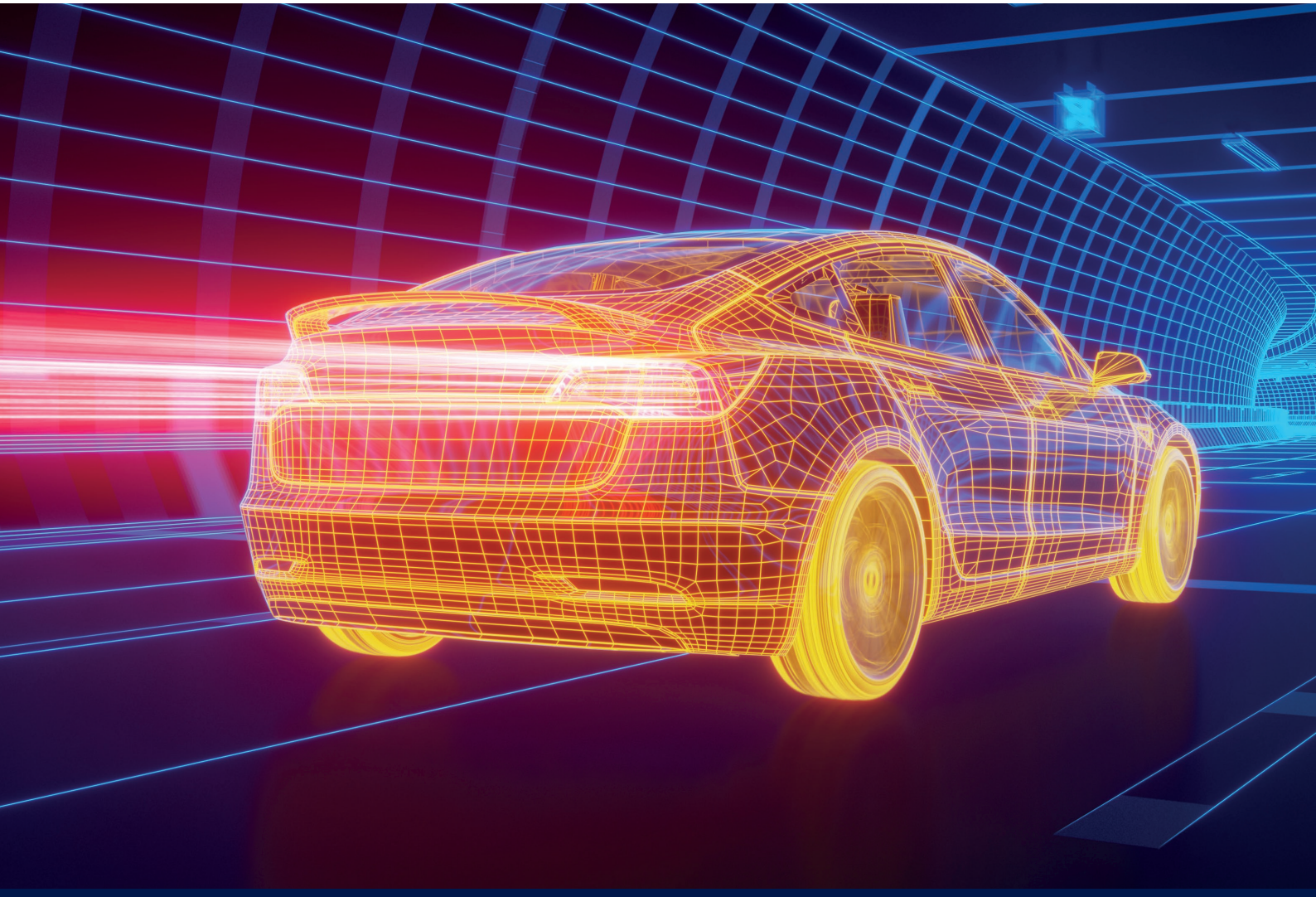
HAVER & BOECKER

DIE DRAHTWEBER

ON THE FAST TRACK WITH WOVEN WIRE CLOTH.

EXAMPLES FROM THE AUTOMOTIVE INDUSTRY. TECHNOLOGICAL PROGRESS WITH WOVEN WIRE CLOTH.



CONTENT

HIGH DEMANDS PLACED ON SMALLEST COMPONENTS.

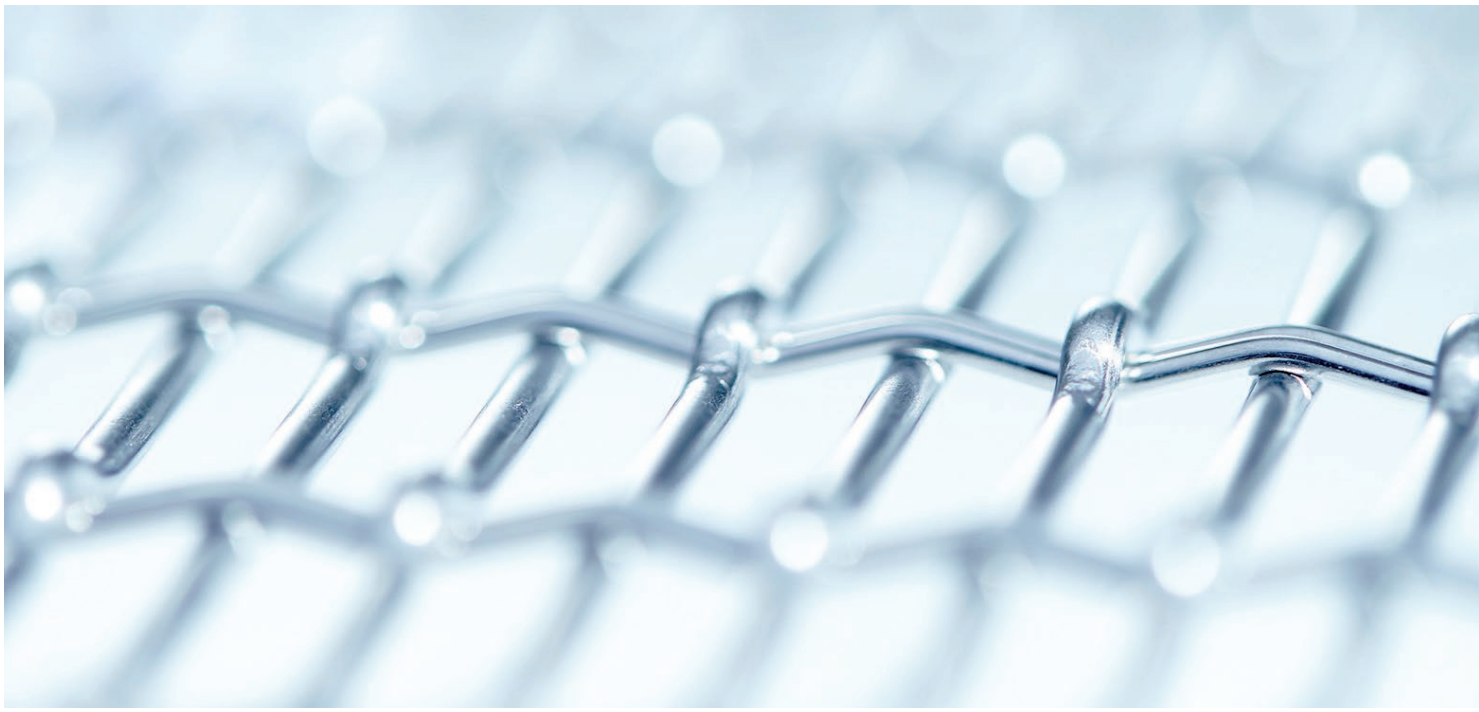
The automotive industry is a highly dynamic sector in which developers and engineers are always searching for new technologies. The focus is increasingly on digitalisation, networking and entertainment. In addition to digital features, intelligent software and new assistance systems, however, technological progress also means above all that classic vehicle technology such as engines and gearboxes must be continually optimised. The aim is to find innovative approaches to increasing efficiency, improving environmental standards and enhancing vehicle and driver safety.

Great leaps in development are often achieved by optimising the smallest of components. Best examples of these are filters and fabricated parts made of woven wire cloth, which already play a key role in the automotive industry. Filter media and mesh components must be extremely fine and precise on the one hand but require extremely high strength and robustness to withstand the effects of high pressures and temperatures on the other. These challenges can be successfully met by implementing innovative manufacturing processes whilst exercising greatest possible care in the development, production and testing of woven wire cloth components. This results in modern filters and fabricated parts, which are precisely tailored to the high demands of automotive engineering and which are often one step ahead of other solutions in terms of efficiency and reliability.

THE ADVANTAGES OF WOVEN WIRE CLOTH.

In the automotive industry today, filters and fabricated parts made of woven wire cloth are used in very different areas and have diverse functions. They filter and regulate fuels and operating agents, protect sensitive equipment in the vehicle and offer options for distinctively designing car interiors. The enormous range of these applications underscores a primary advantage of woven wire cloth - its versatility.

The wide scope of possible designs, material selection and wire thickness gives engineers and developers a great deal of freedom for working with woven wire cloth, which thus allows them to fully focus their attention on the ideal solution for the end customer. For example, the pore size and flow characteristics of filter elements made of woven wire cloth can be precisely defined. At the same time, woven wire cloth has a much higher inherent stability than alternative materials. This stability is an important quality factor, in particular when the mesh is exposed to physical loads when used under pressure or at high temperatures for example. This in addition to the enormous flexibility with which woven wire cloth can be optimally integrated into existing component designs. This applies, for example, to using woven wire cloth in friction bearings or as electrical contacts in fuel injectors.



PRACTICAL APPLICATIONS.

The following applications are examples of how filters and fabricated parts made of woven wire cloth make an important contribution towards smooth functionality and safety in the automotive sector.

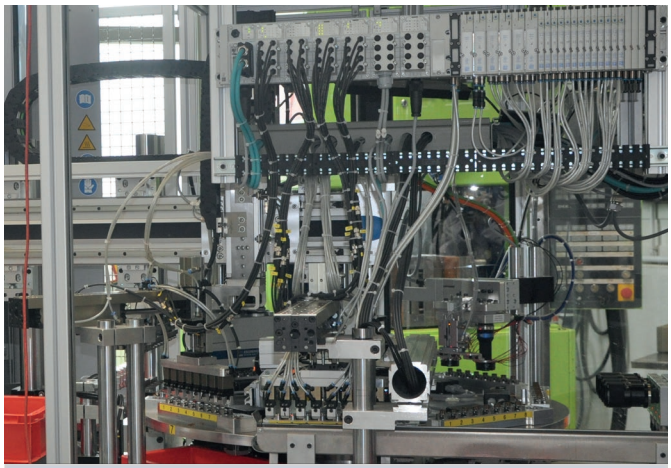
FILTERS FOR PETROL DIRECT INJECTION SYSTEMS

The product and its function

Woven wire cloth, with its uniform filtration performance over the entire surface of the filter, is the ideal medium to filter out unwanted particles from the technological heart of a vehicle - namely the engine. When a filter for petrol direct injection was being developed, a hybrid filter fitted with a superfine metal woven wire cloth was chosen, which retains all particles larger than 15 microns.

Special challenges

The initial focus of the development process for this specific filter was the question which woven wire cloth would combine the required fineness with optimum flow characteristics and at the same time be stable enough to function reliably even under enormous pressure. In determining a suitable fabric specification, empirical values and preliminary simulations led to the decision in favour of a high performance filter cloth. Even in the small pore size range of 15 microns, the type of weave of this filter cloth makes it possible to achieve a high fuel flow rate with a minimum loss of pressure. Very thin weft wires are woven in linen weave without any space to the following weft wire (0 mesh). In this way, the required strength is achieved in addition to the high flow rate of the filter.



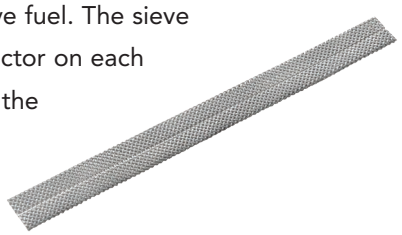
The production of filigree filters requires highly complex equipment.

The next step involved was the focusing on the most efficient production process possible, which was to be completely automated from the feeding of mesh strips to the final quality inspection of the plastic-coated filter. Based on the exact specifications for the plastic component, an individual process was developed: the mesh is fed to the specially designed tool, cylindrically shaped, then positioned for the plastic injection moulding process carried out in adherence to tight tolerances, and later removed and packed. Camera inspection of all filters rounds off the complete process under quality assurance aspects.

PIEZOELECTRIC SIEVE ELECTRODE

The product and its function

In conjunction with common rail injection, woven wire cloth is not only used as a filter element but also as a conducting medium. Here, the conductivity of metal woven wire cloth is used to save fuel. The sieve electrode in this case is made from woven wire cloth and is located in the piezo injector on each of the two opposing sides of the piezo ceramic stack. This sieve electrode transfers the electrical voltage to the ceramic layers. When energised, the ceramic stack expands and opens the fuel injection port.



How a piezo injector works

The switching valve in the piezo injector closes one of the two fuel injection ports by expanding the ceramic stack thus allowing the fuel to flow under a higher level of pressure through the still open injection port onto the injector at the end of the port thereby forcing it back.

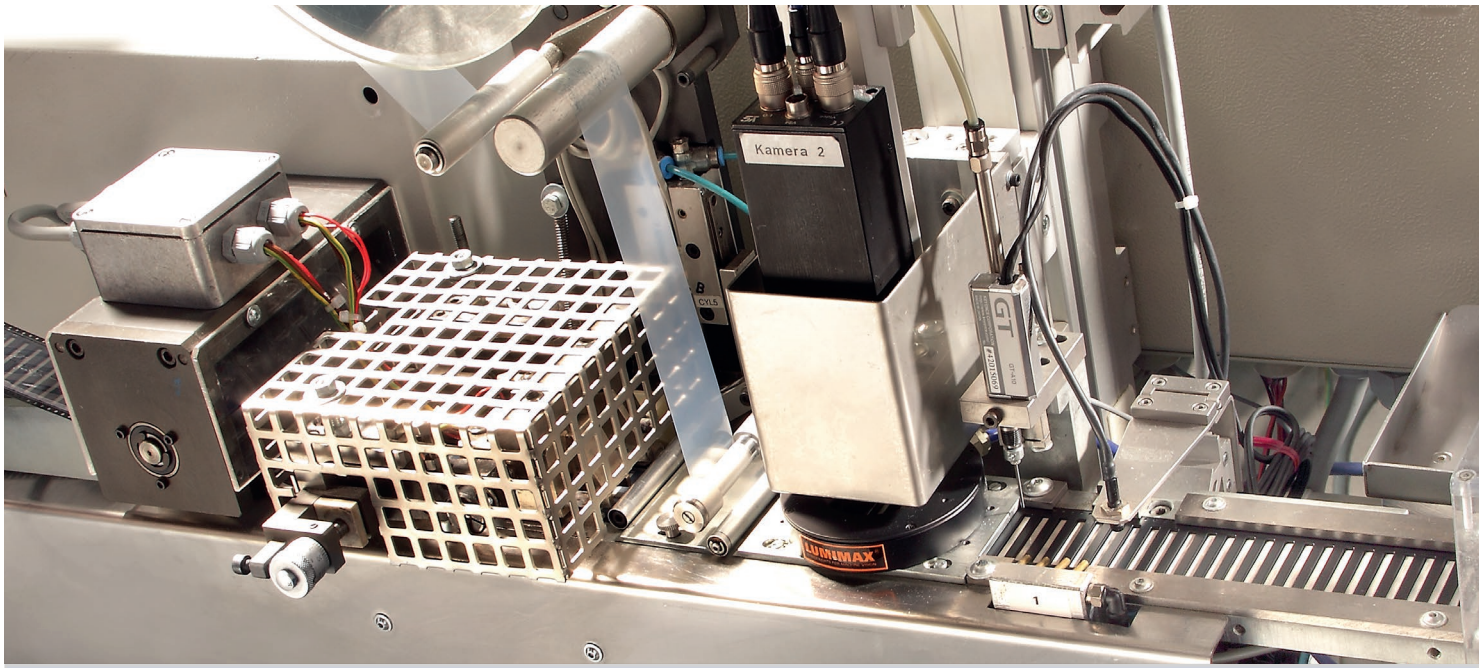
Compared to the externally mounted solenoid valve injectors in the past, the pulse frequency of the internal piezo actuator is four times higher. This results in more precise dosing of the fuel quantity for pre-injection, main injection and post-injection. The effect: the combustion is quieter and there is less exhaust gas, which not only contributes towards protecting the environment, but ultimately is also easier on the wallet of the car owner.

Special challenges

In a component as small as the piezo injector, the dimensions and geometry of the individual components are important and often limiting factors. This also applies to the electrodes, which must be as small and flexible as possible in order to be installed in the injector. Accordingly, a sieve electrode was developed taking into account a precisely formulated catalogue of requirements, which with its space-saving size of only 38.1 x 2.7 mm fits on both sides of the ceramic stack. The sieve electrode thus adapted to the predefined width of the piezo actuator is significantly thinner than wound wire used as an alternative for contacting.

The ceramic stack, to which the mesh is directly connected, expands briefly as described above to open the injection port. The electrode must therefore also be elastic in order to be able to permanently accompany this movement. Woven wire cloth offers exactly this elasticity and for this reason is much better suited for use in the piezo injector than a rigid plate. While constant expansion and compression is a basic principle of the injector, undesirable expansion due to differences in temperature must be avoided at all costs. The ceramic material guarantees this stability even at the high temperatures that typically occur in the engine compartment of vehicles. The electrode material must also have the same properties: an electrode, which expands at high temperatures could disrupt contact with the ceramic stack. The mesh is made of a special material in order to prevent exactly this from happening. The coefficient of thermal expansion of the mesh is comparable to that of the ceramic and thus ensures an ideal interaction between the two components.

The coating is a key component in the complex manufacturing process of this "small bundle of energy". Meeting special conductivity and connection requirements for the electrodes necessitates outsourcing of the coating process to competent specialists. Camera inspections before and after coating ensure that process stability is maintained.

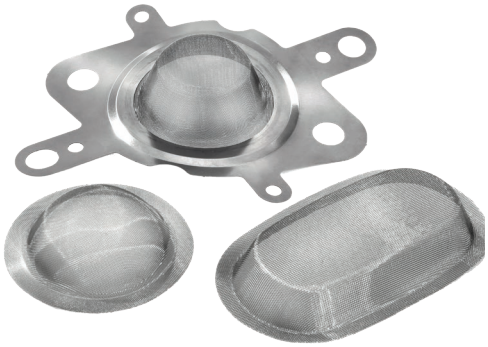


The piezo sieve electrode production process ends by packing them fully automatically in blisters.

FILTERS FOR LOW-PRESSURE EXHAUST GAS RECIRCULATION

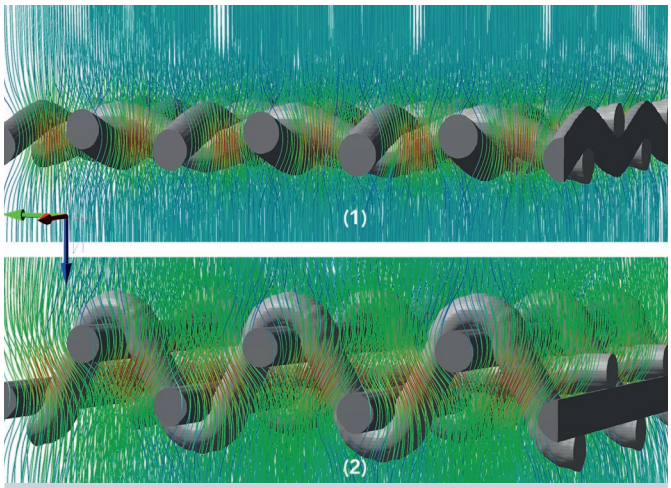
The product and its function

The topic of filtration is a relevant aspect, especially in conjunction with diesel vehicles. In order to protect the environment it is important to reduce nitrogen oxide emissions by implementing a system such as low pressure exhaust gas recirculation (LP-EGR). Depending on the installation conditions, low-pressure exhaust gas filters produced as circular blanks or ready-to-install fabricated parts made of woven wire cloth allow a high exhaust gas flow rate. These components filter out all particles that exceed the maximum permissible particle size of 200 microns, which would damage turbochargers and engines.



Special challenges

Low-pressure exhaust filters must have an extremely high heat resistance as they are often exposed to high temperatures of up to 850°C. Although different materials satisfy these property requirements, many of these standard metals are not automatically suitable for withstanding fluctuating temperatures. Constantly changing low and extremely high temperatures requires the use of a special material.



Simulation of the flow behaviour of square aperture mesh (1) and 3D mesh (2) using GeoDict software.

In order for the exhaust gas aftertreatment system to function as efficiently as possible, the filter, which is located upstream of the turbocharger must obstruct the flow of exhaust gas as little as possible. In this case, a specially developed 3D mesh was used which, thanks to its special structure, reduces the pressure loss in the flow by up to 36% versus a square aperture mesh. Compared to alternative 3D filter inserts, precisely defined, constant aperture widths over the entire filter surface ensure a precise, reliable cut. In order to determine the ideal filtration parameters in advance at an earliest possible stage and without time-consuming and cost-intensive tests, 3D simulation software has been implemented to determine the optimal specifications for this application long before the filter was produced.

Ideally, an exhaust filter will last "the life of the car" and still retain the same high filter quality. Irrespective of their round, angular or oval geometry, low-pressure exhaust filters always have a special, pot-like shape. Because the wire surface is larger than that of flat filters, the particle retention is higher. While most of the particles are deposited the edge areas over the course of time, the front surface of the filter remains free of particles.

AN OUTLOOK ON FURTHER AREAS OF APPLICATION.

These three practical examples illustrate only a small selection of the potential areas of application of metal wire mesh. The large field of the automotive sector offers many more possibilities.

Efficiency and sustainability

The potential of woven wire cloth components is diverse especially where cleanest possible drive technologies and completely new mobility concepts are concerned. They already play a decisive role in reducing nitrogen oxide emissions, not only as filters for low-pressure exhaust gas recirculation, but also as flow straighteners in exhaust-driven turbochargers. In future, the significance of woven wire cloth will also continue to increase in the field of e-mobility - especially due to its excellent shielding properties in connection with electromagnetic compatibility (EMC). Flat woven wire cloth made from copper or aluminium, for example, protects the sensitive electronics in electric cars from interference signals from electronic power components and pulse inverters. It also effectively protects control units against electromagnetic radiation during the inductive battery charging process.

Design and aesthetics

As well as engineers and designers from the automotive sector, more and more designers are also recognising the advantages of versatile woven wire cloth, which is ideal for use as a design element in car interiors. Although elements made of plastic, wood or carbon are frequently used for designing car interiors, stainless steel is at least equal to - and in some cases even superior to - these materials in terms of elegance, durability and purity. Design mesh made from stainless steel offers a perfectly uniform structure, which not only can be seen but also felt. And depending on the fabric pattern, it can create a serene or sporty atmosphere. The coolness frequently associated with stainless steel can be offset by combining the mesh with PET monofilament fibres in all RAL colours. Individual corporate designs can also be included - interlaced with the gleam of stainless steel. The appearance of the metal wire and hybrid fabric varies depending on the viewing angle. Even the seemingly closed-surface of design mesh is permeable to light and sound and offers additional creative flexibility.

Whether with or without a backing, the surface of the design mesh reveals its very individual effects depending on the viewing angle.

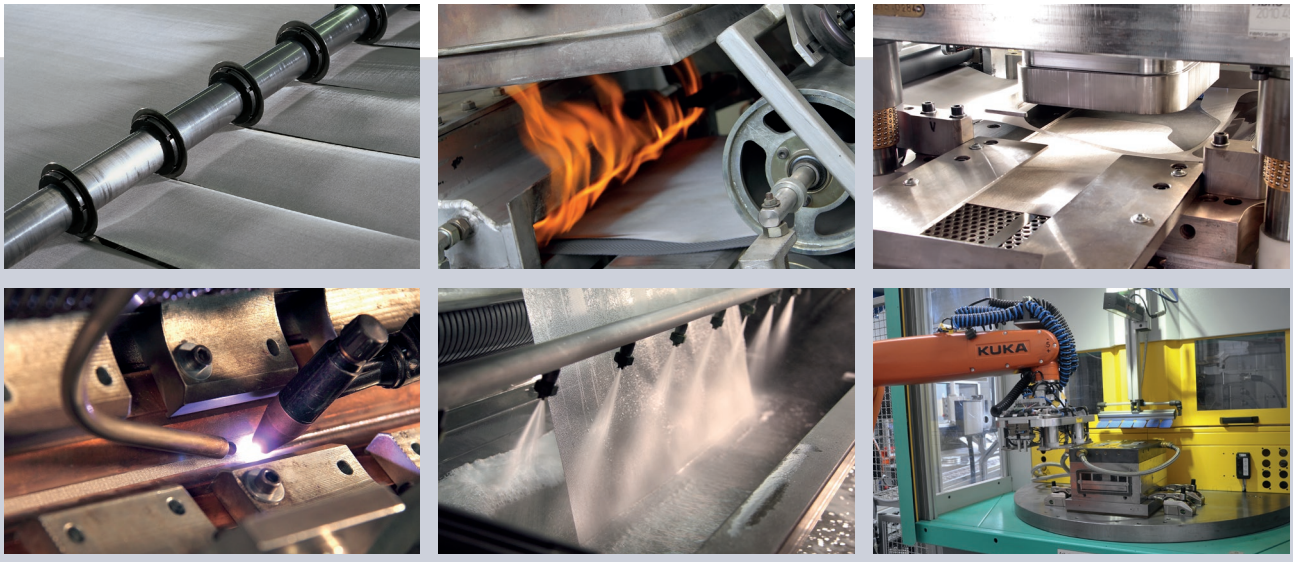
Due above all to its immense versatility, woven wire cloth can be used in a variety of ways exceeding by far merely shape and function. The choice of the type of weave and the wire materials not only influences the appearance, but also always provides the perfect answer to typical industry requirements such as absolute corrosion and heat resistance. There are virtually no limits to the possibilities of optimising existing and developing new mesh specifications. With the help of complex simulation software, it is now possible to accurately determine the optical effects and functionalities such as the flow behaviour of a newly created mesh and to adapt it precisely to the particular application.

THE HALLMARKS OF A GOOD COMPONENT MANUFACTURER.

In the development of new, sophisticated solutions, engineers in the automotive industry are faced with the challenge of the increasingly complex process of planning and designing individual components due to expensive feasibility tests and extensive testing procedures. Suppliers are therefore being tasked more and more with the development, production and continuous improvement of components. With their expertise they are becoming increasingly more involved in planning and implementation processes. It is thus all the more important to rely on experienced, competent and reliable partners when selecting component manufacturers and suppliers of individual parts.
Haver & Boecker is your competent partner in the field of woven wire cloth manufacturing.

ALL FROM ONE SOURCE.

Backed by more than 130 years of experience in the production and further processing of metal woven wire cloth, our engineers know what is important when it comes to manufacturing components for the automotive industry.
Haver & Boecker combines a particularly high in-house production depth under one roof: from weaving individual wires, punching, embossing and plastic injection moulding of woven mesh parts, as well as welding of complex filter elements, up to and including the process-reliable packing of finished components. The complete development and production remains in the same hands and can thus be optimally coordinated. High production and storage capacities for a large number of mesh types additionally ensure a continuous supply for the further process chain.



Production facilities at Haver & Boecker include:
Cutting · Heat treatment · Stamping and forming · Welding · Cleaning · Plastic injection moulding.

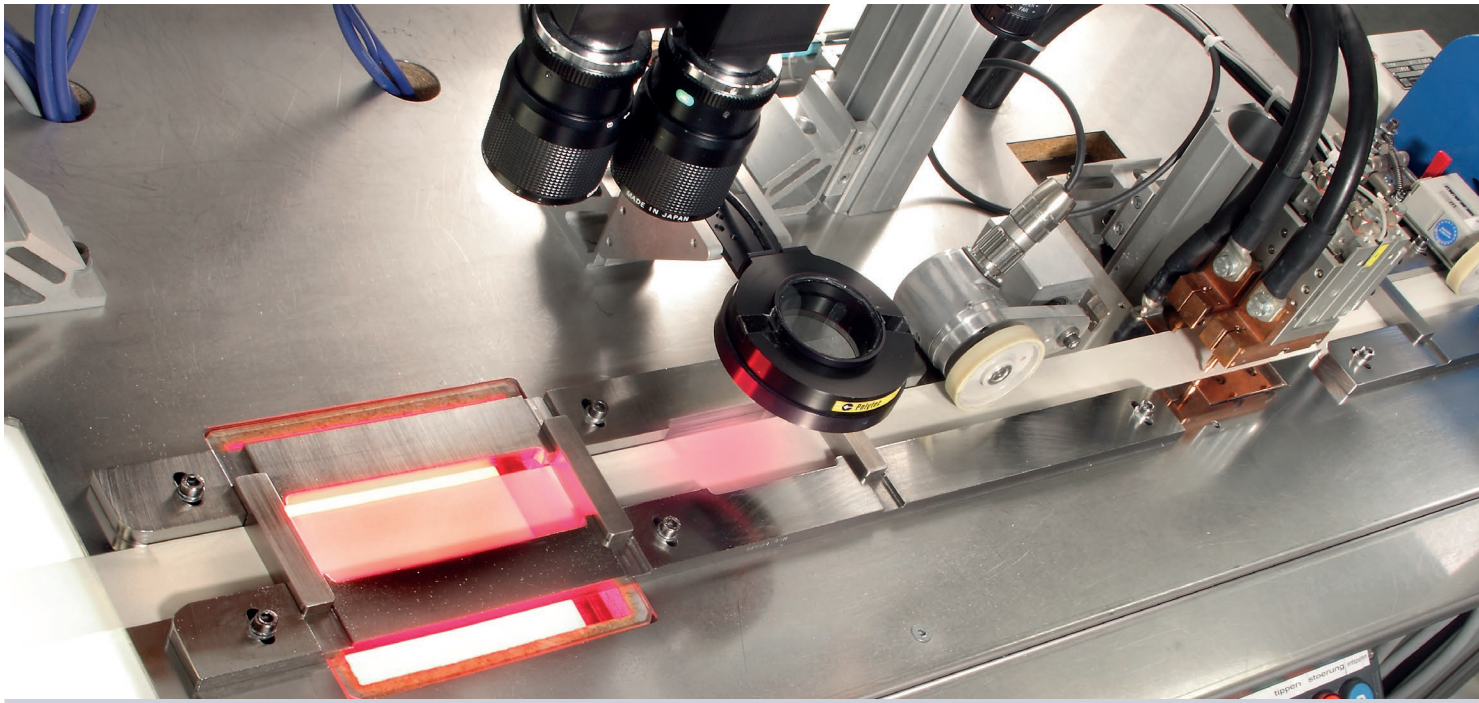
ALL IN THE INTEREST OF YOUR SAFETY.

MADE IN GERMANY

In the automotive industry, the reliability of supply is an extremely important aspect with regard to integration into strictly regulated supply chains. The predominantly regional procurement of primary materials and local processing of wire up to and including dispatch of the finished components is embedded in a customer-specific concept for safeguarding the supply. All of these measures are the basis for providing very reliable statements on delivery times and avoiding production downtimes due to supply bottlenecks.

EVERYTHING UNDER CONTROL.

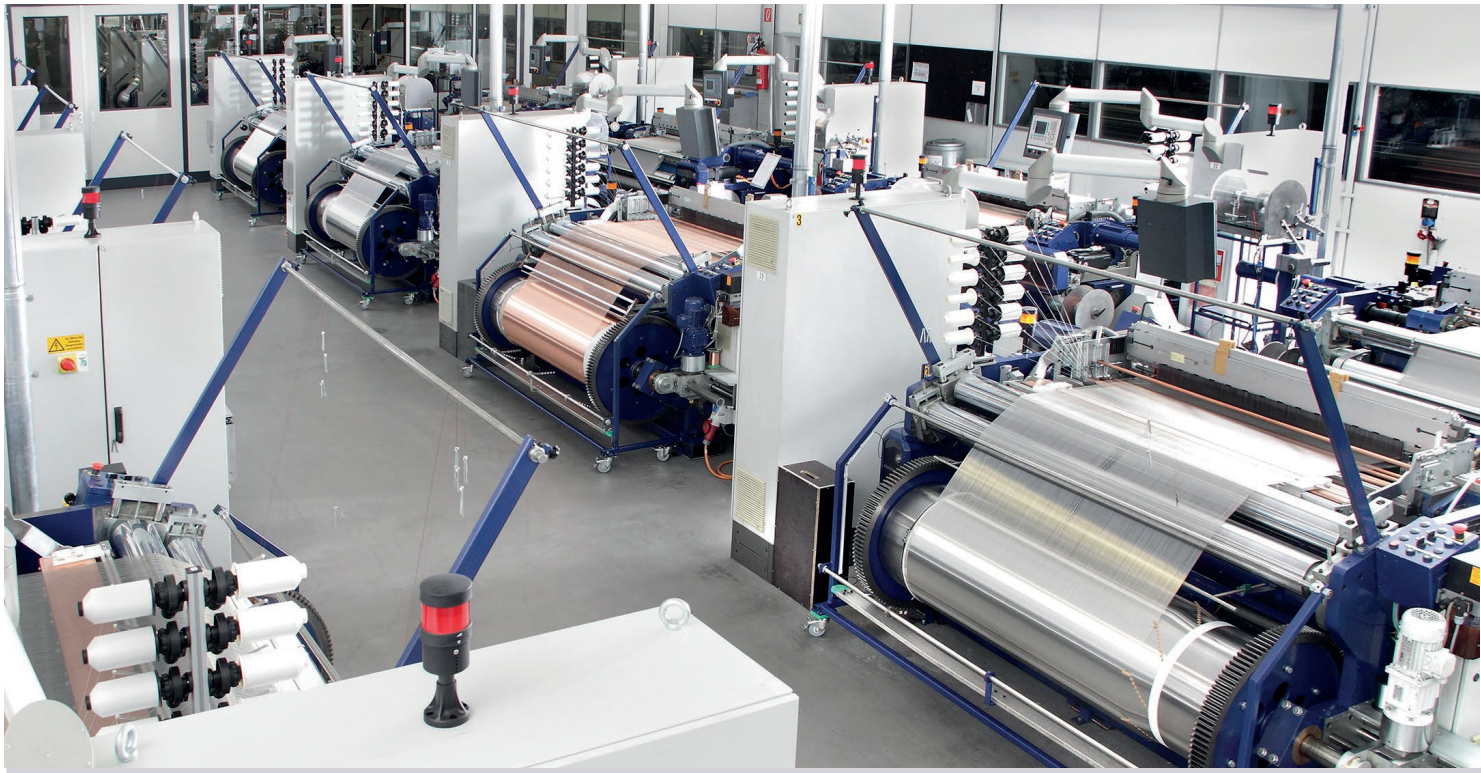
Thorough and comprehensive quality management in every step of production are a matter of course at Haver & Boecker. In order to meet the demanding requirements of the automotive industry, detailed testing procedures, intensive controls and documentation accompany the complete production process. We offer facilities for 100% camera inspection with our specially developed HAVER Vision System. This system is used to visually inspect and monitor products manufactured in large lots and is constantly being further developed to meet growing quality requirements. With the help of manual in-line inspections, Haver & Boecker pursues a zero-error strategy within a quality management system, which has been certified in accordance with both DIN EN ISO 9001 as well as IATF 16949.



Everything in view: The "HAVER Vision System" utilises visual inspection and monitoring to meet the high quality requirements of finished mesh products.

ANYTHING IS POSSIBLE.

In addition to maximum precision and diligence, Haver & Boecker's activities throughout all areas of woven wire cloth production are characterised by an extraordinary innovative spirit. Our weaving machines and tools are designed and manufactured in our own factory in Germany so that adjustments for process optimisation can be implemented flexibly and at short notice. These weaving machines are used to produce newly developed and to some extent previously patented types of weave as well as close-to-production prototypes, which are the starting point for customised products and a main element in the development and optimisation process. In the search for new challenges and clever solutions, Haver & Boecker relies on the experience of its employees, dynamic teams as well as the use of modern technologies and intelligent software.



A special competence of Haver & Boecker is to design and manufacture woven wire cloth with weaving looms developed in-house.

ABOUT HAVER & BOECKER.

Haver & Boecker began producing wire cloth in Hohenlimburg, Germany in 1887. Today, the company is a worldwide leading manufacturer of woven wire cloth for industry, engineering, architecture and design.

Haver & Boecker has been a pioneer in the technology of wire weaving for more than 130 years. The company develops and processes woven wire cloth into filters and fabricated components fulfilling the highest standards.

Whether it's aerospace and aviation, automotive, electrical engineering, medicine, chemicals, water filtration, mechanical engineering or plastics processing – customized solutions from Haver & Boecker offer the basis for efficient production processes, reliable function, optimum quality and distinctive design.

HAVER & BOECKER OHG · Filters and Fabricated Parts
Ennigerloher Straße 64 · 59302 Oelde · Germany
Telefon: +49 (0) 25 22-30 522 · Fax: +49 (0) 25 22-30 404
E-Mail: fuf@haverboecker.com · Internet: www.weavingideas.com