OPERATING
MANUAL FOR MICROWELDER
FLAME POLISHER

The original MICROWELDER product line has been designed and manufactured by Johnson Matthey p.l.c.

CODE OF PRACTICE

Our equipment is built in accordance with "Good Practice" as laid down in the various standards that govern the use of electrical equipment in flammable atmospheres. It is important that similar "Good Practice" should be observed during the operation and maintenance of the equipment. Among the standards that apply are the following:

BS 5345
Storage of flammable liquids GN CS2

For the use of the equipment outside of the United Kingdom of Great Britain and Northern Ireland the equivalent local national standards should be consulted. The customer is to confirm that local standards are satisfied by the equipment.

The illustrations and drawings included in this manual are only representative of the equipment supplied. There are variations between each model but the basic principle remains the same. Sherwood Scientific reserve right to alter, modify, upgrade or vary the equipment in any way that they see fit to improve the product. This is a feature of our ambition in our constant search for excellence.

HEALTH HAZARD

Potassium Hydroxide is a strong alkali and is dangerous when improperly handled, producing severe burns. Contact with the eyes causes severe damage. Inhalation of dust is capable of causing injury to the entire respiratory tract. Swallowing usually results in severe injury. Contact of dusts and mists with eye or nose usually causes stinging sensation momentarily.

VENTILATION

Areas where Potassium Hydroxide mist or dust is present should be provided with adequate ventilation to minimise exposure.

PROTECTIVE EQUIPMENT

Eye Protection	Plastic cup type with approved lens and with adequately designed air vents BS.2092 - Letter 'C'
Face Protection	Plastic shield (full length with forehead protection) may be worn in addition to chemical safety goggles where complete face protection is required.

Eye baths must be immediately available at all these locations. In places where mist or dust is formed, a Martindale Type 'U' respirator should be worn.

Foot Protection Safety shoes or boots should be made of rubber, these should be thoroughly cleaned and ventilated after use.

NOTE: Leather is attacked by Potassium Hydroxide.

In the event of chemical contact, the affected areas of the body should be immediately washed thoroughly with copious amounts of water. As a general measure washing before meals and at the end of the day is required.

Rubber—Plastic gloves should be worn when handling caustic or caustic solutions

Labelling Drums of solid or liquid must be plainly marked with their contents. The same applies to any waste solutions.

Handling Where Potassium Hydroxide is stored or handled, running water should be available for emergency use in dissolving and flushing away spilled caustic. Spilled solid forms of caustic may be shovelled up, followed by flushing with water. Dilute acid, preferably acetic acid, may be used to neutralise the final traces of caustic immediately after flushing. Washing or mopping similar leaks may be followed by a liberal covering of Sodium Bicarbonate.

Preparation of solutions When preparing solutions always add potassium Hydroxide slowly and in small amounts to avoid violent boiling and spattering. Hot water must not be used. Eyes, face, hands must be protected. Waste caustic solutions should not be discharged directly into drains. The caustic must be converted to a neutral salt, as by neutralisation with acid and well diluted with water.

SPECIFICATION FOR DISTILLED/ DE-MINERALISED/ DE-IONISED WATER.

The British Standards BS 3978 specifies requirements for water suitable for general laboratory use. Water of the specified quality is suitable to mix with Potassium Hydroxide to be used a electrolyte for Microwelders. The water specified will be produced by distillation exchange or otherwise.

A representative sample of the material not less than two litres shall be taken from the bulk for the purpose of examination in accordance with this specification. The sample shall be of such size that it is nearly filled by the sample. Care shall be taken to avoid the risk of contaminating the contents in any way.

The material shall leave not more than 5mg of non-volatile residue per litre when tested by the method described in BS 3978.

The material shall be water purified by distillation exchange or other suitable means. It shall be clear and colourless.

The material shall not leave more than 2mg of residue on ignition per litre when tested by the method described in BS 3978.

The material shall have a pH value not lower than 5.0 and not higher than 7.5. The material shall have a specific conductance not higher than 10 micromhos per centimetre measured at 20 degrees celsius.

For oxidizable matter the material shall not completely discharge the colour of the potassium permanganate solution when tested by the method described in BS 3978.

For ammonia the material shall not give a more intense colour than is produced in the control solution when tested by the method described in BS 3978.

For chloride the material shall give a clear and colourless solution when tested by the method described in BS 3978.

For sulphate the material shall give a clear colourless solution when tested by the method as described in BS 3978.

OPERATING INSTRUCTIONS

CONTENTS

* The Microwelder is also known as a Flame Polisher. There is no difference between the machines, and these instructions apply to both.

1. INTRODUCTION

All the Microwelders/Flame Polishers in the range are of similar layout and operate on the same principles therefore these instructions apply to all the machines. Where there is any difference this is mentioned.

All Microwelders/Flame Polishers produce oxygen and hydrogen by electrolysis. The volume of gas produced by each machine varies within the product range from the A^+ with one operator through to the model B with up to four operators. The production of the oxygen and hydrogen is achieved using specially designed cells through which a high value of electric current is passed. This flow of electric current breaks down the water into its constituent gases. Since water is chemically made up of two parts hydrogen and one part oxygen the resultant gases after electrolysis are in the same proportions. The gas pressure generated is less than 1 lb/in^2 ($0.0703kg/cm^2$) and the gas is used up as it is produced so there is no gas storage involved. The machine is inherently safe as there is no danger of a high-pressure gas explosion.

1.1 WARNING

In order to afford protection especially from fire, electric shock and burns, good workmanship and proper materials have been used in the manufacture of the equipment. Each Microwelder affords protection against electric shock, thermal effects and over-current. However all of this protection is to no avail should the user fail to observe the basic safety precautions when filling the gas production cell.

The Microwelder is a safe and reliable machine providing it is correctly operated and maintained. Its method of operation depends on the use of CAUSTIC CHEMICALS and INFLAMMABLE LIQUIDS, and it produces a HIGHLY INFLAMMABLE GAS. It is therefore essential that when using and servicing the machine the following precautions are taken:-

a. Whenever the caustic solution is being made or the gas production cell is being filled with water great care should be taken not to splash caustic into the eyes or onto the hands. It is therefore recommended that SAFETY GLASSES and RUBBER GLOVES are worn.

NEVER ATTEMPT TO SIPHON LIQUID FROM THE CELL BY SUCKING. IT IS HIGHLY CAUSTIC AND CAN CAUSE SERIOUS BURNS TO THE MOUTH.

It is important to note that the solid caustic pellets are completely dissolved in the de-mineralised/distilled water before the electrolyte is added to the gas production cell on the instrument. Gradually add the pellets to the water with stirring until they are completely dissolved. Heat will be generated by the chemical reaction that takes place during the preparation of the electrolyte.

Protective clothing, in the form SAFETY GLASSES and GLOVES must be worn while handling caustic pellets or solution.

If caustic is splashed onto the skin or clothes, wash the affected part thoroughly under a running tap and seek medical help as soon as possible. Remove all contaminated clothing.

b. The liquid used in the atomiser is inflammable. Therefore always detach the atomiser bottle and fill it away from the work area, preferably out of doors or in a well-ventilated area. Never store the liquid for the atomiser in the work area.

c. The gases produced by the Microwelder are HYDROGEN and OXYGEN, which make an explosive mixture. Therefore read section 2.3 of this manual carefully and follow the instructions so that the Microwelder is used safely.

d. Never switch the machine off without first extinguishing the torch. If the gas pressure to the torch is allowed to decay away in this manner, a blow-back can happen.

1.2 DESCRIPTION

The Microwelder generates hydrogen and oxygen by electrolysis of distilled water in the gas production cell. The gas pressure generated is less than 1 lb/in^2 ($0.0703kg/cm^2$) and the gas is used up as it is produced, so there is no gas storage involved. Thus the machine is inherently safe as there is no danger of a high-pressure gas explosion.

The purpose of the gas atomiser is to allow the introduction of a volatile solution into the oxygen and hydrogen gas mixture. This allows the flame characteristics to be changed. The lower section of the atomiser is filled with Methyl-Ethyl-Ketone or an alternative solution. The gas is admitted through the GAS IN connection and forces the liquid into the top chamber. When all the liquid is in the top chamber the gas bubbles through the liquid thus picking up some of the liquid or vapour. The temperature of the flame using Methyl Ethyl Ketone as the atomiser fluid can be expected to be 1750^0C. The characteristics of the flame will show a large blue core with an orange tail, ideal for most applications.

Generally the more volatile the liquid used in the atomiser the more it will be picked up by the gas mixture. The resulting flame will become larger and cooler.

The atomiser fluid needs to be changed after 30 hours of operation when using the blue handled torch. When using gas flux and the red handled torch the level in the atomiser MUST be maintained above $^1/_3$ full and the mixture changed after 20 hours.

The Microwelder is compact and is best bench-mounted where its operation is easily watched and controlled.

1.3 OPERATION AND USES

Detailed instructions for operation are given in section 2 of this manual and these must be followed if the Microwelder is to be used with safety.

The Microwelder has been designed for use wherever there is a need for soldering, brazing, welding or cutting of small precision components. It is therefore suitable for use in the jewellery and dental industries, and also other flame industries where cleanliness and flame control is important, such as in the flame polishing of acrylic plastics. The flame burns very cleanly and is slightly 'reducing' in chemical terms, therefore the work is not contaminated with soot and oxides.

2. OPERATION

The Microwelder is delivered packed in a box with its accessories. Before placing in position check the items which should include the following:

Microwelder cabinet
Bracket for atomiser
Atomiser
A length of black, neoprene torch tubing
Torch and torch holder bracket
Box of torch tips in various sizes according to model
Filler funnel (for distilled/de-mineralised water)
A sealed pack of pellets for charging the cell

2.1 SETTING UP

2.1.1 INSTALLATION

The maximum length of the rubber tubes for the torch is 2 metres. The Microwelder must be positioned near the work-bench so that the tubes are not stretched. This makes monitoring the fluid more convenient.

The two ends of the machine must be unobstructed so that there is a free flow of air through the machine.

a. Fit the gas atomiser bracket to the Microwelder cabinet, on the top cover at the corner above the gas outlet, using the cover fixing screw.

b. Cut a 450mm. length of the black, neoprene tube and connect it to the gas outlet on the machine.

c. Put the Gas Atomiser into the bracket.

d. Connect the other end of this tube to the 'GAS IN' position on the atomiser.

e. Use the rest of the tubing to connect the 'TORCH' position on the atomiser to the torch.

f. Fit the appropriate torch tip to the torch. The tip is a close fit onto the torch and should be attached using a pushing and screwing action.

g. Fit the torch holder bracket to the work-bench. Alternatively it can be fixed to the Microwelder cabinet if this is more convenient. Use one of the cabinet cover screws and bend the bracket through 90 degrees.

DO NOT LEAVE THE TORCH ALIGHT WHEN IT IS LEFT IN THE BRACKET

The machine is now ready to fill with the liquids.

2.1.2 FILLING WITH DISTILLED, DE-MINERALISED OR DE-IONISED WATER

Before work can commence the gas production cell must be charged with electrolyte. Thereafter topping-up is done with water only. The electrolyte is a mixture of caustic pellets and distilled, de-mineralised or de-ionised water. The machine is supplied with the caustic pellets in a separate, sealed pack. It is important that the correct quantity of liquid is used to charge each cell. The cell MUST NOT be overfilled. This point cannot be over-emphasised.

The table below shows the exact amounts needed for the various models

	Water	**KOH**
Model 'A' Plus	1.00 litre	350 gms.
Model Super 'A'	2.00 litres	625 gms.
Model 'B'	2.00 litres per cell (2 Cells)	625 gms. per cell (2 Cells)

During mixing the solution will get hot and may foam and give off an acrid vapour. Keep eyes and hands protected and avoid inhaling the vapour. To mix the electrolyte, pour the full quantity of water into an open-topped plastic container of suitable size and slowly add about half the specified weight of pellets.

TAKE CARE NOT TO SPLASH THE LIQUID.

Stir with a plastic stirrer to encourage the pellets to dissolve - the solution becomes clear with no residue at the bottom when completely dissolved. Repeat with the rest of the pellets. When they too have dissolved allow the solution to cool.

To fill the gas production cell, use the funnel provided to slowly add the electrolyte solution to the gas production cell/cells. If the level of electrolyte is not evident in the sight tube, there might be an air lock in the sight tube - the machine may be tilted gently backwards through 30^0 to break the air lock. Alternatively run the machine with the torch and atomiser connected for 5 to 10 minutes to clear the air lock.

In normal use, if the level of electrolyte is not evident in the sight tube, add distilled/de-mineralised water until the level in the sight tube is just above the "TOP UP" and below the "FULL" marks on the sight-tube label.

2.1.3 FILLING THE GAS ATOMISER

The Gas Atomiser is a vessel containing the Atomiser liquid and has a sight tube to indicate the level of liquid. The Atomiser has been designed to contain gas pressure and therefore care must be taken to make sure that all gaskets and washers are correctly fitted and in good condition. Also check that all parts of the atomiser are undamaged and SECURELY FASTENED.

CAUTION. The liquid used in the atomiser is highly inflammable. It is therefore recommended that the atomiser be removed from the machine and filled in the open air or other well-ventilated area.

DO NOT FILL AT THE WORK-PLACE WHERE THERE MAY BE NAKED LIGHTS.

TO FILL THE ATOMISER:

a. Remove the top cap and lift the top section away from the bottom section. Note the fitting of the 'O' ring seal.

b. The filling mark is machined into the centre rod approximately 2" from the bottom. Fill the bottom section to the mark with MEK (Methyl-Ethyl- Ketone) or if that is not available with a 3:1 mixture of Methyl Alcohol (or methylated spirit) and Acetone

c. If the Atomiser is being topped up only, allow any liquid in the top chamber to drain back into the bottom section before topping up to the mark on the centre rod otherwise the atomiser can be overfilled. If the liquid will not drain back easily, allow air to enter the top chamber by disconnecting the tubing to the torch.

d. Fit the top cap making sure that the rubber washer is in place and screw together firmly. A smear of silicone grease on the rubber washer will make sure that the top cap can be properly tightened. In operation the gas pressure from the machine pumps the liquid up into the top chamber of the atomiser and the level will then show in the sight tube.

2.1.4 ELECTRICAL CONNECTION

Microwelders are supplied for use on 240 Volt or 110 Volt supplies.

Check the serial-plate on the machine to make sure that it is the correct voltage for the supply to which it is to be connected.

The electrical cable on the machine is colour-coded as follows:-

Brown Wire	Live
Blue Wire	Neutral
Yellow/Green Wire	Earth

The power characteristics of the machines are listed below.

	Voltage	Amperes	Voltage	Amperes	Max. Torch Tip Size (with only one torch attached to machine)
Model 'A' +	240	3	110	6	Gauge 20
Model Super 'A'	240	5	110	10	Gauge 18
Model 'B'	240	7	110	14	Gauge 17

Each machine is fitted with internal fuses for over current protection. Current drawn listed above is the maximum expected pulse value.

2.2 OPERATION OF THE MACHINE

NEVER SWITCH THE MACHINE OFF WITH A FLAME ALIGHT AT THE TORCH.

The Microwelder is automatic in operation and only needs periodic attention to the liquid levels and an understanding of how the indicator lights work. The automatic Microwelder machines have one or more gas production cells which operate intermittently, according to the demand from the torch(es).

2.2.1 INDICATOR LIGHTS

All machines with automatic gas regulation are fitted with two red lights (NEONS). The Model A+ has one fitted above the ON/OFF switch (Top NEON), the other adjacent to the switch (Bottom NEON). The Model Super A and Model B have one red light fitted between the START and STOP switches (Top NEON), the other fitted below the START switch (Bottom NEON)

Indicator	Function	Action
1. Top NEON	Indicates the minimum gas pressure is available to supply a flame.	Lit a few seconds after switched 'ON'. Remains lit during operation.
2. Bottom NEON	Indicates gas cell is producing gas.	Lit when the cell is producing gas. Goes out when a maximum pressure is reached and the cell stops producing gas. During normal operation the light goes on and off. With larger flames the cell has to produce more gas and the light pulses more frequently. It should never be on for more than 50% of the time.

NOTE: If too large a torch tip is used or there is a gas leak, the cell will be unable to produce gas fast enough and the light beside the switch will remain lit.

OPERATING IN THIS WAY WILL OVERHEAT THE CELL AND CAUSE DAMAGE.

2.2.2 CHECKING FOR GAS LEAKS

Operating the Microwelder with a gas leak is dangerous and may cause overheating and damage to the gas production cell. Therefore, if the indicator light which shows gas production remains lit all of the time or indicates gas is being produced when the torch is turned off, checks should be made for one or more of the following:

a. Damaged hoses
b. Hoses disconnected both inside and outside the cabinet
c. Damage to the torch or the ON/OFF valve
d. Gas leaks from the Atomiser
e. Gas leaks from the cell cap

To check for leaks follow the procedure in the order given below with the machine switched ON:

a.	Pinch the rubber hose on the outlet from the machine	The indicator light besides the switch should go out and remain off. If it does not there is a leak inside the machine, or from the cell cap.
b.	Pinch the rubber hose on the outlet from the atomiser	The indicator light should go out and remain off. If it does not there is a leak in the atomiser.
c.	Turn off the valve on the torch.	The indicator light should go out and remain off. If it does not, place a finger over the torch tip. If it comes on, then the torch is faulty.

2.3 STARTING UP AND USE - OPERATING CHECKS

The following points must be watched carefully during use:

1. Always make sure that the electrolyte level is correct. Too low a level will cause overheating and too high a level may result in internal spillage of caustic electrolyte solution and damage to the machine. Over-filling of electrolyte will infringe any warranties on the machine.

2. **Check the level of liquid in the Atomiser frequently:**

   TOO LOW A LEVEL WILL INCREASE THE POSSIBILITY OF A BLOW-BACK TO THE GAS PRODUCTION CELL AND THIS MAY DAMAGE THE PRESSURE SWITCH.

3. If the torch 'pops' when it is turned off, check the liquid level in the Gas atomiser. This is a sign that a blow-back may occur. The latest model (blue handled) torch supplied with the machine has a flash-back arrestor built into the handle but this cannot be relied upon to work if the Atomiser liquid level is allowed to become too low. If the torch cannot be extinguished without a "crack" even with the Atomiser level topped up, change the Atomiser solution for a more volatile fluid.

   Before using the Microwelder the correct Gas Atomiser liquid and the correct torch tip must be used.

2.3.1 GAS ATOMISER LIQUID

The Gas Atomiser holds a volatile liquid and as it passes through the Atomiser a small quantity of its vapour is mixed with the oxygen/hydrogen gas stream. This has the effect of slowing down the burning of the oxygen/hydrogen mixture and makes the flame easier to control.

The usual liquid to use in temperate climates (Europe) is MEK (Methyl-Ethyl-Ketone), but in hotter climates (or warm workshops) a less volatile liquid such as Methyl Alcohol (or methylated spirit) can be used.

In colder climates (or cold workshops) a more volatile solution should be used. This solution can be made up by adding a small amount of acetone to the MEK or methylated spirit.

Table 1. (on the following page, p14) illustrates the different types of liquid which can be used and how they vary the temperature and heat output of the flame. The liquids can be mixed to affect a gradual change in flame character.

The torch handle will remain cool during normal operation; in the event that the handle gets warm it could be that the flashback arrestor has been damaged. The end of the torch tip will get hot and burn back if the atomiser liquid is too low.

TABLE 1

GAS ATOMISER LIQUIDS

Atomiser Fluid	Flame Temperature	Flame Character
Acetone	1200^{0}C	Large bushy blue flame. Reducing in character. Spreads the heat well.
MEK with methyl borate (as gas flux). Must be used with red handled torch to prevent blocking.	1200^{0}C	Highly reducing in character. Bright green flame. Specialised applications.
Methyl-Ethyl-Ketone (MEK)	1750^{0}C	Larger blue core. Orange tail. Ideal for most applications.
Industrial Alcohol or methylated spirit	2200^{0}C	Small intense flame. Small blue cone. Fast burning speed may extinguish with a 'pop' in cold conditions.
Water. Acts to quench should a flash back occur.	3300^{0}C	Gas mixture in the flame oxygen/ hydrogen as produced by the machine. Pale colour flame -extremely hot, torch tip may start to burn away. Not recommended for normal use. Great care should be taken when extinguishing the flame to avoid the possibility of blow-back.

In general the more volatile the liquid, the more it will be picked up by the oxy-hydrogen gas mixture from the machine, and the large and cooler will be the resulting flame.

Acetone is more volatile than MEK, which is more volatile than methylated spirit. Also, the volatility of any liquid increases with temperature, so more of the vapour will be picked up by the gas stream. This has the effect of reducing the flame temperature, increasing the flame size and making it more reducing in character. The flame has an inherently slower rate of burning and hence can be extinguished more easily without popping or risk of flash-back.

If a hotter or more intense flame is required then the use of a less volatile Atomiser liquid is recommended (commonly methylated spirit is used).

2.3.2 SELECTION OF TORCH TIP

The torch tips are graded according to the amount of gas that they will pass and therefore the flame size. A number is stamped on the tip to indicate its size, the higher the number the smaller the flame size.

Note: The valve on the torch is for ON/OFF control only and must **NOT** be used to vary the flame size.

Table 2. shows the maximum tip size which can be used for a particular machine without overloading the gas production cell.

TABLE 2

TORCH TIP MAXIMUM SIZES

(The smaller the gauge size the larger the tip)

Number of operators working simultaneously	**1**	**2**	**3**	**4**
Model 'A' +	20			
Model Super 'A'	18	20		
Model 'B'	17	18	20	22

2.3.3 LIQUID LEVELS

GAS PRODUCTION CELL

During operation the distilled water in the gas production cell is used up. The correct level as shown in the sight tube must be maintained otherwise damage will occur.

a. Do not overfill the machine.

b. **NEVER ATTEMPT TO SIPHON THE LIQUID FROM THE CELL BY MOUTH.**

c. If it is necessary to remove some liquid, use a pump action siphon.

Always use rubber gloves and safety glasses. ALTHOUGH ONLY DISTILLED WATER IS ADDED TO THE CELL THE ELECTROLYTE MAKES THE CELL SOLUTION HIGHLY CAUSTIC. If difficulties are experienced and it is suspected that the electrolysis cell has been overfilled contact the local agent or SHERWOOD SCIENTIFIC.

ATOMISER

The liquid in the Atomiser not only controls the flame, but also acts as a flame suppressant if the torch should blow back. The correct levels as shown in the sight tube must be maintained.

A sign that the liquid is running low, or that liquid with too low a volatility is being used, is 'popping' of the flame when the torch is turned 'off'.

IF THIS SIGN OF LOW LIQUID LEVEL IS IGNORED THE FLAME MAY BLOW BACK AND DAMAGE THE MACHINE.

3. MAINTENANCE

A separate manual covers major maintenance of the Microwelder. The following section lists checks that must be carried out regularly.

3.1 REGULAR CHECKS

Daily

a. Check liquid levels. In hot weather the liquids will be used up more quickly. Top up when the level approaches the minimum as shown in the sight gauge. ONLY ADD DISTILLED OR DE-MINERALISED OR DE-IONISED WATER TO THE GAS PRODUCTION CELL(S).

b. Check operation of indicator lights.

c. Check for leaks.

Weekly

Completely change the liquid in the Atomiser after every 36 hours of use. MEK tends to discolour after several hours use and stands to lose its volatility. After approximately 36 hours use, discard all the MEK in the Atomiser and start again with a fresh charge.

3.2 TORCH

The latest design of torch (with a blue handle) includes a flame arrestor built into the body, which is designed to prevent a blow back to the atomiser. After a long period of use and especially if a blow back to the atomiser has occurred, the effectiveness of the flame arrestor in extinguishing a flame reduces. Old or damaged torches should be serviced or replaced with new ones. Where gas fluxing is employed it is necessary to use a torch without a flame arrestor (red handled) to prevent blocking of the torch by the flux.

MAINTENANCE MANUAL

FOR

MICROWELDER / FLAME POLISHER

NOTE: This maintenance manual refers to instructions in the main Microwelder operating manual (above) and must be used in conjunction with that manual. The user is especially directed to follow the safety procedures detailed therein.

CONTENTS

1.0 Fault finding charts

FAULT	CAUSE	REMEDY
When switched on, indicator lamps fail to illuminate	Lamp failure	Replace lamp as necessary
	Main supply failure	Check power supply and fuse
	Failure of machine fuse	Replace fuse as necessary
	Fuse fails again	Check fuse rating
	Loose connections	Unplug machine, remove top cover and check for loose wires
	Damaged pressure switch	Check for electrolyte leaks and correct
	Damaged mains switch	Check for electrolyte leaks and correct. Replace mains switch if necessary
	Fan failure	Check fan and connector block
	Diode failure	Check and replace as necessary
Top lamp fails to illuminate	Lamp failure	Replace lamp as necessary
	Possible leak on machine	Check tightness of cell top cap and condition of seal
	Hose from cell to pressure switch damaged	Replace hose
	Pressure switch damaged	Replace switch
	Possible leak on cell	Seal between top and bottom section damaged
		Top cap seal damaged
Bottom lamp stays on	Possible gas leaks	Check all pipe and gasket joints on gas production cell and atomiser
	Failure of pressure switch	Replace pressure switch
	Electrolyte has deteriorated	Clean out gas production cell and renew the electrolyte charge
Bottom lamp stays off	Blocked torch tip	Clean or replace torch tip
	Atomiser blocked	Push wire through pipes to clear solid matter. Immerse top half of atomiser in hot water and rinse out. If the blockage was caused by gas flux, leave in soak overnight.
Gas production cell too hot to touch	Torch tip fitted is too large for machine model.	Fit correct size torch tip according to Table 2. (page 15 of the main Microwelder operating manual)
	Gas production cell requires servicing	Fit a torch tip one size smaller than maximum for model. If, under these conditions the indicator lamps stay on, then gas production cell requires servicing.

2.0 Primary Checks

Connect machine to mains power. A torch with the appropriate tip must be fitted to the atomiser that has the correct level of atomiser liquid. Check that the level of electrolyte in the gas production cell is correct.

Switch ON the mains switch.
Check that the bottom light is ON.
Check that the top light is ON.
Check that the bottom light pulsates ON and OFF.
Allow machine to run for two minutes then ignite the torch.

3.0 Gas Production Cell service instructions

The need to service of the gas production cell is indicated by two factors. The gas production cell is hot to touch and both lights on the front panel remain on. In order to service the gas production cell it is necessary to remove the top cover of the machine.

1. Disconnect the machine from mains electrical power.
2. Remove all screws holding the top cover in position [on A+ model - remove all except the 4 screws on the left-hand end of the instrument, then go to item 5]
3. Do not attempt to remove the cover at this stage.
4. The connector-block that carries the mains power to the cooling fan is located inside the left hand cover near the bottom front. Disconnect the leads to the fan leaving the terminal block attached to the leads in the machine.
5. The top cover may now be removed.
6. Disconnect the electrical connection to the top plate of the cell.
7. Disconnect plastic pipe from cell to gas outlet on front of machine.
8. Disconnect rubber pipe from cell to pressure switch.
9. Release the screws on the front panel that hold the sight tube is position.
10. Raise the machine so that the nuts that secure the tie rods to each gas production cell can be released. The machine must be kept in the vertical position to ensure that any residual electrolyte is not released.

NOTE: With model 'B', only one cell will be connected to the chassis. The remaining cell has an insulating bush fitted between the base and the chassis. On the underside of the machine there is fitted an insulation ring between the nut and the base. At no time allow the cells to be connected direct to the chassis. The holes into which the insulation bushes fit are larger. Only one cell will be connected to the chassis. Take note of the position of the electrical leads before disconnection.

11. Remove the cell, keep it upright, and place it on the bench.

TAKE CAUTION: A HIGHLY CAUSTIC ELECTROLYTE IS WITHIN THE CELL!

OIL FROM THE SKIN WILL POLLUTE THE SURFACE OF THE INNER CELL. NEVER TOUCH THE PLATED INNER CELL WITH BARE HANDS

12. Remove the nuts at the top of the cell.

13. Remove the insulation bushes from the top plate.

14. Separate the top plate from the outer cell without removing it completely.

15. Place absorbent material on work-bench to absorb electrolyte when inner cell is removed.

16. Remove inner cell and stand it on absorbent material.

17. Empty the electrolyte from the outer cell down a suitable drain with a copious supply of tap-water to dilute the caustic.

18. Rinse the inner cell with plenty of cold water. Remove the top rubber seal and discard.

19. Fill the outer cell with very hot water. Place inner cell into outer cell and allow it to stand for a few minutes to warm through. Discard the water.

20. Add a cupful of household detergent to the outer cell and fill cell with boiling water. Place the inner cell into the hot detergent solution. Allow it to stand until the solution is cool.

21. Using plastic scouring pad (Scotchbrite) thoroughly clean both the inside and outside of both inner and out cell. Discard the detergent solution and thoroughly rinse both parts with plenty of cold water. When all traces of detergent have been removed give a final rinse with hot water. It is important that rinsing is thorough – a good test is that no bubbles caused by residual detergent should appear.

22. Release top connection of sight tube and allow hot water to flow from both pipes projecting from the cell. When all traces of detergent are removed and the cell is clean empty the cell and set aside to dry.

23. Fit the new rubber seal onto the inner cell without touching the plated surface. Place inner cell into outer and guide the tie rods through the top plate. The position of the bolt welded on the top plate must be in the same position relative to the sight tube.

24. Renew the sight tube. Replace the cell into the machine and refit the fixing nuts to the tie rod ends that project through the base of the case. With the nuts fully tightened the end of the tie rod should be flush with the head of the nut.

25. Fit the insulation washers over the tie rods and press them down into the holes of the top plate. Fit the stud washers and the fixing nuts but only tighten finger tight. The top-plate needs to be loose enough to be moved against the friction of the rubber seal but tight enough to stay in place. This is necessary since the filler tube must be aligned with the hole in the top cover.

26. Check that the transformer lead to the cell will not foul the top cover of the machine. Fit the top cover of the machine first by the four corner screws then one in each end panel at the bottom. Align the filler tube projecting through the top cover. Carefully remove the top cover without disturbing the filler tube. Tighten the four cell top-plate fixing nuts to a torque of 0.75ft/lbs. (≡ 1.0Nm.)

27. Connect the transformer lead to the cell top-plate ensuring that it does not make contact with the corner top-plate fixing nut. Tighten to a torque of 35 ft/lbs. (≡ 48Nm.)

28. Renew plastic tube from the top of the cell to the gas outlet on the front of the machine. Secure the tube in position with plastic cable tie. Renew the length of rubber tube from the top-plate of the cell to the pressure switch.

29. To fill the gas production cell follow the instruction in section 2.1.2 (page 9 of the Microwelder operating manual). When completed, fit the cell top-cap(s).

30. Check that the gas atomiser is filled with clean Methyl-Ethyl-Ketone to the fill line on the stem. Connect short hose from gas outlet on front of machine to gas inlet on atomiser. Connect long hose from torch position on atomizer to torch. Fit torch with largest tip indicated for model - see Table 2 (page 15 of the Microwelder operating manual).

31. Ensure the valve on the torch is turned fully clockwise to the "OFF" position. Switch on mains supply using switch on machine. DO NOT ATTEMPT TO LIGHT TORCH. Check for gas leaks - see section 2.2.2 (page 12 of the Microwelder operating manual).

    Open the torch valve by turning fully anti-clockwise. The lower indicator lamp will now come on intermittently. Allow machine to run in this state for two minutes to purge out the air before lighting the torch.

32. If the machine operates correctly, close the torch valve, switch off the machine and disconnect from the mains electricity. Place the cover near the machine and connect the fan leads to the terminal block [not required on model A+]. Fit the cover onto the machine, with the grey insulating ring in place, and ensure that the fan lead is not trapped. Fit and tighten all the screws that hold the cover on.