

Article # 22

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Mysteries and Misconceptions About Measuring Equipment and Procedures for Stack Gas Analysis

The response to issue paper # 21 was very encouraging. Many practical hints were provided and we are in progress of analysing it and making a summary. In this paper I would like to touch upon the first issue of combustion gas analysis, and discuss some of the misconceptions and misunderstandings that are evident.

First, quite a number of replies had the erroneous opinion that CO₂ is measured. In fact it is only calculated in almost all instruments except infrared systems, and the calculated number displayed on the instrument is of no use and relevance as long as the instrument does not know the ultimate chemical analysis of the fuel. Another feature found on many instruments, "calculated efficiency," is also a gimmick that only gives meaningful results if the fuel composition, ambient conditions and stack gas conditions (in particular temperatures), are known and correctly entered.

Another misconception is the accuracy of the calculated combustion efficiency. Displaying a calculated efficiency with an accuracy of two decimal points is simply a bad joke considering the many rough assumptions made. Note, that all measurements are in % volume dry basis. Therefore, the software must be also capable to calculate based on this.

Having used and tested most combustion gas analysis instruments over a span of 20 years, my choice of a mobile instrument is very clear. An instrument that can measure in real time at the same sampling location O₂, CO, stack gas temperature and duct pressure is acceptable from a professional point of view. Anything else throws us back to the 1970's.

Most mobile combustion gas analysis instruments measure O₂ and CO with chemical cells which have a limited life time. Furthermore, the CO cell can be easily poisoned. Therefore, care must be used in their operation. In spite of these drawbacks, these types of instruments provide the best results. All other sensor systems such as Fyrite, Zirconia Oxide, infrared etc. are second choice for mobile energy auditor instrumentation because they are either too inaccurate in the case of Fyrite or measure only % O₂ on a wet basis as in the case of Zirconia Oxide.

When measuring the % O₂ in the stack gas, an energy auditor (as well as the operator) should also observe what happens to the combustion if % O₂ is increased or decreased. One way to check is to also measure what happens to the ppm concentration of CO in the stack gas, or observe soot generation. Adjusting % O₂ to the design value for the design fuel and according to burner specifications without observing ppm concentration of CO is not acceptable and often outright dangerous.

Another important consideration for stack gas measurements is that the stack gas pressure at the point of % O₂ measurement must be known because any sign of negative pressure will alert you that the measuring point may be infiltrated by ambient air and may result in inflated % O₂ readings. Reducing excess air based on this information may result in dangerous by low level of excess air up streams.

Measuring the stack gas and ambient temperatures will give the important ΔT of sensible heat loss and an indication of wrong firing, overload, or fouling of the heat exchanger components in boilers and furnaces.

It is emphasized that under any performance testing code and in particular commissioning it is of paramount importance that measurement of temperature, pressure and stack gas composition must be done at the same point and in real time.