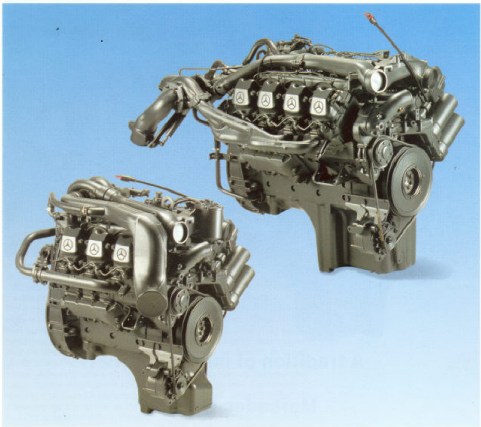
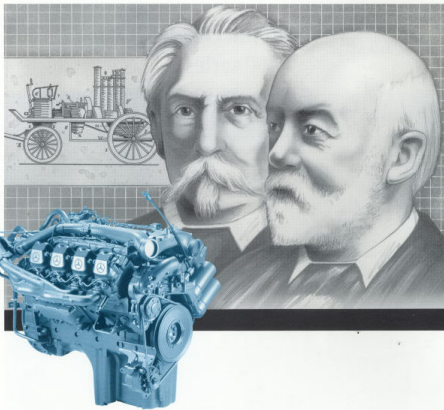
Mercedes-Benz
Industrial engines

Technical concept
400 series

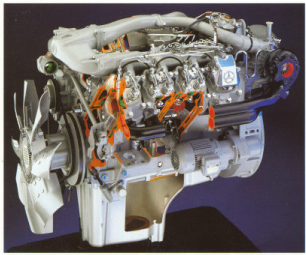




A tradition of innovation:

Mercedes-Benz
industrial diesel engines

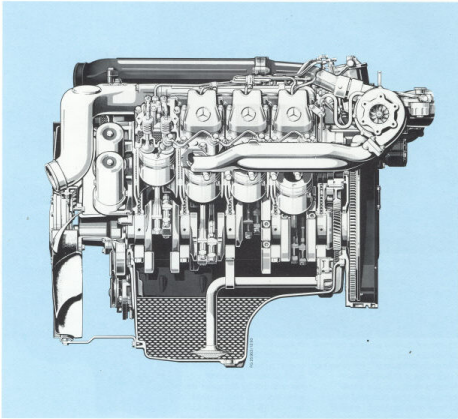
The 400 engine series from Mercedes-Benz



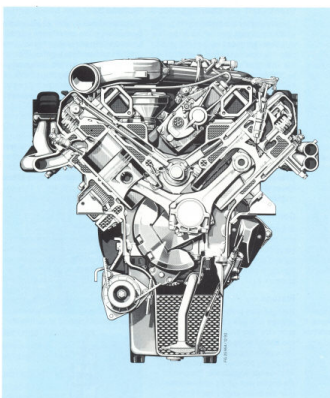
Engine development at Mercedes-Benz has always been pursued along the lines of advanced design, modern technology and precision in manufacture.
The diesel engines of the 400 series achieve very high standards, in every respect, and are used for a large variety of purposes: to drive powerful commercial vehicles, heavy-duty purpose-built vehicles, implements and machines for a wide range of different tasks.
Mercedes-Benz industrial diesel engines have been developed from the large-scale production range of commercial vehicle engines already tried and tested over millions of miles of operation around the globe. Because service life, weight, space requirements, fuel consumption, exhaust emission and reliability have been optimised and ideally matched to one another, they can be selected with confidence for all applications, however demanding. The 400 series of industrial diesel engines comprises six, eight, ten and twelve-cylinder V-engines. It also includes horizontal and vertical versions of a six-cylinder in-line engine.

By means of offset connecting rod journals, the crankshaft of the 6-cylinder 90° V-engine makes for even ignition spacing and thus for the smooth running characteristics of a six-cylinder in-line engine. There are naturally-aspirated engines, exhaust-gas turbocharged engines and versions with intercooler. Depending on the type of operation, the charge air is either liquid-cooled or air-cooled.
The output of the Mercedes-Benz 400 series industrial diesel engines ranges from 147 kW (200 hp) to 612 kW (832 hp). The high degree of parts commonality between the individual engines, and the world-wide Mercedes-Benz service network, have decisive advantages for vehicle and implement manufacturers and users in that parts storage is simplified, maintenance is facilitated and downtime reduced.
Large-scale manufacture ensures consistently high quality and maximum precision. It is in this field that the experience of a leading manufacturer of commercial vehicles and diesel engines bears fruit: as early as the planning stage in the design of new engines, the most up-to-date production methods are considered. The 400 series is a comprehensive range of engines that are matched to the most varied vehicles and implements. However, Mercedes-Benz offer more than just engines. Experienced experts, who are always up to date with practical requirements, are available to give our customers competent advice and assistance.

The basic principles: economy and high performance



The wide range of engine models meets many different requirements as regards output and operation. No other range includes as many versions as this V-engine series. This is the result of the most advanced design principles and the latest technological findings of the entire development potential of Mercedes-Benz. The high degree of parts commonality not only has advantages in parts storage, it also facilitates the work of the designers of vehicle and implement manufacturers.
The six-cylinder engines are fitted with an exhaust-gas turbocharger. The eight, ten and twelve-cylinder engines have two turbochargers, one charger being fitted at the end of each bank of cylinders, on the flywheel side. Two small chargers provide faster acceleration than a single large one, so high charge pressures are reached even in the lower engine speed ranges.



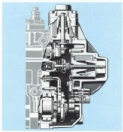
The brawny full-load curve and the associated torque increase with decreasing engine speed, which results in a high torque rise, ensure high elasticity and optimum performance. The maximum torque is already available at low engine speeds in the range of lowest specific consumption.

Matching engine displacement and engine speed is one of the essential preconditions for long service life and operational reliability, low fuel consumption and environmentally compatible operation.
The 6- and 8-cylinder EURO 2 engines achieve the emission values specified under the general heading of EURO 2 which will apply as of October 1996 for vehicles to be newly introduced onto the market.
Turbochargers and intercooling are used on all engines and combustion in the engine has been optimised.

Electronic control, which is implemented with the help of the control-sleeve pump, forms the nucleus of the system as it once again considerably reduces pollutant and particulate emissions.

Engine speed and load control

Sensors supply information for every operating state to the electronic system for map-optimised control of the positioners. The data processed are engine speed, current start of injection, control rod travel, boost pressure, charge air temperature, fuel and coolant temperature, engine start/stop switch, Tempomat/cruise control, Tempopset and autmatic switchover to RQV governor characteristics when engaging a PTO. The start quantity limiter, which is independent of the coolant temperature, prevents excessive smoke formation and unnecessary revving up of the engine after starting.



Electrical equipment

Different types of starters and alternators are available.

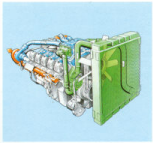
Lubrication system

Forced-feed lubrication by means of gear-type oil pump. Various oil coolers are used which are either combined with the oil filter or installed separately. All points to be lubricated as well as all areas to be cooled are supplied with pressure oil. The injection pump and the governor are connected to this circuit, and so are the exhaust-gas turbocharger and the air compressor if included in the equipment.

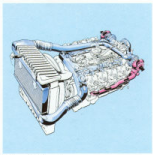
Cooling system

The cooling system is a closed, pressurised circuit, with cooling ducts cast into the crankcase and designed for operation with finned radiators or heat exchangers. The two thermostats, connected in parallel, and the V-belt driven centrifugal coolant pump are together fitted in one housing. Areas which are subjected to thermal stress, like cylinder liners, valve lands, injection nozzles and oil coolers, are cooled very intensively.

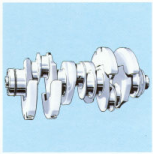
For different applications, there are suction and pusher-type fans available which are fitted on the crankshaft or in a raised position on a bearing bracket. On engines with air/coolant charge-air cooling, the intercooler is connected to the inner coolant circuit.



Schematic drawing – air/coolant charge-air cooling



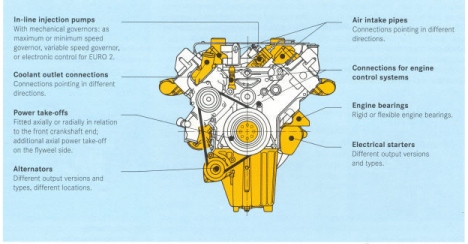
Schematic drawing – air/air charge-air cooling

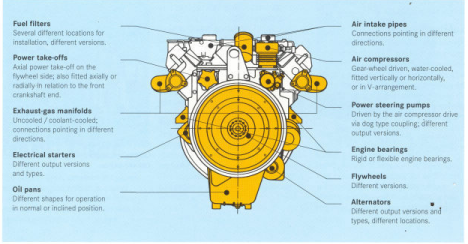


Crankshaft with even ignition spacing – OM 441 engine

The 400 series – basic engines with a large variety of versions

Wherever a reliable and economical industrial engine is needed, special-vehicle and original-equipment manufacturers can safely rely on Mercedes-Benz. The modular system of the 400 series comprises basic engines which can be complemented by a large variety of practical components and assemblies, so as to solve every problem. Economy is improved by the high degree of parts commonality; this not only facilitates maintenance but also simplifies parts stocking and thus reduces downtime. From the large variety of versions, we can only give you a few examples to illustrate that the 400 series engines can be adapted to every type of operation and to the most varied installation requirements.





Advanced technology down to the smallest detail

The engines of the 400 series are universally applicable and fulfil the specific requirements of the relevant applications. Over many years, they have proved their power and reliability in vehicles and implements. These compact engines owe their long service life, high torque over a wide engine speed range and their economy to a multitude of special design features, some of which will be described below as examples of the overall philosophy.

Crankcase

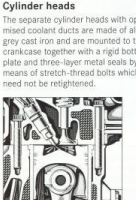
The rigid cylinder crankcase with reinforced intermediate walls, cover and exterior walls is made of alloyed grey cast iron with cast-in coolant ducts. The sidewalls reach down below the center of the crankshaft, and the oil pans are made of light alloy.

Timing gear case

The timing gear case on the flywheel side can accommodate power-take-off units for air compressor, power-steering pump and other accessories.

Cylinder heads

The separate cylinder heads with optimised coolant ducts are made of alloy grey cast iron and are mounted to the crankcase together with a rigid bottom plate and three-layer metal seals by means of stretch-thread bolts which need not be retightened.



The hottest area, between the valves and the injection nozzle, is cooled very intensively. The injection nozzles and fuel lines are arranged outside the light-alloy cylinder head covers.

Crankshaft and bearings

Counterweights are bolted to the precision-forged crankshaft which is provided with hardened radii on the journals. The connecting rod journals of the V6 engine's crankshaft are offset by 30° for the right-hand and left-hand cylinder banks. The even ignition spacing of 120° thus obtained leads to the vibration response of an in-line six-cylinder engine.
Sputtered bearing shells are used, that is wear-resistant multi-layer materials applied to the supporting steel shell by cathodic sputtering. The front end of the crankshaft has been designed so as to permit fitting of additional accessories which can then be driven via propshafts or pulleys.

Connecting rods

Smooth bearings are used in the precision-forged and obliquely split connecting rods. An oil bore reaching from the big end to the piston pin boss supplies the upper connecting rod bearing with pressure oil.

Pistons

The light-alloy pistons of the EURO 2 engines with new combustion chamber geometry have two compression rings and one oil scraper ring.
The cast-in ring carrier of the upper piston ring provides for precise and wear-resistant guidance. The pistons are cooled with oil via spray nozzles over the entire engine speed range.
In turbocharged engines the piston pin is carried in two pressed-in bronze bushings.
The pistons and connecting rods are removable from above.

Cylinder liners

The well-sealed, wet centrifugally cast cylinder liners are made of a special alloy; they have a tight fit at the upper end and are subject to little distortion. This makes the pistons highly resistant to seizure and wear on the cylinder contact surface.

Camshafts

These are driven by gear wheels on the flywheel end. The cam shape results in faster opening and closing of the valves which in turn leads to high volumetric efficiency at minimal gas cycle work. Each individual cam is sprayed with oil.
Air compressor, power steering pump, PTO and injection pump are driven via the camshaft.

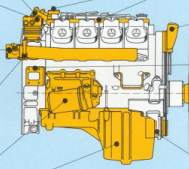
Valves

The overhead valves are fitted with conically shaped valve spring retainers. They are controlled by the camshaft in the crankcase via tappets, push rods and rocker arms. The chromium-plated valve stems run in pressed-in alloy cast iron guides and are sealed via spring-type lip seals.

Injection system

The EURO 1 regulations are met with the mechanically controlled high-pressure in-line injection pump; an electronically controlled control-sleeve pump is used for EURO 2. It allows pressures of up to 1200 bar and minimal injection times. The electromagnetic positioner flanged to the injection pump comprises a linear solenoid to control the

injection quantity and a second solenoid to vary the injection timing. It actuates a slide valve on the lifting-element plunger to release fuel injection with new 6-hole nozzles. An additional programme to reduce white smoke emission in the warm-up phase is not required under ordinary climatic conditions.



Fuel filters
Several different locations for installation, different versions.

Air compressors
Gear-wheel driven, water-cooled; fitted vertically or horizontally, or in V-arrangement.

Power steering pumps
Driven by the air compressor drive via dog type coupling; different output versions.

Exhaust brake
Pneumatically operated via compressed air cylinders. Throttle valves either integrated into exhaust manifolds or in separate butterfly valves.

Lube oil filter and cooler
Different versions.

Oil pans
Different shapes for operation in normal or inclined position.

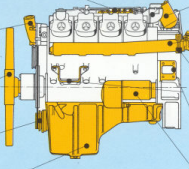
Air intake pipes
Connections pointing in different directions.

Coolant outlet connections
Connections pointing in different arrangements.

Engine bearings
Rigid or flexible engine bearings.

Fans
Different versions as regards output, direction of air flow, location.

Alternators
Different output versions and types, different locations.



In-line injection pumps
With mechanical governors: as maximum or minimum speed governor, variable speed governor, or electronic control for EURO 2.

Coolant outlet connections
Connections pointing in different directions.

Fans
Different versions as regards output, direction of air flow, location.

Alternators
Different output versions and types, different locations.

Oil pans
Different shapes for operation in normal or inclined position.

Air intake pipes
Connections pointing in different directions.

Fuel filters
Several different locations for installation, different versions.

Exhaust-gas collecting pipes
Uncooled / coolant-cooled; connections pointing in different directions.

Exhaust brake
Pneumatically operated via compressed air cylinders. Throttle valves either integrated into exhaust manifolds or in separate butterfly valves.

Engine bearings
Rigid or flexible engine bearings.

Electrical starters
Different output versions and types.

Mercedes-Benz industrial diesel engines – employed worldwide in all fields of application

In the design of the diesel engines from the 400 series, the engineers were able to draw on the experience gained in decades of research and development. These engines have proved themselves worldwide, under all conceivable operating conditions.

Purpose-built vehicles

Buses, mobile cranes, tractors, road sweepers, special fire-fighting vehicles, snowcutters, ski run levellers, aircraft tractors.

Farming machinery

Combine harvesters, forage harvesters, heavy-duty harvesting machinery, heavy-duty farm tractors.

Building machinery

Hydraulic and cable-controlled excavators, wheeled loaders, crawler loaders, bulldozers, road-building machinery, trench-cutting machines, concrete pumps, compressors.

Lifting and hauling machinery

Stationary and mobile cranes, fork-lift trucks, container handling equipment, industrial tractors.

Should you require further material for your information, please do not hesitate to contact our division for industrial engines and automotive components at the following address:

Mercedes-Benz AG
Produktbereich
Fahrzeugaggregate (PBA Z 609)
D-70322 Stuttgart
Phone + 49 (7 11) 17-0
Fax + 49 (7 11) 17-9 09 36
Telex 7 2 524-0 db d

Mercedes-Benz offer not only a high-quality product with a high standard of technology, but a comprehensive range of services as well.
Some examples:

Project consulting.

Mercedes-Benz not only offer a series of engines with a wide range of power outputs to ensure functional suitability. Their experienced specialists also assist in selecting the right drive unit from a wide variety of possibilities. It is a cooperation based on a sense of partnership which has been practised for many years with the many users of Mercedes-Benz industrial engines.

The choice of engine is therefore determined by the requirements made on the power train. For this reason, comprehensive project consulting is indispensable if one is to arrive at the best possible solutions to one's requirements.

Application engineering consulting.

An engine may well be as long-lived and powerful as they make them – but it will never be able to offer the optimum solution if the particular application envisaged is not considered at the time of installation. The experts and facilities of Mercedes-Benz ensure a practice-oriented installation solution even in the most difficult of situations.

An economical solution is ensured only if the right engine with matching components and accessories has been found and correctly installed.

Parts support.

Mercedes-Benz make sure that parts are available for many years to come. Quality and delivery times are up to the high standards which Mercedes-Benz have set with their industrial engines all over the world.

Long-term parts availability and fast deliveries ensure continued year-long reliability of operation for Mercedes-Benz industrial engines.

Service network.

Mercedes-Benz have service facilities all over the world. These include well-equipped workshops as well as qualified personnel who are always up to date on the current state of technology.

Efficient service also decides whether high product quality can be converted into equally high application value.

Service training.

Mercedes-Benz Service Training provides the specialist knowledge required for proper maintenance, service and repair work on industrial engines. Special training courses with information tailored to specific needs, as well as flexible arrangements at home and abroad, ensure the training courses' success.

Since even the best product can only be as efficient as the experts that put it to work, service and maintain it, service training is a clear profit for the buyers of Mercedes-Benz industrial engines.

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