

# Gemstones in Metal Clay

Many natural gemstones can be set into metal clay and fired in place. Other gemstones will not survive the heat of a kiln and should be set after firing. These charts show the results of kiln and torch tests that have been performed on both natural and synthetic gemstones, adapted with permission from the original testing by Kevin Whitmore of Rio Grande.

This information is for reference and should be used as a guide. There is always some risk of losing a natural gemstone even if others of it's kind have survived in the past. Gemstones may have internal flaws that can be liquid or gaseous filled, or contain crystals of other materials that can cause the gemstone to fail where it usually does not. This guide aims to help metal clay artists sort out gemstones that are known to survive under fire from those that are not.

Gemstones are minerals that are classified into groups based upon the constancy of their major properties. Each mineral family has one or more varieties contained within the group. When we sort the tested gemstones according to their mineral group, it becomes clear that an easy way to gauge the survivability of a gemstone is to look at the results of other varieties within that same group. Aquamarine and emerald, for example, are both varieties of the beryl group of minerals. The result of tests done on aquamarine and emerald indicate that minerals in the beryl group will not survive kiln heating. There are exceptions, as there always are in the natural world, but in general this method can be reliable for many varieties. For simplicity many gems have been classified into their main group rather than their sub-variety.

This updated version now classifies stones as No Fire, Low Fire and High Fire. High fire stones are those that can withstand 1650F for at least 1 hour with no color change. No Fire stones are those that must be set after firing. Low Fire stones are those that are heat sensitive with a risk of color change.

We've included the Moh's hardness of each gemstone to help dispell the myth that hardness determines survivability. (Additional information on the Moh's scale is listed at the end of this publication.)

## Natural Gemstones

### Kiln: Fast ramp

Gemstone	Mineral Group	Mohs Scale	Maximum Suggested Firing Temp/Time			
			No Fire	Low Fire	High Fire	Torch
Aquamarine	Beryl	7.5-8	✗			
Emerald	Beryl	7.5-8	✗			
Malachite	Borate	3.5-4	✗			
Rhodocrosite	Calcite	3.5-4.5	✗			
Alexandrite <sup>1</sup>	Chrysoberyl	8.5			1650F/1H	
Alexandrite Cats Eye <sup>1</sup>	Chrysoberyl	8.5			1650F/1H	✓
Black Star Sapphire	Corundum	9			1650F/2H	✓
Padparadscha	Corundum	9			1650F/2H	✓
Ruby	Corundum	9			1650F/2H	✓
Sapphire	Corundum	9			1650F/2H	✓
Diamond <sup>2</sup>	Diamond	10	✗			
Almandine	Garnet	6.5/7.5		1560F/30		✓
Demantoid	Garnet	6.5-7.5		1560F/30		✓
Pyrope Garnet	Garnet	7-7.5		1560F/30		✓
Rhodolite Garnet	Garnet	7-7.5		1470F/30		✓
Tsavorite	Garnet	7-7.5		1470F/30		✓
Amazonite	Feldspar	6 to 6.5		1200F/30		

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## Kiln: Fast ramp

Gemstone	Mineral Group	Mohs Scale	Maximum Suggested Firing Temp/Time			
			No Fire	Low Fire	High Fire	Torch
Labradorite	Feldspar	6 to 6.5		1200F/30		
Moonstone-Gray	Feldspar	6-6.6		1200F/30		
Moonstone-Peach	Feldspar	6-6.5		1110F/30		
Moonstone-White	Feldspar	6-6.5		1110F/30		
Sunstone	Feldspar	6-6.5		1200F/30		
Iolite	Iolite	7-7.5	✗			
Hematite	Iron Mineral	5.5-6.5			1650F/2H	✓
Zircon	Nesosilicate	7.5			1650F/1H	✓
Peridot	Olivine	7		1470F/30		✓
Turquoise <sup>3</sup>	Phosphate	5-6	✗			
Chrome Diopside	Pyroxene	5-6		1200F/30		
Star Diopside	Pyroxene	5-6		1200F/30		
Jadeite	Pyroxene	5-6	✗			
Agate (Cameo)	Quartz	7	✗			
Aventurine	Quartz	7	✗			
Black Onyx	Quartz	7	✗			
Chalcedony	Quartz	7	✗			
Carnelian	Quartz	7	✗			
Citrine	Quartz	7	✗			
Rose Quartz	Quartz	7	✗			
Rutilated Quartz	Quartz	7	✗			
Smokey Quartz	Quartz	7	✗			
Spinel	Spinel	8			1650F/1H	
Fire Opal	Silicate	6-6.5	✗			
Pyrite <sup>3</sup>	Sulphide	6-6.5	✗			
Topaz (all varieties)	Topaz	8	✗			
Green Tourmaline	Tourmaline	7-7.5		1200F/30		
Pink Tourmaline	Tourmaline	7-7.5	✗			
Tanzanite	Zoisite	6.5-7		1600F/30		✓
Denim Lapis	Rock	5.5	✗			
Lapis Lazuli <sup>4</sup>	Rock	5.5	✗			

<sup>1</sup>Some believe this stone is not available or is too expensive to use. It can be pricey, but there are plenty of sources for this stone, including Cat's Eye. Loupe the stone before firing. Do not fire if you see "bubbles".

<sup>2</sup>Diamonds are risky in the kiln. There have been a few firing successes for diamonds. If you do fire, keep your time and temperature low. Diamonds can take a lot of heat, but not for long. Since results are inconsistent/inconclusive, it is probably a better idea to set diamonds after firing or until further testing indicates a safe method for firing diamonds.

<sup>3</sup>Turquoise is a secondary mineral of hydrated copper aluminum phosphate.

<sup>4</sup>Pyrite is dangerous in the kiln. Pyrite contains sulphur which can be explosive when heated.

<sup>5</sup>Lapis lazuli is not a mineral, but a microcrystalline rock composed mainly of the mineral lazurite, with some pyrite and white calcite. Denim lapis is a low quality lapis with less lazurite and more white calcite.

## Lab Gemstones & Cubic Zirconia

### Kiln: Fast Ramp

Gemstone	Mineral Group	Mohs Scale	Maximum Suggested Firing Temp/Time			
			No Fire	Low Fire	High Fire	Torch
Lab Alexandrite	Synthetic	8.5			1650F/2H	✓
Lab Emerald <sup>1</sup>	Synthetic	7.5-8		1470F/30		
Lab Opal	Synthetic	5.5-6	✗			
Lab Ruby	Synthetic	9			1650F/2H	✓
Lab Sapphire Blue	Synthetic	9			1650F/2H	✓
Lab Sapphire Orange <sup>2</sup>	Synthetic	9			1650F/1H	✓
Lab Sapphire Yellow <sup>3</sup>	Synthetic	9			1650F/1H	✓
Lab Spinel	Synthetic	9			1650F/2H	✓
CZ Amethyst	Simulant	8.5-9			1650F/2H	✓
CZ Champagne	Simulant	8.5-9			1650F/2H	✓
CZ Emerald/Bright <sup>4</sup>	Simulant	8.5-9		1110F/10		
CZ Garnet	Simulant	8.5-9			1650F/2H	✓
CZ Light Amethyst	Simulant	8.5-9			1650F/2H	✓
CZ Olivine/Dark <sup>5</sup>	Simulant	8.5-9			1650F/1H	✓
CZ Orange <sup>6</sup>	Simulant	8.5-9		1560F/20		✓
CZ Pink	Simulant	8.5-9			1650F/2H	✓
CZ Tanzanite <sup>7</sup>	Simulant	8.5-9		1110F/10		
CZ Yellow	Simulant	8.5-9			1650F/2H	✓
CZ White	Simulant	8.5-9			1650F/2H	✓

<sup>1</sup>Temperature given is for hydrothermal grown gems.

<sup>2</sup>This stone can darken after 2 hours at 1650F. The color will become a bit more orange, more intense.

<sup>3</sup>This stone can darken after 2 hours at 1650F. The color will become a bit more orange, more intense.

<sup>4</sup>All bright green CZ's are extremely heat sensitive. Fire at 1110F/10 minutes for any bright green stone, regardless of color name.

<sup>5</sup>CZ's in the olive hue are stable up to 1650F for 1 hour.

<sup>6</sup>Orange CZ's can be fired up to 2 hours at 1650F, but color will fade.

<sup>7</sup>Tanzanite CZ's incur a very slight darkening, but no color loss at 1110F/10. Do not extend time. Extremely heat sensitive.

### The Moh's Scale

The Moh's Scale is a non-linear scale of hardness defined as resistance to scratching or abrasion.

On the Moh's scale, 10 represents the hardest material and 1 the softest. A diamond can scratch another diamond and anything softer than itself. A corundum cannot scratch a diamond, but it can scratch itself and anything softer than it, and onward down the scale to talc.

In viewing the Moh's scale, it would appear that corundum is almost as hard as diamond, but the Mohs scale is deceptive because it is non-linear. It has steps from 1 to 10, but they are not equal steps. If we compare the same chart of minerals on an absolute hardness scale it is apparent that rubys and sapphires (corundum minerals) are actually only 1/4 the hardness of diamond, not 90% as the Moh's scale would seem to suggest.

The Moh's scale can be helpful in identifying gemstones, but provides no information on what might happen in the kiln.

Mineral	Mohs Scale	Absolute Scale
Diamond	10	1600
Corundum	9	400
Topaz	8	200
Quartz	7	100
Feldspar	6	72
Apatite	5	48
Fluorite	4	21
Calcite	3	9
Gypsum	2	3
Talc	1	1