



FURNACE & ASSAY

— S U P P L I E S —

Electric 100 Place Cupellation Furnace Operation & Maintenance Manual

Electrical:

220/380/415/440v

- Electrical Connection is 3 phase with Earth.
- Transformer 15va Multi-tap 50-60Hz.

Working Area

- 560mm Deep
- 480mm Wide
- 190mm High

Pair With

- 50 Place Fusion Furnace

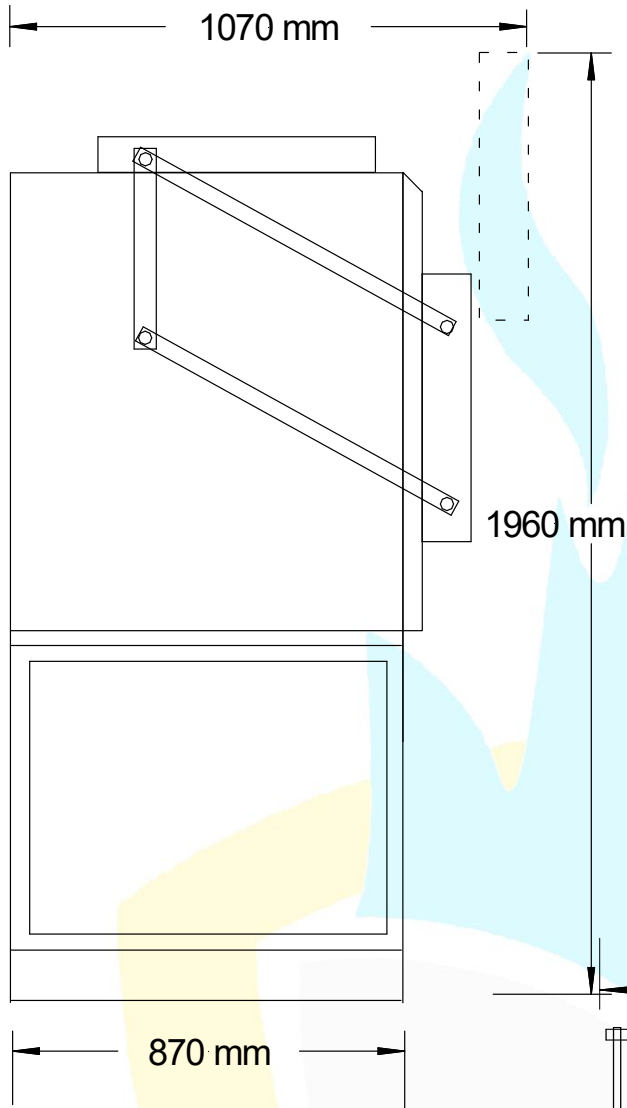


Tel: +61 8 9399 9299

E-mail: info@fandasupplies.com

Manual Index

System Overview	3-4
Spare Parts List	5-6
Installation Procedure	7
Installing Elements	8-9
Element Information	10-15
Operating Instructions	16-17
Electrical Schematic	18
Muffle Start-up Procedure	19
Maintenance	20-30
Contact Details	31



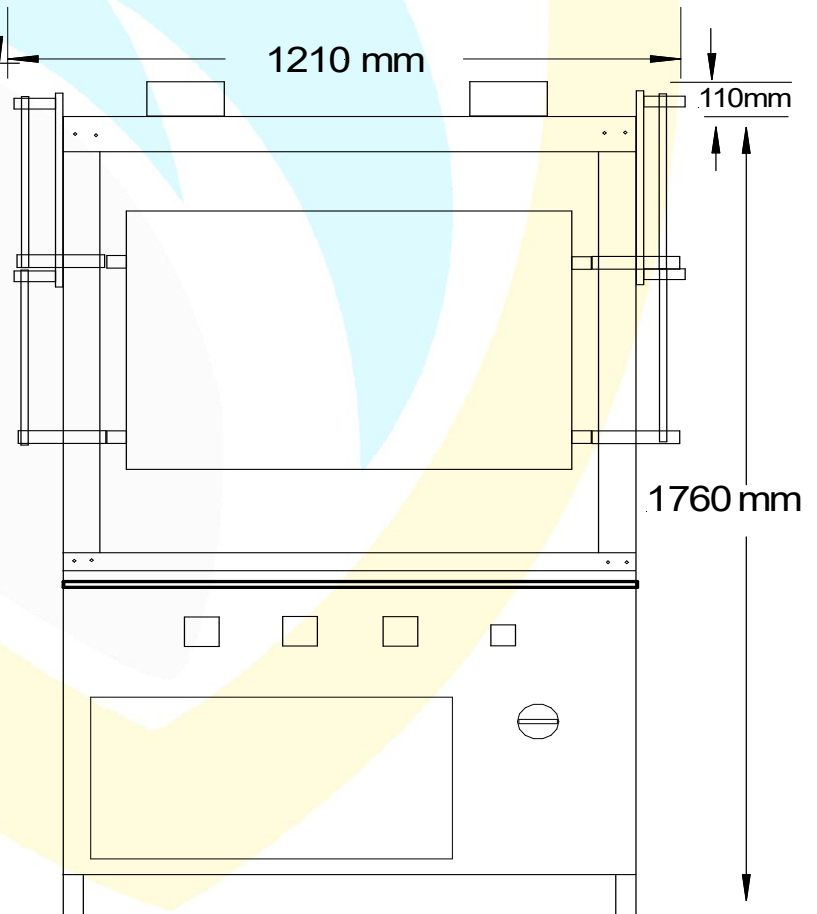
Construction

- Furnace body construction is durable 2mm laser-cut plate
- High quality refractory brick and insulation
- Pneumatic door controls with foot pedal.
- Optional port viewing window in door
- Door panel for easy access to transformer
- Furnace body can be separated from console section

Shipping

- ISPM 15 Heat treated export crates

Length	1410mm
Width	1490mm
Height	2080mm
Weight	970KG



Please note you will require a minimum of 1 metre clearance around the furnace.

* Dimensions are approximate only and may vary slightly with each furnace.

System Overview

System Overview:

This furnace has an easy to use main rotary on/off switch.

It is heated by 12 elements mounted in the side walls. It is ideally suited to continuous running as this will prolong the life of the elements.

Temperature is monitored and modulated automatically by a Type K thermocouple system and Omron temperature controller, pre-set for a maximum temperature of 1100 degrees Celsius. This controller is simple to operate, and has a 2-level display (PV and SV), that shows actual temperature as well as the temperature the furnace is set to.

The door has an Omron door switch installed that will automatically cut power to the heating elements when the door is opened.



Parts List for

Electric 100 Place Cupellation Furnace

Recommended 12 Months Consumables

FAS Part#	FAS Description	Qty
FAS-202	Muffle #5 to suit E100PCF & 100PCF	4
FAS-212	Vent Slotted #5 to suit E100PCF & 100PCF & 168PCF	5
FAS-302	Floor Tile 560x480x25mm to suit E100PCF & 100PCF & E20PFF	6
FAS-406	Thermocouple Cupellation 230mm plus 75mm bend	6
FAS-407	Thermocouple Inner Sheath 250x10mm	5
FAS-408	Thermocouple Outer Sheath 250x15mm	5
FAS-603	Ceramic Anchor, (Complete) 3"	18
FAS-803	Isowool Blanket (Kaowool) 160kg x 25mm	1
FAS-1008	Refractory Mortar 2 KG	2

Recommended Critical Spare Parts

FAS-209	Silica Carbide Heating Element 20x500x1000mm to suit E100PCF & E20PFF	12
FAS-416	Element Clip 20mm to suit E100PCF & E20PFF	12
FAS-417	Element Strap 25A 15m to suit E50PCF & E20PFF & E100PCF	12

Recommended Spare Parts

FAS Part#	FAS Description	Qty
FAS-145-DOOR	E100PCF Door, factory lined (No Hinges or pins)	1
FAS-411	Porcelain 2-way Element Connectors	1
FAS-421	Ammeter 0-50Amp 72x72mm	1
FAS-509	Door Switch, OMRON D4D-1121N	1
FAS-515A	Contactors ABB AF52-30-00-13	1
FAS-608	Thermocouple Wire	6
FAS-648R	Temperature Controller, Omron E5CC-RX2ASM-800	1
FAS-654	Air Hose, Double Insulated	4
FAS-657	Foot Pedal, Festo	1
FAS-801	Isowool Blanket (Kaowool) 128kg x 25mm	2

Associated Spare Parts

FAS-145-SHL	E100PCF New Body and Bricks
FAS-145-DHP	E100PCF Door and Hinge with Pneumatics
FAS-145-EXT	E100PCF Back Extraction Piece
FAS-145-BKT	E100PCF Refractory Reline Kit (no muffle/vent/tile)
FAS-214	15kva Transformer to suit E100PCF & E20PFF
FAS-216	Control Transformer
FAS-521	Main Rotary Switch P3-63
FAS-655	Pneumatic Cylinder
FAS-656	Pneumatic Cylinder set
FAS-658	Pneumatic Foot Kit (inc cylinders, foot pedal, mounting brackets and fittings)
FAS-659	Pneumatic Regulator
FAS-674	Plug in 6mm Air Fitting
FAS-801	Isowool Blanket (Kaowool) 128kg x 25mm
FAS-1004	Refractory Mortar 25kg Drum

For pictures, data sheets and more info on spare parts please go to products tab on our website <http://www.fandasupplies.com/products>

Installation Procedure

- *Unpack furnace from crate and store in dry area. The furnace usually has timber supports installed inside for transport. Remove before operation.**
- *Furnace requires a min of 1 metre space around it to carry out maintenance / repairs.**
- *Install fuel supply. This must be carried out by a qualified technical person.**
- *For door operation air is required to run the pneumatics. Connect air supply to the filter on the furnace.**
- *Electrical connection is 3 phase with Earth. Connection is made at the terminal strip inside electrical cabinet. Once connection is made, before turning on power, CHECK all other connections as they may have come loose during transport.**
- *BEFORE STARTING CHECK THAT ALL EXHAUST DUCTING IS IN PLACE.**

Installing Elements

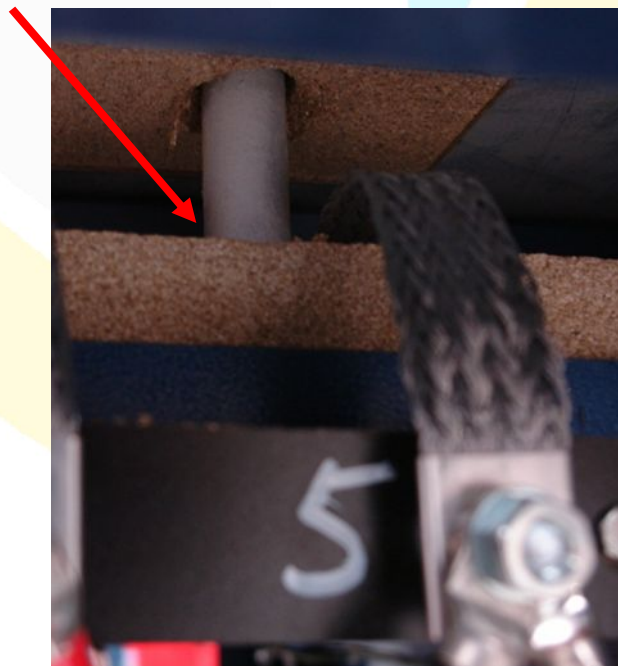
When installing elements be careful not to force any into position.

The elements are fragile, and if there is too much pressure on them or if they hit the floor of the furnace they may break.

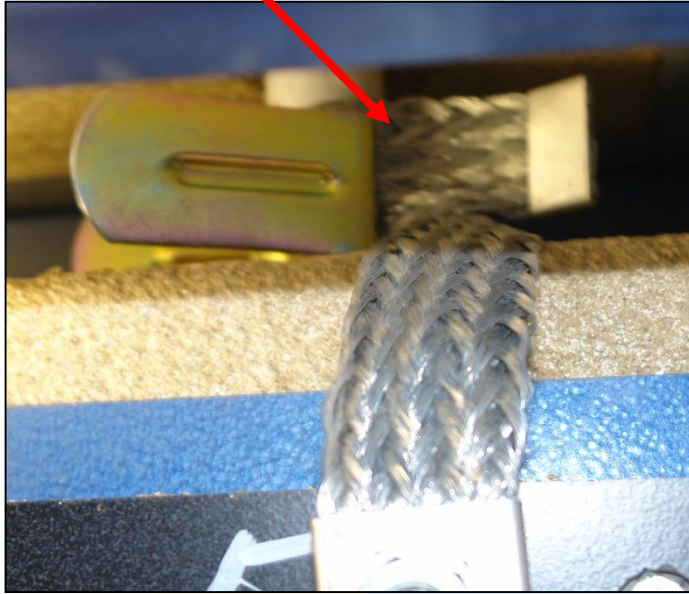
It is best to install the elements before the muffle chamber is in if possible, as then you can have two people to guide the elements through the bottom holes.



When installing, make sure that the elements sit flat on the element holder underneath the body.

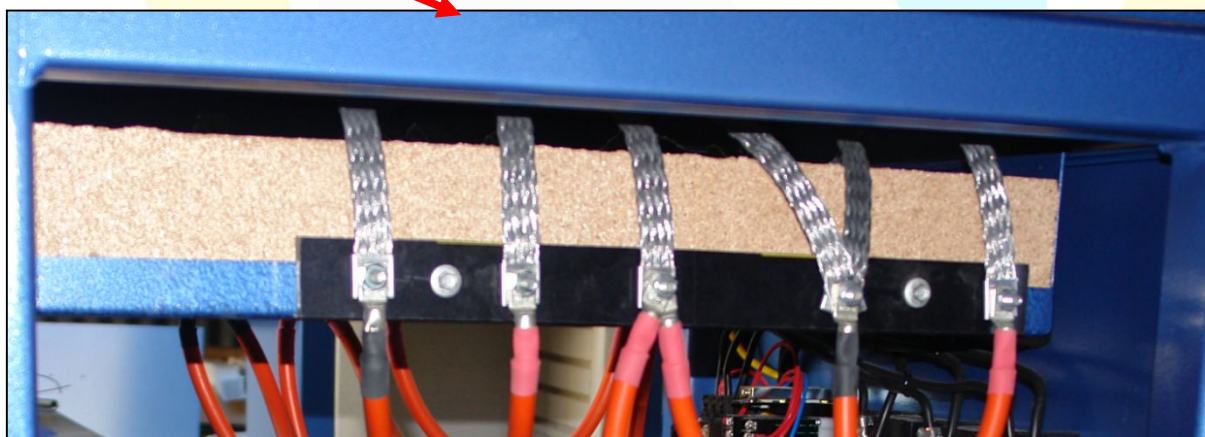


Once all the elements have been installed, wrap the element straps around the elements and secure with an Element Clip, making sure that you have a good connection. (Connection diagram on next page)



Check that none of the straps and clips are touching the frame or the top cover.

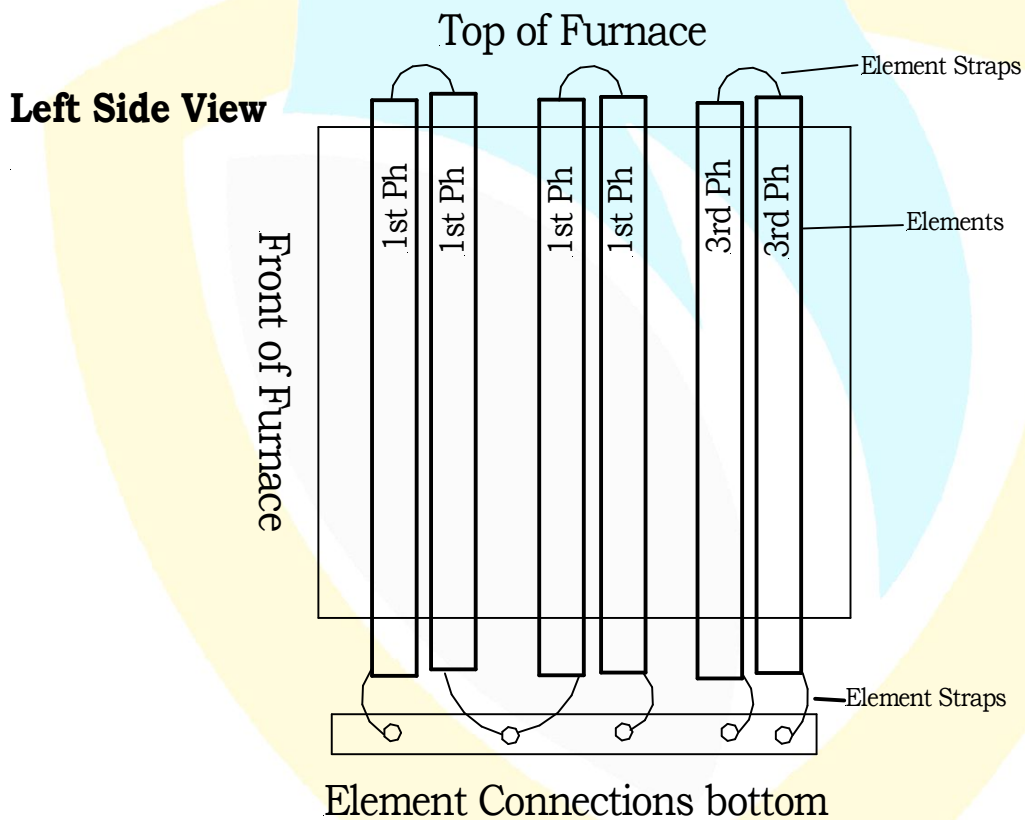
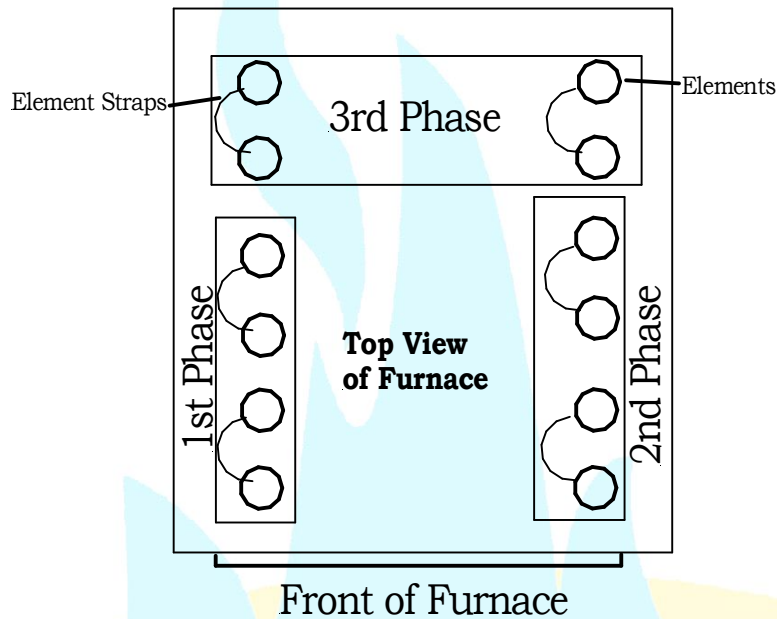
Element Clip



Check that all nuts holding the connections (straps) are tight.

Replace covers then install the muffle if not already installed.

Element Connections



NOTE:

Element connections are from front to back

First 4 elements are 1st or 2nd phase

(depending on the left or right side of the furnace)

and the rear 2 Elements are part of the 3rd phase (on both sides).

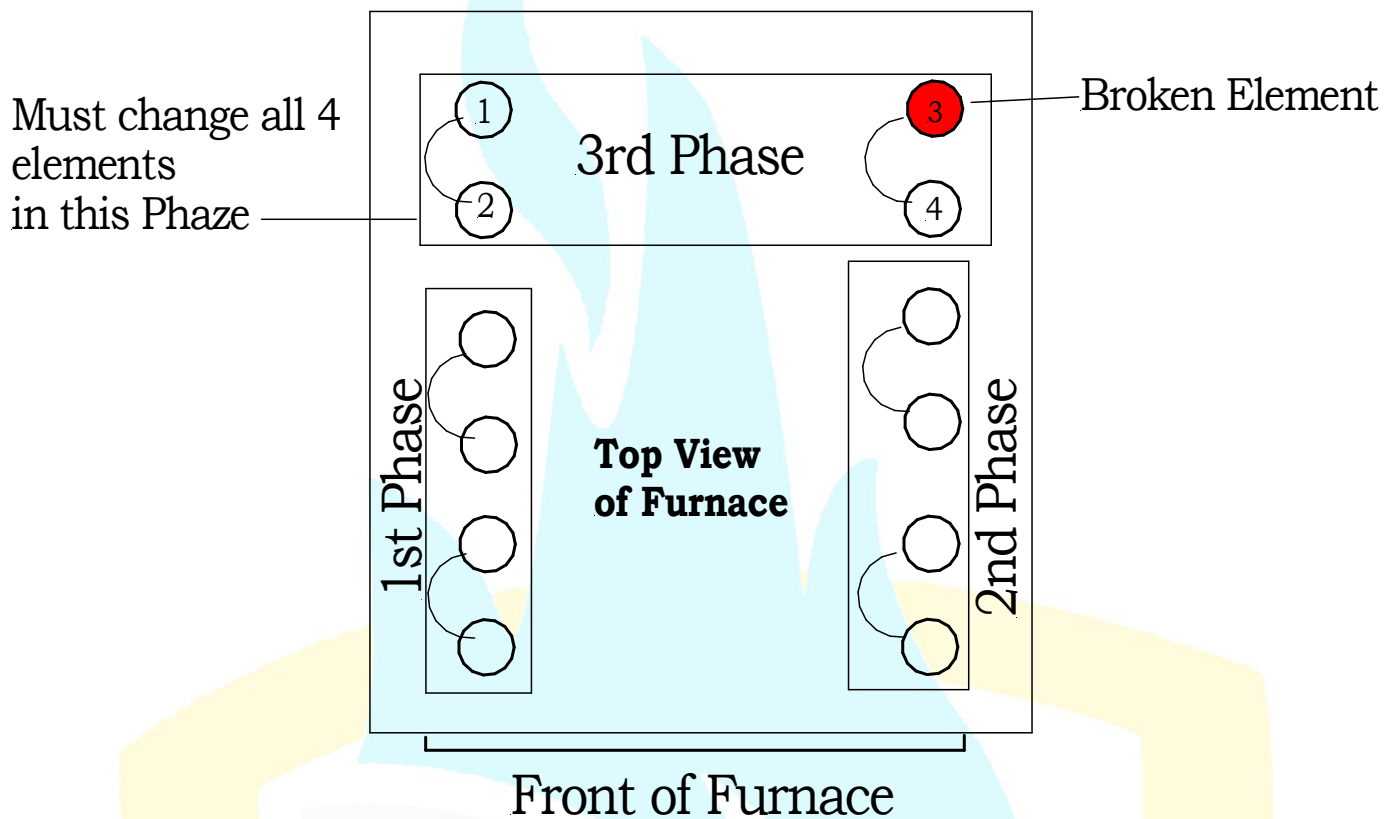
Things to Remember About Elements

It is ok to have each phase on different voltages so that you can balance the amps.

E.g. If one phase is only running at 5amps then you can increase the voltage to that phase to run the same as the other phases.



Also if an element breaks or it fails for some reason, you must change all elements in that phase and then reset the voltage tap back to the setting required for new elements.



If you only replace the one damaged element then you will rapidly reduce the life of that element as you will still require higher voltage to operate the other 3 elements left in that phase. When an element has failed in a phase, most labs replace all the elements and then keep the undamaged elements to one side in case another element is damaged later. They can then replace the older element into that phase without changing the voltage taps and thus save using new elements

SILICON CARBIDE ELEMENTS

Generally a heating element made of silicon carbide is gradually oxidised due to its application over long periods, increasing its electrical resistance; that is, aging results. This is due to the partial oxidation of SiC, which is formed into SiO₂, diminishing the electrical conductivity of SiC according to the reaction.



To prevent oxidation and to preclude an increase in electrical resistance, the surface is covered with a film coating, which, being stable without comparison, helps minimise aging and ensures a considerably longer life. When the electrical resistance has increased to about five times the incipient value, the service life of a heating element may be considered expired. In actual application its aging speed depends on the applicable temperature, watt density, operating type (continuous or intermittent), atmosphere in the furnace, and so on.

EFFECT OF APPLICABLE TEMPERATURE:

The aging speed on SiC varies considerably according to its applicable temperature; the higher the temperature, the quicker the aging speed.

If, however, the density of its surface load is diminished despite high temperatures inside the furnace, silicon carbide elements can be employed over a prolonged time.

EFFECT OF OPERATING TYPE: (CONTINUOUS OR INTERMITTENT)

Even when the furnace temperature and the watt density remain the same the effect on continuous operation of silicon carbide differs from that of intermittent operation (for instance, operations only during the day); that is, the latter type has harmful influence upon silicon carbide. This is considered

due to the fact that SiO₂ formed by the oxidisation of SiC experiences abnormal expansion and contraction at about 250 degrees C (the transformation point of cristobalite), the repetition of which imparts mechanical shocks to the inner structure of the heating element, producing tiny cracks.

INSTRUCTIONS ON REPLACING PROCEDURES:

When replacing the heating elements, replace all of the elements installed in the same regulating circuit. This will not only ensure there long service life, but will also prove more economical for the following reasons:

Partial replacement of heating elements in a parallel connection will overload the new elements, and that in a series connection will overload the old elements. This will not only disturb temperature distribution but also will impair the service life of the elements. Classify the removed elements according to their electrical resistance, and store them as spares.

BECAUSE SILICON CARBIDE ELEMENTS INCREASE IN RESISTANCE AS THEY AGE, THE POWER SUPPLY TO THE ELEMENTS IS SUPPLIED PER A MULTI-TAPPED TRANSFORMER. THE TAPPINGS ON THE TRANSFORMER FITTED TO THE FURNACE MAY START AS LOW AS 30 VOLTS AND GENERALLY ARE IN 5 TO 10 VOLT STEPS TO AS HIGH AS 150 VOLTS, WITH ONE TERMINAL MARKED COMMON OR TO" VOLTS.

TO INCREASE THE VOLTAGE SUPPLY TO THE ELEMENTS, MOVE ONLY THE CABLES ON THE VOLTAGE TAPS.

DO NOT MOVE THE CABLE MARKED ZERO V (COMMON) UNLESS THE TRANSFORMER IS FITTED WITH 0V + 5V TERMINALS, IN THIS CASE THE MAIN TAPS ARE AT 10 V INTERVALS AND IT IS POSSIBLE TO SPLIT EACH 10V TAP BY MOVING THE LEAD FROM THE 0V TAP TO THE + 5V TAP THEN BACK TO THE 0V TAP ON THE NEXT CHANGE UP ON THE MAIN TERMINALS AND SO ON.

INCREASE IN THE RESISTANCE OF THE ELEMENTS WILL BE EVIDENT BY A SLOWING *DOWN OF* THE RECOVERY TIME (HEAT UP) OF THE FURNACE. THIS IS ALSO INDICATED BY THE AMMETER/S.

THE MAXIMUM RECOMMENDED READING ON THE AMMETER/S FOR THIS FURNACE is 25 AMPS.

IT IS POSSIBLE THAT THIS READING MAY BE EXCEEDED BY 10% UPON STEPPING UP THE TRANSFORMER. THIS IS ACCEPTABLE BUT HIGHER READINGS WILL OVERLOAD THE ELEMENTS AND TRANSFORMER.

REPLACING ELEMENTS

SHOULD ONE OR MORE ELEMENTS FAIL PREMATURELY IT IS RECOMMENDED THAT THE COMPLETE SET IN THAT PHASE BE REPLACED.

THE AGED ELEMENTS CAN BE STORED AS SPARES AND GRADED BY THEIR ELECTRICAL RESISTANCE.

PARTIAL REPLACEMENT OF A SET OF ELEMENTS IS **NOT RECOMMENDED.**

ELEMENT LIFE.

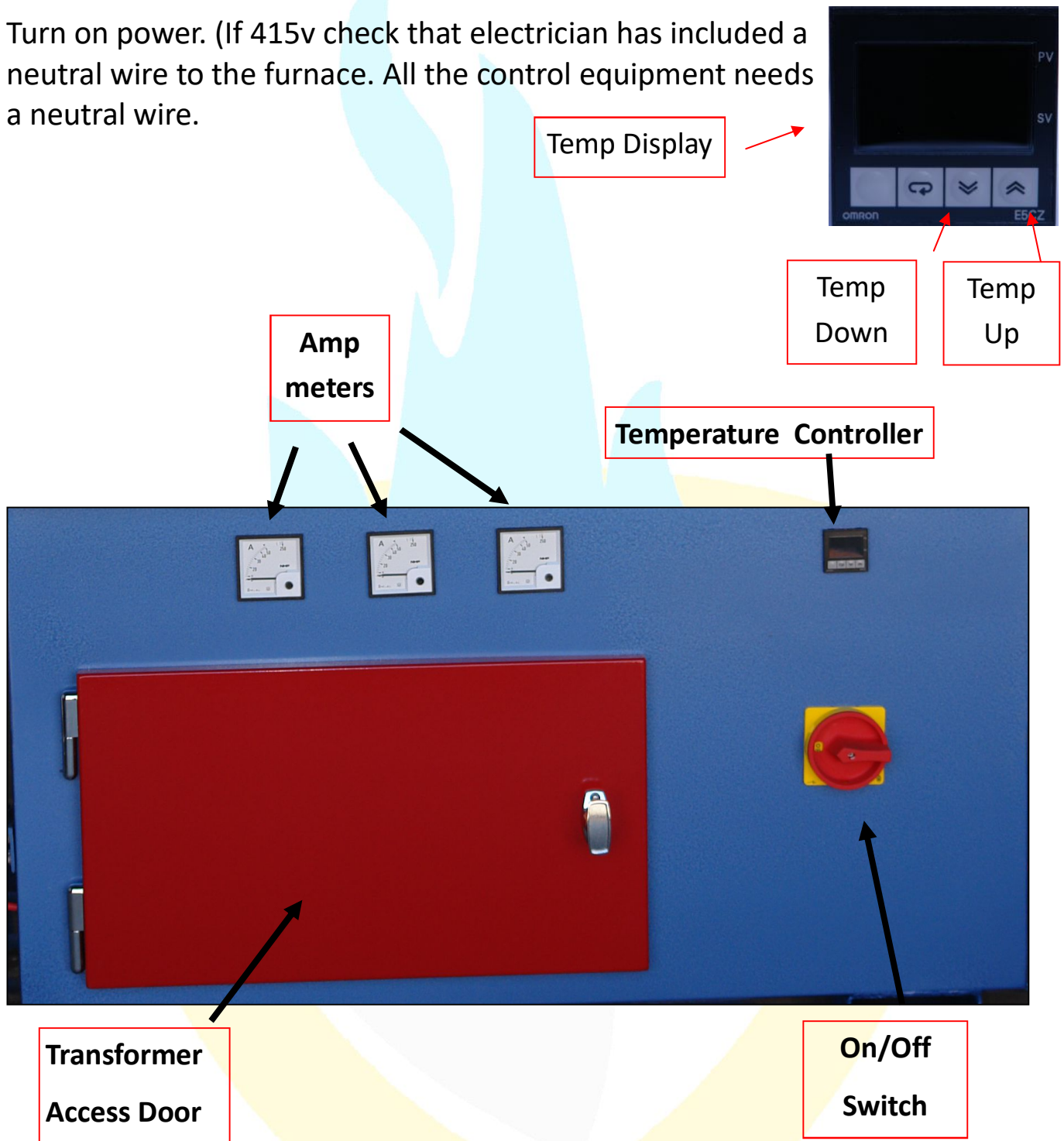
AS PREVIOUSLY STATED, THE LIFE EXPECTANCY OF SILICON CARBIDE ELEMENTS DEPENDS ON SEVERAL FACTORS.

BECAUSE OF THE RELATIVELY LOW OPERATING TEMPERATURE OF CUPELLATION FURNACES, THE INCREASE IN RESISTANCE OF THE ELEMENTS SHOULD REMAIN WITHIN 7 -10% PER 1000 HOURS OF OPERATION.

AFTER FITTING A, NEW SET OF ELEMENTS, GO BACK TO THE LOWEST TAP ON THE TRANSFORMER TO START.

STARTING UP FURNACE

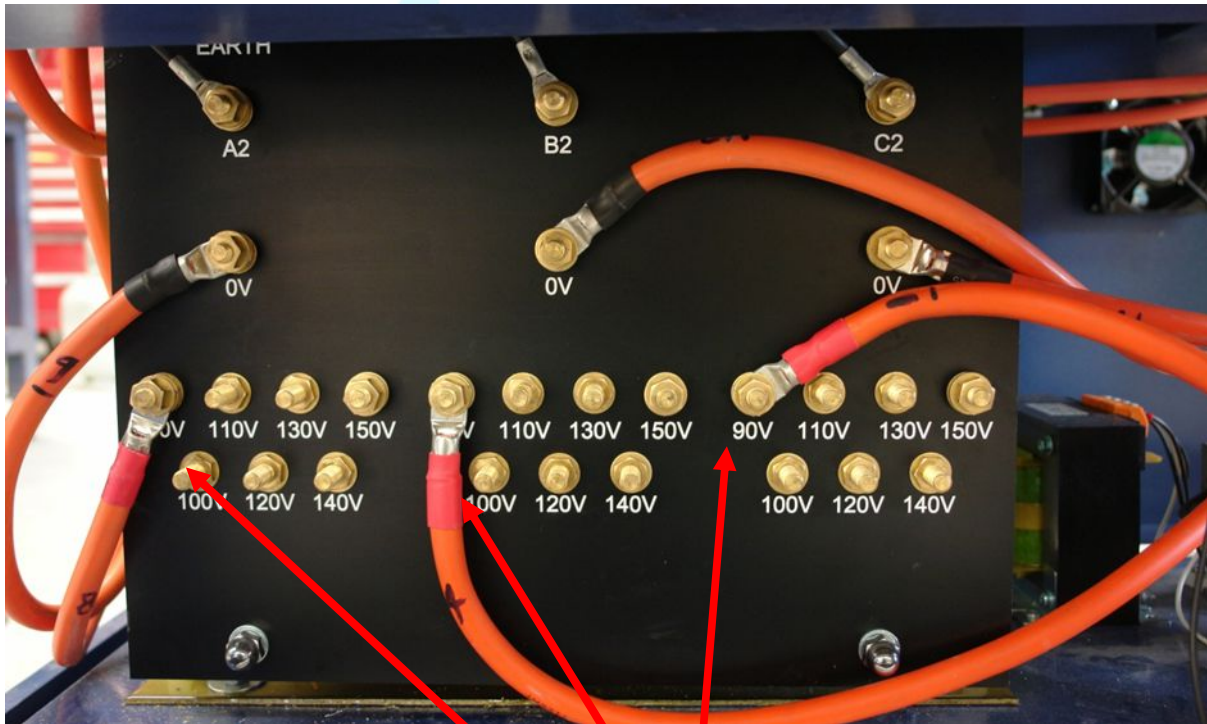
Turn on power. (If 415v check that electrician has included a neutral wire to the furnace. All the control equipment needs a neutral wire.)



As you look at the furnace you will see 3 amp meters. There is an Amp meter for each phase.

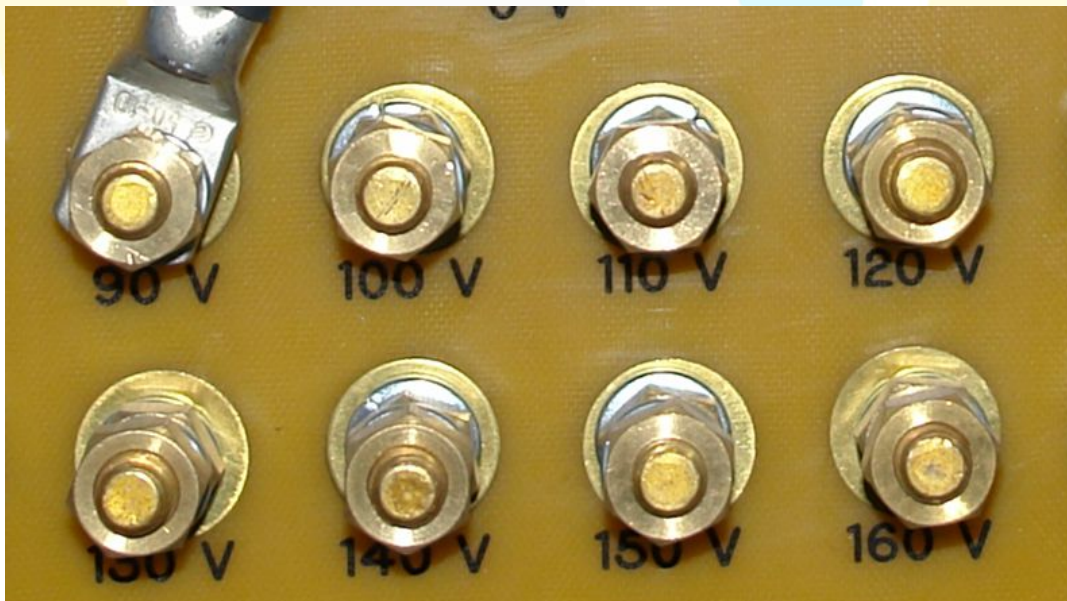
At start up the amps will slowly climb up to 30 amps (1/2 hour). If this does not happen after this time you will need to increase the voltage.

Isolate power then open the transformer access door.



Voltage Leads

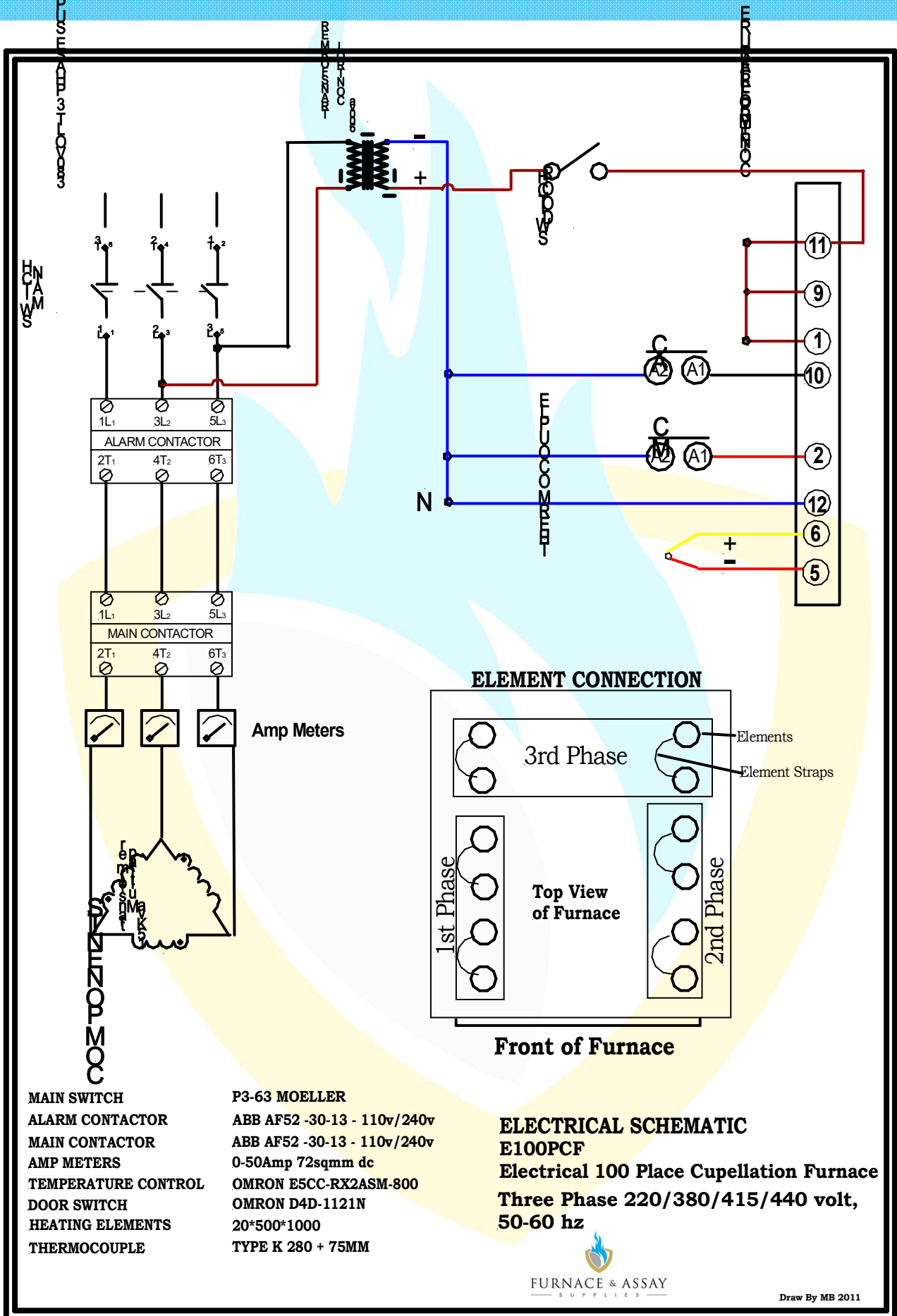
Move your voltage leads (only) to the next voltage setting.
You will see these clearly. 90v,100v etc.



Optimum amps for operating is 30amps for the fusion and 15 amps for the cupellation furnace.

Once you have done this then slowly warm up the furnace to cure the refractory.

Electrical Schematic



- MAIN SWITCH
- ALARM CONTACTOR
- MAIN CONTACTOR
- AMP METERS
- TEMPERATURE CONTROL
- DOOR SWITCH
- HEATING ELEMENTS
- THERMOCOUPLE

- P3-63 MOELLER
- ABB AF52 -30-13 - 110v/240v
- ABB AF52 -30-13 - 110v/240v
- 0-50Amp 72sqmm dc
- OMRON E5CC-RX2ASM-800
- OMRON D4D-1121N
- 20*500*1000
- TYPE K 280 + 75MM

ELECTRICAL SCHEMATIC E100PCF
Electrical 100 Place Cupellation Furnace
Three Phase 220/380/415/440 volt, 50-60 hz



FURNACE & ASSAY
SUPPLIES

Draw By MB 2011

New Muffle Start-Up From Cold Procedure

Regular maintenance is required to make sure furnace is running correctly.

When starting a furnace up with a new muffle installed or starting the furnace from cold you must do so slowly. This is to reduce any cracking in the cold muffle/Furnace.

FIRST TIME START UP

Once muffle is in place and rear vent has been installed into furnace:

For LPG, NG and Diesel Furnaces:

- Turn Furnace onto **low fire** for 15 mins, turn off for 15 mins, repeat for 1 hour with door open.
- Shut furnace door and start on **low fire**, run until reaches 500°C
- Hold 500°C for minimum of 1 hour.
- Increase temperature 100°C every hour up to normal running conditions. Keep a close eye on any cracks that may develop, this is indicated by moisture seeping through refractory. If you see this then maintain temperature until moisture clears.

Procedure For Electric Furnaces only- Set furnace to 500°C , once reached, increase 100°C every hour up to normal running conditions.

FURNACE START UP ONCE SHUT DOWN FOR 36+ HOURS

- Start furnace on **low fire** for a minimum of 2 hours.
- Set temperature to 500°C and run for another 1 hour.
- Set temperature to normal running conditions and muffle is ready for use

Maintenance

A good clean combustion chamber will allow the furnace to run efficiently.

To do this and to extend the life of your muffle and furnace, regularly check that muffle chamber has no cracks, if so then seal with some refractory cement.



Make sure a floor tile is always installed, with about 15mm of Bone Ash underneath it.

Regularly scrape and clean the floor tile. If there is build up on one side, flip the tile over to double its life. Change floor tile regularly.

It is very important to keep the rear vent clean.

If blocked Pb will stick to the walls of the chamber reducing the life of the Muffle. This also increases the density of the chamber.

The furnace will then need to use additional power to maintain temperature of the chamber and will have longer cupellation times. Your muffle chamber will also last longer if you keep everything clean.

To do this you will need a vent cleaning tool, or a piece of metal or jimmy bar to ream the vent out. Make sure the vent has been cleaned all the way through, not just at the front. You may need to shine a torch into the vent to see your progress.



Regularly change or clean the floor tile along with the bone ash for collection of spills.

Keep the floor areas around the furnace clean and free of dirt, as it will layer onto the transformer and control equipment.

This chokes the equipment, making it run hotter and it may over heat.

Remember a Muffle is a consumable item in a furnace. You must change a muffle out at least 2 – 3 times a year if looked after correctly. If little or no maintenance is done on a furnace, the chamber can last as little as 1 month. If the muffle is left unchanged, the brick work of the furnace will be eaten away. This will severely reduce the life of your furnace.



Failing to change Muffle/Vent when required.

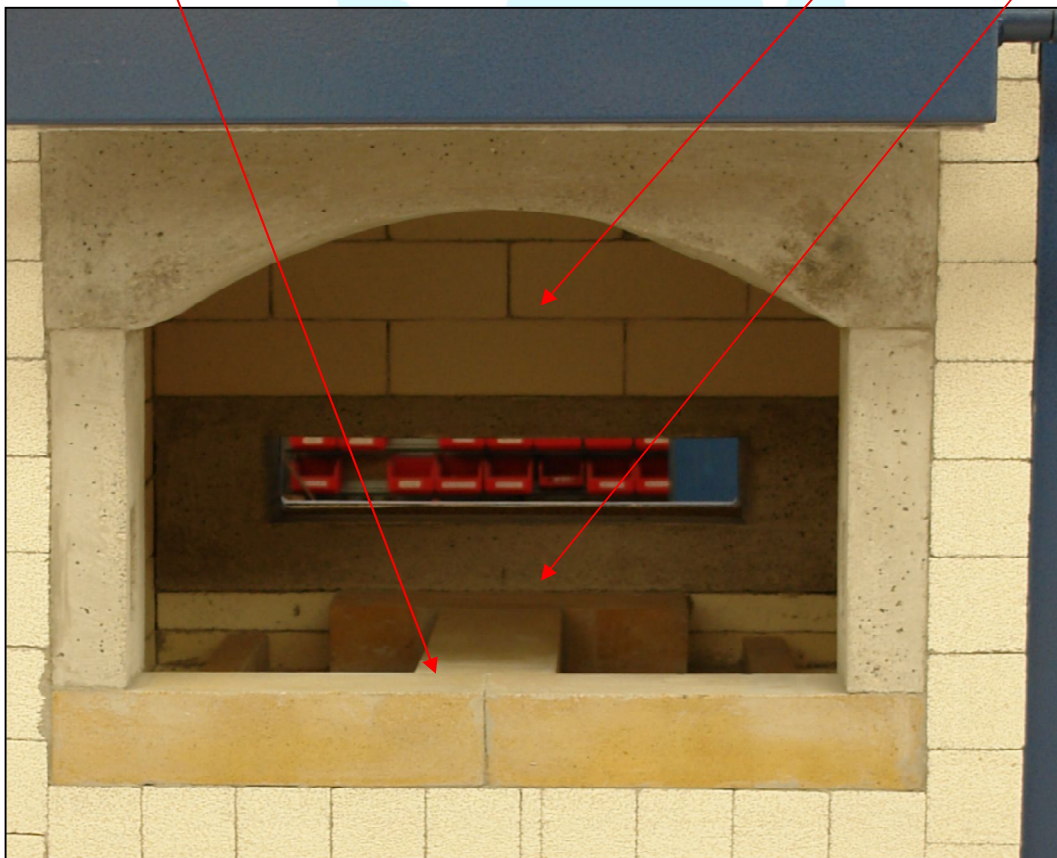
Note the damage to the brick work.

Installing Muffle Chamber

Remove Thermocouple and lead extraction.

If replacing a muffle remove old muffle and vent. Ensure that all debris is removed.

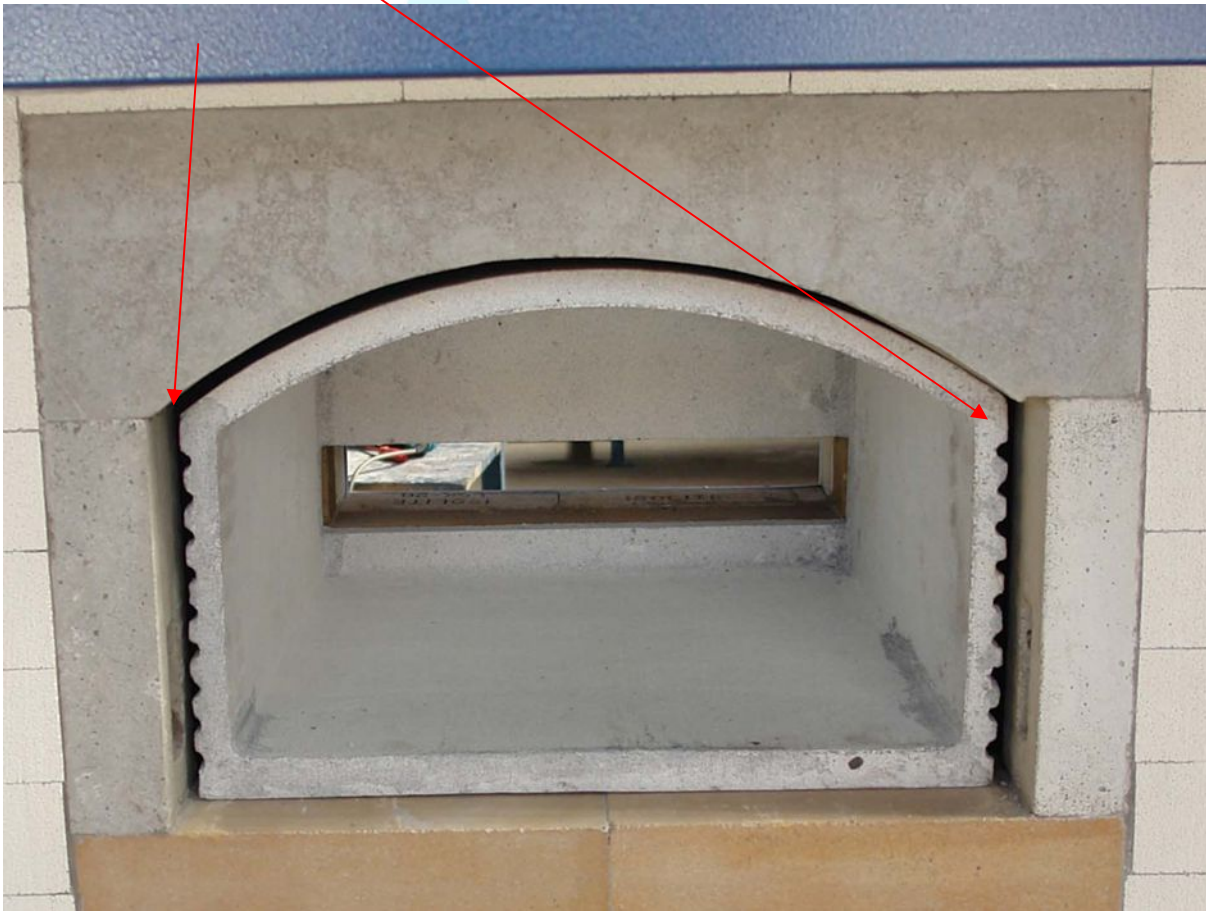
Before installing new muffle you must make sure that the back wall, back ledge and front ledge are clean and smooth.



Note: If the back wall, back ledge and front ledge are not cleaned properly, the muffle will not sit correctly, meaning the muffle will not work correctly, and will not last as long.

Depending on size of muffle, lift in by hand or place into position with forklift. (Put tynes together and pick up via roof of muffle)

Position new muffle in place by lining up the back vent, and trying to leave even gaps either side of the muffle



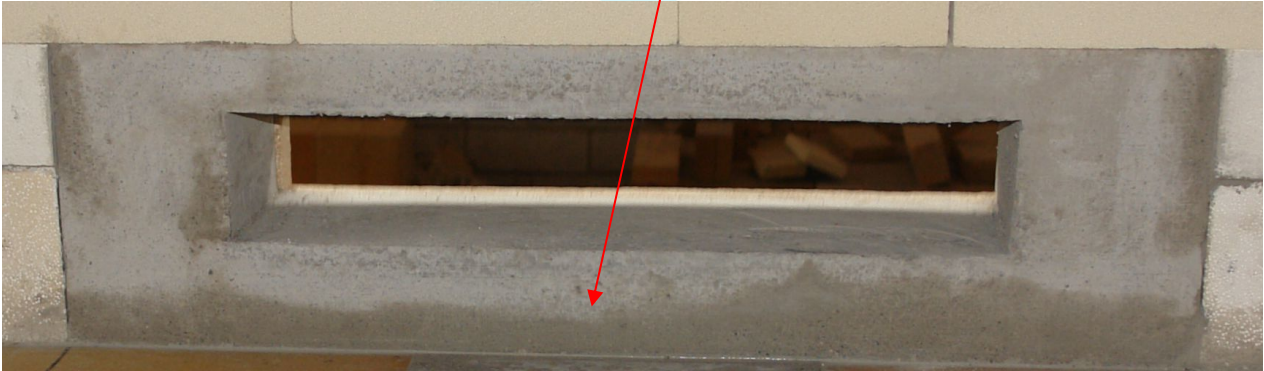
Once muffle is in position, cut lengths of 25mm Kaowool (20mm wide x length of roll) and stuff around muffle, Make sure it is a tight fit and do not leave any gaps. Once all kaowool is installed smear a thin layer of mortar over the kaowool and lip of muffle.

Make sure you do not cover the vent in the side bricks.



Installing Vent

Smear some refractory Mortar across the bottom of the back vent



Insert vent from the back and line up flush with the inside of muffle.

If need be fill any gaps around vent with kaowool and seal with mortar.



Re-install Thermocouple and Lead extractor.

Installing Floor Tiles

This method can apply to all fusion and cupel furnaces .

Reason: To stop the tile from sticking to the furnace or muffle floor so it can be easily removed when needs to be replaced.

If tile does not crack it is also possible to reuse the tile on the opposite side.

Each time you replace a tile you must scrape out the old mabor powder (or bone ash) and replace with new.

Mabor powder is used to soak up any spills you have during fusion or cupellation processes.

The following is a tile install for a Cupellation furnace.



Step 1
Shovel Mabor powder or similar product onto the floor



Step 2
Using a flat edge, flatten off so that powder is about 1/2" thick. Make sure the service is level from front to back.



Step 3
Place floor tile into position and settle down flat.





Step 4

Sprinkle a little powder on top of tiles ready for the first pour. If a spillage occurs then scrape out to the front of the furnace and sprinkle powder back on the floor.



By following this practice your tiles will last longer and the furnace will stay clean.

Summary

A good clean combustion chamber will allow the furnace to run efficiently.

To do this and to extend the life of your muffle and your furnace, regularly check that muffle chamber has no cracks, if so then seal with some refractory cement.



Make sure a floor tile is always installed, with about 15mm of Bone Ash underneath it.

Keep the back Vent clean and clear, and change it when needed.

Regularly scrape and clean the floor tile. If there is build up on one side, flip the tile over to double its life. Change floor tile regularly.

Regular maintenance is required to make sure furnace is running correctly.

Maintain Door ceramic blanket. If in poor condition change.



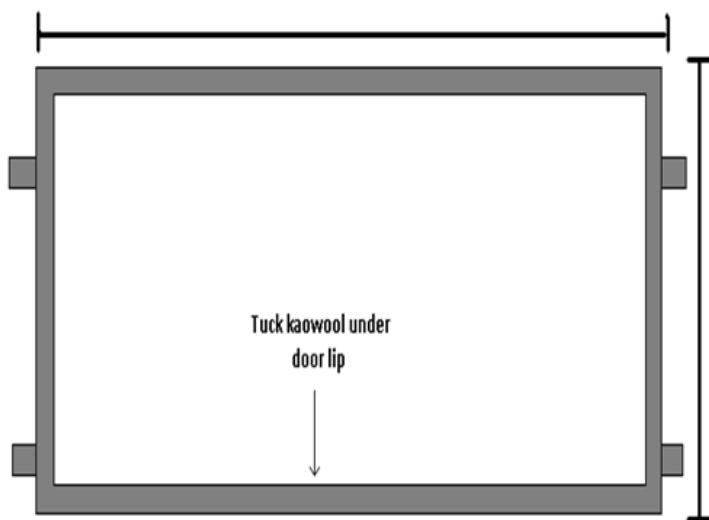
Door Repacking



First, second and third layer

Cut 3 x 25mm Kaowool wide (or 1x50mm & 1 x 25mm) wide

and fill the inside of the door, making sure all 3 layers are tucked under the door's lips.



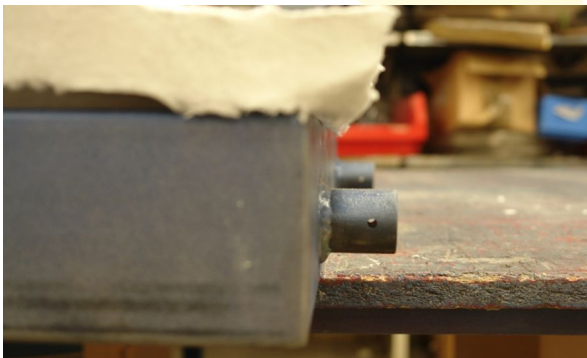
Fourth Layer

Cut 25mm Kaowool so it fits on the inside lip of the door

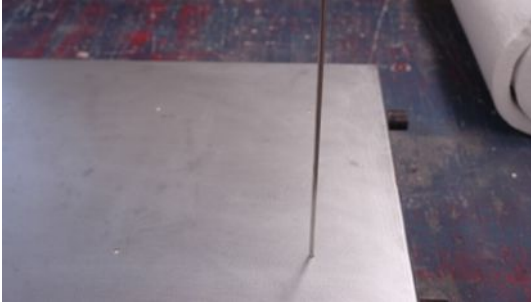


Final layer

Cut 25mm Kaowool to the length of the door plus 40mm (width = roll width) and place so that a 20mm overhang of kaowool is present on the edges shown.



- Using a guide like a screw driver, push up through the existing anchor holes in the door's body, keeping the guide straight until it comes through top layer of kaowool. Once guide is through wiggle around to make a slightly bigger hole.



- Place a screwdriver through the hole (kaowool side up) then the cutter over the screwdriver (a piece of pipe with a circumference of about 25mm by 100mm long with a mark about 50mm up). Keeping the cutter at 90 deg, cut down to marked line in cutter (50mm) and pull out. Knock out kaowool stuck in cutter.



Once cutter is pulled out there is a hole big enough to place anchor through.



6. Screw anchors into holes cut out by cutter in kaowool until the bolts come through the pre drilled anchor holes in the door's body. Once bolt is through secure with a wing nut.



7. Once all anchors have been installed, use a straight edged, flat piece of wood and a sharp knife to cut off overhanging kaowool. Make sure the straight edge is lined up flush with the outer lip of furnace door top and bottom. Push straight edge down firmly and cut off excess kaowool.



Contact Details



FURNACE & ASSAY

— S U P P L I E S —

54 Owen Road,
Kelmscott, 6111
Western Australia, Australia

Phone

+61 8 9399 9299

Fax

+61 8 9399 9288

Email

Info@fandasupplies.com

Web

www.fandasupplies.com