Focus Edition from GC

Phosphate Bonded Investments for C&B techniques

Table of contents

Introduction 3

Guidelines for optimal use of phosphate bonded investments for Crown & Bridge techniques 5

1 Preparation before investing 6

2 Expansion and investing 12

3 Heating up / Burnout procedures 18

4 Casting 23

5 Effects of the main factors influencing the casting results 25

6 The GC Europe range of Phosphate bonded investments for C&B techniques 26

7 Related products 27

Troubleshooting Phosphate Bonded Investments for C&B techniques 29

1 Investment sets too quickly 30

2 Investment sets too slow 31

3 Differences in Investment texture (too thin or too thick, not consistent) 31

4 Rough casting surfaces (pits, nodules and porosities) 32

5 Investment cracking (fins on the castings, miscasting ….) 34

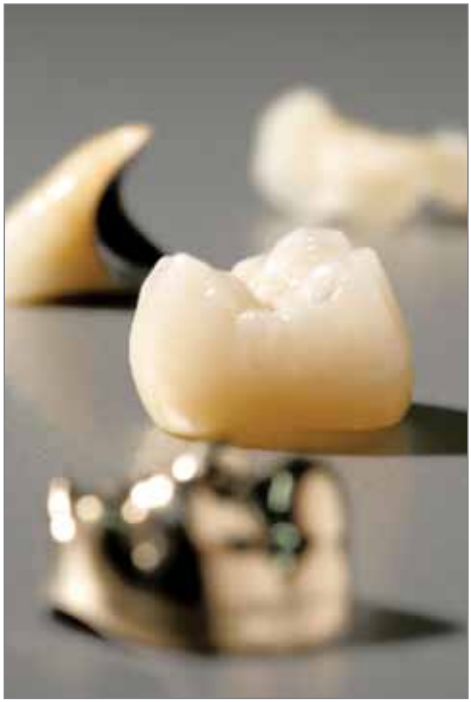
6 Incomplete castings & rounded cervical edges 36

7 Inaccurate fit of casting objects 37

Instructions for use for implantology 39

Optimal fit, a simple step by step procedure 49

Clinical Cases 59



For more information on GC products please visit our website www.gceurope.com

Introduction

Dear Customer,

Thank you very much for selecting GC Europe's Phosphate Bonded Investment material for your crown and bridge technique. You have purchased high quality products which have been specifically designed to produce consistently accurate castings and meet the production requirements of the modern dental laboratory.

The construction of high quality crown and bridge restorations is dependant both on precise workmanship and a clear understanding of the processing instructions of the various materials involved in the dental casting process.

The aim of this document is to help you understand our products in more detail and provide useful information that will help you to avoid mistakes and potential problems in the future, by identifying the optimal techniques for their use and by analysing the various problems that can occur if 'best practice' is not followed.

Whilst we have tried to be as comprehensive as possible no guide can cover every eventuality, so should you require further any assistance please do not hesitate to contact your local GC representative.

Guidelines for optimal use of phosphate bonded investments for Crown & Bridge techniques

This chapter will help you understand our Phosphate Bonded Investments for C&B techniques in more detail and provide useful information that will help you to avoid mistakes and potential problems in the future, by identifying the optimal techniques for their use and by analysing the various problems that can occur if 'best practice' is not followed.

1 Preparation before investing

1.1 Instruction for Use

When working with our investments it is imperative that the 'Instructions For Use' are consulted from the outset as they offer you a clear summary of each working stage, based both on the results of comprehensive laboratory testing, carried out by the GC Europe Research and Development Department in combination with an extensive range of casting trials.

Each investment type has its own specific characteristics that should be taken into account to guarantee consistently accurate results.

However because the working methods and equipment can differ between individual dental laboratories (e.g. waxes, resins, casting liner, mixing equipment, etc.) it is possible that differing end-results may be obtained.

Each package of GC investment contains multilingual 'Instructions for Use' and it is important that you use the latest version included with your material as this information is under a process of continual review.

The latest instructions for use are always available at the download section of our website **www.gceurope.com**.

1.2 Storage

When used on a regular basis the powder and liquid may be stored at normal room temperature (21-23°C), this is also the optimal working temperature. However for longer term or bulk storage a slightly lower temperature is preferable (please also see point 2.3).

The storage environment must be dry to avoid the risk of exposing the powder to humidity (this is particularly important once a package has been opened) which will cause it to react in an unpredictably fast manner.

It is important that the liquid is never stored below 5°C as once it has frozen it can no longer be used and must be discarded. Pay particular attention to winter deliveries, if debris or crystals are present in the liquid, it must never be used!

The bottles should always be kept tightly sealed and away from direct sunlight to avoid problems caused by evaporation.

1.3 Working temperature

The working temperature of the investment powder and liquid are critical factors in determining the setting time, expansion, surface roughness and consequently the final fit of the castings.
The optimal working temperature of both powder & liquid is 21-23°C, this must be considered if either the room temperature is lower than this or the materials have been stored at a lower temperature.

If the ambient working temperature is below 20°C, the following problems can occur:
- A delay in setting time
- Uncontrollable expansion values
- A reduced surface quality, meaning a rougher surface of the casting object
- A higher risk of crack formation leading to possible miscasting

Likewise if the ambient working temperature is higher than 21-23°C the following factors must be considered:
- An increase in temperature of liquid and/or powder decreases the working time and accelerates setting
- The working time at 23°C is approximately 9 min, whilst at 24°C it will be approximately 8 min as for each 1°C increase in working temperature the working time decreases by +/- 1 min
- If the temperature of the powder and liquid cannot be optimised a slight reduction in the mixing time may help increase the working time

The use of a temperature controlled refrigerator set at 21-23°C is highly recommended for the storage of the investment powder, liquid and mixing vessels, as this completely eliminates the risk of seasonal temperature differences.

1.4 Preparations before investing

1.4.1 Modeling

- Die Separator

Use a high quality type 4 dental stone such as GC Fujirock EP for optimal accuracy and wear resistance. GC Multi Sep is an ideal wax separator, leaving no oily residue on the die stone surface.

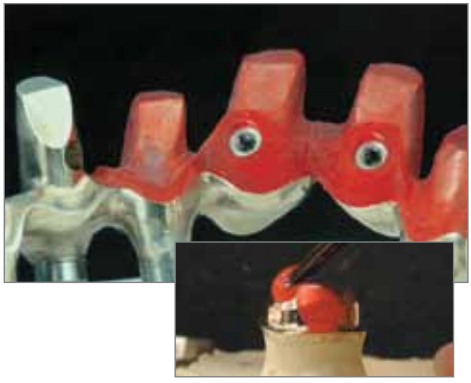
- Modeling materials

The correct positioning of the wax/resin patterns is important in order to ensure sufficient thickness of investment material around the objects to withstand the casting forces and provide sufficient expansion. The highest point of the pattern structure should be 5-10 mm lower than top of the ring and at least 5 mm away from the axial wall of investment ring.

- Resin modeling materials

GC Pattern Resin LS makes an excellent choice, offering a high degree of accuracy in combination with optimal burnout properties which leave no residues.
It is always advisable to cover the pattern resin with a layer of wax to allow for its expansion during the burnout process.
For single crowns, the investing and burnout procedures can be performed in the usual manner, however for larger amounts of pattern resin it is advisable to hold the temperature at 250°C (482°F) for 1 hour, before rising to the final burn out temperature or follow the step heating schedule according to the 'Instructions for Use.'

The rigid nature of the pattern resin material means that the initial setting expansion can be restricted, which may result in a tight casting. This problem can be solved by the adoption of a slightly higher ratio of investment liquid/distilled water.



1.4.2 Ring sizes

The majority of GC Europe investment materials can be utilised for both the ring and ringless techniques, using either the quick or step heating technique as detailed in the particular 'Instructions for Use.'
In most instances GC Europe investments can be used with all ring sizes from X1 to X9 for the casting ring technique (metal ring with liner) and sizes from X1 to X6 for the ringless technique.

The choice of ring size depends on the size and type of work, however to get consistently accurate casting results it is advisable to take a uniform approach. This is best achieved by always selecting the same size/type of investment ring for the same size/type of work. In general terms ring sizes X3 & X6 provide consistently accurate and reproducible results due to the optimal volume of investment material that is used.

When using the X1 type ring tighter castings may be produced, this is caused by the smaller amount of material producing a smaller setting expansion; this is related to the exothermic reaction during setting. Conversely ring sizes above X6 tend to produce a less stable expansion values and an increased risk of cracking.

1.4.3 Ring types

Various sizes and types of casting ring are available, all created with the same goal of producing a refractory investment mould which can be heated to eliminate the pattern material and filled with molten alloy.

When using the metal casting ring technique it is advisable to use a high quality casting liner such as GC New Casting Liner. This enables the investment material to expand during setting and provide the optimal buffer to achieve consistently accurate castings and reduce any risk of cracking (please see section 1.4.4).

When using the ringless technique, it is best to use a soft type of silicone ring former to allow the optimal setting reaction and expansion to occur. This type of ring former also has the advantage of being sufficiently flexible to be easily removed from the investment material after the initial set without the need for excessive or damaging removal forces.

Using the more rigid type of plastic ring former can impede the setting reaction as they tend to be poor insulators, allowing the heat from the exothermic reaction to be dissipated far too quickly.
The rigidity of the plastic also means that these formers need to be removed very quickly after the initial set, as they allow for very little expansion. This creates the further problem that 'weak' investment may be placed under too much stress if this is done at a too early stage, resulting in cracks or distortion.

1.4.4 Liner for metal ring types

When using a metal casting ring type, it is advisable to use a high quality casting ring liner such as GC New Casting Liner which is approximately 1 mm thick. This enables the investment material to expand during setting and provides the optimal buffer to achieve accurate castings and reduce the risk of cracking.

The borders of the liner should be sealed with a thin layer of petroleum jelly. GC New Casting Liner is impervious to the absorption of liquid and should not be immersed in or moistened with water. If the border is not sealed, a wet liner used or an absorbent dry liner there is a risk that the powder/ liquid ratio of the mixture will be altered and consequently alter the expansion.
Be sure that the entire inner surface of the metal ring is evenly covered with casting liner and that the liner is flush with the upper rim of the metal ring, so that there is no direct contact between investment and metal ring. A badly fitting ring liner leads to an uneven expansion and the risk of crack formation.

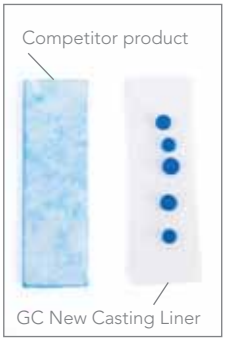
We therefore recommend the use of GC New Casting Liner, a dry casting liner made of ceramic fibers

For X3 ring size = Use 1 layer of GC New Casting Liner
For X6 ring size = Use 2 layers of GC New Casting Liner
For X9 ring size = Use 2 layers of GC New Casting Liner

As a liner needs to provide an optimal buffer to achieve accurate castings and reduce the risk of cracking it is important that it is of the correct thickness and does not absorb any water from the investment. Liners that absorb water are best avoided as they can remove moisture from the investment mixture whilst setting, thus compromising the final result by either causing cracking or expansion in an unpredictable manner. Conversely if the liner is soaked there is a similar risk, but this time the problem is the dilution of the investment mixture.

Dry GC New Casting Liner & Competitor product

Competitor product,
liner absorbing water



GC New Casting Liner
a dry casting liner

1.4.5 Wetting agents

A surface tension reducing agent is designed to allow the investment to flow uniformly and smoothly over all areas of the pattern helping to eliminate casting bubbles; however please bear in mind the following:

- All GC investment materials have the optimal fluidity and smooth consistency which eliminates the need for these agents.

- If these agents are used, it is very important to check that they are fully dry before pouring in the investment material as a wet residue of these agents may adversely react with the investment material, creating a rough mould and casting surface together with an increased risk of fracture.

1.5 Powder / Liquid ratio

All of the phosphate bonded investment materials manufactured by GC Europe for the Crown and Bridgework technique share a common Powder/ Liquid ratio of 100 g to 22 ml (with the exception of GC Vest-G, please consult the 'Instructions for Use').
In order to obtain consistently accurate castings the correct powder/liquid ratio must be used, as this ratio is the result of comprehensive laboratory development and batch testing.

Any alteration of the ratio is likely to result in less predictable expansion properties, inferior casting surface and an increased risk of mould fracture.

The use of an accurate electronic balance for weighing the powder together with a measuring cylinder or pipette for the liquid is highly recommended. It is also suggested that only distilled water is used when diluting the investment liquid.

Ringsize	Powder	Liquid
X1	60 g	13,2 ml
X3	150 g	33,0 ml
X6	300 g	66,0 ml
X9	420 g	92,4 ml

1.5.1 Atomized measuring equipment for investments

Whilst as previously discussed in sections 1.3 & 1.5 the use of accurate measuring equipment and a temperature controlled refrigerator should guarantee consistent results, an alternative method exists in the form of atomized measuring equipment. This combines an integrated cooling system with precise measuring technology to produce a consistently accurate temperature controlled ratio of water, investment liquid and investment powder to produce highly accurate mixing results and subsequent castings.

These devices need to be programmed with correct ratio and it should be noted that as the measuring of the liquids is done by weight for increased accuracy the precise input of the liquid density is a critical factor. The correct densities for GC Europe phosphate bonded investment liquids are listed in the table below.

	Liquid Density (g/cm^3)
GC Fujivest II Liquid	1,25
GC Fujivest II Low Expansion Liquid	1,15
GC Fujivest Super Liquid	1,14
GC Fujivest Super High Expansion Liquid	1,23
GC Fujivest Platinum	1,14
GC Vest-G	1,19
GC Stellavest	1,23
GC Fujivest Premium	1,25

2 Expansion and investing

2.1.1 General rules about expansion levels

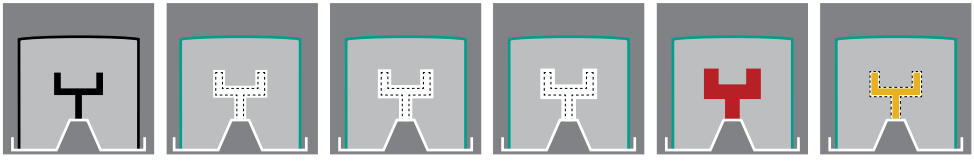
The expansion rate of phosphate bonded investment material may be adjusted by altering the ratio of expansion liquid to water, we can therefore state that:
- Pure liquid gives the maximum setting expansion, meaning the largest casting.
- Diluting the liquid with water will result in the reduction of the setting expansion resulting in smaller castings.

Use only distilled water to dilute the expansion liquid and use only the correct expansion liquid designed for the investment powder that you are using, do not use other liquids.

The required concentration of the expansion liquid depends on various factors:
- Type of alloy
- Type of work (e.g. posts & inlays require less expansion)
- The fit required
- Type of pattern material (see 1.4)

Comprehensive guidance is given in the "liquid dilution chart" in the 'Instructions for Use', which should enable you to find the optimal expansion values for your individual requirement (see 2.1.4). It should also be noted that the expansion value is also influenced by the following factors:
- Storage & working temperature of the investment materials (see 1.2 & 1.3)
- Mixing time & paddle speed (see 2.2)

2.1.2 Why is expansion needed?



Total expansion is needed to compensate for metal shrinkage during the cooling phase.

2.1.3 Liquid dilution chart

The liquid dilution chart is designed to help produce the optimal expansion value for your individual castings and is based upon the type of alloy and size of ring used. This information is contained within the 'Instructions for Use' and is based on extensive laboratory testing in combination with a complete series of casting trials.For example here is the liquid dilution chart for GC Fujivest Premium.

Type of Alloy	Liquid / Water ratio %	Ring size: Liquid / Water				
		X1 / 60 g	90 g	X3 / 150 g	X6 / 300 g	X9 / 420 g
High Precious > 70% Au	50/50	6.6 ml/6.6 ml	9.9 ml/9.9 ml	16.5 ml/16.5 ml	33 ml/33 ml	42.2 ml/42.2 ml
Semi Precious < 55% Au	60/40	8 ml/5.2 ml	11.8 ml/8 ml	20 ml/13 ml	40 ml/26 ml	55.4 ml/37 ml
Pd-base	60/40	8 ml/5.2 ml	11.8 ml/8 ml	20 ml/13 ml	40 ml/26 ml	55.4 ml/37 ml
Non-precious alloy	NiCr 75/25	10 ml/3.2 ml	15 ml/4.8 ml	25 ml/8 ml	50 ml/16 ml	55.4 ml/37 ml
	CoCr 100%	13.2 ml	19.8 ml	33 ml	66 ml	92.4 ml
High Precious ceramic alloy	55/45	7.3 ml/5.9 ml	11.8 ml/8 ml	18 ml/15 ml	36 ml/30 ml	55.4 ml/37 ml
Semi Precious ceramic alloy	55/45	7.3 ml/5.9 ml	11.8 ml/8 ml	18 ml/15 ml	36 ml/30 ml	55.4 ml/37 ml
Pd-base ceramic alloy	60/40	8 ml/5.2 ml	11.8 ml/8 ml	20 ml/13 ml	40 ml/26 ml	55.4 ml/37 ml
Non-precious ceramic alloy	NiCr 72/25	10 ml/3.2 ml	15 ml/4.8 ml	25 ml/8 ml	50 ml/16 ml	69,4 ml/23 ml
	CoCr 100%	13.2 ml	19.8 ml	33 ml	66 ml	92.4 ml

However because the working methods and equipment can differ between individual dental laboratories (e.g. waxes, resins, casting liner, mixing equipment, etc.) it is possible that differing end-results may be obtained requiring slight changes to the stated ratios (see 2.1.4).
All of the fit tests have been carried out on castings using the quick heating method (20 min setting) and it should be noted that a longer setting time would increase the expansion.

2.1.4 Individual liquid dilution chart

When trying new alloys, alloy manufacturers or investment materials we suggest that initially you use the correct ratio as stated in our 'Instructions for Use'. It is then possible for you to judge whether this provides the correct expansion for your needs or a slight alteration of the dilution is needed.

We also provide a chart that can be used to indicate the alloy type, type of work and your personal choice of dilution ratio obtained following your personal casting experiences.

Here it is very important to consider the information given in sections 1.5 & 2.1.1.

Name dental alloy	Ring type X1	Ring type X3	Ring type X6	Ring type X9

Example :

Dental alloy XYZ	6,6 ml Exp.Liq 6,6 ml H2O	16,5 ml Exp.Liq 16,5 ml H2O	33 ml Exp.Liq 33 ml H2O	46,2 ml Exp.Liq 46,2 ml H2O

2.2 Mixing of the investment

In order to obtain a complete chemical reaction between the powder and the liquid, it is important to ensure that the components are mixed to a homogeneous consistency.

- Pre-mix powder and liquid thoroughly by hand with a spatula.
  Be sure that all of the powder is completely wetted by the liquid to produce a uniform mixture.
- Mix for 60 sec under vacuum (320-420 rpm).
  Always use a clean mixing bowl and check the vacuum level. An inadequate vacuum level leads to an inconsistent fit and casting bubbles.

Insufficient mixing produces rougher casting surfaces.
Faster mixing (and or longer mixing) accelerates the set and decreases the working time and may also result in lower expansion values.
Always check if the mixture is homogenous and smooth with no dry 'lumps' before pouring the investment.
Over time it is possible for a residue of investment material to build up on the inner surfaces of the mixing bowl and this can reduce the expansion, so when switching to a new mixing bowl an increased expansion may sometimes be noticed.

Tips for mixing:

- Use different mixing bowls for gypsum and for phosphate-bonded investments!
  Gypsum contamination interferes with setting of phosphate-bonded investments.
- For efficient, homogeneous mixing, mix for only one ring at a time.
- Check the mixing and vacuum efficiency.
  Do not rely on the indicated vacuum levels on the mixing devises.
- Use calibrated equipment.
- Change worn paddles or mixing bowls.
- To keep the mixing bowl, mixing paddle and instruments clean:

Always clean them immediately after use eliminating all residues of investment material and store them in a clean plastic container (the GC Fujirock container makes an excellent choice) filled with water to help reduce the risk of a build up of sediment.

2.3 Investing

2.3.1 Working time (see 1.3)

The working and pouring time for each investment material is stated in their individual 'Instructions for Use,' however it must be understood that this is calculated for material stored and used at normal room temperature of 21 - 23°C. Temperature variations will result in a longer (if cooler) or shorter (if warmer) working times.

2.3.2 Investing , filling the moulds

Invest using a thin stream of material and low frequency (gentle) vibration, once the ring is filled **stop the vibration immediately** and do not touch the investment until set. The optimised consistency of GC Europe's phosphate bonded investments means that they possess excellent flow properties rendering strong vibration unnecessary.

2.3.3 Investing under pressure

We do not recommend high pressure investing as this may lead to a delayed setting (especially when the compressed air temperature is low) which can result in a rough casting surface and increased risk of fining on the cast objects.

2.4 Setting

2.4.1 Setting time

The optimal setting time prior to insertion in the furnace is normally 20 min, however please always check the most recent 'Instructions for Use.' The setting time is based on the material being stored and used at a room temperature of 21 - 23˚C, as said previously variations in this temperature may affect the setting time and expansion.

Best results are then normally obtained by placing the casting ring immediately into a preheated burnout furnace. Prior to putting the investment into the burnout furnace it is essential to make sure that it has fully set, as unset investment material is likely to cause casting defects such as distortion and/or rough surfaces.

Lengthening the setting time before putting the mould into the furnace is a technique often used when a lot of investing is done late in the day and the casting is to be undertaken the next morning, this is the so called "over night" burn-out technique. This longer setting period will usually work but can result in an over expansion, a reduction of surface smoothness and increased risk of cracking.

If the filled investment ring does need to be left for an extended period prior to burnout it is better to put it into a plastic container or bag which will help retain humidity within the investment material, it can be inserted into the burnout furnace and processed with the conventional step heating method.

2.4.2 Advise on variations in setting time

Product	Heating up schedule	Setting times		
		20 ' setting	120' setting	"Overnight"
GC Fujivest Platinum	Speed technique Furnace at end temperature	X		
	Step heating technique Furnace in steps to end temperature	X		X*
GC Fujivest Premium	Speed technique Furnace at end temperature	X	X*	
	Step heating technique Furnace in steps to end temperature	X	X*	X*
GC Fujivest Super	Speed technique Furnace at end temperature	X		
	Step heating technique Furnace in steps to end temperature	X		X*
GC Fujivest II	Speed technique Furnace at end temperature	X	X*	
	Step heating technique Furnace in steps to end temperature	X	X*	X*
GC Stellavest	Speed technique Furnace at end temperature	X		
	Step heating technique Furnace in steps to end temperature	X		X*
GC Vest-G	Step heating technique Furnace in steps to end temperature	X		X*

X	Recommended
X*	Can be used. A longer setting time can result in a somewhat looser fit. An increased risk of cracks and reduction of the surface quality can be observed.
Remark	In the case that investment has to be left overnight, put it in a container which can reatin its humidity, prior to placing in burnout furnace and heat it up with conventional step heating.
	Not recommended , increased risk on crack formation and miscastings.

2.4.3 Preparation prior to burnout

The investment material at the top of the investment ring will normally have a smooth 'glazed' appearance; this must be scraped with a sharp knife to create a slightly roughened porous surface.

This allows for an easier escape of gases during both the burnout and casting procedures. Failure to undertake this procedure may cause cracking due to a build up of pressure and lead to miscasting.

The use of a model trimmer for this process is to be discouraged as the quartz and cristobalite particles within the investment will cause rapid wear of the diamond disc.

3 Heating up / Burnout procedures

3.1 Schedule in Instruction for Use

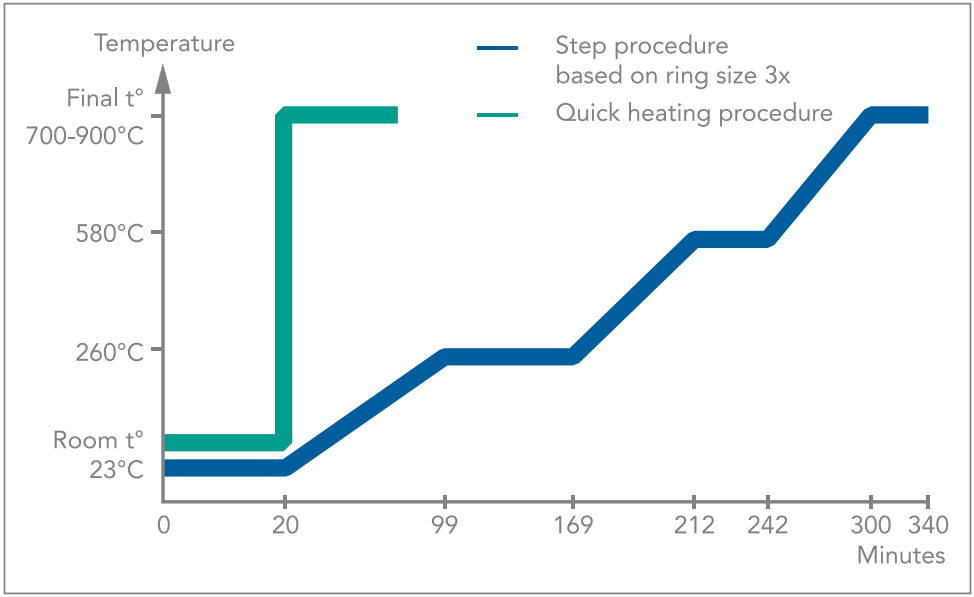
The majority of GC Europe investment materials can be used with either the quick or step heating technique, however as each investment has its own heating schedule the corresponding 'Instructions for Use' must be consulted. For example here is the heating schedule for GC Fujivest Premium.

	Quick heating	Conventional Step heating
Insertion temperature	Pre-heated furnace at 700°-750°C/1290-1380°F for Au - alloys 800°-850°C/1470-1560°F for Ceramic alloys 900°C/1650°F for Non-precious alloys	Room temperature
Step 1		Room temperature (23°) to 260°C/500°F Heat rate 3°C/37° F per min
Step 2		Holding time at 260°C/500°F 40-90 min
Step 3		Rise temperature from 260°C/500°F to 580°C/1076°F Heat rate 6°C/43° F per min
Step 4		Holding time at 580°C/1076°F 20-50 min
Step 5		Rise temperature from 580°C/1076°F to 750°C/1380°F for Au-Alloys Rise temperature from 580°C/1076°F to 800-850°C/1470-1560°F for Ceramic Alloys Rise temperature from 580°C/1076°F to 900°C/1650°F for Non-precious Alloys Heat rate 9°C/48°F per min
Holding time	X1 40 min at end temperature	X1 30 min at end temperature
	X3 50 min at end temperature	X3 40 min at end temperature
	X6 60 min at end temperature	X6 50 min at end temperature
	X9 90 min at end temperature	X9 60 min at end temperature

- Due to aggressive burning out, do not open the furnace during heating-up. In case of vacuum pressure casting, raise the end temperature by 50°C/122°F.
- When several investment rings are put into the furnace at the same time, prolong the heating period by 10 min per investment ring.
- Best results are obtained by putting immediately into a preheated furnace after 20 min, i.e. the Quick heating method.

3.2 “Quick heating” versus conventional “step heating”

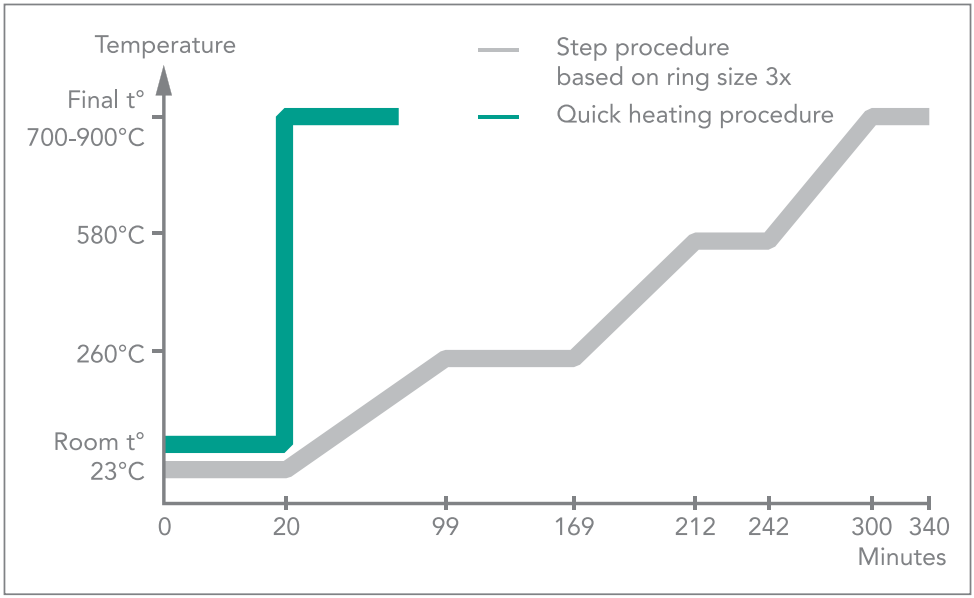
Schematic time/temperature chart



Heating-up schedules

3.2.1 Process of a Quick Heating schedule (Speed technique) QH

The investment is allowed to set for 20 min and then placed in the burnout furnace at the end temperature, it is then allowed to heat soak at this temperature for a period as stated in the 'Instructions for Use' prior to casting.



Heating-up schedules

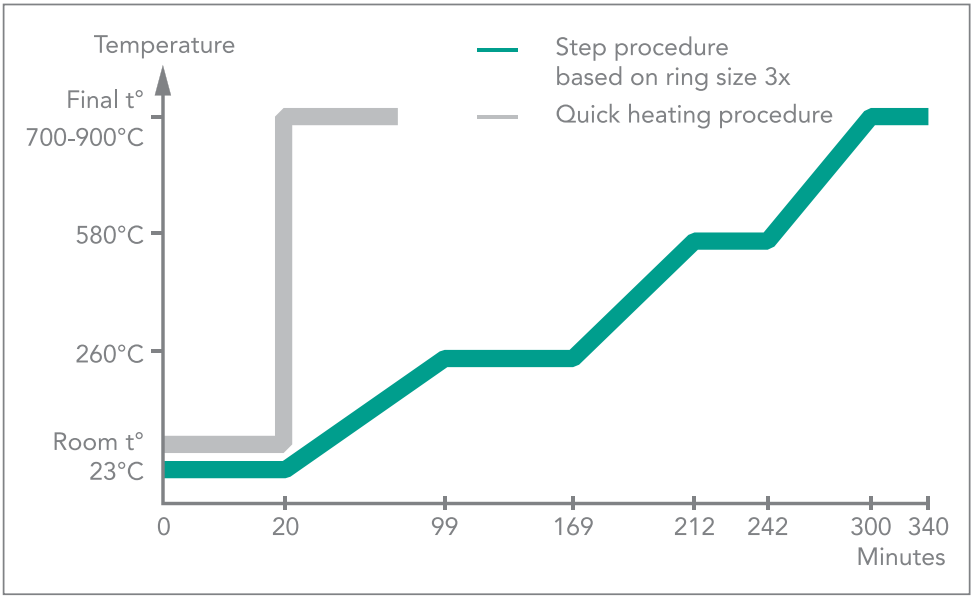
20 min setting starting from mixing

QH Into furnace at end temperature between 700-900°C

SLH Into furnace at room temperature. Start heating schedule immediately!

3.2.2 Process of a Step- Heating schedule (Conventional technique) SLH

The investment material is allowed to set for 20 min and then placed in the burnout furnace at room temperature; it is then heated up in a series of temperature steps, before being heat soaked at the final end temperature for a period as indicated in the 'Instructions for Use' prior to being cast.



Heating-up schedules

High temperatures assuring a complete burnout of all pattern materials, extra stimulated by a "steam" effect

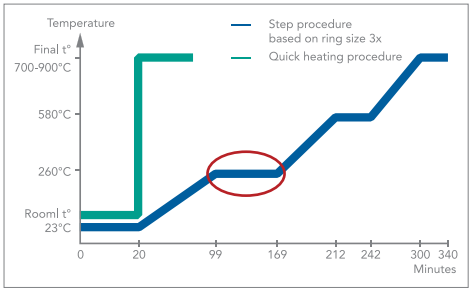
Perfectly cast objects

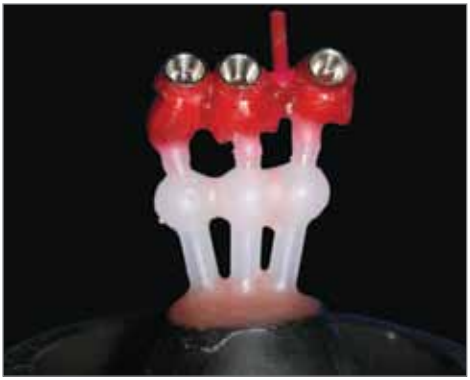
3.3 Selecting the Correct Burnout Procedure

Burning out immediately after the 20 min initial set has a positive effect as the retained moisture within the investment material stimulates the production of steam, this creates an even heating of the mould and encourages a highly effective elimination of the wax residue. It is therefore highly recommended to start the burnout procedure at this point, either by the quick or conventional step heating technique.

It should also be noted that the highest strength (robustness of the investment mould) will always be obtained by using the quick technique.

When a large amount of pattern resin and / or prefabricated resin parts are used it is advisable to use the step heating method, this allows the resin to get an adequate burnout time (resin materials normally burn out between 220-270°C). If this is ignored there is a risk of the resin expanding in an uncontrolled manner causing the mould to crack.





4 Casting

GC Europe phosphate bonded investment materials are suitable for use with the normal variety of dental casting methods including centrifugal and vacuum pressure.
We highly recommend that you consult the instructions for use from both the alloy and casting device manufacturer in order to ensure that you are adopting 'best practice.'

Vacuum Pressure Casting
Temperature controlled, vacuum melting process and inert gas supply to prevent oxidation.

Centrifugal Casting
Melted with flame or induction heating, the preset acceleration and specially designed centrifugal arm fill the mould by centrifugal force.

Cooling down and devesting

Unless otherwise stated by the alloy manufacturer it is recommended that the cast mould is slowly cooled to room temperature. This process can be helped by placing the warm cast mould into a cold burnout furnace preventing the rapid dissipation of heat.

In order to prevent inhalation of silica particles and aid investment removal it is suggested that once cool the mould is soaked in water for a few min.

GC Europe investments are specifically formulated to be removable from the cast parts with a minimum of force, eradicating the need for excessive force or harsh abrasion.

Key to symbols	
No measurable difference	≃
Higher	↑
Lower	↓
Slightly higher	↗
Slightly lower	↘

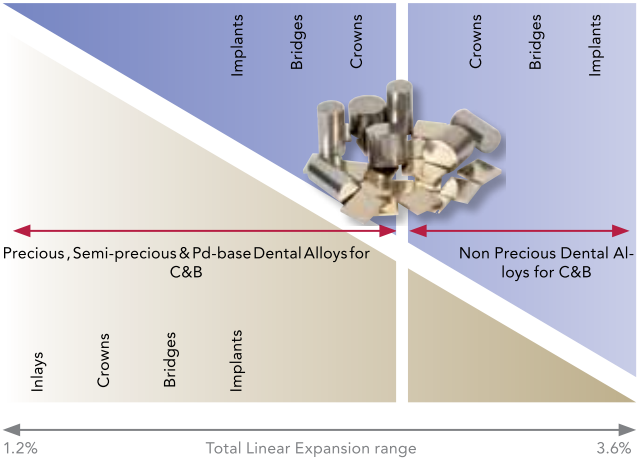
5 Effects of the main factors influencing the casting results

Factors influenced by customers	Standard advise in IFU	Change	Effect on expansion level	Effect on Fit	Effect on Surface of casting objects	Effect on mould cracks/ defects
Powder Liquid ratio	Standard ratio :100 g powder / 22 ml distilled water	Higher (=more powder)	↑	↑	↓	↗
		Lower (=more liquid)	≃	≃	↑	↗
Storage temperature	Store powder and liquid at normal room temperature (23°C).Do not store the powder above 35°C. If stored below 21°C, let powder and liquid adjust to room temperature before use. Do not store the liquid below 5°C,once frozen, the liquid can not be used anymore	Higher	Uncontrolled	Uncontrolled	↓	↗
		Lower	≃	≃	≃	≃
Working temperature (=temperature of powder and liquid)	Favourable powder & liquid temperature is 21-23°C.	Higher	↓	↓	↓	↓
		Lower	↑	↑	↓	≃
Dilution ratio	Dilution ratio as advised in IFU per type of alloy	Higher concentration	↑	↑	≃	↑
		Lower concentration	↓	↓	≃	↓
Setting time (waiting time before goining into furnace)	20 min	Longer	↑	↑	↗	↑
		Shorter	↓	↓	↓	↑
Mixing speed of vacuum mixer	320 - 420 Rpm	Higher	↓	↓	↓	↑
		Lower	≃	≃	↘	↗
Mixing time with VAC mixer	1 min with Vacuummixer	Longer	↘	↘	↑	↗
		Shorter	≃	≃	↘	↗
Pre-Vacuum	Depends on type of investement, consult IFU	> 15 sec	↓	↓	↓	≃
Ringtype	Depends on type of investement, consult IFU	Ring	≃	≃	↑	↓
		Ringless	↗	↗	↙	↑
Quality of water to dilute	Use Distilled water	Distilled	≃	≃	≃	≃
		Tap water	Uncontrolled	Uncontrolled	Uncontrolled	Uncontrolled

6 The GC Europe range of Phosphate bonded investments for C&B techniques

GC Europe offers a wide range of phosphate bonded investments, some of which are specialised products designed specifically for a certain range of dental alloys whilst others are intended for universal usage. In order to ascertain the suitability of a particular material it is always advisable to consult the 'Instructions for Use' from the outset, this will ensure that it is suitable for the type of alloy and work being undertaken.

For example here are the indications for GC Fujivest Platinum & GC Fujivest Premium



Individual and complementary positioning of the new investment line. The chart clearly shows the positioning of each investment for the type of dental alloy and type of restoration.

7 Related products

Troubleshooting Phosphate Bonded Investments for C&B techniques

This chapter lists problems encountered during the use of Phosphate Bonded Investments for C&B techniques, by analysing the cause and offering a remedy.

1 Investment sets too quickly

Cause	Remedy
- Inaccurate powder / liquid ratio	- Check the correct ratio in the instructions for use and test the accuracy of your measuring equipment
- Mixing time too long	- Reduce mixing time
- Room temperature is too warm or investment and liquid are stored above 25°C	- Rinse mixing bowl in cool water before use and/or store investment & liquid in a cooler location. Correct powder & liquid temperature (favourable powder & liquid temperature is 21-23°C)
- Contamination such as material residue left in the mixing bowl	- Thoroughly clean or replace the mixing vessel
- Mixing large amounts of investment at a high speed generates heat	- Use slower mixing speed or smaller mix size (please refer to instructions for use)
- Aged investment powder	- Do not use improperly stored or outdated material

2 Investment sets too slow

Cause	Remedy
- Room temperature is too low; investment and/or liquid are stored below 19°C	- Store at the correct temperature of 21-23°C and avoid cold room temperatures
- Contamination of mixture	- Avoid contaminants such as detergents. Use distilled water. Ensure that the mixing vessel is thoroughly clean and used only for phosphate bonded investments
- Insufficient spatulation/mixing time	- Increase spatulation/mixing time in accor-dance with the instructions for use

3 Differences in Investment texture (too thin or too thick, not consistent)

Cause	Remedy
- Incorrect powder/liquid ratio	- Ensure that the ratio stated in the instructions for use is used and test the accuracy of your measuring equipment
- Aged investment powder	- Discard outdated or improperly stored material. Store in an airtight container

4 Rough casting surfaces (pits, nodules and porosities)

Cause	Remedy
- Insufficient mixing/spatulation	- Mix as recommended in the instruction manual to ensure that the complete setting reaction occurs. Replace mixing equipment if worn
- Rate of burnout too fast (plastic parts)	- Decrease heating rate or try the step heating procedure as detailed in the instructions for use
- End (final) burnout temperature too high or heat soak too long (over 1.5 hours)	- Reduce end temperature; do not hold at the final temperature for more than 1.5 hours. Check calibration of burn out furnace
- Overheating alloy melt	- Review both the alloy and casting equipment manufacturer's instructions and guidelines
- Defective pattern and/or pattern material	- Use only high quality pattern materials such as GC Pattern Resin and wax taking care to avoid contamination with debris
- Wet pattern, use of surface wetting agents	- If a surface wetting agent is used ensure that it is allowed to thoroughly dry
- Incorrect powder/liquid ratio	- Use correct ratio as stated in the instructions for use
- Impurities in wax or pattern resin	- Work cleanly and ensure that the pattern material is free of impurities
- Air bubble entrapped	- Avoid air entrapment by using a thin stream when investing
- Insufficient vacuum during mixing	- Check efficiency of vacuum on mixing unit

Cause	Remedy
- Entrapment of loose investment particles	- Ensure that the pattern and sprueing system contain no sharp edges. Inspect the sprue hole for sharp edges, trim them away and thoroughly clean the area before placing into the furnace. Make sure that the junction between sprue and wax pattern is smooth and correctly connected. Do not re-cast alloy that has been contaminated with investment particles
- Crystals in expansion liquid	- Keep investment liquid bottle tightly closed, discard contaminated liquid
- Incorrect sprueing	- Review your pattern construction & sprueing techniques
- Incomplete burnout	- Increase burnout time and/or burnout temperature to ensure complete elimination of the pattern material
- Absorption of gases into alloy melt during the casting process	- Use at least 50% fresh alloy check your alloy melting equipment and technique
- Use of carbon containing investment material	- Use carbon-free investment material
- Water quality (contamination)	- Use distilled water to dilute the expansion liquid

5 Investment cracking (fins on the castings, miscasting ….)

Cause	Remedy
- Too early and/or too fast burnout procedure	- Lengthen the time of bench setting before investment mould is placed in furnace. Consult the instruction for use for the correct setting time, end-temperature and heating up schedules
- Investment mould burnt out and allowed to cool for too long prior to casting	- Cast as soon as possible after removing from furnace
- Investing was continued when the material had begun to set or the mould was disturbed during setting	- Leave the mould to bench set completely away from vibration, do not pour investment when its consistency is not correct or it begins to set
- Blockage of the main sprue hole during early burnout by high melting pattern materials, causing a build-up of pressure within the mould	- Select pattern and sprue materials that melt easily and burn out without difficulty; coat plastic sprues with wax in order to allow wax to drain away and plastic to expand for optimal burn-out. It is preferable to use hollow sprue systems
- Too many patterns	- Avoid placing too many patterns, use a larger sized investment ring
- Patterns placed too close to ring wall or near to the top of the ring	- Space patterns 5 mm from investment mould wall and top of mould
- Mould is not porous enough for gases to escape	- Scrape the top of the investment mould before burnout
- Use of excessive pressure/force during casting procedure	- Reduce pressure (number of turns/pressure)
- Invested with metal ring without liner	- It is advised to use the GC New Casting Liner when using a metal ring (consult the instruction for use)

Cause	Remedy
- Use of a soft type of investment with ring less technique and large amount of alloy	- Either use a more robust investment material, the ring technique, calculate the amount of alloy required according to the wax weight
- Air bubble in set mould	- Avoid air entrapment by using a thin stream when investing. Check the vacuum level of the mixing devise
- Incorrect powder/liquid ratio causes a less robust investment	- Check ratio in instructions for use the accuracy of your measuring equipment
- The investment has been left too long after investing	- If investment material is to be left for several hours it is best to place it in a plastic bag or other airtight sealed container to preserve its humidity, prior to placing it in a burnout furnace and heating according to the step procedure
- Crystals in liquid	- Keep investment liquid bottle tightly closed, discard contaminated liquid
- Investing under pressure	- Not recommended
- Use of pre-heated furnace at high temperature	- In case of a step heating schedule it is advised that the initial temperature of the furnace should be below 240°C
- Investment not thoroughly set	- Mix longer, use powder and liquid stored at correct temperature (21-23°C) or allow to set in warmer room
- Insufficient setting time	- Lengthen the time of bench setting before mould is placed in oven. Check the instructions for use

6 Incomplete castings & rounded cervical edges

Cause	Remedy
- Incomplete elimination of pattern materials	- Heat soak longer at the recommended temperature, ensure that the furnace is correctly vented and calibrated
- Insufficient heating of the alloy/melt too cold	- Increase casting temperature of alloy, preheat the crucible, check the alloy manufacturer's data
- Investment mould too cold during casting	- Transfer investment mould to casting machine and cast at once
- Casting machine operated with insufficient pressure or too few turns	- Increase casting pressure; use more turns
- Misalignment of crucible and sprue hole	- Position investment mould with sprue hole aligned with crucible
- Insufficient amount of alloy by weight	- Calculate the correct amount based upon the wax weight
- Patterns improperly sprued ,Wax-up too thin, wrong position of casting objects	- Review the pattern & sprueing system

7 Inaccurate fit of casting objects

Cause	Remedy
- Incorrect liquid concentration	- To increase expansion, increase the liquid concentration and to decrease expansion, decrease liquid concentration (by diluting with water). Do not dilute more than advised , the use of too much water leads to uncontrollable expansion level
- Incorrect powdrer/liquid ratio	- Check liquid/powder ratio in instructions for use and the accuracy of your measuring equipment
- Low temperature of mixture, low room temperature	- Optimal working temperature of powder and liquid is 21-23°C for most consistent results
- Incorrect liner thickness	- Use GC New Casting Liner to avoid the risk of too little expansion
- Pattern material	- Pattern material with lower melting point (e.g. inlay wax) can produces larger castings whilst higher melting material (e.g. Pattern Resin) can result in smaller castings
- Pattern deformation	- Handle wax pattern with extreme care, wax-up under uniform temperature conditions and allow the wax to rest to create a stress free object
- Incorrect positioning/spruing of patterns in the investment mould	- Ensure uniform thickness of investment material around the objects to allow even expansion. Review your sprueing technique
- Too fast cooling down of investment mould	- Allow a slow cooling down of investment mould before devesting
- Improper mixing	- Check the Instructions for Use

Instructions for use for implantology

using GC Fujivest Super

This specific additional instructions for use, created for implant suprastructures and long span bridges IFU concentrates only on details for casting implant suprastructures and long span castings with a '**passive fit**'. The obtained results are based upon long term experience by the author using GC Fujivest Super as Investment material.
Please refer to the standard instructions for use, for the basic information about the use of GC Fujivest Super.
Nevertheless this technique explained in this document can be reproduced with other GC Investment materials of course following the dedicated Instructions for use of the corresponding investment.

1. Modellation

1.1 Covering the implant abutments with wax. The layer of wax must have a sufficient thickness to neutralise unfavourable CTE. This is to avoid a negative effect on porcelain firing.

1.2 Take care to not have wax all the way up to the margin of the abutment in order to avoid molten alloy flowing into the abutment during casting.

1.3 Total anatomical completion of the wax modellation, without connecting the interproximal of the various individual abutments / elements.

2. Stabilisation of the wax modellation (I)

2.1 Place this wax-up modellation, still on the master model, for 30 min in a pre-heated incubator, maintaining a temperature of 37°C.

2.2 Remove from the pre-heated incubator and let cool down at room temperature for 1 hour.

3. Final modellation

3.1 Connect all single abutments and the wax modellation at their interproximal contacts using GC Pattern Resin.
- Use the brush technique for applying GC Pattern Resin.
- Avoid using a too fluid consistency of GC Pattern Resin in order to minimize the polymerisation shrinkage.

4. Sprueing technique

4.1 Connections to crossbar: 3.5 mm-3 mm.

4.2 Distance from modellation to crossbar: 2.5 mm.

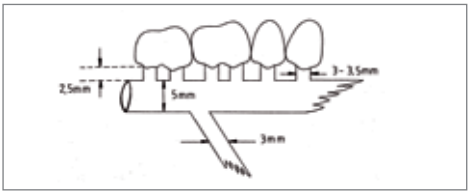
4.3 Thickness of the crossbar: 5 mm-4 mm.

4.4 Thickness of sprues to crossbar: 3 mm.

4.5 The number of separations of the crossbar, depends on the size of the suprastructures e.g. (see photograph) separation into 3 parts for total horseshoe shape.

4.6 Use only one 3 mm sprue per crossbar separation.

4.7 Attach thin degassing sprues to the buccal/labial side of the modellation.

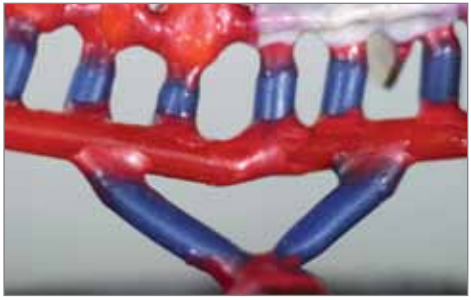


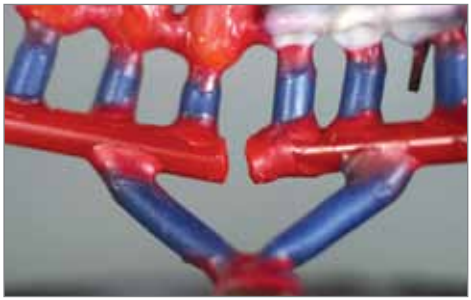
The goal of every implant case is a passive fit. As we know, the thickest casting parts tend to have porosities and contract more than the thinner sections, therefore we have two possibilities to work against this.

First of all we can use an alloy plate from the same alloy and wax it onto the thickest part.

As the alloy solidifies, crystallisation cells form on the alloy plate, which forces the metal to solidify faster.

The second possibility is to separate the cross sprue with a hot waxing knife after attachment to the casting form.





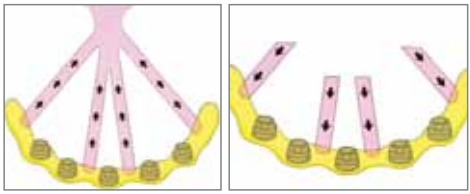
Otherwise as the melt solidifies, the cross sprue shrinks, which causes distortion to the construction.

5. Determining the necessary amount of alloy needed for casting

The sprues should not have any contact with another after casting (no casting button) in order to avoid distortion of the framework.

5.1 Take the wax construction from the master model and weigh it on a digital scale.

5.2 Deduct the weight of all metal parts / abutments.



Source: G.E. White: Osseointegrated Dental Technology (QZ)

FORMULA: $\frac{\text{net wax weight}}{1.05}$ x density of the alloy = the amount (g.) of casting alloy to use

6. Stabilisation of the wax modellation (II)

6.1 Replace the wax construction on the master model and tighten the abutments with their screws.

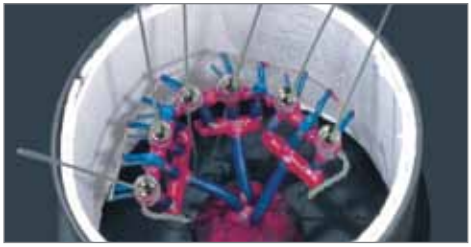
6.2 Place the model with wax construction in a pre-heated incubator for 2 hours at 37°C.

Note: Modellation made out of GC Pattern Resin LS only may not be placed in a pre-heated incubator, because of deformation (shrinkage) of the resin.

6.3 Remove from the pre-heated incubator and let cool down at room temperature for 1 hour.

7. Stabilisation of the wax modellation (III)

7.1 GC Fujivest Super powder & liquid should be stored at room temperature (± 23°C).
- If longer working time is required, store powder and liquid at a lower temperature (18°C-21°C).
- Liquid may freeze when exposed to a temperature below 0°C. Once frozen, the liquid cannot be used anymore.



7.2 - Place completed wax construction on the crucible former in such a way that the separated crossbars are in the middle of the casting ring.
- Rotational direction (centrifugal casting and vacuum pressure casting) is important for the even filling of the casting ring with molten alloy. Position the wax modellation opposite to the direction of rotation.

7.3 Ring sizes and casting liner use a 1 mm thick dry casting liner (GC Casting Liner) which does not absorb any liquid.

7.4 The use of GC Casting Liner.
- Apply a thin layer of Vaseline to the inner metal surface of the ring to provide good adaptation of casting liner to the metal ring.

- Seal the adjoining edges of the liner with a thin layer of Vaseline as well.
- Be sure to have casting liner covering the total inner surface of the metal ring.
- 3 x ring size = 1 layer of GC Casting Liner.
  6 x ring size = 2 layers of GC Casting Liner.
  9 x ring size = 2 layers of GC Casting Liner.

8. Powder/Liquid ratio

Ring size	Powder	Liquid
3 x	150 g	33 ml
6 x	300 g	66 ml
9 x	420 g	92.4 ml

9. Liquid dilution

Based on GC Fujivest Super High Expansion liquid.

	High precious ceramic alloy 75% Au / 10% Pd			High precious casting alloy >70% Au/Ag-Cu		
Wax Pattern	71%	6 x	9 x	45%	6 x	9 x
		46.8 ml HE liquid 19.2 ml dist. water 66 ml total	65.6 ml HE liquid 26.8 ml dst. water 92.4 ml total		29.7 ml HE. liquid 36.3 ml dist. water 66 ml total	41.6 ml HE. liquid 50.8 ml dist. water 92.4 ml total

Measurements based on bench setting.
NO setting under pressure is necessary.

10. Mixing

10.1 Pre-mix powder and liquid manually with a spatula. Make sure that all powder is moistened with the liquid before starting vacuum mixing.

10.2 Mix for 60 sec under vacuum (420 rpm).

11. Pouring the casting ring

11.1 4 minutes of pouring time at 23°C. Higher temperatures shortens the working/pouring time.

11.2 A thin 0.7-0.8 mm wax wire is put into all abutments before investing. Immediately after investing these wax wires are pulled out. This pulling out creates a vacuum, which avoids/eliminates air-bubbles in the abutments.

11.3 Invest under low vibration.

12. Setting time

12.1 Leave to set for 20 min from start of mixing.

12.2 Scrape the top surface of the investment ring with a sharp knife.

12.3 Put into a cold furnace, immediately after the 20 min. setting period and start the heating-up cycle.

13. Setting time

13.1

Step heating	Heat rate	Time	
		x 6	x 9
1. Room temp. (23°C) → 260°C	2°C/min		
2. Holding time at 260°C		70 min	90 min
3. 260°C → 580°C	3°C/min		
4. Holding time at 580°C		40 min	50 min
5. 580°C → 750°C Au-alloy 850°C Ceramic alloy	5°C/min		
6. Holding time at end temp.		70 min	60 min

Note:
- If more than 1 ring is placed in the furnace at the same time, each holding time(phase) should be extended by 10 min.
- If vacuum pressure casting is being used raise the end temperature by 50°C.

13.2 When pre-heating is done over night, proceed with pt. 1 and 2. of the step heating cycle (13.1) immediately after the 20 min setting period. Shut off the furnace and re-start from pt. 1 during the night. Leave the casting ring in the furnace.

14. Casting

Casting in the usual manner: centrifugal casting, vacuum-pressure casting, etc. Take care with the positioning of the casting ring in the casting device (see 7.2). Cast as quick as possible after taking the ring out of the furnace.

15. Cooling

After casting let the casting ring cool down as slowly as possible. e.g. Place the ring after casting in a cold furnace and close the furnace.

16. Sandblasting

16.1 Carefully remove bulk of investment around the casting with devesting scissors.

16.2 Sandblast the metal framework with glass-beads. Do not sandblast inside the abutments.

16.3 Remove residual investment in the abutment by using a pickling agent (e.g. hydro-fluoric acid or alternative).

17. Checking the fit

17.1 Fill the abutments with mixed GC Fit Checker Silicone. Put the suprastructure back on the master model by means of the implant-screws.

17.2 Let set for 3 min (at 23°C) and then remove the framework from the model.

17.3 Results:
a. If on the abutments there is an even thin layer of GC Fit Checker · expansion is ok

b. If on the lingual side of the abutments there are pressure spots, meaning hardly any or no GC Fit Checker is on the abutment → *too high expansion, reduce the liquid concentration (more water less liquid).*

c. If on the buccal side of the abutments there are pressure spots, meaning hardly any or no GC Fit Checker is on the abutment → *too little expansion, increase the liquid concentration (more liquid, less dist. water).*

About the Author

Thomas Schmidt completed his certification in Stuttgart, Germany. He then worked for Ludwig A. Rinn in Aarau, Switzerlandand and later was self-employed in Bern, Switzerland. After returning to Germany, he absolved his Master Dental Technician in Frankfurt, Germany and then set up his own laboratory in Marburg, Germany.

In 1985 his interest in wax burnout properties and investment materials began, followed by the development of the Grey Yeti Thowax in 1987.

Thomas Schmidt is the author of various articles in Dental Labor and Quintessenz, as well as the book 'Inlays-Onlays, a practical working Concept', published by Quintessence, as well as co-author of several other books and video publications. He was on the editorial staff of Quintessenz from 1990 thru 2000.

He has given courses and lectures in Europe, USA, Canada, Australia, and the Philippines.

Optimal Fit

A simple, step by step procedure to achieve precision castings using Fujivest Platinum

Introduction text by S.Hein

As enthusiastic user of many GC products, I have put together a simple step by step guide, to demonstrate the way that I use the fabulous GC Fujivest Platinum and to show how I work my wax-ups and castings, which I have done with joy and pleasure. I hope the interested reader will benefit from the illustrations and find fulfillment in achieving the perfect fit of a cast metal restoration, even in the current, ever-present CAD/CAM hype.

Fig. 1 The working model which was chosen for the demonstration of a fixed three unit posterior bridge and two upper central PFM crowns.

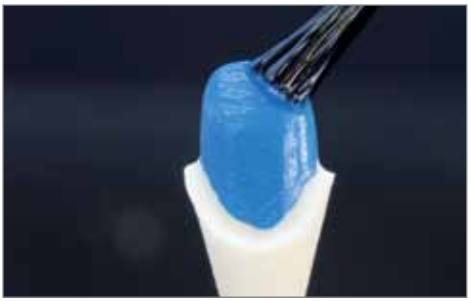


Fig. 2 The already blocked-out dies are being separated using GC Multisep.

Fig. 3 The wax copings are being formed with the help of the dipping technique using a special non-contracting dipping wax.

Fig. 4 The dipped wax copings on the model.

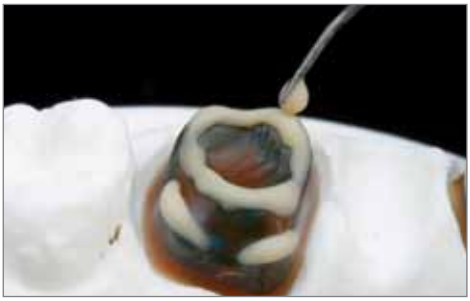


Fig. 5 An inorganic wax is used to design the coping for adequate porcelain support.

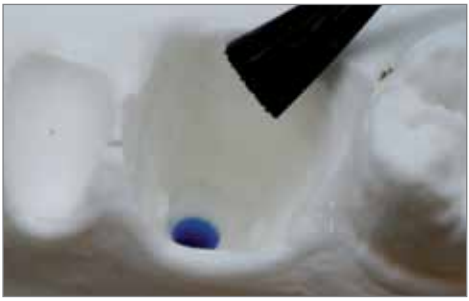


Fig. 6 The root socket is being separated.

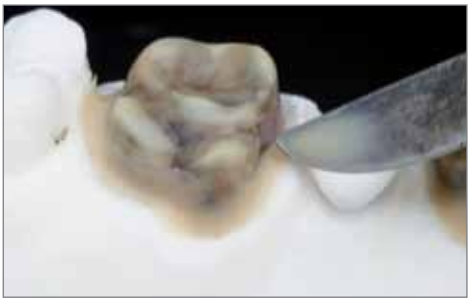


Fig. 7 A hot wax knife is being used to inject the wax into the marginal area.

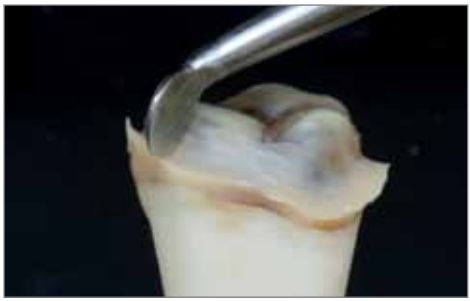
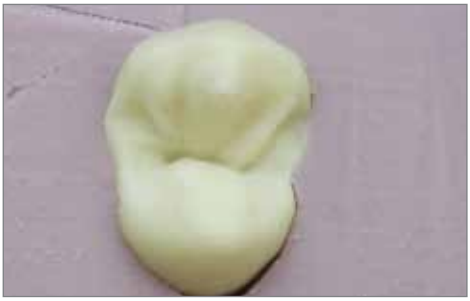


Fig. 8 A carving instrument is being used to design the lingual metal collar.

Fig. 9 & 10 A wax-up was used to determine the correct position of the Pontic.



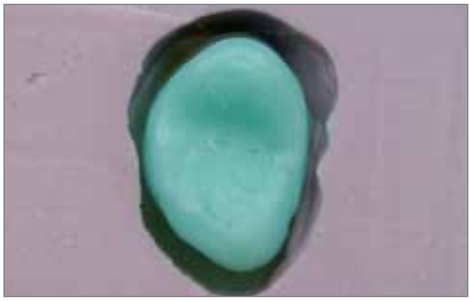
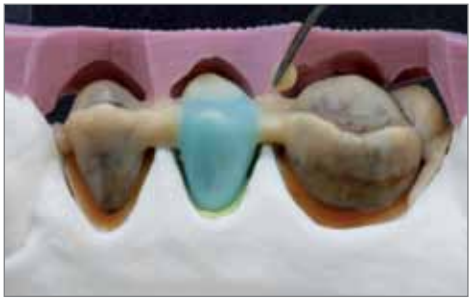


Fig. 11 & 12 A silicone index is a helpful aid to place a wax pattern which will later be the pontic for the missing second premolar.

Fig. 13 A correctly placed pontic must be in exact position and must have the corresponding shape with the desired anatomy of the tooth.



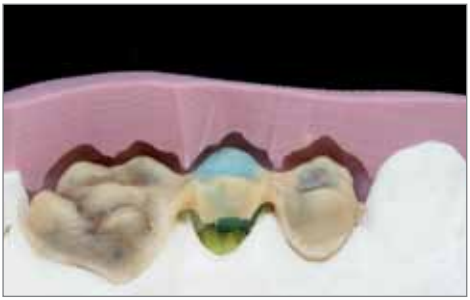


Fig. 14 & 15 A silicone key is being used to check for adequate support for the porcelain from the buccal and lingual aspect.

Fig. 16 & 17 A very fine separating saw is being used to cut through the pontic.

Fig. 18 The cut results in a very fine gap between the two half of the pontic.

Fig. 19 An electric wax knife is being used to correct the margins using a hard inlay-wax even if it is planed to have a circular porcelain margin to be able to check the precision of the fit after casting.

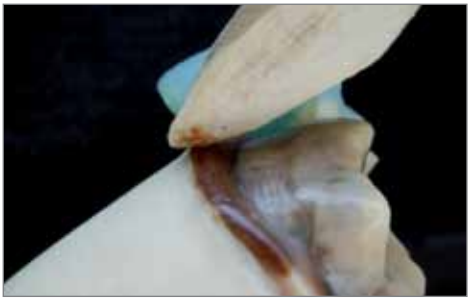


Fig. 20 An individually fashioned orange wood stick is used to carve back the margins. Any metallic instrument might damage the die, thus compromising the precision of the restoration.

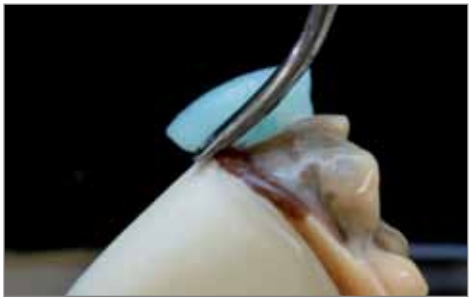


Fig. 21 A very lightly warmed instrument in the shape of a beaver tail is used to adapt the wax margin, using a stereo microscope.

Fig. 22 Both pieces of the bridge are being placed on the master model for passive joining.

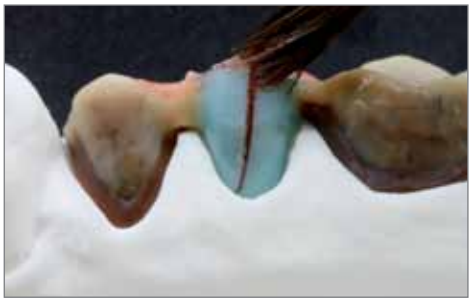


Fig. 23 & 24 GC Pattern Resin LS is used to passively join the two parts of the bridge.

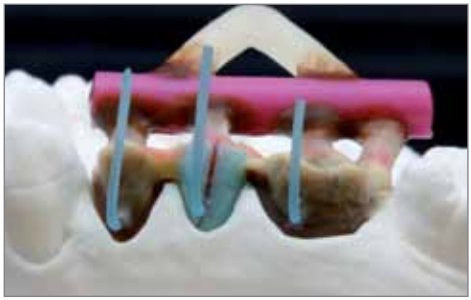


Fig. 25 The bridge is being conventionally sprued with cross-bar reservoir and decompression channels for the centrifugal casting method.

Fig. 26 The sprued objects on the model.

Fig. 27 A ringless casting system can be used with GC Fujivest Platinum for equal and unhindered expansion of the investment and to keep metal oxide contamination of the burnout furnace at a minimum if it is also used for burning out rings for pressable ceramics.

Fig. 28 Devested casting using a standard palladium containing precious bonding alloy. Note the fine surface that GC Fujivest Platinum yields.

Fig. 29a & 29b A ratio of 8 ml of distilled water and 24 ml of investing liquid for 150 grams of GC Fujivest Platinum is used to achieve a precise but relatively loose, passive fit that doesn't compromise the tactility of vital teeth when the restoration is cemented.

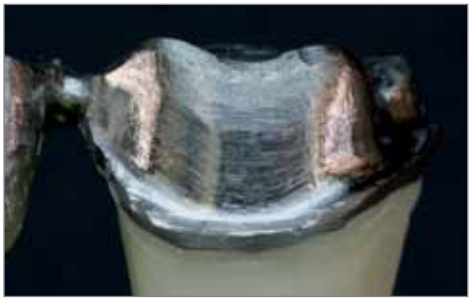


Fig. 30; 31; 32; 33 Precision fit after casting.

Fig. 34 A pear shaped tungsten carbide bur is used for trimming the frame work.

Fig. 35 A permanent marking felt pencil is used to mark the reduction for the porcelain margin.

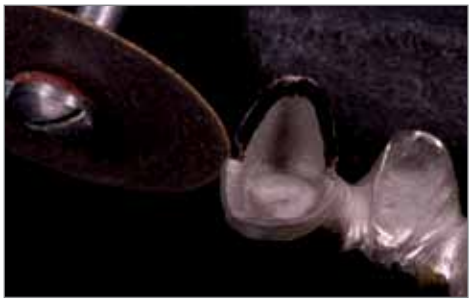


Fig. 36 The mesial and distal metal-ceramic-junction is defined using a fine cut off disc.

Fig. 37 The bulk of the metal is being trimmed using a coarser cut off disc.

Fig. 38 It is important to check that the mesial metal-ceramic-junction is placed in the non-visible area.

Fig. 39 Sharp mechanical edges are the result of trimming the metal with tungsten carbide burs which is obstructing to the application of the wash opaque.

Fig. 40 Before sandblasting using 110 micron aluminum oxide, the entire frame work surface is smoothed, using a silicone polisher to avoid any sharp edges and also to detect any casting porosities and to eliminate any metal folds (especially when soft, high-gold bio-alloys are used), which could result in bubbles or cracks in the porcelain.

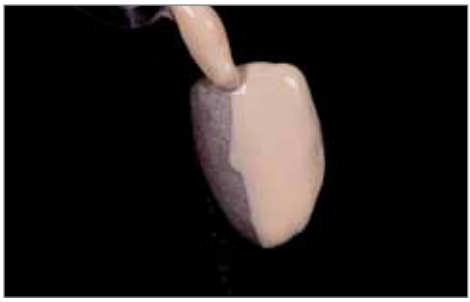


Fig. 41 The unobstructed application of the opaque using a glass probe.

Fig. 42 Anterior view of the finished restoration veneered with a modern feldspar based metal ceramic material.

Fig. 43 The exact occlusal design of the posterior bridge is related to a well designed metal frame work with adequate porcelain support.

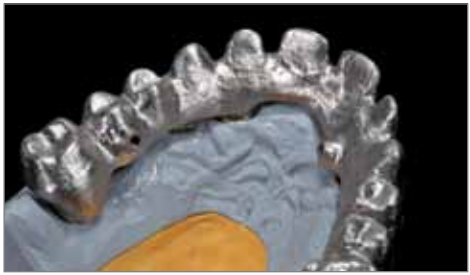
Fig. 44 Assembly of the upper fixed posterior bridge and the two central crowns.

About the Author Sascha Hein completed his undergraduate training at the Technical College II in Munich, Germany. He later worked in several countries including, Germany, Italy, Switzerland and the United Arab Emirates. In 2000 he completed the Senior Dental Technician training at the Kuwata College at Itabashi, Tokyo. In 2004/05, he attended Master School in Freiburg, Germany and graduated as top of school. In 2006 he scored the second place at the annual Kanter Award competition. Since 2007 he's an Oral Design member.

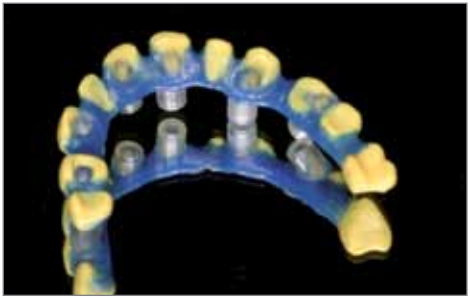
Clinical Cases

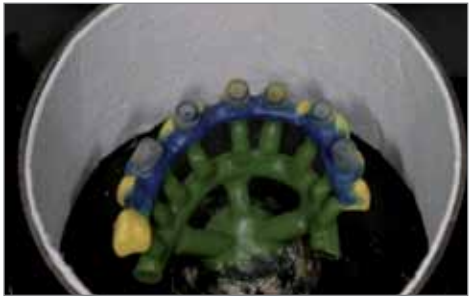
A variety of clinical cases illustrating the high performance of GC Europe's Phosphate Bonded Investments.

Type of work: Implant suprastructure
Alloy: Precious ceramic alloy
Investment used: GC Fujivest Super
Work by: MDT Andreas Kunz, Berlin, Germany

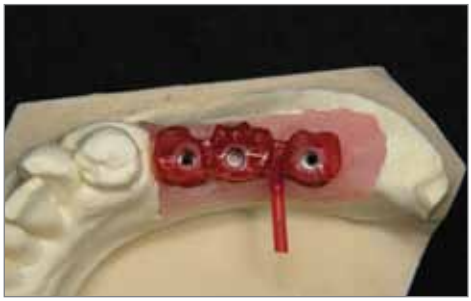


Type of work: Implant suprastructure
Alloy: Non-precious ceramic alloy
Investment used: GC Fujivest Premium
Work by: MDT Svein Thorstensen, Oslo, Norway



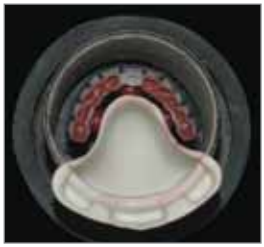


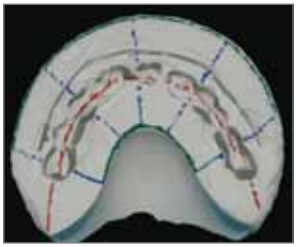
Type of work: Implant supported bridgework
Alloy: Non-precious ceramic alloy
Investment used: GC Fujivest Premium
Work by: MDT Deguillaume, Paris, France

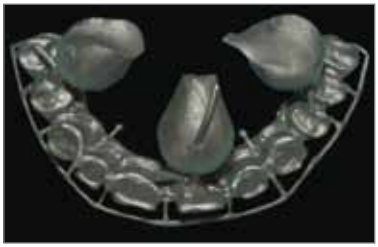


Type of work: Implant copings and superstructure
Alloy: Precious Ceramic alloy /Precious casting alloy
Investment used: GC Fujivest Platinum
Work by: Arte Denta, Maasmechelen, Belgium

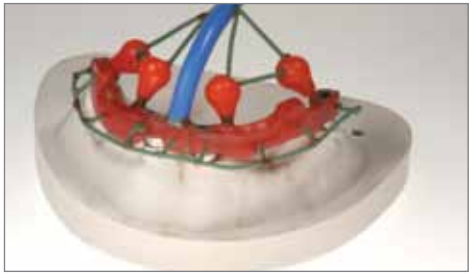
Type of work: Implant suprastructure
Alloy: Precious ceramic alloy
Investment used: GC Fujivest Platinum
Work by: MDT Stefano Biacchessi, Alfadent, Bologna, Italy







Type of work: Implant suprastructures
Alloy: Precious ceramic alloy
Investment used: GC Fujivest Platinum
Work by: MDT Christian Rothe, Berlin, Germany



Notes

Dear Customer,

We hope that reading this document has helped to improve your understanding of GC Europe phosphate bonded investment materials in a practical and relevant manner that is beneficial to your daily 'Crown & Bridgework' practice.

Should you require any further assistance or have some suggestions about this document please do not hesitate to contact either us, your local GC representative or our website **www.gceurope.com**.

Contact Addresses
Diederik Hellingh - Laboratory Products Manager
GC Europe N.V. - Interleuvenlaan 33 - 3001 Leuven, Belgium

Acknowledgments
MDT Adrian J. Rollings (Birmingham, United Kingdom) for his expert technical support and grammatical advice
MDT Thomas Schmidt (Marburg, Germany) for his expert advice on casting techniques

Printed: September 2008 - Revised: September 2008

GC EUROPE N.V. - Head Office
Researchpark Haasrode-Leuven 1240
Interleuvenlaan 33
B - 3001 Leuven
Tel. +32.16.74.10.00
Fax. +32.16.40.48.32
info@gceurope.com
http://www.gceurope.com

GC UNITED KINGDOM Ltd.
12-15, Coopers Court - Newport Pagnell
UK - Bucks. MK16 8JS
Tel. +44.1908.218.999
Fax. +44.1908.218.900
info@uk.gceurope.com
http://uk.gceurope.com

z L MA EN 4 97 04/12