The most accurate measurement for the Total overall efficiency percentage of a wood burning furnace is your "stack loss efficiency percentage". This would be the total Btu's lost up the stack divided by the total input BTU's from the wood consumed for the burn minus 100%. Whereas, the "direct heat output efficiency percentage" only takes into consideration the Btu's recorded from the air flow when the heat distribution blower is on. This is recorded at the end of the 20 feet of insulated ductwork coming off the side of an insulated heat bonnet at the top of the furnace. This reading only shows Btu's from the blower being on and doesn't show Btu's when the blower is turned off - such as gravity heat. The more the blower is on, the more heat that is extracted. The total overall efficiency percentage, which includes all conduction, convection and radiation heat isn't in the direct heat output percentage - only in the overall stack loss efficiency percentage.

When I had our Vapor-Fire 100 tested against the EPA emission standards I decided to adjust the snap disc button thermostat somewhat higher to cycle the blower on and off for the Category 1 and Category 2 burns. For the Category 2 burn the blower was on and off approximately the same amount of time and for the Category 1 burn it was off more than it was on. This allowed me to achieve the four Btu burn category requirements for the standard. At the same time the particulate matter pounds/million Btu's ended up less than or equal to 0.15 for all four categories surpassing the 2020 and beyond requirement.

When you adjust the distribution blower button thermostat higher you end up with a lot of gravity heat that is never recorded in the "direct heat output efficiency percentage", as explained before, and this definitely hurts that percentage. For instance, my direct heat output efficiency percentage ended up at only 34% for Category 1, but the pm#/mBtu was still less than or equal to 0.15. But all this gravity heat showed up in the stack loss efficiency percentage, which was 78% because it resulted in less heat lost up the stack. Also, because the standard is based on #pm/mBtu of direct heat output, the less the blower blows, the more wood you'll need to burn to reach one million Btu's. The more wood you burn the more total amount of emissions you'll have per million Btu's in most cases.

With our VF100, the extra wood and more total emissions that resulted when the blower was off didn't hurt too much because of our "smokeless burns". More wood burned didn't necessarily mean a lot of extra emissions for the VF100. However, if your furnace produced a lot of smoke (emissions) while the blower is off - when it could be on, it would result in a higher pm#/mBtu's and may knock you from certification.

One more important point is that the EPA is only concerned with the higher heat value (HHV) of wood and doesn't take into consideration the valuable heat (Btu's) used during a burn to drive moisture from the wood. This would be the LHV (lower heat value). I believe that LHV better reflects the heat value produced while burning wood, but the EPA doesn't use it. For gas and oil the HHV is accurate because valuable Btu's are not being used to drive off moisture. But this is not the case when burning wood.