Check Burner Air to Fuel Ratios

Periodic checking and resetting of air-fuel ratios is one of the simplest ways to get maximum efficiency out of fuel-fired process heating equipment such as furnaces, ovens, heaters, and boilers. Most high temperature direct-fired furnaces, radiant tubes, and boilers operate with about 10 to 20 percent excess combustion air at high fire to prevent the formation of dangerous carbon monoxide and soot deposits on heat transfer surfaces and inside radiant tubes. For the fuels most commonly used by U.S. industry, including natural gas, propane, and fuel oils, approximately one cubic foot of air is required to release about 100 British thermal units in complete combustion. Exact amount of air required for complete combustion of commonly used fuels can be obtained from the information given in one of the references. Process heating efficiency is reduced considerably if the air supply is significantly higher or lower than the theoretically required air.

Air-gas ratios can be determined by flow metering or flue gas analysis. Sometimes, a combination of the two works best. Use the Available Heat Chart below to estimate the savings obtainable by tuning burner air-gas ratios. The excess air curves are labeled with corresponding oxygen percentages in flue gases.

To figure potential savings, you need to know:

- The temperature of the products of combustion as they leave the furnace
- The percentage of excess air or oxygen in flue gases, at which the furnace now operates
- The percentage of excess air or oxygen in flue gases, at which the furnace could operate.

On the chart, determine the available heat under present and desired conditions by reading up from the flue gas temperature to the curve representing the excess air or O2 level; then, read left to the percentage available heat (AH). Calculate the potential fuel savings:

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\text{% Fuel Savings} = 100 \times \left(\frac{\text{%AH Desired} - \text{%AH Actual}}{\text{%AH Desired}}\right)
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Suggested Actions

To get the most efficient performance out of fuel-fired furnaces, ovens, and boilers:
1. Determine the best level of excess air for operating your equipment.
2. Set your combustion ratio controls for that amount of excess air.
3. Check and adjust ratio settings regularly.

Example

A furnace operates at 2,400°F flue gas temperature. The optimum ratio is 10 percent excess air (2.1 percent O₂ in flue gases), but tests show an actual ratio of 25 percent excess air (4.5 percent O₂ in flue gases). The chart shows an actual available heat of 22 percent compared to an ideal of 29 percent.

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\text{Fuel Savings} = 100 \times \left( \frac{29 - 22}{29} \right) = 24 \text{ percent}
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