Model CCO 5500
Carbon Monoxide (CO) Analyzer
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Why Measure Carbon Monoxide (CO)?
Why Measure CO?

- Boiler operating costs are reduced with the aid of a continuous carbon monoxide (CO) measurement.
- CO measurement opens your viewing window to the boiler’s or heater’s combustion performance.
- Attempts to reduce NOx by reducing available oxygen can also potentially increase unburned fuels.
- An increasing CO reading while the flue gas O2 is being controlled at its setpoint means the burners need maintenance; combustion efficiency is on the decrease and fuel usage is on the increase.
**Burner Problem Indication**

- O$_2$ at 7 to 6%
- CO over 900PPM
Why Measure CO?

- When boiler/burner defects are not immediately detected, hundreds to thousands of dollars a day are wasted through increased fuel usage and heat loss.
- A minimum O2 setpoint for the oxygen trim controller can only be determined by measuring CO in the flue gases.
- The CO measurement is essential in larger combustion processes because inefficient combustion results in large and expensive fuel losses.
- Automatic CO/O2 trim control is made possible with the installation of an in situ CO analyzer.
Minimum O2 Setpoint

O2, CO x 100PPM

ROSEMOUNT®
Analytical

EMERSON.
Process Management
Application Advantages

- The continuous measurement of CO can save hundreds to thousands of dollars per day because the boiler’s air/fuel ratio can be set to lower fuel consumption and heat loss.

- Peak boiler efficiency is obtainable when operators are able to adjust the O2 trim controller setpoint to a lower yet safe operating level.
CO/O2 Relationship

- Steep CO/O₂ Characteristic
- Gradual CO/O₂ Characteristic
- Appropriate Operating Margin from Minimum O₂
- CO Limit (400 ppm typical)
- Minimum O₂
- Automatic Boiler Controls Adjusted to this O₂ Level

CO IN FLUE GAS -- PPM

OXYGEN IN FLUE GAS -- %
**Application Advantages**

- Boiler/burner maintenance is easily determined when critical combustion measurements are a part of continuously recorded data.

- CO measurement is added assurance of boiler safety. A high CO alarm can be set to alert the operator of changing conditions.
Application Advantages

- A high CO warning is especially critical on heaters with multiple burners because the failure of any burner is quickly detected when the CO reading suddenly increases.

- Automatic CO trim controllers require only one setpoint level, regardless of boiler loads and different fuels. Unlike oxygen trim controllers, setpoint characterization is not required with CO trim control.
Model CCO 5500 Carbon Monoxide (CO) Analyzer
In Situ CO Analysis

Typical Installation

Theory of Operation

Infrared absorption spectroscopy is used to continuously measure CO concentration in combustion flue gases. The infrared source is mounted directly on the flue gas duct or stack on the side opposite from the receiver. Infrared energy is radiated by the source, through the flue gas, to the receiver. The receiver employs gas filter correlation and narrow band pass optical filtration with a solid state detector to determine the absorption of radiation by CO in the flue gas.
Theory of Operation

→ IR Absorption
Model CCO 5500 Principles of Operation

- The Model CCO 5500 uses infrared absorption spectroscopy to continuously measure CO concentration in combustion flue gases.
- The infrared source is mounted directly on the flue gas duct or stack on the side opposite from the receiver.
- Infrared energy is radiated by the source, through the flue gas, to the receiver.
- The receiver employs gas filter correlation and narrow bandpass optical filtration with a solid state detector to determine the absorption of radiation by CO in the flue gas.
Model CCO 5500 Principles of Operation

- Infrared energy, radiated by the source, passes through the flue gas where a portion of the energy is absorbed by any CO present.

- The remaining energy passes through the receiver window, focusing lens and, alternately, through two gas cells.

- These two cells, one filled with CO and the other with nitrogen, are inserted alternately in the optical path at a fixed frequency.
Model CCO 5500 Principles of Operation

- Energy at the wavelengths of interest is fully absorbed in the CO reference cell.
- However, energy is transmitted through the nitrogen cell without further absorption.
- After passing through the narrow band pass filter, the remaining energy impinges upon the detector.
Model CCO 5500 Principles of Operation

- Two energy levels are sensed alternately by the detector:
  1. source radiation reduced by the flue gas and reference cell CO
  2. source radiation reduced by flue gas CO only
- The resulting signals are ratioed and compared with the ratioed signals developed under zero CO calibration conditions.
- The comparative difference in ratios is used to compute flue gas CO concentration.
**In Situ CO Analysis**

- IR Spectroscopy- Specific to the CO molecule
  - Across the stack (averaging), short dual path, or extractive (point measurement)
  - Minimally affected by O₂ infiltration- dilution, only
  - Very sensitive- expect an active signal
  - Temperature limited ~ 1000° F
  - Across the stack:
    - Average, only. No burner diagnostic component
    - Heavy particulate streams are a problem
    - Requires purge air to keep optics clean, and for cooling
    - Maximum path length is 26’
Key Features

- Minimum Range of 200 PPM
  - better signal resolution for CO/O2 control
  - maximum range of 10,000 PPM

- Digital Communications
  - improved signal integrity
  - 3 conductor cable - lower installation costs
**Key Features**

- Non-cooled, Pyroelectric Detector
  - operates at ambient temperatures
  - stable, drift-free performance
  - eliminates maintenance required with thermoelectric cooling systems used with competitive lead selenide detectors

- Long life Kanthal Infrared Source
Model CCO 5500 Setup Advantages

- The calibration source and span calibration cell are inserted into the optical path during zero and span calibration of the instrument.

- The infrared source design contains no focusing optics, eliminating vibration sensitivity and precise alignment procedures.
Model CCO 5500 Setup Convenience

- The Model CCO 5500 microprocessor-based control module provides the operator with convenient access to all functions of the CO analyzer.
- The simple 2 key, dual-function keyboard allows the user to input all variable operating parameters.
- It also provides instant, single keystroke access to all normally used functions without the need for specialized training.
Model CCO 5500 Setup Advantages

- All computational and diagnostic routines are completely microprocessor controlled.
- Digital display of source intensity during set up. Eliminates need for sophisticated tools.
Model CCO 5500 Maintenance Advantages

- No routine maintenance is required.
- Diagnostic routines include daily automatic zero and span calibration.
- Diagnostics are so comprehensive that they will alert the operator to preventive maintenance requirements.
- Continuous microprocessor self-interrogation of memory/software, and hardware/mechanical functioning status.
- Computational routines include: carbon monoxide concentration in PPM, optical path length compensation, automatic compensation for flue gas temperature.
- All measured data, operating parameters and fault or error conditions are indicated on the easy-to-read LCD display.
- In the event of a disabling fault or error condition, the Model CCO 5500 will automatically hold the output at the last valid measured CO value.
How the Model CCO 5500 Will Benefit Customers

- Using the Model CCO 5500 to continuously measure CO can save hundreds to thousands of dollars per day because the boiler’s air/fuel ratio can be set to lower fuel consumption and heat loss.

- Continuous recording of critical combustion measurements can pinpoint needed boiler/burner maintenance.

- CO measurements from the Model CCO 5500 are an added assurance of boiler safety. A high CO alarm alerts the operator to changing conditions.

- A high CO warning is especially critical on heaters with multiple burners. The failure of any burner is quickly detected when the CO reading suddenly increases.
How the Model CCO 5500 Will Benefit Customers

- Peak boiler operating efficiency is obtainable when operators are able to adjust the O2 trim controller setpoint to a lower yet safe operating level.

- The CO measurement provided by the Model CCO 5500 can be used with a CO trim controller. The setpoint for this CO trim controller is set at one level, regardless of boiler load or fuel used.
Installation Consideration
Who Buys CO Analyzers?

- Chemical industry - power/steam boilers
- Refinery industry - process heaters
- Utility industry - power generation
- Pulp & Paper industry - power/steam boilers
- Steel industry - furnaces