

# Compressor Performance Test Rig

## Performance testing of small refrigeration compressors up to 1500 W cooling capacity

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### Introduction

Small refrigerant compressors are widely used in home appliances like refrigerators, freezers and heat pump tumble dryers. The cooling capacity range of these applications can go up to 1500 W.

According to the standard **DIN EN 13771-1** a test setup was designed to perform compressor benchmarking tests. Further, it allows the investigation of the performance using a standard or a drop-in refrigerant.

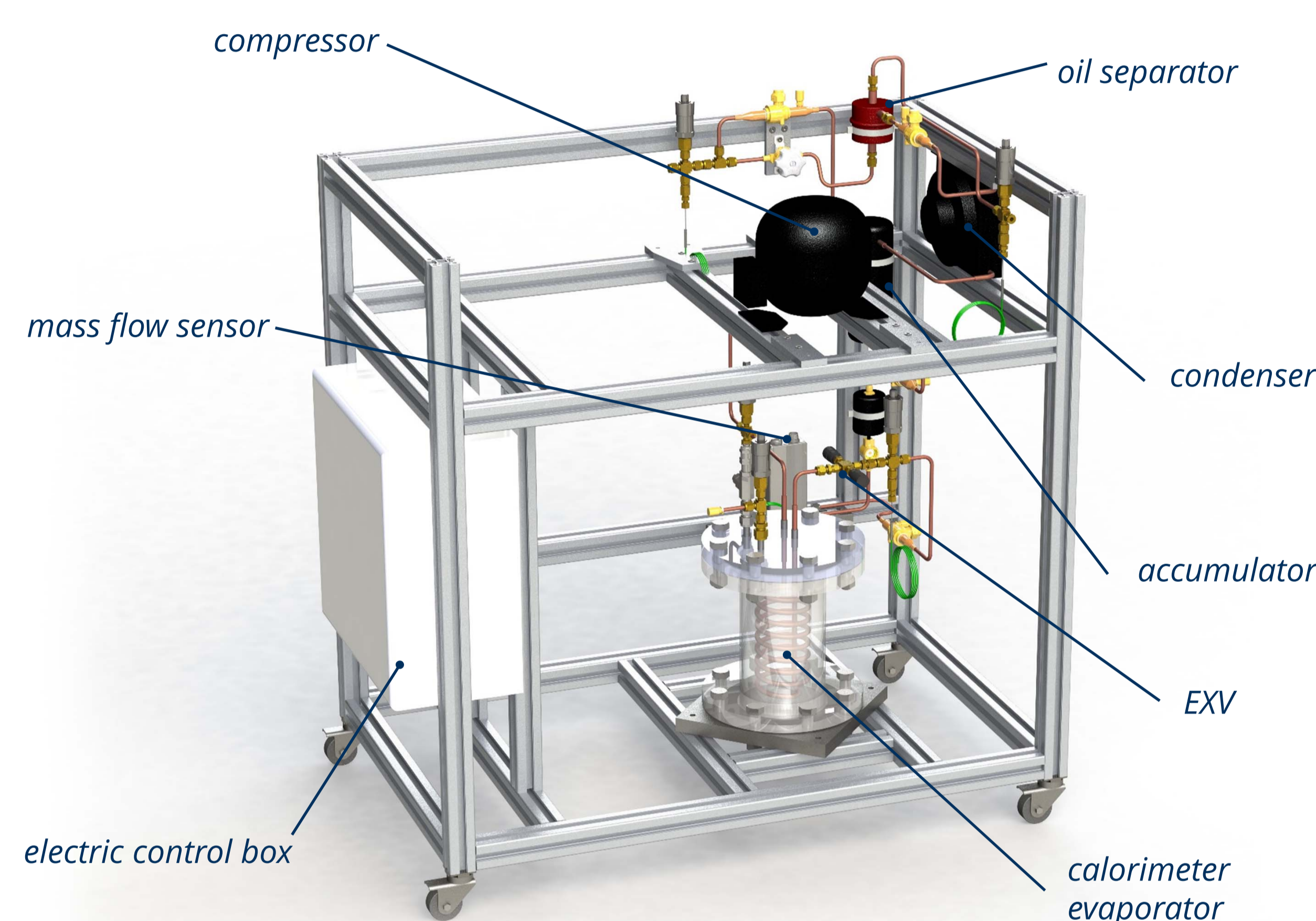


Fig. 1: CAD-model of the compressor test setup

### Measuring Principle

During the steady state testing operation of the compressor the refrigerant mass flow rate and the electrical input power will be recorded. For determining the mass flow rate two different and independent measuring devices are required in accordance to DIN EN 13771-1.

The first device is a **calorimeter** evaporator using a secondary fluid, which is heated by a controlled electrical heater. The second device is a **mass flow sensor**.

The resulting mass flow rate is then the mean value of both measuring devices.

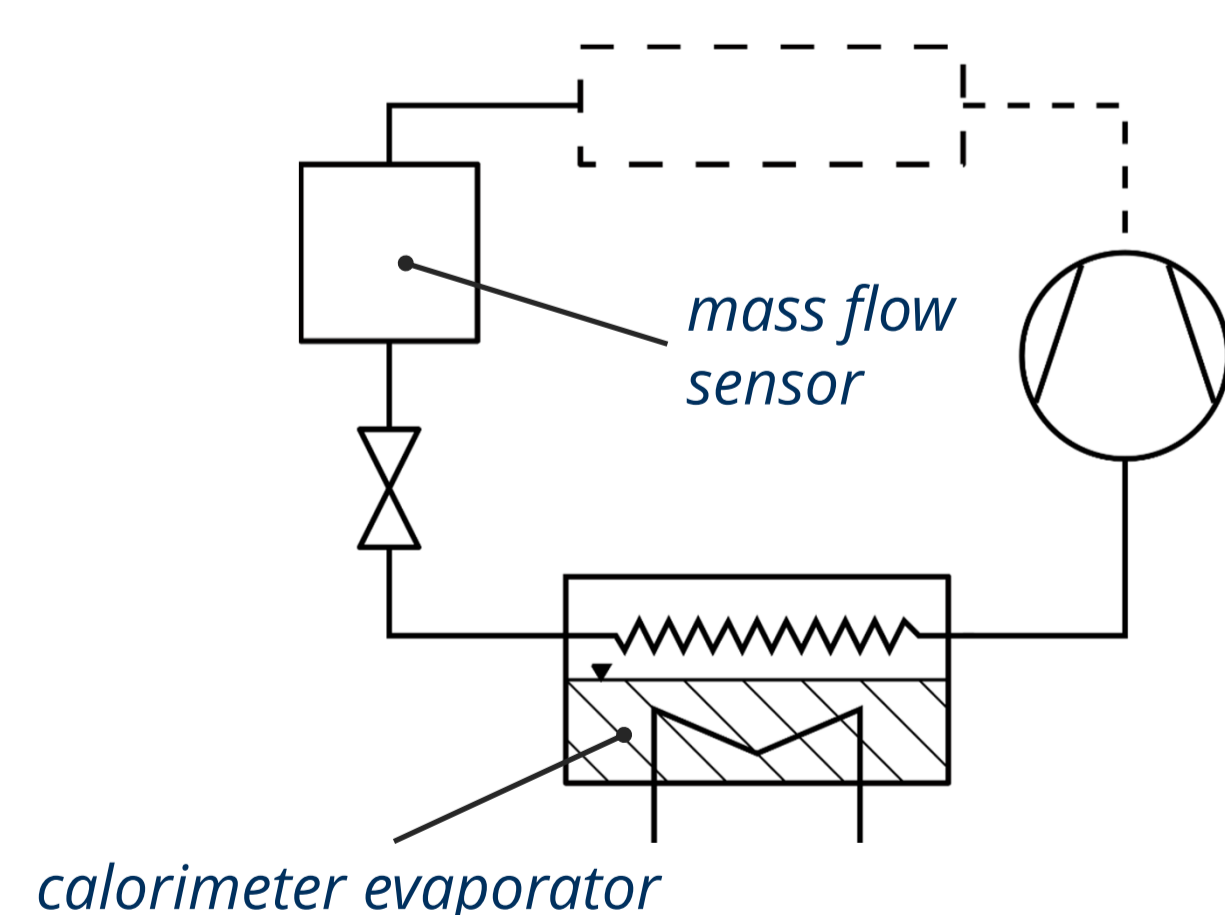


Fig. 2: Measuring devices for the refrigerant mass flow

### Operating Conditions

The testing conditions follow the standard DIN EN 12900. In accordance with the compressor range, the operating point is set by the following **control devices**:

- condenser-fan
- heating element in the calorimeter
- electronic expansion device

Steady state operation of the compressor is achieved, if certain parameters of the refrigerant cycle remain below their permitted deviation values given in the table below. The measuring inaccuracy is as well limited by the standard DIN EN 13771-1.

parameter	permitted deviation
abs. pressure @ compressor inlet and outlet	± 1,0%
refrigerant temp. @ compressor inlet	± 3,0K
compressor speed	± 1,0%
power supply frequency	± 1,0%
power supply voltage	± 1,0%
ambient temperature	± 3,0K

### Data Evaluation

To determine the thermodynamic condition of the refrigerant cycle the calorimeter temperature and pressure values are measured at five locations throughout the cycle. Additionally, the power consumption of the compressor and the heating element are logged.

The cycle operation and data recording is being realized with LabView™. The phase angle control of the condenser-fan and the electrical heater are operated manually. The supplied controller for the electronic expansion valve is integrated in the program operation also acting on a manual command.

For comparing the performance of different compressors a specific dataset is computed from the recorded data with respect to the testing conditions. This **dataset** consists of:

- volumetric efficiency  $\lambda$
- isentropic efficiency  $\eta_i$
- isentropic compression power  $P_{th}$
- electrical input power  $P_{el}$
- cooling capacity  $\dot{Q}_0$
- **COP**.

