



MODEL: FM660 (manual and power table)
Single Heater Vacuum Forming Machine

Installation Operating and Service Manual

For Parts, Service & Technical Assistance

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Thank you for choosing Formech.
Please read and follow the below safety instructions
before attempting to install or operate your machine.



Special attention should be paid to sections dealing with safety.



It is impossible to cover all aspects of thermoforming within the scope of this manual, we are therefore available to offer advice on special problems regarding thermoforming techniques, tooling and materials.



1) The electrical supply to the machine must be of adequate capacity. Wiring must be to IEE regulations and carried out by a suitably qualified technician. THIS MACHINE MUST BE EARTHED IN ACCORDANCE WITH LOCAL REGULATIONS.



2) Ensure that where a pneumatic supply is required it is regulated to 6 BAR or less and is properly filtered & lubricated using a good quality airline oil. A competent person must make compressed air connections.



3) Do not operate the machine until you have been trained and are fully conversant with it. Read and understand all of this User Manual. Users of this machine should complete regular competence tests.



4) Never remove any panels unless both the electrical and pneumatic supplies have been isolated. Never remove any warning labels from the machine. It is important to understand that high pressures may be present within parts of the pneumatic system even after the supply has been isolated. Special care must be taken if any parts have become jammed to ensure that all pressure is removed before attempting a repair.



5) Daily repetitive use of this or any other machine may lead to a) fatigue and loss of concentration, b) possible strains. Operators should be trained in the use of correct lifting techniques in order to minimise these effects.



6) When servicing the machine care must be taken to prop any heavy moving parts. This refers particularly to the mould table, clamping frame and counter balance weights. Always restrict movement of these parts before entering any part of the machine to prevent possible injury.



7) Always let the machine cool down before attempting to work on it. Some parts of the heater and heat shield become extremely hot during operation.



8) Only use the machine for vacuum forming plastic. It is not intended for any other purpose.



9) Ensure that the area you are working in is properly ventilated and that you are aware of the potential hazards from the plastics you are forming.



10) Ensure that the area surrounding the machine is clean and frequently cleared of finished product and any scrap.




11) This machine is fitted with a dry running vacuum pump. Do not lubricate. Do not allow any liquid to enter the vacuum system. Severe damage may be caused if the above is not observed.


HEALTH & SAFETY.


Hazards specific to this machine.


It is vital that any person using this machine is made fully aware of the potential dangers that could arise from incorrect use.


These can be broadly categorised as: -

 **1. Electric shock.** This machine uses Voltages up to 415V. NEVER ATTEMPT ANY REPAIR UNLESS THE ELECTRICAL SUPPLY HAS BEEN LOCKED IN THE OFF POSITION. ONLY SWITCH ON WHEN ALL COVERS & GUARDS HAVE BEEN REPLACED.

 **2. Burning.** Parts of this machine reach temperatures in excess of 300 ° C over large areas. WAIT UNTIL THE MACHINE HAS COOLED DOWN BEFORE SERVICE WORK COMMENCES. SPECIAL PRECAUTIONS MUST BE TAKEN TO ENSURE THAT ONLY THE MACHINE OPERATOR IS IN THE OPERATING AREA DURING USE

 **3. Injury from compressed air.** Pressures up to 100 PSI will be present in large volumes on this machine. BE EXTRA CAUTIOUS WHEN DEALING WITH COMPRESSED AIR. EVEN AFTER MAIN SUPPLY HAS BEEN SHUT OFF DANGEROUS RESIDUAL PRESSURE MAY STILL BE PRESENT WITHIN THE SYSTEM.

 **4. Toxic Fume Inhalation.** When large sheets of plastic are heated fumes will be given off. ENSURE THAT THE MACHINE IS POSITIONED IN AN ADEQUATELY VENTILATED PLACE. ASSESS THE RISKS OF THE MATERIALS TO BE FORMED PRIOR TO USE.

 **5. Injury from moving parts.** Where pneumatics components are used to power moving parts there is a risk of personal injury. NEVER REMOVE ANY PANEL OR ATTEMPT ANY REPAIR UNLESS THE COMPRESSED AIR SUPPLY HAS BEEN DISCONNECTED. BE EXTRA CAUTIOUS WHEN DEALING WITH COMPRESSED AIR. EVEN AFTER MAIN SUPPLY HAS BEEN SHUT OFF DANGEROUS RESIDUAL PRESSURE MAY STILL BE PRESENT WITHIN THE SYSTEM. NEVER ATTEMPT TO OVERRIDE ANY CONTROL SYSTEM INTERLOCK.

Introduction

The **Formech FM660** is a compact, manually operated Vacuum Forming Machine that will produce high definition mouldings in up to 6mm thick material.

The **Formech FM660** incorporates powerful infrared ceramic heaters, which are thermostatically controlled in concentric zones.

A powerful reverse-blow facility to release the moulding from the tool is integrated into the FM660.

The machine is fitted with an auto-level facility, which detects a droop in the sheet of plastic resulting from softening during its heat cycle. Air is then blown into the chamber beneath the plastic keeping the sheet level until it is ready to be formed.

A countdown timer is fitted as standard.

The machine has been designed to be highly adaptable and functions such as changing a mould, or fitting reducing windows (which allow smaller sheets to be used) can be carried out in the minimum amount of time.

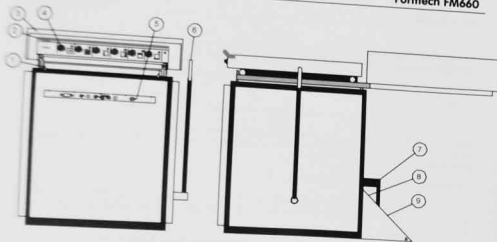
The powered table version of this machine allows easy and safe use of heavy moulds.

The FM660 is ideal for prototype development work whilst also quite capable of small and large production runs.

This manual informs the user on machine assembly, operation and service. It also provides an introduction into vacuum forming with some useful advice on mould making and post forming processes. If you would like a more comprehensive guide to the vacuum forming process then please visit the support section of the Formech web page. A **Training Manual** is provided in a download and printable format.

General Arrangement

Formech FM660



Features

- | | |
|-----------------------------------|--------------------------------|
| 1 Material clamp | 6 Drape table lever |
| 2 Heater movement handle | 7 Electrical Box & Main Switch |
| 3 Heater safety guard | 8 Vacuum filter |
| 4 Heater zone controller and neon | 9 Stabiliser attachment |
| 5 Control panel | |

Mechanical specifications

Material size	660mm x 660mm
Forming area	620mm x 620mm
Depth of draw	400mm
Mat. thickness	5.0mm max.
Overall height	1280mm
Overall depth	1900mm
Overall width	940mm
Weight	260Kgs

Optional extras

550W cooling fan system
 Pneumatic table (Depth of draw, 300mm)
 Reducing windows—450mm x 450mm / 300mm x 300mm / 150mm x 150mm
 Reel feed gantry
 Primary Particle Filter with Drain.

Electrical specification

Standard voltage	220/240V S/ Phase
	380/415V 3/ Phase
Standard frequency	50/60Hz
Standard max Power	7550W

Pneumatic specification

Compressed air-80PSI / 6 bar

Initial Assembly

Formech FM660

The machine should be sited on a level concrete floor. Dusty or draughty areas will compromise machine performance but it is important to allow enough space around the machine to allow access into the various panels and to ensure a good airflow to prevent overheating. During all of the following installation ensure that the power supply is properly isolated.

Electrical connection

An electric supply of correct voltage, current & frequency is required. An isolating switch with facility to be locked in 'OFF' position and capable of handling full current should be wall mounted, within easy reach of the operator.

415V Three phase supply.

The major current consuming devices within this machine are 230V single phase. However, in order to balance the load to electricity generator's requirements, each phase of a standard three phase supply should be connected to the L1 L2 & L3 of the machine. A neutral wire of full load capacity is required in this case.



THIS MACHINE MUST BE PROPERLY EARTHED IN ACCORDANCE WITH LOCAL REGULATIONS.

Pneumatic connection

The connection to the machine should be via a lockable shut off valve.



All fittings are threaded BSP. If flexible hoses are used it is strongly advised that they are of canvas or wire reinforced rubber and suitably rated for pressure and temperature. Connection hose size should be 12mm diameter.

Maximum airline pressure must not exceed 6BAR or 80 PSI

Attaching the stabiliser bar arrangement

The kit comprises two sidepieces, one stabiliser bar and fixing screws.

- 1 Remove the two lower screws from each side of the rear panel.
- 2 Align stabiliser side piece with the panel holes.
- 3 Insert screws. Do not tighten at this stage.
- 4 Place stabiliser bar between the side pieces aligning with the screw holes and insert screws.
- 5 Ensure the stabiliser assy is situated at its lowest point of adjustment and tighten up all screws.

Heat Guard assembly and fitting

The Heater Guard is attached to the rear rails and heat shield. The rails slot together with the rail key bar. Remove the screws fitted to the rear of the front rails and slide the complete heater guard into place. Refit the two M6 screws and nuts into the rail key and rear rail, one on each side. Ensure that these fixing are tight and that the rails are aligned.

660 Heater - no fitting required.

The heater is attached to the machine with the heater wheels sitting on the rails. The heater is connected to the electrical box located at the rear of the machine with cable and chain and electrical conduit. Remove any transit ties after fitting the Heater guard and rear rails. The heater should roll freely back into the heater guard.

Drape Table lever

This lever may require fitting. Remove the bolt from the main crank on the right hand side of the machine. Place the bolt in the main shaft of the lever and push the keyed shaft into the keyed main crank. Tighten the shaft bolt well. It is important that this retaining bolt remains tight, check regularly.

Counterbalance arms and weights

The counterbalance arms attach to the clamp frame of the machine with the screws supplied. The two counterbalance weights are normally supplied fitted to the arms and need to be set in position to balance the clamp frame. They are easily adjusted by loosening the grub screw. Ensure that the end stops are always in place.

Adjustment is required if, for example, a reducing window is fitted.

Optional Cooling System

Attaching the Cooling System:

- 1 Fit the gantry sides to the two heater rails at the boltholes on either side of the moulding area with the four nuts and screws supplied.
- 2 Fit the Gantry cross member to the gantry sides with the four nuts and bolts supplied. The fan mounting post should be attached to the cross member so that the fan can be positioned behind the cross member directing the fan draft forward away from the heater.
- 3 The swivel block should be supplied fitted to the fan unit. Slide this onto the cross member post and tighten the grub screws and locking nuts. Never fit the fan posts on the underside of the cross member as the fan may fall and cause injury.
- 4 Adjust the fan unit to the required position, tighten all the grub screws and lock nuts.

Using the Cooling System

The corresponding ON / OFF buttons on the control panel can operate the cooling fan at the appropriate time to cool the moulding. It is worth considering the position of the fan mounting to achieve good and consistent results.

Directing the airflow from behind the cross member down towards the centre of the moulding will reduce the cooling effect of the fan on the heater.

Control panel general arrangement and use.

FM660



FM660PT



The FM660 / FM660PT is operated from the control panel. The various buttons are labelled as above. Unlike conventional push button systems, the FM660 control panel is flush with touch sensitive buttons. Simply touch the button. No force is required. These buttons have no moving parts. The following is a brief description of the operation of the buttons to be referred to in conjunction with the operating procedures on the next page.

Auto-level

This operation will latch the pump 'on' and monitor the beam sensor. The pump pressure valve will turn on when the beam is broken. Pressing any sequence button will unlatch this function.

Pre-stretch

This operation will turn on the compressed air valve to allow air to flow into the sealed cabinet. This function does not latch.

Mould

This operation will latch the pump and the vacuum valve on to apply vacuum to the table hole. Pressing any sequence button will unlatch this function.

Cooling Fan

There is an 'ON' and an 'OFF' button for this function. No other buttons will affect the fan operation.

Release

This operation will turn on the pump and the pressure valve together. This function does not latch.

Stop

This button will stop any latched function and return the system to standby.

Timer

This has a 999 second digital display countdown timer. The up and down buttons adjust the set time, holding these button will speed up the adjustment. Set to zero to disable the timer. Countdown will start when the heater is moved to the forward position.

Table Up (FM660PT only)

These two buttons must be touched simultaneously and held to allow the table to be driven up. Removing either hand during the command will stop the table movement.

Table down (FM660PT only)

This button will drive the table down when held. The command will stop if not held.

- ❑ Turn the isolator switch situated on the electrical box on the rear of the machine to the 'ON' position.
- ❑ Using the heater controls, turn the zones on to provide power to the heaters. It usually takes between 15 and 20 minutes before the heaters have reached their operating temperature.
- ❑ Place your mould onto the drape table. See the section dealing with mould design to ensure that your mould is suitable. Place the table into the lower position by pushing the table lever (6) away from you.
- ❑ Open the material clamps (1) and raise the clamp frame. Position a sheet of plastic over the aperture. See the section dealing with plastics to ensure that your material is suitable.
- ❑ Pull the clamp frame down and close the material clamps. The plastic should completely cover the white seals around the aperture. Use the adjusting screws at the front of the material clamps to properly grip the plastic. The rear of the clamp is spring loaded. The pre-load spring tension can be adjusted by moving the position of the two lock nuts.
- ❑ After the heater has reached operating temperature, pull it forward over the plastic using the handle at the front of the heater unit.
- ❑ Activate the auto-level by touching the blue button. This enables the auto-level feature. If the plastic is sagging and not being heated evenly then the auto-level feature may be used to keep the plastic level while the heater is forward and until ready to form a mould.
- ❑ As the plastic heats up it may begin to rise slightly. It will then soften and begin to drop back.
- ❑ If the heating cycle time is known then the timer can be set prior to bringing the heater forward.
- ❑ If not using the timer push the heater back slightly to test the softness of the plastic manually or to observe its state. Continue heating until it is soft enough to form. At this point, push back the heater all the way.
- ❑ Touch the white pre-stretch button to inflate the plastic before moulding if required. This feature is particularly useful if the mould is high because it keeps the plastic at a more even thickness throughout the moulding. Pre-stretch may also be used as the table is rising to keep the bubble inflated. If the moulding is quite high it may be necessary to pre-stretch the plastic before moulding takes place.
- ❑ Press the green 'Mould' button and lift the mould table by pulling back the drape table lever until the crank locks in place and the drape table is fully raised.
- ❑ The green mould button is used to apply vacuum to the table. The moulding will form around the tooling.
- ❑ For the powered table option the table is raised by touching both the two red 'Table Up' buttons simultaneously (this must be performed with both hands and held until the table is fully up).
- ❑ At the appropriate time the fans may be turned on to start the plastic cooling process – touch the white 'ON' button. When the moulding is cooled, touch the white 'OFF' button.
- ❑ Once the plastic has cooled sufficiently the yellow release button may be pressed to blow the moulding off of the mould. Too long or too soon a release may distort the moulding.
- ❑ Once released the moulding is now complete and the table may be lowered using the drape table lever and the clamp frame unclamped. To lower the powered table touch the 'Table Down' button, holding this until the table has reached its lower position.

Heaters

The powerful infrared ceramic heaters are designed to heat the plastic rapidly without burning the surface. The time required to heat the plastic sheet remains fairly constant once the heaters have reached their operating temperature.

The movement of the heater is manually controlled. The operator is able to send the heater partially back to check the condition of the plastic and then bring it forward to continue the heating process. This action will not interrupt and restart a timed heating cycle unless the time has elapsed and the alarm already sounded. Always use the red handle to move the heater.

The heater control system uses 'simmerstats' to vary the output of individual zones as displayed on the heater front panel. There are six controllable heating zones, three concentric zones, the outer zone is split into four zones to enable users to balance the heating and allow for sides drafts etc.

After the required zone heat level, as set on each simmerstat, has been reached, the corresponding red neon indicator will go off. This indicates that the zone is not drawing any power. As the elements cool down the power cuts back in and reheats the zone.

The individual zones may be set up to provide an even spread of heat. To achieve the best results set the inner zones lower than the outer zones and remember that the rear of the heater will always run hotter than the front. Having set the heaters, slight adjustments may have to be made depending on the mould design, plastic type / thickness / colour and the machine & environment temperature / conditions.

When using the full forming area it is advisable to keep the central zones 1 and 2 turned down slightly. These areas retain the heat the most and the outer zones lose the heat the fastest. When using reducing frames the zones not in use should be turned down. Always push heaters over rear heat shield when not heating plastic.

Heating cycle times vary according to a number of factors. With a little experience, timings may be easily estimated. Some plastics such as styrene have a wide tolerance to heating times giving consistently good mouldings. Care must be taken with materials, which are Hygroscopic (retain moisture) such as ABS, as the surface will blister if the material has not been pre-dried.

The moulding should be formed when the plastic is sufficiently 'relaxed' or at its 'plastic transition' temperature. A properly heated sheet will give an excellently defined moulding. If the sheet is not hot enough while forming the moulding will not pick up all the detail from the tool.

The times below were recorded using styrene at an ambient temperature of 20°C with the machine at operating temperature. Please note that these times are a guide only.

Various factors will affect the heating time including the colour and surface finish of the material.

1.5mm Thick	= 45 seconds
2.0mm Thick	= 95 seconds
4.0mm Thick	= 170 seconds

Heater timer

The FM660 is fitted with a three digit LED count down heater timer intended to assist the production of a large number of similar mouldings.

The timer function is enabled when a number is shown in the display and disabled when the display shows Zero. The timing seconds value is adjusted by touching the '↓' or '↑' buttons either side of the three digit display. The adjustment count will speed up if you hold your finger on the up/down adjustment buttons.

The timer countdown is triggered when the heater reaches its forward position and visibly counts down the seconds to give a useful indication of the heat time remaining.

An audible beep is given when the countdown is complete and the display resets to the pre-set time. The buzzer indicates that the heating cycle is complete and the heater may be pushed back.

Pushing the heater partially backward or forward during the heating cycle will not interrupt the countdown.

Bubble moulding

With the FM660/FM660PT it is possible to produce bubble mouldings without using a tool. To form a bubble the plastic sheet should be heated with the drape table in the lowered position. When the plastic sheet has heated right through, push back the heater, touch the pre-stretch button and hold. If you are using the FM660 without an air supply use the release button to blow. The plastic will start to inflate.

Tools

Tools for vacuum forming should always be solidly constructed as the operating air pressure reaches approximately 100 kg over an area 100mm x 100mm (one ton per square foot)

All tools should be mounted on a baseboard. They cannot have undercuts and must be produced with slightly angular sides ('draft angle') to aid release. Vent holes are needed to allow the air to be evacuated from pockets and sharp angles on the tool. Providing these holes are kept small they will not leave marks on the surface of the finished moulding.

Tools made from wood or medium density fibreboard (MDF) are easily constructed and can give short runs of good quality mouldings at a low cost. (See note below)

The use of close-grained wood will avoid grain patterns appearing on the mouldings.

Plaster of Paris may be used for one-offs but the plaster must be allowed to properly dry out. (See note below)

Metal tools have the advantages of carrying fine detail and being more resistant to both distortion and surface damage. Metal tools should be pre-treated before use. A cool metal mould will absorb some of the heat from the plastic sheet before it can take up the full definition.

Resin tools combine most of the advantages of metal moulds with relative ease of manufacture. Various resinous materials are commercially available especially for vacuum forming tool production.

NOTE Porous mould materials such as wood and plaster should be properly sealed to prevent the vacuum pump from sucking out any moisture or sawdust, loose plaster etc. The vacuum circuit may quickly become choked with dust or slurry if moulds are not properly sealed.

Repairs to the vacuum circuit can be costly. A drain filter option is available and strongly recommended if forming plaster moulds. The vacuum filter is not designed to prevent moisture getting into the vacuum pump.

As the plastic cools after forming it will contract, gripping the tool tightly. If the tool has been made with sloping sides and has a good surface finish it will release more easily. Where the draft angle must be kept to a minimum a release agent may be used to assist release.

Sealed moulds will usually release more easily. Silicon based release agents may be used on more difficult moulds. Silicon based release agents are rapidly absorbed by porous (unsealed) moulds, rendering them ineffective.

The use of talc as a release agent is not recommended. It may clog the vacuum circuit.

Plastic sheet is commercially available in a wide variety of grades, thickness and colours. Materials such as styrene and PVC are most suited to vacuum forming. Other materials such as acrylic, polypropylene and polycarbonate will mould but difficulties may be encountered.

It is not within the scope of this manual to attempt to list all the potential problems and their solutions. It is recommended that the newcomer to vacuum forming gains experience and confidence with easily formed materials before moving onto the more difficult materials.

Post Forming Operations

Formech FM660

After forming

After forming, most plastics can be subsequently heat formed to add such details as folds or clips. Although many plastics can be printed, and in some cases painted, the presence of release agent used to help free a tight moulding may make the surface resistant to further decoration.

Trimming

An ideal moulding will be ready for use when removed from the machine and requires no finishing. However, most mouldings do require trimming before they can be used. There are numerous methods available for this process.

Thin materials can be trimmed with a sharp knife. Shaped cutting dies can be used to cut out intricate shapes. If no flange is required on the finished product then a trimming saw mounted in a pillar drill will cut the moulding in a horizontal plane to free it from the surrounding material. Trim or Spindle saw are available from Formech. Please contact our sales department for further information.

In mass production environments the range of equipment available for this requirement encompasses clicking presses, roller presses, routers, horizontal band saws, water jet cutters, laser cutters and many others.

Forming Difficulties

Formech FM660

The purpose of the following section is to help the user in overcoming some problems frequently encountered in thermofforming. Please remember that the majority of thermofforming faults are caused by incorrect machine setting or poor mould design.

This section is a guide only and cannot impart the practical experience and skill that any user will eventually attain. You can find a more comprehensive trouble-shooting guide in the Formech training Manual located in the support section of the Formech web page: www.formech.com

PROBLEM	CAUSE	REMEDY
Lack of definition	Material too cold	Increase heating time/temp.
	Mould too cold	Warm mould
	Insufficient vacuum	Adjust vacuum timings
		Check vent holes on mould
		Is mould restricting vacuum flow? Are vacuum tracks in mould adequate?
Webbing (small pleats at corners of mouldings)	Incorrect pre-stretch height	Adjust pre-stretch flow and/or time. Check panels for leaks
	Incorrect heater zoning	Adjust problem zones
	Material overheated	Reduce heating time
	Vacuum speed too fast	Regulate to suit
	Mould design/position	Increase tapers or radii. Use plug assist. Move cavities further apart (Multiple moulds)
Webbing	Excess material	Reduce material size or use 'dummy' moulds
Shrinkage of moulding (after removal from mould)	Product removed from mould too quickly	Increase timings to allow longer mould contact
		Increase cooling time
Moulding too thin in areas	Incorrect heater zoning	Decrease temperature in problem zones
	Too much pre-stretch	Decrease flow or timing
	Cold spots	Check elements are working. Are there any draughts?
	Mould too cold	Warm mould
	Material not consistent	Consult supplier

PROBLEM	CAUSE	REMEDY
Cracked or distorted formings	Excessive mould release pressure or timing	Adjust to suit
	Material too hot at release	Increase cooling time
	Material thinning	Adjust heater zoning
Thick tops on finished mouldings. (Chill marks)	Mould too cold causing rapid cooling on contact	Increase mould temperature. Adjust flow on water cooled moulds
	Design of mould	Use plug tool to assist material flow
	Insufficient pre-stretch	Increase pressure, flow or time
Marks on finished mouldings	Material too hot or too cold	Increase heating time/temp.
	Damaged or dirty mould	Repair or clean mould. Use blowgun between formings.

Reliability and a long service life are synonymous with the Formech brand. However, as with any machinery, certain parts will require periodic replacement and regular maintenance and care will prolong machinery life.

Clamp Seals

The silicon seals applied to the mould table and to the top aperture of the machine (clamp) are seen as being consumable parts, their service life will depend on how the machine is treated and how often it is used.

The table and clamp seals are not covered by our warranty.

Heating elements

The infrared heating elements supplied with this machine are manufactured from a ceramic material and are very brittle. A shock to the machine may break an element.

The heating elements contain a length of resistance wire internally, which becomes extremely hot when electricity is applied. The wire expands and contracts as it heats and cools.

Eventually, due to the continual expansion and contraction, the wire will fracture and a new element will be needed. This may take a decade or more. Alternatively it could happen as a result of an impact or shock. Because of this we are unable to apply our standard warranty to ceramic heating elements.

The heating elements are not covered by our warranty.

Vacuum system

The vacuum system on this machine is fairly simple but uses high quality components throughout. The life expectancy of the vacuum system will be compromised by the ingress of dirt, shavings, dust, liquid etc.



THE VACUUM CIRCUIT INCLUDING THE VACUUM PUMP WILL NOT BE COVERED BY OUR WARRANTY IF THEY ARE FOUND TO BE BLOCKED WITH FOREIGN MATTER OR CORRODED BY THE INGRESS OF LIQUID.

Apart from the table and clamp seals, which are considered to be consumable items, it is unlikely that you will need to service or repair your machine for many years. This is providing that you have noted the sections regarding the vacuum system and heating elements.

Electrical

Before any maintenance work is carried out both electrical and air supplies must be locked in the OFF position. Only a qualified electrical technician may work on any parts carrying mains voltage and should be responsible for ensuring that the machine is in a safe condition before allowing services to be restored.

Faults on circuit boards are rare but loose plugs and terminals are responsible for most electrically based failures. A logical approach to detecting the fault begins with an exact appraisal of the fault scenario.

Much time can be wasted looking in the wrong areas for a problem that, when found, was obvious.

Heater

The flexible conduits between the heaters and the control cabinet contain a number of heatproof power (and in some cases thermocouple) cables. Due to the continual motion of the heater these will eventually suffer from fatigue and require replacement.

Only the correct grade of cable should be used, and the work carried out by a skilled technician.

The ceramic heating elements should be periodically inspected particularly for hairline cracks. There is usually no specific reason for this occurring other than through age due to the expansion & contraction of the ceramic material. The same applies to the resistance wire within the ceramic case. Although no warning of failure is visible, if the element fails to heat, then the wire has probably broken inside.

For the reasons stated, the elements, associated cables, connectors, fuses and triac controllers are specifically excluded from our standard warranty

Replacing a heating element

- If the plastic is not being heated evenly and there is an obvious cold spot then follow the below procedure. This procedure is simplified if the checks are performed from 'cold'
- Switch off machine and let heater cool completely, this will take at least 15 minutes.
- Bring the heater half way forward, place hand near but not on elements to see if they are still hot. If they are, let machine cool for a further 15 minutes.
- When elements are completely cool, turn on each zone individually and feel each element connected to that specific zone. The difference in temperature will quickly become noticeable. If one or more elements fail to heat then follow below

Replacing a heating element - continued

- Disconnect the electrical mains supply
- Bring the heater completely forward.
- Remove the self tapping screws securing the slotted heater cover and place to one side with the cover. At this stage check that the wiring terminal block connections and the thermostat connectors at the front of the heater are fully tightened and that the fault was not merely a loose connection or a disconnected clip.
- Remove the cap from the terminal block associated with the faulty element, loosen the terminal block screws and remove the element leads and insulation sleeves.
- Remove the retaining clip holding the faulty element placing hand underneath heating element to prevent it from falling. Remove the element.
- Push new element into hole and fix spring & clip from top.
- Slide on the insulation sleeves, replacing with new if perished or damaged. Ensure that the connections are fully tightened and correctly wired.
- Replace the terminal block cover and check that no cabling is touching any metal parts.
- Replace the slotted heater cover and fit the self tapping screws.

Auto-levelling system

This machine is fitted with an automatic sheet levelling system. An optical sensor directs a beam of infrared light across the machine, a 'honeycomb' reflector receives this light and shines it back to the sensor. If the beam is broken air is pumped onto the base of the machine under the plastic lifting it until the reflected beam is re-established.

When the plastic is heated it begins to sag and cuts the beam, the compressed air lifts the plastic until it has cleared the beam. The air is then shut off until the plastic sags again. The intervals between the air turning on & off may be very short.

The alignment between the optical sensor and the reflector is finely adjusted. It may require re-adjusting if the machine has been transported or used roughly.

If the heater is left for any time over the forming area (without plastic clamped in) the reflector may become distorted. The sensor may fail if it is exposed to high temperatures.

The optical sensor is located under the top-frame on the left-hand side. The reflector is opposite.

When the sensor is in the 'beam received & returned unbroken' state only the green LED will light. When the beam is broken the red & green LEDs will light. No other combination will work properly. If the above LED's light at the correct time but the Auto-Level does not work properly then either the beam is shining too low or too high. Alternatively the pneumatic system is failing.

Service/Repair

Formech FM660

Auto-Leveling system - continued

Adjustment may be carried out by slightly bending the sensor mounting plate or the reflector plate. Certain machines are fitted with an adjustable bracket, which allows for fine trimming of the sensor. The sensor has two small adjusting screws that alter sensitivity and range. These have been set at the factory and are unlikely to have moved. Only adjust these if you cannot make the sensor work properly by any other means.

If no LEDs are visible at any time then the sensor may have lost its power connection or become faulty. The Auto-Level may be working properly but blows the plastic up higher than the top-frame level. If this is the case adjust the sensor mounting plate slightly downward.

Test the machine by placing a narrow strip of plastic across the top-frame at right angles to the sensor approx. midway between sensor and reflector. Clamp the strip in the usual way. Push the plastic down until the sensor operates.

Vacuum

Warning: never oil any part of the vacuum pump. It is designed to run dry and could be severely damaged by lubrication.

The vacuum circuit requires very little maintenance. The inlet filter is mounted on the rear external panel for easy access. Unclip the top cover of the filter box. The paper cartridge filter will prevent small particles and dust from entering the vacuum pump. This filter should be inspected periodically and blown out or replaced if in poor condition. Do not run the machine without this filter.

Worn or damaged seals around the perimeter of the table may cause loss of vacuum. These are classed as a consumable part and require replacement after some time. To replace seals follow the procedure on page 21.

Other causes of vacuum loss are loose or damaged flexible hose from table to metal pipe (at back of machine), blocked filters or build up of contamination in the vacuum or tank valves. The valves should be dismantled and cleaned with paraffin or diesel fuel. Be sure to remove all traces of the solvent used before re-assembling.

Lubricants or other liquid may cause irreparable damage to the pump if introduced into the vacuum circuit.

Vacuum / pressure system

If the vacuum or pressure appears to be weak or non-existent check the following:

- The mould baseboard is not restricting the vacuum inlet in the drape table.
- NOTE: If the mould baseboard is too soft it may pull down under vacuum and block the vacuum inlet.
- The mould is adequately vented to allow trapped air to be evacuated.
- The table and clamp seals are in good order and the table is locking properly at the top of its travel.
- There are no holes drilled in the drape table.
- The filter box cover is correctly fitted.

Vacuum / pressure system - continued

If all the above points are OK and you can hear the pump running when you switch it on then one of the following points will be the cause of the problem. If the pump does not run, refer to the Electrical trouble shooting section above.

- A pipe is loose, damaged or blocked.
- The pump filter is blocked.
- The vacuum pressure valve is blocked or corroded.
- The vacuum pump is blocked or corroded.

If the heater has been left in the forward position, with no plastic in the clamp frame, the table will start to overheat. The pipe attached to the back of the table will shrink and constrict the passage of air. Pipes become less flexible over time and may loosen or crack.

Pneumatics

Check oil in lubricator daily.

Providing there is a good filtered and lubricated air supply, using a good quality airline oil, maintenance will be minimal. However, a thorough inspection of the machine is necessary from time to time. Any mechanical damage of pipes and fittings should be dealt with before re-using the machine.

Always lock air supply OFF and bleed out system air before attempting any maintenance of air system.

Other problems that cylinders and solenoid valves may suffer from are:

- Lack of electrical supply - Check appropriate circuitry.
- Solenoid has become open circuit - Replace with new solenoid.
- Return mechanism jammed or broken - Dismantle valve to investigate. Replace if required.
- Wet or dirty air supply - Check condition of air compressor and condensate management system.
- Internal leaks within valves & cylinder.

Please specify cylinder valve number & model when ordering any pneumatic spare parts.

The importance of filling the lubricator with oil on a daily basis cannot be over emphasised. Adjust the lubricator such that a small amount of oil mist is visible in the cylinder exhaust.

Many problems can be caused by water in the pneumatic system.

Clamp & table seals

These are regarded as a consumable part and should be replaced when signs of wear become apparent. See section dealing with Vacuum.

Formech supply a kit comprising the necessary seals and sealant for the **Formech FM660/FM660PT**. We recommend that only the correct silicone seals and sealant are used to give an effective seal.

To replace a damaged or worn seal

- Remove the all traces of the existing seal and sealant.
- Using masking tape, make a frame inside where the seal will go (table) or outside (clamp). Gain a good 'key' to the sealing surface using an abrasive cloth or paper.
- Degrease the area and remove all dust.
- Cut the seal strip to the lengths required allowing for 25mm overlap at the corners.
- Apply a bead of sealant to the masked area where the seal is to be placed and spread to achieve a thin and linear coating. Ensure a generous layer covers all of the sealing area.
- Bed down the strips of silicon seal until it is firmly seated in to the sealant. Do not attempt to stretch the seal strip it will contract back to its original size before the sealant sets.
- Ensure the strips are straight along the sides and perpendicular at the corners. Cut through the strips at 45° where they meet at the corners. Continue this process for all 4 corners.
- Apply a small amount of sealant to the mitred joints and firm together to achieve a clean, square and close joint. Place masking tape over the mitred corners to help keep them firmly positioned until the sealant sets.
- Carefully remove the masking tape and leave overnight.

Panel seals

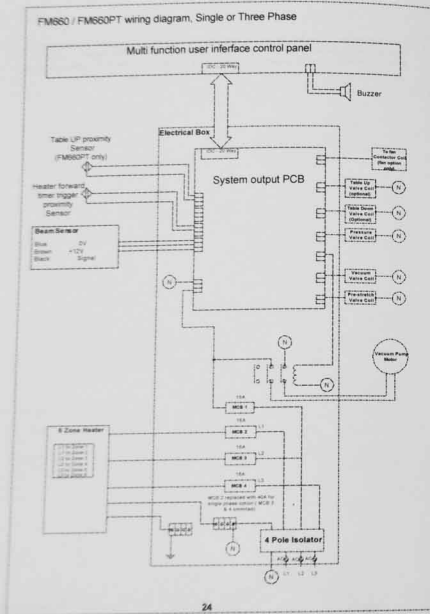
The rubber seals fitted to the side panels should be periodically inspected and replaced where necessary. Failure of these seals will prevent the correct functioning of the auto-level and pressure functions.

If you are unable to cure any problem relating to your machine, or if you wish to order spare parts please contact us at the address on the front of this manual stating the model, **FM660 / FM660PT**, the serial no. (on specification plate), and a full description of the fault or parts you need.

If you are unable to cure any problem relating to your machine, or if you wish to order spare parts please contact us at the below address, stating the model (FM660 manual or power table) the serial No. (on specification plate) and a full description of the fault or parts you need.



FM660 / FM660PT wiring diagram, Single or Three Phase



Formech FM660 Heater Wiring

Conduit cable Lengths 3100mm
 Single Phase 2 x 4mm SIAFGL
 Three phase =N Star 3 x 2.5mm Neutral 4mm SIAFGL
 Conduit, Adaptaflex 20mm with Swivels @ 700mm
 Cable chain 32 Links +End Bracket

Earth @ 2.5mm SIAFGL GY

