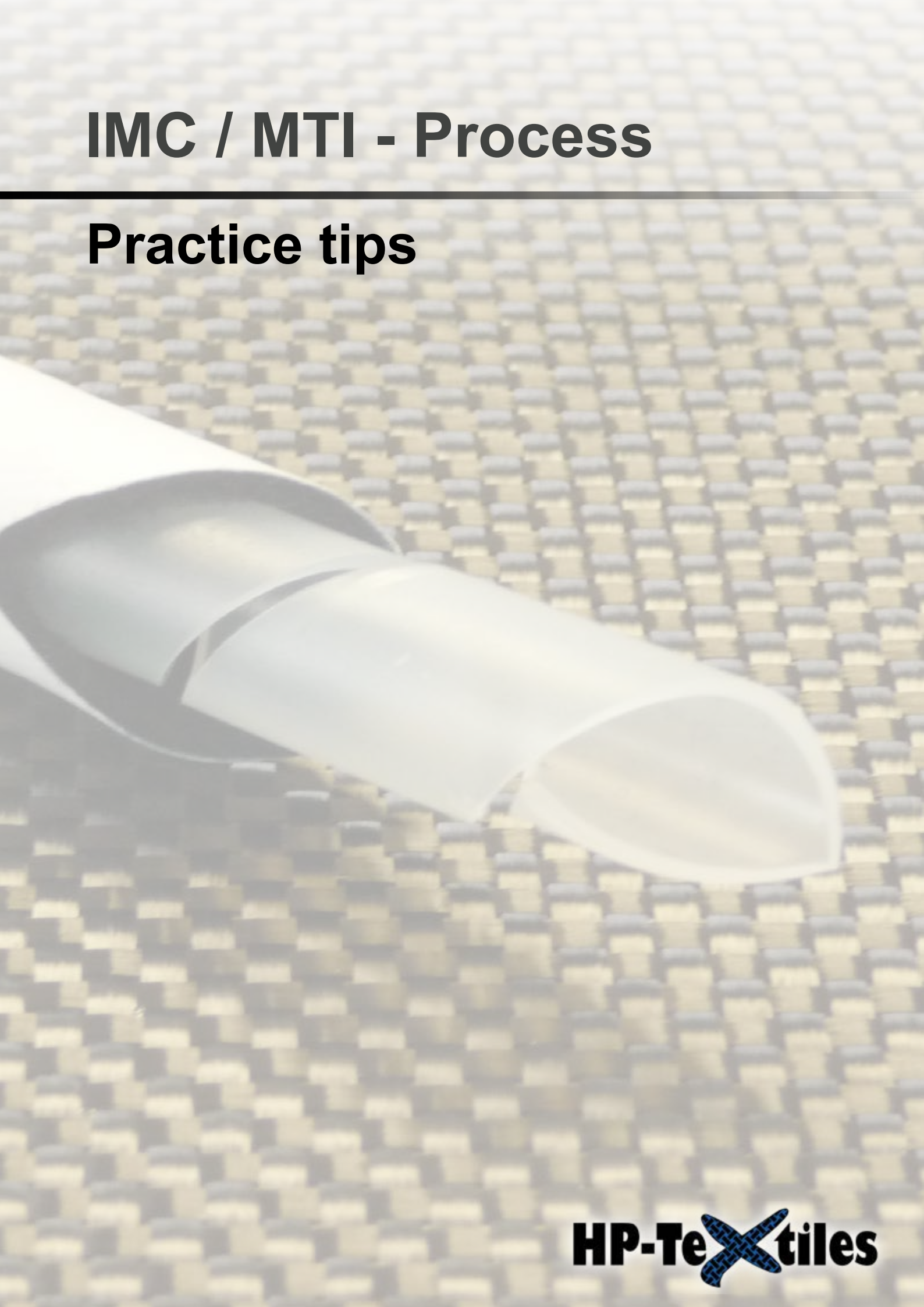
IMC / MTI - Process

Practice tips



HP-Textiles

About us

Since the company was founded in 2004, HP-Textiles GmbH has stood for the development and distribution of fibre-reinforced materials. In addition to a wide range of fibre reinforcement materials and specially formulated epoxy resins, further strategic business areas have been created with DeinTeich.de and bredderpox®. As a result, our satisfied customers include not only the composites industry but also users from the pool construction and surface protection systems sectors.

Our business areas:

Composite Materials

hp-textiles.com/shop

GRP-Coatings

deineinteich.de

Building chemistry

www.breddermann-kunstharze.de

In order to guarantee our business partners a continuously high quality of our services as well as optimal process reliability, the quality management of HP-Textiles was certified according to DIN EN ISO 9001 in 2011. Through enthusiasm and passion for scientific research, coupled with an understanding of our customers‘ wishes, we guarantee optimal product properties in the future as well.

Together with strong partners from science and industry, we also offer custom synthesis and manufacturing of a wide variety of products. The establishment of a networked, cross-company development allows us to respond to customer wishes even at short notice. Variable batch sizes enable us to supply large industrial customers as well as small quantities for project developments.

Our young, qualified team, a large warehouse and reliable logistics partners guarantee fast processing of your order.

The constant further development of our product range should also be a basic requirement in the future in order to guarantee optimum component properties at economical prices!

Your team of
HP-Textiles GmbH

Table of Contents

Background information

What does IMC / MTI procedure stand for?

The IMC/MTI® process combines the advantages of our in-mold coating with the benefits of membrane tube infusion in component production using the injection process.

IMC / MTI® - Process

In-Mould Coating
A coating system applied in the mold coating system

+

MTI®-Cable
The air-permeable but at the same time resin-barrier suction line for vacuum infusion

= Saving time and money

Finished painted components of the highest quality

With the IMC/MTI® process, the molded part is already painted in the tool or negative mold. Instead of sanding and painting fiber-reinforced components afterwards at great expense, with this process the paint is applied in the mold - on the visible side of the molded part.

Thanks to the specially developed formulation, a PU coating applied in this way forms a chemical bond with the GRP/CFRP even after weeks without any problems. Productions using vacuum infusion or vacuum pressing processes in particular benefit from this principle.

The MTI® line is a membrane-encased suction line → permeable to air or gases → impermeable to the resin system. It is placed in the vacuum setup as a ring line at the edge of the molded part and ensures even distribution of the resin during the vacuum infusion process without sucking the resin out of the component.

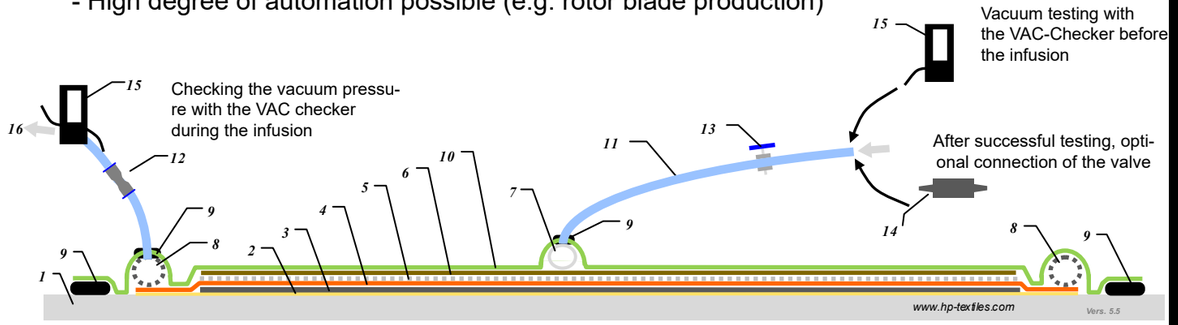
In addition to low investment costs and very flexible application options, the IMC/MTI® process offers a high degree of process reliability while at the same time optimizing component quality.
The IMC/MTI® process has been used successfully for years by various large and well-known manufacturers in the wind power and automotive sectors, as well as by users in model aircraft construction.
What began as a modified infusion process quickly became synonymous with a completely new overall package for the production of fiber composite structures.

Vacuum infusion setup

In a fiber-plastic composite, the load is primarily absorbed by fibers. To achieve high strength, composite components should therefore have as high a fiber volume proportion as possible. This is achieved using the vacuum infusion process. In this process, the fiber material is inserted dry into the mold and sealed airtight with vacuum film and sealing tape. The air between the film and the mold is then sucked out and a very thin infusion resin is sucked in via a second connection. The reinforcing fibers are thus deaerated, impregnated and simultaneously compacted by the infusion resin in a closed process.

Advantages of the vacuum process:

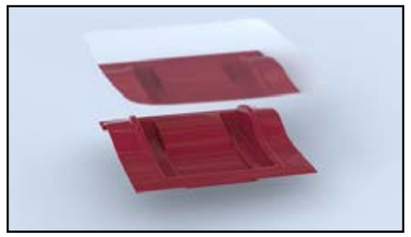
- Very high fiber volume ratio and thus achievement of optimum component properties
- Minimization of gas and air inclusions due to closed impregnation process
- Production of complex, three-dimensional components possible
- Integration of inserts and foam cores possible
- High degree of automation possible (e.g. rotor blade production)



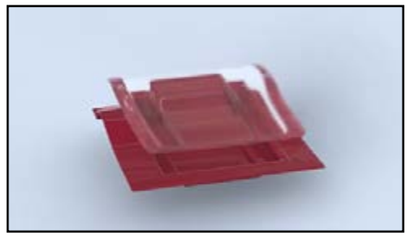
	Description	Material / Notes	Item
1 -	**Mould**		
2 -	**Release agent**	aqueous, up to 150°C or80°C Priming wax and PVA, up to 100°C Carnauba wax, up to 80°C	**HP-HGR5, HP-HGR80** **HP-G** and **HP-PVA** **HP-CX7**
3 -	**Reinforcement fibres**	various types	
4 -	**Peel ply**	Polyamide, twill / plain, var. width	**HP-P83P** or **HP-T105P**
5 -	**Perforated film**	HDPE, 30g/m² or 44g/m²	**HP-RF30/130** or **HP-RF44**
6 -	**Flow aid**	PE 145g/m², width 100cm	**HP-IM145/100** or **HP-IM230/120**
7 -	**Flow channel**	PE spiral hose / Blade-Runner®	**HP-ST060, HP-ST080**, **HP-ST100 / HP-VZ1475**
8 -	**Vacuum ring line**	MTI®-hose	**HP-MTI-08**
9 -	**Vacuum sealing tape**	Butyl rubber, use up to 80°C, black synth. rubber, use up to 210°C, yellow	**HP-ST12X3/80** **HP-ST10X3/210**
10 -	**Vacuum bagging film**	PA/PE/PA, width 2,60m PA/PE/PA, width until 8m, very clear PA/PE/PA as hose, width 1,50m PA as hose, width 20, 30, 60, 90cm	**HP-VF60/260** **HP-VF70** **HP-VFT75/150** **HP-VFT50**
11 -	**Vacuum hoses**	PE (esp. inexpensive), 10 or 12mm PUR (esp. flexible), 10 or 12mm	**HP-VZ1010** or **HP-VZ1020** **HP-VZ1030** or **HP-VZ1040**
12 -	**Plug connectors**	various types, manometer, valves, etc…	
13 -	**Squeezee®/Squeezer®**	hose clamp	**HP-VZ1400** or **HP-VZ1425**
14 -	**MTI® Valve**	Automatic valve for vacuum infusion	**HP-VZ1450**
15 -	**VAC Checker**	Digital Vacuum Gauge	**HP-VZ1440**
16 -	**Vacuum pump**	Rotary vane pump, oil-lubricated	**HP-VZ1200, HP-VZ2000**

The IMC-MTI process Step-by-Step

1. Structure of the separating layer



First of all, the surface of the negative form must be cleaned.
For molds made with HP-E30FB mold making resin, solvents (acetone, XB thinner) can be used for this purpose.



The release agent (here: HP-HGR5) is then applied in at least 2-3 coats of 20-25g/m² each.

If desired, it can be polished to a high gloss after just a few minutes.

After the last layer, the entire release layer structure should cure for at least 30 minutes.

The release agent layer is suitable for multiple demolding, but should be refreshed with a layer of HP-HGR5 in between.

Click here for the matching video of the IMC/-MTI® procedure

Selection of release agents

The optimum release agent is selected according to the existing process temperatures, among other factors.

The high adhesion of the in-mold coating requires the use of particularly effective release agents to avoid “nasty surprises”.

In addition to the well-known products based on carnauba wax or PVA (see table below), we also offer a special high-gloss release agent on an aqueous basis: HP-HGR5.
This product is suitable for a permanent processing temperature of up to approx. 150°C (briefly up to almost 200°C).

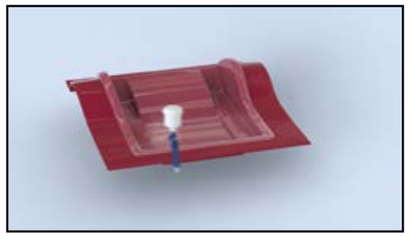
Products	SPECIAL FEATURES	CONSUMPTION g/m²	DRYING TIME (minutes at 20°C)	TEMPERATUREN ...Processing min. (recommended) °C	TEMPERATUREN ... max. operating temp. C°
HP-HGR5 * Aqueous release agent, liquid	Aqueous base - 100% solvent-free! Very good release effect, even with PUR (IMC). Residues can be washed off with water.	20 - 25	5 - 15	15	**150**
HP-G * Priming wax, viscous	NOT a single release agent ! Primer for HP-PVA. Residues can be removed with white spirit or XB thinner.	**30**	5 - 15	**15**	**100**
HP-PVA * Film release agent, liquid	Very safe separating layer. Primer HP-G necessary. Alternatively HP-BM17 or HP-CX7 possible. Residues can be washed off with water.	**60**	5 - 10	**15**	**100**
HP-CX7 * Carnauba wax, pasty	Polish in several layers. High gloss release agent. Also as a primer for HP-PVA. Residues can be removed with white spirit or XB thinner.	**15 - 20**	10 - 15	**20**	**80**
HP-HGR80 * Aqueous release agent, liquid	Aqueous base - 100% solvent-free! Very good release effect, even with PUR (IMC). Residues can be washed off with water.	20 - 25	10 - 15	20	**80**

*Free of silicones and PTFE

2. In-mold coating processing

Select the desired RAL color of the in-mould coating.

Then mix the in-mold coating at a mixing ratio of 100:50 (by weight).



Apply the in-mold coating within the processing time (approx. 30 minutes at 20°C).

Brief info:

The basis for the HP-IMC in-mold coating is a high-quality 2k PU coating.

Advantages of in-mold coating:

- No need for subsequent sanding and painting work
- High adhesion properties
- maximum protection for the fiber composite
- available in RAL or transparent

Mixing in-mold coating:

Prepare the resin component and add the required amount of hardener (100:50 parts by weight). Then mix everything carefully. Avoid the formation of air bubbles at this stage. Now everything can be processed within the pot life (approx. 30 minutes).

For optimum quality, we recommend spraying. (Application with a paint roller / paint brush is also possible, but generally results in a less homogeneous layer thickness).

Apply evenly in a cross coat and avoid bubble formation. Sanding before the 2nd application of the in-mold coating is not necessary if this is carried out within 24 hours (at 20°C).

Mixture	Processing	Consumption
100 parts (resin) 50 parts (hardener) if required: 5-10 parts thinner	Nozzle: 1.2 - 1.4 mm Pressure: approx. 4 bar	40 - 50µm (per spray pass) 2 - 3 spray passes recommended
Consumption: 1 liter mixture = approx. 7m² at 50µm		

Once the in-mold coating has been painted into the mold, the epoxy resin coating (or infusion) can be applied without an additional coupling layer! For this purpose, the in-mold coating only needs to achieve a sufficient degree of cross-linking before further processing (pre-curing until tack-free).

The duration of pre-curing depends largely on the temperature. At 20°C this is approx. 24 hours > at a mold temperature of 80°C this is reduced to a few minutes!

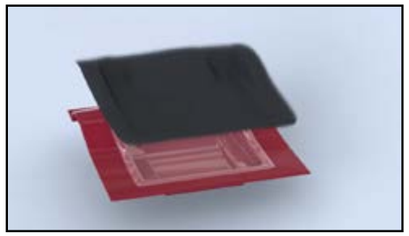
IMPORTANT:

The In-Mould Coating HP-IMC must no longer be sticky before coating with epoxy. This has the advantage that the laminate can still be applied after up to 4 weeks (at 20°C)!

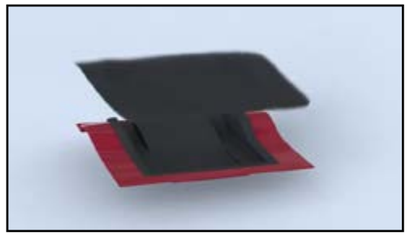
Temperature	**Pre-curing time** (before coating with epoxy)
80°C	few minutes
60°C	40 - 80 min
40°C	4 - 6 h
20°C	24 h

Guide values may deviate due to the process. We recommend preliminary tests.

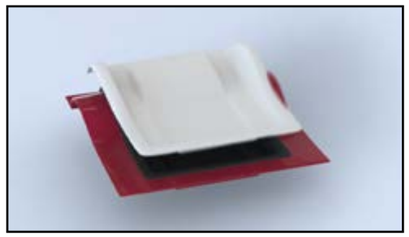
3. Layer structure and vacuum materials



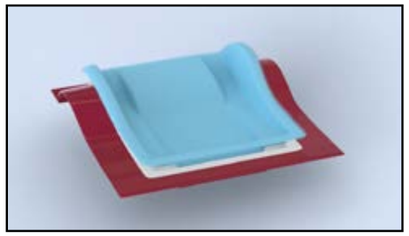
Lay the reinforcing fibers (fabric, scrim, etc.) dry. Fix the individual layers with a little spray adhesive or the self-adhesive glass mesh fabric tape (see p. 11).



A major advantage of the IMC/MTI® process compared to prepregs, for example:
The high investments for autoclaves and cooling equipment are eliminated. In addition, a larger selection of fabrics / scrims is directly available.

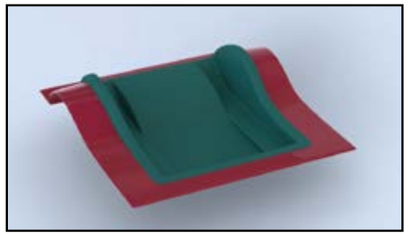


The vacuum aids are now applied for optimum infusion.
The first step is a peel ply.
This absorbs excess resin and leaves a uniformly rough surface.



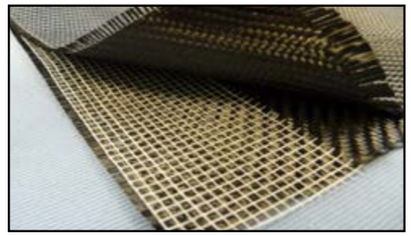
This is followed by a perforated film.

TIP:
Simply fix the perforated film at the corners with some masking tape.



To allow the resin to flow quickly, a flow aid is now placed on top and also held in position with some masking tape.

Fixing of the fiber layers:



In addition to a spray adhesive, the fiber layers can be fixed with the help of a glass fiber mesh fabric tape (HP-AM075/050). This product is not only self-adhesive, but also consists of a glass fiber mesh, which is why it can simply remain in the laminate.

Structure of the vacuum aids:

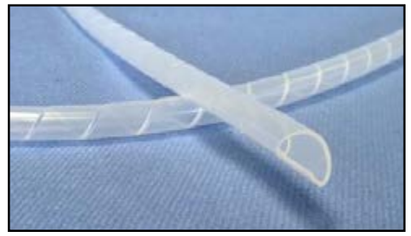
1. Peel ply
→ Leaves an evenly roughened surface and absorbs excess resin.

2. Perforated film
→ Facilitates the separation between the flow aid and peel ply.

3. Flow aid
→ Ensures a uniform vacuum and a good flow of resin good resin flow even in angled areas.

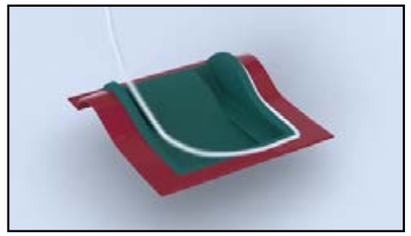
All vacuum aids can be easily cut with one of our scissors.

Create flow channels for the infusion resin:



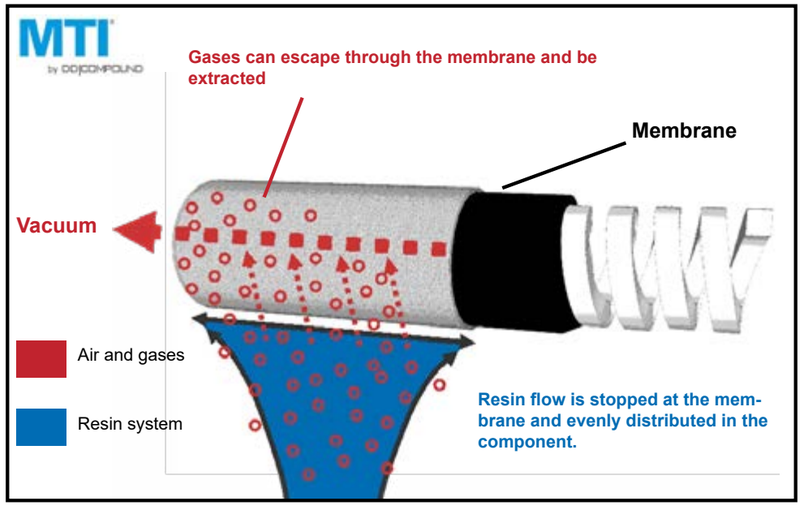
For components with longer flow paths, “resin channels” can also be created. For this purpose, our spiral hose can be fixed to the flow aid with adhesive tape so that larger quantities can flow here later. The spiral hoses are available in different sizes.

4. Installing the MTI® hose



The MTI® line is fixed to the edge of the mold using vacuum sealing tape. Alternatively, the line can also be secured against slipping with some adhesive tape.

The MTI® line is then connected to the vacuum line. Vacuum sealing tape can also be used for this.



The MTI® line is a membrane-encased extraction line. This membrane is permeable to air or gases, but resins cannot escape through it. The MTI® line is placed as a ring line at the edge of the mold in the vacuum setup. If the introduced resin reaches the suction line at one point, it stops here and continues to flow through the fiber material of the component to be impregnated.

Advantages:

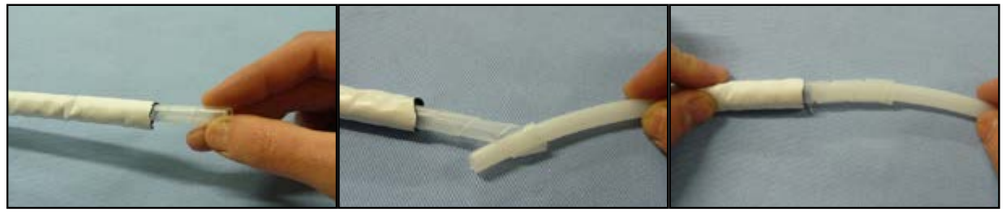
- Optimization of component quality and minimization of air inclusions
- Resin trap is no longer required, which reduces resin consumption
- Freely configurable resin flow, eliminating the need for time-consuming calculations
- Minimization of dry spots, complete component impregnation and greater process reliability
- High fiber volume fraction, adjustable via the infiltrated resin quantity

The all-rounder for bonding and sealing:

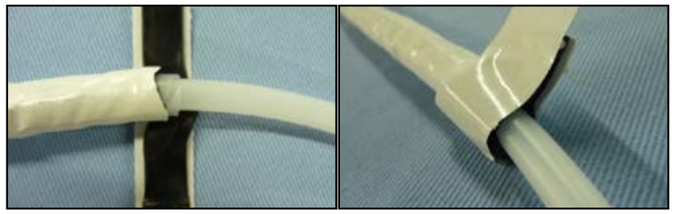
Our vacuum sealing tapes are made of butyl rubber and are characterized in particular by their high adhesion to various substrates. To achieve a high sealing effect at the same time, the tapes are approx. 3 mm high and approx. 12 mm wide, so that even small unevennesses or kinks in the vacuum film can be easily sealed.

Connect the MTI® line to the vacuum line:

First pull a few centimeters of the inner spiral out of the diaphragm. Then wrap this spiral line around the hose that leads to the vacuum pump.



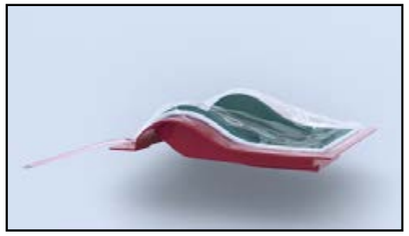
Then pull the membrane back up to the height of the spiral line. Wrap some vacuum sealing tape around it so that the transition to the hose is completely surrounded.



Close the endings:

Simply remove some sealing tape from the carrier film and place it in the end of the pipe. Then press together carefully, fold over and seal with another piece of vacuum sealing tape.

5. sealing with vacuum film

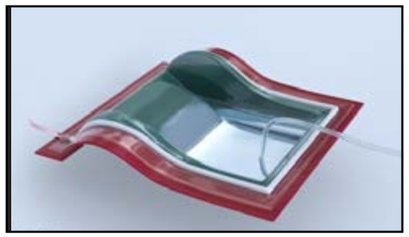


Use the vacuum sealing tape to fix the vacuum film to the edge of the mold.
Incorporate generous darts (ears, folds) so that the film does not stretch.

Alternatively, a film tube can also be used. The complete component and mold can then be placed in this.
Then seal the narrow sides (interfaces) with vacuum sealing tape.

A leak test is carried out before the actual infusion!
This often allows any leaks to be detected and eliminated at an early stage.

6. prepare and introduce infusion resin

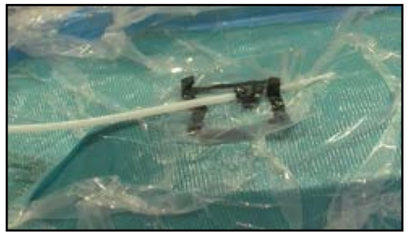


Before the infusion resin is introduced, it must first be degassed.
To do this, it is placed in a desiccator immediately after mixing (MV = 100:30) and the air is evacuated. Depending on the strength of the vacuum, the first air bubbles burst after just a few seconds.

The degassed infusion resin can then be “sucked” into the component.

Direct route to our infusion resin systems:

Resin supply connections (infusion line):

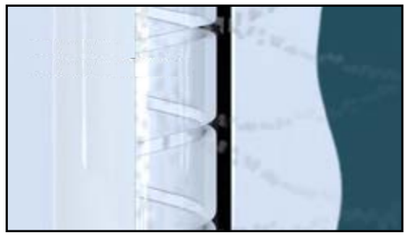


If possible, work in connection points for resin injection in such a way that the entire object can be easily infused from this point. As a rule, central points are selected for this purpose. This allows the resin to saturate the fibers and displace the air to the outside (i.e. towards the suction line at the edge of the component). Connections can be incorporated both before sealing and afterwards. It often makes sense to incorporate the suction line beforehand.

Incorporate the infusion line directly:

First wrap some vacuum sealing tape around the supply line.
Then cut a piece of foil about 10 x 10 cm in size. Make a small hole in this as well. Then seal the edges of the piece of foil. Now feed the hose through the opening in the foil so that the opening is sealed by the vacuum sealing tape on the pipe.
The vacuum sealing tape in the middle (on the hose) and on the edge should now be on the same side of the film.
Now guide the protruding end of the supply line through a cut under the vacuum sealing film (on the component). Then seal this area by first pressing the middle sealing tape (on the hose) against the opening in the film and then pressing it against the edge of the piece of film.

The MTI® hose during infusion:

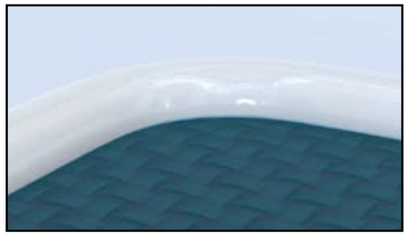


Top view of the MTI® line from above, partly without membrane:

The infusion resin, including air bubbles, flows towards the MTI® line from the right...

... and hits the membrane.

This allows the air bubbles to be sucked out further WITHOUT the infusion resin getting into the suction line.



If the infusion resin (including the finest microbubbles) hits the MTI® line at the edge of the component, it is held back by the membrane.

However, the air bubbles are still extracted.

By using the MTI® line, the component is completely impregnated. At the same time, the membrane prevents the resin from being sucked out (as is the case when using a conventional spiral line).

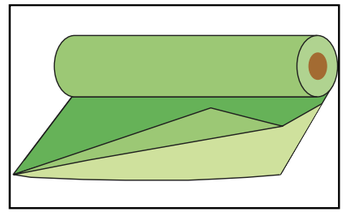
Vacuum infusion process parameters: (as a guide)

- optimum processing temperature = from 20 - 25°C - higher temperatures are of course possible!
- Optimum process pressure = approx. <20 mbar absolute

For low-bubble infusions, pressures <20mbar (absolute) are recommended! A powerful vacuum pump should be used for this.

IMPORTANT:
The applied vacuum must be maintained for a sufficiently long time, i.e. even beyond the gel phase of the resin system!

Vacuum film or vacuum hose?

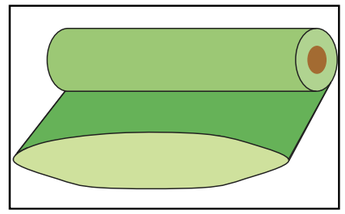


Vacuum film

Inexpensive vacuum film with very good mechanical properties:
- high tear resistance
- good temperature resistance
- flexibility
- very low permeability

In the layer structure, the vacuum film is the last material to be fixed to the mold using a vacuum sealing tape.

ARTICLE	WEIGHT g/m²	THICKNESS µm	WIDTH cm	max. TEMPERATURE °C	ELONGATION AT BREAK %	MATERIAL
HP-VF70/260	70	70	260	127	> 400	PE/PA/PE
HP-VF70/400	70	70	400	127	> 400	PE/PA/PE
HP-VF70/600	70	70	600	127	> 400	PE/PA/PE
HP-VF70/800	70	70	800	127	> 400	PE/PA/PE



Vacuum tube

Inexpensive vacuum film with very good mechanical properties:
- high tear resistance
- Very good temperature resistance
- flexibility
- very low permeability

Molded parts can simply be pushed into the hose. The ends are sealed using a vacuum sealing tape. Suitable for epoxy and polyester resins.

ARTICLE	WEIGHT g/m²	THICK-NESS µm	Ø cm	TEMPERATURE max. °C	MELTING POINT °C	ELONGATION AT BREAK %	MATERIAL
HP-VFT50/030	50	50	19,1	195	> 205	> 330	PA
HP-VFT50/060	50	50	38,2	195	> 205	> 330	PA
HP-VFT50/090	50	50	57	195	> 205	> 330	PA
HP-VFT70/150	70	70	95,49	100	> 127	> 300	PE/PA/PE
HP-VFT75/150	75	75	95,49	120	> 120	> 360	PA/PE/PA

Products for the MTI / IMC process

In-Mould-Coating

- In-Mould-Couting HP-IMC
- Top coat resin (Gelcoat) HP-E25DM

Epoxy resins

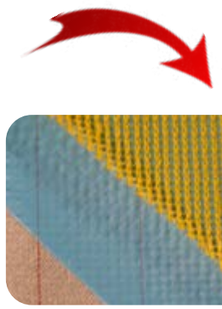
- Mold making resin HP-E30FB
- Infusion resin systems, e.g. HP-E3000GL, HP-HE300RI

Release agents

- Release agents HP-HGR5
- Priming wax HP-G
- Film release agents HP-PVA
- Carnauba wax HP-CX7
- Release agents HP-HGR80

Peel ply fabric

- Peel ply, plain, e.g. HP-P83P
- Peel ply, twill, e.g. HP-T105P



Or alternatively the Triplex-Mesh HP-TX280/150

Our Triplex Mesh combines three auxiliary vacuum materials in one: peel ply, perforated film and mesh.

Infusion Mesh

- Perforated Release Film e.g. HP-RF30/130
- Infusion mesh, e.g. HP-IM145/100

Vacuum assistants

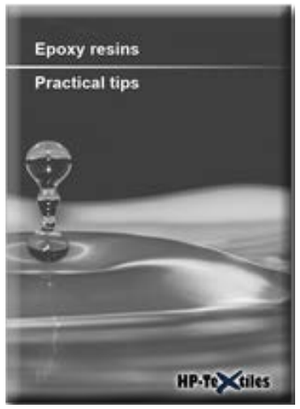
- MTI-Hose HP-MTI-08
- MTI-Valve HP-VZ1450
- Vacuum sealing tape, e.g. HP-ST12x3/210
- Vacuum film, vacuum hose, e.g. HP-VT70/800
- Plug-in connector
- Hose clip Sqeezee
- Vacuum gauge HP-VZ1440
- Vacuum pump, e.g. HP-VZ1200
- Pressure gauge e.g. HP-VZ1180
- Spiral hose, e.g. HP-ST060
- Mesh adhesive tape, HP-AM075/050
- Scissors, HP-L1054, HP-L1055

Further information

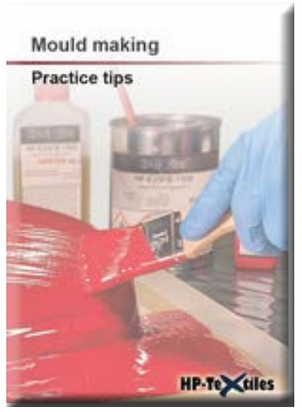
In the video and download portal of our online store www.hp-textiles.com/shop various work instructions and videos on different topics are available.
available. Some examples are listed here and can be easily accessed using the QR codes.

Working instructions

Practical tips for epoxy resins



Practical tips for mold making



Application videos

Our business areas:

HP-Textiles
Composite Materials

DeinTeich.de
Teich Pool Dach
GRP Coatings

bredderpox®
Building Chemistry

HP-Textiles

Otto-Hahn-Str. 22
48480 Schapen
Germany

phone.: +49 (0) 5905 945 98 70
fax: +49 (0) 5905 945 98 74

info@hp-textiles.com
www.hp-textiles.com