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FOTOS: R. DOMINA

An undeniable success

TRUCK-TEST We knew that the turbo compound engine would live up to its epithet "I-Save", but with its latest model upgrades, the Gothenburg-based company has gone one better: With small but highly effective changes to the aerodynamics, software and drivetrain, the turbo compound pulls narrowly ahead of its rivals from Södertälje – and is even a touch faster.

The two Scandinavian truck manufacturers are currently competing head-to-head in the 500-hp segment. While the new Scania 500 Super (see Transport 7/22) left the competition far behind in the last issue, the upgraded Volvo FH 500 is now attracting attention and ousting the Scania – albeit only very narrowly – from first place in our all-time best list. Well okay, it also has nearly ten extra horsepower under the bonnet and in the end, the turbo compound boasts a power rating of 374 kW, which (times 1.36) actually equates to just short of 509 hp. An understatement? Possibly, but the fact is, '500' is written on the door and Volvo officially names this FH the FH 500.

But wait a minute, none of this really matters when you look at the torque, as rarely if ever do we drive in the rated power range, but this is where the torque is highest, and here we see a massive 2,800 Nm in the Volvo data sheet. In comparison, the Scania 500 Super is rated at 2,650 Nm and the Actros 510 at 2,500 Nm.

So where is the power really coming from? Definitely from the torque. Yet even that is only half of the truth. Although it's true that Volvo has set the turbo compound to 2,800 Nm, it is only called upon when necessary – and that is something new. In practical terms, the FH has two torque performance curves: one for 2,800 Nm and one for around 400 Nm less, i.e. 2,400 Nm.

Where there's smoke, there's fire

That is extremely clever of course. And you don't even notice it in practice. I assume

Tuning on all curves and roundings: Even smallest gaps are now sealed with gaskets. Especially the big gap which enables the cabines flexibility towards the fixed parts at the front.

The enemy is air turbulence: New rubber lips on the side aprons leave only ten centimetres of clearance to the road, the mudguard mountings on the front axle narrow the gap to the tyres.

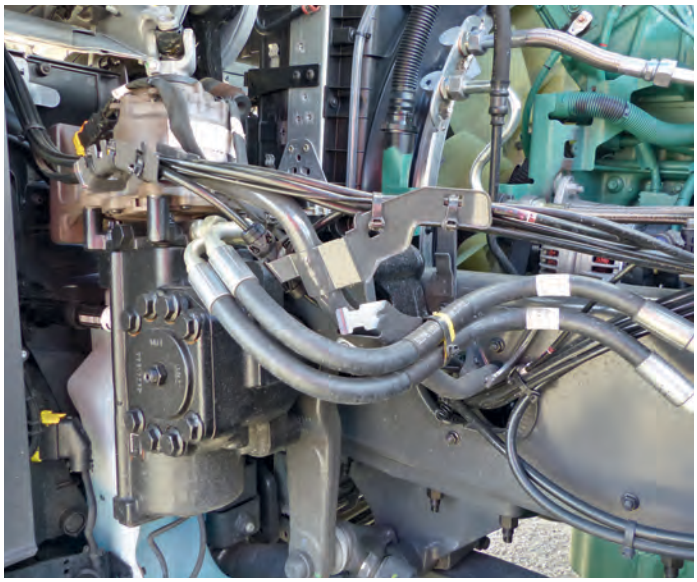
that when operating predominantly under partial load (i.e. nearly all the time), the more moderate torque is used. But there is no denying it, where there is smoke, in the end there is fire, which means fuel is being unnecessarily consumed. And that is exactly what inhibits this two-torque-curve philosophy. These days, the computer knows best how the engine can practically always run in its sweet spot. But don't worry, this does not turn the turbo compound into a lame duck. On the contrary, this makes it incredibly fast – and economical.

There is a whole range of other factors that mainly affect the rules by which Volvo's GPS cruise control I-See operates. Amazingly, the FH is now able to operate at speeds as low as 40 km/h instead of 60 km/h in the past. At these speeds, you are more likely to drive with the accelerator pedal than with the cruise control set. However, the trick is, I-See analyses what is happening on the road ahead, even in accelerator mode, whether there is a slight uphill or downhill gradient, and regulates the accelerator characteristics accordingly. Again, the whole process happens so smoothly that the driver doesn't even notice it and thus the system protects itself against unruly acceleration that just leads to unnecessary fuel consumption.

Now the Volvo driving test has also long understood that a "pulse and glide" driving style – can save up to two per cent diesel on the flat. At first I didn't even notice what was happening on our rolling route between Ingolstadt South and Langenbruck. The good point is that the "pulse and glide" is set very gently at +/- 2 km/h relative to the set speed. But it manages it – just like the MAN and the Scania, by the way. If ACC (adaptive cruise control) is engaged, the computer also takes into account the distance to the vehicle in front. Although, as we have recently proven, the vehicle in front doesn't play a major role here and nor does the driver behind notice anything of these ups and downs in driving speed behaviour.

The setting options of I-See are also new and have been greatly simplified. The one- to three-star driving programs no longer exist, only the overshoot can still be freely selected and the driving program regulates the range of the undershoot. By the way, the standard program is now called "Balanced" – and that is exactly how it drives – in

Two turbos are better than one, especially if the second one (left) acts directly on the crankshaft via a gear train and freewheeling. Volvo has perfected this turbo compound principle.



The electrically boosted and adjustable Dynamic Steering can be set to suit a wide range of individual preferences, which takes some getting used to and a lot of trial and error.

Measured Values: Volvo FH 500 I-Save

Comparison: Scania Super 500

Comparison: MB Actros 1851 Stream Space

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Volvo's turbo compound and Scania's new six-cylinder are virtually neck-and-neck on the Transport test route – with marginal advantages for the Volvo. It is very fast, especially going uphill, and yet remains economical – with comparatively low AdBlue consumption. In June, we will test the revised 1851 Mercedes Actros on the route. Things remain exciting in the diesel segment, although the heavy e-trucks are catching up significantly in terms of development.

Mileage: 12,400 km
Test weight: 38,420 kg
Trailer: TP test trailer IV, Krone
Weather: 6-14°C, dry
Wind: 14 km/h from NW
Rpm at 84 km/h: 1,020/min
Axle ratio: 2.31
Highest gear (12): 1.0
GPS cruise control: I-See, I-Roll with Pulse & Glide, Economy, Dip +2 km/h

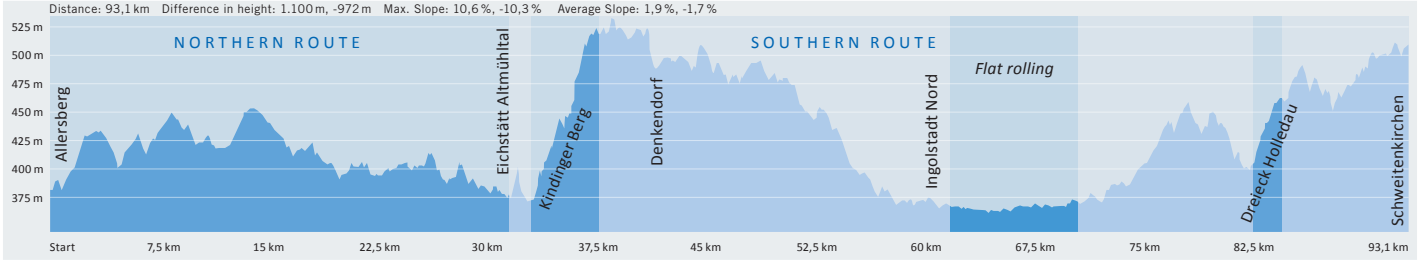
Mileage: 47,000 km
Test weight: 38,440 kg
Trailer: TP test trailer IV, Krone
Weather: 10-14°C, dry
Wind: 9 km/h from ESE
Rpm at 84 km/h: 1,050/min
Axle ratio: 2.35
Highest gear (14): 0.78
GPS cruise control: Active Prediction; Eco-Roll with Pulse & Glide, Economy, Dip +1 km/h

Mileage: 12,000 km
Test weight: 38,975 kg
Trailer: TP test trailer IV, Krone
Weather: 21°C, mainly dry
Wind: 8 km/h from W
Rpm at 84 km/h: 1,090/min
Axle ratio: 2.41
Highest gear (14): 1.0
GPS cruise control: PPC Interurban, Eco-Roll, Economy, Dip +1 km/h

Route (part of route)	**Consumption** [l/100 km]	**Average Speed** [km/h]	**Consumption** [l/100 km]	**Average Speed** [km/h]	**Consuption** [l/100 km]	**Average Speed** [km/h]
AB (52 %) **Southern Route A9** 1)	23,3	83,7	23,6	83,6	25,3	83,4
AB (52 %) **Northern Route A9** 2)	22,2	84,9	21,9	84,6	24,5 (23,2)5)	85 (82,5)
Rolling time Northern Route % of measured route	15 min 24 s 36 %		10 min 06 s 23 %		10 min 21 s (10 min 49 s) 24 % (24 %)	
Flat rolling on route 3)	18,9	84,9	17,8	84,6	19,2	83,7
Autobahn total	**22,8**	**84,2**	**22,9**	**84,1**	**24,9 (24,4)**	**84,1 (83,0)**
Flat rural roads (14 %)	23,5	60,0	24,8	58,8	24,4	58,0
Difficult rural roads (24 %)	35,2	57,3	35,2	55,6	38,6	55,1
Rural roads total	30,9	58,3	31,3	56,7	33,4	56,1
Total route	**25,6**	**73,0**	**25,8**	**72,0**	**27,8 (27,5)**	**71,7 (71,2)**
Consumption of AdBlue	5,5 % of diesel consumption		11,0 % of diesel consumption		4,8 % of diesel consumption	
Fahrleistungen						
Testhill A (rural road, near Pfahldorf, 9 %)	Average speed: 45,8 km/h Lowest speed: 39 km/h in gear 8 of 12		Average speed: 44,3 km/h Lowest speed: 37 km/h in gear 8 of 12 (+OD+CR)		Average speed: 44,3 km/h Lowest speed: 32 km/h in gear 8 of 12	
Kindinger Berg 4) **(4,5 km)**	Average speed: 84,4 km/h Absolute consumption (4,5 km): 3,98 l Lowest speed: 75,0 km/h Shifting sequence: 12-11 Driving program: Performance		Average speed: 83,5 km/h Absolute consumption (4,5 km): 3,70 l Lowest speed: 75,0 km/h Shifting sequence: OD-12-11-12 Driving program: Standard		Average speed: 76,4 km/h Absolute consumption (4,5 km): 3,85 l Lowest speed: 72,0 km/h Shifting sequence: 12-11-12 Driving program: Efficiency+	
Noise level in cab	57 dB(A) at 85 km/h 12th gear 57 dB(A) at 65 km/h 11th gear		62 dB(A) at 85 km/h 13th gear 60 dB(A) at 65 km/h 13th gear		63 dB(A) at 85 km/h 12th gear 61 dB(A) at 65 km/h 11th gear	

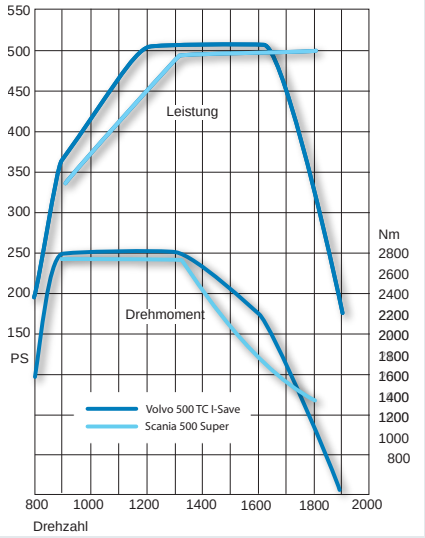
1) All: Motorway A9, AS Eichstätt/Altmühltal to Langenbruck (due to road works) and back. 2) Motorway A9, AS Eichstätt/Altmühltal to AS Allersberg and back, with 1851 Economy normal
3) Part of southern route, A9, Ingolstadt South to Langenbruck and back. 4) Part of southern route, A9 Eichstätt Altmühltal km 430.5 to 435.0
5) Values in brackets: Motorway driving in "Economy+" instead of "Economy"

HEIGHT PROFILE OF THE *Transport* TEST ROUTE



Technical Data: Volvo FH 500 I-Save 3/22

Engine, model	Volvo D13K500 Turbo TC, six-cylinder in-line engine with turbo compound turbine, wastegate turbo, uncooled exhaust gas recirculation
Exhaust gas treatment	SCR system with AdBlue injection, particle filter
Injection process	Common rail, injection pressure up to 2,400 bar, rail under valve cover.
Engine weight (dry)	1,199 kg
Cubic capacity	12.8 litres
Power output	374 kW (500 hp) at 1,250 to 1,600/min
Torque	2,800 Nm at 900-1,300/min



The second exhaust gas turbine makes the difference: The Volvo engine always provides up to 50 hp more than the new Scania six-cylinder in the main driving range – when performance is called for (full load). Otherwise, the turbo compound ranks below even the Scania's curves in terms of performance, when it only runs at 2,400 Nm at partial load.

Specific power output	29.2 kW per litre of cubic capacity
Oil change interval	100,000 km or once a year
Transmission	Volvo I-Shift AT2812F, fully automated 12-gear transmission, dry weight: 278 kg
Spread	14.94 – 1.0, R 17.48 – 3.16
Axle ratio	2,31
Rpm at 65/85 km/h in highest gear	790/1,032/min
Minimum manoeuvring speed at 500/min	Reverse: 0.65 m/s or 2.4 km/h Forward: 0.8 m/s or 2.8 km/h

Brakes	
Permanent brakes	VEB+ engine brake with brake blending via foot brake
Engine braking power	380 kW at 2,300/min (VEB+),
braking system back/front	EBS, front and rear discs, spring accumulator also on front axle, automatic parking brake, additional air tank 2x30 l, aluminium
Safety and assistance systems	I-See, I-Roll, I-Save (turbo compound); Impulse stretch brake, Emergency Brake Assist with collision warning system; Attention Assistant (DAS); Turning Assistant (radar and camera-based), Lane Keeping Assist; ACC, ESP, hill holder

Axels and chassis	
Front	Rigid axle on offset 1-leaf parabolic spring, stabiliser
Rear	Rigid axle on 4-bellow air suspension, differential lock, weight-optimised aluminium control arms
Steering	Volvo Dynamic Steering Evo: multi-adjustable steering feel, 4.5 turns from left to right, leather steering wheel 45 cm
Tyres	Conti Efficient Pro, front 385/55 R 22.5, rear 315/70 R 22.5, Alco Durabright aluminium wheels
Driver's cab	XL Globetrotter cab with low engine tunnel (9cm), 4-point air suspension, 1-bed equipment with high shutter lockers at rear above, comfortable bed below, W x L 66-82 x 200 cm, blind spot camera on right, LED driving lights with adaptive high beam, static cornering lights. I-Cool stationary air conditioner, Alexa voice control

Measurements	
Wheelbase	3.700 mm
Width x height of tractor unit incl. roof spoiler	250 x 393 cm
Height of 1st step/driver's cab floor	39/155 cm
W x H x D of large outer storage box,	56 x 41 x 64 cm
Height of storage box loading edge above ground	152 cm
Tank volume for diesel/AdBlue	405/64 Liter

Weights	
Tare weight of tractor unit weighed	7,314 kg incl. 1 driver, right-hand tank full, no spare wheel
Max. axle loads front/rear	7,100/12,000 kg
Test max. laden weight	38,414 kg

AT A GLANCE

+	Drivetrain with variable torque, long and economical transmission. Control quality GPS cruise control, low cabin noise, LED driving lights, aerodynamic fine tuning.
–	Front axle with 385 tyres rolls somewhat clumsily.

a very balanced way. Between 60 and 80 km/h, the hilltop speed increases to within up to five per cent of the speed just set, i.e. at 65, minus a good three km/h and a good four km/h at 85. That is fairly moderate and should hardly be noticed by the trucks following (unless they themselves are already travelling with undershoot before the crest of the hill).

Handled with care

In the more economical Eco mode, the undershoot is as low as minus five km/h at 60 and minus ten km/h at 80, which is far more noticeable. However, the program handles the situation very carefully and only introduces as much hilltop speed as necessary to come out at a top speed of 90 again in the dip and subsequent I-Roll. The Volvo can't resist taking the dip one or two km/h faster – but that also saves fuel and compensates for strong undershoots. In other words, this is how to remain fast, despite the uncompromising use of momentum.

No less elegantly, Volvo's strategists have integrated the VEB+ engine brake in the new system. The potential of this valve lever engine brake is widely recognised: At 2,300 rpm, the VEB+ alone decelerates with 380 kW of braking power, with the 200 kW of the exhaust cut-out brake coming on top. In other words, plenty of wear-free braking power, rendering a secondary retarder completely unnecessary. The trick is to transmit this braking power to the rear axle in a precisely controlled manner, which is anything but trivial when taken as a whole. In the past, the transmission would simply shift down two gears to end up at just under 2,000 rpm. The delay kicked in hurriedly and harshly, and the accompanying noise has jolted many a driver out of their midday daze.

Today, the focus is on a finely controlled speed curve, as after all, the downhill stretches need to be used optimally, and the following climb tackled with as much reserve as possible. This is the game – driving at just under 80 over the crest, then gliding, before switching to the overrun phase, adaptive braking by downshifting, then staggered application of the engine brake. If it's not enough, shift another gear down.... stop! Just a minute, it can't be as simple

The engine brake and windscreen wiper levers are far too close together and still take some getting used to.

The steering wheel buttons on the left control all the cruise control functions, including the new downhill cruise control.

as all that: Shifting down on a downhill stretch? Wouldn't the whole vehicle immediately start getting out of control? Yep. In normal circumstances and if the gradient is steep enough. The antidote is "co-braking" with the foot brake, or "brake blending", as they say in Sweden. In the past, we controlled it by sensitively applying the foot brake, but today the driving program does the job.

And that is downright fascinating to experience. For example, on the Beilngrieser Berg, a two-kilometre-long, very constant seven-per-cent downhill gradient stretch, here we do not want to exceed 68, which trucks with retarders manage almost effortlessly in top gear – not an issue. However, the situation changes when the engine brake is used. Of course, the FH sees what's coming and shifts into tenth at the top to slowly increase impetus towards 68 km/h, then the shift into ninth – and you can feel it – with a very slight application of the foot brake. And then finally down into eighth. Now the FH whizzes down the slope at up to 2,250 rpm, safely braked without further co-braking and without losing control. "It would've managed it in ninth, too," says Volvo Truck test expert Thomas Tschakert.

The FH's coffee maker is located between the driver's seat and the 33-litre cool box, but cool drinks are still within easy reach.

Retarder not required

A quick calculation tells me only 1,700 rpm would have been required instead of 2,200, combined with significantly less noise and perhaps one or two light co-braking phases. So of course I look up the test report of the predecessor

Three 12- and 24-V sockets are located in the middle, with a USB socket for a smartphone at the top. The red button activates the alarm system in the event of a robbery or an emergency.

model FH 500, also with a turbo compound, driven in 2019. Too bad, it had a retarder. But it's also interesting that it roared down the same hill with a constant speed of 68 km/h in eleventh gear at 1,100 rpm. And what about the Scania 500 Super, also fitted with a (new) valve lever brake? It constantly runs at 1,800 rpm at 68 km/h in tenth gear, which is actually ninth in this case because of the overdrive transmission. In other words, anyone lucky enough to have a valve-lever engine brake, whether it's called VEB+ at Volvo or CRB (Compression Reduction Brake) at Scania, can do without the heavy and expensive retarder, while at the same time being very smoothly integrated in the assistance systems.

Getting back to the performance range, we drove over Kindinger Berg using the various programs available. With this Volvo, we decided to rate the drive in the sporty Performance mode. Why? Because, firstly, this shows what the full 510 hp are capable of when called upon. Secondly, it is evident here that despite the very high average speed, the consumption of 3.98 l (maximum) is still just below the four-litre limit for trucks that are already very economical to run. To compare, in Balanced mode we used 3.95 litres but were seven seconds slower, in Eco mode it was just 3.6 litres and 15 seconds slower at an average speed of 78.3 km/h. So you can also take the higher speed into account.

In other words, we see fine tuning and integration on all fronts. The same goes for the aerodynamics. The FH already had the large corner radii when the new cab was first presented. The fine tuning now relates to the sealing of all gaps across the front and on the sides with rubber profiles. This includes the naturally large gap between the suspended cab and the part of the front section that is firmly connected to the chassis, which is now also sealed off with a rubber profile, i.e. a whole host of minor individual measures that add up to a saving of one or two per cent. This also applies to the downwardly extended rubber strips of the side trim, which now leave only ten centimetres of space between them and the road. Just like the mudguard mountings, which have been moved closer to the tyres to improve the airflow around the vehicle in no small measure.

Conclusion: The operation was a success, the patient is really fast and still economical. What more could you want these days? *rod*

COMMENT

Robert Domina,
Head of test and technology

The end of the line

There's nothing for it. We have to ask ourselves the questions: Was that it now? Is there anything else in the pipeline? Or is what the truck manufacturers are delivering here the end of the line when it comes to diesel engines? I'm afraid so. Scania has gone all out again and built a new six-cylinder engine. And the competition hasn't been lazy, either, repeatedly modifying their vehicle's diesel-powered engine and sophisticated transmission system. What can we expect next? The halving of nitrous oxide emissions? And a doubling of AdBlue consumption? I'm afraid so, we're working on it.

Writing off the diesel engine in the face of highly efficient e-motors and increasingly powerful batteries would actually be the logical consequence. At least in the field of national long-distance transport, including the heavy-duty distribution trucks. We probably won't need diesel engines any longer, even if the new designs are more efficient than ever before. But it is also a fact that electric motors are simply always twice as efficient, at least from a "tank to wheel" perspective.

The last chance for diesel trucks would be to power them with e-fuels from renewable sources, but it will take years before they are widely available. What about fuel cells and hydrogen? It works in heavy trucks, but currently still has the problem of high costs for the fuel cell and the availability of green, liquefied hydrogen.

There are still plenty of unanswered questions regarding alternatives to diesel. Nonetheless, I'm sure that the technical simplicity and high efficiency of electric motors will very soon make the diesel a thing of the past – and even more quickly than I had ever thought possible.

The front upper cabin features a large emergency exit and plenty of storage space behind blinds or flaps.

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