CASTING PROCEDURES
CASTING

Casting can be defined as the act of forming an object in a mould.
OBJECTIVES

1. To heat the alloy as quickly as possible to a completely molten condition.
OBJECTIVES....

2. To prevent oxidation by heating the metal with a well adjusted torch.
OBJECTIVES....

3. To produce a casting with sharp details by having adequate pressure to the well melted metal to force into the mold.
STEPS

1. Tooth preparation
2. Impression
3. Die preparation
4. Wax pattern fabrication
5. Attachment of sprue former
6. Ring liner placement
7. Investing
8. Burn out
9. Casting
10. Recovery
11. Pickling
12. Polishing
IMPRESSION
DIE PREPARATION
WAX PATTERN FABRICATION
SPRUE
RING LINER
INVESTMENT
BURN OUT
CASTING
RECOVERY
POLISHING
DIE PREPARATION
DIE PREPARATION....

A Die is a positive replica of the prepared tooth.

Fabrication of indirect wax pattern.

Commonly used die materials are

1. Dental stone
2. Electroformed dies
3. Epoxy resins
4. Divestment
DIE PREPARATION....

Desirable qualities of die materials

1. Accurate reproduction
2. Dimensional stability
3. Adequate strength
4. Contrasting color to that of inlay wax
DIE PREPARATION....

DENTAL STONE

Advantages....
1. Good reproduction
2. Dimensional stability
3. Inexpensive

Disadvantages...
1. Lack of abrasion resistance
DIE PREPARATION....

Electroformed dies

Advantages....
1. Better reproduction
2. Good strength

Disadvantages...
1. Time consumption
2. Expensive
3. Silver cyanide
DIE PREPARATION....

Epoxy resins

Advantages....
1. Best reproduction
2. Good resistance to abrasion

Disadvantages....
1. Polymerization shrinkage
2. Not compatible with hydrocolloid impression
DIE PREPARATION....

Divestment
Combination of die stone and investment. It is a gypsum based material which can be used as the die material as well as the investing medium.

Advantages....
1. Good reproduction of details
2. Ease of use
3. Compatible with most impression materials

Disadvantages....
1. Not suitable for high fusing alloys.
WAX PATTERN FABRICATION
WAX PATTERN FABRICATION....

Direct wax pattern

Advantages....
1. Less lab work
2. Less discrepancies
3. Less time

Disadvantages....
1. More skill
WAX PATTERN FABRICATION....

Indirect wax pattern

Advantages....
1. Less chairside time
2. Finishing and polishing can be done on the die,

Disadvantages....
1. More lab work
2. Inaccuracies of impression and cast results in errors.
SPRUE
SPRUE....

The sprue former provides a channel for the molten metal to flow into the mold space in an invested casting ring after the wax pattern has been eliminated.
SPRUE....

Types....
The sprue former may be made of wax, resin or metal.

Wax and resin sprue formers have the advantage of being eliminated during burnout, so there is no need to remove them before casting.
Sprue....

Diameter....

Depends upon the size of the wax pattern, casting machine and the type of alloy.

The sprue former diameter should be greater than the thickest portion of the wax pattern.
SPRUE....

Length....
The length should be such that the end of the wax pattern is 3.25mm to 6.5mm away from the open end of the casting ring.
The sprue former should be attached to the bulkiest portion of the wax pattern due to:

1. To reduce the residual stresses in the wax during attachment.
2. To ensure supply of molten metal to fill all thinner sections of the mould.
Angulation....

The sprue former should always be attached at an angle of 45 degrees to the bulkiest portion of the pattern. This will allow easy and efficient flow of the molten alloy.
SPRUE....

Reservoir....
This is formed by wax added around the sprue former (1-2mm from the wax pattern)
To provide a constant supply of molten alloy to fill the mold space.
The alloy in the reservoir solidifies last after the mold space is completely filled.
INVESTMENT
Casting ring liner....

In order to allow more uniform setting and hygroscopic expansion of the investment a liner is placed inside the ring.
Ceramic or cellulose liners are used.
The liner is kept 3mm short at each end of the ring.
BURN OUT
BURN OUT....

The sprue base is removed and the casting ring is placed in the burn out.

1. Low heat technique (hygroscopic technique) – 500°C.

2. High heat technique (thermal expansion technique) – 700°C.
CASTING
CASTING....

1. Centrifugal casting machines.
2. Air pressure casting machines.
CASTING DEFECTS

Defects in castings can be classified under four headings:
1. Distortion
2. Surface roughness and irregularities
3. Porosity
4. Incomplete or missing detail.
I. DISTORTION

Any marked distortion of the casting is probably related to a distortion of the wax pattern.

This type of distortion can be minimized or prevented to proper manipulation of the wax and handling of the pattern.

Some distortion of the wax pattern occurs as the investment hardens around it. The setting and hygroscopic expansions of the investment may produce an uneven movement of the walls of the pattern.
Prevented by.....,

1. Manipulation of wax at high temperature
2. Investing pattern within one hour after finishing.
II. SURFACE ROUGHNESS

Excessive roughness or irregularities necessitate additional finishing and polishing to prevent a proper seating of an otherwise accurate casting.
II. SURFACE ROUGHNESS....

**Air Bubbles.** Small nodules on a casting are caused by air bubbles that become attached to the pattern during or subsequent to the investing procedure.

**Water Films.** Wax is repellent to water, and if the investment becomes separated from the wax pattern in some manner, a water film may form irregularly over the surface. This type of surface irregularity appears as minute ridges or veins on the surface.
II. SURFACE ROUGHNESS....

*Rapid Heating Rates.* It results in fins or spines on the casting.
The mold should be heated gradually.
The greater the bulk of the investment, the more slowly it should be heated.
II. SURFACE ROUGHNESS....

*Under heating.* Incomplete elimination of wax residues may occur if the heating time is too short or if insufficient air is available in the furnace.

The casting may be covered with a tenacious carbon coating that is virtually impossible to remove.
II. SURFACE ROUGHNESS....

**Liquid: Powder Ratio.** The higher the L:P ratio the rougher the casting.

**Prolonged Heating.** A prolonged heating of the mold at the casting temperature is likely to cause a disintegration of the investment. The products of decomposition are sulfur compounds that may contaminate the alloy. Such contamination may be the reason that the surface of the casting sometimes does not respond to prickling. Never higher than 700°C and the casting should be made immediately.
II. SURFACE ROUGHNESS....

**Temperature of the Alloy.** If an alloy is heated to too high a temperature before casting, the surface of the investment is likely to be attacked, and a surface roughness may result.

**Casting Pressure.** A gauge pressure of 0.10 to 0.14 MPa in an air pressure casting machine or three to four turns of the spring in an average type of centrifugal casting machine is sufficient for small castings.
II. SURFACE ROUGHNESS....

**Composition of the Investment.** The ratio of the binder to the quartz influences the surface texture of the casting. In addition, a coarse silica causes a surface roughness.

**Foreign Bodies.** When foreign substance gets into the mold, a surface roughness may be produced.
II. SURFACE ROUGHNESS....

**Impact of Molten Alloy.** The direction of the sprue former should be such that the molten alloy does NOT strike a weak potion of the mold surface.

**Pattern Position.** If several patterns are invested in the same ring they should not be placed too close together.
II. SURFACE ROUGHNESS....

Carbon Inclusions. An improperly adjusted torch, or a carbon-containing investment, can be absorbed by the alloy during casting.
Surface roughness and irregularities

Air Bubbles.
Water Films.
Rapid Heating Rates.
Under heating.
Liquid: Powder Ratio.
Prolonged Heating.
Temperature of the Alloy.
Casting Pressure.
Composition of the Investment.
Foreign Bodies.
Impact of Molten Alloy.
Pattern Position.
Carbon Inclusions.
III. POROSITY

Porosities in noble metal alloy castings may be classified as follows:

1. Solidification defects
   - Localized shrinkage porosity
   - Microporosity

2. Trapped gases
   - Pinhole porosity
   - Gas inclusions
   - Subsurface porosity

3. Residual air
Localized shrinkage is generally caused by incomplete feeding of molten metal during solidification.

If the sprue freezes in its cross section before this feeding is completed to the casting proper, a localized shrinkage void will occur in the last portion of the casting that solidifies.
Localized shrinkage porosity

This type of void may also occur externally, usually in the interior of a crown near the area of the sprue.

The entering metal impinges onto the mold surface and creates a higher localized mold temperature in the region that is called a **hot spot**.

This hot spot causes the local region to freeze last and result in what is called **suck-back porosity**
Microporosity This premature solidification causes the porosity shown in the form of small irregular voids.

Both the pinhole and the gas inclusion porosities are related to the entrapment of gas during solidification. Both are characterized by a spherical contour, but they are decidedly different in size. The gas inclusion porosities are usually much larger than pinhole porosity.
Subsurface porosity They may be caused by the simultaneous nucleation of solid grains and gas bubbles at the first moment that the metal freezes at the mold walls.
Entrapped air porosity on the inner surface of the casting, sometimes referred to back-pressure porosity, can produce large concave depressions. This is caused by the inability of the air in the mold to escape through the pores in the investment.
IV. INCOMPLETE CASTING

*Incomplete Casting* The obvious cause is that the molten alloy has been prevented, in some manner, from completely filling the mold.
1. Distortion
2. Surface roughness and irregularities
3. Porosity
4. Incomplete or missing detail.
Surface roughness and irregularities

- **Air Bubbles.**
- **Water Films.**
- **Rapid Heating Rates.**
- **Under heating.**
- **Liquid: Powder Ratio.**
- **Prolonged Heating.**
- **Temperature of the Alloy.**
- **Casting Pressure.**
- **Composition of the Investment.**
- **Foreign Bodies.**
- **Impact of Molten Alloy.**
- **Pattern Position.**
- **Carbon Inclusions.**
Porosity

Localized shrinkage porosity
Suck-back porosity

Microporosity
Pinhole porosity

Gas inclusion porosities
Subsurface porosity
Entrapped air porosity