ASSEMBLY BENCHES

P5731 BASIC REFRIGERATION BUILD BENCH
1. The bench is built up on a wheeled trolley frame to allow the students work to be stored out of the way between work periods.
2. The bench is built up from components selected for their ease of work.
3. The circuit comprises of a hermetic compressor feeding an air cooled condenser. Optionally the student can be asked to guard the fan, although a guard is provided.
4. Typical filters and sight glasses are included in the circuit.
5. Expansion is provided by a capillary tube coil, and the refrigerant is evaporated in an air warmed coil.
6. A basic thermostat is provided. Pipe work comprises of a mix of 1/4” and 3/8” annealed copper.
7. The students will need to prepare pipe runs, cut and bend pipes. flare joints, braze connections and wire the circuit.

P5732 COMMERCIAL REFRIGERATION BUILD BENCH
1. This bench is also built up on a wheeled trolley and is similar to the basic build bench, but represents a more advanced build requirement for the student.
2. Differences include the compressor being a semi hermetic 1 HP unit, a receiver and isolation valves are included.
3. The expansion is through a thermostatic expansion device.
4. The evaporator includes an electric heating defrost circuit, and the control is provided by a more advanced programmable sensor.
5. Assembly skills involve more complex piping and wiring.

P5734 BEVERAGE COOLER BUILD BENCH
1. The bench mounted refrigeration system is equipped with a facia mounting plate, on which a mimic of the refrigerant circuit is provided showing the compressor, condenser and evaporator within an insulated chamber.
2. An expansion valve, driers and filters are included in the circuit, and a range of different joint techniques are required as part of the assembly process, such as brazing and pipe flaring.
3. Pressure transducers and thermocouples can be installed in the circuit.
4. Detail, step by step assembly instructions are provided.
5. Faults can be initiated by switches set in the control and monitoring circuits.

P5735 REFRIGERATION WIRING SKILLS BENCH
1. The unit is a bench top mounted unit, and with a mimic of the refrigeration circuit on the front panel.
2. Junction boxes for mechanical components such as compressors, condenser fans, thermostats and transducers are provided to which the wiring can be installed.
3. A range of different fuses, isolators and circuit breakers are provided to teach the basics of circuit protection. Detail, step by step assembly instructions are provided.
4. Faults can be initiated by switches set in the control and monitoring circuits.

VOCATIONAL & FAULT FINDING BENCHES

P5720 DOMESTIC REFRIGERATION TRAINER
1. The Domestic Refrigeration Trainer is a bench top mounted refrigeration system to provide students with experience in the safety, operation and faults of a domestic refrigeration system.
2. A mimic of the refrigerant circuit is provided on the front panel showing the circuit comprising of compressor, condenser and evaporator within an insulated chamber.
3. Expansion of the refrigerant is possible through a number of different devices such as regulating valves and capillary tubes of various lengths.
4. Pressure is displayed at two points on the circuit.
5. Faults can be initiated by switches set in the control and monitoring circuits.

P5721 COMMERCIAL REFRIGERATION TRAINER
1. This commercial Refrigeration Trainer is similar to the P5720, being a bench top mounted unit, and with a mimic of the refrigeration circuit on the front panel.
2. However the circuit is considerably more complicated including one chamber for chilling and one chamber for frozen produce.
3. The circuits are arranged within the evaporators to allow for hot gas defrosting.
4. Faults that can be simulated include blockage of pipes, filters, failure of expansion devices, thermostats etc.

P5722 MULTI COMPRESSOR REFRIGERATION TRAINER
1. Provided on a wheeled, floor mounted frame based and comprises a refrigeration system with three compressors and a compound controller.
2. An air cooled condenser is provided, together with an electrically heated evaporator built into a brine bath.
3. A mimic of the refrigerant circuit is provided on the front panel showing the circuit.
4. Faults can be initiated by switches set in the control and monitoring circuits.

P5723 COLD ROOM REFRIGERATION TRAINER
1. The unit is also provided on a wheeled floor mounted frame, and with a mimic of the refrigeration circuit on the front panel.
2. The insulated chamber is provided with two air evaporators focusing on opposite sides of the chamber.
3. A heat source can be moved within different areas of the cold room, whilst thermostats provide control signals to the expansion valves.
4. Faults that can be simulated include blockage of pipes, filters, failure of expansion devices, thermostats etc.

P5724 COMPRESSOR CONTROLS SIMULATOR
1. A bench top mounted control simulator utilising a programmable logic controller to simulate the operation and consequences of problems in compressor safety, operation and starting.
2. A mimic of the electric circuit is provided on the front panel with a range of commercial products such as controls and switching devices.
3. Faults can be initiated by side mounted switches so that the lecturer can keep them hidden from students view.
4. Symptoms of the failure are indicated by the illumination of LED’s and the students are required to relate these symptoms to determine which fault had been initiated.
5. Twelve different faults can be initiated, such as loss of power, fuse failure, motor coil failure etc.

P5725 REFRIGERATION CONTROL SIMULATOR
1. The unit is similar to the P5724, being a bench top mounted unit, but with a mimic of the refrigeration circuit on the front panel.
2. Faults that can be simulated include blockage of pipes, filters, failure of expansion devices, thermostats etc.
TRADITIONAL EXPERIMENT BENCHES

P5750 VAPOUR COMPRESSION REFRIGERATOR AND HEAT PUMP APPARATUS
[1] To study the thermodynamics of a vapour compression cycle operating as either a refrigerator or a heat pump.
[7] Instrumentation to include pressure gauges (3), multi-point direct reading electronic thermometer for all temperatures under push button control, variable area flowmeters (2), meter for heating element current, meter for torque readout and tachometer.
[8] Instrumentation to be carried on five colour instrument panel with flow diagram.

For 220/240V, 50/60Hz, 1 phase supply.
Dimensions: 1.37m long x 0.7m wide x 1.6m high. Nett Weight 320 kg.

P5751 DATA LOGGING OPTION FOR P5750 (FACTORY FITTED ONLY)
[1] Consists of 3 pressure transducers with associated 6 channel data logging interface PCB which also interfaces the speed, torque and heater current outputs.
[2] Temperature outputs to be provided via an 8 channel thermocouple amplifier PCB.
[3] Coolant and refrigerant flow transducers to provide outputs via a 2 channel frequency to voltage amplifier.
[4] All the outputs to be in the form of 0-10V dc analogue signals at a 25 way ‘D’ connector.

P5755 REFRIGERATION TRAINER UNIT
1. The Refrigeration Trainer Unit is a bench top mounted unit, designed for ease of understanding for engineering students.
2. The unit comprises of a rear frame, fronted by a transparent facia sheet, on which instruments are mounted.
3. A mimic of the refrigeration circuit is silk screened on the facia so that students can follow both the cycle and relate the cycle to the physical components.
4. The system comprises of a motor driven compressor, pumping refrigerant into a condenser and through a manual expansion valve into the evaporator.
5. The condenser is cooled by a secondary water flow, whilst the evaporator is prevented from icing over by water flow.
6. Temperatures are measured by thermocouple and displayed by a digital display unit. Float type flow meters are provided to measure the water flow into the condenser and into the evaporator.
7. A pressure gauge is used to show the pressure at the condenser and a second gauge shows the pressure at the evaporator.

P5758 ABSORPTION REFRIGERATION APPARATUS
1. The absorption refrigeration apparatus is a desktop unit able to provide students with a clear and effective understanding of absorption refrigeration.
2. The circuit contains a mixture of ammonia, hydrogen and water and comprises of a boiler, condenser, evaporator and the absorber.
3. The system is maintained at sufficient pressure so that the ammonia is in a liquid state, until heat is applied to the boiler.
4. The evaporator is fed with hydrogen which causes the ammonia to evaporate, chilling the chamber.
5. The product includes four pressure gauges and eight thermocouples.
6. The evaporator is water cooled to allow an energy output to be determined.
7. The boiler is electrically powered but propane gas is available as a costed option.

**P5759 STEAM JET REFRIGERATION APPARATUS**
1. The apparatus is bench mounted and comprises of a small propane powered steam boiler.
2. The gas flow can be varied to vary the steam supply.
3. The evaporator from which the water vapour is drawn by the low pressure chills a small flow of water.
4. Thermocouples and a collecting jar allow the cooling effect to be measured.
5. The steam drain is cooled by an air cooled condenser, and returned to the evaporator in a batch process.

**MODULAR FRAMES**

**P5740 MODULAR REFRIGERATION SYSTEM**
The Cussons Modular Refrigeration System makes up a working refrigeration circuit through the selection of the different modules.

Available modules comprise of the following:

- **Compressors**, comprising three modules, each with outlet pressure gauge and cut off,
  1. Hermetic Type approx 200W
  2. Semi hermetic type approx 400W
  3. Open type approx 400W

- **Condensers, comprising two modules,**
  1. Air cooled type with fan, with thermocouples
  2. Liquid receiver, with water flow meter, water control and thermocouples

- **Refrigerant flow meter** (visual flow), drier and filter module

- **Thermostatic expansion valve** (capillary tube) with equaliser, and alternative circuit to manual needle valve (without equaliser). Module includes pressure gauge and thermocouple

- **Evaporators, comprising two modules,**
  1. Water evaporator with electrical heater—the heater power is adjusted to balance cooling and a timer cut out is provided
  2. Finned air evaporator with fan

- **Electrical services module**, displaying temperatures digitally and providing services to other modules. This module is permanently mounted on the support frame.

Each module is connected to its appropriate services by plug in units.

The refrigerant circuit can be isolated at each module interface by shut off valves, and a short flexible hose unscrewed to minimise refrigerant loss.

The shut off valves can be used for fault simulation.

Temperatures are measured by thermocouples, which are connected via plugs to a digital display on the electrical services module.

**AIR CONDITIONING UNITS**

**P5801 SPLIT SYSTEM DOMESTIC A/C TRAINER**
1. A bench top mounted trainer utilising a split system domestic air conditioning package.
2. The compressor and condenser are mounted within one unit at the rear of the bench whilst the evaporator and thermostat are mounted on the front of the bench.
1. Two pressure gauges show the pressure in the system.
2. A mimic of the refrigerant circuit is provided on the front panel together with a temperature display.
3. Faults can be initiated by side mounted switches so that the lecturer can keep them hidden from students view.
4. Symptoms of the failure are indicated by the illumination of LED’s and the students are required to relate these symptoms to determine which fault had been initiated.
5. Ten different faults can be initiated, such as loss of power, fuse failure, motor coil failure etc.

**P5802 CAR AIR CONDITIONING TRAINER**

1. Automotive Air Conditioning Trainer unit is similar to the P5801, being a bench top mounted unit, but with a mimic of the refrigeration circuit on the front panel.
2. The components are typical of those used in production cars.
3. The compressor is driven from an electric motor.
4. The control and indication circuits all operate at 12V. Faults that can be simulated include blockage of pipes, filters, failure of expansion devices, thermostats etc.

**P5803 OPEN DUCT AIR CONDITIONING TRAINER**

1. A trolley mounted trainer utilising an open duct air conditioning system cooled by a compact refrigeration plant.
2. The compressor and condenser are mounted within one unit at the base of the trolley, whilst the evaporator and thermostat are mounted within the open duct.
3. The unit has eight thermocouples and two pressure gauges.
4. Airflow in the duct is controlled by a variable speed motor, and the flow is measured by differential pressure transducer.
5. A mimic of the refrigerant circuit is provided on the front panel, together with a temperature display.
6. Faults can be initiated by side mounted switches so that the lecturer can keep them hidden from students view.
7. Symptoms of the failure are indicated by the illumination of LED’s and the students are required to relate these symptoms to determine which fault had been initiated.
8. Ten different faults can be initiated, such as loss of power, fuse failure, and motor coil failure etc.

**P5804 AIR CONDITIONING WITH CLIMATE CHAMBER**

1. The air Conditioning Trainer with climate chamber is similar to the P5803, but comprises of a closed air circuit, routed through a modest climate chamber.
2. The air conditioning unit therefore includes a humidity control and steam injector system.
3. The climate chamber includes an electric heater, and a water tray can be introduced to vary the demand from the chamber.
4. Humidity sensors and additional thermocouples are provided for different points in the system.
5. A flap drive is used to regulate the mix of fresh to re-circulated air. A PLC controls the unit.

**P5810 DOMESTIC A/C CONTROL SIMULATOR**

1. A bench top mounted control simulator utilising a programmable logic controller to simulate the operation and consequences of problems in a domestic air conditioning system.
2. A mimic is provided on the front panel showing the circuit flow.
3. It includes a range of commercial products such as thermostats and switching devices.
4. Faults can be initiated by side mounted switches so that the lecturer can keep them hidden from students view.
5. Symptoms of the failures are indicated by the illumination of LED’s, and the students are required to relate these symptoms to determine which fault had been initiated.
6. Twelve different faults can be initiated, such as loss of refrigerant, failure of evaporator fan etc.

**P5811 COMMERCIAL A/C CONTROL SIMULATOR**
1. The unit is similar to the P5810, being a bench top mounted unit, but with additional controls such as humidity measurement devices and controls for the proportion of air to be recirculated and to be admitted.
2. It can be set to operate in a warm climate or cold climate mode.

**EXPERIMENTAL BENCHES**

**P5780 THERMODYNAMIC TRAINER UNIT**
1. The unit comprises of a range of different heat exchangers through which a hot water circuit and a cold water circuit can be pumped.
2. Hot water is provided by an thermostatically controlled, electric water heater.
3. Heat can be lost from the cold water system by diverting the water through the water and air radiator.
4. The unit incorporates suitable flow rate, temperature and pressure measurement required for each experiment. P5780e includes a data acquisition system incorporating a computer with mimic display showing readings of temperature and pressure in real time

**P5670 AIR TO WATER HEAT PUMP**
1. Apparatus mounted on castors, comprises semi-hermetic, twin-cylinder, air-cooled, reciprocating compressor with 48 mm bore, 30 mm stroke and capacity of 9.46 m$^3$/hr at 1450 rev/min.
2. A shell and tube type condenser with water on tube side; an air handling unit with 3 speed fan providing 2.37 m$^3$air/sec with measurement points for wet and dry bulb temperatures at inlet and outlet.
3. Fitted with air flow measurement orifice 0.2m diameter on a removable inlet duct.
4. The exhaust duct fitted with silencer and unit housing direct expansion evaporator for working fluid.
5. Instrumentation consists of digital indication of working fluid temperature at eight points around the circuit, cooling water temperature into and out of condenser, and wet and dry bulb air temperature at inlet and outlet of air handling unit, analogue indication of working fluid pressure at four points around circuit by Bourdon Tube gauge, indication of water and working fluid mass flow rate by tapered tube variable area flowmeters, measurement of air orifice depression by inclined manometer and digital indication with analogue trend of compressor electrical power input.

**SECTIONED EQUIPMENT**

**P2255**  SECTIONED REFRIGERATION COMPRESSOR

**P2256**  BOARD OF SECTIONED REFRIGERATION COMPONENTS

**P2257**  SECTIONED HERMETIC REFRIGERATION UNIT

**P2258**  SECTIONED ROOM AIR CONDITIONING UNIT