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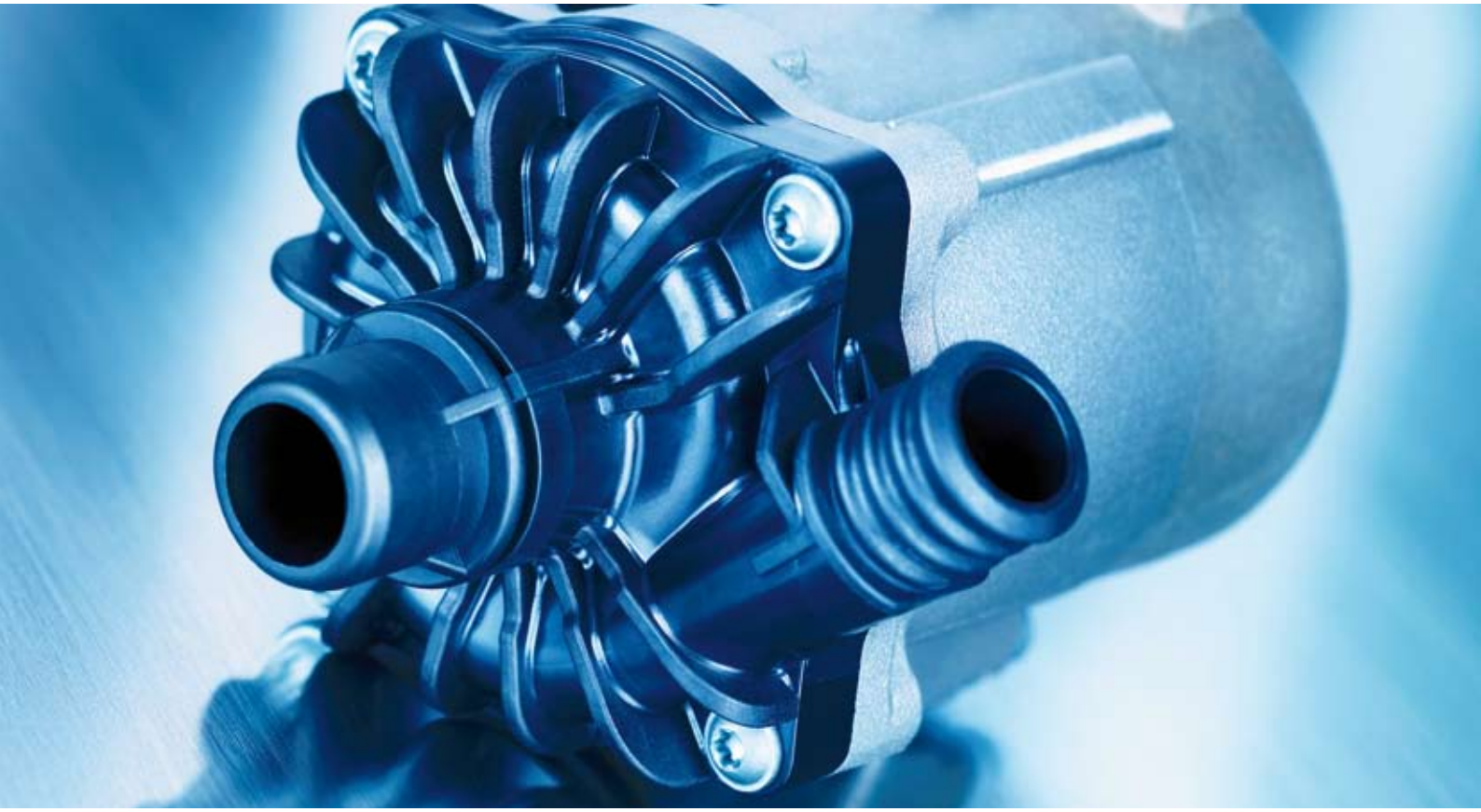

ELECTRIC COOLANT PUMPS –

Always at the Correct Temperature

PIERBURG
PUMP TECHNOLOGY

Electric coolant pumps

Conventional pumps for engine cooling are driven by toothed belts and hence their output is coupled to engine RPM. Coolant pumps need to ensure sufficient cooling even at low engine RPM with high engine loads and at elevated outdoor temperatures, and so for normal operations (higher RPM and low load) they are inevitably oversized. The use of an electric coolant pump together with state-of-the-art thermal management of the combustion engine has measurable advantages. Demand-driven cooling, particularly in the cold-start phase, saves fuel (approx. 3 percent) and leads to a corresponding reduction in emissions. Moreover, improved air conditioning can achieve greater comfort in the passenger compartment. The lack of dependence on a mechanical drive also results in considerable flexibility in component packaging within the engine compartment.

The product selection from Pierburg Pump Technology covers the complete range of applications for electric water circulation and coolant pumps in the automotive industry. The range includes water circulation pumps for stationary air conditioning, run-on and ancillary assembly cooling via electric coolant pumps for charge air and engine cooling. In fact, our company has extensive experience in the area of electric water pumps, especially with regard to EC engine technology and hydraulics. Today in addition to more than 5 million mechanical coolant pumps, more than 1.4 million electric water circulation pumps and coolant pumps with electronically commutated motors are produced each year.

Areas of application

Besides areas of application, the pumps are also classified according to output: the electric water circulation pumps with a total output of 15 to 30 W and the electric coolant pumps with 50 to 1,100 W output.

Typical applications are:

- **15 W**
  - Supplemental and ancillary assembly cooling, air conditioning for passenger vehicles, engine-off cooling and use in electric vehicles
- **50 W – 100 W**
  - Charge air cooling in passenger vehicles
  - Stationary air conditioning for commercial vehicles
  - Bus heating
- **200 W – 400 W**
  - Engine cooling in passenger vehicles (including supplemental and ancillary assembly cooling, air conditioning)
  - Charge air cooling in commercial vehicles
- **600 W – 1,100 W**
  - Cooling drive units in hybrid and fuel cell vehicles

Fig. 1: 3-D CAD model CWA 200

Technology

Innovative new technologies have been applied in the areas of engine and electronics design and hydraulics as part of the development of the electronically regulated water circulation and coolant pumps.

The canned motor concept was selected to meet the high requirements for operational reliability and service life. This special motor design has an additional tube placed in the space between the stator and the rotor, which keeps the stator statically sealed with respect to the medium pumped by the running rotor. Since this drive system requires no dynamic sealing elements which are subject to wear (rotating mechanical seals), the water circulation and coolant pumps are especially reliable and free of wear problems. Moreover, the EC motor used in the pumps requires no brushes.

Eliminating the mechanical commutation system leaves the durability of the rotor bearings as practically the only limiting factor for service life. In addition to that, the lower number of moving parts results in significantly reduced noise.

The electronics in the motor casing were developed in-house. They measure the rotor position of the motor without a sensor and provide current – depending on its position – to the stator windings. Regulation of the electric coolant pump takes place via the hybrid-designed electronics, which receive relevant information from the motor management system and use it to set the flow of coolant needed in each case. Both PWM signals and digital signals like the LIN-bus can be used for this.

The compact pump design and modular construction of the electric coolant pump (hydraulics, canned motor, electronics) as well as the avoidance of complex coupling mechanisms for leak-proof sealing of the drive enable the space required and weight to be reduced. For example, the water circulation pump, which weighs a mere 260 grams, can deliver as much as 800 liters per hour with a back pressure of 100 mbar, and the coolant pump (CWA 200), which weighs about 2,000 grams, can deliver more than 7,500 liters per hour with a back pressure of 450 mbar.

Benefits of the electric water circulation and coolant pumps

- **Save fuel and reduce emissions**
  Matching electric coolant pump output to the actual cooling requirement of the combustion engine can reduce fuel consumption and exhaust emissions. Instead of the approximately 2.0 kW rated input for conventional mechanical pumps, in the future an electric pump with 0.2 kW can be used in passenger vehicles up to 200 kW engine rating. Particularly in future exhaust emission tests at cold-start temperatures of under -7 °C, the improvements in emission reduction are considerable.

- **Cooling even without operation of the combustion engine**
  It is possible to run the pump after switching off the engines to avoid „hot spots“ or, in the winter, to make use of residual heat.

- **Utilization of various control variables**
  The electronics of the pump make it possible to use control variables from the engine other than coolant temperature. The pump speed can be influenced this way to achieve more uniform component temperatures and raise or lower the temperature safely according to the engine load.

- **Faster heater action**
  The electric coolant pump allows a faster response of the heater after a cold engine start and consequently makes an additional contribution to safety and comfort.

- **Added installation latitude**
  With the electric coolant pump, the design engineer is no longer tied to the belt systems for the installation location in a combustion engine. Instead, the coolant pump can be positioned anywhere in the engine compartment. This facilitates integration with other components of the coolant circuit (such as the radiator).

- **Modular connection of the coolant pump with the thermostat valve**
  The integration of the water valve in the coolant pump leads to the linking of functions and advantages in installation for the customer.

- **Technology of the future: hybrid and fuel cell vehicles**
  The use of an electrically-driven coolant pump for drive designs of the future, such as those using hybrid or fuel cell technology, is inevitable. Since these new technologies use much higher on-board voltages (200 – 500 V), higher-performance pumps with correspondingly higher efficiencies can be installed.

Fig. 2: Section view of the electric coolant pump

Fig. 3: CWA 50

Fig. 4: CWA 200

Fig. 5: CWA 100.2

Fig. 6: CWA 1100

Fig. 7: CWA 350

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