

## 9.9: The Significance of The Machine-based Statement of The Second Law

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Our entropy-based statement of the second law asserts the definition and basic properties of entropy that we need in order to make predictions about natural processes. The ultimate justification for these assertions is that the predictions they make agree with experimental observations. We have devoted considerable attention to arguments that develop the definition and properties of entropy from the machine-based statement of the second law. These arguments parallel those that were made historically as these concepts were developed. Understanding these arguments greatly enhances our appreciation for the relationship between the properties of the entropy function and the changes that can occur in various physical systems.

While these arguments demonstrate that our machine-based statement implies the entropy-based statement, we introduce additional postulates in order to make them. These include: the premise that the pressure, temperature, volume, and energy of a reversible system are continuous functions of one another; Duhem's theorem; the tiling theorem; and the presumption that the conclusions we develop for pressure–volume work are valid for any form of work. We can sum up this situation by saying that our machine-based statement serves a valuable heuristic purpose. The entropy-based statement of the second law is a postulate that we infer by reasoning about the consequences of the machine-based statement. When we want to apply the second law to physical systems, the entropy-based statement and other statements that we introduce below are much more useful.

Finally, we note that our machine-based statement of the second law is not the only statement of this type. Other similar statements have been given. The logical relationships among them are interesting, and they can be used to develop the entropy-based statement of the second law by arguments similar to those we make in [Section 9.2](#) to [Section 9.8](#).

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