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Let’s talk curves

TRAILER-TEST Everyone knows that optimised trailer aerodynamics offer massive potential savings. Schmitz Cargobull has addressed this issue and developed an entire series of trailers with a teardrop-shaped, sloping rear section. The EcoFLEX trailers are said to be capable of reducing fuel consumption by up to 5%. We have closely examined the flexible concept with extensive support from MAN road testing.

The term “teardrop” is something that quickly catches my attention. However, Schmitz Cargobull would actually rather not hear the word. Why is that? “Well, there are subtle differences”, explains spokesperson, Silke Hesener, “We would simply prefer the term ‘EcoFLEX’…” Okay…? So, it’s not a teardrop trailer. In truth, when you look at it more closely, the EcoFLEX does not actually have a teardrop-shaped appearance, but is rather more of a wedge that slopes to the rear, even if it does have a subtly rounded contour.

I had the opportunity to photograph a true teardrop truck two years ago directly outside our test fuelling station on the B13 highway in Eichstätt/Altmühltal (see the photo on page 13). The profile contours of the furniture express truck are more like a proper “teardrop”: the contour rises slightly from the front up to around the middle, and then slopes downward relatively steeply. This hump clearly illustrates the teardrop characteristic. No matter. One thing is certain: The British have long understood the value of its aerodynamic qualities. Thousands of teardrop trucks and trailers are on the road throughout the British Isles. To be fair, one has to point out that vehicle heights of roughly 4.6 m are permissible in Great Britain. An aerodynamically shaped roof section is more permissible here than elsewhere.

The especially aerodynamic qualities of the teardrop shape have long been proven. The downside is that it is somewhat restrictive. On a semi-trailer, it reduces the volume and loading height. Regardless of this, Schmitz Cargobull offers three FLEX concepts with the sloping roof line. There is the adjustable EcoFLEX trailer (normal height) and the EcoVARIOS for an interior height of 3 m. As the name suggests, the EcoFIX is a fixed body with an unchangeable wedge shape.

A gecko among trailers

We were particularly interested in the EcoFLEX. It offers the best of both worlds: a maximised volume of 10 m³ and the wedge shape. It can even be adjusted to match the transport task, which is a major advantage in itself. Because who likes transporting air inside a body with the least favourable aerodynamics when they can enjoy the benefits of a more aerodynamic, fuel-saving body – using one and the

PHOTOS: R. DOMINA

The lower rear section reduces the through-loading height of the rear doors by half a metre (from 2,550 mm to 2,050 mm).

PHOTOS: MAN

Converted in 20 minutes: It all begins with releasing the tensioning locks.

The rod for manipulating the roof flap is located between the body and the pallet box.

Open both doors and secure them at 270 degrees, unlock the roof flap with the rod and push it up.

Important: Before lowering the roof section, always swing the doors inward.

All of the support points are now relieved of their load with a brief stroke of the hydro-pneumatic pump.

PHOTO: SCHMITZ CARGOBULL

The rear shapes compared: On the EcoFIX with fixed aerodynamic geometry, the tarpaulin is super smooth. On the EcoFLEX (middle) and the EcoVARIOS high-volume model, the tarpaulin is not 100% smooth in the corner areas.

same vehicle? That is the EcoFLEX concept: flexibility. Transport high-volume freight with a 2.55 m interior height to its destination, then return with steel or other heavy scrap using the wedge-shape and lower fuel consumption. Sounds perfect.

However, true perfection still faces several hurdles. First of all, the trailer has to be converted. How long does that take? And what is the cost of rear doors with a height adjustable by 50 cm? In addition, two or three intermediate stanchions also have to be height-adjustable to ensure a harmonious slope of the roof line. The first stanchion (seen from the front) can remain as it is since there is no bend here at the front. The second has to be 5 cm shorter, the third 25 cm, and the rear doors are then 50 cm lower. This reduces the through-loading height at the rear: In the aero position, the clear door height decreases from 255 cm to 205 cm.

This needs to be taken into consideration, and freight forwarders need to know the height of their freight to avoid having to constantly switch back and forth between aero and rectangular. After all, conversion costs time. We have repeatedly measured the process in both directions. Unsurprisingly, we always clocked a time of around 20 minutes (plus/minus a minute or two). Matthias Muffert, Senior Product Manager General Cargo at Schmitz Cargobull, demonstrated how and we tried our hand at it. It takes 20 minutes and there is no way around it.

The conversion process is not that complicated. Starting with the rectangular shape (see the sequence of pictures), the process is as follows: First open all of the tensioning locks. However: this is not always necessary at the front and the first seven of the total of 23 locking ratchets can stay locked if the truck is on a level surface. That goes quickly (faster than closing them…). Loosening the rear tie rods completely releases the tarpaulin at the rear. Now we reach between the pallet boxes and the body, and grab the hooked tarpaulin rod stored there.

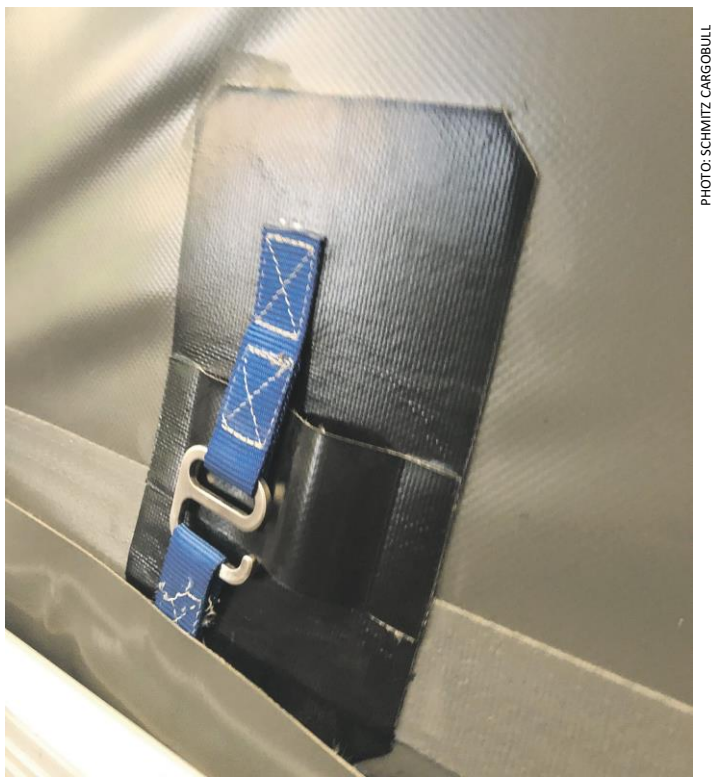
Measurements: Schmitz Cargobull EcoFLEX

The effectiveness of the aerodynamic roof is strongly dependent on the prevailing wind conditions. With a strong wind from the front, fuel savings of up to 5% are possible. But even the 2% measured almost entirely without wind make a world of difference in truck aerodynamics.

	VOLUME MODE		AERO MODE		
	Consumption [l/100 km]	Ø speed [km/h]	Consumption [l/100 km]	Ø speed [km/h]	Consumption advantage aero vs. volume mode
Measurement I: Almost wind-still	**23.7**	85.0	**23.2**	85.0	**-2.1%**
Measurement II: Strong westerly wind	**26.1**	85.0	**24.7**	85.0	**-5.4%**

Test vehicle: MAN TGX 18.510 GX cab, 32,000 kg TW, reference vehicle: MAN TGX 18.510, 32,000 kg TW
Wind measurement I (almost wind-still): 5–6 km/h from WSW
Wind measurement II (strong westerly wind): 15–20 km/h (gusts up to 29 km/h)

PHOTO: SCHMITZ CARGOBULL



Easier handling: the new internal hooks are still prototypes.

We use this to unlock the roof flap and lever it upwards.

Roof lifts at the press of a button

Now, it is important to swing the doors from the 270° position into the "almost closed" position. Great: the doors can be secured in this position using their handles. It is important to swing the doors in as otherwise the roof catches on the doors resting against the tarpaulin as it lowers. This should obviously be avoided. To take relieve the load on the various height stops, we now lift the roof slightly by pressing a button. A hydraulically driven pump handles the lifting work and pumps the hydraulic oil into the two lifting cylinders in the rear door. This only takes two seconds. Now, the height stops can be effortlessly unlocked and moved downward. In the process, you work between the tarpaulin and the stanchions. In heavy rain you are likely to get very wet from the waist down.

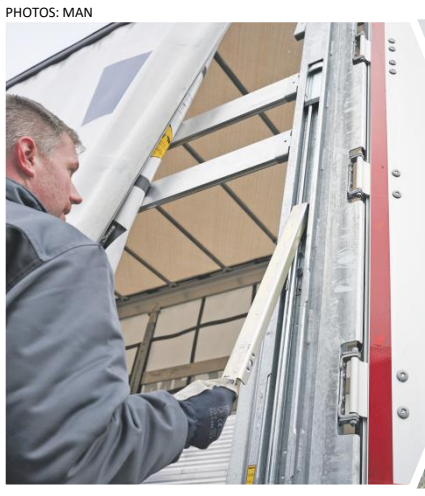
Now, we have to fold the lower tarpaulin overhang inward and hang it on the hook on the inner wall of the tarpaulin. A quick check before lowering: Are the doors folded inward? Have all of the height stops been adjusted and locked? Time for the pump: Move the lever to the position marked with the blue arrows and the roof lowers into the aero position. So far, so good. The rest is routine: Insert the tie rods and tension the ratchets along the length of the trailer. This causes large wrinkles in the upper rear corner that cannot really be pulled tight. Matthias Muffert explained that this is due to the changed geometry of the side tarpaulin: the curved upper longitudinal beam means that there is more tarpaulin left over at the top than at the bottom. However, this extra material cannot be rolled up on the tie rods. They are already working on a solution to this.

Next, hook the tensioning locks into the shortened position and snap all the tensioners into place. Secure the doors at 270° again, pull the tailgate down with the hook and let it snap into place. Close the doors and put away the rod. Done.

PHOTO: R. DOMINA

The curved side line changes the geometry of the side tarpaulin. The tie rod cannot roll up the excess, creating wrinkles. The developers are working on a solution.

PHOTOS: MAN



Now the height stops can be easily pushed into the aero position.

Two of the three intermediate stanchions also have to be moved.

Now the driver disappears behind the tarpaulin, folds the excess tarpaulin inward and secures it.

Schmitz Cargobull has already replaced the clumsy hooks on the test vehicle with new models.

Simply press a button on the controller to lower the roof to the aero position.

PHOTO: R. DOMINA

The shape of this British furniture truck exemplifies the teardrop design: The body rises slowly from the front, forming a hump near the middle, and sloping down toward the rear.

Complete the steps in reverse to convert the body back to the rectangular shape. Only this time, the pneumatically driven hydraulic pump has to work harder. However, the air consumption is low according to Matthias Muffert: "You could raise and lower the roof 20 times without using up the air supply in the trailer." So, no problem there.

To filter out the differences in fuel consumption between the aero and rectangular positions, we received extensive support from MAN road testing thanks to Rainer Miksch and his team. Measurement engineer Christian Horn provided high-end measuring equipment to record every test drive. A special photostory on the TRANSPORT Online website (see: Galerien/Flexibel-durch-den-wind…) shows all of the details.

The wind factor

How do you measure aerodynamic differences? The ideal classic approach uses test runs driven at constant speeds on the same route. Once in the aero position and then in the rectangular position, and then preferably in the reverse order again. Naturally, MAN also provided us with a reference vehicle. This is important to compensate for changes to the weather and varying traffic conditions. The broad level stretch of the A92 between the Wörth an der Donau exit and Deggendorf served as the measurement route. This route runs exactly 49.5 km East-West, and we drove the route numerous times over the course of two days in calm January weather. "Calm" is a relative term. On the first day, there was practically no wind, while on the second day the wind was rather strong with gusts of up to almost 30 km/h and bitingly cold. Not from the east, but rather from the west.

Ultimately, this was a fortunate turn of events. The initial results with almost no wind were almost disappointing for the team. Only slightly more than 2% less fuel consumption? We had hoped for more, but the figures did not lie. Our initial conclusion was that at 85 km/h cruising speed and with almost no wind, the EcoFLEX in the Aero position saved 2.1% diesel. At least this represents a saving of 0.5 l/100 km (test weight: 32 t).

Then, on the second day, we had more sunny sections than on the overcast day before. There was a strong, gusty wind almost precisely from the west. And there it was! At the end of the day, we measured a 5.4% improvement in the aero position! So, it's true. With "up to 5%" fuel savings, Schmitz Cargobull has not promised more than it can keep.

That's great – on the flat and with a strong headwind (or tailwind). Incidentally, the difference in these conditions is astonishing: driving from East to West (against the wind) the consumption was around 30 l/100 km, while in the other direction roughly only 20 l/100 km. This is a 10 l/100 km difference simply because of a strong headwind! Now you understand why freight companies that exclusively serve the windy plains in the north of Germany prefer to pay for more power, because otherwise they could not even maintain their cruising speed against the wind.

Cheating the wind

The final results prove Schmitz Cargobull right: cheating the wind is worthwhile, especially for a trailer manufacturer. On average, our measurements actually showed savings of between 3.5% and 4%. That represents considerable potential savings in CO_2. Naturally, flexible aerodynamics come with a price tag. Manufacturers are reluctant to talk about absolute prices, but Schmitz Cargobull revealed this much: the price difference for the EcoFLEX is very moderate in comparison to a lifting roof trailer at around 5% more given that the lifting mechanism is roughly the same. This is a price increase of roughly 10% compared to a standard trailer without any lifting equipment. *rod*

Comment

by **Robert Domina**,
Head of Tests and Technology

Fixed or flexible?

Let us quickly do the maths: 5% fuel savings, 120,000 km per year, 25 l/100 km average fuel consumption, four years of use, 50% of the mileage in aero mode, diesel price 140 ct net. According to Schmitz Cargobull's CO_2 calculator, the EcoFLEX then saves exactly 1,050 euros per year, adjusted for the CO_2 tax. Over the course of four years this amounts to savings of 4,400 euros for fuel and 7.9 t of CO_2. Per vehicle. That will definitely more than compensate for the additional price of the already affordable EcoFLEX concept.

From a purely visual perspective, I found the wrinkles in the upper rear corner less than perfect. But as the product manager Matthias Muffert said: "Ironing out those wrinkles is anything but trivial…". Of course not: the curved tarpaulin rail changes the tarpaulin geometry. Conversely, the winding distance that the tie rods provide remains unchanged. A tricky problem awaiting a solution.

Incidentally, the EcoFIX with its permanent teardrop shape does not have this problem. The tarpaulin is smooth and tight. That looks great! And I would like to bet that it provides between 1 and 1.5% more fuel savings. The disadvantage of the EcoFIX is that it is missing around 4.2 m^3 of cargo capacity. Always. That is in comparison to a standard trailer, which ironically, represents around 5% loss in volume. But only in the upper roof area of the rear half of the trailer.

So, I would certainly go and carefully analyse my loads. Everything under 2.5 m fits through the rear doors. That probably makes up three quarters of all loads, depending on the loading repertoire. I would choose the fixed teardrop roof over the FLEX solution.

Routine: Ratcheting the tie rod into place tightens the tarpaulin horizontally. The tensioners are attached to the higher "short" position.

Then, attach all of the tarpaulin tensioners and tighten them.

Close the doors and done.

Schmitz Cargobull EcoFLEX Curtainsider

Equipment	
Pallet stop	yes
Landing gear	JOST module
Ram protection	Bulkhead with steel ram protection in the base, 350 mm high
Lifting roof or EcoFLEX	Hydro-pneumatic lifting roof to set the eco or volume position or for side loading and unloading
Load securing certificate	EN 12642 XL, VDI 2700, including Daimler 9.5 and beverages
Body	
Floor	28 mm screen printing plate, 7.1 t stacker axle load
Bulkhead	Anodised aluminium bulkhead with hot-galvanised steel corner supports
Rear doors	Double wing door made of aluminium profiles, recessed espagnolette locks, hot-galvanised steel corner supports
Corner stanchions	Steel, hydraulic height adjustment
Intermediate stanchions	Stanchion 1: fixed, stanchion 2: 5 cm, stanchion 3: 25 cm height-adjustable
Laths	Aluminium insertable laths, 3 rows each side
Sliding tarpaulin	Schmitz Cargobull sliding tarpaulin from the rear to the front including front parking position. Can also be moved to the rear.
Tarpaulin fasteners	Bidirectional locking ratchets, extendable lowering range
Tarpaulin	Fire-resistant to ISO 3795-1989, 880 gr/m²
Pallet capacity	34
Axles and running gear/chassis	
Frame design	MODULOS hot-galvanised single piece rolled I-beam
Tyres	Schmitz Cargobull Hankook 385/65 R22.5
Axles	Schmitz Cargobull ROTOS 22.5 axles with 430 mm disc brakes
Axle mounting	Bolted
Suspension	Schmitz Cargobull MRH (Multi Ride Height) air suspension
Brakes	EBS brake system with RSP
Stacker axle load loading capacity	7,100 kg
Front section	Steel, neck height 125 mm
Spare wheel holder	Galvanised steel, for 2 wheels, behind the axle unit
Underride guard	Schmitz Cargobull pallet boxes for 24 Euro pallets, galvanised
Dimensions	
Total exterior height rectangular shape/lowered rear	4,000 mm / 3,500 mm
Clear loading height rear lowered front/rear	Front interior 2,700 mm Rear interior 2,200 mm
Through-loading height rear door rectangular shape/lowered rear	2,550 mm / 2,050 mm
Coupling height	1,135 mm
Neck thickness	125 mm
Clear interior dimensions W x H	13,620 x 2,480 mm
Exterior width	2,550 mm
Exterior length	13,690 mm
Swing radius	2,040 mm
Wheelbase to middle axle	7,700 mm
Axle spacing	1,313 mm
Weights	
Total weight, technical	39,000 kg
Unladen weight, test trailer	6,716 kg
Minimum unladen weight, EcoFLEX (depending on equipment)	from 6,100 kg
Max. technical payload	32,284 kg
Max. technical trailer load	15,000 kg
Axle load (technical)	3 x 9,000 kg
Price	
EcoFLEX price above standard trailer	approx. 10 %
EcoFLEX price above standard trailer with lifting roof	approx. 5 %

At a glance

+	Optional rectangular and aero positions, worthwhile fuel-saving effects in the aero position, large number of identical parts thanks to modular system, affordable additional costs.
–	Wrinkles in the side tarpaulin at the top rear in the aero position.