

# KVA – A Comprehensive Software Package for Reciprocating Piston Compressor Stations

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## Motivation

The goal of the software is to provide a comprehensive calculation tool for reciprocating piston compressors including all relevant peripheral components, that

- covers all thermodynamic and mechanical aspects of the entire compressor and all additional devices
- uses a modular approach to provide universal and customized applicability
- accounts for real gas behavior
- is applicable without commercial software
- allows easy handling through a modern and user-friendly graphical user interface (GUI)

## Objectives and Benefits

- Increased design reliability
- Optimization of compressor efficiency
- Interpretation and control of measurements
- Calculation of operating behavior
- Estimation of gas pulsations as well as crankshaft and foundation loads
- Explanation of internal processes such as heat transfer, valve behavior, and sealing characteristics etc.

## Software Architecture

Components of the software package:

- G-KVA: Input program (graphical user interface with supportive user guidance)
- C-KVA: Calculation program (w/o user contact)
- R-KVA: Evaluation program (user-defined Excel-based workbook)

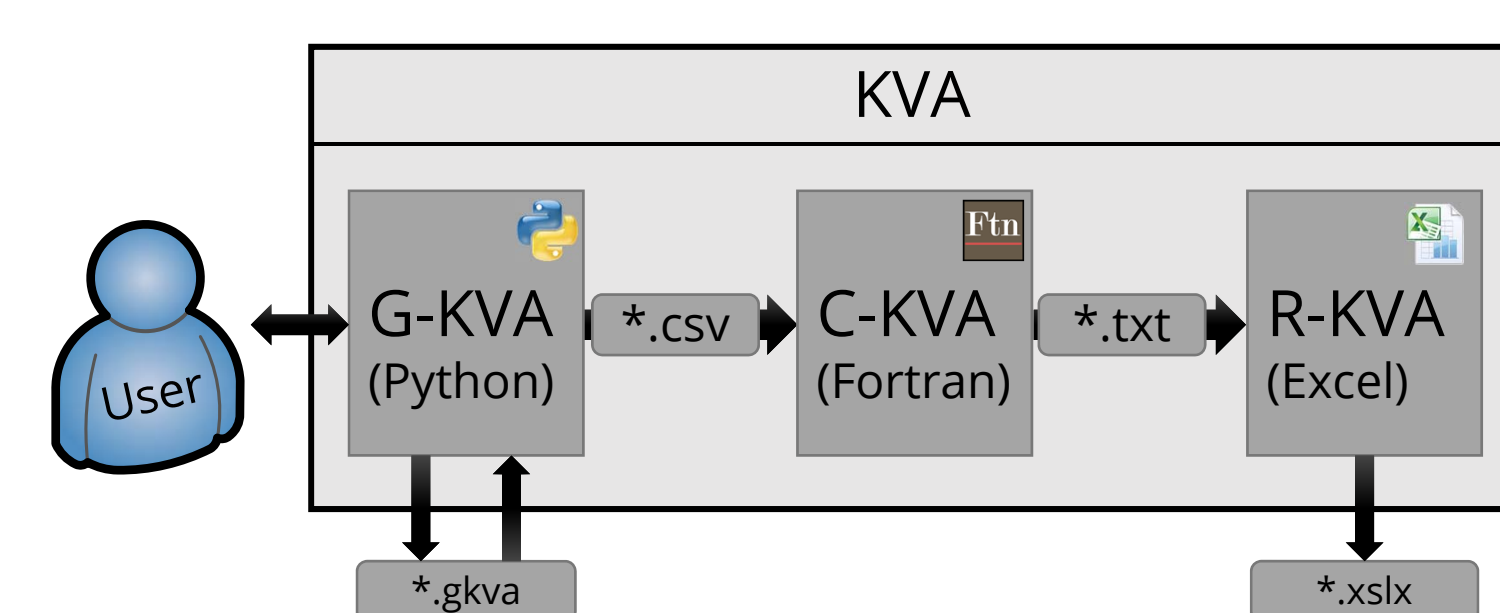


Fig. 2: Structure of the software

## Modelling & Calculation

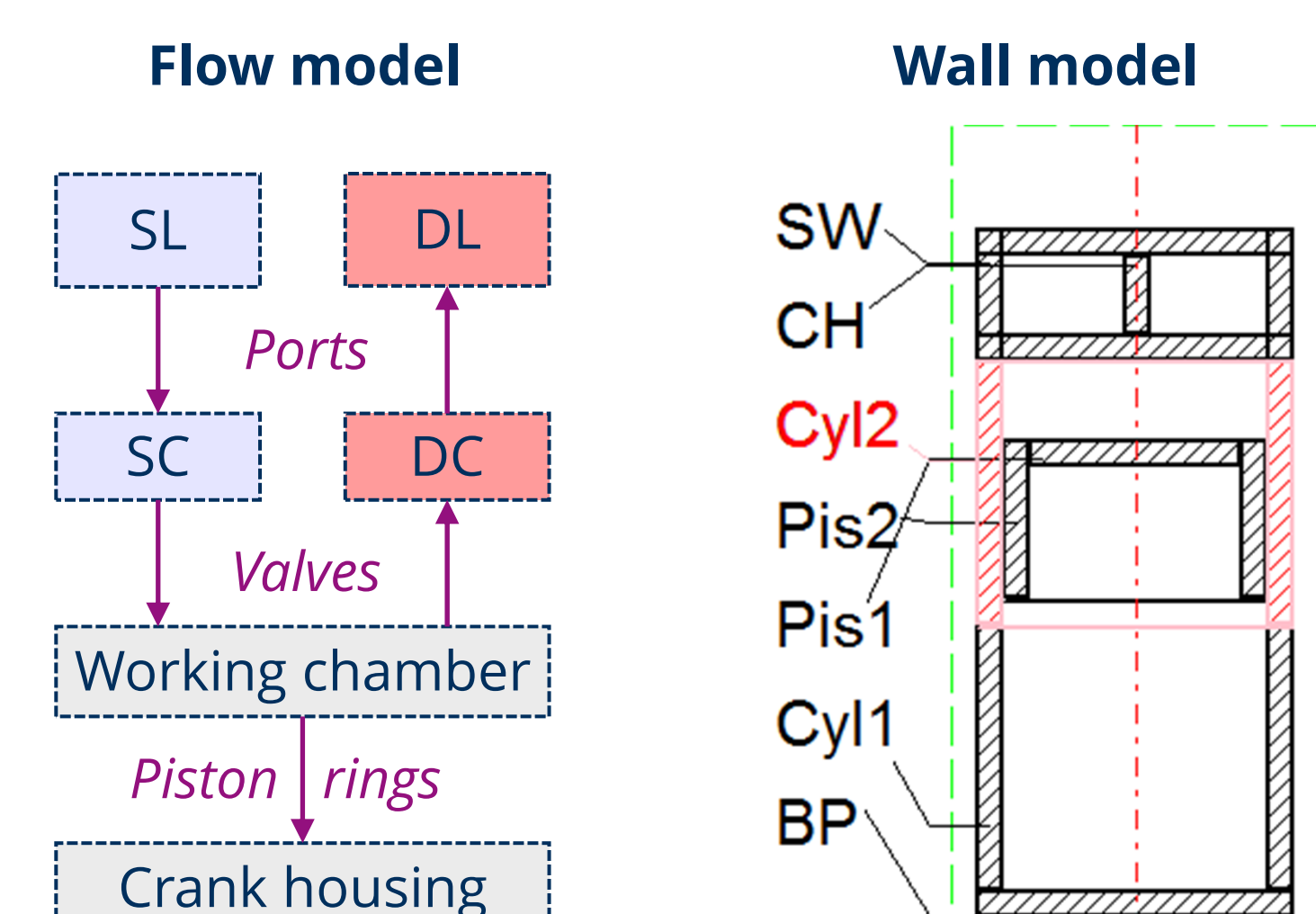
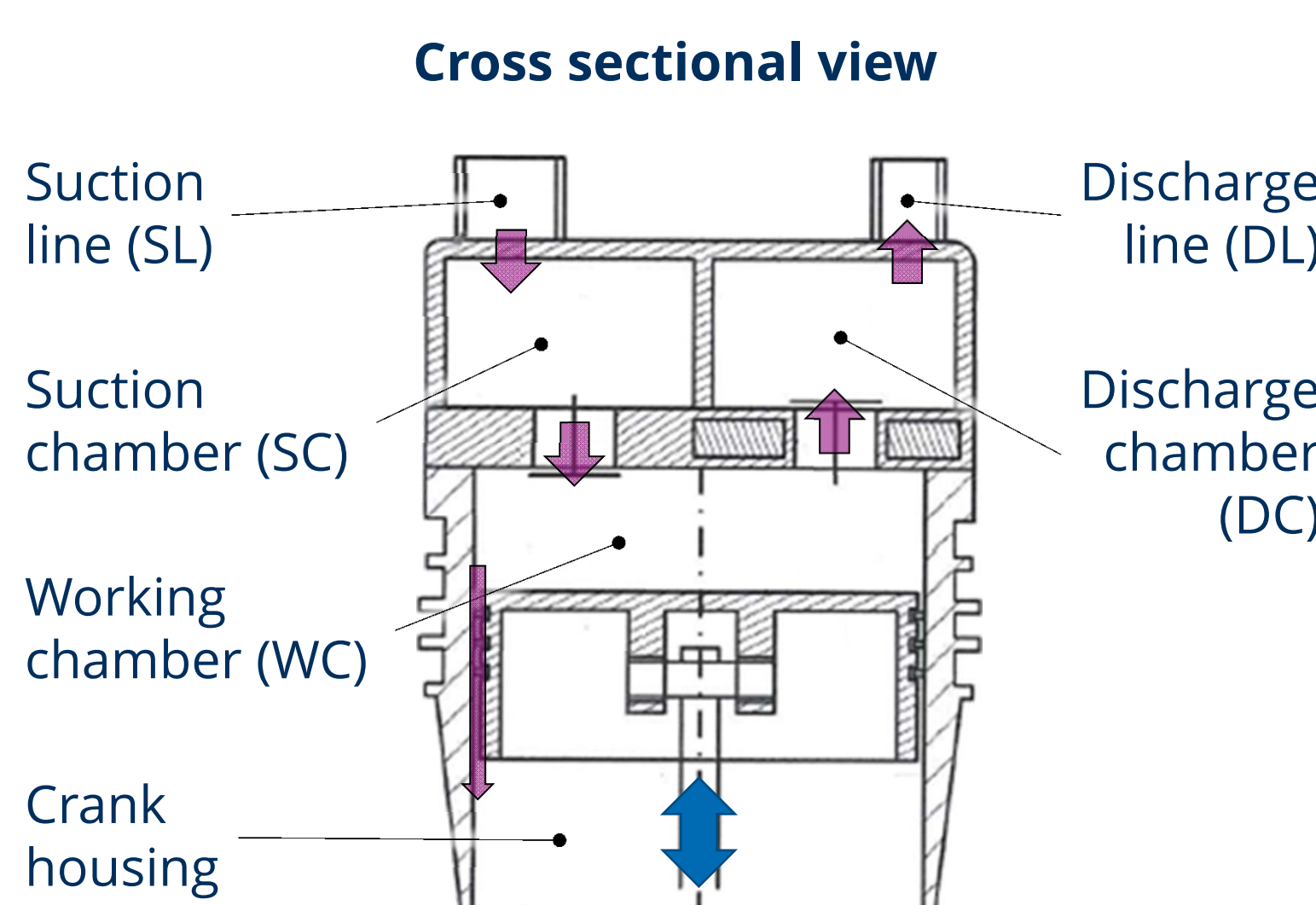
The flow path of the gas through the compressor is modelled as a network of lumped elements and connections in between.

- The lumped elements represent gas volumes (e.g. working chambers, suction and discharge chambers, vessels or heat exchangers) and account for all thermodynamic state properties.
- The connections between the gas volumes act as pipes, valves, seals etc. to provide for the flow.
- Heat transfer is accounted for by walls surrounding the gas volumes.
- The kinematics of the driveline, i.e. the mass, forces and torque are considered as well.

After setting the initial conditions for each gas volume the behavior is calculated by a time-step solving procedure.



Fig. 1: Sectional view of an air compressor [Voith]



## Results & Validation

All calculated values can be displayed over one crank revolution or against other data, e. g.  $p, V$  or  $T, s$  diagram. The comparison with measured results show encouraging correspondence. Favorably, KVA can reveal information that are typically not available from measurements.

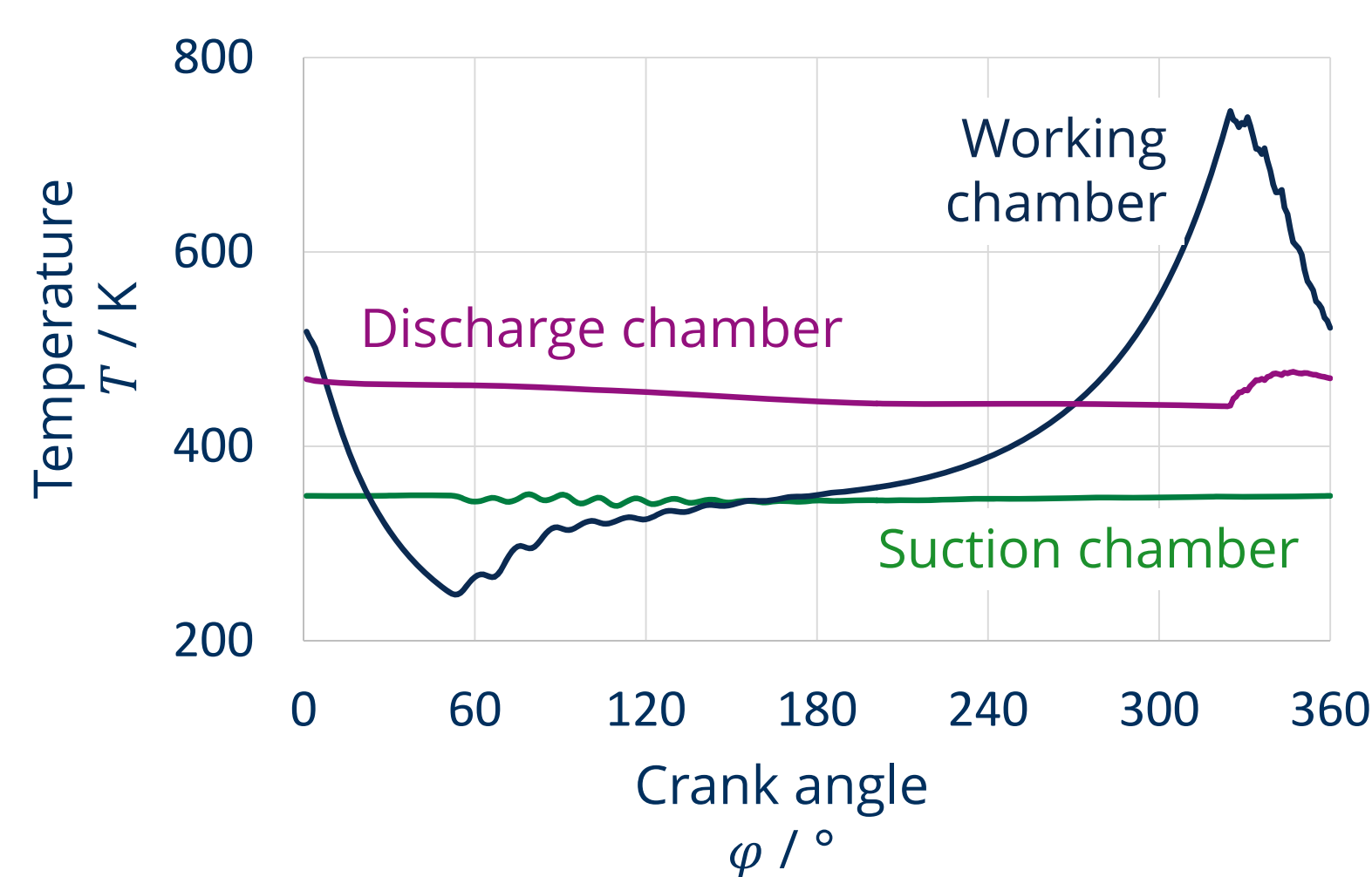


Fig. 3: Temperature behavior inside the compressor chambers

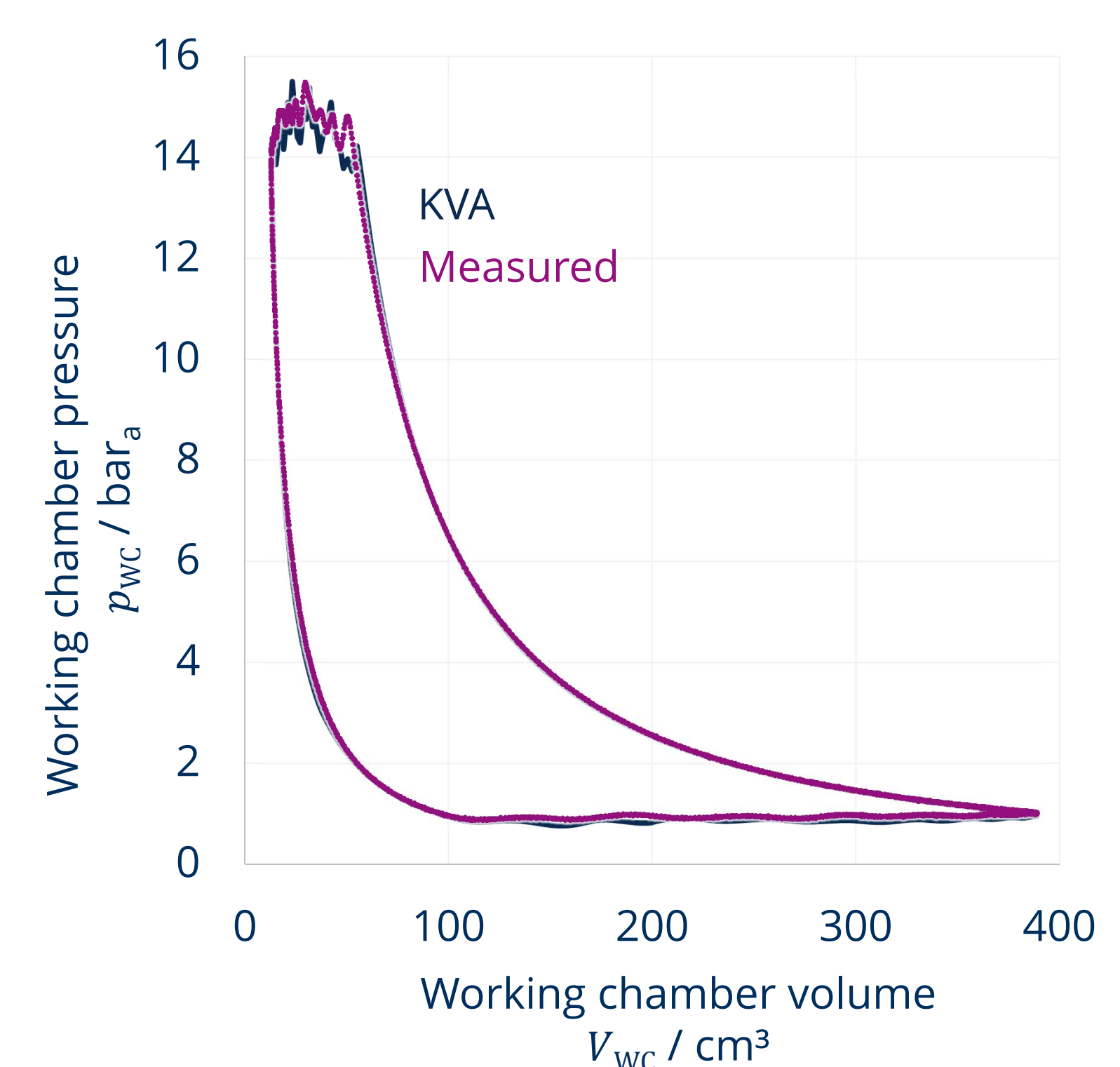


Fig. 4: Comparison of measured and calculated values