

THE PROP BUILDER'S
MOLDING & CASTING HANDBOOK



THURSTON JAMES

(Author of The Theater Props Handbook)

■ A comprehensive guide to the use of more than thirty molding and casting materials in the design and construction of theater properties and scenic elements. ■ Includes a section on designing and building a vacuum forming machine for use in constructing theater props. ■



THE PROP BUILDER'S

MOLDING & CASTING

HANDBOOK

THURSTON JAMES

BETTERWAY BOOKS
CINCINNATI, OHIO

 Published by Betterway Books, an imprint of F+W Publications, Inc. 4700 East Galbraith Road, Cincinnati, Ohio 45236. (800) 289-0963. First edition.

Cover design by David Wagner
Typography by Typecasting

Every precaution has been taken in preparing *The Prop Builder's Molding & Casting Handbook* to make these projects as safe and successful as possible. However, neither Betterway Books nor the author assume any responsibility for any damages or injuries incurred in connection with the use of this manual.

Other fine Betterway Books are available from your local bookstore or direct from the publisher.

15 14 13 12 11 22 21 21 19 18

Library of Congress Cataloging-in-Publication Data

James, Thurston.

The prop builder's molding & casting handbook / Thurston James.

p. cm. Includes index.

ISBN 13: 978-1-55870-128-1 (pbk.)

ISBN 10: 1-55870-133-8—ISBN 10: 1-55870-128-1 (pbk.)

1. Plaster craft. 2. Molding (Founding)—Amateurs' manuals. 3. Plastics—Molding—Amateurs' manuals. 4. Stage properties—Design and construction. I. Title. II. Title: Prop builder's molding and casting handbook.

TT295.J36 1989

792'.025—dc20 89-36138

Acknowledgments

I am under some obligation to Marsha Frank–Burke, editor and author, for her work
editing this series of books on property construction techniques. She helped me to find a
order to a very wide ranging subject. As the texts received their first exposure to editin
Marsha unknowingly taught me a subject I refused to take seriously in high school: how
communicate in written English. I am grateful.

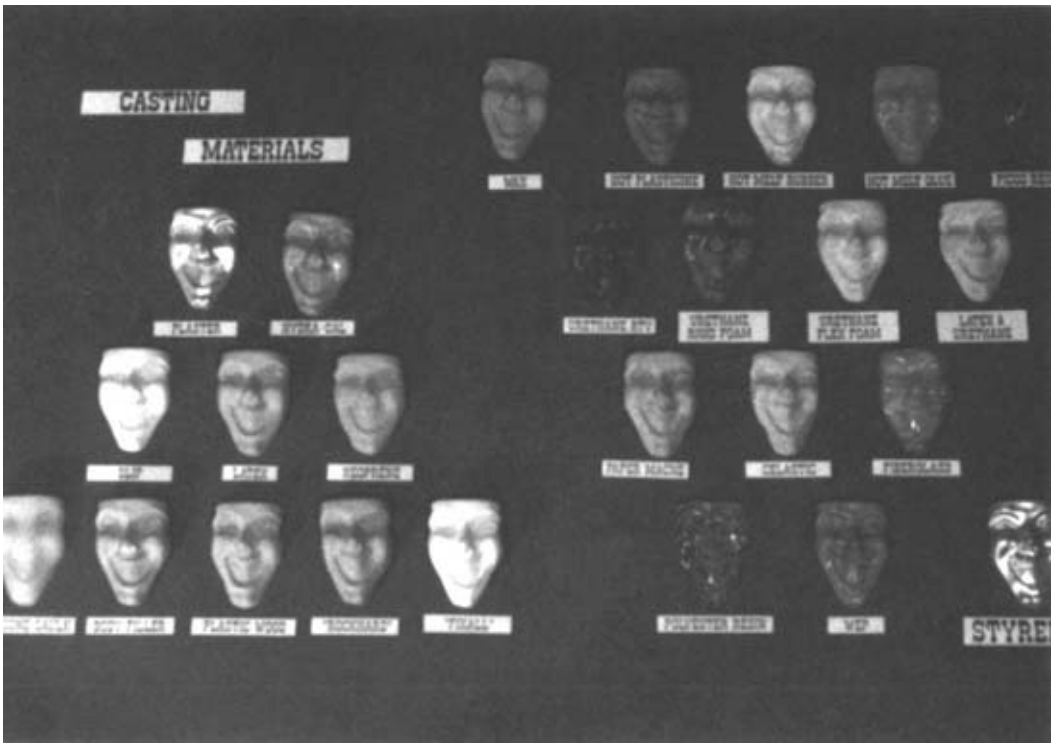
I want to thank Rob Secrest, a molding and casting expert from the Albuquerque area. H
read a first draft of this text and made many helpful comments. Rob was also available fo
regular consultation as the final text was being completed.

I am indebted to Nick Bryson, President of Gerriets International, for developing the bas
design of the vacuum forming machines which are demonstrated in the final chapter of th
book. I appreciate the work done by Jeff Wachtel, Principal Electronic Technician for Th
Department of Theater at UCLA, as we modified this concept to build a vacuum formi
machine specifically for use in producing properties.

LaVahn Hoh of the University of Virginia read, reviewed, and criticized the fin
manuscript. His careful reading and concerned comments prompted the rewriting of sever
sections.

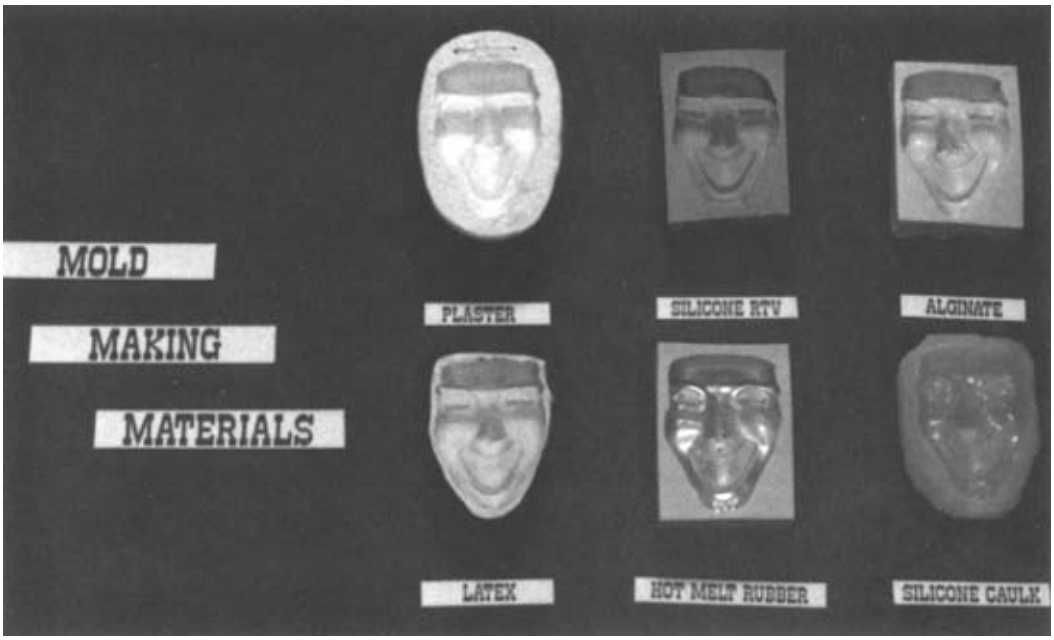
I acknowledge The Department of Theater, Film, and Television at UCLA for allowing m
to use the theater facilities during my off-duty hours to photograph the properties for ou
productions as they were being made.

CONTENTS

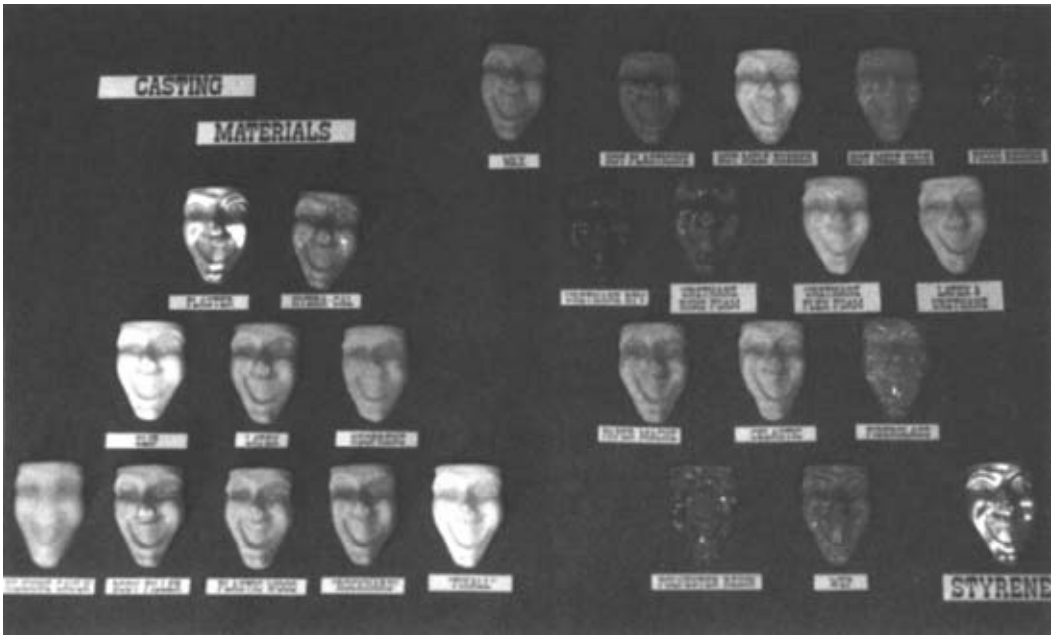


The Materials of Molding and Casting

This book will demonstrate the methods and techniques for using thirty different molding an casting materials, ranging from papier-mâché to breakaway glass. No assumption has bee made that the reader has any previous experience.



The mold-making materials include plaster, two kinds of alginate, two forms of silicon rubber, latex, and hot-melt rubber.



Casting materials long familiar to theater technicians—plaster and its cousins and Celastic- are covered with the same thoroughness as the more recent flexible plastics which have bee developed: latex and three variations of polyurethane.

Thermosets are discussed with an emphasis on the polyester resins, fiberglass, and wat extendable polyester.

A series of materials which become liquid when heated to their melting point is thoroughl demonstrated. The “hot melt” materials include wax, hot-melt rubbers, and hot-melt pic resins used in the manufacture of breakaway glass.

The section on slipcasting shows how a newer product, neoprene, uses an age-old potte process to great advantage in the theater.

Products found at local hardware stores in the form of putties and caulking compounds a included, showing their unique features and how they can be pressed into service as castin materials when nothing else is readily available.

Near the end of the book is a section devoted to the construction of a vacuum formi machine. The instructions are intended to aid an experienced electrician and metal worker the special problems encountered in building this large tool. This is the only portion of te that is not directed to an inexperienced person. The final chapter explains some techniques using this machine or any of the commercially made vacuum forming machines being fou

in increasing numbrs in university and community theater scene shops.

How to Get Started

How does a person go about learning the techniques of casting and mold-making? Here a some of the ways:

1. Attend workshops
2. Apprentice with an “old timer”
3. Jump in, experience trial and error, and learn by doing
4. Read product literature and experience new materials as they come along
5. Read a book

Begin with any of these and work your way through them all. Maybe all of the ways will n be open to you. That’s probably O.K. —do what you can. These are all good ways, and the all have their limitations. Let’s touch on each of these methods, and discuss some of the advantages and disadvantages.

Workshops

In most cities, hobby shops and plastic suppliers conduct workshops as a means of showcasi their products. If your supplier does not have this service, you might at least arrange for th demonstration of certain specific products you are interested in. The problem with even well-organized workshop is that there is limited time provided in which to demonstrate time-consuming subject. In three or four hours you can only be introduced to three or fou products, and these only in the most basic fashion. But at least you will have bee introduced.

Apprentice with a Working Craftsman

This is a good idea if you have the time and really are serious about learning the craft. Searc out a mold maker with some experience, spend some time with him, and pick his brai Count yourself as very fortunate if you can place yourself with a mold-making craftsma

Keep your mind open, realizing that even experts have prejudices and favorite methods, an very frequently they do not agree with other experts.

I do not believe that mold-making and casting experts are an endangered species. The have just become more specialized. You will find them in the porcelain and ceramics field, aerospace, as tool and pattern makers, in plastic toys, plastic packaging, and plastic produc of all kinds. The motion picture audiences' thirst for the bizarre has produced a market for wide variety of aliens and extraterrestrials. Most of the designers of these monsters are n old timers, they are comparative youngsters. And speaking of youngsters … I was recently the curators' workroom at the Museum of Natural History in Los Angeles, where the staff wa working with junior high schoolers making latex impressions of delicate tropical ferns for us on the museum's wild animal exhibits. The museum was getting a large volume of authenti looking plastic foliage, and the kids were getting a hands-on experience in the technique mold-making.

Jump In and Try

Experience is a great teacher. After you have picked up a little knowledge of a material, us it. Make sure you understand its hazards and how to use it safely; then pile in. If you hav had little or no previous experience I suggest you begin with plaster, latex rubber, an neoprene. These are relatively safe materials to work with, they are inexpensive, and th chance of success is high. As you gain confidence with these materials, branch out into oth materials, building on the knowledge you have acquired with these first experiments. Alway keep alert to the toxic potential of the product you are about to use and guard against i danger. You will soon become your own expert. It won't be long before you can pick u literature on a newly introduced plastic product and use it more comfortably than the chemi who developed it.

Read a Book

Not a bad idea. Don't overlook this resource. There are some very good books on the marke Most of them are specialized. You will find books devoted to the subjects of plaster castin polyester, moulage, and several on fiberglass casting. The book you hold in your hand provides a broad-based introduction to the craft. Reading has its limitations too; it's got to b

backed up by *doing* for the learning to take place. Have fun getting smart.

A Word About Failure

If your personality is one that cannot run the risk of failure, you may be in for som psychological trauma. Frequently, your early work will be failures. If you are working wi someone who has had previous experience with the materials, perhaps he can tell you wh Don't look to your mentor expecting godlike qualities—he will have failures too. Usually th "old timer" will know enough to use an untried system or process in private until he comfortable with it. Then he can show it off without spoiling his reputation as an exper Well, good for him! That technique is, in itself, one that is acquired as the result experience.

You must expect occasional unusual results.

They happen. If the shelf life of some products is exceeded, they may not give the expecte results. If some plastic chemicals become contaminated, they will not work as expected. you work for a long time with resins, the time will surely come when you forget to use mold release, or you will use the wrong catalyst, or you will forget again and use no cataly at all. These mistakes will bring predictably unsuccessful results. You will be able understand immediately why your casting failed as soon as you realize your mistake. B there will also be the times that you will run into freakish, unreasonable problems that de explanation.

SAFETY

Protecting Yourself from the Effects of Hazardous Chemicals

The Surgeon General has determined that smoking cigarettes is hazardous to your healt Many people have quit—some of the public is stubborn, however, or suspicious of authorit or naïve, or gullible, because this element of the public continues to smoke with a confidence. "We have been doing it for a lifetime without serious consequences, an therefore, the Surgeon General must have his facts confused."

Thirty-five years ago, craftsmen began receiving similar warnings concerning the chemica in the plastic materials they work with. Warnings concerning the toxic effects of some of th new polyester and epoxy resins, solvents, lacquers, aerosol sprays, and dyes. The attitude o the artists and craftsmen to whom these warnings were directed was, at first, very much lik the attitude of the smoking public: "I know what I am doing, I have been doing it for a lon time without any problems, and these threats are being published by a bunch of alarmists The term *chronic long term effects* was not widely known then, and those who did know, chos not to deal with it.

Becoming Aware of Health Hazards

Some of the products which have "been around for years," such as asbestos, were actuall proven to be doing fatal damage to the lungs. Cancer became linked to specific carcinogen chemicals such as benzine. Skin rashes broke out as a direct result of some of the oth solvents that were being used. Slowly, an awareness dawned upon these craftspeople that th warnings were perhaps more than just threats. **Too often, however, the attitude continue that the danger is for those others, and not myself.**

Do You Need an Attitude Adjustment?

What do you think? Are these labels put here by the manufacturer with a serious concer that you might be injured with improper use of the product? Or do you, the consumer, loo suspiciously at these clear warnings as disclaimers that the manufacturer must make for h own protection on the rare chance that someone might be injured?

Who should be most concerned about potential risks to ***your*** health? Society at large Government agencies? Manufacturers of useful chemical products? You yourself? Who ca you trust to be most responsive to your health needs? Without removing the responsibili from others, I propose that you selfishly become accountable for yourself. Take the step necessary to make yourself aware of the dangers of chemical products. If you are unaware o the dangers of the chemicals of molding and casting, or if you are guilty of using thes chemicals without proper safeguards, please read the next few paragraphs with a sel concerned, open mind. I will outline some of the dangers of the chemicals used in moldin and casting and propose ways of using them safely. You, the user, must then take th necessary precautions to protect yourself from their ill effects, which can, at their worst, b life threatening.

The Toxic Assault on Our Bodies

Toxic substances can enter your body in three ways: by contact with skin, by inhalation, o by ingestion through the mouth. We are familiar with the dangers of taking poisons throug the mouth. We have known since childhood that arsenic, cyanide, strychnine, and hemloc are likely to kill if they are eaten in any quantity, so we are careful not to do that. We hav learned that babies will get sick if they eat paint, bleach, or gasoline, so we don't do th either—or do we? We have habits that cause harm to our bodies that we are unaware of. have known people to pick dried Celastic from their fingers with their teeth. Some artis have been taught to put a point on their paint brushes by taking them into their mouths. Th practice of having a filled coffee cup at the work table where it is sure to becom contaminated is common. The published warnings on chemical packages warn us to wash ou hands and refrain from smoking. Part of this warning has to do with fire dangers, but th other part is to reduce the possibility of transferring these poisons to our mouths and thu swallowing them.

The most frequent way that toxins are introduced into the body is through the nose. Dust fumes, gases, and vapors can cause direct damage to the respiratory system just as smokin can, except that the dangers from chemicals can be greater. All solvents and aerosol can admonish the user to use the product in well-ventilated places. Why don't more people do it Maybe we don't know that when they say "well-ventilated," they really mean "use in a spra booth," or "use by an exhaust fan." Inhaled toxic gases can also be absorbed into th bloodstream. In exactly the same way that the life-supporting gas, oxygen, is absorbed an transported, poisonous vapors are absorbed and distributed where they can do their dirt work on their favorite body organ. This organ usually turns out to be your liver, heart, lung kidneys, or brain.

Finally, poisons can get to your organs through your skin. Cuts, abrasions, and open sores that allow blood to leak out of the body will also allow chemical poisons to get in. Some solvents, however, do not even need this kind of doorway to get into your living space. They can work their way into your bloodstream through the pores of your skin. Other chemicals—battery acid, lye, and gasoline—attack the skin itself, causing burns or rashes. There are also many less offensive but nonetheless noxious chemicals, some of which you will encounter while working with the materials explained in this book.

Degree of Risk

Industrial hygienists have recently been devoting time to studying the dangers that plasti workers are exposed to. They have worked out some definitions useful in explaining thes dangers. They say that there are three factors which contribute to your "degree of risk" working with chemicals.

First, there is the amount of exposure to a single toxic substance. There are three thing which contribute to this exposure. They are:

1. The quantity of the material you are exposed to
2. The duration of the exposure
3. The frequency of the exposure

The cumulative effect of all the separate exposures to chemicals is called your "bod burden." When your body burden exceeds your capacity to eliminate the encountere poisons, injury to some part of your body takes place.

Another factor that must be considered in figuring your degree of risk is that som chemicals are much more dangerous to the body when combined than when either one encountered alone. A good example of this complication is the case of smokers who a exposed to asbestos fibers. Smokers have about ten times the chance of getting lung cancer non-smokers; however, the risk is multiplied again by nearly ten times when these smoke are exposed to asbestos fibers. Their risk of getting lung cancer is ninety-two times greate than people who are exposed to neither. The last factor you should consider in figuring you danger or risk in working with toxic materials is your own susceptibility or sensitivity chemical injury. Some people are more sensitive to the harmful effects of chemicals tha others. A problem with this is that people who are not sensitive have the idea that they a immune to the dangers. This is a mistake! It just means that your body's protective systen are not yet overloaded. Keep it up, and you can overtax your body's abilities to protect yo Injuries will certainly result.

You probably already know by experimentation whether you are skin sensitive to th exposure of harsh chemicals. It is not as easy to detect your sensitivity to liver or kidne damage or to cancer. And it is not wise to experiment till you know the limit.

Now, all of this has been said to instill a respect for the problem, not to frighten yo unduly into a resolve to never again come in contact with another chemical. You could driv yourself crazy trying to eliminate this contact. In this world we live in today, we a

constantly in contact with potentially dangerous materials. But you can become aware of th more dangerous products, and choose not to use them. You can use the less hazardou consumer products, and use them with precautions, thus greatly reducing your body burden.

You can read and heed the warnings published on the cans of chemical products. Mo warnings can be summarized in the following list:

1. Use solvents and sprays in well-ventilated places, and away from flames.
2. When working around dusts, mists, sprays, and vapors use properly fitted respiratory protection.
3. Use non-porous gloves or barrier creams.
4. Wash your hands well after working, especially before eating.
5. Wear overclothing (a lab coat or apron) to avoid taking toxic dusts home to your living and eating spaces.

This list contains good advice, but obeying the can warning is only a beginning.

If you are really interested in becoming responsible for your own health and well-bein you can take some, or all, of the following precautions.

1. Request Material Safety Data Sheets from the manufacturers of products you have any questions about.
2. Do some reading. Research the chemicals in the products you are using, and learn how they are evaluated for relative toxicity. See the bibliography at the end of this book.
3. If you choose to use a material which is advertised as potentially hazardous, provide all of the engineering controls you can. Install spray booths and/or exhaust fans. Make sure you have and use personal protection: safety glasses, respirators, gloves, and aprons.

Personal Protection Equipment

Let’s take just a moment, and talk about some of the equipment that can protect your eye lungs, and skin.

Glasses and Goggles

Eye protection is available in the form of safety glasses or goggles. Eyeglasses are usual clear, non-prescription, and primarily designed for protection from dust and sparks. Som safety glasses come equipped with side shields which make them more effective against thes flying particles. Goggles, however, provide the best defense against chemical spills.

Gloves

Many kinds of gloves are available, each is useful for protection against a particular harmf material.

A very inexpensive glove made of polyethylene is sold in paint stores to protect the painte from getting his hands soiled. These gloves are not good for much except painting. Th chemicals of molding and casting very soon dissolve these thin attempts at protection.

Thin latex gloves are recommended for most molding and casting operations that cou chemically affect your skin. These gloves are usually green (like surgeons wear), are ver thin, and do not totally eliminate your sense of touch.

Thick leather gloves with high cuffs that completely cover the wrist are good protectio against hot liquids. Care must be taken not to allow hot liquids to pour into the large, blouse cuffs. Leather gloves are available as standard equipment from welding suppliers.

Neoprene gloves are impervious to almost all harsh liquids, even acids, but are thick an clumsy, and not necessary for protection against any of the chemicals mentioned in this book

Respirators

Breathing protection is of two distinct types, and if you are to operate safely you mu understand the distinction. A respirator has a changeable cartridge and can be used in defens against both types of respiratory hazard.

The first type is protection against particles. A surgical mask is helpful in filtering mist an dust particles. A dust mask is better, and a respirator fitted with a particle filter is also qui good.

The other type is protection against vapors or fumes. It is essentially a gas mask. For respirator to control the intake of fumes, it must be fitted with a fume cartridge.

If a respirator is going to be effective against anything, it must fit your face well and b

strapped securely to your head. A respirator is ineffective when worn over a beard. Th craftsman who works constantly with polyesters or urethanes must sacrifice his facial hair.

In Conclusion

Once you are well-informed, you can make rational decisions about whether you consider product dangerous, and whether you have the facilities to use it safely. Frequently you ca substitute a safer product for a product you decide to be too hazardous.

When you select a material for a particular job, always look on the selection a being tentative— check to see whether you have the knowledge and special safet equipment (exhaust fans, fume hoods, safety glasses, respirators, gloves, aprons, an confidence) the process requires. If you cannot perform the necessary steps safel choose another material!

You see, you really are not being forced to use potentially hazardous materials. I however, you choose to use them, choose also to use them safely.

Molding and casting is a process involving three distinct stages:

1. Selection and preparation of the Model (or pattern)
2. Making the mold
3. Making and finishing the castings

Preparing the Model

The first step in mold making is the consideration of the pattern or model. In the followi pages you will be led through the steps of making a vase, a fish, and a milk pitcher. Each these will be copied from a real, “found” model. On the other hand, you might want to ma a thing that isn’t readily available, or perhaps that no one has ever seen before. You mig need Aladdin’s magic lamp, or a space gun, or Excalibur, or Cinderella’s glass slipper. If y want a fantasy item, you must sculpt your own original.

Sculpting a Model

If you must design and sculpt the model from your imagination, wet clay and non-dryi clays (commonly known as ‘'Plasticine”—trade name held by Peter Pan Playthings Ltd.) a good modeling materials. Non-drying modeling clay is available in a wax base or oil base a in four grades of softness or workability. No. 1 is very soft. This clay is useful on lar projects where you need to push around large masses of clay. It moves easily, but sometim it moves so easily that it won’t hold its shape.

No. 2 and No. 3 are utility grades of modeling clay. They work well where you want to wo

fast and the features you are trying to produce are not extremely fine.

No. 4 is the firmest. It works best with clay working tools. The smallest details will hold the shape while the mold is being made.

As you gain experience with the materials of mold making, you will find that som materials are not chemically compatible with others. For instance, the sulphur content in o based clay will inhibit the curing of silicone RTV rubbers. Therefore, you must not make model of this oil-based clay if you plan to make the mold in silicone. I mention this because is one of the considerations of model sculpting that must be dealt with.

If you are inexperienced, you should begin by sculpting your model from either wet clay oil clay, and making your mold in plaster.

Keep the model simple enough that you can get away with a one- or two-piece mold. If yo design your model with undercuts that appear in both the front and side views, the patte cannot separate from the mold, and you will be in for some troubles. If you use a four object as a model, you may find it necessary to alter the original, filling in undercuts wi modeling clay, and definitely patching over holes that pass completely through it.

The more complex shapes can certainly be accomplished with multiple part molds, but the are not easy and in my experience they are rarely necessary. You will be well advised, as yo start out, to make some simple compromises in the figure you sculpt or select, so that it ca be accommodated by a two-part mold.

Defining Some Terms

The words *mold* and *cast* have become somewhat intermixed by common usage. But th dictionary assures me that *mold* has a preferred meaning which is: “A form that gives particular shape to anything in a fluid or plastic condition.” *Cast* has a preferred meanin