



Mercedes-Benz 4MATIC - the harmonious efficiency of all-wheel drive



Extra driving safety, dynamics and well-suited to winter use are helping all-wheel drive systems to become popular in all vehicle classes. In the Mercedes-Benz models, 4MATIC is available in two different versions: in the E-Class with an open central differential and with additional technical improvements in the S, CL, C (refer also to *ADVANTAGEScompact* 18/07) and GLK-Classes. The CL 500 4MATIC is therefore the only luxury coupé with all-wheel drive apart from the Bentley Continental GT. (A later edition of *ADVANTAGEScompact* will inform you about the 4MATIC in the off-road models of the GLK, M, GL and the all-wheel drive of the G-Class).

The press seems to be impressed: 4MATIC "... works so well that at the end of a winter's day you could believe that snow is nothing more than white-coloured asphalt." *Stern/D*, 19.12.07

4MATIC: balanced power distribution without surprises

As with any permanent all-wheel drive, the 4MATIC also works with a central differential. A double epicyclic gearbox distributes the power dynamically in a ratio of 45:55% (f:r). ESP® and 4ETS® take on "locking" functions. The new generation of the 4MATIC in the S, CL, C and GLK-Classes with two-disc clutch and 50 Nm locking torque between the axles improves traction and driving stability even further. That leads to predictable driving behaviour. This makes the model with 4MATIC even faster when driving away, especially on ice and snow. *"The C-Class drives away fast, no slithering, no fish-tailing is to be felt."* (*Spiegel Online/D*, 13.12.07). Other advantages:



The new CL 500 4MATIC

- > Lower weight (approx. 30% lighter than the competitors' transmissions) and friction optimisation on the wheels and bearings reduces additional consumption further. This applies in particular to the S, CL, C and GLK-Classes. The comparisons on the following pages show that the E-Class consumption is already below that of the competitors.
- > Extremely compact shape that does not restrict the front passenger's foot space. (S, CL, C and GLK-Classes).
- > The torque distribution is ideally matched to the vehicle, the characteristics are always clear and predictable, driving behaviour is predictable at all times (all models).

The competition's systems have an equally high level but do not achieve the balanced nature of the 4MATIC. *ADVANTAGEScompact* shows you the competitors' systems and how they work. You can find more detailed, interesting information on this subject in *ADVANTAGEScompact* 16/06.

Audi quattro: with a differential that is sensitive to torque

In the quattro, a Torsen differential (comes from TORque SENsing) controls the power flow and includes additional worm gears. The differential responds independently to each torque difference between the axles with a continuously variable increase in locking effect. In the Audi A4 and A5 quattro, power distributions of up to 85:15% in favour of the rear axle and 65:35% in favour of the front axle are possible, because here an additional planetary gear set distributes the torque in a ratio of 40:60% to the front and rear axle. With the A6 and A8, on the other hand, up to 85% of the torque is distributed to the opposite axle in each case as its basic power distribution without a planetary gear set is 50:50%.



Audi A4 Avant quattro

- > The purely mechanical power distribution of the Torsen differential determines the under/oversteer which is sometimes difficult to predict without including driving dynamics data such as acceleration or yawing moment.
- > Special feature with Audi: The Audi A3 and TT quattro models are equipped with the all-wheel drive system from group parent company VW. The front-wheel drive characteristic of the Haldex system does not match the sporty positioned Audi TT quattro in particular (f:r 90:10%, see below).
- > Consumption disadvantage: refer to the last column of the table "A brief overview of the all-wheel drive systems" on page 3 of this ADVANTAGEScompact.

BMW xDrive: multi-disc coupling with brains

The all-wheel drive from BMW is called xDrive. There is currently no BMW equivalent of the S-Class with 4MATIC as the current 7 Series is only available with rear-wheel drive. In contrast, the successor will be available with xDrive as an option. xDrive is also available for 5 and 3 Series BMWs.



BMW 3 Series with xDrive

- > From the rear-wheel drive, an electrically actuated multiplate clutch splits off torque to the front axle as needed via a distributor gearbox. If the coupling is not completely closed, the front axle receives a fraction of the torque that is split off from the rear - continuously from 0:100% to 50:50% (front:rear).
- > The proactive reactions of the BMW xDrive appear unfamiliar and synthetic to many drivers.
- > Consumption disadvantage: refer to the last column of the table "A brief overview of the all-wheel drive systems" on page 3 of this ADVANTAGEScompact.

BMW DPC (Dynamic Power Control), which is introduced in the BMW X6, is not part of the all-wheel drive system. DPC supports steering and bend behaviour by active torque distribution between the drive wheels on the rear axle (so-called "torque biasing").

VW 4MOTION: start-off aid for the front-wheel drive

Volkswagen 4MOTION, like Audi quattro, is a collective term - it refers as much to all-wheel drive with a Haldex clutch as to real permanent all-wheel drive in the Touareg models. 4MOTION with Haldex clutch and transversely mounted engines is not comparable with 4MATIC because:



VW Passat 4MOTION

- > With 4MOTION a multi-disc clutch responds to slip on the front axle and then involves the rear axle up to 50% in the propulsion. As a matter of principle, only 10% of the force is available to the rear wheels. When manoeuvring, the VW only uses front-wheel drive in order to avoid twisting in the transmission.
- > As the Haldex clutch normally distributes 90% of the power to the front, the typical disadvantages of front-wheel drive are retained: steering effects and the tendency to understeer.

A brief overview of the all-wheel drive systems

	Traction	Handling	Dynamics	Safety	Additional consumption
Permanent all-wheel drive					
Audi quattro (A4 and A5) Variable power distribution, rear-accented basic distribution 40:60% (using planetary gear set)	+	+	+	+	
Audi quattro (A6 and A8) Variable torque distribution, neutral basic distribution: 50:50% (using planetary gear set)	+	+	++	+	<ul style="list-style-type: none"> • A6 2.8 FSI vs. E 280: +0.4 l • A8 3.2 FSI vs. S 350: +0.4 l
Mercedes-Benz 4MATIC Fixed torque distribution, rear-accented basic distribution: 45:55% (using planetary gear set)	++	++	+	++	
Automatically engaging transmission					
BMW xDrive Passive coupling, electronic control	+	+	++	+	• BMW 525xi vs. E 280: +0.3 l
Volkswagen 4MOTION Active coupling, electronic control	+	+	-	+	

The 4MATIC in comparison

A comparison by **Auto Motor und Sport** (D, No. 22/06) of an E 350 4MATIC, Honda Legend SH-AWD and the competitors Audi A6 3.2 FSI quattro and BMW 530xi brought the E 350 4MATIC the top position. The colours mean:

Best value	Worst value
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Driving tests empty/laden km/h	A6 3.2 FSI quattro	530xi	Legend 3.5 V6 SH-AWD	E 350 4MATIC
Slalom 18 m	59,3/58,1	62,2/60,2	59,9/58,7	59,5/58,9
ISO double lane-changing test	123,8/123,4	127,7/124,1	124,9/123,8	128,6/124,5
VDA "elk test"				
Entrance speed	71/71	69/69	70/69	72/72
Exit speed	52/50	55/54	48/48	60/58
Handling track	65,4	65,3	64,4	67,8
Wet circular course, ø 65 m	58,8	59,2	57,7	59,1
Starting acceleration Uphill gradient, 20% gradient, μ-aggregate				
0-20 km/h	2,0	2,2	2,0	1,7
0-30 km/h	4,3	3,8	4,2	3,3

Conclusions: The test winner has got even better

The results in the table above show clearly how impressively the 4MATIC wins the comparison tests. The new 4MATIC version also offers more driving fun, safety and efficiency. For example, the **Süddeutsche Zeitung** (D, 18.12.07) writes about the C-Class with 4MATIC after a winter test: *"with careful accelerator control, you can even round tight bends without wakening the ESP"*.



The German **Tagesspiegel** on 19.01.08 put it in a nutshell after testing the S-Class: *"No handling or comfort losses; the technology provides safety but the driver does not have to worry about it."*

The next **ADVANTAGEScompact** in this series presents the advantages of 4MATIC in the SUV segment.

Unadulterated driving fun with the C-Class Estate and 4MATIC