MCP
TOOLING TECHNOLOGIES LIMITED

OPERATING MANUAL

VACUUM CASTING MACHINE

TYPE CCS

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Thank you for choosing an MCP vacuum casting machine.

The equipment, which is controlled by a PLC, combines a vacuum pump with fast exhaust rate and a highly efficient mixing unit to ensure the production of premium quality castings in a variety of moulding materials.

The vacuum chamber itself is used for de-gassing both the silicone rubber mixture from which moulds are formed, and the two-component MCP resins used for the actual castings.

Please follow carefully the instructions for installation and use that are to be found in this Operating Manual, which also covers routine checks and adjustments. A separate SERVICE MANUAL is provided to deal with specific repairs, fault-finding and replacements.

A further Manual, VACUUM CASTING TECHNIQUE, gives an overview of the system. A copy is supplied with every machine.

HEALTH AND SAFETY

All units supplied on or after 1st January, 1995, bear the **CE** *mark. The Declaration of Conformity will be found at the end of this Manual.*

ELECTRICAL SAFETY

Certain of the tasks described in this manual require access to the electrical control enclosure, and should therefore be carried out only by a suitably qualified person.

MATERIALS SAFETY DATA

Though no special hazard is likely when they are used in accordance with the suppliers' recommendations, each of the materials used in the process is the subject of a Safety Data Sheet, supplied at the time of first purchase and giving information in conformity with both European Directive 98/37/EC and (in the United Kingdom) the Consumer Protection Act 1987.

NOISE

The equivalent continuous A-weighted sound-pressure level during working of this machines does not exceed 70dB(A).

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Fig. 1 General front view

Fig. 2 General view with chamber doors open

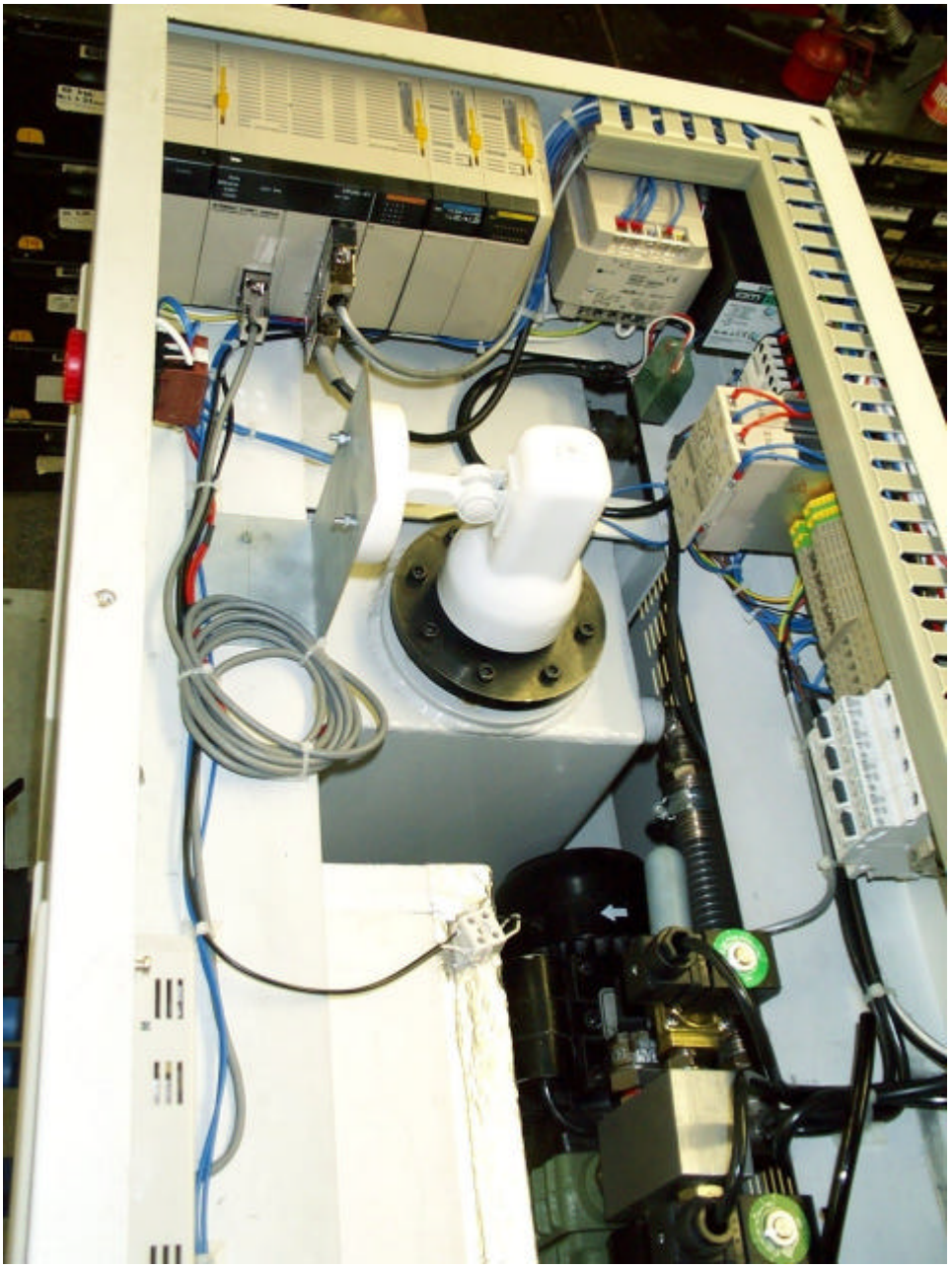
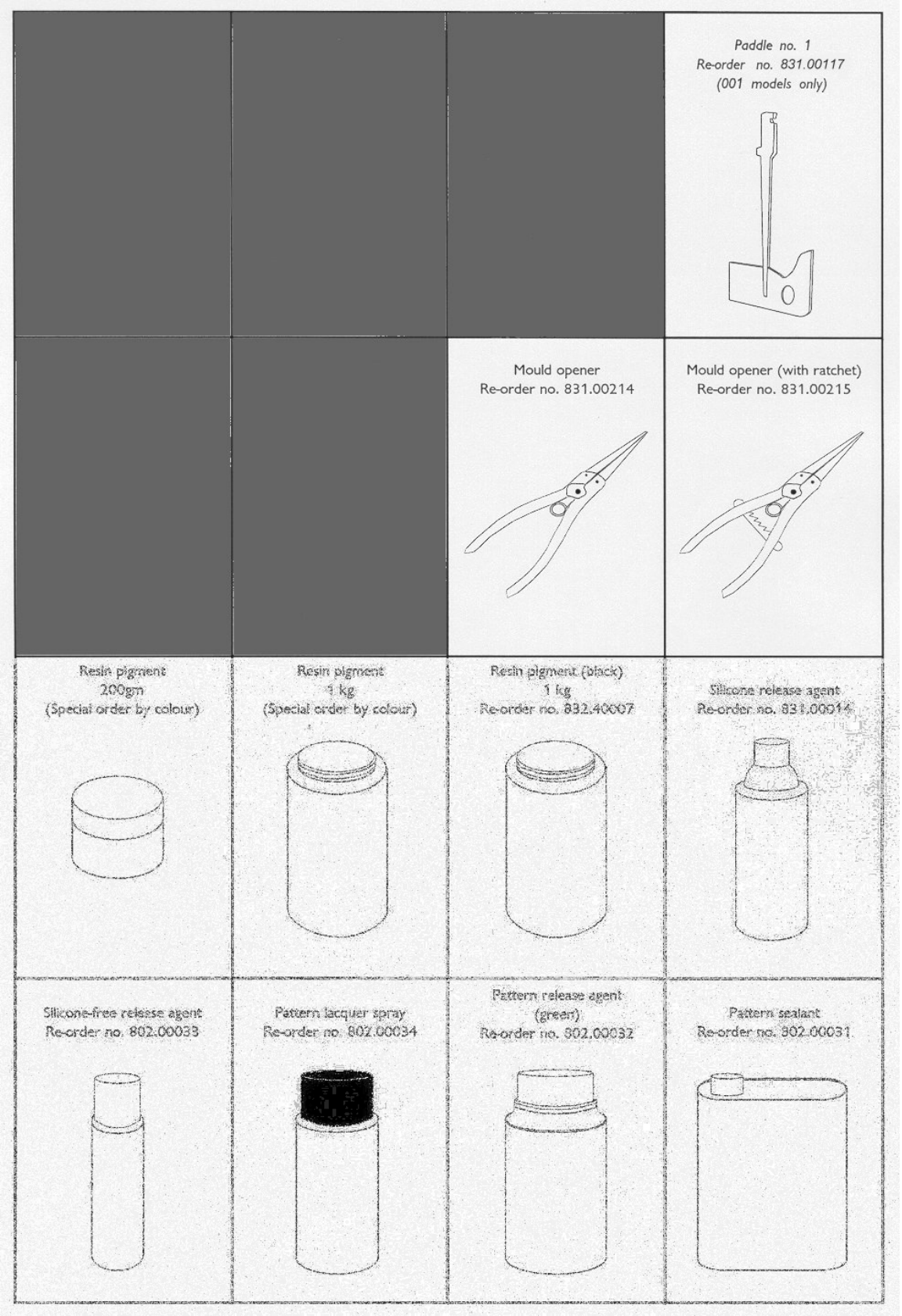


Fig. 3 Top view with access panel open

STANDARD ACCESSORIES RANGE

(NOT AVAILABLE FOR CCS)



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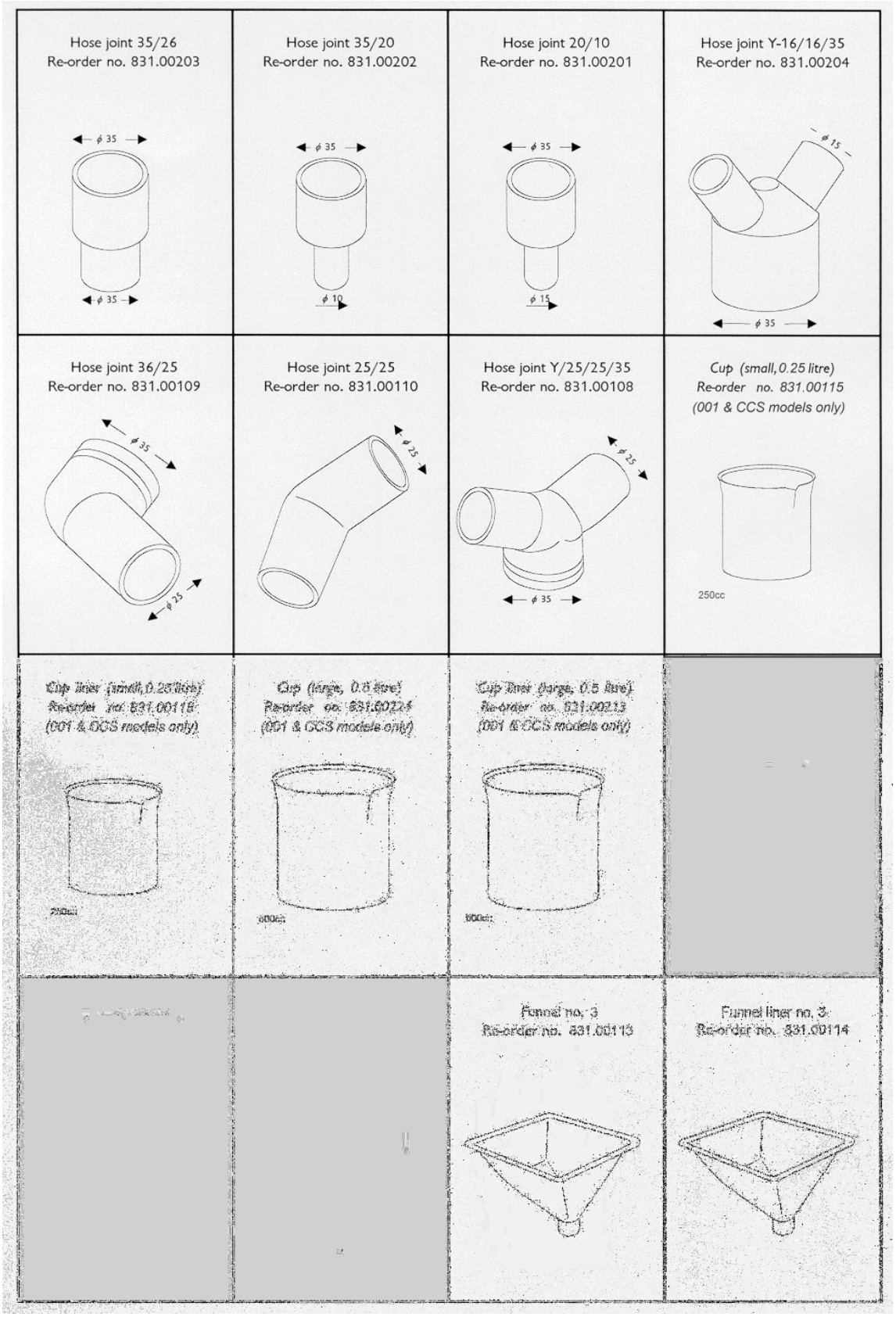

INSTALLATION

WEIGHT AND DIMENSIONS

* Weight: shipping weight, 175kg; unpacked 150kg
  External dimensions (mm): 870 high x 840 wide x 550 front-to-back.

POWER REQUIREMENTS

* The unit requires a single-phase, 220 or 110 volt 50/60Hz supply.
  Normal current rating, 6.5A; maximum surge 16A.
  In countries of the European Union, units are supplied with the appropriate plug, fused as necessary.

* An earthing point and a circuit-breaker must be provided.

SITING THE MACHINE

* Do not site the unit in an area subject to excessive heat or high humidity.

* Choose a well-ventilated room. If possible, provide local exhaust ventilation to an outside vent.

* Avoid areas exposed to dust or vibration.

* If required, the complete unit may be lifted by slinging from the three eye-bolts mounted on the top of the cabinet.

* Ensure that the unit stands on a level surface (adjustable feet are not provided)

INSTALLATION SEQUENCE

Before installing, please read through the instructions and ensure that you can identify each of the parts referred to.
Note that access to the main electrical panel is by the lockable side panel on the right-hand side of the cabinet.

1. Open the vacuum pump access panel. Check the oil level and, if necessary, fill the vacuum pump to the level indicated by a market on the sight glass using the oil supplied.
   Close the access panel

2. Ensure that the main isolator is set to 'OFF' and that the Emergency Stop shown *(fig. 4)* is pushed into the 'OFF' position.

3. Open the top electrical access panel and ensure that the circuit breaker switch is in the 'up' position (i.e. switched on). Make and check the earth connection to the unit.
   Close the access panel.

4. Connect to the power supply, using the cable and plug supplied

Fig. 4 Operating panel

5. Switch on at the main isolator switch.

6. Release the Emergency Stop knob by turning it anti-clockwise.

7. Press the 'Re-set' (green) button on screen.

8. Check that the chamber illumination light is now on. If it is not, turn off the machine at the isolator, open the side access panel and check the light-bulb switch on the operating screen.

9. Insert and adjust the mixing paddle *(fig. 5).*

Note that the paddle has a slot (1) which fits over a pin within the slot in its holder and is retained by pressure from a spring-loaded steel ball. The locked grubscrew (2) that carries the ball may be adjusted (using an M6 spanner and 3mm AF Allen key): it should be possible to remove and replace the paddle by hand, without slackness when it is in position.

A cup and liner should be in position while height adjustment is made. To adjust the height, use a 2mm AF Allen key to slacken the grubscrew (3) to allow the holder to slide up or down the shaft. When correctly positioned, the paddle should rotate with a clearance of 1-2 mm from the cup liner. Re-tighten the grubscrew.

Fig. 5 Adjusting the paddle and holder

10. The slow leak valve is accessible from the back panel *(fig. 3).* Check the adjustment of the flow-control governed by this device. The valve handle should be inclined at approximately 45° to the valve body.

WARNING

DO NOT operate the vacuum pump for longer than 30 seconds while the vacuum chamber is open. Failure to observe this precaution might result in excessive wear on the pump's components.

SAFE WORKING PRACTICES

Users of equipment should satisfy themselves that they comply with the requirements of the relevant legislation within the United Kingdom (or equivalent regulations within the country of use).

Particular attention is drawn to the following:-

- Health and Safety at Work etc. Act 1974;
- Personal protective Equipment at Work Regulations 1992;
- Provision and Use of Work Equipment Regulations 1998;

Provision and Use of Work Equipment Regulations

In general terms, the Regulations require that equipment provided for use at work is:

- Suitable for the intended use;
- Safe for use, maintained in a safe condition and, in certain circumstances, inspected to ensure this remains the case;
- Used only by people who have received adequate information, instruction and training; and;
- Accompanied by suitable safety measures, e.g. protective devices, markings and warnings.

Personal Protective Equipment

Users should be aware of the requirements of the Personal Protective Equipment at Work Regulations 1992 when providing equipment.

The main requirements of the PPE at Work Regulations 1992 is that personal protective equipment is to be supplied and used at work wherever there are risks to health and safety that cannot be adequately controlled in other ways.

Because the effectiveness of PPE can easily be compromised, e.g. by not being worn properly, it should always be considered as a last resort and only used where other precautions cannot adequately reduce the risk of injury.

Even where engineering controls and safe systems of work have been applied, some hazards might remain. In considering methods of safeguarding machinery the use of personal protective equipment may be used to minimise the risk of injury. This includes the need for special clothing, including footwear, hearing, eye and respiratory protection.
The guidance shown below may be used to consider the risks which may or may not be present. The user should make his own assessment of risks depending upon the circumstances of use.

	Hazards	**Options**
HANDS 	Abrasion; Temperature extremes; cuts and punctures; impact; chemicals; skin irritation.	Gloves, gauntlets Notes: • Don't wear gloves when operating machines where gloves might get caught. • Care in selection is needed.
EYES 	Chemical or metal splash; dust; projectiles.	Spectacles, goggles, visors. Notes: • Make sure the eye protection chosen has the right combination of protection for the task.
FEET 	Wet; slipping; falling objects; heavy loads; metal and chemical slash	Safety boots and shoes. Notes: • Consider conditions of use.
BODY 	Heat; chemical or metal splash; spray from pressure leaks; impact; entanglement of own clothing.	Conventional or disposable overalls, aprons. Notes: • Consider choice of materials in relation to the chemicals involved.
RESPIRATORY 	Dusts; gases and vapours.	Disposable respirators, half masks or full face masks, powered respirators. Notes: • The right type of respiratory must be used for the substance being handled.
HEARING 	Impact noise; intensities; pitch.	Ear plugs or defenders. Notes: • See Noise at Work Regulations 1989.

NOTE: Use personal protective equipment only as a last resort. Wherever possible engineering controls and safe systems of work should be used instead. All those required to wear protective equipment should be given training in its proper use, care and maintenance.

PREPARATION FOR CASTING

The sequence of operations (explained in general terms in the companion Manual VACUUM CASTING TECHNIQUE) requires the resin component cups, the whisk for mixing, a funnel and hoses all to be put correctly into place above the entrance gate(s) to the mould.

PREPARING THE MOULD AND FLOW-SYSTEM

The standard accessory range includes several joints (see page 5), which may be employed in conjunction with clear plastic hose to direct the mixed resin into the mould, with the flow being spilt through Y-joints if need be

Fit the funnel (see *fig. 7*) into the centre of the carriage in the upper part of the chamber, locating the front edge over the guard plate on the funnel position, and place the prepared mould (on a support platform in necessary) in the lower chamber. NB – *do not use any form of support which might inflate under vacuum*.

Decide on the pattern and sizes of hose and any connectors that may be needed, keeping the runs as short as conveniently possible.

Prepare the hose outlets, fixing to both funnel and mould. Ensure that you obtain a good fit, but one that is not too tight. Leave no end open.

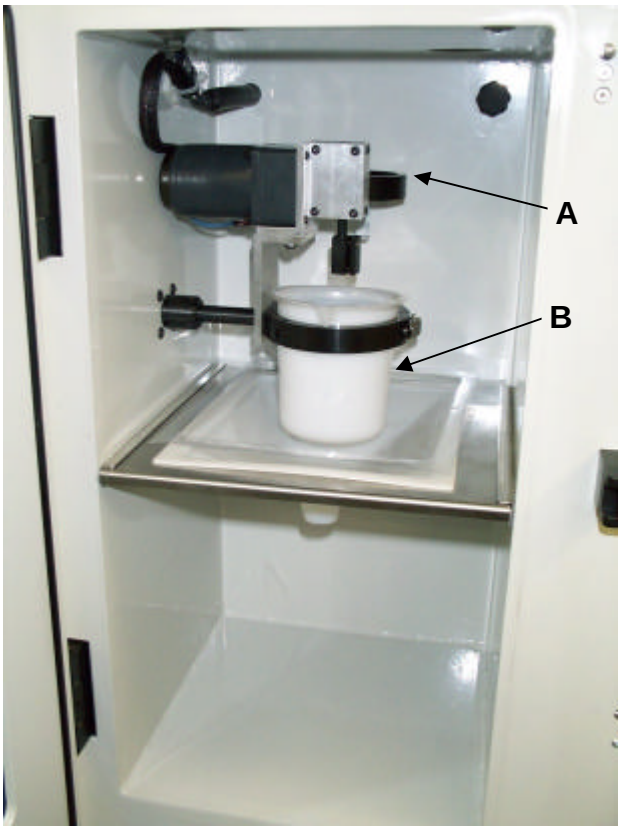

Fig. 7 Arrangement of the mould and accessories

PREPARING THE RESIN

Two- or three-component resins should be prepared in accordance with the supplier's instructions and placed in the appropriate cups.

Although casting may be carried out without them, it is recommended that cup liners be always used.

For general guidance, refer to the manual *Vacuum Casting Technique: a guide for new users* supplied with the machine.

FITTING THE CUPS AND PADDLE

Fit the cups into their cradles, ensuring always that component 'A' is in cup 'A' (the upper right cup).

(a) Place cup A in its cradle, engaging the spout with the V-shaped cut-out. Ensure that the lip of the cup (and that of it's liner, if used) is in position.

(b) Remove the paddle from its clip (above cup B).

(c) Pull open the retainer assembly (with V-shaped cut-out) for cup B. Slide the cup B into the cradle, ensuring that the lip of the cup (and that of it's liner, if used) is in position. Close up the retainer place, keeping the spout of the cup in the V-shaped cut-out.

Re-fit the paddle by sliding it into its holder, ensuring that it is fully engaged by the spring-loaded ball.

BEFORE BEGINNING A CASTING, ALWAYS HAVE READY THE APPROPRIATE SOLVENT FOR CLEANING UP RESIDUAL RESIN.

WORKING PROCEDURES

1. TO MAKE THE MACHINE READY FOR USE

Switch on the machine at the isolator.
Press the re-set button on screen (the inside of the chamber is now illuminated).

The machine is now ready for use.

ALWAYS CHECK THAT BOTH RESIN COMPONENTS – AND THE MOULD – ARE IN POSITION BEFORE ATTEMPTING TO MIX AND CAST

2. OPERATING MODES

The machine can be operated entirely in manual mode or auto.

KEEP YOUR HANDS OUT OF THE VACUUM CHAMBER WHILE ANY OF THE MECHANISMS ARE OPERATING

3. OPERATING IN MANUAL MODE

See notes on Page 15 and “Vacuum Casting Techniques – A Guide to New Users”

4. USING THE AUTOMATIC OPERATION SEQUENCE

See notes on Page 15 and “Vacuum Casting Techniques – A Guide to New Users”

5. STOPPING IN AN EMERGENCY

To deal with unforeseen or unplanned steps in operation (for example, forgetting to load with a resin component, or an apparent malfunction as a result of faulty programming):

Operate the red STOP button (it will lock into place)
The machine is now completely shut down: nothing with operate.

6. RE-STARTING AFTER EMERGENCY

Rotate and release the red STOP button
Press the Reset button
Press ‘Esc’ to return to the main screen.

The machine can now be operated again. Gain access to the chamber after first operating the FAST LEAK control to release the vacuum. It will then be possible to correct any fault before continuing.

7. SHUTTING DOWN

Complete shut-down: turn off the power supply at the isolator switch.

AFTER CASTING – A REMINDER

Remove the cups and liners, the funnel and the pipes as soon as possible and clean them out with the recommended solvent, ready for re-use.

The Combined Casting System (CCS) is controlled by the use of the Touch-Screen in the form of the Omron NT20S, shown in Fig.8. The screen displays all the information and available actions, which are then acted upon by use of the keys/thumb-wheels placed on the screen.

Safety; an Emergency Stop button is mounted on the fascia which when operated will stop all functions of the Mixer. The button has a twist release, which will need to be released after each operation.

Fig. 8 – Title Screen

Title Screen

The opening screen displays the Machine Title and software version number; in this case the software version is V1.0. Pressing any part of the screen will take the user to the MENU screen. The first time this is done after switching the machine on, the next screen will be the one shown in Fig. 8. Pressing the "RESET" button shown will take the user to the MENU screen.

Fig. 9 – Reset Screen

Menu Screen

The Menu Screen gives the user two options, OVENS and MOULD. These represent Oven Control mode and Mould Control mode. At the bottom of the screen there is a button which toggles the internal light On and Off. Finally, in the opposite top corner, the ESC button takes the user back to the previous screen, in this case the TITLE screen.

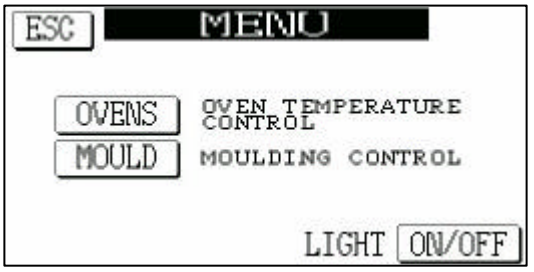

Fig. 10 – Menu Screen

Temp Control Select

This screen is displayed when the user selects OVENS from the Menu screen. The temperature control of the Ovens has two options, Manual and Automatic. Manual mode allows the operator to simply select an individual temperature set point and toggle the ovens On or Off. Automatic mode allows the operator to enter a simple Oven programme for each oven.
As before, the ESC button will take the user back to the previous screen, the Menu screen.

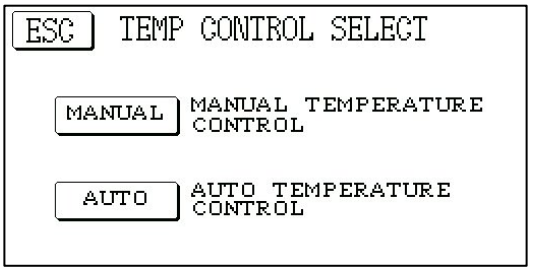

Fig. 11 – Temperature Control Screen

Both ovens need a minimum of 45 minutes to "settle" when switched on from cold. It is important that the ovens remain empty during this period due to fluctuations above the set temperature

Manual Oven Control

The Manual control of the oven is a simple way to input a target temperature set point and to switch the required oven on and off. The screen shows two controllers, one for each Oven. Oven 1 being the top oven and Oven 2 being the larger bottom oven. Each controller displays the actual oven temperature (PV) and the required target temperature (SP). Below these are two buttons, one with an up arrow and one with a down arrow. These raise and lower the required Set-Point temperature. The buttons increase or decrease the value faster

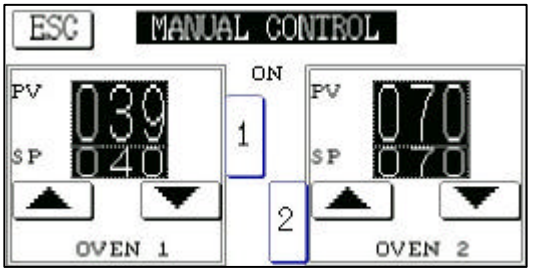

Fig. 12 – Manual Control Screen

the longer the button is pressed. This allows the user to make large changes quickly and small changes accurately.

When the user has entered the desired temperature for the respective ovens, he can then switch the ovens On. This is done using either button in the middle of the screen. Button “1” toggles the top oven On or Off and button “2” toggles the bottom oven. To indicate when an Oven is on or off, the button has two display modes. When the oven is off the button will look as it does in Fig. 12, when the oven is on the button will flash in reverse video.

Even when the oven is on the user can adjust the Set Point, the oven will then either call for more or less heat input depending on the actual temperature in the oven.

As before, the ESC button takes the user to the previous screen.

Automatic Oven Control

As the title suggests, this screen allows the user to control the ovens in an automatic mode. This is a simple way to control each oven individually to a temperature for a given time. If, for example, the user wishes to cure a moulding over night for a set time and temperature, they can do so with this mode.

As with the Manual control, the screen shows two controllers. This time however, each controller has more buttons and displays. The displays show both the actual and required temperatures and in addition, the duration of the time period required. The required temperature and time are adjusted with the corresponding up and down keys below each display. At each edge of the display are the program control keys, these take the form of the internationally recognised symbols for the control of PLAY, PAUSE and STOP.

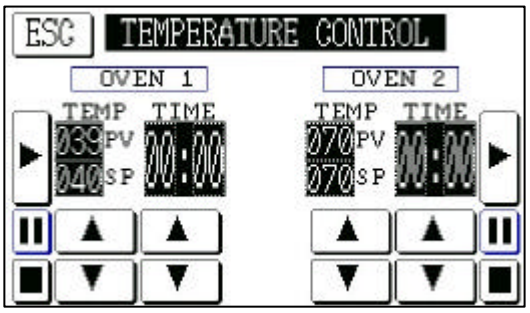

Fig. 13 – Automatic Oven Screen

Once the user has entered the required values for time and temperature, the programme can be started (Run) by pressing the “PLAY” key. At this point, the title “OVEN 1” for example, will flash to indicate that the programme is running and the oven is On. The oven will now start to heat up to the required temperature. The timer will not start until the oven is within a temperature band of ± 10° around the set point.

To indicate that the timer is running, a small progress bar between the display and the raise/lower buttons will increase in seconds each minute. The display will count down, i.e. displaying time remaining.

At any time during the programme run, the PAUSE key can hold the programme. This stops the timer, keeping the oven on, until the pause key is pressed again. When in the pause mode, the PAUSE key flashes.

To stop a programme once it is running simply press the STOP key once.

Mould Control Select

This screen is displayed after the user selects MOULD from the main menu screen. It gives the user two options for the control of the mould section of the machine. The first is Manual control and the second is Automatic control. Either selection allows the user to control the operation of the moulding/casting section of the machine.

ESC takes the user back to the main menu screen.

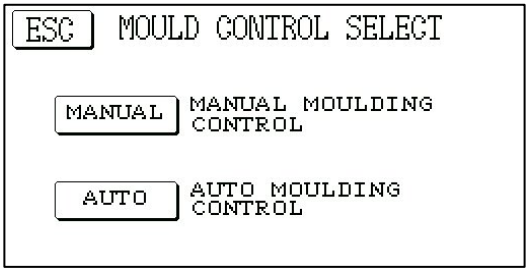

Fig. 14 – Mould Selection Screen

Manual Moulding Control

Once Manual control has been selected, the screen shown in the adjacent figure will be displayed. This screen contains all the buttons to control the moulding in a manual form. It is divided up into three main areas, from left to right, the first is the Mixer control. The two buttons control the Run/Stop and the Speed of the mixer motor. The Run/Stop button has a toggle action in that the first press starts the motor and the second stops the mixer. The SPEED key allows the user to increment and decrement the speed in 3 steps. When the button is pressed the speed will increase from its current position to the next speed, when it is at speed 3 the next press of the button will decrease the speed back down to 2 and then 1.

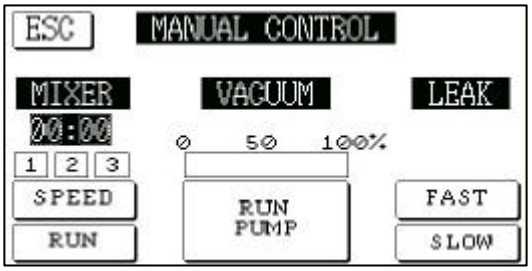

Fig. 15 – Manual Moulding Screen

Above these buttons, the speed is indicated by the use of three lamps. These go to reverse video when selected. Also, a time run display is included. This displays the time in minutes the mixer has been run. This is zeroed whenever the mixer is started.

The middle part of the screen controls the Vacuum pump. Again this is a toggle button, the first press to start and the second to stop. Above the button is a Vacuum display, which is scaled as a percentage of a full vacuum, 100% represents a near Vacuum. When the pump is running the button is displayed in reverse video.

Finally, the right hand part of the screen controls the two Leak valves. Each valve has its own button which again, have a toggle type operation. When the either valve is operated the respective button goes to reverse video.

Automatic Moulding Control

This screen is very similar to the Manual screen and has only a few changes. The first of these changes is to the Mixer section. The user can only select the speed the mixer runs. The Pump button has changed from a RUN key to a START key and there is now a time display above it. This button starts the auto sequence when pressed. There is no change to the leak valve control.

The final change to the screen is the addition of a button in the top right of the screen. This TIME button takes the user to the timer set-up screen. This contains the two timers for mix and vacuum times. The timers are set using the thumb-wheel controls above and below each number.

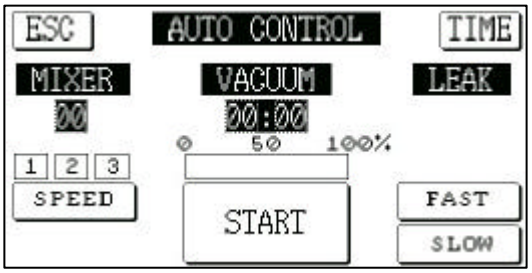

Fig. 16 – Automatic Moulding Screen

When the times have been entered, the user can start the sequence. It should be pointed out that the user should have the mould, resin etc ready and in place before starting. The user starts the sequence by pressing the START button. At this point the Vacuum pump and Mixer motor will start and the vacuum level will be displayed above the key. The vacuum timer will not start and time down until sufficient vacuum has been attained.

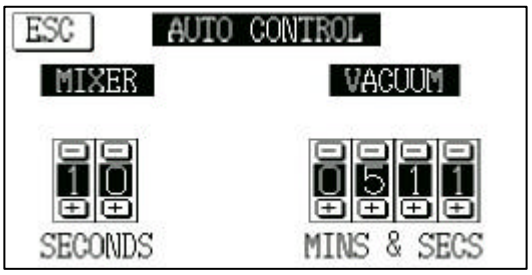

Fig. 17 – Automatic Timer Setting Screen

When the Vacuum timer has completed timing, the screen will sound an intermittent beep for 5 seconds. When the sounder stops, the mixer motor stops. This allows the user to tip the contents of Cup A into Cup B in preparation for mixing.

When the operator has completed this he can restart the mixer by pressing the START key a second time. This will start the mixer timer. This will time down in the same way as the Vacuum timer. When complete, the Vacuum pump and Mixer will stop and the screen will sound the internal buzzer for 5 seconds. The sequence is now complete

ROUTINE MAINTENANCE PROCEDURES

Apart from keeping the unit in a generally clean condition, routine maintenance of the Vacuum Casting Machine is concerned with the vacuum pump and its associated filters. Users are referred to the Service Manual for other repair or replacement procedures.

* Before carrying out any operation on the vacuum pump or its filters, allow the equipment to stand idle for at least one hour.

* Never use any oil but the correct grade as recommended.

* Check the oil level regularly. The optimal frequency depends greatly on usage and should be set after observation at short intervals (e.g. daily or weekly) during the first periods of use.

OIL CHANGES

The first oil change for a new pump should be made after 150 hours of operation.

The period between subsequent changes may be varied to match actual usage. Assuming a full working week of forty hours, MCP Equipment suggest that the oil be changed at intervals of three months, corresponding to 520 hours (refer to the maintenance schedule in the pump manufacturer's manual in case of any doubt). Longer periods allow the build-up of sludge and other deleterious matter, which may shorten the life of the pump by causing excessive wear.

A copy of the pump manufacturer's manual is supplied with the casting machine. For the user's convenience, the following instructions summarise the procedure for maintenance of the pump, but the manual itself should be consulted for explicit instructions for changes of oil and/or filter as well as other cleaning operations.

1. Remove the oil filler cap from the top of the pump

2. Open the drain tap at the bottom left of the pump and allow it to drain (through a hose) into a suitable receptacle.

3. When the oil-flow appears to have ceased, operate the pump for **no more than thirty seconds** with the vacuum chamber doors open.

4. Close the drain tap and put in 0.2 litres of fresh, clean vacuum pump oil. Replace the filler plug.

5. Close the vacuum chamber doors and operate the pump for three or four minutes, to flush out residual deposits.

6. Repeat operations 1, 2 and 3.

7. Close the drain tap and refill the pump with fresh, clean oil to the gauge on the sight window. Replace the oil filler cap.

Operating the machine in very humid conditions can cause moisture to be drawn into the vacuum pump, where it will form a layer of water at the bottom of the sump and cause the level to rise about the gauge line. If you notice this effect (which is most easily discernible after a period of non-use, such as over a night), drain off the layer through the drain tape to bring the oil down to its correct level.

NOTE: Internal Filter is not a regular service item.

DECLARATION OF CONFORMITY

Manufacturer's name and address:	MCP TOOLING TECHNOLOGIES LTD. WHITEBRIDGE WAY, WHITEBRIDGE PARK, STONE STAFFORDSHIRE ST15 8LQ
Equipment type and designation:	Vacuum Casting Machine Type CCS and variants
Serial Number:	……
Directives/Regulations to which the equipment conforms:	1. Council Directive 89/392/EEC and its amending directives, leading in the United Kingdom to The Supply of Machinery (Safety) Regulations (SI 1992 No. 3073) (as they apply to equipment with a moving part and intended for treating or moving material. 2.Council Directive 89/336/EEC and its amending directives, leading in the United Kingdom to The Electromagnetic Compatibility Regulations (SI 1992 No. 2372). 3. Council Directive 73/23/EEC and its amending directives, leading in the United Kingdom to The Low Voltage Electrical Equipment (Safety) Regulations (SI 1989 No. 728).
Safety standard to which the Equipment uses:	BS 2771 : Part 1, as applicable to the electrical and electronic equipment of machines not portable by hand when working, used in industrial production and operated from a supply up to 1000 V a.c. (equivalent to European standard EN 60 204). The equipment also complies with the essential Health and Safety requirements.
Person responsible for Technical File:	Simon Peter Scott Manager for Technical Data – MCP Tooling Technologies