

## Third Generation CO<sub>2</sub> Expander

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### ABSTRACT

If one replaces the throttle valve in a transcritical CO<sub>2</sub> refrigeration cycle by a work extracting expander, the COP of the cycle can be improved by about 60%. Between 1995 and 2000 in our laboratory a first generation expander/compressor with two expansion and two compression cylinders was designed and manufactured. It was tested in an experimental refrigeration loop and brought an improvement of about 30 % compared with the same plant operated with a throttle valve, compared with the theoretically possible 60%.

One drawback of the first generation expander was that the expander could be operated only in the so-called full-pressure mode. This was caused by the machine principle, where the expander and compressor pistons moved always with exactly identical velocities.

Therefore in a second generation expander, which was described in 2002, the movement of expander and compressor pistons were decoupled. This brought a further improvement in performance, but the device still depended on complicated and expensive expander inlet and outlet valves.

For the third generation expander we want to overcome this deficiency. The expansion is now done by three full-pressure expansion stages in series, whereas the compression is still done by one double-acting piston, in line with the expansion stages. The inlet and outlet flows of the CO<sub>2</sub> to and from the expansion cylinders are handled by a common simple sleeve valve. This third generation expander is presently (January 2003) in fabrication. Testing is planned for summer 2003.