THREE-TEMPERATURE FURNACE FOR
DENTAL CASTING

BY

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ABSTRACT

For increased efficiency of dental casting procedure, an electric furnace with
three rooms thermostatically controlled to three different temperatures was devised.
Adequate temperatures for individual rooms and the time required for keeping
rings in them were experimentally determined. The furnace is now successfully
being used, without producing any fins on castings due to investment cracking.

INTRODUCTION

Gas and electric furnaces are generally used for preheating dental casting
rings or flasks. A gas furnace is convenient for a dental school or a large
dental laboratory to heat many rings one after another, moving them from
the lower temperature to the higher. However, it lacks in the accuracy of
temperature control and disturbs the effect of an air conditioner. On the
other hand, an electric furnace with a thermometer can control the tempera-
ture accurately but does not allow the ring to be put in or taken out during
the heating. For eliminating such disadvantages of these types, a new electric
furnace having three rooms of thermostatically controlled temperatures was
devised.

DESIGN AND FUNCTION OF CONTROLLED THREE-TEMPERATURE FURNACE

This electric furnace has three separate temperature zones; (1) a low
temperature compartment on the top, inside the cover, (2) a thermostatically
controlled intermediate temperature zone in the lower chamber, and (3) a
thermostatically controlled high temperature zone in the upper chamber
(Fig. 1). The medium and high temperature rooms are directly, and the low
temperature room is indirectly through the high temperature room, con-
trolled thermostatically to desired temperatures.

The low temperature room on the top is heated by hot air from the high

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Fig. 1. The whole view of the Three-temperature Furnaces closed (left) and opened (right): L = low temperature room, M = medium temperature room, H = high temperature room, T = thermometer with thermostatic regulators for M and H, S = the main switch.

Fig. 2. The low temperature room on the roof: left = the bottom (B) having four holes (H) and plugs for them (P), middle = the deck (D) placed over the holes to support casting rings (R) and having a smoke exhausting pipe (S), right = the cover (C).

temperature room coming through four holes on its floor. The temperature is controlled by plugging of the holes (Fig. 2, left). The room is kept at approximately 100°C with three or four holes open when the high temperature room is heated to 700 or 600°C. A stainless steel deck with a pipe for exhaust smoke is placed over the holes to support casting rings (middle). A stainless steel cover is placed over the deck to homogeneously heat the rings inside (right).
In the low temperature room, rings are heated to remove excess water and to melt wax in the investment block. The temperature should be high enough to dry the rings efficiently but not so high as to cause boiling or explosion. The adequate temperature seems to be around 100°C.

The medium temperature room, the lower chamber, is to heat the investment mold through the transformation temperature of cristobalite, which is 250°C. If the temperature of this room is set too high, the heating rate of the investment becomes too fast and will crack the cristobalite investment block. For time efficiency, however, the highest temperature is desired within the limit that assures no cracking. The greatest effort was devoted in this study to the determination of the optimum temperature and heating time of this room.

The medium temperature room, the lower chamber, contains a stainless steel rotating deck with numbers marked on the side of its rim. The operator can pick up his objective casting ring by remembering the number (Fig. 3). Nickel-chromium wires for heating are arranged in the grooves of the side walls. Smoke is exhausted through a hole on the back wall. A thermocouple is inserted from the back and connected to a thermostatic controller to keep the chamber at a desired temperature.

The high temperature room, the upper chamber, is to burn out the wax completely, give the mold the desired thermal expansion, and preheat it for insuring the success of casting. The temperature of this room should vary according to the type of alloy used, and 700°C is adequate for gold alloys. The structure of this room is similar to that of the medium temperature room.

Fig. 3. Inside of the medium or high temperature room, the upper or lower chamber; D=the rotating deck with numbers marked on its rim sides, R=casting rings, T=thermocouple, H=heating wires in grooves.
TEMPERATURE AND TIME REQUIREMENTS IN THREE-STEP BURNOUT

The temperatures and period of heating to cast gold alloys, as required in the three-step burnout process, are shown in Table 1. A cristobalite in-

<table>
<thead>
<tr>
<th>Order</th>
<th>Chamber</th>
<th>Temperature Step</th>
<th>Temperature °C</th>
<th>Minimum time required (in min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Small ring (Ø 24 mm)</td>
</tr>
<tr>
<td>1</td>
<td>On the roof</td>
<td>Low</td>
<td>100</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Lower chamber</td>
<td>Medium</td>
<td>300</td>
<td>25</td>
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<tr>
<td>3</td>
<td>Upper chamber</td>
<td>High</td>
<td>700</td>
<td>10</td>
</tr>
<tr>
<td>Total of minimum time required</td>
<td></td>
<td></td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

Table

Heating procedure of casting rings for gold alloy in the three-temperature furnace

Fig. 4. Proximo-occlusal inlays (top), full coverage crowns (middle), and one-piece cast bridges (bottom) cast by preheating rings under the conditions shown in Table 1.
vestment\textsuperscript{2} was used in this study. No fins due to investment cracking were found (Fig. 4) when proximo-occlusal inlays, crowns, and bridges of clinical form were cast respectively using small, medium, and large casting rings and heating them under the conditions shown in Table 1. This furnace is now generally used in the operative technique room and the clinical laboratory of the Department of Conservative Dentistry of this University with quite favorable results.

CONCLUSION

A thermostatically controlled three-temperature furnace was designed. It can heat casting rings with cristobalite investment efficiently and without producing any cracks, when used under the conditions shown in Table 1. It makes it possible to put many rings in or out one after another and is convenient for use by many operators at dental schools or laboratories.

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REFERENCES


\textsuperscript{**} Shofu Cristobalite Investment, Shofu Dental Mfg. Co., Kyoto.