How to cast an award winning performance with Bluesil™ RTV-2

BLUESTAR SILICONES

Contents

1. Advantages of using Bluesil™ RTV-2 silicones in moulding 3
2. Applications 5
3. Preparing the model 6
4. Moulding techniques 8
5. Advice to users 18
6. Mass production moulding techniques 21
7. Vacuum moulding of industrial prototypes 28

Introduction

This document is intended as a practical guide: showing how silicones are used in moulding applications. It's contents are addressed both to those already moulding with other materials and those wanting to learn these techniques.
With this goal in mind, the document provides full, unabridged details of certain moulding techniques.

1 Advantages of using Bluesil™ RTV-2 silicones in moulding

Silicone elastomers are one of several materials used to produce moulds, together with polyurethane elastomers, plasters, alginates and latex.

These elastomers have enabled new moulding techniques to be developed (e.g. very flexible sock moulds) and the moulding of very aggressive reproduction resins (polyurethanes, polyester, epoxies, etc.). Access to translucent and transparent grades together with the appropriate mechanical properties have also enabled the development of vacuum prototype moulding. This type of application covers a very broad-ranging market, spanning from decorative moulding to industrial moulding.
The Bluesil™ RTV-2 range was developed with this in mind, to meet all these requirements. Bluesil™ RTV-2 silicone elastomers have specific properties which provide users with many advantages.

Flexibility	simplified mould, gentle on model
Easy to use	no need for heavy equipment
Release properties	easy to demould
Tear strength	thin section membranes, complex shapes
Room temperature curing, no heat release	no oven, gentle on model
Fine reproduction detail	details to the nearest micron
Ageing resistance	reusing of stored moulds, especially for polyaddition RTV-2's moulding of exothermic
Heat stability	reaction materials and low melting point alloys
Dielectric properties	use in HF moulding and in galvanoplastics
Low shrinkage	moulding accuracy

The Bluesil™ RTV-2's used in moulding are two-component, room temperature curing elastomers.

There are two different types

1. Polycondensation type Bluesil™ RTV-2's supplied as base and catalyst.
2. Polyaddition type Bluesil™ RTV-2's supplied as part A and part B.

Each of these types has specific features that means it will be chosen according to the moulding technique and the user's requirements.

	Polycondensation (PC)	Polyaddition (PA)
Mixing ratio	100/2 to 100/10	100/10 to 100/100
Safety precautions during mixing	Requirements (glasses, gloves) Preferably in a well ventilated area	None
Pot life and demoulding time	Variable depending on catalysis Not heat accelerated	Can be independent Heat accelerated
Risk of inhibition	No	Yes
Sensitive to reversion in confined spaces	Yes	No
Shrinkage*	0.8 to 1.2%	0.05 to 0.2%

* After 7 days curing at 23 C/RH 50% measured on a cylinder H/200 mm, 40mm

Curing starts once the two components are mixed at a rate that depends on the operating conditions.The ideal conditions are:
- temperature of 23℃
- relative humidity of 50%.

In order to comply with dimensions, it is preferable to use:
- moderate temperatures, 23 to 30℃, and in any case no less than 20℃
- in an atmosphere that is not too dry (30% minimum)
- with the recommended catalyst dosage.

2. Applications

There are numerous moulding applications for Bluesil™ RTV-2's, here we will only mention a few of them, classed according to the type of material moulded.

Moulding of materials in Bluesil™ RTV-2 moulds

Examples of use	Material
Furnishing Figurines Bas relief Frames - mirrors - paintings Buttons Display stands Souvenirs Palaeontology Reproduction of old objects Miscellaneous decoration	Polyester
Furnishings Prototypes Leather goods Shoes Interior car trim Cornices - roses	Polyurethane
Shoes Leather goods Automotive equipment	PVC
Master prototype models Production of tooling Reproduction of statuettes	Epoxies
Prefabrication Decoration	Concrete
Staff Figurines Master moulds for tiles Ceramics Porcelain	Plaster
Reproduction of works of art Interior and exterior decoration	Reconstituted stone
Decorative candles Artistic metalwork (lost wax process) Jewellery (lost wax process)	Wax-paraffin
Fancy jewellery Prototypes Small production runs of decorative items	Low melting point alloys
Giftware Jewellery Decorative objects	Acrylic resins

N.B. Different types of materials exist suited to various uses. Please refer to us.

Production of tooling or moulded parts in RTV-2

- Thermoforming and High Frequenc moulding matrix.
- Pads for pad printing.
- Accessories for special effects.

3 Preparing the model

Models are made in a wide range of materials whose surface condition and porosity can be changed by ageing. Even though Bluesil™ RTV-2's inherently do not adhere to most materials, it is usual to take certain precautions before taking impressions. It is notably recommended to prepare the model to avoid any RTV sticking and thus damaging the model. Various possibilities are offered to the user the following examples - which are not limiting - have been tested in our laboratories.

Type of model	Recommended treatment
Plaster, concrete, stone, biscuit, terracotta, etc.	Remove dust and apply a pore filler from among the following: - polyvinyl alcohol type 4/125 diluted - soaping: dissolve 250 g of glycerine soap in one litre of boiling water; use once cool - wax or paraffin deposit (diluted to 5% in xylene) - vaseline deposit - varnishing: gum lacquer or cellulose or acrylic varnish
Metal	Degreasing with a solvent or washing with a water based solution made with 5% liquid detergent, then drying Wax
Glass, porcelain, ceramics	Apply a very thin coat of Vaseline
Leather	Apply a very thin coat of Vaseline Wax
Wood	Apply wax or Vaseline, a cellulose pore filler or cellulose varnish
Plastics	Degrease with an appropriate solvent for the plastic concerned
RTV-2	Apply a very thin coat of Vaseline Wax
Resins (polyurethane, epoxy, acrylic, etc)	Apply a polyvinyl alcohol, then a very thin coat of Vaseline Wax
Wax	No treatment required

Positioning the model

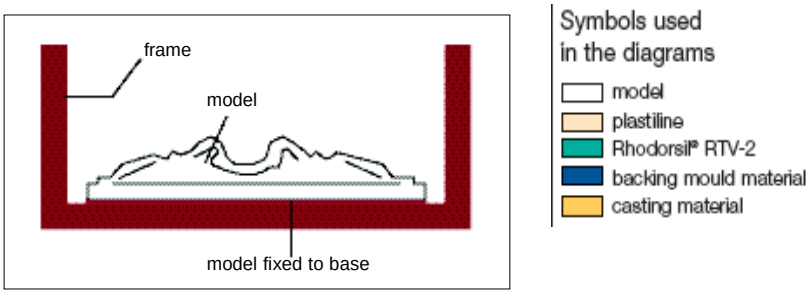
When cast moulding, the model is installed in a frame that can be dismantled or left in place.

The following precautions should be taken
- The model must be held in place on the rigid base, either by attaching it or by bonding it temporarily using an adhesive or modelling dough (e.g.plastiline) etc.

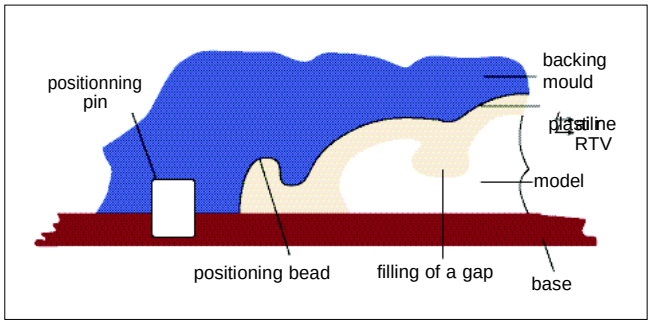
- Any gaps that we do not want to take the imprint of must be previously filled with plastiline.
It is also recommended to seal the base of the model.

To create the casing,
use the following materials
- Glass, wood, plastics, metals, earth, plastiline*, cardboard, etc. with the usual precautions (surface preparation).

*Food grade plastiline for polyaddition RTV-2's



Initial model (block moulding)



Detail of preparation and marking (skin moulding method)

Preparing the model: particular case of historical objects and monuments

This type of moulding requires a specific approach in order to avoid damaging the models. Notably, we have to ensure the compatibility between the model and the insulating products (pore fillers, release agents).
It should also be checked that if demoulding takes place significantly after the recommended time (23°C for 24 h) has lapsed, there is no adhesion (phenomena) on to the model. This can be performed on a non-visible part of the model (e.g. the base) or on a test sample.

4. Moulding techniques

Bluesil™ RTV-2's enable moulds to be made for all types of applications, using a few basic processes.
In spite of the multitude of variants that are possible, basic processes exist which are described in this brochure.
In order to become familiar with the terms used in moulding, we invite you to read the glossary found on page 31.

Comparison of moulding techniques

	Model features	Moulding techniques	Application technique
	Flat back, few or no undercuts	1 part Block Moulding	Casting
	Fully structured few or no undercuts	2 or more parts Block Moulding	
	Flat back accentuated undercut	1 part skin moulding	Casting
	Fully structured, accentuated undercut	2 part skin moulding	
	Little or accentuated undercuts Voluminous model on base On-site reproduction	1 side impression moulding* (Brush Moulding)	Brush, Spatula, Spraying*
	Little or accentuated undercuts Fully structured Voluminous model that is not easy or that cannot be moved	2 or more part impression moulding* (Brush Moulding)	

*Generally the product is applied with a spatula or a brush. It may also be applied using a device for one, or two component spraying. The advantage of this technique is that it saves time and also enables large surfaces to be covered. As an example we can mention the taking of imprints at the Tautavel grotto.
The choice of material naturally depends on the operation that is planned. Please consult us on this subject.

The choice of moulding process is made taking particular account of the following parameters:

- time constraints
- materials constraints
- size, shape and position of the model (horizontal, vertical or overhead).

The table below enables a quick comparison of the various moulding techniques.

Advantages	Disadvantages
Quick and easy to perform Self supporting moulds Low cost to produce	Limited to relatively simple shape that do not vary much in cross-section Significant material consumption
Thin section membranes Economical in materials (RTV) Large degree of flexibility favouring difficult moulding operations (accentuated undercuts), «sock» moulding Availability of tooling enabling the production of membranes	Longer to implement than the block moulding method Cost of production greater
Possibility of taking the imprint on site Possibility of taking vertical or overhanging imprints Adapted to large dimension mouldings Economical in materials (RTV) Difficult moulding	Membrane is not interchangeable between backing mould Longer to implement than the block moulding method

Below we give a simple and brief
description of the three main moulding techniques.

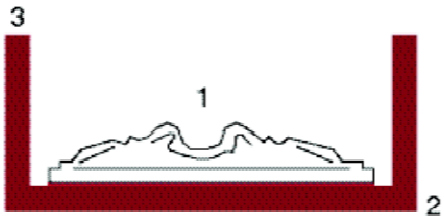
Block moulding

This process is characterised by its simplicity and rapidity; it is intended to produce self-supporting moulds, with one or two parts, by simple casting of the Bluesil™ RTV-2 in its liquid state around the initial model. However, its drawback is that it uses a lot of silicone which itself loses a certain amount of flexibility due to the thickness. This loss in flexibility of the membrane can be limited by positioning spacers in the casting mould. It is also possible to use a low hardness Bluesil™ RTV-2 (8 to 12 Shore A). This process is therefore limited to quite simple shapes not having any accentuated undercuts.

One part moulding

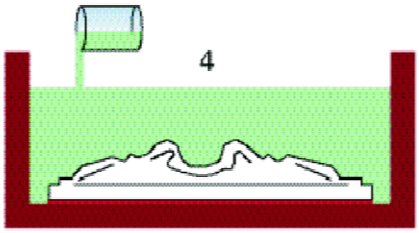
Preparing the mould

1. Model
2. Base
3. Frame
4. RTV membrane thickness of the order of 20 to 50 mm according to the shape of the model and the RTV-2's properties.



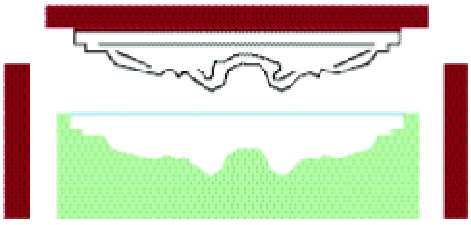
Demoulding the RTV

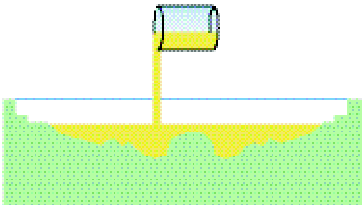
The demoulding time is variable as a function of the choice of product and temperature.
As a general rule, it is recommended to demould after 24 H at 25℃.



Reproduction of the model

There is a large choice of reproduction materials.
For the processing of these materials, please refer to the manufacturer's manuals.
As for RTV-2's, precautions must be taken concerning the risks of air bubbles, notably by pouring the materials slowly into the lowest part of the mould.





Processing the RTV

Prior degasing of the catalysed mixture enables air bubbles to be eliminated.
If degasing is not possible, it is recommended to apply a first coat to the model using a brush in order to avoid the risk of bubbles on the surface.
We can then proceed pouring to a slow trickle at the lowest point of the mould to avoid entrapment of air bubbles.

Two part moulding

The operation is performed in two stages

- Moulding of the model up to the decided parting line.
- After curing, casting of the remaining part.

Mould preparation

Part 1

- The mould is positioned in the plastiline up to the decided parting line.
- The positioning pins are positioned according to one of four layouts:

a) sunken groove, cut out of the base all around the model,
b) or in relief, positioned around the outside,
c) or positioning pins,
d) or inclined parting line for centring and marking (the case shown here).

- The RTV is poured and left to cure.
- After turning the assembly, the plastiline* base (1) is removed taking care not to move the model (2).

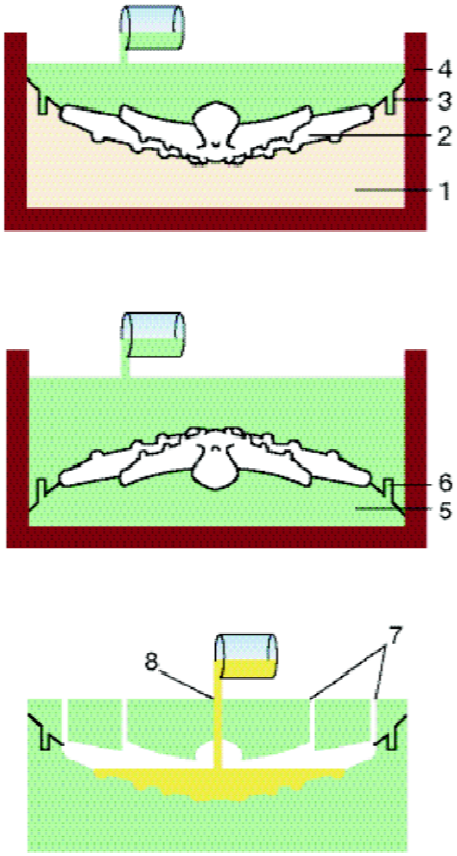
Part 2

- A thin coat of Vaseline grease is applied to the first part of the silicone mould to avoid adhesion between the two parts.
- The RTV is poured according to the recommended method for a one-part mould.

Comment: the choice of positioning of the pouring hole and the vents will be made according to the model's configuration.

Reproducing the model

Same procedure as for a one-part mould.



1. plastiline base
2. model
3. parting line
4. dismantlable frame
5. first vulcanised half
6. positioning pins
7. vents
8. pouring hole

Symbols used in the diagrams

- model
- plastiline
- Rhodorsil® RTV-2
- backing mould material
- casting material

*As a general rule, the bases are in plastiline, clay or plaster.

Skin moulding technique

This technique is very commonly used both in crafts and industry. The production of a one-part skin mould is described in detail below*; please refer to the diagrams and the paragraph entitled “working with plastiline” on page 18. The two part skin moulding technique is simply an extrapolation of this technique (ref. p14).

Precautions to be taken

In both cases avoid the formation of creases and the inclusion of bubbles which could cause wearing and damage to the backing case.

One part skin moulding technique

Positioning the model

- The model must be surface treated (see page 13).
- Position it on the base, attach (e.g. by screwing) seal the joint between the base and the model with plastiline avoiding any air inclusions which may cause bubbling if the temperature rises.
- The previously protected model is then covered in aluminium foil, with a layer of plastiline of constant thickness, taking care not to leave any accentuated undercuts on the outer surface.
- A plastiline alignement bead is then placed around the whole model.
- The dismantlable frame is then set up.
- A mould release agent is then applied to all surfaces (frame and support).
- Make sure there are no gaps between the frame and the support using plastiline, heat weldable PVC glue sticks, or clay.

Producing the backing case

The backing case can be made from plaster or epoxy resin or polyurethane, by casting or by polyester lamination. Below we have summarised the classical polyester laminating process:

- catalysis of the polyester gel coat,
- application of the gel coat layer by brush,
- laminating over this,
- applying of armature or frame.

1. Reinforcing the backing case using glass mat

Whilst the gel coat is still tacky, place strips of glass mat starting at the four corners of the mould. They are applied using a polyester soaked brush. The first coat produced in the way is then strengthened with new coats (up to three) taking particular care of the angles, to give good strength to the casing.

*It goes without saying that moulding techniques and tricks can vary from one case to another; the following details are only recommendations.

2. Reinforcing the backing case using glass fabric

The glass fabric is cut into bands and the still tacky gel coat is completely covered. This is applied in the same manner as the glass mat. Then a second layer is applied at right angles to this. In this case the fibre is pre-impregnated.

The backing case obtained is stronger than in case n°1 and is used for moulds that are bigger.

Reinforcing

Often it is advisable to strengthen the backing case using struts made from cardboard or plywood coated in glass fibre + polyester. Extra reinforcing (optional, but an obligation for moulds that are intended for intensive use), generally involves the adding of a system of struts around the backing case in order to be able to attach handles, hinges, locks, etc. The object is to limit shrinkage and deformation.

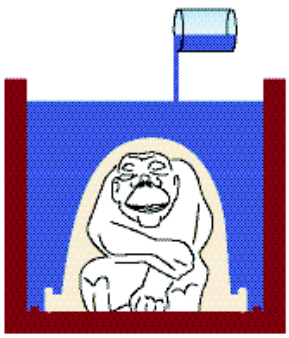
Producing the membrane

- The frame is dismantled.
- The mould is opened: the extractors are screwed in place.
- The plastiline is removed (recyclable) together with the protective film (aluminium, plastic).
- The plastiline is weighed to know how much RTV is to be used.
- Fill gaps on the surface, touch-up where required, sand down the uneven edges of the backing case gel coat.
- Make the pouring and venting holes.
- To pour the RTV, drill a hole vertically from the lowest part of the model and a vent hole that is thinner at each high point, using a file, make a small channel to evacuate the air from the positioning channel. Tubes, for instance in polyethylene are set up at each hole and sealed to the backing case with plastiline. To ensure correct filling, a pouring point is provided at a point higher than the level of the vent outlets.

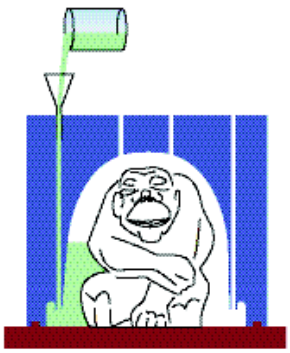
Surface treatment

- Cover the whole internal surface of the backing case with Vaseline grease to avoid any suction. Spread the Vaseline under a stream of hot air (hair dryer).
- Also cover the model in a very fine layer of Vaseline; spread it in the same way.

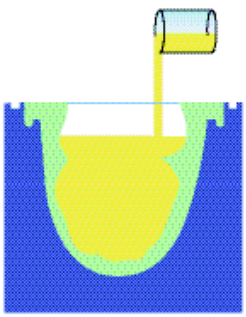
The care taken with this operation will govern



Producing the casing*



Producing the membrane



Reproduction

Symbols used in the diagram

- model
- plastiline
- Rhodorsil® RTV-2
- backing mould material
- casting material

*Plaster casing

the detail of reproduction that is achieved.

-Position the backing case on the model again; fix them together and set up a funnel on the pouring tube.

Preparing the two-component Bluesil™ RTV

- Comply with the base/catalyst or (A/B) ratio.
- The weight of catalysed mixture must take account of the difference in specific gravity between the plastiline and the RTV as well as usual losses (funnel, mixing recipient).

Degasing

- The mixture is degased under a vacuum of 20 to 50 mbar in a recipient that is as wide as possible. The product will expand under the action of the vacuum to between 3 and 4 times its initial volume and bubble on its surface.

These bubbles will disappear gradually and the mixture will sink back down to its initial volume within 5 to 10 minutes. Releasing the vacuum once or twice during the operation will improve and facilitate gas removal.
(see RTV processing inset on page 10)

Two part skin moulding technique

This procedure is the same as the one used for 1-part skin moulding technique but is done twice, whilst observing several precautions:

- choose a parting line to be as invisible as possible or as easy to sand down as possible,
- positioning markers must be set up for both membranes and both - backing cases.

Schematically, the following procedure will be followed.

Producing the backing case

- Position the model up to the chosen parting line in a plastiline base.
- Apply a calibrated plastiline sheet to the exposed part of the model.
- Apply a plastiline alignement bead.
- Position the marker keys for the backing cases.
- Make the first half of the backing case A.
- Once the first half of the backing case has hardened, remove the plastiline making up the base and turn the first half over.
- Apply a calibrated sheet of plastiline on the second exposed part of the model.
- Apply the second plastiline alignement bead.
- Apply a mould release agent on the exposed surface of the outer casing.
- Make the second half of the backing case B.

Making the membrane

- Once the second half of the membrane has hardened, one of the two sheets of plastiline covering the model is removed (preferably the one with the largest surface area).
- Drill through pouring holes and vents;

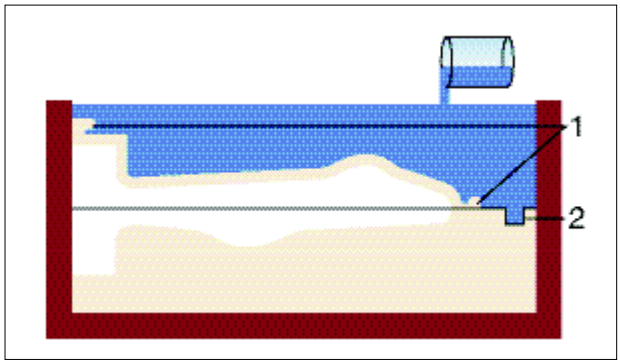
proceed as for the one part moulding:

- release treatment of the internal side of the half casing,
- pouring of the first RTV membrane C,
- elimination of the second plastiline sheet and preparing of the second half backing case,
- pouring of the second half membrane D.

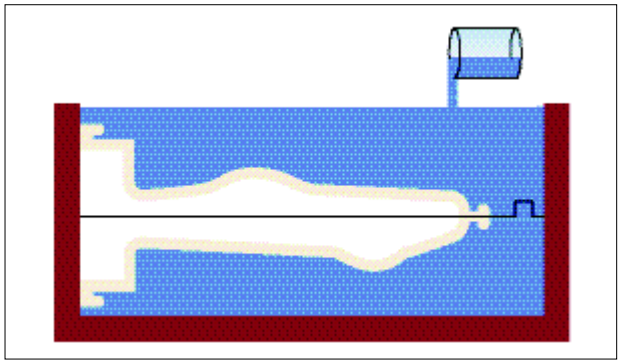
Please note: To avoid coat to coat adhesion of the RTV, please apply a release agent (grease and Vaseline) on the backing surface of the first half membrane.

Pouring the Bluesil™ RTV-2

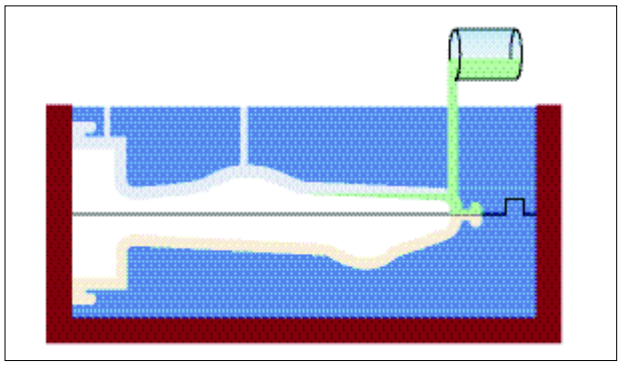
This is performed by gravity, blocking the vents as soon as they start to overspill, whilst keeping a small reserve amount in the funnel to compensate volumetric variations related to curing and possible leaks. Demoulding is carried out once curing is complete (see the product's technical data sheet). Cut off the flash from the pouring and venting holes. Equipment is cleaned using a solvent (petrol, acetone).



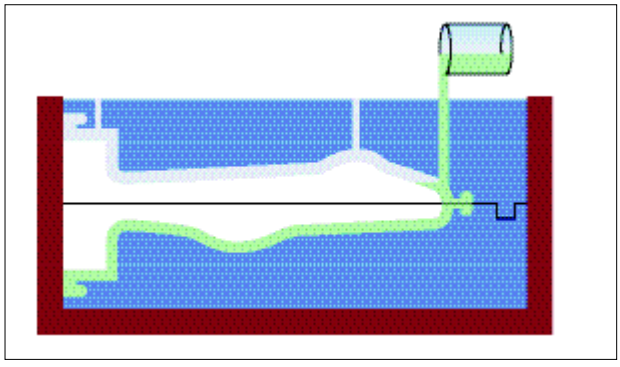
A. 1st first half backing case
1. positioning lines
2. marker keys



B. 2nd second half backing case



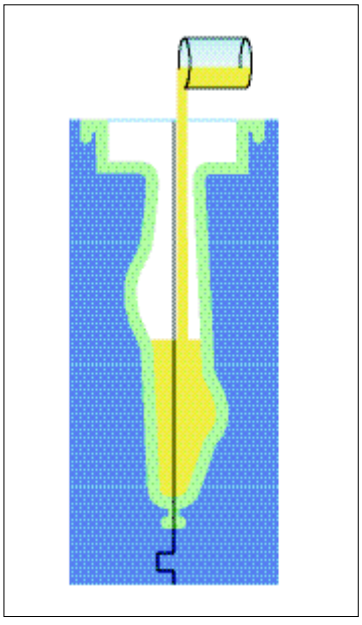
C. 1st membrane



D. 2nd membrane

Symbols used in the diagrams

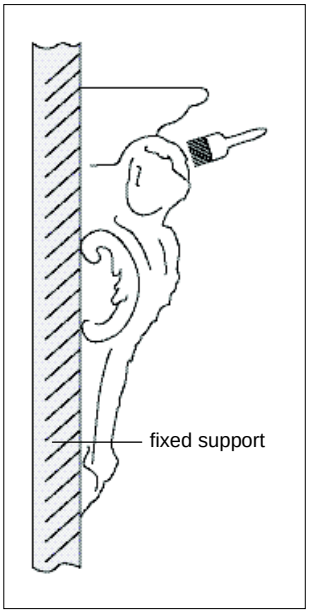
- model
- plastiline
- Rhodorsil® RTV-2
- backing mould material
- casting material



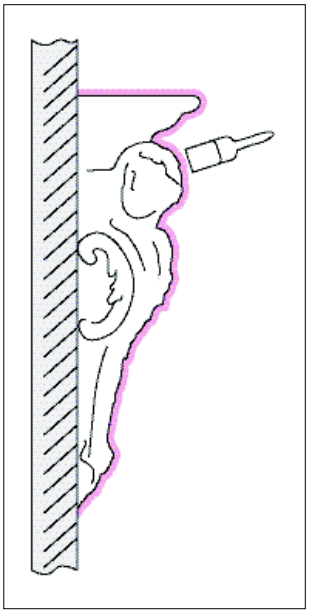
Reproduction

Brush moulding

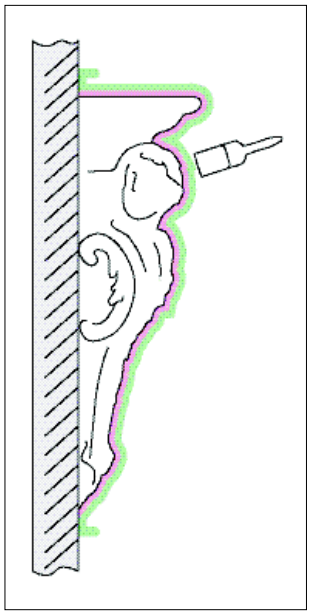
This method is suited to taking imprints of inclined, vertical or overhanging models, generally when they are large or when it is impossible to move the model. As opposed to this, the technique has the disadvantage of the membrane not being interchangeable from one shell to another.



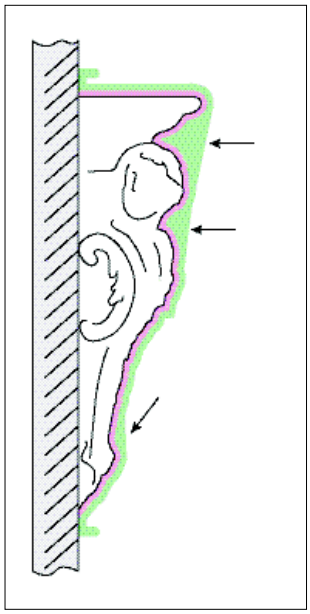
- Apply a thin coat of release coating to the model to make it easier to demould.



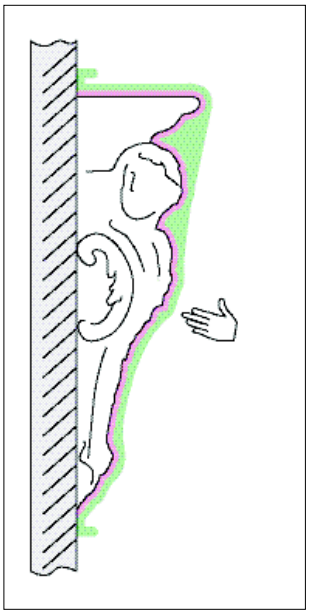
- Apply the first coat of RTV that is either thixotropic or otherwise (through an additive) with a brush (impression coat).



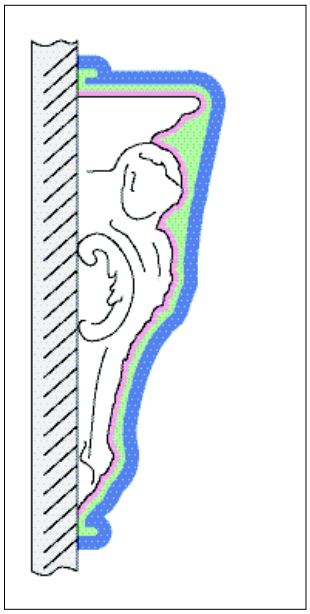
- Without waiting for the RTV to cure completely (after 1 to 4 h depending on ambient temperatures) apply the number of coats that are required to obtain the final thickness (generally 1 to 2 coats).



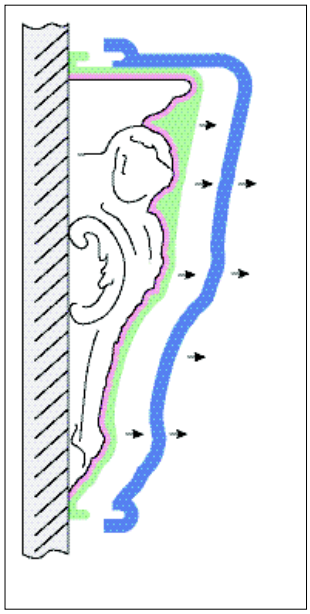
- Accentuated undercuts will be filled with an RTV paste before producing the shell.
- Leave to cure for 16 to 24 h at ambient temperature.



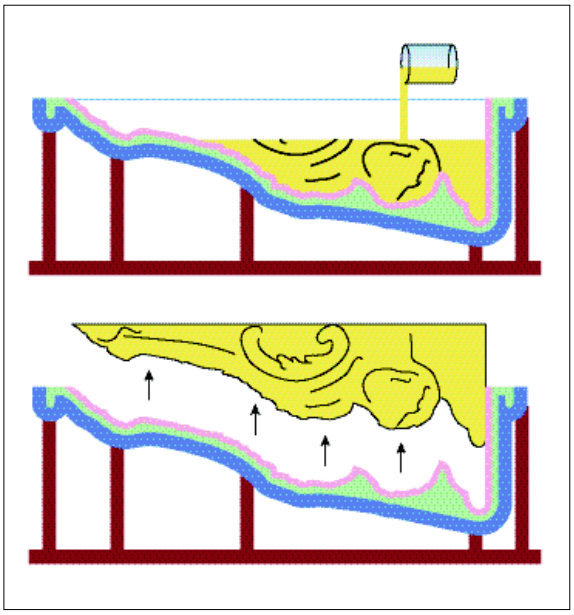
- Mark off the membrane several centimetres around its edge and apply a release agent to the outer surface.



- Make the supporting shell in plaster, polyester or in epoxy/glass fabric.



- Dismantle the shell and the membrane.



- Reposition the membrane in the shell to produce the reproductions.

Symbols used in the diagrams

- model
- plastiline
- Rhodorsil® RTV-2
- backing mould material
- casting material
- 1*coat RTV-2

5. Advice to users

Processing guide for Bluesil

Remix each of the 2 components of the Bluesil™ RTV-2 every time before using. Mix them thoroughly together in a clean recipient in the recommended proportions, either by spatula or using a mechanical mixer on a low speed setting so as to limit the inclusion of air in the mixture, until a perfectly uniform mixture is obtained. Bluesil™ diluent 2030 can be added to dilute the RTV. This causes a reduction in both viscosity and hardness. However beyond 10%, the mechanical properties of the RTV are deteriorated.

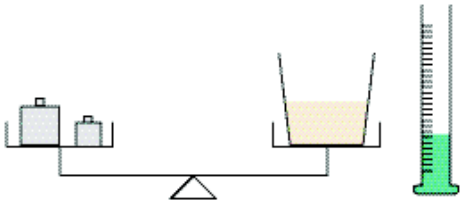
In order to determine the uniformity of the mixture, it is possible to colour the RTV using a colour base recommended for Bluesil™ RTV-2's.

It is recommended to ensure that the colouring of the RTV is compatible with the final application of the membrane.

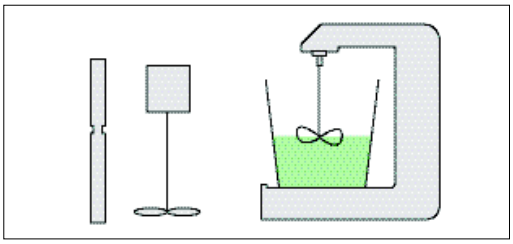
Degasing

The catalysed mixture is degased under a vacuum of 20 to 50 mbar, releasing the vacuum once or twice during the operation; the RTV will expand under the action of the vacuum and it is therefore necessary to have a recipient of an appropriate size, if possible, wider than it is high (l= 3 to 5 times h). Degasing generally lasts several minutes and at least until the bubbles stop rising regularly to the surface when the vacuum is released. However, prolonged degasing can cause the departure of certain components that are required for curing.

The catalysed RTV is poured in under gravity to the lowest part of the mould (it may be advantageous to tip it slightly) avoiding trapping any air. We can also, in the case of a skin moulding, pour under low pressure in order to reduce the processing time; this is the case when producing membranes in large quantities or that have large dimensions.

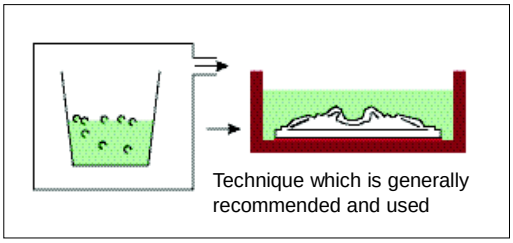


Weighing out the base and catalyst

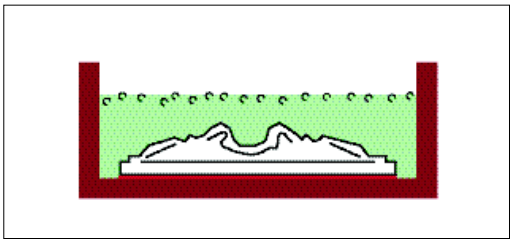


Mixing the base and catalyst

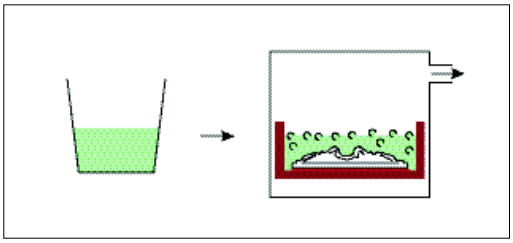
Processing the RTV



1. Degasing the RTV under vacuum then pouring in the mould



2. Free degasing in the mould*



3. Direct pouring in the mould then vacuum degasing*

Symbols used in the diagrams

- model
- plastiline
- Rhodorsil® RTV-2
- backing mould material
- casting material

**Apply an first coat using a brush on the model to avoid bubbles.*

Curing at temperature

RTV-2's shrink least at room temperature. Above 50℃ the shrinkage of the membrane increases significantly. This must be taken into account for polycondensation RTV-2's, in cases in which we want to increase the production rate of moulds, by increasing the cure temperature.

1. For polycondensation bluesil™ RTV-2's
Heating to accelerate curing is possible up to around 50℃. Beyond this temperature, the risk of the membranes bubbling is significant.

2. For polyaddition bluesil™ RTV-2's
There is very little shrinkage of polyaddition RTV-2's (+/-0.1 to 0.3%). If the production rate is to be
increased, we can accelerate curing by heating up to 150℃. This significantly shortens curing times:

- 24 h at 25℃,
- 4 h at 65℃ or
- 1 h at 100℃ or
- 1/2 h at 150℃.

When heating it is necessary to take account of the volume expansion coefficient of the RTV as a function of temperature (see the technical data sheet). In any case, after curing at 100℃ and beyond, we can observe a dimensional variation related to differences in the expansion coefficient of the silicone and of the materials making up the casting mould and the model. We can therefore lose the benefit of the very small shrinkage of this type of Bluesil™ RTV at room temperature.

Inhibition

The risk of inhibition is generally only seen with polyaddition type RTV-2's. Inhibition is seen as
a curing fault of the RTV that is more or less accentuated on contact with certain materials containing amines, sulphur, tin or heavy metals (e.g. barium or cobalt); natural and synthetic rubbers that are vulcanised using sulphur, polyester resins and sealants, flexible PVC's, polycondensation RTV-2's, chloroprene glues, certain modelling putties, certain adhesive tapes etc. Precautions to be taken (see inset opposite).

Precautions to be taken

- Clean the model with a decontamination agent diluted in water, according to the manufacturer's recommendations, then wash with a brush and rinse off with water (this treatment may not be effective on absorbent surfaces).
- Prepare the materials to be used (plastiline, brushes, spatulas, etc.).
- If in doubt it is recommended to perform a test on a sample.
- If necessary use a protection agent such as polyvinyl alcohol (e.g. Rhodoviol) or an acrylic varnish or codex Vaseline grease.

Working with plastiline

Plastiline is a special grade of modelling putty that is particularly suited to moulding with Bluesil™ RTV.

Using plastiline
This modelling putty comes in 5 kg blocks and can be flattened to size either in a press or in a 4 to 8 mm high frame, or with a roller running over two thickness adjusters; use a polythene film as a release coating.

- Cut into strips or sheets.
- Fill the undercuts on the model.
- Stick the bands to the model.
- Avoid joints on prominent parts.
- Precut the alignement bead line using agouge, press it on the support to ensure that it bonds well.
- Smooth off the plastiline, for instance with a brush or a cloth soaked in petrol.
- A coat of Vaseline grease release coating must be applied.

Plastiline that has been used with a polycondensation Bluesil™ RTV cannot be used for a polyaddition Bluesil™ RTV following this, due to the risks of inhibition.

Prolonging membrane life

Flexible membranes are damaged in time by tearing on handling or by chemical attack from the reproduction materials (resins). In many cases we can prolong the life of these membranes by adopting certain precautions - (care in mould design, care in handling, surface protection) - or by repairing with a CAF.

Firstly it is recommended to cure in a relatively isothermic room (around 25℃) for dimensional consistency.
It is important to comply with a storage time of the membranes after they are demoulded. For example the technical data sheets for polycondensation RTV-2's inform us that the mechanical properties are only achieved fully after 4 days curing at 23℃ RH 50 %.

This time is only 24H for polyaddition RTV-2's. It also goes without saying that the care taken over producing the mould can contribute to the length of time that the membrane will last. It is therefore right from the mould design stage that the quality and accuracy of membranes
is determined.

Protective agents

We can class the materials used for reproduction in terms of increasing chemical aggressiveness relative to RTV-2's:
- Non aggressive: plaster, wax, stearine, etc.
- Slightly aggressive: low melting point alloys, cement, etc.
- Quite aggressive: semi-rigid polyurethanes, filled polyesters*, etc.
- Very aggressive: epoxies, rigid polyurethanes, non-filled polyester, etc.

Protection of the membrane is therefore specially recommended for the moulding of epoxy's and polyurethanes.
Therefore the choice of a polyester or a quick curing polyurethane resin is beneficial for the membrane. Sprayed on in small quantities, a 5% isopropanol solution of Bluesil™ Resin 9515 increases the mould release effect and protects the mould surface. In all cases the presence of Bluesil™ Resin 9515 can make future operations on the moulded part rather difficult, such as painting, bonding, decoration or surface finishing.
In certain applications, this function is ensured by the applying a filmogenic or powder based finishing product before moulding which by transferring to the moulded product (barrier varnish, bronze powder) will protect the membrane. It is also beneficial to leave the membranes to rest at a moderate temperature (around 60℃) for a shift (i.e. the night) to enable volatile substances** (e.g. styrene) to evaporate.

Repairing moulds

When a tear is detected on the outside of the membrane, in other words on the casting mould side, it must immediately be repaired by bonding using a CAF (the interior of the membrane is of course irreparable).

*Varies according to the styrene concentration.
**Residual products from the reproduction materials.

6. Mass production moulding techniques

Mass production of moulds and reproductions

In this chapter we will describe the successive stages of the mass production moulding process.

1. Producing the master mould p. 22
2. Producing the production backing moulds p. 23
3. Producing the master membrane and the master models p. 24
4. Production of membrane moulds and membranes p. 25
5. Mass production p. 27

1. Producing the master mould

This involves manufacturing the first backing mould A that is then used to manufacture a certain number of master moulds or models and a series of backing moulds.

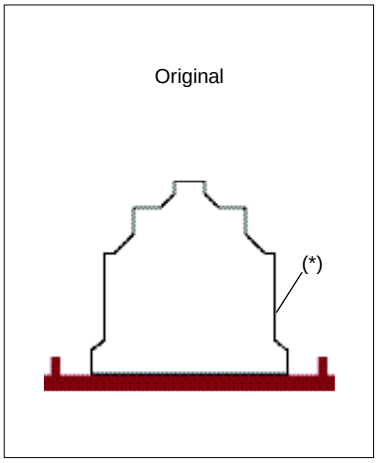
1.1. After being surface treated, the original is fixed on a flat surface.

1.2. A layer of plastiline of around 6 mm thick is then placed over the entire model*.

1.3. The 1.2 assembly is then placed in a casing
in which the plaster or the resin is poured; once hardened, the material forms the backing mould A; the 1.3 assembly is demoulded and the plastiline is taken off.

1.4. This gives the master mould A that is used to make backing moulds A'.

*Protection if required with a sheet of aluminium of polythene.



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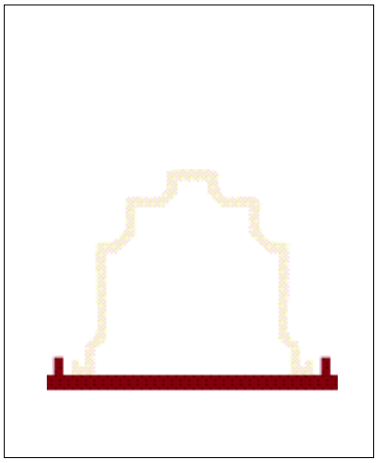

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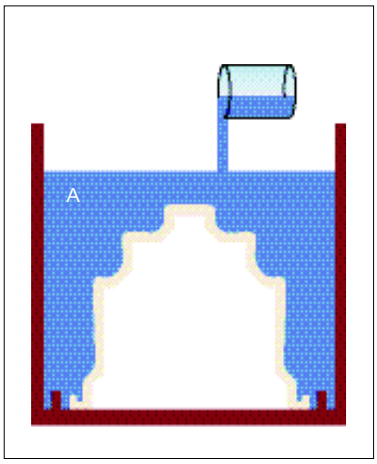

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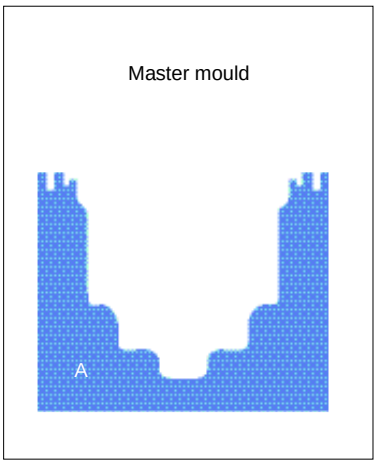

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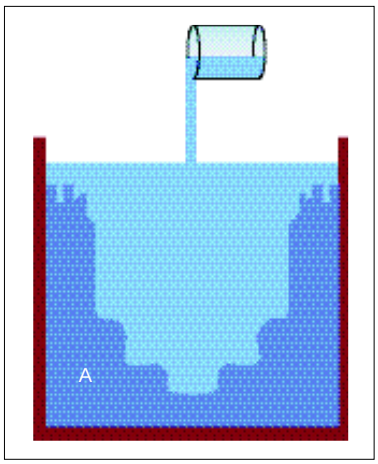
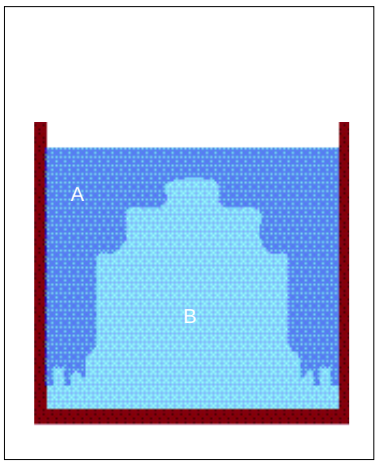
This involves manufacturing the backing moulds A' that will be used in the ultimate production stage to hold the membranes. We move from A to A' by using a negative mould B.

2.1. The negative B of the master mould A is taken by casting in a suitable material, most often in concrete or epoxy, polyurethane or acrylic resins.

2.2. Backing moulds of type A' are obtained from the negative B; a sufficient quantity of them are produced to make the required number of production moulds.



2.1



2.2

Symbols used in the diagrams

- model
- plastiline
- Rhodorsil® RTV-2
- backing mould material
- casting material

The master membrane, produced directly from the original is used to produce master models, exact reproductions of the original, which can be substituted for it in the instance of loss or damage to the latter.

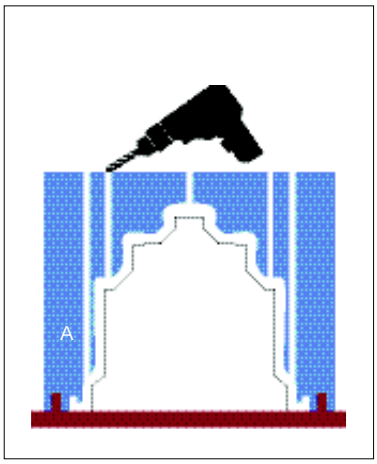
3.1. The master mould A, obtained in 1.4 is taken*; casting and vent holes are drilled in the backing mould and the original is fixed in position.

3.2. The Bluesil™ RTV-2 is cast; after curing it gives the master membrane.

3.3. Master model D is produced in epoxy resin.

Operation 3.3 is performed enough times to produce the required number of master models.

*In this case the master mould is used as a backing mould.



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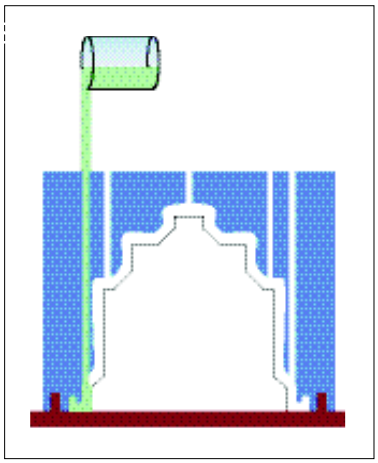

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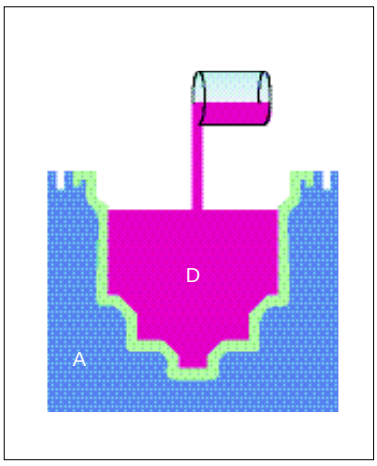

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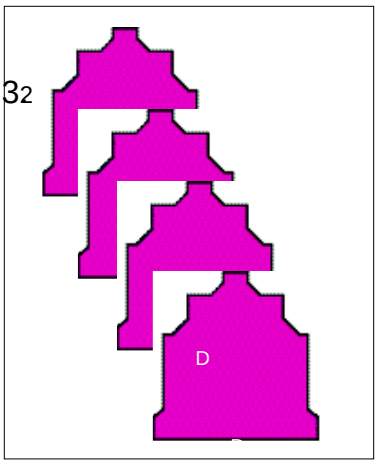

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Symbols used in the diagrams

model	plastiline	Rhodorsil® RTV-2
backing mould material	casting material	1st coat RTV-2

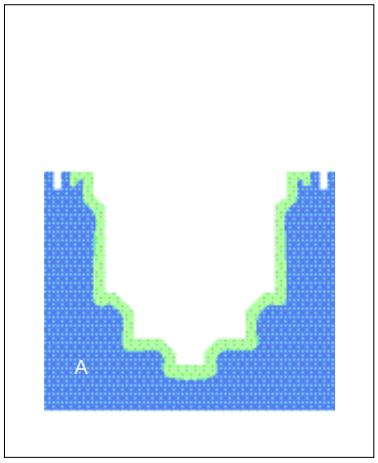
4.1. Backing mould A' obtained in 2.2 is taken and the master membrane is set up in it.

4.2. Casting moulds C are produced by casting
with great care since there are also master models integrated with each of these backing moulds.

4.3. The negative B obtained in 2.1 is taken to produce the backing moulds A" (they are generally different from backing moulds A' due to their material, the outer shape and their strength); indeed as opposed to production backing moulds A', those of type A" will have to withstand less handling.

4.4. A casting hole and vents are drilled in each
backing mould A"; parts C and A are assembled to produce a membrane mould (also called
a membrane cast).

The curing of Bluesil™ RTV-2 occurs without any consequences in terms of heat or pressure for the membrane moulds; it is simply necessary to place the casting moulds previously produced for this purpose in an ordinary frame.



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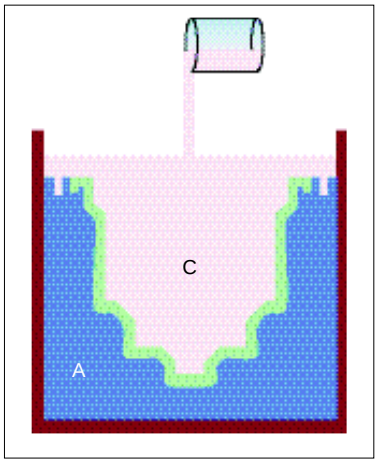

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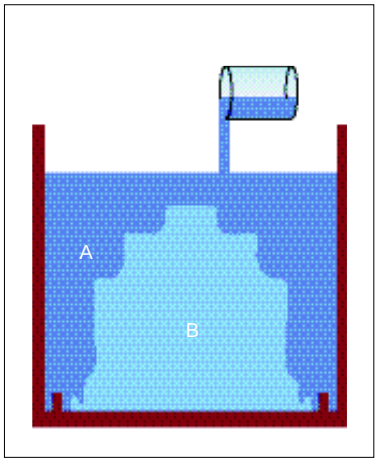

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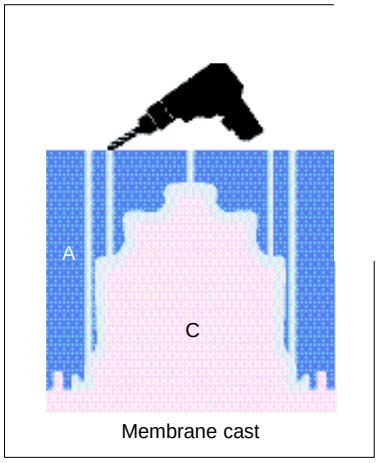


Membrane cast

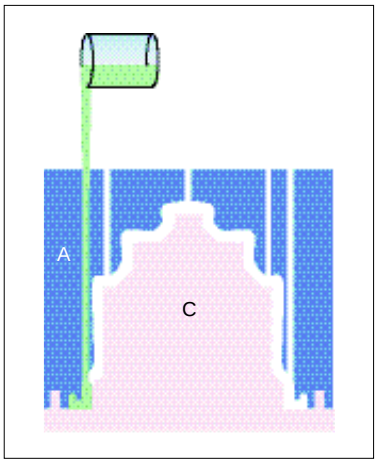
4₄

4.5. The Bluesil™ RTV-2 is then cast.

4.6. After curing, the first mass production membrane is then demoulded.

After reassembling, operations 4.4 and 4.5 are repeated as many times as required.

Comments:
It is conceivable to mass produce the membranes from the original without using the above procedure; a series of master membranes would then be obtained. However, this practice would have the disadvantage of gradually damaging the surface of the original, through wear, clogging or distortion; certain models will only withstand a very small number of moulding operations.
In another variant, casting mould C, with an integrated master-model can be simply replaced by a backing mould of type B on which will have been attached a master-model. Nonetheless, the recommended and previously illustrated technique has the advantages of a perfect seal at the joint face, the absence of running by infiltration under the master model, the eliminating of a cause of bubbling, the best interlocking of the casting moulds and in all, a saving of time.



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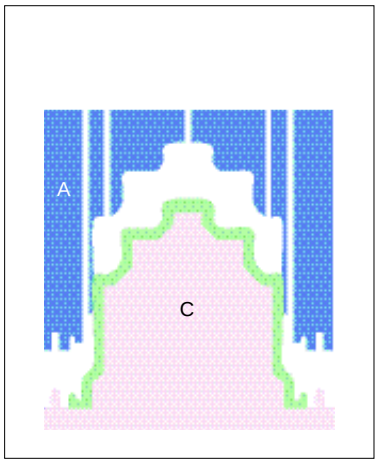

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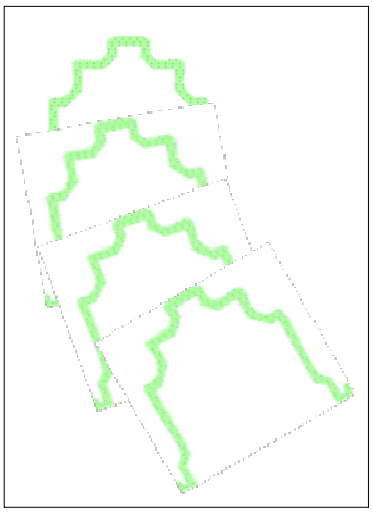
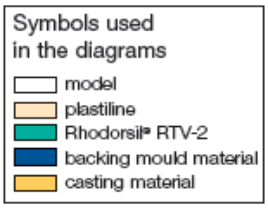




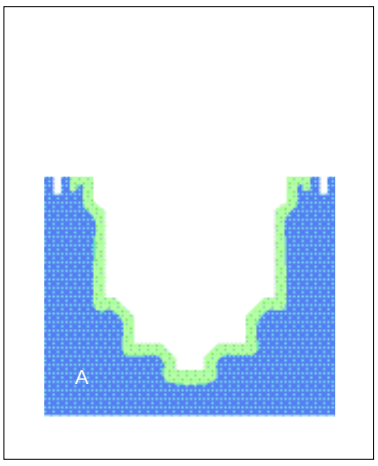
5.1. A mass production membrane 4.6 is placed in the production backing mould A'.

5.2. The reproduction material is cast in the mould. When the cast material has set, the part is extracted from the membrane.

We can simultaneously use an appropriate number of moulds relative to the number of reproductions required.

Casting machines for Bluesil™ RTV-2's

Machines are available for the processing of two component elastomers. Our laboratories have experimented with various types of these machines and are available to advise users on this subject.



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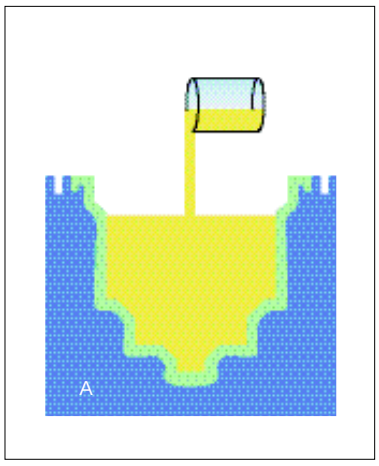

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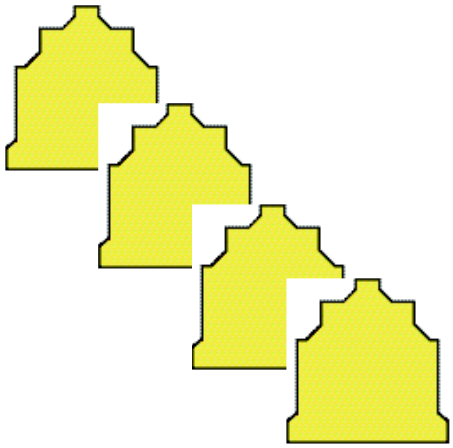


7. Vacuum moulding of industrial prototypes

These days, mass market goods are prone to being in and out of fashion very quickly and models are changing increasingly fast.
In industry the speed of adapting to these changes is crucial and the vacuum moulding technique provides just this capability.

Objective

Producing accurate industrial prototypes as quickly and as inexpensively as possible with a vacuum moulding machine, a silicone mould and casting resins of polyurethane or epoxy type.
The parts concerned are generally technical parts (for the automotive industry, domestic appliances, etc.) which will be mass produced in injected thermoplastics.

Interest

For a new part, designers generally need 5 to 30 prototypes. Making them all by hand, by machining or directly by injection in a metal mould is time consuming and expensive.
Vacuum moulding enables the required number of exact copies to be produced of a single model in little time and at very little expense.

The machines

This technology is Japanese in origin, the machines currently used have generally been imported from Japan or even produced by their users. They can be automated to a certain extent but all have a vacuum chamber with a system for mixing and pouring the reproduction resin and possibly an oven.

The resins

Polyurethane and epoxy resins are most often used. The grade chosen generally depends on the appearance or mechanical properties required in the final thermoplastic product that will be launched in mass production.

Bluesil™ RTV-2 silicones

Bluesil™ RTV 2's enable flexible moulds to be produced from a single model, which are then used for the production of industrial prototypes.
The required properties are:
- low shrinkage,
- heat accelerated curing,
- excellent mechanical properties,
- good resistance to casting resins (PUR, epoxies).

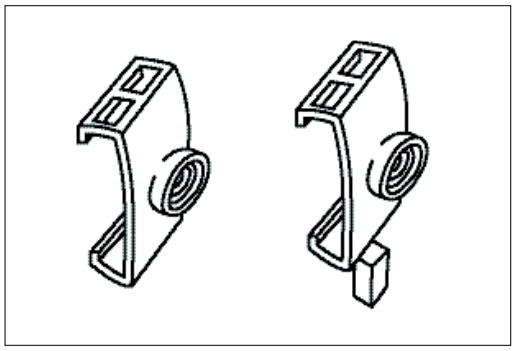
To facilitate the cutting of the mould, certain users prefer a translucent or even transparent product.

The users

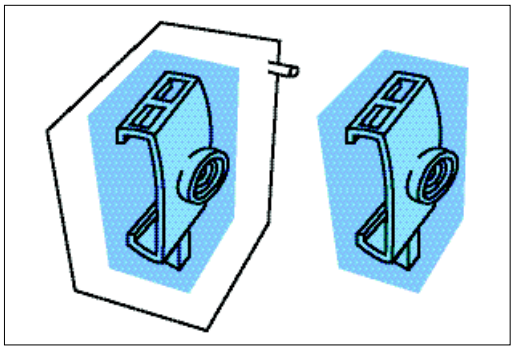
1. Specialised companies in the production of models, mock-ups and prototypes.

2. Workshops integrated in major engineering offices in the following sectors: automotive, office equipment, domestic appliances, electronics, toys.

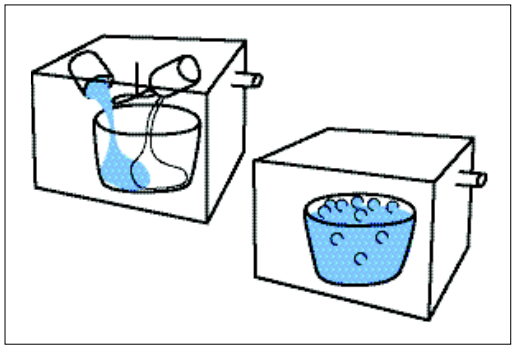
Vacuum moulding of industrial prototypes - principle



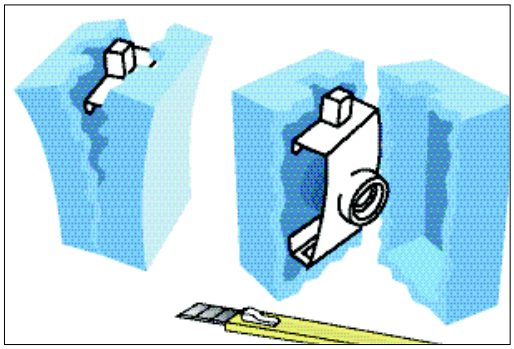
1. The model (wood, metal, plastic, etc.) that has been made by hand, machined or produced by whatever method (stereolithography, stratodesign, CAD) is bonded to a support.



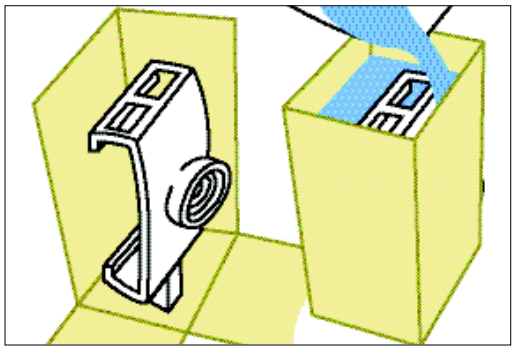
4. The assembly is again placed under vacuum to remove any air that was included when casting.



2. The 2 components of the Bluesil™ RTV-2 are mixed and degased under vacuum.



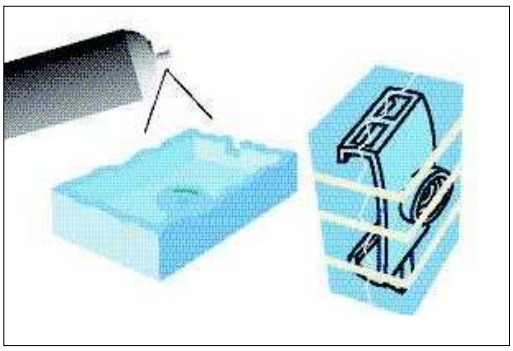
5. Curing occurs at room temperature or under the action of heat. The silicone block is then cut with a scalpel. Certain tricks can help in marking the joint surface and make this operation easier (adhesive tape, metal wire, etc.)
A zigzag cut will make it easier to position the different parts of the mould when in use.



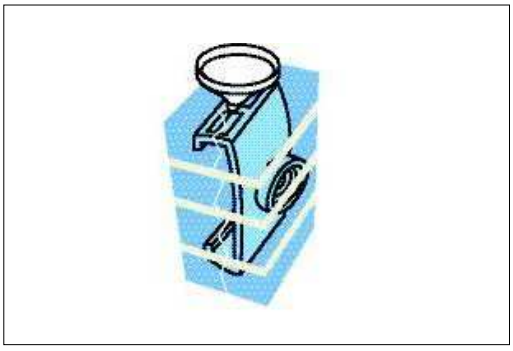
3. The model is placed in a box that is filled with the silicone mixture.

Symbols used in the diagrams

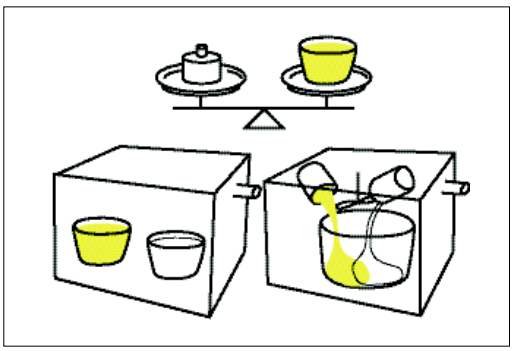
- model
- Rhodorsil® RTV-2
- casting material
- outermould



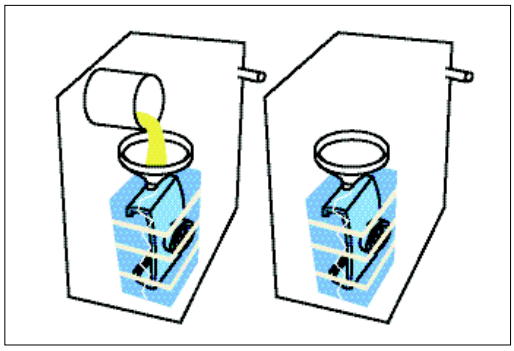
6. Once the model is taken from it, the mould is put back together, having previously applied a protective agent (refer to us).



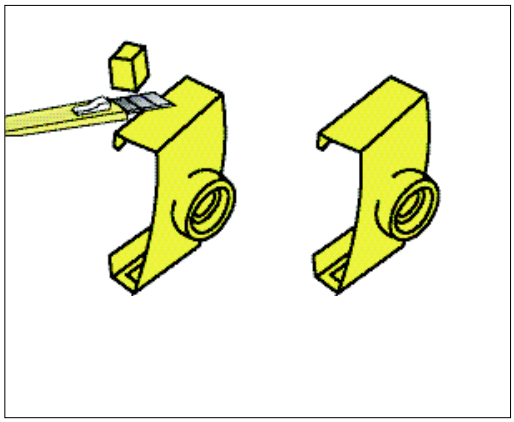
7. A funnel is placed in the pouring hole created by the support.



8. The two resin components are weighed out then mixed under vacuum.



9. The resin is cast under vacuum, then the chamber is set back to atmospheric pressure



10. After the curing of the resin (at room temperature or heat accelerated) the prototype is removed and then trimmed.

Glossary

Whilst writing this guide, it soon became clear there was a problem of vocabulary - meaning that there are certain terms in moulding which are commonly used by those involved in industry or in artisanal, be they modelers, sculptors, moulders, melters whose concerns whilst very similar, would have opposing points of vue – ie., “positive” for one would mean “negative” to another.

Frame/Outer Mould
Casing to limit the horizontal dimensions of the mould.
Casing, outer.

CAD
Computer aided design.

Case
Same “backing case”, implying the notion of possibly rigid.

Position marks/pins
Device to ensure that the two halves of the casings fit into one another.

Outer case
See Baking mould.

Backing Mould
Serves to support and hold the membrane mould in place whilst casting. See Backing Case, Casting Mould.
Certain backings moulds can be used as moulds to make the membranes.

First impression
First coat of RTV on the model applied with a brush - allows to avoid bubbles in contact with the model/object.

Equivalent or synonyms
Outer case: can be used to store the membranes.
Cover/lid: usually the lid of the backing case.
Shell: the base/body of the backing case.

Casing
See outer mould/backing mould.

Start up See base.

Impression
The reproduction of relief.

Positioning pins
Two interlocking metal pins
- one for each part of the mould
- to hold the mould in place.
Also - modeler’s positioning key or centring point.

Master
Synonym of “master model”; in the car industry, the master is the grained standard model.

Matrix
Taken in its classic sens from thermoforming used in the “shoe” industry - and used to describe the membrane.

Membrane
Rubbery, flexible and thin mould directly in contact with the casting material; it is the skin mould which supports the casting/moulded piece. The skin mould needs a backing mould as a support.

Master membrane (mould)
Is the first membrane, cast directly on the model, in the master mould.

Case moulds
Moulds for mass reproduction of plaster moulds for the Ceramics Industry.

Supporting base
Often the base made out of plastiline onto which the model is placed before moulding (two part technique). This helps to determine the parting line.
Also - support, base.

Model
The original piece or object which will be reproduced, duplicated or copied.
Synonym: original, pattern.

Master model
Replica of model, which it will substitute to make the reproductions.
Synonym: master, reserve (model).

Mould
Made up of one, two or several parts, used in production. The moulds is either self supporting, or flexible supported by a backing mould. Also - imprints, impressions, reproduction mould.

Master mould
Is the first combination of backing moulds, mase up from the original, used to make the master membrane.

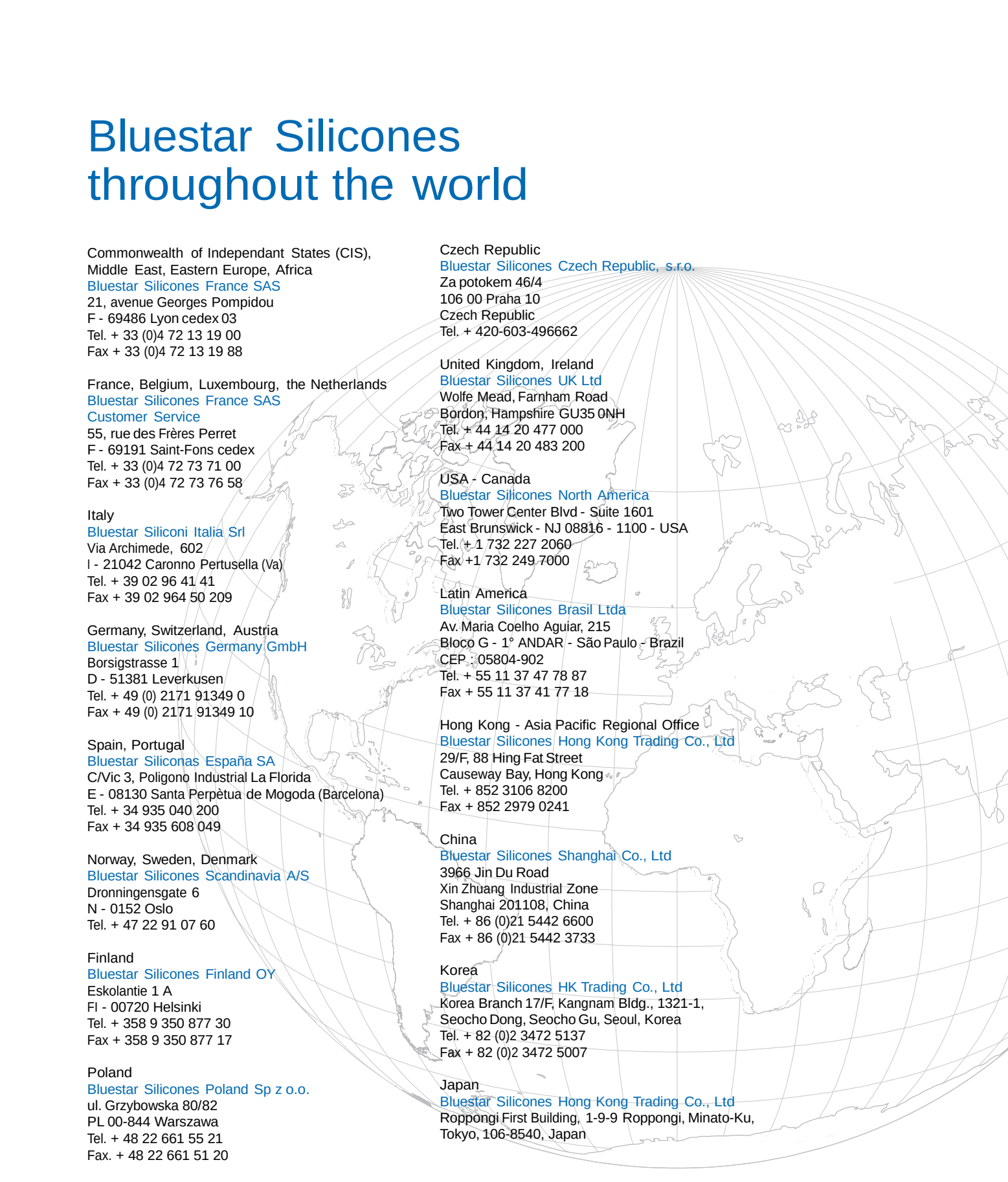
Replica
Copy of the relief (contours) of the model-eg., the master is a true copy of the original model.

Stereolithography
Process which allows to make a model in layers of resin which are cured under UV laser.

Base
Is the plate onto which the original is placed.
Also described as the base, the start up.

Vulcanization
In the original sense of the word, vulcanization consisted of linking the long molecules of natural rubber by means of sulphur and heat. The concept has been extended to all elastomers, with other agents that sulphur, and a wide range of temperatures.
For PVC, the action of heat causes gelling, which is in fact only a melting. Synonyms (in this booklet):
Cross-linking: this is the only correct term in the strict sense; polymerisation; curing.

Bluestar Silicones throughout the world



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