

## Technical Information

### GRP LINING on other substrates

Before lamination on to a wood, steel, aluminium or concrete structure, it is essential to know the temperature which the laminate and the structure will be exposed.

There are considerable differences in thermal expansion between a glass fibre reinforced polyester or vinyl ester laminate and steel or concrete, especially when the temperature exceeds 60 °C ( for polyester resins ) and 75 °C ( for vinyl ester resins ).

Linear Coefficient of Expansion:

Polyester / vinyl ester laminate (Dependent of glass content)	15-30 x 10 <sup>-6</sup> / °C
Wood	5-50 x 10 <sup>-6</sup> / °C
Steel	11 x 10 <sup>-6</sup> / °C
Aluminium	24 x 10 <sup>-6</sup> / °C
Concrete	10 x 10 <sup>-6</sup> / °C

It is recommended that polyester resin/glass fiber lined wood, steel, aluminum or concrete constructions are not exposed to temperatures higher than 60 °C or large/ rapid temperature variations. When vinyl ester resin is used, the maximum exposure temperature is raised to 75 °C due to higher elongation and better bonding properties. The maximum temperature precautions are taken to minimize the danger of debonding between the laminate and the substrate.

**Note!** It is of utmost importance that before a lining is to be made, to make sure that all cracks and holes are filled with polyester or vinyl ester putty, and that sharp edges are rounded to obtain a smooth passage and consequently decrease the possibility of air inclusions.

### **Lining on wood**

Sometimes one would like to cover old or new wooden constructions with a chemically resistant polyester or vinyl ester resin to obtain a more durable construction. In such cases one must take certain precautions.

The pretreatment is of decisive importance for the final result. All old paint or coating must be removed and the construction must be absolutely dry.

Grease and dirt must be removed with a suitable solvent.

Larger irregularities and cracks should be filled with polyester / vinyl ester putty and before priming the wood should be sanded with an abrasive paper.

For the primer use polyester or vinyl ester resin diluted with approx. 10 % or 5 % styrene, added a suitable curing system, apply thoroughly and leave to cure until tack-free.

Lamination with polyester / vinyl ester resin and glass fiber is then performed, preferably before the primer has cured completely to ensure the best possible adhesion. Use a minimum of 3 plies of powder bonded 450 g/m<sup>2</sup> glass fiber mat, and complete the lamination with 1 ply of C-glass 30 g/m<sup>2</sup>, or 2 plies of 30 g/m<sup>2</sup> synthetic surface veil impregnated with 90% polyester. Then a topcoat/top layer has to be applied (pol./vinyl ester resin ) with 2 % NORPOL Wax Solution 9872.

## **Lining on steel**

To prevent corrosion of a steel tank, this is often coated with a chemically resistant laminate / lining.

### **Steel Substrate**

#### **Surface Preparation**

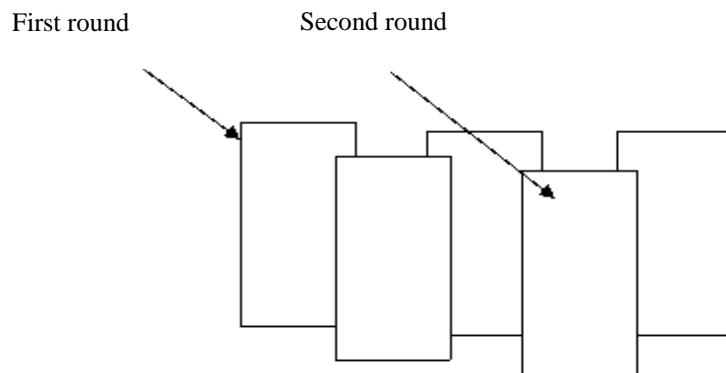
- 1) All openings on the vessel should be standard flanged nozzles. A 300 mm (minimum) flanged nozzle must be placed at each end of the tank for ventilation. A man way positioned at the end of the vessel may be used as one of these ventilation nozzles.
- 2) All weld splatter shall be removed, and sharp edges rounded. All welds shall be either ground smooth or rounded with resin putty.
- 3) All metal surfaces shall be abrasive blasted with grit to a "white metal" condition. NOTE: An adequate size abrasive must be used to obtain a 75 to 100  $\mu$ m angular anchor pattern.
- 4) All abrasive dust must be removed from the surface by vacuuming or brushing.
- 5) All outside corners must be radiused, 3 mm minimum. All inside corners must be filleted, 25 mm radius.
- 6) All well-bonded FRP surfaces shall be feathered by grinding.
- 7) FRP shall not be applied until preparatory work is deemed adequate by a qualified inspector.

The tank wall must first be washed thoroughly with a suitable detergent (degreasing agent), e.g. "Pingo Kraftvask" or a solvent, and thereafter sandblasted to Swedish Standard Sa 2,5. with an average surface profile ( measured peak-to-trough ) of 75  $\mu$ m (microns).

All dust, residues and debris left on the surface after blast cleaning shall be removed by brushing and vacuum cleaning. The primer should be applied within 8 hours ( depending on local conditions ). A carbonate free, 2-comp. epoxy may be used as primer. The epoxy primer should be allowed to post cure for min. 7 days at 20 °C. This paint work must not be carried out at temperatures below 10 °C. We do however recommend to use a polyester / vinyl ester resin as a

primer. Elongation at break for the polyester / vinyl ester used should be higher than 2,5. The best solution is, however, to use ATPRIME 2 as a primer. ATPRIME 2 has a high elongation at break. Lamination over the primer can be carried out after 12 hours.

Lamination with polyester / vinyl ester resin / glass fibre should in this case be performed in a special way, as the risk of the laminate separating from a steel plate is higher than for the case with a wooden or concrete substrate. Good overlap is ensured by leaving open an area of 70-80% of the width of the glass fibre mat until one has reached around the tank once. Thereafter lamination is performed on the remaining areas to ensure a good overlap.



Each layer should be properly cured before the next layer is applied. Then the lamination work is continued until 3 layers of powder bonded 450 g/m glass fibre mat have been built up. The lamination should then be completed with 1 ply 25-30 g/m<sup>2</sup> C-glass, or 2 plies 25-30 g/m<sup>2</sup> synthetic surface veil, which should be impregnated with approx. 90% polyester / vinyl ester resin. On top a topcoat/top layer has to be applied (polyester / vinyl ester resin) with 2 % NORPOL Wax Solution 9872.

**Lining on aluminium**The surface should be sand blasted after cleaning/degreasing as mentioned for steel. As a primer ATPRIME 2 as above the lamination work can be started after 12 hours. The method of building up a laminate is the same as mentioned under Lamination on steel

### **Lining on concrete**

The concrete must meet with the following requirements:

The concrete should be low in alkali content. Concrete additives based on PVA should be avoided. These may hydrolyze if exposed to humidity and cause adhesion failure. The concrete should be post cured for approx. 30 days and have a humidity content below 4% (to be measured with CM-Gärat) at 10 cm depth.

### **Preperation of concrete**

These procedures have been developed for our customers to use as a guideline in the development of their fiberglass laminate lining specifications.

Concrete to be lined shall be sound with proper foundation to eliminate flexing and shifting under service conditions.

All angles must have a minimum of 1/2 inch(12mm) radius.

All preparation and lining shall be done by experienced workmen.

#### Surface preparation

Concrete shall be sandblasted to expose a rough concrete surface free of dirt and grease.

If the service temperature is to be in excess of 180°F(82 Deg C) an anchor pattern must be put in the concrete. A pattern of 2 inch( 50mm deep by 2 inch(50mm) diameter holes on two foot centres has proven successful.

Any irregularities, cracks, and anchor holes must be filled with a catalyzed resin grout formulation.

### **New concrete.**

All surfaces to be lined shall be treated to remove laitance and shutter release agents.

Alternative treatments.

- a) Blast cleaning
- b) Wire brushing
- c) Grinding

After blast cleaning or mechanical treatment all dust and debris shall be completely removed.

Thereafter it is recommended to acid etch the surfaces. The surface should be treated with commercial grade HCl diluted in proportion 1:4 or 1:5 with water.

A bristle brush can be used, and the concrete should be treated for approx. 15 minutes.

Thereafter flush thoroughly with clean water. The surface must be properly dried before coating.

Acid etching without blast cleaning or mechanical treatment is only really applicable to horizontal surfaces as it is very important that the acid is allowed to dwell on the surface a sufficient length of time to remove all the laitance.

### **Old concrete**

Blast cleaning is recommended for old concrete which has previously been coated or painted.

Make sure that all remains of glue, lacquers, oil etc. are removed.

All irregularities in the concrete should be filled with polyester / vinyl ester putty.

Any concrete construction should be sealed against the earth side with a diffusion tight foil to prevent humidity from entering the concrete from outside.

The polyester / vinyl ester resin which is to be used for lamination should also be used as a primer, thinned with 5 - 10 % styrene. The primer is accelerated and catalyzed to obtain a gel time of 20-40 minutes.

After the primer is partly cured, one can start to laminate with polyester / vinyl ester and glass fibre. Apply a minimum 3 plies of powder bonded, 450g/m<sup>2</sup> glass fibre mat, and complete the lamination with 1 ply 30 g/m<sup>2</sup> C-glass, alternatively 2 plies 30 g/m<sup>2</sup> synthetic surface veil, which should be impregnated with approx. 90% polyester / vinyl ester.

Then a topcoat / top layer has to be applied (polyester / vinyl ester resin) with

2 % NORPOL Wax Solution 9872.

Apart from the possibility of reinforcing an old, destructed construction with a composite liner, the lining of a steel or concrete construction is normally done to improve the chemical/corrosion resistance of the construction.

In this context, the composite lining must have a certain quality.

That the correct material system is used, to withstand the required long-term properties, is of cause important.

The quality of the workmanship is also important, and international standards set quality requirements to the lining. From BS 4994-87, BS 6374-84 and ASTM D 2567-87 we can make the following set-up for acceptable limits for possible visual defects.

Accepted limits for laminate failure/defects - visually evaluated:

Laminate failure	I	II	III
	Topcoat/ gelcoat	Surface mat	Laminate properties
Blisters	None	None	-
Cracks	None	None	None
Dry areas	None	None	None
Alien objects	None	None	None
Exposed glass	None	None	-
Porosity	None	None	-
Pores/pits	Max. 3 mm dia- and 0,3 mm depth. The number shall not exceed 1 per 100 cm.		
Scratches	Max. 0,3 mm depth.		
Air pockets/ inclusions	None >0,3 mm	None >0,3 mm	0,3-1,5 dia The number shall not exceed 5 per 100 cm.

This recommendation is based on

1. British Standard BS 4994-87
2. ASTM D 2567-87
3. British Standard BS 6374-84 - Lining of Equipment with Polymeric Materials for the Process Industries-Part 4 , Specification for lining with cold curing thermosetting resins.

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