the volumetric flow rate, temperature and pressure of each fuel to the unit.

(2) An owner or operator of a unit which is subject to the requirements of Subsection (d)(1) shall install continuous monitors to allow for instantaneous monitoring of the operational characteristics of the unit and of the flue-gas NOx reduction system, as applicable. Examples of operational characteristics include, but are not limited to, the following:

(i) Stack-gas oxygen content.

(ii) Percentage of flue gas recirculated.

Continuous monitors shall be installed, calibrated and maintained in accordance with all applicable local, state and federal regulations, and procedures approved by the Air Pollution Control Officer.

(3) An owner or operator of a unit which is subject to the requirements of Subsection (d)(2) shall monitor and record the higher heating value and annual usage of each fuel.

(4) An owner or operator of any unit which is burning liquid fuel during natural gas curtailment or an emergency shall monitor and record the cumulative annual hours of operation on liquid fuel. At a minimum, these records shall include the dates and times of operation on liquid fuel and any corresponding totalizer readings.

(5) An owner or operator of any unit which is burning liquid fuel for equipment testing purposes shall monitor and record the cumulative annual hours of operation on liquid fuel. At a minimum, these records shall include the dates and times of operation on liquid fuel and any corresponding totalizer readings.

(6) An owner or operator of a unit complying with Subsection (d)(2)(iii) shall maintain documentation verifying the required annual tuneups including the data required in Section (j).

(7) The owner or operator of any unit subject to this rule shall maintain all records required by Section (e) for a minimum of three calendar years. These records shall be maintained on the premises and made available to the District upon request.

(f) **TEST METHODS**

(1) To determine compliance with Section (d), measurement of oxides of nitrogen, carbon monoxide, and stack-gas oxygen content shall be conducted in accordance with ARB Test Method 100 as approved by the EPA.

(2) Certification of the higher heating value of a fuel as required by Subsection (e)(3), if not provided by a third party fuel supplier, shall be determined by one of the following methods:

(i) ASTM Test Method D240-87 or D2382-88 for liquid hydrocarbon fuels.

(ii) ASTM Test Method D1826-88, or D1945-81, in conjunction with ASTM D3588-89 for gaseous fuels.

(3) Certification of continuous monitors shall be conducted in accordance with all applicable local, state and federal regulations, and procedures approved by the Air Pollution Control Officer.

(g) **SOURCE TEST REQUIREMENTS**

(1) Source testing shall be performed at no less than 80% of the heat input rating.

(2) Source testing shall be preceded by a minimum of two hours of combustion in the unit. Interruptions in combustion within the two hours shall be allowed provided that interruptions total less than 30 cumulative minutes.

(3) Measurement of emission concentrations shall be based on a 15 continuous minute sampling period. For the purpose of averaging, a minimum of five data sets with averaging intervals no greater than three minutes shall be used.

(4) A unit subject to the requirements of Subsections (d)(1), (d)(2)(i), (d)(2)(ii), (d)(2)(iv), or (d)(3) shall be tested for compliance at least once every 12 months, unless otherwise approved in writing by the Air Pollution Control Officer. Testing shall be conducted in accordance with Section (f) and a source test protocol approved in writing by the Air Pollution Control Officer. Test reports shall include the operational characteristics, as listed in Subsection (e)(2), of the unit and of all flue-gas NOx control systems.

(h) **COMPLIANCE SCHEDULE**

(1) No later than May 31, 1995 for an existing unit subject to the provisions of this rule and located at a major stationary source, or no later than September 27, 1996 for an existing unit not located at a major stationary source, an owner or operator shall submit an application for an Authority to Construct the air pollution control and monitoring equipment and any unit modification(s) necessary to meet the requirements of Sections (d) and (e) of this rule. The following information shall be submitted with the application:

(i) A list of all units, the anticipated annual heat input of each unit, the heat input rating as specified by the manufacturer, and the heat input rating as stated in a District Authority to Construct or a Permit to Operate.

(ii) For each unit listed, the selected method for meeting the applicable requirements of Section (d).

(2) For an existing unit located at a major stationary source, an owner or operator shall be in compliance with all applicable provisions of this rule as follows:

(i) No later than May 31, 1997 for a unit subject to the provisions of Subsection (d)(1); or

(ii) No later than May 31, 1996 for a unit subject to the provisions of Subsection (d)(2).

(3) An owner or operator of an existing unit not located at a major stationary source shall be in compliance with all applicable provisions of this rule no later than September 27, 1998.

(4) Any person installing a new unit subject to the provisions of this rule shall comply with all applicable provisions of this rule upon initial installation and startup.

(j) **TUNING PROCEDURE**

The owner or operator of a unit subject to Subsection (d)(2)(iii) of this rule shall comply with the following tuning procedure.

(1) Operate the unit at the firing rate most typical of normal operation. If the unit experiences significant load variations during normal operation, operate it at its average firing rate.

(2) At this firing rate, record stack gas temperature, oxygen concentration, and CO concentration (for gaseous fuels) or smoke-spot number (for liquid fuels), and observe flame conditions after 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 excess oxygen values, and if CO emissions are low and there is no smoke, the 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.

(i) The smoke-spot number can be determined with ASTM test method D-2156 or with the Bacharach method. The Bacharach method is included in a tune-up kit that can be purchased from the Bacharach Company.

(ii) Typical minimum oxygen levels for boilers at high firing rates are:

1. For natural gas: 0.5 - 3%
2. For liquid fuels: 2 - 4%

(3) Increase combustion airflow to the furnace until stack gas oxygen levels increase by one to two percent over the level measured in Step 2. As in Step 2, record the stack gas temperature, CO concentration (for gaseous fuels) or smoke-spot number (for liquid fuels), and observe flame conditions for these higher oxygen levels after boiler operation stabilizes.

(4) Decrease combustion airflow until the stack gas oxygen concentration is at the level measured in Step 2. From this level, gradually reduce the combustion airflow 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.

(5) 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 ppm.

(iii) Smoking at the stack.

(iv) Equipment-related limitations - such as low windbox/furnace pressure differential, built in air-flow limits, etc.

(6) Develop an O_2/CO curve (for gaseous fuels) or O_2/smoke curve (for liquid fuels) similar to those shown in Figures 1 and 2 using the excess oxygen and CO or smoke-spot number data obtained at each combustion air flow setting.

(7) From the curves prepared in Step 6, find the stack gas oxygen levels where the CO emissions or smoke-spot number equal the following values:

Fuels	Measurement	Value
Gaseous	CO Emissions	400 ppm
#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 unit manufacturer. If the minimum level found is substantially higher than the value provided by the combustion unit manufacturer, burner adjustments can probably be made to improve fuel and air mix, thereby allowing operations with less air.

(8) Add 0.5 to 2.0 percent to the minimum excess oxygen level found in Step 7 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.

(9) If the load of the combustion unit varies significantly during normal operation, repeat Steps 1-8 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 best performance over the range of firing rates. If one firing rate predominates, setting should optimize conditions at the rate.

(10) 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 Step 5 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.

Nothing in this Tuning Procedure 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.

FIGURE 1: OXYGEN/CO CHARACTERISTIC CURVE

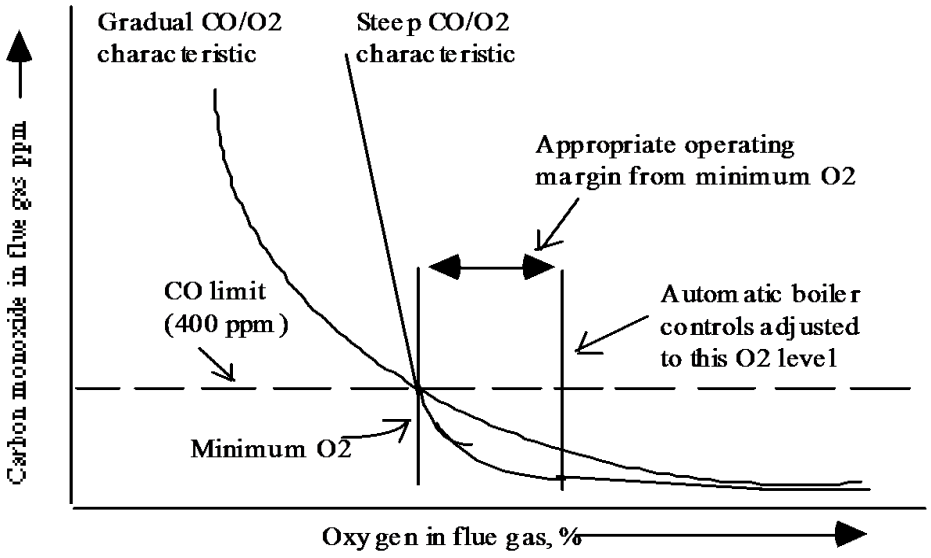
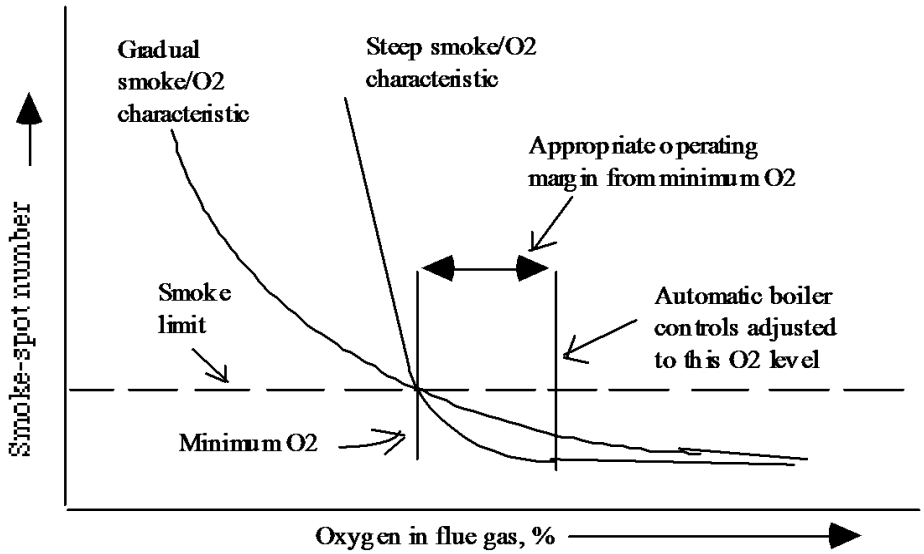
FIGURE 2: OXYGEN/SMOKE CHARACTERISTIC CURVE