

Spilling Steam Compressor

Spilling Technologies GmbH

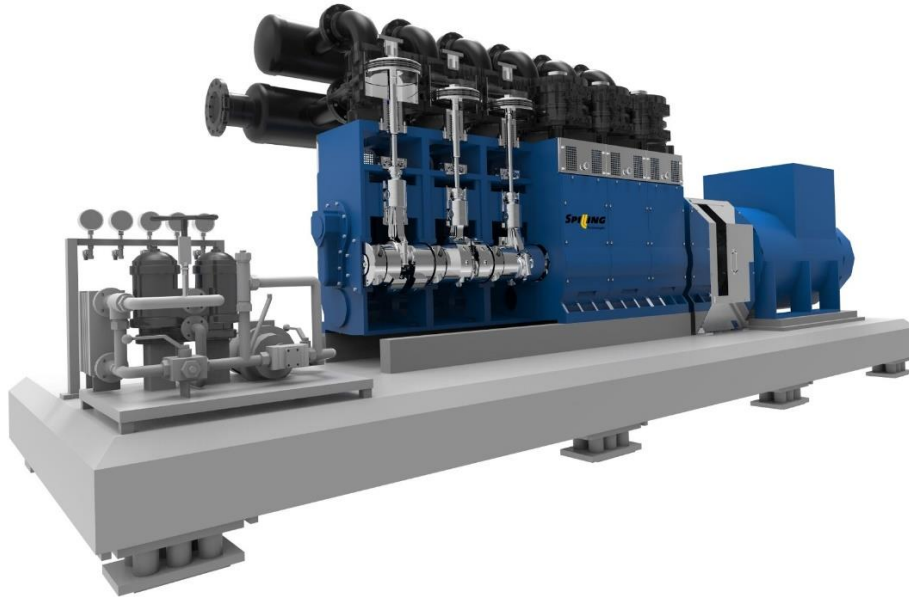


Figure 1: 3D drawing of a Spilling steam compressor.

Summary of technology

Spilling is a known manufacturer of expansion machines and compressors for steam. Historically, the focus has been on steam expanders, which were used to recover power when expanding steam to lower pressure levels. However, in the context of the increasing focus on decarbonization of process heat, the focus shifts to also include steam compressors that are upgrading heat to useful pressure levels and temperatures.

The technology from Spilling is an electric driven steam piston compressor, which can be used both in an open HTHP cycle with steam recycling and a closed HTHP cycle. Typical applications are in the chemical industry, food sector, petro-

chemistry, pharma industry, bio-mass processing and other industries.

The design of the compressors is application specific and is based on a modular design with 1 to 6 cylinders, where the piston sizes are adapted for the steam parameters at inlet and outlet, while up to three compression stages can be realized in one unit.

The design is oil-free ensuring no contamination of steam by oil, and the electro-motor includes a variable speed drive for 300 RPM to 1,000 RPM, and accordingly a steam flow variation from approximately 30 % to 100 %, which provides high efficiency, also in part load, and gives good regulation behavior, also for fast changing loads.

The technology is most promising for temperatures and pressures above 120 °C at 2 bar(a) for



the source side, and 250 °C and 40 bar(a) for the sink side. The pressure increase of each stage is possible up to a factor of 3 per compression stage, hence with a triple stage compressor a temperature increase of >100 K is possible in the same unit. For lower source temperatures than ~120 °C, a combination with steam blowers or other closed heat pumps is possible.

The compressor portfolio covers steam flows between approx. 2 t/h to 20 t/h and thermal loads between approx. 1 MW to 15 MW.

About 20 compressor units with this technology have been sold in the last 20 years.

Table 1 shows the estimated performance for the technology for various temperature ranges.

Table 1: Estimated performance for steam compression in open cycles.

$T_{\text{source,in}}$ = T_{evap}	$T_{\text{sink,out}}$ = T_{cond}	$\text{COP}_{\text{heating}}^*$
[°C]	[°C]	[-]
125	151	9.5
133	230	3.5
148	175	10.3
152	211	5.3
175	215	8.4

* Ratio of condensing heat (with subcooling to 105 °C) to compression power.

Project Example

An example of an application is recycling of excess steam from reactor cooling at a chemical plant located in North England. In this application a Spilling steam compressor is installed with two units in parallel:

- 1 x 6-cylinder compressor (double stage)
- 1 x 3-cylinder-compressor (double stage)

The inlet pressure/temperature is 5 bar(a) at 152 °C, and the outlet pressure/temperature is 19.5

bar(a) at 211 °C with a COP of 5.3 at a steam flow rate on the suction side of (11 + 5.5) t/h = 16.5 t/h and a heat load of the HP steam at the discharge side at ~(8 + 4) MW = 12 MW (for the two units).

The recycling of excess steam is here a much better option than production of electricity with the excess steam (by means of a steam turbine) from both an energy efficiency and economical point of view.

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: 1 MW to 15 MW

Temperature range: Source >120 °C; sink < 250 °C (typical) resp. < 280 °C (max). Temperature lift of up to 100 K in one unit (three stage compressor) possible

Working fluid: R-718 (water)

Compressor technology: Piston compressor

Specific investment cost for system without integration: 100-400 €/kW

TRL level: TRL 9

Expected lifetime: ~20 years

Size: ~15 tons to 45 tons and ~35 m² to 70 m² (size of installation room)

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All information has been provided by the supplier without third-party validation. The information was provided as an indicative basis and may be different in final installations depending on application-specific parameters.

