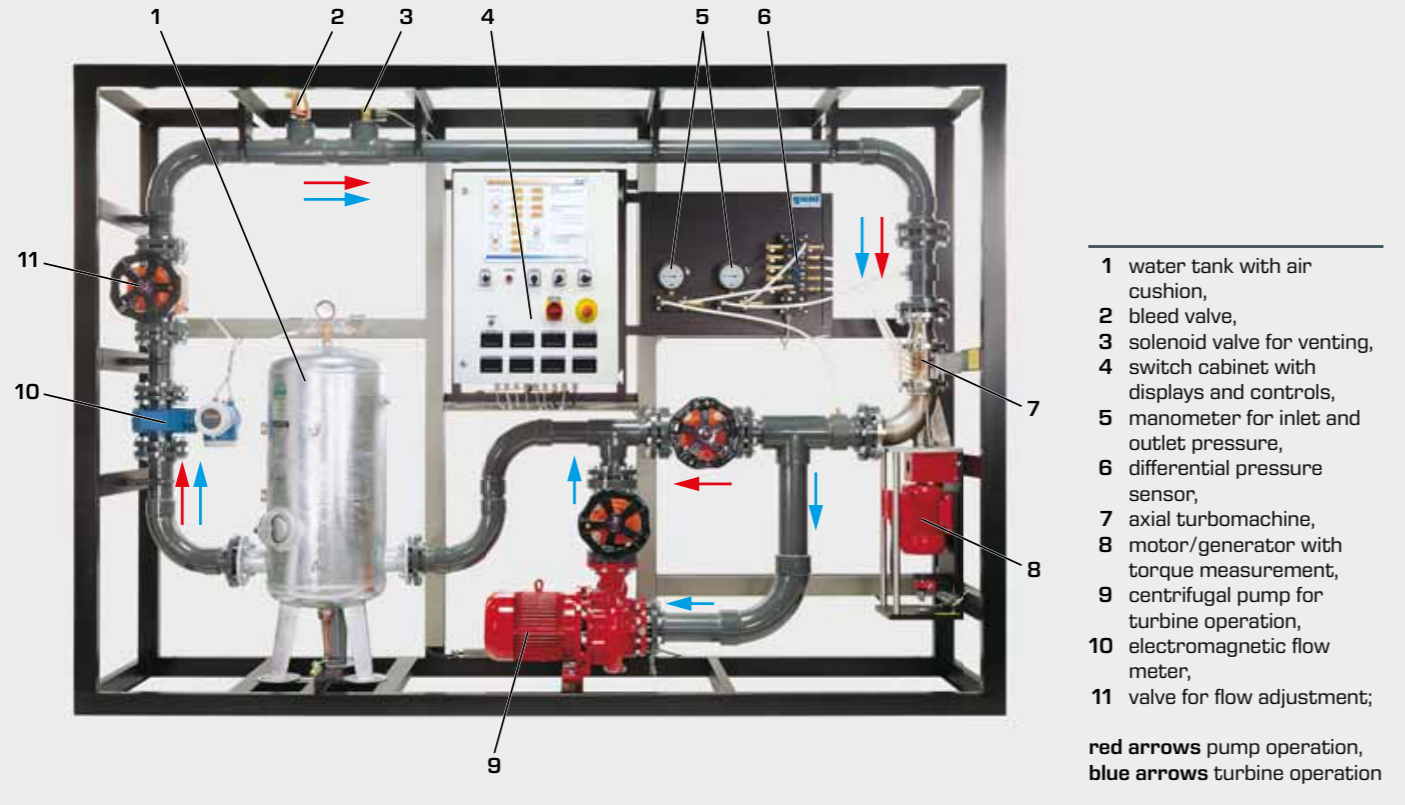


# HM 405 Axial-flow turbomachines



- 1 water tank with air cushion,
  - 2 bleed valve,
  - 3 solenoid valve for venting,
  - 4 switch cabinet with displays and controls,
  - 5 manometer for inlet and outlet pressure,
  - 6 differential pressure sensor,
  - 7 axial turbomachine,
  - 8 motor/generator with torque measurement,
  - 9 centrifugal pump for turbine operation,
  - 10 electromagnetic flow meter,
  - 11 valve for flow adjustment;
- red arrows pump operation,  
blue arrows turbine operation

The experimental plant HM 405 illustrates the function of an axial turbine with interchangeable rotors and stators. By replacing these, the turbomachine can be operated as a turbine or pump. Different rotors and stators respectively impellers and guide vane systems are provided so that their influence on the power characteristics can be investigated.

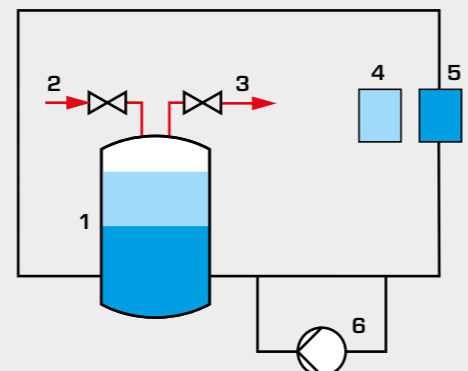
The housing is made of transparent material in order to provide insight into the flow processes upstream, between and downstream of rotor and stator respectively impeller and guide vane system.

In turbine mode the electric motor operates as a generator to generate electricity. In pump mode it operates as a drive for the pump. The electricity produced from the generator is fed into the centrifugal pump for turbine operation.

Practical experiments and calculations on the following topics can be performed depending on the operating mode:

- record characteristics
- determine dimensionless characteristic variables
- velocity triangles and pressure curves
- investigation of energy conversion within the turbomachine
- how blade / vane shape affects power and efficiency
- determine the outlet angular momentum and its effect on the power
- cavitation effects

The system can be depressurised in order to attach the guide vanes and blades. In this way the pump is emptied with no loss of water. The water runs back into the tank. Admitting compressed air to the tank refills the system. The compressed air is also used to adjust the upstream pressure. An automatic bleed valve removes the remaining air from the pipe system.



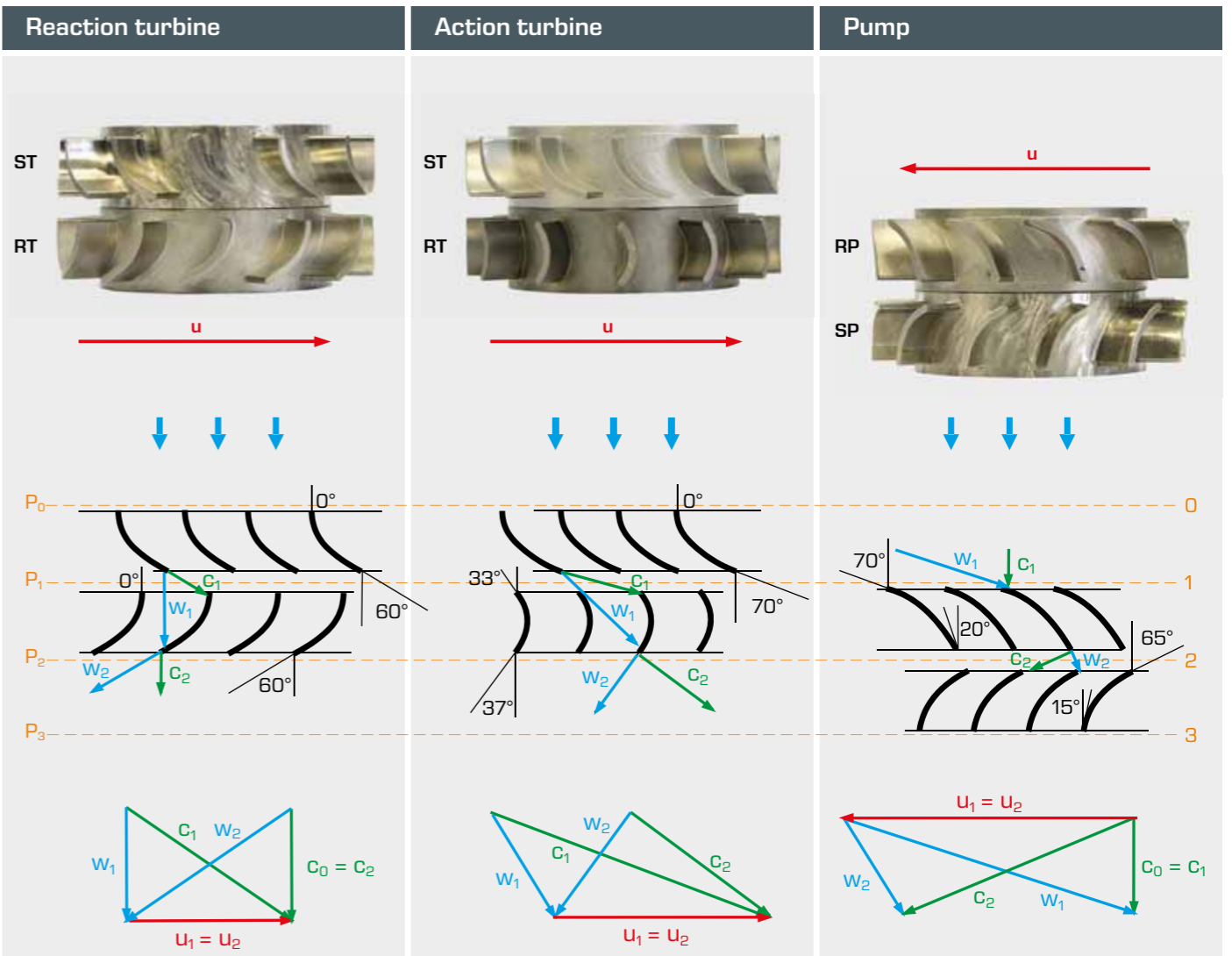
- 1 water tank with air cushion, 2 compressed air, 3 bleeding,
- 4 empty turbomachine, 5 filled turbomachine, 6 centrifugal pump;
- refill system,
- drain system

The 3-hole probe (1) can be used to measure the direction and velocity in the flow field directly upstream of, between and downstream of rotor and stator respectively impeller and guide vane system. These values are used to record the velocity triangles for the blade/vane shapes.

Varying load, speed and flow rate offers a wide range of experiments.



### Velocity triangles on turbines or pumps



ST turbine stator, SP pump guide vane system, RT turbine rotor, RP pump impeller, w relative water velocity, c absolute water velocity, u circumferential velocity, P<sub>0</sub>...P<sub>3</sub> pressure measuring points