Working cast and die

By Dr. Mohamed Hamed Ghazy
Professor & Chairman of Fixed Prosthodontics
Faculty of Dentistry, Mansoura University, Egypt
mghazy@mans.edu.eg
February 13, 2016

Working (Master) cast = Replica of the prepared teeth, ridge areas, and other parts of the dental arch.

Die = Positive reproduction of the prepared tooth and consists of a suitable hard substance of sufficient accuracy (usually an improved stone, resin, or metal).

The accuracy of a cast-and-die system is a function of the completeness and accuracy of the impression, or optical capture.

The cast cannot contain more information than the impression from which it was made.
REQUIREMENTS OF GOOD WORKING CASTS

1. It must reproduce both prepared and unprepared tooth surfaces.

2. Unprepared teeth adjacent to the preparation must be free of voids.

3. Surfaces of teeth involved in anterior guidance and the occlusal surfaces of all unprepared teeth must allow for precise articulation of the opposing casts.
4. All relevant soft tissues should be reproduced in the working cast (edentulous spaces and residual ridge contours that will be involved in the fixed prosthesis).

REQUIREMENTS OF GOOD WORKING DIES

1. *It must reproduce the prepared tooth exactly.*

2. *All surfaces must be accurately duplicated, and no bubbles or voids can be accepted.*
REQUIREMENTS OF GOOD WORKING DIES

3. The unprepared tooth structure cervical to the finish line should be easily discernible on the die (0.5 - 1 mm).

4. Adequate access to the margin is imperative.
**REQUIREMENTS OF DIE MATERIALS**

1) Should have *high strength* to withstand handling without being fractured or destroyed.

2) Should have *surface hardness* to resist *scratching* and *abrasion* while the wax pattern is being formed.

3) Should have *excellent dimensional accuracy*.

4) Should be *compatible with the impression materials*.

5) Should have *good color contrast* with other materials so the preparation margins can be easily detected.

6) Should be *compatible with the separating medium* that may be used.

**IDEAL PROPERTIES OF DIE MATERIALS**

1. It should be dimensionally accurate.

2. It should have high abrasion resistance, should possess good strength, & have smooth surface.

3. Toughness – to allow burnishing of foil & resist breakage.

4. Ability to reproduce all fine details in the impression.

5. Compatibility with all impression materials.


7. Easy & quick manipulation & rapid fabrication.

8. Non-injurious to health by touch or inhalation.

MATERIALS AVAILABLE FOR CONSTRUCTION OF DIE MATERIAL CAN BE CLASSIFIED INTO:

1. Stone (Gypsum) die.
2. Amalgam die.
3. Acrylic or epoxy die.
4. Refractory die (ceramic die).
5. Electroplated die.
   - Silver plated
   - Copper plated
6. Flexible die.

1) GYPSUM

- Gypsum products are available in 5 forms:
  - Type I: Impression plaster.
  - Type II: Model plaster.
  - Type III: Dental stone.
  - Type IV: High-strength dental stone.
  - Type V: High-strength, high-expansion stone.

The physical properties of die stone are improved over those of dental stone because less water is needed to obtain a sufficiently fluid mix.

100 g of plaster requires 45 to 50 mL of water,
100 g of dental stone requires 30 to 35 mL of water
100 g of die stone requires 20-25 mL of water, depending on the particular brand.
Gypsum (CaSO\(_4\).2H\(_2\)O)

**Dehydration**
- **Calcination**
  - Heating the (CaSO\(_4\).2H\(_2\)O) at 115°C in open kettle
- **Autoclaving**
  - Heating the (CaSO\(_4\).2H\(_2\)O) at 125°C with steam under pressure
- **Boiling**
  - Boiling the (CaSO\(_4\).2H\(_2\)O) in 30% CaCl\(_2\)

- β - Ca SO\(_4\). ½ H\(_2\)O
- α - Ca SO\(_4\). ½ H\(_2\)O
- α - Ca SO\(_4\). ½ H\(_2\)O

**Type I gypsum**
- (Impression plaster)

**Type II gypsum**
- (Model plaster)

**Type III gypsum**
- (Hard stone)

**Type IV gypsum**
- (Extra hard stone)

**Type V gypsum**
- (Extra hard-high expansion stone)

**Clinical material**

**Laboratory materials**

- Gypsum can be mixed by:
  - **Hand mixing**
  

![Image of hand mixing](https://example.com/hand-mixing)

![Image of laboratory setup](https://example.com/laboratory-setup)
Vacuum mixing

**Advantages:**

1. Dimensional accuracy.
2. Good surface detail reproduction with Type IV and Type V gypsum products.
3. Inexpensive.
4. Easy to use.

**Disadvantages:**

Poor resistance to abrasion.

1) **GYPSUM**

**Advantages:**

1. Dimensional accuracy.
2. Good surface detail reproduction with Type IV and Type V gypsum products.
3. Inexpensive.
4. Easy to use.

**Disadvantages:**

Poor resistance to abrasion.
Attempts to overcome its poor resistance to abrasion included:

- "Gypsum hardeners"
  - *e.g.*, colloidal silica.

- Impregnate the surface of the die with a low-viscosity resin
  - *e.g.*, cyanoacrylate

- Resin-strengthened gypsum products such as ResinRock
2) AMALGAM DIE

- used only in copper band impression with modeling compound, contraindicated with rubber base due to the elastic properties of the material so it will not withstand forces of amalgam condensation.

- It is harder but it is only used with compound impression and has long setting time and greater setting expansion.

3) RESIN DIE

**Resin die materials may be:**
- *Epoxy resins.*
- *Polyurethane.*

**Advantages:**
- Better abrasion resistance than gypsum.
- Not need expensive equipments.

**Disadvantages:**
- More expensive than gypsum.
- Shrinkage during polymerization ... So... FPD fabricated on resin dies will fit more tightly.
- Not compatible with certain impression materials (i.e., polysulfide and hydrocolloid).
4) REFRACTORY DIE

Refactory cast trimmed with stone base.
Refactory Dies:

- These are made for preparation of all ceramic restorations.
- **Advantages**: Excellent marginal adaptation

A low viscosity polyvinyl siloxane duplicating material is used to reproduce dies

Adapt a strip of putty around the prepared teeth on working cast and dies to limit the flow of mold material.

To avoid air entrapment, fill the putty reservoir by pouring the mix.

The duplication material should be at least 3.00mm thick and it should extend 3 mm beyond incisal edges of teeth to provide adequate support refractory material.

- The duplicating material is allowed to set for about 30 minutes.
5) ELECTROPLATED DIES

• Using electric current to deposit a coat of pure dissolved silver or copper on the surface of impression.

• Advantages:
  1. Dimensionally stable.
  2. Strong.
  3. Can be saved for many years.

• Disadvantages:
  1. Liability to distortion if the metal coat if not performed slowly.
  2. Time consuming and tech sensitive.

5) ELECTROPLATED DIES

3. Not all impression materials are suitable for plating.

• Silicone imp. are difficult to electroplate evenly because of their low surface energies.

• Polyether imp. can not be plated, because of their hydrophilic nature, imbibe water and become distorted.

• Polysulfide imp. can be silver plated, but it is much more difficult to copper plate them.

4. Poisoning effect: Silver plating uses cyanide solution ... toxic.
6) FLIXIBLE DIE MATERIALS

- Similar to heavy-bodied silicone or polyether impression materials.
  Used to make provisional restorations or indirect composite resin inlays or onlays.

Use:-

- To make provisional restoration.
- Indirect composite resin inlays or onlays.
- Maryland bridges.

Advantage:-

- More rapid setting — 10min.
- Ease of removal of provisional restoration.

TABLE 17-1 Die Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Recommended Use</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADA type IV stone</td>
<td>Dimensional accuracy</td>
<td>Will be damaged if not handled carefully</td>
<td>Most situations</td>
<td>Accurate proportioning essential</td>
</tr>
<tr>
<td></td>
<td>Straightforward in-office procedure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADA type V stone</td>
<td>Straightforward technique</td>
<td>Increased expansion</td>
<td>Most situations</td>
<td>Accurate proportioning essential</td>
</tr>
<tr>
<td></td>
<td>Low cost</td>
<td></td>
<td></td>
<td>Vacuum mixing recommended</td>
</tr>
<tr>
<td></td>
<td>Straightforward in-office procedure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Harder than type IV stone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epoxy resin</td>
<td>High strength</td>
<td>Polymerization shrinkage</td>
<td>Complete ceramic crowns</td>
<td>Not compatible with polysulfide or hydrocolloid</td>
</tr>
<tr>
<td></td>
<td>Good abrasion resistance</td>
<td>Time-consuming, complex procedure</td>
<td></td>
<td>Silver entails use of cyanide, which is toxic</td>
</tr>
<tr>
<td>Electroplating</td>
<td>High strength</td>
<td>Time-consuming</td>
<td>Complete ceramic crowns</td>
<td>Incompatible with many impression materials</td>
</tr>
<tr>
<td></td>
<td>Good abrasion resistance</td>
<td>Special equipment needed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Methods available for construction of working casts and dies (Die Systems)

• Working cast with separate die.

• working cast with removable die:
  - Dowel Pin technique.
  - Di-Lock Tray System.
  - Pindex System.
  - DVA Model System.

• The single die used with single copper band imp.

Working Cast with Separate Die

= Solid Cast with Individual Die
= Multiple-pour Technique
WORKING CAST & SEPARATE DIE SYSTEM

Here, two casts are poured from a single impression.

One cast is sectioned and used as a die and

The other is not sectioned and is used as the working cast.

The wax pattern is prepared on the die and later transferred to the working cast.

The die is shaped and finished using an acrylic trimmer and the portion of the die below the cervical line is finished using a scalpel.

Sharp undercuts in the base should be avoided.

WORKING CAST & SEPARATE DIE
WORKING CAST & SEPARATE DIE

- Technique -

Disinfection
WORKING CAST & SEPARATE DIE

Technique

Bubbles form where two masses of massow meet.

1 inch
WORKING CAST & SEPARATE DIE

Technique

Model saw
WORKING CAST & SEPARATE DIE

**Technique**

1) **Simplicity** and no need for special equipments.

2) **Accurate** because it keeps the relationship between abutments fixed.

3) Requires only **minimum trimming**.

4) The **gingival tissue** and other landmarks are intact.

**Advantages:**
WORKING CAST & SEPARATE DIE

Disadvantages:

1. Wax pattern must be transferred from one cast to the other.
2. Difficult to transfer complex wax patterns from die to cast.
3. Seating the pattern on the master cast may be problematic.
4. Can be used only with elastomeric imp materials.

Working Cast with a Removable Die
If a removable die system is used, it should satisfy these requirements:

i. The dies must return to their exact original positions.

ii. The dies must remain stable, even when inverted.

iii. The cast containing the dies must be easily mounted on the articulator.

WORKING CAST WITH REMOVABLE DIE

Advantage:

• Convenient to use

• Various drawback of separate die are overcome

Disadvantage:

• Risk of introducing error in the pattern if die does not seat accurately in the working cast
SYSTEMS USING DIE PINS

Methods of repositioning die in its working cast

Systems using pre formed plastic trays without die pins
**CONVENTIONAL DOWEL PIN SYSTEMS**

- **Dowel pin (GPT 8):** A metal pin used in stone casts to remove die sections and replace them accurately in the original position.

**STRAIGHT DOWEL PIN**

- Flat sided dowel
- Double straight dowel with common head (Bi pin)
- Rounded single dowel pin
BI-PIN with case

BI-FIXED-pin

Doubles straight dowel with fixing wire for accurate positioning in impression

• Four systems are presented here:

1) Dowel Pin System.
2) Pindex System.
3) Di-Lok Tray System.
4) DVA Model System.
Procedure
(Pre pour technique)
Dowel Pin System

Diagram showing the process of creating a dental impression using the Dowel Pin System.
Dowel Pin System

- This type of dowel also can be cemented into holes drilled into the flat underside of a cast that has already been poured
  
  i.e. post-pour technique.

Pre-pouring tech ≠ Post-pouring tech
Dowel Pin System

10 mm max.

Dowel Pin System
Dowel Pin System

PINDEX SYSTEM
(COLTENE / WHALEDENT)

- Light beam director
- Work table
- Drill hole
- Handle bar
- Motor housing
Pour the impression with height of 20 mm.
Trim the cast to get perfectly flat base.

- Use a pencil to mark the desired location of the pins on the occlusal surfaces of the teeth or preparations.
Remove any debris.
Cyanoacrylate for cementation

- place the sleeves over the pins
  ... then ... lubrication.
- Utility wax.

- Add the base to the cast.

1- Boxing
2- Base former.
Di-Lok Tray

Pre manufactured base system
Two tapered round brass pins per die - 7mm
DVA MODEL SYSTEM

DVA MODEL SYSTEM
DVA MODEL SYSTEM

ZEISER MODEL SYSTEM
(GIRRBACH DENTAL GMBH, GERMANY)
Impression leveled, blocked out with silicone putty

Positioned over the base

Pin locations determined

Pin holes drilled in base
Pins inserted into base

Impression is poured

Base inverted

The cast is separated from the impression
BELLE DE ST. CLAIRE

Round slightly tapered S.S. dowel pins 15 mm long

Flat surface and plastic indexer $\rightarrow$ positive lock $\rightarrow$ retention and anti-rotational Feature.

Holes $\rightarrow$ pindex system with drill available with the system
Plastic indexers

Question?