RULE 430. CONTROL OF OXIDES OF NITROGEN FROM INDUSTRIAL, INSTITUTIONAL, AND COMMERCIAL BOILERS, STEAM GENERATORS, AND PROCESS HEATERS

(Adopted 7/26/95, Revised 11/12/2014)

A. APPLICABILITY. The provisions of this Rule shall apply to boilers, steam generators, and process heaters with rated heat input capacities greater than or equal to five (5) million British Thermal Units (BTU) per hour used in all industrial, institutional, and commercial operations. Note that this Rule is based on a 1995 performance standard that set minimum retrofit requirements for existing units at that time. For new or modified emission units with combined ratings above 2 million BTU per hour, more stringent requirements likely apply in accordance with District Rule 204, Requirements. Contact the District for site specific requirements prior to purchase or setting bid specifications.

B. DEFINITIONS. For the purposes of this Rule the following definitions shall apply:

1. "Alternate Fuel": Any fuel other than natural gas used exclusively during times of natural gas curtailment or as required to maintain an alternate fuel system.

2. "Annual Heat Input": 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.

3. "Boiler or Steam Generator": Any external combustion equipment fired with any fuel used to produce hot water or steam.

4. "Gaseous Fuel": Any fuel which is a gas at standard conditions; including but not limited to natural gas, refinery make gas, and oil field produced gas.

5. "Heat Input": The chemical heat released due to fuel combustion in a unit, using the higher heating value of the fuel. This does not include the sensible heat of incoming combustion air.

6. "Higher Heating Value (hhv)": 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.

7. "Process Heater": Any external combustion equipment fired with liquid and/or gaseous fuel which indirectly transfers heat from combustion gases to water or process streams. A process heater is not a kiln or oven used for drying, baking, cooking, calcining, or vitrifying; or any fuel-fired degreasing or metal finishing equipment.

8. "Rated Heat Input Capacity": The heat input capacity specified on the nameplate of the combustion unit's burner.

9. "Therm": 100,000 BTU.

10. "Unit": Any boiler, steam generator, or process heater as defined in Subsections B.2 and B.6.

C. EXEMPTIONS

1. The provisions of this Rule shall not apply to the following:

   a. Boilers used by public utilities to generate electricity which are subject to Rule 429, Oxides of Nitrogen and Carbon Monoxide Emissions from Electric Utility Boilers.

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

c. Unfired waste heat recovery boilers that are used to recover heat from the exhaust of any combustion equipment.

2. The provisions of Subsection D.1 and D.3.c shall not apply to boilers, steam generators, or process heaters while operating on alternate fuel under either of the following conditions:

a. Alternate fuel use is required due to the curtailment of natural gas service to the individual unit by the natural gas supplier. Alternate fuel use in this case shall not exceed the period of natural gas curtailment; or

b. Alternate fuel use is required to maintain the alternate fuel system. Alternate fuel use in this case shall not exceed 50 hours per year.

3. The provisions of Section D shall not apply to the use of an emergency standby unit during an equipment breakdown or during routine maintenance of the primary unit. This exemption shall only apply if breakdown relief is granted under Rule 107, Breakdown or Upset Conditions and Emergency Variances. Operation of the standby unit shall not occur beyond the period of the primary unit's emergency breakdown.

4. The provisions of Section D shall not apply during the cold startup of an applicable unit. The duration of this exemption shall not exceed three (3) hours.

5. Any unit that has been inactive for 12 consecutive months or more need not conduct the tuning procedure required under Subsection D.3.c until reactivation of the unit.

D. REQUIREMENTS - STANDARDS

1. For units with rated heat input capacities of greater than or equal to five (5) million BTU per hour and annual heat inputs of greater than or equal to 90,000 therms for any of the three previous calendar years, oxides of nitrogen (NOx) emissions shall not exceed the following levels:

a. 30 parts per million by volume (ppm_v) referenced at dry stack-gas conditions and 3.0 percent by volume stack-gas oxygen (dry at 3.0 % O_2), or 0.036 pound per million BTU of heat input, when operated on gaseous fuel; or

b. 40 ppm_v dry at 3.0 % O_2, or 0.052 pound per million BTU of heat input, when operated on nongaseous fuel; or

c. the heat input weighted average of the limits specified in Subsections D.1.a and D.1.b when operated on combinations of gaseous and nongaseous fuel as determined by the following equation:

$$L = \frac{(Q_g \, x0.036 \; lb/mmBTU) + (Q_n \, x0.052 \; lb/mmBTU)}{(Q_g + Q_n)}$$

where:

L = the heat input weighted average of the NOx limits specified above
Q_g = the total heat input when operated on gaseous fuel
Q_n = the total heat input when operated on nongaseous fuel

2. Emissions from units subject to Subsection D.1 shall not exceed a carbon monoxide (CO) concentration of 400 ppm_v dry at 3.0 % O_2.

3. Units with rated heat input capacities of greater than or equal to five (5) million BTU per hour and annual heat inputs of less than 90,000 therms for each of the three previous calendar years shall comply with at least one of the following:

   a. Be operated in a manner that maintains stack-gas oxygen (O_2) concentrations at less than or equal to 3.0 percent by volume on a dry basis; or

   b. Be operated with a stack-gas oxygen trim system set at 3.0 percent by volume O_2, plus or minus 0.15 percent; or

   c. Be tuned at least once per year by a technician that is qualified, to the satisfaction of the Air Pollution Control Officer (APCO), to perform a tune-up in accordance with the procedure described in Attachment 430-1 or 430-2 or other tune-up procedure approved in advance by the APCO; or

   d. Be operated in compliance with the applicable emission levels specified in Subsections D.1, and D.2.

E. REQUIREMENTS - EQUIPMENT

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

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

3. If the combustion unit has been physically modified such that its maximum heat input capacity is different than the rated heat input capacity specified on the nameplate, the modified maximum heat input capacity shall be considered as the rated heat input capacity. The modified maximum heat input capacity shall be demonstrated to the District through the use of a fuel meter while operating the unit at maximum capacity.

F. REQUIREMENTS - COMPLIANCE DETERMINATION

1. All emission determinations shall be made with the unit operating at conditions representative of normal operations, except that emission determinations shall include at a minimum one source test conducted at the maximum attainable firing rate allowed by the unit's permit to operate. Source testing to determine compliance with the requirements of Subsection D.1 shall not be performed within three (3) hours after a continuous period in which fuel flow to the unit is shut off for 30 minutes or longer.

2. All ppm_v emission limits specified in Subsections D.1 and D.2 are referenced at dry stack-gas conditions and 3.0 percent by volume stack-gas oxygen. Emission concentrations shall be corrected to 3.0 percent oxygen as follows:

$$[\ ppm_v\ NOx\ ]_{corrected} = \frac{20.95\% - 3.00\%}{20.95\% - [\%\ O_2\ ]_{measured}}\ x\ [\ ppm_v\ NOx\ ]_{measured}$$

$$[\ ppm_v\ CO\ ]_{corrected} = \frac{20.95\% - 3.00\%}{20.95\% - [\%\ O_2\ ]_{measured}}\ x\ [\ ppm_v\ CO\ ]_{measured}$$

where:

20.95 %	=	the assumed oxygen concentration in ambient air
[% O_2] $_{measured}$	=	the O_2 concentration in the gas stream as measured using the method specified in Subsection G.3
[ppm$_v$ *NOx*] $_{measured}$	=	the NOx concentration in the gas stream as measured using the method specified in Subsection G.1
[ppm$_v$ *CO*] $_{measured}$	=	the CO concentration in the gas stream as measured using the method specified in Subsection G.2

3. All pounds per million BTU emission rates for NOx shall be calculated as pounds of nitrogen dioxide per million BTU of heat input.

G. TEST METHODS. Compliance with the emission requirements of Section D shall be determined using the following test methods:

1. NOx: California Air Resources Board (ARB) Method 100 or United States Environmental Protection Agency (EPA) Method 7E.

2. CO: ARB Method 100 or EPA Method 10.

3. Stack Gas O_2: ARB Method 100 or EPA Method 3 or 3A.

4. NOx Emission Rate (Heat Input Basis): EPA Method 19.

5. Stack gas velocities: EPA Method 2.

6. Stack gas moisture content: EPA Method 4.

7. Certification of the higher heating value shall be provided by the fuel supplier or determined by using the most current version of one of the following test methods:

   a. The American Society for Testing and Materials (ASTM) Method D 2015 for solid fuels;

   b. ASTM Method D 240 or ASTM Method D 2382 for liquid hydrocarbon fuels; or

   c. ASTM Method D 1826, or ASTM Method D 1945 in conjunction with ASTM Method D 3588 for gaseous fuels.

8. An alternative source test method may be used provided the alternative method is at least as accurate as the test methods listed above and further provided that the alternative method has been approved by the ARB or EPA, and has received prior written approval from the APCO.

H. RECORDKEEPING

1. The owner or operator of units subject to Subsections D.1.c and D.3 shall record for each unit the higher heating value and monthly usage of each fuel. These records shall be maintained for a period of three (3) years and shall be made available to the District upon request.

2. The owner or operator of any unit operated under the exemption of Subsection C.2 shall monitor and record for each unit the type of fuel, the quantity of fuel, and the cumulative annual hours of operation on each alternate fuel during curtailment and during testing.

3. The owner or operator of a facility operating multiple units subject to Subsection D.3 that do not have individual fuel meters shall comply with one of the following:

   a. Monitor and record the cumulative hours of operation on a monthly basis for each unit. The annual heat input for each of the units shall be calculated by multiplying the rated heat input capacity for each unit in BTU/hr by the cumulative annual hours of operation for that unit and dividing by 100,000 to convert to therms; or

   b. Install a totalizing fuel meter for each applicable unit and for each fuel. Meters shall be accurate to ± one (1) percent, as certified by the manufacturer in writing. Totalizing fuel meter readings shall be recorded monthly, shall be maintained for a period of three (3) years and shall be made available to the District upon request.

I. REPORTING

1. The owner or operator of any unit subject to Subsection D.3.c shall submit an annual report to the APCO. This report shall verify that a tune-up has been performed and that the results were satisfactory.

ATTACHMENT 430-1
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 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.

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 gas is at the lower end of the range of typical minimum values[3], 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.

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 is reached:

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

   b. Stack gas CO concentration greater than 400 ppmv; or

   c. Smoking at the stack; or

   d. 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 430-1 and 430-2, 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:

[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 percent - 3 percent.
2. For liquid fuels: 2 percent - 4 percent.

Fuel	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 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 manufacture, 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 of 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 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.

Figure 430-1

Oxygen/CO Characteristic Curve

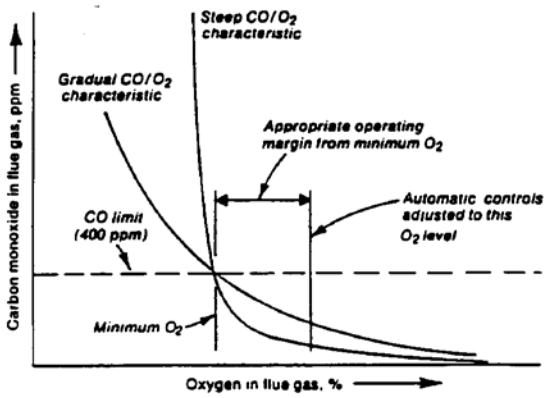
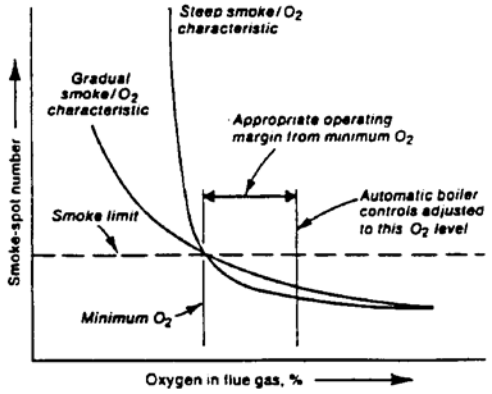


Figure 430-2

Oxygen/Smoke Characteristic Curve



ATTACHMENT 430-2

Equipment Tuning Procedure
for Natural Draft-Fired Equipment

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 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. Steps in the Procedure not applicable to specific units may be omitted.

1. Preliminary Analysis:

   a. Verify that the boiler, steam generator, or process heater (unit) is operating at the lowest pressure or temperature that will satisfy load demand. This pressure or temperature will be used as a basis for comparative combustion analysis before and after tuneup.

   b. Verify that the unit operates for the minimum number of hours and days necessary to perform the work required.

   c. Verify that the size of air supply openings is in compliance with applicable codes and regulations. Air supply openings must be fully open when the burner is firing and air flow must be unrestricted.

   d. Verify that the vent is in good condition, properly sized and free from obstruction.

   e. Perform a combustion analysis (CO, O_2, etc.) at both high and low fire, if possible. Record all data, as well as the following:

      1) Inlet fuel pressure at burner at high and low firing rates.
      2) Pressure above draft hood or barometric damper at high, medium and low firing rates.
      3) Steam pressure, water temperature, or process fluid pressure or temperature entering and leaving the unit.
      4) Inlet fuel use rate if meter is available.

2. Checks & Corrections:

   a. Clean all dirty burners or burner orifices. Verify that fuel filters and moisture traps are in place, clean, and operating properly. Confirm proper location and orientation of burner diffuser spuds, gas canes, etc. Replace or repair damaged or missing burner parts.

   b. Remove external and internal sediment and scale from heating surfaces.

   c. Verify that the necessary water or process fluid treatment is being used. Confirm flushing and/or blowdown schedule.

   d. Repair all leaks. In addition to the high-pressure lines, check the blow-off, drain, safety valve, bypass lines, and, if used, the feed pump.

3. Safety Checks:

   a. Test primary and secondary low water level controls.

   b. Check operating and limit pressure and temperature controls.

c. Check pilot safety shut off operation.

d. Check safety valve pressure setting and verify that the setting is consistent with unit load requirements.

e. Check limit safety control and spill switch.

4. Adjustments. Perform the following checks and adjustments on a warm unit at high fire:

a. Adjust unit to fire at the maximum inlet fuel use rate: record fuel manifold pressure.

b. Adjust draft and/or fuel pressure to obtain acceptable, clean combustion at both high, medium and low firing rates. The CO value should not exceed 400 ppmv at 3.0 percent O_2.

c. Verify that unit light-offs are smooth and safe. Perform a reduced fuel pressure test at both high and low firing rates in accordance with the manufacturer's instructions.

d. Check and adjust the modulation controller. Verify proper, efficient and clean combustion through the range of firing rates.

When optimum performance has been achieved, record all data.

5. Final Test. Perform a final combustion analysis on the warm unit at high, medium and low firing rates, if possible. Record data obtained from combustion analysis, as well as the following:

a. Inlet fuel pressure at burner at high and low firing rates.

b. Pressure above draft hood or barometric damper at high, medium and low firing rates.

c. Steam pressure, water temperature, or process fluid pressure or temperature entering and leaving the unit.

d. Inlet fuel use rate if meter is available.