

**RULE 2.27 ~~INDUSTRIAL, INSTITUTIONAL, AND COMMERCIAL-LARGE~~ BOILERS,
STEAM GENERATORS, AND PROCESS HEATERS**

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100 GENERAL

101 **PURPOSE:** To ~~reduce emissions of Nitrogen Oxides (NOx) from boilers, steam generators, and process heaters, provide a control measure to limit emissions of NO_x from industrial, institutional, and commercial boilers, steam generators and process heaters in conformance with BARCT determinations approved by the California Air Resources Board to meet the requirements of the California Clean Air Act.~~

102 **APPLICABILITY:** This Rule applies to boilers, steam generators, and process heaters with rated heat inputs of greater than or equal to five (5.0) million BTU per hour.

110 **EXEMPTIONS – GENERAL:** The provisions of this Rule shall not apply to:

110.1 Boilers used by electric utilities to generate electricity;

110.2 Waste heat recovery boilers;

110.3 Dryers;

110.4 Cement and lime kilns, glass melting furnaces and smelters; or

110.5 Hot water pressure washers;

~~, **NONGASEOUS FUELS:** If gas is unavailable for purchase, units which normally burn only gas and are subject to the requirements of Section 301 of this rule shall comply with a NO_x emission limit not to exceed 0.6 lbs/mmbtu when burning nongaseous fuel according to the following equation:~~

~~$(X)*(Y) < 36.12$, where:~~

~~X = lbs/mmbtu NO_x emission rate, and~~

~~Y = hours of operation per calendar year.~~

~~36.12 = Regulatory constant~~

~~The hours of operation limit in this exemption shall not include equipment testing and emissions testing time of less than 48 hours per calendar year.~~

111 **EXEMPTION, LOW USAGE:**

111.1 Section 300 of this Rule shall not apply to process heaters used less than 250 hours per calendar year.

111.2 Section 300 of this Rule shall not apply to boilers or process heaters under curtailment conditions, provided that the curtailment fuels are not burned more than 200 cumulative hours in a calendar year, including testing and maintenance. During this time, NO_x emissions shall not exceed 150 ppmv @ 3% O₂;

111.3 Sections 301 and 302 of this Rule shall not apply to boilers or process heaters with a permitted capacity factor of 4.0 percent or less.

~~, **ELECTRIC UTILITY BOILERS:** The provisions of this rule do not apply to boilers used by electric utilities to generate electricity.~~

~~112 **EXEMPTION, WASTE HEAT RECOVERY BOILERS:** The provisions of this rule do not apply to waste heat recovery boilers that are used to recover sensible heat from the exhaust of combustion turbines.~~

~~113 **EXEMPTION, DRYERS:** The provisions of this rule do not apply to units in which a material is being dried while in direct contact with the products of combustion.~~

~~114 **EXEMPTION, CEMENT AND LIME KILNS, GLASS MELTING FURNACES, AND SMELTERS:** The provisions of this rule do not apply to cement and lime kilns, glass melting furnaces and smelters.~~

~~115 **EXEMPTION, LOW USE PROCESS HEATERS:** Section 300 of this rule does not apply to process heaters used less than 250 hours per calendar year.~~

200 DEFINITIONS

201 **BOILER:** Any external combustion equipment fired with any fuel and used to produce hot water or steam including: boilers, steam generators, and hot water heaters.~~**ANNUAL HEAT INPUT:** The total heat input of fuels burned by a unit in a calendar year, as determined from the HHV and cumulative annual usage of each fuel.~~

202 **BRITISH THERMAL UNIT (BTU):** The amount of heat required to raise the temperature of one pound of water from 59°F to 60°F at one atmosphere.~~**BARCT:** "Best Available Retrofit Control Technology" as defined in section 40406 of the California Health and Safety Code as "an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source".~~

203 **CURTAILMENT CONDITIONS:** Periods in which a unit that normally burns natural gas instead burns a nongaseous fuel only during emergency interruption of natural gas delivery by the serving utility.~~**BOILER OR STEAM GENERATOR:** Any combustion equipment fired with any fuel and used to produce steam that is not used exclusively to produce electricity for sale. This definition does not include any waste heat recovery boiler that is used to recover sensible heat from the exhaust of a combustion turbine.~~

- 204 **DRYER:** Any unit where the material being dried comes into direct contact with the products of combustion. ~~**BRITISH THERMAL UNIT (BTU):** The amount of heat required to raise the temperature of one pound of water from 59°F to 60°F at one atmosphere.~~
- 205 **GASEOUS FUEL:** Any fuel which is a gas at standard conditions. ~~**FLUE GAS NO_x REDUCING TECHNOLOGY:** Engineering controls of NO_x emissions employed after combustion but prior to release from the exhaust stack.~~
- 206 **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. ~~**GAS:** Any fuel which is a gas at standard conditions.~~
- 207 **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 their standard states at standard conditions. HHV shall be determined by one of the following test methods:
- ~~207.1 ASTM D 2015 for solid fuels; or~~
~~207.2 ASTM D 240 or ASTM D 2382 for liquid hydrocarbon fuels; or~~
~~207.3 ASTM D 1826 or ASTM D 1945 in conjunction with ASTM D 3588 for gaseous fuels.~~
- ~~**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.~~
- 208 **HOT WATER PRESSURE WASHER:** High-pressure cleaning machine in which the hot water discharge line (spray nozzle) is hand supported and intended for commercial and industrial applications. ~~**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 their standard states at standard conditions. HHV shall be determined by one of the following test methods:~~
- ~~208.1 ASTM D 2015 85 for solid fuels; or~~
~~208.2 ASTM D 240 87 or ASTM D 2382 88 for liquid hydrocarbon fuels; or~~
~~208.3 ASTM D 1826 88 or ASTM D 1945 81 in conjunction with ASTM D 3588 89 for gaseous fuels.~~
- 209 **NO_x EMISSIONS (NO_x):** The sum of nitric oxides and nitrogen dioxide in the flue gas.
- 210 **NONGASEOUS FUEL:** Any fuel which is not a gas at standard conditions.

211 **PARTS PER MILLION (BY VOLUME) (ppmv):** The ratio of the number of gas molecules of a given species, or group of species, to the number of millions of total gas molecules.

~~212 **PERMITTED CAPACITY FACTOR:** The annual permitted fuel use divided by the product of the manufacturer's specified maximum hourly fuel consumption times 8,760 hours per year, as specified on the unit's District Permit to Operate (PTO).~~

2123 **PROCESS HEATER:** Any combustion equipment fired with any fuel, and which transfers heat from combustion gases to water or process streams. This definition does not include any dryers in which the material being dried is in direct contact with the products of combustion, cement or lime kilns, glass melting furnaces, and smelters.

2134 **RATED HEAT INPUT:** The heat input capacity, in million BTU per hour, 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 maximum heat input shall be considered as the rated heat input.

~~214 **SHUT-DOWN:** The period of time a unit is cooled from its operating temperature to ambient temperature, or the time specified by the unit manufacturer.~~

215 **STANDARD CONDITIONS:** 68°F and one atmosphere.

~~216 **START-UP:** The period of time a unit is heated from ambient temperature to its operating temperature, or the time specified by the unit manufacturer.~~

~~217 **THERM:** One hundred thousand (100,000) BTU.~~

~~218 **THREE PREVIOUS CALENDAR YEARS:** The three consecutive years immediately preceding the year in which final compliance is required by this rule, or the three consecutive years immediately preceding each calendar year of compliance thereafter.~~

2196 **UNIT:** Any boiler, steam generator, or process heater as defined in Sections 203201 and 212213 of this Rule.

~~217 **WASTE HEAT RECOVERY BOILER:** A device that recovers normally unused energy and converts it to usable heat. Waste heat recovery boilers incorporating duct or supplemental burners that are designed to supply 50 percent or more of the total rated heat input capacity of the waste heat recovery boiler are not~~

considered waste heat recovery boilers, but are considered boilers. Waste heat recovery boilers are also referred to as heat recovery steam generators.

300 STANDARDS

~~301 **ANNUAL HEAT INPUTS 90,000 THERMS:** For units with rated heat inputs of greater than or equal to 5 million BTU per hour and annual heat inputs of greater than or equal to 90,000 therms for any single calendar year of the three previous calendar years, NO_x emissions shall not exceed the following levels:~~

~~301.1 30 parts per million by volume (ppmv), or 0.036 pound per million BTU of heat input when operated on gas; or~~

~~301.2 40 parts per million by volume (ppmv), or 0.052 pound per million BTU of heat input, when operated on nongaseous fuel; or~~

~~301.3 the heat input weighted average of the limits specified in 301.1 and 301.2, above, when operated on combinations of gas and nongaseous fuels.~~

~~Emissions from units subject to this Section shall not exceed a carbon monoxide concentration of 400 parts per million by volume (ppmv).~~

~~302 **ANNUAL HEAT INPUTS < 90,000 THERMS:** Units with rated heat inputs of greater than or equal to 5 million BTU per hour and annual heat inputs of less than 90,000 therms for each of the three previous calendar years or units with rated heat inputs of greater than or equal to 5 million BTU per hour and not subject to the provisions of Section 301 shall:~~

~~302.1 Be operated in a manner that maintains stack gas oxygen concentrations at less than or equal to 3.00 percent by volume on a dry basis during normal, steady state operation (or maintain oxygen concentrations at the optimum O₂ level as specified by the manufacturer); or~~

~~302.2 Be tuned not less than once every twelve months by a technician that is qualified to perform a tune-up in accordance with Section 600 of this rule; or~~

~~302.3 Be operated in compliance with the applicable emission levels specified in Section 301 of this rule. **EMISSION LIMITS**~~

301.1 Gaseous Fuel Firing: NO_x emissions shall not exceed the following levels when firing on gaseous fuels.

<u>Unit Size/Description</u> <u>mmBtu/hr Rated Input</u>	<u>Effective</u> <u>August 14, 1996</u>	<u>Effective</u> <u>December 31, 2023</u>
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	<u>NOx Limits ppmvd @ 3% O2</u>	<u>NOx Limits ppmvd @ 3% O2</u>
<u>≥ 5.0 - ≤ 20.0</u>	<u>30</u>	<u>15</u>
<u>> 20.0</u>	<u>30</u>	<u>9</u>

301.2 Nongaseous Fuel Firing: NOx emissions shall not exceed 40 ppmvd @ 3% O2 when firing on nongaseous fuels.

301.3 Units installed on or after January 1, 2020 shall meet the December 31, 2023 standards at the time of installation.

301.4 For units that operate simultaneously on combinations of gaseous and nongaseous fuels, the NOx emissions shall not exceed the rated heat-input weighted average of the standards specified in Sections 301.1 and 301.2 above.

301.5 Emissions from units subject to this Section shall not exceed a carbon monoxide concentration of 400 parts per million by volume (ppmv).

302 PERFORMANCE TESTING: Effective, December 31, 2019, any unit subject to section 301 shall perform testing to demonstrate compliance with the emission limitations in accordance with the following frequency:

<u>Rated Heat Input mmBTU/hr</u>	<u>Frequency</u>
<u>≥ 5.0 - ≤ 20.0</u>	<u>Source test at least once every 24 months</u>
<u>> 20.0</u>	<u>Source test at least once every 12 months</u>

303 EQUIPMENT REQUIREMENTS

~~303.1 Owners or operators of units which simultaneously fire combinations of gaseous and nongaseous fuels, and are subject to the requirements of Section 301 (annual heat inputs greater than or equal to 90,000 therms), shall install mass flow rate meters in each fuel line. Alternatively, volumetric flow rate meters may be installed in conjunction with temperature and pressure meters in each fuel line. All volumetric and mass flow meters required by this section must be non-resettable, totalizing meters.~~

~~303.2 Owners or operators of units which employ flue gas NO_x reducing technology and are subject to the requirements of Section 301 of this rule, shall, through yearly testing or by installing data collection devices, collect sufficient data consistent with determining compliance with this rule. Such measurements may include, but are not limited to, the oxygen~~

~~concentration, CO concentration, stack gas temperatures, and/or any other data necessary to accurately assess the effectiveness of the NO_x reduction equipment.~~

303 TUNE-UPS: Any unit exempted from the Section 301 and 302 standards pursuant to Section 111.3 shall be tuned not less than once every 12 months by a technician that is qualified to perform a tune-up. The tune-up shall be done in accordance with manufacturer's recommendations or EPA 40 CFR 60 Subpart JJJJJ guidance.

304 MONITORING EQUIPMENT:

304.1 Fuel meters: Owners or operators of units subject to this Rule shall install and maintain a dedicated non-resetting totalizing fuel meter in each fuel line. If a volumetric flow rate meter is installed, it must compensate for temperature and pressure using integral gauges. Owners or operators may use the serving utility provider meter if the meter serves only one unit.

304.2 Hour meters: For units with a rated heat input equal to or less than 20.0 mmBTU/hr, the owner or operator may use a non-resetting totalizing hour meter or computerized tracking system in lieu of a dedicated fuel meter. In this case, the fuel usage shall be calculated by multiplying the number of operating hours for the unit by the maximum fuel usage for the unit as specified by the unit manufacturer.

400 ADMINISTRATIVE REQUIREMENTS

~~401 COMPLIANCE SCHEDULE: The owner or operator of units subject to this rule shall fulfill the following increments of progress:~~

~~401.1 Submit, by October 27, 1995, a plan containing the following:~~

~~A list of all units with their rated heat inputs and anticipated annual heat inputs.~~

~~For owners or operators of units subject to Section 301 (annual heat inputs greater than or equal to 90,000 therms), for each unit listed, the selected method of achieving the applicable standard or standards of Section 301.~~

~~For owners or operators of units subject to Section 302, for each unit listed, a selection of one of the options specified in Section 302 to achieve compliance with this rule.~~

~~401.2 By October 27, 1995, all owners or operators subject to the provisions of this rule shall submit an application for Authority to Construct for any modifications required to achieve compliance with the requirements of this rule.~~

~~401.3 By June 1, 1998, all owners or operators subject to this rule shall demonstrate final compliance with all applicable standards and requirements of this rule.~~

An owner or operator of any unit(s) subject to this Rule shall fulfill the following increments of progress:

401.1 By August 1, 2019, submit an application for Authority to Construct for any existing unit for which the low usage exemption pursuant to Section 111.3 will be claimed.

401.2 By December 31, 2019, submit a written plan containing a description of the method the owner or operator will use to comply with the applicable standards of Section 301.

401.3 By December 31, 2021, all owners or operators subject to the provisions of this Rule shall submit an application for Authority to Construct for any modifications required to achieve compliance with the requirements of this Rule.

401.4 By December 31, 2023, all owners or operators subject to this Rule shall demonstrate final compliance with all applicable standards and requirements of this Rule.

402 **COMPLIANCE DETERMINATION:**

~~402.1 An owner or operator of any unit(s) shall have the option of complying with either the pounds per million BTU emission rates or the parts per million by volume emission limits specified in Section 301.~~

~~402.2~~ When making All emission determinations in accordance with Section 302, the determinations shall be made in the as-found operating condition, except that emission determinations shall include at a minimum at least one ~~source test~~ run conducted at the maximum firing rate allowed by the District permit, and no compliance determination shall be established within two hours after a continuous period in which fuel flow to the unit is zero, or shut off, for ~~thirty~~30 minutes or longer.

~~402.23~~ All ppmv emission limits specified in Sections ~~110~~111 and 301 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:

$$[ppm NOx]_{corrected} = \frac{20.9\% - 3.0\%}{20.9\% - [\%O2]_{measured}} * [ppm NOx]_{measured}$$

$$[ppm\ CO]_{corrected} = \frac{20.9\% - 3.0\%}{20.9\% - [\%O_2]_{measured}} * [ppm\ CO]_{measured}$$

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

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

~~402.4 All pounds-per-million-BTU emission rates shall be calculated as pounds of nitrogen dioxide (NO₂) per million BTU of heat input.~~

~~402.5 All emission concentrations and emission rates shall be based on 15-consecutive minute averages. These averages shall be calculated from no less than five data sets, recorded from sampling on intervals of no greater than three minutes.~~

~~402.6 All operators of units covered under Sections 301 and 302 shall conduct source tests to demonstrate initial compliance with the requirements of this rule. For units subject to Section 301, operating parameters shall be established during the initial source tests in order to allow future compliance monitoring from tune-up data. Such parameters may include, but are not limited to, the gas flow rate, steam flow rate, steam pressure, excess oxygen levels, CO levels, stack gas temperatures, or any other parameters that the Air Pollution Control Officer deems necessary to ensure compliance. These operational parameters must be submitted to the District with the initial source test report. Additional source testing may be required by the Air Pollution Control Officer as necessary to ensure compliance with the standards set forth in Sections 301 and 302 of this Rule.~~

~~402.7 Sources subject to Section 301 shall perform annual source tests in accordance with Section 502 or tune-ups in accordance with Section 600 to demonstrate compliance with this rule. If annual tune-ups are used to certify compliance, then the tune-up data demonstrating the equipment is operating within the parameters established during the initial source test must be submitted to the District. The Air Pollution Control Officer shall require additional source testing if the tune-up data indicates a deviation from the parameters established in the initial source test.~~

~~402.8 Failure to comply with all of the provisions of an approved plan under Section 401.1 shall constitute a violation of this rule.~~

~~402.9 The cumulative annual usage of each fuel shall be monitored from utility service meters, purchase, or tank fill records, or by any other acceptable methods approved by the Air Pollution Control Officer.~~

403 **TEST REPORTS:** ~~The owners or operators of units subject to Section 301 of this rule shall, at least every twelve months, submit either source or tune up test reports on each unit for each fuel burned, including any fuels which may be burned in accordance with Section 110. For units complying with Section 302.2, tune up verification reports shall also be submitted not less than once every twelve months. Test reports shall include the operational characteristics of all flue gas NOx reduction equipment that were monitored as required by Section 303.2. The first test or tune up report, for each unit subject to Section 300 of this rule shall be submitted by June 1, 1998. The owners or operators of units subject to Section 302 of this Rule shall submit a written protocol to the District for approval at least 14 days prior to the test event, and shall submit a completed written test report to the District for approval within 60 days after performing any test.~~

404 TUNE-UP REPORTS: The owners or operators of units subject to Section 303 of this Rule shall maintain documentation (e.g. receipt or work order) that a tune-up was performed. In addition, written documentation of the tune-up method used (manufacturer's recommendations or EPA tune-up guide) shall be maintained. All documentation shall be maintained by the owner or operator for at least five years and made readily available to the District upon request.

500 MONITORING AND RECORDS

501 **FUEL USAGE ~~MONITORING AND OPERATING HOURS:~~** ~~The owners or operators of units subject to Section 300 of this rule shall monitor and record for each unit the HHV and cumulative annual usage of each fuel and the cumulative annual hours of operation during shut down and start up procedures as defined in Sections 214 and 216. The owners and operators of units exempt from Section 301 in accordance with Section 110 shall monitor and record for each unit the cumulative hours of operation on each nongaseous fuel. Owners and operators of units exempt from Section 300 in accordance with Section 115 shall monitor and record for each unit the cumulative hours of operation per year. The records shall be updated weekly and made available to the District upon request. Historical annual data for the five previous calendar years shall be kept and made available to the District upon request. Owners or operators of units subject to this Rule shall monitor and record for each unit the actual annual hours of operation or usage of each fuel using the meter(s) required in section 304. Records shall be updated quarterly.~~

Records shall be maintained by the owner or operator for the five previous calendar years and made available to the District upon request.

502 TEST METHODS:

502.1 Compliance with NO_x emission requirements and the stack-gas carbon monoxide and oxygen requirements of Section 300 shall be determined using the following test methods:

- a. Oxides of Nitrogen - ARB Method 100.
- b. Carbon Monoxide - ARB Method 100.
- c. Stack-Gas Oxygen - ARB Method 100.
- d. NO_x Emission Rate (Heat Input Basis) - EPA Method 19.

502.2 Test methods other than those specified in Section 502.1 for oxides of nitrogen, stack-gas oxygen, and stack-gas carbon monoxide, may be used to determine compliance so long as they are functionally equivalent and approved by the ~~Air Pollution Control Officer, the California Air Resources Board, and the U.S. EPA-APCO and EPA.~~

502.3 For source testing performed pursuant to Section 302, compliance with an applicable standard or numerical limitation of this Rule shall be determined from the arithmetic average of three (3) 30 consecutive minute test runs. If two (2) of three (3) runs are above an applicable limit, the test cannot be used to demonstrate compliance with an applicable limit. With prior District approval, multiple smaller measurement periods may be combined into composite runs of at least 30 minutes provided that the smaller measurement periods are not separated by long spans of time or by an adjustment to the unit being tested.

~~600 TUNING PROCEDURE~~

~~601 GENERAL: Nothing in these tuning procedures¹ 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 This tuning procedure is based on a tune-up procedure developed by KVB, Inc. for the EPA.~~

~~602 PROCEDURES FOR TUNING MECHANICAL DRAFT BOILERS, STEAM GENERATORS, AND PROCESS HEATERS:~~

~~602.1 Operate the unit at the firing rate most typical of normal operation. If the unit experiences significant load variations during normal operations, operate the unit at its average firing rate.~~

~~602.2 At the firing rate established in Section 602.1, record stack gas temperatures, oxygen concentration, and CO concentration (for gaseous fuels) or smoke spot number² (for liquid fuels), and observe flame conditions after unit operation stabilizes at the selected firing rate. If the excess oxygen in the stack gas is at the lower end of the range of typical minimum values³, 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.~~

~~602.3 Increase combustion air flow until the stack gas oxygen levels increase by one or two percent over the level measured in Section 602.2. As in Section 602.2, 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 unit operation stabilizes.~~

~~602.4 Decrease combustion air flow until the stack gas oxygen is at the level measured in Section 602.2. 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.~~

~~602.5 Continue to reduce combustion air flow stepwise, until one of the following limits is reached:~~

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

~~² The smoke spot number can be determined with ASTM test method D-2156 or with the Bacharach method. The charach method is included in a tune-up kit that can be purchased from the Bacharach company.~~

~~³ Typical minimum oxygen levels for units at high firing rates are:
A. For natural gas: 0.5 - 3%
B. For liquid fuels: 2 - 4%.~~

- ~~b. Stack gas CO concentrations greater than 400 ppm;~~
- ~~c. Smoking at stack;~~
- ~~d. Equipment related limitations such as low windbox/furnace pressure differential, built in air flow limits, etc.~~

~~602.6 Develop an O₂/CO curve (for gaseous fuels) or O₂/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.~~