(Adopted October 5, 1990)(Amended July 10, 1992)(Amended May 13, 1994)
(April 2, 2008)

RULE 1146.1 EMISSIONS OF OXIDES OF NITROGEN FROM SMALL INDUSTRIAL, INSTITUTIONAL, AND COMMERCIAL BOILERS, STEAM GENERATORS, AND PROCESS HEATERS

(a) Applicability

This rule applies to boilers, steam generators, and process heaters that are greater than 2 million Btu per hour and less than 5 million Btu per hour rated heat input capacity used in any industrial, institutional, or commercial operation.

(~~a~~b) Definitions

(1) ANNUAL HEAT INPUT means the actual amount of heat released by fuels burned in a unit during a calendar year, based on the fuel's higher heating value.

(2) BOILER OR STEAM GENERATOR means any combustion equipment fired with liquid and/or gaseous and/or solid fossil fuel, used to produce steam or to heat water, and that is not used exclusively to produce electricity for sale. Boiler or Steam Generator does not include any waste heat recovery boiler that is used to recover sensible heat from the exhaust of a combustion turbine or any unfired waste heat recovery boiler that is used to recover sensible heat from the exhaust of any combustion equipment.

(3) BTU means British thermal unit or units.

(4) HEALTH FACILITY has the same meaning as defined in Section 1250 of the California Health and Safety Code.

(~~4~~5) NO_x EMISSIONS means the sum of nitric oxide and nitrogen dioxide in the flue gas, collectively expressed as nitrogen dioxide.

(~~5~~6) PROCESS HEATER means any combustion equipment fired with liquid and/or gaseous and/or solid fossil fuel and which transfers heat from combustion gases to water or process streams. Process Heater does not include any kiln or oven used for drying, curing, baking, cooking, calcining, or vitrifying; or any unfired waste heat recovery heater that is used to recover sensible heat from the exhaust of any combustion equipment.

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(~~6~~7) RATED HEAT INPUT CAPACITY means the heat input capacity specified on the nameplate of the combustion unit. If the combustion unit has been altered or modified such that its maximum heat input is different than the heat input capacity specified on the nameplate, the new maximum heat input shall be considered as the rated heat input capacity.

(8) SCHOOL means any public or private school, including juvenile detention facilities with classrooms, used for purposes of the education of more than 12 children at the school, including in kindergarten and grades 1 to 12, inclusive, but does not include any private school in which education is primarily conducted in private homes. The term includes any building or structure, playground, athletic field, or other area of school property, but does not include unimproved school property.

(~~7~~9) THERM means 100,000 Btu.

(~~8~~10) UNIT means any boiler, steam generator, or process heater as defined in paragraph (~~a~~b)(2) or (~~a~~b)(~~5~~6).

~~(b) Applicability~~

~~This rule applies to boilers, steam generators, and process heaters that are greater than 2 million Btu per hour and less than 5 million Btu per hour rated heat input capacity used in any industrial, institutional, or commercial operation.~~

(c) Requirements

(1) On or after (date of adoption), ~~T~~the owner or operator of any unit subject to subdivision (~~b~~a) shall operate such unit so that it discharges into the atmosphere no more than 30 ppm of NO_x emissions or 0.037 pound NO_x per million Btu of heat input, as specified in the permit to operate~~ and no more than 400 ppm of carbon monoxide. For each unit, a selection must be indicated in the application for permit to construct and operate between the ppm NO_x or pounds of NO_x per million BTU heat input compliance option~~.

(2) An owner or operator of any unit subject to subdivision (a) must select to comply with one of the following NOx emission limits specified in Table 1146.1-1 and apply for a permit to construct to operate such unit in compliance with the selected emission limit and the corresponding permit application and full compliance dates.

Table 1146.1-1

Category	Limit	Permit to Construct	Full Compliance
Any Units Fired on Landfill Gas	25 ppm	January 1, 2014	January 1, 2015
Any Units Fired on Digester Gas	15 ppm	January 1, 2014	January 1, 2015
Any Units Fired on Natural Gas, Excluding Units Located at Schools and Universities	9 ppm or 0.011 lbs/10^6 Btu	January 1, 2011	January 1, 2012
Any Units Fired on Natural Gas Located at Schools and Universities		January 1, 2013	January 1, 2014

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(3) For dual fuel co-fired combustion units subject to subdivision (d) a weighted average limit calculated by Equation 1146.1-1 may be used provided a totalizing fuel flow meter is installed pursuant to paragraph (c)(7), for units burning a combination of both fuels.

$$\textbf{Weighted Limit} = \frac{(CL_A \times Q_A) + (CL_B \times Q_B)}{Q_A + Q_B} \qquad \textbf{Equation 1146.1-1}$$

Where:

CL_A = compliance limit for fuel A

CL_B = compliance limit for fuel B

Q_A = heat input from fuel A

Q_B = heat input from fuel B

(4) In lieu of complying with the compliance limits specified in paragraph (c)(1) or paragraph (c)(2) for natural gas fired units, the owner or operator of any unit may operate the unit in a manner that does not exceed the emission concentration limits specified in equation 1146.1-2 provided that they are specified on the Permit to Operate.

$$\textbf{CL}_a = CL \times ECF \qquad \textbf{Equation 1146.1-2}$$

Where:

CL_a is the adjusted concentration, ppm

CL is the concentration limit specified in paragraph (c)(1) or paragraph (c)(2) for natural gas fired units, ppm

ECF is the efficiency correction factor.

The ECF shall be 1.0 unless:

(i) The unit's operator has measured the unit's specific efficiency (EF_a), in compliance with ASME Performance Test Code PTC 4 – 1998, at the average firing rate of the unit; and

(ii) The ECF-corrected emission limit is made a condition of the unit's Permit to Operate.

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The ECF is calculated as follows:

$$\text{ECF} = \frac{[\text{Measured } EF_a, \%]}{[\text{Benchmark}, \%]} \qquad \textbf{Equation 1146.1-3}$$

ECF shall not be less than 1.0.

(5) The owner or operator of any unit(s) with a heat input capacity greater than or equal to 2 million Btu per hour shall not discharge into the atmosphere carbon monoxide (CO) emissions in excess of 400 ppm.

(6~~2~~) In lieu of complying with the applicable emission limits specified in paragraph (c)(1) or (c)(2) ~~Any~~ any unit(s) subject to subdivision (b) in operation prior to (date of adoption), and with an annual heat input of less than or equal to 18,000 therms per calendar year, shall:

(A) be operated in a manner that maintains stack-gas oxygen concentrations at less than or equal to 3 percent on a dry basis for any 15-consecutive-minute averaging period; or

(B) be tuned at least twice per year, (at intervals from 4 to 8 months apart) in accordance with the procedure described in Attachment 1 or the unit manufacturer's specified tuneup procedure. If a different tuneup procedure from that described in attachment 1 is used then a copy of this procedure shall be kept on site. The operator of any unit(s) selecting the tune-up option shall maintain records for a rolling of twenty four month period verifying that the required tune-ups have been performed. If the unit does not operate throughout a continuous six-month period within twelve month period ~~a calendar year~~, only one tuneup is required for the twelve month period that includes the entire period of non-operation ~~that calendar year~~. For this case, the tune-up shall be conducted within thirty (30) days of start-up. ~~The ow.er or operator of any unit(s) who chooses to comply with subparagraph (c)(2)(B) shall maintain a record for a period of two years verifying that the tuneup has been performed.~~ No tune-up is required during a rolling twelve month period ~~calendar year~~ for any unit that is not operated during that rolling twelve month period~~calendar year~~; this unit may be test fired to verify availability of the unit for its intended use but once test firing is

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completed it shall be shutdown. Records of test firings shall be maintained for a rolling twenty four month period~~ of two years~~, and shall be made accessible upon request from an authorized District representative upon request~~; or~~

~~(C) meet the emission limits specified in paragraph (c)(1)~~.

~~(3) The owner or operator of any unit(s) subject to paragraph (c)(2) shall submit and have approved by the Executive Officer, a compliance plan that demonstrates compliance with paragraph (c)(2). Such plan shall contain:~~

~~(A) A list of permits of all units with the rated heat input capacity, anticipated annual heat input; and~~

~~(B) For each unit listed, a selection of one of the three options specified in paragraph (c)(2) to achieve compliance with this rule; and~~

~~(C) Non-resettable, totalizing fuel meter(s) specifications; date of installation; and recorded fuel usage since installation.~~

(7) An owner or operator that has installed or modified a natural gas fired unit prior to the (*date of adoption*) complying with the applicable BACT emission limit of 12 ppm or less of NOx may defer compliance with paragraphs (c)(2) for 15 years from the date the unit's burner(s) was installed or modified.

(~~4~~8) Any owner or operator who chooses the pound per million Btu of heat input compliance option in paragraph (c)(1) or (c)(2) for natural gas fired units or chooses the weighted average emission limit using Equation 1146.1-1 under paragraph (c)(3) shall install a non-resettable, totalizing fuel meter for each fuel used on an individual unit basis, as approved by the Executive Officer.

(d) Compliance Determination

(1) Owners or operators of any units shall have the option of complying with either the pound per million Btu of heat input or parts per million emission limits specified in paragraphs (c)(1), (c)(2), or (c)(7).

(2) All emission determinations shall be made in the as-found operating condition, except no compliance determination shall be established during unit start up, shutdown, or under breakdown conditions. Start up or shutdown intervals shall not last longer than is necessary to reach stable

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temperatures. In no case shall the start up or shutdown interval last longer than six hours or the time specified in the permit to operate, whichever is less. Start-ups and shutdowns shall not last longer than is necessary to reach stable conditions. An emission determination shall be conducted at least 250 operating hours, or at least thirty days subsequent to the tuning or servicing of any unit, unless it is an unscheduled repair.

(3) All parts per million emission limits specified in ~~paragraph~~ subdivision (c) ~~(1)~~ are referenced at 3 percent volume stack-gas oxygen on a dry basis averaged over a period of 15 consecutive minutes.

(4) Initial ~~Compliance~~ compliance with the NO_x and CO emission requirements of paragraphs (c)(1) through (c)(5), and (c)(7) and the stack-gas oxygen concentration requirement of subparagraph (c)(6)(A) shall be determined according to the following procedures:

(A) ~~in~~ District Source Test Method 100.1 - Instrumental Analyzer Procedures for Continuous Gaseous Emission Sampling (March 1989), or

(B) District Source Test Method 7.1 - Determination of Nitrogen Oxide Emissions from Stationary Sources (March 1989) and Method 10.1 - Carbon Monoxide and Carbon Dioxide by Gas Chromatograph/Non-Dispersive Infrared Detector (GC/NDIR) - Oxygen by Gas Chromatograph-Thermal Conductivity (GC/TCD) (March 1989), or

(C) United States Environmental Protection Agency Conditional Test Method CTM-030, Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Emissions from Natural Gas-Fired Engines, Boilers and Process Heaters Using Portable Analyzers; or

(D) ASTM D6522-00(2005) Standard Test Method for Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Concentrations in Emissions from Natural Gas-Fired Reciprocating Engines, Combustion Turbines, Boilers, and Process Heaters Using Portable Analyzers

(E) any other test method determined to be ~~equivalent~~ alternative and approved before the test in writing by the Executive Officers of the District and the California Air Resources Board and the Regional Administrator of the United States Environmental Protection Agency, Region IX.

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Records of all source tests shall be maintained for a period of two years and shall be made available to District personnel upon request. Emissions determined to exceed any limits established by this rule through the use of any of the above-referenced test methods shall constitute a violation of this rule.

(5) For any owner or operator who chooses the pounds of NO_X per million Btu of heat input compliance option of paragraph (c)(1)~~,~~ (c)(2), or (c)(7) for natural gas fired units, NO_X emissions in pounds per million Btu of heat input shall be calculated using the procedures in 40 CFR Part 60, Appendix A, Method 19, Sections 2 and 3.

(6) Compliance determination with the NOx and CO emission requirements specified in paragraph (d)(4) shall be conducted once every five years.

(7) Any owner or operator shall check emissions with a portable NOx, CO and oxygen analyzer according to the Protocol for the Periodic Monitoring of Nitrogen Oxides, Carbon Monoxide, and Oxygen from Units Subject to South Coast Air Quality Management District Rules 1146 and 1146.1 at least quarterly or every 2,000 unit operating hours, whichever occurs later. If a unit is in compliance for four consecutive emission checks, without any adjustments to the oxygen sensor set points, then the unit may be checked semi-annually or every 4,000 unit operating hours, whichever occurs later, until there is a noncompliant emission check.

Records of all monitoring data shall be maintained for a rolling twelve month period of two years and shall be made available to District personnel upon request. An owner or operator shall not be considered in violation of the emissions limits of this rule or in permit conditions if the owner or operator complies with requirements specified in paragraph (d)(8). Any emission check conducted by District staff that finds excess emissions is a violation.

(8) If a source test specified under paragraph (d)(6) or an emission check conducted under the requirements specified in paragraph (d)(7) finds emissions in excess of those allowed by this rule or a permit condition, the owner or operator shall correct the problem and demonstrate compliance with another emission check or source test, as applicable, or shut down the unit by the end of an operating cycle, or within 72 hours from the time the owner or operator knew of excess emissions, or reasonably should have known, whichever is sooner.

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(e) Compliance Schedule

~~The owner or operator of units subject to this rule shall meet the following increments of progress:~~

(1) ~~For~~ O~~o~~wners or operators of units ~~subject to~~shall comply with the applicable schedule specified in paragraphs (c)(1),(c)(2).~~shall:~~

~~(A) By January 1, 1993, submit required applications for permits to construct and operate, and~~

~~(B) By July 1, 1994, demonstrate compliance with paragraph (c)(1).~~

(2) Prior to the July 1, 2010, an owner or operator may opt to lower the unit's rated heat input capacity. The lower rated heat input capacity shall be based on manufacturer's identification or rating plate or permit condition.

~~For owners or operators of units subject to paragraph (c)(2) shall:~~

~~(A) By January 1, 1993, submit a plan pursuant to paragraph (c)(3), and~~

~~(B) By December 31, 1993, demonstrate compliance with paragraph (c)(2).~~

(3) On or after January 1, 2015 or during burner replacement, whichever is later, no person shall operate in the District any unit subject to paragraph (c)(6) which does not meet the emissions limits specified in paragraph (c)(1).

(4) If any unit subject to paragraph (c)(6) exceeds 18,000 therms of annual heat input from all fuels used in any twelve month period, the owners or operators shall:

(A) within 4 months after exceeding 18,000 therms of heat input in any twelve month period, submit required applications for permits to construct and operate; and

(B) within 18 months after exceeding 18,000 therms of heat input in any twelve month period, demonstrate and maintain compliance with all applicable requirements specified in paragraphs (c)(1) through (c)(5) and (c)(8) for the life of the unit.

(5) The Executive Officer shall grant a time extension to the full compliance date with the applicable NOx compliance limits for any natural gas fired units specified in paragraph (c)(2) for any health facility as defined in Section 1250 of the California Health and Safety Code that can demonstrate that the Office of Statewide Health Planning and

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Development has approved an extension of time to comply with seismic safety requirements pursuant to Health and Safety Code Sections 130060 and 130061.5. The extension of time granted by the Executive Officer shall be consistent with the time extension granted pursuant to Health and Safety Code Section 130060 but not to exceed January 1, 2015 and shall be consistent with the time extension granted pursuant to Health and Safety Code Section 130061.5 but not to exceed January 1, 2020. Those health facilities granted a time extension shall submit a compliance plan to the Executive Officer on or before January 1, 2010.

~~(f) Exemption~~

~~The provisions of paragraph (c)(1) shall not apply provided the owner or operator:~~

~~(1) Installs by January 1, 1992, or at the time the permit to construct for the unit is issued, a non-resettable, totalizing fuel meter for each fuel that demonstrates that the unit(s) operate with an annual heat input at or below 18,000 therms per calendar year; and~~

~~(2) Has available for inspection by the Executive Officer by February 1 of each year, records listing cumulative annual usage of each fuel for the preceding calendar year. Records shall be maintained and made accessible to the Executive Officer or authorized District representative for a period of two years; and~~

~~(3) Demonstrates compliance with the requirements specified in subparagraphs (c)(2)(A) or (c)(2)(B), and (c)(3).~~

~~(g) Loss of Exemption~~

~~If any unit subject to a compliance plan submitted pursuant to paragraph (c)(3) exceeds 18,000 therms of annual heat input in any calendar year after 1992, the owners or operators shall:~~

~~(1) Within 4 months after the end of the calendar year during which the unit exceeded 18,000 therms of annual heat input, submit required applications for permits to construct and operate; and~~

~~(2) Within 18 months after the end of the calendar year during which the unit exceeded 18,000 therms of annual heat input, demonstrate and maintain compliance with paragraph (c)(1) for the life of the unit; and~~

~~(3) Maintain compliance with requirements of paragraph (c)(2) until compliance with paragraph (c)(1).~~

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ATTACHMENT 1

A. Equipment Tuning Procedure[1] for Forced-Draft Boilers, Steam Generators, and Process Heaters

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 not smoke, the unit is probably operating at near optimum efficiency - at this particular firing rate.
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.

However, complete the remaining portion of this procedure to determine whether still lower oxygen levels are practical.

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[1]This tuning procedure is based on a tune-up procedure developed by KVB, Inc. for the United States 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%

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.
   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.
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.

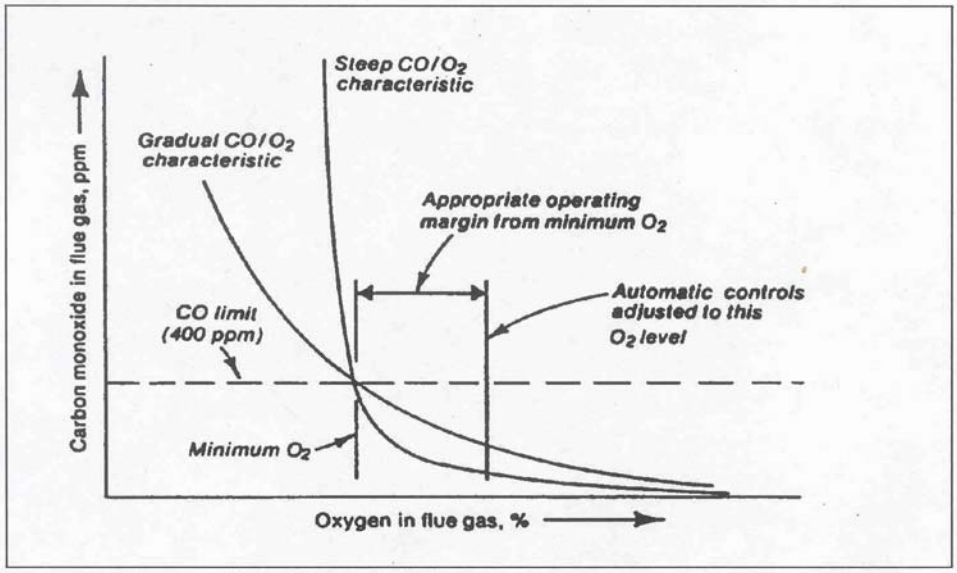

Figure 1 Oxygen/CO Characteristic Curve

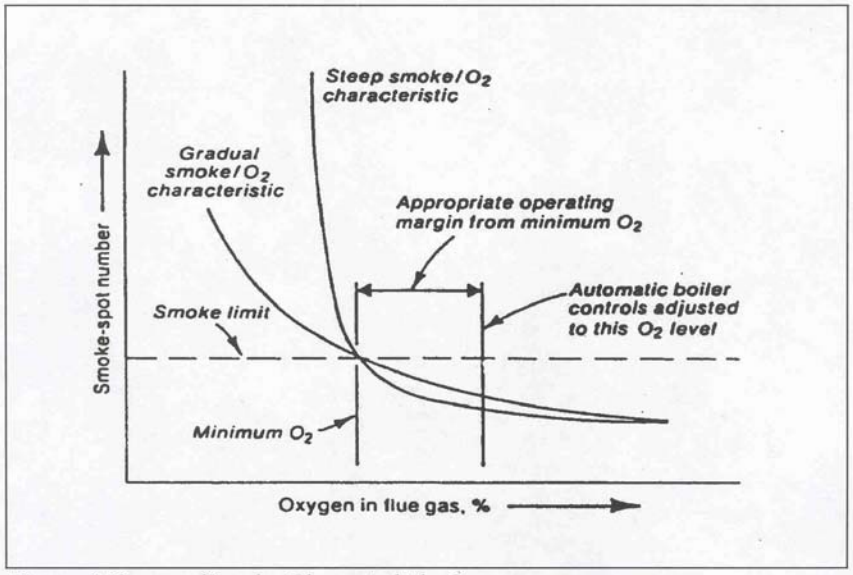

Figure 2 Oxygen/Smoke Characteristic Curve

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 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 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 ~~of~~ O2 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 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.

11. When the above checks and adjustments have been made, record data and attach combustion analysis data to boiler, steam generator, or heater records indicating name and signature of person, title, and date the tuneup was performed.

B. Equipment Tuning Procedure for Natural Draft-Fired Boilers, Steam Generators, and Process Heaters.

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 codes, regulations, and equipment manufacturers specifications and operating manuals.

Should a different tuning procedure be used, a copy of this procedure should be kept with the unit records for two years and made available to the District personnel on request.

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1. **PRELIMINARY ANALYSIS**

a. CHECK THE OPERATING PRESSURE OR TEMPERATURE.

Operate the boiler, steam generator, or heater at the lowest acceptable pressure or temperature that will satisfy the load demand. This will minimize heat and radiation losses. Determine the pressure or temperature that will be used as a basis for comparative combustion analysis before and after tuneup.

b. CHECK OPERATING HOURS.

Plan the workload so that the boiler, steam generator, or process heater operates only the minimum hours and days necessary to perform the work required. Fewer operating hours will reduce fuel use and emissions. For units requiring a tuneup to comply with the rule, a totalizing non-resettable fuel meter will be required for each fuel used and for each boiler, steam generator, and heater to prove fuel consumption is less than the heat input limit in therms per year specified in the rule.

c. CHECK AIR SUPPLY.

Sufficient fresh air supply is essential to ensure optimum combustion and the area of air supply openings must be in compliance with applicable codes and regulations. Air openings must be kept wide open when the burner is firing and clear from restriction to flow.

d. CHECK VENT.

Proper venting is essential to assure efficient combustion. Insufficient draft or overdraft promotes hazards and inefficient burning. Check to be sure that vent is in good condition, sized properly and with no obstructions.

e. COMBUSTION ANALYSIS.

Perform an "as is" combustion analysis (CO, O_2, etc.) with a warmed up unit at high and low fire, if possible. In addition to data obtained from combustion analysis, also record the following:

i. Inlet fuel pressure at burner (at high & low fire)

ii. Draft ~~above~~ at inlet to draft hood or barometric damper

1) Draft hood: high, medium, and low

2) Barometric Damper: high, medium, and low

iii. Steam pressure, water temperature, or process fluid pressure or temperature entering and leaving the boiler, steam generator, or process heater.

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iv. Unit rate if meter is available.

With above conditions recorded, make the following checks and corrective actions as necessary:

2. **CHECKS & CORRECTIONS**

a. CHECK BURNER CONDITION.

Dirty burners or burner orifices will cause boiler, steam generator, or process heater output rate and thermal efficiency to decrease. Clean burners and burner orifices thoroughly. Also, ensure that fuel filters and moisture traps are in place, clean, and operating properly, to prevent plugging of gas orifices. Confirm proper location and orientation of burner diffuser spuds, gas canes, etc. Look for any burned-off or missing burner parts, and replace as needed.

b. CHECK FOR CLEAN BOILER, STEAM GENERATOR, OR PROCESS HEATER TUBES & HEAT TRANSFER SURFACES.

External and internal build-up of sediment and scale on the heating surfaces creates an insulating effect that quickly reduces unit efficiency. Excessive fuel cost will result if the unit is not kept clean. Clean tube surfaces, remove scale and soot, assure proper process fluid flow and flue gas flow.

c. CHECK WATER TREATMENT & BLOWDOWN PROGRAM.

Soft water and the proper water or process fluid treatment must be uniformly used to minimize scale and corrosion. Timely flushing and periodic blowdown must be employed to eliminate sediment and scale build-up on a boiler, steam generator or process heater.

d. CHECK FOR STEAM, HOT WATER OR PROCESS FLUID LEAKS

Repair all leaks immediately since even small high-pressure leaks quickly lead to considerable fuel, water and steam losses. Be sure there are no leaks through the blow-off, drains, safety valve, by-pass lines or at the feed pump, if used.

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 and capacity to meet boiler, steam generator or process heater requirements.

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e. Check limit safety control and spill switch.

4. **ADJUSTMENTS**

While taking combustion readings with a warmed up boiler, steam generator, or process heater at high fire perform checks and adjustments as follows:

a. Adjust unit to fire at rate; record fuel manifold pressure.

b. Adjust draft and/or fuel pressure to obtain acceptable, clean combustion at both high, medium and low fire. Carbon Monoxide (CO) value should always be below 400 parts per million (PPM) at 3% 0_2. If CO is high make necessary adjustments.

Check to ensure boiler, steam generator, or process heater light offs are smooth and safe. A reduced fuel pressure test at both high and low fire should be conducted in accordance with the manufacturers instructions and maintenance manuals.

c. Check and adjust operation of modulation controller. Ensure proper, efficient and clean combustion through range of firing rates.

When above adjustments and corrections have been made, record all data.

5. **FINAL TEST**

Perform a final combustion analysis with a warmed up boiler, steam generator, or process heater at high, medium and low fire, whenever possible. In addition to data from combustion analysis, also check and record:

a. Fuel pressure at burner (High, Medium, and Low).

b. Draft above draft hood or barometric damper (High, Medium and Low).

c. Steam pressure or water temperature entering and leaving boiler, steam generator, or process heater.

d. Unit rate if meter is available.

When the above checks and adjustments have been made, record data and attach combustion analysis data to boiler, steam generator, or process heater records indicating name and signature of person, title, company name, company address and date the tuneup was performed.

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