Boiler Cheat Sheet

Boiler capacity, Bhp (or hp) vs real capacity in lb / hr.

The boiler horsepower (Bhp or hp) is a unit of measurement of the boiler output. Although it is an old unit, it is still very widely used. However, it is sometimes misused and therefore deserves the following clarifications:

By definition, a Bhp is the amount of energy required to evaporate 34.5 lb / hr (15.7 kg / hr) of steam at atmospheric pressure and a temperature of 212 ^{o}F (100 ^{o}C). Since the water vaporization enthalpy at this temperature is 970.2 BTU / lb (2257 kJ / kg), it requires therefore 33.475 BTU / hr (9,811 kilowatts) to generate 1 hp.

Unfortunately, the common practice is to use the conversion factor of 34.5 lb / hr hp to calculate the boiler generated steam rate without considering that the boiler does not work at atmospheric pressure.

ex.   500 hp x 34.5 lb / hp hr = 17,250 lb / hr produced by the boiler.

This is what we call the nominal boiler capacity. In reality, the operating pressure and feedwater temperature must be taken account of to calculate the real boiler capacity. Thus, in the example above and using an operating pressure of 130 psig (896 kPag) and a water temperature of 180oF (82oC), the real boiler capacity is calculated as follows:

ex .:   Enthalpy of steam at 130 psig = 1194.2 BTU / lb
Enthalpy of water at 180oF = 148 BTU / lb
500 hp x 33475 BTU / hr hp = 16,737,500 BTU / hr

The real capacity will be 16,737,500 = / (1194.2 - 148) = 15.998 lb / hr

The difference between the nominal capacity and the real capacity in this example appears to be low, but it is significant because it represents an increase of 8% of the capacity. If a boiler is over fired to its nominal capacity, the result will be a reduction in the combustion efficiency and in the burner modulation ratio, causing an increase in the boiler operation costs.

In conclusion, always be wary of a boiler manufacturer that does not distinguish between nominal and real capacity and always ask the manufacturer to provide you with the boiler predicted performances calculated with to specific operating conditions.