



FIRING CHART

	Palette MASK	MASK Powder	Palette Paste	Opaque Powder	Shoulder	Dentines/ Incisals	Natural Glaze	Glaze High Stains	Add On	Glaze Low LF Stains
Dry out	7 min	5 min	7 min	3-5 min	3-5 min.	3-5 min.	3-5 min.	3-5 min.	3-5 min.	3-5 min.
Insertion	482°C	593°C	482°C	593°C	593°C	593°C	593°C	593°C	515°C	515°C
	900°F	1100°F	900°F	1100°F	1100°F	1100°F	1100°F	1100°F	960°F	960°F
Heat rate ° / min.	55°C	55°C	50°C	50°C	50°C	50°C	50°C	47°C	55°C	55°C
	100°F	100°F	90°F	90°F	90°F	90°F	90°F	85°F	100°F	100°F
Vacuum start	482°C	593°C	482°C	593°C	593°C	593°C	None	None	Optional	None
	900°F	1100°F	900°F	1100°F	1100°F	1100°F				
Vacuum stop	971°C - 982°C	971°C - 982°C	954°C - 966°C	954°C - 966°C	941°C - 946°C	927°C - 938°C	None	None	Optional	None
	1780°F - 1800°F	1780°F - 1800°F	1750°F - 1770°F	1750°F - 1770°F	1725°F - 1735°F	1700°F - 1720°F				
Firing Temp.	977°C - 988°C	977°C - 988°C	960°C - 971°C	960°C - 971°C	946°C - 952°C	932°C - 943°C	932°C - 943°C	932°C	849°C	849°C
	1790°F-1810°F	1790°F - 1810°F	1760°F - 1780°F	1760°F - 1780°F	1735°F - 1745°F	1710°F - 1730°F	1710°F - 1730°F	1710°F	1560°F	1560°F
Hold Time	0	0	0	0	0	0	0	15 sec.	15 sec	15 sec
Cool Time	0	0	0	0	0	0	0	0	0	0
Texture	Semi-Gloss	Semi-Gloss	Eggshell-Shiny	Eggshell-Shiny	Eggshell	Grainy-Shiny	Shiny	Glossy	Glossy	-
Thickness (approx.)	Thin/ Wash	Thin/ Wash	0.1-0.3 mm	0.1-0.3 mm	0.2 mm	0.5-1.0 mm				

* The above temperatures are recommended and can vary with individual furnaces. The crucial factors for the firing temperatures are the appearance and the surface condition of the restoration after the firing process.

Recommended alloy CTE range : **14.1-14.7** x 10⁻⁶/°C @ 500°C

CERATEC PORCELAIN

INSTRUCTION MANUAL

A Dental Porcelain

featuring all of the characteristics
and products desired by the ceramist.



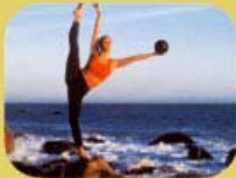
Ease of Handling and Modeling



Immediate and Accurate Shades



Translucency and Color Depth



Extremely Stable CTE



ceratec[®]

Absolutely Beautiful

CERATEC DENTAL PORCELAIN

INSTRUCTION MANUAL

CHARACTERISTICS

1. Great modeling ease, especially suitable for laboratories in which speed and accuracy are top priority.
2. Easy to use for the ceramist with little experience but with all of the properties and porcelains necessary for the expert ceramist.
3. Immediate and accurate shade matching with the mere application of opaque/dentine/incisal layering; color stability even for varied thickness.
4. Extremely stable linear expansion coefficients during subsequent firing processes; safely withstands up to six firing cycles.
5. Minimum shrinkage.
6. Great translucency and color depth.
7. Opaque, Dentine and Opacious Dentine available in all shades A0 – D4.
8. Wide color range 5 shoulder shades, 7 opaque modifiers, 9 dentine modifiers, 16 incisals and incisal modifiers, 11 stains.
9. “Live” and natural fluorescence in all light conditions.

CERATEC is the product to use for:

- Porcelain Fused to Metal (PFM) Crowns and Bridges
- Jacket Crowns
- Inlays - Onlays
- Veneers

NOTES ON ALLOYS AND FRAMEWORKS

1. FABRICATION OF THE MODEL AND DIE

During model and die preparation, keep in mind that porcelain fused to metal restorations require a minimum thickness of 1.5 to 1.8 mm of which 0.3 to 0.5 mm is the metal portion. The model can be prepared using the desired technique. Remember that the use of shoulder porcelain requires a proper shoulder preparation.

2. THE METALLIC FRAMEWORK

- 2.1. The modeling of the metallic framework can be performed with the desired technique. The space reserved for the ceramic covering should not be less than 0.8 mm. The ceramic layer should not exceed 2 mm in thickness on the incisal borders to avoid the risk of fractures.
- 2.2. Avoid creating sharp corners, indentations, angles or curved edges on the metal surface that is to be covered. Every sharp corner is a potential point of origin for fractures, while every indentation could cause defects in the ceramic fusing process or fractures due to the contraction that occurs during firing.
- 2.3. The ceramic must be well supported by the metal, especially in the areas of contact with the opposing dentition. In order to avoid fractures or separations, the points of contact between ceramic and metal should not coincide with the points of contact between opposing surfaces. At the same time, metal structures that are extremely open must offer great flexural stability, keeping in mind the necessary aesthetic and hygienic considerations, because any possible bending that might occur will cause fractures or separations of the ceramic.
- 2.4. It is possible to create complete or extensive arches in a single casting, but they should be made capable of withstanding lateral or flexural movements by way of a stabilizing bar that is sufficiently wide and can be left in place until the final glazing of the ceramic has been completed.
- 2.5. The surface of the metal structure that is to be covered must be perfectly clean, degreased and free of faults or porosity. It is recommended to use abrasives in aluminum oxide with a ceramic binder or carbides. Always grind or refinish in the same cutting direction of the instrument, without intersecting the cutting lines on the metallic structure. The finished and sanded structure must be washed with water using clean brushes. Avoid using oily substances such as soaps. Degrease with moderately acidic liquids or with a jet of steam.

3. CHOOSING THE ALLOY

- 3.1. In general, most of the alloys used for ceramic fused to metal restorations are compatible with CERATEC porcelains. However, since every alloy reacts differently with respect to the coefficient of expansion and can sometimes be unpredictable beyond the officially published data, we suggest that you utilize the alloys recommended for the product with a CTE in the range of $14.1 - 14.7 \times 10^{-6} / ^\circ\text{C}$, measured in the range of $25 - 500^\circ\text{C}$.
- 3.2. A practical compatibility test can be performed in the laboratory. Put a framework of at least six units through a minimum of six firing cycles. If there are no signs of cracks or fractures by the sixth firing cycle, the alloy is almost definitely compatible even with borderline operations.
- 3.3. If you should have any doubts about the alloy to use, contact CeraGroup Industries or your CERATEC distributor for more detailed information.
- 3.4. Be careful when re-casting alloys because in many cases this gives rise to substantial and unpredictable alterations in the expansion coefficient. Therefore, it is best not to add more than 50% of re-melted alloy to the new casting. It is also important to place the alloy in the crucible in such a way that during casting, the two alloys meld together while entering into the investment.
- 3.5. The linear coefficient of thermal expansion of CERATEC is included in the interval $12.60-13.0 \times 10^{-6} / ^\circ\text{C}$ for all porcelains ($25-500^\circ\text{C}$, opaque, dentine and incisal).
- 3.6. The glass transition temperature is between $480-500^\circ\text{C}$ for all CERATEC porcelains.

4. DEGASSING / OXIDATION

- 4.1 It is fundamental that the alloy go through a phase of heat degassing or oxidation in the oven muffle. Careful attention must be paid during the degassing of palladium-silver alloy, even though the manufacturer might state that oxidation is not necessary.
- 4.2 Always verify that the oxidation layer is sufficient but not excessive as a layer that is too thick compromises the porcelain-metal bond and becomes a potential separation point of the interfaces.

5. ALLOYS CONTAINING SILVER

- 5.1 Alloys containing a high percentage of silver may generate discoloration

- phenomena resulting in a greenish shade to the porcelain. This is caused by the volatilization of some silver oxides that tend to attach themselves onto the porcelain and on the refractory material of the oven muffle and recirculate during successive firing cycles. In order to avoid this occurrence, be sure to decontaminate the oven periodically (at least once a week).
- 5.2 CERATEC porcelains are manufactured with a non-greening chemistry, however, in order to increase safety levels, it is wise to adopt a specific program of muffle decontamination, closely adhering to the oven manufacturer's instructions.
- 5.3 Alloys should be sandblasted using Aluminum Oxide of 100-110 microns in order to clean the surface of the alloy and to better create an adequate mechanical bond

WORK TECHNIQUE

1. TREATMENT OF MIXTURES AND MODELLING

- 1.0. CERATEC porcelain can be mixed and modeled using the desired techniques, including condensed onto the model, pre-vibrated onto a mixing slab, pre-condensed onto a mixing slab and brush or spatula modeled.
- 1.1. During the preparation and working of the porcelain powder, remember that certain actions can lead to modifications of some of the material's characteristics:
- 1.1.1 The porcelain should be mixed and moistened on a flat surface and not inside of deep wells. When mixed in the well, the liquid tends to deposit itself on the bottom, pulling with it finer particles and color pigments. This can modify the condensation characteristics of the porcelain as well as the resulting color.
- 1.1.2 The drying of the liquid in excess after mixing should never be done from above, but always from the side of the moistened powder body. The liquid emerges due to capillary action, pulling with it finer particles and color pigments. Drying from above by way of absorption draws up the finest particles, which are principally responsible for the natural glaze, and modifies the porcelain's coefficient of thermal expansion.
- 1.1.3 Drying of the restoration that is being modeled after condensation should always be done from the lower edge by simply dabbing it with the absorbent material. In this case, the ceramic powder itself acts as a filter, entrapping the fine particles and allowing only the liquid to flow out due to capillary action.
- 1.1.4 The dried porcelain can always be remoistened with either distilled water or Modeling Liquid and condensed for additional modeling. Remix the dried mixtures carefully.
- 1.2 The more pre-condensed is the porcelain on the mixing slab, the greater the

handling qualities. There are substantial advantages in modeling drier and pre-condensed porcelain:

- It reduces condensation on the framework, which is always dangerous for the granulometric integrity, the coefficient of thermal expansion, the auto-glazing capacity and the chromatic qualities of the porcelain.
- It increases the compactness of the porcelain, which results in better translucency and greater hardness.
- It reduces contraction during firing, which avoids excessive over modeling of the restoration.

1.2.1 However, it is not always possible to keep to a strong pre-condensation, especially when complex aesthetic treatment is foreseen, creating the need for chromatic layers and supports that are differentiated in depth as well as in extension. In all of these cases, there are no contraindications in adapting the fluidity of the mixture to the work being done.

1.2.2. Whenever possible, however, it is recommended to work in accordance with the instructions given above. At least partial pre-condensation of the powder, careful drying at the side or lower edge so as not to lose granulometric consistency and coloring pigmentation, and preparation on flat surfaces instead of bowls, will result in more consistent, higher quality restorations.

1.3. If you should prefer to model with a spatula, it is recommended to proceed with porcelain that has been condensed and brought to the proper level of compactness on the mixing surface.

1.3.1 The optimal state in which the porcelain should be mixed for modeling is well condensed and dried, plastic and pliable without being runny.

2. METAL CONDITIONER

2.1 Met-Con is a bond enhancer and color controller designed for optional use with alloys that produce excessive oxides. Met-Con is compatible with all CERATEC porcelains.

2.2 Either expel Met-Con Paste from the tube or mix the Met-Con Powder and Liquid to a thin slurry and apply to the surface that will receive the porcelain. A thin even coat should be applied. Dry slowly in front of the muffle until a white chalky surface appears. Fire according to the recommendations in the CERATEC firing chart.

3. APPLICATION OF THE OPAQUES

- 3.1 In addition to its functions of opacifying and bonding to metal, the opaque provides the fundamental color for the fixed prosthetic restoration. The proper, complete and uniform layering of the opaque is therefore a primary premise for the final chromatic result.
- 3.2. In general, the lighter the opaque, the more light that will be reflected on the treated surface. The final color will be more luminous and will seem lighter. The darker the opaque, the more the final chroma will be heightened, at the expense, however, of an increased opacity, resulting in a color that seems more saturated. For this reason, modest but interesting variations in base color value can be obtained by substituting or flanking, within the same color dominant, a lighter shade of opaque with a darker shade and vice versa ie: substituting completely or in limited areas the opaque A3 with the opaque A2 (lighter) or A4 (darker). Only after much practical color experience, however, will it be possible to opaque dominants as the color result is difficult to predict.

The opaquing system begins with MASK, a first coat ceramic material with exceptional masking abilities that is available in aerosol spray, paste or powder packaging.

- 3.3. There are 18 opaque porcelains, one for each dentine shade A0 – D4, available in both powders and pastes Ceratec opaques are the foundation of the shade and therefore are in the same color range as the Dentines, Chroma Dentines and Opacious Dentines.
 - 3.3.0 When using the Mask spray, an extremely fine layer will produce excellent results. Spraying on this first layer is best accomplished with the restoration still on the die(s) to eliminate the need to remove opaque form the inside of any coping. Ceratec opaque powders are the finest grain opaque powders available. This allows complete coverage with a very thin layer.
 - 3.3.1 Mask is a neutral opaque material with a composition which allows it to be used as a first opaque layer under all shades other than A0 or B0, creating a thin but effectively masking wash opaque layer.
 - 3.3.2 Opaque or Mask powder can be mixed with distilled water. However, this is best done with CERATEC Opaque Liquid to provide the creamiest most homogeneous mix possible. Because ceratec opaques are very fine grain opaques they can be applied in a thicker layer and will fire to a very thin but opacifying coverage

- 3.3.3 If using opaque or Mask paste, open the jar and mix the paste to a homogeneous consistency using a glass spatula. Remove the required amount from the jar and apply over the metal with a glass instrument or a brush pre-moistened with CERATEC Paste Liquid. If it is determined that the paste consistency needs to be thinned with a very small amount of Paste Liquid, remove the desired amount from the jar and mix with Paste Liquid on a glass slab.
- 3.3.4 Layer the opaque, vibrating slightly to obtain a good contact. Place into muffle area at a muffle temperature no higher than 600 C for powders or 400 C for pastes. Dry and fire according to the firing chart indications for opaques. Allow the restoration to cool and treat it with a jet of steam.
- 3.3.5 Mix the opaque in a creamier or denser way and apply it as a second layer with the proper brush or glass instrument. With a well-coated brush or instrument, allow the material to slide onto the framework, vibrating very gently to obtain a uniform and homogeneous flow. Be certain that the distribution is homogeneous and that all of the metal is well coated. After firing, the metal structure should not be visible. Should this not be the case, retouch and perform a third firing cycle. Any sort of correction or addition can be made on a layer of dry unfired opaque by re-moistening the dry surface. The second opaque layer, either powder or paste, should be applied in the same fashion but applied as a thicker, creamier coat.
- 3.3.6 In the case of non-precious alloys, you may model the opaque body about 1 mm beyond the metallic margin to avoid the formation of dark oxidation borders. Reduction should be performed only after the final firing. A thickness of about 0.2 mm is necessary to obtain a good opacifying and color effect.
- 3.3.7 Do not use excess liquid for wetting the brush or to alter the consistency because this will detrimentally affect the handling of the paste. Do not be afraid of applying a thick layer of paste. Once the paste is dried and fired, the final thickness of two layers of opaque will be less than 0.2 mm.
- 3.4. Opaque Modifiers:
The following opaque modifiers are available in both powder and paste
- White
 - Yellow
 - Ochre
 - Brown
 - Gray
 - Pink
 - Orange

4. SUGGESTED LAYERING

- 4.1. Due the excellent translucency of CERATEC porcelains, proper shade can be obtained even in cases of minimal reduction of the preparation. With the desired

- 1.5mm of space, accurate shades can be obtained. exclusively with the opaque, dentine, and enamel or incisal porcelains.. In case of limited reduction of the preparation the use of chroma dentine or opacious dentine allow for excellent shade matching with reduced porcelain thickness.. Please see the illustrations and photos below and follow the appropriate layering techniques depending upon available space. In order to obtain a good color result, the layering should have a minimum thickness of 1.2 to 1.3 mm (in addition to the thickness of the opaque layer) and about 2 mm overall in the occlusal and incisal areas. Lesser thicknesses create the need to reinforce the color with modifiers.
- 4.2. This layering is simple and immediate and allows for considerable savings of time and high productivity, if all work instructions are followed perfectly, particularly those regarding handling and firing procedures. Any variation in the recommended methods could bring about possible color modifications, which would result in a more complicated subsequent layering for shade attainment.
 - 4.3. If an advanced chromatic operation is planned, one can create as complex a layering scheme as desired. Even in these cases, the loss of simplicity in the work will be amply compensated by the aesthetic results obtained.
 - 4.4. CERATEC porcelain has an extremely small sintering contraction or shrinkage (up to 12% if modeled from pre-condensed mixes). Overbuild slightly to compensate for dimensional sintering contraction, but not excessively, especially if you are using the spatula technique. The brush technique, when used with porcelains that are not pre-condensed, causes a slightly higher sintering contraction.
 - 4.5. Always insulate the parts of the model that could have potential contact with the porcelain to be modeled with Shoulder SEP Liquid, preventing the stone model from absorbing the Modeling Liquid.
 - 4.6. If the entire form of the crown is built with dentine, cut back for the incisal layer, being careful that all of the edges are well blended to obtain gradual and coordinated chromatic passages.
 - 4.7. The occlusal surfaces of molars and premolars must have profiles that are not excessively pronounced or sharp. Mastication produces forces that, when applied in the direction of the cut, can lead to a premature fracturing of the ceramic. The optical plasticity should be sought instead through substitute chromatics like the use of “cold” colors on the walls of the fossa or dark colors on the inside of the profiles of the fossa.
5. DENTINE AND INCISAL PORCELAINS
 - 5.1 Dentine porcelains

There are 18 dentine porcelains, one for each shade A0 – D4

5.2 Chroma Dentines

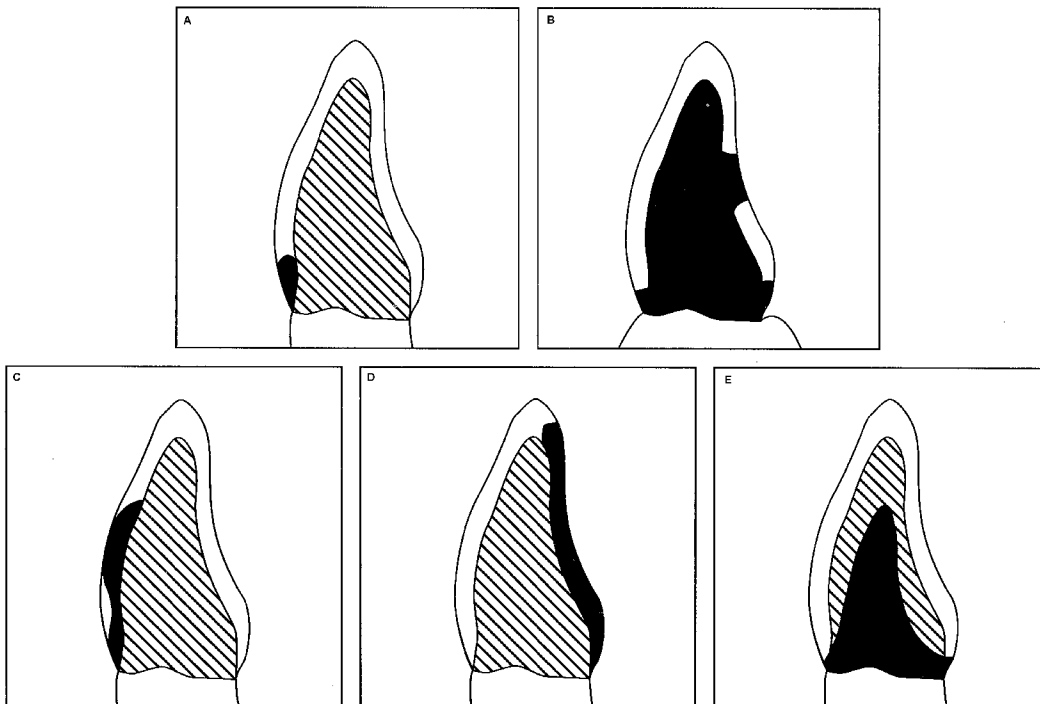
There are 18 chroma dentines, one for each shade A0 – D4. Ceratec Chroma Dentines are in the same color range as the corresponding Dentine porcelains but higher in chroma and therefore less translucent.

5.3. Opacious dentines

There are also 18 opacious dentines, one for each shade A0 – D4. Ceratec Opacious Dentines are in the same color range as the corresponding Chroma Dentine porcelains but higher in chroma and therefore even less translucent. They possess such a good opaquing capacity that they can be used when the base opaque appears too evident or in those modeling areas that are chromatically critical.

Note: Differences in color and appearance may be noted between the restoration on the model and in the mouth, particularly when the intraoral illumination of the restoration is well defined. Cervical zones of intermediate proximity to the gingival mucosa can give dark reflections to the dentine, making the other parts of the restoration appear lighter by contrast. In other areas that are closest to the cervical margin, the color of the opaque can be accentuated because of an excessively thin dentine layer.

5.3.1 Major uses for opacious dentines are:



- A. Thin dentine areas, especially those close to the margin. In these areas, a layer of opacious dentine can be modeled in order to avoid chromatic variations in relation to the other areas of the tooth.
- B. Sub gingival areas of the restorations. In these areas, a layer of opacious dentine can be modeled in order to reproduce the exact color and reduce the shadow effect due to the presence of the gingiva and to the scarce quantity of light present.
- C. Central labial areas. In these areas, a good layering of opacious dentine allows for interesting chromatic effects permitting the reproduction of secondary pigmentation without affecting the overall chromatic character of the restoration.
- D. Inter dental spaces. The use of a layering of opacious dentine in these zones lends a more natural appearance to the restoration through better light reflection and a reduction of the shadow effect.
- E. Posterior zones (lingual and palatal). A layering of opacious dentine helps to camouflage the presence of visible metal collars.

5.4 Incisal Porcelains

The incisal porcelains are highly translucent as compared to dentine porcelains. During the layering process, remember that the chromatic effect of the incisal porcelain is that of reducing the color saturation of the dentine while increasing luminosity. It is critical to remember that a general incisal layering of the surface of the restoration leads to an overall grayish appearance. CERATEC dentine porcelains are highly translucent and when covered with the more translucent incisals, the effect is a grayish appearance. Therefore when a more saturated or intense color is desired, apply the incisal only to the incisal third of the restoration. Apply incisal porcelains in very thin layers. If a greater luminosity is desired or less dentine color saturation, apply the incisal in thicker layers.

- 5.4.1. Six high translucent incisal porcelains are recommended to be used according to the following chart:

DENTINE	INCISAL
A0 and B0	I-6
A1, B1, C1 and D2	I -1
A2, B2 and D3	I -2
A3, C2 and D4	I -3
A3.5, B3, B4 and C3	I-4
A4 and C4	I -5

Additional Incisals available include:

Violet White Pink Blue Yellow Translucent

Opal Incisals include:

Opal Incisal Clear
Opal Incisal Light
Opal Incisal Medium
Opal Incisal Dark

Additional Enamels (Incisals less translucent) E1, E2, E3, E4 are available for combining with shades depending on effects desired by the technician. See relative opacity and color combination charts in the annex.

5.4.2 The additional incisal shades may be used alone or may be used as incisal modifiers for the other shades.

5.5 Gingival porcelains

The following porcelains are available for characterizing the gingival zones:

- Gingival Light
- Gingival Dark

5.6 Modifiers

Nine porcelains for color modification of incisal and dentine porcelains are available:

White	Pink
Yellow	Violet
Orange	Blue
Gray	Ochre
Brown	

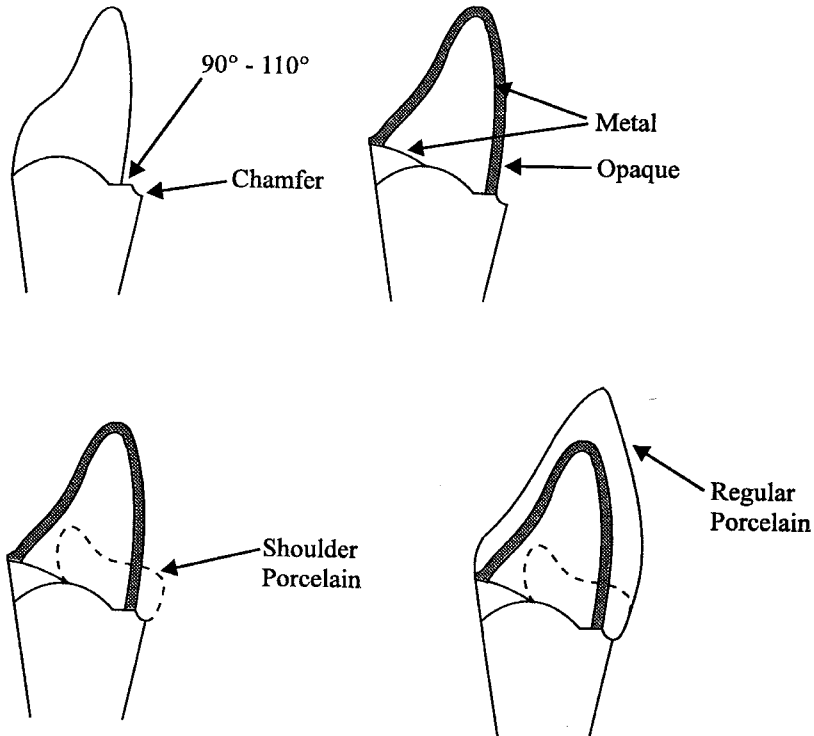
6. SHOULDER PORCELAIN

6.1. In porcelain fused to metal crowns, the visibility of the metallic part on the cervical border can produce a crown margin that is dark or gray, detracting from the aesthetic appearance. To remedy this inconvenience, many experts recommend modeling the cosmetic shoulder without metal. However, dentine porcelain would not provide a perfect seal due to the sintering contraction and the

rounding of the margins. For this reason, the modeling of these parts is done with shoulder porcelain.

- 6.2. The shoulder must be prepared in a clean step. The internal angle may be rounded but the external angle must be between 90 and 110 degrees. The preparation must be 1 – 2 mm deep in order to guarantee a good appearance. The step must not be covered in metal (the metal must end before the floor of the step). The metal can be extended to the step only when there is sufficient space available.
- 6.3. There are five shoulder porcelains, in varying degrees of chroma and are recommended to be used according to the following chart:

SHOULDER	RECOMMENDED SHADE
BLEACH	A0,B0
LIGHT	A1,B1,C1,D2
MEDIUM-LIGHT	B2,D3
MEDIUM	A2,A3, C2,D4
MEDIUM-DARK	A3.5, B3, B4
DARK	A4,C3,C4
DILUENT	AS NEEDED



- 6.4 Apply and fire the opaque porcelain as previously recommended. Technique for the application of shoulder bodies:
- a. Mark the margin of the preparation with a pencil or felt tip pen.
 - b. Insulate the shoulder of the preparation with a thin layer of the Shoulder SEP.
 - c. Position the crown carefully on the die. Mix the shoulder powder with Shoulder SET Liquid, which will allow the powder to harden on the die allowing safe removal of the restoration without affecting the unsupported porcelain. Apply the shoulder porcelain with little or no vibrating and adapt it accurately to the margin, carefully drying the porcelain.
 - d. Mark the margin of the shoulder with a pencil and allow the applied porcelain to dry for a few minutes. Remove the crown from the die and extract the excess porcelain from the inside of the crown.
 - e. Fire the shoulder according to the recommended cycle.
 - f. Check to see if a second addition of shoulder porcelain is needed due to the sintering contraction. If so, apply the necessary porcelain vibrating slightly and repeat the firing procedure.
 - g. Continue with the restoration according to the previously recommended techniques.

7. SPECIAL STAINS (SURFACE COLORS)

7.1 Stains are highly pigmented powders that should always be used in limited quantities due to their strong coloring effect. They can be used mixed with the normal CERATEC porcelains as color modifiers, paying attention to accurate mixing and their strong chromatic effect, or in combination with glazes. In this case, be sure that the surface of the restoration is perfectly clean before proceeding with the application. Remember that an excessive amount of stain gives a greater opacity to the inside of the restoration due to the lesser light transmission. Therefore, always apply them in a thin and well-blended layer.

7.2. The stains are available in the following colors:

White	Blue
Yellow	Black
Orange	Green
Gray	Ocher
Pink	Violet
Brown	

- 7.3 Stains are to be used alone or in a combination with the glazes. They should be fired according to the tables given for the appropriate glaze. When mixed with other CERATEC porcelain powders, they are to be fired according to the instructions given for the porcelain being used.

8. GLAZING AND CORRECTION

8.1 Natural Glazing

If the ceramic has been sintered to perfect maturation, a natural glaze can be done without the use of the specific glaze powders or pastes.

- 8.1.1 After all necessary morphological corrections have been completed, proceed with polishing using the desired instruments or polishing paste appropriate for porcelain. Add or correct any morphological effects or characterizations. Fire the restoration according to the recommended firing cycle.

8.2 Glazes

If a perfect glaze effect is desired, or if the previous firing of the porcelain left a surface texture that was unsatisfactory for a natural glaze, it is recommended to use an artificial glaze. Glazing gives the tooth a greater surface shine that is moist and silky and appears similar to the surface of the shade guide.

Glazes are available in both powder and paste as:

- Glaze High
- Glaze Low

- 8.2.1 Glaze powder must be mixed with Stain and Glaze Medium. Mix a small quantity of the appropriate powder with Stain and Glaze Medium and apply an extremely thin layer onto the restoration.

- 8.2.2 Glaze Pastes may be mixed on the mixing slab or applied directly to the restoration.

- 8.2.3 Each glaze must be fired according to the appropriate cycle on the firing chart.

- 8.3 After all the necessary morphological corrections have been made, polish using the desired instruments or polishing paste appropriate for porcelain. Add or correct any morphological effects or characterizations. Expel the selected Glaze Paste or mix the selected powder into a creamy and fluid consistency and apply a very fine layer with a brush. During this procedure, stains can be layered alone or mixed with the glaze. Slowly place the restoration into the oven and fire without engaging vacuum according to the firing chart.

8.4 Correction with Add On porcelain

Seven Add On porcelains are available:

ADD ON

Opaque Light
Opaque Dark
Dentine Light
Dentine Medium
Dentine Dark
Incisal Clear
Incisal Light

- 8.4.1 If it is necessary to make slight corrections after the final firing procedures, CERATEC Add On correction porcelain can be used. Firing can be done at the same time as that of the Glaze Low without vacuum. CERATEC Add On must only be used in small quantities. When placed in the contact area, they tend to harmonize chromatically with the adjacent porcelain.
- 8.4.2 Treat the concerned surfaces with an abrasive and wash carefully. Apply the correction porcelain mixed with Modeling Liquid, keeping in mind the firing shrinkage. Fire according to the chart with or without vacuum as preferred. The surface appearance will be shiny and will harmonize with any previously glazed surface. Pay attention to the previously prepared glaze while polishing the newly prepared one.

9. MIXING AND MODELLING LIQUIDS

The following mixing and modeling liquids are available:

- Met-Con Liquid: a special liquid used in the mixing of Met-Con metal conditioner.
- Opaque Liquid: a special liquid to be used in the mixing of Opaque powders. When used, this liquid will provide an opaque powder mix that is creamier and easier to apply the metal. Also used for moistening the brush for enhancing the application of paste opaques porcelains.
- Modeling Liquid: a special liquid for use with dentine and incisal porcelains to enhance the building and modeling of the ceramic as well as improving the density of the fired restoration.

- Modeling Colors: intense organic colors used alone or mixed with distilled water or Modeling Liquid for enhanced visual control during the building process. Available in Red, Blue, Yellow and Green.
- Stain and Glaze Medium: a special liquid to be used only for the mixing of glaze and stain powders.
- Shoulder SET: this liquid is used in the mixing of shoulder powders allowing the shoulder to harden on the die facilitating removal without affecting unsupported porcelain.
- Shoulder SEP: a separating medium used over the stone model to prevent adherence of the porcelain to the stone.

10. OTHER APPLICATIONS

10.1 VENEERS

Prepare a refractory die following the instructions of the investment manufacturer. Apply a thin layer of opacious dentine over the labial surface and fire according to recommendations in the firing chart. If necessary, apply a second coat of opacious dentine and fire using the same firing cycle. Continue the veneer build up with dentine and incisal porcelains as required and fire according to the recommended cycle. Continue with standard veneer procedures.

10.2 INLAYS – ONLAYS

Prepare a refractory die following the instructions of the investment manufacturer. Place opacious dentine into the mold cavity in small increments. Do not overbuild and do not bring the material to the margins. Leave a small space of refractory near the margin. Fire this layer as per the recommendations in the firing chart. Apply a second layer of opacious dentine, again using the same firing cycle. A third layer may be added as needed for additional strength or opacity. Continue building the restoration to full contour with CERATEC dentine and incisal porcelains. It is not necessary to overextend the margins. Fire according to the recommendations in the firing chart and proceed with normal inlay – onlay procedures.

10.3 PORCELAIN JACKET CROWNS

Prepare a refractory die following the instructions of the investment manufacturer. Apply a thin layer of opacious dentine to the predetermined area and fire according to the recommendations in the firing chart. Because two thin layers are recommended rather than one thick layer, apply a second layer and fire again using the same firing cycle. A third layer may be added as needed for additional strength or opacity. Continue the build up to full contour using CERATEC dentine and incisal porcelains and fire according to the recommendations in the firing chart. Continue with standard jacket crown procedures.

SINTERING (FIRING PROCESS)

1. NOTES ON THE FIRING PROCESS

- 1.1 The temperature instructions given are guidelines. Porcelain is a mineral substance that does not have a clearly defined maturation point, but has a maturation interval.
- 1.2 Each technician must decide which level of porcelain maturation is most suitable for his or her style. Properly matured porcelain has a fine eggshell surface texture and a good luster. If the surface texture is opaque, soft or granular, the sintering temperature was too low. If the surface is too smooth and too lustrous, the sintering temperature was too high and the color will lack strength or be too light. The technician must acquire familiarity with optimal temperature needed for his or her oven and working habits, following the guidelines for each specific porcelain as established in the CERATEC firing chart.
- 1.3 CERATEC porcelains display an excellent level of sintering maturity in the interval of 910-960 °C.
- 1.4 The recommended high temperature for dentine and incisal porcelains is 921°C.
- 1.5 If the porcelain is fired to perfection, that is, if it displays a glossy, fine, eggshell texture, it is possible to omit the glazing procedure or simply move on to natural glazing. If the porcelain is fired at a slightly lower or slightly higher temperature, the natural glaze may not be sufficient and the appropriate glazing porcelain can be used.
- 1.6 Opaques require a slightly higher temperature (+ 30°C). Low Glaze and correction porcelains, on the other hand, require lower temperatures.
- 1.7 Do not fire the opaque at a temperature that is too low or the coloring pigments do not mature properly and the chromatic yield can vary greatly.
- 1.8 Do not insert the porcelain at a temperature that is too high. The immediate vitrification of the surface layers will inhibit the emission of air, leaving porosity that will cause color variations and structural weaknesses in the restoration.
- 1.9 Do not fire additional layers of porcelain at temperatures that are too low. Always fire at the same temperatures for the same porcelains.
- 1.10 Do not fire the porcelain at a temperature that is too low out of caution of for safety reasons. The porcelain must arrive at perfect maturity in order to fully offer all of its chromatic characteristics.

- 1.11 Do not impose rates of temperature increase that are too high or the coloring pigments will not have the time to mature and the color yield will be imperfect.
- 1.12 Always air cool CERATEC porcelain by immediately opening the oven and directly removing the restoration upon completion of the firing cycle. Slow cooling raises the coefficient of expansion and pushes CERATEC porcelain beyond the predisposed values for the product.
- 1.13 The maximum number of firing processes that can be performed safely is six. Beyond this limit, it is best to work CERATEC Add On porcelain.

2. THE CERAMIC OVEN

- 2.1 CERATEC porcelains can be fired in all commercial ceramic ovens with temperature levels and rates of temperature increase that are compatible with the CERATEC firing chart.
- 2.2 Every oven possesses its own characteristics, even identical products, especially after a long period of use. Different series of the same model vary in temperature calibration, muffle characteristics and heating elements, in addition to rates of temperature increase. The maturation of the porcelain is based on time and temperature. Every oven will behave in a slightly different way regarding porcelain maturation. The firing temperatures, from 590 to 950°C, are only suggested temperatures. It is important to familiarize yourself with the optimal temperature necessary for your oven, without, however, adopting this temperature as an absolute value for other ovens.
 - 2.2.1 Horizontal ovens may require a temperature that is 10 – 20°C higher.
- 2.3 As has already been indicated, the phenomenon of greenish discoloration caused by alloys containing silver arises from the volatilization of silver components that attach themselves to the inner coating of the oven. If alloys containing silver are used, decontaminate your oven periodically (at least once a week) following the manufacturer's instructions.

3. STANDARDS

CERATEC porcelains meet the following standards:

- ISO 6872/95 Dental Ceramic.
- ISO 9693/99 Metal-ceramic restorative systems.

The fundamental requirements are as follow:

- **Uniformity:** no segregation of the pigments shall take place when the powder is mixed with the recommended liquid.
- **Freedom from extraneous materials:** material shall be free from extraneous materials when assessed by visual inspection.
- **Radioactivity:** Ceramic shall have a radioactive emission of not more than 0.2 Bq-g^{-1} of U238.
- **Flexural strength:** minimum 50 MPa.
- **Chemical solubility:** Loss in mass, $100 \mu\text{g/cm}^2$ max.
- **Adhesion to alloys:** The adhesion between the ceramic and at least one specified metallic material shall be greater than 25 MPa.

4. TECHNICAL DATA

- **Radioactivity:** There are no radioactive elements in CERATEC porcelains compositions. The total radioactivity is less than 0.2 Bq-g^{-1} of U238.
- **Toxic or harmful elements:** CERATEC porcelains are completely free of Lead, Uranium, Antimony and Cadmium.
- **Flexural strength:** 125 MPa with a standard deviation of 10 MPa.
- **Chemical solubility:** $55 \mu\text{g/cm}^2$.
- **Adhesion to alloys:** 36.8 MPa as tested with CERAKAST 1 non-precious alloy.
- **Linear thermal expansion coefficient:** Opaque: after two firings: $12.6 \times 10^{-6}/^{\circ}\text{C}$; after four firings: $12.8 \times 10^{-6}/^{\circ}\text{C}$ (25-500°C).
- Dentine: after two firings: $12.8 \times 10^{-6}/^{\circ}\text{C}$; after four firings: $12.95 \times 10^{-6}/^{\circ}\text{C}$ (25-500°C).
- Incisal: after two firings: $12.6 \times 10^{-6}/^{\circ}\text{C}$; after four firings: $12.9 \times 10^{-6}/^{\circ}\text{C}$ (25-500°C)
- **Glass transition temperature:** Between 480-500°C for all CERATEC porcelains.
- **Specific gravity:** 2.7 g/ml

CERATEC COLOR COMBINATION TABLE

OPAQUE	A0	A1	A2	A3	A3.5	A4	B0	B1	B2
SHOULDER	Bleach	Light	Medium	Medium	Medium Dark	Dark	Bleach	Light	Medium Light
OP. DENTINE	A0	A1	A2	A3	A3.5	A4	B0	B1	B2
DENTINE	A0	A1	A2	A3	A3.5	A4	B0	B1	B2
ENAMEL	E1 E4	E1 E4	E1 E3	E1 E3	E1 E2	E1 E2	E1 E4	E1 E4	E1 E3
INCISAL	I-6	I-1	I-2	I-3	I-4	I-5	I-6	I-1	I-2

OPAQUE	B3	B4	C1	C2	C3	C4	D2	D3	D4
SHOULDER	Medium Dark	Medium Dark	Light	Medium	Dark	Dark	Light	Medium Light	Medium
OP. DENTINE	B3	B4	C1	C2	C3	C4	D2	D3	D4
DENTINE	B3	B4	C1	C2	C3	C4	D2	D3	D4
ENAMEL	E1 E2	E1 E2	E1 E4	E1 E3	E1 E2	E1 E2	E1 E4	E1 E3	E1 E3
INCISAL	I-4	I-4	I-1	I-3	I-4	I-5	I-1	I-2	I-3

CERATEC PORCELAIN RELATIVE OPACITY CHART



Opacity ±
%

Opaque	100
Shoulder	92-95
Opacious Dentine	90-95
Chroma Dentine	85-90
Dentines	80-85
Enamel E4	75
Enamel E3	70
Enamel E2	65
Enamel E1	55
Incisal	40-50
Translucent	25



FIRING CHART

	Palette MASK	MASK Powder	Palette Paste	Opaque Powder	Shoulder	Dentines/ Incisals	Natural Glaze	Glaze High Stains	Add On	Glaze Low LF Stains
Dry out	7 min	5 min	7 min	3-5 min	3-5 min.	3-5 min.	3-5 min.	3-5 min.	3-5 min.	3-5 min.
Insertion	482°C	593°C	482°C	593°C	593°C	593°C	593°C	593°C	515°C	515°C
	900°F	1100°F	900°F	1100°F	1100°F	1100°F	1100°F	1100°F	960°F	960°F
Heat rate ° / min.	55°C	55°C	50°C	50°C	50°C	50°C	50°C	47°C	55°C	55°C
	100°F	100°F	90°F	90°F	90°F	90°F	90°F	85°F	100°F	100°F
Vacuum start	482°C	593°C	482°C	593°C	593°C	593°C	None	None	Optional	None
	900°F	1100°F	900°F	1100°F	1100°F	1100°F				
Vacuum stop	971°C - 982°C	971°C - 982°C	954°C - 966°C	954°C - 966°C	941°C - 946°C	927°C - 938°C	None	None	Optional	None
	1780°F - 1800°F	1780°F - 1800°F	1750°F - 1770°F	1750°F - 1770°F	1725°F - 1735°F	1700°F - 1720°F				
Firing Temp.	977°C - 988°C	977°C - 988°C	960°C - 971°C	960°C - 971°C	946°C - 952°C	932°C - 943°C	932°C - 943°C	932°C	849°C	849°C
	1790°F-1810°F	1790°F - 1810°F	1760°F - 1780°F	1760°F - 1780°F	1735°F - 1745°F	1710°F - 1730°F	1710°F - 1730°F	1710°F	1560°F	1560°F
Hold Time	0	0	0	0	0	0	0	15 sec.	15 sec	15 sec
Cool Time	0	0	0	0	0	0	0	0	0	0
Texture	Semi-Gloss	Semi-Gloss	Eggshell-Shiny	Eggshell-Shiny	Eggshell	Grainy-Shiny	Shiny	Glossy	Glossy	-
Thickness (approx.)	Thin/ Wash	Thin/ Wash	0.1-0.3 mm	0.1-0.3 mm	0.2 mm	0.5-1.0 mm				

* The above temperatures are recommended and can vary with individual furnaces. The crucial factors for the firing temperatures are the appearance and the surface condition of the restoration after the firing process.

Recommended alloy CTE range : **14.1-14.7** x 10⁻⁶ /°C @ 500°C

