HAVER & BOECKER

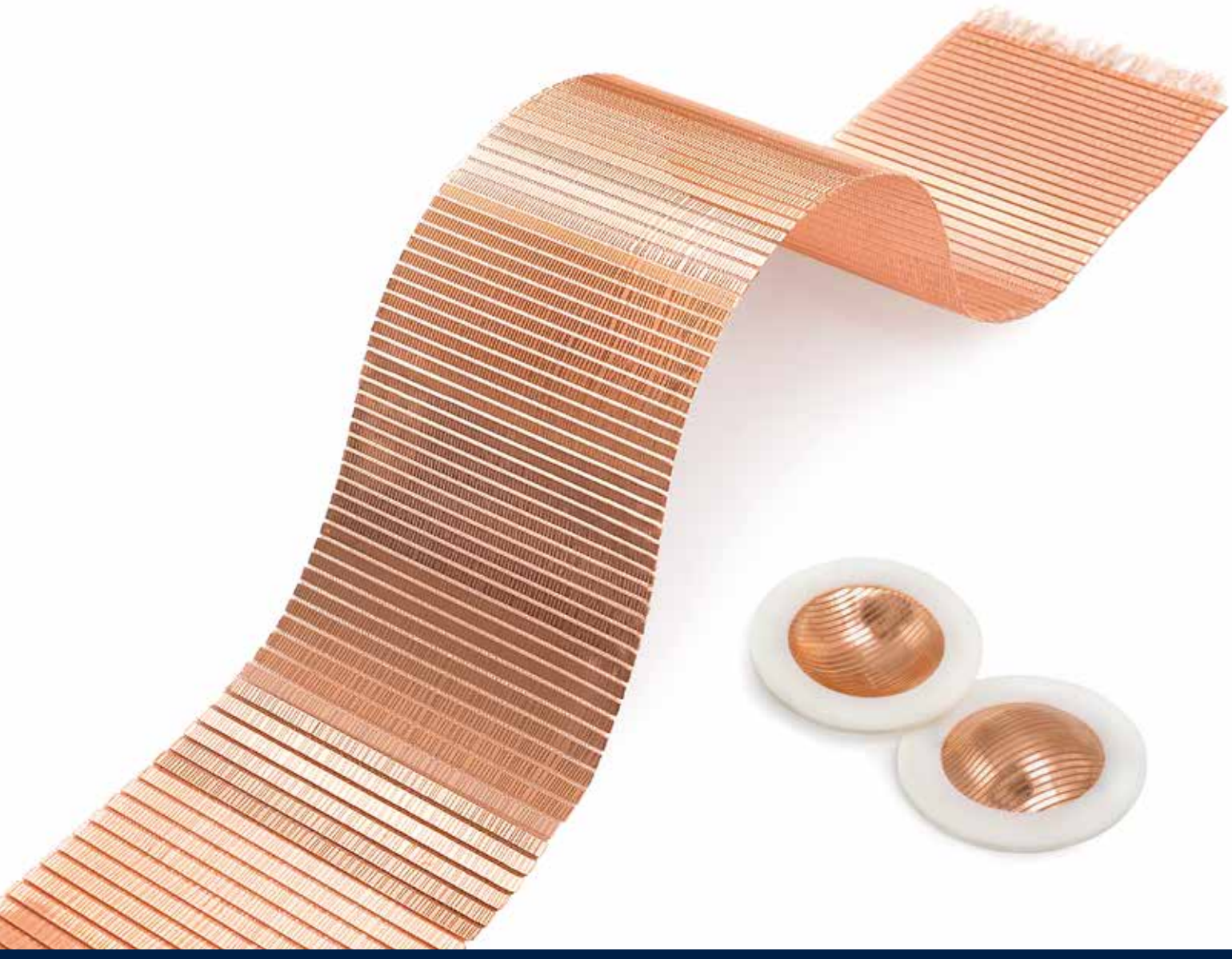
DIE DRAHTWEBER

KERN-LIEBERS

GROUP OF COMPANIES

NEW FORMS OF ELECTROMAGNETIC SHIELDING.

Metal mesh for optimal EMC conformity in electromobility.



PROTECTING AND SHIELDING WITH HIGH-QUALITY METAL MESHES

Electromagnetic fields accompany us throughout our everyday lives. They occur wherever electrical currents flow. Traction current or the public power grid, radio transmitters, mobile communications or microwaves - the causes of electromagnetic fields are manifold and cover a broad frequency spectrum from quasi-static fields to dynamic high and ultra-high frequency fields beyond the visible light spectrum.

With the electrification of automobile drivetrains and the use of ever more powerful electronics, the shielding of alternating fields is increasingly becoming a challenge in the design of electric cars. This is because all components installed in a vehicle, ranging from sensors to drive electronics to infotainment, must be electromagnetically compatible so that they always function reliably. Another factor is - of course - also protecting vehicle occupants from electromagnetic radiation..

The electromagnetic spectrum at a glance

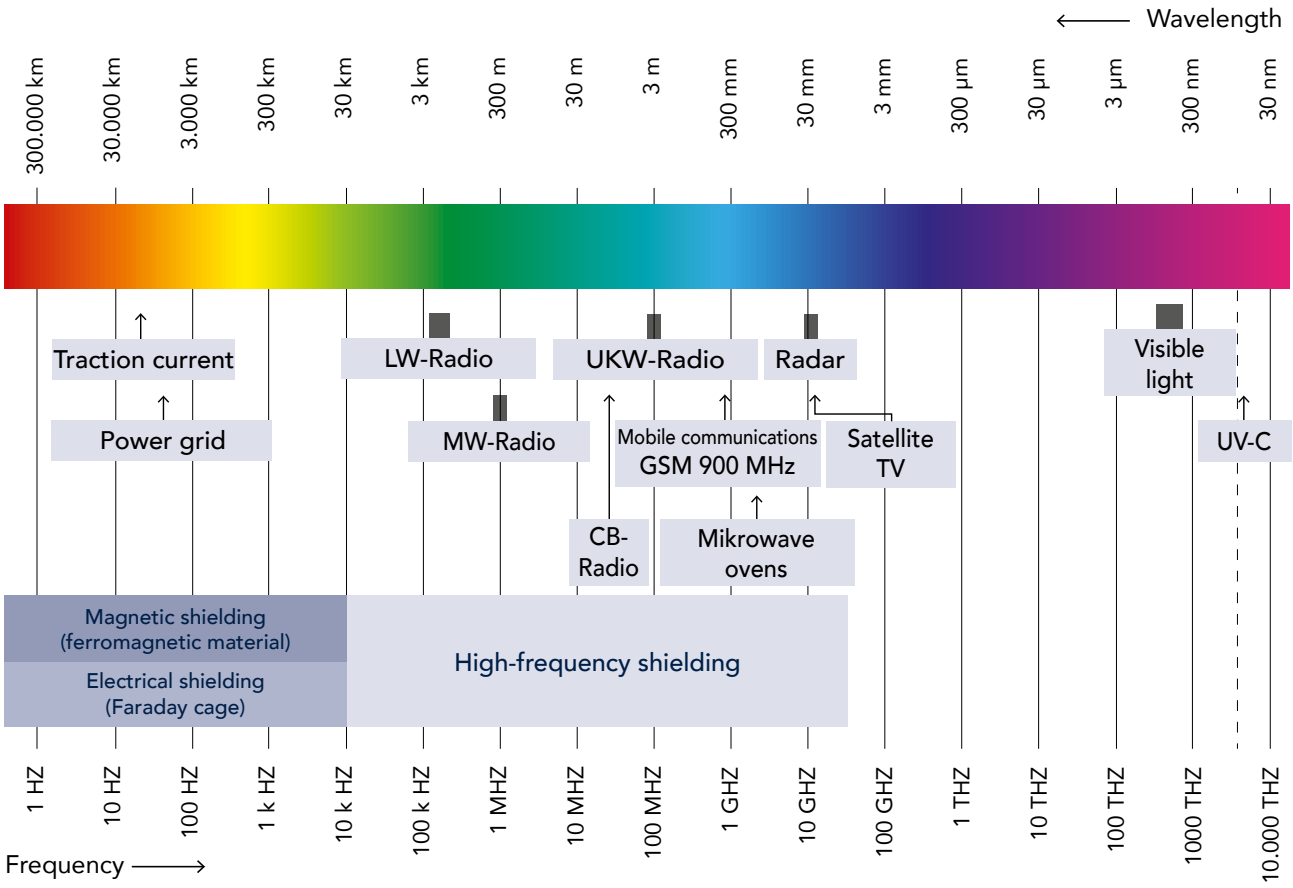


Fig. source: modified from „Electromagnetic Spectrum", W+R Schirmungstechnik, Rheinstetten, Germany

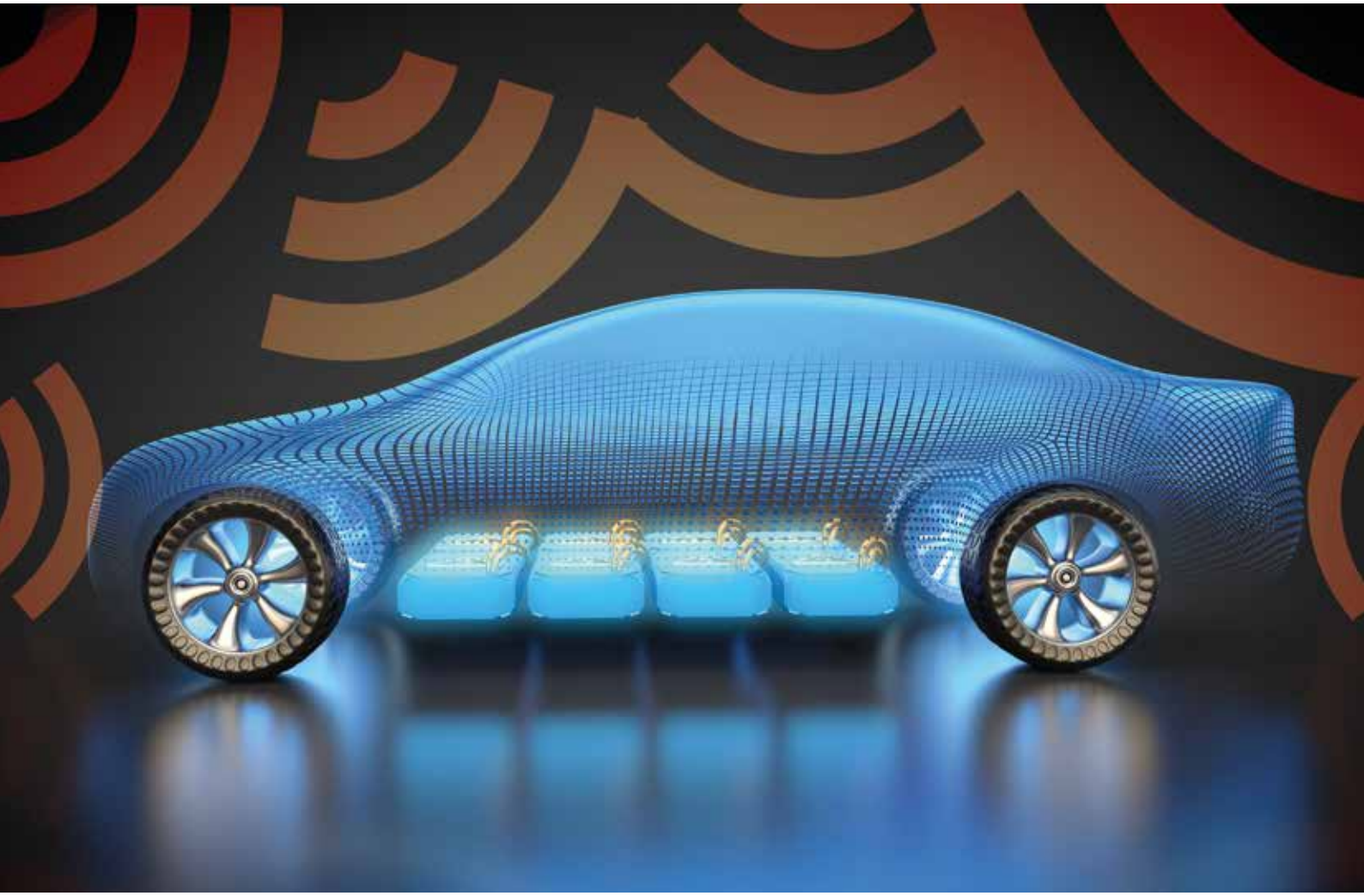
The tension mounts: from kilohertz to gigahertz

The critical frequency spectrum in electric cars extends from the lower kilohertz to the gigahertz range. For example, strong electromagnetic emissions of several GHz are generated in the electronics between the electric motor and the battery when high power is converted by corresponding switching frequencies.

In the high-voltage network of electrically powered vehicles, voltages of 48 to 800 V are present with current ratings of up to several 100 A. Without effective shielding, this leads to considerable interference with the vehicle's complex electronics, which also includes impairment of safety-relevant control and monitoring units as well as the infotainment systems.

Interfering scatter radiation also occurs when charging the drive batteries. This applies both to inductive charging, which typically uses alternating current between 75 and 90 kHz, as well as cable-based conductive charging. In addition, interference signals also occur in the low-frequency range such as in the electronic modules for controlling the acceleration and braking processes.

The importance of electromagnetic shielding in electric cars is reflected not least in the legal requirements ranging from the EU (Directive 2014/30/EU) to ICNIRP (International Commission on Non-Ionizing Radiation Protection) to CISPR (Comité international spécial des perturbations radioélectriques [International Special Committee on Radio Interference]) with the aim of protecting vehicle occupants as well as the functional safety of technical systems.



THE DIRECT LINE TO EFFECTIVE SOLUTIONS FOR OEMS

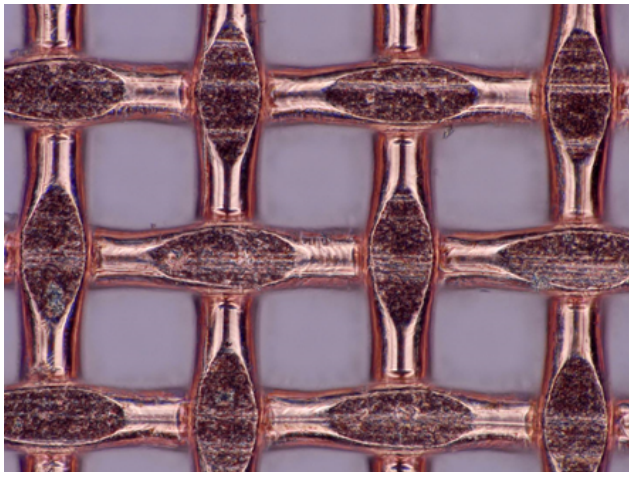
Avoiding interference radiation ideally begins with the radiation-minimising constructional design of electronic components. However, further shielding measures in addition those above are required in electric cars. Here, metal mesh offers a multitude of decisive advantages by combining effective shielding with excellent stability and formability as well as permeability to light, air and vapour. In the automotive sector, the wire diameter and mesh size as well as type of mesh element material can be precisely adapted to individual customer requirements and processing procedures.

In addition to the classic types of mesh made of round wires in warp and weft direction, which have been used in the shielding industry for many years, new types of mesh and in particular flat-wire mesh offer further electromagnetic and physical advantages. Flat wire is processed as weft wire for these innovative types of mesh.

Stable performance
When integrated into a matrix such as plaster or masonry to shield buildings, round wire mesh also achieves a particularly high interlaminar shear strength (ILSS).

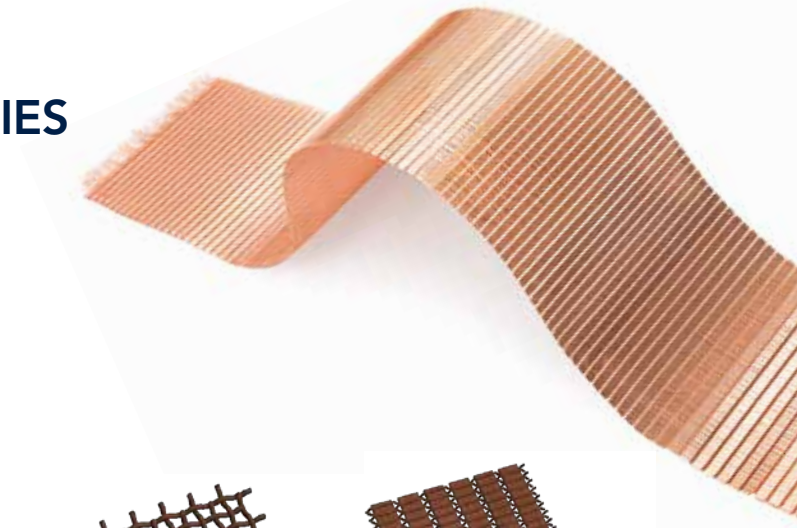
	Field types	Corresponding shielding mechanism
Static	Electrostatic fields	Faraday cage
	Magnetostatic fields	High permeability shielding / active magnetic shielding
Dynamisc	Alternating electric fields **(slowly changing)**	1. Generation of eddy currents and induction of opposing fields
	Alternating magnetic fields **(slowly changing)**	2. Influence and magnetic shielding attenuation have positive effects on shielding attenuation
	Electromagnetic fields (rapidly changing)	Advanced shieldings

Using round and flat wire mesh in particular has a positive effect on „slowly changing" field types.



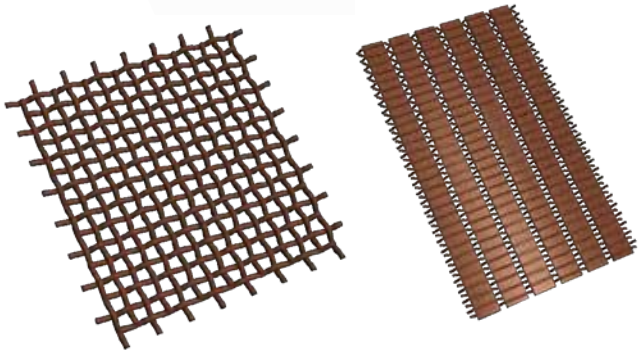
Round wire mesh made of copper.
The dimensional stability of this type of wire mesh is extremely high when calendered and heat-treated. These can be provided with edges and corners according to the customer's requirements. The crossing points of the wires, smoothed by calendering, increase the contact area to improve the conductivity and ensure that shielding effectiveness is reliable.

NEW FLAT WIRE MESH: MANY ADVANTAGES IN SERIES



Haver & Boecker, in cooperation with the Kern-Liebers company, has developed new types of wire mesh made of wafer-thin flat wire combined with round wire especially for EMC applications.

For this, Haver & Boecker processes flat wire supplied by the Kern-Liebers company with a thickness of less than 100 µm. A significant advantage over pure round wire mesh is, among other things, the greater surface density, which, with a comparable mesh size, achieves a significantly higher shielding capability.



Round wire mesh
(60% area coverage)

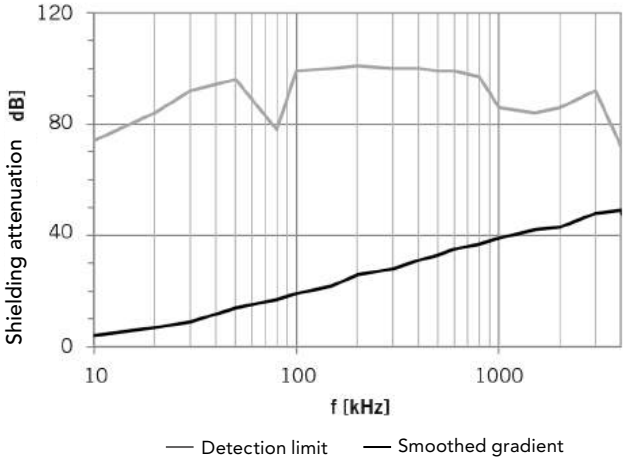
Flat wire mesh
(86% area coverage)

Both round and flat wire mesh are suitable for shielding alternating electric and magnetic fields. Mesh made of flat and round wire with a comparable mesh size achieves an area coverage of 86% while a coverage of about 60% is obtained using only round wire mesh.

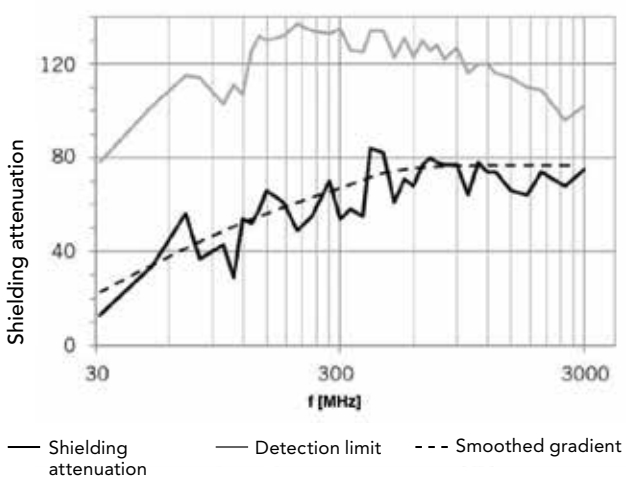
Effective EMC-compliant shielding attenuation

Measurements conducted using magnetic antennas show that the flat wire mesh from Kern-Liebers and Haver & Boecker achieves an excellent shielding attenuation of up to 80 dB in the MHz range, which is decisive for the on-board electronics of electric cars.

Measurement of the electromagnetic shielding effect in the GHz range.



Measurement for low frequencies using magnetic antennas.



Measurement of the electromagnetic shielding effect in the GHz range.

High robustness, lighter weight

Combining flat and round wire provides a high level of physical stability and at the same excellent formability and consequently optimal adaptation to a wide variety of installation situations. The low density of the mesh offers distinct weight advantages compared to classic sheet metal shielding, which is a particularly important factor for lightweight concepts in automotive engineering.

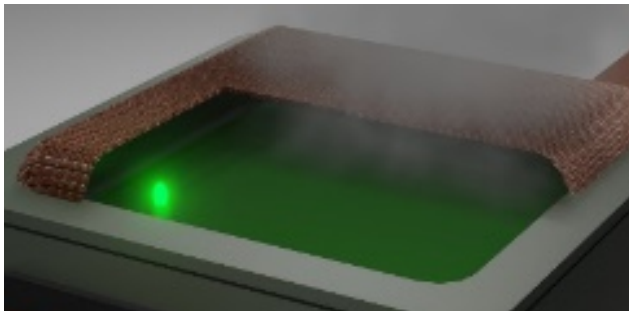
Wire mesh at its best

Modern manufacturing processes guarantee maximum precision and reproducibility and thus consistently high quality assurance. The mechanical and electrical properties of the fabricated parts can be precisely defined based on parameters such as the wire diameter, mesh size and the materials used.

Virtually any geometric shape can be obtained during a further processing step by stamping, embossing or deep-drawing the mesh.

From high-voltage batteries to infotainment

From extremely small to extremely large components, combining formability and dimensional stability offers more flexibility when it comes to enclosing or covering components. Flat wire mesh can be produced in widths of up to 150 cm, which can also be used for shielding even large surfaces in electric cars, such as entire HV cables up to and including complete enclosure of the battery. In the event of an accident, the permeable wire mesh also offers maximum protection against the formation of condensation, high pressure and the risk of explosion.



The optical permeability also allows the use and non-contact control of detectors and signal transmitters.

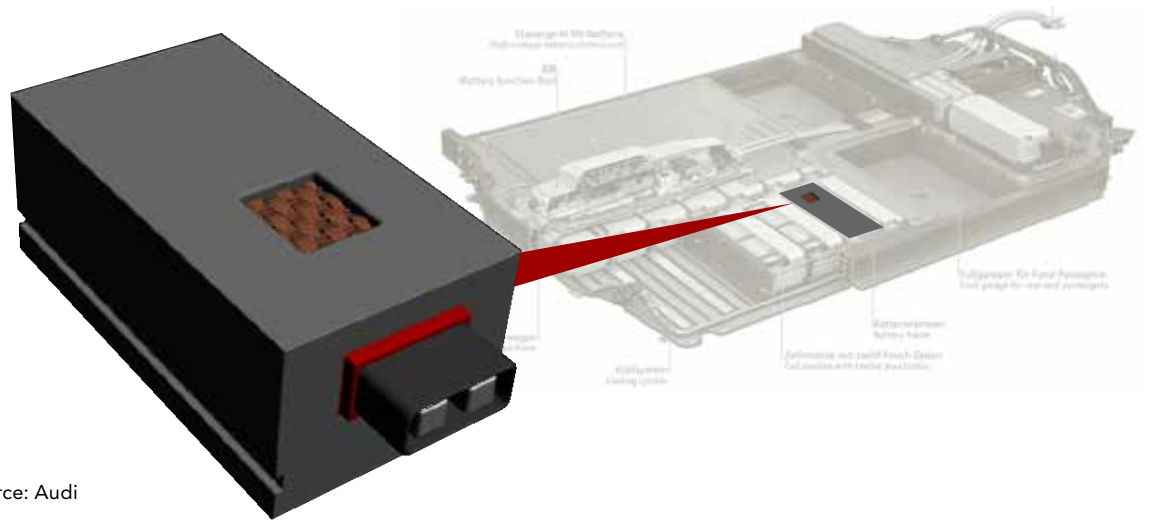
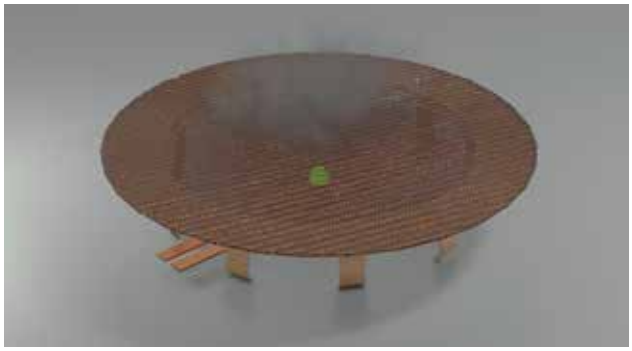


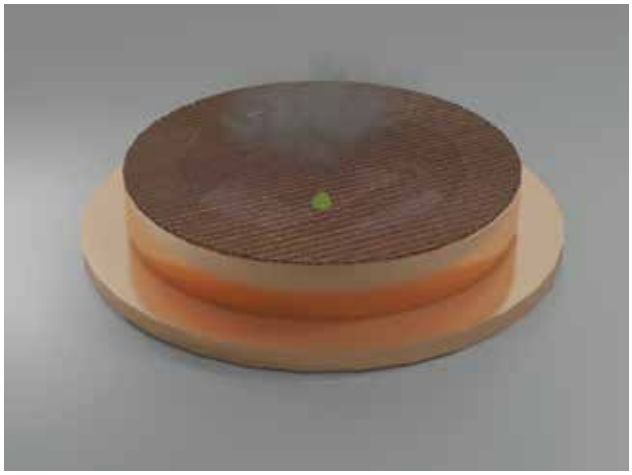
Fig. source: Audi

PERFECTLY FITTING PLASTIC AND METAL EDGINGS

The stamped mesh elements can be fitted with plastic or metal edgings or fixings according to the installation requirements. Polyamide injection moulds are used, for example, in fuel filters for internal combustion engines or for electrical plug connections. In conjunction with EMC, on the other hand, the fabricated parts are fitted with stamped or stamped-bent parts, such as metal edgings or EMC shield clips.

A new welding process developed by the Kern-Liebers company is used here in order to ensure an optimal galvanic connection across the weld seams to reliably discharge induced eddy currents.





When using metal edgings, the mesh is welded to the connecting stamped or stamped-bent parts to reliably dissipate eddy currents. In addition to a highly conductive material, the quality of the welding spots is crucial for obtaining reliable shielding.

Special plastic edgings provide support for every geometric shape and offer concrete product solutions for automation processes.

A suitable material for every application

The type of material used to produce the metal mesh depends on the requirements of the individual customer. Traditionally, meshes are comprised of both flat and round copper wire with a purity of > 99.5% (CW003A, CW004A).

Aluminium alloys such as AlMg5 (EN AW-5019) or AlMg3 (EN AW-5754), for example, are the materials of choice for particularly weight-saving designs for aerospace engineering applications. CuSn6 (CW452K) bronze alloys are an alternative option.

In a nutshell: EMC compliant and customer specific

With its wide range of high-tech wire meshes, Haver & Boecker and the Kern-Liebers company offer manufacturers and suppliers high-quality solutions for EMC-critical components in the field of electromobility. The new flat wire meshes in particular are impressive thanks to their excellent shielding attenuation, high stability and light weight as well as excellent formability and edgings designed for a widest range of installation situations. On the basis of this technology, the experts at Haver & Boecker and Kern-Liebers work together with the customer to develop perfectly fitting fabricated parts that are optimally adapted to the individual functional and process requirements in the production of electric vehicles.

Metal mesh offers compelling solutions not only in the automotive sector but wherever EMC conformity and reliable protection against electromagnetic radiation are required. Imaging systems in medicine (MRI, CT, etc.) and sensitive structures in power plants and data centres are just a few of many examples. Using light metal alloys also makes it possible to use these products in the aerospace industry. And foreseeable even now is the development of ever more new applications.

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