



FIRED UP KILNS

and pottery supplies



Owner's Manual

Industry Range

Last Updated: Feb 2024

Congratulations and thank you for purchasing a Fired Up Kiln.

Our kilns are built from the highest quality materials by expert craftsmen to ensure you have many years of trouble-free operation. This range of kilns, manufactured in Cape Town, South Africa, guarantees you safe and enjoyable use for many years.

Read this manual carefully before installing and using your kiln. In this manual, you will find instructions on how to install and use the kiln. This manual also provides instructions on how to safely install your kiln in its proper space or studio, as well as instructions for the safe use of your kiln.

If you have any questions after reading this manual, please contact us.

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Special Notes



Please take special note of the following:

- Read this manual and the controller manual **before operating your kiln**.
- **Contact us** if you have any questions or queries. We are always happy to help.
- **Do not exceed 1300°C** in your kiln. Doing so will lead to severe damage not covered under warranty. To extend element life, avoid exceeding 1260°C.
- Never alter or interfere with your kiln's **electrical connections**, there is the risk of electrocution.
- Be careful when working near an operating kiln as the **external casing temperature can cause injury**.
- **Never** leave a firing kiln unattended, there are multiple uncontrollable factors that can cause a kiln to overfire, your vigilance is the only reliable prevention.
- **Use pyrometric cones**, they provide invaluable information, particularly when glaze firing.
- **Don't let ware touch the thermocouple** as this can lead to disastrous over firing.
- Gaps between bricks, hairline cracks and browning are **normal signs** in a kiln due to repeated expansion & contraction, they are cosmetic and do not impact on function.
- **Treat your kiln with care** and make sure element channels are clear of debris before firing. Using a vacuum cleaner is best to avoid touching the elements.
- **Have fun and enjoy** using your kiln safely and creating wonderful pieces of art.

1. Locating your kiln

The location of your kiln is important and there are certain precautions that must be observed when choosing a suitable position for your kiln. Accessibility and safety are primary considerations.

- a. Select a dry, well-ventilated area that has good access to allow for easy loading and unloading. Ensure that the kiln is placed on a flat, solid surface that allows air circulation beneath and around the kiln.
- b. Ensure there is 400mm of clearance around the sides of the kiln and at least 1000mm of clearance above the kiln.
- c. Position the kiln with spy-holes visible and the controller within easy reach. If the controller is mounted onto the side of the kiln ensure easy access.
- d. Ensure all combustible and flammable materials such as curtains, plastic, paper etc. are well removed from the kiln. Do not rest anything against the kiln or place objects under or on top of the kiln.
- e. Keep children well away from the kiln.
- f. If you are positioning your kilns in an outdoor area, such as verandah, outdoor shed or carport, ensure it is shielded at all times from rain. A heavy duty BBQ cover placed over the kiln when not in use is a good idea. It is vital that the kiln not be exposed to water. This will damage the electrics, leading to an electrocution risk and can lead to brick damage, as the kiln bricks will absorb moisture and crack on firing.
- g. As the bricks are hydrophilic (absorb moisture) it is a good idea if you are not using your kiln for prolonged periods to fire it to 200c and soak it for 2 hours every 2-3 weeks to ensure any moisture that has built up over time is driven off.

2. Health and Safety

Kilns use a considerable amount of current and generate significant heat when operating. As a result, please ensure you operate your kiln with due care and attention.

- a. Always use appropriate protective clothing when operating or working with heat and near the kiln. The outside of the kiln will be hot when the kiln is operating so treat the kiln with caution. Avoid looking into the kiln without protective eyewear when the temperature exceeds 1000°C and NEVER put your hand or face within 500mm of either the vent or spy-hole when the kiln is operating.
- b. Your kiln uses high voltage and the control box has been labelled with a warning notice to advise you of this. Only suitably qualified electricians should access the control box.
- c. Please ensure you read both this manual and the Controller manual before operating the kiln. Please contact us if you have any questions or queries.

- d. Do not attempt any repair work on the kiln.
- e. It is essential that you don't leave a kiln that is operating unattended. Any equipment has the potential to malfunction or be affected by power surges etc. The operator is responsible for monitoring, adjusting and maintaining the kiln and controls. A malfunction that is undetected can result in overfiring, causing extensive damage to your kiln.
- f. If your kiln has been fitted with an overtemperature controller, this is designed to protect the kiln from contactor failure or control relay failure. Normally the set value of the overtemperature controller is 5 – 10 deg above the temperature you are firing too. There is no protection from over firing if the thermocouples are left out of the kiln or partially removed (i.e. the tip is hidden in the refractory).
- g. Your warranty **does not** cover the effects of overfiring regardless of the cause.
- h. All of our kilns are fitted with an automatic safety cut off switch. The switch works by shutting off power to the elements if the door is opened, in order to prevent potential electrical shocks when the kiln is opened whilst the power is on. **NEVER** attempt to bypass this switch. We recommend that you only open the door when you have isolated power to the kiln, by either removing the plug from the power point or ensuring that your isolator switch is in the OFF position and the kiln circuit is placed in the OFF position at the mains.

3. Electrical Connections

The following electrical considerations apply to our kilns;

- a. Ensure that all electrical connections are performed by a qualified electrician. **NEVER** attempt to perform this yourself. There is a considerable risk of electrocution. It is critically important that your kiln is connected to power in full compliance with all your local electrical regulations.
- b. **NEVER** attempt to alter the kiln wiring, electrical circuits or controller wiring. Doing so will void the warranty.

4. The Firing Chamber

The interior of your kiln is constructed using Morgan K23 light insulating firebricks. They have been selected for their quality as well as their excellent insulating properties. They are a very porous brick, filled with many air pockets. It is these numerous air pockets that make the bricks light and allow for their excellent insulating capabilities.

- a. Kiln bricks are fragile in nature and should be handled with great care.
 - i. After a few firings you may notice hairline cracks in some of the bricks. These are simply expansion cracks and in no way effect the functioning of the kiln.
 - ii. We use pins (rather than mortar) in construction to prevent brick fracture, pins allow for brick expansion and movement during firing and helps prevent large brick fractures. When cool, you may notice small gaps (2mm) between bricks, this is normal and does not effect function.
 - iii. Every time you fire your kiln it will expand by approx. 1 -2 %, therefore some movement of the bricks is inevitable during this 'kiln breathing'.
- b. It is important that you take care when loading and unloading your kiln so as not to bump the bricks with kiln furniture. **Always** close the kiln door gently.
- c. Our front load kilns are fitted with a 13mm ceramic fibre door seal. The ceramic fibre seal is held in place with refractory cement. Avoid over tightening the adjustable door latch to tighten/loosen the door seal. In time the fibre will compress or become damaged. It can be replaced by a competent handy man by removing the old fibre with a putty knife and preparing a new fibre seal from fresh 13mm B128 fibrefrax. Apply refractory cement to the fibre and the exposed door bricks then close the door to allow the cement to set.
- d. **NEVER** open the kiln when the interior temperature is greater than 200°C. Doing so may cause thermal shock to the bricks and shearing of the surface as well as injury to you. Our kilns **ARE NOT** suitable for raku
- e. Kiln bricks expand roughly 5 mm per metre at 1000C, this creates stress which is released through the lining cracking along bonded seams. This is normal.
- f. The roof of the kiln has been covered with a vermiculite mélange to allow the refractories to breath as the sides are clad with 316 stainless steel. The movement of the refractories often cause cracks in the vermiculite mélange, this is normal

5. Elements

Your kiln is fitted with high quality Kanthal A1 (or equivalent) elements. These elements are fitted into element grooves in the bricks and pinned in place to prevent contraction, collapse and intrusion into the firing chamber.

- a. Over time kiln elements become brittle, as a result they can fracture if knocked whilst packing/unpacking the kiln.
- b. When you first turn the kiln on, you may notice a "hum" for a short time. This is normal as the elements begin to heat up.

- c. Element lifespan is directly related to the temperature that you are firing to. The higher the firing temperature, and the length of your final soak time will shorten the lifespan of the elements. You may expect 350 firings from a set of elements to 1050°C but only 100 firings when firing to 1280°C. Our kilns have an absolute maximum firing temperature of 1300°C, however we advise NEVER exceeding 1280°C to maximise element lifespan.
- d. The manufacturer of Kanthal A1 provide the following as a guide to illustrate the effects of operating temperature;

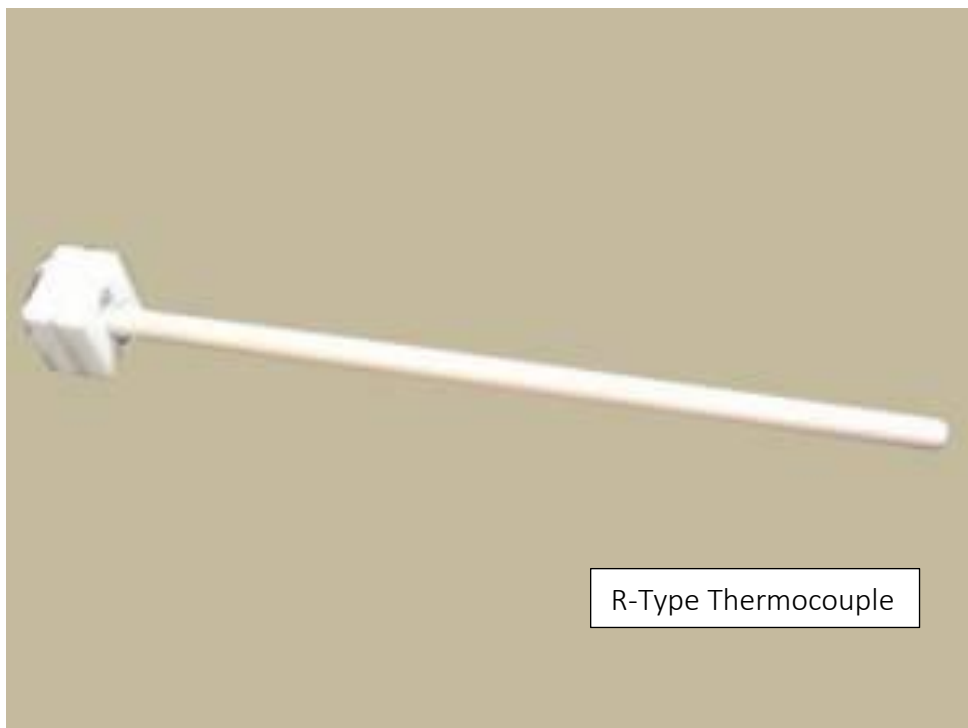
Element Temperature °C	Kiln Temperature°C	Proportional Life %
1150	1120	100
1200	1170	46
1260	1230	22
1315	1285	12

- e. Element lifespan is shortened considerably if the metal element comes into contact with glass, clay, glaze or kiln wash. As such always place ware 40mm from the elements and ensure that all element channels are vacuumed out prior to each firing. Use a soft vacuum attachment when vacuuming inside the kiln to prevent damage to the firebrick. Avoid touching the elements with the vacuum head as cold elements are very brittle and can break easily.
- f. If your kiln is failing to reach temperature, it is likely that you have either a failed or compromised element.
- g. We strongly advise not to do reduction firing in an electric kiln.
- h. With continued use you will find that the elements will start to move in their channels. Sometimes they may pop out of the element channels. It is important not to attempt to replace them without first heating the element material to at least 350c-400c. Attempting to replace a cold element will cause it to break as they become very brittle with age. By heating the element, it will become pliable and may be replaced and repinned back in its groove.
- i. The elements in a new kiln (and replacement elements) need to be oxidized. The process of oxidation provides a protective layer on the surface of the element, shielding the element from the corrosive fumes that are generated during a firing. This happens when a kiln is rapidly fired to 1100C and held there for 3 hours with the bungs and vents open. Oxygen from the air that is allowed to flow through the kiln feed the oxidation process. During the life of the element it continues to feed the oxide layer until there is insufficient alumina left, at which point the element starts to consume its iron and turns red, this causes an increase in resistance and a drop in power.
- j. Its time to change your elements when they turn red, collapse, bunch up in the groove, show signs of pitting, or your firings are progressively slowing down due to a loss of power in the elements
- k. We carry replacement elements for all of our kilns, which can be replaced by a registered electrician or kiln technician.

6. Thermocouple

The thermocouple measures the temperature in the kiln and feeds this information to the controller thus allowing it to manage the selected firing program.

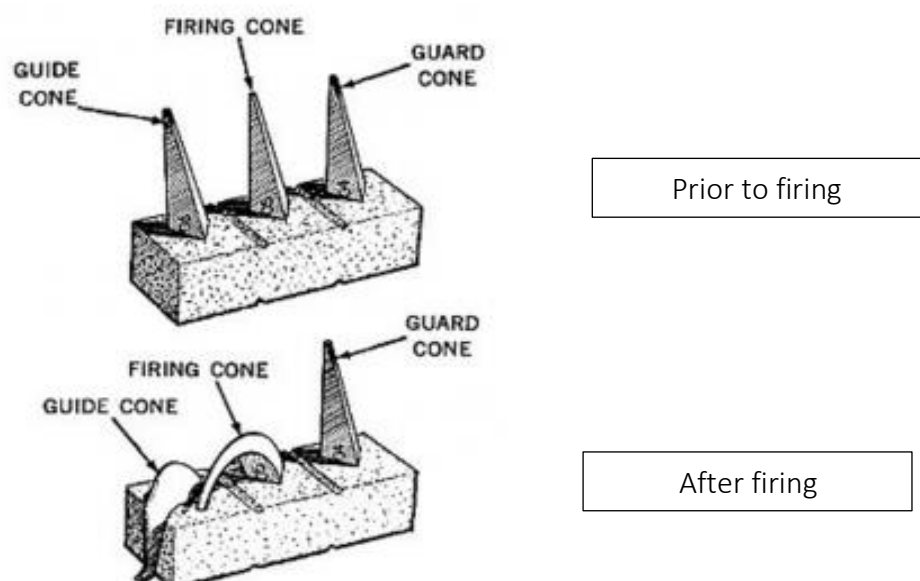
- a. Your kiln is fitted with an R-type thermocouple. R-type thermocouples are suited to continual high temperature use and should not require replacing unless broken by impact with kiln shelves etc..
- b. A thermocouple consists of two different metal wires – platinum & rhodium in the case of R-type. These metal wires are joined at the end to form a junction that is located in the kiln. The voltage different between the two metals is measured and converted to a temperature reading on your controller. These wires are usually shielded in a complete sheath in the case of R-type. A thermocouple will only sense the temperature in the **immediate vicinity** of the junction.
- c. In order to read the temperature in the kiln accurately, it is important that the thermocouple protrudes about 30-40mm into the kiln chamber. **Be careful** when loading the kiln that you do not push the thermocouple into the kiln wall or place any ware within 30mm of the thermocouple. This will lead to the controller registering a lower temperature than the actual kiln temperature and can lead to over-firing that can damage the kiln beyond repair.
- d. Important to note the red wire in the compensating cable has to be connected to the negative terminal of the controller and thermocouple.



7. Pyrometric Cones

Thermocouples measure temperature only, and they do so only in the immediate vicinity of the junction. Pyrometric cones measure “heat work” – this is a measure of time and temperature.

- a. Cones consist of a mixture of carefully controlled ceramic materials that are designed to give a graduated scale of fusing temperatures. The most commonly available cones are manufactured by the Orton company, and they provide a chart that provides the fusing temperature with a corresponding cone number. See page 18 for the chart.
- b. Cones are mounted either in a specific refractory cone holder or alternatively embedded in a wad of clay, with each cone placed to the same depth and at an angle of 15° to the vertical. This is assisted by a slant on the base of the cone.
- c. A series of three cones is standard, the cone placed on the far left indicates 20°C below the required temperature, the middle cone indicates the required temperature and the cone to the right indicates a temperature 20°C above the required temperature. The collapse of the first cone serves as a warning that the required temperature is being reached, whilst the second cone collapse indicates the correct temperature. The third cone, or “guard” cone should remain upright as it serves to warn of potential over firing. The fusion point of any cone is indicated when the tip of the cone touches the base on which the cone is mounted.
- d. It is a good idea to place cones in a number of locations in your kiln so you can get a feel for the hot and cold spots. This is more important in larger kilns. Its important to position a cone within a 10cm radius of the tip of the probe, this will inform you if the controller behaved normally. We recommend that you do this with every glaze firing to help to identify the source of any problems (i.e. the cone looks normal, therefore it must be a glaze or clay related matter).
- e. Every kiln is different, and it may take some time to learn the idiosyncrasies of your kiln!



8. Kiln Controller

Please refer to the attached controller manual, care is taken to select a controller which offers flexibility, accuracy and the easy management of the firing process of your kiln.

- a. If your kiln is stored outdoors (veranda, carport, balcony etc.) we recommend removing the controller when the kiln is not in use and storing it indoors to prevent moisture ingress and short circuiting of the board. Where the controller is permanently mounted to the side of the kiln, cover it with a water and dust proof cover.

9. Loading your kiln

Generally, kilns will fire more evenly when they are packed well and a full load is fired. It is advisable to ensure your kiln is loaded evenly both across the width/depth and height of the kiln.

- a. Always ensure that your kiln is switched off at the isolator switch or unplugged whilst loading or unloading.
- b. Make sure that all element channels are clear of any debris and have been vacuumed out. Take adequate precautions when vacuuming, be gentle and don't knock the elements and always wear a mask.
- c. Check that your kiln shelves and props are sound and have no cracks that can cause them to collapse in the firing. Be sure the shelf bottoms are clean to prevent dust or dirt falling onto the ware below.
- d. If large flat pieces are being fired, the edges should be placed between the elements. This may eliminate possible cracking caused by uneven heating.
- e. Place the shelves in the kiln carefully so that the walls of the kiln are not bumped or damaged. Use 3 props per level, as this is the most stable configuration.
- f. **Ensure all ware and furniture is completely dry.** If they are wet, then as they heat up steam forming can lead to explosion of items.
- g. It is advisable to put a shelf on the floor of your kiln before placing your props in the kiln, especially if you are packing to capacity as this will protect the soft insulation bricks on the floor of your kiln. In addition, it protects the floor of the kiln from possible glaze spills.
- h. Do not jar or shake the kiln after loading has started since your products on the shelf could be knocked down or the shelves may collapse..
- i. Keep shelves and wares at least 30mm from the thermocouple probe in the kiln and 30 mm from the wall of the kiln.

WARNING: CONTACT BETWEEN WARE AND THE THERMOCOUPLE CAN CAUSE DISASTEROUS OVERFIRING.

- j. Avoid positioning your shelves in line with the elements, as this can increase the risk of thermal shock and the referred heat from the edge of the shelf back onto the elements may damage them.

- k. NEVER attempt to unload your fired items until the kiln is cool enough (below 100°C), as serious burns could result.



10. Loading and Firing Bisque ware (920°C - 1060°C)

When firing your bisque ware it is essential that all items are “bone” dry. If they are not, then as the kiln heats up and moisture in the ware converts to steam you may experience explosion of your ware. If your ware feels cool then it is probably damp. To minimize damage to greenware, it is best to use a temperature rise of no more than 60°C/hr over the first 2 hours of the firing to allow any moisture to escape gradually. For very thick or large pieces it may be worth doing a drying out firing at 40°C for 12 hours. The rule of thumb is ‘bigger & thick go low & slow’.

- a. Generally when packing "greenware" in your kiln, items can touch each other and items can be packed inside one another.
- b. It is best to fire a piece in its natural position, however, large flat items such as wall plaques or clocks should be fired on a flat side to prevent warpage.
- c. Thin cups may be fired upside down or stacked lip to lip, if the rim is strong enough.
- d. Cannisters and other pieces with lids should be fired with the lids in place to ensure a good fit.
- e. Always leave your kiln bungs out until you have reached a temperature of 250°C-300°C. This will allow all the moisture to escape from the kiln. They can be replaced for the rest of the firing.

11. Loading and firing Earthenware (1040°C - 1080°C)

- a. Do not load families of red, green, yellow or yellow-green glazes or any metallic or luster glazes with greenware. Allow a minimum of 50mm of space around red glaze pieces.
- b. If it is necessary to mix loads, always try to place the red glaze separately on a shelf below the items which it may contaminate.
- c. Glazed pieces must not touch or they will stick together. At least 15mm should be allowed between glazed pieces to prevent contamination from the release of bubbles and gases from other glazes.
- d. The tops of the shelves should have batt wash applied to protect against drops or runs of glaze. The kiln roof and the underside of the shelves should be clean to prevent dust particles from falling on the glazed ware.
- e. Glazed ware must be stilted (earthenware) or dry footed to prevent sticking to the shelves. For low fire glazes (cone 04,05,06) stiling is recommended.
- f. If a piece wobbles when stilted, it may fall during the firing, be sure all stilted pieces are solid.

- g. It is a good idea to soak the kiln at temperature for 30 min to allow the temperature to even up throughout the kiln.
- h. Orton cones provide invaluable information about “heat work” that cannot be provided by a controller and so we would always recommend doing a glaze firing with the guidance of cones.

12. Loading and firing Mid-fire – Stoneware (1220°C - 1280°C)

- a. Stoneware cannot be placed on stilts as the item is likely to slump at higher temperatures.
- b. For glaze firing, the top of the shelves must be coated with kiln wash and the ware should be dry footed (this involves removing all unfired glaze from the foot of the piece as well as a reasonable margin above the foot to prevent glaze running onto a shelf).
- c. Orton cones provide invaluable information about “heat work” that cannot be provided by a controller and so we would always recommend doing a glaze firing with the guidance of cones.

13. Cooling the kiln

As a result of the insulating materials used in your kiln it may seem to take a considerable amount of time to cool sufficiently. Care should be taken when cooling any product, be it pottery, glass or metal.

- a. Do not open the kiln if the internal temperature exceeds 200°C. This can cause serious damage to the bricks through thermal shock.
- b. If you wish to speed up the cooling of the kiln, then bungs can be removed at 300°C, and the door opened by 5mm. Wait until the temperature is below 200°C before opening the door further. It is best to open the door slowly and in stages if the kiln has not cooled to room temperature so as to avoid thermal damage to your ware.
- c. Be careful when unpacking the kiln as the furniture and ware are often hotter than the interior temperature. Heat resistant gloves are advised.

14.Maintenance

The life of a kiln can be extended for many trouble-free years of service, if the kiln is treated with due care and routine maintenance is performed. These are but a few suggestions to ensure you get the most from your kiln;

- a. Examine the interior of the kiln to ensure it is clean and free of dust. Check the roof and walls for loose fragments of insulating firebrick which might fall onto your products. Vacuum the interior to remove all dust and any objects from around the elements.
- b. Check that kiln shelves are adequately coated with kiln wash.
- c. Check the condition of your shelves and props for warping or cracks.
- d. Remove glass or glaze spots from the walls, bottom, or shelves of the kiln prior to the next firing. If this is not done, glass will re-melt and spread with each firing. Elements can also be damaged by direct glass or glaze contamination.
- e. Avoid moving your kiln un-necessarily. Over time the bricks will “bed down” and become brittle with firing. Constant movement may cause the bricks to break apart.
- f. hinges on front-loading kilns will benefit from lubrication with WD-40.
- g. Do not allow your kiln to get wet – moisture is your enemy!



15. Kiln Furniture

Follow these tips to get the most out of your kiln furniture.

- a. **Always store your kiln shelves on their end.** Never store kiln shelves flat and certainly never flat stacked on top of each other. Doing so significantly increases the risk of shelves cracking.
- b. **Always use kiln wash** to minimise the risk of glaze runs ruining a shelf. Regularly scrape off and reapply your kiln wash.
- c. **Always flip** kiln shelves when using them in the kiln. This will minimise warping. All shelves will begin to warp, particularly at temperatures exceeding 1260c. Thicker shelves minimise warpage, but may also be excessively heavy, so making loading them difficult. The best solution is to use shelves that you can manage easily and regularly flip them. This may require the application and sanding of kiln wash on alternative sides of the shelf (if the underside of a shelf is kiln washed, then you risk having flakes of kiln wash drop onto your glazed ware, causing damage, so best to remove and clean the underside).
- d. **Always** make sure you kiln shelves are **bone dry** when using them. If there is moisture in the shelves then as they heat they are likely to suffer expansion cracks.
- e. **Always use moderate ramp rates** in the initial stages of firing up until 200c (generally rates below 120c/hr are safe). Fast ramp rates may cause rapid expansion of the shelves, leading to cracking. The same applies when cooling your kiln. Avoid rapid cooling below 250c as sudden drops in temperature will cause thermal shock and cracking.
- f. **Always use 3 props** to support a shelf. This is the most stable configuration. Ensure the props are placed in line vertically, so that the load of each shelf is passed down the props.
- g. **Always check your shelves** carefully when packing your kiln. If a shelf is showing signs of cracking DON'T use it. Better to replace a suspect kiln shelf than risk a collapse of furniture and ware in the kiln.

Sadly, kiln shelves don't last forever, but by sticking to the above pointers you will prolong the life you get from them. The higher you fire, the more likely you are to experience warping and cracking of your shelves even with the best of kiln shelf care.

Fired Up Kilns offer not only traditional Cordierite-Mullite shelves but also Oxygen Bonded Silicon Carbide (OBSiC) and Nitrogen Bonded Silicon Carbide (NBSiC) shelves.

16. Warranty

To view the Warranty and Terms and Conditions please visit the resources page of the [Fired Up Kilns website](#)

17. Trouble Shooting

The problem	The possible cause	The solution
Increase in firing time	<ol style="list-style-type: none"> 1. Check program 2. Defective or ageing element/s 3. Check for burned or discoloured connections in kiln, wiring or wall receptacle 4. Ramp rate higher than kiln capability (this is not uncommon in programs with high ramp rates i.e. Greater than 150c/hr above 1150c) 	<ol style="list-style-type: none"> 1. Adjust program 2. Replace 3. Clean or replace as necessary 4. Reduce ramp rate
Kiln will not heat up as programmed	<ol style="list-style-type: none"> 1. Fuse or breakers blown 2. Controller not activated or is faulty 3. Burned power cord or isolator 4. Limit switch has disengaged 	<ol style="list-style-type: none"> 1. Replace or reset 2. Ensure temperature is set on auto controllers or that the correct program has been selected on your controller. Check thermocouple and replace if necessary. 3. Consult a qualified electrician 4. Ensure kiln lid/door is firmly engaging limit switch.
Wall receptacle or plug heats up	<ol style="list-style-type: none"> 1. Loose connection in wall receptacle 	<ol style="list-style-type: none"> 1. Consult a qualified electrician
Safety switch or circuit breakers trip immediately after the kiln is turned on	<ol style="list-style-type: none"> 1. Moisture has built up in the kiln bricks 2. Short circuit in kiln 	<ol style="list-style-type: none"> 1. Place moisture absorbent material (Dampriid) in the kiln and use heaters around the kiln to dry it out. To avoid in future, fire kiln to 200c and soak for 3 hours every 2-3 weeks 2. Consult a qualified electrician to check wiring of the kiln for burn or discoloured connections, check for contact of a hot wire with the grounded portion of the kiln
Elements hum when the kilns is first turned on	<ol style="list-style-type: none"> 1. Normal – This is a 50 cycle hum which may resonate in the element until it is hot enough to soften 	<ol style="list-style-type: none"> 1. No action
Kiln over fires	<ol style="list-style-type: none"> 1. Firing time to long 2. Incorrect temperature set 	<ol style="list-style-type: none"> 1. Check your selected program

	<ol style="list-style-type: none"> 3. Thermocouple issue 4. Faulty controller 	<ol style="list-style-type: none"> 2. Choose correct temperature setting 3. Check that the thermocouple is protruding at least 30mm into kiln and is not in contact with any ware 4. Consult supplier or kiln manufacturer
Kiln shuts off before desired temperature is reached	<ol style="list-style-type: none"> 1. Thermocouple failure 2. Power failure 	<ol style="list-style-type: none"> 1. Replace thermocouple 2. Reactivate your controller. Some controllers are set to automatically restart when power returns. Refer to the attached controller manual
Elements becoming loose from the brick groove	<ol style="list-style-type: none"> 1. Due to loosening of the pin caused by expansion and contraction of the element during repeated heating & cooling 	<ol style="list-style-type: none"> 1. Repin element. Be sure to heat element to above 300c to avoid breaking due to the element becoming brittle over time & when cool.
No power to the kiln	<ol style="list-style-type: none"> 1. Blown circuit breaker/tripped safety switch 2. Blown internal fuse 3. Over temperature controller (if fitted) has tripped the onboard mains isolator 	<ol style="list-style-type: none"> 1. Check power board and reset breakers 2. To protect the kiln electrics from power surges, there is a fuse in the electrical terminal block located in the kilns terminal box as well as two fuses in the controller. 3. Thermocouple has failed on the OT controller - replace 4. OT controller is set below the top value of the fired program. adjust the set value on the OT controller to be 5 -10c above this value.
Kiln heating up rapidly and not responding to controller inputs	<ol style="list-style-type: none"> 1. Jammed contactor 	<ol style="list-style-type: none"> 1. TURN POWER OFF AT THE ISOLATOR SWITCH OR UNPLUG KILN IMMEDIATELY and consult an electrician

19. Pyrometric Cones Temperature Chart

Temperature Equivalents for Orton Pyrometric Cones (°C) Cone Numbers 022-14



Heating Rate* Firing Speed Cone #	Self Supporting Cones						Large Cones				Small
	Regular – SSB			Iron Free – SSK			Regular – LRB		Iron Free – IFB		Regular
	15°C/hr	60°C/hr	150°C/hr	15°C/hr	60°C/hr	150°C/hr	60°C/hr	150°C/hr	60°C/hr	150°C/hr	300°C/hr
	Slow	Medium	Fast	Slow	Medium	Fast	Medium	Fast	Medium	Fast	Fast**
022		586	590								630
021		600	617								643
020		626	638								666
019	656	678	695				676	693			723
018	686	715	734				712	732			752
017	705	738	763				736	761			784
016	742	772	796				769	794			825
015	750	791	818				788	816			843
014	757	807	838				807	836			870
013	807	837	861				837	859			880
012	843	861	882				858	880			900
011	857	875	894				873	892			915
010	891	903	915	871	886	893	898	913	884	891	919
09	907	920	930	899	919	928	917	928	917	926	955
08	922	942	956	924	946	957	942	954	945	955	983
07	962	976	987	953	971	982	973	985	970	980	1008
06	981	998	1013	969	991	998	995	1011	991	996	1023
05½	1004	1015	1025	990	1012	1021	1012	1023	1011	1020	1043
05	1021	1031	1044	1013	1037	1046	1030	1046	1032	1044	1062
04	1046	1063	1077	1043	1061	1069	1060	1070	1060	1067	1098
03	1071	1086	1104	1066	1088	1093	1086	1101	1087	1091	1131
02	1078	1102	1122	1084	1105	1115	1101	1120	1102	1113	1148
01	1093	1119	1138	1101	1123	1134	1117	1137	1122	1132	1178
1	1109	1137	1154	1119	1139	1148	1136	1154	1137	1146	1184
2	1112	1142	1164				1142	1162			1190
3	1115	1152	1170	1130	1154	1162	1152	1168	1151	1160	1196
4	1141	1162	1183				1160	1181			1209
5	1159	1186	1207				1184	1205			1221
5½	1167	1203	1225								
6	1185	1222	1243				1220	1241			1255
7	1201	1239	1257				1237	1255			1264
8	1211	1249	1271				1247	1269			1300
9	1224	1260	1280				1257	1278			1317
10	1251	1285	1305				1282	1303			1330
11	1272	1294	1315				1293	1312			1336
12	1285	1306	1326				1304	1324			1355
13	1310	1331	1348				1321†	1346†			
14	1351	1365	1384				1388†	1366†			

Pyrometric cones have been used to monitor ceramic firings for more than 100 years. They are useful in determining when a firing is complete, if the kiln provided enough heat, if there was a temperature difference in the kiln or if a problem occurred during the firing.

Cones are made from carefully controlled compositions. They bend in a repeatable manner (over a relatively small temperature range - usually less than 40° F). The final bending position is an indication of how much heat was absorbed.

Behavior of Pyrometric Cones

Pyrometric cones deform due to the formation of glass and the pull of gravity as they are heated to their designed operating temperature. This is known as pyro plastic deformation. Careful control over the shape and composition allows Orton to provide a standardized product that reliably performs to known heating conditions. Cones bend and deform in an arc as they start to develop glass within. This behavior is gradual at first, and hastens as the cone reaches its maximum operating temperature. The time interval from when a cone begins to deform until the tip of the cone reaches the shelf is typically 15-25 minutes. The interpretation of the location of the tip of the cone along the bending arc can be done in a couple of ways. One method of interpretation is to correlate the position of the tip to the numbers on a clock face. Initially, the cone is in the 1 o'clock position and continues to deform until the tip is in contact with a shelf, the 6 o'clock position. A more precise method of interpretation is to use the Orton measuring template. The template measures the angle of deformation along a protracted scale numbered from 0 to 90°. The endpoint temperature for a cone is considered to be when the tip is measured with a 90° bend, or in the 5 o'clock position.

The difference in temperature between cones in the 90° (or 5 o'clock) position to one where the tip is touching the shelf is typically only a few degrees and is considered insignificant.

Temperatures shown on the Orton charts were determined using precisely controlled kilns in an

air atmosphere. Cones do not measure temperature alone. They measure heatwork, the combined effect of time and temperature. The role that heating rates have on the endpoint temperature is observed to be that the temperature required to cause a cone to bend will be higher for faster heating rates and lower for slower rates. Heating rates that simulate fast, medium, or slow firings were tabulated.

Temperatures shown for small cones were determined using a heating rate of 300C/hr (540F/hr) in a gas fired kiln. Small cones will come close to duplicating the results of self-supporting cones if mounted upright, properly simulating the position of a self-supporting cone. Typically, small cones will deform 7-10 degrees C earlier than a self-supporting cone, so the temperature values for a self-supporting cone can be used to determine an equivalent small cone temperature by subtracting 7-10 degrees C (or 12-18 degrees F). Placing a small cone or bar cone into a kiln shutoff device (Kiln sitter), will not always produce the desired temperature stated on the cone chart. To produce a properly fired result, the next cone higher in sequence is placed into the shutoff device and the result is confirmed by a cone placed inside the kiln on a kiln shelf.

Reducing atmospheres can affect the bending behavior of cones, especially the red colored cones manufactured between numbers 010-3. If these cones are used in the absence of oxygen, the red iron oxide used in the formulation can reduce and change the appearance so the cone will appear matte, green, or bloated. Orton recommends using the Iron free series for all reduction firings between cones 010-3.

For more information on pyrometric cones, contact Orton or visit us at www.ortonceramic.com



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Cones made with red iron oxide
Cones made without iron oxide

* Heating Rate during the last 100°C of Firing ** Fired in a gas kiln

These tables provide a guide for the selection of cones. The actual bending temperature depends on firing conditions. Once the appropriate cones are selected, excellent, reproducible results can be expected. Temperatures shown are for specific mounted height above base. For Self Supporting - 1¾"; for Large - 2"; for Small - 1½/16". For Large Cones mounted at 1¾" height, use Self Supporting temperatures. † These Large Cones have different compositions and different temperature equivalents.

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Fired Up Kilns works from the lands of the Wurundjeri Woi Wurrung and Bunurong peoples of the Kulin Nation and pay our respects to their Elders past and present. We also acknowledge the Elders, Ancestors, cultures, and heritage of all Aboriginal and Torres Strait Islander Nations.

