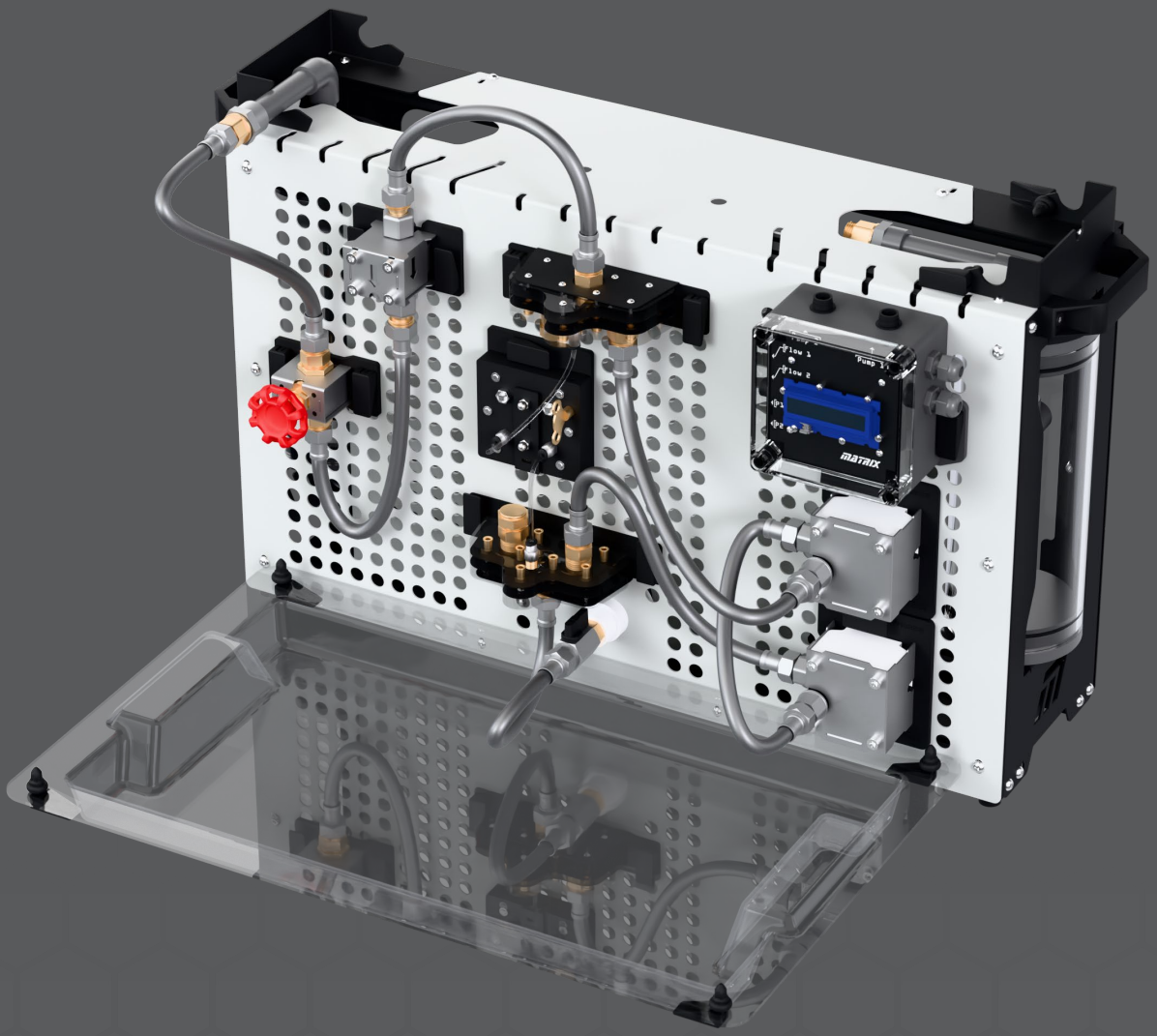
MATRIX | FLUID MECHANICS



FLUID MECHANICS TRAINER USER MANUAL

FM1000

Inspiring The Next Generation Of Engineers

www.matrixtsl.com

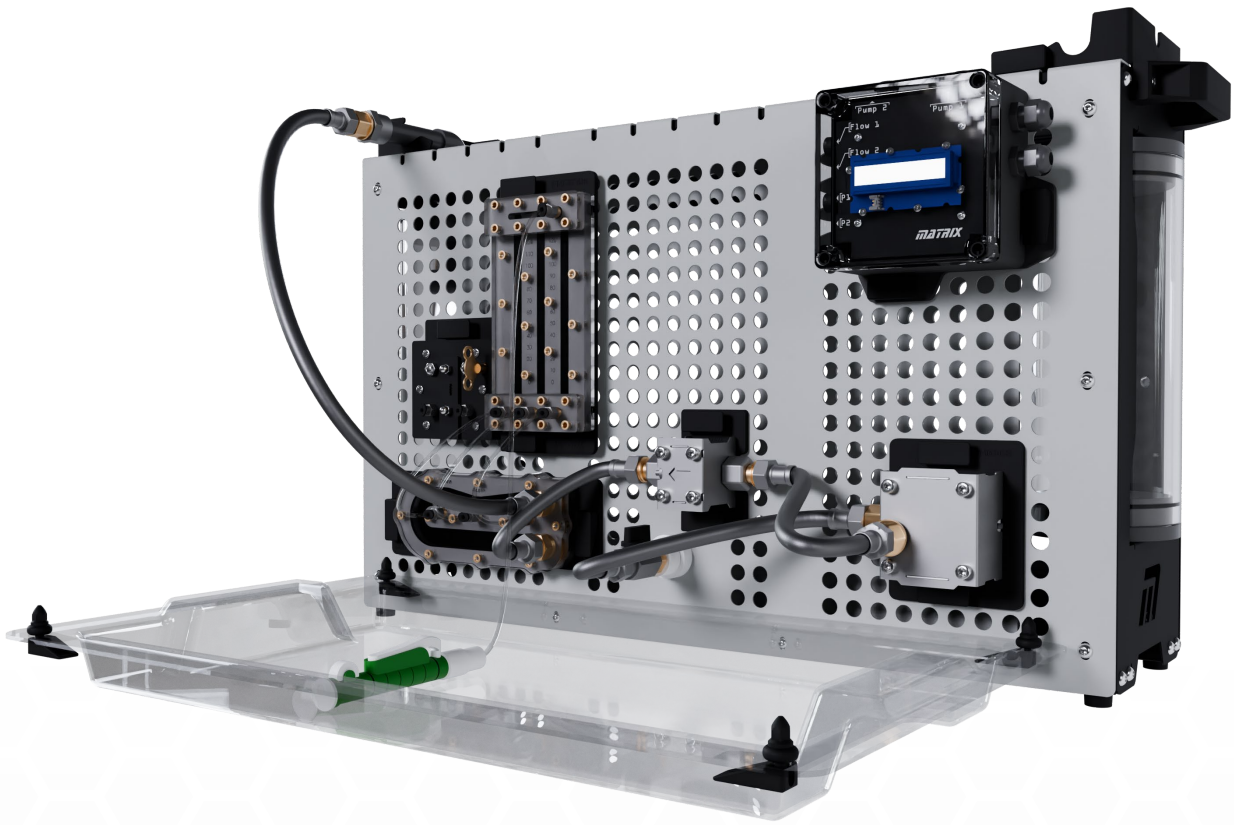
Contents

INTRODUCTION

This manual supports tutors, technicians, and students in the safe and effective setup, operation, and care of the FM1000 Fluid Mechanics Trainer. The FM1000 is a modular fluid mechanics teaching platform includes a workstation, interchangeable experiment modules, a data control module, and PC software for monitoring and data handling. It is designed to help learners investigate core fluid mechanics principles through practical experiments, while giving teaching staff a consistent platform for classroom, laboratory, and workshop use

Intended Audience

- College students aged 16+ studying fluid mechanics, mechanical engineering, manufacturing, or applied science
- Apprentices and trainees developing a practical understanding of flow, pressure, pumps, and experimental measurement
- Instructors, technicians, and laboratory staff responsible for experiment delivery, setup, and equipment maintenance



SAFETY INFORMATION

Read this section before operating the system. Failure to follow safety guidance may result in injury or equipment damage

Electrical Equipment Caution	
24 V DC – disconnect power before opening or servicing. **Symbol:** ISO 7010 W012 – Risk of electric shock	
General Warning	
• The FM1000 workstation weighs approximately 30 kg. Use safe lifting practice and a two-person lift where necessary. • Use clean water only and wipe up spills immediately. Keep electrical connections and the bench area dry during setup and operation. • Ensure all experiment modules are fully seated and secured with swell latches, and all hoses are attached and tightened before opening the inlet valve and running the system. Loose modules or unsecure connections may leak or shift during use. • Place the FM1000 workstation on a stable, level bench. Do not operate the system if the unit is unstable or if hoses create a trip or pull hazard. • **Symbol:** ISO 7010 W001 – General warning	
Emergency Shutoff Instruction	
In the event of an emergency or malfunction, immediately disconnect the power cable from the product or unplug it directly from the main power socket to remove all power from the system. **Symbol:** ISO 7010 - M006	
Disconnect Before Maintenance	
Disconnect power before accessing wiring or components. **Symbol:** ISO 7010 M002	

SAFETY INFORMATION

Residual Risk Statement

- Electrical exposure – although operating at 24 V DC, improper use may still pose risk.

Always ensure users are supervised when in a learning environment.

Electrical Safety

- Only use the supplied 24 V DC power supply.
- Disconnect the PSU before performing any maintenance or inspection.
- Do not bypass the control box by wiring pumps directly to 24 V. This may result in uncontrolled operation and thermal damage.
- Inspect power cables periodically for signs of damage or wear.

Mechanical Safety

Unstable Placement

The unit is portable and bench-mounted. Dropping or tipping it can cause mechanical damage

Pinch Points

Some mounted components (e.g., swell latches, mounting brackets/holes) may create small pinch points during handling or wiring.

Personal Protective Equipment (PPE)

- No PPE is required under normal use

EMERGENCY PROCEDURES

This system is intended for educational use and does not include an emergency stop device.

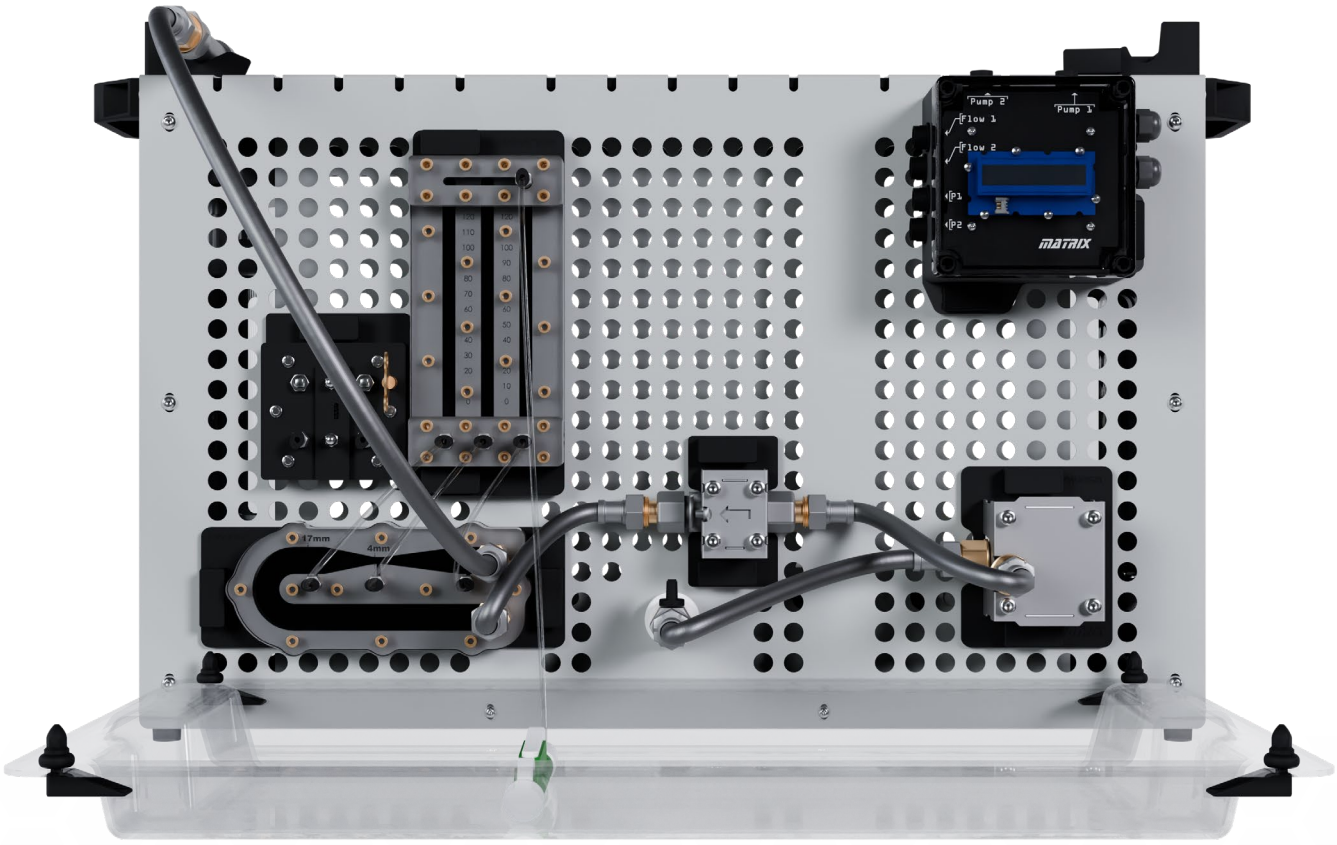
In the event of unsafe or unexpected system behaviour, follow the procedure below:

- Disconnect the unit from the 24 V DC power supply immediately.
- Check for obvious issues such as leaking hoses, damaged fittings, or incorrect setup.
- Do not reconnect power until the cause has been identified and addressed.
- For issues that persist, disconnect the unit from use and consult your instructor or technician.

SYSTEM DESCRIPTION

Functional Overview

The rig provides a practical introduction to fluid mechanics using a main workstation and interchangeable experiment modules. Students can assemble nine different experiments to investigate key principles such as pressure, flow, viscosity, Bernoulli's principle, centre of pressure, and pump performance. Six experiments use USB-connected pressure and flow sensors for automatic graph plotting and analysis, while the remaining three are carried out and plotted manually. Experiments that use the pump modules require a PC running the Fluids app, as the pumps are operated through the software. Quick-release swell latches allow each component to be fitted and removed quickly, making the system well suited to hands-on work in an educational environment. Once assembled, between 2 and 3 litres of water are poured into one of the tanks; both tanks fill together because they are linked. The drip tray has a 6-litre capacity and can comfortably hold the full contents of both tanks



PROCESS OVERVIEW

Fluid Mechanics Software

The Fluid Mechanics Software communicates with the FM1000 workstation through the data control module. It is used to control supported experiments, display flow and pressure readings, and record results for analysis.
The software can communicate with up to two pumps, two flow meters, and two differential pressure sensors. Communication begins when the user starts the software connection. When connected correctly, the application and communication indicators confirm that the workstation is online.

- During use, the software can:
- control pump operation
- display live pressure and flow readings
- log discrete readings
- record sweep data automatically
- store results in a selected log-file location

The application settings include options such as settling delay, sample timing, sweep range, voltage step size, and log-file location. These settings may be adjusted depending on the experiment being carried out.

Fluids Data Control Module

The Fluids Data Control Module is a custom-made controller housed in an IP68-rated enclosure for use in the FM1000 system. It provides the central connection point for powered and sensor-based experiments.
The module includes six IP68-rated sockets for connecting and powering:

- 2 differential pressure sensors
- 2 turbine flow meters
- 2 centrifugal pump modules

A flying lead with a barrel socket is provided for connection to the power supply. The module also includes a USB cable for connection to a PC, allowing data from the connected modules to be transferred directly to the Fluids App.
The module has an integral screen, which sequentially displays information received from the connected modules. This allows the user to monitor module status and readings directly from the control unit during operation.

PROCESS OVERVIEW

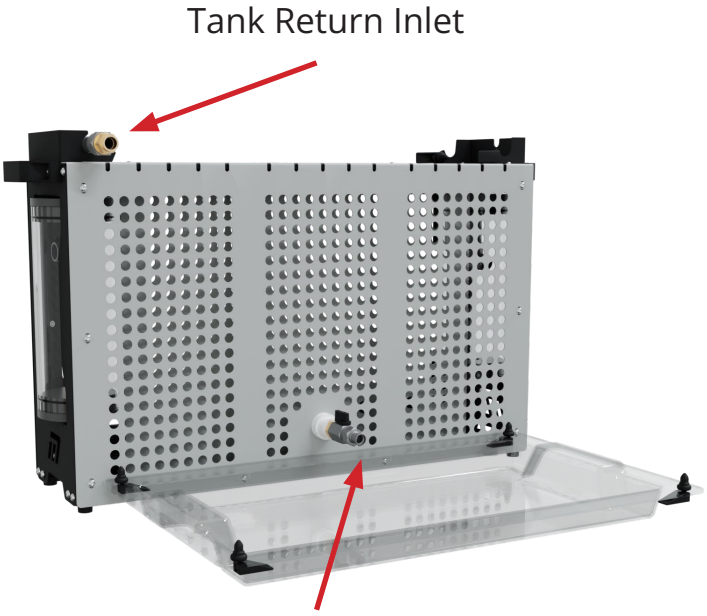
Key Components

This training rig is built to give students and engineers hands-on experience in fluid mechanics using a combination of practical experiment modules, manual measurement devices, and software-supported sensing. Each component has been selected to help learners investigate key principles such as pressure, flow, viscosity, centre of pressure, and pump performance in a clear and practical way, using equipment suited to educational and laboratory environments.
The following section outlines the purpose and capabilities of the core components used in the rig.

Workstation

- **Purpose:** Provides the main platform for assembling and carrying out Fluids experiments.

- **Key Features:**
  - Provides the base structure for the different experiment configurations within the Fluids system.
  - Includes two linked tanks for holding the water used during practical experiments.
  - Includes an inlet valve and tank return inlet as part of the water system arrangement.
  - Provides compact storage for all modules, making the system easy to store and handle.
  - Modules are fitted to the workstation in the required position using swell latches.



PROCESS OVERVIEW

Data Control Module

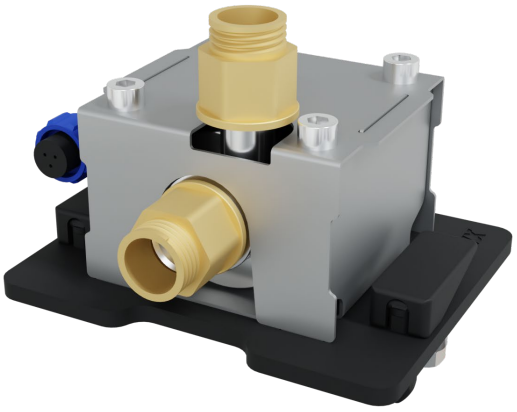
- **Purpose:** Central interface module for connecting, powering, and monitoring the Fluids experiment modules.

- **Key Features:**
  - Custom-made controller in an IP68-rated enclosure
  - 6x IP68-rated sockets for modules connection
  - USB cable for connection to a PC.
  - Integral screen sequentially displays information received from connected modules

Centrifugal Pump Module

- **Purpose:** Provides controlled water circulation through the system

- **Key Features:**
  - Pump speed is determined by the settings selected in the Fluids App.
  - Current status is displayed on the Data Control Module and in the Fluids App.

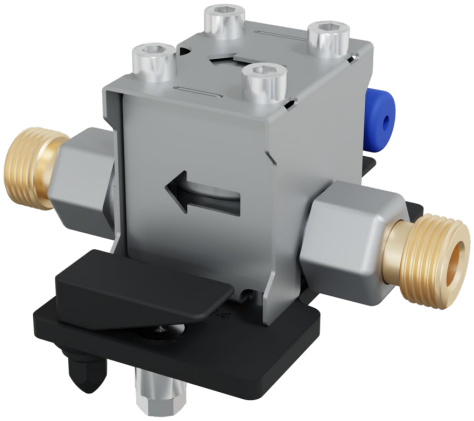


PROCESS OVERVIEW

Turbine Flow Meter

- **Purpose:** Measures the flow rate of water moving through the system.

- **Key Features:**
  - An internal turbine spins as water passes through the module. The speed of rotation is used to calculate flow rate.
  - The readings can be viewed on the Data Control Module or in the Fluids App.



Differential Pressure Sensor

- **Purpose:** Measures the difference in pressure between two points in the system.

- **Key Features:**
  - Used for automated pressure readings in the system.
  - The readings can be viewed on the Data Control Module or in the Fluids App.
  - Solid-state pressure sensor positioned between the chambers.
  - Two self-sealing pressure ports for connection to pneumatic tubing.

PROCESS OVERVIEW

Inclined Manometer Module

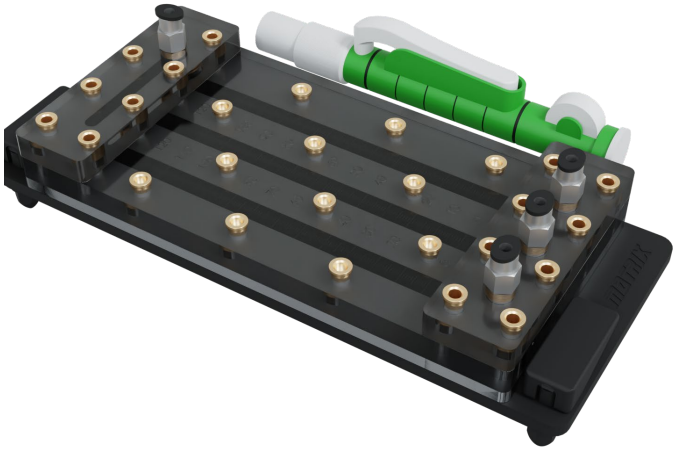
- **Purpose:** Measures and indicates liquid pressure.

- **Key Features:**
  - Contains three manometers: a single tube manometer, a U-tube manometer, and an inclined single tube manometer.
  - The angle of the inclined manometer can be adjusted.
  - Used for manual pressure readings in pressure-measurement experiments.
  - Includes pressure ports for connection to pneumatic tubing.

Multitube Manometer Module

- **Purpose:** Measures and indicates liquid pressure at multiple points in the system.

- **Key Features:**
  - Inverted U-tube manometer with three limbs.
  - Allows comparison of pressure at three points in the fluid flow.
  - Common top section can be pressurised to adjust the zero level.
  - Self-sealing pressure ports for connection to pneumatic tubing.



PROCESS OVERVIEW

Venturi Tube Module

- **Purpose:** Demonstrates the relationship between fluid velocity and pressure in a constricted flow passage.

- **Key Features:**
  - Flow-tube reduces in width from 17 mm to 4 mm in the venturi section.
  - Three self-sealing pressure ports allow comparison of pressure at different points through the module.
  - Pressure change can be measured using one of the manometers.
  - Used in experiments on Bernoulli's principle and flow measurement.

Losses In Bends Module

- **Purpose:** Demonstrates pressure losses caused by fluid flowing around bends.

- **Key Features:**
  - Contains three differently shaped bends. Each bend changes the flow direction by 90°.
  - Six self-sealing pressure ports allow pressure readings to be taken across different bend shapes.
  - Pressure change can be measured using one of the manometers.
  - Used in the Minor Losses in Bends experiment.

PROCESS OVERVIEW

Viscosity Apparatus

- **Purpose:** Demonstrates viscosity and Stoke's law by measuring the fall time of test samples through a liquid.

- **Key Features:**
  - Used with vegetable glycerine as the test liquid.
  - Supplied with ball-bearings and sample balls of different sizes and materials.
  - Includes top and bottom valves for filling, draining, and sample recovery.
  - Used in the Viscosity Matters experiment.

Centre of Pressure Module

- **Purpose:** Demonstrates the centre of pressure on a submerged surface.

- **Key Features:**
  - Uses the principle of moments to determine the position of the centre of pressure.
  - Contains weights for balancing the effect of water pressure on the end of the tank.
  - Used in the Centre of Pressure experiment.

PROCESS OVERVIEW

Bourdon Gauge Calibration Kit

- **Purpose:** Demonstrates the calibration of a Bourdon gauge by comparing its analogue reading with known applied pressure values.

- **Key Features:**
  - Uses three types of pressure gauge: a solid-state device, a liquid-filled manometer, and a Bourdon gauge.
  - Contains weights for applying known pressure values to the loading plate.
  - Used in the Calibrating the Pressure Gauge experiment.

TECHNICAL SPECIFICATIONS

The system is designed for safe, low-voltage use in training environments. Key electrical, mechanical, and environmental parameters are summarised below:

Parameter	Value
Supply voltage	24 V DC (via external double insulated PSU)
Input current	2.5 A
Power consumption	< 60 W
Ingress protection	IP20 (training lab use)
Ambient temperature	5 °C … 35 °C
Noise emission	< 60 dB A at 1m
Overall dims (W×H×D)	790 × 581 × 375 mm
Mass	30 kg

Note: The rig operates at SELV levels only; no mains voltages are present inside or outside the enclosure.

STANDARDS & COMPLIANCE

The Fluid Mechanics Trainer has been designed with reference to standards relevant to electrical safety and electromagnetic compatibility for measurement, control and laboratory equipment.
The principal safety standard referenced for the Fluid Mechanics Trainer is:

- **BS EN 61010-1:2010+A1:2019** - Safety requirements for electrical equipment for measurement, control, and laboratory use. General requirements.

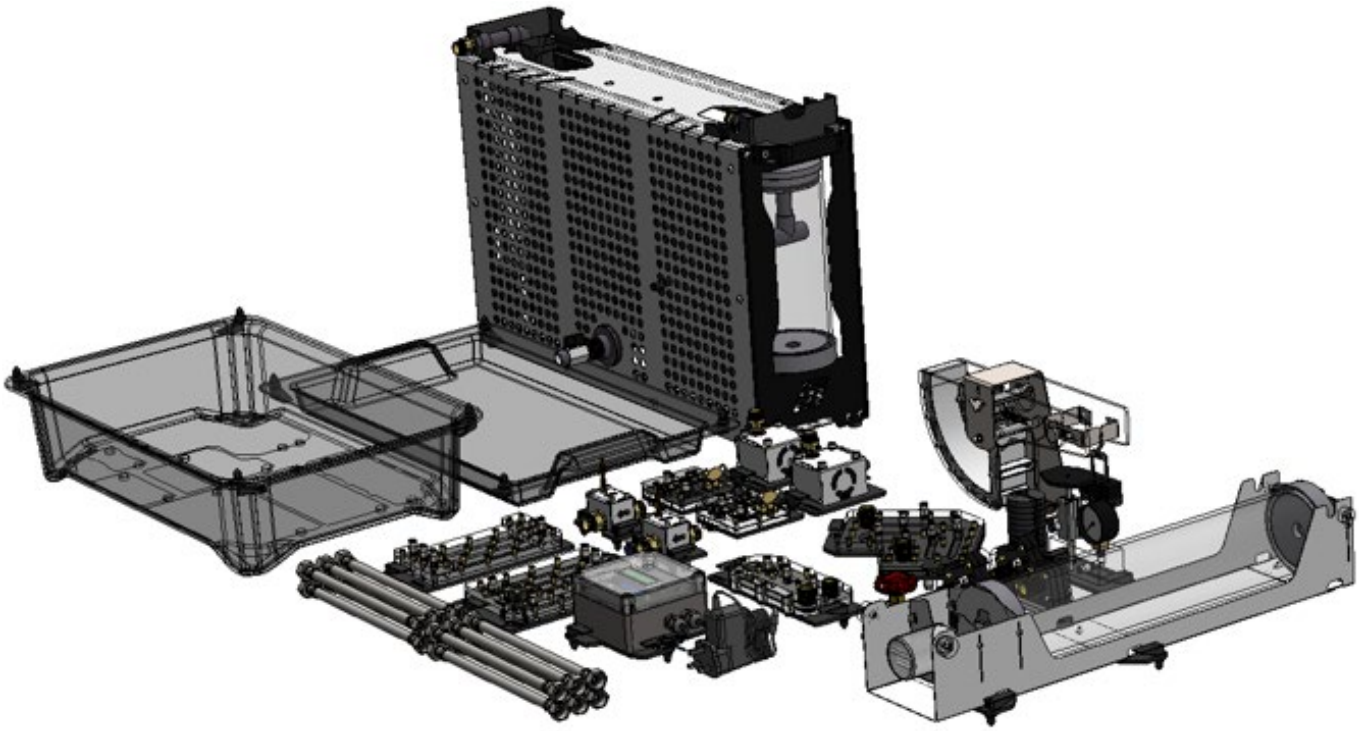
This standard addresses protection against hazards including electric shock, mechanical hazards, excessive temperature, fire, and hazards arising from fluids and fluid pressure.
Electromagnetic compatibility for this type of equipment is addressed by:

- **BS EN IEC 61326-1:2021** - Electrical equipment for measurement, control and laboratory use. EMC requirements - General requirements.

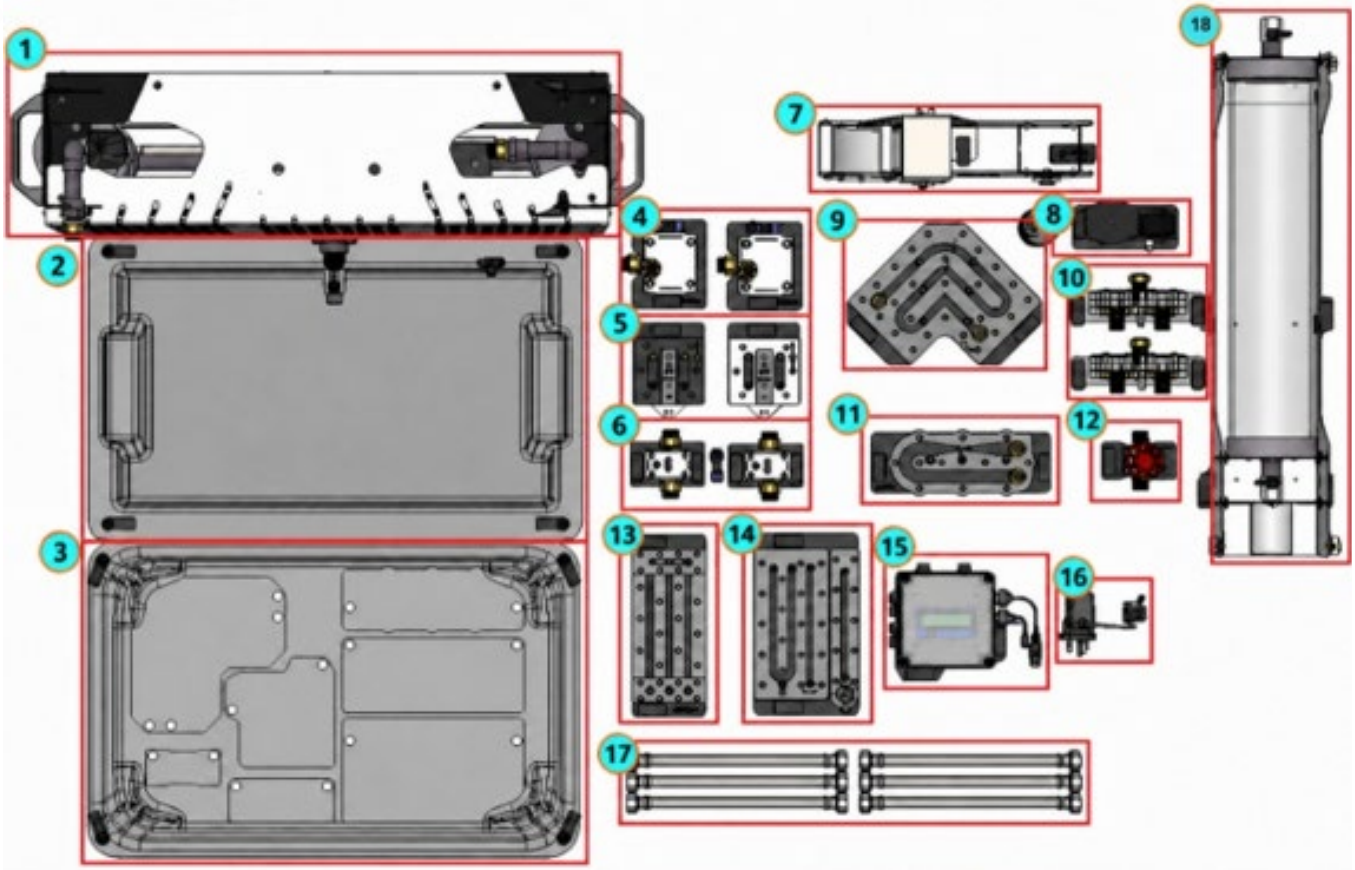
This standard is relevant to electromagnetic emissions and immunity for electrical equipment used in educational, laboratory and control applications. Where applicable, associated electrical components supplied with the system should be used in accordance with their own product markings, ratings and approvals.
The Fluid Mechanics Trainer is intended for supervised educational use and must be operated in accordance with this manual.
It must be installed, operated and maintained in accordance with this manual and with the supplied electrical accessories specified for the system.

DESCRIPTION OF COMPONENTS

This section summarises the principal FM1000 components using the local product specification, packing list, and curriculum references in this workspace. It is intended as a practical guide to what each assembly or module is used for within the Fluid Mechanics Trainer system.



DESCRIPTION OF COMPONENTS



Item	Name
1	Fluids workstation
2	Drip tray
3	Storage cover
4	Centrifugal pump modules (2)
5	Differential pressure sensors (2)
6	Turbine flow meters (2)
7	Centre of pressure kit
8	Bourdon gauge calibration kit
9	Losses in bends module

Item	Name
10	Tee piece / manifold (2)
11	Venturi tube module
12	Gate valve module
13	Multitube manometer
14	Inclined manometer module
15	Data control module
16	Power Supply
17	Assorted hoses and tubing
18	Viscosity apparatus

Note: Not all supplied items are shown. Refer to Appendix A - Customer check list for the full contents.

DESCRIPTION OF COMPONENTS

Core Assemblies

FM2368 Fluids Workstation

The workstation is the main base assembly of the FM1000 system. It provides the working platform for mounting experiment modules and carrying out practical activities, including setup, filling, draining, and observation. Modules are fitted to the workstation using swell latches, and the workstation includes the fluid-holding arrangement used during normal teaching.

FM2342 Fluids Data Control Module

The Data Control Module is the powered interface unit supplied with the FM1000 system. It provides flow control and sensor feedback during supported activities, displays information from connected modules, and connects to the PC for use with the Fluids app where applicable.

Drip Tray

The drip tray is used to collect water during setup, operation, and draining of the FM1000 system. It fits beneath the workstation and provides a 6-litre collection capacity, sufficient to hold the full contents of both tanks during normal teaching activities.

Experiment Modules

FM0363 Fluids Centrifugal Pump Module (Qty 2)

The centrifugal pump module is used to circulate water through the FM1000 system during pump-based experiments. It provides controlled fluid movement through the connected modules, with pump operation set through the Fluids app and system status shown on the Data Control Module and in the software.

FM1820 Differential Pressure Sensor Module (Qty 2)

The differential pressure sensor module is used to measure the pressure difference between two points in the FM1000 system during sensor-based experiments. It provides automated pressure readings from its two self-sealing pressure ports, with measurement data shown on the Data Control Module and in the Fluids app.

DESCRIPTION OF COMPONENTS

FM4594 Flow Sensor Module (Qty 2)

The flow sensor module is used to measure the flow rate of water through the FM1000 system during sensor-based experiments. It provides automated flow readings as water passes through the internal turbine, with measurement data shown on the Data Control Module and in the Fluids app.

FM4462 Venturi Tube Module

The Venturi tube module is used to demonstrate the relationship between fluid velocity and pressure in a constricted flow passage within the FM1000 system. It includes a reduced-width venturi section and self-sealing pressure ports for connection to measuring devices during flow and pressure experiments.

FM9403 Losses in Bends Module

The losses in bends module is used to demonstrate pressure losses caused by fluid flowing around bends within the FM1000 system. It includes three differently shaped 90° bends and self-sealing pressure ports for connection to measuring devices during the Minor Losses in Bends experiment.

FM1498 Inclined Manometer Module

The U-tube and inclined manometer module is used to measure and indicate liquid pressure during manual-reading experiments within the FM1000 system. It includes a single tube manometer, a U-tube manometer, and an inclined single tube manometer, with an adjustable angle on the inclined section for comparison of readings.

FM6678 Multitube Manometer Module

The multitube manometer module is used to measure and indicate liquid pressure at multiple points within the FM1000 system during manual-reading experiments. It includes three manometer limbs for comparing pressure at different points in the fluid flow, with a common top section that can be pressurised to adjust the zero level.

FM3057 Bourdon Gauge Calibration Module

The Bourdon gauge calibration module is used to demonstrate the calibration of a Bourdon gauge by comparing its analogue reading with known applied pressure values. It includes the components needed to apply known loads and compare readings using different pressure-measurement methods during calibration experiments.

DESCRIPTION OF COMPONENTS

FM5473 Centre of Pressure Module

The centre of pressure module is used to demonstrate the position of the centre of pressure on a submerged surface within the FM1000 system. It allows students to investigate the relationship between water depth, force, and turning moment during the Centre of Pressure experiment. The module is supplied with the hanger and weights required for balancing and measurement during the experiment.

FM2203 Tee Piece / Manifold (Qty 2)

The tee piece / manifold is used to split, join, or redirect water flow within the FM1000 system during practical experiments. It provides connection points within the fluid circuit to support different module configurations and pressure-measurement arrangements.

FM9213 Gate Valve Module

The gate valve module is used to control and restrict water flow within the FM1000 system during practical experiments. It allows the flow path to be opened, closed, or adjusted as required for setup, operation, and investigation of system behaviour.

FM9005 Viscosity Apparatus

The viscosity apparatus is used to demonstrate viscosity and Stoke's law within the FM1000 system. It allows students to measure the fall time of test samples through a liquid and compare the behaviour of different ball sizes and materials during the Viscosity Matters experiment. The apparatus is supplied with a set of test balls for use in these investigations.

DESCRIPTION OF COMPONENTS

Accessories and Service Items

COM6654 24 V PSU 60 W 2.5 A

The 24 V power supply unit is used to provide external power to the FM1000 system during normal operation. It supplies 24 V DC to the Data Control Module and supported connected devices used in practical activities.

COM5825 UK Head / COM5826 EU Head / COM5827 USA Head for 24 V PSU

These interchangeable heads are used with the 24 V power supply unit to provide a mains connection suitable for UK, EU, or USA power outlets. They form part of the external power arrangement for the FM1000 system.

COM00170 Pipette Filler, 10 ml Capacity

The pipette filler is used to apply or release small changes in pressure during manual pressure-measurement experiments within the FM1000 system. It allows students to adjust liquid levels in connected manometers when setting zero points or taking comparative readings.

AWP-EQTEE Junction Equal Tee, 4 mm

Hose-routing and connection fitting used within the fluid circuit.

COM1974 Swell Latch, Medium, Black

Module-retention fitting used to secure experiment modules to the workstation panel.

Hoses and Tubing (COM4177-11, COM4177-22, COM00255, COM00272)

The hoses and tubing are used to carry water and pressure connections between modules within the FM1000 system during practical experiments. The kit includes assorted hoses and tubing lengths to provide flexible connections for different experiment configurations and pressure-measurement arrangements.

COM00067 Bleed Key

The bleed key is used to open the bleed valves when adjusting water levels in the differential pressure sensor chambers.

PRI00282 Funnel

The funnel is used to add water to the workstation tank more easily and with less risk of spillage during setup and operation.

DESCRIPTION OF COMPONENTS

COM00214 100 ml Measuring Beaker

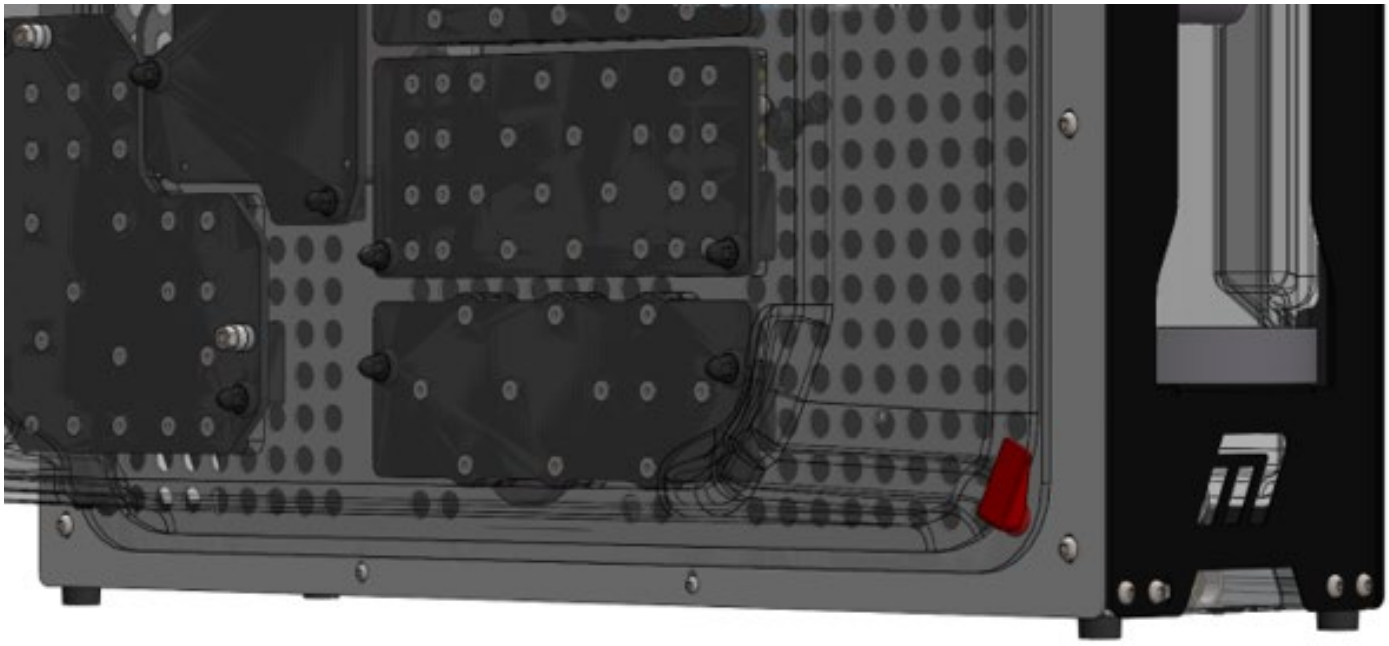
The measuring beaker is used in the Viscosity Matters experiment to collect the ball-bearings released from the viscosity apparatus.

HP2211 Barley Straw Bugs (50ml)

Barley Straw Bugs is a water-treatment additive used to help prevent algae growth within the system. At the manufacturer's initial treatment rate, 50ml is sufficient to treat up to approximately 1,818 litres of water. Only a small quantity is required for use with the Fluid Mechanics Trainer. This item may be purchased separately from external suppliers or contact Matrix TSL for further information.

UNPACKING & INSTALLATION

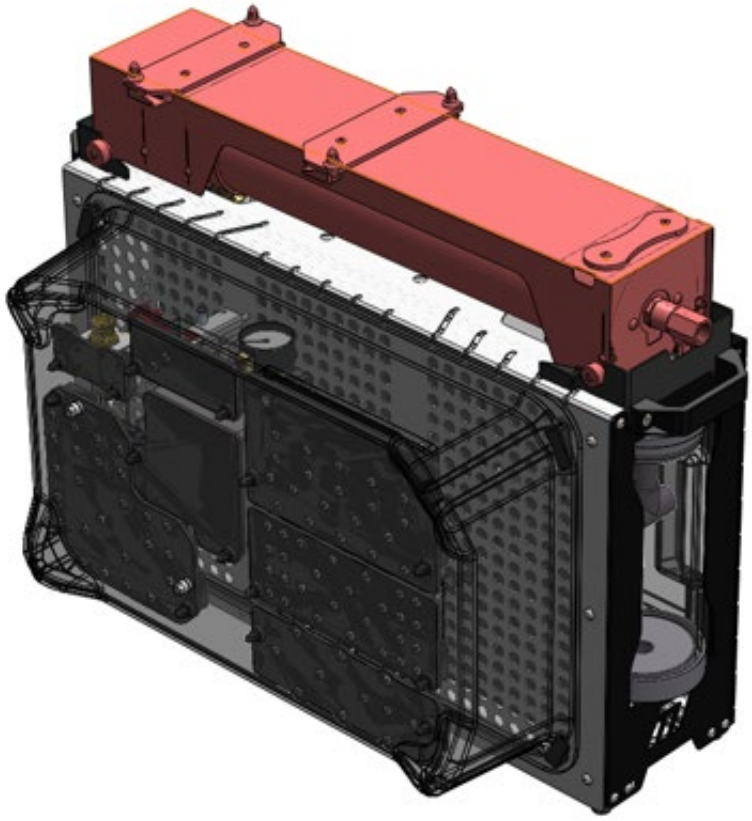
1. Inspect the packaging for signs of transit damage.
2. Place the workstation on a stable, level bench with enough space for safe opening and handling.
3. Remove the drip tray and storage cover from the workstation to gain access to the stored components. Each module is secured in position using the swell latches (highlighted in the figure). To remove either item, support it by hand, turn the swell latches to release them from the workstation mounting holes, then take the module. To refit and secure the items, repeat the process in reverse. Ensure the swell latches are in the open position, place the item in the correct position, insert the latches into the mounting holes, then turn them to the closed position.



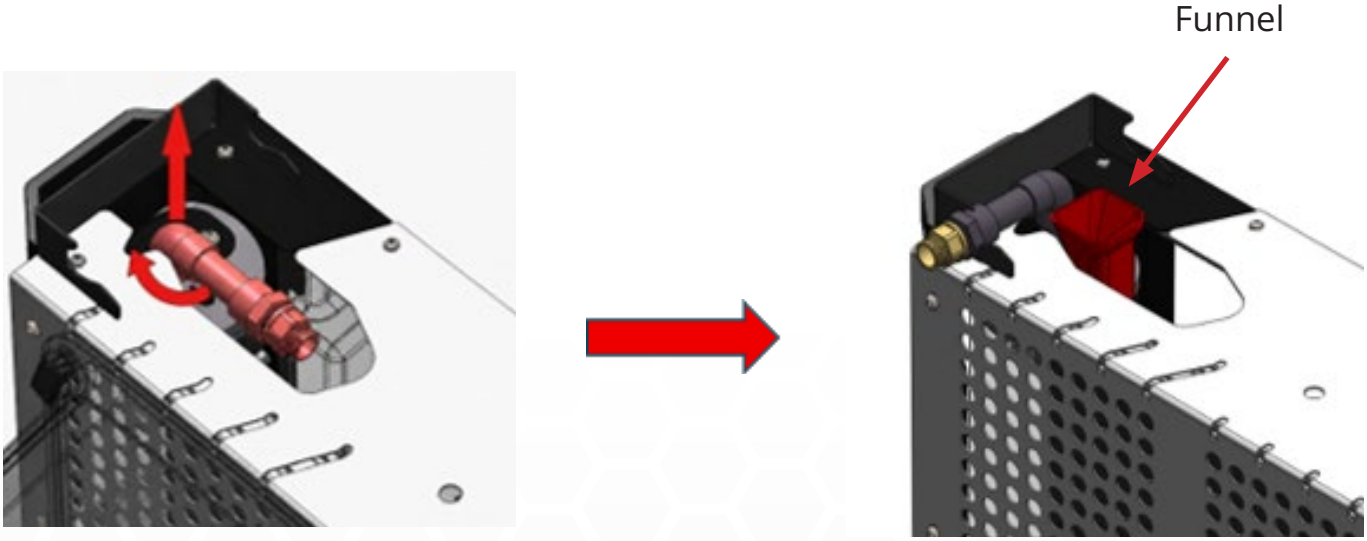
4. Check the contents against the packing list / customer check list before first use.
5. Position the drip tray correctly for use with the workstation.

COMMISSIONING / START UP

1. Ensure the inlet valve is closed.
2. Remove the Viscosity Apparatus (highlighted in the figure) gain access to the filling hole.

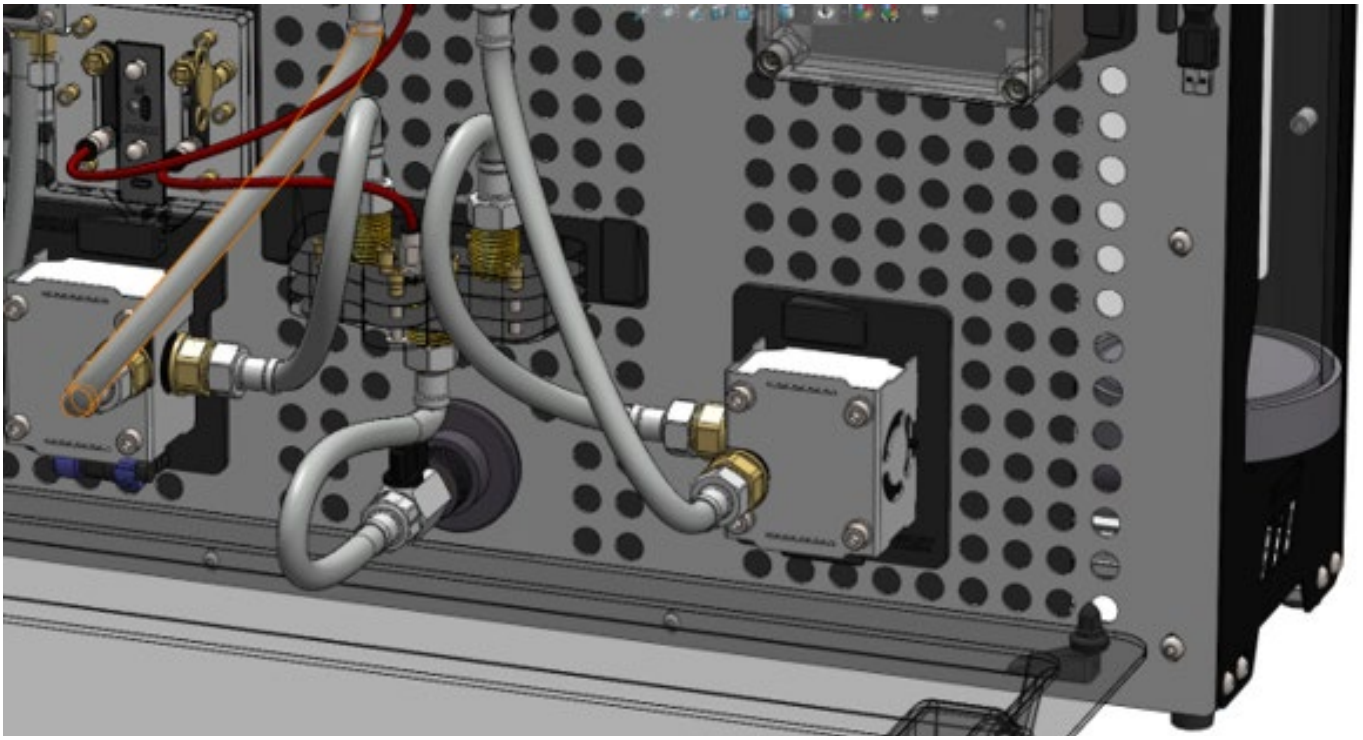


3. Lift and turn the **Tank return inlet** into the working position, place a **funnel** in the filling hole, and add approximately 2 to 3 litres of clean water. Because the tanks are linked, both tanks will fill together. Add a small quantity of Barley Straw Bugs to the water.



COMMISSIONING / START UP

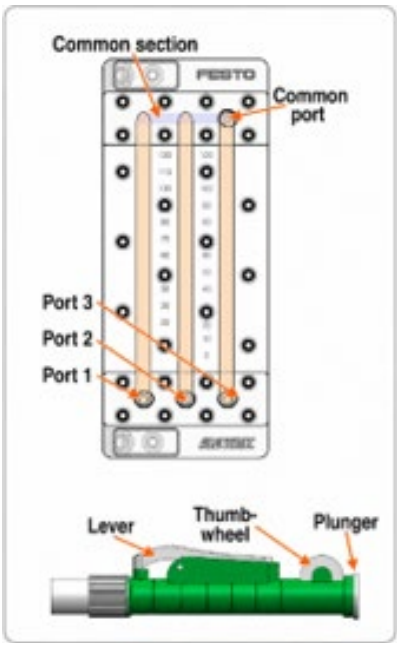
4. Fit the modules required for the selected experiment using the swell latches, then connect the hoses as needed for the selected setup. An example of typical modules and hoses connections is shown in the figure below. Refer to the previous section for instructions on using the swell latches.

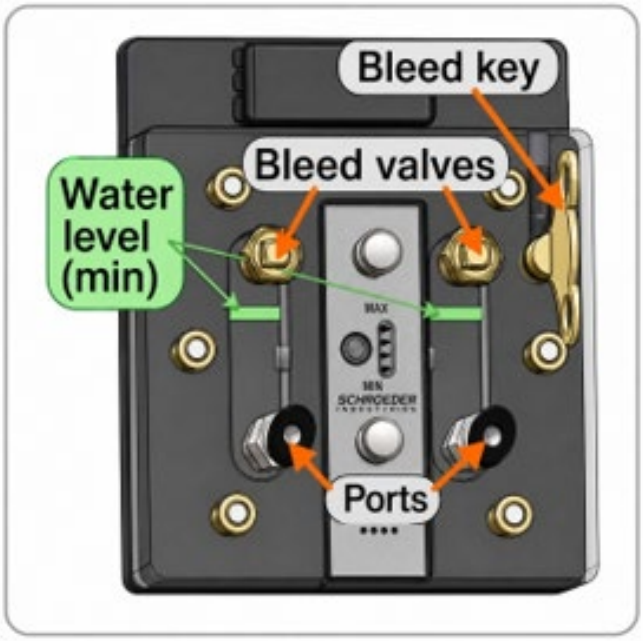


5. Check that all modules are secure and that all hose connections are correctly fitted.
6. Open the inlet valve where required for the selected experiment.
7. Before applying power, check that there are no obvious leaks and that the system is ready for operation.
8. Connect the 24 V DC power supply to the Data Control Module using the lead with the barrel socket.
9. If the selected experiment uses pumps or software-based sensing, ensure the Fluids app is installed on the PC, then connect the workstation to the PC.
10. Start the Fluids app where required and confirm communication with the connected modules. Refer to the Fluid Mechanics Trainer Software section for installation and operating instructions.
11. For pump-based experiments, ensure the pump is primed with water before use. If an air lock is present, remove the pump module from the workstation and lower it below the water level in the tank so that it fills with water. If the pump does not prime fully, drain the system and repeat the procedure.

COMMISSIONING / START UP

12. Where manometers or differential pressure sensors are used, connect the required tubing and purge unwanted air from the system before taking readings. For the multitube manometer, open the inlet valve and use the Fluids app to set the pump voltage to 12 V, then switch the pump on briefly to help remove air from the system. Attach the pipette filler to the top (common) port of the manometer, with the plunger set about halfway down its range. Remove air from the connecting tubing by lowering and then raising the pipette plunger slowly. Use the pipette filler thumb wheel to pressurise the common section until the water level in port 2 (centre) is at 0 mm.
13. For the differential pressure sensor, the chambers are isolated from each other and must be adjusted separately. Use the bleed valves to regulate the water level in each chamber and fill each chamber to the required level. With the pumps switched off, use the Zero button in the Fluids app to initialise the relevant pressure sensor before taking readings.





NORMAL OPERATION

Starting the System
- Prepare the workstation as described in the Commissioning / Start-Up section.
- For pump-based or software-supported experiments, connect the workstation to the PC, open the Fluids app, and confirm communication with the connected modules.

Using the Fluids App
- Use the Fluids app where required to establish communication, view sensor readings, zero pressure sensors, and operate the pump modules.
- Refer to the Fluid Mechanics Trainer Software section for software installation and operating instructions.

Taking Readings
- For manual experiments, take readings directly from the relevant measuring devices and record them as required.
- For sensor-based experiments, readings are shown on the Data Control Module and in the Fluids app.
- Follow the worksheet or experiment instructions when recording results.

Changing Experiments
- Close the inlet valve before changing the experiment setup.
- Reconfigure the workstation using the modules and hoses required for the next experiment.
- Some water may remain in the system when modules are removed or replaced. Use the drip tray to catch any water released during reconfiguration.
- If a significant amount of water is lost during reconfiguration, add clean water to the tanks before starting the next experiment.
- Ensure all modules are securely fitted using the swell latches and that all hose connections are correctly fitted.

Shutdown Procedure
- When the experiment is complete, stop the pump where used and close the Fluids app.
- Disconnect the power supply when the system is no longer in use.
- Remove the fitted modules and open the inlet valve to empty water from the system into the drip tray. Take care to check that the drip tray does not leak or overflow, and be ready to close the inlet valve if required.
- Empty and wipe the drip tray and dry any remaining water from the workstation and components.
- Return the components to their storage positions, then secure the storage cover and drip tray on the workstation for storage or transport.

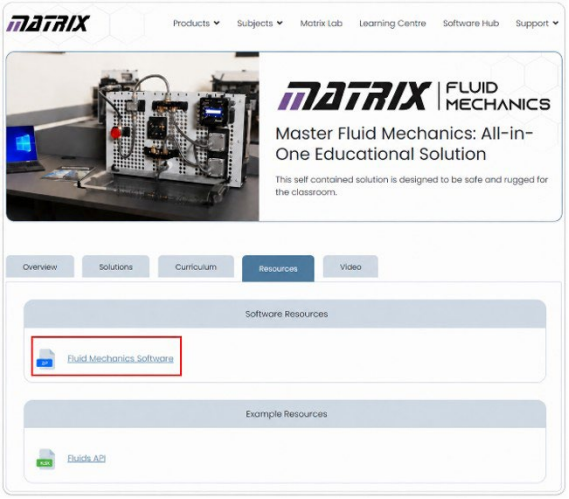
Introduction

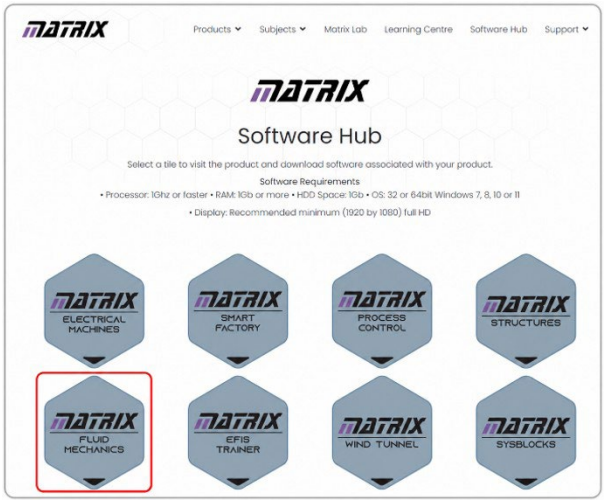
The Fluid Mechanics Trainer Software is used with pump-based and software-supported experiments on the FM1000 system. It is used to communicate with the Data Control Module, display flow and pressure readings, control the pump modules, zero pressure sensors, and record experimental data.

Software Installation

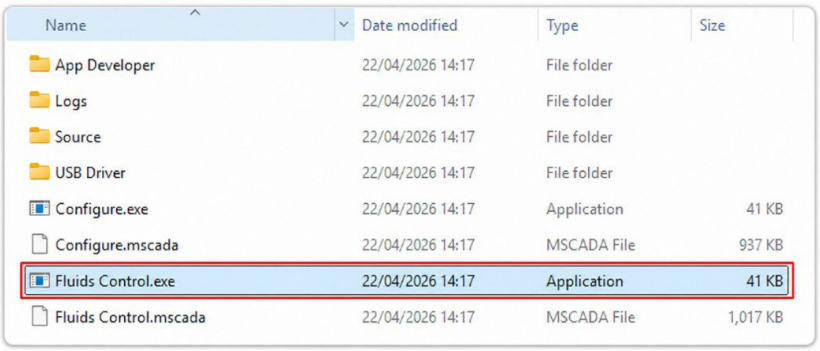
The Fluid Mechanics Trainer Software is available from the Matrix TSL website in either of the following locations:

- On the Fluid Mechanics product page, under the Resources tab, in Software Resources: Matrix TSL Fluid Mechanics product page
- In the Matrix TSL Software Hub, under the Fluid Mechanics section: Matrix TSL Software Hub





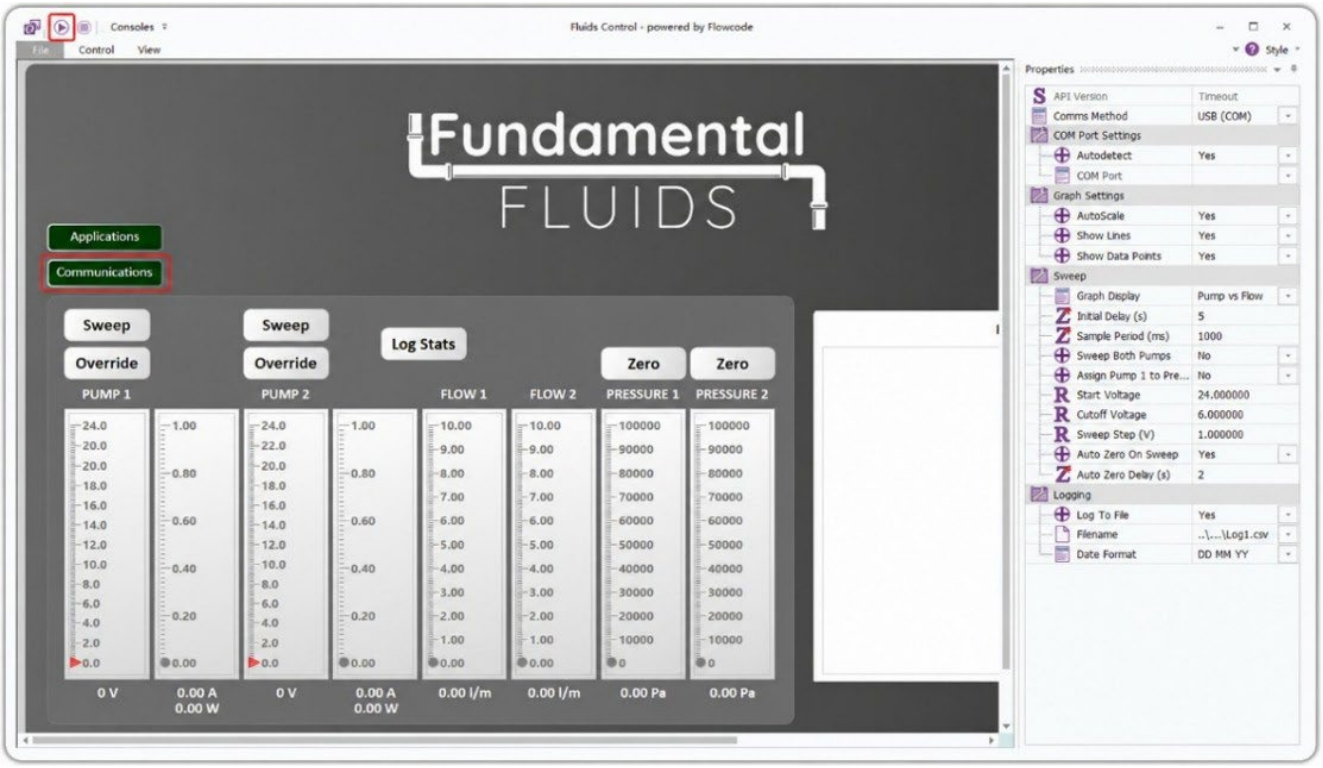
Download the software package to the PC that will be used with the workstation, then install and run **Fluids Control.exe.**
On some PCs, this may appear simply as Fluids Control if file extensions are hidden.

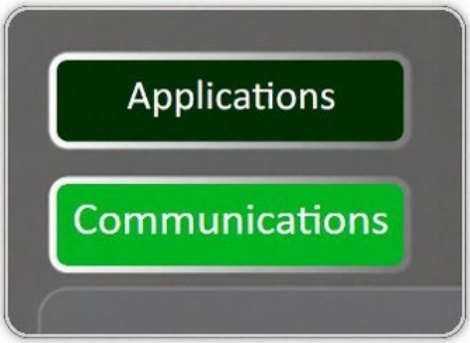


SOFTWARE MANUAL

Establishing Communication

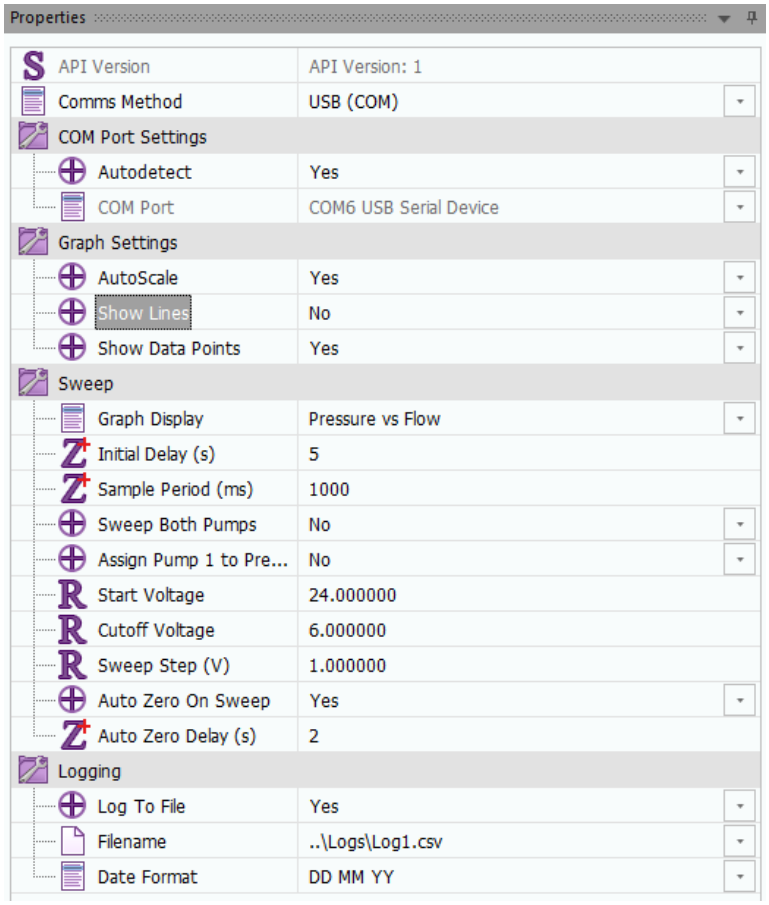
Connect the Data Control Module to the PC using the USB cable. Open the Fluids app and click the **Play** button to establish communication with the connected modules through the Data Control Module. When communication is established, the relevant indicators in the software turn green.





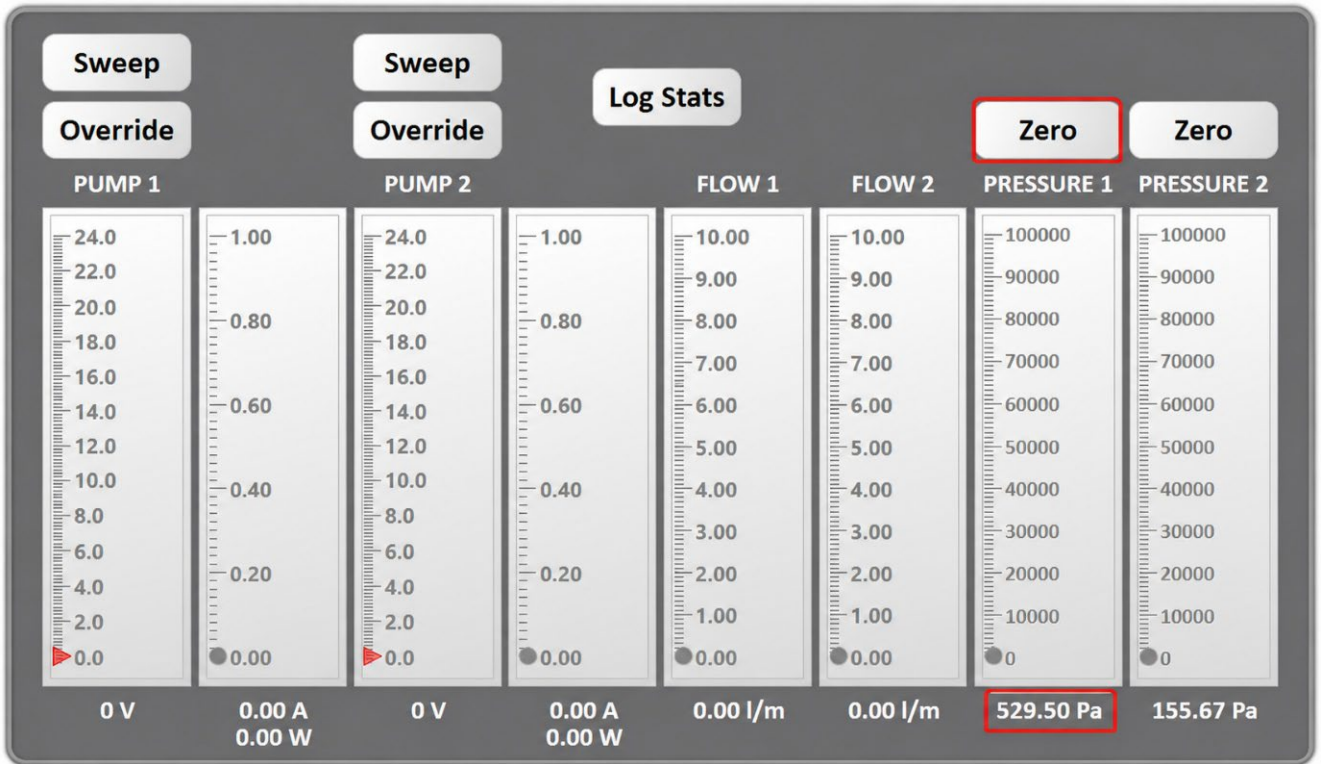
App Settings

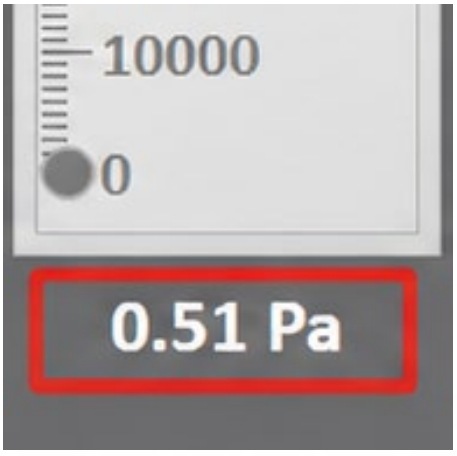
The Fluid Mechanics Trainer Control app includes settings for an initial delay to allow flow to settle, the time between samples, the range of pump voltages and step size used during sweeps, and the location and file name of the log file where experiment data is stored.
Typical settings are shown in the next illustration, although these may be changed to suit the investigation being carried out.



Zeroing Pressure Sensors

Where differential pressure sensors are used, the relevant sensor should be zeroed before taking readings. With the pumps switched off, click the Zero button for the required pressure sensor in the Fluids app.

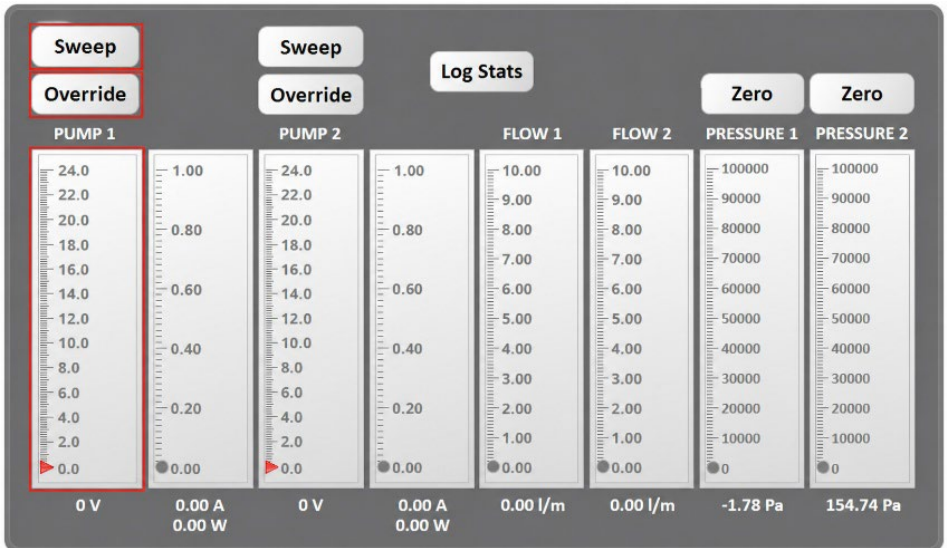




Controlling the Pump

There are three ways to operate a pump in the Fluids app:

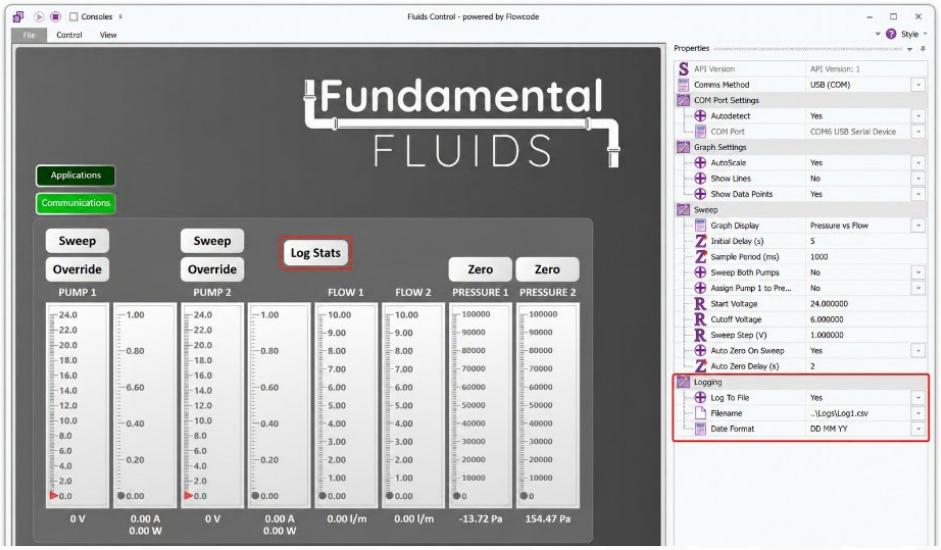
- Adjust the Slider to the required voltage.
- Use the Override function to enter an exact voltage value.
- Use the Sweep function to vary the pump voltage automatically according to the selected sweep settings.



Taking and Logging Readings

For software-supported experiments, readings are displayed in the Fluids app and on the Data Control Module. Data can be recorded during the experiment using the logging functions in the software.
Recorded data can be saved in three ways.

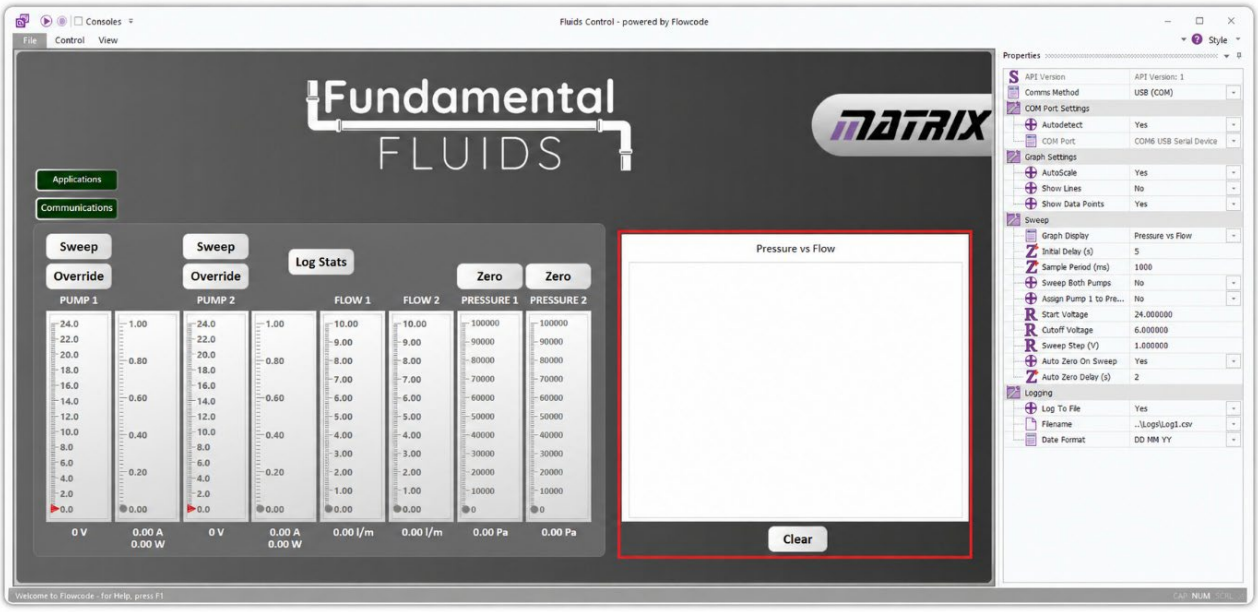
- After a Sweep operation, the readings are saved automatically to the folder containing the Fluids Control app.



- For manually selected readings, use the Log Stats button to save the data to the same folder.
- Recorded data can also be reviewed and exported directly from the graph area. Right-click the graph area and select Show Stored Data to open a window showing the data collected during the current experiment. Use the Export button in this window to save the recorded data as a .csv file.

Graph Display

The graph area displays recorded data during supported experiments. When the **Sweep** function is used, the graph shown depends on the settings selected for the investigation, for example **Pressure vs Flow, Pump vs Flow,** or **Pump vs Pressure.**



MAINTENANCE & CALIBRATION

This system does not require extensive routine maintenance. However, regular checks should be carried out to help ensure reliable performance, accurate readings, and safe operation.
Maintenance should only be carried out by trained staff.

12.1 Maintenance schedule

Task	Interval	Method
Visual inspection	Before each class	Check the workstation, modules, hoses, cables, and connectors for signs of damage, wear, leaks, or loose fittings.
Functional test	Weekly	Prepare the system and confirm that the Data Control Module, connected sensors, pump modules, and Fluids app operate correctly.
Hoses, cables & connectors check	Monthly	Inspect all hoses, pneumatic tubing, USB and power connections, and module connectors for wear, damage, or poor fit.
Clean exterior	Monthly	Wipe down the workstation, modules, drip tray, and external surfaces with a soft cloth. Ensure all parts are dry before storage or reuse.
Software check	Termly / Before term	Confirm that the Fluids app is installed, up to date, and available on the PC used with the system, and that communication with the Data Control Module can be established correctly.
Sensor and reading check	Annually	Check that flow and pressure readings respond correctly during use and investigate any unexpected or unstable readings.
Storage check	Before each term	Confirm that the storage cover, drip tray, and stored components are present and in good condition, and that all components can be fitted correctly in their storage positions using the swell latches.

TROUBLESHOOTING

This section provides guidance on common issues that may occur during the setup or operation of the Fluid Mechanics Trainer. The checks below are intended to help identify possible causes and appropriate corrective actions.

Problem	Possible Cause	Action
No communication between the workstation and the Fluids app	1. USB cable not connected correctly; 2. Power supply not connected; 3. Fluids app not running;	1. Check/reconnect the USB cable; 2. Check/reconnect the power supply cable; 3. Restart the Fluids app and re-establish communication.
Pump does not operate	1. Communication issue; 2. Fluids app frozen; 3. Pump not primed / air lock in the pump	1. Re-establish communication between the Data Control Module and the Fluids app; 2. End the app task in Task Manager, then restart the app; 3. If an air lock is present, remove the pump module from the workstation, lower it below the water level in the tank so that it fills with water, and repeat the priming procedure if required.
No or low water flow	1. Inlet valve closed; 2. hose connection incorrect; 3. hose kinked; 4. insufficient water in the tanks; 5. pump voltage set too low; 6. air in the system	1. Check that the inlet valve is open where required; 2. confirm the hose arrangement; 3. remove any kinks from the hoses; 4. check the water level in the tanks; 5. increase the pump voltage if required; 6. remove air from the system
Pressure readings are unstable or incorrect	1. Sensor not zeroed; 2. air in the sensor chambers or tubing; 3. incorrect tubing connection; 4. sensor calibration incorrect	1. zero the relevant pressure sensor 2. remove air from the system 3. Check the tubing connections; 4. calibrate the sensor
Flow readings are unstable or incorrect	1. Poor flow through the system; 2. air in the system; 3. incorrect module setup	1. Check the module and hose arrangement; 2. remove air from the system; 3. confirm that the experiment has been assembled correctly.

TROUBLESHOOTING

Problem	Possible Cause	Action
Water leaking from the system	1. Loose hose connections; 2. remaining water released during reconfiguration	1. Check that all hoses are fitted securely; 2. Use the drip tray to catch released water.
Unable to configure the experiment correctly	1. Modules not aligned correctly; 2. incorrect modules or hoses arrangement; 3. obstruction in the mounting or storage position	1. Check the swell latches and realign the modules; 2. Check the worksheet or experiment setup, and confirm that the correct modules and hoses are being used; 3. ensure the mounting positions are clear before refitting.

Contact Support

If a fault cannot be resolved using the checks above, stop using the system and refer the issue to trained staff or Matrix TSL for further support.

CRITICAL SPARES

This system uses standard, commercially available components that can be replaced as needed. Most parts are not considered critical, and replacements can typically be sourced through major suppliers. However, downtime should be accounted for when planning lessons.
The PSU is considered critical due to its essential role in powering and protecting the system.
These are recommended for on-site storage to minimise disruption:

Item	Part number / Order Code	Qty	Notes
Power Supply (24 V DC, 60 W)	Mean Well GEM60I24 P1J	1	IEC C8 inlet, main system PSU

Important note:

The Data control module and software are pre-programmed with custom Matrix software. If either unit is damaged or requires replacement, the new device will not function correctly without reloading the project files. This process requires specific technical knowledge and is not intended to be carried out by the end user. If you need to replace the data control module, please contact Matrix Technology Solutions for technical support or reprogramming services.

TEACHING & ASSESSMENT AIDS

For training environments using this equipment, structured worksheets are available separately:

- CP2599 – Fundamental Fluids

Refer to this document for further information on structured procedures and experiment activities.

CP2599 – Fundamental Fluids

WARRANTY & SUPPORT

12 months parts & labour from invoice date.
Warranty void if operated outside specs, modified, or unclean water is used.
For support:

Email: sales@matrixtsl.com
Phone: +44 (0)1422 252 380
Quote serial number: **FM1000**

APPENDIX A – CUSTOMER CHECK LIST

Code: **FM1000** **Description:** **Fluid Mechanics**

This product contains the items shown in the table below. Please check that all of these items are in your package before using any of the products. This is the complete packing list for this product - you may find that some items have already been combined for you - for example nuts and bolts may be combined with plastic covers and circuit boards.

Tray (if relevant)	Quantity	Reference	Description	Check
	1	AWP-EQTEE	Junction Equal Tee 4mm	
	1	COM5825	UK head for 24V PSU (65 series) for COM6654	
	1	COM5826	EU head for 24V PSU (65 series) for COM6654	
	1	COM5827	USA head for 24V PSU (65 series) for COM6654	
	1	COM6654	24V PSU 60w 2.5a (65 series)	
	1	HP4039	Tray Lid	
	1	HP5540	Deep tray	
	8	HP8600	Crash Foam 360mm x 260mm, thickness 25mm	
	2	COM1974	Swell latch, medium, black	
	1	MET1425	Square hanger stem FM2915 (Structures & Fundamentals) *bare*	
	5	MET2563	Square weight hanger gram FM2915 (Structures & Fundamentals)	
	4	LAS1212	5g plastic weight for FM2666 (FM2915)	
	1	COM2966	Mass and Hanger set cast alloy 1000g	
	1	COM00067	Radiator key	
	1	COM00214	100ml Measuring beaker	
	10	COM00297	2mm diameter steel ball	
	10	COM00298	3mm diameter steel ball	
	10	COM00299	4mm diameter steel ball	
	10	COM00300	5mm diameter delrin ball	
	10	COM00301	6mm diameter delrin ball	
	1	COM00170	Pipette filler 10ml capacity	
	10	COM00255	300mm 1_2 BSF hose	
	1	COM00272	600mm 1_2 BSF hose	
	1	PRI00282	3D Printed Funnel	
	2	AU1073-00	DNU Tubing, 4mm, clear, 300 mm length	
	4	AU1073-11	DNU Tubing, 4mm, clear, 200 mm length	
	1	FM1000-00	Fluid Mechanics	
	1	BOX1013	Fluids wooden crate	

Notes

FLUID MECHANICS TRAINER USER MANUAL

FM1000

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