

Can high burner turndown ruin a boiler?

Is the “common knowledge” that high turndown can ruin boiler equipment? It used to be common knowledge that the Earth was flat too. Thank you Galileo Galilei for pointing out how wrong *that* common knowledge was.

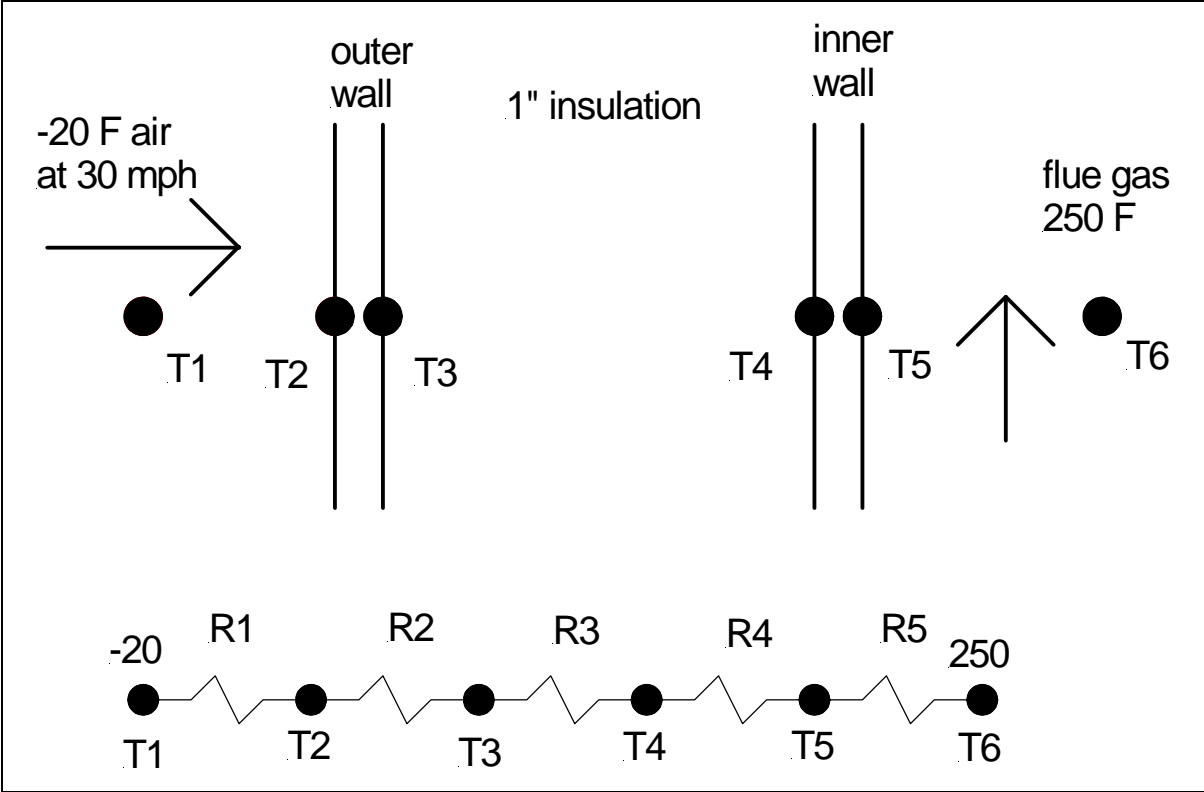
Common knowledge in some circles says that steam boilers cannot have a high turndown because flue gas will condense and corrode the boiler. Since the water vapor in the flue gas cannot condense unless it contacts a temperature below about 125°F (the dew point) the common knowledge seems like “flat Earth” stuff.

If boilers are in a high burner turndown mode, the gasses are resident within the boiler for a longer period of time and there will be a higher propensity for water vapor molecules to contact a cold surface and condense. If a boiler is operating with water temperatures just below the dew point there may not be any condensation – because the velocity of gasses is considerable. But at that same water side condition, there can be condensation on lower firing rates. The solution to the problem is quite obvious. Don't let the water temperature get that low!

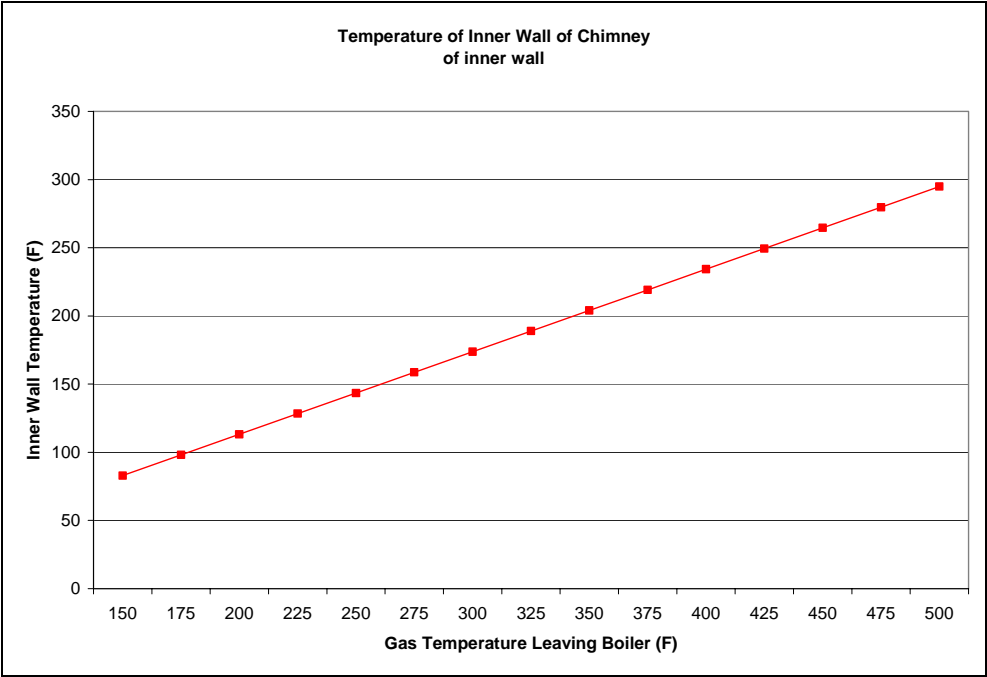
The chimney is a potential problem with high turndown burners but it doesn't show up as a real problem unless other factors are present. At very low firing rates, the gasses reside longer and exit the boiler at lowered temperatures. If the chimney wall temperature was below the dew point, then condensation would occur and could potentially be subjected to corrosion failure. But even that common knowledge is flawed!

Even at a 10:1 turndown ratio the gasses are still turbulent so relatively hot gasses tend to re-evaporate condensate. Condensate is not overly corrosive unless it is allowed to concentrate as well. The cycle of the minute condensation and re-evaporation does not allow the condensate to become cooled and thereby concentrate. (This is a well known fact that Consulting Engineers use to prevent condensation on windows by having air move across them)

Following are calculations for a chimney operating with 250°F gasses and at 10:1 burner turndown. The wall temperature drops to only 143.5°F with a 30 mile per hour wind at -20°F ambient. That is still above the dew point.



Once all of the numbers are crunched and the data is compiled the value of the chimney's inner wall temperature was compiled into the following graph:



The graph clearly shows that condensation is minimal (if there is any) unless the gas temperature leaving the boiler is well below 225 degrees F. The use of carbon steel chimneys might be problematic if that low of a gas temperature is present, but stainless steel does quite well. Especially when there is gas flow that tends to prevent the concentration of condensation to corrosive levels.

Boilers that produce stack temperatures in the problem range are listed as condensing or near-condensing appliances that require the use of Category IV materials which are able to handle corrosive condensate.