

Performance Measurements with the TU Dresden CO₂ Expander/Compressor

J. Nickl, G. Will, H. Quack
Technische Universität Dresden
Institut für Energietechnik
Hans.Quack@tu-dresden.de

In recent years a free-piston expander/compressor has been developed and successfully tested at the TU Dresden, which shall be replace the throttle valve in CO₂ refrigerators. The expansion part consists of 3 stages of full-pressure expansion leading from the supercritical state of CO₂ into the two-phase region. The compression part, which is driven by the expander, works „on the right side“ of the vapor dome.

Normally one would describe the efficiency of an expander/compressor by an isentropic efficiency of the expansion, a mechanical efficiency for the power transfer and an isentropic efficiency of the compression. But in such a compact machine the flow of mass, heat and power is more complicated and there exist a number of side effects:

- A bypass flow doing work on the slide valve, which controls the inlet and outlet of the expander volumes
- Internal leakage between different volumes of the machine
- Heat flow between the different volumes and thermal exchange with the surroundings.

The experimental and analytical determination of the efficiencies and the influence of the side effects can be determined analytically and by the evaluation of the measured p-V diagrams of the different working volumina.