



Understanding Dental Gypsum

A Dental Lab Professional's Guide to All Things Gypsum



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Gypsum Types

Dental gypsum is one of the most commonly used materials in the dental laboratory. They are manufactured in many colors, strengths and with many different degrees of expansion. Though every dental lab uses at least one, few technicians understand the differences and the affect they can have on the final restoration or prosthetics.

Dental gypsum is separated into 5 different types. Understanding how they are to be used will help determine which type you should choose for any given application. Every gypsum product fits into a specific type as defined by the ISO (the International Organization for Standardization). That rating categorizes the material in terms of its properties, i.e. compressive strength and expansion.

A clear example of differences in classification type would be between type 4 and type 5. Each must offer a minimum of 5,100 psi, but type 4 is 0 - 0.15% expansion and type 5 picks up at the 0.16% expansion all the way up to 0.30%.

TYPE 1 & 2

These low strength gypsum materials are typically referred to as dental plasters. They are for applications like mounting models to articulators. Or, they can be used to make diagnostic models which will not be worked on. Type 1 and Type 2 gypsums are available in 'fast' and 'regular' working times...the choice is based on the preference of the laboratory technician.

TYPE 3

These are sometimes called 'model stone' or 'specialty stone'. This stone is used for

- Opposing models
- Bases in the pinning technique
- Crown & bridge applications
- Models for the denture technique

Type 3 gypsums should be chosen for:

- Their working time (how fast or slow you need to work)
- Their expansion.

Lower expansion is best for crown & bridge applications and for implant work while larger expansion is best for denture work.

Gypsum Types

TYPE 4

Gypsum with an ISO rating of 4 can be a specialty stone, and is most commonly used as a die stone.

Most cases use a low expansion die stone (around .08). If the casting fits the model, but is a little tight in the patient's mouth, then it would be wise to switch to a larger expanding stone, in the .12 to .15 range.

TYPE 5

Type 5 gypsum is a high expansion die stone, beginning at .16 and increasing. It is recommended to use this kind of gypsum when the dentist is using impression materials that have a large linear contraction of .25 or greater, or when a 'loose' or 'passive' fit in the mouth is desirable.

With a thorough understanding of gypsum ISO ratings you can more wisely choose a stone to fit your application.

Physical Properties

Compressive Strength

Because of the traditional processing of prosthetics, compressive strength has played an important role in gypsum and is thus required reporting by the American Dental Association.

Compressive Strength is a measurement of a material's resistance to compression, which is created by any force applied to the stone mass. In the removable side of dental technology, compressive stress takes place when the completed prosthesis wax-up is flasked, trial packed and then final packed and pressed using a hydraulic or axial press. Compressive Strength is measured with a device called a Tinius machine, which creates single directional pressure, measured in pounds per square inch, on a sample of the material to be tested. When the material fractures under an increasing load, a measurement is noted and assigned to that tested material.

A certain amount of compressive strength is necessary to withstand the pressure from these procedures. However an important balance also needs to be present as there is a relationship between the compressive strength of a material and the material's ability to be broken and removed from the flask, model and prosthesis. For example, die stones of the TYPE IV and TYPE V categories are substantially higher in compressive strength (this is not an indication of higher surface hardness nor of general tensile strength) and are generally not used in removable prosthetic flasking processes because they are difficult to fracture and remove.

When flasking in preparation for trial packing, technicians generally follow a rule of using a flasking stone with a lower compressive strength than the model on which the denture or partial was originally constructed. Some even create their own materials by combining stones and plasters in various ratios to reduce the compressive strength of the flasking materials. The technician should be aware that the combining of materials also changes all of the other physical properties stipulated by the manufacturer. It is always preferable to use a stone that is designed and manufactured for your specific purpose if you are looking for consistency in performance.

The compressive strengths of materials can be reviewed and compared by looking at the manufacturer's PHYSICAL PROPERTIES CHART, and then make your selection according to the process needs.

8 Good Rules to Follow When Selecting a Gypsum

- 1 Find out the contraction of your impression materials.**
All impression materials contract (shrink) to their greatest mass, making the size of the imprint slightly larger than the original object.
- 2 Use a reported low expansion Die Stone.**
Matching the expansion of the stone to the contraction of the impression material may make the resulting model large.
- 3 If the "fits are tight", use a larger expanding die stone.**
Loosen the fit of the coping/crown over the prepared surface or die by changing the stone.
- 4 Not all Doctors perceive "tight" the same way.**
Find out exactly where the tightness occurs before changing your process.
- 5 Surface problems with the stone are not chemistry in the stone, but chemistry acting on the stone.**
Make sure that the impression is free from all contaminants, both biological and chemical, before pouring.
- 6 Use a low expansion Base Stone.**
Mid or high expansion stones may cause die drift showing as ill-fitting bridges or contacts. Don't solve one problem, only to cause another.
- 7 Higher compressive numbers do not necessarily mean a HARDER surface.**
The reported numbers are a factor of compression, not hardness. No one reports Brinell or Vickers numbers relative to surface hardness.
- 8 Combining stones changes all the properties.**
Some users make up their own "Specialty Stones". These non-homogeneous mixes will change all of the corresponding physical properties, and expand or set differently in each part of the mix.

Now That You've Decided Which Gypsums You Want to Use, How Should You Use Them Properly?

The physical and mechanical properties of gypsum can be manipulated by procedures that influence the difference in solubility and growth of the dihydrate crystals. Certain procedures can either enhance or hinder your gypsum material in the mixing process. Achieving an ideal mixture that produces an optimal working consistency can be challenging, but there are specific guidelines you can follow that take the "trial and error" out of achieving a perfect gypsum mixture.



Preparation:

For the best results, it is essential that the mixing equipment is clean before mixing the gypsum. Any residue would have a negative effect on the setting time and expansion of the mixture. The gypsum should be mixed under vacuum and to the recommended water/powder ratio.



Mixing Water:

Room temperature tap water can normally be used for mixing. It is even safer to use demineralized or distilled water. The mix may be affected if other liquids are used, such as water from the model trimmer or gypsum hardener liquids.



Adding Powder to Water:

When mixing by hand, the gypsum must be quickly and evenly added to the water within a time span of no more than 10 seconds. In accordance with EN ISO 6873, timing starts when the gypsum and water come into contact. After the gypsum has been soaked for 20 seconds, it can be mixed with a spatula.

Mixing in a vacuum mixer improves the quality (density) of the mixture and saves time. Manual mixing requires approx. 60 seconds and mechanical mixing approximately 30 seconds.

The vacuum should be set at 27 inches of mercury when mixing. Altitude will affect vacuum by losing 1 inch per 1000 feet. Adding water or gypsum when the consistency is too thick or too thin affects the setting process and damages the crystalline structure of the gypsum.



Pouring the impression:

The impression should be poured immediately after mixing. Pouring the impression should be completed within the working time. The gypsum begins to crystallize at the end of the working stage.

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At this point, no further work should be carried out because fine details can no longer be accurately reproduced after the setting phase begins. The strength of the gypsum would also be greatly reduced. This even happens when using a vibrator. Vibration should be completed before the setting stage. Following cleaning, disinfecting and neutralizing, alginate and hydrocolloid impressions should be poured immediately with gypsum because they are not volumetrically stable.

Shaping gypsum:



Gypsums have an exact setting time. If hard stone has a setting time (final set) of e.g. 10 - 12 minutes, it can be worked on for approx. 5 minutes (approx. half the setting time).

When the surface of the stone loses its gloss, it can still be shaped for approx. 1 minute. After this the setting time begins. At this point no further work can be done, as this would affect crystallization



Removing the model:

In general, the set model must not be removed from the impression for a minimum of 30 minutes after pouring.

Stone in an alginate or hydrocolloid impression should be removed after 30 minutes because these impression materials react aggressively with gypsum. It is advisable to leave other impression materials for up to an hour before removing the stone.

Setting Expansion:

All gypsums expand during the final setting phase. The amount of expansion depends on the composition of the gypsum, the volume of the cast and the ambient temperature and humidity. According to EN ISO 6873, comparable measurements of expansion can only be made under the same conditions. Please note that the percentage expansion of the gypsum must be measured after two hours. Compressive strength is measured in N/mm² after one hour, and again at 48 hours.

Ensure that standards and times are accurate when making comparisons. In practice, some expansion is necessary to compensate for the contraction of other materials. Slight shrinkage occurs if the model is stored at room temperature and low humidity over a longer period. If the model is soaked, as it is sometimes necessary, expansion of the gypsum increases slightly. Whip Mix gypsums are well below the expansion values allowed by the DIN standard.

Now That You've Decided Which Gypsums You Want to Use, How Should You Use Them Properly?

Preparing the impression:

Problems continually arise in the laboratory (time, disinfectant, saliva, blood, etc.). Since some impression materials react with gypsum, lab technicians and dental assistants who pour them must take precautions to obtain an accurate gypsum model with a smooth surface.

Sawing the preparation:

It is advisable to saw, prepare and trim dental arches within two hours of removing from the impression. If models have to be sawn or prepared much later than that, they can be soaked briefly to prevent gypsum chipping. Use a sharp blade.

Boiling out, steam cleaning, cleaning

These standard laboratory procedures, which are often unavoidable, must be carried out very carefully. Gypsum models can exhibit complications if exposed to sudden changes in temperature.

We strongly recommend immersing the model in warm water at approx. 50°C for a few minutes to avoid chipping or even completely fracturing the model. Steam-cleaning the model can also lead to surface abrasion. In many cases it is better to clean the model using a soft brush and a soap solution.

IMPORTANT STEPS FOR GYPSUM MODEL PREPARATION

Even with the latest developments in scanning and milling, the use of gypsum-based materials is essential to your laboratory processes. An in-depth understanding of these materials and their behavior is part of the foundation of success in your business.

Store Gypsum Wisely

Remember that all gypsum products should be sealed and stored in low humidity cabinets. An open 50 lb. box left on the floor with the liner pulled back is an open invitation for material ruin. "The first half of this box worked great, but now it has problems. I think I got a bad batch". Wall bins are great for access but should not be filled so full that the material sits prior to use, for days on end exposed to the atmosphere.

Measure Twice, Mix Once

Measuring accurately and mixing properly are just as critical. 100gr of plaster is not the same in volume as 100gr of die stone. Manufacturers create defined physical properties for each gypsum product. When you change the parameters of Water/Powder ratio and mix time, you also change the other physical properties. If a particular product is not behaving as you would like, it may be the wrong product for your application or you may not be following the instructions correctly. Review the procedures on a regular basis to make sure that you have not drifted from the intended use or handling instructions.

Clean is Best

If your clients walked in right now, would you be embarrassed to have them in the lab? How would you react if your physician's medical lab looked like your dental lab? Make sure that your areas and your equipment are clean and in proper working order.

Beware of Interactions

Gypsum that has already set acts as a catalyst when in contact with unset gypsum and can cause changes in the set and working times. Don't mix gypsum stones and plasters in the same bowls used for phosphate investments. The phosphate can keep the gypsum from setting properly.

Less is More

Other chemistry issues can also affect you. Excessive disinfectant solution or water can give you unset or powdery gypsum at the surface. Make sure that your impressions are clean and only slightly damp before you pour. Excessive use of alcohol based surfactants or debubblers can also create surface issues like softness or chalkiness.

IMPORTANT STEPS FOR GYPSUM MODEL PREPARATION

Eliminate Impression Headaches

Impression materials and their use can sometimes be problematic. Do your best to match the linear expansion of your stone to the linear contraction of the impression materials that you receive. Stones generally range from .05% to .3% expansion. Impression materials are being reported from .0018% to .4% contraction, so you can see there is a great possibility of mismatch. If your doctors are constantly complaining of tight crowns you may want to check for a mismatch problem before you change the ratios in your investment materials.

Always check the impressions for problem areas. Tares, voids, unset material, air traps on marginal areas or tray showing through material. All are potential sources of case failure and should be pointed out to the doctor and noted on the prescription, along with the Doctor's indication to continue or re-take the impression. Pouring and pulling (once set) can damage what you first see. If possible it may be a good idea to take a picture of the concerning area and send it to the doctor so he can see the problem and respond before you pour the impression.

Presentation Counts

Sloppy gypsum work leaves your clients with the image that you are a sloppy, unprofessional laboratory. See that the model work and articulations are smooth, free from excess gypsum and clean. There should not be articulating ink, pencil marks, fingerprints or other unnecessary markings left on the casts when returned to the client.



Remember that what you do with your gypsum work is the foundation of all that happens on it. Beginning with a solid and attractive foundation helps to ensure that your restorative creativity will be appreciated by the dentist, the assistant and the patient.

Additional Resources:

<http://info.whipmix.com/dental-gypsum-behavior>

<http://info.whipmix.com/prevent-gypsum-model-chipping>

<http://info.whipmix.com/understanding-dental-gypsum-iso-types>

<http://info.whipmix.com/why-compressive-strength-is-important-when-choosing-a-dental-stone-or-plaster>



No matter what your gypsum needs are, Whip Mix can help you with our full selection of gypsum die stones, model stones, specialty stones & plaster.

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