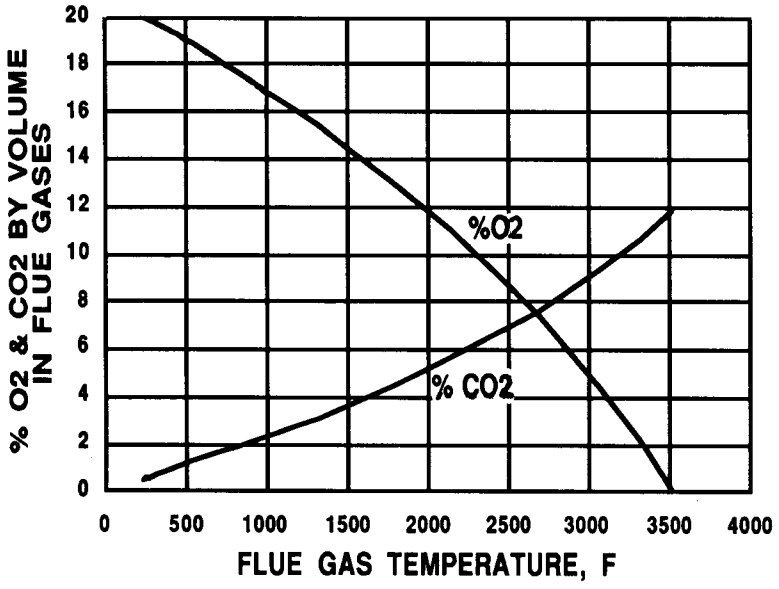
Janus Technology Group's

Foresight & Hindsight No. 1

Janus Tech Fact - % O2 & CO2 vs. Flame Temperature



One of the things that simplifies a day's work is an abundance of handy charts that allow us to avoid tedious calculations. In combustion work, two of the most useful are the Flame Temperature (or Hot Mixture) Chart, which relates the temperature of the combustion gases at the flame tip to percent excess air, and the Flue Gas Analysis Chart, which predicts the percentages of oxygen, CO_2 and other combustion products, also in relation to excess air.

Time after time, we've used the two together, starting with the maximum permitted process temperature to figure out how much excess air the burner needs, and then converting that to an O_2 or CO_2 reading for the benefit of the people starting or tuning up the system.

And time after time, we've grumbled about the inconvenience of using two charts, because nobody seems to have published one that would allow you to go directly from flame temperature to flue gas analysis.

Until now. This graph provides you with the shortcut. In addition to predicting the flue gas constituents that correspond to a certain flame tip temperature, it's also helpful for trouble-shooting sick jobs. Say, for example, you have an oven unable to maintain a process temperature of 1000°F. A flue gas check shows 18% O_2, which corresponds to a flame temperature of only about 900°F. This suggests that either the burner gas-air ratio is set too lean, or there's an excessive amount of makeup or infiltration air entering the oven.

The curves are calculated for Birmingham Natural Gas (1002 Btu/cu ft, 0.6 specific gravity) burned with 60°F combustion air, but will be reasonably accurate for most other natural gas compositions. Flame temperatures are corrected for dissociation. Propane, oil and other fuels require entirely different CO_2 curves, but the oxygen curve will be close.

When using this chart to predict what flue gas analysis to expect, keep in mind that burner flame temperatures must be somewhat higher than the process temperature, or there won't be any heat available for the workload. In addition, normal heat losses in furnaces make it difficult to achieve process temperatures above 3100°F, regardless of what the flame temperature should be.

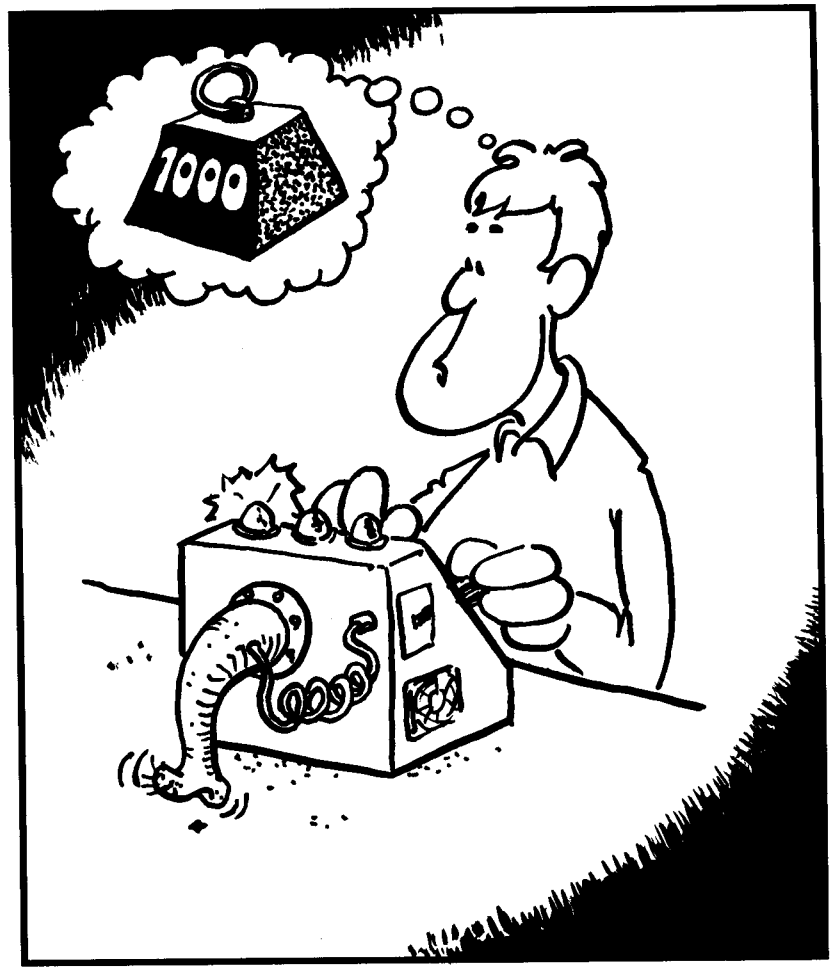
This is due to the fact that the flame begins losing heat to its surroundings before all the fuel has completely burned.

Foresight & Hindsight is published by Janus Technology Group Inc. to share information and discuss issues of interest to the industrial heating and energy technology fields.

Please accept it with our compliments. If you have suggestions for improvement or ideas for future topics, please write us.

Dick Bennett

What You See Is What You (Must) Get



The rationale behind any specification, whether it be a machine tolerance or an air emission standard, is that if the specification is met, the finished product should be satisfactory. Air emission source standards are derived from several factors, but one of the main drivers is the resulting quality of the air in the neighborhood of the source.

Over the years, however, we've observed that if something is difficult to measure, it tends to get ignored. After all, there are so many other, easier-to-measure things to occupy our attention. Twenty years ago, there were no really accurate portable NOx analyzers and few CO or combustibles analyzers that could read accurately below 0.1%. Consequently, when you tuned up a burner, any combustibles reading below 0.1% was "Good enough", and NOx wasn't even mentioned.

Today, several instrument manufacturers are marketing reasonably-priced portable combustion monitors that measure CO, NOx, unburned hydrocarbons and other air contaminants with reasonable accuracy down into sub-100 parts per million range. Suddenly, one-tenth of one percent, which is a hideous-sounding 1000 parts per million in today's terms, will no longer do. We're now capable of measuring emissions at much lower concentrations, and our expectations, in the form of air quality standards, seem be following our enhanced ability to measure.

What we think about this phenomenon really doesn't matter. We should, however, be concerned about its implications for the future. The technology of emissions measurement seems to be advancing at a faster pace than the technology of low emission combustion. In the coming years, will we find ourselves facing air quality standards we're unable to satisfy?

Who's the Two-Faced Guy?

He's Janus, our namesake. Janus was the Roman god of beginnings and endings, as well as the god of portals, and he gave his name to the month of January.

We believe the soundest business decisions result from looking back at our past as well as forward into the future. Old Janus seemed to be doing just that, so we gave him the job of being our logo.

Foresight & Hindsight is published by Janus Technology Group Inc., PO Box 2872, Rockford, IL 61132-2872, Phone 815-282-8044, FAX 815-282-8043, e-mail 104635.1603@compuserve.com. It is distributed free of charge to selected organizations and individuals.