

BB026 2182

USG MASTER CASTER

A MANUAL OF METHODS
AND MATERIALS FOR
PLASTER CASTING
SHOPS



BB026 2183

An Index

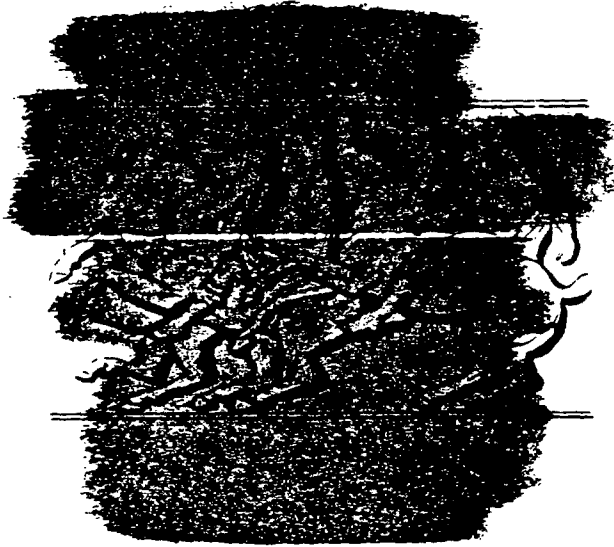
TO QUALITY

METHODS AND MATERIALS
FOR SUPERIOR PLASTER CASTING

Published by
UNITED STATES GYPSUM CO.
CHICAGO, ILL.

Introduction

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The purpose of this booklet is to show the great and growing use of cast plaster—to provide the plaster casting shop with basic information and technical data for obtaining more uniform results and avoiding waste of time and materials, thus assuring more satisfactory profits.

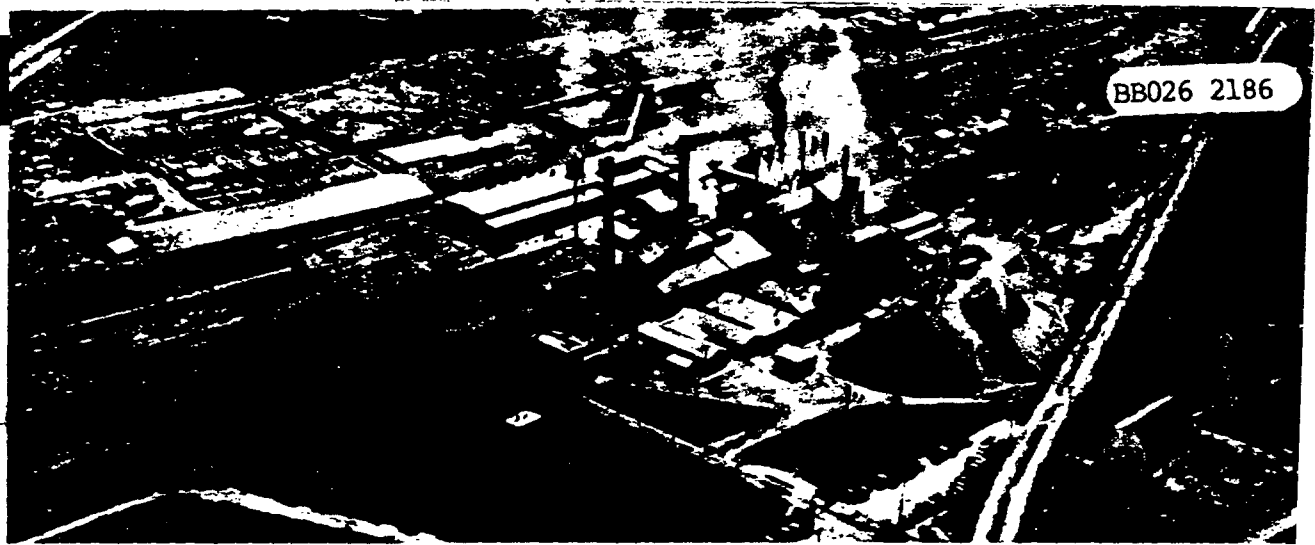


Research and Improvement

The United States Gypsum Company, as the world's largest producer of gypsum products, is well qualified to speak authoritatively on this subject. Many years of research and collaboration with practical plaster casting men have brought the development of new varieties

for specific purposes. With its own mines scattered over many of the 48 states, unequalled manufacturing and laboratory facilities, and 40 years of practical and scientific experience, the company has pioneered in improving the materials employed in casting plaster work.

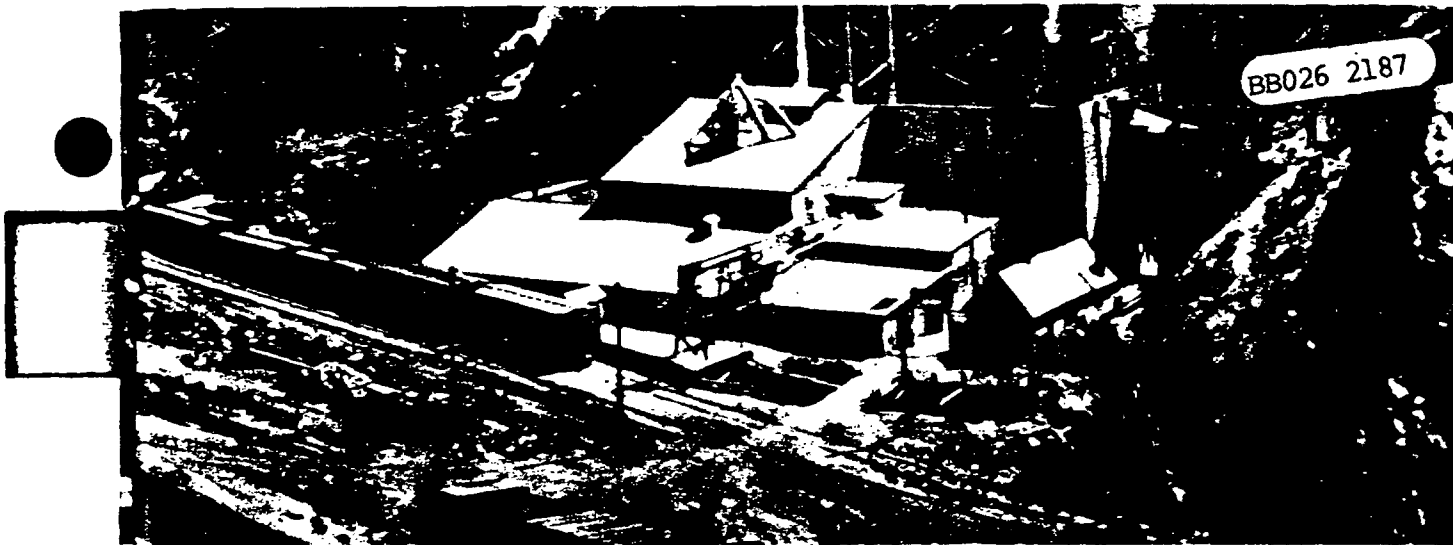




U S G research has also demonstrated the need for painstaking control of quality. Its scientists, for example, have studied the effect of the size of plaster particles on the texture of the set plaster cast. An entire new plant

has been built that provides closer control of this important property.

The improvement in the quality and uniformity of casting plasters today is matched by better and more uniform methods of han-



dling them in the casting shop. Guesswork and haphazard methods have been displaced in well-operated shops by standard techniques which assure quality and uniformity of results. U S G field representatives and labora-

tory facilities are constantly at the disposal of casting shop operators with special problems. *The most up-to-date methods as practiced in modern, well-managed casting shops are outlined on the following pages.*

Modern Uses of Cast Plaster

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Today gypsum plaster finds literally thousands of uses. The ability to form dimensionally accurate casts makes it useful for—

ART . . antique replicas for drawing classes, statuary, friezes, ornamental casts, museum pieces, working models, dioramas, figurines, lamp bases, art objects, moulds.

ARCHITECTURE . . for form work as basis of Portland cement sculpture, outside fountains, statues. Also used in making column caps, pediments, columns, mantels, wall plaques, decorative interior work, baroque and other styles.

INDUSTRY . . master patterns, foundry patterns, foundry core boxes, foundry moulds, and for the casting of non-ferrous metals to extremely accurate dimension. Base moulds for contour die sinking metal moulds, slip

moulds, jigger and case moulds for pottery, moulds for insulators, moulds for papier-mâché, working models of all kinds. Properly formulated with refractory materials, it is used for the bending and shaping of glass articles and for casting glass shapes.

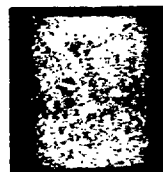
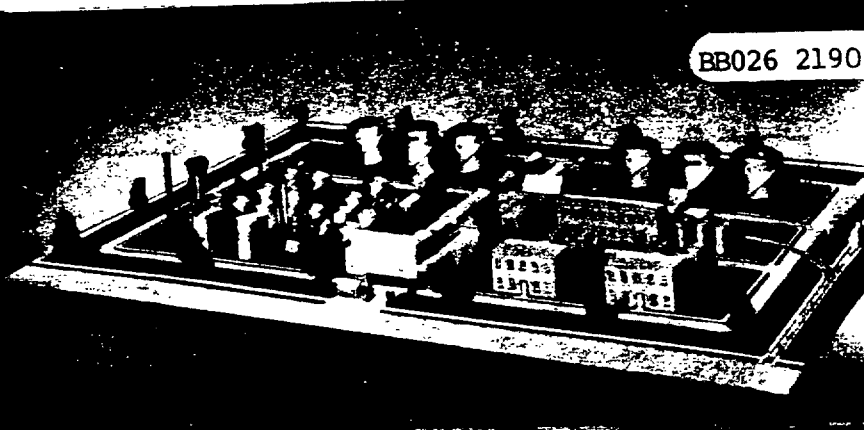
SCIENCE . . orthopedic casts, anatomical figures and details showing articulation, muscles, etc. Casts of foot-prints for crime detection.

ADVERTISING . . working models, displays, dioramas, casts for papier-mâché, trade-mark figures and casts, mannequins, millinery and display heads and busts, novelties.

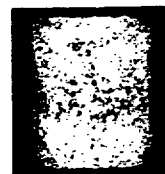
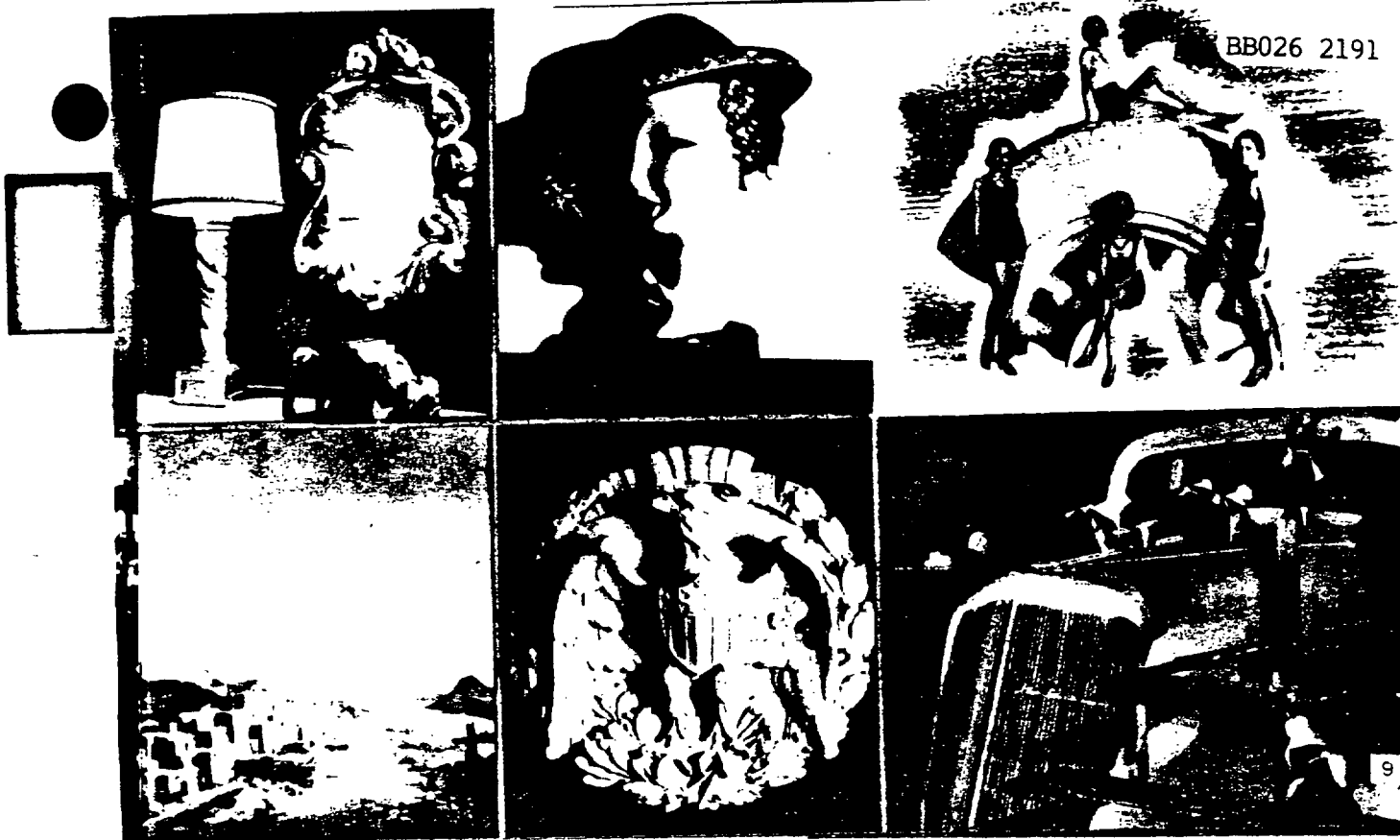
The wide scope of cast plaster is pictured upon the following pages, which show only a limited selection of the tremendous part cast plaster plays in the world of today.



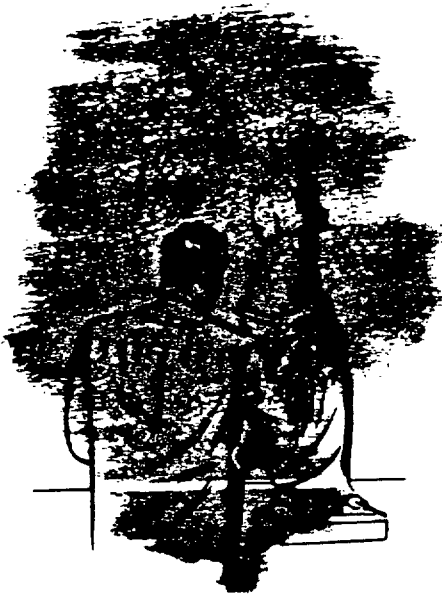
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RED TOP NO. 1 Moulding

This is the general utility casting plaster best suited and quite generally used in many casting shops for most non-specialized work. The dependable uniformity in fineness of grinding and setting characteristics makes it admirably suited for moulds, plaques, and other items of a general nature. May be used as gauging for admixture with lime putty for plastering and architectural ornament; is standard for the shop casting of all ornamental decorations, such as coffers, capitals, and grillwork; is the standard form of "Plaster of Paris."

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U.S.
RED TOP
WHITE
NO. 1 MOULDING
PLASTER
UNITED STATES GYPSUM COMPANY

• REG. U. S. PAT. OFF.

BB026 2194

Superfine Casting

Here is a plaster similar to No. 1 Moulding except that it has a much finer grain-size. This results in smoother castings showing excellent detail. Such faithful reproduction is important in the making of fine plaques and art statuary. Superfine Casting is ideal for use in modeling where this is done directly in plaster. Its fine grain-size permits the carving of minute detail with faithfulness under the carving tools. The carving of minute detail with faithfulness, and its smoothness and softness under the carving tools are highly desirable as a working medium for sculptors.

BB026 2195



RED TOP
SUPERFINE
GYPSUM
CASTING PLASTER

MADE IN U.S.A.

UNITED STATES GYPSUM COMPANY

TYPE

1-1

Art Casting-White-Ivory

BB026 2196



White or Ivory Art Plasters are designed especially for castings which are to be painted or which require a hardened smooth-textured finish. The addition of a surface-hardening ingredient minimizes paint absorption, yet sacrifices none of the smooth working qualities of untreated plasters. Best and most uniform surfaces are developed by drying Art Plaster Castings rapidly in circulating warm air, and this practice is recommended. (Note—Mildew may develop in warm weather unless this is practiced.) Castings should be trimmed and sanded before drying.

NO. 1 Casting

No. 1 Casting Plaster is a newly developed product which has found wide usage in the casting of statuettes, novelties, etc. It is formulated to develop unusual surface density and hardness and readily lends itself to painting and other surface finishing.

Best and most uniform surfaces are developed by drying No. 1 Plaster Castings rapidly in circulating warm air, and this practice is recommended. (Note—Mildew may develop in warm weather unless this is practiced.) Castings should be trimmed and sanded before drying.

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USG

No. 1 CASTING PLASTER



FOR HARDER CASTS

(GYPSUM PLASTER)

MANUFACTURED BY
UNITED STATES GYPSUM COMPANY
IND. U. S. PAT. OFF.

NO 1. Casting (Special)

USG

NO. 1 CASTING PLASTER



SPECIAL

FOR HARDER CASTS

(GYPSUM PLASTER)

MANUFACTURED BY
UNITED STATES GYPSUM COMPANY
REG. U. S. PAT. OFF.

This formula supplements the characteristic of surface density with greater structural strength. A lower proportion of water to plaster is needed, resulting in greater strength and hardness. No. 1 Casting—Special is particularly desirable for lamp bases, book ends, mirror frames, decorative columns and other objects that are finished in paint or lacquer.

Castings are uniformly hard from center to surface, and may be sanded or buffed without damage. They are uniformly porous on surface, and should be primed with thin shellac or pigmented lacquer before final decoration.

HYDROCAL *White or Gray*

Hydrocal White and Gray are recently perfected casting plasters developing from two to three times greater strength and hardness than regular moulding plasters if mixed with the correct proportion of water to Hydrocal.

Both Hydrocals make fluid mixes with less water than moulding or casting plasters. Castings made from them are practically free from air bubbles, and are ideal for painting or lacquering. The great strength and hardness of Hydrocal has made it possible to develop new and practical uses for cast plaster.

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USG

INDUSTRIAL HYDROCAL

WHITE

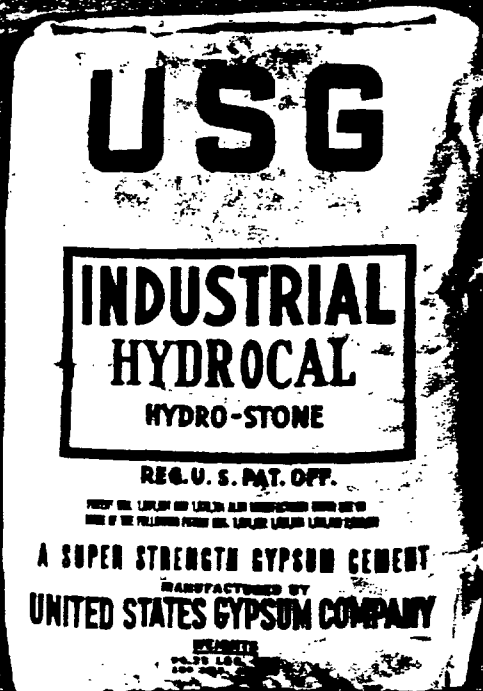
REG. U. S. PAT. OFF.

PATENT NOS. 1,814,811 AND 1,814,812 ALSO REGISTERED UNDER ONE OF
SEVERAL OF THE FOLLOWING PATENT NOS. 1,814,813 1,814,814 1,814,815 1,814,816

A SUPER STRENGTH GYPSUM CEMENT
MANUFACTURED BY
UNITED STATES GYPSUM COMPANY

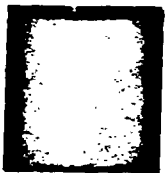
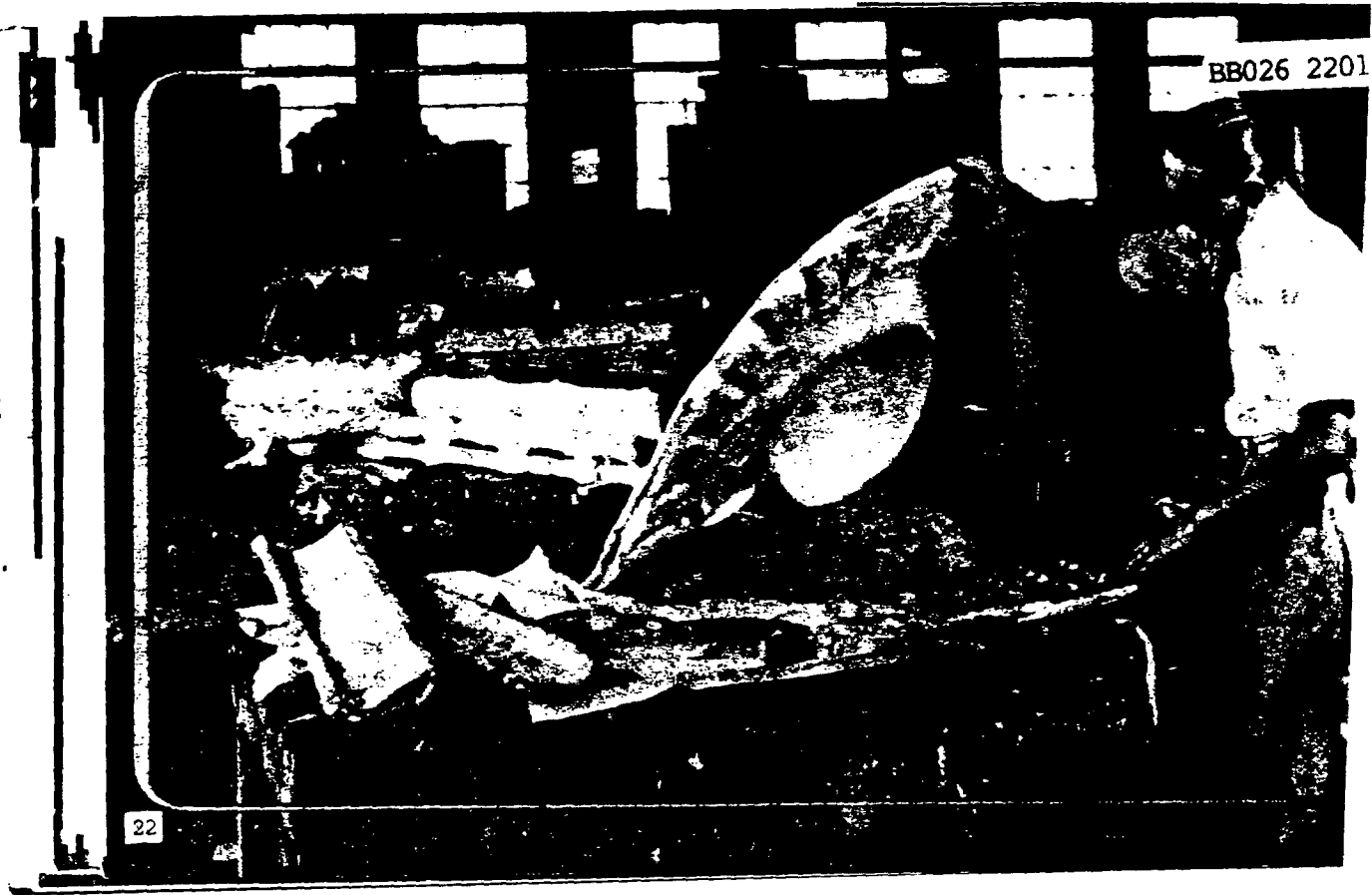
HYDROSTONE

BB026 2200



Hydrostone is the hardest and strongest gypsum plaster known. If mixed with the minimum amount of water, to develop a pouring mix, it has a compressive strength of approximately 11,000 pounds per square inch.

Compared to regular casting plasters Hydrostone is from 6 to 8 times greater in strength and hardness. Hydrostone is recommended for any purpose demanding a plaster with the maximum strength, hardness and density. This is a development of the United States Gypsum Company's Laboratories which are continually formulating more new and better gypsum products.



Gypsum Properties

All calcined gypsum has the same basic properties. It is calcium sulphate-hemihydrate ($2\text{CaSO}_4 \cdot \text{H}_2\text{O}$) and is a dry powder varying in color with the purity of the original rock. However, variations in processing during manufacture make possible wide changes in the characteristics of the finished plaster. By such treatment, the mixing water required to develop workability is varied within wide limits, permitting control of strength and hardness.

The outstanding chemical property of calcined gypsum is its recrystallization back to hydrated rock form when mixed with water.

The time required for this rehydration, or setting, can be accurately controlled by the use of "accelerators" or "retarders."

The casting shop operator today has at his disposal a great variety of plasters, offering different and useful characteristics. The properties of each type of plaster are accurately determined in manufacture, assuring the operator of time, energy and money-saving results when the plasters are correctly handled. The strength of casts, the setting time, the volume change in hardening, all can be accurately predicted and made to conform with the requirements of specific jobs. The selection of the correct plaster and accurate control of the plaster-water ratio used in mixing insure against unsatisfactory results.

PROPER STORAGE OF PLASTER

All plasters must be kept in a dry place, free from water or damp air. Even in the moisture-resistant bags in which USG plasters are furnished, the plaster will absorb dampness and become quicksetting or lumpy when stored in an unsatisfactory place.

ACCELERATORS AND RETARDERS

The normal setting time for each particular type of plaster should be used whenever possible. When it is necessary to speed up or slow down the normal setting time, accelerators or retarders should be used carefully.

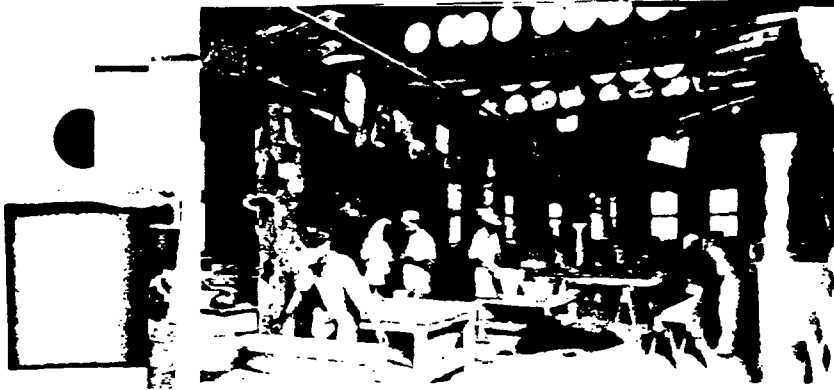
USG plaster retarder may be used for slowing down the set. It must be thoroughly mixed with water and strained before introducing into the mixing water. One-half ounce per hundred-pound bag will slow down the setting time of normal plaster to one hour. Retarders should be mixed and introduced carefully because tiny pieces of unmixed retarder will cause pits and soft spots in castings. If a slower set plaster in considerable quantity is desired, it should preferably be mixed by the manufacturer.

For best results, USG Sodate retarder should be used with all casting plasters. Being water soluble, readily



dispersed, and colorless, it is entirely compatible with plaster for all purposes and permits the setting time to be controlled to suit job conditions.

USG accelerator may be used for speeding up the set. Where quickening of the set is desired, the best accelerator to use is USG No. 1 Terra Alba, in amounts not over 2%. It is pure raw ground gypsum, and becomes an integral part of the set plaster. When the setting time must be quickened and no accelerators are available, a longer mixing time will often suffice. Extra mixing quickens the set. However, precautions should be taken not to mix through the set as this destroys the



ability to harden properly. A good, practical accelerator can be made by mixing one pound of plaster with one gallon of water and stirring the entire mix for twenty-five to thirty minutes, or until it becomes thick and creamy. A cupful of this cream to fifty pounds of plaster will quicken the set five to ten minutes. The cream must be stirred thoroughly with the mixing water.

HARDENING GYPSUM CASTINGS

The hardness of gypsum castings depends upon several factors, the most important of which are (1) the type of plaster used, (2) the amount of water used in the mixing,

(3) the method of forming the cast, and (4) the addition of special ingredients in the plaster mix for treating the set casting.

Whenever possible, the proper type of plaster should be selected to give the correct hardness. This plaster should then be mixed with water in the correct proportion. The less water used, the harder the casting will be. Where lightness of weight or maximum water-absorbing power is desired, more water should be used. The best shop practice is to record your results and weigh and measure ingredients.

Harder casts may be made by using a heavy mix, which is tamped or puddled into the mould. Even harder casts can be made by using a still heavier mix and vibrating it into the moulds. Vibrating the mould helps to drive out all of the small air bubbles in the plastic mass and makes a harder, denser, more uniform cast.

Where a greater surface hardness is required, one of the best common surface hardeners to use is dextrine. Used in amounts of one to two pounds per hundred pounds of plaster, dextrine will approximately double the surface hardness. The dextrine should be mixed



thoroughly with the water used in mixing the plaster. It may also be dry-mixed if all lumps are broken up in the plaster and the dry mix carefully mixed with water. The drying of plaster castings containing dextrine must be continuous, and the casting must not remain damp for any length of time. It is unnecessary to use dextrine with Art or No. 1 Casting Plasters.

Other admixtures to increase hardness are gum arabic, boric acid, ammonium borate and marshmallow root. Generally speaking, the use of these various hardening agents is costly, and the same results may be obtained using some of the various plasters described in this booklet.

Surface washes and other surface treatments are also used. Solutions of most of the hardening agents noted in the paragraph above are employed, as well as solutions of magnesium silicofluoride and aluminum sulphate. The impregnating agents which soften by melting, such as waxes, stearic acid, and paraffin, are also employed, as are various types of drying oils, such as linseed. Lacquers and varnishes also are used. Many ornamental casting shops use melted paraffin or melted stearic

acid, as an impregnation to seal pores of dry castings.

PROTECTION FROM MOISTURE AND WEATHER . . Where gypsum plaster casts are used for outdoor purposes, such as statues for outdoor advertising, the casts should be made from the densest material possible.

The cast should be very thoroughly dried in warm circulating air, at a temperature of not over 150° F., and no cold drafts of air should be allowed to touch the casting while it is warm.

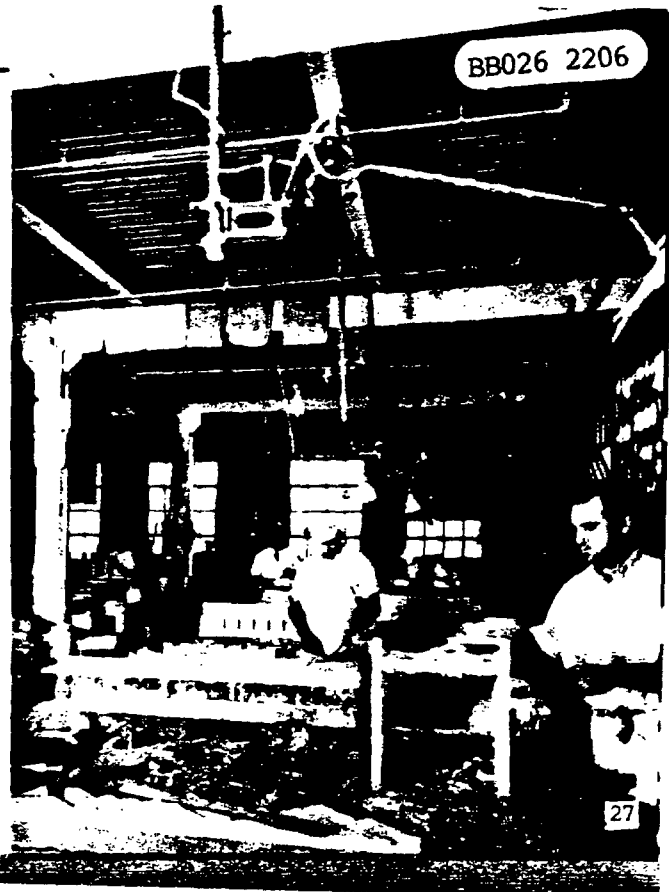
While the casting is still warm, it should be thoroughly primed with several coats of protective material, such as paraffin, stearic acid, linseed, clear lacquers, etc. After the priming coats have been thoroughly hardened, the whole cast should be covered with several coats of a very good grade exterior paint.

When the casting is erected out-of-doors, it should be so placed that it cannot draw moisture from the ground by protecting the base or any portion of the casting exposed to dampness.

After the cast has been set, it should be gone over carefully for scratches and cracks or other injuries of the surface. All of these surface injuries should be carefully reprimed and repainted.

Casts which have been given this treatment stand up remarkably well under severe outdoor conditions. However, unless the surface is thoroughly protected and kept protected by frequent inspection and repainting, the casts will slowly absorb moisture and the surface disintegrate under the paint, causing the paint to scale off.

INTEGRAL COLORING . . The United States Gypsum Company manufactures a complete line of limeproof colors, which are ideal for use in giving integral coloring to plaster casts. They are available in a very wide range of true, clear colors. The dry color should be added to a little water, mixed thoroughly to a stiff paste, and strained through a fine mesh screen to remove lumps. The wet mixed color is added to the plaster, mixing water in the quantity required to give the desired shade.





PAINTING . . Before paint is applied to a plaster cast, all free moisture should be removed by complete drying. The cast must not be heated to the point where calcination of the surface takes place, which is about 130° F. under ordinary conditions.

Casts may be soaked in a linseed oil size, made by using a good grade of boiled linseed oil to which is added a little turpentine and dryer.

This treatment will give a size surface for paint treatment and will reduce the brittleness of the surface and help to prevent easy chipping. Any good grade of paint may be applied over such a surface. For dull or mat finishes, U S G Paste Texolite Art Colors (pure pigment in casein vehicle) furnish novel and beautiful color effects.

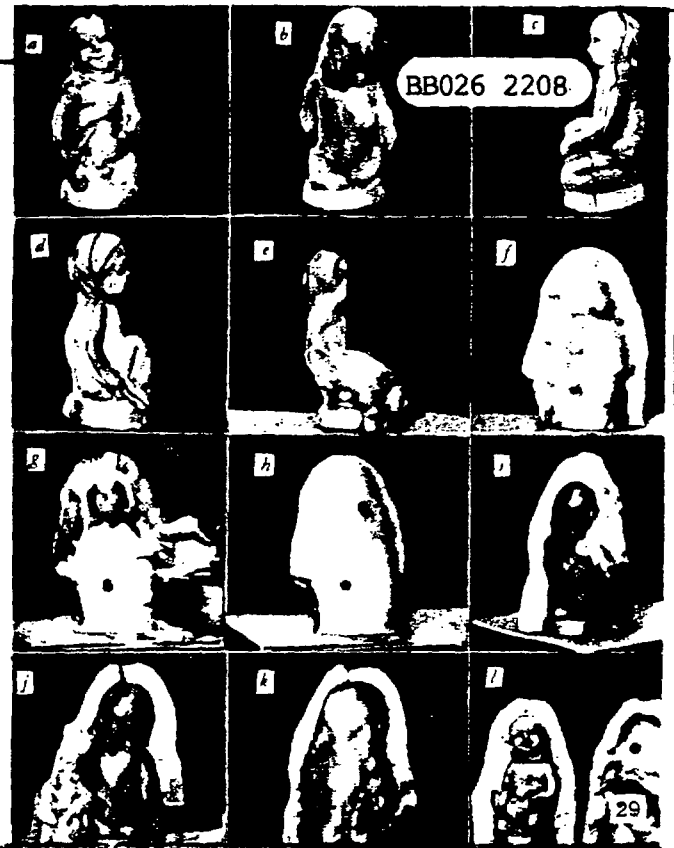
Mixing—Pouring—Drying

Plaster and water mixtures are suspensions of solids in water. For average volume yield of mix, 100 lbs. of plaster in a mixture with water occupies the volume of 40 lbs. (about 5 gals.) of water.

Being suspensions, and plaster being heavier than water, it is desirable that all mixes be made thick enough not to settle out before setting, or, if thinner, that they be mixed steadily until they thicken up before pouring into moulds.

MIXING . . The hardness, strength, density and porosity of the finished plaster product are affected by the proportion of water to plaster in the mix. Uniform results are possible only when water and plaster are weighed to assure proper proportioning. Tables of proper proportions appear on pages 36 and 37. Casting shops that use precision methods in weighing and measuring ingredients, and make careful notes of results, will have more uniform castings than those using "rule of thumb" methods.

Water and mixing utensils must be clean, free from set plaster, acid, or alkali. Good drinking water is satisfactory for this purpose. Plaster is sifted into the water and allowed to soak until wet through. Plaster and water are then mixed thoroughly by hand, spoon or mechanical mixer until smooth and creamy.



MECHANICAL MIXING OF PLASTER . . For castings of smoothest texture, greatest uniformity, and practical freedom from pinholes, mechanical mixing is recommended. All U S G plasters and Hydrocals are well adapted to this modern method of handling.

Mechanical mixers vary in size and type from spatulators designed for mixes of a pound or two, up to large propeller-type machines that handle batches of one hundred pounds or more. Equipment and procedure must be suited to the kind of work that is to be done. With the propeller-type mixers generally used for batches larger than a few pounds, best results are obtained when the speed of rotation, the angle of the shaft, and the size and location of the agitator are chosen so as to impart a rapid, circulating agitation to the mix. Circulation must be sufficient to prevent the formation of "dead" spots, but should not be so great as to cause splashing or to draw air into the batch.

The precautions normally observed in handling plaster apply equally to machine mixing. In order to realize the full advantage and economy of mechanical mixing, soaking and mixing times must be accurately con-

trolled. For uniformity, amounts of plaster and water must be weighed for each batch.

U S G will furnish complete information on mechanical mixing to fit any desired operation.

POURING AND SETTING . . The mix should be poured promptly. Most U S G casting plasters begin to stiffen 15 to 20 minutes after mixing and set hard after another 5 to 10 minutes. After hardening there is a 5 to 10-minute lag before the heat of crystallization develops. This time lag permits casts to be removed before heating can melt the surfaces of gelatin moulds. In the use of moulds not affected by small rises in temperature, extreme care is not essential. In the summer months, it is advisable to use cooled water when pouring into gelatin moulds. A cake of ice in the water supply barrel is good practice. Moulds made of plaster, rubber or Korogel are not affected by the heating of plaster during setting.

DRYING . . Free water must be removed from gypsum plaster moulds and casts by drying before they attain full strength. Drying temperatures should be kept at or below 130° F., otherwise the outside of the casts

will be calcined, resulting in a soft chalky surface.

Cool drafts should be kept away from warm casts because uneven cooling causes cracks. Proper mechanical circulation of air, however, is desirable because it will increase the drying rate.

Mould Making

Moulds for plaster casting are of two basic types—rigid and flexible. Rigid moulds are used for plane surface castings with sufficient draft to permit removal intact. Plaster, wood, metal, or similar materials are employed. Flexible moulds, which permit removal by bending, are used for complex and for curved surface castings.

Moulds are made from models which resemble the patterns used in casting iron and other metals. For ornamental and structural work, clay models are standard because they permit more rapid and economical preparation. Plaster models often are used, particularly in pottery practice. They may be shaped from solid blocks or slabs of cast plaster by sawing, turning in a

lathe, or carving; or they may be built up by troweling or pressing a heavy plaster mix on a core of plaster, wood, or clay. Plaster models have an advantage over wood models because details can be changed easily by patching. Plaster models are as accurate as wood models and more permanent than clay models.

Plaster models, when finished, should be covered with a thin coat of shellac to seal the surface and greased lightly before plaster is poured around them.

PLASTER MOULDS . . Moulds must be nonporous. Face surfaces should be sealed with cut shellac (1 lb. shellac to 1 gal. alcohol). Before making a plaster cast, the mould should be lubricated by brushing on a thin coating of vaseline or a solution of one part stearin to four parts of kerosene. This prevents plaster from sticking to the mould.

WOOD MOULDS . . Wood moulds are subject to shrinkage, warping, and expansion under changes in humidity. They should be made of wood such as white pine and should be protected by sealing the entire surface with shellac or paint.

RUBBER MOULDS . . According to Professor Carl D. Clarke, Associate Professor of Art of the University of Maryland, the recommended material for making rubber moulding is Vultex H-235, made by the General Latex and Chemical Corporation, Cambridge, Mass. Very satisfactory results can also be obtained with No. 100-99a Latex, made by the American Anode Co., 60 Cherry St., Akron, Ohio. The accepted method of making these moulds is as follows:

The first coat is atomized on a plasteline or clay model. This dries in about ten to fifteen minutes. A second coat may then be painted on with a brush and also dries in about fifteen minutes. Vultex is then mixed with cellucotton and applied for the third coat. This coat can be one-quarter of an inch thick, depending on the size of the model. It takes overnight to dry. The fourth coat consists of the latex and fine sawdust, which is built up to the desired thickness according to the size of the mould. This mixture is allowed to dry for twenty-four to forty-eight hours. The longer the substance dries on the model, the less shrinkage takes

place. The mother mould or shell is then built over this. Because of the expansion of most types of plaster, it is recommended that all large shells be made with Hydrocal A-11, reinforced with long sisal fiber or burlap. The low expansion of A-11 Hydrocal maintains the perfect fit necessary between mould and shell.

SPECIAL PURPOSE MOULDS . . When a semi-polished surface is desired, glass, copper, bronze, or aluminum moulds may be used. The metal mould surface may be highly polished, or nickel or chrome plated.

GELATIN OR GLUE MOULDS . . These are flexible moulds which may be bent to permit removal of undercut castings. Therefore, they need not be made in a large number of pieces. These moulds are suitable for making plaster casts for interior decoration and all types of statuary. The material is top quality glue or gelatin.

In making a mould, the gelatin should be wetted in a closed container with 10% to 20% of its weight of water. When thoroughly wetted, the mixture should be heated in a steam or hot water jacketed kettle to a temperature of not over 140° F. Before pouring, the temperature

should be raised rapidly until the gelatin liquefies, stirring at intervals to be sure that the whole mass is melted. Before pouring, sufficient time should be allowed to permit air bubbles to come to the top. These are skimmed off, and the liquid gelatin is then poured around the model, which usually is encased in a rough plaster backing or case to limit the thickness of the gelatin.

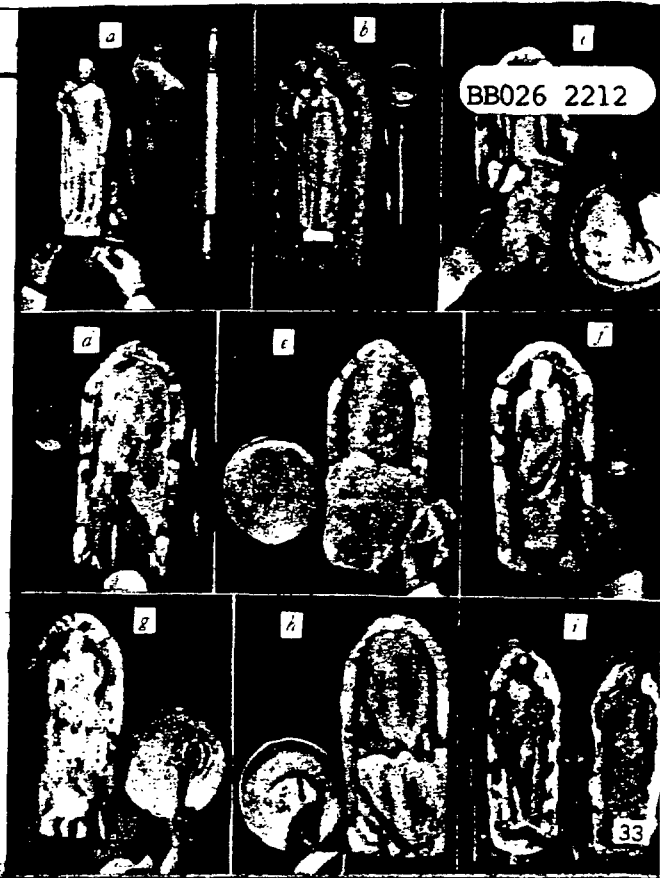
To protect gelatin from mildew and organic deterioration, the addition of 1% zinc sulphate by weight, or of one teaspoonful of phenol (carbolic acid) per gallon of melted glue, is considered good practice. Substitution of glycerin for 1/10 to 1/6 of the melting water prevents rapid shrinkage of the finished mould.

Gelatin mould cases customarily are made of plaster, reinforced with sisal fiber or burlap.

Before using a gelatin mould it is desirable to "tan" the surface with two or three applications of 10% alum solution, or with 5% formaldehyde solution.

Formaldehyde hardened gelatin cannot be remelted.

Properly protected from atmosphere and bacterial action, the gelatin mould has long life. The gelatin itself can be reused many times before it decomposes.



KOROGEL MOULDS . . Four years of practical experience have proved the adaptability and usefulness of Korogel as a mould material for casting nearly all types of plaster. Korogel replaces glue or gelatin. It is particularly applicable to the production of statuary, wall plaques, etc. Korogel is not affected by water or common materials found in casting shops. Moulds do not require sizing or other treatment between casts. It is not affected by atmospheric conditions—the same composition may be used winter and summer. Moulds may be stored for indefinite periods because Korogel does not dry out or deteriorate with age. With reasonable care, a thousand casts may be taken from the same mould. Korogel may be remelted and used repeatedly, 20 meltings being average performance when done carefully. It slowly darkens with each melting, and remelts should preferably be made with material of about same age and service.

Korogel moulds are made in substantially the same way as glue moulds, with a few variations due to Korogel's higher melting and pouring temperature.

Korogel must be melted in an enamel or glass container, and, while melting, must be kept free from contact with metal. It must not be heated above 300° F. The use of a thermometer is recommended. Melting should be started with a small quantity of solid Korogel. When this has melted, another small quantity is added and this procedure continued until the required quantity is melted. The weight of solid material added each time may be successively increased.

The safest way for the amateur to melt Korogel is in a covered Pyrex dish, putting all the Korogel in the dish, covering it, and heating in kitchen oven with thermostat set at 250° to 275° F., until all bubbles have disappeared and the Korogel is a smooth, clear liquid.

Small batches of Korogel may be melted in an enameled or glass container on an asbestos mat over a slow gas flame. Continuous stirring is necessary to prevent burning at the bottom. Larger batches should be melted in a double boiler filled with high flash point oil. Specially manufactured electric heaters for melting are also available.

After melting, the Korogel should be allowed to stand

without heating or stirring to permit air bubbles to rise to the surface for skimming. The temperature for pouring should be approximately 250° F., but this can be varied by the judgment of the individual operator. Because of the higher pouring temperature, plaster models used with Korogel should be thoroughly dry.

The most satisfactory method of making a Korogel mould from a plaster model is to prepare the model using Hydrocal in the ratio of about $4\frac{3}{4}$ parts of water to ten parts of Hydrocal. After the Hydrocal model has been thoroughly dried, it should be soaked in very thin, warm shellac (one pint of regular shellac to three pints of alcohol is satisfactory) from one-half to one hour. Dry the shellac and clean all surfaces with alcohol, dry again, and then grease with a thin coat of good engine oil—about 10W viscosity; pour the Korogel, being careful to break all air bubbles after heating to 290° F., until it becomes clear and then cooling to 250° F. before pouring. In order to give you the benefit of long experience in successful casting shop practice a list is given at right showing how various casting shop operators treat plaster models by one or more of the following methods:

1. A very thin coating of a smooth mixture of equal parts of French chalk and white vaseline.
2. A very thin coating of high grade lubricating oil.
3. A very thin coating of melted stearic acid applied to warm model.
4. Immersing in melted Montan or Carnauba Wax, slowly raising the wax temperature until bubbling ceases.
5. Immerse porous plaster or Hydrocal model (not sealed) in ice water, or ice cold 25% glycerin and water, until all air pores are completely saturated. Wipe off surface water, apply thin coat of vaseline and talc, or of soap size, and pour Korogel at once, allowing it to flow from bottom to top of the mould being made. By saturating the pores, the normal expansion of the contained air, and resultant bubbling, are avoided.

To prevent Korogel from adhering to the mould case, the inside of the case should be treated with a thin mixture of French chalk and vaseline such as is used for treating the model. A coating of glycerin also is satisfactory.

WATER RATIO DATA EQUIVALENTS

WATER Per 100 Plaster	PLASTER Per Pound Water	Water-Plaster -100	Density Dry Lbs. Per Cu. Ft.	Percent Void Volume	Dry Com- pressive Strength
			(Approximate Data)		
				Total Absorption	Lbs. per Sq. In.
67	1 lb. - 8 oz.	40 -60	71	51.0%	2100 p.s.i.
64	1 lb. - 9 oz.	39 -61	73.0	49.7	2275
61.5	1 lb. -10 oz.	38 -62	75	48.5	2400
59	1 lb. -11 oz.	37 -63	77	47	2750
57	1 lb. -12 oz.	36 -64	78.5	46	3000
55	1 lb. -13 oz.	35 $\frac{1}{2}$ -64 $\frac{1}{2}$	80.5	44.5	3250
53	1 lb. -14 oz.	35 -65	82	43.5	3500
51.7	1 lb. -15 oz.	34 -66	83.5	42.5	3650
50	2 lbs. - 0 oz.	33 -67	85.0	41.5	3750
48.5	2 lbs. - 1 oz.	32 $\frac{1}{2}$ -67 $\frac{1}{2}$	86.5	40.5	4000
47	2 lbs. - 2 oz.	32 -68	88.2	39.2	4500
45.7	2 lbs. - 3 oz.	31.4-68.6	89.5	38.3	5000
42	2 lbs. - 6 oz.	29 -71	93.8	35.5	5500
40	2 lbs. - 8 oz.	28 $\frac{1}{2}$ -71 $\frac{1}{2}$	96.0	34.0	6000
38	2 lbs. -10 oz.	27 $\frac{1}{2}$ -72 $\frac{1}{2}$	99.0	31.6	7000
33.5	2 lbs. -13 oz.	26 -74	102.0	29.5	8250
33.3	3 lbs. - 0 oz.	25 -75	105.5	27.0	9750
30.0	3 lbs. - 3 oz.	24 -76	110.8	23.5	11000
27.0	3 lbs. -11 oz.	21.3-78.7	116	20	15000
24.0	4 lbs. - 2 oz.	19.3-80.7	122	16	20000
21.0	4 lbs. -12 oz.	17.4-82.6	128	11.5	25000

**MIXING
TABLES**

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WATER RATIO DATA EQUIVALENTS

WATER RATIO DATA EQUIVALENTS			Density Dry Lbs. Per Cu. Ft.	Percent Void Volume	Dry Com- pressive Strength
WATER Per 100 Plaster	PLASTER Per Pound Water	Water—Plaster —100		Total Absorption	Lbs. per Sq. In.
				(Approximate Data)	
160	0 lbs.-10 oz.	61 -39	37.3	74.3%	50 p.s.i.
145	0 lbs.-11 oz.	59 -41	40.5	72.1	100
133	0 lbs.-12 oz.	57 -43	43.2	70.2	200
123	0 lbs.-13 oz.	55 -45	46.0	68.3	300
114	0 lbs.-14 oz.	53 -47	48.8	66.3	400
107	0 lbs.-15 oz.	51 -49	51	64.8	500
100	0 lbs.-16 oz.	50 -50	54.5	62.4	650
94	1 lb. - 1 oz.	48 ¹ / ₂ -51 ¹ / ₂	56.2	61.2	850
89	1 lb. - 2 oz.	47 -53	58.5	59.6	1000
84	1 lb. - 3 oz.	46 -54	61.0	58.0	1200
80	1 lb. - 4 oz.	44 -56	63	56.5	1400
76	1 lb. - 5 oz.	43 -57	65.3	55.0	1600
73	1 lb. - 6 oz.	42 -58	67	53.8	1750
70	1 lb. - 7 oz.	41 -59	69	52.5	2000
67	1 lb. - 8 oz.	40 -60	71	51.0	2100
64	1 lb. - 9 oz.	39 -61	73.0	49.7	2275
61.5	1 lb. -10 oz.	38 -62	75	48.5	2400
59	1 lb. -11 oz.	37 -63	77	47	2750
57	1 lb. -12 oz.	36 -64	78.5	46	3000
55	1 lb. -13 oz.	35 ¹ / ₂ -64 ¹ / ₂	80.5	44.5	3250