



C7MkII shown with F1-10

## TECHNICAL DETAILS - C6-MKII-10

Overall Dimensions:	Height: 1.10m Width: 2.25m Depth: 0.50m
Test Pipe Diameters:	19.1mm O.D. x 17.2mm I.D. 12.7mm O.D. x 10.9mm I.D. 9.5mm O.D. x 7.7mm I.D. 6.4mm O.D. x 4.5mm I.D.
Roughened pipe:	19.1mm O.D. x 15.2mm I.D.
Test Pipe Length:	1000mm
Number of tapping points:	38

Requires Hydraulics Bench Service unit F1-10

### INSTRUMENTATION OPTIONS

#### Manual Data Acquisition

In order to complete the full range of experiments possible with the C6MkII, it is necessary to measure pressures over a greater range than a single instrument can provide. Armfield recommend the use of a water manometer for the low pressure measurements and an electronic pressure meter for the high pressure measurements.

#### Order codes:

H12-2: One metre pressurised water manometer  
H12-8: Hand held digital pressure meter

Also available for use with manual data acquisition instruments is a software package, which performs all the necessary calculations from readings entered manually.

**Order code:** C6-301: Educational software (manual data entry)

#### C6-50: Data logging accessory

The C6-50 is a small data logging unit, which enables the recording of data to a suitable PC (not supplied). The unit comprises an interface device with USB port and cable, a turbine type flowmeter complete with associated pipework, and two independent pressure sensors with quick release fittings. The unit is supplied with software which runs under Windows.

The software features real-time data display on a 'mimic diagram' of the apparatus, tabular and graphical display of logged data and calculated parameters, plus full educational help texts detailing operational procedures and practical exercises.

**\*Note: The electrical sensors supplied with the C6-50 have been selected to measure over the full range of the C6MkII pressures and flow rates. However, in order to obtain accurate results at very low flows or differential pressures, it may be necessary to use a volumetric flow measurement method and/or a pressurised water manometer.**

## C7-MKII PIPE SURGE AND WATER HAMMER APPARATUS

**This free-standing accessory to the F1-10 clearly demonstrates the difference between the phenomena of pipe surge and water hammer and how each is created.**

### MEASUREMENT CAPABILITIES

- > Demonstration of pipe surge resulting from slow deceleration of flow in a pipe
- > Determination of the oscillatory characteristics of a surge shaft used to attenuate pipe surge
- > Measuring the pressure profile characteristics associated with water hammer associated with rapid deceleration of flow in a pipe
- > Comparison between theoretical and measured pressure profiles associated with water hammer
- > Determination of the velocity of sound through a fluid in an elastic pipe

### DESCRIPTION

The equipment is free-standing and comprises two stainless steel test pipes connected to a constant head tank with the necessary connections to an F1-10 Hydraulics Bench.

Pipe surge demonstrations are conducted using the first test pipe, which incorporates a transparent surge shaft and lever operated valve at the discharge end. An additional valve downstream enables the flow through the test pipe to be varied before closing the lever operated valve. A scale on the surge shaft enables the low speed transients in water level to be measured.

Water hammer demonstrations are conducted using the second test pipe, which incorporates a fast acting valve at the discharge end. An additional valve downstream enables the flow through the test pipe to be varied before closing the fast acting valve. The unique fast acting valve, specifically designed by Armfield, enables water hammer to be generated in a relatively short length of straight pipe because of the extremely short closure time achieved using a trigger actuator.

Tappings incorporating electronic pressure sensors are located in the test pipe adjacent to the fast acting valve and half way along the test pipe. These sensors measure the high speed pressure transients inside the pipe as the water hammer travels backwards and forwards along the test pipe. The time delay between the sensors can be used to determine the speed of sound through the water that is attenuated by the elasticity of the metal pipe wall.



C11MKII shown with F1-10

## C7-MKII - CONTINUED

The pressure sensors are connected to a conditioning unit with USB connection for direct connection to a PC.

The transient pressure waves can be analysed on the PC (not supplied) using the software supplied. The pressure sensors are powered from the USB port on the PC so no additional power supply is necessary.

### TECHNICAL DETAILS

Overall dimensions:

Height: 1.865m

Length: 3.575m

Depth: 0.725m

Test pipes: Stainless steel, 20.2mm inside diameter, nominally 3m long

Surge shaft: Clear acrylic, 40mm inside diameter, 800mm high

Head tank: PVC, capacity 45 litres

Requires Hydraulics Bench Service unit F1-10

## C11-MKII PIPE NETWORKS

**This free-standing accessory to the F1-10 demonstrates the characteristics of flow through different arrangements of pipes and the effect of changes in pipe diameter on the flow through a particular network.**

### MEASUREMENT CAPABILITIES

- > Measurement of head loss versus discharge for different sizes of pipes
- > Characteristics of flow through interconnected pipes of different sizes
- > Characteristics of flow through parallel pipe networks
- > Characteristics of flow through series pipe networks
- > Application of doubling pipes on existing networks to increase flow rate
- > Characteristics of flow around a ring main and the effect of changes in supplies and off-takes

### DESCRIPTION

The permanent arrangement of PVC pipes and fittings is mounted on a free-standing support frame that is designed to stand alongside an F1-10 Hydraulics Bench. Connection to the F1-10 is via a reinforced flexible tube and threaded union with 'O' ring seal enabling connection to the F1-10 without the use of tools.

Isolating valves enable a wide range of different series, parallel and mixed pipe configurations to be created without draining the system. Flow into the network and flow out from the network at each outlet can be individually varied to change the characteristics of the system.

All clear acrylic test pipes are installed using threaded unions with 'O' ring seals that enable the pipes with different diameters to be repositioned without the use of tools.

Self-sealing quick release fittings at strategic points in the network permit rapid connection of the digital hand-held pressure meter, enabling appropriate differential pressures to be measured. Flow leaving any of the outlets in the network is measured using the volumetric facility incorporated on the F1-10 Hydraulics Bench.

### TECHNICAL DETAILS

Overall dimensions:

Height: 1.380m    Width: 0.785m    Depth: 0.656m

Length of pipes: 0.7m

Inside diameter of pipes: 14mm (1x) 10mm (1x)  
9mm (2x) 6mm (1x)

Differential pressure measurement: Digital pressure meter

Requires Hydraulics Bench Service unit F1-10