Höganäs

Gear up for new PM business opportunities

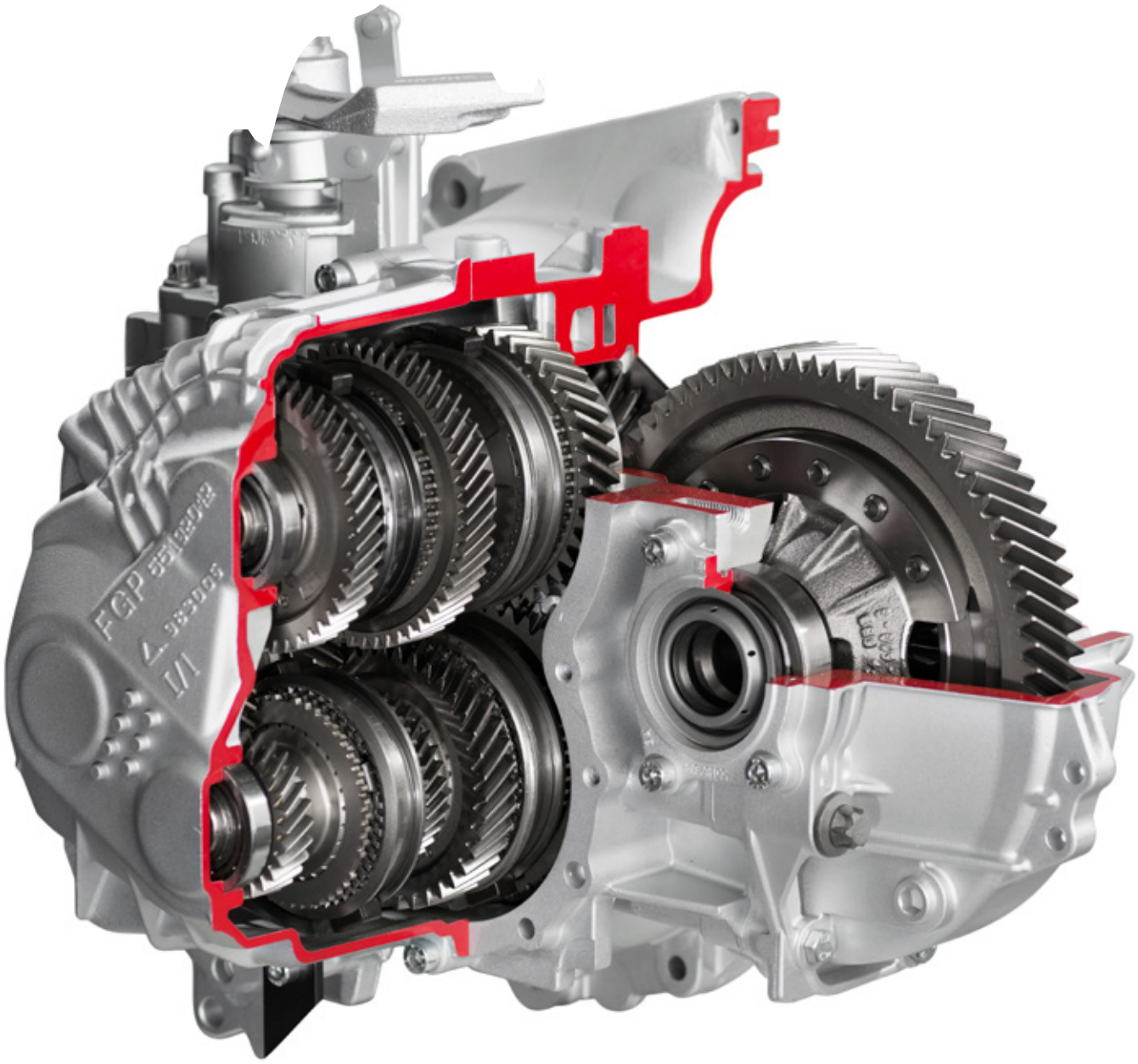
Powder metal gear solutions for high load carrying transmission applications

New PM applications require breakthrough thinking

The main challenges of automakers and first tier suppliers are to optimise fuel efficiency and minimise weight while increasing power density. At the same time, the industry strives to optimise manufacturing process chains and thus reduce manufacturing and investment costs for upcoming powertrain operations.

Today, thanks to the net shape advantage and competitiveness of powder metallurgy (PM) technology, high performance structural components made from sintered PM materials can be found in virtually every modern transmission, engine, pump, steering system, body and chassis, etc. Millions upon millions of automotive PM components are travelling the roads of the world.

Cost efficiency, high precision and repeatability combined with maximum material utilisation, tailored properties, freedom of design and sustainability are only a few of the advantages driving the use of PM component solutions.



Six-speed manual M32 transmission with PM gear technology.

Höganäs is the global leader in innovating new PM materials and applications and driving the market for PM solutions. Now, Höganäs has successfully developed and proven the suitability of PM technology for high load carrying gear applications in modern automotive transmissions.

Based on a novel and holistic design approach combined with advanced manufacturing technologies, we are able to present the world's first successfully re-engineered, design-optimised, prototyped and road-tested PM-geared automotive transmission.

PM gearbox demonstrator vehicle.

All to gain with PM gears

While the new PM gear solutions not only meet OEM's performance duty life cycle requirements, they also help to drastically shorten the traditional gear manufacturing process chains. Thanks to its near net-shape advantages, PM gear technology eliminates the majority of current machining processes. This makes it possible to substantially reduce the investment costs when setting up new gear machining and transmission manufacturing operations.

At the same time several technical advantages can be realised, such as reducing gear weights and inertia, integrating additional design features, optimising gear root shapes and reducing structural borne vibrations, thereby reducing gear noise.

Additional benefits are minimised plant footprint, substantial reduction in the use of machining fluids, elimination of chip disposals and overall reduced energy consumption. As an enabler to reduce weight, thus improving fuel economy and reducing CO_2 footprint, PM gear technology can be considered a highly sustainable and efficient gear manufacturing technology.

Höganäs' design- och weight-optimised M32 4th drive PM transmission gear.

Höganäs' PM gear box demonstrator vehicle.

A solution based on application performance and OEM design requirements

To prove the implementation readiness and demonstrate the full potential of PM gear technology in modern automotive transmissions, the world's first 6-speed manual transmission has been prototyped and bench-tested. The car has already been driving on the roads for thousands of miles.

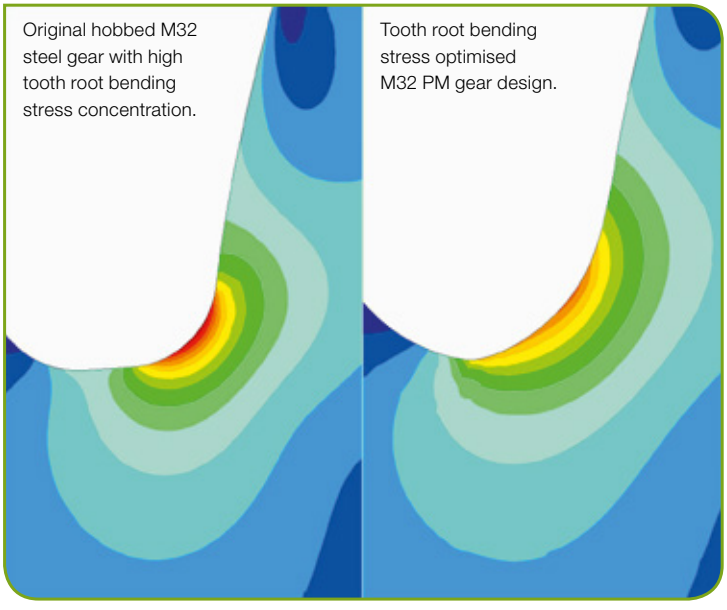
Succeeding in PM gear technology requires deep knowledge of micro-geometrical modification needs and systems design competencies. Our extensive gear material fatigue test data is a perfect base for that.

Trust the know-how leader

By understanding modern transmission designs and their application performance requirements, our expert team can help you analyse specific gear load scenarios. We can assist you in optimising the component's macro and micro design modification needs. We can also help you choose the best suitable manufacturing processes and material solutions and ensure a proper heat treatment result. To put it simple, we can help you open up new business opportunities with PM gear technology.

We also invite you to work closely with us and our extensive tech partner network in our application- and process development centre. Here we can support you all the way from technical feasibility analysis, to design optimisation, prototyping and off-tool sampling for PM gear testing and validation purposes.

Let's show you how to gear up for new PM business opportunities!



The benefits with Höganäs PM gear technology

Höganäs' gear testing lab.

Reduced weight and inertia of PM gears thanks to lower densities and smarter, more near-to-net-shape gear designs. Based on the design freedom given by PM and our in-depth gear design analysis/ stress calculations, we put weight only where it is functionally required. In some cases, we can even incorporate weight-reducing design features, such as slimmer web sections. Weight lightning holes can also be realised at no additional cost.

Reliable material data relevant for PM gear design is the basis for meeting OEMs' duty life cycle requirements and getting the maximum out of the PM material performance. Höganäs has worked extensively with this, both considering contact stresses, tooth root bending and rolling contact fatigue. No surprise that we have our own gear-testing lab in line with applied gear industry standards to support you with relevant design data.

High performance PM materials meeting highest quality and cleanliness standards. As the world leader in metal powder production we continuously push the performance limits of our materials and manufacturing processes. Robust processes, the world's largest production batch sizes and highest quality measures guarantee repeatedly high-quality powders enabling highest material performance levels.

When working with PM materials, it is essential to **optimise gear stresses and transmission error (NVH)** by design modifications on a micro and macro geometry scale as well as on the system level. A simple copy of existing wrought steel gear geometries will always sub-optimise the PM gear performance and noise behaviour. Let us help you to modify the gear flanks and micro geometries to better results. For system integration needs, we work closely with world-leading engineering partners.

Even more benefits with Höganäs PM gear technology

Reducing vibrations and gear noise becomes more important nowadays, especially with the increased hybridisation and electrification of modern power-trains. The higher internal damping and increased energy dissipation are advanta-geous for powder metal gear structures. PM gears are more silent than wrought steel gears. Shift clonks, impact noise and NVH behaviour can be improved with PM gear technology.

Proven PM gear expertise on real transmissions and demo cars. Höganäs has a track record of having implemented and tested PM gears in multiple demo car transmissions. This includes PM gears in a SMART car, a high-performance rally car, an electric vehicle and a 320 Nm popular European 6-speed manual transmission passenger car. We have hands on experience and supporting data for several successful applications of PM gear technology.

Höganäs is your **one-stop-shop PM gear development and prototyping partner.** We bundle our own capabilities, product innovations and customer services with some of the world's leading tech partners in system design, gear machining, PM tool manufacturing, PM compaction solutions, surface densification technologies, heat treatments, etc.

Securing your best possible PM gear performance through a **proper heat treatment process tailored towards your PM application.** Heat treatment of PM is not difficult, but it is different from wrought steel. Let our experienced technical support staff help you find the best suitable material and optimise your heat treatment results. A tailor-made case profile and sub-surface compressive stresses are important to maximise your PM gear performance.

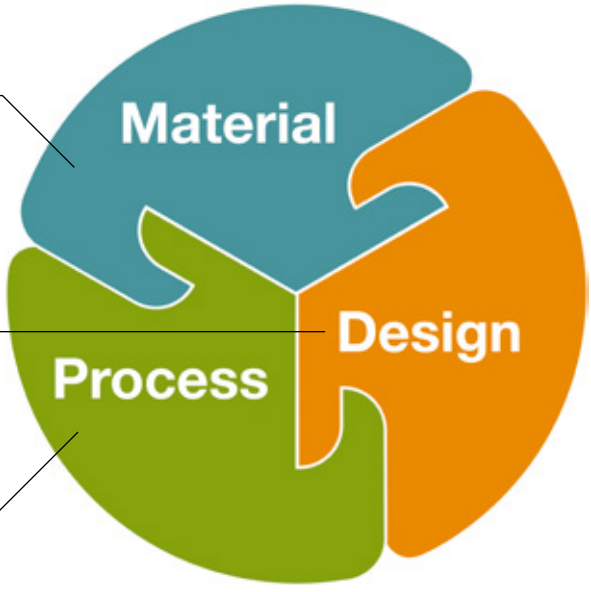
PM gear technology is more sustainable. Stemming from its net shape advantage, recycled steel raw materials, lower energy input, high material utilisation, reduced machining operations, waste minimisation, etc., PM gear technology minimises the impact on the environment, society and economy.

PoP Centre – where it all comes together

The materials expertise to select the right powder solution.

The design support to create innovative PM applications.

The process know-how to ensure optimum production efficiency and quality.



In the PoP Centre, Höganäs offers the infrastructure to develop new PM applications and enabling processes. Here you can team up with Höganäs' experts and our tech partners to benefit from our material expertise and customer services ranging from design optimisation and component prototyping to complete application development projects.

Power of Powder®

Metal powder technology has the power to open up a world of opportunities. The inherent properties of metal powders provide unique possibilities to tailor solutions to match your exact requirements. Our ambition is to constantly widen and grow the range of metal powder applications. That's what we call Power of Powder®. With our leading position in metal powder technology, Höganäs is perfectly placed to help you explore these opportunities.

To find out how you can benefit from the Power of Powder®, please contact your nearest Höganäs office.

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