RULE 342. CONTROL OF OXIDES OF NITROGEN (NO_x) FROM BOILERS, STEAM GENERATORS AND PROCESS HEATERS. (Adopted 3/10/1992, revised 04/17/1997)

A. Applicability

This rule applies to boilers, steam generators, and process heaters with rated heat inputs greater than or equal to 5 million Btu per hour used in all industrial, institutional, and commercial operations.

B. Exemptions

1. This rule shall not apply to:

   a. boilers used by public electric utilities to generate electricity.

   b. process heaters, kilns, and furnaces where the products of combustion come into direct contact with the material to be heated.

   c. waste heat recovery boilers that are used to recover heat from the exhaust of combustion turbines or reciprocating internal combustion engines.

   d. equipment that does not require a permit under the provisions of Rule 202.

2. Section D.1.b shall not apply to boilers while forced to burn nongaseous fuel during times of natural gas curtailment. This exemption shall not exceed 168 cumulative hours of operation per calendar year excluding equipment testing time not exceeding 24 hours per calendar year.

C. Definitions

1. **Annual Heat Input** means the 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.

2. **Boiler or Steam Generator** means any external combustion equipment fired with any fuel used to produce hot water or steam.

3. **Higher Heating Value (HHV)** means the total heat liberated 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.

4. **Process Heater** means any external combustion equipment fired with liquid and/or gaseous fuel and which transfers heat from combustion gases to water or process streams.

5. **Rated Heat Input** (million Btu per hour) means the heat input capacity specified on the nameplate of the combustion unit. If the combustion unit has been physically modified such that its maximum heat input is different than the heat input capacity specified on the nameplate, the modified maximum heat input shall be considered as the rated heat input. The modified maximum heat input capacity shall be demonstrated to the District by a fuel meter while operating the unit at maximum capacity.

6. **Unit** means any boiler, steam generator or process heater as defined in 2 and 4 above.

D. Requirements - Emission Standards

1. For units with rated heat inputs of greater than or equal to 5 million Btu per hour and permitted annual heat input of greater than or equal to 9 billion Btu, NO_x emissions shall not exceed the following levels:

   a. 30 parts per million by volume (ppmv) or 0.036 pound per million Btu of heat input when operated on gas.

   b. 40 parts per million by volume or 0.052 pound per million Btu of heat input when operated on nongaseous fuel.

   c. the heat-input weighted average of the limits specified in a. and b., above, when operated on combinations of gas and nongaseous fuel.

   Emissions from units subject to this section shall not exceed a carbon monoxide concentration of 400 parts per million by volume.

2. **Units** with rated heat inputs of greater than or equal to 5 million Btu per hour and permitted annual heat inputs of less than 9 billion Btu's shall be:

   a. operated in a manner that maintains stack-gas oxygen concentrations at less than 3.00 percent by volume on a dry basis; or

   b. operated with a stack-gas oxygen trim system set at 3.00 ±0.15 percent oxygen by volume on a dry basis; or

   c. tuned at least once every twelve months in accordance with the procedure described in Attachment 1; or

   d. operated in compliance with the applicable emission levels specified in Subsection D.1.

E. Requirements - Equipment

1. Owners or operators of units which simultaneously fire combinations of different fuels, and are subject to the requirements of section D.1, shall install totalizing mass or volumetric flow rate meters in each fuel line. Gas flow rate meters shall be installed in conjunction with temperature and pressure probes.

2. Owners or operators of units which employ flue-gas NO_x reduction technology, and are subject to the requirements of section D.1, shall install meters as applicable to allow instantaneous monitoring of the operational characteristics of the NO_x reduction equipment.

3. The use of anhydrous ammonia to meet the requirements of this rule is prohibited.

F. Requirements - Compliance Determination

1. All emission determinations shall be made in the as-found operating condition, at the maximum attainable firing rate allowed by the District permit. No determination of compliance with the requirements of section D.1 shall be established within two hours after a continuous period in which fuel flow to the unit is shut off for 30 minutes or longer.

2. All ppmv emission limits specified in Subsection D.1 are referenced at dry stack-gas conditions and 3.00 percent by volume stack-gas oxygen. Emission concentrations shall be corrected to 3.00 percent oxygen as follows:

$$[\text{ppm } NO_x]_{corrected} = \frac{20.95\% - 3.00\%}{20.95\% - [\%\, O_2]_{measured}} \text{ X } [\text{ppm } NO_x]_{measured}$$

$$[\text{ppm CO}]_{corrected} = \frac{20.95\% - 3.00\%}{20.95\% - [O_2]_{measured}} \text{ X } [\text{ppm CO}]_{measured}$$

3. All pounds-per-million-Btu NO_x emission rates shall be calculated as pounds of nitrogen dioxide per million Btu of heat input.

G. Requirements - Testing

1. Except units complying with Subsection D.2.c, all units covered under Subsections D.1 and D.2 shall be tested for compliance not less than once every 24 months.

2. The owner or operator of any unit which is found not to be in compliance with Section D as a result of a source test shall comply with the following:

   a. A repeat source test shall be performed to demonstrate compliance with Section D within the time period specified by the District.

   b. Annual source tests shall be conducted on any noncompliant unit until two consecutive tests demonstrate compliance with Section D. When the unit is demonstrated to be in compliance with Section D by two consecutive source tests, the unit shall comply with the provisions of Section G.1.

H. Test Methods

Compliance with the NO_x emission requirements and the stack-gas carbon monoxide and oxygen requirements of section D shall be determined using the following test methods.

1. Oxides of Nitrogen - EPA Method 7E.

2. Carbon Monoxide - EPA Method 10.

3. Stack Gas Oxygen - EPA Method 3 or 3A.

4. NO_x Emission Rate (Heat Input Basis) - EPA Methods 2 and 4 if applicable, or 19.

5. If certification of the HHV is not provided by the third party fuel supplier, it shall be determined by one of the following test methods: (1) ASTM D 2015-85 for solid fuels; (2) ASTM D 240-87 or ASTM D 2382-88 for liquid hydrocarbon fuels; or (3) ASTM D 1826-88, or ASTM D 1945-81 in conjunction with ASTM D 3588-89 for gaseous fuels.

For numbers 1, 2, 3 and 4 above there shall be a minimum of three 40 minute tests with a strip chart recorder. For instrument methods, the maximum data reduction averaging interval is ten minutes, i.e. four or more intervals per test run. Compliance is determined via the arithmetic mean of the three runs.

I. Recordkeeping

1. The owners or operators of units subject to Section D of this rule shall monitor and record for each unit the Higher Heating Value and cumulative annual usage of each fuel.

2. The owners and operators of units operating under the exemption of Section B.2 shall monitor and record for each unit the cumulative annual hours of operation on each nongaseous fuel. This data shall be updated monthly.

3. The owners and operators of units operated under the provisions of Section D.2.c shall maintain documentation verifying the required tune-ups.

4. The records required above shall be kept for three calendar years and shall be made available to the District on request.

J. Reporting Requirements

The owners and operators of units subject to Sections D1, D.2.a, D.2.b, and D.2.d shall submit compliance test reports on each unit for each fuel burned. Test reports shall include operational characteristics of all flue-gas NO_x reduction equipment or technology.

K. Compliance Schedule

The owner or operator of units subject to this rule shall:

1. Apply for a District Permit to Operate by June 8, 1992 in accordance with District Rule 202.

2. By March 10, 1994 submit a plan containing the following:

   a. A list of all units with their rated heat inputs and permitted annual heat inputs.

   b. For each unit listed, the selected method for meeting the applicable requirements.

3 By March 10, 1994 apply for an Authority to Construct for control equipment required to meet the standards of this Rule.

4. By March 10, 1996 demonstrate final compliance with this Rule.

ATTACHMENT 1

Equipment Tuning Procedure[1]

Nothing in this Equipment 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 Insurors, 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.

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[2] (for liquid fuels), and observe flame conditions after unit operation stabilizes at the firing rate selected. If the excess oxygen in the stack is at the lower end of the range of typical minimum values[3], and if the 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.

3. Increase combustion air flow 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 air flow until the stack gas oxygen concentration is at the level measured in Step 2. 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.

5. Continue to reduce combustion air flow stepwise, until one of these limits in reached:

    a. Unacceptable flame conditions - such as flame impingement on furnace walls or burner parts, excessive flame carryover, or flame instability.

    b. Stack gas CO concentrations greater than 400 ppm.

    c. Smoking at the stack.

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

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1. This tuning procedure is based on a tune-up procedure developed by KVB, Inc. for the EPA.

2. The smoke-spot number can be determined with ASTM Test Method D-2156 or with the Bacharach method. ASTM Test Method D-2156 is included in a tuneup kit that can be purchased from the Bacharach Company.

3. Typical minimum oxygen levels for boilers at high firing rates are:

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

6. Develop an 02/CO curve (for gaseous fuels) or 02/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:

Fuel	**Measurement**	**Value**
Gaseous	CO Emissions	400 ppm
#1 & #2	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 CO or smoke threshold, or as the minimum excess oxygen level.

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 mixing, thereby allowing operation 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, settings should optimize conditions at that rate.

10. Verify that the new settings can accommodate the sudden 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 affect 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.

Figure 1

Oxygen/CO Characteristic Curve

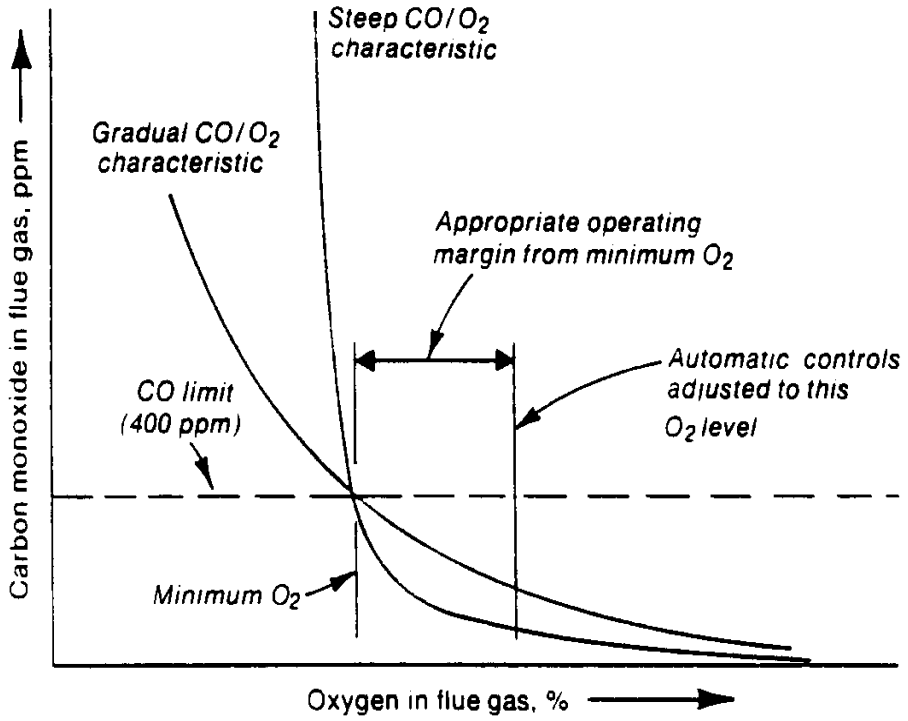

Figure 2

Oxygen/Smoke Characteristic Curve