

CO Hot Pot™, Model 1 ***A Calibrated Tool for the Standardized Testing of Carbon Monoxide Emissions from Gas Range Top Burners***

The CO Hot Pot is a calibrated device which allows repeatable and standardized measurement of carbon monoxide (CO) and other emissions from gas range-top burners. The CO Hot Pot is used in conjunction with a CO measuring meter, such as the PCA 25, manufactured by Bacharach. Meters such as the PCA 25 measure CO in units of parts per million (ppm), air-free and as-measured.

Carbon monoxide emissions are easy to measure from all combustion appliances except gas range-top burners. This is because all combustion appliances other than gas range-top burners have an emissions-containing device, e.g., the vent pipe of a gas or oil furnace, the vent pipe of a gas dryer, and the vent port of a gas oven. However, a gas range-top burner is an open flame without a vent pipe or port to contain the combustion emissions, thus making it difficult to sample and measure CO with any degree of accuracy. The CO Hot Pot solves this problem.

The CO Hot Pot is set on the burner grate of the gas range-top burner. The steel probe of the CO measuring meter is inserted into the hole in the side of the CO Hot Pot and then through the eye of the eye bolt at the center of the housing. The CO measuring meter is turned on and then the gas burner is ignited. The CO Hot Pot directs the combustion emissions upward past the gas-intake end of the steel probe of the CO meter. The CO Hot Pot contains the emissions in the same manner as the vent pipe on a gas furnace. The stainless steel pot at the bottom of the CO Hot Pot (sitting on the burner grate) allows the gas flame to impinge upon it, thus simulating a cooking pot. The stainless steel pot at the bottom of the CO Hot Pot may be filled with water for the test (wet-test) or may be left empty (dry-test). Tests at the Gas Research Institute laboratory indicated that the dry-test measurements more closely correlate with the ambient CO concentrations.¹

The CO Hot Pot can also be used to measure the "air-free" CO emissions from a gas range-top burner. To do this, a CO sample of the emissions is taken with the CO Hot Pot and an oxygen (O₂) or carbon dioxide (CO₂) sample is taken from the same emissions. The CO sample is then adjusted to simulate oxygen-free conditions (no excess air). The equations used for this adjustment are:

For all fuels, using measured CO and O₂:

$$(1.1) \quad \text{CO}_{\text{AFppm}} = \frac{20.9}{20.9 - \text{O}_2} \times \text{CO}_{\text{ppm}}$$

For propane (LPG), using measured CO and CO₂:

$$(1.2) \quad \text{CO}_{\text{AFppm}} = \frac{14}{\text{CO}_2} \times \text{CO}_{\text{ppm}}$$

For natural gas, using measured CO and CO₂:

$$(1.3) \quad \text{CO}_{\text{AFppm}} = \frac{12.2}{\text{CO}_2} \times \text{CO}_{\text{ppm}}$$

¹ R. Karg was able to use the GRI laboratory house in Park Ridge, Illinois, from May 30 to June 1, 2001. GARD Analytics provided a laboratory technician to assist Karg for the testing of five methods of measuring CO emissions from gas range top burners. The CO Hot Pot, Model 1 was found to be the device exhibiting the best correlation between CO measured at the burner and ambient CO concentrations. This testing was completed as part of the research for the development of the [Proposed Field Protocol for Gas Range Carbon Monoxide Emissions Testing](#). Funding for this testing was provided by the Gas Research Institute of Des Plaines, Illinois, through GARD Analytics of Park Ridge, Illinois and WEC Consulting of Potomac, Maryland.

Where:

CO_{AFppm} = Carbon monoxide, air-free ppm.

CO_{ppm} = Measured combustion gas carbon monoxide ppm.

O_2 = Percentage of oxygen in combustion gas, as a percentage.

CO_2 = Percentage of carbon dioxide in combustion gas, as a percentage.

Some test instruments, such as the Bacharach PCA 25, test for CO and O_2 simultaneously. A computer chip in the device uses the CO and the O_2 readings to calculate and then display the air-free ppm level of CO. These air-free measurement devices save time and promote accuracy.

Instructions for Use of the CO Hot Pot on Gas Range-Top Burners

- Test the range-top burners before the gas oven is turned on for testing.
- All testing shall be done with the burner grates in place. If any burner grates are missing, they must be replaced before carbon monoxide testing is done.
- Range-top burner testing shall be performed with the Co Hot Pot, a calibrated tool for the standardized testing of carbon monoxide emissions from gas range burners. The Co Hot Pot tester shall not be filled with water for the testing (dry test).
- Heat the Co Hot Pot on one of the burners until sections of the stainless steel pan resting on the burner grate are red-hot. The purpose is to heat up the tester so that the temperature of the tester will be approximately the same for the first burner tested as for the last burner tested. The temperature of the tester affects the carbon monoxide reading.
- Turn the burner off.
- Without delay, move the Co Hot Pot to the first burner to be tested. Center the tester on the burner grate, insert the probe of the carbon monoxide tester in the hole in the side of the CO Hot Pot, and then through the eye of the eye bolt at the center of the Co Hot Pot housing. The probe should extend about one-half inch beyond the eye of the eye bolt.
- Take care not to burn you hands or parts of the carbon monoxide tester on hot parts of the range top or Co Hot Pot.
- Watch the carbon monoxide ppm reading. It will rise and then start to fall. When it stops falling and stabilizes (the stabilized low level), record the reading. Another option is to wait six minutes before recording the measurement.
- Move the Co Hot Pot to the next burner. Center the Co Hot Pot over the next burner, insert the probe of the carbon monoxide tester and turn on the burner. Record the reading as instructed above.
- Continue this procedure until all the burners have been tested.
- The carbon monoxide reading must be 35 ppm as-measured or less at the stabilized level, measured with the calibrated Co Hot Pot (dry test).
- If any of the range-top burners have carbon monoxide readings of more than 35 ppm air-free, delay any building tightening work until appliance is adjusted and producing 35 ppm air-free or less of carbon monoxide.
- Make certain the CO Hot Pot is cool to the touch before placing in back into the copolymer carrying case.
- Proceed with the testing of the gas oven.

Gas Ovens Testing (please refer to www.karg.com/rangeprotocol.htm for oven testing instructions)

Glossary

Air-Free. Measurement of CO that accounts for the amount of excess air by incorporating an adjustment to the as-measured ppm value, thus simulating air-free (oxygen-free) conditions in the combustion gases. To do this, a reading of oxygen (O_2) or carbon dioxide (CO_2) percentage is taken from the combustion gases along with the as-measured CO reading. This can be done with a meter having the capability of measuring CO and O_2 or CO_2 percentage, or it can be done with two different meters, one measuring CO ppm and one measuring O_2 or CO_2 percentage.

As-Measured. Measurement of CO taken with no concern for the amount of excess air (oxygen) diluting the CO concentrations.

Dry Range-Burner Test. A carbon monoxide emissions test of a gas range-top burner using an empty pan resting on the grate of the burner, above the gas flame. The Co Hot Pot made by WxWare Diagnostics is useful for performing a dry range burner test. Contrast this to Wet Range Burner Test. A dry test usually emits lower concentrations of carbon monoxide than a wet range burner test because the relatively hot pan surfaces quench (cool) the impinging gas flame to a lesser degree. Use caution when performing a dry range burner test; the pan surfaces can reach temperatures above 1000oF. This can cause severe burns and ruin metal pans.

Emissions-Containing Device. Any device that contains the emissions from combustion in a manner that allows the accurate measurement of the emissions. Examples are vent connectors on combustion heating systems, gas dryer exhaust vents, and gas oven vent ports.

Peak Level. Carbon monoxide emission from a combustion appliance that have reached a maximum level during any one emissions test. Emissions usually rise just after the combustion process in a combustion appliance begins. A peak level is reached, then the emissions begin to fall, and eventually they reach a stabilized low level.

ppm. Parts per million. 1,000,000 is equal to 100% concentration by volume, 100,000 is equal to 10%, 10,000 ppm is equal to 1%. 200 ppm is equal to 0.02%, 35 ppm is equal to 0.0035 %, and 9 ppm is equal to 0.0009% concentration by volume.

Stabilized Low Level. Carbon monoxide emissions that have reached a stable low (minimum) level during any one emissions test. Emissions usually rise just after the combustion process in a combustion appliance begins. A peak level is reached, then the emissions begin to fall, and eventually they reach a stabilized low level.

Wet Range-Burner Test. A carbon monoxide emissions test of a gas range-top burner using a water-filled pan resting on the grate of the burner, above the gas flame. The Co Hot Pot made by WxWare Diagnostics is useful for performing a wet range burner test. Contrast this to Dry Range Burner Test. A wet test usually emits high concentrations of carbon monoxide than a dry range burner test because the relatively cool pan surfaces quench (cool) the impinging gas flame to a greater degree.