

Turbo2Steam: R718 heat pump for steam generation

Steam is commonly used in industry as a heat carrier or directly used in the industrial process. Water (R718) as working fluid is competitive with the commonly used synthetic fluids in efficiency and applicability, but components and systems need to be developed further. This heat pump test rig is able to test different compressors and steam components solutions and produce up to 10 bar steam with a capacity of more than 1 MW from a 100-120°C waste heat source.

The most important components in the heat pump are the compressors. This heat pump test rig uses turbo compressors from the automotive industry because of low investment cost, matching pressure ratios and volumetric flowrate for many industrial applications.

The test rig consists of two **oil-free turbo compressors**, in two stages, which can rotate up to 80.000 rpm.

The system has been tested up to 5.3 bar, corresponding to condensing temperatures of 155°C while producing steam able to deliver over 1 MW of heat.

With the Turbo2Steam installation it is possible to validate the performance of full-scale components such as compressors, desuperheaters, separators, sensors, expansion valves and more in an experimental setup and demonstrate the industrial potential in relevant conditions. The test rig can be integrated with either one or two compressors in series, handling steam flow rates between 100 – 1500 kg/h. A steam generator provides steam conditions of 1 – 2.5 bara, 100 – 170 °C as input to the compressors. On the discharge side pressures and temperatures up to 10 bara, 300 °C are applicable.

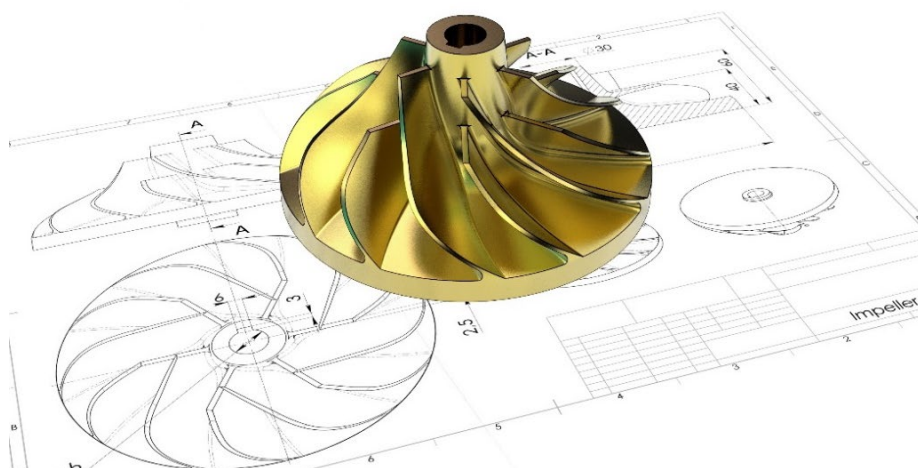


Figure 1: Typical impeller design for a turbo compressor

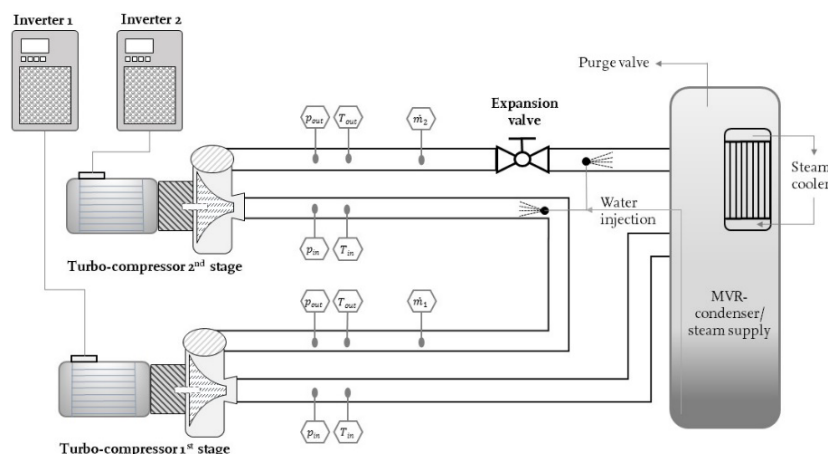


Figure 2: Simple process schematic of the Turbo2Steam installation at SINTEF

The capacities of the test rig have previously been demonstrated in the DryFiciency and FRIENDSHIP projects, demonstrating reduced energy consumption of up to 80% compared to conventional steam dries and gas boilers. The test rig is currently available for both research institutes and industry to test and validate compressors and other components in full-scale steam environments.

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