**Rule 3.21** INDUSTRIAL, INSTITUTIONAL, AND COMMERCIAL BOILERS, STEAM GENERATORS, AND PROCESS HEATERS (Adopted: 6/05/2006)

**A. APPLICABILITY**

This rule applies to boilers, steam generators, and process heaters having the heat input capacities greater than or equal to 1 million BTU per hour (MMBTU/hr), used in all industrial, institutional, and commercial operations.

**B. EXEMPTIONS**

B.1 The requirements of Section D of this Rule shall not apply to the units with a rated heat input greater than or equal to 1 MMBtu/hr but less than 5 MMBtu/hr which are willing to accept permit conditions that restricts operation to less than 90,000 therms of annual heat inputs.

a. To continue to qualify for the exemption provided in Section B.1, the owner or operator of any applicable unit(s) shall submit to the Air Pollution Control Officer (APCO) annual fuel use data and/or annual hours of operation that will demonstrate the unit(s) to have an annual heat inputs of less than 90,000 therms.

b. Following the adoption of this rule, an exemption granted for any unit will become null and void, and in violation of this rule if the unit have an annual heat inputs more than or equal to 90,000 therms.

**C. DEFINITIONS**

C.1 Annual Heat Input: The total heat input of fuels burned by a unit in a calendar, as determined from the fuel's HHV and cumulative annual usage of each fuel or cumulative hours of operation.

C.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 any unit that is used exclusively to produce electricity for sale, any waste heat recovery boiler that is used to recover sensible heat from exhaust of combustion or a combustion turbine, nor does it include equipment associated with a chemical recovery cycle.

C.3 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.

C.4 Commercial/Institutional Boiler: A boiler used to provide steam and/or hot water which is used in commercial or institutional establishments including but not limited to hospitals, research centers, educational facilities, hotels, dormitories, or laundries.

C.5 Gaseous Fuel: Any fuel which is a gas at standard conditions.

C.6 Gas-Fired: Using natural gas, propane, or any other gaseous fuel for firing the boiler or steam generator.

C.7 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.

C.8 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.

C.9 Industrial Boilers: A boiler used in manufacturing, processing, mining, refining and any other industries, where it provides steam, and/or hot water.

C.10 Modification: Any physical change or operational change to an exiting emission unit, including a change in hours of operation or production rate which would necessitate a change in permit conditions. (Also defined in Rule 10.1)

C.11 North FRAQMD: The area of the Feather River Air Quality Management District which is north of a line connecting the northern border of Yolo County to the Southwestern tip of Yuba County, and continuing along the Southern Yuba County border to Placer County. (Also defined in Rule 10.1)

C.12 NOx Emissions: The sum of nitric oxides (NO) and nitrogen dioxide ($NO_2$) in the flue gas.

C.13 Nongaseous Fuel: Any fuel which is not a gas at standard conditions.

C.14 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.

C.15 Process Heater: Any combustion equipment fired with any fuel, and which transfers heat from combustion gases to heat 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.

C.16 Rated Heat Input Capacity: The heat input capacity, in million BTU per hour (MMBTU/hr), 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.

C.17 Sacramento Federal Non-attainment Area (SFNA)for Ozone: The area defined in 40CFR Section 81.305 for the Sacramento Metro Area. (Also defined in Rule 10.1)

C.18 Standard Conditions: 68°F and one atmosphere.

C.19 Therm: One hundred thousand (100,000) BTU.

C.20 Unit: Any boiler, steam generator or process heater as defined in Sections C.2 and C.15 of this rule.

**D. REQUIREMENTS**

D.1 No later than one (1) year following District adoption of this Rule, the owner or operator of any unit(s) under his/her control with a rated heat input capacity less than 5 MMBTU/hr but greater than or equal to 1 MMBTU/hr and an annual heat input greater than or equal to 90,000 therms shall submit an application and a list of all operating units to the District. The owner or operator of the unit also shall select one of the following four options to be added as a permit condition to the Permit to Operate for each unit, in order to achieve compliance with this Rule. All new or modified units shall also comply with the requirements of District Rule 10.1, New Source Review. The options are:

a. Operate in a manner that maintains stack gas oxygen concentrations at less than or equal to 3% by volume on dry basis for at a minimum of fifteen (15) consecutive minute averaging period. The averages shall be calculated from no less than five data set, recorded from a samplings on interval of no greater than three minutes; or

b. 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

c. Tune the unit at least once per year by a qualified technician to perform a tune-up in accordance with the procedure described in Attachment 1. The owner/operator of any unit(s) is required to submit an annual report verifying

that the tune-up has been performed with satisfactory results in accordance to procedures described in Attachment 1. The report shall contain any other information or documentation that the APCO determines to be necessary; or

d. Operate in compliance with the emission limits specified in Table 1 of this Rule.

D.2 No later than one (1) year following District adoption of this Rule, all units with a rated heat input capacity greater than or equal to 5 MMBTU/hr and an annual heat inputs less than 90,000 therms shall select one of the following four options in sections D.1.a-D.1.d to be added as a permit condition to the Permit to Operate for each unit, in order to achieve compliance with this Rule. All new or modified units shall also comply with the requirements of District Rule 10.1, New Source Review.

D.3 No later than one (1) year following District adoption of this Rule, all units with a rated heat input capacity greater than or equal to 5 MMBTU/hr and annual heat inputs greater than or equal to 90,000 therms shall demonstrate compliance with the following emission limits dependent upon the area of non-attainment and specific fuel fired in the unit as shown in Table 1. All new or modified units shall meet the emission limits shown in Table 1 and comply with the requirements of District Rule 10.1, New Source Review.

**Table 1. EMISSION LIMITATIONS FOR NOx**

| | **Type of Fuel Used** | | |
|---|---|---|---|
| | **Only Gaseous Fuel Firing Units** | **Gaseous & Non-Gaseous Fuel Co-Firing Units** | **Non-Gaseous Firing Units** |
| **North Portion of FRAQMD Emission Limits** | 0.08 lbs/MMBTU or 70 ppmv @ 3% $O_2$ | *Heat Input Weighted Average Fuel Limits | 0.15 lbs/MMBTU or 115 ppmv @ 3% $O_2$ |
| **SFNA Portion of FRAQMD Emission Limits** | 0.036 lbs/MMBTU or 30 ppmv @ 3% $O_2$ | *Heat Input Weighted Average Fuel Limits | 0.052 lbs/MMBTU or 40 ppmv @ 3% $O_2$ |

*The weighted average shall be calculated as follows:

$$\text{Emission} = \frac{(x * X) + (y * Y)}{(X + Y)}$$

Where x = emission limit for gaseous fuel

y = emission limit for non-gaseous fuel
X = heat input of the gaseous fuel
Y = heat input of the non-gaseous fuel.

D.4 Emissions from units subject to D.3 shall not exceed a carbon monoxide (CO) concentration of 400 ppm corrected to 3% oxygen ($O_2$) by volume when using only a gaseous or a combination of gaseous and liquid fuels. Solid fuel-fired units shall not exceed CO limits expressed in the Permit to Operate.

D.5 No person shall allow the discharge of ammonia (NH3)emissions in excess of 20 ppmv at dry stack conditions adjusted to 3% oxygen into the atmosphere from any emission control devices.

**E. EQUIPMENT REQUIREMENT**

E.1 Any persons subject to the provisions of Section B and Section D of this Rule shall install one of the following no later than one (1) year following District adoption of this Rule:

a. A totalizing fuel meter. Fuel meters shall be installed to cumulatively record the total fuel used. Fuel meters shall be accurate to ±1% as certified in writing by the manufacturer and the fuel consumption for each unit shall be compiled monthly into a rolling twelve calendar month report , or;
b. A non-resettable hour meter. Hour meter shall be installed with 9,999 non-resettable display capacity and the hours of operation shall be compiled monthly into a rolling twelve calendar month.

A meter shall be installed for each applicable unit that fires gaseous and/or liquid fuel and shall be used to demonstrate compliance of the Permit to Operate, validate the exemption, and/or track annual emissions.

E.2 Any person who operates a unit rated less 5 MMBtu/hr but greater than or equal to 1 MMBtu/hr or a unit rated at or greater than 5 MMBtu/hr with annual heat inputs of less than 90,000 therms who selects the option D.1.b shall install an Oxygen Trim System. The Oxygen Trim System shall be set accordingly to the requirements in section D.1.b and all related conditions on the Permit to Operate.

**F. COMPLIANCE DETERMINATION**

F.1 Initial Compliance: All existing, modified, or new units subject to meet requirements of Table 1 or section D.1.a of this rule shall demonstrate initial compliance. Initial compliance can be achieved by conducting a source test on a unit. All units shall be

tested using the appropriate test method specified in Section G.

F.2 Compliance Demonstration: All owners or operators of any unit subject to meet the emission limits listed in Table 1 or section D.1.a shall demonstrate compliance once every 8,760 hours of operation, or once every two calendar years; whichever occurs more frequently. All units shall be tested using the appropriate test method specified in Section G.

F.3 Emission Determination: All emission determinations shall be made in the as-found operating conditions, except that emission determinations shall include, at a minimum, one source test 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 thirty (30) minutes or longer.

F.4 Emission Concentration: All ppmv emission limits specified in Table 1 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 (O2) as follows:

$$[\text{ppm}]\ \text{corrected} = \frac{20.95\% - 3.00\%}{20.95\% - [\%O2]\ \text{measured}} * [\text{ppm}]\ \text{measured}$$

F.5 Emission Averaging: All emission concentrations and emission rates shall be based on 15-consecutive-minute averaging periods. The averages shall be calculated from no less than five data sets, recorded from samplings on intervals of no greater than three minutes.

F.6 Continuous Emission Monitoring: All units using continuous emission monitoring system to obtain data such as emission concentrations and emission rates shall utilize the test methods specified in Section G, Test Methods.

## G. TEST METHODS

G.1 Compliance with the emission requirements in Table 1 shall be determined using the following test methods:

a. Oxides of Nitrogen – EPA Method 7E or CARB Method 100
b. Carbon Monoxide – EPA Method 10 or CARB Method 100
c. Stack Gas Oxygen – EPA Method 3A or CARB Method 100
d. NOx Emission Rate (Heat Input Basis) – EPA Method 19

e. If certification of the higher heating value of the fuel is not provided by a third party fuel supplier, it shall be determined by EPA Method 19.

G.2 For determination of the NH3 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.)

**H. RECORDKEEPING REQUIREMENTS**

H.1 To assure compliance with this rule, the facility shall maintain records for a period of three (3) years and shall be made available for inspection by any authorized personnel upon request. The facility shall maintain the following information:

a. The monthly hours of operation or quantity of fuel consumed for each unit, and;
b. At the end of each calendar year, the facility shall compile a month-to-month report of the unit's total operation i.e. fuel usage or hours of operation, and;
c. A maintenance or testing log which includes but not limited to tune-up verification and source test results to verify compliance.

H.2 The APCO may include additional recordkeeping requirements to assure compliance of this rule for each unit.

H.3 Any person subject to the provisions of Section D.3 and D.4 who fires 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 limits.

**ATTACHMENT 1**

**Tuning Procedure**

General: Nothing in the tuning procedures** 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.

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

A. Procedures for tuning mechanical draft boilers, steam generators, and process heaters:

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.

2) At the firing rate established in Section A.1, record stack-gas temperatures, oxygen concentration, and CO concentration (for gaseous fuels) or smoke-spot number(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 values, 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.

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

   b) Typical minimum oxygen levels for units at high firing rates are:

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

3) Increase combustion air flow until the stack-gas oxygen levels increase by one or two percent over the level measured in Section A.2. As in Section A.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.

4) Decrease combustion air flow until the stack-gas oxygen is at the level measured in Section A.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 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;
   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.

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.

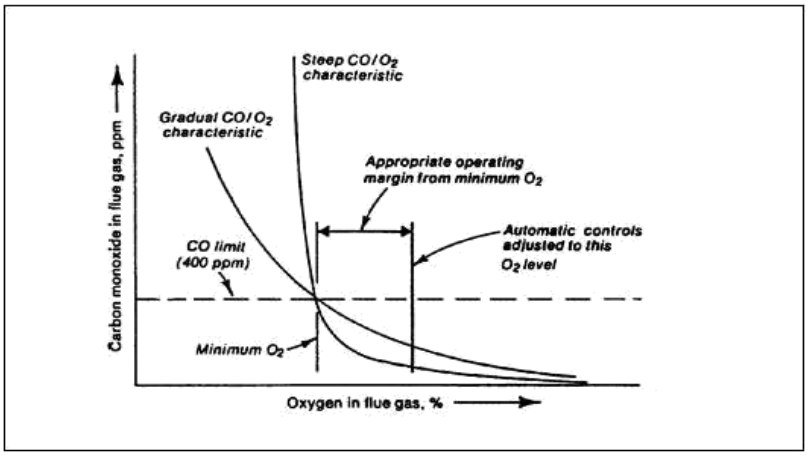


**Figure 1** Oxygen/CO Characteristic Curve
(Source: KVB Inc.)

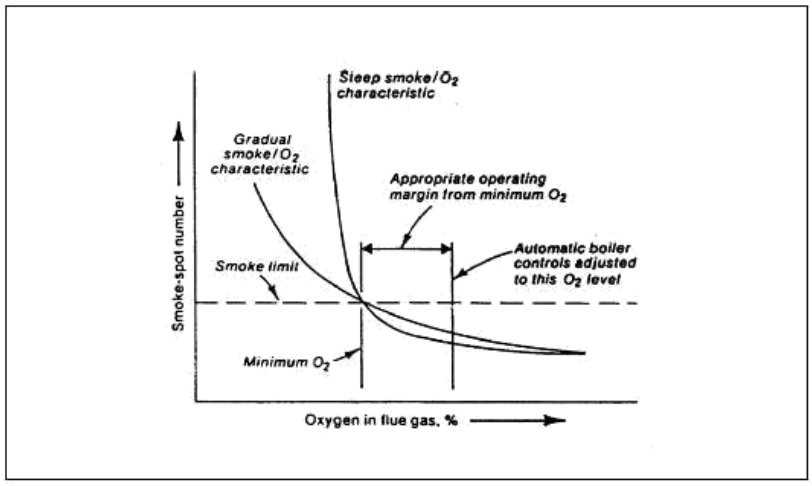


**Figure 2** Oxygen/Smoke Characteristic Curve
(Source: KVB Inc.)

7) From the curves prepared in Section A.6, find the stack-gas oxygen levels where the CO emissions or smoke-spot number equal the following values:

| **Fuel** | **Measurement** | **Value** |
|---|---|---|
| Gaseous | CO Emissions | 400 PPM |
| #1 & #2 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-spot 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 manufacturer, burner adjustments can probably be made to improve fuel and air mix, thereby allowing operations with less air.

8) Add 0.5 to 2.0 percent to the minimum excess oxygen level found in Section A.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 non-repeatability or play in automatic controls

9) If the load of the combustion unit varies significantly during normal operation, repeat Sections A.1-A.8 for the 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 the best performance over the range of the firing rates. If one firing rate predominates, the setting should optimize the 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 Section A.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.

B. Procedures for tuning natural and induced draft boilers, steam generators, and process heaters.

1) Preliminary Analysis

a) Check the Operating Pressure or Temperature. Operate the boiler, steam generator, or process 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 tune-up.

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.

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) 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.

f) Combustion Analysis. Perform an "as is" flue gas analysis (O2, CO, CO2, etc.) with a warmed up boiler steam generator, or heater at high and low fire. In addition to data obtained from combustion analysis, also record the following:

1) Inlet fuel pressure at burner (at high and low fire)
2) Draft above draft hood or barometric damper
   a. Draft hood: high, medium, and low
   b. Barometric damper: high, medium, and low
   c. Steam pressure, water temperature, or process fluid pressure or temperature entering and leaving the boiler, steam generator, or process heater.
   d. Unit rate if meter is available.

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

2) Checks and 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 and Heat transfer Surfaces. External and internal build-up of sediment and scale of the heating surfaces creates an insulating effect that quickly reduces unit efficiency. Excessive fuel cost will result if units are not kept clean. Clean tube surfaces, remove scale and soot, and assure proper fluid 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 safety valve pressure and capacity to meet boiler, steam generator, or process heater requirements.

d) Check limit safety control and spill switch.

e) Check pilot safety shut-off operation.

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 rated capacity, record fuel manifold pressure.

b) Adjust draft and/or fuel pressure to obtain acceptable, clean combustion at high, medium and low fire. Carbon monoxide value should always be below 400 ppm at 3% O2. 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 manufacturer's instructions and maintenance manuals.

c) Check and adjust operation of modulation controller. Ensure proper, efficient, and clean combustion through the 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. 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 tune-up was performed.