Stage 3 Crown & Bridge

Melting & Casting

Dental Alloys
At the end of today’s session you should be able to:

- Describe melting a dental alloy using a torch flame
- Identify and describe the zones of a torch flame
- Describe the different techniques utilized to melt dental alloys using electricity
- Describe the different techniques used to cast dental alloys
- Identify and describe casting defects
The dental alloy to be cast can be heated and melted by the use of:

- Torch (gas/air)
- Electric current
Torch Melting
Torch Melting

The two most common torch flames used to melt dental alloys are generated by:

- **Natural gas and oxygen**
- **Propane (Liquid Petroleum Gas: LPG) and oxygen**
Torch Melting

LPG/Oxygen is the most popular choice, because it produces a hotter flame.

Torch melting is done by directing the flame produced from the gas/oxygen combination at the dental alloy to be melted.
Torch Melting

The heat produced from this flame is then radiated throughout the dental alloy until it is molten and ready to cast.
Torch Melting

Torch melting is generally used with centrifugal casting machines.
Torch Melting

**Flame Zones**

The torch flame can be divided into four zones:

- **Mixing Zone**
- **Combustion Zone**
- **Reducing Zone**
- **Oxidizing Zone**
Torch Melting

**Flame Zones cont’d**

The inner most part of the flame is the **Mixing Zone**. It is cool, colourless and consists of unburnt gas.
Flame Zones Cont’d

Directly around this area is a greenish-blue area called the Combustion Zone in which partial combustion takes place. This area is an Oxidizing Zone.
Torch Melting

**Flame Zones Cont’d**

The **Reducing Zone** is the dim blue area which is the hottest area of the flame.
Torch Melting

*Flame Zones* Cont’d

The outer zone is another *Oxidizing Zone* in which the final combustion between the gas and the surrounding air occurs.
The best area to use for melting an alloy is marked with an ‘X’.
Electrical Melting
Electrical Melting

The three types of electric heating used to melt dental alloys are:

*Resistance*

*Induction*

*Arc*
Electrical Melting

Resistance Melting

All resistance melters use some kind of high temperature wire (like the wire in light bulbs) wound into a spiral outside the crucible.

When electricity moves through the wire, the wire offers resistance to the electricity and becomes hot enough that the heat radiates through the crucible to heat the metal.
Electrical Melting

Resistance Melting cont’d

This type of melting provides the best means of temperature control and can be used for all types of Crown and Bridge alloys.

It also offers a choice of crucibles, carbon for high gold alloys and ceramic (and flux) for palladium alloys.
Resistance Melting cont’d

Resistance melting can be used with centrifugal or vacuum/pressure casting machines.
Electrical Melting

**Induction Melting**

Induction melting works by inducing electrical eddy currents in the metal.
Electrical Melting

Induction Melting cont’d

The source is a water-cooled induction coil that carries an alternating current and surrounds the crucible.
The eddy currents heat the metal eventually melting it.

This method provides the fastest way of melting an alloy but can lead to problems with temperature control.
Induction Melting cont’d

It requires a pyrometer that is focused on the alloy to monitor the temperature of the melt.

It is used mainly for cobalt-chromium-nickel alloys and titanium alloys.

Settings need to be changed for the various alloys used.
Induction Melting cont’d

Induction melting can be used with centrifugal or vacuum/pressure casting machines.
Arc Melting

Arc melting is a process of melting where heat is generated by an electric arc between two electrodes and the metal. This electric discharge or arc is created between the electrodes in an argon gas atmosphere. Arc melting is generally not used in dental laboratory as the machinery is expensive and extremely large.
Casting Machines
Casting Machines

The main two casting machines used in Dentistry are:

Centrifugal

Vacuum/pressure
Casting Machines

**Centrifugal Casting Machine**

This machine works on the principle of centrifugal force: the metal can be accelerated outward by rapid spinning.

This principle is similar to that used to spin the water out of wet clothing in the final cycle of a washing machine.
Casting Machines

Centrifugal Casting Machine Cont’d
Casting Machines

Centrifugal Casting Machine Cont’d

When the alloy is completely molten, the hot casting ring is placed behind the crucible that contains the molten alloy and the crucible-ring assembly is spun rapidly, which accelerates the alloy into the casting ring into the space previously occupied by the sprue and wax pattern.
Casting Machines

- Casting ring
- Force from rotation
- Invented pattern (burned out)
- Casting machine
- Ceramic crucible
- Molten metal
Casting Machines

Vacuum/Pressure Casting Machine

The pressure/vacuum casting machine produces pressure over the molten alloy.

A vacuum is applied to the bottom of the mould: the molten alloy is “pushed and sucked” simultaneously into the mould.
Casting Machines

**Vacuum/Pressure Casting Machine cont’d**

The vacuum/pressure casting machine first evacuates the melting chamber to reduce oxidation and then applies air pressure uniformly around the casting ring, forcing the alloy into the mould.
Casting Defects
Casting Defects

Large nodule—Air trapped during investing.

Multiple random nodules—Inadequate vacuum during mixing.

Nodules on underside only—Prolonged vibration after pouring.
Casting Defects

Shrink-spot porosity—
Spue attachment too bulky. 
Sprue too long or thin. 
Button too small.

Random porosity—
Dirt in wax pattern. 
Loose particles of investment 
from sharp edges (arrow).

Fins—
Dropped ring, rapid heating 
of wet or unhardened mold, 
liner flush with end of ring, 
excessive casting force.
Casting Defects

Short, rounded margins with rounded or lumpy button—Alloy not hot enough or insufficient casting force.

Short, rounded margins with sharp button—Pattern too far from end of ring or, if casting is shiny, incomplete burnout of wax.

Black, rough casting—Breakdown of investment from excessive heat.
Outcomes Achieved

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- Identify and describe casting defects