About the charts

These charts provide the heating value of four of the five Burners from Hybridburners.com. The graphs are a result of calculation rather than actual measurement, so are theoretical. The calculations use some approximations but are based on methods believed to be reasonably accurate. Heating value is considered to be limited by either the amount of propane escaping the gas jet or by the amount of air drawn through the burner tube. The values should be considered as an ideal case starting point to a calculation rather than a final answer. In a forge or furnace application the portion of the burner output available to heat the work may be only 10 or 20% of the output of the burner. Thus these charts are more useful to answer questions like “which gives off more heat: two ‘Shorty’ burners running at 10 PSI or a single TRex running at 15 PSI?”

More technicalities

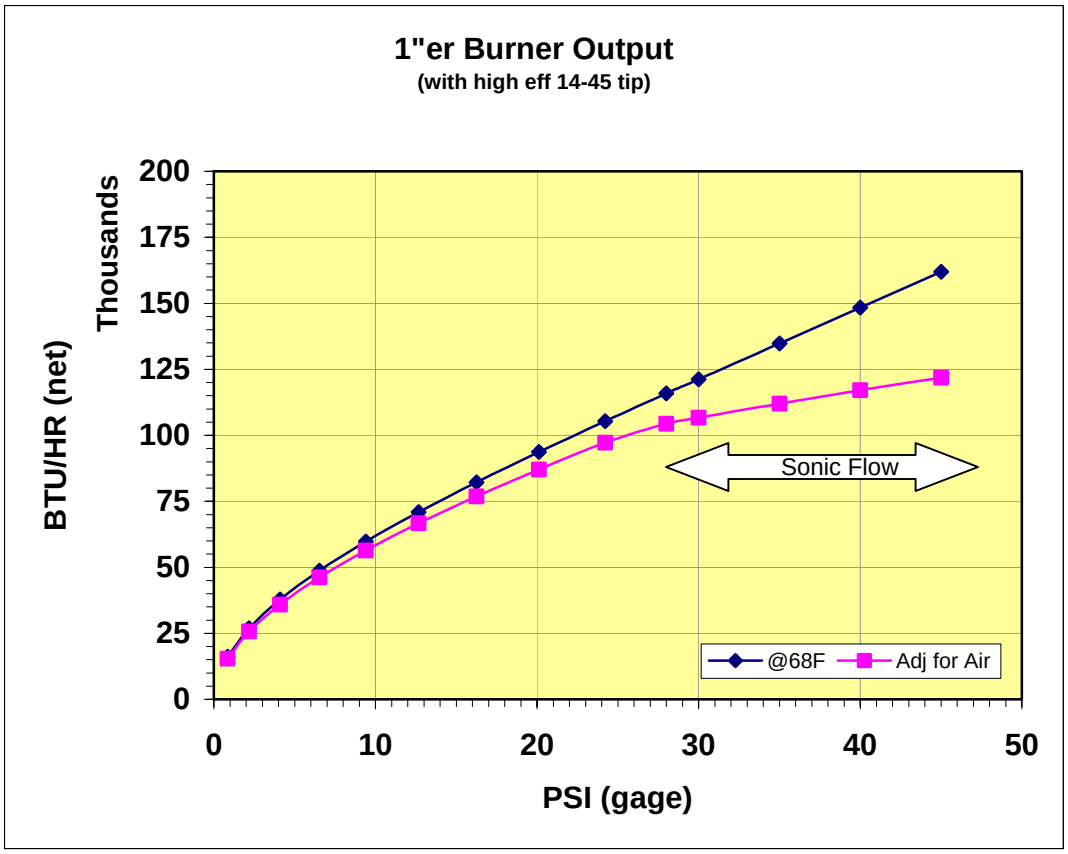
The BTU/Hr value given is 'net,' meaning it excludes the heat of vaporization of the water in the products of combustion. Environmental conditions, the specific composition of the fuel gas actually used, manufacturing tolerances of the burners, and many other factors can affect the actual output. The values charted are for ideal conditions and a 100% conversion of fuel to heat energy. The heat required to bring the air entering the burner tube from room temperature to combustion temperature is accounted for but the heat exiting the forge or furnace at an elevated temperature is not. As an example, if the exhaust gasses are at 2400F almost 50% of the heat goes up the flue.

The net heating value of propane used is 19,944 BTU/Lb. This comes from Marks' Standard Handbook For Mechanical Engineers, 10th Ed., McGraw Hill, 1996. Other sources have slightly different values. The physical characteristics of propane are from the National Institute of Science and Technology WebBook (http://webbook.nist.gov/cgi/cbook.cgi?ID=74986). The computation of flow through the gas jet is based on the methods for adiabatic frictional flow from Compressible Fluid Flow, 2nd Ed., Michel A. Saad, Prentice Hall, 1993 plus other sources. The calculation of the air drawn in to the burner tube should be considered a best case approximation as it assumes all the momentum of the gas jet is available to induce air flow. (Based on Combustion, 3rd Ed., Irvin Glassman, Academic Press, 1996, pg. 178-9.) Thus these burners probably run a bit richer and thus less efficiently than indicated especially in the sonic flow range.

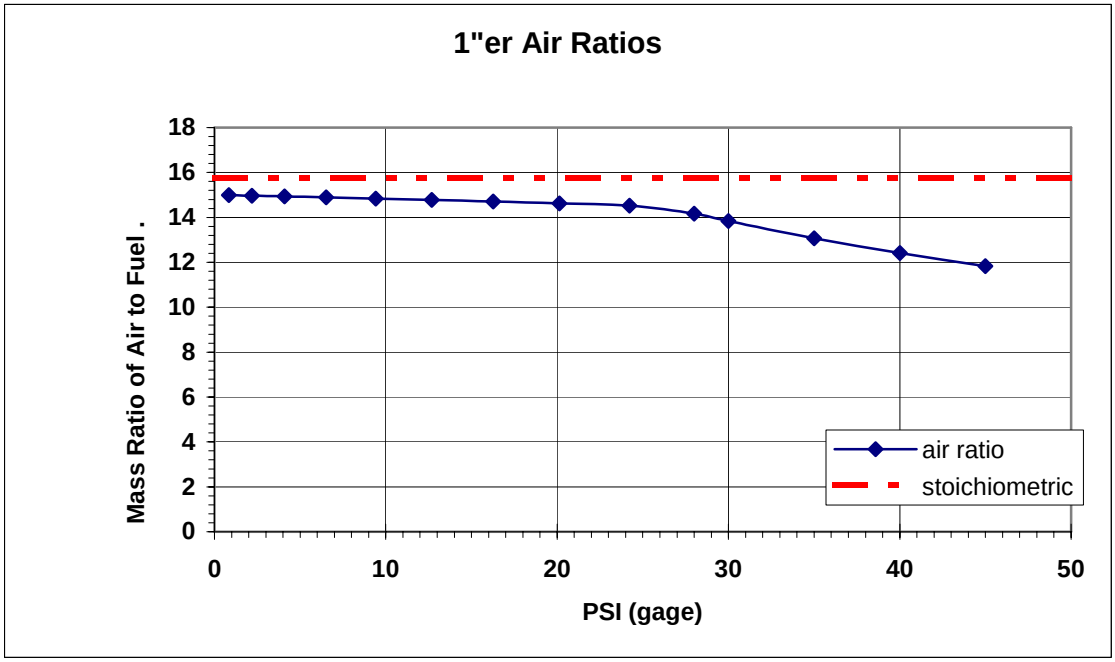
What the charts show

Each of the output charts has two lines: the upper one in blue gives the BTU content of the fuel and is solely determined by the gas jet; the lower one in pink gives the BTUs released by burning propane in the amount of air drawn in by

through the burner tube. The difference indicates that some fuel is left over to be burnt by air entering the forge from the openings or more likely burnt as the exhaust gasses exit the forge. When operated in this way (called reduction mode) maximum heating efficiency is reduced but excessive scaling of ferrous metals while in the forge is largely avoided.



Each of the charts indicates the point (the arrow labeled “sonic flow”) where the gas pressure is high enough that the flow through the nozzle is at the speed of sound. The speed of sound in Propane is 823 Ft/sec. Below this point, the increasing velocity of the fuel gas stream combines with the greater flow of fuel to draw in more air to support combustion at nearly constant air to gas ratios – this fact accounts for the ease in adjusting these burners from low-fire to full output. In the sonic flow region, the flow of gas continues to increase with increasing supply pressure but the velocity is already at its maximum so the air to fuel ratio drips off. The chart below, derived from the 1”er burner characteristics shows these effects.



At pressures above about 27 PSI for this burner, the amount of air drawn in doesn't increase quite as fast as the fuel increases. (Larger burners will generally reach the sonic flow condition at lower supply pressure levels.) Thus operating in the sonic range is not recommended unless efficiency is not an issue in your application.

All these calculation were done by Paul Boulay. If you have any questions please feel free to contact Paul or me.

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