FLUID MECHANICS

A knowledge of fluid mechanics is essential for all branches of engineering. The comprehensive range of **SOLTEQ®** equipment covers all aspects of the teaching of fluid mechanics in a safe and simple way, supported by high quality teaching materials. The **SOLTEQ®** equipment has an extensive range of optional accessories making our product a very flexible and economic investment. Our product range covers such as: hydrostatics, pipe networks, flow visualization, laminar and turbulent flow, pressure and flow measurement, investigation of Bernoulli's equation, drag forces on various shapes, study of turbulence, investigation of boundary layer development, pressure distribution of flow around a bend, jet attachment, pressure distribution around a cylinder, pressure distribution around an aerofoil, turbo machinery and fan performance characteristics.

SOLTEQ®

FLUID MECHANICS

Equipment List

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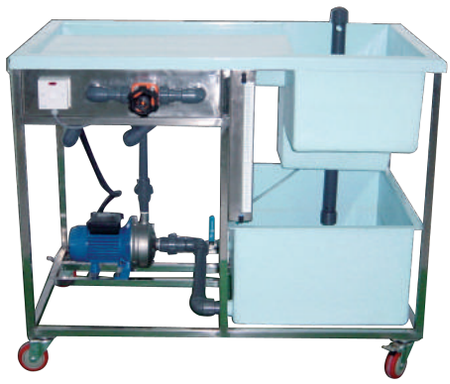
FLUID MECHANICS

Equipment List

FUNDAMENTALS OF FLUID MECHANICS

Hydraulic Bench (Model : FM 110)



This **Hydraulic Bench** is designed to complement a wide range of accessories for experiments on the subjects of fluid mechanics. The unit consists of upper and lower mouldings mounted on a steel structure fitted with lockable wheels. The mouldings are made of fiberglass for lightweight and corrosion resistant features. An open channel and volumetric measuring tank are incorporated with the bench along with the means for mounting and connecting various accessories.

This unit consists of:

- Sump tank and volumetric tank made from fibreglass
- Centrifugal delivery pump

Osborne Reynolds Demonstration (Model : FM 11)*

This **Osborne Reynolds Demonstration** is designed to reproduce the classic experiments by Professor Osborne Reynolds on visualization of fluid flow.

This unit consists of:

- Transparent header tank
- A flow visualization pipe
- A dye injection system *(installed on top the header tank so that flow pattern in the pipe can be visualized)*

Experimental capabilities:

- Visualization of the laminar, transitional, turbulent flow and velocity profile

Orifice Discharge (Model : FM 12)*

This **Orifice Discharge** is designed to demonstrate the measurement of orifice discharge.

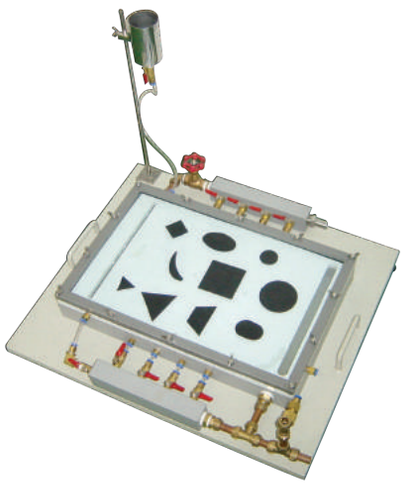
This unit consists of:

- A cylindrical acrylic tank which has an orifice fitted at the base
- A traverse assembly is provided to allow a pitot tube to be positioned anywhere in the jet
- A wire is attached to the pitot tube which can traverse across the jet. *(to accurately measure the jet diameter and the vena contracta diameter in order to determine the contraction coefficient)*

Experimental capabilities:

- Determination of the contraction and velocity coefficients of different orifices
- Calculation of the orifices discharge coefficient

Flow Visualisation Apparatus (Model : FM 22) *



This **Flow Visualisation Apparatus** is designed to provide flow visualization of various drag bodies.

This unit consists of:

- Chamber complete with ink injection tank, flow sources and flow sinks

Experimental capabilities:

- Demonstration of flow/path lines
- Simulation of flow sources and flow sinks

During the experiment, ink is injected through a fine nozzle to the flow chamber.

- Eight different drag bodies are provided, with which the influence of different bodies to the flow/path lines can be demonstrated
- 4 sources holes and 4 sink holes are provided to allow simulation of flow sources and flow sinks according to potential field theory.

Bernoulli's Theorem Demonstration Unit (Model : FM 24) *

This **Bernoulli's Theorem Demonstration unit** is designed to demonstrate the principles of Bernoulli's theorem.

This unit consists of:

- A classical venturi test section made of clear acrylic for flow visualization
- A pitot static tube which can be traversed across the centerline of the venturi section
- A manometer bank with eight tubes for measuring the static pressure distribution along the converging test section and total pressure traversed along the centerline of the test section.

Experimental capabilities:

- Demonstration of venturi as a flow measurement device
- Determination of the venturi discharge coefficient

Orifice and Jet Flow Unit (Model : FM 25)*

This **Orifice and Jet Flow Unit** unit is designed to demonstrate measurement of orifice discharge and jet flow.

- A constant head tank with a jet trajectory tracer
- Orifices of different diameters (installed at the side, near the base of the tank)
- A jet trajectory device allows the path followed by the jet to be ascertained

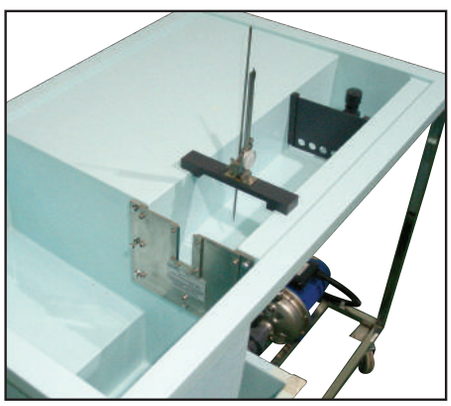
This unit consists of:

- Adjustable head tank
- Orifices with different diameters
- Jet trajectory tracer

Experimental capabilities:

- Determining velocity coefficient and discharge coefficient for a small orifice at a constant and variable head flow condition.
- Comparing the measured jet trajectory with that predicted by theory

Flow Over Weirs (Model : FM 26)*



This **Flow Over Weirs** apparatus comes with two weir plates of different shapes, allowing familiarisation and comparison with weir theory. The unit is capable to demonstrate flow characteristic cover:

This unit consists of:

- Weir plates
- Rectangular notch
- Vee notch

Experimental capabilities:

- Demonstration of flow characteristic of weir:
  I. Rectangular notch
  II. Vee (V) notch
- Determination of discharge coefficients of weir plates

Impact of Jet Apparatus (Model : FM 31) *

This **Impact of Jet Apparatus** is designed for study on the force developed by a water jet impinging on different non-moving targets.

This unit consists of:

- A clear acrylic cylinder where water is fed through a nozzle and discharged vertically to strike the target
- Three different target plates (supported on a stem which extends through the cover)
- Flat plate
- 120º cone
- Hemispherical cup
- A dead weight (applied on the upper end of the stem counter balance the force exerted by the water jet)

Experimental capabilities:

- Measurement of the force exerted by a water jet upon targets of different shapes and comparison with the forces predicted by momentum theory

Hydraulic Ram (Model : FM 39) *

This **Hydraulic Ram** comprises a cast iron base incorporating pulse and non-return valves and a supply reservoir on a stand which is fed by the Hydraulic Bench. An air vessel above the valve chamber smooth cyclic fluctuations from the ram delivery.

This unit consists of:

- Cast iron base incorporating pulse and non-return valves and a supply reservoir

Experimental capabilities:

- Establishing flow/pressure characteristic and determining efficiency of the hydraulic ram.

Venturi Meter (Model : FM 40) *

This **Venturi Meter** (Model: FM 40) is designed for experiments on the usage of a venturi. The venturi test piece has a circular cross section and is accurately machined from clear acrylic material with pressure measurement tappings at the converging/diverging sections and throat.

This unit consists of:

- Transparent venturi meter
- Manometer
- Discharge valve

Experimental capabilities:

- Demonstrating the use of venturi as a water flow meter
- Determining the venturi flow coefficient
- Establishing the relationship that flow is proportional to the square root of the pressure drop between entry and the venturi throat
- Investigating the degree of pressure recovery at the end of the divergent section of the venturi tube.

Demonstration Pelton Turbine (Model : FM 41) *

This **Demonstration Pelton Turbine** unit provides a simple low cost introduction to turbine performance.

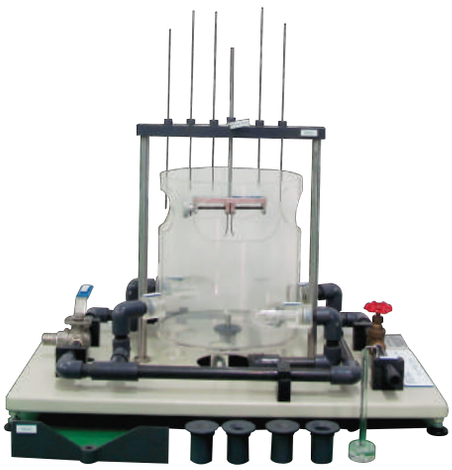
This unit consists of:

- A miniature pelton wheel with spear valve arrangement mounted on a support frame, which is located on top of the Hydraulic Bench (Model: FM 110)
- A simple friction dynamometer (to absorb mechanical output from the turbine)

Experimental capabilities:

- Determination of the operating characteristic of a Pelton turbine such as power, efficiency and torque at various speeds.

Free & Forced Vortex (Model : FM 42)*



This **Free & Force Vortex** is designed to generate and measure free and forces vortices.

This unit consists of:

- Clear acrylic cyclinder
- Interchangeable orifice
- Combined calliper and depth scale

Experimental capabilities:

- To study the difference between free and forced vortices
- To investigate the surface profile of a free vortex
- To investigate the surface profile and total head distribution of a forced vortex.
- Observation of secondary flow in free vortex

Pipe Friction Apparatus (Model : FM 111)*

This **Pipe Friction Apparatus** is designed for students to measure pipe friction losses for laminar and turbulent flows.

This unit consists of:

- Manometers
- Water storage tank
- Test pipe

Experimental capabilities:

- Measurement of pressure loss for laminar and turbulent flow
- Determination of critical Reynolds number
- Head loss measurement using U-tube manometer

Pressure Gauge Calibration Bench (Model : FM 01)

This **Pressure Gauge Calibration Bench** is a complete laboratory bench for pressure gauge calibration.

Three different types of pressure gauges are provided:

- Diaphragm
- Bellows
- Bourdon

This unit consists of:

- Bellows pressure gauge
- Membrane pressure gauge
- Bourdon pressure gauge
- Digital pressure calibrator
- Pressure regulator
- Pressure release valve

Experimental capabilities:

- Pressure measurement with various pressure gauges
- Pressure gauges calibration
- Determination of pressure gauges error
- Calibration of pressure gauges

Pressure Measurement Bench (Model : FM 01B)

This **Pressure Measurement Bench** is a complete laboratory bench for test and calibration of different types of pressure measuring elements.

This unit consists of:

- Pressure gauge
- Vacuum gauge
- Differential pressure gauge
- U-tube manometer
- Single tube manometer
- Inclined tube manometer
- Digital pressure calibrator

Pressure/Vacuum pump and tanks are also provided

Experimental capabilities:

- Pressure measurement comparison by manometer and Bourdon gauges
- Error determination for gauges
- Pressure gauges calibration

Properties of Fluids and Hydrostatics Bench (Model : FM 02)

This **Properties of Fluids and Hydrostatics Bench** is a self contained and mobile bench equipped with all necessary apparatus for a comprehensive range of experiments on the properties and basic principles of fluids.

Properties of fluid:
- Water manometer
- Oil manometer
- Bourdon gauge
- Aneroid barometer
- Thermometer
- Hydrometer
- Hygrometer
- Vernier hook gauge
- Capillary attraction plates
- Capillary tubes
- Capillary viscometer
- Specific gravity bottle

Basic Principle of Fluids
- Archimedes' apparatus
- Pascal's apparatus
- Dead weight pressure tester
- Hydrostatic apparatus
- Metacentric height apparatus

Experimental capabilities:
- Measurements of density, specific gravity, viscosity, pressure and humidity
- Function and use of hydrometer
- Demonstration of fluid upthrust (Pascal's Law)
- Capillarity
- Determination of center of pressure and metacentric height

Pipe Surge and Water Hammer Apparatus (Model : FM 04)

This **Pipe Surge and Water Hammer Apparatus** is designed for experiments on the transient effects of pipe surge and water hammer as a result of gradual or instantaneous changes in fluid velocity.

This unit consists of:
- Pipe surge test section
- Water hammer test section
- Head tank and Hydraulic Bench

Experimental capabilities:
- To demonstrate pipe surge and water hammer phenomena
- To study the oscillatory characteristics of the surge shaft
- To study the frictional head loss between reservoir and surge shaft
- To compare the measured water hammer pressure profiles with theory
- To determine the velocity of sound in pipe

Serial/Parallel Centrifugal Pump Test Rig (Model : FM 07A) SOLDAS SOLCAL EI

This **Serial/Parallel Pump Test Rig** is designed to demonstrate to students the operating characteristic of centrifugal pump in single configuration, series configuration & parallel configuration. Basic instruments are included to monitor the pump speed, pump head and flow rate.

This unit consists of:

- 2 units of centrifugal pumps
- Transparent circulation tank
- Suction and delivery pressure gauge
- Rotameter

Experimental capabilities:

- Evaluation of inherent pump speed
- Evaluation of pump characteristic curves

Laminar Flow Table (Model : FM 23)

This **Laminar Flow Table** is designed to simulate ideal fluid flow and give clear visualization of the flow patterns created using water as the working fluid. This enables a comprehensive investigation into the principles of potential flow and allows modeling appropriate physical systems.

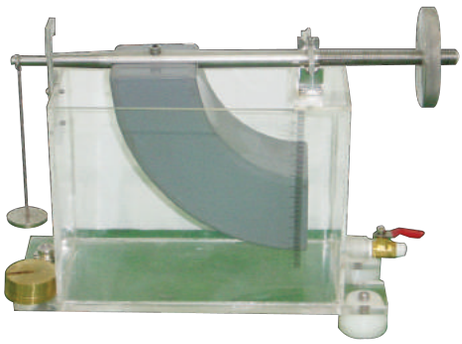
This unit consists of:

- Two closely spaced sheets of laminated glass arranged horizontally on a glass fibre moulding
- Inlet and discharge tank
- Eight miniature tappings for sinks or sources

Experimental capabilities:

- Ideal flow around immersed bodies
- Ideal flow in channels and at boundaries
- Ideal flow associated with sinks and sources
- Use of streamlines to analyse two-dimensional flow
- Modeling of two-dimensional systems

Hydrostatic Pressure (Model : FM 35)



This **Hydrostatic Pressure** apparatus is designed to introduce the concept of centre of pressure of an object immersed in fluid.

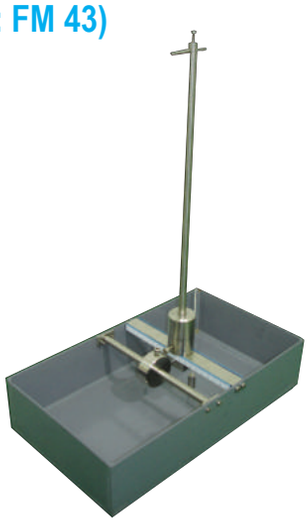
This unit consists of:

- Quadrant
- Clear reservoir tank
- Balance arm
- Weight set

Experimental capabilities:

- Measurement of the static thrust exerted by a fluid on a submerged surface
- Comparison of the magnitude and direction of the force with theory.

Metacentric Height (Model : FM 43)



This **Metacentric Height** allows a thorough investigation of factors affecting the stability of a floating body.

This unit consists of:

- Plastic rectangular floating pontoon complete with vertical and linear mass and linear scale

Experimental capabilities:

- Determination of the centre of gravity of a pontoon (floating body)
- Determination of the metacentric height and the metacentre of a pontoon
- Investigation of variation of metacentric height with angle of heel.

Dead Weight Pressure Calibrator (Model : FM 44)

This **Dead Weight Pressure Calibrator** is designed to demonstrate calibration of a Bourdon type pressure gauge.

This unit consists of:

- A precision machined piston and cylinder assembly mounted on leveling screws.
- A Bourdon gauge for calibration
- The weights (added to the upper end of the piston rod which is rotated to minimize friction effects)

Experimental capabilities:

- Calibration of Bourdon type pressure gauge

Pitot Static Tube (Model : FM 50)

This **Pitot Static Tube** is designed for students to determine the change in flow speed within a tube cross-sectional.

This unit consists of:

- Pipe section
- Manometer
- Pitot static tube and scale

Experimental capabilities:

- Static and dynamic pressure measurement
- Determination of velocity profile in a tube flow
- Demonstration of the characteristic of a pitot static tube

Particle Drag Coefficient Apparatus (Model : FM 102)

This **Particle Drag Coefficient Apparatus** is designed to introduce the fundamental characteristics of particle / fluid systems, in particular the relationship between drag coefficients of falling particles and Reynolds number.

This unit consists of:

- Two vertical glass tubes which contain different liquids
- Particles covering a range of sizes and densities

Experimental capabilities:

- Effect of different liquids on drag coefficients
- Effect of properties of particles on drag

Liquid Mixing Equipment (Model : FM 103)

SOLDAS SOLCAL EI

This **Liquid Mixing Equipment** is a benchtop unit designed for visualization of solid/liquid and liquid-liquid mixing.

This unit consists of:

- Stirrer
- Different impellers
- Baffles

Experimental capabilities:

- Effect of different impellers on mixing process
- Effect of baffles on mixing process

FLOW IN PIPES

Energy Losses in Bends and Fittings (Model : FM 34) *

This **Energy Losses in Bend and Fittings** is designed for investigation of energy losses in pipe bends and fittings, including valves. This will enable students to appreciate energy losses associated with different devices.

This unit consists of:

- 45° & 90° elbow
- Bend
- Sudden contraction & Sudden expansion
- Gate valve
- Manometer

Experimental capabilities:

- Measurement of losses in devices as related to flow rate
- Calculation of loss coefficients as related to velocity head
- Comparison of pressure drop across each devices

Losses In Pipes And Fittings Apparatus (Model : FM 36) *

This **Losses In Pipes and Fittings Apparatus** is designed for students to energy losses in pipes and fittings including valves.

Experimental capabilities:

- Determination of pressure drop across various pipes and fittings at differing flow rates.
- Estimation of Loss Coefficient (K) for various pipes, pipe, pipe fittings and valve settings
- Flow rate/diameter relationship determination for fluid flow in pipes
- 'Friction Factor' determination for fluid flow in smooth pipes

Pipe Network Apparatus (Model : FM 06)

This **Pipe Network Apparatus** is designed for students to measure flows and pressure drops in a wide range of pipe network configurations using water as the fluid.

This unit consists of:

- Different diameter of test pipes
- Digital manometer
- U-tube manometer

Experimental capabilities:

- Calibration of system components – head loss vs. discharge
- Characteristics of serial and parallel pipe networks
- Application of doubling pipes

Fluid Friction Measurement Apparatus (Model : FM 100) SOLDAS SOLCAL EI

This **Fluid Friction Measurement Apparatus** is designed for students to study the fluid friction head losses of an incompressible fluid flow.

This unit consists of:

- Smooth bore pipes of various diameters
- An artificially roughened pipe
- 90° bend, elbow and T
- 45° elbow and Y
- Sudden enlargement and contraction
- Ball, gate and globe valve
- Inline strainer
- Venturi made of clear acrylic
- Orifice plate made of clear acrylic
- Pitot static tube section made of clear acrylic

Experimental capabilities:

- Friction losses
- Laminar to turbulent flow regimes on smooth bore pipe of various diameters and an artificially roughened pipe

Flowmeter Measurement Apparatus (Model : FM 101)

This **Flowmeter Measurement Apparatus** is designed to introduce students to the operating characteristic of various types of flowmeters.

This unit consists of:

- A rotameter
- A venturi
- An orifice meter

Experimental capabilities:

- Apply Bernoulli equation for incompressible fluids
- Determine flow coefficients of venturi and orifice meter
- Establish the relationship between flow and differential pressure/fluid velocity for venturi meter and orifice plate.

HYDROLOGY

Flow Channel and Flume Apparatus (Model : FM 77) *

This **Flow Channel and Flume Apparatus** is a bench top unit designed for easy installation. This equipment introduces students to the basic concept of flow characteristics in an open channel.

This unit consists of:

- Self-contained , compact and easily installed bench mounted unit
- Perspex channel with large depth to width ratio
- Dye reservoir
- Fully instrumented for water and dye

Experimental capabilities:

- Demonstrating basic phenomena associated with open channel flow
- Visualisation of flow patterns over or around immersed objects

Rainfall Hydrographs (Model : FM 03)

SOLDAS SOLCAL EI

This **Rainfall Hydrographs** is a bench scale unit designed to allow students to study different situations of rainfall runoff. Student shall be able to obtain catchment rainfall and runoff values as functions of time.

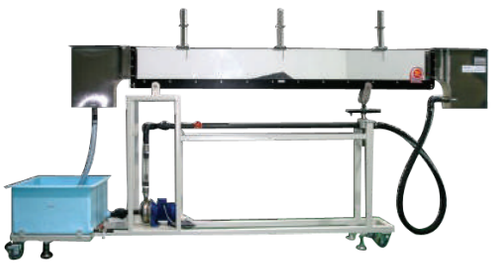
This unit consists of:

- Gravel filled tank
- Detachable curtains
- Runoff collector
- Flow meter
- Control valve

Experimental capabilities:

- Storm hydrographs from single or multiple storms
- Storm hydrographs from a previously saturated catchment
- Storm runoff from impermeable catchments
- Effect of a moving storm on flood hydrograph
- Effect of a reservoir storage on flood hydrograph
- Effect of land drains on flood hydrograph

Flow Channel & Flume Apparatus (Model : FM 27)



2.5 m long flume

5.0 m long flume

This **Flow Channel & Flume Apparatus** is designed for students to study the principles of open channel flow. This unit comes with an open channel made of transparent working section mounted on a strong framework.

This unit consists of:

- Clear acrylic flow channel
- Sump tank
- Venturi flume
- Sharp and broad crested weirs
- 3 vernier level gauges
- Crump weir
- Adjustable undershot weir

Experimental capabilities:

- Measurement of water level by hook and point gauges
- Measurement of flow rate using a pitot-static tube.
- Force-momentum and steady flow energy equations
- Relationship between water level above the crest of a weir and flow rate over the weir.
- Flow and level control using hydraulic structures
- Measurement of velocity profiles.

Hydrology Study System Apparatus (Model : FM 512) SOLDAS SOLCAL EI

This **Hydrology Study System Apparatus** is designed to demonstrate the run-off hydrographs from model catchments, construction of draw-down curves for one or two well systems in a sand bed , hydraulic gradients in ground water flow, investigation of model stream flow in alluvial material, formation of river features and development over time, and sediment transport, bed load motion, scour and erosion.

This unit consists of:

- Stainless steel tank, tiltable using a dual linked jacking system
- 8 stainless steel spray nozzles mounted on an adjustable height gantry
- A stilled tank providing a formed flow river inlet
- Two flowmeters
- An outlet tank allowing both water and sediment flow to be measured
- Two French drains, two well points and 20 manometer tapping points linked to a manometer bank
- A large plastic sump tank plus a recirculating pump

Experimental capabilities:

- Run-off hydrographs from model catchments
- Draw-down curves for one well and two well systems
- Ground water flow in alluvial material
- Formation and development of river features over time
- Sediment transport, bed load motion, scour and erosion

TURBOMACHINERY APPLICATION

Multi-Pump Test Rig (3 Pumps) (Model : SE 701A-3) SOLDAS SOLCAL EI

This **Multi-Pump Test Rig** is designed for demonstrations of the operating characteristics of three different types of pumps. Sensors are included to monitor pump speed, power, pump head and flow rate, enabling students to produce pump characteristics curves.

This unit consists of:

- Horizontal single stage centrifugal pump
- Vertical multistage centrifugal pump
- Gear pump
- Water tank
- Oil tank
- Instrumentations for measuring flowrates, pressures, pump speeds and motor power

Experimental capabilities:

- Pump characteristic curves for centrifugal pumps
- Series and parallel operation of pumps
- Determination of the capacity and efficiency of pumps

Multi-Pump Test Rig (6 Pumps) (Model : SE 701E-6) SOLDAS SOLCAL EI

This **Multi-Pump Test Rig** is fitted with six pumps and sensors necessary to allow pump characteristics study for different pumps.

This unit consists of :

- Centrifugal pump
- Axial pump
- Piston pump
- Gear pump
- Vane pump
- Channel Impeller pump
- Thyristor controlled DC motors

Experimental capabilities:

- Head/flow rate plots at various constant speeds
- Measurement of brake power input
- Determination of volumetric and total efficiency
- Variation of pump capacity with speed
- Specific speed analysis
- Cavitations

Plunger Pump Demonstration Unit (Model : FM 18-B) SOLDAS SOLCAL EI

This **Plunger Pump Demonstration Unit** is designed to demonstrate the working principle of a plunger or ram pump.

This unit consists of:

- Plunger pump
- Acrylic water tank
- Instrumentations for measuring pressure, displacement and flowrate

Experimental capabilities:

- Measurement during each pump cycle of plunger displacement, cylinder pressure and pump outlet pressure
- Online P-V diagram displays
- Measurement of volumetric efficiency
- Effect of spring loading valve or needle valve, outlet loading valve and the inclusion of a pulsation damper vessel, on pump performance

Multi Turbine Test Set (3 Turbines) (Model : FM 46) SOLDAS SOLCAL EI

This **Multi Turbine Test Set (3 Turbines)** unit is designed to demonstrate the operation of three types of turbines and their performance characteristics such as mechanical power, hydraulic power, hydraulic efficiency and specific speed. The turbines will be driven by a 3kW pump, together with dynamometer and data acquisition system. The turbines provided are:

This unit consists of:

- Francis (radial flow) turbine
- Kaplan (axial) turbine
- Pelton (impulse) turbine
- Pump
- Dynamometer

Experimental capabilities

Operation and performance characteristics of:

- Francis (radial flow) turbine
- Kaplan (axial) Turbine
- Pelton (impulse) turbine

Experiments on:

- Mechanical power out
- Hydraulic power in
- Hydraulic efficiency
- Specific speed

Axial Fan Demonstration Unit (Model : FM 51) SOLDAS SOLCAL EI

This **Axial Fan Demonstration Unit** consists of a self contained bench top unit with a small scale axial fan and all the necessary instrumentations

This unit consists of:

- Axial fan
- Transparent ducting
- Air flow control
- Instrumentation for pressure, differential pressure, temperature and impeller rotational speed

Experimental capabilities:

- Effect of static and total pressures, rotor speed and motor input power as a function of air inlet flow
- Calculation of overall efficiency and estimation of impeller power efficiency
- Measurement of performance at constant speeds
- Scale-up calculations using similarity laws

Centrifugal Fan Demonstration Unit (Model : FM 52) SOLDAS SOLCAL EI

This **Centrifugal Fan Demonstration Unit** consists of a self contained bench top unit with a small scale centrifugal fan and all the necessary instrumentations, allowing students to study the effect of different types of fans.

This unit consists of:

- Centrifugal fan with forward and backward curved blade impellers
- Transparent ducting
- Air flow control
- Instrumentation for pressure, differential pressure, temperature and impeller rotational speed

Experimental capabilities:

- Effect of static and total pressures, rotor speed and motor input power as a function of air inlet flow
- Calculation of overall efficiency and estimation of impeller power efficiency
- Measurement of performance at constant speeds
- Scale-up calculations using similarity laws

Centrifugal Pump Demonstration Unit (Model : FM 54) SOLDAS SOLCAL EI

This **Centrifugal Pump Demonstration Unit** is designed for students to perform the characteristic studies of a centrifugal pump.

This unit consists of:

- Fixed speed centrifugal pump
- Circulation tank
- Pressure gauge
- Rotameter

Experimental capabilities:

- Single pump operation
- Pump characteristic curves for centrifugal pump
- Determination of pump capacity
- Determination of pump efficiency
- Visualisation of pump mechanism

Axia Flow / Turbine Test Rig (Model : FM 60) SOLDAS SOLCAL EI

This **Axial Flow / Turbine Test Rig** is designed to study the performance of a pump/turbine in four different modes of operation.

This unit consists of:

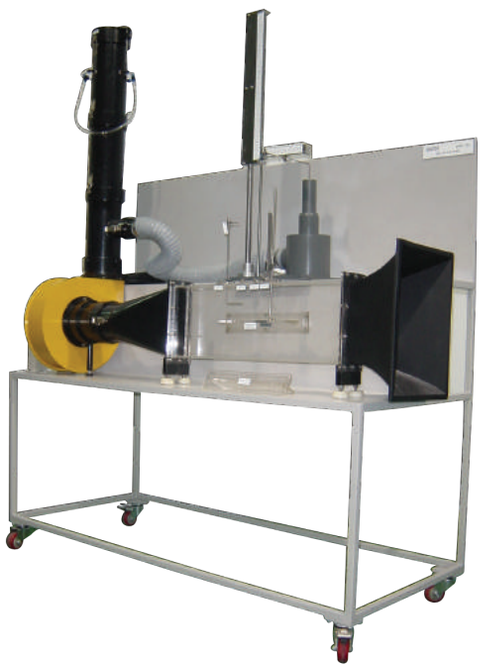
- Pump/Turbines unit-mounted on a stand, complete with DC motor and speed controller
- A complete set of pipe work
- A differential manometer
- An inline flowmeter

Experimental capabilities:

- Turbine outputs at design shaft speeds and constant head (output/flow characteristics)
- Turbine efficiencies at optimum design shaft speed and constant head (efficiency/flow and efficiency/output characteristics)
- General characteristics curves of the turbines under constant head at varying shaft speeds (iso-efficiency /curves) on parameters of unit speed and unit flow with lines of constant spear or guide vane opening
- Runaway speed envelope curves at constant head and various openings
- Determinataion of continuous ‘normal’ pump and ‘reverse’ turbine and pump characteristics curves
- Observation of cavitations curves under pump and turbine duty

FUNDAMENTALS OF AERODYNAMICS AND AIRFLOW

Air Flow Bench (Model : FM 21)



This **Air Flow Bench** Unit is designed to demonstrate the principles of compressible fluid flow, The basic unit comes with a motor driven centrifugal fan for studying air flow characteristics.

This unit consists of:

- Centrifugal Fan
- Differential Pressure Transmitter.

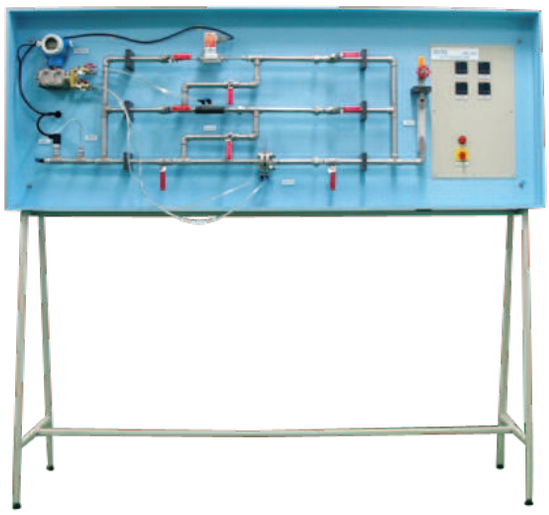
The unit can be used with the following accessories for more comprehensive experiments on air flow.

- FM 21A - Multitube manometer test board
- FM 21B - Venturi , orifice and pitot tube flow measurement test sets
- FM 21C - Bernuolli's theorem test set
- FM 21D -Flow around a bend
- FM 21E - Flow in pipes
- FM 21F - Jet dispersion test set
- FM 21G - Boundary layer growth test set
- FM 21H - Wind tunnel demonstration
- FM 21J - Smoke generation system
- FM 21K - Lift and drag forces

Experimental capabilities

- Characteristics of fan
- Flow rate measurements using venturi and orifice
- Bernoulli's theorem demonstrations
- Flow around a bend
- Pressure losses in pipes test set
- Jet dispersion measurements
- Determination of boundary layer growth
- Smoke Generation

Gas Flow Measurement Bench (Model : FM 120) SOLDAS SOLCAL EI



This **Gas Flow Measurement Bench** is designed for students to study the fluid flow of compressible gas.

This unit consists of:

- Venturi meter made of clear acrylic
- Orifice plate made of clear acrylic
- Pressure transmitter
- Digital flowmeter
- Temperature sensor
- Rotameter
- Water and mercury manometer

Experimental capabilities:

- Flow measurement using venturi meter
- Flow measurement using orifice plate
- Flow measurement using rotameter
- Use of manometers
- Flow compensation for pressure and temperature
- Flow measurement using electronic flowmeter (optional)

SOIL AND WATER MODEL TANK (MODEL: FM 514) SOLDAS SOLCAL EI

This **Soil And Water Model Tank** is developed to investigate several aspects of surface irritation and drainage system.

This unit consists of:

- Soil and water model tank
  a) Dimension (LxWxD) = 1000mm x 25mm x 450mm
  b) Front side made from clear see-through material
  c) Removable end plates
- Pump
- Flowmeter
- Nozzles
  a) Flood type
  b) Drip type
- Y connector
- Overflow mechanism

Experimental capabilities:

- Surface and sub-surface effects of surface water application

Ground Water Flow Unit (Model : FM 531) SOLDAS SOLCAL EI

This **Ground Water Flow Unit** is to demonstrate on a small scale, the hydrological principles of ground water flow and the application of these to certain engineering constructions.

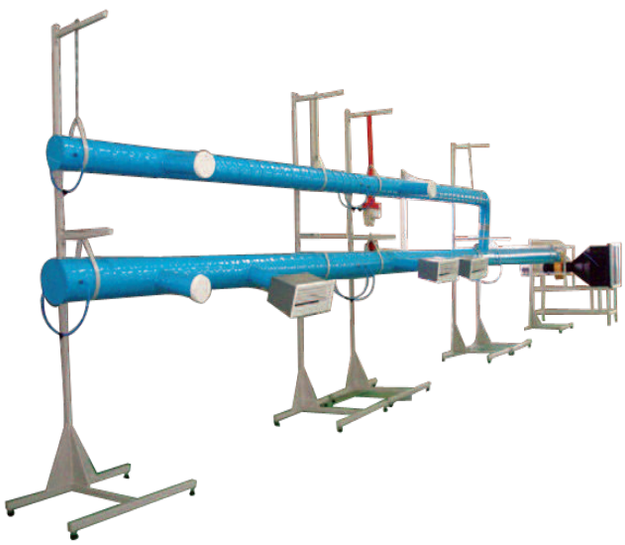
This unit consists of:

- Tank
- Sliding cursor permits measurement of level

Experimental capabilities:

- Hydraulic gradients in ground water flow, including the effect of permeability
- Cone of depression for a single well in an unconfirmed acquifer
- Cone of depression for two wells
- De-watering of an excavation site using two wells.
- Abstraction from a single well in a confined acquifer
- Draining of a polder or lake

Ventilation Training Unit (Model : FM 801) SOLDAS SOLCAL EI



This **Ventilation Trainer** is designed to demonstrate the basic operation of air ventilation .

This unit consists of:

- A forward curved variable speed centrifugal fan
- Integral control panel together with a rectangular air intake and filter holder
- Ducting components (supplied with the unit to enable parallel branch and line balancing experiments to be undertaken)

Experimental capabilities:

- Examination of typical components , fabrication , installation and assembly techniques used in air handling systems
- Investigation of pressure losses in bends, branches , changes of section and over straight lengths of duct together with the variation in pressure drop with velocity
- Determination of the 'k' factor for the pressure loss of the above components in each particular configuration
- Investigation of the fan pressure and volume flow characteristics at various fan speed
- Examination of standard types of panel and bag filters and their pressure drop against face velocity
- Measurement of air floe rate using air velocity meter