



armfield

CAPTURE MkII – Issue 2

PUMP DEMONSTRATION UNITS AIR FLOW DEMONSTRATION UNITS TURBINE DEMONSTRATION UNITS



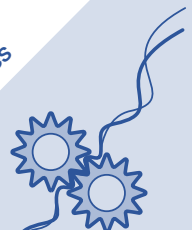
The Armfield CAPTURE range is a unique range of small scale teaching equipment, designed to give students an unparalleled insight into the principles of these machines.

With the introduction of CAPTURE, machines that were once costly, cumbersome and difficult to use became affordable, space saving and easy to use. Now CAPTURE MkII takes the concept forward into new realms of student understanding, adding superb visibility of the working of the machines and taking full advantage of the latest software and instrumentation techniques.

All the CAPTURE units use standard PCs to display, record and manipulate the data. The world-beating Armfield educational software provides extensive facilities aimed specifically at engineering education and enhancing the learning experience. A common software format is used across all machines. Similarly the machines all use a common interface unit, thus providing a cost effective solution when more than one demonstration is required.

CAPTURE MkII comprises:
Pumps, Fans and Compressors, and Turbines.

Fluid Machines



FM

CAPTURE MKII AIR FLOW DEMONSTRATION UNITS

FM40 SERIES

FLUID
MACHINES

THE AIR FLOW MACHINES

The CAPTURE MkII Air Flow Machines are designed to demonstrate to engineering students the operating principles and characteristics of different types of fans and compressors.

Three different machines are available, a centrifugal fan, an axial fan and a centrifugal compressor.

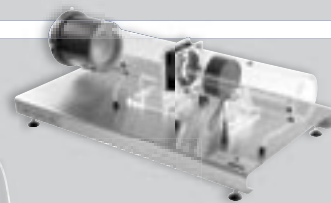
FM40

CENTRIFUGAL FAN DEMONSTRATION UNIT



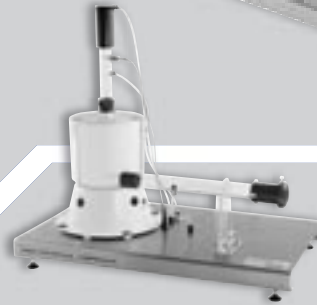
FM41

AXIAL FAN DEMONSTRATION UNIT



FM42

CENTRIFUGAL COMPRESSOR DEMONSTRATION UNIT



COMMON FEATURES OF ALL AIR FLOW MACHINES

- Transparent ducts for maximum visibility of the machines, and associated educational benefit
- Computer linking, with a common interface unit for all the CAPTURE MkII range (IFD7)
- Advanced educational software included with all units
- Simple interconnections and interfacing
- Stainless steel bases

The FM40 and FM42 use three phase ac motors, allowing:

- Stable speed control using a slip compensated inverter drive.
- Electronic measurement of torque at the motor drive shaft using a sensor-less torque vector drive.

The FM40 and FM42

CAPTURE MKII PUMP DEMONSTRATION UNITS

FM50 SERIES
FLUID
MACHINES

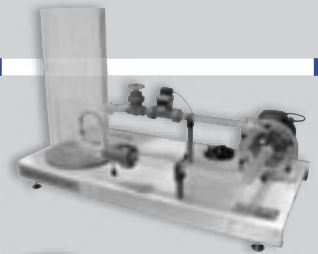
THE PUMPS

The CAPTURE MkII Pumps are designed to demonstrate to engineering students the operating principles and characteristics of different types of pumps.

Three different pump types are available, a centrifugal pump, a gear pump and a plunger pump, all using identical electric motors to allow a realistic comparison to be made. Also the FM51 includes two centrifugal pumps, which can be configured as single pump, two pumps in parallel and two pumps in series.

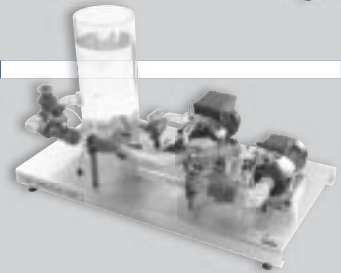
FM50

CENTRIFUGAL PUMP DEMONSTRATION UNIT



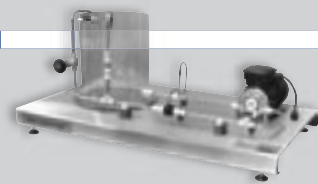
FM51

SERIES AND PARALLEL PUMPS DEMONSTRATION UNIT



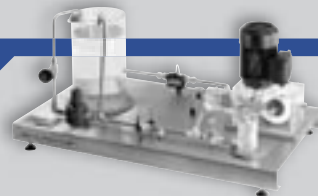
FM52

GEAR PUMP DEMONSTRATION UNIT



FM53

PLUNGER PUMP DEMONSTRATION UNIT



COMMON FEATURES OF ALL PUMP RIGS

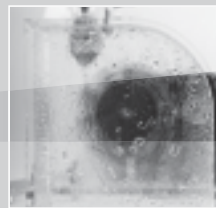
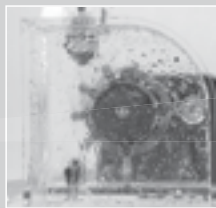
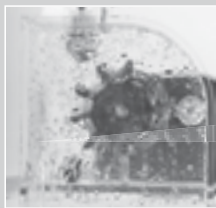
- Transparent Pump bodies for maximum impact and educational benefit
- Computer linking, with a common interface unit for all the CAPTURE MkII range (IFD7)
- Advanced educational software included with all units
- Stable speed control using a slip compensated inverter drive
- Electronic measurement of torque at the pump drive shaft using a sensor-less torque vector drive
- Simple interconnections and interfacing
- Stainless steel bases

CAPTURE MKII TURBINE DEMONSTRATION UNITS

FM60 SERIES FLUID MACHINES

THE TURBINES

The CAPTURE MKII Turbines are designed to allow students to investigate the performance of different types of water turbine. Four models are available, three compact units which fit onto a common service unit, and one larger, self contained floor standing unit.



FM6X
TURBINE SERVICE UNIT



FM6X shown fitted with the FM62 Pelton Turbine Demonstration unit

FM63
PROPELLER TURBINE DEMONSTRATION UNIT



FM60 SERIES

FLUID
MACHINES

FM60

IMPULSE TURBINE DEMONSTRATION UNIT



FM61

REACTION TURBINE DEMONSTRATION UNIT



FM62

PELTON TURBINE DEMONSTRATION UNIT



COMMON FEATURES OF ALL TURBINES

- *Transparent working section to allow visibility of moving parts*
- *Link to a computer via a common interface (IFD7)*
- *Electronic sensors measure key variables*
- *Advanced educational software for results processing*

FM64

PUMP TEST ACCESSORY



CAPTURE MKII SOFTWARE

FM SERIES FLUID MACHINES



SOFTWARE

Windows based software is supplied with the CAPTURE range of equipment offering a complete teaching package of course work and laboratory investigation. The familiar Windows environment allows the student to explore the principles of each machine quickly and easily, highlighting the difference between theoretical and practical measurements, thus providing a good understanding of the principles involved.

This software runs under the XP operating system and has been designed for maximum flexibility and ease of use. Comprehensive Help screens guide the student through both the theoretical background and the practical investigation of the machine under examination. Suggested laboratory investigations and further questions for the student to answer are included in the software, together with all the information required to set up and run the teaching exercises.

See www.armfield.co.uk/softsens for an overview of the powerful features of the Armfield software.

SOFTWARE CAPABILITIES

This software includes a range of functions and capabilities designed to make the operation of the equipment and processing of the results more straightforward, and also to enhance student understanding of the subjects being covered.

It includes:

- Diagrammatic representation of the equipment, complete with real time display of the various sensor outputs
- Presentation screens, giving an overview of the software, the equipment, the procedure and associated theory
- Detailed 'Help' facilities giving in depth guidance
- Automatic data logging of sensor values into a spread sheet format
- Control over sampling intervals
- Student questions and answers, including a layered 'Hint' facility
- Processing of sampled values (this may be linked to the questions and answers to ensure student understanding)
- Sophisticated graph plotting facilities of both measured and calculated values, including comparisons taken under different conditions
- Export of data to Microsoft Excel or other spread sheets
- Links to user defined word processor
- Calibration facility for sensors
- Real time bar graph display of sensor outputs
- Recent history graphical display



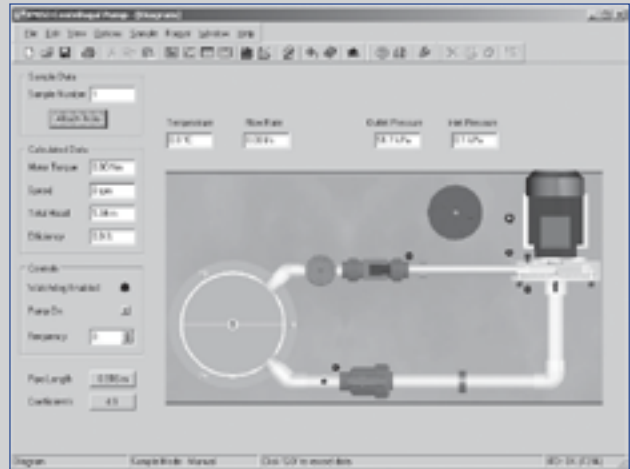
TECHNICAL DETAILS

The analogue output data is digitised and transferred to a computer using the standard USB. This allows any standard modern Windows computer to be used, including notebooks, and does not require any internal access to the computer.

The equipment is supplied complete with a USB lead for connection to the computer.

The CAPTURE MkII unit interfaces to the user's computer using the IFD7 device and the USB port of the user's computer.

Also available is a software driver that allows the outputs to be read in other software programs, such as Labview.



Typical software screenshot of Mimic diagram

CAPTURE MKII ESSENTIAL EQUIPMENT – IFD7

IFD7 Interface Unit

The interface between the CAPTURE MkII units and the user's computer is provided by the Armfield IFD7 Interface device.

This conditions the raw data from the sensors, digitises the data and transfers it to the computer using the USB interface.

It also includes a sophisticated 3 phase inverter for providing accurate motor speed control, and a second motor drive output, all under software control.



Armfield IFD7 Interface Unit

ORDERING SPECIFICATION

- A computer interface accessory for use with all CAPTURE MkII FM fluid machines.
- Connects to FM equipment sensors via a single multi-way connector.
- 3-phase mains output with variable frequency for accurate motor speed control.
- Sensor-less vector motor drive to measure motor torque.
- Automatic slip compensation to maintain constant speed.
- Secondary mains output, switched under software control.
- Interface driver allows linking to other software packages.
- Built-in watchdog circuitry for remote operation (with suitable equipment).

Typical CAPTURE MKII set-up

Main unit (Pump, Fan, Compressor or Turbine), linked to the IFD7 Interface Unit, connected to the user's PC running the supplied advanced educational software.

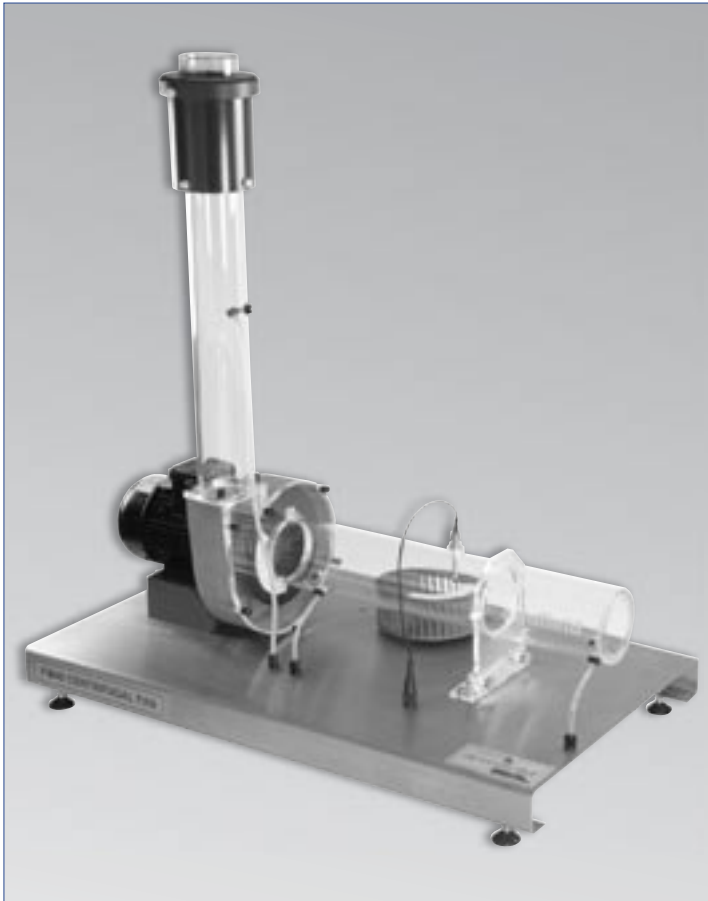


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CENTRIFUGAL FAN DEMONSTRATION UNIT

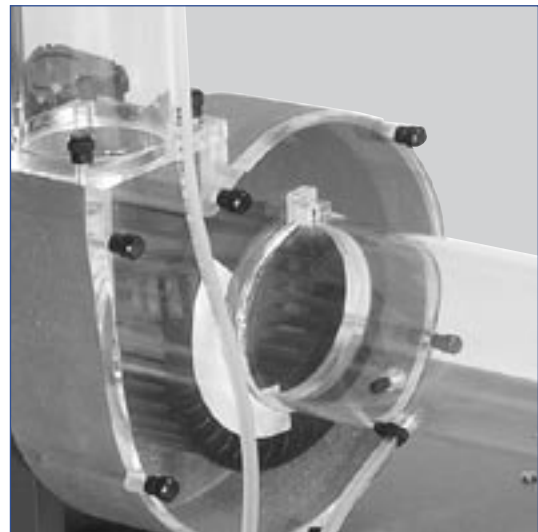
FM40
issue 2



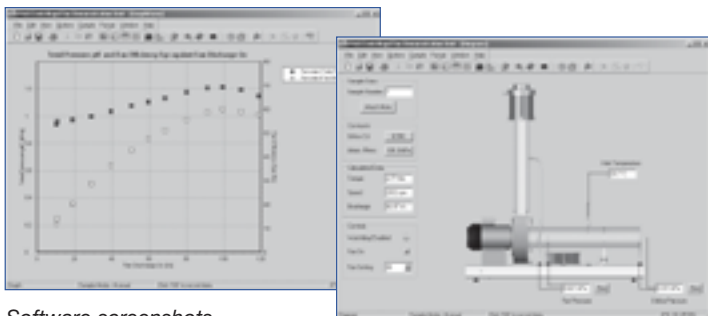
FM40 Centrifugal Fan Demonstration Unit

The centrifugal fan is a radial flow machine which produces the necessary pressure to move gas by the centrifugal force built up inside the fan casing. The design of the fan blade has a primary influence on performance.

These types of fans are usually employed for ventilating duties requiring a somewhat higher delivery pressure than that available from axial fans.



Detail of the Centrifugal Fan



Software screenshots

INSTRUCTIONAL CAPABILITIES

- *Measurement of constant-speed machine performance in terms of static and total pressures, rotor speed and motor shaft power, as a function of inlet flow*
- *Measurement of fan efficiency and estimation of impeller power efficiency*
- *Measurement of performance at constant speeds*
- *Introduction to similarity laws for scale-up*
- *Comparison of student calculations with computer results*

DESCRIPTION

A motor driven centrifugal fan, mounted on a stainless steel plinth. Transparent air inlet and air outlet ducts allow the fan volute and the impeller to be clearly observed. A manually operated adjustable aperture allows the air flow rate to be varied at constant fan speed. A calibrated orifice plate is used on the discharge to measure the air flow rate.

Interchangeable backward and forward curved blade impellers are provided, to facilitate direct comparison between their respective operating characteristics and to demonstrate to which duties each is best suited.

Electronic sensors measure the pressure head developed across the fan, the pressure across the orifice plate (and hence the flow rate) and the air temperature.

The fan speed is accurately controlled by an advanced electronic inverter within the IFD7 (an essential accessory). This inverter also calculates the torque produced at the motor drive shaft, allowing the power used by the fan to be derived. The IFD7 also provides the conditioning electronics for the sensors and allows their readings to be displayed on the computer software. Connections to the IFD7 are a single multi-way connector for the sensors and a connector for the fan motor drive.

The equipment is provided with advanced education and data logging software. See the software section of this datasheet for further details.

PERFORMANCE SPECIFICATION

*Max Flow Rate: 70 l/second typical
Max Head: 0.7KPa
Max fan speed 3000rpm
Motor Power rating 550W*

ORDERING SPECIFICATION

- ***A small-scale centrifugal fan demonstration unit, comprising of an inlet duct, the fan, an outlet duct and an adjustable aperture, all mounted on a stainless steel base.***
- ***Equipped with electronic measurement sensors for fan head pressure, flow-rate (via orifice plate) and air temperature.***
- ***Transparent cover plate on fan volute for visibility.***
- ***Supplied with two different, easily interchangeable impellers.***
- ***Capable of being linked to a PC (not supplied) via a USB interface console (an essential accessory), which does not require internal access to the computer. Also allows interfacing to other software packages.***
- ***Supplied with software providing full instructions for setting up, operating, calibrating and performing the teaching exercises. Facilities for logging, processing and displaying data graphically.***
- ***Offers a complete teaching package of coursework and laboratory investigation, complete with a student questions and answers session.***

ESSENTIAL EQUIPMENT

*Armfield IFD7 Interface Unit
PC with spare USB port*

OVERALL DIMENSIONS

*Height: 0.97m
Length: 0.88m
Width: 0.51m*

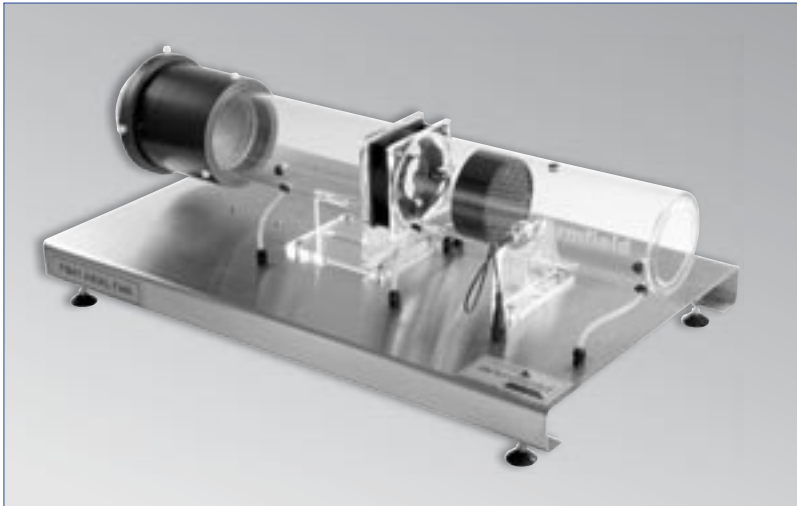
SHIPPING SPECIFICATION

*Gross Weight: 90Kg
Volume: 0.75 m³*



AXIAL FAN DEMONSTRATION UNIT

FM41
issue 2



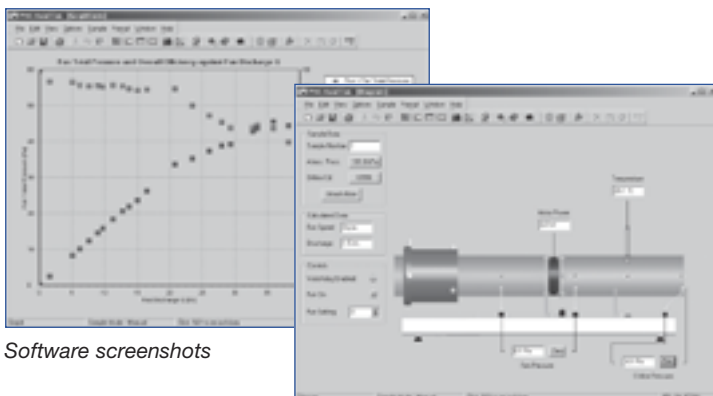
FM41 Axial Fan Demonstration Unit

The axial fan produces gas flow by virtue of the momentum changes imparted across the rotary blades, parallel to the axis of rotation. Such fans are more suitable for higher flows at lower delivery pressures than their centrifugal counterparts.

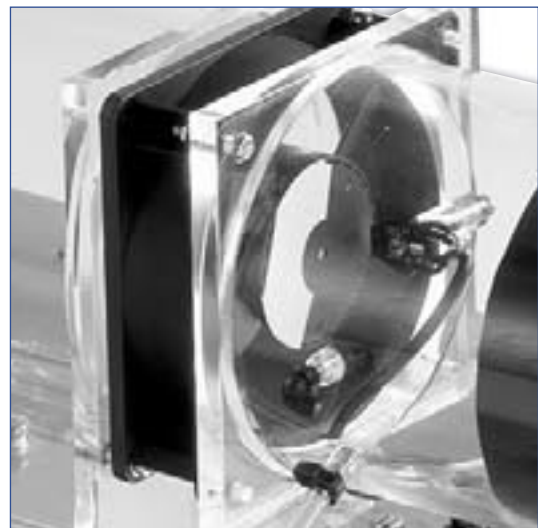
Comparison of the performance characteristics of the FM41 Axial Fan with those of the FM40 Centrifugal Fan thus provides an instructional exercise of valuable practical application.

INSTRUCTIONAL CAPABILITIES

- *Measurement of inherent-speed machine performance in terms of static and total pressures, rotor speed and motor input power, as a function of inlet flow*
- *Measurement of overall efficiency and estimation of impeller power efficiency*
- *Measurement of performance at constant speeds*
- *Introduction to similarity laws for scale-up*
- *Comparison of student calculations with computer results*



Software screenshots



Detail of the Axial Fan

DESCRIPTION

An axial fan, mounted on a stainless steel plinth. Transparent air inlet and air outlet ducts allow the fan construction to be clearly observed.

A manually operated adjustable aperture allows the air flow rate to be varied.

A calibrated orifice plate is used on the discharge to measure the air flow rate.

Electronic sensors measure the pressure head developed across the fan, the pressure across the orifice plate (and hence the flow rate), the rotational speed of the fan and the air temperature.

The fan speed is controlled by modulated dc supply, complete with current sensing to allow the power drawn by the fan to be measured.

An IFD7 is required to provide the conditioning electronics for the sensors and to allow their readings to be displayed on the computer software. Connections to the IFD7 are a single multi-way connector for the sensors and a power connector for the fan drive.

The equipment is provided with advanced education and data logging software. See the software section of this datasheet for further details.

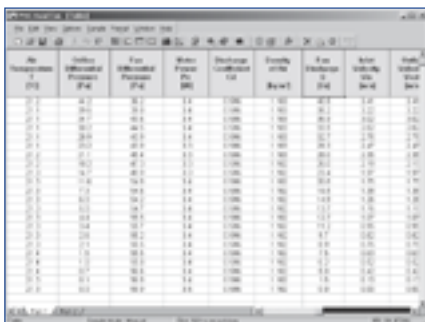
PERFORMANCE SPECIFICATION

Max Flow Rate: 38 l/s typical

Max Head: 0.06 KPa

Max fan speed 2700rpm

Motor Power rating 5W



Time	Flow Rate (l/s)	Pressure Head (KPa)	Fan Speed (rpm)	Air Temperature (°C)
0.0	0.0	0.00	0	20.0
0.1	1.0	0.01	100	20.0
0.2	2.0	0.02	200	20.0
0.3	3.0	0.03	300	20.0
0.4	4.0	0.04	400	20.0
0.5	5.0	0.05	500	20.0
0.6	6.0	0.06	600	20.0
0.7	7.0	0.07	700	20.0
0.8	8.0	0.08	800	20.0
0.9	9.0	0.09	900	20.0
1.0	10.0	0.10	1000	20.0
1.1	11.0	0.11	1100	20.0
1.2	12.0	0.12	1200	20.0
1.3	13.0	0.13	1300	20.0
1.4	14.0	0.14	1400	20.0
1.5	15.0	0.15	1500	20.0
1.6	16.0	0.16	1600	20.0
1.7	17.0	0.17	1700	20.0
1.8	18.0	0.18	1800	20.0
1.9	19.0	0.19	1900	20.0
2.0	20.0	0.20	2000	20.0
2.1	21.0	0.21	2100	20.0
2.2	22.0	0.22	2200	20.0
2.3	23.0	0.23	2300	20.0
2.4	24.0	0.24	2400	20.0
2.5	25.0	0.25	2500	20.0
2.6	26.0	0.26	2600	20.0
2.7	27.0	0.27	2700	20.0
2.8	28.0	0.28	2800	20.0
2.9	29.0	0.29	2900	20.0
3.0	30.0	0.30	3000	20.0
3.1	31.0	0.31	3100	20.0
3.2	32.0	0.32	3200	20.0
3.3	33.0	0.33	3300	20.0
3.4	34.0	0.34	3400	20.0
3.5	35.0	0.35	3500	20.0
3.6	36.0	0.36	3600	20.0
3.7	37.0	0.37	3700	20.0
3.8	38.0	0.38	3800	20.0
3.9	39.0	0.39	3900	20.0
4.0	40.0	0.40	4000	20.0

Software screenshot

ORDERING SPECIFICATION

- **A small-scale axial fan demonstration unit, comprising of an inlet duct, the fan, an outlet duct and an adjustable aperture, all mounted on a stainless steel base.**
- **Equipped with electronic measurement sensors for fan head pressure, flow-rate (via orifice plate), fan speed and air temperature.**
- **Transparent ducts give visibility of the fan in operation.**
- **Capable of being linked to a PC (not supplied) via a USB interface console (an essential accessory), which does not require internal access to the computer. Also allows interfacing to other software packages.**
- **Supplied with software providing full instructions for setting up, operating, calibrating and performing the teaching exercises. Facilities for logging, processing and displaying data graphically.**
- **Offers a complete teaching package of coursework and laboratory investigation, complete with a student questions and answers session.**

ESSENTIAL EQUIPMENT

Armfield IFD7 Interface Unit

PC with spare USB port

OVERALL DIMENSIONS

Height: 0.945m

Length: 0.85m

Width: 0.45m

SHIPPING SPECIFICATION

Gross Weight: 90Kg

Volume: 0.75m³

CENTRIFUGAL COMPRESSOR DEMONSTRATION UNIT



FM42
issue 2

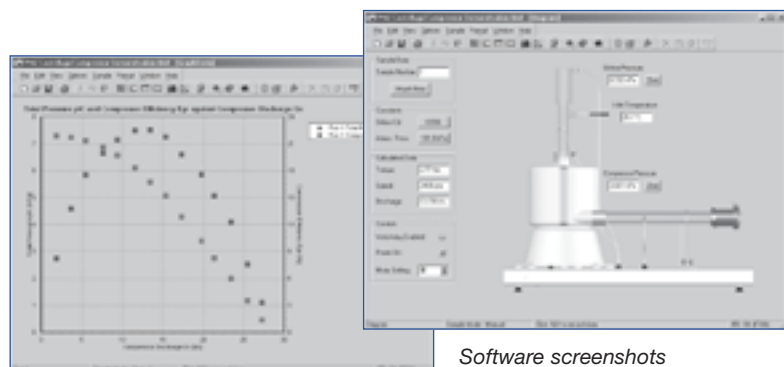
FM42 Centrifugal Compressor Demonstration Unit shown with the IFD7 Interface Unit accessory.

Multi-stage compressors are used industrially for high pressure deliveries of gas flows or suction duties.

The kinetic energy imparted to the gas by the impeller rotation is converted into pressure energy which progressively increases from stage to stage.

INSTRUCTIONAL CAPABILITIES

- *Measurement of constant-speed machine performance in terms of static and total pressures, rotor speed and motor shaft power, as a function of inlet flow*
- *Measurement of compressor efficiency and estimation of impeller power efficiency*
- *Measurement of performance at constant speeds*
- *Introduction to similarity laws for scale-up*
- *Comparison of student calculations with computer results*



Software screenshots

DESCRIPTION

A motor driven multi-stage centrifugal compressor, mounted on a stainless steel plinth with transparent air inlet and air outlet ducts. A manually operated adjustable aperture allows the air flow rate to be varied at constant fan speed. A calibrated orifice plate is used on the discharge to measure the air flow rate.

Electronic sensors measure the pressure head developed across the blower, the pressure across the orifice plate (and hence the flow rate) and the air temperature.

The compressor speed is accurately controlled by an advanced electronic inverter within the IFD7 (an essential accessory). This inverter also calculates the torque produced at the motor drive shaft, allowing the power used by the fan to be derived. The IFD7 also provides the conditioning electronics for the sensors and allows their readings to be displayed on the computer software. Connections to the IFD7 are a single multi-way connector for the sensors and a connector for the pump motor drive.

The equipment is provided with advanced education and data logging software. See the software section of this datasheet for further details.

PERFORMANCE SPECIFICATION

*Max Flow Rate: 20 l/s typical
Max Head: 6.0KPa
Max fan speed 3000rpm
Motor Power rating 250W
Number of stages 7*

ORDERING SPECIFICATION

- *A small-scale multi-stage centrifugal compressor demonstration unit, comprising of an inlet duct, the compressor, an outlet duct and an adjustable aperture, all mounted on a stainless steel base.*
- *Seven stages in the compressor.*
- *Equipped with electronic measurement sensors for head pressure, flow-rate (via orifice plate) and air temperature.*
- *Capable of being linked to a PC (not supplied) via a USB interface console (an essential accessory), which does not require internal access to the computer. Also allows interfacing to other software packages.*
- *Supplied with software providing full instructions for setting up, operating, calibrating and performing the teaching exercises. Facilities for logging, processing and displaying data graphically.*
- *Offers a complete teaching package of coursework and laboratory investigation, complete with a student questions and answers session.*

ESSENTIAL EQUIPMENT

*Armfield IFD7 Interface Unit
PC with spare USB port*

OVERALL DIMENSIONS

*Height: 0.945m
Length: 0.88m
Width: 0.51m*

SHIPPING SPECIFICATION

*Gross Weight: 100Kg
Volume: 0.75m³*

CENTRIFUGAL PUMP DEMONSTRATION UNIT



FM50
issue 2

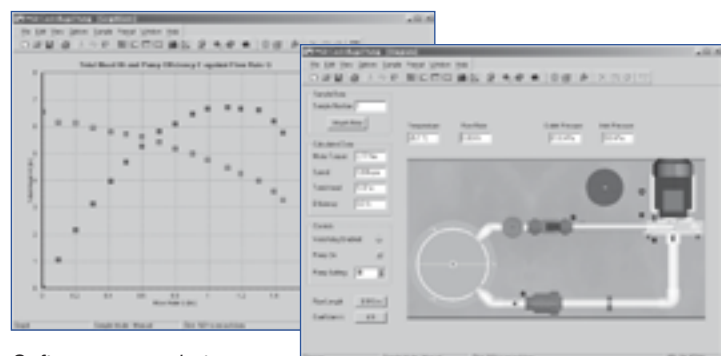
FM50 Centrifugal Pump Demonstration Unit shown with the IFD7 Interface Unit accessory.

The centrifugal pump is the machine most commonly used to move liquids from one place to another. As such it is a particularly instructive unit with which to introduce students to the whole subject of rotodynamic fluid machines.

Discovering the relationship between head, flow, rotational speed and power provides a framework of general applicability. For example, matching the required duty point to the conditions of maximum energy efficiency may be explored as a creative student project.

INSTRUCTIONAL CAPABILITIES

- *Demonstration of a single-stage centrifugal water pump in operation*
- *Measurement of constant-speed pump performance, including production of characteristic curves:*
 - *pump total head*
 - *motor shaft power*
 - *impeller speed*
 - *pump efficiency*
- *Introduction to pump speed laws*
- *Investigation of impeller styles*
- *Comparison of student calculations with computer results*



Software screenshots

DESCRIPTION

A motor driven centrifugal pump, mounted on a stainless steel plinth with a water reservoir and pipework for continuous circulation. The pump volute and the water reservoir are manufactured from clear acrylic for maximum visibility. Similarly the pipe runs are made from transparent pvc. Manually operated valves at the pump inlet and outlet allow control of the flow and also facilitate the study of suction effects.

The pump volute has been designed so that the impeller can be easily accessed and replaced without tools. The FM50 is delivered with two impellers, one with forward curved blades and one with backward curved blades, allowing the students to investigate the effects of impeller characteristics.

Electronic sensors measure the pump inlet pressure, the pump outlet pressure, the flow rate and the water temperature.

The pump speed is accurately controlled by an advanced electronic inverter within the IFD7 (an essential accessory). This inverter also calculates the torque produced at the motor drive shaft, allowing the power used by the pump to be derived. The IFD7 also provides the conditioning electronics for the sensors and allows their readings to be displayed on the computer software. Connections to the IFD7 are a single multi-way connector for the sensors and a connector for the pump motor drive.

The equipment is provided with advanced education and data logging software. See the software section of this datasheet for further details.



FM50 Centrifugal Pump with cover removed.

PERFORMANCE SPECIFICATION

Max flow rate:	1.6L/sec typical
Max head:	9.0m
Max pump speed:	1800rpm
Motor power rating:	250W

ORDERING SPECIFICATION

- A small-scale centrifugal pump demonstration unit, comprising of a water reservoir, the pump, control valves and interconnecting pipework all mounted on a stainless steel base.
- Equipped with electronic measurement sensors for pump head pressure, suction, flow-rate and water temperature.
- Transparent pump volute for visibility.
- Capable of being linked to a PC (not supplied) via a USB interface console (an essential accessory), which does not require internal access to the computer. Also allows interfacing to other software packages.
- Supplied with software providing full instructions for setting up, operating, calibrating and performing the teaching exercises. Facilities for logging, processing and displaying data graphically.
- Offers a complete teaching package of coursework and laboratory investigation, complete with a student questions and answers session.

ESSENTIAL EQUIPMENT

Armfield IFD7 Interface Unit
PC with spare USB port

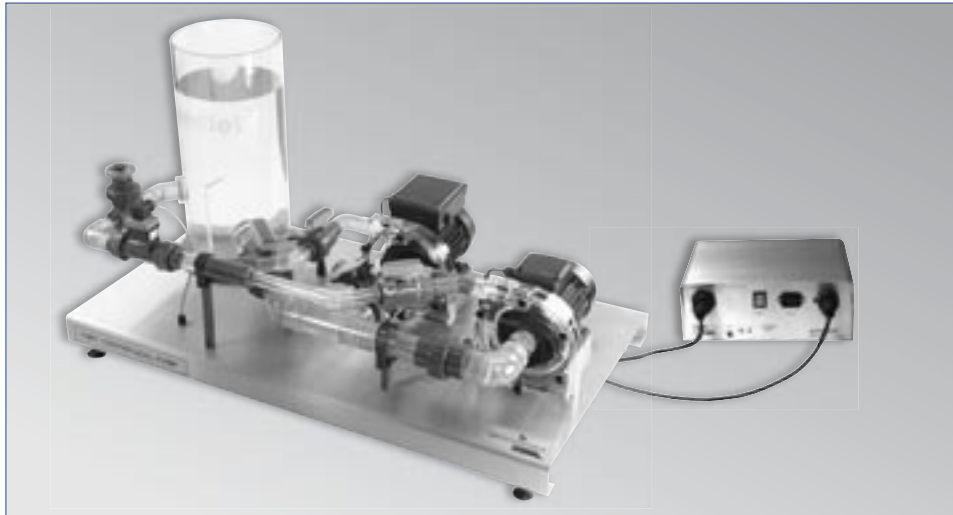
OVERALL DIMENSIONS

Height:	0.6m
Length:	0.88m
Width:	0.51m

SHIPPING SPECIFICATION

Gross Weight:	110Kg
Volume:	1.10m ³

SERIES AND PARALLEL PUMPS DEMONSTRATION UNIT



FM51
issue 2

FM51 Series and Parallel Pumps Demonstration Unit shown with the IFD7 Interface Unit accessory.

Centrifugal pumps are often used together to enhance either the flow rate or the delivery pressure beyond that available from the single pump.

The unit is designed to demonstrate the operational advantages of parallel or series operation, depending on the required duty.

INSTRUCTIONAL CAPABILITIES

- *Demonstration of either series, parallel or single pump operation*
- *Measurement of constant-speed pump performance, including production of characteristic curves (one pump)*
- *Comparison of head-flow characteristics with single pump operation, at inherent speed*
- *Investigation of impeller styles*
- *Comparison of student calculations with computer results*

DESCRIPTION

Two motor driven centrifugal pumps, mounted on a stainless steel plinth with a water reservoir and pipework for continuous circulation. The pumps can be configured for single pump operation, two pumps in parallel or two pumps in series by using manually operated ball valves. Similarly, manual valves are used to control the flow and facilitate the study of suction effects, including demonstration of air release.

In parallel operation the two pumps draw from a shared inlet pipe of a wider diameter than the pump inlet, reflecting a typical industrial configuration of parallel pumping. Each pump has impellers that can be easily accessed and replaced without tools. The FM51 is delivered with three impellers in total, one with forward curved blades and two with backward curved blades, allowing the students to investigate the effects of impeller characteristics.

Electronic sensors measure the pump outlet pressure of each pump, the shared pump inlet pressure, the flow rate and the water temperature.

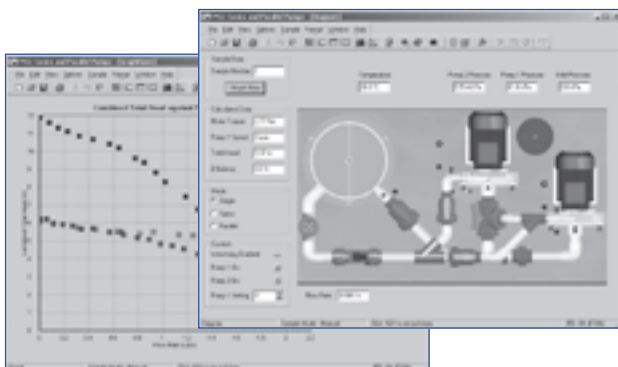
The pump speed of the first pump is accurately controlled by an advanced electronic inverter within the IFD7 (an essential accessory) and can be varied over the full range. The inverter also calculates the torque produced at the motor drive shaft, allowing the power used by the pump to be derived. The second pump runs at inherent motor speed. This combination of control facilities allows a wide range of different configurations to be investigated.

The IFD7 also provides the conditioning electronics for the sensors and allows their readings to be displayed on the computer software. Connections to the IFD7 are a single multi-way connector for the sensors and a connector for the pump motor drive.

The equipment is provided with advanced education and data logging software. See the software section of this datasheet for further details.

PERFORMANCE SPECIFICATION

Max Flow Rate:	2.2 l/sec (parallel pumping, both pumps 50 Hz)
Max Head:	6.0 m (single pump) 12.0m (series)
Max pump speed	1800 rpm (pump1) 1500 rpm (pump 2 nominal)
Motor Power rating	250W



Software screenshots

ORDERING SPECIFICATION

- A small-scale series/parallel pump demonstration unit, comprising of a water reservoir, two pumps, control valves and interconnecting pipework, all mounted on a stainless steel base.
- Equipped with electronic measurement sensors for pump head pressure (2 off), suction, flow-rate and water temperature.
- Transparent pump volutes for visibility.
- Inlet valve throttling demonstrates air release.
- Supplied with different easily interchangeable impellers.
- Capable of being linked to a PC (not supplied) via a USB interface console (an essential accessory), which does not require internal access to the computer. Also allows interfacing to other software packages.
- Supplied with software providing full instructions for setting up, operating, calibrating and performing the teaching exercises. Facilities for logging, processing and displaying data graphically.
- Offers a complete teaching package of coursework and laboratory investigation, complete with a student questions and answers session.

ESSENTIAL EQUIPMENT

Armfield IFD7 Interface Unit
PC with spare USB port

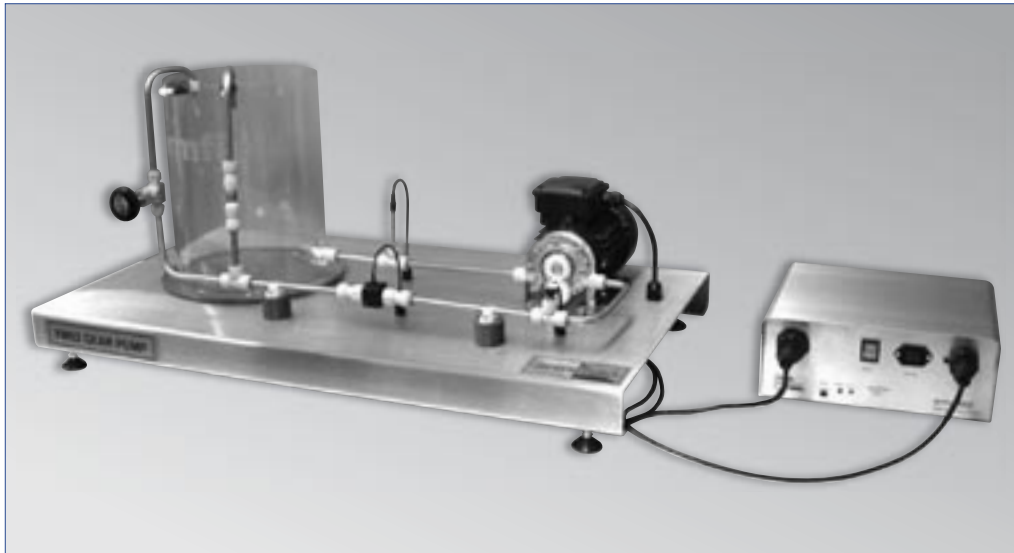
OVERALL DIMENSIONS

Height:	0.59m
Length:	1.01m
Width:	0.58m

SHIPPING SPECIFICATION

Gross Weight:	120Kg
Volume:	1.40m ³

GEAR PUMP DEMONSTRATION UNIT



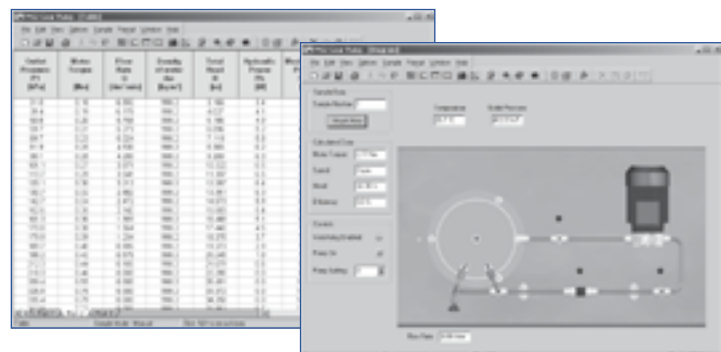
FM52
issue 2

FM52 Gear Pump Demonstration Unit shown with the IFD7 Interface Unit accessory.

The gear pump is the most widely used of the positive action rotary pumps. Two gear wheels operate inside a casing. One is driven whilst the other rotates in mesh with it. The liquid is carried around in the space between consecutive teeth and then ejected as the teeth mesh. The pump has no valves. It is a positive displacement pump and will deliver against high pressures. The output is a more even flow than that of a reciprocating pump. It is particularly suitable for high viscosity fluids.

INSTRUCTIONAL CAPABILITIES

- *Demonstration of a gear pump in operation*
- *Measurement of constant-speed pump performance, including the production of characteristic curves of outlet pressure against:*
 - *flow rate*
 - *motor shaft power*
 - *pump speed*
 - *pump efficiency*
 - *volumetric efficiency*
- *Comparison of student calculation with computer results*



Software screenshots

DESCRIPTION

A motor driven gear pump, mounted on a stainless steel plinth with a water reservoir and pipework for continuous circulation. The pump head and the water reservoir are manufactured from clear acrylic for maximum visibility. A manually operated valve at the pump outlet allows control of the flow and a pressure relief valve protects the operator and the equipment.

Electronic sensors measure the pump outlet pressure, the flow rate and the water temperature.

The pump speed is accurately controlled by an advanced electronic inverter within the IFD7 (an essential accessory). This inverter also calculates the torque produced at the motor drive shaft, allowing the power used by the pump to be derived. The IFD7 also provides the conditioning electronics for the sensors and allows their readings to be displayed on the computer software. Connections to the IFD7 are a single multi way connector for the sensors and a connector for the pump motor drive.

The equipment is provided with advanced education and data logging software. See the software section of this datasheet for further details.

PERFORMANCE SPECIFICATION

<i>Max flow rate:</i>	<i>6.5L/min typical</i>
<i>Max head:</i>	<i>25m</i>
<i>Max pump speed:</i>	<i>1800rpm</i>
<i>Motor power rating:</i>	<i>250W</i>



FM52 Gear Pump

ORDERING SPECIFICATION

- *A small-scale gear pump demonstration unit, comprising of a water reservoir, pump, control valve, relief valve and inter-connecting pipework, all mounted on a stainless steel base.*
- *Equipped with electronic measurement sensors for pump head pressure, flow-rate and water temperature.*
- *Transparent pump head for visibility.*
- *Capable of being linked to a PC (not supplied) via a USB interface console (an essential accessory), which does not require internal access to the computer. Also allows interfacing to other software packages.*
- *Supplied with software providing full instructions for setting up, operating, calibrating and performing the teaching exercises. Facilities for logging, processing and displaying data graphically.*
- *Offers a complete teaching package of coursework and laboratory investigation, complete with a student questions and answers session.*

ESSENTIAL EQUIPMENT

*Armfield IFD7 Interface Unit
PC with spare USB port*

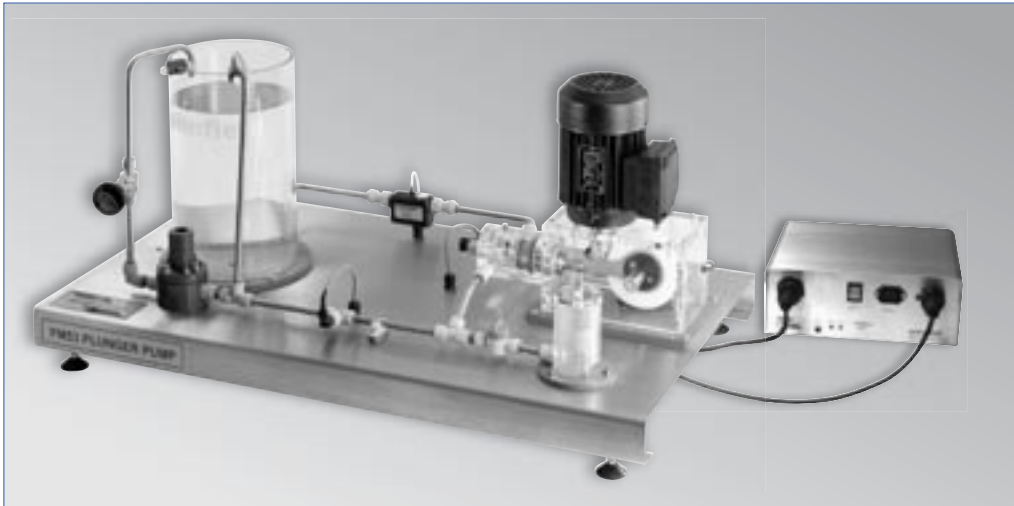
OVERALL DIMENSIONS

<i>Height:</i>	<i>0.41m</i>
<i>Length:</i>	<i>0.88m</i>
<i>Width:</i>	<i>0.51m</i>

SHIPPING SPECIFICATION

<i>Gross Weight:</i>	<i>100Kg</i>
<i>Volume:</i>	<i>0.75m³</i>

PLUNGER PUMP DEMONSTRATION UNIT



FM53
issue 2

FM53 Plunger Pump Demonstration Unit shown with the IFD7 Interface Unit accessory.

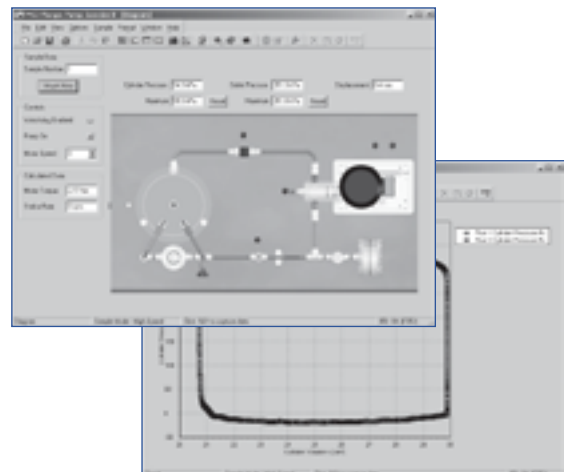
The plunger or ram pump is a positive displacement pump and is used for pumping small quantities of liquid at high pressures. It is similar to a piston pump except that the sealing gland is at one end of the cylinder. The reciprocating motion of the plunger gives an uneven flow, although the inclusion of a damping vessel can reduce this effect. Priming is unnecessary.

INSTRUCTIONAL CAPABILITIES

- *Measurement during each pump cycle of:*
 - *plunger displacement*
 - *cylinder pressure*
 - *pump outlet pressure*
- *On-line P-V diagram displays*
- *Measurement of volumetric efficiency*
- *Measuring the effect on pump performance of:*
 - *sprung loading valve or needle valve*
 - *adjusting the outlet loading valve*
 - *the inclusion of a pulsation damper vessel*



Detail of the Plunger Pump



Software screenshots

DESCRIPTION

A motor driven plunger pump, mounted on a stainless steel plinth with a water reservoir, pulsation damper and pipework for continuous circulation. The pump head, measuring tank, pulsation damper and the water reservoir are manufactured from clear acrylic for maximum visibility. The pump outlet is connected to both a sprung loading valve and a needle valve to investigate different loading characteristics. A pressure relief valve protects the operator and the equipment. An additional valve can be used to isolate or include the pulsation damper, allowing the effect of damping to be investigated

Electronic sensors measure the instantaneous cylinder pressure within the pump, the pump displacement and the cumulative flow over a period of time.

The pump speed is accurately controlled by an advanced electronic inverter within the IFD7 (an essential accessory). The IFD7 also provides the conditioning electronics for the sensors and allows their readings to be displayed on the computer software. Connections to the IFD7 are a single multi-way connector for the sensors and a connector for the pump motor drive.

The equipment is provided with advanced education and data logging software. See the software section of this datasheet for further details.

PERFORMANCE SPECIFICATION

<i>Max flow rate:</i>	<i>0.725 l/min typical</i>
<i>Max head:</i>	<i>4 bar</i>
<i>Swept volume:</i>	<i>15mm stroke x 32mm diameter</i>
<i>Pumping speed:</i>	<i>variable up to 60 strokes/minute</i>
<i>Motor power rating:</i>	<i>250W</i>

ORDERING SPECIFICATION

- ***A small-scale plunger pump demonstration unit, comprising of a water reservoir, pump, control valve, relief valve and interconnecting pipe work, all mounted on a stainless steel base.***
- ***Includes both a sprung loading valve and a needle valve for loading the pump.***
- ***Equipped with electronic measurement sensors for cylinder pressure, plunger position, pump outlet pressure and cumulative flow.***
- ***Pulsation damping facility.***
- ***Transparent pump head for visibility.***
- ***Capable of being linked to a PC (not supplied) via a USB interface console (an essential accessory), which does not require internal access to the computer. Also allows interfacing to other software packages.***
- ***Supplied with software providing full instructions for setting up, operating, calibrating and performing the teaching exercises. Facilities for logging, processing and displaying data graphically.***
- ***Offers a complete teaching package of coursework and laboratory investigation, complete with a student questions and answers session.***

ESSENTIAL EQUIPMENT

*Armfield IFD7 Interface Unit
PC with spare USB port*

OVERALL DIMENSIONS

<i>Height:</i>	<i>0.41m</i>
<i>Length:</i>	<i>0.88m</i>
<i>Width:</i>	<i>0.51m</i>

SHIPPING SPECIFICATION

<i>Gross Weight:</i>	<i>120Kg</i>
<i>Volume:</i>	<i>1.00m³</i>

FM6X TURBINE SERVICE UNIT



FM6X Turbine Service Unit and IFD7 Interface

The FM6X Turbine Service unit provides a water supply which is required to operate the FM60, FM61 and FM62 turbine demonstrations. The service unit consists of a stainless steel base on which is mounted a water reservoir, a compact three-phase pump and an electronic flow meter. The pump is controlled direct from the computer using the speed controller inside the IFD7 USB interface console.

INSTRUCTIONAL CAPABILITIES

- ▶ *Determining the characteristics of the selected turbine, including the relationships of volume flow rate, head, torque produced, power output and efficiency to rotational speed. (FM60/FM61/FM62)*
- ▶ *Comparison of nozzle and throttling control of an Impulse Turbine (FM60)*
- ▶ *Comparison of throttle control and spear valve control of the speed of a Pelton Turbine (FM62)*
- ▶ *Determination of characteristic performance curves for a peripheral pump, including constant speed head/flow and efficiency curves. (FM64)*

DYNAMOMETER

The turbine under test is connected to the dynamometer by a toothed drive belt. Load is applied to the turbine using a magnetic brake controlled directly from the computer. The outer casing of the brake is restrained from rotating by a lever arm which is connected to a load cell, which allows the braking force and hence the torque produced to be directly measured. The dynamometer unit also incorporates an optical sensor which measures the rotational speed of the turbine.

PERFORMANCE SPECIFICATION

Reservoir Capacity: 28 litres
 Maximum Flow Rate: 20 litres/min
 Maximum Head: 30 m

ESSENTIAL EQUIPMENT

Armfield IFD7 Interface Unit
 PC with spare USB port.

ORDERING SPECIFICATION

- *A bench top service unit which provides a suitable water supply for testing a range of different turbines.*
- *Clear acrylic reservoir which holds up to 28 litres.*
- *Peripheral type pump providing up to 20 litres per minute or up to 30m head (not simultaneously).*
- *Paddle wheel type flow meter.*
- *Magnetic type dynamometer controlled from software.*
- *Software control of both pump and brake allows remote operation of the equipment over an internet.*
- *Links to a suitable computer via a USB interface device which does not require internal access to the computer. Also allows interfacing to other software packages.*
- *Supplied with full education software package including comprehensive results processing and help facilities.*

REQUIREMENTS

SERVICES

Single phase electrical supply:
 FM6X-A 230V/50Hz
 FM6X-G 220V/60Hz

OVERALL DIMENSIONS

Height: 0.73m
 Width: 0.80m
 Depth: 0.51m

SHIPPING SPECIFICATION

Gross Weight: 100Kg
 Volume: 1.10m³



FM60 IMPULSE TURBINE



FM60 Impulse Turbine



Software screenshot

FM60
issue 1

The FM60 is a small scale impulse turbine unit which is designed to be used in conjunction with the FM6X service unit. An impulse turbine uses the momentum transferred from the impact of a jet of water onto the turbine blades to generate power.

INSTRUCTIONAL CAPABILITIES

- *Determining the characteristics of the turbine, including the relationships of volume flow rate, head, torque produced, power output and efficiency to rotational speed.*
- *Comparison of nozzle and throttling control of an Impulse Turbine.*

DESCRIPTION

The FM60 consists of an inlet manifold which supplies water to four jets which are equally spaced around the turbine runner. Each of the jets can be individually controlled using ball valves. The runner itself is mounted on a horizontal shaft with a clear acrylic splash guard to allow maximum visibility of the workings.

The unit incorporates a pressure sensor to measure the inlet condition of the water. This pressure can be accurately controlled using the software supplied with the service unit.

PERFORMANCE SPECIFICATION

*Maximum Power: 35W
Maximum Speed: 7000 rpm
Maximum Torque: 0.15Nm*

ORDERING SPECIFICATION

- *Small scale hydropower unit designed to demonstrate the operating principles of an impulse turbine.*
- *Horizontal shaft and transparent guarding allow excellent visibility.*
- *Mounts on a dedicated service unit.*
- *Connects to a PC via the service unit and a USB interface device.*

REQUIREMENTS

See Essential Equipment

ESSENTIAL EQUIPMENT

*FM6X Service Unit
IFD7 Interface Unit*

OVERALL DIMENSIONS

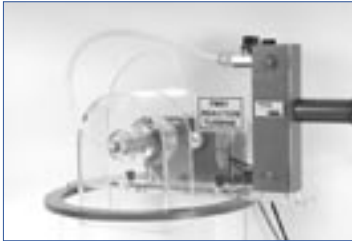
*Height: 0.29m
Width: 0.56m
Depth: 0.13m*

SHIPPING SPECIFICATION

*Gross Weight: 20Kg
Volume: 0.20m³*



FM61 REACTION TURBINE



FM61 Reaction Turbine



Software screenshot

FM61
issue 1

The FM61 is a small scale reaction turbine unit which is designed to be used in conjunction with the FM6X service unit. A reaction turbine uses the momentum transferred from the reaction of a jet of water leaving a nozzle to generate power.

INSTRUCTIONAL CAPABILITIES

Determining the characteristics of the turbine, including the relationships of volume flow rate, head, torque produced, power output and efficiency

DESCRIPTION

The FM61 consists of an inlet manifold which supplies water to a central hub. Water exits the hub radially through two square orifices. The hub is connected to the manifold using a graphite face seal. The turbine is mounted on a horizontal shaft with a clear acrylic splash guard to allow maximum visibility of the workings

The unit incorporates a pressure sensor to measure the inlet condition of the water. This pressure can be accurately controlled using the software supplied with the service unit.

PERFORMANCE SPECIFICATION

Maximum Power: 25W
Maximum Speed: 8000rpm
Maximum Torque: 0.12Nm

REQUIREMENTS

See Essential Equipment

ORDERING SPECIFICATION

- Small scale hydropower unit designed to demonstrate the operating principles of a reaction turbine.
- Horizontal shaft and transparent guarding allow excellent visibility.
- Mounts on a dedicated service unit.
- Connects to a PC via the service unit and a USB interface device.

ESSENTIAL EQUIPMENT

FM6X Service Unit
IFD7 Interface Unit

OVERALL DIMENSIONS

Height: 0.29m
Width : 0.56m
Depth: 0.18m

SHIPPING SPECIFICATION

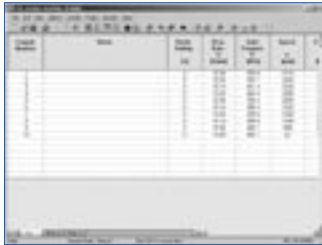
Gross Weight: 20Kg
Volume: 0.20m³



FM62 PELTON TURBINE



FM62 Pelton Turbine



Software screenshot

FM62
issue 1

The FM62 is a small scale Pelton turbine unit which is designed to be used in conjunction with the FM6X service unit. A Pelton turbine uses the momentum transferred from the impact of a jet of water onto its buckets to generate power.

INSTRUCTIONAL CAPABILITIES

- ▶ Determining the characteristics of the turbine, including the relationships of volume flow rate, head, torque produced, power output and efficiency to rotational speed.
- ▶ Comparison of throttle control and spear valve control of the speed of a Pelton Turbine.

DESCRIPTION

The FM62 consists of an inlet manifold which supplies water to a spear valve which allows users to vary the jet cross section while maintaining the water velocity. The runner itself is mounted in a clear acrylic enclosure to allow maximum visibility of the workings.

The unit incorporates a pressure sensor to measure the inlet condition of the water. This pressure can be accurately controlled using the software supplied with the service unit.

PERFORMANCE SPECIFICATION

Maximum Power: 23W
Maximum Speed: 3800rpm
Maximum Torque: 0.20Nm

REQUIREMENTS

See Essential Equipment

ORDERING SPECIFICATION

- Small scale hydropower unit designed to demonstrate the operating principles of an impulse turbine.
- Transparent guarding allows excellent visibility of the pelton wheel operation.
- Mounts on a dedicated service unit.
- Connects to a PC via the service unit and a USB interface device.

ESSENTIAL EQUIPMENT

FM6X Service Unit
IFD7 Interface Unit

OVERALL DIMENSIONS

Height: 0.33m
Width: 0.52m
Depth: 0.14m

SHIPPING SPECIFICATION

Gross Weight: 20Kg
Volume: 0.20 m³

FM63 PROPELLER TURBINE



FM63 Propeller Turbine

The FM63 is a self contained, small scale propeller turbine unit. This fixed blade, axial flow turbine may be considered as the prototype form of a propeller turbine, itself a forerunner of the Kaplan turbine. The inclusion of angled inlet guide vanes and the design of the runner blades utilise both impulse and reaction effects. It can be demonstrated that this type of machine works most efficiently where high flows at relatively low heads are available.

INSTRUCTIONAL CAPABILITIES

Determining the turbine characteristics of a propeller turbine, including the relationships of volume flow rate, head, torque produced, power output and efficiency to rotational speed

DESCRIPTION

The FM63 consists of a framework base which houses a large water reservoir and a circulating pump. A stainless steel top supports the turbine itself and a dynamometer assembly. The propeller itself is housed in a clear acrylic pipe to allow maximum visibility of the workings.

The unit incorporates a paddle wheel type flow meter and a pressure sensor to measure the inlet condition of the water. The dynamometer module incorporates a magnetic type brake which applies load to the turbine. The level of braking is controlled directly from the software. A load cell measures the braking force, and hence the power, and an optical sensor measures the rotational speed of the turbine.

PERFORMANCE SPECIFICATION

Maximum Power: 55W
Maximum Speed: 8500rpm
Maximum Torque: 0.60Nm

REQUIREMENTS

SERVICES

Single phase electrical supply:
FM63-A 220V-240V/50Hz/13A
FM63-B 120V/60Hz/25A

ORDERING SPECIFICATION

- Self contained, small scale hydropower unit designed to demonstrate the operating principles of a propeller turbine.
- 75 litre water reservoir.
- Circulating pump which produces 14m head at 4.4 litres/second.
- Loaded by a magnetic brake unit which is controlled direct from the PC
- Links to a PC via a USB interface.
- Electronic sensors monitor process variables.
- Supplied with full education software package including comprehensive results processing and help facilities.

ESSENTIAL EQUIPMENT

IFD7 Interface Unit

OVERALL DIMENSIONS

Height: 1.12m
Width : 0.91m
Depth: 0.66m

SHIPPING SPECIFICATION

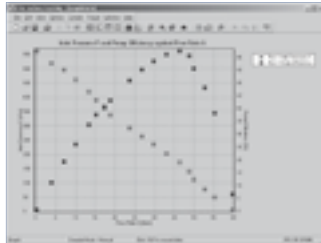
Gross Weight: 160Kg
Volume: 1.40m³



FM64 PUMP TEST ACCESSORY



FM64



Software screenshot

FM64
issue 1

The FM64 is a compact accessory which allows the FM6X service unit to be used as a pump test accessory.

INSTRUCTIONAL CAPABILITIES

Determination of characteristic performance curves for a peripheral pump, including constant speed head/flow and efficiency curves.

DESCRIPTION

The FM64 consists simply of a return tube incorporating a gate valve, which can be attached to the pump outlet on the FM6X service unit.

The unit incorporates a pressure sensor to measure the inlet condition of the water.

PERFORMANCE SPECIFICATION

Maximum Flow: 50 litres/min
Maximum Head: 55m

REQUIREMENTS

See Essential Equipment

ESSENTIAL EQUIPMENT

FM6X Service Unit
IFD7 Interface Unit

ORDERING SPECIFICATION

- Compact accessory to allow investigation of pump performance.
- Mounts on a dedicated service unit.
- Links to a PC via the service unit and a USB interface console.

OVERALL DIMENSIONS

Height: 0.23m
Width: 0.50m
Depth: 0.14m

SHIPPING SPECIFICATION

Gross Weight: 10Kg
Volume: 0.10m³

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