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De IJssel Coatings B.V. supplies a full range of coatings and construction materials for new building, repair and maintenance of pleasure Boats. All products in the range are carefully developed and each combination of products (the paint system) offers the best protection against the influences of sun, wind and water. All products of De IJssel Coatings are easy to apply and offer colour and protection.

The product range includes materials for protection and decoration of various surfaces such as wood, steel, aluminium, epoxy and GRP. The range is as follows:

- **IJMOPOX**
High solid two component epoxy primers and coatings.
- **VARIOPOX**
Solvent free epoxy construction materials, adhesives, fillers and coatings.
- **POLTIX**
Products for repair and fillers bases on unsaturated polyester resins.
- **DOUBLE COAT**
A durable gloss and colour can be achieved with Double Coat, a high performance two component polyurethane finish.

This manual describes the requirements for models and which paint systems are suitable for models. Each system is recommended for different surfaces:

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INTRODUCTION

Products made from glass-fibre reinforced unsaturated polyester resins are produced from negative moulds. In order to achieve a highest quality of finish, both the model and the mould should meet the highest demands for surface perfection.

Already at the first steps in the design process of the model or mould, the developer should take following topics into consideration:

- The number of products to be made in the mould;
- The size and dimension of these products;
- The shape and design of the products;
- The quality of surface.

A final consideration is the emission of styrene monomers during the application of unsaturated polyester resins. The aim is to reduce the emission to the lowest possible concentration which can be reasonably achieved. As a consequence, the production of products using closed moulds using RTM, vacuum or pressure injection moulding, increases. This requires moulds with an even higher quality of surface.

In this brochure the model is equivalent to the prototype, original or plug. The product is the final product which is produced in the mould.

THE MODEL

The model is the original and positive form. It is the base for the future products to be produced. The production of a high quality model involves many hours of delicate work and skill of labour. It is therefore important to select the most suitable material to produce this model. The choice of material depends on the shape and size of the model and the possibilities for surface preparation. In some cases the model may be used for other purposes as well. In the boat-building industry often the first boat is used as a model for a mould to produce future boats in polyester. In that case, other demands are required for the coating system than when ordinary one-off models are produced.

The final part is the selection of the coating system for the model. This coating system should be fully resistant to strong solvents such as styrene, acetone or ethyl acetate.

The time schedule between acceptance of the model and production of the actual mould may take a few weeks. This should be taken into consideration when producing the model. During storage, the materials used for the model may shrink or expand, especially when the temperature and relative humidity are subject to change.

A model may be treated with a paint system and cured curing is sometimes accelerated by increasing the temperature, sometimes between 40 and 60°C. This will indeed accelerate drying and curing but may cause surface imperfections due to further shrinkage of fillers at such temperatures.

Materials for the model

The model may be produced from one of the materials mentioned in following table. Every material has its specific field of application, advantages and disadvantages during use.

<i>Material:</i>	<i>Application:</i>	<i>Advantages:</i>	<i>Disadvantages:</i>
Aluminium	<ul style="list-style-type: none"> • small models from cast aluminium • larger models from aluminium sheets 	<ul style="list-style-type: none"> • fixed shape 	<ul style="list-style-type: none"> • special tools required
EPS, foam	<ul style="list-style-type: none"> • medium to large models, substrate for tooling paste 	<ul style="list-style-type: none"> • cost effective • easy to work 	<ul style="list-style-type: none"> • not styrene resistant
Plasterboard, gypsum	<ul style="list-style-type: none"> • small models 	<ul style="list-style-type: none"> • casting of complex shapes 	<ul style="list-style-type: none"> • fragile • porous surface
Wood, plywood	<ul style="list-style-type: none"> • medium to large models 	<ul style="list-style-type: none"> • fixed shape 	<ul style="list-style-type: none"> • moisture and temperature sensitive

<i>Material:</i>	<i>Application:</i>	<i>Advantages:</i>	<i>Disadvantages:</i>
Wood, hardwood	• small models	• easy to use	• moisture and temperature sensitive
MDF	• small to medium models	• fixed shape and low shrinkage	• moisture sensitive
PU, foam	• small models	• easy to modify by cutting and sanding	• high costs
Steel, stainless or polished	• large models	• fixed shape	• special tools required
Tooling paste	• all models when accuracy in dimensions is important	• applied over EPS • easy to modify by CNC cutter	• moisture sensitive • solvent resistance • T _g value

Prior to the selection of the material for the model, the procedure how the model and mould are to be produced should be decided. The technical properties of all materials should be compatible with each other. The solvent resistance of all products used for the model and mould is important. Additionally, the temperature resistance is of equal importance. During the production of the mould the exothermic reaction will cause a rapid temperature increase. Models made from materials with a low T_g value might give distortions and surface defects. Systems known for an exothermic reaction are some rapid tooling systems and vacuum injection systems with low pot life.

Reinforcing the material

A laminate can be applied to improve the structural properties of the model. The stiffness, strength and dimensional stability will be improved. The best choice is an epoxy laminate combined with a woven glass fibre. Epoxy resins have lower shrinkage and better adhesion. Polyester resins or combinations of polyester and epoxy are not recommended.

Variopox products are free from solvents and recommended for EPS. An EPS model can be made resistant to styrene using suitable epoxy- or polyurethane compounds.

Tooling systems

A new development in the making of a model is shaping of EPS foam blocks using CNC milling machines. These blocks are first covered with a special tooling paste based on epoxy, polyurethane or unsaturated polyester. These tooling systems should resist solvents, equivalent to coating systems. Adequate solvent resistance of the tooling paste will prevent film defects and surface distortions during mould making.

FINISHING THE MODEL

Paint system

Normally the model is coated with a suitable paint system before applying the gelcoat for the mould. Using a paint system the final gloss and texture of the model may be determined. *When selecting a paint system it is essential that all separate components of the system, including fillers, are resistant against styrene.* Insufficient resistance against styrene will lead to surface defects in the mould. Not all two component coatings are resistant. An example of a coating with good styrene resistance is Double Coat.

It can be easily determined if a surface resist solvents or not. Place some cotton wool saturated with solvent 10 minutes on the surface of the model. When after 10 minutes the surface is dissolved or easily can be damaged by nail, the solvent resistance is not sufficient. In that case, the surface should be treated with Variopox Sealer before continuing the application of the coating system.

Secondly, the paint system of the model may not affect the curing mechanism of the unsaturated polyester gelcoat. Gelcoats may cure insufficiently when applied to models or moulds treated with epoxy paint systems. A finish based on epoxy is therefore not recommended.

MODEL, MOULD AND PRODUCT

When choosing the material to produce the model, it is important to consider the possibilities for application of the paint system. When the model has to be coated in a spray booth where the temperature is raised to 40 to 60°C, one has to consider possible shrinkage. The dimensional stability at such temperatures should be as high as possible.

In the table an overview is given of the product range of De IJssel Coatings for models. Please contact us for detailed paint system recommendation or coating schedule.

In all cases the surface should be clean, dry and free from dust, grease and other contamination. Steel and aluminium should be grit blasted with suitable grit to remove possible corrosion products and oxides. When fillers are required, always styrene resistant two component fillers should be used.

	<i>Product name</i>	<i>Description</i>
Primers	Variopox Sealer	Two component epoxy sealer, solvent free. Eliminates porosity, improves solvent resistance, and reduces solvent retention.
	IJmopox ZF primer	Primer with excellent adhesion to metals.
	Tweecolux	Rapid curing and easy to sand primer. Several layers can be applied in one day.
Fillers	Poltix Rijplamuur Poltix Spuitplamuur Poltix Superplamuur Poltix Vezelplamuur IJmofix	Five different polyester fillers. Fast curing, excellent sanding properties.
	Variopox Plamuur Variopox Finishing Plamuur Variopox LG Plamuur	Three different epoxy fillers with low shrinkage, suitable for small and large surfaces.
Build coats	IJmopox HB coating	Two component high solid build coat.
Finishes	Double Coat Modellak	Two component polyurethane finish with rapid curing. Recommended for smaller models. High gloss. After 24 hours resistant to gelcoat.
	Double Coat	Mar and scratch resistant two component polyurethane finish. Excellent levelling, recommended for larger models. High gloss or semi-gloss, available in many colours.

Surface texture of the model

By applying a surface texture to the surface of the model, the polyester product made in the mould will obtain the same texture. This texture may be applied using special effects, such as:

<i>Effect:</i>	<i>May be achieved with:</i>
Anti-slip structure	Add anti-slip powder to Double Coat high gloss, Double Coat Modellak or Double Coat silk gloss and apply with air spray. Also special materials with an anti-slip profile are applied to the surface of the model.
High gloss	Apply Double Coat Modellak by spray or Double Coat high gloss by brush, roller or spray.
Leather grain	Apply artificial leather to the model.
Splatter structure	Apply Double Coat high gloss, Double Coat Modellak or Double Coat silk gloss by spray with nozzle with large orifice at low pressure.
Silk gloss	Apply Double Coat silk gloss by spray. A silk gloss surface is difficult to repair as gloss variations may be possible.

Anti-slip materials or artificial leather grains which are fixed to the surface with adhesives should be resistant to styrene.

PRODUCTION OF THE MOULD

Also the mould or negative form may be made from various materials. The choice depends on the size and design of the model as well as the number of products which will be made from the mould. In

many cases materials such as reinforced polyester is chosen. Alternatives are epoxy, vinyl ester or (stainless) steel.

When reinforced polyester is chosen, it is important to know if the product should be smooth on only one or on both sides. This determines the construction of the mould. A product which should be smooth on both sides requires a closed mould:

<i>Required product</i>	<i>Type of mould</i>	<i>Production method</i>
One side smooth	Open mould	<ul style="list-style-type: none"> • Hand lay up • Spray up
Both sides smooth	Closed mould	<ul style="list-style-type: none"> • BMC • Vacuum injection • Pressure injection • RTM

The mould may be made as one piece when the model is fully releasing. All angles and corners on the model should be smaller than 90 degrees. When angles or corners are smaller, the mould should be made consisting of various separate parts.

Application conditions

As during the production of the model, it is important during the production to control the temperature and relative humidity during application. Temperature, ventilation and relative humidity in the workshop should not be subject to rapid changes, both during daytime or night-time. Rapid changes in temperature or humidity, draft or poor ventilation may cause problems in the curing process of the materials, resulting in print-through of glass fibre or insufficient hardness of the gelcoat materials.

Surface preparation model

Before a start can be made with the production of the mould, the model should be prepared. First should be checked if the coating system is fully cured and resistant to styrene. If so, a suitable mould release agent may be applied.

Depending on the choice of release agent, four to five coats may be required. Wait between each coat for a few hours to allow solvents to evaporate. Every coat should be buffed carefully. Small residues of mould release agent may become visible in the mould, so buffing and polishing should be done thoroughly and carefully.

To complicated shapes a layer of liquid PVA release agent may be applied. When in doubt the model will release completely PVA should be applied. This requires skill of labour to apply this release agent without brush marks, sags or runs. *Models to which a structured material is applied (such as a leather grain or anti-slip profile) should always be coated with PVA mould release agent.*

Selection of system

The selection of the system and materials for production of the mould depend on the final use of the mould. Import criteria are the number of lifts a day, the required life time of the mould and the temperature during curing of the products when the mould is in use. For less critical use and applications with only a few lifts of products the quality requirements are lower compared to critical use with many lifts a day. For less critical use a standard system may be chosen, For critical systems with many lifts and higher temperatures a premium system is available. Both systems are summarized in following table:

	Standard system	Premium system
Step 1	Poltix Gelcoat M-EB <ul style="list-style-type: none"> • Based on vinylester resins • Application by brush • Available in 9 colours • High HDT • Scratch and impact resistant • High chemical resistance, no dull patches • Two coats recommended 	Poltix Gelcoat M-EB <ul style="list-style-type: none"> • Based on vinylester resins • Application by brush • Available in 9 colours • High HDT • Scratch and impact resistant • High chemical resistance, no dull patches • Two coats recommended
Step 2	Poltix Lamineerhars in in combination with a glass mat of 150 gram/m ² <ul style="list-style-type: none"> • Based on isophtalic resins • Hand lay-up application • Thixotropic • Cure indicator 	Poltix Resin M-EB in combination with a glass mat of 150 gram/m ² <ul style="list-style-type: none"> • Based on vinylester resins • Hand lay-up application • Light thixotropy • High HDT
Step 3	Poltix Lamineerhars in in combination with a glass mat <ul style="list-style-type: none"> • Based on isophtalic resins • Hand lay-up application • Thixotropic • Cure indicator 	Poltix Resin M-EB-K in combination with a glass mat <ul style="list-style-type: none"> • Based on vinylester resins • Hand lay-up application (vacuum injection possible) • Low shrinkage
Step 4	Poly Lak ortho ED (Poltix Topcoat OB-E) <ul style="list-style-type: none"> • Based on orthophtalic resins • Application by brush • One coat application • Available in 4 colours 	

Application of the gelcoat

Before applying the gelcoat, dust and foreign materials should be removed from the surface of the model. A first layer of gelcoat is applied by brush at a thickness of 350 µm. The gelcoat should be applied in an even film, without holidays or areas with low thickness. Spray application might lead to small air entrapment in the gelcoat. The gel time should be adjusted with MEK peroxide to approx. 20 minutes. Curing of the gelcoat at lower parts may be inhibited by styrene vapours, turning the model will avoid this.

When the first layer is fully cured, a next layer of 350 µm gelcoat may be applied. Usually, this is possible after 3 hours. Applying the second layer gelcoat in a different colour, it is possible to check if sufficient film thickness is applied.

Laminating

After 6 to 8 hours the gelcoat is fully cured. The sharp edges may be reinforced with Balsaplast or IJmobond T. This will avoid air enclosures when the first chopped strand mat is applied. Usually the first layer has a thickness of approx. 80 gram/m² and following layers a thickness between 225 and 450 gram/m². Curved areas may be covered with small stripes of chopped strand mat of 225 gram/m². Sanding after curing will remove any protruding glass fibres, thus avoiding air entrapment when the chopped strand mat is applied. The laminate is built from chopped strand mat with a thickness of 300 or 450 gram/m². A rule of thumb is to construct a mould with a thickness three to four times the thickness of the product that will be produced in the mould.

Additional rigidity may be obtained by including polyurethane foam board to the flat areas in the laminate. The board is first cut to the right size and then glued with Balsaplast or IJmobond T to the surface. The sides of the board are cut at an angle to facilitate proper coverage with the chopped strand mat. Normally the foam board is covered with a laminate with a 450 gram/m² mat. Finally it may be necessary to construct a wooden frame around the mould.

24 hours after application of the last layer the mould may be released from the model. Using wooden or nylon wedges, damage to the mould may be avoided

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Disclaimer

The information in this data sheet is based on thorough research and development in combination with practical experience, is to the best of our knowledge and correct at the date of printing. De IJssel Coatings BV does not accept any liability as the final result depends on a number of factors beyond our control, amongst others, but not limited to, skill of labour, application conditions and surface preparation. De IJssel Coatings BV reserves the right to change data without prior notice. This data sheet supersedes all previous issues.