HM 155
Water hammer in pipes

Description

- **investigation of water hammer and pressure waves in pipes**
- **60m long pipe section**
- **determining the wave propagation velocity in water**
- **solenoid valve with adjustable closing time**
- **GUNT software for displaying the pressure curve**

Water hammer in pipes is a significant problem in engineering as they can cause severe damage to piping, fittings and system components. Water hammer is caused by the inertia effect of the flowing fluid being subjected to an abrupt changes in velocity, e.g. when rapidly closing a valve. Therefore, knowledge about the emergence of water hammer is an important aspect of designing pipework systems.

The HM 155 trainer can be used to study water hammer and pressure waves in long pipelines. Water hammer is generated by closing a valve at the end of the pipe section. The water hammer is then reflected to the beginning of the pipe as an inverted wave. A pressure vessel with air cushion at the start of the pipe section simulates the open beginning of the pipe, so that there is a clear reflection of the wave. In order to achieve reflection times that are large enough, a 60m long pipe section has been installed, which is shaped as a coiled tube to save space.

In experiments, the emergence of water hammer is studied as a function of the valve closing times. The trainer therefore includes two solenoid valves, one with constant closing time and one with adjustable closing time. The resulting pressure oscillations are measured by a pressure sensor and the pressure curve is displayed by the GUNT software.

A valve is used to adjust the flow rate. System pressure and flow rate are displayed. A safety valve protects the system against overpressure.

Learning objectives/experiments

- water hammer as a function of flow rate
- water hammer as a function of valve closing time
- display pressure curve
- determine reflection time
- calculation of the wave propagation velocity in water

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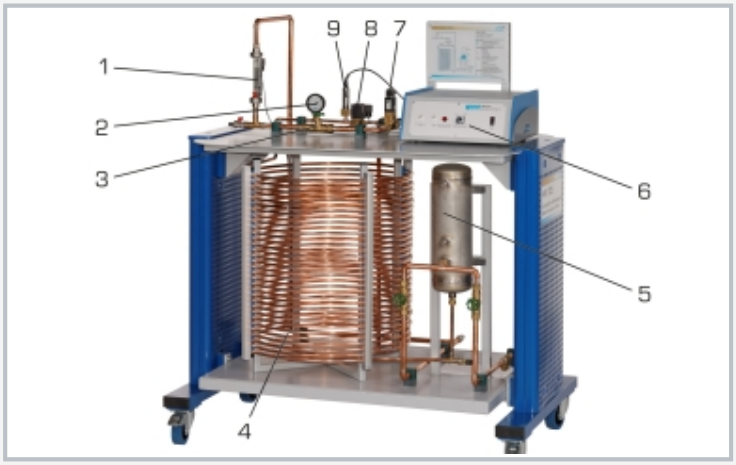
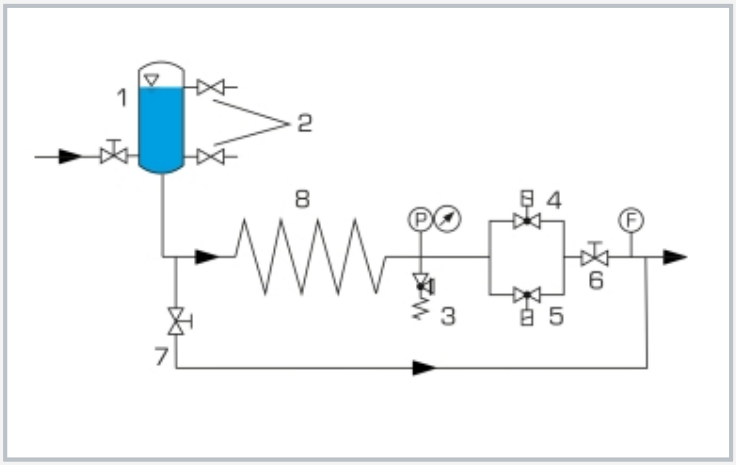
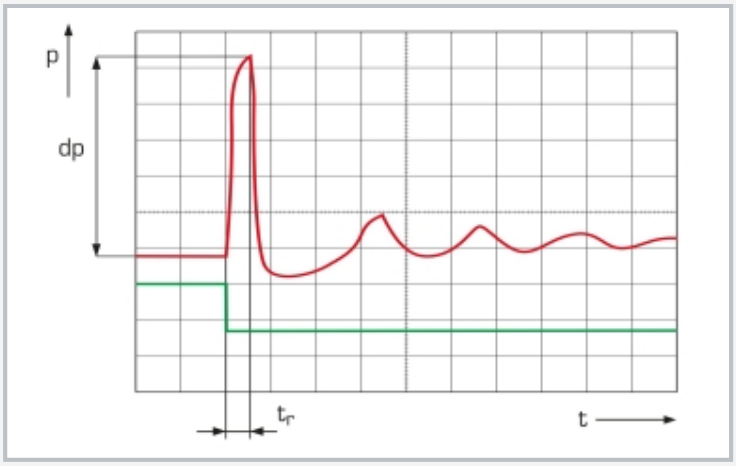


1 flow meter, 2 manometer, 3 valve for flow rate adjustment, 4 pipe section, 5 pressure vessel, 6 control unit, 7 adjustable solenoid valve, 8 constant solenoid valve, 9 pressure sensor



1 pressure vessel with air cushion, 2 valves for adjusting the level, 3 safety valve, 4 adjustable solenoid valve, 5 constant solenoid valve, 6 valve for adjusting flow rate, 7 valve for emptying the pressure vessel, 8 pipe section; P pressure, F flow rate



Course of pressure over time at solenoid valve with constant closing time; red: pressure curve, green: trigger signal; p pressure, t time, t_r reflection time, dp: water hammer

Specification

[1] investigation of water hammer and pressure waves in pipes
[2] pipe section as coiled tube to save space
[3] generation of water hammer via solenoid valve with constant closing time
[4] generation of water hammer via solenoid valve with adjustable closing time
[5] pressure vessel with air cushion reflects the wave
[6] safety valve protects against overpressure in the system
[7] instruments: pressure sensor, rotameter, manometer
[8] representation of the pressure curves and the flow rate with GUNT software
[9] GUNT software for data acquisition via USB under Windows 11

Technical data

Solenoid valve, constant closing time
- closing time: 20...30ms
- operating pressure: 0...10bar

Solenoid valve, adjustable closing time
- closing time: 1...4s
- operating pressure: 0,2...12bar

Safety valve: 16bar

Pipe section, copper
- length: 60m
- inner diameter: 10mm

Pressure vessel: 4L

Measuring ranges
- pressure: 0...16bar
- flow rate: 30...320L/h

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 1310x790x1500mm
Weight: approx. 155kg

Required for operation

water connection 300L/h, drain
PC with Windows

Scope of delivery

1 trainer
1 GUNT software + USB cable
1 set of hoses
1 set of instructional material

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Optional accessories

for Remote Learning

GU 100	Web Access Box
with	
HM 155W	Web Access Software