

# Are Adiabatic Work Processes in the Classical Ideal Gas Intrinsically Irreversible?

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**Abstract.** The notion that a reversible thermodynamic process is necessarily quasi-static is one of the cornerstones of thermodynamics, yet to the author's knowledge the notion has never been subjected to any sort of critical analysis. The equation of state for an ideal gas contains three variables so in an adiabatic process in which one variable, such as pressure, is altered by a small change of external constraint which is then reversed, an additional variable of state, either the volume or the temperature, also has to be reversed if the state is to return to the original. If the work done on the gas during compression is the same as the work done by the gas during expansion, this will happen naturally, but as the total external work done in the different directions is not the same, the work of compression being smaller than the work of expansion, true reversibility requires an additional, but as yet unspecified constraint. In this paper, the thermodynamics of this idea are examined critically. It is argued that the idea of quasi-static adiabatic reversibility is incompatible with known thermodynamics. The consequences for our understanding of entropy are explored.

**Keywords:** Quasi-Static, Reversibility, Adiabatic, Entropy, Clausius