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August 1998

Audi TT Coupé

The sports car

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Brief copy

Audi TT Coupé

The sports car

The Audi TT design study shown at the 1995 German Motor Show was greeted enthusiastically, not least for the sheer purity of its design. Now the series-production model is about to be launched, and confirms the fascinating, no-compromise design of this remarkable sports car. The original concept is still totally intact – something of a rarity in automobile development! The necessities of series production have been incorporated into the design with exceptional care.

The TT first took shape in the minds – or better still, in the hearts – of Audi designers who have retained all their enthusiasm for a truly outstanding car, and who were given as much freedom as possible to translate their concept of “the way Audi should build a sports car” into reality.

With the TT, Audi acknowledges the strong pull exerted by the thoroughbred sports car in its original form. Even the model name is a tribute to one of the legends of motor sport, the famous “Tourist Trophy” race.

High-torque turbocharged engines with five valves per cylinder, permanent four-wheel drive or front wheel drive, sports suspension with large cast alloy wheels and wide tyres, a comprehensive safety package including driver’s and front passenger’s front airbags and head-and-thorax side airbags: these are just some of the remarkable technical features of this compact sports coupé with its dramatic lines and powerful proportions, its crouched stance when viewed from the side and its extremely short body overhangs.

With a specific power output of 125 bhp per litre, the 165 kW (225 bhp) 1.8-litre 5-valve turbocharged engine in the Audi TT Coupé quattro achieves a figure that outperforms many an admired sports car engine. Two charge-air intercoolers help it to attain this impressive level of efficiency.

Its peak torque of 280 newton-metres satisfies the driver's every wish for brisk, forceful acceleration, even from the very bottom end of the engine-speed scale. This TT quattro reaches 100 km/h from a standing start in only 6.4 seconds and has a potential top speed of 243 km/h.

Flexibility is remarkable too: only 11.2 seconds for the sprint from 60 to 120 km/h in 5th gear – another guarantee of sporting high performance. Yet the total fuel consumption of only 9.2 litres per 100 kilometres according to EU standard 93/116 for the 165 kW (225 bhp) TT quattro is a remarkably good figure for a car with this kind of performance on tap.

Maximum torque from the 132 kW (180 bhp) version, which is available either with front-wheel drive or as a quattro, is a healthy 235 Nm, available as low down the engine-speed scale as 1950 rpm. Whether in front-wheel drive or quattro form, however, the TT with this engine accelerates from 0 to 100 km/h in 7.4 seconds; the front-wheel drive version's top speed is 228 km/h, that of the quattro version 226 km/h.

True to its character as a genuine sports car, the TT makes rapid, precise gear changes a delight. Both versions with 132 kW engine have a five-speed gearbox; the 165 kW TT quattro has a 6-speed gearbox as standard equipment.

A new development in the TT quattro is the electro-hydraulically controlled four-wheel drive system. A multi-plate clutch between the propeller shaft and the rear axle distributes engine power in precisely the proportions needed between the front and rear axles. Its control unit evaluates a variety of signals, including wheel rotating speeds, engine speed and engine torque. The advantage of this new system is its ability to react incredibly quickly when driving conditions change.

Audi's chassis and suspension development engineers had a clear picture of how a genuine sports car is intended to perform. They gave it a short wheelbase for maximum agility, a wide track, large wheels with wide rims, a low centre of gravity and firm suspension settings for excellent dynamic stability.

The very latest electronic co-pilots maintain traction, dynamic stability and safety. All TTs are equipped as standard with anti-lock braking (ABS), electronic braking-pressure distribution (EBD) and an electronic front-axle differential lock (EDL).

The 132 kW front-wheel drive version also has Traction Control (ASR). The power-assisted steering has a direct overall ratio, for optimum road “feel” and precise control at high speeds.

A highlight of the interior equipment and trim are the sports seats, upholstered in a combination of leather and Alcantara. The driver’s and front passenger’s seats are well contoured and continuously variable in height. Both are heated too as standard equipment, to ensure the occupants’ well-being in all weathers.

Other items in a generous standard equipment specification are central locking with radio remote control, electric windows and a sports steering wheel of three-spoke design with a TT-specific aluminium ring on the centre boss.

If necessary the centrally split rear seat back can be folded to transform a pure sports car into a tourer with up to 540 litres of luggage space available (quattro: up to 490 litres). The large curving luggage compartment lid opens to a wide angle and makes loading easy.

The new Audi TT will appeal to men and women who appreciate technical skills and performance, and who wish to live out and demonstrate their personal style with an unmistakable sports car of advanced design. For them, the new Audi TT Coupé, in particular the quattro, is a unique chapter in automobile culture that fully matches their own high standards.

The TT Coupé is the first Audi model to be built and assembled as a joint operation between Ingolstadt, Germany and Győr, Hungary.

The thoroughbred sports car: design, technical features, performance

Purity of design, exclusive technical features, exceptional performance potential. This is the concept that identifies Audi with the very origins of the pure-bred sports car, which it has interpreted in such an advanced form in the TT.

High-torque turbocharged engines with five valves per cylinder, developing up to 165 kW (225 bhp); permanent four-wheel drive or front-wheel drive; sports suspension with large cast aluminium wheels and wide tyres; a comprehensive safety package including airbags for the driver and front passenger as well as head-and-thorax side airbags: these are all features of a car that's unique in the sports-car segment of the market.

The TT is equally unique in its appearance: the compact 2 + 2-seater coupé with large rear load-area flap is a strong visual challenge. The interior, the low seated position close to the road and the ideally placed controls are an intensive way of experiencing the unity between car and driver that a true sports car should offer.

The Audi TT is the sports car for people born with the proverbial shot of "petrol in their blood": people who love to drive, who appreciate skilled automobile engineering and performance, who wish to live out and demonstrate their personal style with an advanced, unmistakable sports car. For them the new TT Coupé, in particular the quattro version, is a unique piece of automobile culture and one that at last satisfies their own high standards.

There are rational reasons lying behind the enthusiasm that this unusual sports car arouses: all versions of the TT are good value for money, with only moderate running costs. Extra attention has been paid to reducing the cost of repairs, so that the Audi TT is at the top of its class in the insurers' typical damage repair cost statistics. This means low third-party and comprehensive insurance premiums.

The fascination of no-compromise design

The Audi TT design study exhibited at the 1995 German Motor Show arouses immense enthusiasm for its purist design and exclusive technical features. Now the series-production model is ready to launch, and proves to have retained all the consequence and visual appeal of this unique sports car. No compromises have been allowed to water down the inspiration of the original design – a rare success in automobile development history. Series-production requirements were incorporated with the greatest possible care.

The TT took shape in the heads – some might say in the hearts – of Audi's designers, who are people that have never lost their enthusiasm for a fine automobile. They were allowed every possible freedom in transforming their conception of "how a sports car made by Audi should look" into reality.

With its compact shape, clear outlines and bold styling, the TT is an ambassador for the distinctive formal language that Audi has made its own. But it doesn't take an eye schooled in the mysteries of automobile design to identify certain similarities between the Audi TT Coupé and the Audi A6.

Such confidence in design is achieved by reducing the outlines and forms to essentials – just as the artists at the "Bauhaus", the first European design school, did back in the nineteen-twenties. They established the concept of modern product design, and their ideas found adherents all over the world.

Everyone would surely agree that the wheels are among the most important of a car's features. Audi's designers therefore put the wheel at the focal point of their creative work and produced a body with "wheel emphasis". Seen from the side in particular, the Audi TT Coupé clearly reveals how the body is "stretched", so to speak, over the wheels. The strictly geometrical wheel arch cut-outs are boldly accented. The bold curved surfaces at front and rear also derive quite clearly from the wheels, as do the roof and window lines and the crouching silhouette of the occupant area.

The result is a low-slung sports car 4.04 metres long, 1.86 metres wide and only 1.35 metres high, with truly exciting lines and powerful proportions largely governed by the crouched stance when seen from the side, the exceptionally short body overhangs and the reduced glass areas.

Every detail of the Audi TT Coupé confirms its designers' refusal to compromise. The emphatic edges which separate the roof visually where it flows into the tail, for example, were only obtainable by adopting an ingenious production method: laser brazing produces the seamless joint between the side panel and the C-post.

The aluminium fuel filler cap is an eye-catching detail. It recalls the quick-release filler caps used in motor sport, though in this case only as an evocative design tribute. The exposed Allen screws, however, are genuinely used to secure the filler cap to the body – this too as evidence that form follows function in every aspect of the TT's design.

The cast aluminium wheels were styled exclusively for the Audi TT. Their spokes are attached at the outer edge of the rim, so that the wheels look even larger and emphasise the TT's sporting character.

Inside the Audi TT Coupé, the same no-compromise approach to forms and materials has resulted in visual appeal of a very special kind. The warm, vital surfaces of the standard leather and Alcantara upholstery creates a deliberate contrast with the cool, shimmering matt finish of the many functional elements made from aluminium: on the gear lever, ventilation outlets, steering wheel, glove box and radio trim panel. The leather-padded support struts linking the dash panel to the centre console and the car's floor are particularly striking. Even the pedals have benefited from the Audi designers' sense of the unusual: brake, clutch and accelerator pedals are of perforated stainless steel, with rubber studs for reliable grip, and with their restrained sense of style enhance the TT's appeal to the active driver.

There is perfection in detail wherever one looks. The smooth sides of the luggage compartment, for instance, are not interrupted by any bulges or recesses. The CD changer has a separate compartment in the side panel behind the driver, the audio system's amplifier is beneath the rear seat and the first-aid box is easily reached when needed in the side panel trim behind the passenger's seat.

"TT" – tribute to a legendary motor-sport event

By naming this model "TT", Audi pays its respects to a motor sport event that has become a legend. "TT" stands for the spectacular car and motorcycle race held for the first time in 1905 on the Isle of Man – the "Tourist Trophy".

The history of the Tourist Trophy began at the very start of this century. At that time Gordon Bennett, the heir to a New York newspaper empire, donated a trophy as a means of comparing the performance of the American and European automobile industries' products. The first Gordon Bennett race was held in 1900, on a 352-mile course from Paris to Lyon in France; in 1902 the race was run from Paris to Innsbruck in Austria, and in 1903 moved to Ireland.

It was planned to hold the 1904 event in England, but the ban on road races had not yet been lifted, and so the Automobile Club of Great Britain decided to switch the venue to the Isle of Man, in the Irish Sea. The Gordon Bennett race took place there for the first time on May 10th, 1904.

A year later, in 1905, the first two Tourist Trophy races were held, one in May for motorcycles and one in September for cars. The only cars permitted to take part at first were tourers, with no limit on engine size or power output.

The Tourist Trophy remained on the Isle of Man until 1922, after which events were held in Ards, Donington, Dundrod, Silverstone and on other circuits. However, it was the sheer difficulty of the Isle of Man road circuit and the notable personalities from automobile history who took part – the race was won in 1906 by C. S. Rolls driving his own Rolls Royce – that soon made the Tourist Trophy the motor-sport legend that it is today.

There are earlier links between Audi and the Tourist Trophy. Ever since 1911, NSU riders contested the motorcycle events, with frequent success. To commemorate this, a sports version of the popular NSU Prinz compact car was named the TT in 1967. The TT was built at the Neckarsulm plant, which today manufactures the Audi A6 and Audi A8.

Developed from the standard TT model for competition use, the NSU TTS had a 1000 cc engine with a power output of up to 85 bhp, and played a leading part in its class on the motor-sport scene. In 1967 it won the Tour d'Europe, at the time the world's longest rally.

Sporting in character, compact, a sprinter with a high top speed – all these characteristics link the TT models of yesterday and today.

A question of identity: from design study to production model

It's a rare event when a design study reaches production maturity without losing any of its character or fascination. But here too the Audi TT Coupé is a welcome exception to the rule.

At first glance there seem to be only minor differences between design study and production car, but a closer look reveals certain changes: the original sketches featured an extremely wide rear roof pillar, whereas the production Coupé has triangular-shaped windows at this point. These not only improve all-round visibility but also create a more free-flowing roof line, so that the entire outline of the car appears longer and more dynamic. A slight increase in length at the rear adds to this impression.

A further look at the visible differences between design study and final production car reveals that the radiator opening at the front now contains a grille of restrained appearance, the air inlets under the bumper now look larger and the rear lights have been repositioned.

The Audi TT Coupé's remarkable degree of conformity between initial design and subsequent production model, between draft and final product so to speak, is due in no small measure to the determination and enthusiasm of everyone concerned with this project, allied to Audi's advanced development techniques.

The art of bridge-building

Within Audi, there is a vehicle-structure geometry team that constitutes the decisive "bridge" between the design and construction areas. It is known as the "Strake" team, using a term that originally came from boat-building. A hull – or the panels of a car's body – is correctly "straked" when the surface is absolutely smooth and free from hollows. This ensures optimum flow (in air or water as the case may be) and satisfies the highest visual standards too. The "Strake" engineers have, in other words, to define the precise geometry of the car's exterior and interior surfaces.

In the past, Audi normally produced a clay model of the final body shape at the end of the design phase. This model was used to supply geometrical data for the subsequent technical development stages. The data sets were not transferred to the construction departments until every surface of the design model had been finalised. However, there were often situations in which the designer's or the structural engineer's wishes could not be interpreted effectively at the first attempt. AUDI AG has therefore adopted an alternative method, in which development work commences simultaneously in the Design, "Strake" and Construction areas. This avoids the unnecessary expense and loss of time involved if development work is duplicated.

This is a genuinely pioneering step forward: even when the early design models are still being produced in clay, initial data can be generated in the "strake" team's computers. The clay model is scanned by stereo photogrammetric methods, resulting initially in a virtual relief drawing, which includes the unavoidable shortcomings of the hand modelling process. The "concept strake" is then produced in a series of stages. The team works closely with the designers and construction engineers until the computer has created a digital replica of the future car with a perfect "Class A" surface. Thanks to this intensive process, the links between the geometrical team, the designers and the construction planners are so close that many tasks can be performed in parallel. The decisions are taken and responsibility assumed wherever specific questions arise.

The computer software used for the "strake" process, on the development of which Audi exerted considerable influence, is called "ICEM Surf".

The Audi TT's brilliant aerodynamics

In 1982 the Audi 100 set up a new aerodynamic world record for saloon cars, with a drag coefficient (c_D) of only 0.30. Since then, Audi has justly been regarded as a pioneer in the field of motor-vehicle aerodynamics. This know-how is a feature of the new sports car too. Its body was aerodynamically optimised in both the wind tunnel and the water chamber. Despite tyres of generous size and the additional air volume needed to cool a high-performance turbocharged engine, a drag coefficient of $c_D = 0.34$ has been achieved – an outstanding value for a sports car. Together with a frontal area of only 1.99 square metres, the result is exceptionally low resistance to the airflow.

The underside of the car has a significant part to play in this. The benefits of the smoothest of bodies can be sacrificed if the under-surface is broken up or includes too many aerodynamically unsatisfactory obstructions. The underside of the Audi TT Coupé was therefore optimised with the aid of a wind-tunnel simulation technique originating from motor sport. The aerodynamic tests are not performed as in a conventional wind tunnel, but on a car that appears to be moving along a road. This phenomenon is achieved by placing the car on fast-moving belts that cause its wheels to rotate. A further belt passes beneath the car's body to simulate the road surface. This new method of measurement yields far more realistic results and increases the engineers' scope for optimisation.

In their striving for the perfect sports car, the aerodynamicists made use of several ingenious technical principles. For example, how can one supply a powerful engine with the necessary volume of cooling air, without spoiling the car's aerodynamics?

Audi has tackled this problem successfully on the TT Coupé and on other models as well by making use of an aviation-industry development: the NACA air inlet. This takes its name from the organisation which preceded the better-known space authority "NASA".

The airspace engineers' task was to develop new cooling concepts for aircraft, in other words to divert as large a volume as possible of air into a suitable duct in order to cool the engines and the oil. The best solution was found to be an aperture which increases in width according to a special pattern – a technique that racing cars have also adopted with success. NACA inlets are used on Audi models in the engine enclosure panels underneath the car.

On the TT, a nose-end enclosure improves the airflow in the front axle and engine areas; a large-area fuel tank cover panel performs the same function at the rear. Eddy currents round the wheels are smoothed by spoilers integrated into the underside of the body.

Low levels of wind noise at high speeds are a sure sign of good aerodynamics. In this respect, the Audi TT Coupé matches the level of comfort achieved by Audi's saloon cars. Special door seals, for example, prevent resonance from building up in the panel and door cavities. The frameless side windows generate only a minimum amount of wind noise right up to the car's top speed. To ensure that the doors can be shut without undue effort despite the side windows pressing firmly against their seals, the windows move down by about a hand's width whenever the door handle is operated, and slide back up again after the door has been closed.

The power train

Turbocharged know-how

Audi's experience in the turbocharged-engine field has a long tradition and results from having the courage to adopt this innovative principle when it was still largely unknown. It was with turbocharged engines that Audi scored its many legendary rally and touring car racing successes, and it has honed this power source to a fine edge in both spark-ignition and diesel forms.

When developing engines for the Audi TT Coupé, the company's engineers had an outstandingly good foundation on which to build: the turbocharged 1.8-litre engine with five valves per cylinder. This engine had always placed the emphasis on abundant torque and was therefore ideal for the task. Using it as a reliable basis, many components were either modified or completely redesigned to suit the new task, from the turbocharger itself and the intake manifold to the electric engine management control unit. In this way it has been possible to increase the engine's power output in the TT to 132 kW (180 bhp) and, in its more powerful guise, to no less than 165 kW (225 bhp).

One of the impressive technical features for which Audi's new turbocharged engines are noted is the design of the inlet ports. They impart a "tumble effect" to the charge air as it enters the combustion chamber. This effect increases the speed of the combustion process and thus ensures more complete combustion. The engine's efficiency is increased and its pollutant emissions are lowered. In this area the TT also benefits from the know-how acquired with the new V6 "biturbo" engine.

The new Audi turbocharged engines feature the latest electronic engine management generation, Motronic ME 7.5.

The sheer number of functions that this adaptive system controls is most impressive: throttle butterfly position, boost pressure control, sequential fuel injection with air mass measurement by means of a hot-film sensor, mapped ignition characteristic with solid-state high-tension distribution system including individual coils for each cylinder, and cylinder-selective knock control with two sensors.

The engine management system senses the amount of torque which the driver wishes to have transmitted to the driven wheels and decides how this wish can be fulfilled most rapidly and economically; it then adjusts the throttle butterfly position, turbocharger boost pressure and ignition timing to the most suitable settings.

The accelerator pedal is no longer connected to the engine mechanically by a wire cable, but electronically. This enables the throttles to be opened and closed by precisely the amount needed in any given operating situation.

The adaptive or “self-teaching” engine management system also makes it possible to modify engine settings according to the grade of fuel which happens to be available, and to maintain the most favourable relationship between boost pressure, torque and ignition timing.

The new engine management control unit also enables all the car’s electronically monitored and regulated functions to be brought together in a single unit. It is connected to the same central information line as the remaining control units, so that full co-operation between them is possible.

The 165 kW (225 bhp) 1.8 T

This 165 kW (225 bhp) turbocharged engine achieves a specific output in the Audi TT Coupé that many a full-blown sports car of recent years would be proud to claim as its own. This level of performance explains why the engine's compression ratio of 8.9 : 1 is extremely high for a turbocharged unit.

To permit this high performance to be achieved reliably, the 1.8-litre engine has been fairly extensively modified. The pistons, connecting rods and big end bearings have been uprated to accommodate the higher combustion pressures. The double-mass flywheel and the clutch have also been modified to match the changed performance characteristic. The intake manifold, turbocharger and exhaust manifold are of entirely new design.

The 165 kW engine is equipped with two charge-air intercoolers, through which the Type K04 turbocharger forces air into the combustion chambers. The airflow path is quite different from the 132 kW version, and together with a larger air cleaner ensures that the temperature of the air reaching the engine is only about 30°C higher than the ambient temperature. This is equivalent to more than 80 % charge-air intercooler efficiency, and keeps the engine supplied with an optimum flow of oxygen-rich air. Maximum boost pressure at the intake manifold can reach 2 bar.

The 165 kW version's pulling power is particularly impressive, with 280 newton-metres of torque available all the way from 2,200 to 5,500 rpm. The engine interprets any desire on the driver's part for brisk acceleration as a powerful leap ahead, even from quite low engine speeds.

The 165 kW TT accelerates from 0 to 100 km/h in 6.4 seconds, and has a top speed in the region of 243 km/h. It is flexible, too, needing only 11.2 seconds to accelerate from 60 to 120 km/h in 5th gear. With a total fuel consumption of 9.2 litres per 100 kilometres according to the EU 93/116 test, the 165 kW quattro is distinctly more economical than might be expected of a car with this kind of performance on tap.

The 132 kW (180 bhp) 1.8 T

With a specific output of 100 horsepower per litre, this engine too is worthy of the pure-bred sports car to which it is fitted.

With five valves per cylinder as a special feature, it owes its vivid throttle response to a compact KKK Type K03 turbocharger. Such relatively small turbochargers have a lower mass moment of inertia and therefore respond more rapidly to accelerator pedal movements. Boost pressure builds up with less delay, so that the unpleasant “turbo lag” effect is avoided. Torque at the lower end of the engine speed range is also improved, this being due equally to optimum throttle butterfly and boost pressure settings. The turbocharger and the five valves per cylinder principle work ideally together, since the potential of the turbocharger can be utilised to the fullest extent by the large total cross-sectional area of the valves in each cylinder.

The high compression ratio of 9.5 : 1 ensures high efficiency and helps to keep fuel consumption low. Total fuel consumption (according to EU 93/116 standard) for the front-wheel-drive version is only 8.0 litres per 100 km, a low figure for a sports car in this performance category.

The 132 kW version has a peak torque of no less than 235 Nm, available over a broad engine-speed range from 1,950 to 5,000 rpm.

This TT version, whether to front-wheel-drive or quattro specification, accelerates from 0 to 100 km/h in 7.4 seconds and has a top speed of 228 km/h (front-wheel drive) or 226 km/h (quattro).

Its flexibility is also a good indicator of what the engine is likely to achieve in practice. It is a direct indicator for the engine's throttle response and pulling power. For example, the more flexible an engine, the faster and more safely overtaking manoeuvres can be carried out. In addition to this, a car with a flexible engine is always more fun to drive – which is surely one of the fundamental motives for buying a sports car in the first place! In 4th gear, the Audi TT Coupé with 132 kW engine accelerates from 60 to 120 km/h in 9.8 seconds, the kind of dynamic sports-car experience that is certain to appeal to the enthusiastic driver.

Clean sound from the exhaust system

Exceptional care has been taken to ensure a clean exhaust. The 165 kW 1.8 T has a secondary air pump attached to the engine which helps to ensure that current emission limits are complied with. Fresh air is taken directly from the air cleaner and pumped into the exhaust ports, where a post-combustion process occurs. The energy which this releases heats the catalytic converter, so that even shortly after the engine has been started a high level of emission control efficiency is reached.

Both of the engines available in the Audi TT Coupé qualify as low-emission units according to EU III D.

Those who drive a sports car know that all the senses are stimulated. For this reason Audi's development staff undertook a multi-stage "sound tuning" process to ensure that the TT's power is communicated to the listener in a convincing way. The result is an unmistakably dynamic sound which could never be regarded as excessive, unpleasant or simply "loud".

Whereas the Top TT with 165 kW can be recognised by its two distinctive tailpipes, the 132 kW versions possess a single tailpipe.

Three-shaft gearbox and short lever movements

In both 132 kW versions of the Audi TT Coupé, that is to say with front-wheel drive or quattro, a five-speed gearbox is used. The 165 kW engine transmits its power through a six-speed gearbox as standard equipment.

For the first time, the 165 kW Audi TT Coupé quattro features a three-shaft gearbox. 5th, 6th and reverse gears are transmitted by way of an additional, third shaft in this unit.

An advantage of this new gearbox is that it occupies less space than a conventional two-shaft design, but is capable of transmitting high torques – up to 350 Nm. As a weight-saving measure, magnesium is used for the casing.

Gears are selected by a wire-cable mechanism. This has the advantage that no rigid mechanical linkage is present between the gearbox and the gear lever, so that the transmission of vibration is largely avoided. Short lever travel, a direct gear-change action, well-defined selection points and a precise clutch capable of controlling even the maximum power needed when the car is driven in a sporting style – the TT fulfils these demands to perfection. As a genuine sports car should, it makes every fast, precise gear change a sensual experience.

Unbelievably quick reactions – the quattro

It's interesting to note how a car's fundamental concept can often influence the decision in favour of a host of individual components. This is demonstrated most effectively by the permanent four-wheel drive featured on the quattro versions of the Audi TT Coupé, with either 132 kW (180 bhp) or 165 kW (225 bhp) engine.

The highly desirable compact character of this sports car, with its exceptionally short body overhangs, calls for a transverse engine layout. This in turn means that the system used to distribute torque between the front and rear axles must match the engine layout.

For the first time in the Audi model programme, therefore, the TT Coupé quattro incorporates an electro-hydraulically controlled torque distribution system. It has the same advantages as previous quattro models, is extremely compact and can thus be said to be ideal for installation in the TT. The ability to respond rapidly which matches the car's sporting character so well is achieved by exceptional sensitivity: before the difference in the angles of rotation of the shafts connected to the front and rear axles has changed by more than 45 degrees, the system is able to respond to changes in road conditions.

For example, if slip occurs at the front wheels so that traction is no longer available in full, the torque distribution system takes effect and redirects an increasing amount of engine torque to the rear axle in an accurately controlled process. By the time this change in torque distribution takes effect, the wheel has rotated a mere 25 centimetres further.

The hydraulic multi-plate clutch is controlled electronically and installed between the propeller shaft and the rear-axle differential. Inside its housing is a plate cluster running in an oilbath. This can be forced together by a controlled increase in hydraulic pressure, so that it is capable of transmitting an increasing amount of torque to the rear axle. An electric pre-load pump maintains pressure to ensure that the clutch responds rapidly. The greater the pressure applied to it, the greater the torque redistributed from the front axle to the rear.

In other words, front/rear torque distribution does not take place according to a fixed characteristic; this is a dynamic system in which torque levels are controlled by a variety of parameters.

Two axial-piston pumps supply the pressure to the pistons which operate the clutch plates.

These pumps are driven by a swashplate, which turns when a difference in rotating speed occurs between the unit's input and output shafts. An electronically controlled valve is capable of varying this pressure continuously. The associated control unit makes use of a wide variety of information, including wheel rotating speeds, engine speed and engine torque.

A software program overrides the system sufficiently to take the driver's requirements into account.

For example, the clutch is released when the anti-lock braking system (ABS) takes effect, and no further redistribution of torque front to rear takes place, so that the ABS regulating system is able to operate without outside influences.

The system remains active when the car is reversed, so that maximum traction is available in this situation too. When coasting, the Audi TT Coupé quattro exhibits a consistently mild handling characteristic, which is of considerable benefit, for example, if the driver is forced to lift off at the accelerator pedal during the actual cornering process.

Positioning the engine at the front and the multi-plate clutch for the four-wheel driveline at the rear, adjacent to the rear axle, improves the car's axle-load distribution and is a major factor in the TT's outstanding dynamic stability.

In practice, the driver of an Audi TT Coupé quattro benefits at all times from the proven advantages of this permanent four-wheel driveline: best possible traction on all road surfaces, directional stability when accelerating, high active safety since every scrap of pulling power can be "put down on the road" if necessary, greater stability when cornering – none of these being merely "poor weather benefits".

Chassis, body and equipment

Sporting emphasis – the running gear

All of Audi's impressive know-how in the chassis and suspension development area is to be found in the Audi TT Coupé. It makes driving this "sports car, Audi style" an experience that simply has to be sampled first hand.

Many of the basic design decisions were clearly biased in favour of authentic sports-car character: the short wheelbase that's essential for maximum agility, the wide track, the large wheels with the wide rims and tyres, the low centre of gravity and the firm spring and shock absorber settings for a high level of dynamic stability.

This was the approach which also led to just about every running-gear element being redeveloped to the necessary extent. The front axle for the 132 kW front-wheel-drive car and for the two quattro versions is of MacPherson strut pattern, with new forged lower control arms, new guide joints with larger-diameter journals, new cast steel pivot bearings and specially chosen axle geometry. The anti-roll bar is pivoted directly on the spring strut at each side.

For the TT quattro, the choice fell on a rear suspension layout with combined trailing and double lateral control arms. This is a particularly space-saving design with the springs and shock absorbers mounted separately, the latter at an angle.

True-running and equally compact in design, the rear axle for front-wheel-drive cars has torsion-crank suspension. Track, camber and toe geometry has been matched to the car's sporting character.

Both rear-axle versions include an anti-roll bar. It further increases the resistance to body roll already assured by the firm suspension settings. On the TT quattro the anti-roll bar is pivoted to the wheel hub backplate by means of a connecting linkage at each side, on front-wheel-drive cars a tubular anti-roll bar is welded into the rear axle assembly.

The Audi TT Coupé has disc brakes at front and rear. The front discs are ventilated, on the more powerful version those at the rear as well. Disc diameters of 312 mm at the front and 256 mm at the rear take the car's high performance into account. The fist-type rear brake calipers are made of aluminium. This saves weight, in particular unsprung mass at the wheels, so that oscillation is reduced and dynamic stability improved. Heat dissipation is also better when the brakes are subject to severe loads.

The 17-inch cast aluminium wheels that are standard on the 165 kW TT quattro are shod with size 225/45 ZR 17 tyres, and make a powerful visual impression. Standard equipment on the 132 kW versions are 16-inch cast aluminium wheels with size 205/55 R 16 tyres.

The Audi TT Coupé's power-assisted steering has a very direct ratio, with a characteristic well suited to a sports car, for optimum road "feel" and high steering precision at all speeds. Here too the essential response of a thoroughbred sports car has been well captured.

The very latest electronic "co-pilots" ensure optimum traction, dynamic stability and safety in varying conditions. All TTs have anti-lock braking (ABS) as standard, and also an electronic differential lock (EDL) in the front axle and electronic braking-pressure distribution (EBD). In addition, the 132 kW front-wheel-drive version has Traction Control (ASR).

Higher rigidity – greater sporting character

Body rigidity is a decisive factor when designing a good sports car: the aim is clearly to transmit the output from a powerful engine efficiently to the road in the form of precise handling and roadholding. This in turn means choosing the most suitable running-gear settings, and for these to have their maximum effect – the body itself must act as an extremely rigid "backbone".

The running gear needs this substantial body structure against which to “react”: even in the most severe conditions, there must be no distortion. Body movements generate oscillation, which can conflict with movements of the suspension and have an adverse effect on the car’s road behaviour.

Modern techniques, from computer simulation to laser welding, enable body rigidity values to be achieved which would previously have been considered impossible. It is a particular challenge, however, to do this while keeping the weight as low as possible. For the Audi TT Coupé the development engineers were able to draw on more than 10 years of experience with the finite-element method of computer-aided strength calculation. In addition, they utilised weight-saving construction principles which also extend back for several model generations, notably those adopted on the Audi A8.

Aluminium is a material used to reduce the weight of the Audi TT Coupé in many areas. The engine compartment lid, for instance, is made from this material, as it is on the Audi A6.

The Audi TT Coupé achieves the high torsional rigidity needed for a sports car with roof frame and door sill elements of generous cross-section – up to a third larger than in comparable saloon cars, though in practice very little heavier.

The dimensions and patterns of the elements which connect the body sections together are also of decisive importance. On the Audi TT Coupé, for instance, the door sills are anchored to the front and rear roof posts and the rear side members by means of large-area metal sections in the side panel frames.

The struts to the left and right of the centre console inside the car create an authentic “sports-car look”, but have a clearly defined function to fulfil as well: they strengthen the entire area between the dash panel and the floor pan, and in doing so significantly reduce steering wheel shake.

As well as “local” measures such as these, high levels of torsional and bending strength are essential if vibration and body shake are to be minimised. The Audi TT Coupé achieves outstanding results in this area. Its static torsional rigidity is 19,000 Nm per degree of angle and the first intrinsic bending frequency is as high as 50 Hz. This latter value in particular is reliable proof of a genuinely rigid bodyshell with a “clean” vibration pattern, and therefore a guarantee of the safe, comfortable ride that is so typical of the TT.

Safety – even higher than legal requirements

In addition to the currently valid crash test standards, the Audi TT Coupé already complies with the new European and American frontal and side-on crash requirements.

Audi, however, goes well beyond anything the law may demand. Forthcoming European frontal crash legislation, for instance, calls for an impact at 56 km/h against a deformable barrier, with 40 percent overlap. The Audi TT Coupé has been tested at the higher speed of 64 km/h, in accordance with the European New Car Assessment Program (Euro NCAP) which has been brought into being as a new vehicle safety standard. In addition to FMVSS (Federal Motor Vehicle Safety Standard) 208, which is mandatory in the USA, it is used by American passenger-car insurers (the Insurance Institute of Highway Safety or IIHS).

The European side crash requirements as laid down in 96/27 EU are also fulfilled. This regulation calls for a barrier impact test using a side-impact dummy for measurement purposes. US side impact protection requirements are also complied with. The door intrusion and side impact test requirements differ in many respects from those imposed by the European Union.

Last but not least, the Audi TT Coupé already satisfies the more stringent US head impact regulation FMVSS 201 which will be imposed shortly. A freely suspended dummy head is propelled against the roof and posts of the car's interior, to simulate the loads which could be encountered by the car's occupants in an accident, if their heads come into contact with the car's body structure.

The body's exceptional rigidity is a basic pre-condition for a crash-resistant occupant zone. Various specific measures have been adopted as well to ensure greater safety in a variety of different types of accident.

The possible effects of a side impact on a typically low-slung sports car, together with the absence of a centre roof post, are undoubtedly a serious challenge to the engineers' skill. A most effective solution has, however, been found for the TT: high-strength aluminium side intrusion bars, door sills of ample cross-sectional area and the side panel together form a strong composite assembly. A tubular reinforcement behind the door – referred to as the “trumpet” because of its unusual shape – supports the side panel against the floor and largely prevents any intrusion by another vehicle if a “sideswipe” collision takes place.

Should the car roll over, roof frame elements of generous cross-section resist intrusion in a similarly effective way.

Front airbags for the driver and front passenger provide protection in a frontal crash. Using the car's ignition key, the passenger's airbag can be de-activated at a switch in the glove box. This permits a rearward-facing child's seat to be installed on the front passenger's seat if required. A yellow telltale lamp on the centre console confirms that the airbag has been switched off.

Should a side impact occur, the driver's and front passenger's head-and-thorax airbags come into action. They protect the occupants from the head down to the ribs. These airbags are installed in the front seat backs and therefore always ideally positioned relation to the seat occupant's body, regardless of seat position or seat back angle.

Pyrotechnic-action tensioners at the front keep the seat belts taut against the wearer's body if a collision should occur. Additional belt force limiters prevent the load imposed by the seat belt from becoming too high, even in a severe frontal crash. The front seat belts are also tautened in a side-on collision if this is violent enough to trigger off the side airbags. This keeps the occupants in closer contact with the seats, which tend to move towards the centre of the vehicle after an impact. This reduces the risk of rib injuries.

The rear seat is authorised for use as a Group 3 child's seat (age approx. 4 – 12) and according to ECE-R 44 safety standard. Children between 1.30 and 1.50 metres in height may occupy it without a raised seat and be secured by the regular lap-and-diagonal seat belt. Furthermore, ISOFIX child's seats can be installed on both the car's rear seats; the car has provision for the standardised mountings to be fitted.

Premium standard equipment standards

The typical sports car from an earlier generation was often spartan in its equipment, with many details that almost seemed to have been improvised.

Today's sports-car driver is looking for performance, but also for character and individuality, together with a modern car's standards of comfort and convenience. The Audi TT Coupé satisfies these wishes at premium level, with every feature from radio remote-control with central locking to illuminated make-up mirrors.

One of the highlights of the interior equipment and trim specification are undoubtedly the sports seats with their combined leather and Alcantara upholstery. To ensure that both the driver and front passenger can find the optimum seated position that is so important in a sports car, both front seats are contoured to fit the occupant's body and have continuously variable height adjustment.

Front seat heating is another standard feature: it is continuously variable, with separate controls for the driver's and front passenger's seats. To adjust the heating level one simply presses the rotary knobs on the dash panel in slightly – they are marked with a ring of illuminated dots – until they pop out again. As the knob is turned to vary the heat output, the illuminated dots go on or off in sequence. A clear and distinctive optical signal, and an example of how good ergonomics can be attractive to the eye.

If necessary, the centrally split rear seat back can be folded to transform this sports car into a highly effective tourer, with up to 540 litres of luggage space at the occupants' disposal (quattro: up to 490 litres). The big, curved rear lid opens to a wide angle and makes loading easy.

Various optional extras can be ordered to individualise what is already a fully equipped sports car, including larger wheels and tyres for the 132 kW version, a driver information system, xenon headlights and all-leather upholstery in place of combined leather and Alcantara at no extra charge.

Every detail of the TT confirms its individuality on the sports-car scene. The designers have always gone for the visually and functional answers that remain true to the TT's character – self-evident, logical and in a convincing formal idiom. A good example of this determined approach is the control panel for the optional automatic air conditioning. The selected interior temperature is displayed digitally, but adjustment is by an analogue rotary and rocker switch which always springs back to its initial position. This enables the air conditioning to be operated with a single easy hand movement, and continues the TT-specific style already adopted for the seat heating controls.

There are four audio systems specially matched to the TT's interior to choose from. The Audi "concert" with BOSE Sound System, for example, has a total of seven loudspeakers including a centre-fill unit in the dash panel, a 175 watt four-channel amplifier and four equalisers.

Various accessories and a collection of exclusive lifestyle products from quattro GmbH have been designed to appeal to the sports-car driver.

Quality made by Audi: TT assembly in Győr

The TT Coupé is the first Audi model to be manufactured as a joint operation between Ingolstadt, Germany and Győr, Hungary.

After examining potential sites for a new engine production plant throughout Europe, Audi settled on the Hungarian town of Győr in 1992. One of the world's most modern engine manufacturing operations has since grown up on this site, and is regarded by many planners in the automobile industry as a benchmark.

Almost the entire Audi engine range, from the 1.8-litre 4-cylinder unit to the 4.2-litre V8, is now produced in Győr; in 1998, total engine output is likely to exceed a million units.

At its Győr plant, Audi has systematically introduced a new, process chain-oriented production concept: the distances are short and the work stages from incoming parts delivery to despatch of the finished engines and vehicles are fast and direct. All the assembly teams reject parts unless they are free from defects, and do not pass on any defective items to the next stage in the production process. The result is "manufactured quality" which avoids the costs and delays of subsequent rectification work.

An ingenious logistical concept has been developed for the movement of materials between Győr and Ingolstadt. Parts from outside suppliers and unprocessed items for Győr, such as ready-painted bodyshells for the Audi TT Coupé, are assembled in Ingolstadt and travel overnight by rail to Hungary. In other words, what has been despatched the evening before in Ingolstadt can be machined and installed in Győr the next morning. Finished engines and cars are also transferred back to Ingolstadt overnight. Ten trains make the run between Germany and Hungary every day.

Audi's plant in Győr is part of a networked international production scheme in which the same principles apply everywhere: teamwork, reliability and quality.

Technical data – Audi TT Coupé

German sales specification - Status: August 1998

Model	Audi TT Coupé 1.8 T 132 kW (180 bhp)	Audi TT Coupé 1.8 T quattro 132 kW (180 bhp)
Engine / electrics		
Engine type	4-cylinder spark ignition, turbocharger with charge-air intercooler, DOHC	
Valve gear / number of valves per cylinder	Hydraulic tappets / 5	
Displacement, cc / bore x stroke in mm / compression ratio	1781 / 81.0 x 86.4 / 9.5	1781 / 81.0 x 86.4 / 9.5
Max. output in kW (bhp) / at rpm (acc. to 80/1269/EEC)	132 (180) / 5500	132 (180) / 5500
Max. torque in Nm / at rpm (acc. to 80/1269/EEC)	235 / 1950-5000	235 / 1950-5000
Engine management	Motronic ME 7.5: fully electronic sequential injection with adaptive idle-charge compensation, acceleration enrichment, fuel cut-off, adaptive oxygen sensing; mapped ignition with solid-state high-voltage distributor; cylinder-selective adaptive anti-knock control; air-mass sensor, integrated boost pressure control; co-ordinated engine-torque control	
Exhaust emission control	Heated oxygen sensor, activated charcoal filter, 3-way catalytic converter	
Emission class	EU III D	
Alternator in A / battery in A/Ah	90 / 280/60	
Drive / transmission		
Driveline	Front drive with ASR, EDS	Permanent four-wheel drive via Haldex clutch, EDS at front
Clutch	Hydraulically actuated single dry plate with asbestos-free lining	Hydraulically actuated single dry plate with asbestos-free lining
Transmission type	5-gear manual shift	
1st gear / 2nd gear ratio	3.300 / 1.944	3.818 / 2.105
3rd gear / 4th gear ratio	1.308 / 1.034	1.345 / 0.972
5th gear / Reverse gear ratio	0.838 / 3.060	0.970 / 4.630
Final-drive ratio	3.938	3.758
Suspension / steering / brakes		
Front axle, type	McPherson strut with triangulated lower control arm, subframe, anti-roll bar	
Rear axle, type	Torsion crank, tubular anti-roll bar	Trailing arm and double wishbone, subframe, anti-roll bar, gas-filled shock absorbers
Steering / steering ratio / turning circle in m (D102)	Maintenance free power-assisted rack-and-pinion / 15.6 / approx. 10.5	
Brake system front/rear	Dual circuit diagonally split ABS/EBD; electronic brake pressure distribution, front: ventilated discs / rear: discs	
Wheels / tyres	7 J x 16 alloy wheels in 5-spoke design / 205/55 R 16 W	
Performance / consumption / acoustics		
Top speed in km/h	228	226
Acceleration 0-80 / 0-100 km/h in s	5.5 / 7.4	5.1 / 7.4
Fuel grade	Premium Plus unleaded, minimum 98 RON	
Consumption urban/extra-urban/total, l/100 km ¹⁾	10.9 / 6.3 / 8.0	12.6 / 6.7 / 8.9
CO ₂ emissions, g/100 km ¹⁾	192	214
Exterior noise level at standstill/drive-by in dB(A)	89 / 74	
Maintenance / warranty (Germany)		
Oil change after km / Inspection after km	15,000 / 30,000 (maximum 1 year)	
Warranty vehicle/paint/body corrosion penetration	1 year unlimited distance / 3 years / 12 years	
Insurance classification: fully comp. / part-comp. / third-party	19 / 32 / 19	
Weight / capacities		
Unladen weight in kg (without driver) / gross weight limit in kg	1205 / 1575	1320 / 1690
Axle load limit front/rear in kg	940 / 735	955 / 835
Trailer load limit, unbraked in kg	not applicable	
Trailer load limit, 8% / 12 % gradient, braked in kg	not applicable	
Roof load in kg	75	
Fuel quantities		
Cooling system capacity (incl. heater) in l	7	
Engine oil capacity (incl. filter) in l	4.5	
Fuel-tank capacity in l, approx.	55	62
Body / dimensions		
Body type	load-bearing shell, fully galvanised, steel, aluminium engine compartment lid	
Seats	2 + 2	
Drag coefficient c _D / frontal area A in square metres	0.34 / 1.99	
Length (L103) / width (- mirrors) (W103) / height (H100), mm	4041 / 1764 / 1346	4041 / 1764 / 1345
Wheelbase (L101)/track front/rear (W101/W102) in mm	2422 / 1528 / 1513	2429 / 1528 / 1505
Loading edge height in mm (H195)	760	767
Luggage space acc. to VDA block test in l (V210)	270 (540 with rear seat back folded down)	220 (490 with rear seat back folded down)

¹⁾ According to 93/116/EU

Technical data – Audi TT Coupé

German sales specification - Status: August 1998

Model	Audi TT Coupé 1.8 T quattro 165 kW (225 bhp)
Engine / electrics	
Engine type	4-cylinder spark ignition, turbocharger with 2 charge-air intercoolers, DOHC
Valve gear / number of valves per cylinder	Hydraulic tappets / 5
Displacement, cc / bore x stroke in mm / compression ratio	1781 / 81.0 x 86.4 / 8.9
Max. output in kW (bhp) / at rpm (acc. to 80/1269/EEC)	165 (225) / 5900
Max. torque in Nm / at rpm (acc. to 80/1269/EEC)	280 / 2200-5500
Engine management	Motronic ME 7.5: fully electronic sequential injection with adaptive idle-charge compensation, acceleration enrichment, fuel cut-off, adaptive oxygen sensing; mapped ignition with solid-state high-voltage distributor; cylinder-selective adaptive anti-knock control; air-mass sensor, integrated boost pressure control.; co-ordinated engine-torque control
Exhaust emission control	Heated oxygen sensor, activated charcoal filter, 3-way catalytic converter
Emission class	EU III D
Alternator in A / battery in A/Ah	90 / 280/60
Drive / transmission	
Driveline	Permanent four-wheel drive via Haldex clutch, EDS at front
Clutch	Hydraulically actuated single dry plate with asbestos-free lining
Transmission type	6-speed manual shift
1st gear / 2nd gear ratio	3.417 / 2.105
3rd gear / 4th gear ratio	1.429 / 1.088
5th gear / Reverse gear ratio	1.097 / 0.912
Final-drive ratio	4.107 / 3.758
Suspension / steering / brakes	
Front axle, type	McPherson strut, triangulated lower control arm, subframe, anti-roll bar
Rear axle, type	Trailing arm and double wishbone, subframe, anti-roll bar, gas-filled shock absorbers
Steering / steering ratio / turning circle in m (D102)	maintenance free power-assisted rack-and-pinion / 15.6 / approx. 10.5
Brake system front/rear	Dual circuit diagonally split ABS/EBD; electronic brake pressure distribution, front and rear: ventilated discs
Wheels / tyres	7,5 J x 17 cast alloy wheels in 6-arm design / 225/45 R 17 Y
Performance / consumption / acoustics	
Top speed in km/h	243
Acceleration 0-80 / 0-100 km/h in s	4.3 / 6.4
Fuel grade	Premium Plus unleaded, minimum 98 RON
Consumption urban/extra-urban/total, l/100 km ¹⁾	12.3 / 7.3 / 9.2
CO ₂ emissions, g/100 km ¹⁾	221
Exterior noise level at standstill/drive-by in dB(A)	87 / 73
Maintenance / warranty (Germany)	
Oil change after km / Inspection after km	15,000 / 30,000 (maximum 1 year)
Warranty vehicle/paint/body corrosion penetration	1 year unlimited distance / 3 years / 12 years
Insurance classification: fully comp./part-comp./third-party	24 / 32 / 22
Weight / capacities	
Unladen weight in kg (without driver) / gross weight limit in kg	1395 / 1765
Axle load limit, front/rear in kg	940 / 735
Trailer load limit, unbraked in kg	not applicable
Trailer load limit, 8% / 12 % gradient, braked in kg	not applicable
Roof load in kg	75
Filling quantities	
Cooling system capacity (incl. heater) in l	7
Engine oil capacity (incl. filter) in l	4.5
Fuel-tank capacity in l, approx.	62
Body / dimensions	
Body type	Load-bearing shell, fully galvanised, steel, aluminium engine compartment lid
Seats	2 + 2
Drag coefficient c _D / frontal area A in square metres	0.35 / 1.99
Length (L103) / width (- mirrors) (W103) / height (H100), mm	4041 / 1764 / 1345
Wheelbase (L101)/track front/rear (W101/W102) in mm	2429 / 1528 / 1505
Loading edge height in mm (H195)	767
Luggage space acc. to VDA block test in l (V210)	220 (490 with rear seat back folded down)

¹⁾ According to 93/116/EU