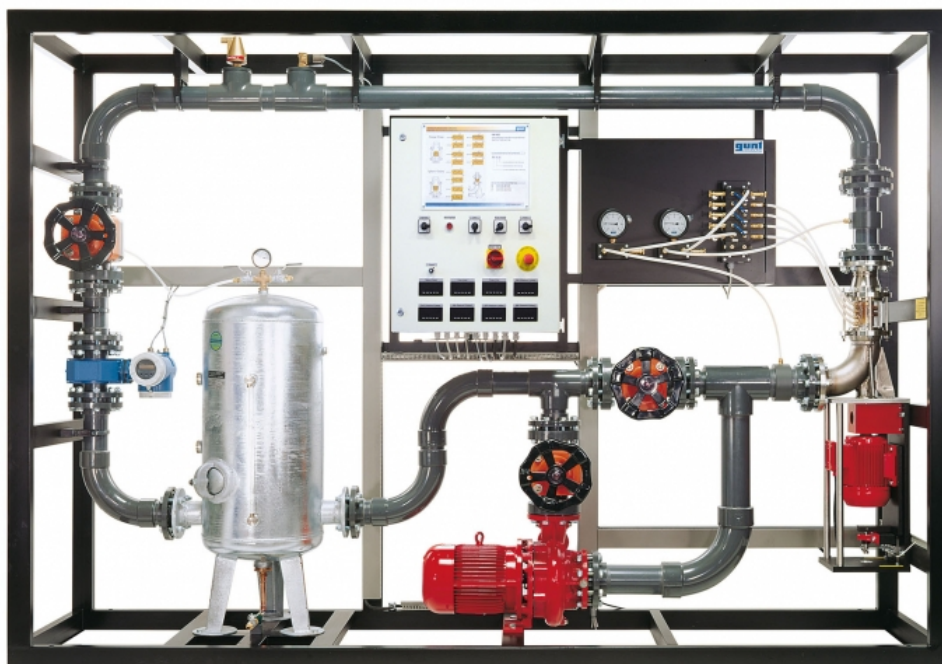


HM 405

Axial-flow turbomachines



Description

- investigation of a single-stage axial turbomachine
- can be operated as pump or turbine by changing rotor / impeller and stator / guide vane system
- probe to determine flow conditions at inlet and outlet of rotor / impeller and stator / guide vane system
- transparent working area

The core piece of the experimental plant is the axial turbomachine with attached asynchronous motor. It can be operated either as a pump or turbine. To this end, different rotors / impellers and stators / guide vane systems are used. Included in the scope of delivery are four rotors / impellers and four stators / guide vane systems supplied with different blade / vane angles. The experimental plant contains a closed water circuit with expansion tank and centrifugal pump. The compressed-air powered expansion tank allows the turbomachine to be converted without loss of water.

The asynchronous motor functions during turbine operation as a generator, and during pump operation as a drive. A powerful pump generates flow and pressure during turbine operation. The power that is generated by the turbine is fed into this pump.

The transparent housing allows a full view of the rotor / impeller and stator / guide vane system and flow processes. The 3-hole probe can be used to measure the direction and velocity in the flow field directly upstream of, between, and downstream of rotor / impeller and stator / guide vane system. These values are used to record the velocity triangles for the blade / vane shapes.

Operation under different pressure levels is possible in order to study cavitation.

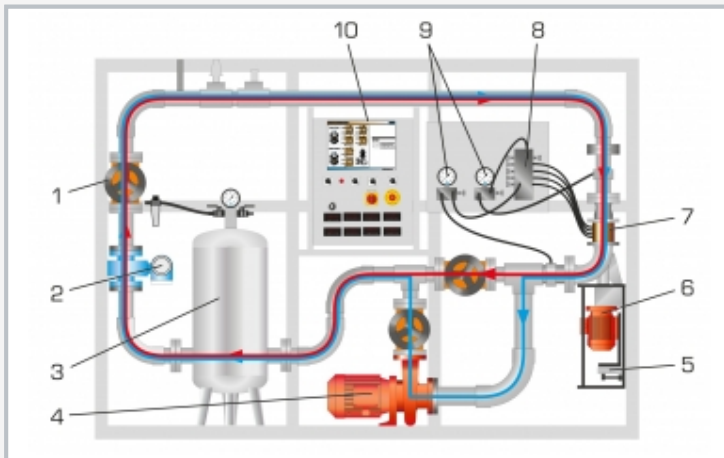
The speed is detected contact-free by means of an inductive displacement sensor on the motor shaft. To determine the drive power, the asynchronous motor is mounted on swivel bearings and equipped with a force sensor to measure the drive torque. Manometers measure the pressures at inlet and outlet. Pressure sensors measure the differential pressures at rotor / impeller and stator / guide vane system. The flow rate is measured by an electromagnetic flow meter. The measured values are read from digital displays.

Learning objectives/experiments

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

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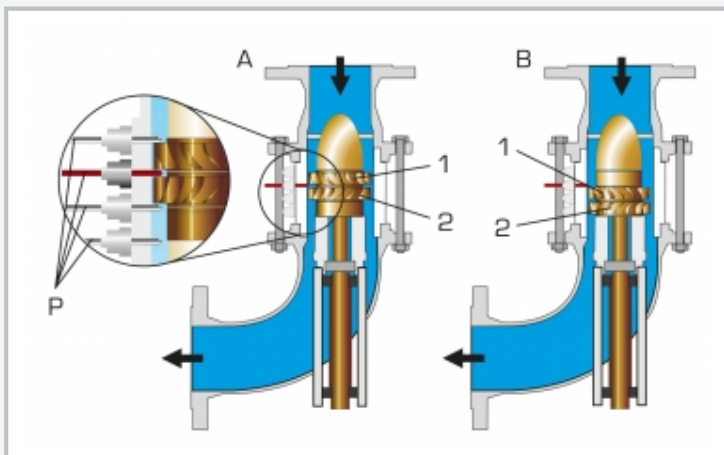
Axial-flow turbomachines



1 valve for adjusting the flow, 2 flow meter, 3 expansion tank with air cushion, 4 centrifugal pump for turbine mode, 5 force sensor for measuring the torque, 6 asynchronous motor, 7 axial-flow turbomachine, 8 differential pressure sensor, 9 manometer, 10 switch cabinet; red: pump mode, blue: turbine mode



The illustration shows cavitation effects in the working area of the axial flow turbomachine



A: axial flow turbomachine as a turbine, 1 stator, 2 rotor;
B: axial flow turbomachine as a pump, 1 impeller, 2 guide vane system;
P pressure sensor

Specification

- [1] investigation of an axial flow turbomachine
- [2] closed water circuit with expansion tank and centrifugal pump
- [3] turbomachine may be operated as a turbine and as a pump
- [4] two sets of impellers and guide vane systems for pump mode and two sets of rotors and stators for turbine mode with different inlet and outlet angles
- [5] asynchronous motor with 4-quadrant operation via frequency converter
- [6] recovery of the brake energy
- [7] motor with pendulum bearing, torque measurement via lever arm and force sensor
- [8] inductive speed sensor on the motor
- [9] manometers for measuring the inlet and outlet pressures
- [10] measuring probe and differential pressure sensor for recording the pressure curve in the turbomachine
- [11] electromagnetic flow meter
- [12] display of power consumption, torque, speed, pressure, differential pressure and flow rate

Technical data

Centrifugal pump

- power: 5,5kW
- max. flow rate: 150m³/h
- max. head: 10m

Asynchronous motor

- power: 1,5kW
- torque: 0...5Nm
- speed: 0...3000min⁻¹

Expansion tank: 150L

Measuring ranges

- pressure (manometer): 2x -1...5bar
- differential pressure: 5x 0...500mbar
- flow rate: 0...100m³/h
- speed: 0...3000min⁻¹
- torque: 0...9,81Nm

400V, 50Hz, 3 phases

LxWxH: 3300x750x2300mm

Weight: approx. 620kg

Required for operation

Compressed air connection: 3...10bar

Scope of delivery

- 1 experimental plant
- 4 rotors
- 4 distributors / guide vanes
- 1 set of accessories
- 1 set of instructional material