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# Proper Burner Adjustment

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It's that time of year: new installations, no-heat calls, annual tune-ups. Each situation calls for proper burner adjustment.

Whether you are installing a new burner, solving a problem, or conducting an annual service call, you eventually get to the point where you have to adjust the burner. If you do it professionally, you will be giving your customers the heating efficiency for which they are paying.

To do it right, you must use instruments. Here's why:

1. In many modern packaged appliances, it is no longer easy to see the flame, due to the incandescent glow of the ceramic chamber. Also, in some cases, there is no viewport.
2. With the more intense flame generated by a good flame retention burner, it is very difficult, if not impossible, to consistently set the smoke to the optimum level by observation. What appears to be a "trace" of smoke could well be zero at a very poor operating level, or even at Number 2 could create efficiency-robbing soot in the heat exchanger.
3. Since we cannot "see" the combustion outputs easily, we must rely on instruments. We must measure draft, smoke, carbon dioxide or oxygen, the stack temperature, and ambient temperature if we are going to achieve reliable results.
4. If the burner is not set up to deliver the high performance that it is capable of producing, unwanted service calls or "call-backs" could quickly neutralize your profit margin. Vital customer goodwill also could be in jeopardy.

## Some Practical Steps

First, make sure the installation site has an adequate fresh air supply to support combustion. This can be a problem with new, tightly weatherized home construction. Normally, you need approximately one square foot of free area for outside air supply for

every one gallon per hour input. Put another way, you need one square inch for every 1000 BTU input. Do not neglect this or your burner will starve for air and possibly create a severely sooted system.

If you are working on a high static pressure burner, such as the AFG or Turbo 2000, make sure there are no air leaks. For example, when you replace a transformer, you must use the proper gasket between it and the housing to contain the static pressure within the housing. Otherwise, combustion problems could result causing pulsation on start-up and appliance sooting.

Next, start the burner and let the system reach a uniform operating level known as steady-state. Now, take a draft reading over the fire. Usually, there is an access hole provided. If not, drill one in the viewport cover. You want .02" W.C. typically, or whatever the manufacturer specifies. The slightly negative pull overfire removes combustion products from the chamber and out the flue.

The stack draft, measured near the appliance flue connection, should be slightly higher than the overfire reading in most cases. The difference represents the pressure drop or draft loss across the heat exchanger. An extremely high drop may mean blockage due to scale or soot deposits. Make sure it is clean before proceeding.

Next, measure the smoke level. We recommend adjusting the burner to make a TRACE OF SMOKE to start with.

Now, measure the carbon dioxide or oxygen percentage at the trace of smoke level. For example, we may have 13.5% CO<sub>2</sub> or 2.5% O<sub>2</sub>. Open the air shutter until this level changes to 12.0% CO<sub>2</sub> or 4.5% O<sub>2</sub>. Check the smoke level again. You should have zero. What have you accomplished? You have built in a margin to ensure clean operation over the heating season. Should the draft decrease, lint accumulate on the air handling parts, or heavier oil be delivered, you have a reasonable margin of protection before smoke production occurs.

The gross stack temperature is measured at steady-state operation. Remember to subtract the ambient or room temperature from the gross stack temperature to obtain a NET reading, which is then combined with the CO<sub>2</sub> or O<sub>2</sub> percent for dependable stack loss efficiency computation. (See Figures 1 and 2.)

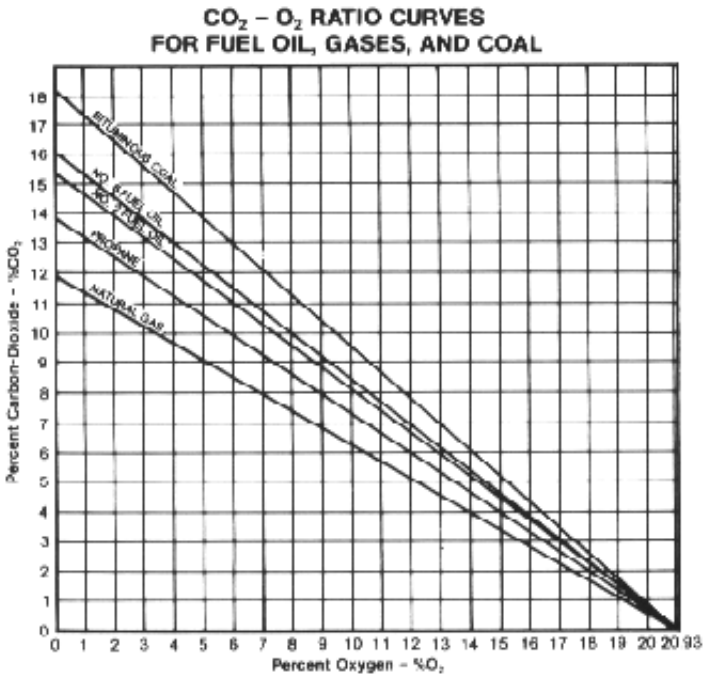


FIGURE 1

NO. 2 FUEL OIL Net Stack Temp. °F

| %O <sub>2</sub> | 100  | 150  | 200  | 250  | 300  | 350  | 400  | 450  | 500  | 550  | 600  | 650  | 700  | 750  | 800  | 850  | 900  |
|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1               | 91.8 | 90.7 | 89.6 | 88.4 | 87.3 | 86.2 | 85.1 | 84.0 | 82.9 | 81.7 | 80.6 | 79.5 | 78.4 | 77.3 | 76.2 | 75.0 | 73.9 |

|           |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| <b>2</b>  | 91.7 | 90.5 | 89.4 | 88.2 | 87.0 | 85.9 | 84.7 | 83.6 | 82.4 | 81.2 | 80.1 | 78.9 | 77.7 | 76.6 | 75.4 | 74.2 | 73.1 |
| <b>3</b>  | 91.6 | 90.4 | 89.2 | 87.9 | 86.7 | 85.5 | 84.3 | 83.1 | 81.9 | 80.7 | 79.4 | 78.2 | 77.0 | 75.8 | 74.6 | 73.4 | 72.1 |
| <b>4</b>  | 91.5 | 90.2 | 88.9 | 87.7 | 86.4 | 85.1 | 83.8 | 82.6 | 81.3 | 80.0 | 78.7 | 77.5 | 76.2 | 74.9 | 73.6 | 72.4 | 71.1 |
| <b>5</b>  | 91.3 | 90.0 | 88.7 | 87.3 | 86.0 | 84.6 | 83.3 | 82.0 | 80.6 | 79.3 | 77.9 | 76.6 | 75.3 | 73.9 | 72.6 | 71.2 | 69.9 |
| <b>6</b>  | 91.2 | 89.8 | 88.4 | 87.0 | 85.5 | 84.1 | 82.7 | 81.3 | 79.9 | 78.5 | 77.0 | 75.6 | 74.2 | 72.8 | 71.4 | 70.0 | 68.6 |
| <b>7</b>  | 91.0 | 89.5 | 88.0 | 86.5 | 85.0 | 83.5 | 82.0 | 80.5 | 79.0 | 77.5 | 76.0 | 74.5 | 73.0 | 71.5 | 70.0 | 68.5 | 67.0 |
| <b>8</b>  | 90.8 | 89.2 | 87.6 | 86.0 | 84.4 | 82.8 | 81.2 | 79.6 | 78.0 | 76.4 | 74.8 | 73.2 | 71.6 | 70.0 | 68.4 | 66.8 | 65.2 |
| <b>9</b>  | 90.6 | 88.9 | 87.2 | 85.5 | 83.7 | 82.0 | 80.3 | 78.6 | 76.9 | 75.2 | 73.5 | 71.7 | 70.0 | 68.3 | 66.6 | 64.9 | 63.2 |
| <b>10</b> | 90.3 | 88.5 | 86.6 | 84.8 | 82.9 | 81.1 | 79.2 | 77.4 | 75.5 | 73.7 | 71.8 | 70.0 | 68.1 | 66.3 | 64.4 | 62.6 | 60.7 |
| <b>11</b> | 90.0 | 88.0 | 86.0 | 84.0 | 81.9 | 79.9 | 77.9 | 75.9 | 73.9 | 71.9 | 69.8 | 67.8 | 65.8 | 63.8 | 61.8 | 59.8 | 57.8 |
| <b>12</b> | 89.6 | 87.4 | 85.2 | 82.9 | 80.7 | 78.5 | 76.3 | 74.1 | 71.9 | 69.7 | 67.4 | 65.2 | 63.0 | 60.8 | 58.6 | 56.4 | 54.1 |
| <b>13</b> | 89.1 | 86.6 | 84.2 | 81.7 | 79.2 | 76.8 | 74.3 | 71.8 | 69.3 | 66.9 | 64.4 | 61.9 | 59.5 | 57.0 | 54.5 | 52.1 | 49.6 |
| <b>14</b> | 88.4 | 85.7 | 82.9 | 80.1 | 77.3 | 74.5 | 71.7 | 68.9 | 66.1 | 63.3 | 60.5 | 57.7 | 54.9 | 52.1 | 49.3 | 46.6 | 43.8 |

Figure 2

## Conclusion

By following our recommended procedure, you may eliminate many nuisance call-backs, without sacrificing very much in efficiency. The margin of protection may possibly cost you 1% over a heating season, or \$5 to \$10 on the average heating bill. How much does a sooted heat exchanger cost you? And, don't forget the price of a service call, and the value placed upon the customer's goodwill. A margin of protection makes good sense, especially when adjusting burners for the long haul over a typical heating season.

The bottom line is this: Use dependable combustion test equipment to properly make oil burner adjustments. It is a good investment for you and your customers.

