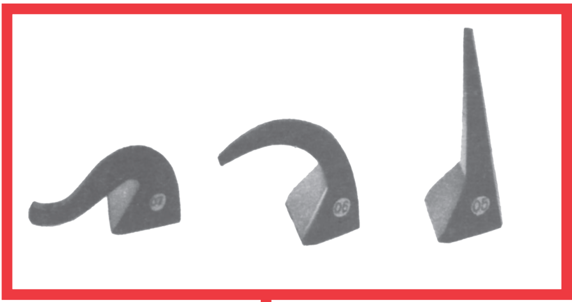
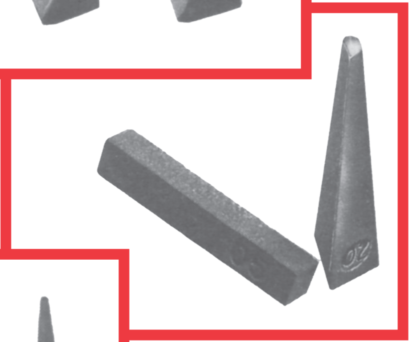
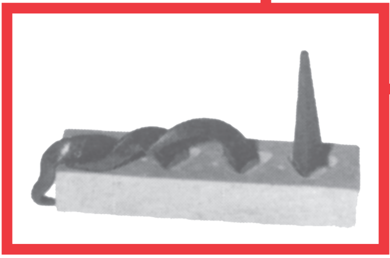
Cones and Firing

a practical guide to successful firings







Orton®
for quality and service

firing is important

Most ceramic and glass products require firing in a kiln, furnace or glass lehr. The application of heat during firing helps these materials develop their desired properties.

Firing is like baking in an oven, except temperatures are much higher. However, unlike an oven, one cannot open the door of a kiln and test the ceramic to determine when it is "done." Instead, indicators, such as pyrometric cones, are used to measure how much heat has been absorbed by the ware.

Cones are slender pyramids made with carefully controlled ceramic compositions. Bars are small uniformly shaped rectangles made from the same compositions as cones. Each cone/bar composition is identified with a number such as 04 or 6.

High quality, reliable Pyrometric Cones have been sold by Orton since 1896 to monitor and control the firing of ceramic and glass products. Orton Standard Pyrometric Cones and Bars are an easy and effective tool for checking the amount of heat work applied by the kiln.

Orton self-supporting or large cones can be placed inside a kiln where they can be observed through a peephole, or on various shelves or locations inside a kiln to check the uniformity of the kiln temperature after firing.

When cones soften and bend, this indicates that a certain amount of heat has been absorbed by the cone and hence, the ware being fired.

Pyrometric Cones and Bars are also used in the Kiln-Sitter®. This mechanical control is designed to cut off electricity to the heating elements in the kiln when the desired temperature in the kiln has been reached. As heat is applied to the kiln, the cone/bar softens and then bends under the weight of a metal sensing rod. In a properly adjusted Kiln-Sitter®, when the cone/bar has bent to a 90 degree angle, the sensing rod will have moved down enough to release a weight outside the kiln. This action cuts off electrical power to the heating elements.

Pyrometric cones and bars are used so extensively for firing ceramics that most bodies, glazes and other materials are designated with a cone number such as a cone 04 clay, a cone 06 glaze or a cone 9 porcelain. Despite these labels, many clays and glazes can also be fired over a range of temperatures and cone numbers with good results (e.g. cone 05-03 for earthenware clays).

cone numbers

Cone numbers range from cone 022 up to cone 42. Cone 022 is the lowest temperature cone number. That is, it requires the least amount of heat to deform or bend. As the cone is heated, it reaches a point where the tip begins to bend and fall due to gravity pulling it down. This indicates the cone and the ware are nearing their maturing range. It typically takes 15 to 22 minutes for cones to bend fully.

Originally, cone numbering start at 1 and went to 20. As demand grew for cones requiring less heat to bend, a new series was developed and a zero was added in front of the number for the lower maturing cones. Sometimes the zero is referred to as an "oh", like the letter "O". A cone 01 needs less heat treatment than cone 1 and cone 020 needs less than 019. It is important not to mix up the lower maturing cones and bars, whose numbers begin with an "0", with the higher cones and bars not containing this prefix.

applications for the Orton Cone

Typical uses for cone numbers are:

Number 022 to 011

These are used in firing of overglaze decorations, lusters, enamels and decals and for glass fusing, slumping and decorating. The temperature range is approximately 1050° to 1550°F (560° to 850°C).

Number 010 to 3

These numbers are made as a regular series (red, iron-containing cones) and as an Iron Free series for use in reducing atmospheres. These cones are used in the firing of many craft and art bodies, for wall tile, glazes and some structural clay products. The temperature range is approximately 1600° to 2150°F (890° to 1170°C).

Number 4 to 12

These cones are used in firing porcelain, floor tile, china, stoneware, structural clay products and some refractory materials. The temperature range is approximately 2175° to 2345°F (1180° to 1340°C).

Numbers 13 to 42

These Cones are used for firing industrial products up to 3659°F (2015°C).

cone behavior and temperature

Although cones do not actually measure temperature, cone bending behavior and temperature are related. Generally, the faster the firing, the higher the temperature required to bend the cone and the slower the firing, the lower the temperature required to bend the cone.

The temperature at which cones deform have been determined for selected heating rates. These are published by Orton (see the chart on page 19). To use the chart as a guide, the heating rate should be known for the last 200 degrees of the firing.

For example, an Orton Self-Supporting Cone 06 heated at 108°F/hr will deform to the 6 o'clock position (90 angular degrees) at 1828°F. If heated at a faster rate of 270°F/hr, the cone will reach the 6 o'clock position at 1875°F. The 6 o'clock position (90 angular degrees) is considered the endpoint of cone bending.

The temperature equivalent charts published by Orton are only accurate when the heating rate identified in the chart is maintained over the last 200°. Equivalent temperatures without known heating rates should only be used as a general guide. Consistent mounting of cones is important. (See page 8.)

how cones can be used

Properly used, pyrometric cones can be used to:

1. Indicate, by visual observations, when a firing is completed.

2. Verify the firing uniformity of a kiln, side to side and top to bottom.

3. Check the performance of any shut-off device.

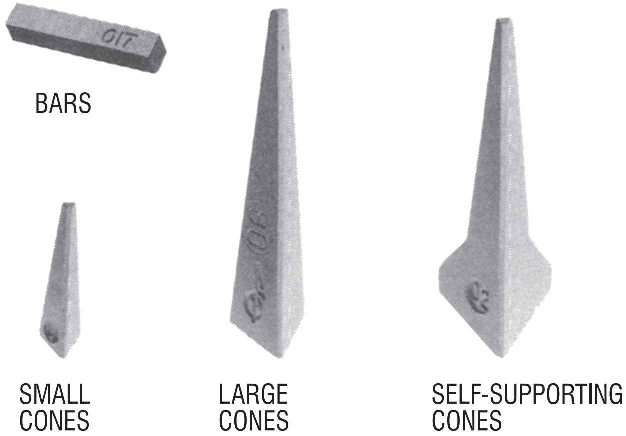
4. Check the temperature measured by a controller.

5. Make a permanent record of the firing.

6. Provide proper shut-off of the Dawson Kiln-Sitter using Orton Small Cones or Pyrometric Bars.

TYPES OF ORTON PYROMETRIC PRODUCTS

Four types of Orton Pyrometric Products are available: Bars (1" long), Small Cones (1 1/8" high), Large Cones (2 1/2" high) and Self-Supporting Cones (2 1/2" high).



small cones and pyrometric bars

Orton Small Cones and Bars are used with the Dawson Kiln-Sitter®. The tapered shape of the Small Cone allows the user some flexibility in adjusting the shut off point. For ease of use, the uniform shape of the Orton Bar assures consistent placement in the Kiln-Sitter® every time.

While not recommended, Orton Small Cones can also be used on the kiln shelf in place of larger cones. Because they are smaller, higher temperatures and more heat are required for them to bend (see page 19). When used in this way, the Small Cones require mounting in cone holders or plaques. (See mounting cones, page 6).

self-supporting cones

Orton's patented Self-Supporting Cones are the most accurate and easy to use cones available. Complete with built-in base, these unique cones require no cone holder or plaque for support on the shelf during firing. Since the correct height and angle are built into the cone, reproducible firings can be achieved time after time. Self-Supporting Cones are popular for use as witness cones.

large cones

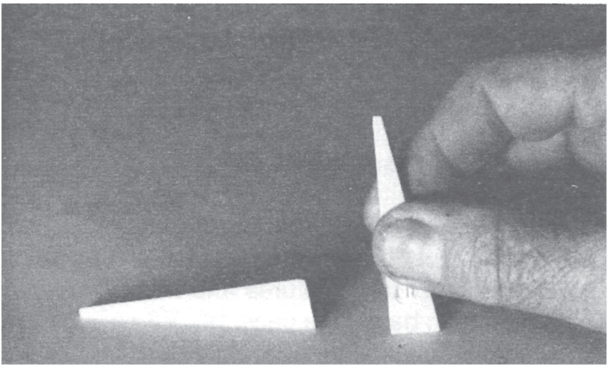
The original pyrometric cone, Orton's Large Regular Cones are widely used to visually check firing progress and to monitor conditions within a kiln. Large cones need to be mounted in a plaque to insure proper bending behavior.

mounting cones

FINDING THE BENDING FACE

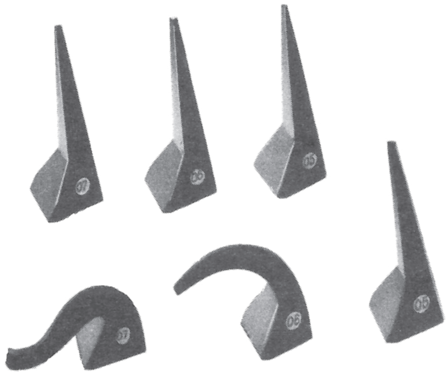
When mounting cones in clay pats, cone holders or commercial cone plaques, the bending face and mounting angle of the cone must be determined. The bending face is the direction in which the cone will bend.

This can easily be determined by holding a cone vertically by the tip and then setting its base down against a flat surface. While the cone is still being held, you will observe that it is leaning at an 8° angle. This is the proper mounting angle for the cone.



Now, let go of the cone…it will fall in the direction that it will bend. The face of the cone that has fallen against the flat surface is known as the “bending face.”

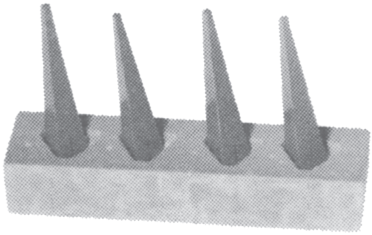
As seen below, Orton Self-Supporting Cones are preset for mounting height and angle.



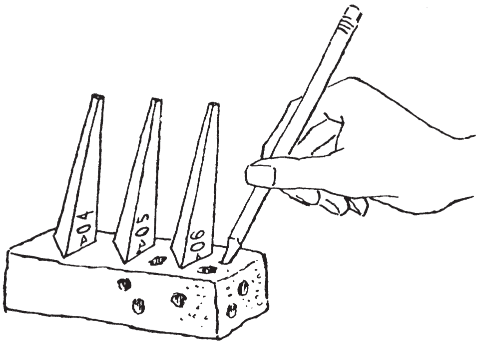
Self-Supporting Cones before and after firing.

placement in cone holders

Orton Large and Small Cones must be supported by a cone plaque, a clay pat or special high temperature wire cone holders for use on the kiln shelf. Cone plaques are made so that cones placed in them are held at the proper angle and height. These plaques are also available from Orton.



Plaques can also be made with a wad of plastic clay shaped to about 4" x 1" x 3/4" deep or smaller if using Small Cones. The pat should be made of porous clay so it will not crack during firing. A pencil can be used to poke holes in the clay for additional porosity (see photo next page).



mounting height and angle

Because gravity pulls the cone over, it is very important to have the proper mounting height and angle for consistent bending performance of the cones. A 1/4" difference in mounting height of Large Cones can cause more than a 1/2 cone difference in bending when the same cone is heated.

Large Cones are normally mounted so *exactly* 2" of the cone is exposed above the tope of the cone plaque or clay pat. A ruler should be used to assure this mounting height is maintained. A 1 3/4" mounting height can also be used for Large Cones, the same as for Self-Supporting Cones. Small Cones are mounted so that 15/16" of the cone is exposed above the top of the plaque or pat.

The mounting angle should be 8°. A guide should be used to assure correct mounting angle. Cones should be positioned so they will not fall against each other during firing.

When using wire holders, care must be taken that they have not bent. Check the mounting height and angle and discard the wire holder if it is bent.

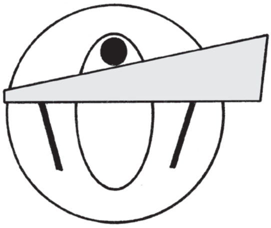
using orton bars or small cones in the kiln-sitter®

Either Orton Small Regular Cones or Orton Pyrometric Bars can be used in the Dawson Kiln-Sitter®. Both can be used to give equivalent heat treatment. Many beginners select the Orton Bar because its uniform shape permits consistent placement with ease every time. Others prefer the flexibility of the tapered Small Cone to adjust the firing range.

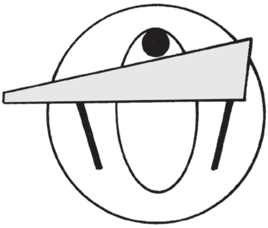
When using either the cone or the bar in the Kiln-Sitter® it is important to keep in mind how the device performs. The combined effect of time and temperature causes the cone or bar to soften. The weight of the sensing rod pressing down on the cone or bar determines when it will bend.

The tapered shape of the Small Cone permits some adjustment in the cone placement in the Kiln-Sitter®. This allows the user to vary bending time and kiln shut off by as much as 1/2 cone. Placing the thin part of the cone under the sensing rod results in a cooler firing. Conversely, placing the thicker part of the cone under the rod results in a hotter firing. This adjustment provides flexibility in firing the kiln.

Cooler Firing



Hotter Firing



The Orton Bar, designed especially to function in the Dawson Kiln-Sitter®, offers advantages of its own. The uniform shape of the bar makes consistent placement easy without affecting the firing. The novice or beginner will welcome its ease of use, while those practiced in firing will appreciate the consistency it affords. The Bar provides the same results as a Small Cone which has been properly centered in the Kiln-Sitter®.

testing the kiln-sitter®

To verify the performance of your Kiln-Sitter®, use the Orton Three Cone System (see page 11). Using three cones will show the amount of heat-work on the kiln shelf and “witness” the shut-off device performance.

Orton Bars and Small Regular Cones, when used in the Kiln-Sitter® are intended to match the deformation of Orton Self-Supporting witness cones used on the kiln shelf. However, depending on the kiln’s firing characteristics, differences may exist between the Kiln-Sitter® and the witness cones.

Reasons for this include:

- Improper adjustment of the Kiln-Sitter®
- Mechanical problems in the Kiln-Sitter®
- Temperature at Kiln-Sitter® hotter or cooler than the witness cones on the shelf
- Small Cone not positioned properly
- Weight of sensing rod reduced due to metal corrosion

The operation of the Kiln-Sitter® should always be checked when changes in cone performance or fired results are noted.

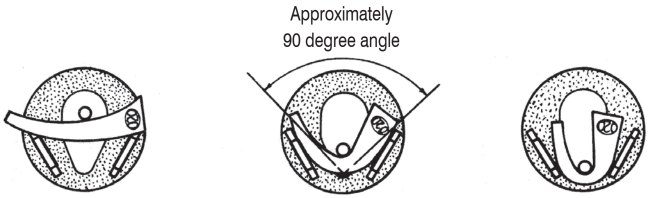
To compensate for differences that exist between the Kiln-Sitter® and the cones on the shelf, it may be necessary to position the Small Cone so the thicker or thinner portion is beneath the sensing rod. It may also be necessary to use a hotter or cooler cone or bar in the Kiln-Sitter®. What is important is to make sure your ware is fired properly. The **shelf cone** is the final judge of the firing process, not the Kiln-Sitter® cone or bar.

If after a test firing you find that the firing cone on the kiln shelf has not bent, this indicates an underfiring—shut-off has occurred too soon. You should retest, using another set of cones (the same numbers) and one cone number hotter in the Kiln-Sitter®.

kiln-sitter® operation

As the kiln reaches the maturing or deformation point of the cone or bar, the weight of the sensing rod will cause the cone to bend as it softens.

When the cone is bent to approximately a 90° angle, the sensing rod in a properly adjusted Kiln-Sitter® will have moved down enough to release the trigger (outside the kiln), dropping the weight to cut off electrical power to the heating elements. Incorrectly adjusted Kiln-Sitter® can result in firing problems.



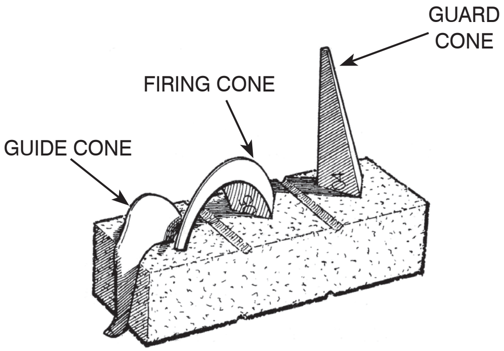
UNDERFIRED (Incorrectly adjusted) — **CORRECT ADJUSTMENT** — **OVERFIRED** (Incorrectly adjusted)

the three cone system

While a single cone may be used on the shelf to "witness" the firing, it is common practice to use three different cones. A group consists of a **Firing Cone**—the desired cone for the ware being produced, the **Guide Cone**—one cone number cooler, and the **Guard Cone**—one cone number hotter than the firing cone. These cones are set deep in the kiln, yet should be visible through a peephole.

When the **Guide Cone** starts to bend, the ware is approaching maturity. The bending of the **Firing Cone** indicates firing is at the correct point. If the **Guard Cone** has bent, you have exceeded the best time-temperature relationship.

When viewing cones through the peepholes, welders glasses should be used to avoid possible eye injury. Sunglasses are not recommended.

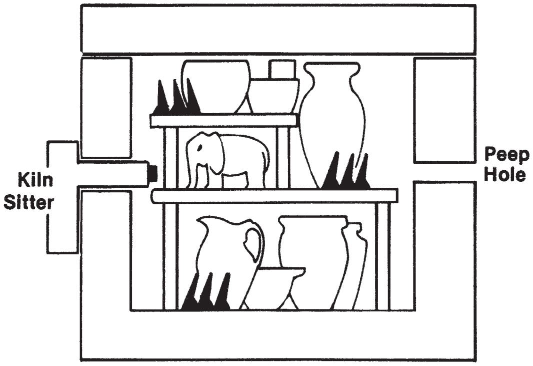


using cones to understand how your kiln fires

Kilns are rarely uniform in temperature, particularly the larger ones. This is because there is much more to heat in a larger kiln than in a smaller one. Using cones, one can determine the amount of heating variation within the kiln.

To evaluate kiln uniformity, sets of three consecutively numbered cones can be placed on each shelf during firing. Afterwards, they can be examined for differences to determine how much variation occurred. Typically, you will see at least a one cone difference from top to bottom in the kiln. This can be even larger depending on the kiln construction and the cone number being fired.

How fast the kiln is heated and how heavily loaded it is will also affect temperature distribution in the kiln. Remember that shelves, posts and setters also receive the same heat treatment as the ware and must be considered part of the kiln load. Many times the furniture will weigh more than the ceramics being fired.



Sectional view of kiln chamber showing Self-Supporting Cones in several locations.

save your cones

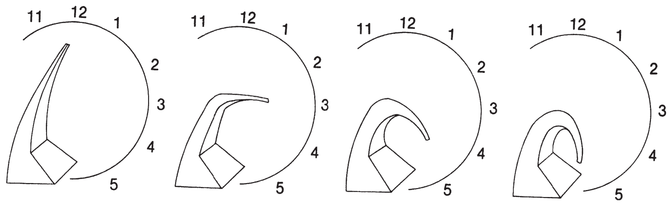
Once your kiln's temperature variations have been characterized, use cones regularly to determine changes in the way your kiln fires.

Select a location in your kiln which represents an average temperature (usually on a center shelf). Place cones in the same shelf location. After firing, compare the new set of fired cones to cones from the last firing. It's good to keep cones from several test firings for comparison. They should look similar. If they don't, then something is affecting the firing, because Orton Cones fired under the same conditions will behave the same, year after year.

Comparing the results of the last 6 to 10 firings will show gradual changes occurring in the kiln, such as heating elements aging.

It is also a good idea to keep a log book and write down the bending positions of the firing cone, as well as information on how the kiln was fired.

The "clock method" can be used to describe the position of the cone tip after firing. Unfired, the cone tip is at 12 o'clock, the end point is at 6 o'clock.



three factors affecting kiln firing

TIME TO REACH TEMPERATURE

The rate of heating for a kiln is determined by (1) the amount of power which can be passed through the heating elements, (2) the heat needed to bring the ware and kiln furniture to temperature and (3) the heat lost from the kiln.

POWER INPUT

The amount of power to the heating elements depends on the position of the switches, the wire size and the voltage supplied by the electric company. More power flows when the switches are on high than when they are on low. Also, how long the power flows is sometimes controlled using electronic controllers or automatic switching devices.

The wire size for the elements was selected by the manufacturer for a specific voltage. As the kiln is used, the wire oxidizes and forms a protective ceramic coating. With time, more metal oxidizes. Since electric current only flows through the metal, as more metal is oxidized less current flows for a given voltage. This reduces the power input to the kiln and slows down the time to heat the kiln.

SWITCHING SEQUENCES

Kilns that inherently fire unevenly can be made to fire more uniformly by increasing the heat input to the cooler areas (usually, the bottom of the kiln) or by reducing the heat to the hotter areas (the top of the kiln).

Electric kilns with 2 or more variable switches, each marked with the settings “high,” “medium, “low” and “off,” can be manipulated to fire the kiln more uniformly.

For example, let us assume that the kiln is cooler at the bottom than at the top. Normally, the kiln would be started with all of the switches in the "low" position. However, to try to eliminate the cooler bottom area, start the kiln with the bottom switch set to "medium" and the remaining switches set on "low." When it is time to increase the heat, the bottom switch would be moved to "high." Since the bottom switch section was on "high" longer than the rest of the kiln, the result should be a more uniform firing.

Another way to improve kiln uniformity would be to leave the top switch "off" until the other sections are switched to the "medium" setting. The top switch would then be set on "low." When the lower sections are set on "high," the top would be set on "medium" for about an hour before moving it to "high" for the remainder of the firing. In the first method, we are increasing the heat to the bottom section of the kiln and in the second method we are decreasing the heat to the top section. Both methods can give the similar results.

LOADING

A more heavily loaded kiln requires more time for heating than one that is lightly loaded.

During firing there is a limited amount of heat available. This heat flows from the hot heating elements to colder areas in the kiln. Radiation (like heat from the sun) shines onto the surface of the ware or kiln furniture and then the heat is conducted through the thickness of the piece.

When pieces are very thick, and the firing is too fast, large temperature differences can exist within the piece. This uneven heating can lead to cracks in the ware. Also, when pieces are blocked or shaded from the hot heating elements by kiln furniture or other ware, it takes longer for them to heat up.

A kiln that is densely loaded in some areas and lightly loaded in others may fire unevenly. As a result, the heavily loaded areas will probably be underfired.

Sets of cones placed in these areas will tell you if underfiring has occurred. Cones may be used in hidden areas as well as areas where they can be seen through a peephole. These hidden cones can then be compared after firing and they provide a permanent record of how the kiln fired.

HEAT LOST FROM KILN

Although kilns are lined with insulating materials to keep heat inside the kiln, considerable heat can be lost through the kiln walls, peepholes, the Kiln-Sitter® and the kiln top and bottom. When heat loss is too great, the kiln may not reach a desired temperature or it will heat much slower than expected.

Heat loss is greatest at high temperatures and so it is very important to keep the kiln lid closed, peepholes plugged and all cracks sealed once the kiln exhibits a dull red color (around 1100°F).

venting your kiln

It is also important that electric kilns be fired with an oxidizing atmosphere (so there is plenty of air in the kiln). Most kiln manufacturers recommend manual venting of your kiln in order to remove carbon monoxide developed early in the firing of your ware. Power vent systems such as those developed by Orton, pull air into your kiln during firing and remove harmful fumes from the work area.

Oxygen is necessary to burn out organics and other carbon materials associated with clays, slips, glazes, decals and decorations. Oxygen is also needed to develop true colors and bright golds, metallics and lusters.

When carbon materials are not burned out, many defects can result in the fired piece. These include:

- dark spots or interiors in bisqued ware
- blistering of glazes and decals
- crazing of glazes
- color variations (reds can turn white)
- mildew in porcelain
- dull or flaking metallics

WHY IS VENTING DIFFICULT?

When your kiln is heated, the air inside is continually expanding (just like with a hot air balloon). Consequently, much of this air escapes through cracks and openings. Because of this outflow of air, it is difficult to bring in fresh replacement air.

Removing peephole plugs and propping the lid during the early stages of firing is a good idea and will help bring some fresh air into the kiln. However, this type of manual venting may not bring air to all areas of the kiln. A downdraft power vent is better, since it draws air into and circulates it through the kiln.

When venting manually, the lid should be left propped and the peepholes open until a dull red heat is observed in the kiln. At this point the lid may be closed and all the peepholes plugged. If defects related to carbon occur, leave the top peephole open for some additional time.

When using a downdraft power vent system, the kiln lid and peepholes are kept closed for the entire firing except for periodic observation of the cones.

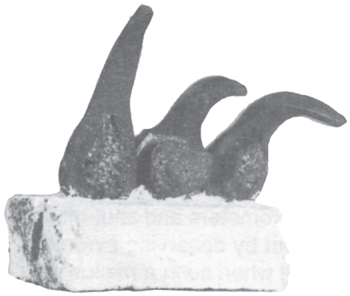
Slowing the heating of the kiln during the venting period also helps carbon burnout. Many problems with the final piece can be traced to inadequate venting or insufficient time to burn out all the carbon in your ware.

cones help detect atmosphere problems

As the kiln fires, organics in the clay, glaze or decoration burn and produce carbon monoxide. Also, any sulphur or fluorine the body will become a gas.

If the kiln is not properly vented, the carbon monoxide and sulfur can affect the color and maturation of the products being fired. Colors may be dull or disappear. Bisque may look grayish. Cones may have a greenish color.

If the color or surface of the cones change, you likely are not providing adequate ventilation or are firing too fast. Cones 010 to 3 are especially susceptible to sulfur gases in the kiln and may form a “hard shell” on the skin of the cone which resists melting. Iron Free cones can be used to avoid this problem.



ceramic firing is affected by temperature and time

Orton Pyrometric Cones are not temperature measuring devices. They measure the amount of heat in the kiln, which is the combined effect of temperature and time. Likewise, the body or glaze is properly fired when a certain amount of heat has been absorbed. When firing faster, a higher temperature is needed for the cone and your ware to receive sufficient heat.

Kiln uniformity normally improves as the temperature increases in the kiln due to radiant heat. With electronic controllers, the kiln can be held (soaked) at a temperature. This allows time for heat to move into all areas of the kiln and ware, greatly increasing temperature uniformity. As a guide:

- lowering the firing temperature by 18°F (10°) requires about 20 minutes of hold time to add the same heat to a cone or body
- lowering the firing temperature 36°F (20°C) requires 40 to 60 minutes of hold time
- lowering the firing temperature 54°F (30°C) requires about 2 hours of hold time

The temperature shown on the chart on page 19 are affected by the cone mounting height, angle and heating rate. With this in mind, temperature equivalent charts, whether published or printed on controllers or pyrometers, should be used only as guides.

Using controllers to slow down the firing in the first half of firing (below red heat—1100°F) is a good idea. When firing bisque, stoneware or porcelain, use a hold to allow heat to penetrate into your ware. When using controllers, it is a good idea to use witness cones to make sure the ware receives the proper amount of heat.

Controllers, pyrometers and shut-off devices occasionally malfunction, but by observing pyrometric cones, the user can readily tell when such a malfunction is occurring.

In addition, pyrometers periodically need recalibration. Cones set within the kiln can be used to determine if the pyrometer is giving an accurate reading.

cone tips

CONES AGING OR GOING "BAD"

Cones do not go "bad" or age. While Orton continues to improve our manufacturing processes, you can still depend on the results of cones made years ago.

HUMID CONDITIONS

The bending behavior of cones will not be affected by humid conditions during storage. It is not necessary to keep cones in air conditioned or controlled environments.

UNEXPECTED PERFORMANCE

When a Kiln-Sitter® cone or bar does not bend or melts into a blob, the problem is generally related to the Kiln-Sitter®.

The cone will melt as the kiln is heated, but it bends due to the sensing rod's downward pressure. If the firing continues too long, the cone will fully melt into a blob.

Some reasons for sensing rod failure include improper adjustment of the Kiln-Sitter®, a bent or corroded sensing rod or Kiln-Sitter® assembly or an object inside or outside the kiln interfering with the sensing rod's movement.

To help prevent these problems, the Kiln-Sitter® should be periodically tested, checked and adjusted using the firing gauge supplied with the device.

TEMPERATURE EQUIVALENTS °F
FOR ORTON PYROMETRIC CONES

These tables provide a guide for the selection of cones. Actual bending temperature depends on firing conditions. Once the appropriate bending cones are selected, excellent, reproducible rsults can be expected.

Cone Type and Composition

	Self Supporting Cones			Large Cones		Small
	Regular			Regular		Regular
Cone	27	108	270	108	270	540
022		1087	1094	N/A	N/A	1166
021		1112	1143	N/A	N/A	1189
020		1159	1180	N/A	N/A	1231
019	1213	1252	1283	1249	1279	1333
018	1267	1319	1353	1314	1350	1386
017	1301	1360	1405	1357	1402	1443
016	1368	1422	1465	1416	1461	1517
015	1382	1456	1504	1450	1501	1549
014	1395	1485	1540	1485	1537	1598
013	1485	1539	1582	1539	1578	1616
012	1549	1582	1620	1576	1616	1652
011	1575	1607	1641	1603	1638	1679
010	1636	1657	1679	1648	1675	1686
09	1665	1688	1706	1683	1702	1751
08	1692	1728	1753	1728	1749	1801
07	1764	1789	1809	1783	1805	1846
06	1798	1828	1855	1823	1852	1873
05 1/2	1839	1859	1877	1854	1873	1909
05	1870	1888	1911	1886	1915	1944
04	1915	1945	1971	1940	1958	2008
03	1960	1987	2019	1987	2014	2068
02	1972	2016	2052	2014	2048	2098
01	1999	2046	2080	2043	2079	2152
1	2028	2079	2109	2077	2109	2163
2	2034	2088	2127	2088	2124	2174
3	2039	2106	2138	2106	2134	2185
4	2086	2124	2161	2120	2158	2208
5	2118	2167	2205	2163	2201	2230
5 1/2	2133	2197	2237	2194	2233	N/A
6	2165	2232	2269	2228	2266	2291
7	2194	2262	2295	2259	2291	2307
8	2212	2280	2320	2277	2316	2372
9	2235	2300	2336	2295	2332	2403
10	2284	2345	2381	2340	2377	2426
11	2322	2361	2399	2359	2394	2437
12	2345	2383	2419	2379	2415	2471

Temperatures shown are for specific mounted height above base. For Self-Supporting - 1 3/4". For Large - 2". For Small Cones, 15/16". For Large Cones mounted at 1 3/4" height, use temperatures shown for Self-supporting Cones.

complete information on pyrometric cone use and helpful firing tips

- using cones
- cone behavior
- mounting cones
- cones and the kiln-sitter®
- three cone system
- understanding firing
- loading
- controlling the kiln
- venting
- kiln atmosphere
- record keeping
- temperature equivalents

The ceramic community has depended on Orton for high quality Pyrometric cones since 1896. We also provide kiln ventilation systems, AutoFire® kiln controllers and many other products and supplies for firing.

Income from the sale of products and services supports research and education to advance the manufacture of ceramic and glass products.

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