



Press Information

SIRION 2CD

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DAIHATSU MOTOR CO., LTD.

The SIRION 2CD—A Compact Car Powered by a Future-Oriented Internal Combustion Engine

Opinion varies as to how much longer the internal combustion engine will remain the mainstream engine for automotive applications. Some people say that the era of the internal combustion engine will draw to a close some time in the first half of the 21st century. There are two main reasons for this view. The first is that the petroleum reserves that supply cheap petrol and diesel fuel are expected to dwindle in the decades ahead. The second is that the continuing use of hundreds of millions of these engines creates too large an environmental problem. Either way, no matter how much we may love the internal combustion engine, we can't keep using it forever.

Accordingly, automakers the world over are working avidly to develop a new technology that can replace the internal combustion engine. Whether this will operate on electric batteries or fuel cells, or whether it will be a hybrid device consisting of an electric motor plus an internal-combustion engine, we don't yet know. But one thing we can assume is that whatever technology eventually prevails as the next-generation standard, it will take huge amounts of time and money before that standard is agreed. On the other hand, efforts to improve current internal combustion engine technology are by no means over. Automakers are continuing to pour their energies into making these engines more efficient, less fuel-consuming and more environmentally friendly. And one of the most recent achievements in this direction has been the development of an engine that makes possible a so-called "3-litre" car that can travel 100 km on 3 litres of fuel.

The SIRION 2CD is a 3-litre car from compact-car specialist Daihatsu. While its main objective is to run for 100 km on 3 litres of fuel, it does so without sacrificing either dynamic performance or riding comfort. This lightweight car is powered by a totally new-concept, 2-stroke cycle, direct-injection diesel engine. It's an engine that gives the user the joy of driving a true eco-car.

Compact and lightweight

The SIRION 2CD's base car, the Sirion, boasts top-class fuel economy as a 1-litre petrol engine car. To further improve its fuel consumption, the SIRION 2CD has been given a 50 kg lighter aerodynamic body featuring specially shaped bumpers, a roof-end spoiler, an engine-under cover and a rear-floor-under cover. As a result, the new car realizes surprisingly low fuel consumption while exhibiting a level of driving performance comparable to that of the petrol version.

Engine

The SIRION 2CD's most characteristic feature is its innovative E202 engine. A 3-cylinder, 987 cc, two-stroke cycle diesel engine with a displacement per cylinder of 329 cc, the E202 is the world's smallest two-stroke cycle, direct-injection diesel engine.

In a four-stroke cycle engine, each cylinder produces a power stroke on every other turn of the crankshaft. But in a two-stroke cycle engine, each cylinder produces a power stroke for every turn of the crankshaft. In other words, two-stroke cycle engines operate with twice as many power strokes per cycle as four-stroke cycle engines. As a result, a two-stroke cycle engine delivers more power for a given rpm. This characteristic is particularly useful in the case of small engines, which tend to lack sufficient torque in the low-speed range. Moreover, because each cylinder produces a power stroke with every turn of the crankshaft, two-stroke cycle engines also exhibit better vibration characteristics than four-stroke cycle engines.

The big advantage of diesel over petrol is that diesel engines, and particularly direct-injection diesel engines, have a higher thermal efficiency. This is environmentally friendly because higher thermal efficiency translates into lower CO₂ emissions, and lower CO₂ emissions ultimately result in less global warming.

On the downside, however, diesel engines generally deliver less power for a given size and they produce more NO_x and particulate matter. What's more, diesel engines generally produce more noise and vibration.

The E202 engine combines the superior power and vibration characteristics of a two-stroke cycle engine with the excellent thermal efficiency of a diesel engine, and also incorporates a wide array of new technologies that help overcome the problems of conventional diesel engines. As a result, this advanced 3-cylinder engine delivers a max. torque of 155 N·m and a max. power of 45 kW from a small 1-litre displacement.

Technologies used in the E202 engine

One of the keys to the performance of a two-stroke cycle engine is its scavenging method—the means of expelling the burned gases from the cylinder. The E202 engine employs a hybrid scavenging system that combines a super charger, a variable nozzle turbo charger and an intercooler together with a bypass control for internal exhaust gas re-circulation. This hybrid scavenging system improves the output and fuel consumption of the engine by using the exhaust energy efficiently and maintaining the scavenging pressure at an optimum level. The bypass control improves the exhaust performance by controlling the residual gas inside the cylinders. Its scavenging port has been especially designed to improve the scavenging efficiency while also producing the precise swirl that is a physical requirement for the operation of the direct-injection diesel engine.

Controlling the scavenging and exhaust timing is another important factor that determines the performance of a two-stroke cycle engine. In this respect, the E202 engine employs the DVVT (Dynamic Variable Valve Timing) system to control the exhaust timing and ensure an optimum expansion period. When the engine is started

Press Information

up, the DVVT maintains the most advanced valve position to ensure startability. From the low- to the high-speed range, the optimum exhaust timing is automatically selected to obtain the best possible fuel consumption and output in response in accordance with the rpm and loading.

The fuel injection system is a state-of-the-art common rail injection type. This system not only provides an injection pressure optimized for the small-bore of 329 cc cylinder from the low-speed, low-load range to the high-speed, high-load range, it is also designed to perform pilot injection as necessary to achieve extra torque in the low-speed range, better mileage and reduced noise. Moreover, four exhaust valves are employed, and the injector is arranged vertically in the centre of the cylinder so that the fuel is distributed evenly throughout the combustion chamber. The high-pressure injection of the common rail injection system, the centrally-arranged injector and the precise swirl combine to produce optimized combustion, resulting in higher power, lower fuel consumption and a cleaner exhaust.

In addition to the above features, twin catalyzers specifically designed for a diesel engine are employed just below the maniverter and engine. Thanks to these devices, the SIRION 2CD clears the Euro III exhaust emission regulations by a clear margin and is also ready to meet the Euro IV regulations.

For further improved fuel consumption, the SIRION 2CD employs a system that automatically stops the engine when idling, thereby significantly reducing fuel wastage.

To increase durability, ensure precise valve performance, and restrain vibration and noise, the following items have also been incorporated:

- Special cast iron pistons with a cooling channel (effective in reducing heat load of the piston)
- Ceramic piston pins (effective in preventing piston seizure)
- Special cast iron liner with a special scavenging port
- Titanium valves (effective in ensuring good rotational performance thanks to their reduced weight)
- A balance shaft employing the camshaft, lash adjuster and scissors gears (effective in reducing noise and vibration).

Furthermore, an active engine mount system is employed to constrain the influence of engine vibration.

The SIRION 2CD is designed to ensure safety, too. In addition to the advanced safety features of the original Sirion, the 2CD is also equipped with the DVS (Daihatsu Vehicle Stability control system), side air curtains to further improve the car's safety performance. The 2CD also features greatly reduced aerodynamic resistance and a much lighter weight, both of which also contribute to its much improved fuel efficiency and to the achievement of the 3-litre car.

Press Information

The SIRION 2CD is a super-fuel-efficient eco car that is also equipped with excellent running capabilities and NV characteristics.

The E202 is what makes the 2CD a pure 3-litre car. We at Daihatsu are delighted to think that we may have helped prolong the era of the internal combustion engine, all thanks to this little two-stroke cycle diesel engine.

SIRION 2CD

Technical Data

Dimensions and weight

Overall length (mm)	3690
Overall width (mm)	1595
Overall height (mm)	1450
Wheelbase (mm)	2345
Track Front (mm)	1410
Rear (mm)	1390
Min. Road clearance (mm)	140
Kerb weight MT (kg)	800
AT (kg)	810
Seating capacity	5
Turning circle-Tyre (m)	8.8

Engine

Type	E202, water-cooled, 2-cycle, 3-cylinder, direct injection diesel
Displacement (cc)	987
Bore × Stroke (mm)	76.0 × 72.5
Max. output (kW/rpm)	45/3500
Max. torque (N-m/rpm)	155/2200
Compression ratio	20.5
Fuel system	Common Rail System
Fuel tank capacity (litres)	30

Power train

Drive	Front-wheel drive
Clutch	Dry single plate diaphragm, mechanical actuation
Transmission 5MT	Forward 5-speed all synchromesh
4AT	Forward 4-speed full automatic
Final reduction gear ratio 5MT	3.282
4AT	3.144

Press Information

Chassis

Suspension	Front	MacPherson struts with coil springs
	Rear	Semi-independent torsion axle beam with coil springs and stabiliser
Steering		Rack and pinion
Brakes	Front	Discs with booster
	Rear	Drums, leading and trailing
	Parking	Mechanically operating on rear wheels
Wheels		15" aluminium
Tyres		185/55R15

Performance

Fuel consumption	MT (litres/km)	3.4/100
	AT (litres/km)	3.8/100
CO ₂ emission (g/km)		90
Trailer towing	with brake (kg)	750
	without brake (kg)	350