

### Product List - H1/H12/H14/H30/H33/H40/H41



The Armfield **H series** provides a complete range of hydraulics instruments for both teaching and research purposes.

The collection includes Vernier Hook and Point Gauges to measure the steady state water surface position. A selection of easy to use manometers measuring differential water pressures up to approximately 12.6 metres of water.

Pitot tubes designed for measuring the velocity of water in open channels or closed ducts. Propeller Velocity Meter used to measure very low point velocities in water and other conductive fluids. The range additionally introduces students into Particle image Velocimetry (PIV).

#### H series product list

##### Vernier hooks, point gauges & stands

- ▶ Vernier hooks & point gauges H1-1/H1-2/H1-3
- ▶ Electronic hook, point gauges & stands H1-7/H1-8/H1-1

##### Open water, pressurised, mercury & kerosene manometers

- ▶ Open water manometers H12-1
- ▶ Pressurised water manometers H12-2
- ▶ Mercury manometers H12-3/H12-4
- ▶ Kerosene manometers H12-5
- ▶ Electronic pressure meters H12-8/H12-9

##### Computer compatible manometer bank

- ▶ Computer compatible manometer bank H14/2

##### Pitot tubes

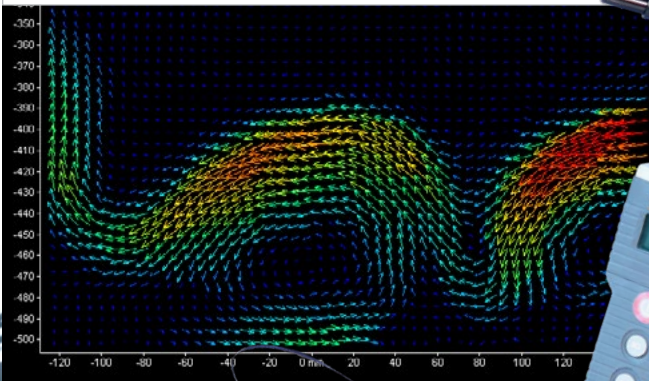
- ▶ Pitot tubes H30

##### Propeller velocity flowmeter

- ▶ Propeller velocity flowmeter H33

##### Wave probe systems & Laser PIV system

- ▶ Wave probe systems H40
- ▶ Laser PIV system H41



## Vernier Hook & Point Gauges - H1

### H1-1 / H1-3 - Hook & Point Gauges

The measurement of steady state water surface position is frequently needed during hydraulic investigations.

This is done by using a small point or hook manually adjusted to touch the water surface, and a reading is taken of the vertical movement using a scale or vernier.

### Description - Vernier Hook & Point Gauges (H1-1, H1-2, H1-3)

A mounting frame is clamped to a suitable support structure and a gauging rod is free to slide up and down over the water surface. A stainless steel hook or point is attached to the bottom end of the rod and is used to locate the water surface.

Gauging is carried out by means of a primary scale attached to the mounting frame and a vernier scale attached to the rod. The scales are in edge contact.

The rod is held in a screwed collar for fine adjustment and can be released for large, rapid changes of position. Zero can be reset by a locking screw positioned on the vernier scale.

### Demonstration Capabilities

- ▶ Location of air-water surface boundaries with high resolution
- ▶ Measurement of slowly changing water levels in flumes and hydraulic models
- ▶ Measurement of mechanical deformation

### Overall dimensions

#### H1-1 (150mm):

Length	265mm
Width	75mm
Height	50mm

#### H1-2 (300mm):

Length	415mm
Width	75mm
Height	50mm

#### H1-3 (450mm):

Length	565mm
Width	75mm
Height	50mm

### Packed and crated shipping specifications

Product	Volume	Gross Weight
H1-1 (150mm):	0.01 m <sup>3</sup>	1.2kg
H1-2 (300mm):	0.01 m <sup>3</sup>	1.5kg
H1-3 (450mm):	0.01 m <sup>3</sup>	1.7kg

### Ordering Specification

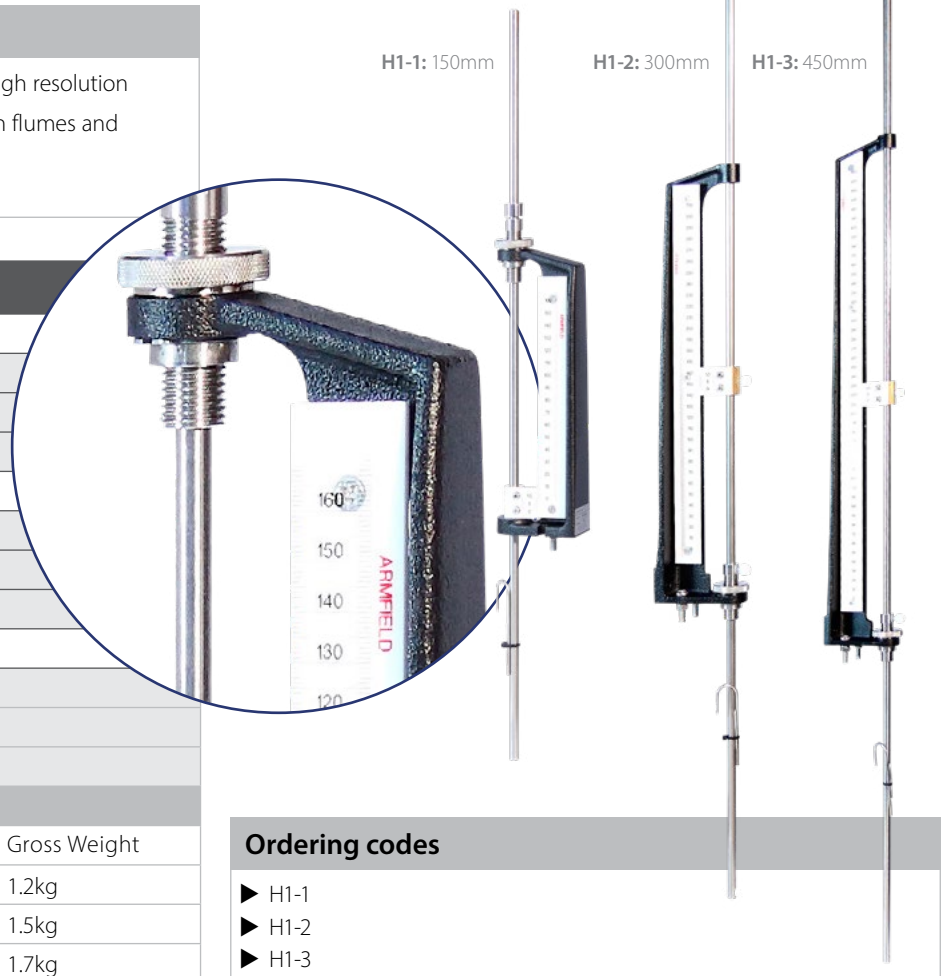
- ▶ A rugged low cost gauge for measurement of water surface position to  $\pm 0.20\text{mm}$
- ▶ Mounting frame in enamelled cast aluminium
- ▶ Gauging rod and adjusting mechanism in bright plated brass
- ▶ Supplied complete with stainless steel hook and point

### HT1 Accessories

- ▶ H1-11: Tripod stand

### Technical specifications

<b>Ranges:</b>	H1-1: 150mm H1-2: 300mm H1-3: 450mm
<b>Resolution:</b>	$\pm 0.10\text{mm}$
<b>Typical accuracy:</b>	$\pm 0.20\text{mm}$
<b>Repeatability:</b>	$\pm 0.10\text{mm}$



### Ordering codes

- ▶ H1-1
- ▶ H1-2
- ▶ H1-3



## Digital Hook & Point Gauges - H1

### H1-7 / H1-8 - Digital Hook & Point Gauges

A range of digital hook and point gauges which includes a liquid crystal display which indicates the movement of the gauging rod.

A push button sets the display to zero at any position, allowing the measurement of movement relative to a datum.

#### Description - Digital Hook & Point Gauges (H1-7, H1-8)

A mounting plate is clamped to a suitable support structure and a flat vertical shaft retained by the gauging unit is free to slide up and down over the water surface.

A steel point or hook is attached to the bottom end of the shaft and is used to locate the water surface.

The gauging unit consists of a liquid crystal electronic display which indicates the movements of the shaft.

A quick-release mechanism permits large changes to be rapidly accommodated, and a screw adjustment is provided for accurate final positioning.

A push button sets the display to zero at any position, so that relative movements compared with a datum can be easily measured.

This gauge is easy to use and minimises potential errors resulting from reading vernier scales.

#### Ordering Specification

- ▶ A direct indicating gauge which eliminates observation errors due to vernier and scale reading.
- ▶ Can be set to zero anywhere in the operating range to permit easy relative level checking.
- ▶ The liquid crystal display is easy to read and has a resolution of  $\pm 0.01\text{mm}$ .
- ▶ A push button gives immediate change to inches from millimetres if required.
- ▶ A quick-release mechanism permits rapid changes of position.

#### Overall dimensions

##### H1-7 (300mm):

Length	450mm
Width	75mm
Height	40mm

##### H1-8 (500mm):

Length	650mm
Width	75mm
Height	40mm

#### Packed and crated shipping specifications

Product	Volume	Gross Weight
H1-7 (300mm):	0.01 m <sup>3</sup>	2kg
H1-8 (500mm):	0.02 m <sup>3</sup>	2.5kg

#### Demonstration Capabilities

- ▶ Measurement of steady state of water with digital display

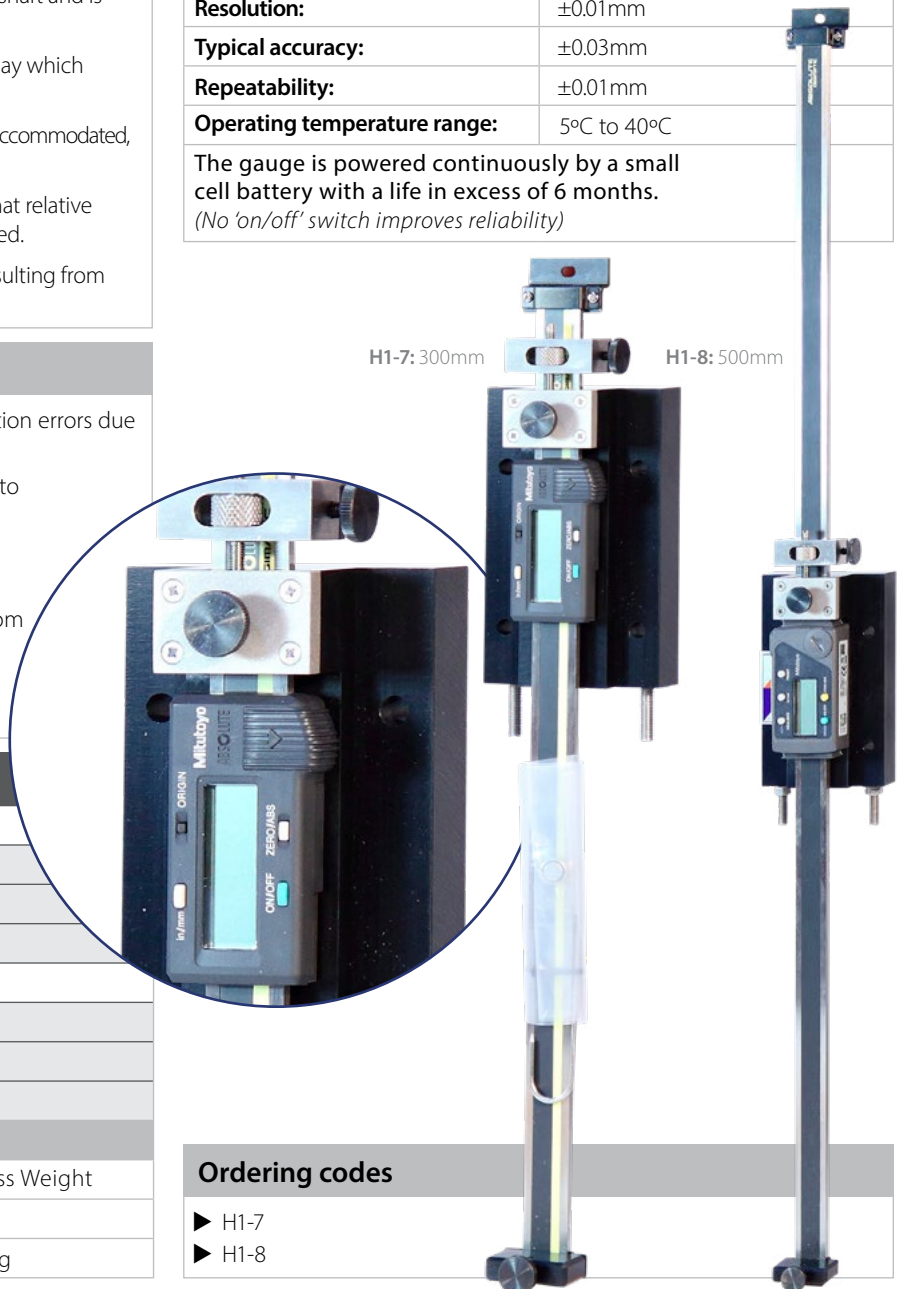
#### HT1 Accessories

- ▶ H1-11: Adjustable Tripod stand with mountings

#### Technical specifications

<b>Ranges:</b>	H1-7: 300mm H1-8: 500mm
<b>Resolution:</b>	$\pm 0.01\text{mm}$
<b>Typical accuracy:</b>	$\pm 0.03\text{mm}$
<b>Repeatability:</b>	$\pm 0.01\text{mm}$
<b>Operating temperature range:</b>	5°C to 40°C

The gauge is powered continuously by a small cell battery with a life in excess of 6 months.  
(No 'on/off' switch improves reliability)



#### Ordering codes

- ▶ H1-7
- ▶ H1-8





## Tripod Stands - H1-11

### HT1-11 - Tripod Stand

A mounting tripod constructed from aluminium alloy is supported on three stainless steel rods secured by thumbscrews.

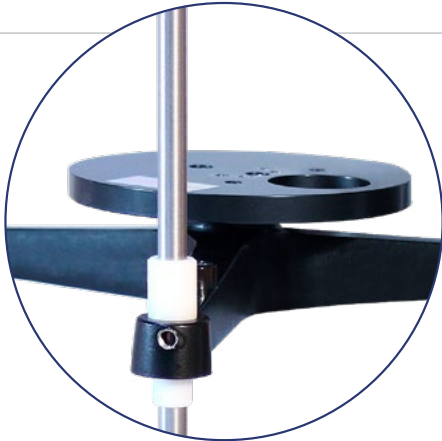
The rods are adjustable allowing the stand to be made level.

#### Description - Tripod Stand (H1-11)

This stand is suitable for use with vernier type Hook & Point gauges (H1-1, H1-2, H1-3) and the Pitot Tubes (H30). It is essential for the convenient use of the gauges in physical models. Also includes mountings and a clamp plate to make it suitable for other instruments, i.e. the Digital Hook and Point gauges (H1-7, H1-8), the micropropeller used on H32 and Propeller Velocity Flowmeter (H33).

Levelling is assisted by use of a 'Bullseye' spirit level mounted on the top plate.

A carrier plate mounted on the tripod supports the gauge. The whole assembly may be adjusted for height on the support rods.



### Technical specifications

<b>Product:</b>	H1-11
<b>Ranges:</b>	500mm (normal)
<b>Diameter of base:</b>	340mm
<b>Overall height:</b>	660mm (without gauge)

### Overall dimensions

<b>H1-11:</b>	
Length	340mm
Width	340mm
Height	660mm

### Packed and crated shipping specifications

Product	Volume	Gross Weight
<b>H1-11:</b>	0.15 m <sup>3</sup>	6kg

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### Ordering codes

► H1-11 Adjustable tripod stand with mountings

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Applications

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**H12-1 / H12-7 - Liquid Manometers**

A range of general purpose laboratory manometers using liquid displacement to measure differential pressure.

**Description - Liquid Manometers (H12-1 / H12-7)**

A range of manometers measuring differential water pressures up to approximately 12.6m H2O. Scales are graduated in 1mm divisions.

- H12-1:** 1 metre scale differential open water manometer
- H12-2:** 1 metre scale differential pressurised water manometer (the air space above the tubes can be pressurised with the pump supplied)
- H12-3:** 1 metre scale differential water over Mercury manometer - Range 12.6m H2O
- H12-4:** 500mm scale differential water over Mercury manometer - Range 6.3m H2O
- H12-5:** 500mm scale differential kerosene over water manometer - Range 0.213m H2O

**Accessories**

- H12-6:** Free-standing column with height adjustment to take two manometers.
- H12-7:** Self-sealing and self-bleeding pressure tapping system which allows a pair of pressurised water or mercury manometers to be connected into and disconnected from a number of points around a pump system.

The equipment consists of ten self-sealing pressure tapping points with 1/4" BSP male threads for fitting into the system and four self-bleeding pressure tapping lines for connection to two differential manometers. Tapping line bleeding is obtained with four in-line vented shut-off valves conveniently mounted on a fixing bracket. The system is supplied complete with a quantity of translucent plastic tubing.

**Demonstration Capabilities**

- ▶ Low cost and easy to use instruments
- ▶ Wide range of pressures accommodated using different manometer fluids

**Ordering Specification**

See description:  
 NOTE: Due to its hazardous nature and severe shipping restrictions, Mercury is not included in Armfield's scope of supply.

**Overall dimensions**

See description:

Packed and crated shipping specifications		
Product	Volume	Gross Weight
H12-1 / H12-7	0.1 m <sup>3</sup>	21.5kg

**Liquid Manometers & Meters - H12**



Ordering codes		
▶ H12-1	▶ H12-3	▶ H12-5
▶ H12-2	▶ H12-4	



**Portable Pressure Meter - H12-8**

**H12-8 - Liquid Manometers & Meters**

A versatile, hand held, battery operated portable pressure meter capable of measuring pressures of water or air from 0 - 2000 mBar (0 - 1500mmHg).

This unit is particularly suitable for use in applications where Mercury manometers have traditionally been used. The use of Mercury is not desirable in a laboratory environment due to its hazardous nature.

**Description - Portable Pressure Meter H12-8**

A battery operated portable pressure meter suitable for measuring gauge (single input) or differential (dual inputs) pressures of air or water.

Measurement capacity is up to 2 Bar differentially and the unit is capable of withstanding 6 Bar on either port without damage.

Housed in a robust, waterproof case and designed to be hand held. Supplied with connections to suit 6mm flexible hose.

An adjustable zero value eliminates offset and an averaging filter function provides steady readings in situations where the pressure is fluctuating. Readings can be displayed in alternative pressure units.

A calibration certificate referred to National Physical Laboratory (NPL: 5 point calibration) or United Kingdom Accreditation Service (UKAS: 10 point calibration) standards can be supplied if ordered with the meter.

**Technical Details**

<b>Measuring range:</b>	0 - 2000mBar (0 - 1500mmHg)
<b>Units: (selectable)</b>	mBar, mmHg, psi, inH2O, inHg, kPa, cmH2O, kgcm-2
<b>Resolution:</b>	1mBar (1mmHg)
<b>Accuracy:</b>	+/-0.2% of full scale
<b>Maximum overpressure:</b>	6200 mBar (4650 mmHg)
<b>Temperature range:</b>	0 - 50°C
<b>Humidity range:</b>	10 - 90% RH non- condensing
<b>Protection:</b>	Dust and waterproof to IP67
<b>Fluid compatibility:</b>	Silicon protection for use with water without sensor corrosion
<b>Connections:</b>	1/8" BSP parallel female with adaptor to 6mm/9mm flexible tubing
<b>Battery type:</b>	MN1604
<b>Battery life:</b>	90 hours

**Overall dimensions**

<b>Length</b>	250mm
<b>Width</b>	100mm
<b>Height</b>	40mm

**Packed and crated shipping specifications**

Product	Volume	Gross Weight
<b>H12-8</b>	0.005m <sup>3</sup>	1kg

**Ordering Specification**

▶ <b>H12-8</b>	Basic Portable Pressure Meter
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**Ordering codes**

▶ <b>H12-8</b>
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Applications



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## Portable Pressure Meter - H12-9

### H12-8 - Liquid Manometers & Meters

A versatile, hand held, battery operated portable pressure meter capable of measuring pressures of water or air from 0 - 140 mBar(0 - 99.99mmHg).

#### Description - Portable Pressure Meter H12-8

A battery operated portable pressure meter suitable for measuring gauge (single input) or differential (dual inputs) pressures of air or water.

Measurement capacity is up to 140 mBar differentially and the unit is capable of withstanding 400 mBar on either port without damage.

Housed in a robust, waterproof case and designed to be hand held. Supplied with connections to suit 6mm flexible hose.

An adjustable zero value eliminates offset and an averaging filter function provides steady readings in situations where the pressure is fluctuating. Readings can be displayed in alternative pressure units.

A calibration certificate referred to National Physical Laboratory (NPL: 5 point calibration) or United Kingdom Accreditation Service (UKAS: 10 point calibration) standards can be supplied if ordered with the meter.

#### Technical Details

<b>Measuring range:</b>	0 - 140mBar (0 - 99.99mmHg)
<b>Units: (selectable)</b>	mBar, mmHg, psi, inH2O, inHg, kPa, cmH2O, kgcm-2
<b>Resolution:</b>	0.1mBar (0.01mmHg)
<b>Accuracy:</b>	+/-0.2% of full scale
<b>Repeatability:</b>	+/-0.1% of full scale
<b>Maximum overpressure:</b>	400 mBar
<b>Temperature range:</b>	0 - 50°C
<b>Humidity range:</b>	10 - 90% RH non- condensing
<b>Protection:</b>	Dust and waterproof to IP67
<b>Fluid compatibility:</b>	Silicon protection for use with water without sensor corrosion
<b>Connections:</b>	1/8" BSP parallel female with adaptor to 6mm/9mm flexible tubing
<b>Battery type:</b>	MN1604
<b>Battery life:</b>	90 hours

#### Overall dimensions

Length	250mm
Width	100mm
Height	40mm

#### Packed and crated shipping specifications

Product	Volume	Gross Weight
H12-9	0.005m <sup>3</sup>	1kg

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#### Ordering Specification

▶ **H12-9** Basic Portable Pressure Meter



#### Ordering codes

▶ **H12-9**

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Applications

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**Computer compatible manometer bank - H14/2**

**H14/2 - Computer Compatible Manometer Bank**

The Armfield H14/2 is designed to replace banks of manometers when used in conjunction with a number of Armfield products. Sixteen simultaneous pressure measurements can be displayed on a user supplied computer and the information data logged.

**Two modes of operation are available:**

**Mode 1:** 16 general purpose channels (350mm H<sub>2</sub>O), with a common reference, suitable for monitoring both wet and dry systems.

**Mode 2:** 14 general purpose channels as above, plus 2 differential high sensitivity channels (125mm H<sub>2</sub>O differential), for accurate measurement of low differential pressures (suitable for dry air only).

**Description - H14/2**

The pressure monitor points are located on the front panel of the unit, with adapters to allow flexible plastic tubing to be attached. Two different sizes of tubing can be used (2mm and 3mm inside diameter). This tubing connects to the test points on the equipment being monitored.

The manometer system connects to the customer supplied computer using a USB interface. The measured pressures are displayed on the computer screen in both numeric and bar chart format.

Sophisticated software is provided with facilities to:

- ▶ Display the data from the 16 channels in real time
- ▶ Record data either on operator request, or at constant sampling periods
- ▶ Define the data sampling periods to be used
- ▶ Record data onto the computer for later retrieval, including the option to record the data in Excel format
- ▶ Display tables and graphs of the captured data, with real time updates
- ▶ Calibrate and scale the individual measurement channels
- ▶ Zero the data channels before taking measurements

**Ordering Specification**

- ▶ Electronic multiple channel pressure measurement system designed to replace liquid manometer banks
- ▶ 16 simultaneous measurements displayed on a PC (not supplied)
- ▶ Sophisticated software included, for logging, recording and displaying data
- ▶ 16 channels of 350mm H<sub>2</sub>O capacity, or 14 channels of 350mm plus 2 channels of 125mm H<sub>2</sub>O differential

**Technical Details**

**General purpose channels:**

<b>Range:</b>	0 to 350mm H <sub>2</sub> O
<b>Repeatability:</b>	0.5mm H <sub>2</sub> O
<b>Absolute accuracy:</b>	0.5% FSD
<b>Media:</b>	Wet or Dry, non corrosive

**High sensitivity channels:**

<b>Range:</b>	0 to 125mm H <sub>2</sub> O differential
<b>Repeatability:</b>	0.1mm H <sub>2</sub> O
<b>Media:</b>	Dry air only

**Essential Equipment**

Personal computer, with USB interface, running Windows 8 and later.

**Requirements**

AC mains: Universal input, 100-250V ac, 50-60Hz

**Associated Armfield Products**

- C2:** Subsonic Wind Tunnel
- F6:** Air Flow Studies



**Overall dimensions**

<b>Length</b>	250mm
<b>Width</b>	260mm
<b>Height</b>	113mm

**Packed and crated shipping specifications**

Product	Volume	Gross Weight
<b>H14/2:</b>	0.015m <sup>3</sup>	15kg

**Ordering codes**

- ▶ H14/2



**H**  
SERIES

**Pitot Tube - H30**

**H30-1H / H30-3H - Pitot Tubes**

A range of Pitot tubes for the measurement of water velocity in open channels and closed ducts.

**Description**

Tubes are in stainless steel and mounted on a supporting body with scale. They are supplied with a watertight gland for installation below water level.

In order to measure velocity, the Pitot tubes must be connected to a manometer, such as the Armfield H12-8 or H12-9.

When used with the H12-9, the range is 0 - 5.2m/s. When used with the H12-8 the range is 0 - 19.8m/s

**Ordering Specification**

- ▶ **H30-1H:**
  - 150mm Pitot tube
  - 150mm traverse Pitot tube supplied with connectors and
  - 10m tubing
- ▶ **H30-2H:**
  - 300mm Pitot tube
  - 300mm traverse Pitot tube supplied with connectors and
  - 10m tubing
- ▶ **H30-3H:**
  - 450mm Pitot tube
  - 450mm traverse Pitot tube supplied with connectors and
  - 10m tubing

**Accessories**

- H1-11:** Adjustable Tripod stand
- H12-8:** Portable pressure meters
- H12-9:** Portable pressure meters



**Overall dimensions**

See Order Specifications

**Packed and crated shipping specifications**

Product	Volume	Gross Weight
H30-1H / H30-2H / H30-3H	0.1m <sup>3</sup>	5kg



**Ordering codes**

- ▶ H30-1H
- ▶ H30-2H
- ▶ H30-3H

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**Propeller Velocity Flowmeter - H33 / H33-10**



**H33 - Propeller Velocity Flowmeter**

Used to measure very low point-velocities in water and other conductive fluids, this flowmeter uses the impedance of a rotating multi-bladed propeller to indicate rotational speed caused by the flowing fluid.

**Description - H33**

The fine diameter of the sensing head enables the meter to be used in small ducts and channels with an ability to measure fluid velocity as low as 25 mm/sec.

A probe and digital indicator are required in combination to perform measurements but the digital indicator is supplied separately from the probes to allow an appropriate probe to be selected to suit specific applications.

**Miniature Propeller Probes (H33-1/H33-2/H33-3)**

Each probe consists of a sensing head that is mounted at the end of a slim stainless steel stem. A co-axial connector at the top of the stem allows the probe to be connected to the H33-10 Digital Indicator.

The sensing head consists of a 5-bladed propeller that runs in jewelled bearings. The propeller is able to rotate freely within a protective shrouded cage. An insulated gold electrode terminates 0.1mm from the tip of the rotating blades and detects the change in electrical impedance as each blade passes. As there is no physical contact between the electrode and blade, the propeller can rotate freely and respond to low velocity of the surrounding fluid.

**Technical Details H33**

<b>Rotor:</b>	11.6 mm diameter, machined plastic (balanced)
<b>Spindle:</b>	Hardened stainless steel with conical ends
<b>Bearings:</b>	Synthetic sapphire vee jewels
<b>Cage:</b>	Nickel plated bronze
<b>Stem:</b>	Stainless steel
<b>Electrical connector:</b>	Co-axial
<b>Weight:</b>	0.20kg
<b>Immersion length:</b>	420mm maximum

**Capabilities**

- ▶ Measurement of velocity in clean conductive fluid within the range 25 to 1500mm/sec (up to 3000mm/sec with the high speed probe)
- ▶ Operation in confined spaces with limited intrusive effects
- ▶ Suitable for both laboratory and field applications - battery powered (rechargeable) and fully portable
- ▶ Measurements are indicated on the digital display and may be connected to a data logger for later analysis

**Accessories**

**H1-11:** Adjustable Tripod stand with mountings

**Packed and crated shipping specifications**

Product	Volume	Gross Weight
<b>H33/1/2/3:</b>	0.1m <sup>3</sup>	2kg
<b>H33-10:</b>	0.1m <sup>3</sup>	5kg

**H33-10 - Digital Indicator**

The digital indicator has been developed for use with the miniature propeller probes H33-1/2/3 where laboratory or field measurement of water velocity is required.

**Description - H33-10**

The digital indicator may be battery powered or mains powered using the standard power adaptor supplied. The power adaptor is intended for world-wide use and has four interchangeable plugs to suit all regions. The unit can operate on 110 Volts or 230 Volts at 50Hz or 60Hz.

When connected to an appropriate probe, the unit will indicate frequency of the pulses from the propeller that can be converted to water velocity using the calibration chart supplied with the probe. The unit can be programmed to read water velocity directly in units of cm/sec by entering a calibration constant for the probe in use (obtained from the chart supplied with each probe). Alternatively the unit can be programmed to count the pulses continuously, allowing averaging of the velocity measurement over a longer (user defined) period.

A 0-5 V DC output allows the unit to be connected to a suitable data logger to provide a permanent record of the variations in water velocity with time. A co-axial lead, 3 metres long, is supplied with the digital indicator for connecting it to any of the miniature propeller probes described above.

**Technical Details H33-10**

<b>Power:</b>	Four AA rechargeable batteries (supplied)
<b>Battery life:</b>	Typically 300 hrs on full charge
<b>Display:</b>	3-digit liquid crystal
<b>Controls:</b>	On/off switch, sample time switches for 1 & 10 seconds
<b>Input:</b>	Miniature socket for co-axial cable from probe
<b>Output</b>	0-5V DC
<b>Case size:</b>	190 x 136 x 55mm overall Moulded ABS plastic
<b>Weight:</b>	0.55kg with batteries fitted

H33-10 Flow meter shown with probe



**Ordering codes**

- ▶ H33    ▶ H33-1    ▶ H33-2    ▶ H33-3    ▶ H33-10



**Wave Probe System - H40-MKII**

**H40-MKII - Wave Probe System**

**The H40-MKII is suitable for use in:**

2D flume: For this configuration, the wave probes are supplied with a mounting block allowing the calibration stem, that is fixed to the wave probe head, to be attached to any vertical surface.

3D wave basin: For basins, The H40-MKII-7 Twin Wire Wave Probe Tripod is used for mounting the 600 to 1200 mm wave probes. For shallow water up to 1 m depth, a smaller stand to fit 300 mm wave probes is available.

**Description - H40-MKII**

The H40-MKII Wave Probe Case contains the signal conditioning circuitry for up to eight wave probes and a network connection to allow a computer to configure the probes. If more than eight probes are required to be used at the same time in the physical model then multiple cases can be linked together, so that only one computer is required for configuration.

The input connections for the wave probes are provided using 4mm sockets on one face of the case. The opposite face has connections to allow the device to be directly connected to a computer via an Ethernet cable and to an existing data acquisition system using analogue signal outputs. The unit is powered from an external 24Vdc laptop-style power supply.

The wave probe case is set up using a built-in web page which is accessed from the PC using the network connection. Whilst testing is underway the data acquired by the instrument is also transmitted over the network connection for collection by appropriate software(not supplied by Armfield).

The wave probe operates by measuring the current that flows between two stainless steel wires that are immersed in water. This current is converted to an output voltage that is directly proportional to the immersed depth. Each wave probe case contains the energising and sensing circuits for the operation of eight wave probes and provides an output voltage (0-5V) for all eight channels on a 16-way output connector. In order to avoid polarisation effects at the probe, a high frequency square wave is used to energise the probe.

Adjacent probes are set to different frequencies to allow probes to be used close together without causing any interference. Each wave probe channel contains circuitry designed to compensate for the resistance of the cable that connects the probe to the wave probe unit. Without this compensation, the output of the wave probe monitor would be non-linear.

The probe output voltage is converted to a digital reading using an analogue to digital converter and the readings are batched and transmitted over the network in packets of data at a rate of 100 samples per second. The configuration process allows the user to set the output level for a given initial probe immersion. This enables the user to scale the output, from zero (no water over probe) to maximum output for a desired full scale immersion.

The wave probes comprise two parallel stainless steel rods with a plastic head and foot. The head is fixed to the calibration stem and a mounting block is supplied that allows the calibration stem to be fixed to any vertical surface.

**Overall dimensions**

Length 250mm / Width 100mm / Height 40mm

**Packed and crated shipping specifications**

<b>H40-MKII</b>	0.1m <sup>3</sup>	3kg
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UK office - email: sales@armfield.co.uk tel: +44 (0) 1425 478781 (for ROW)

USA office - email: info@armfield.inc tel: +1 (609) 208-2800 (USA only)

**Features / benefits**

- ▶ Extremely linear output
- ▶ No hysteresis
- ▶ Reliable, proven design, easily calibrated
- ▶ Longer distances from the data acquisition PC can be achieved by linking two wave probe cases together
- ▶ Supplied with 8 channels as standard
- ▶ Data can be logged directly into a computer via the network link

**Technical specification (Wave probe case)**

<b>Case configuration:</b>	8 channels (wave probes)
<b>Output signals:</b>	EtherNET digital output comms cable network to data acquisition PC 0-5 V via 16-wayDC connector
<b>Excitation frequency:</b>	3 kHz to 11 kHz
<b>Filter band width:</b>	-3 dB at 2.0Hz
<b>Supply voltage:</b>	220 or 110 V ±10% 40-60 Hz
<b>Trigger function:</b>	+5 V input signal trigger

**Technical specification (Wave probe)**

<b>Active working range:</b>	300, 600, 900, 1200mm
<b>Probe diameter (300mm):</b>	1.6mm
<b>Probe diameter (600, 900, 1200mm):</b>	6.0mm
<b>Probe cable length:</b>	30m (Supplied)

**Requirements**

**Scale**

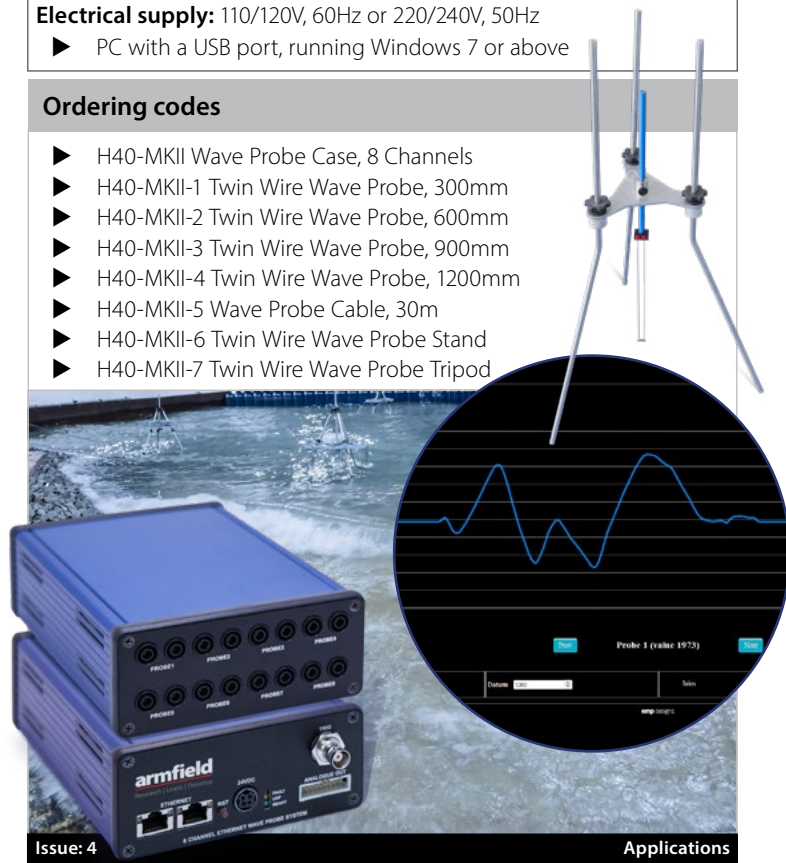


**Electrical supply:** 110/120V, 60Hz or 220/240V, 50Hz

- ▶ PC with a USB port, running Windows 7 or above

**Ordering codes**

- ▶ H40-MKII Wave Probe Case, 8 Channels
- ▶ H40-MKII-1 Twin Wire Wave Probe, 300mm
- ▶ H40-MKII-2 Twin Wire Wave Probe, 600mm
- ▶ H40-MKII-3 Twin Wire Wave Probe, 900mm
- ▶ H40-MKII-4 Twin Wire Wave Probe, 1200mm
- ▶ H40-MKII-5 Wave Probe Cable, 30m
- ▶ H40-MKII-6 Twin Wire Wave Probe Stand
- ▶ H40-MKII-7 Twin Wire Wave Probe Tripod



Issue: 4

URL: <http://www.armfield.co.uk/h1>

Applications



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**Description**

The H41 consists of two main assemblies: the nanoLase light sheet projector and the rtCam camera, with built-in timing synchroniser. The rtCam interfaces to the rtControl software package, which runs on a standard PC under Windows XP (not supplied by Armfield).

The nanoLase consists of a low-power solid-state laser, together with optics to form the beam into a ~3mm thick, 45° wide light sheet. The laser is modulated to produce pairs of pulses, with an adjustable delay (known as  $\Delta t$ ) of between 100µs and 5s. Both the pulse separation and pulse width can be set directly from the rtControl software.

The nanoLase and rtCam are arranged orthogonally around the flow to be measured, with the laser being used to illuminate flow-following 'seeding' particles that have been mixed into the water. The system is supplied with 100g of 100µm polyamide particles, which are suitable for the majority of water-based flows. These particles scatter light toward the rtCam, which acquires a pair of images every time the laser emits a pulse pair.

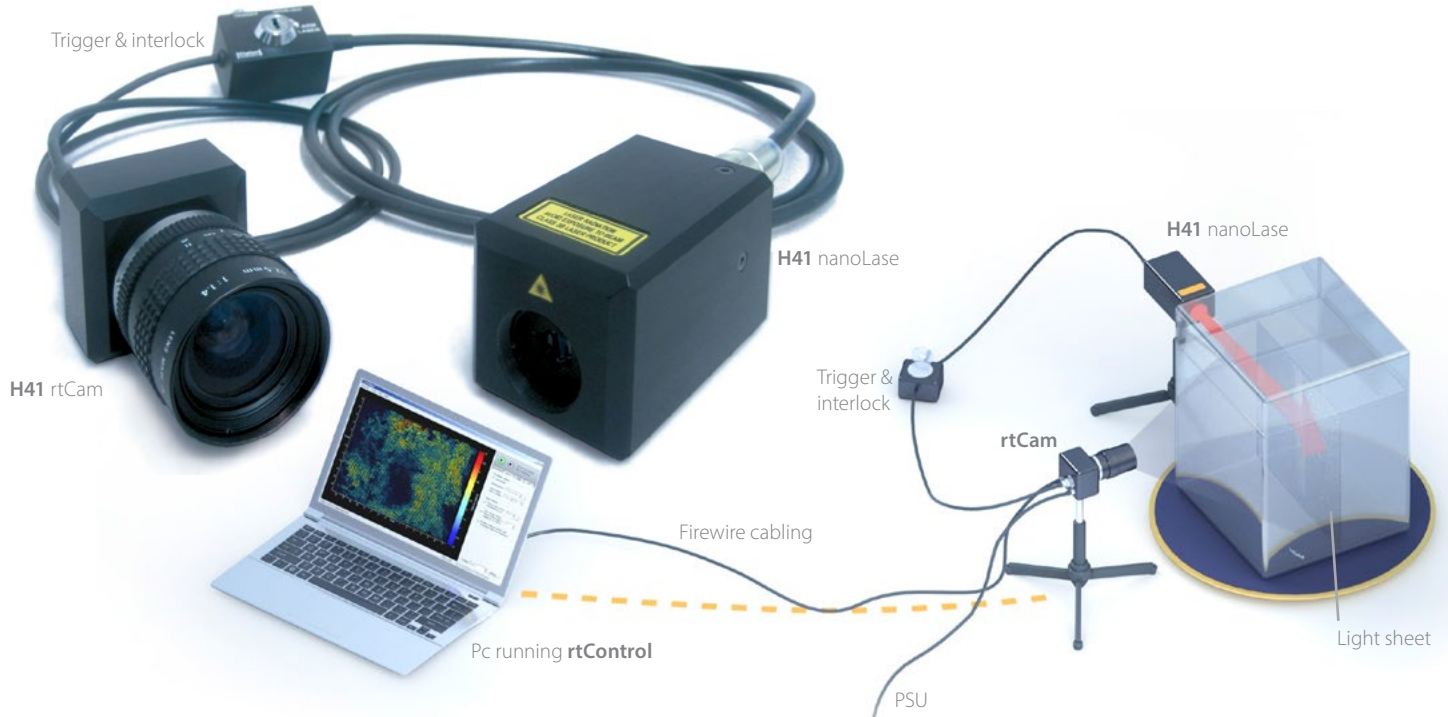
Each pair of particle images are immediately sent to the control PC using a standard FireWire (IEEE 1394) connection. The rtControl software then subdivides the images into 'tiles', which are cross-correlated in order to measure the displacement of the seeding particles in that area.

Because the delay between the images is known, a velocity map can be calculated for the whole of the camera's field of view. While most PIV systems take several minutes to get to this point, rtCam and rtControl can repeat the entire process up to 16 times a second.

In addition to the real-time velocity vector maps, rtControl can calculate and display derived statistical data (such as vorticity or time-averaged velocity) with options to superimpose vectors, scalars, and video on top of each other. Similarly, there are options to record data as either raw images (in BMP format), or as processed vectors or scalars (in AVI movie, CSV spreadsheet, or Matlab® archive format). Previously recorded data sets can be loaded into rtControl for subsequent display and analysis.

Both the rtCam and the nanoLase are fitted with standard mountings suitable for a selection of different mounting mechanisms. The system is supplied with one small desktop tripod; larger tripods and various snake-arm mounts are available as accessories. Also available are purpose-designed mounts designed for use with Armfield flow channels.

The system is provided complete with all cables and packed into an aluminium flight case for safe storage and easy transport.



**Features**

- ▶ The H41 uses particle image velocimetry (PIV) to measure, non-intrusively, fluid velocities at multiple points in a flow, at a rate of up to 16Hz.
- ▶ The compact and portable hardware (which uses a safe, non-pulsed Class 3b laser) and extremely easy-to-use software with real-time display, make this an ideal tool for undergraduate teaching and demonstration.
- ▶ With its sophisticated multipass processing, the H41 matches the performance of higher power PIV systems costing several times more. It is therefore also an ideal, cost-effective tool for experimental fluid dynamics research.
- ▶ The intuitive software provides a wide range of processing, display and recording functions for both velocity and derived statistical data, using a standard PC.



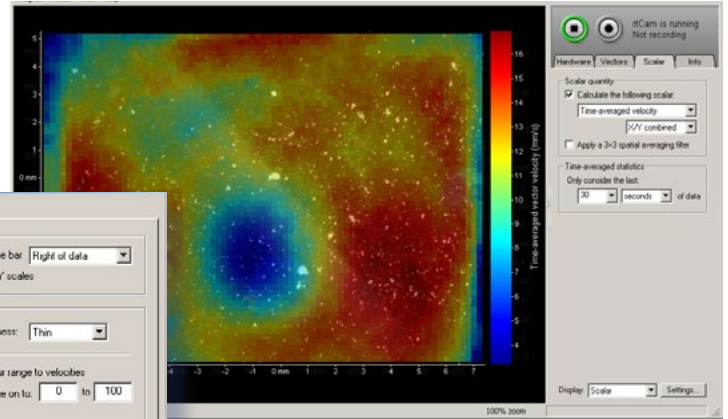
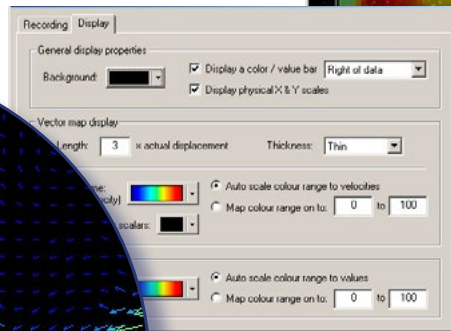
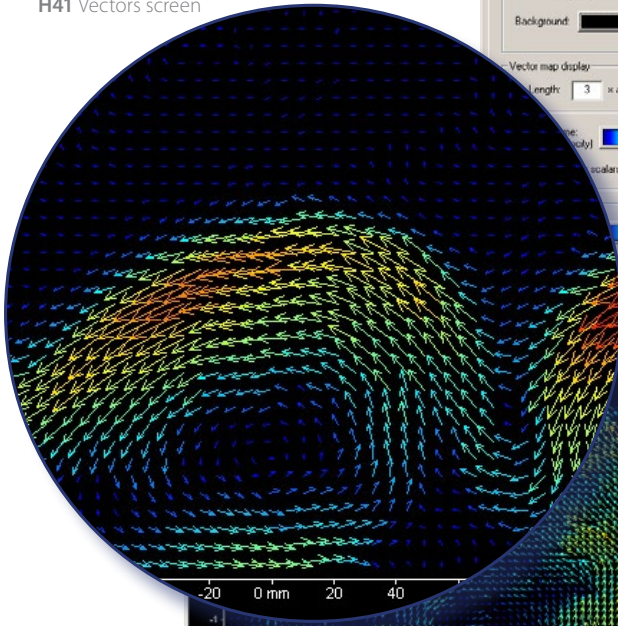
## Technical specifications

<b>Lasers:</b>	<ul style="list-style-type: none"> <li>▶ Solid-state air-cooled 200mW, 660nm laser diode (Class 3b)</li> <li>▶ Standard optics produce a ca 3mm thick, 45° light sheet (ca 200mm wide at 250mm)</li> <li>▶ Interchangeable 20° light sheet optic available (H41-3)</li> <li>▶ Pulse separation (<math>\Delta t</math>) of between 100<math>\mu</math>s and 5s (in steps of 10<math>\mu</math>s)</li> <li>▶ Pulse width of between 10<math>\mu</math>s and 32ms (in steps of 10<math>\mu</math>s)</li> </ul>
<b>Camera:</b>	<ul style="list-style-type: none"> <li>▶ Super-sensitive VGA CMOS sensor: <ul style="list-style-type: none"> <li>- 640x480, 6.0<math>\mu</math>m pixels (1/3" format);</li> <li>- ~50% quantum efficiency at 660nm;</li> <li>- 75-110dB dynamic range;</li> <li>- 4.8 V/lux-sec sensitivity</li> </ul> </li> <li>▶ Trigger input enables image pair acquisition to be synchronised with external events</li> <li>▶ Accepts standard CS or C-mount lenses (12.5mm f/1.4 lens supplied)</li> <li>▶ Camera exposure can be linked to the laser's pulsing, thereby enabling operation in a lit room</li> </ul>

## Software processing

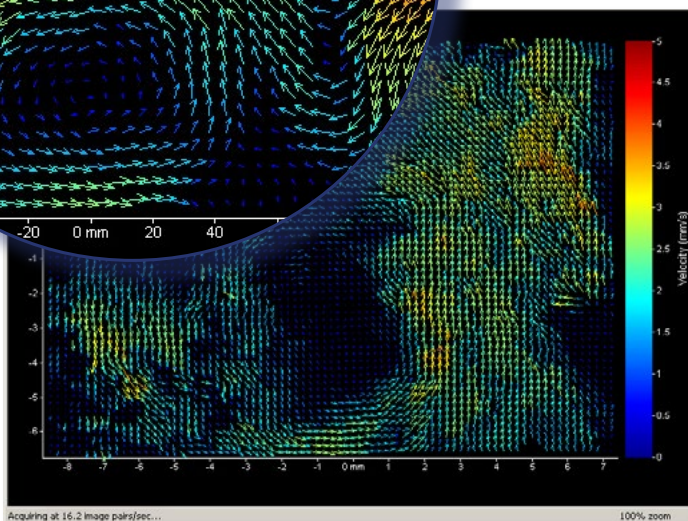
- ▶ Data refresh and recording rate up to 16Hz (dependent on the computer speed, the selected acquisition and PIV analysis parameters and the recording taking place)
- ▶ Real-time, or offline, two-component vector calculation
- ▶ Single-pass or adaptive multipass cross-correlation with 8, 12, 16, 24, 32 or 64 pixel window sizes
- ▶ 0% or 50% window overlap (ie maps of up to 19,000 vectors)
- ▶ Optional vector interpolation and filtering based on:
  - User-supplied velocity limits
  - RMS of neighbouring vectors' values
- ▶ Calculation of the following derived scalars:
  - Vector angle and magnitude
  - Vorticity and swirl
  - Time-averaged mean velocity
  - RMS and turbulence intensity
- ▶ Where applicable, vector component and statistical sample number are user-defined

H41 Vectors screen

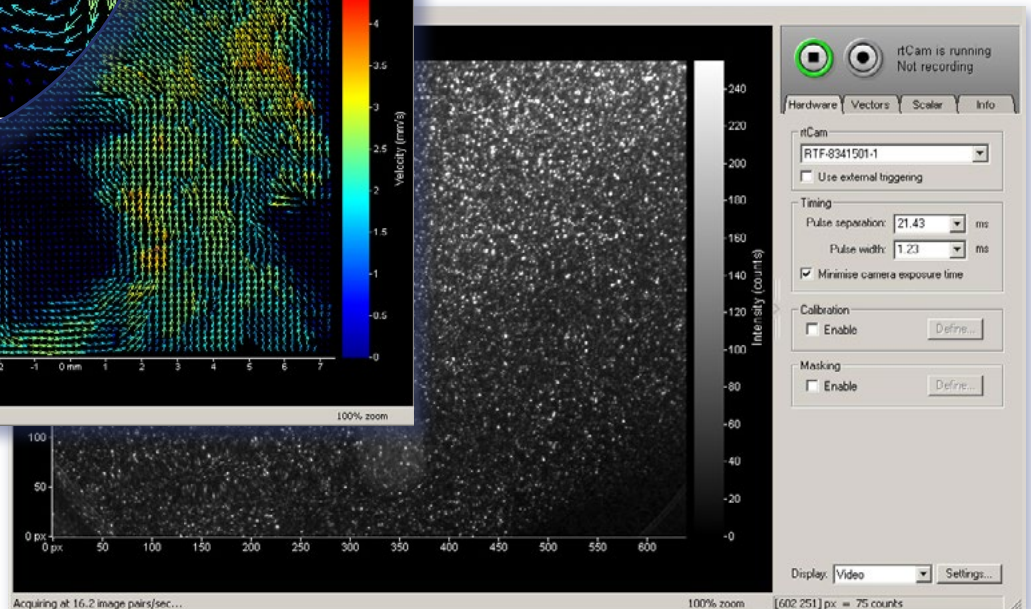


H41 Scalar screen

H41 Video screen



H41 Vectors screen



## Options

- ▶ A range of further options are available to suit specific user applications, including:
- ▶ Waterproof enclosure for the rtCam, to enable complete submersion in water, eg for use with a large towing tank
- ▶ Flashlamps can be supplied in place of the nanoLase, for surface velocimetry measurements
- ▶ Higher power versions of the nanoLase are available for measuring larger areas or faster flows
- ▶ The rtCam can be supplied with macro or telephoto lenses
- ▶ A light-sheet thickness adjuster is available for micro-PIV measurements

**Please contact Armfield for further details of these options.**

## Requirements

## Scale



- ▶ Electrical supply:  
**H41-1-A, H41-2-A:** 220-240V/1ph/50Hz
- ▶ Voltage Variants:  
**H41-1, H41-2:** 90-264V, 47-63Hz
- ▶ A PC running Windows 98 or above, with a FireWire port. Laptop FireWire ports require a suitable four to six-pin cable.
- ▶ It is recommended the PC has at least 2GB RAM with a processing speed of at least 2GHz. The display resolution should be at least 1024x768, true colour.
- ▶ The data refresh rate achievable is dependent on the specification of this computer. For example, to achieve 16Hz data refresh and recording rate, a 2.66GHz Intel dual core processor or better is required, and the hard drive must support sustained writes at 9.5 Mb/s.

## Overall dimensions

### nanoLase:

Length	0.05mm
Width	0.05mm
Height	0.085mm

### Submersible nanoLase:

Length	0.05mm
Width	0.05mm
Height	0.095mm

### rtCam:

Length	0.05mm
Width	0.05mm
Height	0.09mm

### Packed and crated shipping specifications

Product	Volume	Gross Weight
H41-1 / H41-2	0.1 m <sup>3</sup>	5kg



## Optional accessories

- ▶ **H41-3 20° Light sheet Optics for nanoLase**  
The standard 45° light sheet optics can be replaced with item H41-3 in order to produce a narrower 22° fan angle. This can be useful in cases where the nanoLase needs to be placed farther away from the measurement area.
- ▶ **H41-5 1.5m tripod for rtCam**
- ▶ **H41-6 Snake-arm with magnetic base for nanoLase**
- ▶ **H41-7 Snake-arm with G-Clamp base for nanoLase**
- ▶ **C4-12 Mounting system for Armfield**
- ▶ **C4-MkII flume** (requires H41-2 submersible nanoLase and H41-3 optics option)
- ▶ **S16-12 Mounting system for Armfield S16 Hydraulic Flow Demonstrator** (requires H41-2 submersible nanoLase and H41-3 optics option)

## Consumables

- ▶ **H41-4 Seeding particles suitable for water flows (200g)**

## Ordering specification

- ▶ Particle Image Velocimetry (PIV) system, comprising a laser light sheet projector, a camera system and processing software
- ▶ 200mW (Class 3b) 660nm laser, with variable pulse width and pulse spacing
- ▶ 45° light sheet optics as standard with optional optics to produce a 20° sheet
- ▶ Real-time 2D display of flow velocity vectors updated at up to 16Hz
- ▶ Data can be recorded in video (avi), bitmap (bmp), text (csv) and Matlab (mat) formats
- ▶ Option of submersible light sheet projector

## Ordering details

**H41-1** Laser PIV System for Flow Measurement and Visualisation

**H41-2** Laser PIV System for Flow Measurement and Visualisation with submersible nanoLase light sheet projector

## Ordering codes

▶ **H41-1**

▶ **H41-2**

## Knowledge base

- > 28 years expertise in research & development technology
- > 50 years providing engaging engineering teaching equipment

Benefit from our experience, just call or email to discuss your laboratory needs, latest project or application.

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