CARBON COATING

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The data of this practical guide have been compiled to the best of our knowledge and belief and correspond to our current state of knowledge.
--- Due to market dynamics we reserve the right to make short-term changes if we regard them as necessary.
We cannot give any warranty for the processing results in individual cases because of the variety of applications. Also storage and processing conditions of our products are beyond our sphere of influence.
When using and processing our products, the current product data sheet must always be observed. Furthermore, our general terms of business and delivery will apply. We generally recommend pre-tests.

With the publication of a new revision of this practical guide or new product data sheets all earlier versions and resulting data are no longer valid.
1. CARBON
- THE HIGH TECH FIBER

... Components made of carbon fibers

Carbon fabrics are indispensable in most high-performance applications. Most limits in aerospace, construction of sports equipment, wind power or motor sports could not be reached without this material. The tensile strength of carbon-fiber-reinforced plastics (CFRP) is several times higher than the tensile strength of conventional aluminium or steel materials. Components made of CFRP are at the same time considerably lighter than metallic materials.

The typical carbon look stands for a new material with high-end features.

--> Please find further details to the manufacturing of CFRP - components with the IMC / MTI® - method in our Online-Shop / category „Downloads“ or under „Videos“. 

... Carbon Coating

Besides manufacturing new and complex CFRP components it is also possible to coat existing parts with carbon.

On the following pages we put together the procedure of the carbon coating and also diverse tips and tricks.

Pic. 1: Sport-seat for the Ferrari 360/430, manufactured with the IMC/MTI-method (full-CFRP)

Pic. 2 (above): A steering wheel which is coated with the carbon fabric HP-T240C.

Pic. 3 (left): Tuning for young professionals: a CFRP coated ride-on vehicle for kids.
2. MATERIAL SELECTION
- THE OPTIMAL CARBON FABRIC

... Selection of the optimal fabric

In the beginning of the selection there is the question which visual appearance is desired. Most visual carbon parts are coated with a 245g/m² carbon fabric (e.g. HP-T240C, see also page 6/7).

Besides this established carbon look there are still various other design-possibilities.

Basic information about the selection of fabric types:

If you want to create **even and flat components** (plates, panels...), it is possible to use other weave-types (e.g. plain weave) instead of twill weave. Furthermore, there is the possibility to use fabrics with a special resistance to shifts. Those fabrics are fixed one-sided so that the fiber cannot shift.

For **3-dimensional components with curves / radii** you should select a material which has a sufficient drapability! The drapability of fabrics is reached with a low grammage and / or a soft weave (e.g. twill weave 4/4 such as our HP-T286C).

—> Please find a detailed selection aid for carbon fabrics on the following pages (6+7)

... Ideal for beginners:
- **HP-KS-CB** - The complete set for carbon coatings

To gain first experiences with these products we offer our complete set for carbon coatings.

This set contains besides the Epoxy-coating system HP-E25DM also the carbon fabric HP-T195C and many tools and equipment.

Pic. 6: The extensive complete set for carbon coatings (HP-KS-CB).
### Overview of carbon fabrics

<table>
<thead>
<tr>
<th>Item number</th>
<th>Description</th>
<th>Field of application and notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HP-P80C</strong> (80g/m², plain)</td>
<td>very light and fine carbon fabrics</td>
<td>use in construction of fine models, coating of switches or other complex components, jewellery, watches, ...</td>
</tr>
<tr>
<td><strong>HP-P96C</strong> (93g/m², plain)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-T240C</strong> (245g/m², twill)</td>
<td>design carbon fabrics</td>
<td>coating of vehicle parts, motorcycle / scooter fairings, furniture, ...</td>
</tr>
<tr>
<td><strong>HP-T240CE</strong> (245g/m², twill, + approx. 10-15g/m² EP-binder)</td>
<td></td>
<td>THE TOP SELLER – used very often for visual carbon parts! ⟷ available in width of 1m, 1,25m and 1,50m (bonnets, roof sections,...)</td>
</tr>
<tr>
<td><strong>HP-T240/125CE</strong> (245g/m², twill, + thermoplastic fixation)</td>
<td></td>
<td>Not prone to shiftings!</td>
</tr>
<tr>
<td><strong>HP-T160C</strong> (160g/m², twill)</td>
<td>medium-heavy carbon fabrics</td>
<td>coating of vehicle parts, motorcycle / scooter fairings, ...</td>
</tr>
<tr>
<td><strong>HP-P160C</strong> (160g/m², plain)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-T195C</strong> (195g/m², twill)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-P195C</strong> (195g/m², plain)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-T200C</strong> (200g/m², twill)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-P200C</strong> (200g/m², plain)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-T286C</strong> (285g/m², twill)</td>
<td></td>
<td>special weave construction (twill 4/4) - thereby very good drapability</td>
</tr>
<tr>
<td><strong>HP-T193C</strong> (193g/m², twill)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-P193C</strong> (193g/m², plain)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-P160S15C</strong> (160g/m², plain)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-T160S15C</strong> (160g/m², twill)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-P160S25C</strong> (160g/m², plain)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP-T405CER</strong> (205g/m², twill)</td>
<td></td>
<td>Carbon-Design-Fabric, coloured use in orthopaedics, cabinetry, coatings of vehicle parts</td>
</tr>
<tr>
<td><strong>HP-T405CEB</strong> (205g/m², twill)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* bright subsoils shine through because of it’s open weave
Illustrations of our products

HP-P96C
1K - 93g/m²
plain
A „carbon-chronograph“

HP-P160C
3K - 160g/m²
plain **

HP-T200C
3K - 200g/m²
twill

HP-T240C
3K - 245g/m²
twill 2/2
for 3-dimensional / curved components

HP-T286C
3K - 285g/m²
twill 4/4

HP-T193C
12K - 193g/m²
twill 2/2
with Spread-Tow coated vehicle-interior parts

HP-T240CE
3K - 245g/m²
twill 2/2
for cuts without fraying

HP-T405CEB
(blue)
HP-T405CER
(red)
Design - 405g/m²
twill 2/2

A “carbon-chronograph”

1 cm

1 cm

1 cm
3. MATERIAL SELECTION

- THE OPTIMAL EPOXY RESINS

... Why Epoxy Resins?

Epoxy Resins have an especially high adhesion on most subsoils. They are the favoured resin matrix for processing carbon fabrics. Epoxy Resins are in many cases the more effective solution where Polyester Resins often reach their performance limits.

... Advantages of Epoxy Resins

- very low material shrinkage
  The single components of the Epoxy Resin react with a so called addition reaction which releases no reaction product. Therefore, the loss of volume is significantly lower than it would be the case by using Vinylester or Polyester Resins.

- free of solvents
  Therefore, does not cause any smells. Furthermore, e.g. sandwich foams are not attacked.

- very good adhesion properties
  Applicable even on existing subsoils (Polyester laminate, wood or several metals) because of it’s high adhesive force.

- suitable for the processing of high-performance fibers (aramid, carbon,...)
  Only process high-quality fibers with high-quality resins!

- long lasting high mechanical strength (low fatigue behaviour)
  Compared to conventional Polyester laminates, composite materials with Epoxy Resins have a much higher resistance.

... Information to tempering

Epoxy Resins should always get a tempering („post-curing“) after hardening. Thereby, the mechanical values such as the heat resistance are significantly improved.

Background: With a subsequent heat supply a much higher degree of cross-linking and therefore an improved strength is reached.

→ Please find further details in our manual for tempering and also in the data sheets of the respective systems and further manuals.
... Selection aid for synthetic resins *(Priming, Laminating Resins, Varnish,...)*

<table>
<thead>
<tr>
<th>Field(s) of application</th>
<th>Type</th>
<th>Short Information</th>
</tr>
</thead>
</table>
| Priming smooth, non-absorbent subsoils | HP-UC-9004 (2K-PUR) | Priming and bonding agent  
Processing on: glass, metals, tiles, many plastics,…  
black coloured and therefore the subsoil does not shine through!  
Pot life approx. 20-30 minutes² |
| Priming slightly porous to highly absorbent subsoils | HP-E80FS (2K-Epoxy) | Priming and bonding agent  
Processing on: metals, GPR, wood,…  
Pot life approx. 35 minutes² |
| Laminating (fiber impregnation; also possible with several fiber layers) | HP-E200GL (2K-Epoxy) | Laminating Resin, increased temperature resistance, GL-approval  
- very fluid -  
Pot life approx. 200 minutes² |
| Laminating | HP-E25KL or HP-E45KL (2K-Epoxy) | Multi-purpose system, Adhesion and Laminating Resin  
Improved adhesion on „complicated“ subsoils, chemical-resistant  
Pot life approx. 25 or 45 minutes²  
**Our recommendation for beginners!** |
| + Epoxy-Top Layer (surface-specialist with improved UV-resistance. Also applicable as a Laminating Resin. Impregnation of up to 2 layers of fabric) | HP-E25DM (2K-Epoxy) | Top Layer Resin, colourless, medium-viscous  
Pot life approx. 25 minutes² |
| | HP-E40D (2K-Epoxy) | Top Layer Resin, colourless, low-viscous (thin)  
Sprayable with thinner XB  
Pot life approx. 40 minutes² |
| | HP-E25D (2K-Epoxy) | Top Layer Resin, colourless, low-viscous (thin)  
Pot life approx. 25 minutes² |
| Clear Varnish High-quality surfaces, good resistance to weathering and UV-protection | HP-PUR (2K-PUR) | 2K-PUR varnish for high-quality surface coatings  
Pot life time approx. 3 h² |
4. PREPARATORY WORK

... Preparation of surfaces

The subsoil has to be degreased, grinded and cleaned before coating so that the coating has a long-lasting adhesion. Here is an overview of the processing steps:

<table>
<thead>
<tr>
<th>1</th>
<th>The subsoil needs to be dry and free of silicones and grease. Degrease the surface with a suitable solvent such as acetone <strong>HP-AC</strong>. Then allow the treated surface to air dry.</th>
</tr>
</thead>
<tbody>
<tr>
<td>wood</td>
<td>Sandpaper with a grain size of 60-180 Types of wood with a high proportion of resin or oil (e.g. teak) are difficult to adhere. Therefore, the surface needs to be degreased especially intensive and grinded against the direction of the grain!</td>
</tr>
<tr>
<td>GPR</td>
<td>Sandpaper with a grain size of 60-120</td>
</tr>
<tr>
<td>Metal</td>
<td>Abrasive blasting or grind roughly with an angle grinder. If the metal has an oxide layer, it has to be removed completely and the Epoxy Resin has to be applied within 2-3 hours.</td>
</tr>
<tr>
<td>Aluminium</td>
<td>Degrease it and grind it carefully! Anodized aluminium / aluminium alloys should also be etched slightly!</td>
</tr>
<tr>
<td>2</td>
<td>Special rules apply here! We recommend the use of our bonding agent <strong>HP-UC-9004</strong>. Clean and degrease the surface carefully! Remove all remains of release agents. After that, the surface needs to be prepared with a solvent cleaner and with abrasive pads. Wait until all parts of the solvent are evaporated. <strong>Tip</strong>: industrially manufactured injection-moulded parts are often manufactured by using internal release agents. To remove all release agents, those plastic parts need to be tempered (heat treatment). Depending on the type of plastic here are approx. 0.5-2h at 50-60°C necessary.</td>
</tr>
<tr>
<td>Plastics</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Remove the grinding dust with compressed air or a vacuum cleaner.</td>
</tr>
<tr>
<td>4</td>
<td>Clean the surface again with a solvent and allow the treated surface to air dry!</td>
</tr>
</tbody>
</table>

**TIPS**

1. Let the surface dry long enough (flash off). The area to be coated should be brought to „operation temperature“. (Background: if the surface is too cold, the hardening speed is massively slowed! There is also the risk of condensate formation.)

2. Protect yourself from the grinding dust and wear suitable protective clothing! Optimal are professional grinding machines with a connected dust extraction.
5. THE COATING

... Step by Step - with practical examples

CUT FABRICS TO SIZE

Cut the fabric to the desired size. However, you should apply the fabric first on a trial basis before coating or it is possible to work with a stencil. Our scissors HP-L1054 are suitable for cutting fabrics to size (except from aramid fibers). To prevent the fabric from fraying it should be equiped with masking tape - in the area that is not visible later. If the fabric is cut through this masking tape, then it is prevented from fraying. (see pic. 9)!

<table>
<thead>
<tr>
<th>Materials</th>
<th>Fabrics (see overview on the pages 6-7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools</td>
<td>Scissors HP-L1054 Masking tape</td>
</tr>
</tbody>
</table>

APPLYING THE PRIMER

Mix the primer according to the data sheet in a ration of 100:50. Directly after that, the primer HP-UC-9004 can be applied in a thin layer with a brush (e.g. HP-L1071). Before applying the Epoxy Resin make sure that the bonding agent is cured (approx. 5h at 40°C). —> For details please refer to the technical data sheet

<table>
<thead>
<tr>
<th>Materials</th>
<th>Primer / bonding agent HP-UC-9004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools</td>
<td>Brush (e.g. HP-L1071) or laminating roller HP-L1018 / HP-L1019 / HP-L1015 Paint tray (e.g. HP-L301)</td>
</tr>
</tbody>
</table>
**MIXING EPOXY RESINS**

**STEP 3**

First, weight in the resin component in a suitable mixing cup (*Pic. 14*).
After that, add the necessary amount of hardener in consideration of the indicated mixing ratio (*Pic. 15*).
After mixing, transfer the mixture in another mixing cup and stir it again carefully (*Pic. 15-16*).

<table>
<thead>
<tr>
<th>Materials</th>
<th>Selection of Epoxy Resins in an overview on page 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools</td>
<td>Nitrile gloves (e.g. HP-L1095)</td>
</tr>
<tr>
<td></td>
<td>Mixing cup HP-L1063 (250ml) or HP-L1064 (500ml)</td>
</tr>
<tr>
<td></td>
<td>Paint tray HP-L301</td>
</tr>
<tr>
<td></td>
<td>Stirring staff HP-L1061 or for quantities &gt;2kg the stirring staff HP-L1051</td>
</tr>
<tr>
<td></td>
<td>Masking tape, suitable scales</td>
</tr>
</tbody>
</table>

*Pic. 14-17: Weight in resin and hardener, stir it carefully, transfer it into another mixing bowl and stir it again.*

**LAMINATING**

**STEP 4**

The ready mixed resin can be applied in a thin layer with a brush or roll.
Then apply the fabric and roll it up with a dagasser roller so that it is completely embedded with resin.
If the component is complex, it is possible to impregnate the fabrics by dabbing with a brush.
Here you have to be careful to avoid shiftings in the fabric!

<table>
<thead>
<tr>
<th>Materials</th>
<th>Selected Epoxy Resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools</td>
<td>Brush (e.g. HP-L1071)</td>
</tr>
<tr>
<td></td>
<td>Degasser roller (e.g. HP-RR-13x75)</td>
</tr>
<tr>
<td></td>
<td>or for larger areas</td>
</tr>
<tr>
<td></td>
<td>Laminating roller HP-L1018 or HP-L1019</td>
</tr>
<tr>
<td></td>
<td>Degasser roller HP-RR-25x75 or HP-RR-25x150</td>
</tr>
</tbody>
</table>

*Pic. 18-21: The Epoxy-laminating resin is applied with a flocked foam roller or a brush. Then, the fabric is applied and impregnated carefully. Air bubbles are eliminated with a degasser roller.*
APPLYING THE PEEL PLY

If the fabric is completely impregnated and there is no remaining air, the Peel ply can be applied. Roll it up onto the wet surface and let a surplus of Peel ply of more than 10cm at the edges.
The Peel ply should be applied in one piece to avoid later optical irregularities caused by different Peel plys.

After a curing time according to instructions (see data sheet of the respective resin) you can „peel“ the Peel ply off the component in an acute angle (Pic. 25/26).

Once this has been done, the surplus of cured laminate can be cut off.

If there are small surface defects or bumps, they can be grinded carefully (grain size of 240 or finer).

Ensure that you do not damage the fabric!

<table>
<thead>
<tr>
<th>Materials</th>
<th>Peel ply:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plain weave (flat surfaces)</td>
</tr>
<tr>
<td></td>
<td>e.g. <strong>HP-P83P</strong> in width between 3 and 150cm</td>
</tr>
<tr>
<td></td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>Twill weave (curved components)</td>
</tr>
<tr>
<td></td>
<td>e.g. <strong>HP-T105P</strong> in width between 25 and 125cm</td>
</tr>
</tbody>
</table>

| Tools           | Scissors **HP-L1054**                  |

**Pic. 22-24: The Peel ply absorbs the surplus of resin.**
Use here an degasser roller for a careful impregnation.

**Pic. 25-27: As soon as the laminate is cured, the Peel ply can be removed. An evenly abrasive surface remains.**

... *Peel ply*
-no additional grinding!
APPLYING THE EPOXY TOP LAYER RESIN

After removing the Peel ply an evenly abrasive surface is remaining. This surface is again coated with Epoxy Resin so that the carbon fabric is completely covered with resin.

This step should be repeated several times to create a homogeneous layer and to correct possible skips.

Avoid the formation of air bubbles by adding 0.2 - 0.8% of the degasser HP-BEL51 (with regard to the total mixture).

Important: If several Top Layer Resins are applied, it is better to work „wet-on-humid“.
So the lower layer should just slightly cure but remain sticky so that the following layer does not peel off the other layer when it is applied. Slightly cured Epoxy Resin is slightly sticky such as the back of an adhesive tape.

Do not wait until the first layer is completely cured!

| Materials | Selection of Epoxy Resins see overview on page 9  
Degasser HP-BEL51 |
|-----------|--------------------------------------------------|
| Tools     | Brush (e.g. HP-L1071)  
or for larger areas  
Laminating roll HP-L1018 / HP-L1019 |

Pic. 28-30: The mixed Epoxy Resin is spread carefully with a flocked foam roller. If necessary, this process should be repeated several times „wet-on-humid“. After curing completely, remaining bumps can be smoothened by grinding.

IMPORTANT: Avoid / remove air bubbles!

Especially the Top Layer should be free of bubbles. Air bubbles interrupt the optical appearance and those parts can not be painted bubble free!

Besides the directly visible air bubbles so called „pinholes“ can also cause problems. These „pinholes“ are very small air bubbles which rise towards the end of the curing process and „get stuck“ below the surface. Mostly, they get only visible after grinding the surface for the following paint.

![Diagram](www.hp-textiles.com)

Pic. 31: Development of so called pinholes caused by rising air bubbles.

TIPS

1. Use the system degasser HP-BEL51 to avoid and reduce the risk of air bubbles!

2. Avoid pinholes by heating the freshly applied resin with a hot air gun! Last air bubbles will burst open and disappear.
APPLYING CLEAR VARNISH

Clear varnish enables an improved gloss and also improves the UV-resistance. Before applying it, the completely cured surface should be grinded carefully with sandpaper with a shrinking grain size.

Begin with a grain size of approx. 320 and move on to a finer size of e.g. 800. Then clean und degrease the surface again.

Mix resin and hardener in a mixing ratio of 100:25 with a suitable stirring device and avoid the formation of air bubbles.

<table>
<thead>
<tr>
<th>Mixing Ratio (parts)</th>
<th>100</th>
<th>25</th>
<th>10 - 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot life (at 20°C)</td>
<td>approx. 3 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing temperature (optimal)</td>
<td>18 - 25 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing conditions</td>
<td>from 15°C and up to 70% relative humidity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Let the mixture rest for 10 minutes so that possible bubbles can escape.

After that, use the mixture within the working time. We recommend an application by spraying for high qualities.

Diameter spray nozzle: approx. 1,2 - 1,4mm, HVLP approx. 1,3 - 1,4mm
Spray pressure: approx. 4bar, HVLP approx. 2 - 2,5bar
Coats: 2 - 3 (recommendation)
Recommended layer thickness: 40 - 50µm (per layer)
Productivity: 1 litre mixture approx. 7m² at 50µm

An application with a flocked foam roll and a subsequent finishing is also possible.

We recommend a painting-test and a subsequent adhesion-test!

--- Please find further details to the processing of the varnish system in the technical data sheet.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Clear varnish HP-PUR, Thinner HP-IMC-X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools</td>
<td>Painting-compressor including accessories or Laminating roller HP-L1018 / HP-L1019 Mixing cup HP-L1063 (250ml) or HP-L1064 (500ml) Paint tray HP-L301</td>
</tr>
</tbody>
</table>

Footnotes:

1 Because of the open weave, bright subsoils might shine through.
2 All data at 20°C and approx. 60% ambient air humidity.
3 To improve the UV and light resistance it should be worked with suitable varnish or clear coat.
HP-Textiles is certified according to DIN EN ISO 9001:2008 by

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