

WHITEPAPER: AUTOMOTIVE

PUMPS AND SYSTEMS FOR THE AUTOMOTIVE INDUSTRY

OUR KNOW-HOW FOR AUTOMOTIVE MANUFACTURING

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Grundfos is present in automotive production with smart and efficient pump solutions in all production areas.

As the world market leader for liquid pumps and front runner in the integration of smart pump solutions for all relevant applications within automotive production, Grundfos has been providing the industry with technically and economically convincing system solutions for years: in terms of energy efficiency as well as in the reduction of water consumption (including through reuse).

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Introduction

Cost and quality assurance accompany the automotive companies as well as their suppliers and service providers.

The growing environmental awareness is an additional topic: How can we generally protect resources, use energy more efficiently and economically? How to minimize the carbon footprint?

Grundfos pumps for automotive production applications support producers in solving these tasks and questions. They ensure that production and processing steps are supported as energy-efficiently as possible. At the same time, they are designed in such a way that they can withstand the harsh conditions in industry and work without interruption in continuous operation.

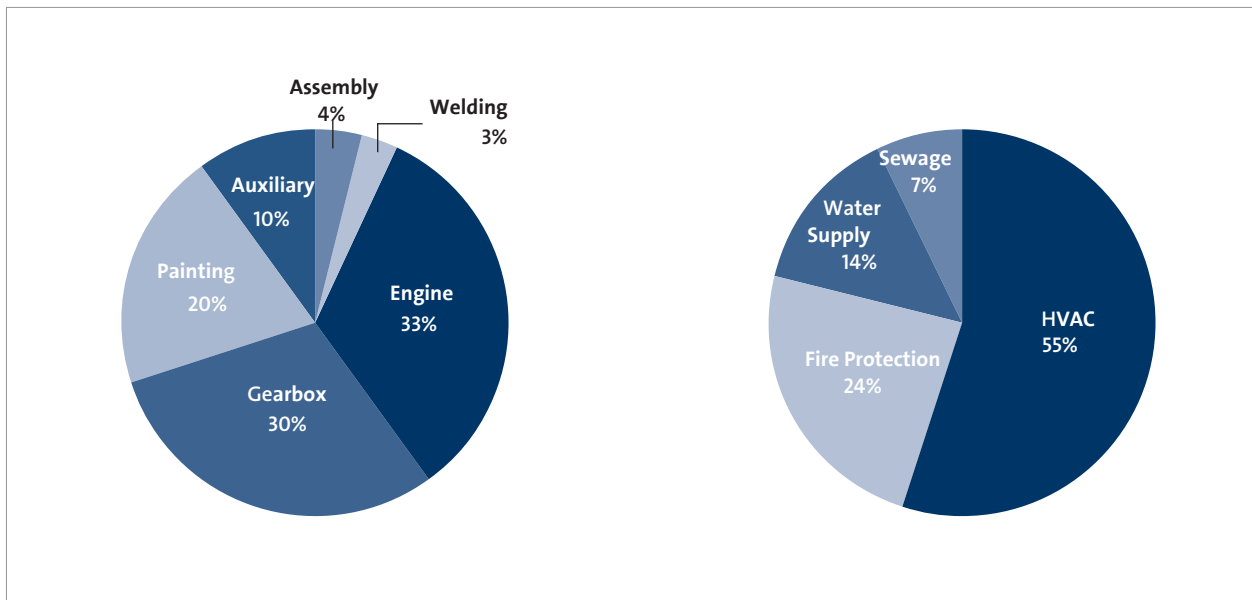
They transport liquid media (water, cooling lubricants, water-glycol mixtures) to the various production stations, convey emulsions mixed with chips for filtration and are also indispensable in the pre-treatment for painting.

The requirements for pumps in the supply processes (utility side, 'secondary pumps') are generally not as strict as for production-related process pumps. Grundfos secondary pumps mainly work in HVAC (heating, ventilation, air conditioning), they can also be found in water extraction, water treatment (also with the aim of reuse), water distribution and waste water disposal.

In addition fire protection, complete pump systems with pressure maintenance and main pumps that are driven either by diesel or electric motors. The pumps process all extinguishing agents - from water to foam; they are certified according to VDS and NFPA 20.

- The most important process areas for the use of centrifugal pumps:
Processing (e.g. engine block, gearbox) and painting (pre-treatment).
- The most important auxiliary processes for the use of centrifugal pumps:
Cooling, lubricating, filtering, cleaning.

As a rule of thumb, an automotive manufacturer has installed around 1,000 process pumps and 800 supply pumps for a production capacity of 100,000 cars.



The most important process areas and auxiliary processes for centrifugal pumps in automomotive production.

Process pumps in processing: cooling & lubrication

Grundfos offers what is probably the most extensive range of cooling lubricant pumps for machine tools - the operator can cover the process around the cooling lubricant circuit completely with pump systems with Grundfos: This ranges from equipping a single machine with variably dimensioned immersion pumps to central cooling lubricant preparation large standard and block pumps. In addition to the supply of filtered cooling lubricant ('clean' part of the cooling lubricant circuit), the product portfolio also includes the return to the filter ('dirty' part of the cooling lubricant circuit).

Motors with integrated frequency converters are available for the majority of the pumps; they increase system efficiency and flexibility (with IE4 classification up to an output of 22 kW, with IE5 classification up to an output of 11 kW). They not only ensure that the tool or workpiece is optimally cooled, they also save a large part of the drive energy. Thanks to the high efficiency, the heat input into the cooling lubricant by the pumps remains extremely low (this ensures the lubricant hygiene and the lubricant life).

In this way, they make an important contribution to reducing the total cost of ownership (TCO). Controlled pumps can also be integrated into complex control and regulation systems and help to optimize manufacturing processes.



Grundfos offers what is probably the most extensive range of cooling lubricant pumps.

For many OEM customers, the wide-ranging standard delivery program already offers a suitable solution. If, however, the pumps have to be integrated in special machines, apparatus or systems, dimensions, media or conveying capacities place special demands on construction, material and equipment, Grundfos develops highly individual products and system solutions together with its customers.

The 'Design Tool' software solution supports the system planner in configuring the entire feed system and selecting an optimal pump for a defined machining process. The efficient design program for all components of the cooling lubricant supply saves up to 60% energy and cooling lubricant costs through their optimization.

In particular, the pumps used in machining centers for cooling and lubricating the tools must have a quick and precise response, so that the manufacturing process can be carried out at the desired speed and without unnecessary tool wear. That is why the iSolutions concept - an intelligent control and monitoring system - is the optimal solution for machine tool applications. It offers all the advantages of e-pumps (pump, motor and frequency converter for speed setting are integrated in one product and optimally matched to one another) and also numerous functions for the special requirements of the machine tool industry.

Predefined operating points: Several setpoints can be set in the e-pump in order to be able to provide the required pressure for various processing steps.

In addition to the typical tasks of pumps used in machine tools, the frequent switching on and off and also the frequent changing of the pressure ratios in comparison to other applications is a particular challenge. This places a heavy load on both the pump and the motor. That is why the pumps are particularly robust for use in machining centers.

The wear of the mechanical seal is specific because the fluid often contains small particles - a leakage is the result. Pump leakage is often an important selection criterion in the machine tool industry.



MTR pump with return to the tank.

With this in mind, Grundfos has developed an MTR pump with a return to the tank. With this pump, the pumped medium remains in the container even if the mechanical seal is worn and leaking. Advantage: No loss of production in the event of leaks; no pollution of the surroundings; longer maintenance intervals; Reduction of unit costs.

Process pumps in filtration

Efficient filtering of the cooling lubricants is particularly important for high-quality machine tools: First, to increase the service life of the tools and the service life of the cooling lubricants. Secondly, to prevent swarf chips from damaging the workpiece surface.

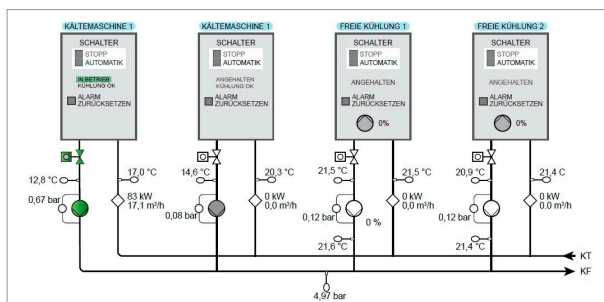


Grundfos submersible pumps of the MTR / MTRE, SPK / SPKE, MTH, MTA and MTS series.

These are the requirements for pumps for central filtration and conveyor systems:

- Suitable for handling swarf chips in cooling lubricants
- The shaft seal must be able to withstand wear particles
- Suitable for pumping gaseous media
- Design for viscous media
- Lift pumps should have an open impeller solution.

The cooling lubricant is conveyed by small lifting pumps with a pressure of up to 5 bar for filtration. Depending on the machining process and the material to be machined, the cleaned coolant then returns to the machines with high pressures and a high coolant flow.



Central filter systems supply several machine tools with clean KSS.

Grundfos' product portfolio includes single and multi-stage submersible pumps from the MTR / MTRE, SPK / SPKE, MTH, MTA and MTS series as well as standard and block pumps (NK / NKE, NB / NBE) that deliver a particularly high flow rate. MTB pumps with an open impeller and high efficiency are available especially for the removal of swarf chips. All pumps can be upgraded to an intelligent, speed-controllable e-solution.

Process pumps for the paint shop

In relation to the total energy and water consumption of a car production, about 50% of the energy and over 90% of the water is used in the painting process.

Stainless steel pumps with FKM or FFKM elastomers are generally used in painting systems. To avoid colour deposits on the mechanical seals, a double mechanical seal (Demineralised water as the barrier medium) or a magnetic drive (MAGdrive) is recommended. In many cases, low speed pumps are specified because excessive movement in the paint tank can affect coating properties.



Grundfos is also a full-range supplier of pumps for ultrafiltration applications.

If a pump is taken out of operation, it must be rinsed with demineralised in order to avoid hardening and blocking due to paint residues in the pump.

PWIS conformity (substances that impair paint wetting) is essential. Grundfos meets this requirement.

Secondary pumps for boiler systems

With its high pressures and temperatures, boiler feed is one of the more demanding tasks for pumps. The multitude of switch-on and switch-offs put additional strain on a feed pump.

Here the operator benefits from this smart solution: steam supply with speed-controlled pumps and direct level control in the boiler reduces the number of system components required - since the pump itself takes care of the control and no valves are required. Since components are omitted (valves, bypass lines, mixing circuits to limit the flow), the operator benefits from reduced investment, maintenance costs and improved energy efficiency.

The pump is controlled by a 4-20 mA level sensor mounted on the boiler. The water supply is continuously adapted to the steam consumption. The pumps run up to full speed when the fill level is low and decrease with increasing fill level. Pump operation stops at the maximum fill level. The boiler fill level remains constant.

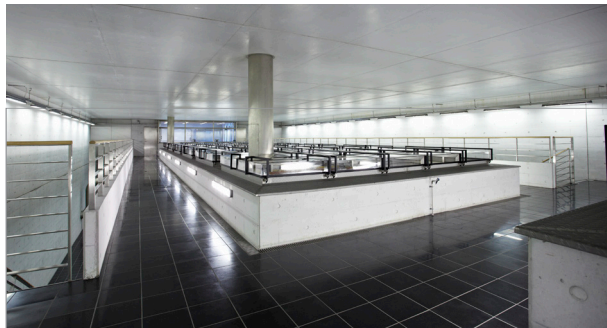


A steam supply with speed-controlled pumps and direct level control in the boiler reduces the number of system components required.

Multi-stage CR pumps in high-temperature design ('Air-cooled Top') are used: An air-cooled shaft seal chamber prevents damage to the mechanical seal by high temperatures and ensures a good insulating effect. In this way, no external cooling media are required to cool the mechanical seal. These pumps also work with a reduced NPSH value: equipped with an oversized first impeller, the CR pumps can handle poor inlet pressure and hot water inlet better.

Secondary pumps in water treatment & water reuse

The reuse of water - for example for parts cleaning / flushing, in the paint shop (e-coating, spray coating), electroplating, boiler feed and cooling tower make-up - is a much discussed trend in the entire industry. It is not only a topic of the 'Green Agenda', but also has interesting economic aspects: Water reuse reduces, among other things, heating and cooling requirements (due to usable temperature differences), as a result of which the required boiler and cooling capacities and pump outputs are reduced. And if water is reused, the amount of waste water and thus the disposal costs decrease accordingly.



Water reuse is an important issue in the automotive industry.

Water reuse costs initially (CapEx, capital expenditures), but then offers long-term lower operating costs (OpEx, operational expenditures). The automotive industry is also increasingly preferring OpEx solutions. Chemical and physical processing play an important role in industrial reuse processes. In this step, the water is conditioned with regard to the pH value and all particles are removed (often by ultrafiltration) in order to prepare the water for the last step: the particularly complex concentrate preparation.

This step is often carried out via crystallization or reverse osmosis with up to three stages. The challenges here are the high pressure and the water chemistry, which can demand a lot from the membranes, but also other components such as pipes, valves and pumps.

All membranes get dirty over time and need to be cleaned. The more the membranes clog, the more pressure is required to treat the water with a constant flow. Speed-controlled pumps compensate for pressure losses and extend the cleaning intervals without reducing the flow of water produced.

In order to limit fouling, metering pumps from the Smart Digital series are often used: They pump the quite expensive chemicals with high precision. Thanks to the integrated volume flow measurement, the dosing pump compares the current dosing volume flow with the setpoint and adjusts its dosing quantity.

Water recycling is also worthwhile for machine tools: Grundfos' DynaFilter is a membrane filtration and separation system for removing metal particles and for oil-water separation. The membrane filtration system uses rotating ceramic discs made of silicon carbide to separate the washing medium and to recover the treated water and chemicals for the machining process. The filter can be operated in automatic mode with backwash mode.



DynaFilter: The compact water treatment solution removes metal particles and oil.

Integration of Pump 4.0 in a BUS system

The high degree of automation in the automotive industry requires the most comprehensive integration of all technical equipment. Integrating a pump into a BUS system in the shortest possible time and thus integrating it into a system concept - that is the task of system integrators who deal with all questions related to EICA (Electrical Instrumentation Control Automation).

For this target group in particular, Grundfos has set up a separate area on its website that includes contains an EICA selection tool (available on the website via www.grundfos-eica.com/en-uk/).

With the help of the tool, the system integrator finds the right communication module for his specific project. Simply select the pump to be installed and the desired BUS protocol type. In addition to the appropriate communication module, the tool provides further information (interface description and resource files; circuit diagram; external libraries; commissioning). The free-of-charge function blocks for Siemens S7 are particularly attractive as a programming example, with which the engineering effort (time!) Is significantly reduced.



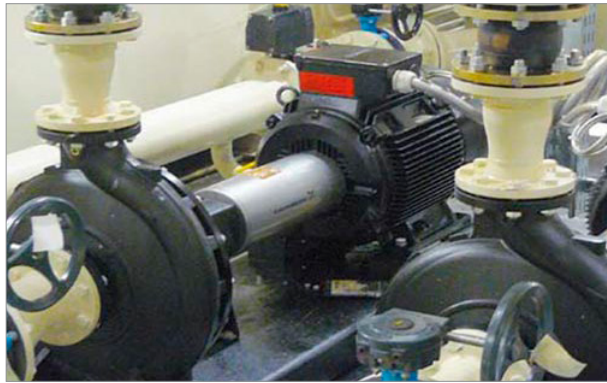
The EICA tool supports the implementation of Pump 4.0 solutions in the desired BUS system.

Process & secondary pumps: Free energy check

A Grundfos Energy Check identifies potential savings and gives recommendations for an efficient, high-performance solution. A comprehensive pump audit is always recommended: The resulting report provides a complete overview of the installed pump systems and their current efficiency. It also shows how the operator can achieve financial and operational savings as well as a lower environmental impact.

Pump audit at Volkswagen AG in Braunschweig

In 2011, VW started a pilot project with Grundfos to record the current state of energy consumption for pumps. Specifically, this was about three supply pumps for the cooling lubricant supply (KSS) of cutting machine tools in the swivel bearing area (there are a total of six such cooling lubricant supply systems in this production area). So far, the mode of operation was such that the pumps were operated in cascade: at least one pump always worked; the second or third pump was switched on as required depending on the quantity.



These three KSS pumps were the focus of interest in the Pump Audit pilot project - due to their economy, they remain in operation. However, their control has been changed.

After monitoring the selected coolant system and discussing the results, it was clear that the pumps themselves did not offer any significant savings potential, but their control should be optimized. The Grundfos service experts' challenge was to implement this optimization as cost-effectively as possible. Finally, an external frequency converter was installed for each pump, controlled by a higher-level pump controller. The result is an autonomously controlled system, the old control cabinet did not have to be converted (practitioners know: such a conversion really costs money!).

A pioneering decision, as it soon became clear: from the expectations of 2011 - after monitoring the current state a saving of 22% was predicted, after the conversion by Grundfos, a saving of 37% has been delivered.

Conclusion:

Grundfos teams specializing in the automotive industry support globally positioned manufacturers of machine tools, paint shop providers and also directly the OEM in selecting the best possible pump system and dimensioning it correctly. They also help to optimize processes and save energy. In addition, the customer has a comprehensive range of services available, from technical support to training and services.

As the world market leader for liquid pumps and front runner in the integration of smart pump systems in all relevant stations of automotive production, Grundfos has been with the industry for years and knows the technical requirements as well as the expectations of the responsible employees in purchasing, operation, maintenance and quality assurance. IT employees are happy about the simple integration of the e-pumps in the control technology, the marketing of the OEM can integrate the remarkable system efficiency of these pumps into their own 'Green Agenda'.