

Temperature Equivalent Chart for Orton Pyrometric Cones (°F) Cone Numbers 022-14



| Cone | Self Supporting Cones | | | | | | Large Cones | | | | Small |
|------|---|------|------|-----------|------|------|-------------|-------|-----------|------|---------|
| | Regular | | | Iron Free | | | Regular | | Iron Free | | Regular |
| | Heating Rate °F/hour (last 180°F of firing) | | | | | | | | | | |
| | 27 | 108 | 270 | 27 | 108 | 270 | 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 | 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 | | | | N/A | N/A | | | 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 |
| 13* | 2389 | 2428 | 2458 | | | | 2410* | 2455* | | | N/A |
| 14* | 2464 | 2489 | 2523 | | | | 2530* | 2491* | | | N/A |

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

Typically, it takes 15 to 25 minutes for a cone to bend once it starts. This depends on the cone number. The cone bends slowly at first but once it reaches the half way point (3 o'clock), it bends quickly. When the cone tip reaches a point level with the base, it is considered properly fired. This is the point for which temperature equivalents are determined. Differences between a cone touching the shelf and a cone at the 4 o'clock position are small, usually 1 or 2 degrees.

Temperatures shown on the charts were determined under controlled firing conditions in electric kilns and an air atmosphere. Temperatures are shown for specific heating rates. These heating rates are for the last 100°C or 180°F of the firing. Different heating rates will change the equivalent

temperature. The temperature will be higher for faster heating rates and lower for slower heating rates.

Cone bending may also be affected by reducing atmospheres or those containing sulfur oxides. Orton recommends the use of Iron-Free cones for all reduction firings (cones 010-3). If a cone is heated too fast, the cone surface fuses and binders used to make cones form gases that bloat the cone. If cones are to be fired rapidly, they should be calcined (pre-fired) before use. Cones should be calcined to about 850°F (455°C) in an air atmosphere.

If a cone is soaked at a temperature near its equivalent temperature, it will continue to mature, form glass and bend. The time for the cone to bend depends on several factors and as a general rule, a 1 to 2 hour soak is sufficient to deform the next higher cone number. A soak of 4 to 6 hours will be required to deform two higher (hotter) cones.

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



The Edward Orton Jr. Ceramic Foundation
 P.O. Box 2760 • Westerville, OH 43086-2760
 (614) 895-2663 • (614) 895-5610 fax
info@ortonceramic.com
www.ortonceramic.com

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 - 15/16". For Large Cones mounted at 1¾" height, use Self Supporting temperatures. * These Large Cones have different compositions and different temperature equivalents.