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Premium vendor relies on combined expertise

LP EGR filters for six-cylinder diesel engines as a joint product by GKD and ElringKlinger

Nearly half of all newly registered cars in Germany have a diesel engine under the hood. A crucial role in this success story is played by diesel particulate filters and diesel oxidation catalysts, exhaust gas recirculation systems and selective catalytic reduction, all of which ensure economical and clean fuel combustion. In terms of compliance with nitrogen oxide (NOx) thresholds, low-pressure exhaust gas recirculation plays a key role. One indispensable element in such systems are high-performance LP EGR filters made of multi-dimensional Volumetric Mesh by GKD – Gebr. Kufferath AG. These protect the engine and turbocharger on the clean-air side against detrimental particles. For its high-end six-cylinder diesel engines, BMW also relies on these filters, which are custom-made by GKD and the automotive supplier ElringKlinger AG in the framework of a strategic cooperation. These two internationally undisputed leaders in technology have developed a product for this specific engine which combines special gasket and filter media in a single, ready-to-install component. The two partners are correspondingly optimistic about their future prospects together, which, in addition to an abundance of further LP EGR filter applications, also include the promise of other fields of potential application.

The combination of growing competition and increasingly stringent exhaust gas norms pose enormous challenges for the automotive industry. Modern engines have to offer agility, performance, cleanliness and economy in order



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to have any chance of survival on the world market. The bigger and more powerful the engine, the harder it is to meet all these requirements "under one hood", so to speak. Downsizing is the order of the day in the development of internal-combustion engines in order to reduce fuel consumption and emissions. On the other hand, getting more power out of less cylinder capacity is the speciality of turbochargers, which explains why they have been state-of-the-art in diesel engines for quite some time now. In the struggle to attain and maintain compliance with the prescribed emission limit values – for NO_x 80 mg/km since the introduction of the Euro 6 standard, for CO₂ reduction of the fleet average from the current 130 g/km down to 95 g/km by 2021 – low-pressure exhaust gas recirculation, especially at high engine loads, is a key technology. The exhaust gas is extracted downstream of the particulate filter and, after being mixed with drawn-in fresh air, is circulated back to the engine upstream of the turbocharger compressor. The trick here is to keep pressure loss inside the exhaust gas recirculation system as low as possible, so that fuel consumption doesn't increase. Low-pressure exhaust gas filters are essential to protect the components on the clean-air side of the particulate filter against damage through particles from the combustion process, and to protect upstream ceramic exhaust gas filters. GKD's Volumetric Mesh is a uniquely efficient answer to both of these challenges, cleverly combining minimum pressure loss with maximum particle retention. Thanks to its special 3D mesh structure, this filter mesh type is significantly thicker than, for example, square mesh. In this way, Volumetric Mesh combines 70 percent more mesh volume for the same amount of material with substantially lower pressure loss and a considerably broader and higher degree of particle separation.



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Reliable component protection

This EGR filter, in the form of an integrated component consisting of the high-performance filter media and a special gasket made by the company ElringKlinger AG, is being used in one of BMW's stock engines. It is installed in the existing platform in the BMW 5, X5 and X6 series. The engineers at BMW had already experienced the reliability of GKD's Volumetric Mesh in a predecessor model. The performance of the 3D mesh as a policing filter upstream of the turbocharger back then predestined it for deployment in the six-cylinder engine. The development of the EGR filter is the first joint product – right from initial customer enquiry through to serial production – to come out of the close collaboration of the two cooperation partners, GKD and ElringKlinger. In this partnership, the gasket specialist ElringKlinger, a well-established development partner of virtually all international engine and vehicle manufacturers, assumed the role of overall module leadership. As a global player in the automotive industry, the company has all the necessary process experience in collaboration with OEMs, and all the required certifications. GKD, as a technology leader in the field of woven metal filter media, brings not only Volumetric Mesh to the table, but also decades of profound expertise in providing design, engineering and production of high-performance filters all from a single source. The gasket and filter system which the two partners have developed for the six-cylinder diesel engine guarantees a pressure loss of less than six millibars at a specified mass flow of over 80kg/h. All particles above the size of 200 µm are reliably filtered out before the EGR low pressure loop. With sustained resistance to temperatures of 800°C and upwards, to acidic diesel condensates and to the thermo-mechanical stresses that prevail in all operating conditions, the system meets the requirements for long-term durability.



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Successful co-engineering

On this basis, ElringKlinger AG designed a gasket tailored to the specified installation space geometry. Apart from defining of the gasket type, intensive collaboration with GKD was required to clarify questions of counter-pressure optimisation, optimal filter geometry and, of course, serial producibility. GKD determined the pressure drop, retention rate and stability of the Volumetric Mesh for the given installation scenario. Working closely with GKD, ElringKlinger investigated how and in which geometric configurations the required filter media could be integrated into the gaskets in serial production. A really tight fit had to be guaranteed in all operating conditions – from cold through to full engine load – under the given thermodynamic stress of from - 40°C to + 820°C and the vibration stress from engine vibration and the component's own natural vibration. The basis for the gasket is a high-temperature-resistant stainless steel carrier with an appropriate high-temperature-proof coating. Both materials are also extremely resistant to chemicals, allowing them to withstand the acidic diesel condensates with a pH of 2 which occur during cooling of the gas system and nitrogen oxide conversion through selective catalytic reduction (SCR). These are material properties that Volumetric Mesh also inherently fulfils. To comply with the specific flange geometry and installation scenario of the planned BMW six-cylinder diesel engine series, ElringKlinger devised a solution which connects the Volumetric Mesh tightly with the gasket into a single component perfectly tailored to the function of the whole system. This was made possible by a tool process specially developed for this project. As a ready-to-install component, the gasket fulfils two key functions in a single unit: sealing and filtering. This means that, for the OEM, the assembly of individual sub-components is now a thing of the past. Along with easier handling, this offers significant benefits for the OEM in terms of expenditure on logistics and installation.



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Strong synergies

All in all, this first joint project by GKD und ElringKlinger took 24 months, from project start through to serial production, to complete. Both cooperation partners were actively involved with the OEM in shaping the overall development. For example, the gasket specialists had coordination meetings with the OEM to finalise details like optimal material thickness and configuration, bolt forces or spacing, as well as additional requirements like long-term durability that came up after initial testing of the component on the engine test bench. For all questions regarding the filter media, the OEM turned to GKD. After final customer approval of technical drawing and model, the actual production of the filter media finally began at GKD. Using detailed test methods like glass bead and air permeability measurements, CFD simulations, tension tests and cleanliness analyses, the technical mesh specialists secured the consistent top quality of the filter mesh. After just under three years of close, multi-phase cooperation, GKD and ElringKlinger can now look back with satisfaction on the strategic cooperation they entered into in early 2014. Thanks to the combination of leading expertise in their respective fields of gaskets and filter media, they have succeeded in tuning the qualitative advantages of their respective products and technologies perfectly to each other and developing this integrated high-end solution for BMW. At the same time, their combined expertise holds the promise of a significant competitive edge, since they are now in a position to provide interdisciplinary solutions – at the highest technological level – to urgent problems facing the automotive industry. In fact, the partners are already working on LP EGR applications that will provide the functions of sealing and filtering in a single unit for petrol engines. Synergies which the two companies also want to increase in other fields of application – for example with serial production of automatic transmission plates featuring integrated filter mesh made by GKD.



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GKD – GEBR. KUFFERATH AG

The owner-run technical weaver GKD – GEBR. KUFFERATH AG is the global market leader for metal and plastic woven solutions as well as transparent media facades. Under the umbrella of GKD – WORLD WIDE WEAVE the company combines three independent business units: SOLID WEAVE (industrial meshes), WEAVE IN MOTION (process belt meshes) and CREATIVE WEAVE (architectural meshes). With its six plants – including the headquarters in Germany and other facilities in the US, South Africa, China, India and Chile – as well as its branches in France, Great Britain, Spain, Dubai, Qatar and worldwide representatives, GKD is never far from its customers.

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