

Rule 250 Industrial, Institutional and Commercial Boilers, Steam Generators and Process Heaters Oxides of Nitrogen Control Measure

RULE 250 CONTENTS

1. PURPOSE
2. APPLICABILITY
3. EXEMPTIONS
4. DEFINITIONS
5. REQUIREMENTS
6. COMPLIANCE DETERMINATIONS
7. TEST METHODS
8. RECORDKEEPING REQUIREMENTS
9. TUNING PROCEDURE FOR MECHANICAL DRAFT BOILERS, STEAM GENERATORS AND PROCESS HEATERS
10. TUNING PROCEDURE FOR NATURAL AND INDUCED DRAFT-BOILERS, STEAM GENERATORS AND PROCESS HEATERS

**RULE 250**

- 1 PURPOSE:** To reduce Oxides of Nitrogen emissions during the operations of Industrial, Institutional and Commercial Boilers, Steam Generators and Process Heaters to levels consistent with reasonably available control technology (RACT).
- 2 APPLICABILITY:** This Rule applies to all boilers, steam generators and process heaters used in industrial, institutional and commercial operations that exist within the boundaries of the Colusa County Air Pollution Control District (DISTRICT) on the date of adoption of this Rule.
- 3 EXEMPTIONS**
  - 3.1** The requirements of Section 5 of this Rule shall not apply to the units which are willing to accept a permit condition that restricts operation to an annual capacity factor of 15% or less.
    - 3.1.1** To continue to qualify for the exemption provided in Section 3.1 above the owner or operator of any applicable unit(s) shall submit to the Air Pollution Control Officer (APCO) annual fuel use data that demonstrates that the unit(s) operated at or below the allowable 15% annual capacity factor(s). For the purposes of this Section, the annual capacity factor for multiple units may be calculated based on the total fuel input to multiple like units.
    - 3.1.2** Following adoption of this Rule, an exemption granted for any unit will become null and void if that unit operates for more than one (1) calendar year at an annual capacity factor greater than 15%.
  - 3.2** The requirements of Section 5 shall not apply to units for which the APCO has determined it is not technically or economically feasible to comply with the Reasonably Available Control Technology (RACT) emission limitations.
  - 3.3** The requirements of Section 5 shall not apply to units with a rated heat input capacity less than one (1) million Btu per hour.
  - 3.4** The use of an emergency standby unit during equipment breakdowns and during routine maintenance of the primary unit. Operation of the emergency standby unit shall not exceed a maximum of 30 days of operation per year.
- 4 DEFINITIONS:** For the purposes of this Rule, the following definitions shall apply.
  - 4.1 Annual Capacity Factor:** The ratio of the amount of fuel burned by a boiler in a calendar year to the amount of fuel it could have burned if it had operated at the rated heat input capacity for 100% of the time during the calendar year.

- 4.2 Boiler or Steam Generator:** An individual piece of combustion equipment fired with liquid, gaseous, or solid fuel with the primary purpose of producing steam. Boiler or steam generator does not include water heaters, any waste heat recovery boiler that is used to recover sensible heat from the exhaust of a combustion turbine, nor does it include equipment associated with a chemical recovery cycle.
- 4.3 British Thermal Unit (Btu):** The amount of heat required to raise the temperature of one pound of water from 59°F and 60° F at one atmosphere.
- 4.4 Gas-Fired:** Using natural gas, propane, or any other gaseous fuel for firing the boiler or steam generator.
- 4.5 Heat Input:** The chemical heat released due to fuel combustion in a boiler using the higher heating value of the fuel. This does not include the sensible heat of incoming combustion air.
- 4.6 Higher Heating Value:** The heat liberated per mass of fuel burned (Btu per pound) when fuel and dry air at standard conditions (68 degrees F and one (1) atmosphere pressure) undergo complete combustion and all resultant products are brought to their standard states at standard conditions. Higher heating value shall be determined using Section 7.1.5.
- 4.7 Induced Draft Unit:** A unit similar to a natural draft unit having a stack, which by itself is not of sufficient size to create the necessary draft for proper combustion, and therefore utilizes a mechanically driven blower in the stack to supplement the draft requirements of the unit.
- 4.8 Natural Draft Unit:** A unit that uses no mechanical means to cause air flow through a combustion chamber, flue, chimney or space.
- 4.9 Oxides of Nitrogen Emissions:** The sum of nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>) in the flue gas collectively expressed as nitrogen dioxide.
- 4.10 Parts Per Million By Volume:** The ratio of the number of gas molecules of a given species, to the number of millions of total gas molecules.
- 4.11 Process Heater:** Any combustion equipment fired with liquid, gaseous or solid fuel and which transfers heat from combustion gases to water or process streams. A process heater does not include any kiln, furnace, recovery furnace or oven used for drying, baking, heat-treating, cooking, calcining, vitrifying or chemical reduction.
- 4.12 Rated Heat Input Capacity:** The heat input capacity specified on the nameplate of the combustion unit. If the unit has been permanently altered or modified such that the maximum heat input is different than the input

capacity specified on the nameplate and this alteration or modification has been approved in writing by the APCO, then the new maximum heat input shall be considered as the rated heat input capacity.

**4.13 Reasonably Available Control Technology (RACT):** The lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.

**4.14 Unit:** Any boiler, steam generator or process heater as defined in this definition Section.

**5 REQUIREMENTS**

**5.1** No later than one (1) year following DISTRICT adoption of this Rule, all existing units with a rated heat input capacity greater than or equal to five (5) million (MM) Btu per hour shall demonstrate final compliance with the following RACT emission limitations dependent upon the specific fuel fired in the unit and based upon a three-hour averaging period. All new units shall comply with the requirements of DISTRICT Rule 430, *New Source Review*.

**EMISSION LIMITS FOR OXIDES OF NITROGEN (AS NO2)**

Gaseous only fuel firing	Gaseous & Non-gaseous fuel co-firing	Liquid or Solid fuel
0.084 lbs/MMBtu or 70 ppmv	Heat input weighted average fuel limits	0.15 lbs/MMBtu or 115 ppmv

The heat input weighted average shall be calculated as follows:  
 Emission limit (ppm) = (70 ppmv \* X) + (115 ppmv \* Y) / X+Y  
 Emission limit (lbs/MBtu) = (0.084 \* X) + (0.15 \* Y) / X+Y

Where X = annual heat input from gaseous fuel, and  
 Y = annual heat input from non-gaseous fuel

**5.2** No later than one year following District adoption of this Rule, the owner or operator of any existing unit(s) with a rated heat input capacity greater than 1 million Btu and less than five (5) million Btu per hour shall submit for the approval of the APCO a list of all units operating within the DISTRICT boundaries and a selection of one of the following four options to be added as a permit condition to the Permit to Operate for each such unit in order to achieve compliance with this Rule:

**5.2.1** Operate in a manner that maintains stack gas oxygen concentrations at less than or equal to 3% by volume on a dry basis for any fifteen (15) consecutive minute averaging period; or

- 5.2.2** Operate with a stack gas oxygen trim system set at 3% by volume oxygen. The operational tolerance of the setting shall be within the range of 2.85% to 3.15%; or
  - 5.2.3** Tune the unit at least once per year by a technician that is qualified to the satisfaction of the APCO to perform a tune-up in accordance with the procedure described in Section 9 or Section 10 of this Rule; Note: The owner/operator of any unit(s) is required to submit an annual report verifying that the tune-up has been performed. The report shall contain any other information or documentation that the APCO determines to be necessary, or
  - 5.2.4** Operate in compliance with the emission limits specified in Section 5.1 of this Rule.
- 5.3** Emissions from units subject to this Rule shall not exceed a carbon monoxide (CO) concentration of 400 parts per million (ppm) by volume when using only gaseous or a combination of gaseous and liquid fuels.
- 5.4** Emissions of ammonia (NH<sub>3</sub>) from any control device installed and operated pursuant to this Rule shall not exceed of 20 ppm by volume at dry stack conditions adjusted to 3% oxygen unless compliance with this requirement is deemed to be technically or economically infeasible by the APCO due to fuel type, boiler configuration, or any other design characteristic of the unit.

## **6 COMPLIANCE DETERMINATION**

- 6.1** An owner or operator of any unit(s) shall have the option of complying with either the pounds per million Btu (lbs/MM Btu) emission rates or parts per million by volume (ppmv) emission limits specified in Section 5.1 of this Rule. All units covered under Sections 5.1 and 5.2 shall be tested for compliance not less than once every 12 months, except that units complying with Section 5.2.3 shall be tuned not less than once every 12 months.
- 6.2** All emission determinations shall be conducted at the maximum firing rate allowed by the DISTRICT permit, and no compliance determination shall be established within two (2) hours after a continuous period in which fuel flow to the unit is zero, or shut off, for fifteen (15) minutes or longer.
- 6.3** All ppmv emission limits for gaseous, liquid or gaseous/liquid fuel firing specified in Section 5 of this Rule are referenced at dry stack-gas conditions and corrected to 3% by volume stack gas oxygen.

Emission concentrations shall be corrected to 3% oxygen (O<sub>2</sub>) as follows:

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

- 6.4** All ppmv emission limits for solid fuel firing specified in Section 5 of this Rule are referenced at dry stack-gas conditions and corrected to 12% by volume stack gas CO<sub>2</sub>.

Emission concentrations shall be corrected to 12% CO<sub>2</sub> as follows:

$$[\text{ppm}] \text{ corrected} = \frac{12\%}{[\text{CO}_2] \text{ measured}} * [\text{ppm}] \text{ measured}$$

- 6.5** All emission concentrations and emission rates shall be calculated or obtained from continuous emission monitoring data obtained by utilizing the test methods specified in Section 7 Test Methods below or using a portable emission analyzer.

## 7 TEST METHODS

- 7.1** Compliance with the emission requirements in Section 5.1 shall be determined using the following test methods:
- 7.1.1** Oxides of Nitrogen - EPA Method 7E or CARB Method 100
  - 7.1.2** Carbon Monoxide - EPA Method 10 or CARB Method 100
  - 7.1.3** Stack Gas Oxygen - EPA Method 3A or CARB Method 100
  - 7.1.4** NO<sub>x</sub> Emission Rate (Heat Input Basis) - EPA Method 19
  - 7.1.5** Higher heating value shall be certified by a third party fuel supplier, or determined by one of the following test methods: ASTM D 2015-85 for solid fuels, ASTM D 240-87 or ASTM D 2382-88 for liquid hydrocarbon fuels; or ASTM D 1826-88, or ASTM D1945-81 in conjunction with ASTM D 3588-89 for gaseous fuels.
- 7.2** A portable emissions analyzer may be used to determine emissions provided approval has been granted from the APCO.
- 7.3** For determination of the NH<sub>3</sub> concentrations in stack gases, Bay Area Air Quality Management District Source Test Procedure ST-1B, "Ammonia, Integrated Sampling" shall be utilized for stack sampling and EPA Method 350.3, "Ion Specific Electrode," shall be utilized as the analysis method.

(Reference EPA 600/4-79-020.)

**7.3.1** Alternate methods may be used with prior approval of the Air Pollution Control Officer.

## **8 RECORDKEEPING REQUIREMENTS**

- 8.1** Any persons subject to the provisions of Section 5.1 of this Rule shall install no later than one (1) year following DISTRICT adoption of this Rule a non-resettable totalizing volumetric or mass-flow fuel meter in each fuel line for each applicable unit that fires gaseous and/or liquid fuel. The meter shall be used to demonstrate that each unit operates at or below the applicable emission limitation.
- 8.2** Meters shall be accurate to  $\pm 1\%$  as certified by the manufacturer in writing. Meter readings and higher heating value shall be recorded at the end of each operating day in units of either cubic feet per day or gallons per day. At the end of each quarter, daily records shall be compiled into a quarterly report. Both quarterly reports and daily records shall be maintained for a period of four (4) years and shall be made available for inspection by the APCO upon request.
- 8.3** Any person subject to the provisions of Section 5.1 who fires a solid fuel in an applicable unit shall provide a means of calculating or verifying fuel input to the unit in lbs/hr that is acceptable to the APCO for purposes of documenting compliance with the specified emission limit.

## **9 TUNING PROCEDURE<sup>1</sup> FOR MECHANICAL DRAFT BOILERS, STEAM GENERATORS AND PROCESS HEATERS:** Nothing in this Tuning Procedure shall be construed to require any act or omission that would result in unsafe conditions that would be in violation of any regulation or requirement established by the Factory Manual, 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.

- 9.1** 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.
- 9.2** At this firing rate, record stack gas temperature, oxygen concentration, and CO concentration (for gaseous fuels) or smoke-spot number<sup>2</sup> (for liquid

---

<sup>1</sup> This tuning procedure is based on a tune-up procedure developed by KVB, Inc. for EPA.

<sup>2</sup> The smoke-spot number can be determined with the ASTM Test Method D-2156 or with the Bacharach methods. The Bacharach method is included in a tune-up kit that can be

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<sup>3</sup>, 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.

- 9.3** Increase combustion airflow to the unit until stack gas oxygen levels increase by 1-2% over the level measured in Step 9.2 above. As in Step 9.2, 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.
- 9.4** Decrease combustion airflow until the stack gas oxygen concentration is at the level measured in Step 9.2. From this level gradually reduce the combustion airflow in small increments. After each increment, record the stack gas temperature, oxygen concentration, CO concentration (for gaseous fuels) and smoke-spot number (for liquid fuels). Also, observe the flame and record any changes in its condition.
- 9.5** Continue to reduce combustion air flow stepwise, until one of these limits is reached:
- 9.5.1** Unacceptable flame conditions, such as flame impingement on furnace walls or burner parts, excessive flame carryover, or flame instability.
  - 9.5.2** Stack gas CO concentrations greater than 400 ppm.
  - 9.5.3** Smoke at the stack.
  - 9.5.4** Equipment-related limitations, such as low wind-box/unit pressure differential, built in airflow limits, etc.
- 9.6** Develop an oxygen/CO curve (for gaseous fuels) or oxygen/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.
- 9.7** From the curves prepared in Step 9.6 above, find the stack gas oxygen levels where the CO emissions or smoke-spot number equal the following values:

---

**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%

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 levels.

Compare this minimum value of excess oxygen to the expected value provided by the combustion unit manufacturer. If the minimum level found is substantially higher than the value provided by the combustion unit manufacturer, burner adjustments could probably be made to improve fuel and air mix thereby allowing operations with less air.

- 9.8** Add 0.5% to 2% to the minimum excess oxygen level found in Step 9.7 above 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 no repeatability or play in automatic controls.
- 9.9** If the load of the combustion unit varies significantly during normal operation, repeat Steps 9.1 through 9.8 above 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 of firing rates. If one firing rate predominates, settings should optimize conditions at that rate.
- 9.10** 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 9.5 above result, reset the combustion controls to provide a slightly higher level of excess oxygen (O<sub>2</sub>) 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.

**(Refer to Figure 1 and Figure 2)**

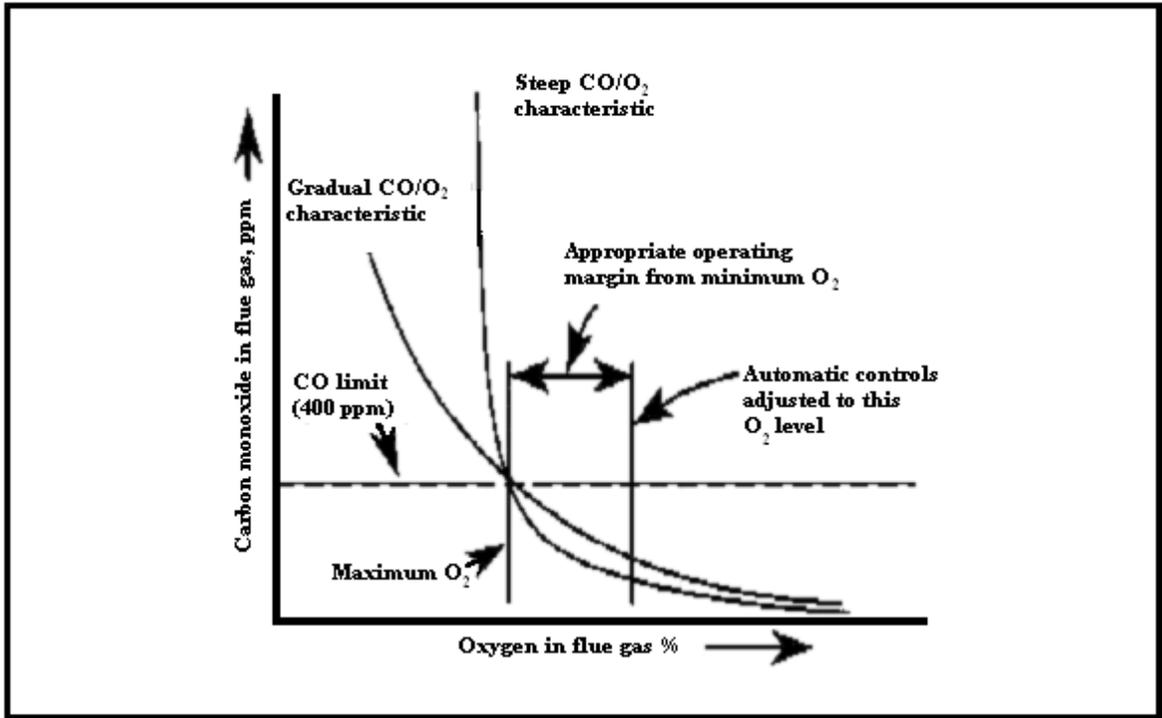


Figure 1: Oxygen/CO Characteristic Curve

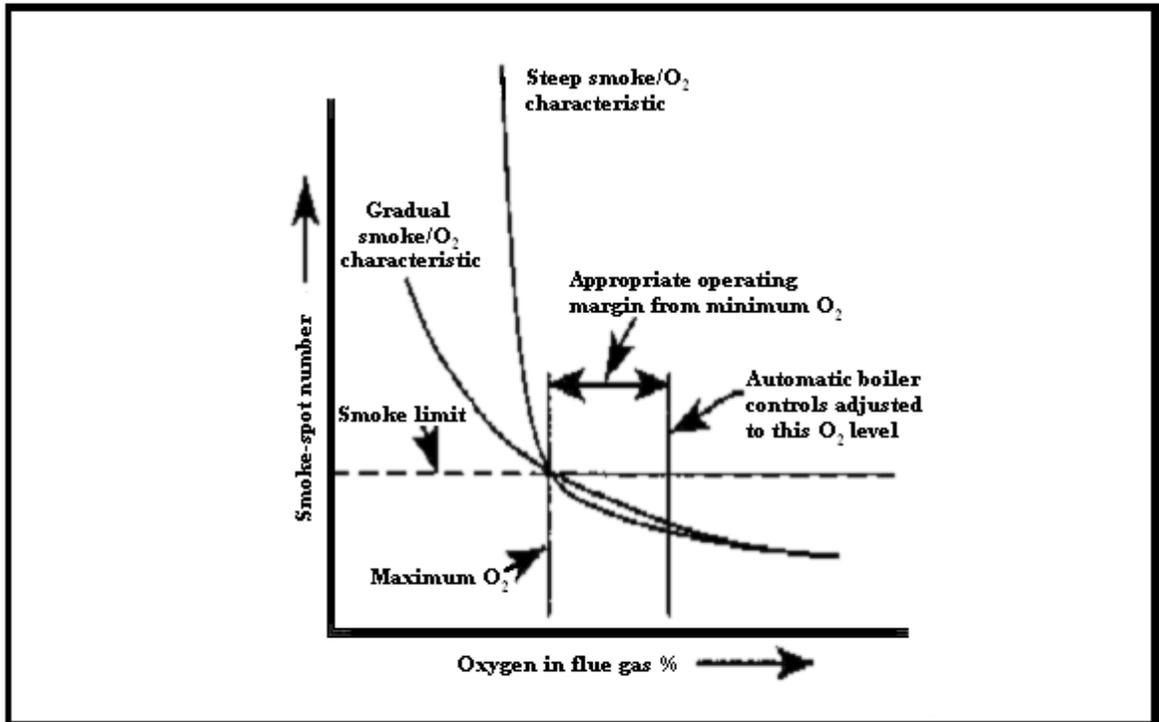


Figure 2: Oxygen/Smoke Characteristic Curve

- 10 TUNING PROCEDURE FOR NATURAL AND INDUCED 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 the Factory Manual, 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.

A different tuning procedure may be used if it produces equivalent results. Should a different tuning procedure be used, a copy of this procedure should be kept with the unit records for two (2) years and made available to the DISTRICT on request.

**10.1 Preliminary Analysis**

- 10.1.1** 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 tune-up.
- 10.1.2** Verify that the unit operates for the minimum number of hours and days necessary to perform the work required.
- 10.1.3** 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 airflow must be unrestricted.
- 10.1.4** Verify that the vent is in good condition, properly sized, and free from obstruction.
- 10.1.5** Perform a combustion analysis (CO, O<sub>2</sub>, etc.) with a warmed up boiler, steam generator or heater at both high and low fire, if possible. Record all data, as well as the following:
- 10.1.5.1** Inlet fuel pressure at burner at high and low firing rates.
- 10.1.5.2** Pressure above draft hood or barometric damper at high, medium and low firing rates.
- 10.1.5.3** Steam pressure, water temperature, or process fluid pressure or temperature entering and leaving the unit.
- 10.1.5.4** Inlet fuel use rate if meter is available.
- 10.1.5.5** Check thermal insulation. Check condition of, or absence of, appropriate insulation on all steam, hot water or process pipes, return tank, heat exchangers, storage tanks, etc. Lack of adequate thermal insulation will significantly increase fuel usage.

**10.2 Checks and Corrections**

- 10.2.1** 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.
- 10.2.2** Remove external and internal sediment and scale from heating surfaces.
  - 10.2.3** Verify that the necessary water or process fluid treatment is being used. Confirm flushing and/or blow-down schedule.
  - 10.2.4** 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.
- 10.3 Safety Checks**
- 10.3.1** Test primary and secondary low water level controls.
  - 10.3.2** Check operating and limit pressure and temperature controls.
  - 10.3.3** Check pilot safety shut-off operation.
  - 10.3.4** Check safety valve pressure and capacity setting and verify that the setting and capacity are consistent with unit load requirements.
  - 10.3.5** Check limit safety control and spill switch.
- 10.4 Adjustments:** Perform the following checks and adjustments on a warm unit at high fire:
- 10.4.1** Adjust unit to fire at the maximum inlet fuel use rate; record fuel manifold pressure
  - 10.4.2** Adjust draft and/or fuel pressure to obtain acceptable, clean combustion at high, medium and low firing rates. The CO value should not exceed 400 ppm at 3% oxygen.
  - 10.4.3** 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 manufacturers instructions.
  - 10.4.4** 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.
- 10.5 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:
- 10.5.1** Inlet fuel pressure at burner at high and low firing rates.
  - 10.5.2** Pressure above draft hood or barometric damper at high, medium and low firing rates.
  - 10.5.3** Steam pressure, water temperature, or process fluid pressure or temperature entering and leaving the unit.
  - 10.5.4** Inlet fuel use rate if meter is available.