



OPERATING MANUAL

VACUUM CASTING MACHINE

WITH “VARIO-VAC” & NYLON MODULE

TYPE MCP 4/04

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MCP EQUIPMENT

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A DIVISION OF MINING & CHEMICAL PRODUCTS LTD.

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. For machine service information please contact your nearest MCP office.

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 91/155/EEC and (in the United Kingdom) the Consumer Protection Act 1987.

NOISE

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

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VACUUM CASTING MACHINE

TYPE MCP 4/04



Fig. 1 General front view

VACUUM CASTING MACHINE

TYPE MCP 4/04



Fig. 2 General view with chamber open

VACUUM CASTING MACHINE

TYPE MCP 4/04

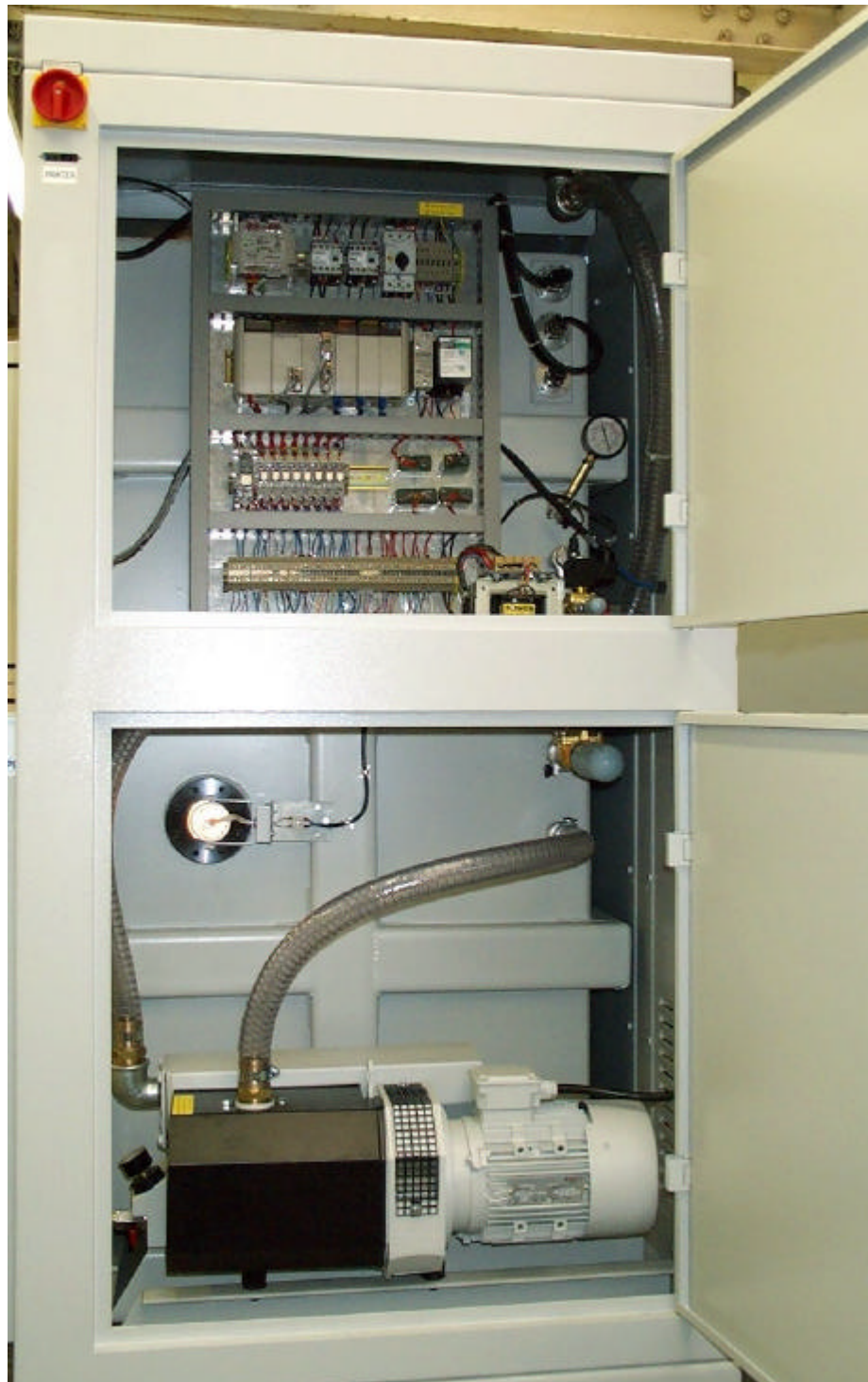






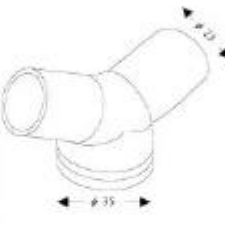






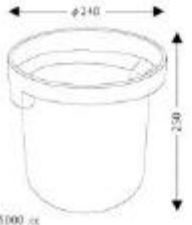

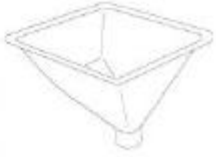


Fig. 3 Side view with access panels open

STANDARD ACCESSORIES RANGE

([REDACTED] NOT AVAILABLE FOR MCP 4/04)

<p>Hose joint 35/26 Re-order no. 831.00203</p> 	<p>Hose joint 35/20 Re-order no. 831.00202</p> 	<p>Hose joint 20/10 Re-order no. 831.00201</p> 	<p>Hose joint Y-16/16/35 Re-order no. 831.00204</p> 
<p>Hose joint 36/25 Re-order no. 831.00109</p> 	<p>Hose joint 25/25 Re-order no. 831.00110</p> 	<p>Hose joint Y/25/25/35 Re-order no. 831.00108</p> 	<p>Cup (small, 0.5 litre) Re-order no. 831.00223 (001 models only)</p>  <p>500 cc</p>
<p>Cup liner (small, 0.5 litre) Re-order no. 831.00212 (001 models only)</p> 	<p>Cup (large, one-litre) Re-order no. 831.00224 (001 models only)</p>  <p>1000 cc</p>	<p>Cup liner (large, one-litre) Re-order no. 831.00213 (001 models only)</p> 	<p>Two-litre cup Re-order no. 831.00207</p>  <p>2000 cc</p>
<p>Cup liner (two litre) Re-order no. 831.00208</p> 	<p>Five-litre cup Re-order no. 831.00105</p>  <p>5000 cc</p>	<p>Cup liner (five litre) Re-order no. 831.00111</p> 	<p>Funnel no. 2 Re-order no. 831.00206</p> 

STANDARD ACCESSORIES RANGE

([REDACTED] NOT AVAILABLE FOR MCP 4/04)

<p>Funnel liner (no. 2) Re-order no. 831.00209</p>	<p>Funnel no. 5 Re-order no. 831.00107</p>	<p>Funnel liner (no. 5) Re-order no. 831.00112</p>	<p>Paddle no. 1 Re-order no. 831.00101 (001 models only)</p>
<p>Paddle no. 2 Re-order no. 831.00205</p>	<p>Paddle no. 5 Re-order no. 831.00106</p>	<p>Mould opener Re-order no. 831.00214</p>	<p>Mould opener (with ratchet) Re-order no. 831.00215</p>
<p>Resin pigment 200gm (Special order by colour)</p>	<p>Resin pigment 1 kg (Special order by colour)</p>	<p>Resin pigment (black) 1 kg Re-order no. 832.40007</p>	<p>Silicone release agent Re-order no. 831.00014</p>
<p>Silicone-free release agent Re-order no. 802.00033</p>	<p>Pattern lacquer spray Re-order no. 802.00034</p>	<p>Pattern release agent (green) Re-order no. 802.00032</p>	<p>Pattern sealant Re-order no. 802.00031</p>

INSTALLATION

WEIGHT AND DIMENSIONS

- * Weight: shipping weight: 1300kg
External dimensions (mm): 1930 high x 1510 wide x 900 front-to-back.

POWER REQUIREMENTS

- * The unit requires a single-phase, 230 volt supply.
Normal current rating, 8A; maximum surge 40A.
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 eyebolts 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 marker 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 side 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. Switch on at the main isolator switch.
5. Release the Emergency Stop knob by turning it anti-clockwise.
6. Press the 'Re-set' (blue) button (under the screen to the right).



Fig. 4 Operating panel

7. 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.
8. 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 grub screw (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 grub screw (3) to allow the holder to slide up or down the shaft. When correctly positioned, the paddle should rotate with a clearance of 12 mm from the cup liner. Re-tighten the grub screw.



Fig. 5 Adjusting the paddle and holder

9. 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 2002;
- 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.

SAFE WORKING PRACTICES CONTINUED

	<i>Hazards</i>	Options
HANDS 	Abrasion; Temperature extremes; cuts and punctures; impact; chemicals; skin irritation.	Gloves, gauntlets Notes: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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 splash	Safety boots and shoes. Notes: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • The right type of respiratory must be used for the substance being handled.
HEARING 	Impact noise; intensities; pitch.	Ear plugs or defenders. Notes: <ul style="list-style-type: none"> • 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 split through Y-joints if need be

Fit the funnel (see *fig. 6*) 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 that 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.

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.

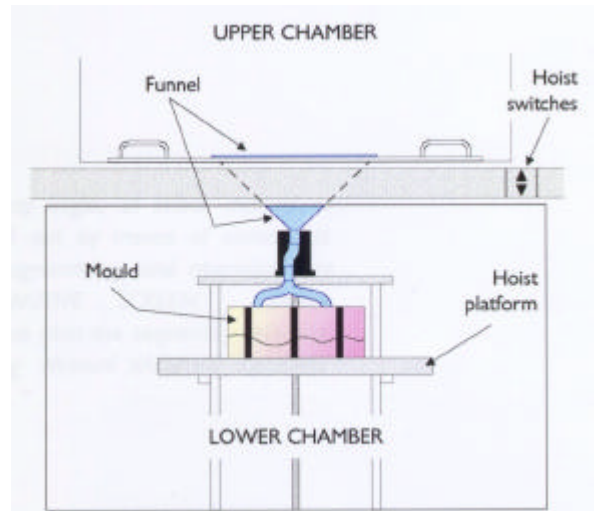


Fig. 6 Arrangement of the mould and accessories

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 cutout. Ensure that the lip of the cup (and that of its liner, if used) is beneath the lip of the retaining clip.
- (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 its liner, if used) is beneath the lip of the retaining clips at the side and rear of the cradle. Close up the retainer place, keeping the spout of the cup in the V-shaped cut-out, and lock it by turning anti-clockwise the knob at its left.

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 blue re-set button (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 (fig. 16).

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

3. OPERATING IN MANUAL MODE

Select the manual screen.

Press 'Pump' to begin chamber evacuation.

Press 'Speed' to select the mixing speed.

Press 'Run' to start the mixing of part B.

Once the vacuum time has been achieved, stop the mixer.

Press 'A' cup down, allowed resin 'A' to drain into cup 'B'

Press 'A' cup up.

Re-start the mixer.

When the mixing is complete, stop the mixer and tilt cup 'B' by pressing its DOWN button. Allow it to drain before pressing the UP button to return cup 'B' to up position.

When the pouring is complete and the resin has settled, press the SLOW LEAK button. The slow leak will start to force the resin further into the mould. This should be continued for up to 30 seconds, after which pressing the FAST LEAK button will release the remaining vacuum fully, forcing the resin completely into the mould.

4. USING THE AUTOMATIC OPERATION SEQUENCE

With the mould, accessories and resin components all in place close the chamber doors.

Select required program

Go to AUTO REPLAY

Start the program.

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 blue re-set 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 shutdown: 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.

CONTROL PANEL TOUCH SCREEN FUNCTIONS

Title Screen

The MCP type 'PLC' vacuum casting machines are controlled by a touch-sensitive screen, which first appears in the form of fig. 15.

Please note that only the lightest of touches is required: do not press the screen unnecessarily hard.

Touching the screen at any point of this display produces the menu screen of fig. 16.

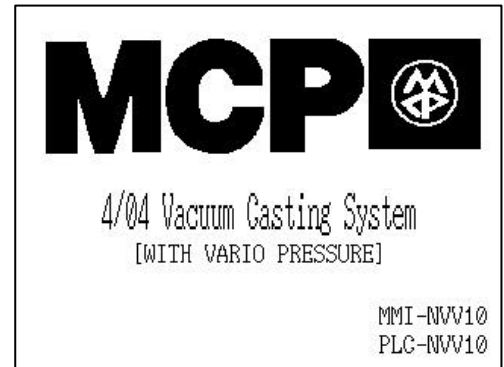


Fig. 15

Menu Screen

Note: the **ESC** button at the top left corner recalls the display last show, while the 'down' arrow at the top right calls up the next screen in a sequence. *These buttons have the same functions on whichever screen they appear.*

Any of seven function screens – briefly introduced below, and described fully on the pages indicated – can be called up by touching the appropriate button on the **Menu** screen. The next four are on a separate screen, reached by touching the arrow button.

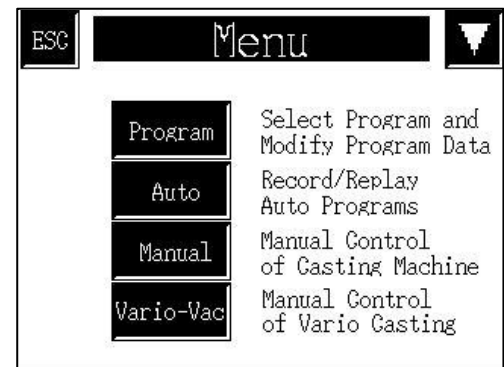


Fig. 16

PROGRAM

Touching the **Program** button produces the Select program screen (*page 15, fig. 19*), from which an existing program may be selected. The selected program may then be either operated or modified, as desired.

AUTO

Touching Auto invokes the **Auto replay** screen (*page 18, fig. 33*), with its two alternatives. The first monitors a running program, while the second allows a program to be recorded and stored.

MANUAL

The **Manual** button leads to the **Manual control** screen, (*page 20, fig. 40*), from which the operator has step-by-step control.

Functions available from **Menu** screen (continued)

The second screen, reached by touching the arrow button at the top right corner, is shown in fig. 17

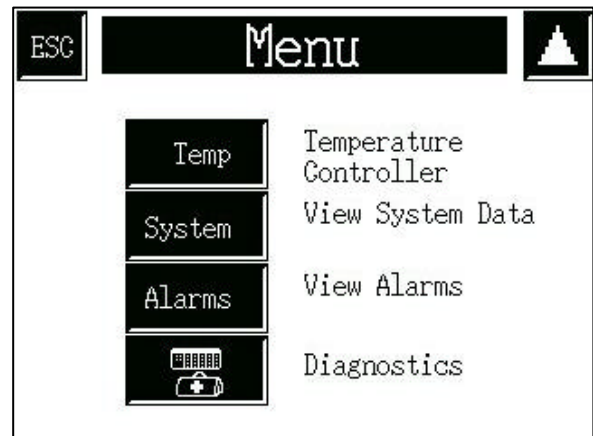


Fig. 17

TEMP

Access to the temperature control screen for cup 'B' is possible only when the option is actually fitted (see Appendix, page 22). If the option is not fitted, the screen in fig. 18 appears when the **Temp** button is selected.

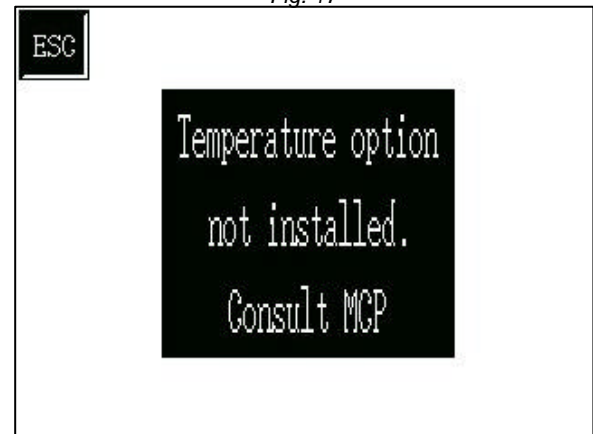


Fig. 18

SYSTEM

The **System data** screen (page 21, fig. 41) displays information about running times of the machine and the mixing speeds (which can be altered at the screen) currently programmed.

ALARMS

The **Active alarms** screen (page 21, fig. 42) shows any current alarm operation. Records of previous alarm operations are also available from the screen.

DIAGNOSTICS

The Diagnostics screen shows the actual PLC input and output states. This is only used to assist with any system fault diagnosis. A battery health lamp warns of the PLC lithium battery condition. If the PLC detects that the internal backup battery has failed the lamp will clear.

THE PROGRAM SELECTION SCREEN

Touching **Program** on the **Menu** screen invokes the screen shown in fig. 19, from which one of five alternatives may be chosen (apart from **Menu**, which returns control to the menu screen)

No program can be run from this screen, or any of its subsidiaries: control must first be returned to the **Menu Screen**.

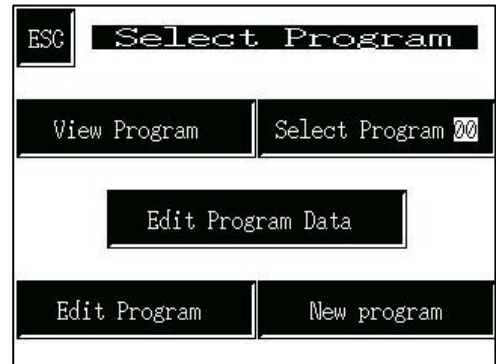


Fig. 19

VIEW PROGRAM

The **View program** option displays the **Program data** screen of fig. 20.

This is simply a display of the currently selected program, not modifiable from this screen. The **Select program** screen can be regained by touching **ESC**.

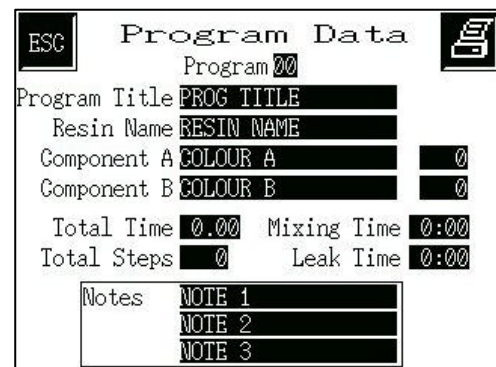


Fig. 20

SELECT PROGRAM 00

The **Select program** option (fig. 21) displays the programs that are stored and currently available.

Touching the arrow button at the top right toggles between similar screens, each with ten stored program options.

Select by touching the appropriate button. After indicating your choice, touch **ESC** (once or twice, as required) to return to the **Select program** screen, and again to display the **Menu** screen.

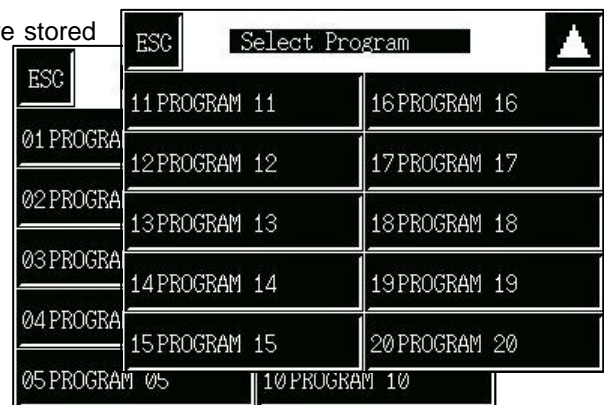


Fig. 21

EDIT PROGRAM DATA

The third choice from the **Select program** screen – available only when a program has already been selected – is **Edit program data**. The user is first asked to choose between UK and HEK resins. When the user makes the selection the screen on the right is displayed.



Twenty popular types of resin are shown on the screen (fig. 22), any of which may be selected for substitution in the already-chosen program; in this case, a series of screens will appear to allow various modifications. When the resin to be used is not shown, the **Other** button will allow an alternative type to be used in the selected program.



Fig. 22

EDIT PROGRAM DATA – continued

STANDARD resin type

Selecting a standard resin type first produces the screen of fig. 23, on which the intended weight of the resin casting is entered by means of the  and  buttons.

The weight may be registered by touching the return button at the bottom right corner, after which the screen of fig. 24 appears.

Each screen that follows in this sequence has an up and a down arrow key to (respectively) return to the previous screen or to proceed to the next.

The current title of the program already selected appears (always in capital letters) on the bar above the keys, and it can be edited if necessary.

Touching **Clear** will remove the existing title, which may then be replaced. Single characters may be removed by the backspace key. The **Num** key toggles the number pad on and off, highlighting the numbers on a red background when it is operative, allowing numbers to be included at will. **SPC** gives a space marked by an underline.

The program components are selected by means of the down arrow button, and appear in the following order below the **Program** bar:

- Colour of component 'A'**
- Colour of component 'B'** (as required)
- Notes – 1, 2 and 3** (as required)

The complete description suite is finally registered by touching the 'carriage return' key at the bottom right corner to show the screen of fig. 25. Either choice will return the display to the **Select program** screen (fig. 21). The entries will appear thereafter on the **Program data** screen (fig. 20) whenever it is invoked for the particular program.

'OTHER' resin type

When a resin is to be used that does not appear on the standard list, touching the **Other** button produces the **Edit program** data screen of fig. 26. Here, the actual weights to be used of each separate component must be entered (remembering always to identify component 'B' with cup 'B' in the casting machine).

The carriage return button moves control to the **Edit program** screen (fig. 24), from where the procedure may be continued. After an initial screen on which the resin name must be entered, procedure is the same as for a standard resin type.

Fig. 23

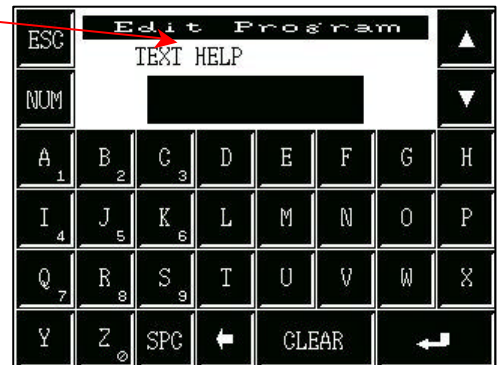


Fig. 24

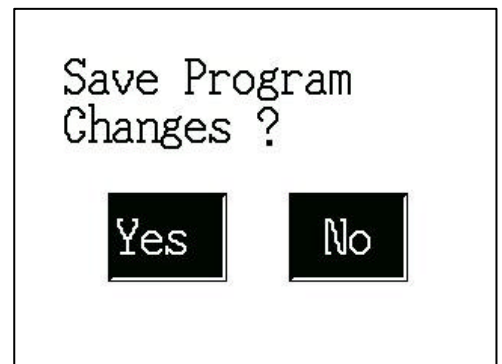


Fig. 25

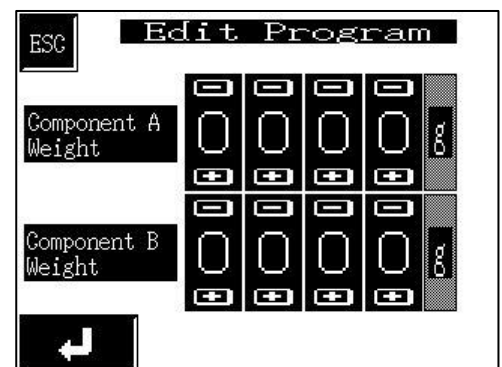


Fig. 26

EDIT PROGRAM

WARNING – the purpose of the **Edit program** facility is to display steps in a program already registered. The displayed program may also be edited, but *only an experienced operator should undertake such a task.*

The fourth choice from **Select program** displays the screen of fig. 27. The left-hand column displays the step numbers of the selected program from 00 to 09 : four further, similar screens display subsequent steps, also in batches of ten, up to no. 49 (the maximum for a program is 50 steps, including 00). The arrow button at the bottom right corner changes to the next display : intermediate screens have two button, for forward and backward movement.

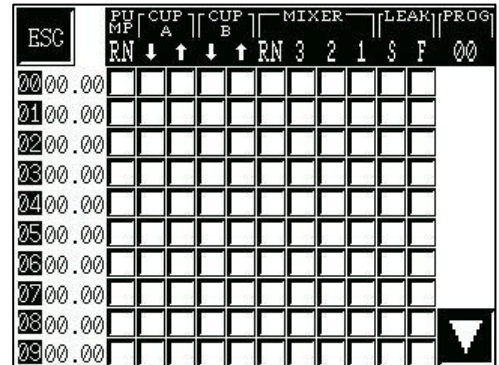


Fig. 27

The buttons in the main body of the display have an on/off toggle action, a blacked out button indicating that a function is active as the step commences. The explanation of the eleven abbreviated column headings is as follows:

PU MP	CUP A	CUP B	MIXER			LEAK	
RN	↓ ↑	↓ ↑	RN	3	2	1	S F
Pump switch	Cup movements (up/down)		On	Mixer switch: fast med.	Slow	Slow leak	Fast leak

The second column across the screen displays the program time, which must elapse before the step occurs. The time may be altered by touching it on the screen, which changes the display to that of fig. 28 (where a number pad has been superimposed by touching the 00.00 adjacent to step 14). The time is accepted by touching the return button, after which further times may be adjusted, or the keypad display hidden. **WARNING: subsequent times are not altered automatically and must, when necessary, be changed manually.**

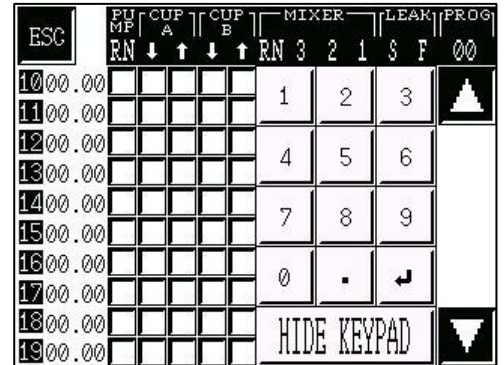


Fig. 28

When all entries are completed, the **ESC** button on the current display shows the screen of fig. 30, where the changes may be confirmed by the **Yes** button, or rejected by the **No** button. Either choice returns control to the **Select program** screen (fig. 21).

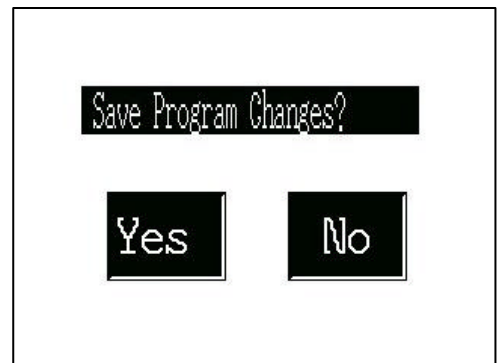


Fig.29

NEW PROGRAM

The final choice from the **Select program** screen is **New program**, which is used to install functions with a resin already selected and for which the component weights are already specified.

The program name and number should already have been selected. The first display to appear (*fig. 30*) requires the length of the first period of mixing to be entered (the default is one minute).

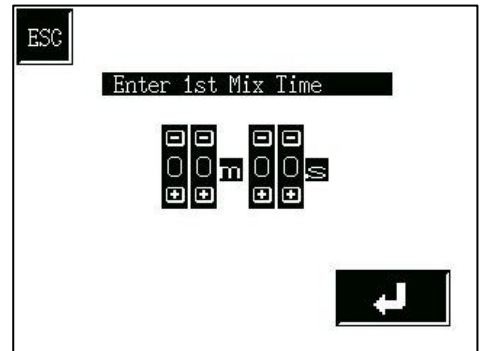


Fig. 30

When the time has been correctly entered, it may be registered by means of the carriage return button, which reveals the display of *fig. 31*, on which the rotation speed of the mixer must be specified. The default speed for the mixer is **1** (low speed).

After selecting the preferred option (the button turning from white to black), it may be confirmed by means of the carriage return button, which displays a screen similar to that of *fig. 30*, but requiring the second mixing period to be entered. Again, the default is one minute: if a second period is not needed, the time should be set to zero.

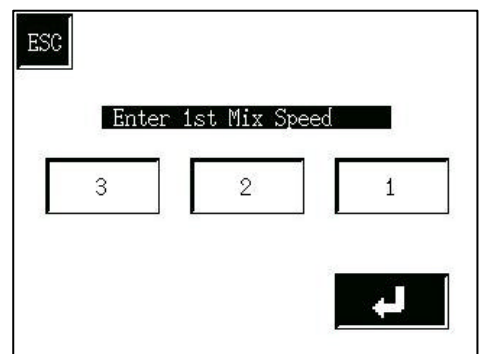


Fig. 31

After confirming the second mixing period by touching the carriage return, a fourth display, similar to that of *fig. 31*, appears for entry to be made of the mixer speed.

When the second mix speed has been selected, the following screen asks for a **Leak Time** to be entered.

The carriage return on this fifth display brings up the screen of *fig. 32*, where the changes may be confirmed by the **Yes** button, or rejected by the **No** button. Either choice returns control to the **Select program** screen (*fig. 21*).

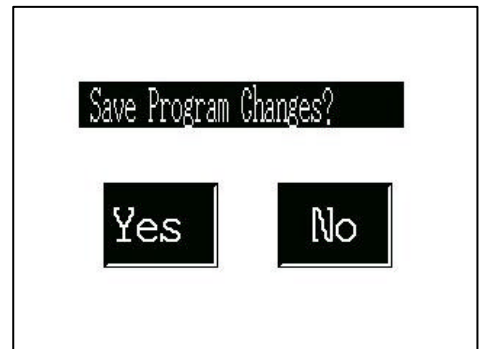



Fig. 32

AUTO RECORD AND REPLAY

On touching the **Auto** button at the **Menu** screen, the **Auto replay** screen (*fig. 34*) appears, displaying the name of the program already selected.

The program may be run as it stands, or it may be replaced by recording over it. The latter option is not a modification, but requires a complete new sequence to be entered.

Two buttons – the 'Play'  and **Auto record** – flash when the screen is opened. One of the other of these options must be chosen before continuing.

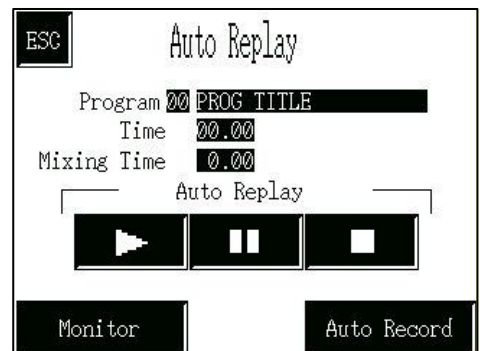





Fig. 33

AUTO REPLAY

Three buttons control the automatic replaying of a selected program :

-  the 'play' button begins the program immediately :
-  the 'pause' button stops the program temporarily :
-  the 'stop' button returns the program to the beginning.

Touching the **Monitor** button (fig. 33, page 20) enables progress of the program to be followed.

The full bar beneath **Pump** indicates progress during initial evacuation of the chamber, completion being shown by the **OK** button.

A lamp indicates an operation in progress. In the example shown, the pump is running, while the program time yet to elapse is 5 min. 23 sec. And the mixer has been running at medium speed for 31 sec. *Note: the counter runs forward during recording, but backward during replay.*

The end of the sequence (normally, when the vacuum has been completely released) is indicated by the appearance of the **Auto replay** display of fig. 33 (page 20). The **ESC** button on this screen also returns control to the display of fig. 33.

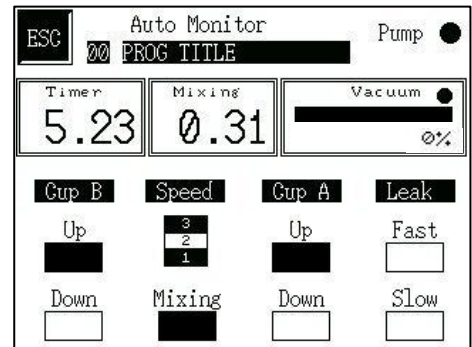





Fig. 34



Fig. 35

AUTO RECORD

Selecting **Auto record** from the **Auto replay** screen brings the display of fig. 36, where:

-  the 'stop' button ends and deletes the recording;
-  the 'auto record' button starts program records;
-  the 'pause' button temporarily halts recording.

The program already selected will usually need to be eliminated by touching the **Erase** button, which produces the confirmatory display of fig. 34.

The **No**, like the **ESC** button, returns control to the previous screen (fig. 33, page 20).

The **Yes** button also returns to the previous display, but the 'auto record' button now flashes, prompting the operator to initiate a recording sequence.



Fig. 36

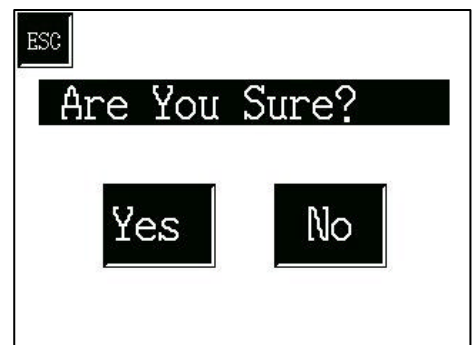


Fig. 37

AUTO RECORD (continued)

After confirming the start of recording by touching the flashing button, **Show controls** (flashing) displays the **Auto recording** screen (fig. 38). From this screen it is possible to record. From this screen it is possible to record the new sequence of actions, *but not to change the data on the resin**.

Any button showing on this screen may be used, changing to black when active (the **Up** button for each cup opens in black, indicating the starting position). In the example of fig. 38, the pump has been running for 1 min. 3 sec., not yet sufficient for evacuation (shown by the bar beneath **Vacuum**) to be complete.

To record the program it is necessary only to operate the various controls at the appropriate moments. The actions taken are indicated by changes in the button colours, while times elapsed are all indicated automatically. The program steps have a resolution of one second: in other words, a one-second increase in program time must elapse before the next step begins (for example, a one-second delay must occur between changes of mixer speed).

A maximum of fifty program steps (00 to 49) is possible. At the last of these steps, the **Memory Full** warning display appears (fig. 39). *It is extremely unlikely that this condition will occur in normal practice.*

The final steps of a sequence will be:

- Switch off the pump;
- Slow leak on;
- Fast leak on;
- Slow leak off;
- Fast leak off.

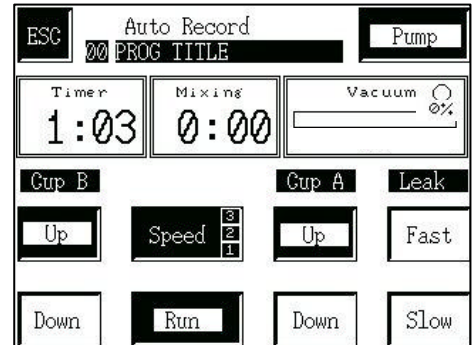


Fig. 38

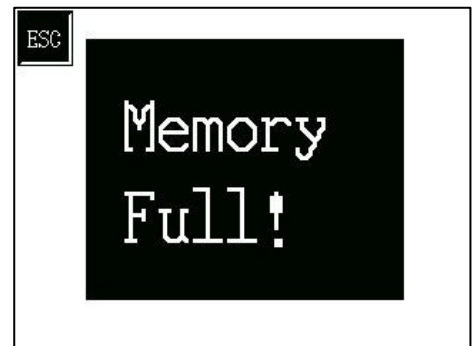


Fig. 39

After the last step has been entered, the **ESC** button is pressed to return control to the **Auto record** screen, on which the 'stop' button, seen to be flashing, must be touched to terminate the sequence. The program may now be deleted (e.g. if a mistake is believed to have been made) by touching **Erase**, when a new recording attempt may be carried out: or it may be accepted by selecting **Save**.

The **ESC** button now returns control to the **Auto replay** screen, from which the program may be replayed. Alternatively, the **Menu** screen may be selected where, if necessary, the resin data may now be changed*.

MANUAL CONTROL OF MACHINE

On touching the **Manual** button at the **Menu** screen, the **Manual control** display of fig. 40 appears.

With the mould mounted and the resin components already weighed out into the cups, a sequence may be run under complete manual control from this screen. The resin type and weight do not need to be entered before beginning.

The operations are exactly as already described for **Auto record**, and must include the same final steps of the sequence.

When casting is complete, **ESC** returns control to the **Menu** screen.

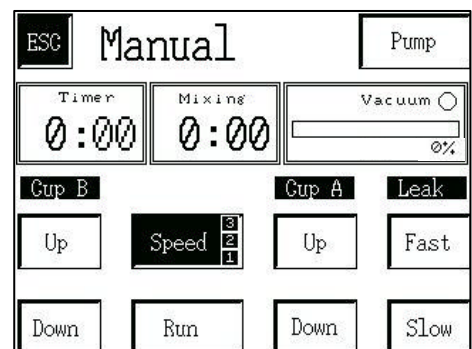


Fig. 40

*see EDIT PROGRAM DATA (page 17)

SYSTEM DATA

Selecting the **System data** display from the **Menu** screen reveals data relevant to maintaining the machine.

The **Run time** shown is re-settable. It should be set to zero when the pump oil is changed, and is then useful in determining the proper time for the next change. If the **Reset** button is selected, the **Are you sure?** screen (fig. 37) appears.

The **Total Run Time** approximates the total operating time of the machine, which is in fact the length of time for which the vacuum pump has been operated. Since the machine will seldom be operated to any significant extent unless the chamber is under vacuum, this provides a reasonably good estimate.



Fig. 41

MIXER SPEEDS

The maximal values for the mixer speeds are the settings in place when the machine is delivered:

1	2	3	
49	99	160	(r.p.m.)

The settings may be adjusted in the usual way to values appropriate to the task in hand, and when the **Menu** button is invoked the new current values will be recorded.

ALARMS

Malfunctions and program faults cause an alarm condition, which can be investigated by examining the **Active alarms** display (fig. 42). Note that in certain conditions, this display may appear at start-up*.

FAULT CONDITIONS

In the example shown, use of the emergency button has been automatically recorded. Other fault conditions, which may have occurred, are similarly recorded.

VACUUM PUMP

It is recommended that the oil in the vacuum pump should be changed every 500 hours and among the fault conditions is a warning that the time limit has expired. When the limit has been exceeded, an attempt to operate the machine will cause the **Active alarms** display to appear with the message 'Pump run 500 hours'. This does not prevent further use of the machine, but is a regular warning that the pump oil should now be changed which will recur until the **Run Time** has been re-set at the **System data** display.

HISTORY OF FAULTS

Touching the **History** button produces the display of fig. 43, which lists the alarm conditions that have occurred, with the time and date (without the year) also indicated.



Fig. 42



Fig. 43

*see also page 12, no.1

APPENDIX A – OVEN & WAX HEAT CONTROL

SYSTEM DATA

The screen displayed having pressed the TEMP button on the Menu screen will depend on the options included in your machine. If only the Heated Cup option is fitted, then the screen shown in Fig.45 will be displayed, if the Heated Oven option is fitted then the screen in Fig.47 will be displayed, if however, both options are fitted then the screen shown in Fig.48 will be displayed.

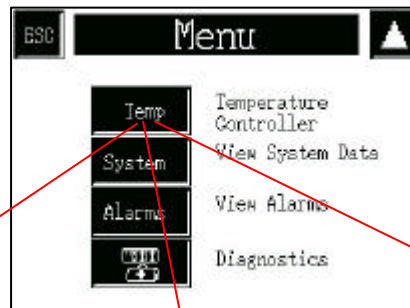


Fig. 44

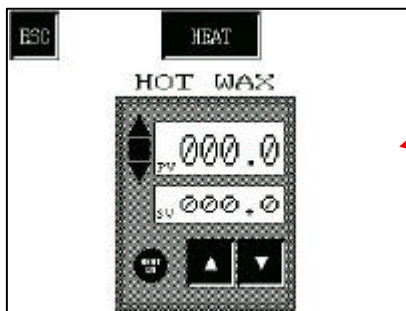


Fig. 45

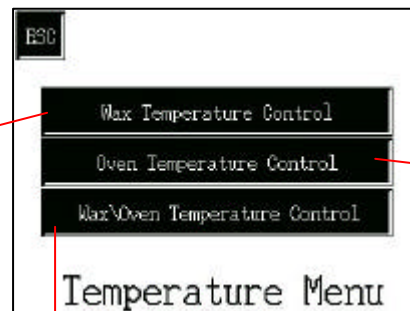


Fig.46

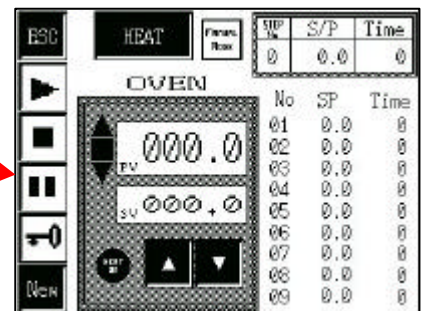


Fig.47

If both options are fitted then the screen shown to the right will be accessible from the Menu above. This screen allows the user to view and operate both temperature control loops concurrently.

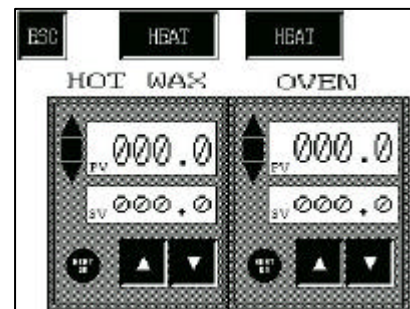


Fig.48

HOT WAX CONTROL

The screen shown in Fig.45 displays the control for the Hot Wax (Heated Cup) temperature. The current temperature of the cup is displayed in the upper window (PV) in centigrade and the lower window displays the set value (SV) also in centigrade.

The two buttons under these windows allow the user to raise or lower the set value. The value will scroll in either the up or downward direction as long as the button is pressed. The heater is turned on and off by the HEAT button at the top of the screen. The round lamp (HEAT ON) to the left of the raise/lower buttons indicates this.

Three further lamps to the left of the PV window indicate the direction of the actual temperature in relation to the SV, e.g. if the temperature is low, the down arrow will be lit.

OVEN CONTROL

The screen shown in Fig.49 displays the control for the Oven temperature. The current temperature of the oven is displayed in the upper window (PV) in centigrade and the lower window displays the set value (SV) also in centigrade.

Manual Mode

The two buttons under these windows allow the user to raise or lower the set value. The value will scroll in either the up or downward direction as long as the button is pressed. The heater is turned on and off by the HEAT button at the top of the screen. The round lamp (HEAT ON) to the left of the raise/lower buttons indicates this.

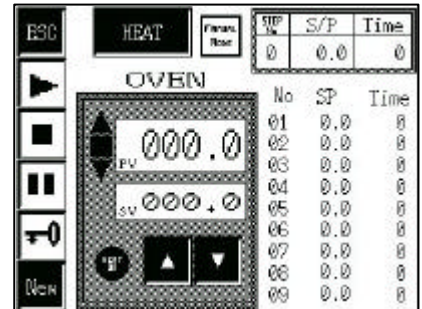


Fig.49

Three further lamps to the left of the PV window indicate the direction of the actual temperature in relation to the SV, e.g. if the temperature is low, the down arrow will be lit, when the temperature is at the set point the centre square lamp will be lit.

Automatic Mode

However, this screen allows the user to define a temperature profile which the oven will follow for up to nine steps. This gives the user a greatly enhanced control over the oven temperature over time. This profile can then be saved and re-used as required. The set up and use of the profile feature is described below.

Entering Profile Elements

The display shows the current values for each step on the right of the screen. These values are edited using a 'pop-up' keypad. The keypad is activated by use of the 'Key' button on the lower left of the screen. Values are then entered on the keypad. The current value being edited will have a flashing box around it. When the desired value has been entered, pressing the Enter key will accept the value and move the box (cursor) onto the next value. The order in which they are edited are as shown on the screen, i.e. Temperature set point then time.

It should be noted that not every step has to be used. If a step is not required, then simply enter zeros for both temperature and time. Also, should a temperature be entered but the time entered as zero, the step will not be used and will simply move onto the next step.

Once the profile has been edited the 'Hide' button closes the keypad.

Running a Profile

Once a profile has been edited and the keypad closed, the user can then run the new profile. This is done using the standard PLAY button (Right Arrow). Once the PLAY button has been pressed, the oven temperature will follow the profile. The current step, set point and time can be seen in the top right of the screen. Whilst running the PLAY button will flash.

At any time during playback the user can pause the profile by pressing the PAUSE button. This will hold the profile in its current state until the PAUSE button is pressed a second time. Whilst in Pause mode, the button will flash.

The profile will end when all 9 steps have been completed. Alternatively, the STOP button can be pressed at any time to stop the profile and reset it. When PLAY is pressed again, the profile will start from the beginning.

Saving a Profile

When a profile has been edited and checked to be correct, the user can save the current profile for use again. This is done using the NEW button. This takes the user to another screen asking if they wish to save or not. Pressing YES saves the profile details to memory and takes the user back to the previous screen. Pressing NO takes the user back to the previous screen without saving.

Pressing the ESC button takes the user back to the Heated Cup/Oven Menu screen.

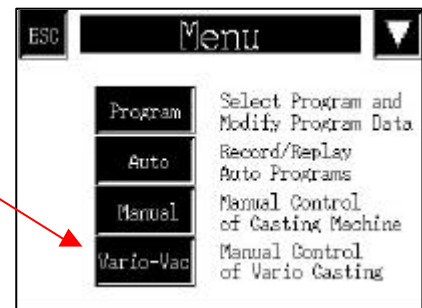
APPENDIX B – “VARIO-VAC” CONTROL

VARIO-VAC SYSTEM OPERATION

The Vario Vac machine has updated software; this is indicated on the opening screen as shown on the right.



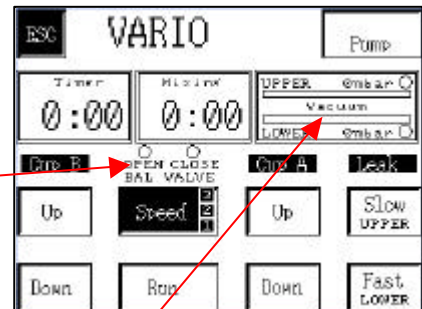
To use the “Vario Vac” system, the operator should select the “Vario Vac” option from the main Menu page.



Once the screen shown on the right appears the operator can then mix the resin as per normal. The main changes on this screen from the normal Manual screen are the dual vacuum display, the Balance Valve control buttons and the leak buttons.

“Vario-Vac” can be operated in two modes; automatic and manual. The manual operation is controlled from the screen shown on the right. Each button operates as before with the addition of the Balance Valve control buttons.

These buttons will open and close the balance valve as required. The balance valve takes approximately 10 seconds to perform either the open or close movement. Whilst moving the appropriate lamp will flash. When the movement has completed the lamp will remain on.



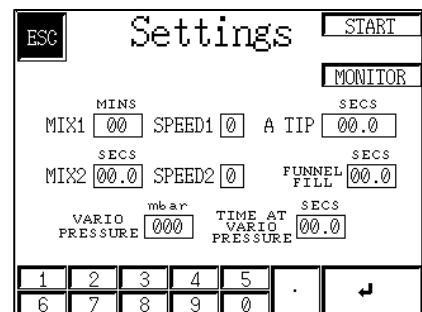
IMPORTANT NOTE:

Care should be taken when running the vacuum pump or leaking the chambers with the balance valve closed. When doing so the differential pressure should not be allowed to exceed 250mbars. An interlock is provided to prevent this happening.

Access to the automatic sequence controls is via a button hidden behind the vacuum level displays. Pressing this will display the screen shown to the right. The settings here allow the user to automatically control the “Vario-Vac” sequence.

The first line of settings control the mixing speed and time before the ‘A’ cup tips into the ‘B’ cup. The ‘A TIP’ time is the time the cup is held in the fully tipped position before returning to the upright position.

The second line of settings control the mixing time and speed once the tip has completed, before the ‘B’ cup is tipped. The ‘FUNNEL FILL’ time is the time allowed for the material to pour from the ‘B’ cup into the funnel creating a seal between top and bottom chambers. After this time the upper chamber will leak the vacuum creating a differential pressure as set in the ‘VARIO PRESSURE’ setting.

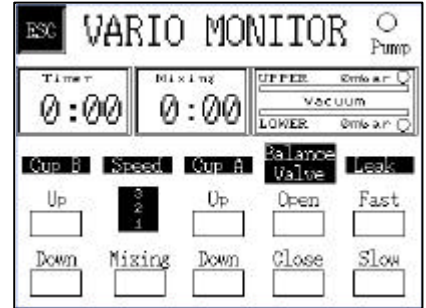


It should be noted that the differential should be kept as low as possible to reduce the stress placed on the tube and joints. A suggested maximum differential is approximately 50-100mbars. Time should be taken, as any air forced into the mould will cause serious flashing.

Once the differential set pressure has been reached the final timer setting will start to time out. This is the time during which the resin is allowed to fill the mould. Once this time has expired the chambers will leak to atmosphere. This leak is controlled to prevent the upper chamber from having a greater vacuum than the lower chamber, thus preventing the resin from being pulled out of the mould. Also it will prevent the lower chamber from having a differential vacuum level greater than 250mbars.

Once the settings have been entered using the keypad at the bottom of the screen, pressing the 'START' button at the top right of the screen can start the sequence. Once running, pressing the 'MONITOR' button can monitor the process. This displays the screen shown on the right. NO controls are accessible from this screen.

Pressing 'ESC' will return the user to the 'SETTINGS' screen. From here, pressing the 'ESC' button will display the manual 'Vario-Vac' screen.



APPENDIX C – AUTO-DEGAS & TIP CONTROL

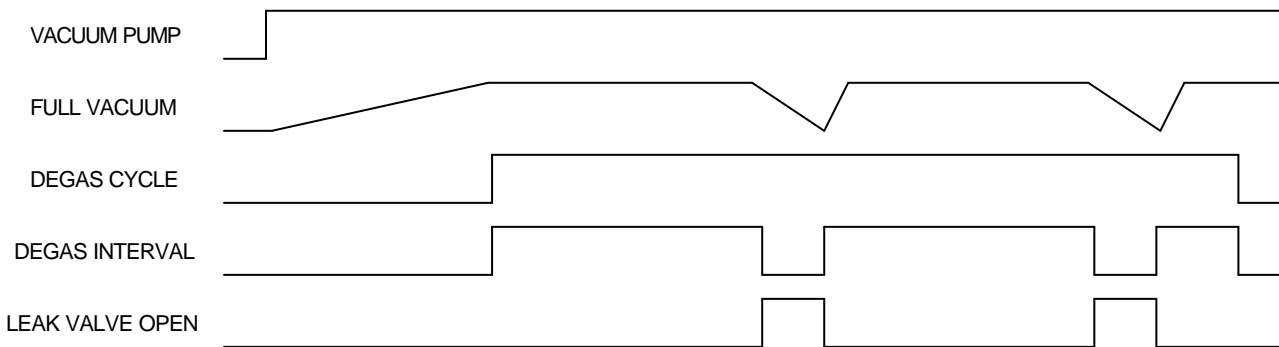
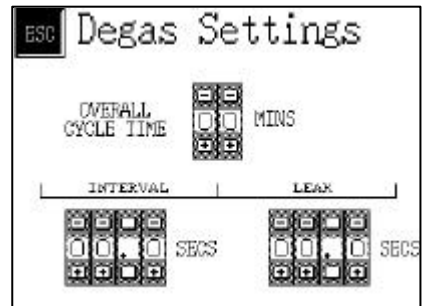
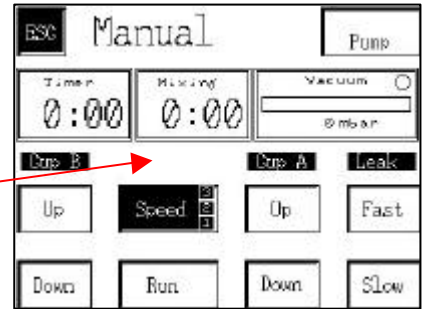
AUTO-DEGASSING SYSTEM OPERATION

The 4/05 has been fitted with an Automatic Degassing system. This allows the user to select prior to starting the Vacuum Pump/s a total Degassing cycle time, a Vacuum time and a Degas time.

This feature is only available when in 'Manual' mode and can only be set-up from the Manual screen via a hidden button located above the SPEED button, as shown on the right.

The set-up screen allows the user to set the three times in seconds and minutes.

Once the times have been set, the user can then start the Vacuum Pump, when the full vacuum level has been reached, the system will automatically start the degassing system for the time set in the Set-up screen. The operation is shown below in a time chart format.

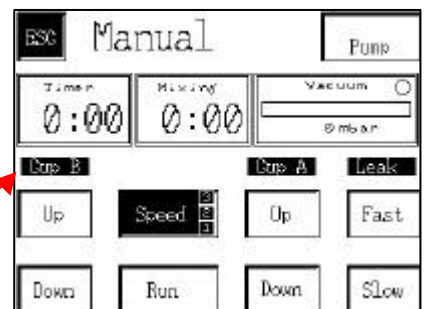


The maximum time that can be set for the total cycle time is 99 minutes. The maximum interval and leak times are 99.9 seconds or 1.6 minutes.

'B' CUP TIP CONTROL

An additional feature has been added to facilitate greater control of the 'B' cup tipping. To control the speed of the pouring of the material into the mould, the cup needed to be tipped slowly and allow the user to stop at any point in the tip. To allow this, the user now has the option of either a single tip where the cup will complete a full tip in one movement, or to tip only whilst the user has their finger on the button.

To enable/disable this feature, the user simply presses a button located behind the 'B' Cup legend as shown on the right. A lamp will illuminate between the 'Up' and 'Down' buttons to indicate that this feature has been selected. To turn it off, simply press the button again.



APPENDIX D – NYLON CONTROL UNIT

THE MCP NYLON MODULE.

The MCP4/04 vacuum casting machine can be equipped with several fully integrated and exchangeable units for casting various materials.

The MCP Nylon Module is specifically designed to be plugged-in for dispensing the range of MCP-HEK nylon casting materials.

Apart from the housing, the module is composed of three main blocks of nickel-plated aluminium, i.e. the reservoir and melting block, the piston block and the valve block. This modular construction ensures the best possible temperature distribution throughout the whole unit.



To fulfil the demand for metering accuracy and ease of operation a stroke based system has been chosen.

As the cast nylon formulation is reduced to a two component 1 : 1 ratio system, only a single 24 V DC servomotor drives the two synchronized pistons, by means of a gear system and two re-circulating ball spindles. The two-way valve system, synchronized by rack and pinion, and pneumatically actuated, enables both re-circulation and dispensing of the liquid A and B components. In conjunction with the two built-in agitators, this re-circulation facility reduces the time to achieve a homogeneous temperature distribution within both components.

OPERATING SAFETY

All moving and heated parts of the Nylon Module are protected from touching by means of the aluminium housing. Due to the fact that the heated main blocks are insulated from the framework, the housing temperature will not exceed 55°C under normal operating conditions.

A built-in safety system prevents excessive heating of the module. Design and engineering is in accordance with the CE regulations. For general rules, please take into account the instructions for use of the MCP4/04 machine.

INSTALLATION REQUIREMENTS AND INSTRUCTIONS

The Nylon Module is a fully integrated part of the MCP4/04 machine, which means that the installation requirements are part of those of the 4/04 machine.

The installation of the Nylon Module is restricted to simply positioning the Nylon Module over the cut-out in the separation plate, on top of the O-ring. Fixation of the Nylon Module is done by means of the knurled M6 bolt in front of the module.

Remains to plug-in the air-hose and the non-interchangeable electrics and data plug.

SETTING THE CONDITIONS FOR MOULDING.

The Cast Nylon Material

The A and B component of the cast nylon are highly reactive; the polymerisation time is less than 5 minutes. However, the reactivity of the A and B component is immediately killed as soon as the components contact water or humidity and reactivity is also negatively influenced by exposure to oxygen.

Please keep in mind that weighing out and filling of the components into the machine has to be executed carefully and quickly, to avoid contamination by humidity or long exposure to environmental air.

The Weighing-Out Procedure

Use a digital balance with a resolution of 1 gram or less and a capacity of approx. 3,000 gram and tare and net facilities.

The cast nylon formulation consists of three base components, i.e.:

Poly1 (P1):	flakes, packed in a 1.000 gram can or bag,;
Poly2A (P2A):	liquid, stored in a 1.000 gram glass bottle;
Härter1 B (H1 B):	flakes, packed in a 1.000 gram can or bag.

As part of the casting procedure, the touch screen indicates which components have to be mixed in quantities calculated by the PLC - Man-machine interface Filling.

As temporary storage of the components on the balance, a disposable PE container (ordering no.) or easily cleanable stainless steel container with a content of at least 500 cm³ will do. Before starting the weighing out procedure, take care and be prepared to close immediately the "bulk container" after having weighed out the present component, leaving a blanket of Nitrogen, class ..., over the remaining flakes or liquid. In case Nitrogen is not available in the prescribed quality, Argon may be used.

B-component:

Assuming the temporary container is placed on the balance, which indicates 0000.0, start with the Härter1B to weigh out the amount of flakes indicated on the touch screen, with a tolerance of ± 1 gram.

Set the balance to 0000,0 and fill up the container with the Poly1 component up to the weight as indicated on the touch screen. Now, the B component is complete and ready to be filled into the B-side filler pipe of the Nylon Module.

Another somewhat quicker method is to first fill the container with the indicated amount of Härter1B and then adding the component Poly1 just until the balance shows half the weight of the total amount of cast nylon to be prepared.

A-component:

Heat up the liquid component Poly2A in its glass bottle until approx. 105°C.

Shake the bottle carefully and weigh out the indicated quantity into a heat resistant container. Pour out the container as completely as possible into the Nylon Module A-side filler pipe. Weigh the remaining Poly2A in the container. Only if the remains are less than 5 gram, add the missing amount of grams to the indicated amount of the Poly1 component, which still has to be added to the A-side of the Nylon Module.

The Machine Mould Interface

To achieve a trouble-free transfer of the A and B components into the mould, two important aspects of the casting procedure have to be considered:

- the difference in viscosity between the A and B component does not allow for impingement mixing of the components, so the use of a static mixing tube is necessary (ordering no.);
- the casting is executed under a predetermined vacuum level and immediately after end of shot the leak is applied. This implicates that some reacting components, outside the mould, will be pressed inwards into the separated component outlets, causing an outlet block by polymerisation in case no precautions are taken.

As far as possible the design of the outlet tube, combined with some pre-programmed machine routines, prevents such an outlet block.

The machine is programmed to disconnect the static mixing tube from the outlet tube, before the leak starts. In doing so, only a small amount of components might cause a polymerisation mostly in the B channel.

Besides, a cleaning shot of 50 cm³ can be applied directly after the leak is completed and the door of the vacuum chamber can be opened.

However, in case this cleaning shot feature is not used properly in time, the aluminium outlet might get blocked after a number of castings, but due to the length of the outlet tube a polymerisation within the Nylon Module itself is not likely to occur.

Interface Mixing Tube-Mould

The function to disconnect the static mixing tube from the machine outlet tube is only working in case the static mixing tube remains fixed in the mould gate as the hoist moves downward. This means that the diameter of the gate should be slightly smaller than the outside diameter of the static mixing tube (gate diameter approx. 10-12 mm).

MAN - MACHINE INTERFACE.

The built-in touch screen of the MCP4/04 is the interface between operator and the 4/04, equipped with one of the add-on modules.

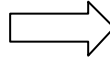
All operating buttons for the Nylon Module are located on the touch screen and divided over 4 pages. However, the machine status is not only displayed on the touch screen, but the Nylon Module is also equipped with the following status indicators:

- | | |
|--------------------------|--|
| on the front panel: | mixer, heater and power by LED's, as well as a mechanical indication of valve positions; |
| on the right side panel: | a mechanical piston position indicator. |

On the front of the 4/04 you will find a double button for the up and down movement of the hoist. During casting, the hoist buttons may be used. The hoist button only has to be used for positioning the static mixing tube in the gate of the mould.

Touching a sensitive area opens the concerning page, i.e.:

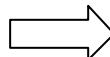
ESC	NYLON MODULE		LEAK
Material: PA 1000		Temperatures:	
Fill	<input type="text"/>	PV	0.0 °C
Level:	0g 3000g	SP	0.0 °C
Dispensing Weight: 0g		A _{comp}	0.0 °C
Dispensing Time: 0 x 0s		B _{comp}	0.0 °C
PUMP	VACUUM: <input type="text"/>	MIXER	HEATER
DISPENSE		CLEAN	RECIRC
DEGASS			
READY TO START			



ESC	MATERIAL		▲
PA 700	TEMP. SP: 0.0°C	Super-tough, high impact resistance, low rigidity.	
PA 1000	TEMP. SP: 0.0°C	Tough, medium impact resistance, medium rigidity.	
PA 2000	TEMP. SP: 0.0°C	Rigid, low impact resistance, high rigidity.	
		7	8
		4	5
		1	2
		0	.
			↵

1. Select and enter the desired formulation.
2. Choose and enter the component temperature: the preferable component temperature is 100°C, however, casting conditions may need adaptation of the temperature.

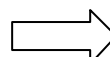
ESC	NYLON MODULE		LEAK
Material: PA 1000		Temperatures:	
Fill	<input type="text"/>	PV	0.0 °C
Level:	0g 3000g	SP	0.0 °C
Dispensing Weight: 0g		A _{comp}	0.0 °C
Dispensing Time: 0 x 0s		B _{comp}	0.0 °C
PUMP	VACUUM: <input type="text"/>	MIXER	HEATER
DISPENSE		CLEAN	RECIRC
DEGASS			
READY TO START			



ESC	FILLING		▲
FILL LEVEL: 0 g		ADD	RESET
FILL AMOUNT: 0 g		500-3000g	
MATERIAL: PA 1000		7	8
B Component	A Component	4	5
P1: 0 g	P1: 0 g	1	2
H1B: 0 g	P2A: 0 g	0	.
5-8%	0%		↵

1. The desired amount of the currently selected nylon casting material, with a minimum of 500 gram, has to be keyed in and entered by pressing . Flashing of the fill amount area stops as soon as the touch sensitive area for entering the H1B concentration is activated.
2. Key in and enter the H1B concentration. For the PA1000 and PA2000 the standard value is 6%.
3. After entering the H1B concentration, the weight of the different components is automatically calculated and displayed on the screen.

ESC	NYLON MODULE		LEAK
Material: PA 1000		Temperatures:	
Fill	<input type="text"/>	PV	0.0 °C
Level:	0g 3000g	SP	0.0 °C
Dispensing Weight: 0g		A _{comp}	0.0 °C
Dispensing Time: 0 x 0s		B _{comp}	0.0 °C
PUMP	VACUUM: <input type="text"/>	MIXER	HEATER
DISPENSE		CLEAN	RECIRC
DEGASS			
READY TO START			



ESC	DISPENSING		▲
DISPENSING WEIGHT:		0 grams	
		100-1800	
DISPENSING TIME:		0x 0 seconds	
		5-45	
		7	8
		4	5
		1	2
		0	.
			↵

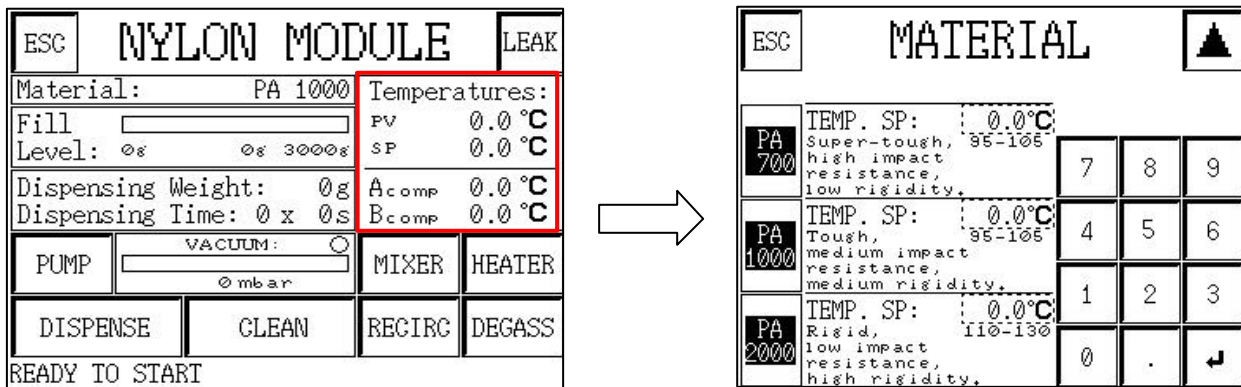
1. If the volume of the mould cavity, including the gate and vents, is known, the dispensing weight can be calculated by the formulae:

$$\text{Cavity volume [cm}^3\text{]} \times 1.1 = \text{dispensing weight [gram]}$$
2. Enter the dispensing weight with a minimum of 100 grams and maximum of 1800 grams.

The dispensing time controls the velocity of the nylon casting material flowing into the mould, as such an important parameter for the quality of the casting.

As a dual or triple shot is only a repetition of a single dispensing cycle, with a much faster programmed piston filling speed, the dispensing time entered on the screen has to be based on the dispensing weight of the first shot.

3. Enter the dispensing time between 5 and 45 seconds as a function of the first dispensing weight and mould geometry.



This area indicates the set point value (SP) and process value (PV), i.e. the temperature of the Nylon Module, as well as the A and B component temperatures. The set point value can be changed on the material page.

Pressing a "button" activates the indicated function. The time depending command buttons such as "Dispense" and "Clean" are flashing during their respective action. The buttons for mixer, heater, re-circulate, pump and degas, turn blue when the function is activated. To stop the function, these buttons have to be pressed again.



In fact the first button to activate the Nylon Module, because the movements of the pistons and valves are blocked until the complete unit has reached a temperature of at least 90°C, by which the eventually remaining components are liquefied again.



This function - to evacuate any encapsulated gas in the flakes during melting - only has to be used directly after filling of the Nylon Module has been completed.

After closing the top and bottom door and pressing the degas button, the following actions are automatically effectuated:

1. The valve between top and bottom vacuum chamber opens.
2. The vacuum pump starts. The vacuum level can be observed on the screen display.
3. As soon as both components have reached a temperature of "set point - 5°C" the mixers are started.

4. If the temperature of both components equals the set point value and the vacuum level is <200mbars, re-circulation starts and stops after a predefined number of cycles.
5. The vacuum pump is then stopped and the vacuum in both chambers is slowly leaked to atmospheric pressure, and the valve between top and bottom chamber closes again.
6. The door can be opened and the MCP4/04 and Nylon Module are ready for casting.
7. If needed, the Leak button can be used to evacuate any remaining vacuum in the chambers to allow door opening.

MIXER

The operation of the two built-in agitators is prevented until the temperature in the mixing chambers has reached a value of at least "set point -5°C". If this condition has been met, the agitators can be started at any time to stir up the components to maintain a homogeneous temperature and component mixture.

RECIRC

As the A and B components consist of at least two base components, re-circulation of the components between piston and melting block helps to achieve a homogeneous temperature and component mixture.

PUMP

Switching on/off the vacuum pump. The actual vacuum level is indicated on the bar graph alongside. If the doors will not open due to any remaining vacuum inside either chamber, the Leak button can be pressed to open both leak valves.

DISPENSE

After pressing the dispense button the following actions are automatically activated:

1. The cylinders are filled with the desired dispensing amount by moving backwards from their zero position.
2. The valves are switched from re-circulation to dispensing.
3. The pistons move forward to dispense the material into the mould.
4. The valves are switched back to re-circulation.
5. In case of a dual or triple shot, steps 1 to 4 are repeated.
6. The hoist is lowered to disconnect the static mixing tube from the outlet tube.
7. The vacuum in the bottom chamber is leaked to atmospheric pressure so the door can be opened.
As mentioned above, if this cannot be done, use of the Leak button will allow any remaining vacuum to be removed.

CLEAN

To prevent an outlet blockage, a cleaning shot of 50 cm³ is effectuated.

LEAK

The Leak button allows the user to open BOTH upper and lower chamber leak valves to remove any remaining vacuum, allowing easy opening of doors. This will be automatically switched off when the vacuum pump is started.

CASTING PROCEDURE

1. Turn on the red/yellow coloured main switch of the 4/04. As a result, the touch screen becomes active and the green signal-lamp "power on" on the front of the Nylon Module lights up.
2. From the Menu screen select the NYLON button. The Nylon Run page is displayed.
3. Check or adjust the temperature setting of the Nylon Module and press the "Heater" button to start heating.
4. Choose one of the two cast nylon types on the menu in accordance with the product specifications and press the appropriate button.
5. Determine the fill amount as a function of shot weight and number of castings and enter the total amount by means of the numeric keypad.
6. The amount of the different base components is calculated and indicated on the screen. Fill the A and B components carefully into the storage/melting chambers with the help of a clean funnel (one funnel for the A component and one for the B component), while keeping the components strictly separated from each other. Always avoid contamination of the components by humidity or long exposure to the air.
7. Press the "Degas" button to initiate the fully automatic degas cycle.
8. Enter the dispensing weight and dispensing time on the dispensing page.
9. Place the mould on the hoist, preferably on a tablet to collect a possible overflow of casting material.
10. Install the static mixing tube on the outlet tube and position the gate of the mould in line with the mixing tube.
11. Raise the hoist until the mixing tube has penetrated into the mould over at least 15 mm and close the door.
12. Press the "Pump" button on the main menu and depress the button when the desired vacuum level has been reached.
13. Press the "dispense" button, the screen indicates that the cylinders are being filled, followed by the dispense action.
14. Directly after the filling of the mould is completed, the hoist lowers automatically over approx. 15 mm, disconnecting the static mixing tube from the outlet tube.
15. The bottom chamber vacuum is now leaked to atmospheric pressure.
16. After completion of the leak, the door can be opened. Any remaining vacuum will prevent the doors from being opened. If this is the case, then use of the Leak button will allow any remaining vacuum to be removed.
17. Turn the mould slightly away to be able to collect the cleaning shot in a cup.
18. Press the "Clean" button and collect the cleaning shot in a cup.
19. Clean the A and B openings of the outlet tube separately, if necessary.
20. Wait for 6 minutes to open the mould and start de-moulding, however, after two to three minutes the mould can be taken out of the 4/04.

A new casting cycle can start now, following the procedure from point 7 onwards.

MAINTENANCE

Besides a regular cleaning of the housing of the unit, only two parts of the Nylon Module have to be cleaned on a daily basis, i.e.:

- the A and B filler cap, because in the storage/melting chambers a vapour arises, which could condense to the inside of the filler cap and may shut off the 3 small bores in the top of the caps;
- the aluminium outlet tube, to ensure an undisturbed flow of the A and B component.

Cleaning of both parts can be easily done by submerging the parts in hot water, 80-90°C to dissolve the solidified nylon components. Take care that the parts are thoroughly dried, for instance with an airgun before placing them back on the machine. Please keep in mind that water immediately kills the reactivity of the nylon components.

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.

- * 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 one litre 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 tap to bring the oil down to its correct level.

DECLARATION OF CONFORMITY

Manufacturer's name and address: MCP EQUIPMENT
(A DIVISION OF MINING & CHEMICAL PRODUCTS LTD.)
UNIT 8, WHITEBRIDGE INDUSTRIAL ESTATE,
STONE
STAFFORDSHIRE ST15 8LQ

Equipment type and designation: Vacuum Casting Machine
Type MCP 4/04 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 Scott,
Manager for Technical Data – MCP Equipment Division