

12 kg velomobile made by Meufel-technology

*Contribution of Harald Winkler
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PE-Foam, carbon fibre and sophisticated design make it possible to build a fully enclosed three-wheeled vehicle weighing less than 12 kg.

Now what's so special about this design? To find out, let's have a look inside that craft. There we see: Almost nothing! No central framework is spreading across the little cabin, the room enclosed by the foamshell is mostly empty, thus offering all its space to the driver and the luggage, which finds its place behind the drivers seat, beneath the rear wheels. Two beams, each at one side of the cabin, split at the rear to take up the rear wheels, connected by the drivers seat, form the carrying structure and serve as a stable suspension for the foamshell at the same time. It's all made of carbon with a styrofoam core. The common crankset and bottom bracket is replaced by a crankshaft (welded steel tube) suspended on both sides with self-aligning ball bearings (industrial type 108 TV, weighing only 14 gr. each). The chainwheel is on the left side of the crankshaft, thus allowing to lead the chain besides the driver straight and direct to the left rear wheel, avoiding the mechanical losses that usually appear at the turn-around sprocket. A cardan joint connects handle bars and frontwheel and allows it to turn around a full 180°. Therefore the turning circle is the smallest possible and heavy cornering is great fun. The cardan joint consists of four adjustable aluminium cones fitted in a flat POM cylinder. It's also acting as a steering damper. If wear should occur after a long time of use, it can always be properly readjusted. A low profile carbon seat offers a comfortable ground clearance of 6 cm, sufficient even for non asphalted gravel walks, although the seat height is as low as 9 cm. Travelling so low means excellent road holding without needing any complicated spring-suspension system. The foamshell is hinged at the front and can be lifted up easily for getting in and out of the vehicle. Slots flap open when you need to give hand signs. It takes only a few seconds to remove the shell completely and to fix it again, no tools required to do this. The canopy offers a 360° panorama look even when closed and can be slid open as known from classic aircraft. Luggage can be easily loaded. Its weight doesn't affect much the lightweight frame structure, because its rested directly at the rear axles.

Technical data

215 cm long, 68 cm wide, 173 cm wheelbase, 97 cm high.

7 speed derailleur gear.

Weights:

Frame and seat unit: 3400 gr. / Frontwheel 16": 630 gr. / Rearwheel 20" left: 1470 gr. / Rearwheel 20" right: 830 gr. / crankshaft and pedals: 1200 gr. / chain: 650 gr. / Brakes: 280 gr. / fork: 350 gr. / Derailleur: 250 gr. / street legal light, dynamo and reflectors: 290 gr. / Foamshell and canopy: 1210 gr. / Wheelcases: 320 gr. / Steering: 590 gr.

Total weight in reality: 11,6 kg

Note that another 150 gr. at least could be easily saved if those bloody expensive lightweight chains would be used.





Something about the MEUFL-technology

The material is a PE-foam with a density of about 30 kg/m^3 and enormous plasticity. Tensile strength is at least $0,18 \text{ N/mm}^2$. The plain foam sheets are warped to a three-dimensional structure by joining their round-cut edges together, thus causing a shortening of this edges. The trick is to find the right cut. Up to now there is no way of exact calculation, you got to have a feeling for it. For more vaulting, the sheet can also be warmed in the middle with a hot-air fan and then carefully be stretched in just that area. Cutting can be done with an ordinary pair of scissors, a sharp knife or an electrically heated, hot wire. The same sort of wire can also be used to weld the edges together. The only difference is that you have to push the sheets together when they are past the wire instead of tearing them apart. Hot air may be used for welding as well. A special micro-fan, with a jet as small as 2.5 mm diameter has recently been designed for that purpose, allowing very precise work, but also ordinary big fans are used for welding of bigger areas. In the early days of MEUFL-technology foam sheets were connected with a pretty smelly glue called "Pattex", but welded connections turned out to have much higher durability, due to the UV-sensibility of the glue.

A foam shell can be used for many years. It is unbreakable, but rather sensitive to scratches and cuts,

that will do a remarkable change to its look over the years. The best way to deal with this is to accept used-look as cool and stylish, a point of view that has been well established with jeans-fashion for quite a long time now. Foam is available in different colours, but white is to prefer, because of its good visibility and because it is the only colour that even looks better when bleached by the sunlight.

You need no special equipment like moulds or models to apply MEUFL-technology, what means extremely reduced costs when you are building just a single prototype. However, if you want to build great numbers of foam shells at an industrial scale, you should prefer a deep-drawing process like John Tetz does. Although this requires a mould and a heating chamber, it quickly pays off in serial production because deep-drawing is so much faster than traditional hand-meufling. Deep-drawn foam shells tend to be a little

heavier than hand-meufled ones, because with deep-drawing it is hard to keep the thickness of the foam constant over the whole of the profile and therefore thicker foam and foam of higher density and stiffness has to be used. Despite this, deep-drawing offers the great chance to produce big series of very cheap foam shells, that are still by far more lightweight than any expensive high-tech hard shell could ever be.

Latest news:

Just a few hours ago, in the evening of 28 July 09, the brand-new MEUFL Prepeller has been tested successfully for the very first time! This device, a combination of a propeller and a repeller mounted on a common shaft, so that the propeller is driven by the repeller exposed to the airstream, keeps the airstream –and the rain coming along with it– off the drivers face like a virtual windscreen. Without any need for being wiped. Weight is less than 20 gr.



MEUFL Prepeller



MEUFL micro-fan