Certified prototypes and small series made using silicone replicas

Practical guide to Rapid Prototyping technologies

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Introduction

Usually we speak about Rapid Manufacturing to indicate a manufacturing process that employs provisional or prototype equipment and materials similar to thermoplastic injection molding polymers. In our workshop we realize prototypes or pre-series plastic using replicas from silicone mold.

A silicone mould is a temporary equipment, it as a production capacity of about 25 castings, obtained through the use of a master or model generally made with stereolithography. It will create a cavity in the mold to be subsequently filled with two-component polyurethane resin. In the next we will analyze in detail the mold construction process and the realization of the flows, we now concentrate attention on the possible applications of this technology.

The use of silicone replicas obtained with certified materials is not only a kind of prototype production but it enters also in the context of a final but numerically limited production suitable for many industrial sectors.

The case history that will follow will show you how our materials certified UL94 V0 (flame retardant) suitable for the production of components to be mounted both on light aircraft or helicopters for civil use and also on electromedical devices; It will also show you the use of FDA certified materials in medica and vending field.

Have you found the right material for you? If you need any more information our contacts are on the last page, please use them!

How to build a silicone mould

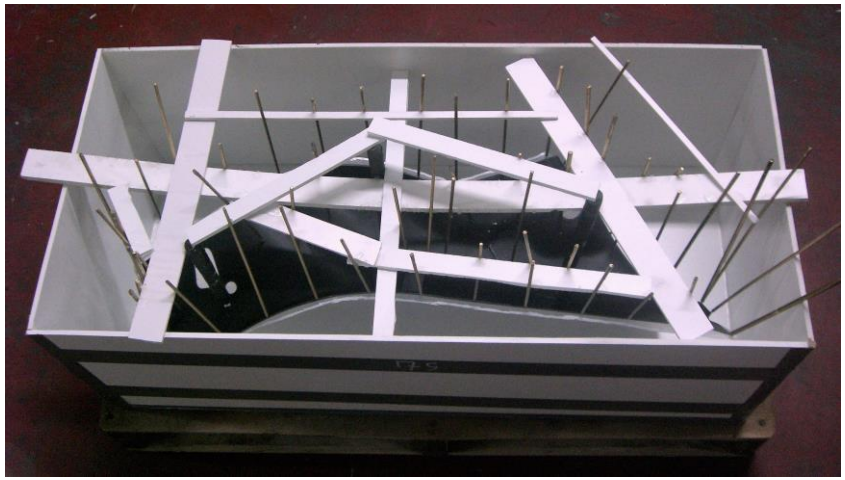
The silicone mold of which we speak in this mini-guide has nothing in common with sweets silicone molds because, as you can see in the picture, this equipment is formed by the two halves, just as in the case of a steel mold but without the possibility of inserting automatic movements. It is in fact a manual process in which the skill and experience of the specialized operator makes the difference on the success of the whole project.

The vacuum is created after the extraction of the master, the physical model of the object to be realized. It is generally done in stereolithography but it can also be used a real object of production, provided that it has no defects or roughness. Any "defect" present on the master will be replicated faithfully in production!
The master is placed in a box and is poured on it the liquid silicone, after the complete solidification it will be cut into the two halves that you see.

The inability to create automatic movements in the mold is compensated in part by the use of inserts which permit the realization of more complex geometries, even with undercuts, that our technicians assess already in the first study phase of the project.

Vacuum casting

As well as the mold is made with a nearly even completely manual production the casting process follows a procedure halfway between automatic and manual, where once again the operator's specialization is a plus to be taken into account.
For each single casting the mold must be closed, heated in the oven and then placed in the vacuum casting machine, to prevent air bubbles forming which alter the structure and solidity of the particular.



After each casting, the mold is “baked” in special ovens to solidify the material inside; as this stage we proceed to the opening of the mold and to the extraction of replication: the mold is now ready for a new casting. According to the production material is necessary to follow rules and drying times, for example, there are materials that can be cast even four times in a day because they have reduced solidification times, while for others it can only proceed with a casting per day. After production we removed small material excess from the parts and we treate them on the surface if required by the design specifications. The average time to achieve a number of 25 replicas is of about 4 weeks, obviously counting the realization of the master and of the production equipment.

FAR 25 V0 Certified Material

The FAR25 certification covers the flammability of materials and responds to an American law concerning especially the avionics and the aerospace. If this material comes into contact with a flame it does not ignite and it does not create fumes. For this particular characteristic is required on civil and military aircraft and also in the medical field for hospital and ambulatory devices.
In our case studies we can offer both rigid and soft materials tires from 50 to 60 Shore A approx.

PX 330

POLIURETANO DA COLATA SOTTO VUOTO
PER PEZZI TECNICI E PROTOTIPI

AUTOESTINGUENTE.: FAR 25- UL 94 V0 - Tg 100°C

APPLICAZIONI

Si utilizza per colata sotto vuoto in stampi silicone per la realizzazione di pezzi tecnici, di prototipi e modelli in scala che devono presentare caratteristiche meccaniche simili a quelle di termoplastici, come l'ABS caricato, che necessitano di una classificazione al fuoco.

CARATTERISTICHE

- ☒ Sformatura rapida
- ☒ Autoestinguente
- ☒ Colorabile mediante coloranti CP
- ☒ Buona tenuta termica

PROPRIETA' FISICHE				
Composizione		ISOCIANATO PX 330	POLIOLO PX 330	MISCELA
Rapporto di miscela in peso		100	100	
Aspetto		liquido	liquido	liquido
Colore		paglierino	biancastro	biancastro
Viscosità a 25°C (mPa.s)	BROOKFIELD LVT	150	4.500	1.000 (1)
Densità parti prima della miscela a 25°C Densità miscela polimerizzata a 23°C	ISO 1675 : 1985 ISO 2781 : 1996	1,22 -	1,33 -	- 1,35
Pot life a 25°C su 200 g (min)	-			5 - 7

(1) : Viscosità dopo 1 minuto di miscelazione (la miscela non è immediatamente miscibile).

RE 11501A-(91) POLIOLO
RE 1020 ISOCIANATO

RESINA POLIURETANICA DIELETTRICA
BI-COMPONENTE – POLIMERIZZAZIONE A FREDDO
FLESSIBILE – UL 94 V0 – RTI 110/120°C

APPLICAZIONI

Resina da colata per numerose applicazioni meccaniche e dielettriche in particolare per basse e medie tensioni.
Esempio: schede elettroniche e componenti.

CARATTERISTICHE

- *Resina poliuretanica liquida bi-componente*
- *Priva di solvente*
- *Caricata*
- *Flessibile*
- *UL 94 V0*
- *Priva di alogeni*
- *Ottime proprietà termiche (RTI 110/120°C)*

PROPRIETÁ FISICHE				
Composizione		POLIOLO	ISOCIANATO	MISCELA
Rapporto miscela in peso Rapporto miscela in volume a 25°C		100 100	10 11	
Aspetto		liquido	liquido	liquido
Colore		nero	ambra	nero
Viscosità a 25°C (mPa.s)	BROOKFIELD LVT	2,600	125	3,400
Densità parti prima della miscela a 25°C Densità prodotto polimerizzato a 23°C	ISO 1675 : 1985 ISO 2781 : 1996	1.31 -	1.22 -	- 1.30
Gel Time a 25°C (min.)	Gel Timer TECAM	-	-	5 su 110 g
Curing time a 25°C (200gr)	ore	-	-	12-24
Durezza finale a 25°C (200gr)	giorni	-	-	7

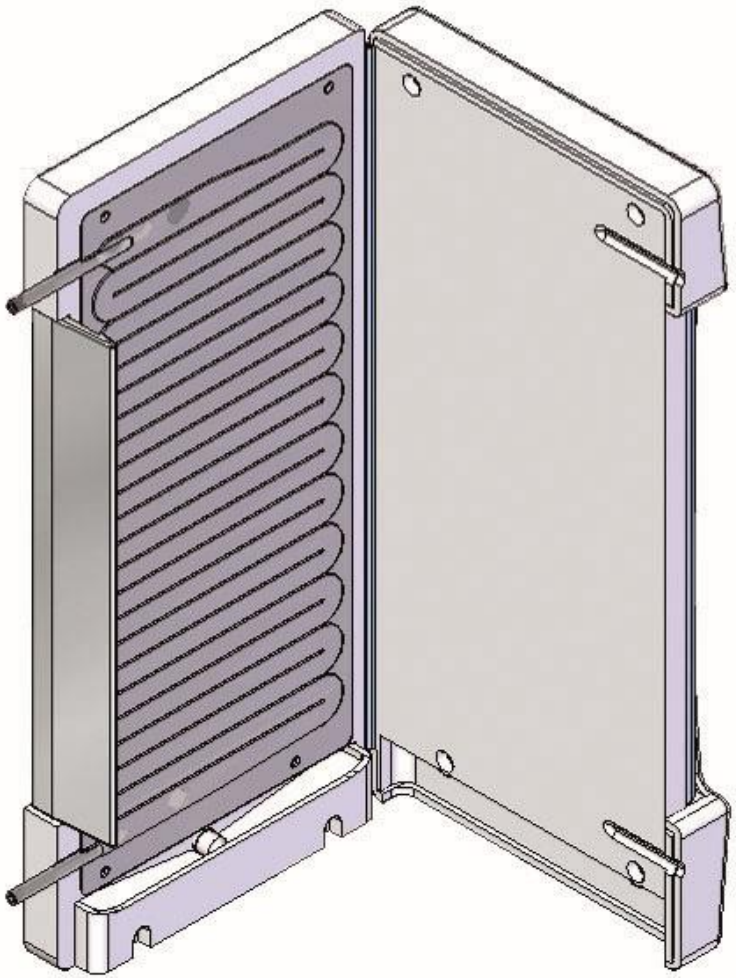
PROPRIETÁ MECCANICHE A 23°C (1)			
Durezza	ISO 868 : 2003	Shore A1 / A15	57 / 54
Resistenza a trazione	ISO 37 : 2004	MPa	1.9
Allungamento a rottura	ISO 37 : 2004	%	300

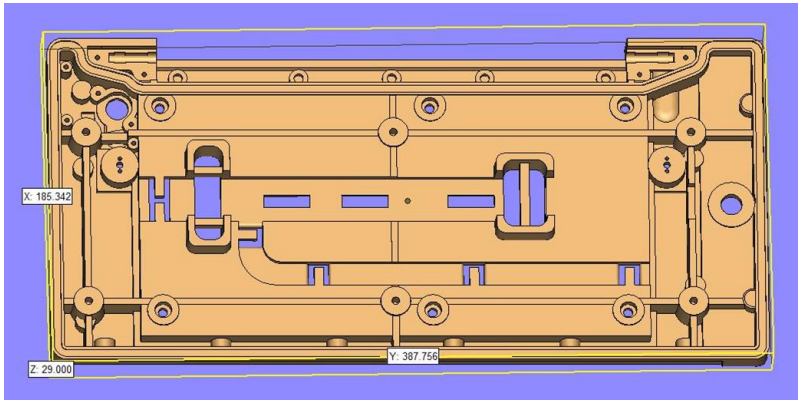
(1): Valori medi ottenuti su provini normalizzati / Indurimento 16 ore a 80°C.

FAR 25 V0 Certified Material

This is an example of using the RE11501A rubber to make the cup holder facilities to be installed on helicopters for civil use.

FAR 25 V0 Certified Material





The product show that there is a heater, widely used medical device in a hospital environment. Our client was called to respect building materials certification have therefore opted for a first set with silicone molds using the rigid material PX330.

FDA certified materials

Data sheet: vacuum casting resin 9012

Description			Simulates ABS
Features		Compliant to both Dry and Wet food FDA requirements	
Suitable for			Dry and wet food use
Cured properties			Test / ISO standard where applicable
Colour		White	
Transparency		Opaque	
Shore hardness	At 23 °C At 60 °C At 80 °C	77 D 74 D 68 D	868
Flexural strength		51 N/mm²	178
Flexural modulus		1310 N/mm²	178
Tensile strength		40 N/mm²	R 527
Tensile modulus		Not measured	R 527
Izod impact		Not measured	180
Yield strength		Not measured	R 527
Elongation yield		Not measured	
Elongation at break		25 %	R 527
Tear strength		Not measured	34
Thermal conductivity		Not measured	BS 874
Heat deflection temperature		90 °C*	(test piece 110 mm × 12.7 mm × 6.4 mm)
Glass transition temperature		108 °C	
Processing information			Notes
Viscosity	Part A Part B	1500 cPs 150 cPs	At 25 °C
Specific gravity	Part A Part B	1.10 1.12	At 25 °C
Mix ratio A:B		29:100	By weight
Mixing time		30 s to 60 s	
Resin temperature		40 °C	Heating chamber
Mould temperature		70 °C	Heating chamber
Curing temperature		70 °C	Heating chamber
Curing time in mould		120 min	
Pot life		720 s	100 g at 25 °C
Post curing process		*4 hr to 5 h at 70 °C gives heat deflection temperature of 90 °C	
Typical shrinkage		0.5 % to 1 %	

FDA certification still concerns an American Directive and affects the material authorized to come into contact with foods both at solid and at liquid state.

It is logical to think that the first interest is directed at the food industries sector and everything that can be connected as appliances and furniture, but in the next page you will find application even in completely different fields.

FDA certified materials

This crankcase belongs to an electromedical device for the administration of chemotherapeutic drugs. In this case the certification is not mandatory but our client has considered it appropriate as an additional security against contamination by toxic agents if the cover was accidentally scratched by its robotic arm..

THANK YOU FOR YOUR ATTENTION

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