# BACK-TO-BASICS

# Casting Techniques to Assure the Integrity of All Alloys

***Back-to-Basics*** *is a series focused on basic skills necessary for a successful career in dental technology. For skilled professionals it is a useful tool as a refresher for skills learned on the job—or long ago. For those new to dental technology, it will be an invaluable resource to keep on hand.*

This is the fourth article in the "Back-to-Basics" series, designed to reinforce core skill training with an emphasis on the science behind the materials being used in the techniques shown. We continue our series with this article. It is our hope everyone in the lab will benefit from this review.

FIGURE 1

## Step 1. Select the best type of alloy for the case

What's your criteria when selecting alloy? Is it functionality, esthetics or the ever-changing economy? Or does your doctor mandate your decision? Understanding the features and benefits of the physical properties in today's leading alloys will help you make discerning choices. *Note: The term "based" when applied to dental alloys identifies the metal that composes the largest percentage of that alloy. Incidentally, there are only four metals used in dentistry for basing out alloys—gold, palladium, nickel or cobalt.*

## Step 2. Select Melting Equipment

**Casting Torch**

A good multi-orifice torch with a fuel injector and a broken-arm casting machine can provide predictable results as long as the fuel and oxygen settings are followed.

Electric Induction has its pros and cons because there are two types: thermo-magnetic and carbon induction. Thermo-magnetic induction is a little more expensive but can handle all types of alloys very well as long as you have an electric eye. Typically, it is a low maintenance system and cost effective in the long run. Carbon Induction machines came from the jewelry industry and are high maintenance. They melt alloys with a lower casting temperature quite well, but do not handle higher melting alloys very well—especially base alloys.

## Step 3. Choose the best fuel for your torch

*Note: The balance of this article focuses on using a casting torch since the majority of laboratories use a torch.* There are three types of fuels that can be used with a torch: natural gas, propane and acetylene. Natural Gas is probably the best type of gas

**CHART 1**

| Alloy Type | Functionality | Esthetics | Economy |
|---|---|---|---|
| **CERAMIC** | | | |
| *AU content 98+%* | Highly biocompatible & better corrosion resistance | Excellent marginal color | Economical—copings 3.5-4.5mm thick |
| *AU content 87+%* | Highly biocompatible & better corrosion resistance | Yellow color | Not economical |
| *AU content 50-66%* | High strength, highly biocompatible & excellent bond | White color & great coefficient | Fairly economical |
| *High Palladium* | Fair biocompatibility | Not esthetic, dark oxide | Fairly economical |
| *Silver Palladium* | Fair biocompatibility Difficult to solder and cast | Not esthetic | Highly economical |
| **CROWN AND BRIDGE** | | | |
| *AU content 75-83%* | High biocompatibility | Highest yellow color | Not economical |
| *AU content 50-65%* | Good strength & biocompatibility | Good yellow color | Fairly economical |
| *AU content 20-46%* | Good strength & biocompatibility | Poor in color | Very economical |
| **BASE ALLOYS** | | | |
| *(High Quality)* | Superior strength and less bulk | Very thin copings allows more room for porcelain—enhancing shades | Greatest economy |

| Metal | Physical Properties | How it affects your alloy |
|---|---|---|
| **GOLD** | Highly soft metal | Gives it a rich yellow color, and adds to biocompatibility |
| **PLATINUM** | Highest in strength | Adds strength & biocompatibility to alloy |
| **PALLADIUM** | High in strength | Adds strength & allows for more volume per weight |
| **SILVER** | Soft metal | Economical filler |
| **COPPER** | Soft metal | Adds to the color of the metal—but can't be used with porcelains |
| **COBALT** | Highest in strength | Hard to burnout and cast/Poor bond strength and color |
| **NICKEL** | Very high in strength for long span bridges | Strengthens |

to use. It has a low hydrocarbon content and it is not a fossil fuel. Propane, if used properly, can melt all metals just fine. Due to its higher hydrocarbon content (four times more than natural gas) you have to be careful on your settings or you can carbonize alloys with Palladium and base alloys. Acetylene is not a good fuel for melting dental alloys. Its hydrocarbon content is extremely high (eight times more than natural gas) and its burning temperature is very high (**Figure 1**).

## Step 4. Adjust fuel settings for all alloys

**Natural Gas** – Always use full pressure from the street. Make sure the street valve and the valve on the torch handle are both completely open.

**Propane Gas** – Use 2 psi for propane gas. Sometimes, at these lower settings, gas-regulating gauges are not very accurate. To check your regulator, light the gas and point the flame toward the ceiling. In this manner you should achieve a 24" flame (**Figure 2**). If not, adjust the gauge accordingly.

## Step 5. Adjust flame with oxygen

Oxygen setting should be at about 6-8 psi on the regulator.

**Crown and Bridge alloys**

When you have the fuel flame adjusted as described above, introduce the oxygen until you get a full flame. Turn the oxygen valve on the handle of the torch down or toward the off position until all of the small inner cones extrude into one single large inner cone (2"-2 1/2"). You will have a perfect soft flame like a Bunsen burner flame (**Figure 3**)—perfect for melting crown and bridge alloys!

**Gold based ceramic alloys**

Follow the settings as listed above for Crown and Bridge alloys. When you have achieved the "Bunsen burner flame-look," turn up the oxygen valve on the torch handle slightly to snap the single inner cone back into small individual inner cones (3/8"-1/2") (**Figure 4**).

*continued on page 30*

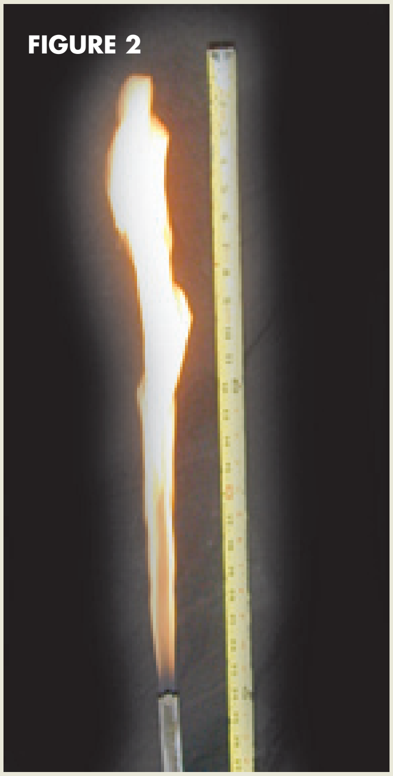
FIGURE 2


FIGURE 3


FIGURE 4

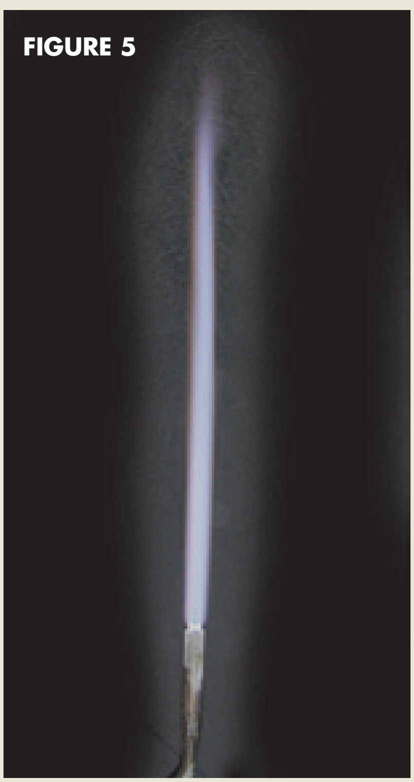
FIGURE 5


FIGURE 6

**Palladium based alloys**

Follow the settings as listed (*see Chart 2, page 31*) for Crown and Bridge alloys with the exception of introducing slightly more oxygen to achieve tighter inner cones (1/4"-3/8'') (**Figure 5**).

**Nickel and cobalt based alloys**

The fuel settings are the same as Crown and Bridge alloys. However, the oxygen setting needs to be 35-40 psi on the regulator. When you adjust the flame, introduce all 35-40 psi of the oxygen into the fuel.

The flame will roar and hiss—which is good (**Figure 6**).

## Step 6. Burn out

This is an extremely important step to achieve perfect grain structure. Ideally the burnout temperature should be set approximately 700˚F / 389˚C lower than the casting temperature of any particular alloy. We use the following guidelines (*see Chart 2*).

**CHART 2**

| Alloy | Burn-out temp |
|---|---|
| Crown and Bridge | 1000˚F - 1100˚F / 538˚C - 593˚ |
| Gold based ceramic | 1350˚F / 732˚C |
| Palladium based ceramic | 1550˚F / 843˚C |
| Nickel based | 1650˚F - 1700˚F / 899˚C - 927˚C |
| Cobalt based | 1900˚F - 2000˚F / 1038˚C - 1093˚C |

*Safety welding goggles with a 5.0 shade will provide protection and are ideal for viewing dental alloys in the melting process.*

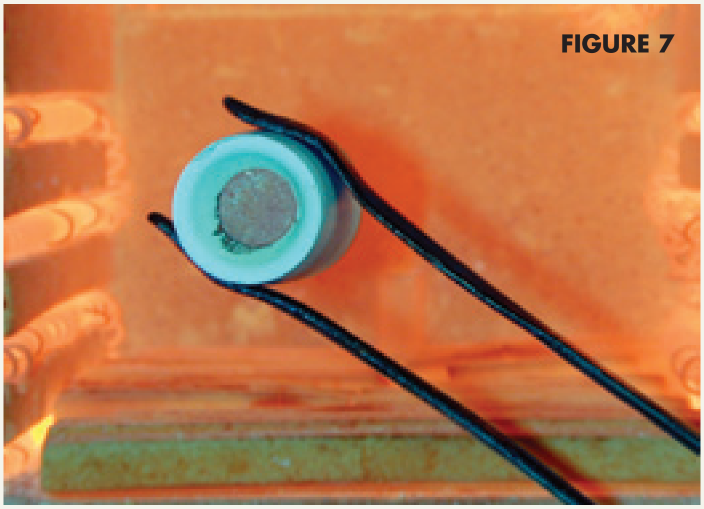

FIGURE 7

## Step 7. Set the broken-arm casting machine

Generally speaking, there is a ratio between the centrifugal force of the casting arm and the specific gravity of the alloy that you are casting. The greater the specific gravity of the alloy, the less winds you would put on the casting machine, respectively. Precious alloys need 3 winds. Semi-precious alloys need 4 winds and base metals need 5 winds.

## Step 8. To quench or not to quench

Generally, any alloy can be quenched after casting when the redness of the button is equal to or less than the redness of the burnout oven it was in prior to casting (**Figure 7**). (See burnout temperatures above). It is not recommended that Crown and Bridge alloys be quenched, as you want the maximum hardness of that alloy. Ceramic alloys will also soften when quenched—ideal for metal finishing. The alloys will reach their maximum hardness during the degassing cycle.

## Step 9. Divesting and metal conditioning

We prefer Brazilian Reddish Brown Aluminum Oxide (the 7th hardest substance under the diamond) for divesting. Its hardness allows you to divest quickly and also adds to better bond strength as a metal conditioner (**Figure 8**). **jdt**

FIGURE 8

*The next edition of Back to Basics will feature "Soldering Techniques for Base and High Palladium Alloys."*


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