

Temperature Equivalents for Orton Pyrometric Cones (°F) 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
	27°F/hr	108°F/hr	270°F/hr	27°F/hr	108°F/hr	270°F/hr	108°F/hr	270°F/hr	108°F/hr	270°F/hr	540°F/hr
	Slow	Medium	Fast	Slow	Medium	Fast	Medium	Fast	Medium	Fast	Fast**
022		1087	1094								1166
021		1112	1143								1189
020		1159	1180								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	1600	1627	1639	1648	1675	1623	1636	1686
09	1665	1688	1706	1650	1686	1702	1683	1702	1683	1699	1751
08	1692	1728	1753	1695	1735	1755	1728	1749	1733	1751	1801
07	1764	1789	1809	1747	1780	1800	1783	1805	1778	1796	1846
06	1798	1828	1855	1776	1816	1828	1823	1852	1816	1825	1873
05½	1839	1859	1877	1814	1854	1870	1854	1873	1852	1868	1909
05	1870	1888	1911	1855	1899	1915	1886	1915	1890	1911	1944
04	1915	1945	1971	1909	1942	1956	1940	1958	1940	1953	2008
03	1960	1987	2019	1951	1990	1999	1987	2014	1989	1996	2068
02	1972	2016	2052	1983	2021	2039	2014	2048	2016	2035	2098
01	1999	2046	2080	2014	2053	2073	2043	2079	2052	2070	2152
1	2028	2079	2109	2046	2082	2098	2077	2109	2079	2095	2163
2	2034	2088	2127				2088	2124			2174
3	2039	2106	2138	2066	2109	2124	2106	2134	2104	2120	2185
4	2086	2124	2161				2120	2158			2208
5	2118	2167	2205				2163	2201			2230
5½	2133	2197	2237								
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
13	2389	2428	2458				2410†	2455†			
14	2464	2489	2523				2530†	2491†			

Cones made with red iron oxide
Cones made without iron oxide

* Heating Rate during the last 180°F of Firing ** Fired in a gas kiln

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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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.