excellence for mobility

NIDEC GPM Group

www.nidec-gpm.com

Providing the best pump solution to the market with innovative thermal management technology.

NIDEC GPM was founded back in 1939 and started water pump production in 1949. Since that time, we have worked permanently on advanced and innovative pump technology for CO_2 reduction and fuel-saving with a high degree of reliability. After joining the NIDEC Group in 2015, we are now able to combine excellent hydraulic pump know-how with world leading electric motor capability. Already being the trendsetter for mechanical switchable and variable pump systems, we are now, as part of the NIDEC Automotive Motor & Electronic Control Business Unit, able to provide thermal management solutions globally for all types of drive systems, whatever the renewable motive source.

One area we would like to emphasise concerns our solutions for the future of personal mobility. Based on our expertise in engine & motor cooling and lubrication, we are now focussing our sights on the next target to grow NIDEC as the largest supplier of key components for electromobility worldwide.

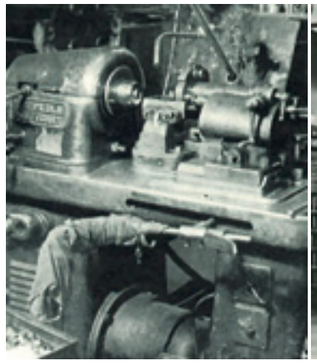
To underline the high demands we make on ourselves, we have decided to apply a new tag line "excellence for mobility" – and in applying CO_2 and fuel-saving concepts, demonstrate our uncompromising commitment to this aim.

In this way, we have our attentions firmly focussed on the future. The way only we can. With NGPM extracting maximum benefit in terms of development.

Yujin Okochi
CEO

Michael Grellmann
COO

Mobilising innovations. This is our tradition. For over 75 years.



NIDEC GPM GmbH stands for more than 75 years of experience in the automotive OEM supplier industry. Since the company was founded in 1939, innovative pump solutions have been a characteristic of our core competencies. Time and again, this business, run as a family concern for many years, has redefined these future-orientated systems for engine & motor cooling and lubrication and became a member of the Japanese NIDEC Corporation group in 2015 with three foreign locations.

Today, we are focussing more than ever before on fuel-saving systems for engine & motor cooling and lubrication in passenger cars, HGVs and in large-volume diesel engines. The objective is a continuous improvement in efficiency.

Our tried-and-tested switchable and variable pumps have made an important contribution to the reduction in CO_2 emissions.

Currently, a tenth of the workforce at NGPM is involved in applying their unique expertise to research and development, to ensure that we will still be redefining standards in the future, as we are today – particularly in the field of electromobility.

The characteristic blend of well-founded experience and a genuinely open attitude towards new openings has secured NIDEC GPM's position at the forefront of the market as an A-supplier to the world's automotive industry for many years.

1939 The Karl Schmidt company is founded, making precision aeroplane components.

1949 Starts manufacturing water pumps and repairing old water pumps for vehicles.

1958 Production supplier of water pumps to Horch, Sachsenring Zwickau and the Eisenach Automobile Factory.

1967 First gold medal at the Leipzig trade fair for water pumps for HGV diesel engines.

1972 Company is nationalised (under the Communist Regime) and becomes VEB GPM.

1990 Reprivatisation under the Senior Partner, Dr. Eugen Schmidt and becomes "Geräte- und Pumpenbau GmbH Dr. Eugen Schmidt".

2001 Foreign location is established in Brazil and the German Merbelsrod location is expanded.

2008 Subsidiaries founded, GPM Automotive Pumps, in Suzhou, China and GPM North America Corporation (Office) in Troy, USA.

2013 Winner of the Automotive News PACE award for variable ECF water pump in Detroit.

2015 GPM becomes part of the NIDEC Group of companies.

2015 Start of development of electrical oil and water pumps.

2016 First nomination for serial production of the electrical water pump by a major German OEM.

2017 Set-up of a production site in Hungary.

Redefining standards with NIDEC and a worldwide network of capable experts.

Since 2015, NGPM has been contributing to the overall activities of the NIDEC Corporation. With its 235 subsidiaries in over 30 countries, the Group is one of the world's largest manufacturers of electric motors.

Ideal prevailing conditions within this outstanding network of competencies make it possible for us to expand our development capabilities and competitiveness systematically, which includes the field of vehicle electrification. We are confident that we have laid the foundations that will allow NGPM to extend its existing, unique innovative skills far into the future. The way we have been for nearly 80 years in the development of systems for engine & motor cooling and lubrication.

AMEC Global Footprint.

1 **Bietigheim-Bissingen, Germany**
R & D, Production, Sales

2 **Merbelsrod, Germany**
R & D, Production, Sales

3 **Niepolomice, Poland**
R & D, Production

4 **Santa Perpetua de Mogoda, Spain**
R & D, Production, Sales

5 **Bercel, Hungary**
Production

6 **Tokyo, Japan**
Sales

7 **Kanagawa, Japan**
R & D, Production, Sales

8 **Zama, Japan**
R & D, Production, Sales

9 **Shiga, Japan**
Headquarters, R & D, Sales

10 **Tochigi, Japan**
R & D, Production

11 **Shanghai, China**
Sales

12 **Dalian, China**
R & D, Production

13 **Pinghu, China**
R & D, Production, Sales

14 **Suzhou, China**
Production, Sales

15 **Changzhou, China**
R & D, Production, Sales

16 **Zhongshan, China**
Production

17 **Seoul, South Korea**
Sales

18 **Chonburi, Thailand**
Production

19 **Ho Chi Minh City, Vietnam**
Production

20 **Neemrana, India**
Production, Sales

21 **Auburn Hills, MI, USA**
R & D, Sales

22 **Suwanee, GA, USA**
Production, Sales

23 **Indianapolis, IN, USA**
R & D

24 **Juarez, Mexico**
R & D, Production

25 **San Luis Potosí, Mexico**
Production, Sales

26 **Sao Paulo, Brazil**
Production

Think globally. Act locally: Business Unit AMEC.

As experts in the field of engine & motor cooling and lubrication, NGPM is a member of the NIDEC Business Unit "Automotive Motor & Electronic Control" (AMEC).

AMEC's main product lines are electric motors, controllers, pumps, radar systems and sensors. Each product family contributes in its own way to improving the three fundamental characteristics "safety", "environmental protection" and "convenience" in connection with vehicles.

Innovative product engineering is also a feature of green technology, where the aim is to reduce energy consumption still more and increase added value: in addition to the above product range, AMEC is developing traction motor systems for hybrid and electric vehicle drive trains. Among the latest developments are electric oil and water pumps that make a verifiable contribution to reducing CO_2.

Excellence for mobility. Outstanding expertise in thermal management.

Today, more than ever before, the focus at NGPM is on improving pump efficiency through research and development.

We have already set ourselves the first milestone regarding fuel reduction with our revolutionary concepts for switchable and variable pumps. Our range of products has been selected to make the right system available in each case to suit differing requirements.

Our range of products comprises four categories: water pumps, oil pumps, vacuum pumps and pump modules.

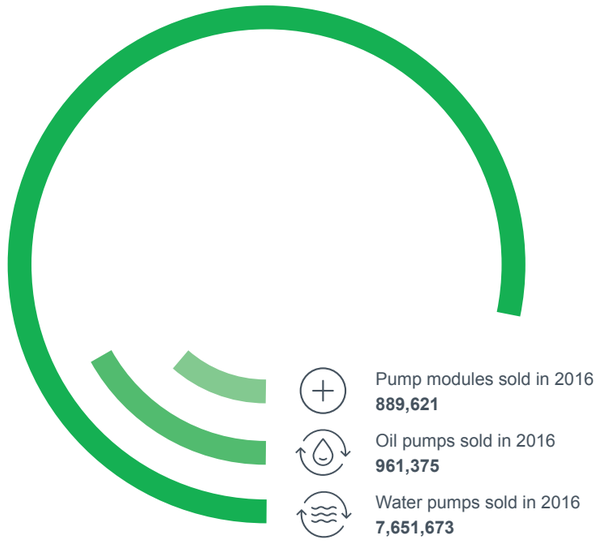
We are commited to our strategy of sustainable growth.

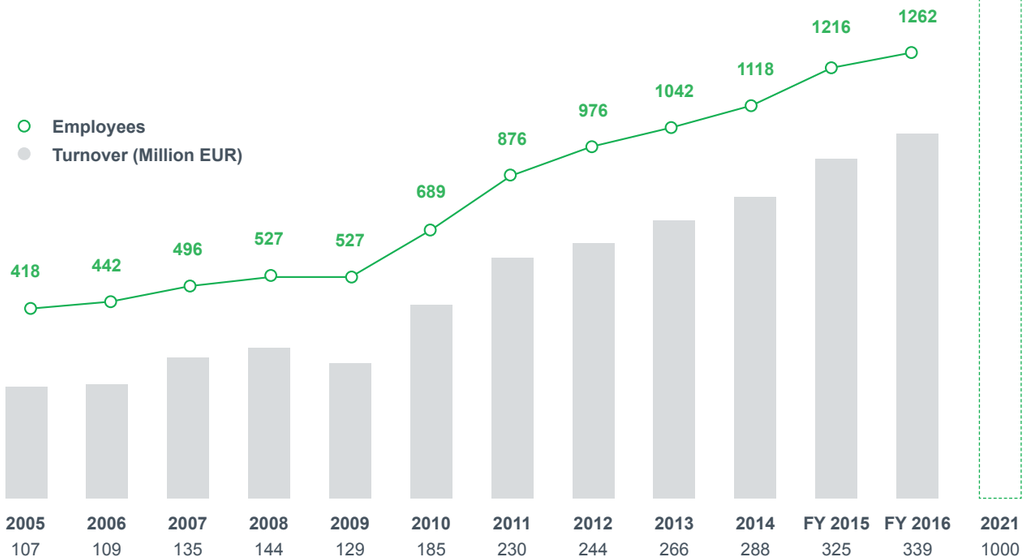
We concentrate all our efforts on refining our core competencies and place the development of new products at the centre of our corporate activities.

Today, around 1300 employees are actively involved in this mission. Each one of them contributes to ensuring that NGPM can demonstrate a consistent, steadily increasing growth curve. Our five locations on four continents are an effective extension to the worldwide network maintained by the NIDEC Corporation. As a technology manufacturer in the automotive sector, we currently generate an annual turnover of well over EUR 339 million. For the future, we will continue to keep our activities firmly focussed on great innovations – in particular in the field of e-mobility. One aspect of this will be in harnessing the potential of electrification in the automotive industry to provide a further impetus for growth.

We have a clear commitment: within the next four years, we intend to triple our turnover. By 2021, this means we anticipate annual turnover of around a billion euros. This objective, that we at NGPM are pursuing with our full commitment, underlines our untiring ambition.

Sales development





Using research and development as a foundation for sustainably strong results.

Pioneering milestones in the field of engine & motor cooling and lubrication bear this out. One key milestone along this road has been the ECF pump, that was first patented in 2009, while another is the development of electrically powered oil and water pumps.

As a measure of how decisive continuous innovation is to our corporate philosophy can be seen from the fact that every tenth employee at NGPM is involved in research and development. We drive outstanding progress by placing considerable emphasis on high-quality, professionally developed know-how with a classic engineering background, while incorporating the disciplines electrics, electronics and software to an ever greater extent. Continued further training in all departments guarantees we maintain our high technical knowledge standards.

We are applying these principles to expand our core competencies, in particular in the field of vehicle electrification. Our declared aim is not merely to make a contribution to the development of future-orientated mechatronics products, but also to continue in our efforts of measurably reducing fuel consumption and CO_2 emissions.

For nearly 80 years, we have proved time and again our enthusiasm for new developments.

Spotlight on electrification.

The combination of excellent motor capabilities and NGPM's skills in mechanical pumps is a future-orientated blend. Together with colleagues from the NIDEC Group, we are developing completely new electrically powered water and oil pump concepts for automotive applications in a voltage range from 12 and 48 volts, but also for high-voltage e-vehicles. In this way, we continue unceasingly to improve performance while, at the same time, reducing energy consumption and CO_2 emissions.

The symbiotic collaboration between NIDEC and NGPM is paving the way to the development of high-performance electrically powered pump systems. This strong position makes it possible for us to provide exactly the right system for every future vehicle model. This is how we generate enthusiasm through our holistic approach.

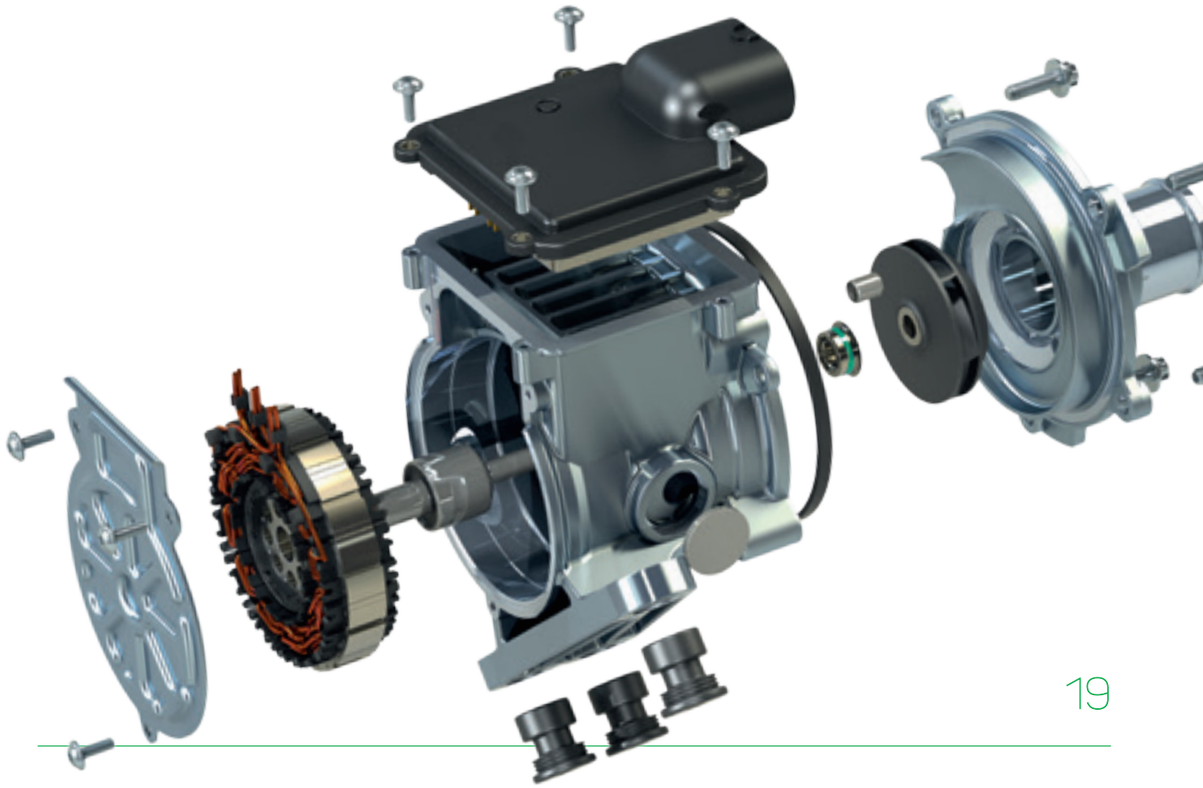
The NIDEC Corporation is the world's largest manufacturer of electric motors.

Shaping the future with our electrically powered water pumps.

Our latest creation, the electric water pump, demonstrates clearly that the high R & D objectives we have set ourselves are, indeed, coming to fruition. This new product blends a mechanical water pump from NGPM with a motor from NIDEC Motors & Actuators.

To date, the automotive industry has tended to use electric wet-runner water pumps. However, with our dry-runner concept, there are decisive benefits regarding size, weight and performance. Our new family of dry-runner water pumps unites these in a single concept. In addition, the coolant flow is freely variable.

This product family is divided into three models. It starts with the small auxiliary water pump, then the large auxiliary water pump and, finally, the main water pump.



Test bench & prototypes: in-house because we like to keep control.

Prototype shop

To be able to define all aspects of quality, it is essential to keep full control. We take this principle seriously – and are proud of our in-house prototype shop. Close internal communication between the production facility and prototype shop enables us to conduct any necessary optimisation loops in the shortest time.

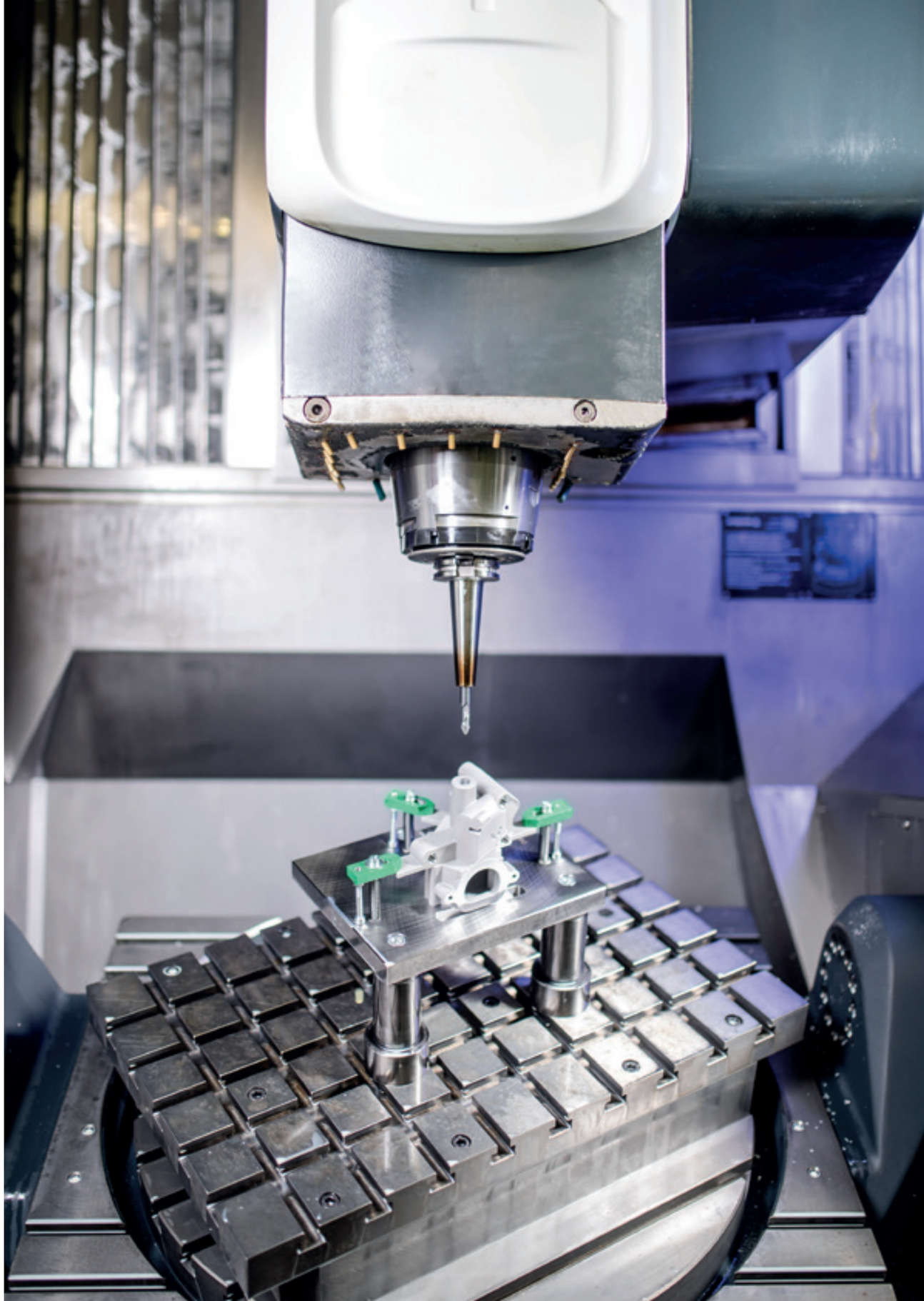
Test bench

NGPM has at its disposal an exceptionally well equipped testing and inspections centre encompassing 70 test methods. These inspections are used to check our pumps meticulously with a fine tooth-comb – including the shaker test, spray mist test, climatic chamber and endurance test. Our customers know they have bought the best possible product and it has been thoroughly safety-tested.

Acoustics laboratory

In our well-appointed, state-of-the-art acoustics laboratory, we test our pumps to monitor their noise levels. The focus here is on ensuring that our pumps run as smoothly as possible. The tests include recording airborne noise emissions. This is used to determine sound pressure and generate a frequency range. These details can be used to determine whether there are any interference frequencies and locate the source of any noise. An additional structure-borne sound sensor is used to confirm the information recorded and allow closer analysis – which enables us to optimise our results still further.

Our acoustics laboratory was certified to DIN EN ISO 3746 (Accuracy Class 1 for anechoic rooms and hemi-anechoic rooms) and to DIN EN ISO 3744 (Accuracy Class 2 for the survey method using an enveloping measurement surface over a reflecting plane).



Computer aided design. Quality from start to finish.

High quality standards are our top priority right from the outset. To ensure this is achieved in practice we use state-of-the-art software packages that enable us to generate unique technologies, refine the designs and manufacture the final product.

Using the latest design software means we can achieve optimum results for our customers. This software is complemented by further special-purpose programs for simulating complex systems. With the aid of these, we are able to test the products early on in the design process and prevent potential defects being transferred to the prototype shop. In this way, corrections can be quickly and easily applied, which saves both time and money. Our latest calculation tool allows us to check a complete pump structure with regard to component tolerances. Which all goes to show, we leave nothing to chance.

Optimal production conditions for first rate products.

The company consistently pursues its policy of manufacturing products that will not just meet but exceed the customer's expectations.

At the production stage, all the components required for making outstanding products come together: state-of-the-art production machines, our trained experts, a first-class automation system and our exemplary Quality Management System.

Besides classic machining, assembly and inspection, we create two-component silicone coatings, apply laser welding and vacuum impregnation, run residual dirt and noise analysis tests, including cleanrooom processes – all to process capable standards.

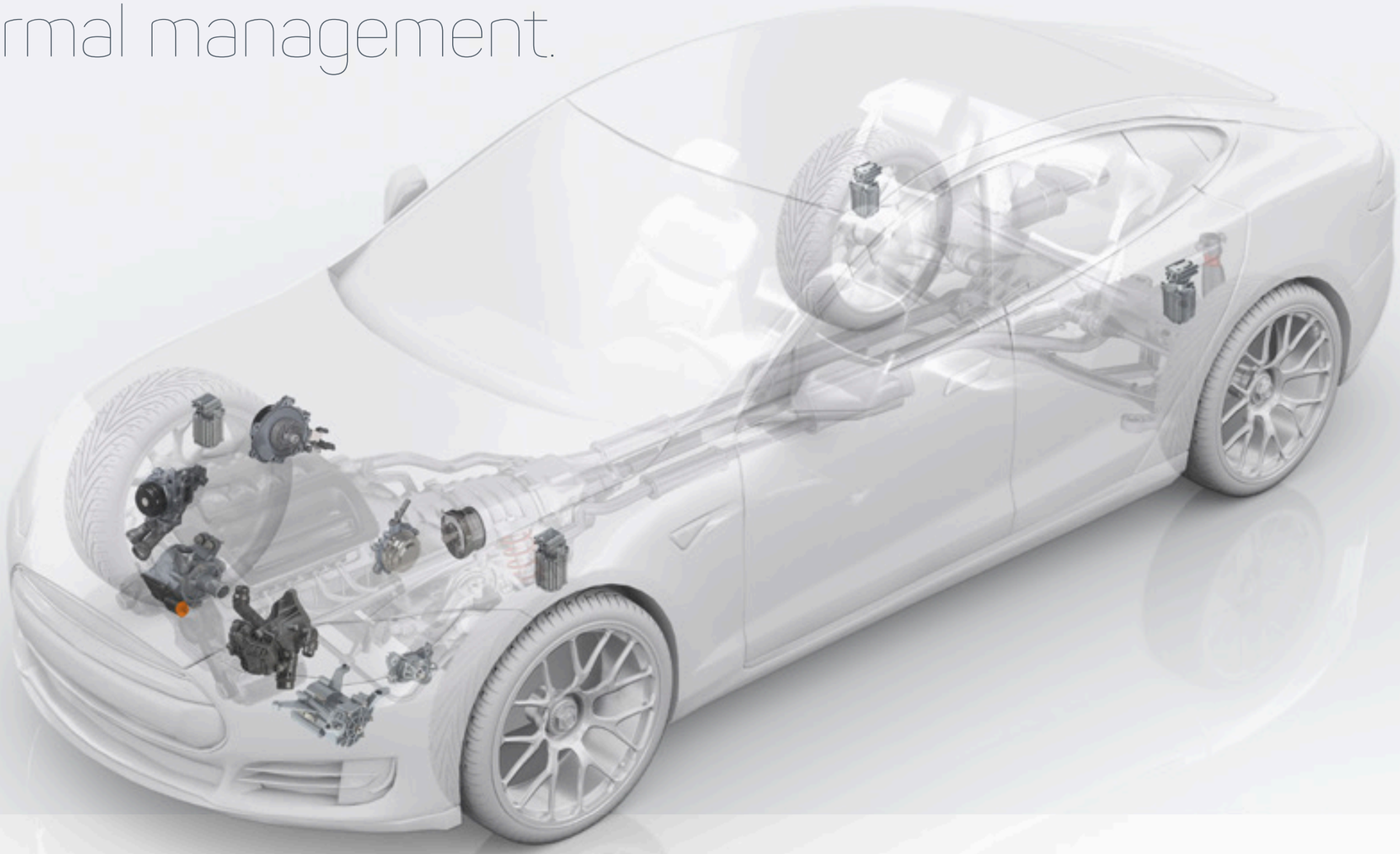
Our process environment is established as a company-wide network which is continually developed and provides all our employees with access to current processes, standard operating procedures and forms.

NGPM's management system links quality and environmental aspects to an equal extent. Defect-prevention is integrated in processes such as development, planning and series production support using the latest methods, including FMEAs and lessons learned. And the objective is always "zero defects". Our NGPM Management System is certified to ISO TS 16949. A further key aspect of our approach is the continual improvement process, that includes lean management methods, and daily continued development in shopfloor management.

At the end of the day, it is the customer's needs that guide us throughout the design and production process.

Product range

Our range of products shows outstanding expertise in thermal management.



- Water pumps
- Oil pumps
- Vacuum pumps
- Pump modules

Oil pumps

Our range of products includes mechanical and electrical oil pumps.

Depending on the intended working environment, we develop and manufacture crankshaft-driven pumps, sump pumps and bedplate pumps. Our response to the increasing demand for variable oil pumps is to develop our own solutions with volumetric flow and variable-displacement oil pumps. This means that, by incorporating the pumps in the engine management system, the pumps only produce the lubrication pressure and flow rates that are required by the engine at that moment.

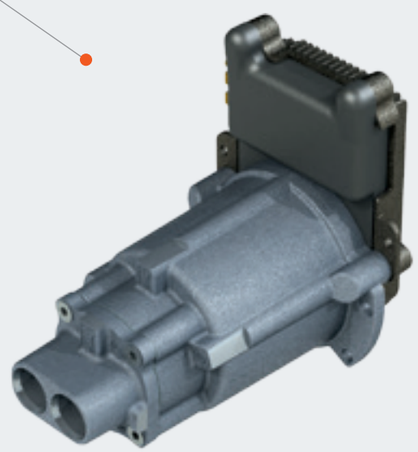
Vane-type pumps by NGPM are available in various types – either directly or indirectly variable versions or as fixed-displacement options. Partial oil pressure reduction can be included using additional valves.

As a direct consequence of vehicle electrification, there is a rapidly increasing need for electrically powered pump systems. The requirements for and expectations of such systems cover a broad spectrum.

Some examples of these are:
- Clutch cooling (low pressure application)
- Ancillary units to boost a main oil pump (high pressure application)
- Pressure build-up during start-stop mode

Electrical Auxiliary Transmission Oil Pump

- Compactness of oil pump, electrical motor, ECU-system
- System as dry- and wet runner available
- Available as high- and low-pressure concept



Water pumps

Mechanical and electrical water pump systems are our core competency.

NGPM provides the right solution for every application. It is crucial that the performance and operating characteristics of pump systems are closely matched to the engine or motor they are working with – whether the vehicle has an internal combustion or diesel engine, a hybrid unit or fully electric drive train.

We are a market leader in the field of switchable ON/OFF solutions. These include pneumatically regulated PSF water pumps – water pumps with pneumatically switched ball-valves – and steplessly regulated water pumps on the ECF principle.

Our latest developments include electrically powered auxiliary and main water pumps. In these pumps, the coolant flow is infinitely variable.

Electrical Main Water Pump (Dry Runner Concept)

- Fully variable
- Best packaging in class
- Proven in use in electric motors
- Concepts for 12 and 48 volts power supply

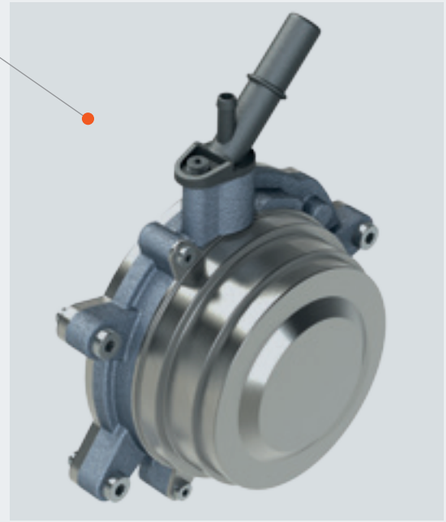
Vacuum pumps

High-performance NGPM vacuum pumps guarantee demand-orientated provision of underpressure in vehicles.

The key function is to evacuate the brake servo unit to provide maximum braking effect when the brake pedal is actuated – a key contribution to safety and a boost to in-car comfort. The vacuum generated by the pump can then be used to actuate the turbocharger, an emissions regulating valve or to vent the fuel tank.

Electrical Vacuum Pump (Wet Concept)

- Set new standards in terms of efficiency, space und universal field of application (plug & play)
- Long service life via BLDC and oil lubrication of the mechanical components
- Lower loads on control units in the vehicle
- Significant reduction of CO_2 emissions



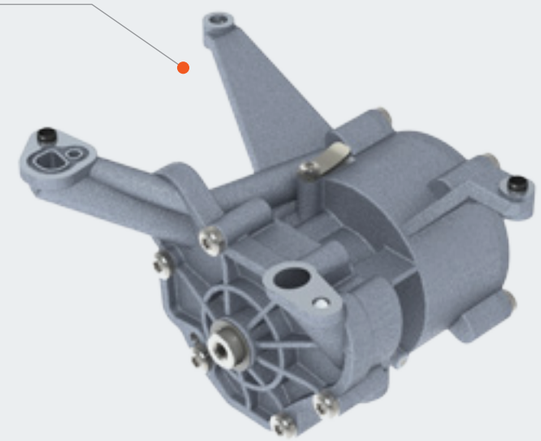
Pump modules

Where additional functionality is required in a pump system, we can provide a broad range of special-purpose modules to enable complex, individual requirements to be fully implemented.

For example, it is possible to unite ancillary drives, mechatronic and electronic components, mounts, valves, filters and coolers to make a complete module. Bespoke solutions. Our customers will always receive checked system quality. This is how we can exclude assembly errors from the start and even reduce the time and costs associated with the assembly process.

Tandem Pump (Oil/Vacuum Pump)

- One housing and shaft for two types of pump
- Integrated, fully-variable oil pump
- Integrated, new, high-efficiency vacuum pump design
- More than 30% lower power consumption



Thermal management technologies made to customer's order.

In the eyes of our customers, we are far more than just a supplier of excellent components. Our technology experts act as active partners in development and production, which makes NGPM a welcome team player in the automotive industry with the skills and commitment to work with customers on future orientated concepts right through to final products ready for series production.

Passenger cars
OEM

- Audi AG
- Beijing Benz Automotive Corp.
- Bentley Motors Ltd.
- BMW Motorsport GmbH
- Daimler AG
- Dr. Ing. h. c. F. Porsche AG
- GM
- Jaguar Land Rover Ltd.
- Mercedes-AMG GmbH
- Opel AG
- SEAT S.A.
- SKODA Auto a.s.
- Smart GmbH
- Volkswagen AG

Tier 1 and Tier n

- BorgWarner Transmission Systems
- ZF Friedrichshafen AG

Medium and Heavy Truck and Non-Auto
OEM

- Caterpillar Energy Solutions GmbH
- Cummins Ltd.
- Cummins Foton (BFCEC)
- Daimler Truck Mannheim
- Deutz AG
- Detroit Diesel Corp.
- EvoBus GmbH
- Liebherr Machines Bulle S.A.
- MAN Truck & Bus AG
- MTU America Inc.
- MTU Friedrichshafen GmbH
- Navistar International Corp.
- Sinotruk
- Yinlun Co. Ltd.

Tier 1 and Tier n

- MAHLE Behr GmbH & Co. KG
- Hengst GmbH & Co. KG
- NewStream Enterprises

We apply ourselves on a daily basis to improving the future.

We are well aware that the NIDEC Group as the world's number one motor manufacturer bears a global responsibility towards the environment and we treat that responsibility with the utmost respect.

This is why sustainable environmentally friendly improvements are key priorities in our work today, more than ever before – and are integrated in our positive vision of the future.

Within the company, we apply carefully managed actions in environmental protection with a view to saving resources and avoiding unnecessary environmental pollution. Whether its is improvements in efficiency in materials management through environmentally aware treatment of wastes or more efficient use of energy using photovoltaic sources.

The sustainability of our environmental protection concerns is reflected in principle in our products in the oil and water pump ranges. For many years, improved performance coupled with low consumption has played a key role in research & development. With an eye on the future, we intend to achieve further fuel and CO_2 savings in vehicles.

By applying a holistic environmental management system demonstrate repeatedly that we not take environmental protection seriously, we have established its principles in the way we think and work every day. A little more every day. For perspectives in harmony with our planet.

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